



Hardware and Software
Engineered to Work Together



Exadata Database Machine: 12c Administration Workshop

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Table of Contents

Course Practice Environment: Security Credentials	I
Practices for Lesson 1: Introduction	1-1
Practices for Lesson 1: Overview.....	1-2
Practice 1-1: Lab Environment Introduction	1-3
Practices for Lesson 2: Exadata Database Machine - Overview	2-1
Practices for Lesson 2.....	2-2
Practices for Lesson 3: Exadata Database Machine Architecture.....	3-1
Practices for Lesson 3: Overview.....	3-2
Practice 3-1: Process Familiarization	3-3
Practice 3-2: Exadata high availability.....	3-7
Practice 3-3: Storage Object Familiarization	3-11
Practice 3-4: Exadata Smart Flash Cache Familiarization	3-17
Practices for Lesson 4: Key Capabilities of Exadata Database Machine	4-1
Practices for Lesson 4: Overview.....	4-2
Practice 4-1: Smart Scan	4-3
Practice 4-2: Exadata Hybrid Columnar Compression	4-8
Practice 4-3: Exadata Smart Flash Cache	4-12
Practice 4-4: Storage Index.....	4-20
Practices for Lesson 5: Exadata Database Machine Initial Configuration	5-1
Practices for Lesson 5: Overview.....	5-2
Practice 5-1: Using the Exadata Configuration Tool.....	5-3
Practices for Lesson 6: Exadata Storage Server Configuration	6-1
Practices for Lesson 6: Overview.....	6-2
Practice 6-1: Cell configuration	6-3
Practice 6-2: Storage reconfiguration.....	6-6
Practice 6-3: Consuming grid disks using ASM	6-28
Practice 6-4: Configuring Exadata storage security	6-31
Practice 6-5: Cell user accounts.....	6-47
Practice 6-6: Using the distributed command line utility (dcli)	6-50
Practices for Lesson 7: I/O Resource Management.....	7-1
Practices for Lesson 7	7-2
Practices for Lesson 8: Recommendations for Optimizing Database Performance.....	8-1
Practices for Lesson 8: Overview.....	8-2
Practice 8-1: Configuring Write Back Flash Cache	8-3
Practice 8-2: Using Exadata Hybrid Columnar Compression	8-9
Practice 8-3: Testing Index elimination	8-23
Practices for Lesson 9: Using Smart Scan	9-1
Practices for Lesson 9: Overview.....	9-2
Practice 9-1: Monitoring Exadata Smart Scan	9-3
Practice 9-2: Monitoring Cell Wait Events for Parallel Query	9-13
Practices for Lesson 10: Consolidation Options and Recommendations	10-1
Practices for Lesson 10.....	10-2
Practices for Lesson 11: Migrating Databases to Exadata Database Machine.....	11-1
Practices for Lesson 11: Overview.....	11-2
Practice 11-1: Migrating to Databases Machine using Transportable Tablespaces	11-3

Practices for Lesson 12: Bulk Data Loading	12-1
Practices for Lesson 12: Overview.....	12-2
Practice 12-1: Bulk Data Loading with Database Machine.....	12-3
Practices for Lesson 13: Exadata Database Machine Platform Monitoring - Introduction	13-1
Practices for Lesson 13.....	13-2
Practices for Lesson 14: Configuring Enterprise Manager Cloud Control to Monitor Exadata Database Machine.....	14-1
Practices for Lesson 14: Overview.....	14-2
Practice 14-1: Configuring Enterprise Manager Cloud Control 12c to Monitor Exadata Database Machine ..	14-3
Practice 14-2: Post-Discovery Configuration and Verification	14-75
Practices for Lesson 15: Monitoring Exadata Storage Servers	15-1
Practices for Lesson 15: Overview.....	15-2
Practice 15-1: Metrics, Alerts, and Active Requests.....	15-3
Practice 15-2: Exadata Storage Server Monitoring with Enterprise Manager	15-15
Practices for Lesson 16: Monitoring Exadata Database Machine Database Servers	16-1
Practices for Lesson 16: Overview.....	16-2
Practice 16-1: Exadata Database Monitoring with Enterprise Manager	16-3
Practices for Lesson 17: Monitoring the InfiniBand Network	17-1
Practices for Lesson 17: Overview.....	17-2
Practice 17-1: Exadata InfiniBand Monitoring with Enterprise Manager.....	17-3
Practices for Lesson 18: Monitoring Other Exadata Database Machine Components	18-1
Practices for Lesson 18.....	18-2
Practices for Lesson 19: Other Useful Exadata Monitoring Tools.....	19-1
Practices for Lesson 19.....	19-2
Practices for Lesson 20: Backup and Recovery	20-1
Practices for Lesson 20: Overview.....	20-2
Practice 20-1: Backup Optimization	20-3
Practice 20-2: Recovery Optimization	20-15
Practices for Lesson 21: Exadata Database Machine Maintenance Tasks	21-1
Practices for Lesson 21.....	21-2
Practices for Lesson 22: Patching Exadata Database Machine.....	22-1
Practices for Lesson 22.....	22-2
Practices for Lesson 23: Exadata Database Machine Automated Support Ecosystem.....	23-1
Practices for Lesson 23.....	23-2

Course Practice Environment: Security Credentials

Chapter I

Course Practice Environment: Security Credentials

For OS usernames and passwords, see the following:

- If you are attending a classroom-based or live virtual class, ask your instructor or LVC producer for OS credential information.
- If you are using a self-study format, refer to the communication that you received from Oracle University for this course.

For other credentials used in this course, see the following table:

Product-Specific Credentials		
Product/Application	Username	Password
Gateway VM and VNC	oracle	oracle
Exadata Database Server VMs: qr01dbadm01 and qr01dbadm02	root, oracle, grid	welcome1
Exadata Storage Server VMs: qr01celadm01, qr01celadm02 and qr01celadm03	root	welcome1
Exadata Storage Server VMs: qr01celadm01, qr01celadm02 and qr01celadm03	celladmin, cellmonitor	welcome
Enterprise Manager VM: em12c	oracle	oracle
Oracle Database: dbm	sys, system	welcome1
Oracle Database: dbm	sh	sh
Oracle ASM	asmnsnmp	welcome1
Enterprise Manager Cloud Control	sysman	Oracle123
InfiniBand Switch: qr01sw-iba01	nm2user	changeme
Database Server ILOM	oemuser	oemuser

Practices for Lesson 1: Introduction

Chapter 1

Practices for Lesson 1: Overview

Practices Overview

In this practice, you will be introduced to the laboratory environment used to support all the practices during this course.

Practice 1-1: Lab Environment Introduction

Overview

In this practice, you will learn how to use the laboratory environment that supports all the practices in this course.

The laboratory environment for this course is based on a Quarter Rack Database Machine. It consists of several virtual machines configured to provide two database servers and three Exadata Storage Servers.

To access the virtual machines, you will first establish a graphical session which is connected to a gateway VM. Your instructor will provide specific details for each student's gateway. From there, you will create terminal sessions as required and connect to the virtualized Database Machine servers by using SSH as described in the tasks for this practice.

During this practice, take care to remember the steps required to establish a terminal session and how to configure the environment to access ASM or Oracle Database. You will be required to repeat these steps many times during the practice exercises in this course.

Please refer to the supplied Course Practice Environment: Security Credentials document for the passwords that you will require to use the laboratory environment.

Tasks

- Establish a terminal session connected to qr01dbadm01 by using the grid operating system account.

Note that you may see additional messages relating to server identities. Answer yes if you are prompted to acknowledge server authenticity.

```
$ ssh grid@qr01dbadm01
grid@qr01dbadm01's password: ???????
[grid@qr01dbadm01 ~]$
```

- Configure your terminal session to access ASM using the +ASM1 instance on qr01dbadm01.

```
[grid@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@qr01dbadm01 ~]$
```

- Execute the following command and verify that all of the listed services are online in your laboratory environment. Your output should look like the example below. Alert your instructor if you do not have the same services online in your environment.

```
[grid@qr01dbadm01 ~]$ crsctl status resource -w "TARGET = ONLINE" -t
-----
Name          Target   State        Server          State details
-----
Local Resources
-----
ora.DATA_QR01.dg
    ONLINE   ONLINE      qr01dbadm01      STABLE
    ONLINE   ONLINE      qr01dbadm02      STABLE
ora.DBFS_DG.dg
    ONLINE   ONLINE      qr01dbadm01      STABLE
```

	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.LISTENER.lsnr				
	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.RECO_QR01.dg				
	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.asm				
	ONLINE	ONLINE	qr01dbadm01	Started, STABLE
	ONLINE	ONLINE	qr01dbadm02	Started, STABLE
ora.net1.network				
	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.ons				
	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
<hr/>				
Cluster Resources				
<hr/>				
ora.LISTENER_SCAN1.lsnr				
	1	ONLINE	ONLINE	qr01dbadm02
ora.LISTENER_SCAN2.lsnr				
	1	ONLINE	ONLINE	qr01dbadm01
ora.LISTENER_SCAN3.lsnr				
	1	ONLINE	ONLINE	qr01dbadm01
ora.cvu				
	1	ONLINE	ONLINE	qr01dbadm01
ora.dbm.db				
	1	ONLINE	ONLINE	qr01dbadm01
	2	ONLINE	ONLINE	qr01dbadm02
ora.oc4j				
	1	ONLINE	ONLINE	qr01dbadm01
ora.qr01dbadm01.vip				
	1	ONLINE	ONLINE	qr01dbadm01
ora.qr01dbadm02.vip				
	1	ONLINE	ONLINE	qr01dbadm02
ora.scan1.vip				
	1	ONLINE	ONLINE	qr01dbadm02
ora.scan2.vip				
	1	ONLINE	ONLINE	qr01dbadm01
ora.scan3.vip				
	1	ONLINE	ONLINE	qr01dbadm01
<hr/>				
[grid@qr01dbadm01 ~] \$				

4. Using SQL*Plus, connect to the clustered ASM environment as an ASM administrator. Verify that you are connected to the ASM instance +ASM1 and exit your SQL*Plus session.

```
[grid@qr01dbadm01 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.2.0 Production ...

SQL> select instance_name from v$instance;

INSTANCE_NAME
-----
+ASM1

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition ...
[grid@qr01dbadm01 ~]$
```

5. Establish a new shell as the oracle OS user.

```
[grid@qr01dbadm01 ~]$ su - oracle
Password: ????????
[oracle@qr01dbadm01 ~]$
```

6. Configure your terminal session to access the dbm database using the dbm1 instance.

```
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

7. Using SQL*Plus, connect to your database as the database administrator. Verify that you are connected to the DBM database and exit your SQL*Plus session.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production ...

SQL> select name from v$database;

NAME
-----
DBM

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition ...
[oracle@qr01dbadm01 ~]$
```

- Use the `srvctl` utility to verify the status of the DBM database and the placement of the database instances.

```
[oracle@qr01dbadm01 ~]$ srvctl status database -d dbm
Instance dbm1 is running on node qr01dbadm01
Instance dbm2 is running on node qr01dbadm02
[oracle@qr01dbadm01 ~]$
```

Note that the DBM database is an administrator-managed Oracle RAC database created on two database servers; qr01dbadm01 and qr01dbadm02. You will use the database instance running on qr01dbadm01 to perform most the practices.

- Many practices refer to SQL scripts, which are provided as an alternative to typing lengthy commands. These scripts are located in the `labs` directory under your student home directory. List the files in the `labs` directory. Notice also the `CSV`, `oeda`, `swingbench` and `TTS` subdirectories. These subdirectories contain additional files for specific practices. You will be directed to these files in the associated practice instructions.

```
[oracle@qr01dbadm01 ~]$ cd labs
[oracle@qr01dbadm01 labs]$ ls
CSV          lab04-03-15.sql  lab06-04-22.sql  lab15-01-32.sql
lab03-02-03.sql  lab04-04-03.sql  lab08-02-04.sql  lab15-01-34.sql
lab03-03-10.sql  lab04-04-04.sql  lab08-02-06.sql  lab15-01-35.sql
lab03-03-11.sql  lab06-02-03.sql  lab08-02-07.sql  lab20-01-04.sql
lab04-01-03.sql  lab06-02-04.sql  lab08-02-15.sql  lab20-01-16.sql
lab04-01-04.sql  lab06-02-08.sql  lab09-01-06.sql  lab20-01-17.sql
lab04-01-08.sql  lab06-02-11.sql  lab09-01-07.sql  lab20-01-22.sql
lab04-02-03.sql  lab06-02-20.sql  lab09-02-07.sql  lab20-02-13.sql
lab04-02-04.sql  lab06-02-30.sql  lab09-02-08.sql  oeda
lab04-02-06.sql  lab06-02-40.sql  lab09-02-09.sql  swingbench
lab04-02-07.sql  lab06-03-03.sql  lab11-01-05.sql  TTS
lab04-03-05.sql  lab06-03-04.sql  lab11-01-15.sql
lab04-03-08.sql  lab06-03-05.sql  lab12-01-22.sql
[oracle@qr01dbadm01 labs]$
```

- Establish a separate terminal session connected to your first Exadata cell using the `celladmin` user. Confirm that you are connected to the cell and then exit the session.

Note that you may see additional messages relating to server identities. Answer `yes` if you are prompted to acknowledge server authenticity.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ???????
[celladmin@qr01celadm01 ~]$ cellcli -e list cell
    qr01celadm01      online
[celladmin@qr01celadm01 ~]$ exit
logout
Connection to qr01celadm01 closed.
$
```

11. Establish another terminal session connected to your second Exadata cell using the `cellmonitor` user. Confirm you are connected to the cell and then exit the session.
Note that you may see additional messages related to server identities. Answer `yes` if you are prompted to acknowledge server authenticity.

```
$ ssh cellmonitor@qr01celadm02
cellmonitor@qr01celadm02's password: ???????
[cellmonitor@qr01celadm02 ~]$ cellcli -e list cell
    qr01celadm02      online
[cellmonitor@qr01celadm02 ~]$ exit
logout
Connection to qr01celadm02 closed.
$
```

12. Exit your terminal sessions. We recommend that you start fresh terminal sessions at the beginning of each practice, and that you exit all of your terminal sessions at the conclusion of every practice. This eliminates the possibility that environment settings used in one practice could cause problems in following practices.

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Practices for Lesson 2: Exadata Database Machine - Overview

Chapter 2

Practices for Lesson 2

There are no practices for this lesson.

Practices for Lesson 3: Exadata Database Machine Architecture

Chapter 3

Practices for Lesson 3: Overview

Practices Overview

In these practices, you will be familiarized with the Exadata cell architecture. You will:

- Examine the Exadata processes
- Exercise Exadata high availability
- Examine the hierarchy of cell objects
- Examine Exadata Smart Flash Cache

Practice 3-1: Process Familiarization

Overview

In this practice, you will examine the Exadata cell software processes.

Tasks

1. Establish a terminal connection to qr01celadm01 as the celladmin user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~] $
```

2. Restart Server (RS) is used to start up and shut down the Cell Server (CELLSRV) and Management Server (MS). It also monitors these services to check if they need to be restarted. Locate the RS processes by using the following command.

```
[celladmin@qr01celadm01 ~]$ ps -ef | grep cellrs
root      1928      1  0 02:53 ?          00:00:00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrssrm -ms 1 -
cellsrv 1
root      1935  1928  0 02:53 ?          00:00:00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrsbmt -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsms.s
tate -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
root      1936  1928  0 02:53 ?          00:00:00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrsmmt -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsms.s
tate -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
root      1937  1928  0 02:53 ?          00:00:02
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrsomt -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsms.s
tate -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
root      1938  1935  0 02:53 ?          00:00:00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrsbkm -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsms.s
tate -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
root      1945  1938  0 02:53 ?          00:00:00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrssmt -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsms.s
tate -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
1000     4344  4294  0 03:16 pts/0      00:00:00 grep cellrs
[celladmin@qr01celadm01 ~]$
```

3. MS provides Exadata cell management and configuration. It works in cooperation with the Exadata cell command-line interface (CellCLI). In addition, MS is responsible for sending alerts and collects some statistics in addition to those collected by CELLSRV. Locate the MS process by using the following command:

```
[celladmin@qr01celadm01 ~]$ ps -ef | grep msServer
root      2007  1 02:53 ?        00:00:28 /usr/java/jdk1.7.0_72/bin/java
-client -Xms256m -Xmx512m -XX:CompileThreshold=8000 -XX:PermSize=128m -
XX:MaxPermSize=256m -Dweblogic.Name=msServer -
Djava.security.policy=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/de
ploy/wls/wlserver_10.3/server/lib/weblogic.policy -XX:-UseLargePages -
XX:ParallelGCThreads=8 -Dweblogic.ListenPort=8888 -
Djava.security.egd=file:/dev/.urandom -Xverify:none -da -
Dplatform.home=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/wl
s/wlserver_10.3 -
Dwls.home=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/wls/wls
erver_10.3/server -
Dweblogic.home=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/wl
s/wlserver_10.3/server -Dweblogic.management.discover=true -Dwlw.iterativeDev=
-Dwlw.testConsole= -Dwlw.logErrorsToConsole=
Dweblogic.ext.dirs=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/depl
oy/wls/patch_wls1036/profiles/default/sysext_manifest_classpath weblogic.Server
1000      4463  4294  0 03:20 pts/0    00:00:00 grep msServer
[celladmin@qr01celadm01 ~]$
```

4. Locate the MS parent process (`startWebLogic.sh`) and its parent process. Start by using the parent process number associated with MS in the output for step 3. When you trace back through the line of processes you will eventually find one of the RS processes, which demonstrates that RS spawns (and, when required, re-spawns) MS.

```
[celladmin@qr01celadm01 ~]$ ps -ef | grep 1939
root      1939  1936  0 02:53 ?          00:00:00 /bin/sh
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/msdomain/bin/star
tWebLogic.sh
root      2007  1939  0 02:53 ?          00:00:32 /usr/java/jdk1.7.0_72/bin/java
-client -Xms256m -Xmx512m -XX:CompileThreshold=8000 -XX:PermSize=128m -
XX:MaxPermSize=256m -Dweblogic.Name=msServer -
Djava.security.policy=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/de
ploy/wls/wlserver_10.3/server/lib/weblogic.policy -XX:-UseLargePages -
XX:ParallelGCThreads=8 -Dweblogic.ListenPort=8888 -
Djava.security.egd=file:/dev/.urandom -Xverify:none -da -
Dplatform.home=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/wl
s/wlserver_10.3 -
Dwls.home=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/wls/wls
erver_10.3/server -
Dweblogic.home=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/wl
s/wlserver_10.3/server -Dweblogic.management.discover=true -Dwlw.iterativeDev=
-Dwlw.testConsole= -Dwlw.logErrorsToConsole= -
Dweblogic.ext.dirs=/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy
/wls/patch_wls1036/profiles/default/sysexit_manifest_classpath weblogic.Server
1000      7761  4294  0 03:48 pts/0    00:00:00 grep 1939
[celladmin@qr01celadm01 ~]$ ps -ef|grep 1936
root      1936  1928  0 02:53 ?          00:00:00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrsmmt -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsmss.
state -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
root      1939  1936  0 02:53 ?          00:00:00 /bin/sh
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/msdomain/bin/star
tWebLogic.sh
1000      7781  4294  0 03:48 pts/0    00:00:00 grep 1936
[celladmin@qr01celadm01 ~]$
```

5. CELLSRV is the primary Exadata software component and provides the majority of Exadata storage services. CELLSRV is a multithreaded server. Primarily, CELLSRV communicates with Oracle Database to serve simple block requests, such as database buffer cache reads, and Smart Scan requests, such as table scans with projections and filters. CELLSRV also implements I/O Resource Management (IORM) and collects numerous statistics relating to its operations. Locate the CELLSRV process by using the following command:

```
[celladmin@qr01celadm01 ~]$ ps -ef | grep "/cellsrv"
root      1941  1937 20 02:53 ?          00:14:30
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellsrv 40 3000 9
5042
1000      8353  4294  0 04:03 pts/0    00:00:00 grep /cellsrv
[celladmin@qr01celadm01 ~]$
```

6. Locate the CELLSRV parent process. Use the parent process number associated with CELLSRV in the output for step 5. Note that RS spawns (and, when required, re-spawns) CELLSRV.

```
[celladmin@qr01celadm01 ~]$ ps -ef | grep 1937
root      1937  1928  0 02:53 ?          00:00:05
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellrsomt -rs_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellinit.o
ra -ms_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsms.s
tate -cellsrv_conf
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/deploy/config/cellrsos.s
tate -debug 0
root      1941  1937 20 02:53 ?          00:14:46
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellsrv 40 3000 9
5042
1000     8385  4294  0 04:04 pts/0      00:00:00 grep 1937
[celladmin@qr01celadm01 ~]$
```

7. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...
CellCLI>
```

8. Execute the following CellCLI command to examine the attributes of the cell. Note that the output also confirms that CELLSRV, MS, and RS are currently up and running. Exit CellCLI after examining the cell attributes.

```
CellCLI> list cell detail
  name:          qr01celadm01
  cellVersion:   OSS_12.1.2.1.0_LINUX.X64_141206.1
  cpuCount:      2
  diagHistoryDays: 7
  fanCount:      0/0
  fanStatus:     normal
  flashCacheMode: WriteThrough
  id:            ef92136a-837c-4e1d-88d2-e01f5ab89b7b
  interconnectCount: 0
  interconnect1:  ib0
  interconnect2:  ib1
  iormBoost:      0.0
  ipAddress1:    192.168.1.105/24
  ipAddress2:    192.168.1.106/24
  kernelVersion:  2.6.39-400.243.1.el6uek.x86_64
  makeModel:      Fake hardware
  memoryGB:      4
  metricHistoryDays: 7
  offloadGroupEvents:
  offloadEfficiency: 650.9
  powerCount:     0/0
  powerStatus:    normal
  releaseVersion: 12.1.2.1.0
  releaseTrackingBug: 17885582
  status:         online
  temperatureReading: 0.0
  temperatureStatus: normal
  upTime:         0 days, 1:23
  cellsrvStatus:  running
  msStatus:       running
  rsStatus:       running

CellCLI> exit
quitting
[celladmin@qr01celadm01 ~]$
```

9. Exit all of your terminal sessions.

Practice 3-2: Exadata high availability

Overview

In this practice, you will observe some of the high availability features of Exadata Storage Server.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/?
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

3. Execute the SQL script /home/oracle/labs/lab03-02-03.sql. The script contains a series of IO intensive queries, which are used in this practice to demonstrate how Oracle Database is insulated from the different Exadata failure scenarios that are demonstrated in the practice. Check on the workload periodically throughout the practice. If the workload completes before you finish all the tasks, then simply re-execute the script to maintain an active workload throughout the practice.

```
SQL> @/home/oracle/labs/lab03-02-03
SQL> set timing on
SQL> select count(*) from sales;
...
.
```

4. Establish a separate terminal connection to qr01celadm01 as the root user. Leave your SQL*Plus terminal session and workload running in the background.

```
$ ssh root@qr01celadm01
root@qr01celadm01's password: ????????
[root@qr01celadm01 ~]$
```

5. Locate the process identification number for CELLSRV by using the following ps command.

```
[root@qr01celadm01 ~]# ps -ef | grep "/cellsrv"
root      1941  1937 20 02:53 ?          00:24:43
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellsrv 40 3000 9
5042
root      9658  9615  0 04:52 pts/0      00:00:00 grep /cellsrv
[root@qr01celadm01 ~]#
```

6. Terminate the CELLSRV process by using the kill command and the process identification number you observed in step 5.

```
[root@qr01celadm01 ~]# kill -9 1941
[root@qr01celadm01 ~]#
```

7. Re-execute the ps command from step 5. You should observe that CELLSRV is automatically restarted with a new process identification number. How was CELLSRV restarted?

```
[root@qr01celadm01 ~]# ps -ef | grep "/cellsrv"
root      9747  9745 76 04:53 ?          00:00:04
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellsrv 40 3000 9
5042
root      10092  9615  0 04:53 pts/0      00:00:00 grep /cellsrv
[root@qr01celadm01 ~]#
```

8. Check on the progress of your workload from step 3. You should observe that the workload continues without error.

```
...
SQL> select count(*) from sales where amount_sold > 2;

COUNT(*)
-----
28856060

Elapsed: 00:01:04.88
SQL> select count(*) from sales where amount_sold > 3;

COUNT(*)
-----
28555621

Elapsed: 00:00:13.87
SQL> select count(*) from sales where amount_sold > 4;
```

9. On qr01celadm01, launch the Exadata cell command-line interface (CellCLI).

```
[root@qr01celadm01 ~]# cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

10. You have already seen how Exadata automatically recovers from an unexpected process failure. Now observe the effect of restarting all the Exadata services.

```
CellCLI> alter cell restart services all  
  
Stopping the RS, CELLSRV, and MS services...  
The SHUTDOWN of services was successful.  
Starting the RS, CELLSRV, and MS services...  
Getting the state of RS services... running  
Starting CELLSRV services...  
The STARTUP of CELLSRV services was successful.  
Starting MS services...  
The STARTUP of MS services was successful.  
  
CellCLI>
```

11. Check on the progress of your workload from step 3. You should again observe that the workload continues without error.

```
...  
SQL> select count(*) from sales where amount_sold > 11;  
  
COUNT(*)  
-----  
26150787  
  
Elapsed: 00:00:13.66  
SQL> select count(*) from sales where amount_sold > 12;  
  
COUNT(*)  
-----  
25850432  
  
Elapsed: 00:00:11.19  
SQL> select count(*) from sales where amount_sold > 13;
```

12. Exit your CellCLI session and re-execute the `ps` command from step 5. You should observe that `CELLSRV` has a different process identification number because of the restart operation executed in step 10.

```
CellCLI> exit
quitting

[root@qr01celadm01 ~]# ps -ef | grep "/cellsrv "
root      10613 10596 34 04:55 ?          00:00:09
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/cellsrv/bin/cellsrv 40 3000 9
5042
root      11162  9615  0 04:55 pts/0        00:00:00 grep /cellsrv
[root@qr01celadm01 ~]#
```

13. If the workload started in step 3 is still executing, stop it by typing `<Ctrl>-C` in your SQL*Plus session window. Wait until the workload stops.

```
...
SQL> select count(*) from sales where amount_sold > 16;

COUNT(*)
-----
24647749

Elapsed: 00:00:09.55
SQL> select count(*) from sales where amount_sold > 17;
^Cselect count(*) from sales where amount_sold > 17
*
ERROR at line 1:
ORA-01013: user requested cancel of current operation

Elapsed: 00:00:01.30

SQL>
```

14. Exit all of your terminal sessions.

Practice 3-3: Storage Object Familiarization

Overview

In this practice, you are introduced to the hierarchy of Exadata storage objects.

Tasks

1. Establish a terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01  
celladmin@qr01celadm01's password: ???????  
[celladmin@qr01celadm01 ~]$
```

2. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

3. In Exadata, a LUN (Logical Unit) is a logical abstraction of a storage device. LUNs are based on hard disks and flash devices. LUNs are automatically created when Exadata is initially configured. Each Exadata cell contains 12 hard disk-based LUNs along with 4 flash-based LUNs. List the LUNs on your primary Exadata cell.

```
CellCLI> list lun
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK00    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK01
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK01    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK02
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK02    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK03
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK03    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK04
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK04    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK05
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK05    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK06
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK06    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK07
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK07    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK08
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK08    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK10
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK10    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK11
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK11    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH00
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH00    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH01
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH01    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH02
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH02    normal
        /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH03
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/FLASH03    normal

CellCLI>
```

Note that the output from the virtualized Exadata cell shows LUNs with names and identifiers that are paths to virtualized disks and virtualized flash devices. On a real Exadata cell, the LUN names and identifiers are based on the PCI slot number and device number of the hard disk or flash device. For example, here is the expected output for the LIST LUN command on a real high capacity Exadata cell.

```
CellCLI> list lun
        0_0      0_0      normal
        0_1      0_1      normal
        0_2      0_2      normal
        0_3      0_3      normal
        0_4      0_4      normal
        0_5      0_5      normal
        0_6      0_6      normal
        0_7      0_7      normal
```

```

0_8      0_8      normal
0_9      0_9      normal
0_10     0_10     normal
0_11     0_11     normal
1_1      1_1      normal
2_1      2_1      normal
4_1      4_1      normal
5_1      5_1      normal

```

CellCLI>

- Examine the detailed attribute listing for the LUN whose name ends with DISK09. Note the attribute setting isSystemLun=FALSE. This indicates that the LUN is not located on a system disk. Notice also that the LUN is associated with one physical disk and one cell disk.

```

CellCLI> list lun where name like '.*DISK09' detail
      name:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      cellDisk:          CD_09_gr01celadm01
      deviceName:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      diskType:          HardDisk
      id:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      isSystemLun:        FALSE
      lunSize:           11
      physicalDrives:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      raidLevel:          "RAID 0"
      status:             normal

```

CellCLI>

- Exadata maintains the physical attributes of each hard disk in a physicaldisk object. A physicaldisk object is automatically created for each hard disk. Examine the attributes for the hard disk associated with LUN you examined in the previous step.

```

CellCLI> list physicaldisk where luns like '.*DISK09' detail
      name:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      deviceName:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      diskType:          HardDisk
      luns:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      physicalInsertTime: 2015-02-17T03:31:42+00:00
      physicalSerial:
/opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      physicalSize:       11
      status:             normal

```

CellCLI>

6. A cell disk is a higher level storage abstraction. Each cell disk is based on a LUN and contains additional attributes and metadata. Examine the attributes for the cell disk-based on the LUN you examined in step 4.

```
CellCLI> list celldisk CD_09_qr01celadm01 detail
      name:          CD_09_qr01celadm01
      comment:
      creationTime: 2015-02-20T00:57:10+00:00
      deviceName:   /opt/oracle/cell12.1.2.1.0_LINUX.X64_141206.1/disks/raw/DISK09
      devicePartition:
      diskType:     HardDisk
      errorCount:   0
      freeSpace:    0
      id:           f369c761-a9a1-4d1b-aaa0-51fc32edbc42
      interleaving: none
      lun:
      physicalDisk:
      raidLevel:    "RAID 0"
      size:         2G
      status:       normal

CellCLI>
```

7. A grid disk defines an area of storage on a cell disk. Grid disks are consumed by ASM and are used as the storage for ASM disk groups. Each cell disk can contain a number of grid disks. Examine the grid disks associated with the cell disk you examined in the previous step. Note the names and sizes of the grid disks.

```
CellCLI> list griddisk where celldisk=CD_09_qr01celadm01 detail
      name:          DATA_QR01_CD_09_qr01celadm01
      asmDiskGroupName: DATA_QR01
      asmDiskName:   DATA_QR01_CD_09_QR01CELADM01
      asmFailGroupName: QR01CELADM01
      availableTo:
      cachingPolicy: default
      cellDisk:      CD_09_qr01celadm01
      comment:
      creationTime: 2015-03-11T03:23:37+00:00
      diskType:     HardDisk
      errorCount:   0
      id:           9a11b79a-1fa7-4527-85bf-28ad5cb98cac
      offset:       400M
      size:         720M
      status:       active

      name:          DBFS_DG_CD_09_qr01celadm01
      asmDiskGroupName: DBFS_DG
      asmDiskName:   DBFS_DG_CD_09_QR01CELADM01
      asmFailGroupName: QR01CELADM01
```

```

availableTo:
cachingPolicy:          default
cellDisk:                CD_09_qr01celadm01
comment:
creationTime:           2015-03-11T03:23:35+00:00
diskType:                HardDisk
errorCount:              0
id:                      e304a244-75de-4ea6-b92d-b480e2226615
offset:                  48M
size:                     352M
status:                  active

name:                     RECO_QR01_CD_09_qr01celadm01
asmDiskGroupName:         RECO_QR01
asmDiskName:              RECO_QR01_CD_09_QR01CELADM01
asmFailGroupName:         QR01CELADM01
availableTo:
cachingPolicy:           default
cellDisk:                CD_09_qr01celadm01
comment:
creationTime:            2015-03-11T03:23:40+00:00
diskType:                HardDisk
errorCount:              0
id:                      9923a077-dc5e-4f53-adc5-4cc3aaaa9916
offset:                  1.09375G
size:                     928M
status:                  active

CellCLI>

```

- Establish a terminal connection to qr01dbadm01 as the grid user and configure the session to access ASM using the +ASM1 instance.

```

$ ssh grid@qr01dbadm01
grid@qr01dbadm01's password: ????????
[grid@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@qr01dbadm01 ~]$

```

- Using SQL*Plus, connect to ASM as sysasm.

```

[grid@qr01dbadm01 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>

```

10. Locate the grid disks from step 7 inside ASM (use the SQL script /home/oracle/labs/lab03-03-10.sql if you prefer). Check that the sizes reported by ASM match the grid disk attributes reported in step 7. Note the capitalization of the value in the like string.

```
SQL> select name, path, state, total_mb from v$asm_disk
2> where name like '%_CD_09_QR01CELADM01';

NAME
-----
PATH
-----
STATE      TOTAL_MB
-----
DBFS_DG_CD_09_QR01CELADM01
o/192.168.1.105;192.168.1.106/DBFS_DG_CD_09_qr01celadm01
NORMAL          352

RECO_QR01_CD_09_QR01CELADM01
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_09_qr01celadm01
NORMAL          928

DATA_QR01_CD_09_QR01CELADM01
o/192.168.1.105;192.168.1.106/DATA_QR01_CD_09_qr01celadm01
NORMAL          720

SQL>
```

11. Determine which ASM disk group the grid disks from step 7 are assigned to (use the SQL script /home/oracle/labs/lab03-03-11.sql if you prefer). Note the capitalization of the value in the like string.

```
SQL> select d.name disk, dg.name diskgroup
  2>   from v$asm_disk d, v$asm_diskgroup dg
  3>  where dg.group_number = d.group_number
  4>  and d.name like '%_CD_09_QR01CELADM01';

          DISK                  DISKGROUP
-----  -----
DBFS_DG_CD_09_QR01CELADM01      DBFS_DG
RECO_QR01_CD_09_QR01CELADM01    RECO_QR01
DATA_QR01_CD_09_QR01CELADM01    DATA_QR01

SQL>
```

12. Exit all your SQL*Plus and CellCLI sessions.

Practice 3-4: Exadata Smart Flash Cache Familiarization

Overview

In this practice, you are introduced to Exadata Smart Flash Cache.

Tasks

- Establish a terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~]$
```

- Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~] $ cellcli
CellCLI: Release 12.1.2.1.0 - Production...

CellCLI>
```

- List the cell disks associated with the flash modules in your Exadata cell. By default, there should be 4 cell disks having names that start with FD.

```
CellCLI> list celldisk where disktype=flashdisk
      FD_00_qr01celadm01      normal
      FD_01_qr01celadm01      normal
      FD_02_qr01celadm01      normal
      FD_03_qr01celadm01      normal

CellCLI>
```

- By default, Exadata Smart Flash Cache is configured across all the flash-based cell disks. Use the LIST FLASHCACHE DETAIL command to confirm that Exadata Smart Flash Cache is configured on your flash-based cell disks. Note that the size of the Exadata Smart Flash Cache on your laboratory cells is much smaller than what you would observe on a real cell; however, all of the other attributes would be similar on a real cell.

```
CellCLI> list flashcache detail
      name: qr01celadm01_FLASHCACHE
      cellDisk:
FD_03_qr01celadm01,FD_02_qr01celadm01,FD_01_qr01celadm01,FD_00_qr01celadm01
      creationTime: 2016-06-02T02:54:32+00:00
      degradedCelldisks:
      effectiveCacheSize: 1.0625G
      id: 3a4cbd94-2ebb-4fc2-8c95-1221cc26d8a5
      size: 1.0625G
      status: normal

CellCLI>
```

5. In addition to Exadata Smart Flash Cache, Exadata Smart Flash Log provides a mechanism for improving the latency of database redo log write operations. Exadata Smart Flash Log uses a small portion of high-performance flash memory as temporary storage to facilitate low latency redo log writes. By default, Exadata Smart Flash Log uses a total of 512 MB on each Exadata Storage Server; however, on your laboratory cells Exadata Smart Flash Log is configured to consume 256 MB on each cell. Use the LIST FLASHLOG DETAIL command to examine the Exadata Smart Flash Log area on this cell.

```
CellCLI> list flashlog detail
      name:          qr01celadm01_FLASHLOG
      cellDisk:
FD_01_qr01celadm01,FD_02_qr01celadm01,FD_00_qr01celadm01,FD_03_qr01celadm01
      creationTime:   2016-06-02T02:54:30+00:00
      degradedCelldisks:
      effectiveSize: 256M
      efficiency:    100.0
      id:            11b847a1-3e09-4185-91bf-887976154371
      size:          256M
      status:        normal

CellCLI>
```

6. Use the LIST FLASHCACHECONTENT DETAIL command to show information about the data inside Exadata Smart Flash Cache. You can see that each entry contains a series of attributes relating to a database object in the cache. For each object, you can see how much data is being cached along with the number of cache hits and misses. This information can help you to assess cache efficiency for specific database objects.

```
CellCLI> list flashcachecontent detail
...
      cachedKeepSize: 0
      cachedSize:     262144
      cachedWriteSize: 0
      columnarCacheSize: 0
      columnarKeepSize: 0
      dbID:           2080757153
      dbUniqueName:   DBM
      hitCount:       11345
      missCount:      9
      objectNumber:   4294967294
      tableSpaceNumber: 0

      cachedKeepSize: 0
      cachedSize:     65536
      cachedWriteSize: 0
      columnarCacheSize: 0
      columnarKeepSize: 0
      dbID:           2080757153
      dbUniqueName:   DBM
```

```
hitCount:          0
missCount:        0
objectNumber:     4294967295
tableSpaceNumber: 4

cachedKeepSize:   0
cachedSize:       81920
cachedWriteSize:  0
columnarCacheSize: 0
columnarKeepSize: 0
dbID:             2080757153
dbUniqueName:    DBM
hitCount:          0
missCount:        0
objectNumber:     4294967295
tableSpaceNumber: 2

CellCLI>
```

7. Exit your CellCLI session.

Practices for Lesson 4: Key Capabilities of Exadata Database Machine

Chapter 4

Practices for Lesson 4: Overview

Practices Overview

In these practices, you are introduced to four major capabilities of Exadata, namely:

- Smart Scan
- Exadata Hybrid Columnar Compression
- Exadata Smart Flash Cache
- Storage Index

Practice 4-1: Smart Scan

Overview

In this practice, you are introduced to the Smart Scan capability of Exadata. You will execute a query with and without Smart Scan enabled and you will examine statistics to measure the effect of Smart Scan.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01  
oracle@qr01dbadm01's password: ???????  
[oracle@qr01dbadm01 ~]$ . oraenv  
ORACLE_SID = [oracle] ? dbm  
The Oracle base has been set to /u01/app/oracle  
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1  
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user and configure the session to enable command timing.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/?  
  
SQL*Plus: Release 12.1.0.2.0 ...  
  
SQL> set timing on  
SQL>
```

3. Execute the following query (or execute the SQL script /home/oracle/labs/lab04-01-03.sql) and verify that the statistics are at or near zero values. If any statistics are significantly greater than zero then reconnect (using connect sh) and try again.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes           .0546875
physical write total bytes          0
cell physical IO interconnect bytes .0546875
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes            0
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.04
SQL>
```

4. Execute the following query (or execute the SQL script /home/oracle/labs/lab04-01-04.sql). Note the optimizer hint that disables Smart Scan for the query.

```
SQL> select /*+ OPT_PARAM('cell_offload_processing' 'false') */
  2  count(*) from sales
  3  where amount_sold = 1;

COUNT(*)
-----
301261

Elapsed: 00:00:58.45
SQL>
```

5. Repeat the statistics query from step 3 (or execute the SQL script /home/oracle/labs/lab04-01-03.sql). Note that all of the data processed by the query in step 4 (physical read total bytes) is returned to the database server over the storage network (cell physical IO interconnect bytes).

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                MB
-----
physical read total bytes          1800.70313
physical write total bytes         0
cell physical IO interconnect bytes 1800.70313
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0

NAME                                MB
-----
cell IO uncompressed bytes          0
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.03
SQL>
```

6. Reconnect to your database in order to reset the session level statistics.

```
SQL> connect sh/??
Connected.
SQL>
```

7. Repeat the statistics query from step 3 (or execute the SQL script /home/oracle/labs/lab04-01-03.sql) and verify that the statistics are again at or near zero values. If any statistics are significantly greater than zero then reconnect again and retry.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes                0
physical write total bytes               0
cell physical IO interconnect bytes     0
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes                0
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.04
SQL>
```

8. Execute the following query (or execute the SQL script /home/oracle/labs/lab04-01-08.sql). This is the same query as in step 4; however, this time there is no optimizer hint to disable Smart Scan.

```
SQL> select count(*) from sales where amount_sold = 1;

COUNT(*)
-----
301261

Elapsed: 00:00:10.33
SQL>
```

9. Repeat the statistics query from step 3 (or execute the SQL script /home/oracle/labs/lab04-01-03.sql). Note that the query still performs approximately 1800 MB of I/O (physical read total bytes). However, this time only about 4.2 MB is actually returned to the database server (cell physical IO interconnect bytes). This is Smart Scan in action.

Also note that in this case, Smart Scan is acting on all of the I/O associated with the query. This is the case because cell physical IO bytes eligible for predicate offload equals physical read total bytes, and cell physical IO interconnect bytes returned by smart scan equals cell physical IO interconnect bytes.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes           1800.70313
physical write total bytes          0
cell physical IO interconnect bytes 4.19950867
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload      1800.70313
cell physical IO bytes saved by storage index            0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 4.19950867
cell physical IO bytes saved by columnar cache          0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes           1800.70313
cell physical write IO bytes eligible for offload        0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.02
SQL>
```

10. Exit your SQL*Plus session.

Practice 4-2: Exadata Hybrid Columnar Compression

Overview

In this practice, you are introduced to Exadata Hybrid Columnar Compression. You will create compressed copies of an existing database table and examine the level of compression you achieve.

Tasks

- Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

- Connect to your database with SQL*Plus. Log in as the sh user and configure the session to enable command timing.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/?
SQL*Plus: Release 12.1.0.2.0 ...

SQL> set timing on
SQL>
```

- Determine the size of the uncompressed MYCUSTOMERS table (use the SQL script /home/oracle/labs/lab04-02-03.sql if you prefer).

```
SQL> col segment_name format a30
SQL> select segment_name, sum(bytes)/1024/1024 MB
  2  from user_segments
  3  where segment_name like 'MYCUST%'
  4  group by segment_name;

SEGMENT_NAME                                MB
-----
MYCUSTOMERS                                  654

Elapsed: 00:00:00.29
SQL>
```

4. Verify that the CUSTOMERS table is uncompressed (use the SQL script /home/oracle/labs/lab04-02-04.sql if you prefer).

```
SQL> col table_name format a30
SQL> select table_name, compression, compress_for
  2  from user_tables
  3  where table_name like 'MYCUST%';

TABLE_NAME          COMPRESS  COMPRESS_FOR
-----              -----
MYCUSTOMERS         DISABLED

Elapsed: 00:00:00.01
SQL>
```

5. Exadata Hybrid Columnar Compression achieves its highest levels of compression with data that is direct-path inserted. Execute the following ALTER SESSION commands to ensure the use of direct-path inserts later in the practice.

```
SQL> alter session force parallel query;
Session altered.

Elapsed: 00:00:00.01
SQL> alter session force parallel ddl;
Session altered.

Elapsed: 00:00:00.00
SQL> alter session force parallel dml;
Session altered.

Elapsed: 00:00:00.00
SQL>
```

6. Create a compressed copy of the MYCUSTOMERS table by using the QUERY HIGH warehouse compression mode (use the SQL script /home/oracle/labs/lab04-02-06.sql if you prefer).

```
SQL> create table mycust_query
  2  column store compress for query high
  3  parallel 4 nologging as select * from mycustomers;

Table created.

Elapsed: 00:00:38.68
SQL>
```

7. Create a compressed copy of the MYCUSTOMERS table using the ARCHIVE HIGH archive compression mode (use the SQL script /home/oracle/labs/lab04-02-07.sql if you prefer). Note that it may take a few minutes for the table to be created.

```
SQL> create table mycust_archive
  2  column store compress for archive high
  2  parallel 4 nologging as select * from mycustomers;

Table created.

Elapsed: 00:01:21.48
SQL>
```

8. Verify the compression mode settings for the tables you just created (use the SQL script /home/oracle/labs/lab04-02-04.sql again if you prefer).

```
SQL> select table_name, compression, compress_for
  2  from user_tables
  3  where table_name like 'MYCUST%';

TABLE_NAME          COMPRESS COMPRESS_FOR
-----
MYCUSTOMERS          DISABLED
MYCUST_ARCHIVE        ENABLED   ARCHIVE HIGH
MYCUST_QUERY          ENABLED   QUERY HIGH

Elapsed: 00:00:00.05
SQL>
```

9. Compare the size of the original uncompressed table with the two compressed copies you created (use the SQL script /home/oracle/labs/lab04-02-03.sql if you prefer).

```
SQL> select segment_name,sum(bytes)/1024/1024 MB
  2  from user_segments
  3  where segment_name like 'MYCUST%'
  4  group by segment_name;

SEGMENT_NAME                      MB
-----
MYCUSTOMERS                         654
MYCUST_ARCHIVE                       113
MYCUST_QUERY                          159

Elapsed: 00:00:00.47
SQL>
```

10. Drop the compressed tables that you created in this practice.

```
SQL> drop table mycust_query;
Table dropped.

Elapsed: 00:00:00.46
SQL> drop table mycust_archive;
Table dropped.

Elapsed: 00:00:00.08
SQL>
```

11. Exit your SQL*Plus session.

Practice 4-3: Exadata Smart Flash Cache

Overview

In this practice, you will examine the use of Exadata Smart Flash Cache. You will execute a series of record lookups and use database statistics to verify the use of Exadata Smart Flash Cache. You will also compare the execution statistics with and without the use of Exadata Smart Flash Cache.

Tasks

- Establish a terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~]$
```

- Execute the following two commands to drop and then re-create Exadata Smart Flash Cache on all of your Exadata cells. You must perform this action so that Exadata Smart Flash Cache is empty at the beginning of this practice; thus ensuring consistent results later in the practice. To do this, you will use the distributed command line utility (dcli) that is provided with Exadata. Using dcli you can execute cell-level administrative commands simultaneously on multiple Exadata cells. A more detailed discussion of dcli features and options is provided later in the course. Be careful not to add any extra spaces in the server list following the dcli -c command line option.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e drop flashcache
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE successfully dropped
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE successfully dropped
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE successfully dropped
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e create flashcache all
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE successfully created
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE successfully created
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE successfully created
[celladmin@qr01celadm01 ~]$
```

- Establish a separate terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

4. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??  
  
SQL*Plus: Release 12.1.0.2.0 Production...  
  
SQL>
```

5. Execute the following query (or execute the SQL script /home/oracle/labs/lab04-03-05.sql) and verify that the statistics are at or near zero values. If any statistics are significantly greater than zero then reconnect and retry.

```
SQL> select a.name, b.value from v$sysstat a, v$mystat b  
  2  where a.statistic# = b.statistic# and  
  3  (a.name like '%flash cache read hits'  
  4  or a.name like 'cell phy%'  
  5  or a.name like 'physical read tot%'  
  6  or a.name like 'physical read req%');  
  
NAME                                     VALUE  
-----  
physical read total IO requests          0  
physical read total multi block requests 0  
physical read requests optimized        0  
physical read total bytes optimized      0  
physical read total bytes               0  
cell physical IO interconnect bytes     0  
cell physical IO bytes saved during optimized file creation 0  
cell physical IO bytes saved during optimized RMAN file restore 0  
cell physical IO bytes eligible for predicate offload 0  
cell physical IO bytes saved by storage index 0  
cell physical IO bytes sent directly to DB node to balance CPU 0  
  
NAME                                     VALUE  
-----  
cell physical IO interconnect bytes returned by smart scan 0  
cell physical IO bytes saved by columnar cache 0  
cell physical write bytes saved by smart file initialization 0  
cell flash cache read hits              0  
cell physical write IO bytes eligible for offload 0  
cell physical write IO host network bytes written during offloa 0  
  
17 rows selected.  
  
SQL>
```

6. Flush the buffer cache to ensure that the queries in step 8 must retrieve the required data from the Exadata cells.

```
SQL> alter system flush buffer_cache;  
  
System altered.  
  
SQL>
```

7. Configure the session to display server output.

```
SQL> set serveroutput on  
SQL>
```

8. The following PL/SQL block performs 500 record lookups spread across a reasonably large table. The workload is representative of the scattered record access normally associated with an OLTP application. Execute the PL/SQL block against your database (or execute the SQL script /home/oracle/labs/lab04-03-08.sql). Note that the workload may take a few minutes to complete.

```
SQL> declare  
 2      a number;  
 3      s number := 0;  
 4  begin  
 5      for n in 1 .. 500 loop  
 6          select cust_credit_limit into a from customers  
 7          where cust_id=n*2000;  
 8          s := s+a;  
 9      end loop;  
10      dbms_output.put_line('Transaction total = '||s);  
11  end;  
12 /  
Transaction total = 3620500  
  
PL/SQL procedure successfully completed.  
  
SQL>
```

9. Repeat the statistics query from step 5 (or execute the SQL script /home/oracle/labs/lab04-03-05.sql). Note the high number of IO requests (physical read total IO requests) relative to the low number of optimized requests (physical read requests optimized and cell flash cache read hits). This indicates that the queries were mostly satisfied by using physical disk reads and is indicative of a recently emptied cache.

```
SQL> select a.name, b.value from v$sysstat a, v$mystat b
  2  where a.statistic# = b.statistic# and
  3  (a.name like '%flash cache read hits'
  4  or a.name like 'cell phy%'
  5  or a.name like 'physical read tot%'
  6  or a.name like 'physical read req%');

NAME                                VALUE
-----
physical read total IO requests      943
physical read total multi block requests 65
physical read requests optimized    162
physical read total bytes optimized 1343488
physical read total bytes          22732800
cell physical IO interconnect bytes 22732800
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0

NAME                                VALUE
-----
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0
cell flash cache read hits          162
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

17 rows selected.

SQL>
```

10. Reconnect to your database in order to reset the session level statistics.

```
SQL> connect sh/??
Connected.
SQL>
```

11. Repeat the statistics query from step 5 (or execute the SQL script /home/oracle/labs/lab04-03-05.sql) and verify that the statistics are again at or near zero values. If any statistics are significantly greater than zero then reconnect again and retry.

```
SQL> select a.name, b.value from v$sysstat a, v$mystat b
  2  where a.statistic# = b.statistic# and
  3  (a.name like '%flash cache read hits'
  4  or a.name like 'cell phy%'
  5  or a.name like 'physical read tot%'
  6  or a.name like 'physical read req%');

NAME                                     VALUE
-----
physical read total IO requests          0
physical read total multi block requests 0
physical read requests optimized        0
physical read total bytes optimized     0
physical read total bytes               0
cell physical IO interconnect bytes     0
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0

NAME                                     VALUE
-----
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0
cell flash cache read hits 0
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

17 rows selected.

SQL>
```

12. Again, flush the buffer cache to ensure that the queries in the next step must retrieve the required data from the Exadata cells. Also, configure your new session to display server output.

```
SQL> alter system flush buffer_cache;

System altered.

SQL> set serveroutput on
SQL>
```

13. Re-execute the PL/SQL block introduced in step 8 (or execute the SQL script /home/oracle/labs/lab04-03-08.sql). Confirm that the result is the same.

```
SQL> declare
  2      a number;
  3      s number := 0;
  4  begin
  5      for n in 1 .. 500 loop
  6          select cust_credit_limit into a from customers
  7          where cust_id=n*2000;
  8          s := s+a;
  9      end loop;
 10      dbms_output.put_line('Transaction total = '||s);
 11  end;
 12 /
Transaction total = 3620500

PL/SQL procedure successfully completed.

SQL>
```

14. Repeat the statistics query from step 5 (or execute the SQL script /home/oracle/labs/lab04-03-05.sql). Compare the values for cell flash cache read hits and physical read total IO requests. They should be much closer together, indicating that most of the I/Os were satisfied by Exadata Smart Flash Cache.

```

SQL> select a.name, b.value from v$sysstat a, v$mystat b
  2  where a.statistic# = b.statistic# and
  3  (a.name like '%flash cache read hits'
  4  or a.name like 'cell phy%'
  5  or a.name like 'physical read tot%'
  6  or a.name like 'physical read req%');

NAME                                     VALUE
-----
physical read total IO requests          1011
physical read total multi block requests 20
physical read requests optimized        983
physical read total bytes optimized     15548416
physical read total bytes               19914752
cell physical IO interconnect bytes    19914752
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0

NAME                                     VALUE
-----
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0
cell flash cache read hits              983
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

17 rows selected.

SQL>

```

In an earlier practice, you saw how to obtain general information about Exadata Smart Flash Cache on an Exadata cell using the `LIST FLASHCACHECONTENT` CellCLI command. Over the remainder of this practice, you will learn how to isolate specific information in Exadata Smart Flash Cache.

15. Use the following query (or execute the SQL script `/home/oracle/labs/lab04-03-15.sql`) to determine the number of optimized physical reads (reads optimized by Exadata Smart Flash Cache or Exadata storage index) for the `SH.CUSTOMERS` table. Note the tablespace number (`TS#`) and object number (`DATAOBJ#`) associated with the table.

```
SQL> select owner, object_name, tablespace_name, ts#, dataobj#,
  2  statistic_name, value
  3  from v$segment_statistics
  4  where owner='SH' and object_name='CUSTOMERS'
  5  and statistic_name='optimized physical reads';

OWNER
-----
-- 

OBJECT_NAME
-----
-- 

TABLESPACE_NAME          TS#    DATAOBJ#
-----                  -----
STATISTIC_NAME           VALUE
-----                  -----
SH
CUSTOMERS
SH                      7      20473
optimized physical reads                         477

SQL>
```

16. Back in the terminal session connected to `qr01celadm01`, launch the Exadata command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...

CellCLI>
```

17. Use the tablespace number (TS#) and object number (DATAOBJ#) you gathered in step 15 to query the Exadata Smart Flash Cache. The output relates specifically to the SH.CUSTOMERS table.

```
CellCLI> list flashcachecontent where objectnumber=20473 and
tablespacenumber=7 and dbuniqueuname=DBM detail
  cachedKeepSize:          0
  cachedSize:              13189120
  cachedWriteSize:         0
  columnarCacheSize:       0
  columnarKeepSize:        0
  dbID:                   2080757153
  dbUniqueName:            DBM
  hitCount:                160
  missCount:               159
  objectNumber:             20473
  tableSpaceNumber:         7

CellCLI>
```

Note that in step 15 the value for optimized physical reads is 477 while the hitCount observed in this step is 160. Why is this so? In the remaining time allocated for this practice, query the Exadata Smart Flash Cache hitCount values for the other cells (qr01celadm02 and qr01celadm03) and compare the hitCount total across all the cells with the optimized physical reads value observed in step 15. Can you explain your observations?

18. Exit your terminal sessions.

Practice 4-4: Storage Index

Overview

In this practice, you are introduced to the storage index capability of Exadata. You will execute a query multiple times and examine statistics to measure the effect of storage index.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

3. Execute the following query (or execute the SQL script /home/oracle/labs/lab04-04-03.sql) and verify that the statistics are at or near zero values. If any statistics are significantly greater than zero then reconnect and retry.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                MB
-----
physical read total bytes          .09375
physical write total bytes         0
cell physical IO interconnect bytes .09375
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0

NAME                                MB
-----
cell IO uncompressed bytes          0
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>
```

4. Execute the following query (or execute the SQL script /home/oracle/labs/lab04-04-04.sql).

```
SQL> select cust_gender, count(*) from mycustomers
  2  where cust_income_level = 'C: 50000 - 69999'
  3  group by cust_gender;

C      COUNT(*)
-
M      135817
F      136226

SQL>
```

5. Repeat the statistics query from step 3 (or execute the SQL script /home/oracle/labs/lab04-04-03.sql).

```

SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes           650.296875
physical write total bytes          0
cell physical IO interconnect bytes 3.811203
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload      650.1875
cell physical IO bytes saved by storage index                0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 3.701828
cell physical IO bytes saved by columnar cache               0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes           650.1875
cell physical write IO bytes eligible for offload            0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>

```

The statistics show that the query in step 4 was conducted using Smart Scan. Note, however, that cell physical IO bytes saved by storage index is zero. This is because storage indexes are memory structures which do not persist when the Exadata cells are restarted. They are dynamically built when tables are referenced for the first time after the cells restart. Now that the mycustomers table has been scanned as a result of the query in step 4, all subsequent queries on the mycustomers table can benefit from whatever storage indexes the Exadata cells automatically create.

6. Reconnect to your database in order to reset the session level statistics.

```
SQL> connect sh/??  
Connected.  
SQL>
```

7. Repeat the statistics query from step 3 (or execute the SQL script

/home/oracle/labs/lab04-04-03.sql) and verify that the statistics are again at or near zero values. If any statistics are significantly greater than zero then reconnect again and retry.

```
SQL> select a.name, b.value/1024/1024 MB  
  2  from v$sysstat a, v$mystat b  
  3  where a.statistic# = b.statistic# and  
  4  (a.name in ('physical read total bytes',  
  5              'physical write total bytes',  
  6              'cell IO uncompressed bytes')  
  7  or a.name like 'cell phy%');  
  
NAME                                MB  
-----  
physical read total bytes            0  
physical write total bytes          0  
cell physical IO interconnect bytes 0  
cell physical IO bytes saved during optimized file creation 0  
cell physical IO bytes saved during optimized RMAN file restore 0  
cell physical IO bytes eligible for predicate offload        0  
cell physical IO bytes saved by storage index                 0  
cell physical IO bytes sent directly to DB node to balance CPU 0  
cell physical IO interconnect bytes returned by smart scan   0  
cell physical IO bytes saved by columnar cache                0  
cell physical write bytes saved by smart file initialization 0  
  
NAME                                MB  
-----  
cell IO uncompressed bytes           0  
cell physical write IO bytes eligible for offload             0  
cell physical write IO host network bytes written during offloa 0  
  
14 rows selected.  
  
SQL>
```

8. Re-execute the query from step 4 (or execute the SQL script
/home/oracle/labs/lab04-04-04.sql).

```
SQL> select cust_gender,count(*) from mycustomers
  2  where cust_income_level = 'C: 50000 - 69999'
  3  group by cust_gender;

C      COUNT (*)
-
M          135817
F          136226

SQL>
```

9. Repeat the statistics query from step 3 (or execute the SQL script /home/oracle/labs/lab04-04-03.sql).

```

SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3 where a.statistic# = b.statistic# and
  4   (a.name in ('physical read total bytes',
  5               'physical write total bytes',
  6               'cell IO uncompressed bytes')
  7 or a.name like 'cell phy%');

NAME                                MB
-----
physical read total bytes          650.1875
physical write total bytes         0
cell physical IO interconnect bytes 3.59671783
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload      650.1875
cell physical IO bytes saved by storage index            595.398438
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 3.59671783
cell physical IO bytes saved by columnar cache           0
cell physical write bytes saved by smart file initialization 0

NAME                                MB
-----
cell IO uncompressed bytes          54.7890625
cell physical write IO bytes eligible for offload        0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>

```

This time you will see that the query in step 8 benefits from the storage index. Instead of conducting more than 650 MB of I/O inside the cells, storage indexes were used to bypass more than 595 MB of I/O. In other words, approximately 55 MB of I/O was conducted instead of 650 MB. Queries that benefit from storage indexes can execute more quickly using fewer resources which allows other workloads to benefit from the unused I/O resources.

10. Exit your SQL*Plus session.

Practices for Lesson 5: Exadata Database Machine Initial Configuration

Chapter 5

Practices for Lesson 5: Overview

Practices Overview

In this practice, you will be introduced to the Oracle Exadata Deployment Assistant configuration tool.

Practice 5-1: Using the Exadata Configuration Tool

Overview

In this practice, you will be introduced to the Oracle Exadata Deployment Assistant configuration tool (Exadata configuration tool). You will use the configuration tool to generate a set of configuration files for example Database Machine implementation scenarios.

Tasks

- Establish a terminal session connected to qr01dbadm01 using the oracle OS user. Ensure that you specify the -X option for ssh.

```
$ ssh -X oracle@qr01dbadm01
oracle@qr01dbadm01 password: ???????
[oracle@qr01dbadm01 ~]$
```

- The latest Oracle Exadata Deployment Assistant is provided as a patch on My Oracle Support. In your laboratory environment, a version of the Oracle Exadata Deployment Assistant is located under /home/oracle/labs/oeda/linux-x64 on qr01dbadm01. Change directory to the directory containing the Oracle Exadata Deployment Assistant.

```
[oracle@qr01dbadm01 ~]$ cd labs/oeda/linux-x64
[oracle@qr01dbadm01 linux-x64]$
```

- Start the Exadata configuration tool.

```
[oracle@qr01dbadm01 linux-x64]$ ./config.sh
```

- Complete a configuration session for an X6-2 Full Rack Database Machine by using the information in the following table. Leave the default values for fields that are not specified in the following table. Examine the options and additional information presented on each page. When you are satisfied with each page, click “Next >” to proceed unless otherwise directed.

Step	Window/Page Description	Configuration Settings and Other Instructions
a.	Welcome	Leave the default selection (Oracle Exadata Database Machine).
b.	Customer Details	Customer Name: Example Industries Application: Example Full Rack Network Domain Name: example.com DNS: 10.7.7.5 NTP: 10.7.7.5
c.	Hardware Selection	This is your deployment: X6-2 Full Rack HC 8TB
d.	Rack Details	Leave the default values.
e.	Define Customer Networks	Subnet 1 (Admin) Gateway: 10.7.7.1 Subnet 2 (Client) Gateway: 172.16.1.1
f.	Administration Network	Starting IP Address for Pool: 10.7.7.101
g.	Client Ethernet Network	Starting IP Address for Pool: 172.16.1.101

Step	Window/Page Description	Configuration Settings and Other Instructions
h.	InfiniBand Network	Leave the default values.
i.	Backup Network	Leave unconfigured.
j.	Identify Compute Node OS	Leave the default configuration.
k.	Capacity-on-Demand	Click Confirmed.
l.	Review and Edit	Review and proceed.
m.	Define Clusters	Cluster Name: dm01 Click "All >>" and then proceed.
n.	Cluster 1	Check the Role Separated option in the Users and Groups section. Grid Infrastructure Home: 12.1.0.2 DBBP160419 Database Home Location: 12.1.0.2 DBBP160419
o.	Review and Edit	Review and proceed.
p.	Alerting	Leave unconfigured.
q.	Platinum Configuration	Uncheck the Capture data for Platinum configuration option.
r.	Oracle Config. Manager	Leave unconfigured.
s.	Auto Service Request	Leave unconfigured.
t.	Grid Control Agent	Leave unconfigured.
u.	Comments	Review and proceed.
v.	Generate	Click "Next >" as instructed.
w.	Select Destination Folder	Leave the default location and click Save.
x.	Finish	Note the names and locations of the generated files. Click "Installation template" and examine the configuration details in the resulting web browser page. When you are finished, close the web browser and click Finish to end the configuration session.

5. Back in your terminal session, examine the contents of the ExadataConfigurations directory, which contains your newly generated configuration files.

```
[oracle@qr01dbadm01 linux-x64] $ ls -hs ExadataConfigurations
total 536K
 12K databasemachine.xml
 4.0K Example_Industries-dm01-checkip.sh
232K Example_Industries-dm01-InstallationTemplate.html
 4.0K Example_Industries-dm01-platinum.csv
 8.0K Example_Industries-dm01-preconf_rack_0.csv
244K Example_Industries-dm01.xml
 32K Example_Industries-dm01.zip
[oracle@qr01dbadm01 linux-x64] $
```

6. Examine the Example_Industries-dm01.xml file (using the more command or vi if you prefer). This is one of the main configuration files that drive the Database Machine deployment process. Examine the file and confirm that the details within it match your inputs to the configuration tool. Take a few minutes to examine the other configuration files as well.

Congratulations, you have now used the Exadata configuration tool to generate a set of configuration files for a Database Machine deployment scenario. In the next part of this practice you will use the configuration tool to import your configuration information and make some changes.

7. Restart the Exadata configuration tool.

```
[oracle@qr01dbadm01 linux-x64] $ ./config.sh
```

8. In your previous configuration session, you created configuration files for an X6-2 Full Rack Database Machine with many default settings. In this configuration session, you will import your previous configuration and make a series of changes by using the information in the following table. If you wish, feel free to experiment with the different configuration options. When you are satisfied with each page, click “Next >” to proceed unless otherwise directed.

Step	Window/Page Description	Configuration Settings and Other Instructions
a.	Welcome	Click Import... Select /home/oracle/labs/oeda/linux-x64/ExadataConfigurations/Example_Industries-dm01.xml and click Open. Click OK to acknowledge the resulting dialog box.
b.	Customer Details	Review and proceed.
c.	Hardware Selection	Review and proceed.
d.	Rack Details	Review and proceed.

e.	Define Customer Networks	Click Advanced... and examine the advanced options. Select the Enable Network VLAN option and click OK. Subnet 1 (Admin) VLAN ID: Specify a unique numeric value between 1 and 4079 Subnet 2 (Client) VLAN ID: Specify a unique numeric value between 1 and 4095												
f.	Administration Network	Click Modify... and examine the resulting dialog. Alter the configuration to use a non-default naming convention by altering any of the name format strings and click Save.												
g.	Client Ethernet Network	Click Modify... and examine the resulting dialog. Alter the configuration to use a non-default naming convention by altering any of the name format strings and click Save.												
h.	InfiniBand Network	Click Modify... and examine the resulting dialog. Alter the configuration to use a non-default naming convention by altering any of the name format strings and click Save.												
i.	Backup Network	Leave unconfigured.												
j.	Identify Compute Node OS	Click the Enable Capacity-on-Demand option and use the slider to set the number of enabled CPU cores on each database server.												
k.	Review and Edit	Review and proceed.												
l.	Define Clusters	Review and proceed.												
m.	Cluster 1	Customize the storage configuration in the Disk Group Details section as follows: <table border="1"> <thead> <tr> <th>Disk Group</th><th>Name</th><th>Redundancy</th><th>Size</th></tr> </thead> <tbody> <tr> <td>DATA</td><td>DATAC1</td><td>HIGH</td><td>90%</td></tr> <tr> <td>RECO</td><td>RECOC1</td><td>HIGH</td><td>10%</td></tr> </tbody> </table>	Disk Group	Name	Redundancy	Size	DATA	DATAC1	HIGH	90%	RECO	RECOC1	HIGH	10%
Disk Group	Name	Redundancy	Size											
DATA	DATAC1	HIGH	90%											
RECO	RECOC1	HIGH	10%											
n.	Review and Edit	Review and proceed.												
o.	Alerting	Leave unconfigured.												
p.	Platinum Configuration	Leave unconfigured.												
q.	Oracle Config. Manager	Leave unconfigured.												
r.	Auto Service Request	Leave unconfigured.												
s.	Grid Control Agent	Leave unconfigured.												
t.	Comments	Review and proceed.												
u.	Generate	Click "Next >" as instructed.												
v.	Select Destination Folder	Enter ExadataConfigurations2 as the destination folder (using the File Name field) and click Save.												

w.	Finish	Note the names and locations of the generated files. Click “Installation template” and examine the configuration details in the resulting web browser page. When you are finished, close the web browser and click Finish to end the configuration session.
----	--------	---

9. Back in your terminal session, compare your configuration files and verify the changes that you made in the second configuration session. For example:

```
[oracle@qr01dbadm01 linux-x64] $ xml_grep diskGroupSize
ExadataConfigurations*/Example_Industries-dm01.xml

<?xml version="1.0" ?>
<xml_grep version="0.7" date="Fri Jun 3 06:02:52 2016">
<file filename="ExadataConfigurations2/Example_Industries-
dm01.xml">
  <diskGroupSize>2037G</diskGroupSize>
  <diskGroupSize>367416G</diskGroupSize>
  <diskGroupSize>40824G</diskGroupSize>
</file>
<file filename="ExadataConfigurations/Example_Industries-
dm01.xml">
  <diskGroupSize>2037G</diskGroupSize>
  <diskGroupSize>349888G</diskGroupSize>
  <diskGroupSize>87444G</diskGroupSize>
</file>
</xml_grep>
[oracle@qr01dbadm01 linux-x64] $
```

10. Restart the Exadata configuration tool and create a configuration for an elastic configuration with virtualized database servers by using the information in the following table. Feel free again to experiment with the different configuration options if you wish. When you are satisfied with each page, click “Next >” to proceed unless otherwise directed.

Step	Window/Page Description	Configuration Settings and Other Instructions
a.	Welcome	Leave the default selection (Oracle Exadata Database Machine).
b.	Customer Details	Customer Name: Example Industries Application: Example with Virtualization Network Domain Name: example.com Name Prefix: vm01 DNS: 10.7.7.5 NTP: 10.7.7.5
c.	Hardware Selection	This is your deployment: X6-2 Elastic Rack HC 8TB
d.	Rack Details	Compute Node count: 4 Storage Cell count: 6

Step	Window/Page Description	Configuration Settings and Other Instructions
e.	Define Customer Networks	Subnet 1 (Admin) Gateway: 10.7.7.1 Subnet 2 (Client) Gateway: 172.16.1.1
f.	Administration Network	Starting IP Address for Pool: 10.7.7.11
g.	Client Ethernet Network	Starting IP Address for Pool: 172.16.1.11
h.	InfiniBand Network	Leave the default values.
i.	Backup Network	Leave unconfigured.
j.	Identify Compute Node OS	Click "All OVM"
k.	Capacity-on-Demand	Click Confirmed.
l.	Review and Edit	Review and proceed.
m.	Define Clusters	Number of Clusters to create: 2 Cluster 1 tab: Cluster Name: c1 Click "All >>" Cluster 2 tab: Cluster Name: c2 Click "All >>".
n.	Cluster 1	Examine the options for Virtual Guest Size. Also click Oracle VM Defaults... and examine the available options. Otherwise, create your own custom configuration or leave the default values.
o.	Cluster 2	Create your own custom configuration or leave the default values.
p.	Review and Edit	Review and proceed.
q.	Alerting	Leave unconfigured.
r.	Platinum Configuration	Uncheck the Capture data for Platinum configuration option.
s.	Oracle Config. Manager	Leave unconfigured.
t.	Auto Service Request	Leave unconfigured.
u.	Grid Control Agent	Leave unconfigured.
v.	Comments	Review and proceed.

Step	Window/Page Description	Configuration Settings and Other Instructions
w.	Generate	Click “Next >” as instructed.
x.	Select Destination Folder	Enter <code>ExadataConfigurations3</code> as the destination folder (using the File Name field) and click Save.
y.	Finish	Note the names and locations of the generated files. Click “Installation template” and examine the configuration details in the resulting web browser page. Close the web browser when you are finished examining the installation template.

11. Use any remaining time to experiment with the Exadata configuration tool to create different configurations. Exit your terminal session when you are finished.

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Practices for Lesson 6: Exadata Storage Server Configuration

Chapter 6

Practices for Lesson 6: Overview

Practices Overview

In these practices, you will perform a variety of Exadata configuration tasks, including cell configuration and storage reconfiguration. You will also consume Exadata storage using ASM, configure Exadata storage security, exercise the privileges associated with the different cell user accounts and use the distributed command line utility (dcli).

Practice 6-1: Cell configuration

Overview

In this practice you examine, set and validate some Exadata cell parameters.

Tasks

1. Establish a terminal connection to qr01celadm01 as the celladmin user.

```
$ ssh celladmin@qr01celadm01  
celladmin@qr01celadm01's password: ???????  
[celladmin@qr01celadm01 ~] $
```

2. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~] $ cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

3. Execute the following CellCLI command to examine the attributes of the cell.

```
CellCLI> list cell detail
  name:          qr01celadm01
  cellVersion:   OSS_12.1.2.1.0_LINUX.X64_141206.1
  cpuCount:      2
  diagHistoryDays: 7
  fanCount:     0/0
  fanStatus:    normal
  flashCacheMode: WriteThrough
  id:           ef92136a-837c-4e1d-88d2-e01f5ab89b7b
  interconnectCount: 0
  interconnect1: ib0
  interconnect2: ib1
  iormBoost:    0.0
  ipAddress1:  192.168.1.105/24
  ipAddress2:  192.168.1.106/24
  kernelVersion: 2.6.39-400.243.1.el6uek.x86_64
  makeModel:    Fake hardware
  memoryGB:    4
  metricHistoryDays: 7
  offloadGroupEvents:
  offloadEfficiency: 791.1
  powerCount:   0/0
  powerStatus:  normal
  releaseVersion: 12.1.2.1.0
  releaseTrackingBug: 17885582
  status:       online
  temperatureReading: 0.0
  temperatureStatus: normal
  upTime:       4 days, 21:22
  cellsrvStatus: running
  msStatus:     running
  rsStatus:     running

CellCLI>
```

4. Configure the cell to send email alerts to a fictitious Exadata administrator.

```
CellCLI> alter cell smtpServer='my_mail.example.com',
           smtpFromAddr='john.doe@example.com',
           smtpFrom='John Doe',
           smtpToAddr='jane.smith@example.com',
           notificationPolicy='critical,warning,clear',
           notificationMethod='mail'
Cell qr01celadm01 successfully altered

CellCLI>
```

5. Reexamine the cell configuration to verify the changes you made in step 4.

```
CellCLI> list cell detail
  name: qr01celadm01
  cellVersion: OSS_12.1.2.1.0_LINUX.X64_141206.1
  cpuCount: 2
  diagHistoryDays: 7
  fanCount: 0/0
  fanStatus: normal
  flashCacheMode: WriteThrough
  id: ef92136a-837c-4e1d-88d2-e01f5ab89b7b
  interconnectCount: 0
  interconnect1: ib0
  interconnect2: ib1
  iormBoost: 0.0
  ipAddress1: 192.168.1.105/24
  ipAddress2: 192.168.1.106/24
  kernelVersion: 2.6.39-400.243.1.el6uek.x86_64
  makeModel: Fake hardware
  memoryGB: 4
  metricHistoryDays: 7
  notificationMethod: mail
  notificationPolicy: critical,warning,clear
  offloadGroupEvents:
  offloadEfficiency: 791.1
  powerCount: 0/0
  powerStatus: normal
  releaseVersion: 12.1.2.1.0
  releaseTrackingBug: 17885582
  smtpFrom: "John Doe"
  smtpFromAddr: john.doe@example.com
  smtpServer: my_mail.example.com
  smtpToAddr: jane.smith@example.com
  status: online
  temperatureReading: 0.0
  temperatureStatus: normal
  upTime: 4 days, 21:23
  cellsrvStatus: running
  msStatus: running
  rsStatus: running

CellCLI>
```

6. Execute the following CellCLI command to validate the email attributes configured for the cell.

Note: Executing this command attempts to send a test email to each of the configured email addresses. The validation process only confirms the ability to successfully send a test email using the specified configuration. The validation process does not confirm the existence of the target email account, nor does it confirm successful receipt of the test email message. In this case an error message is observed because the target email server (my_mail.example.com) does not really exist.

```
CellCLI> alter cell validate mail

CELL-02578: An error was detected in the SMTP configuration:
CELL-05503: An error was detected during notification. The text
of the associated internal error is: Unknown SMTP host:
my_mail.example.com.

The notification recipient is jane.smith@example.com.

Please verify your SMTP configuration.

CellCLI>
```

7. Execute the following CellCLI command to perform a complete internal check of the cell configuration settings.

```
CellCLI> alter cell validate configuration
Cell qr01celadm01 successfully altered

CellCLI>
```

Note that the ALTER CELL VALIDATE CONFIGURATION command does not perform I/O tests against the cell's hard disks and flash modules. You must use the CALIBRATE command to perform such tests. The CALIBRATE command can only be executed in a CellCLI session initiated by the root user.

8. Exit your CellCLI session.

Practice 6-2: Storage reconfiguration

Overview

In this practice, you alter the Database Machine storage configuration. The approach used in this practice allows the storage reconfiguration to occur while the system is running and databases remain available. The procedure is based on one of the methods described in the section entitled *Resizing Storage Grid Disks* in the *Oracle Exadata Database Machine Maintenance Guide*.

In this practice you will reconfigure the RECO_QR01 ASM disk group. The aim is to resize the disk group and underlying Exadata grid disks so that some of the available free space can be used to create another disk group in the following practices.

Often storage is reconfigured to alter the balance of space allocated to the default DATA and RECO disk groups. In such cases, both disk groups are reconfigured in parallel, with the space freed from one disk group immediately consumed by the other disk group. See the *Oracle Exadata Database Machine Maintenance Guide* for more information.

Note: To complete this practice successfully, you must follow the instructions carefully and replicate the commands exactly. Failure to do so could result in unrecoverable damage to your lab environment. Please take care.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the grid user, and configure the terminal session to access ASM using the +ASM1 instance on qr01dbadm01.

```
$ ssh grid@qr01dbadm01  
grid@qr01dbadm01's password: ???????  
[grid@qr01dbadm01 ~]$ . oraenv  
ORACLE_SID = [grid] ? +ASM1  
The Oracle base has been set to /u01/app/grid  
[grid@qr01dbadm01 ~]$
```

2. Using SQL*Plus, connect to ASM as an ASM administrator.

```
[grid@qr01dbadm01 ~]$ sqlplus / as sysasm  
  
SQL*Plus: Release 12.1.0.2.0 Production...  
  
SQL>
```

3. Examine the ASM disk groups in your environment using the following query (or execute the SQL script /home/oracle/labs/lab06-02-03.sql). Note that the RECO_QR01 disk group is mostly free space.

```
SQL> select name, total_mb, free_mb, total_mb-free_mb used_mb
  2  from v$asm_diskgroup;

NAME          TOTAL_MB    FREE_MB    USED_MB
-----        -----
DATA_QR01      25920       11220      14700
DBFS_DG        12672        2432      10240
RECO_QR01      33408       32580       828

SQL>
```

4. The following query shows a summary of the space utilization for the disks in each disk group (use the SQL script /home/oracle/labs/lab06-02-04.sql if you prefer). For each disk group the query shows the number of associated disks, the size of each disk and the minimum and maximum amount of free space on the disks. Examine the output to ensure that the disk group being reconfigured is reasonably well balanced. In particular ensure that none of the disks are at or near capacity because this may cause problems with later rebalancing operations. If required rebalance the disk group using the ALTER DISKGROUP ... REBALANCE command prior to proceeding.

```
SQL> col name format a15
SQL> select dg.name, count(*), d.total_mb, d.os_mb,
  2  min(d.free_mb) MIN_FREE_MB, max(d.free_mb) MAX_FREE_MB
  3  from v$asm_disk d, v$asm_diskgroup dg
  4  where dg.group_number=d.group_number and d.mount_status='CACHED'
  5  group by dg.name, d.total_mb, d.os_mb;

NAME          COUNT(*)    TOTAL_MB    OS_MB  MIN_FREE_MB  MAX_FREE_MB
-----        -----
DBFS_DG        36           352         352        4            84
DATA_QR01      36           720         720       292          328
RECO_QR01      36           928         928       888          916

SQL>
```

5. Resize the ASM disks in the RECO_QR01 disk group so that each ASM disk shrinks from 928 MB to 608 MB.

```
SQL> alter diskgroup reco_qr01 resize all size 608m
  2  rebalance power 1024;

Diskgroup altered.

SQL>
```

6. Repeat the earlier queries from steps 3 and 4 and verify the effect of shrinking the RECO_QR01 disk group.

```

SQL> select name, total_mb, free_mb, total_mb-free_mb used_mb
  2  from v$asm_diskgroup;

NAME          TOTAL_MB    FREE_MB    USED_MB
-----
DATA_QR01      25920       11220     14700
DBFS_DG        12672       2432      10240
RECO_QR01      21888       21060      828

SQL> select dg.name, count(*), d.total_mb, d.os_mb,
  2  min(d.free_mb) MIN_FREE_MB, max(d.free_mb) MAX_FREE_MB
  3  from v$asm_disk d, v$asm_diskgroup dg
  4  where dg.group_number=d.group_number and d.mount_status='CACHED'
  5  group by dg.name, d.total_mb, d.os_mb;

NAME          COUNT (*)  TOTAL_MB    OS_MB  MIN_FREE_MB  MAX_FREE_MB
-----
DBFS_DG          36         352       352       4           84
DATA_QR01        36         720       720      292         328
RECO_QR01        36         608       928      568         596

SQL>

```

At this point you have shrunk the RECO_QR01 disk group so that each ASM disk now consumes 608 MB. However, each underlying Exadata grid disk still consumes 928 MB, as shown by the value in the OS_MB column.

In the next part of this practice, you will also resize each grid disk associated with the RECO_QR01 disk group. To use the method outlined in this practice requires at least enough free space so that the disk group can tolerate the temporary loss of the storage from two Exadata Storage Servers. Therefore, since the RECO_QR01 disk group now totals 21888 MB spanning three Exadata Storage Servers, the method outlined in this practice requires 14592 MB (two-thirds of 21888 MB) of free space, which is easily the case in your practice environment.

You can vary the approach outlined in this practice to cater for situations where you have enough free space to tolerate the temporary loss of only one Exadata Storage Server from the disk group. This option is discussed later in the practice. However, if you do not have enough free space to tolerate the temporary loss of even one Exadata Storage Server from your disk group, you will not be able to use an online rebalancing method and you will need to consider alternatives such as using backup and recovery.

7. Check that no ASM rebalance operations are currently active across the cluster. If required, periodically repeat the query until no rows are returned. **Do not proceed to the next step until the query returns no rows.**

```
SQL> select * from gv$asm_operation;

no rows selected

SQL>
```

8. Drop the disks associated with the cell qr01celadm01 (use the SQL script /home/oracle/labs/lab06-02-08.sql if you prefer). Note that a disk group rebalance is specified in order to maintain data redundancy.

```
SQL> alter diskgroup reco_qr01
  2  drop disks in failgroup qr01celadm01
  3  rebalance power 1024;

Diskgroup altered.

SQL>
```

9. Monitor the rebalance operation using the following query.

```
SQL> select * from gv$asm_operation;

INST_ID GROUP_NUMBER OPERA PASS      STAT      POWER      ACTUAL      SOFAR
----- -----
EST_WORK   EST_RATE EST_MINUTES ERROR_CODE
----- -----
CON_ID
-----
2          3 REBAL RESYNC      DONE      1024
0
2          3 REBAL RESILVER    DONE      1024
0
INST_ID GROUP_NUMBER OPERA PASS      STAT      POWER      ACTUAL      SOFAR
----- -----
EST_WORK   EST_RATE EST_MINUTES ERROR_CODE
----- -----
CON_ID
-----
2          3 REBAL REBALANCE    WAIT      1024
0
2          3 REBAL COMPACT     WAIT      1024
```

INST_ID	GROUP_NUMBER	OPERA	PASS	STAT	POWER	ACTUAL	SOFAR
EST_WORK	EST_RATE	EST_MINUTES	ERROR_CODE				
CON_ID							
0							
1	3	REBAL	RESYNC	DONE	1024	1024	0
0	0		0				
0							
1	3	REBAL	RESILVER	DONE	1024	1024	0
INST_ID	GROUP_NUMBER	OPERA	PASS	STAT	POWER	ACTUAL	SOFAR
EST_WORK	EST_RATE	EST_MINUTES	ERROR_CODE				
CON_ID							
0	0		0				
0							
1	3	REBAL	REBALANCE	RUN	1024	1024	4
68	403		0				
0							
INST_ID	GROUP_NUMBER	OPERA	PASS	STAT	POWER	ACTUAL	SOFAR
EST_WORK	EST_RATE	EST_MINUTES	ERROR_CODE				
CON_ID							
1	3	REBAL	COMPACT	WAIT	1024	1024	0
0	0		0				
0							

8 rows selected.

SQL>

10. Periodically repeat the query to monitor the rebalance operation, which will take a few minutes to complete in your laboratory environment. When the query returns no results, the rebalance operation is completed. **Do not proceed to the next step until the rebalance operation completes.**

```
SQL> select * from gv$asm_operation;  
  
no rows selected  
  
SQL>
```

11. Use the following query (or execute the SQL script /home/oracle/labs/lab06-02-11.sql) to confirm that the disks are dropped (HEADER_STATUS=FORMER and MOUNT_STATUS=CLOSED).

```
SQL> select path, free_mb, header_status, mount_status  
  2  from v$asm_disk  
  3  where path like '%RECO_QR01%celadm01';  
  
PATH  
-----  
FREE_MB HEADER_STATUS MOUNT_S  
-----  
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_10_qr01celadm01  
      0 FORMER      CLOSED  
  
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_06_qr01celadm01  
      0 FORMER      CLOSED  
  
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_00_qr01celadm01  
      0 FORMER      CLOSED  
  
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_05_qr01celadm01  
      0 FORMER      CLOSED  
  
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_08_qr01celadm01  
      0 FORMER      CLOSED  
  
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_03_qr01celadm01  
      0 FORMER      CLOSED
```

```
PATH
-----
FREE_MB HEADER_STATUS MOUNT_S
-----
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_09_qr01celadm01
    0 FORMER      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_04_qr01celadm01
    0 FORMER      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_01_qr01celadm01
    0 FORMER      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_07_qr01celadm01
    0 FORMER      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_02_qr01celadm01
    0 FORMER      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_11_qr01celadm01
    0 FORMER      CLOSED

12 rows selected.

SQL>
```

12. Establish a separate terminal connection to the qr01celadm01 Exadata cell as the celladmin user. Maintain your ASM administrator SQL session as you will require this throughout the rest of the practice.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ???????
[celladmin@qr01celadm01 ~]$
```

13. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...

CellCLI>
```

14. Examine the grid disks on qr01celadm01. Notice the ASMModeStatus for the dropped disks.

```
CellCLI> list griddisk attributes name, size, ASMModeStatus
  DATA_QR01_CD_00_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_01_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_02_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_03_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_04_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_05_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_06_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_07_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_08_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_09_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_10_qr01celadm01      720M    ONLINE
  DATA_QR01_CD_11_qr01celadm01      720M    ONLINE
  DBFS_DG_CD_00_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_01_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_02_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_03_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_04_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_05_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_06_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_07_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_08_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_09_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_10_qr01celadm01       352M    ONLINE
  DBFS_DG_CD_11_qr01celadm01       352M    ONLINE
  RECO_QR01_CD_00_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_01_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_02_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_03_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_04_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_05_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_06_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_07_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_08_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_09_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_10_qr01celadm01     928M    UNUSED
  RECO_QR01_CD_11_qr01celadm01     928M    UNUSED
```

```
CellCLI>
```

15. Drop the grid disks on qr01celadm01 previously associated with the RECO_QR01 disk group.

```
CellCLI> drop griddisk all prefix=reco_qr01
GridDisk RECO_QR01_CD_00_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_01_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_02_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_03_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_04_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_05_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_06_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_07_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_08_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_09_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_10_qr01celadm01 successfully dropped
GridDisk RECO_QR01_CD_11_qr01celadm01 successfully dropped

CellCLI>
```

16. Create a new set of grid disks. Use the same grid disk prefix as before, but specify a size of 608 MB for each grid disk.

```
CellCLI> create griddisk all harddisk prefix=RECO_QR01, size=608M
GridDisk RECO_QR01_CD_00_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_01_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_02_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_03_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_04_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_05_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_06_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_07_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_08_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_09_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_10_qr01celadm01 successfully created
GridDisk RECO_QR01_CD_11_qr01celadm01 successfully created

CellCLI>
```

17. Re-examine the grid disk on qr01celadm01. Notice the reconfigured grid disks with the RECO_QR01 prefix.

```
CellCLI> list griddisk attributes name, size, ASMModeStatus
  DATA_QR01_CD_00_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_01_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_02_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_03_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_04_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_05_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_06_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_07_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_08_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_09_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_10_qr01celadm01    720M   ONLINE
  DATA_QR01_CD_11_qr01celadm01    720M   ONLINE
  DBFS_DG_CD_00_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_01_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_02_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_03_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_04_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_05_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_06_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_07_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_08_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_09_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_10_qr01celadm01     352M   ONLINE
  DBFS_DG_CD_11_qr01celadm01     352M   ONLINE
  RECO_QR01_CD_00_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_01_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_02_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_03_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_04_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_05_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_06_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_07_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_08_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_09_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_10_qr01celadm01    608M   UNUSED
  RECO_QR01_CD_11_qr01celadm01    608M   UNUSED
```

CellCLI>

18. Exit your CellCLI session but keep your terminal session open. You will require a terminal session connected to qr01celadm01 as the celladmin user later in the practice.

```
CellCLI> exit
quitting

[celladmin@qr01celadm01 ~]$
```

19. Back in your ASM administrator SQL session, re-execute the following query (or execute the SQL script /home/oracle/labs/lab06-02-11.sql). Notice that the reconfigured grid disks are listed with HEADER_STATUS=CANDIDATE.

```
SQL> select path, free_mb, header_status, mount_status
  2  from v$asm_disk
  3  where path like '%RECO_QR01%celadm01';

PATH
-----
FREE_MB HEADER_STATUS MOUNT_S
-----
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_10_qr01celadm01
          0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_06_qr01celadm01
          0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_00_qr01celadm01
          0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_05_qr01celadm01
          0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_08_qr01celadm01
          0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_03_qr01celadm01
          0 CANDIDATE      CLOSED
```

```

PATH
-----
FREE_MB HEADER_STATUS MOUNT_S
-----
o/192.168.1.105;192.168.1.106/RECO_QR01_CD_09_qr01celadm01
    0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_04_qr01celadm01
    0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_01_qr01celadm01
    0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_07_qr01celadm01
    0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_02_qr01celadm01
    0 CANDIDATE      CLOSED

o/192.168.1.105;192.168.1.106/RECO_QR01_CD_11_qr01celadm01
    0 CANDIDATE      CLOSED

12 rows selected.

SQL>

```

20. Add the reconfigured grid disks back into the RECO_QR01 disk group, and at the same time drop the disks associated with the cell qr01celadm02 (use the SQL script /home/oracle/labs/lab06-02-20.sql if you prefer).

```

SQL> alter diskgroup reco_qr01 add disk
  2  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_00_qr01celadm01',
  3  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_01_qr01celadm01',
  4  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_02_qr01celadm01',
  5  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_03_qr01celadm01',
  6  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_04_qr01celadm01',
  7  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_05_qr01celadm01',
  8  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_06_qr01celadm01',
  9  'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_07_qr01celadm01',
 10 'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_08_qr01celadm01',
 11 'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_09_qr01celadm01',
 12 'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_10_qr01celadm01',
 13 'o/192.168.1.105;192.168.1.106/RECO_QR01_CD_11_qr01celadm01'
 14 drop disks in failgroup qr01celadm02
 15 rebalance power 1024;

Diskgroup altered.

SQL>

```

The preceding operation requires at least enough free space so that the disk group can tolerate the temporary loss of the storage from two Exadata Storage Servers. In situations with only enough free space to tolerate the temporary loss of one Exadata Storage Server from the disk group, you can perform the preceding operation in 2 steps. Firstly, add the reconfigured disks back into the disk group, and then drop the next set of disks. This two-step approach requires less free space to work; however, it results in 2 rebalance operations, which requires more time to perform.

21. Monitor the rebalance operation by using the following query.

```
SQL> select * from gv$asm_operation;

...
INST_ID GROUP_NUMBER OPERA PASS      STAT      POWER      ACTUAL      SOFAR
----- -----
EST_WORK   EST_RATE EST_MINUTES ERROR_CODE
-----
CON_ID
-----
2          3 REBAL COMPACT    WAIT      1024
0
8 rows selected.

SQL>
```

22. Periodically repeat the query to monitor the rebalance operation. When the query returns no results the rebalance operation is completed. **Do not proceed to the next step until the rebalance operation completes.**

```
SQL> select * from gv$asm_operation;

no rows selected

SQL>
```

23. Re-execute the query from step 4 (use the SQL script /home/oracle/labs/lab06-02-04.sql if you prefer). Now you can see the RECO_QR01 disk group in a partially reconfigured state. At this point the storage associated with the RECO_QR01 disk group has been reconfigured on qr01celadm01 (12 disks) and the disks on qr01celadm02 have been dropped.

```
SQL> select dg.name, count(*), d.total_mb, d.os_mb,
  2  min(d.free_mb) MIN_FREE_MB, max(d.free_mb) MAX_FREE_MB
  3  from v$asm_disk d, v$asm_diskgroup dg
  4  where dg.group_number=d.group_number and d.mount_status='CACHED'
  5  group by dg.name, d.total_mb, d.os_mb;

NAME          COUNT(*)    TOTAL_MB    OS_MB  MIN_FREE_MB  MAX_FREE_MB
-----  -----
DBFS_DG           36        352        352         4          84
DATA_QR01         36        720        720       292         328
RECO_QR01          12        608        608       572         592
RECO_QR01          12        608        928       576         592

SQL>
```

24. Establish a separate terminal connection to the qr01celadm02 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm02
celladmin@qr01celadm02's password: ???????
[celladmin@qr01celadm02 ~]$
```

25. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm02 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production ...

CellCLI>
```

26. Examine the grid disks on qr01celadm02. Notice again the ASMModeStatus for the dropped disks.

Note: If the ASMModeStatus for the RECO_QR01 prefixed grid disks is ONLINE then you have either dropped the wrong disks in step 20 or you are connected to the wrong cell (you should now be connected to qr01celadm02). In either case, **do not proceed to the next step until you have resolved the problem.**

```
CellCLI> list griddisk attributes name, size, ASMModeStatus
          DATA_QR01_CD_00_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_01_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_02_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_03_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_04_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_05_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_06_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_07_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_08_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_09_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_10_qr01celadm02      720M    ONLINE
          DATA_QR01_CD_11_qr01celadm02      720M    ONLINE
          DBFS_DG_CD_00_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_01_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_02_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_03_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_04_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_05_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_06_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_07_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_08_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_09_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_10_qr01celadm02       352M    ONLINE
          DBFS_DG_CD_11_qr01celadm02       352M    ONLINE
          RECO_QR01_CD_00_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_01_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_02_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_03_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_04_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_05_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_06_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_07_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_08_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_09_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_10_qr01celadm02      928M    UNUSED
          RECO_QR01_CD_11_qr01celadm02      928M    UNUSED
```

```
CellCLI>
```

27. Drop the grid disks on qr01celadm02 previously associated with the RECO_QR01 disk group.

```
CellCLI> drop griddisk all prefix=reco_qr01
GridDisk RECO_QR01_CD_00_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_01_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_02_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_03_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_04_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_05_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_06_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_07_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_08_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_09_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_10_qr01celadm02 successfully dropped
GridDisk RECO_QR01_CD_11_qr01celadm02 successfully dropped
```

28. Create a new set of grid disks. Use the same grid disk prefix as before, but specify a size of 608 MB for each grid disk.

```
CellCLI> create griddisk all harddisk prefix=RECO_QR01, size=608M
GridDisk RECO_QR01_CD_00_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_01_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_02_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_03_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_04_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_05_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_06_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_07_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_08_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_09_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_10_qr01celadm02 successfully created
GridDisk RECO_QR01_CD_11_qr01celadm02 successfully created
```

29. Exit your CellCLI session.

```
CellCLI> exit
quitting

[celladmin@qr01celadm02 ~]$
```

30. Back in your ASM administrator SQL session, add the reconfigured grid disks on qr01celadm02 back into the RECO_QR01 disk group, and at the same time drop the disks associated with the cell qr01celadm03 (use the SQL script /home/oracle/labs/lab06-02-30.sql if you prefer).

```
SQL> alter diskgroup reco_qr01 add disk
  2  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_00_qr01celadm02',
  3  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_01_qr01celadm02',
  4  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_02_qr01celadm02',
  5  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_03_qr01celadm02',
  6  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_04_qr01celadm02',
  7  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_05_qr01celadm02',
  8  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_06_qr01celadm02',
  9  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_07_qr01celadm02',
 10  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_08_qr01celadm02',
 11  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_09_qr01celadm02',
 12  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_10_qr01celadm02',
 13  'o/192.168.1.107;192.168.1.108/RECO_QR01_CD_11_qr01celadm02'
 14 drop disks in failgroup qr01celadm03
 15 rebalance power 1024;

Diskgroup altered.

SQL>
```

As was the case in step 20, the preceding operation requires at least enough free space so that the disk group can tolerate the temporary loss of the storage from two Exadata Storage Servers. In situations with only enough free space to tolerate the temporary loss of one Exadata Storage Server from the disk group, you can perform the preceding operation in 2 steps by separately adding the reconfigured disks and then dropping the next set of disks.

31. Monitor the rebalance operation as before.

```
SQL> select * from gv$asm_operation;
...
INST_ID GROUP_NUMBER OPERA PASS      STAT        POWER      ACTUAL      SOFAR
----- -----
EST_WORK   EST_RATE EST_MINUTES ERROR_CODE
-----
CON_ID
-----
2          3 REBAL COMPACT    WAIT       1024
0
8 rows selected.

SQL>
```

32. Periodically repeat the query to monitor the rebalance operation. When the query returns no results, the rebalance operation is completed. **Do not proceed to the next step until the rebalance operation completes.**

```
SQL> select * from gv$asm_operation;

no rows selected

SQL>
```

33. Re-execute the query from step 4 (use the SQL script /home/oracle/labs/lab06-02-04.sql if you prefer). Now the storage associated with the RECO_QR01 disk group has been reconfigured on two cells (24 disks on qr01celadm01 and qr01celadm02) and the disks on the remaining cell (qr01celadm03) have been dropped.

```
SQL> select dg.name, count(*), d.total_mb, d.os_mb,
  2  min(d.free_mb) MIN_FREE_MB, max(d.free_mb) MAX_FREE_MB
  3  from v$asm_disk d, v$asm_diskgroup dg
  4  where dg.group_number=d.group_number and d.mount_status='CACHED'
  5  group by dg.name, d.total_mb, d.os_mb;

NAME          COUNT (*)    TOTAL_MB      OS_MB  MIN_FREE_MB  MAX_FREE_MB
-----  -----
DBFS_DG           36        352        352          4          84
DATA_QR01         36        720        720        292        328
RECO_QR01         24        608        608        572        592

SQL>
```

34. Establish a separate terminal connection to the qr01celadm03 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm03
celladmin@qr01celadm03's password: ???????
[celladmin@qr01celadm03 ~] $
```

35. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm03 ~] $ cellcli
CellCLI: Release 12.1.2.1.0 - Production ...

CellCLI>
```

36. Examine the grid disks on qr01celadm03. Notice again the ASMModeStatus for the dropped disks.

Note: If the ASMModeStatus for the RECO_QR01 prefixed grid disks is ONLINE then you have either dropped the wrong disks in step 30 or you are connected to the wrong cell (you should now be connected to qr01celadm03). In either case, **do not proceed to the next step until you have resolved the problem.**

```
CellCLI> list griddisk attributes name, size, ASMModeStatus
DATA_QR01_CD_00_qr01celadm03      720M    ONLINE
DATA_QR01_CD_01_qr01celadm03      720M    ONLINE
DATA_QR01_CD_02_qr01celadm03      720M    ONLINE
DATA_QR01_CD_03_qr01celadm03      720M    ONLINE
DATA_QR01_CD_04_qr01celadm03      720M    ONLINE
DATA_QR01_CD_05_qr01celadm03      720M    ONLINE
DATA_QR01_CD_06_qr01celadm03      720M    ONLINE
DATA_QR01_CD_07_qr01celadm03      720M    ONLINE
DATA_QR01_CD_08_qr01celadm03      720M    ONLINE
DATA_QR01_CD_09_qr01celadm03      720M    ONLINE
DATA_QR01_CD_10_qr01celadm03      720M    ONLINE
DATA_QR01_CD_11_qr01celadm03      720M    ONLINE
DBFS_DG_CD_00_qr01celadm03       352M    ONLINE
DBFS_DG_CD_01_qr01celadm03       352M    ONLINE
DBFS_DG_CD_02_qr01celadm03       352M    ONLINE
DBFS_DG_CD_03_qr01celadm03       352M    ONLINE
DBFS_DG_CD_04_qr01celadm03       352M    ONLINE
DBFS_DG_CD_05_qr01celadm03       352M    ONLINE
DBFS_DG_CD_06_qr01celadm03       352M    ONLINE
DBFS_DG_CD_07_qr01celadm03       352M    ONLINE
DBFS_DG_CD_08_qr01celadm03       352M    ONLINE
DBFS_DG_CD_09_qr01celadm03       352M    ONLINE
DBFS_DG_CD_10_qr01celadm03       352M    ONLINE
DBFS_DG_CD_11_qr01celadm03       352M    ONLINE
RECO_QR01_CD_00_qr01celadm03      928M    UNUSED
RECO_QR01_CD_01_qr01celadm03      928M    UNUSED
RECO_QR01_CD_02_qr01celadm03      928M    UNUSED
RECO_QR01_CD_03_qr01celadm03      928M    UNUSED
RECO_QR01_CD_04_qr01celadm03      928M    UNUSED
RECO_QR01_CD_05_qr01celadm03      928M    UNUSED
RECO_QR01_CD_06_qr01celadm03      928M    UNUSED
RECO_QR01_CD_07_qr01celadm03      928M    UNUSED
RECO_QR01_CD_08_qr01celadm03      928M    UNUSED
RECO_QR01_CD_09_qr01celadm03      928M    UNUSED
RECO_QR01_CD_10_qr01celadm03      928M    UNUSED
RECO_QR01_CD_11_qr01celadm03      928M    UNUSED

CellCLI>
```

37. Drop the grid disks on qr01celadm03 previously associated with the RECO_QR01 disk group.

```
CellCLI> drop griddisk all prefix=reco_qr01
GridDisk RECO_QR01_CD_00_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_01_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_02_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_03_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_04_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_05_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_06_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_07_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_08_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_09_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_10_qr01celadm03 successfully dropped
GridDisk RECO_QR01_CD_11_qr01celadm03 successfully dropped

CellCLI>
```

38. Create a new set of grid disks. Use the same grid disk prefix as before, but specify a size of 608 MB for each grid disk.

```
CellCLI> create griddisk all harddisk prefix=RECO_QR01, size=608M
GridDisk RECO_QR01_CD_00_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_01_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_02_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_03_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_04_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_05_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_06_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_07_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_08_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_09_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_10_qr01celadm03 successfully created
GridDisk RECO_QR01_CD_11_qr01celadm03 successfully created

CellCLI>
```

39. Exit your CellCLI session.

```
CellCLI> exit
quitting

[celladmin@qr01celadm03 ~]$
```

40. Back in your ASM administrator SQL session, add the reconfigured grid disks on qr01celadm03 back into the RECO_QR01 disk group (use the SQL script /home/oracle/labs/lab06-02-40.sql if you prefer).

```
SQL> alter diskgroup reco_qr01 add disk
  2  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_00_qr01celadm03',
  3  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_01_qr01celadm03',
  4  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_02_qr01celadm03',
  5  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_03_qr01celadm03',
  6  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_04_qr01celadm03',
  7  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_05_qr01celadm03',
  8  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_06_qr01celadm03',
  9  'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_07_qr01celadm03',
 10 'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_08_qr01celadm03',
 11 'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_09_qr01celadm03',
 12 'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_10_qr01celadm03',
 13 'o/192.168.1.109;192.168.1.110/RECO_QR01_CD_11_qr01celadm03'
 14 rebalance power 1024;
```

Diskgroup altered.

SQL>

41. Monitor the rebalance operation as before.

```
SQL> select * from gv$asm_operation;
...
INST_ID GROUP_NUMBER OPERA PASS      STAT        POWER      ACTUAL      SOFAR
----- -----
EST_WORK   EST_RATE EST_MINUTES ERROR_CODE
-----
CON_ID
-----
2          3  REBAL COMPACT    WAIT       1024
0
8 rows selected.

SQL>
```

42. Periodically repeat the query to monitor the rebalance operation. When the query returns no results the rebalance operation is completed. **Do not proceed to the next step until the rebalance operation completes.**

```
SQL> select * from gv$asm_operation;
no rows selected
SQL>
```

43. Re-execute the query from step 4 (use the SQL script /home/oracle/labs/lab06-02-04.sql if you prefer). Now the storage associated with the RECO_QR01 disk group has been reconfigured on all three cells.

```
SQL> select dg.name, count(*), d.total_mb, d.os_mb,
  2  min(d.free_mb) MIN_FREE_MB, max(d.free_mb) MAX_FREE_MB
  3  from v$asm_disk d, v$asm_diskgroup dg
  4  where dg.group_number=d.group_number and d.mount_status='CACHED'
  5  group by dg.name, d.total_mb, d.os_mb;

NAME          COUNT(*)    TOTAL_MB    OS_MB  MIN_FREE_MB  MAX_FREE_MB
-----        -----
DBFS_DG           36       352        352        4          84
DATA_QR01         36       720        720       292         328
RECO_QR01         36       608        608       560         596
SQL>
```

In the final part of this practice, the free space created by reconfiguring the RECO_QR01 disk group will be used to create another set of grid disks.

44. Launch the Exadata cell command-line interface (CellCLI) on qr01celadm01.

```
[celladmin@qr01celadm01 ~]$ cellcli  
CellCLI: Release 12.1.2.1.0 - Production ...  
  
CellCLI>
```

45. Use the following CellCLI command to show the free space on each cell disk.

```
CellCLI> list celldisk attributes name, freeSpace where freeSpace != 0  
CD_00_qr01celadm01      320M  
CD_01_qr01celadm01      320M  
CD_02_qr01celadm01      320M  
CD_03_qr01celadm01      320M  
CD_04_qr01celadm01      320M  
CD_05_qr01celadm01      320M  
CD_06_qr01celadm01      320M  
CD_07_qr01celadm01      320M  
CD_08_qr01celadm01      320M  
CD_09_qr01celadm01      320M  
CD_10_qr01celadm01      320M  
CD_11_qr01celadm01      320M  
  
CellCLI>
```

46. Create a set of grid disks which consume all of the available free space. Specify prefix=DATA2_QR01.

```
CellCLI> create griddisk all harddisk prefix=DATA2_QR01  
GridDisk DATA2_QR01_CD_00_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_01_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_02_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_03_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_04_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_05_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_06_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_07_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_08_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_09_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_10_qr01celadm01 successfully created  
GridDisk DATA2_QR01_CD_11_qr01celadm01 successfully created  
  
CellCLI>
```

47. Examine the newly created grid disks. Note that they are now ready to be consumed in an ASM disk group.

```
CellCLI> list griddisk attributes name, size, ASMModeStatus where name like  
'DATA2.*'  
DATA2_QR01_CD_00_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_01_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_02_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_03_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_04_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_05_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_06_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_07_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_08_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_09_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_10_qr01celadm01 320M UNUSED  
DATA2_QR01_CD_11_qr01celadm01 320M UNUSED  
  
CellCLI>
```

48. Exit your CellCLI session but keep your terminal session open.

```
CellCLI> exit  
quitting  
  
[celladmin@qr01celadm01 ~] $
```

49. In step 46, a set of grid disks was created on qr01celadm01. Use the following command to create similar grid disks on qr01celadm02 and qr01celadm03.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm02,qr01celadm03 cellcli -e  
create griddisk all harddisk prefix=DATA2_QR01  
qr01celadm02: GridDisk DATA2_QR01_CD_00_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_01_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_02_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_03_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_04_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_05_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_06_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_07_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_08_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_09_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_10_qr01celadm02 successfully created  
qr01celadm02: GridDisk DATA2_QR01_CD_11_qr01celadm02 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_00_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_01_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_02_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_03_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_04_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_05_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_06_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_07_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_08_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_09_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_10_qr01celadm03 successfully created  
qr01celadm03: GridDisk DATA2_QR01_CD_11_qr01celadm03 successfully created  
[celladmin@qr01celadm01 ~]$
```

50. Use the following command to verify the existence of the newly created grid disks on all three cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e list griddisk attributes name, size, ASMMModeStatus where name like
'\DATA2.*\''"
qr01celadm01: DATA2_QR01_CD_00_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_01_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_02_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_03_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_04_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_05_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_06_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_07_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_08_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_09_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_10_qr01celadm01      320M    UNUSED
qr01celadm01: DATA2_QR01_CD_11_qr01celadm01      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_00_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_01_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_02_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_03_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_04_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_05_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_06_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_07_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_08_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_09_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_10_qr01celadm02      320M    UNUSED
qr01celadm02: DATA2_QR01_CD_11_qr01celadm02      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_00_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_01_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_02_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_03_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_04_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_05_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_06_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_07_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_08_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_09_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_10_qr01celadm03      320M    UNUSED
qr01celadm03: DATA2_QR01_CD_11_qr01celadm03      320M    UNUSED
[celladmin@qr01celadm01 ~]$
```

51. Exit your CellCLI and SQL*Plus sessions.

Practice 6-3: Consuming grid disks using ASM

Overview

In this practice, you consume some newly created Exadata grid disks using ASM.

Assumptions

Before beginning this practice you must complete Practice 6-2. Your ability to complete this practice depends on the existence of the grid disks that are created in practice 6-2.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the grid user, and configure the terminal session to access ASM using the +ASM1 instance on qr01dbadm01.

```
$ ssh grid@qr01dbadm01
grid@qr01dbadm01's password: ????????
[grid@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@qr01dbadm01 ~]$
```

2. By using SQL*Plus, connect to ASM as an ASM administrator.

```
[grid@qr01dbadm01 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

The ASM environment you are using is clustered across the entire Database Machine. All of the grid disks on all of the Exadata cells are visible inside ASM. In the previous practice you configured some new grid disks. Now you will consume those grid disks using ASM.

3. Execute the following query (or execute the SQL script /home/oracle/labs/lab06-03-03.sql). Note the capitalization inside the `like` string. The output shows a series of disks having `HEADER_STATUS=CANDIDATE`. This indicates that the disks do not belong to an ASM disk group and are ready to be consumed by ASM. Examine the `PATH` output. Can you determine the Exadata cell that contains each grid disk?

```
SQL> select name, header_status, path from v$asm_disk
  2  where path like 'o/%/DATA2%'
  3  and header_status='CANDIDATE';

NAME                  HEADER_STATUS
-----
PATH
-----
                                CANDIDATE
o/192.168.1.105;192.168.1.106/DATA2_QR01_CD_05_qr01celadm01

                                CANDIDATE
o/192.168.1.109;192.168.1.110/DATA2_QR01_CD_06_qr01celadm03

                                CANDIDATE
o/192.168.1.107;192.168.1.108/DATA2_QR01_CD_05_qr01celadm02

...
                                CANDIDATE
o/192.168.1.105;192.168.1.106/DATA2_QR01_CD_11_qr01celadm01

                                CANDIDATE
o/192.168.1.105;192.168.1.106/DATA2_QR01_CD_03_qr01celadm01

                                CANDIDATE
o/192.168.1.107;192.168.1.108/DATA2_QR01_CD_10_qr01celadm02

36 rows selected.

SQL>
```

Exadata grid disks are consumed inside ASM in two ways. You can add disks to an existing ASM disk group, which you did in the previous practice when you added disks back into the RECO_QR01 disk group. Or you can create a new ASM disk group based on Exadata grid disks.

4. Create a new ASM disk group consuming all the grid disks that you created in the previous practice (use the SQL script /home/oracle/labs/lab06-03-04.sql if you prefer).

```
SQL> create diskgroup data2_qr01 normal redundancy
  2  disk 'o/*/DATA2_QR01'
  3  attribute 'compatible.rdbms' = '12.1.0.2.0',
  4  'compatible.asm' = '12.1.0.2.0',
  5  'cell.smart_scan_capable' = 'TRUE',
  6  'au_size' = '4M';

Diskgroup created.

SQL>
```

The newly created disk group can be used to house Oracle data files in the same way as an ASM disk group based on any other storage. To complement the recommended AU_SIZE setting of 4 MB, you should set the initial extent size to 8 MB for large segments. The recommended approaches are discussed in the lesson entitled *Optimizing Database Performance with Exadata*.

5. Examine your newly created disk group using the following query (or execute the SQL script /home/oracle/labs/lab06-03-05.sql). Note how the grid disks from each different Exadata cell are automatically grouped into separate failure groups.

```

SQL> select d.path, dg.name GNAME, d.failgroup, d.state
  2  from v$asm_disk d, v$asm_diskgroup dg
  3 where d.group_number = dg.group_number
  4 and dg.name = 'DATA2_QR01';

PATH
-----
GNAME          FAILGROUP      STATE
-----
o/192.168.1.109;192.168.1.110/DATA2_QR01_CD_08_qr01celadm03
DATA2_QR01      QR01CELADM03  NORMAL
o/192.168.1.109;192.168.1.110/DATA2_QR01_CD_05_qr01celadm03
DATA2_QR01      QR01CELADM03  NORMAL
o/192.168.1.107;192.168.1.108/DATA2_QR01_CD_06_qr01celadm02
DATA2_QR01      QR01CELADM02  NORMAL
...
o/192.168.1.105;192.168.1.106/DATA2_QR01_CD_05_qr01celadm01
DATA2_QR01      QR01CELADM01  NORMAL
o/192.168.1.105;192.168.1.106/DATA2_QR01_CD_07_qr01celadm01
DATA2_QR01      QR01CELADM01  NORMAL
o/192.168.1.105;192.168.1.106/DATA2_QR01_CD_09_qr01celadm01
DATA2_QR01      QR01CELADM01  NORMAL

36 rows selected.

SQL>

```

6. Drop the disk group you created in step 4.

```

SQL> drop diskgroup data2_qr01;

Diskgroup dropped.

SQL>

```

7. Exit your SQL*Plus session.

Practice 6-4: Configuring Exadata storage security

Overview

In this practice, you configure Exadata storage security.

Assumptions

Before beginning this practice you must complete Practice 6-2. Your ability to complete this practice depends on the existence of the grid disks that are created in practice 6-2.

Tasks

Exadata storage security has two modes; ASM-scoped security and database-scoped security. ASM-scoped security must be implemented before database-scoped security can be configured. In the first part of this practice, you will configure ASM-scoped security across your lab environment.

- Establish a terminal connection to qr01dbadm01 as the grid user, and configure the terminal session to access ASM using the +ASM1 instance on qr01dbadm01.

```
$ ssh grid@qr01dbadm01
grid@qr01dbadm01's password: ????????
[grid@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@qr01dbadm01 ~]$
```

- Using SQL*Plus, connect to ASM as an ASM administrator.

```
[grid@qr01dbadm01 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

- Note the DB_UNIQUE_NAME setting for the ASM environment and then exit SQL*Plus.

```
SQL> show parameter unique

NAME                                     TYPE        VALUE
-----
db_unique_name                           string      +ASM
SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0 - 64bit Production...
[grid@qr01dbadm01 ~]$
```

4. Use the `su` command to assume the privileges of the `root` user.

```
[grid@qr01dbadm01 ~]$ su
Password: ????????
[root@qr01dbadm01 grid]#
```

To implement ASM-scoped security you must shut down the ASM cluster and any databases that are using it. However, in many cases it is easier to simply shut down the cluster across the Exadata Database Machine.

5. Shut down the cluster across your Exadata Database Machine environment.

```
[root@qr01dbadm01 grid]# crsctl stop cluster -all
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm01'
CRS-2790: Starting shutdown of Cluster Ready Services-managed
resources on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.LISTENER_SCAN2.lsnr' on
'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.LISTENER_SCAN3.lsnr' on
'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.dbm.db' on 'qr01dbadm01'
...
CRS-2790: Starting shutdown of Cluster Ready Services-managed
resources on 'qr01dbadm02'
CRS-2673: Attempting to stop 'ora.DBFS_DG.dg' on 'qr01dbadm02'
CRS-2673: Attempting to stop 'ora.dbm.db' on 'qr01dbadm02'
CRS-2673: Attempting to stop 'ora.LISTENER.lsnr' on
'qr01dbadm02'
...
CRS-2792: Shutdown of Cluster Ready Services-managed resources
on 'qr01dbadm02' has completed
CRS-2677: Stop of 'ora.RECO_QR01.dg' on 'qr01dbadm01' succeeded
CRS-2673: Attempting to stop 'ora.DATA_QR01.dg' on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.DBFS_DG.dg' on 'qr01dbadm01'
...
CRS-2792: Shutdown of Cluster Ready Services-managed resources
on 'qr01dbadm01' has completed
CRS-2677: Stop of 'ora.crsd' on 'qr01dbadm01' succeeded
CRS-2673: Attempting to stop 'ora.ctssd' on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.evmd' on 'qr01dbadm01'
...
CRS-2673: Attempting to stop 'ora.cssd' on 'qr01dbadm01'
CRS-2677: Stop of 'ora.cssd' on 'qr01dbadm01' succeeded
CRS-2673: Attempting to stop 'ora.diskmon' on 'qr01dbadm01'
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm01' succeeded
[root@qr01dbadm01 grid]#
```

6. Exit the root user session.

```
[root@qr01dbadm01 grid]# exit  
exit  
[grid@qr01dbadm01 ~]$
```

7. Leave the current terminal session active and establish a separate terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01  
celladmin@qr01celadm01's password: ???????  
[celladmin@qr01celadm01 ~]$
```

8. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

9. Use the CREATE KEY command to generate a random hexadecimal key string. Then exit CellCLI.

```
CellCLI> create key  
aecacf517c96683eb33eaff589a59818  
CellCLI> exit  
quitting  
  
[celladmin@qr01celadm01 ~]$
```

10. Use the ASSIGN KEY command to assign the previously generated security key to the Oracle ASM cluster on all of the cells accessed by the ASM cluster. Use the DB_UNIQUE_NAME observed earlier. Note that this is case-sensitive.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03  
"cellcli -e assign key for +ASM='aecacf517c96683eb33eaff589a59818'"  
qr01celadm01: Key for +ASM successfully created  
qr01celadm02: Key for +ASM successfully created  
qr01celadm03: Key for +ASM successfully created  
[celladmin@qr01celadm01 ~]$
```

11. Use the ALTER GRIDDISK command to configure security on the grid disks that you want the ASM cluster to access. Set the Oracle ASM DB_UNIQUE_NAME in the availableTo attribute of each grid disk.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e alter griddisk all availableTo='+ASM'"
qr01celadm01: GridDisk DATA2_QR01_CD_00_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_01_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_02_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_03_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_04_qr01celadm01 successfully altered
...
qr01celadm03: GridDisk RECO_QR01_CD_07_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_08_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_09_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_10_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_11_qr01celadm03 successfully altered
[celladmin@qr01celadm01 ~]$
```

12. Return to your grid user session on qr01dbadm01 and change directory to /etc/oracle/cell/network-config.

```
[grid@qr01dbadm01 ~]$ cd /etc/oracle/cell/network-config
[grid@qr01dbadm01 network-config]$
```

13. Create a cellkey.ora file containing the key value from step 9 and the DB_UNIQUE_NAME for the ASM cluster.

```
[grid@qr01dbadm01 network-config]$ cat << END > cellkey.ora
> key=aecacf517c96683eb33eaff589a59818
> asm=+ASM
> END
[grid@qr01dbadm01 network-config]$
```

14. Confirm the contents of the cellkey.ora file.

```
[grid@qr01dbadm01 network-config]$ cat cellkey.ora
key=aecacf517c96683eb33eaff589a59818
asm=+ASM
[grid@qr01dbadm01 network-config]$
```

15. Set the file permissions and verify the settings.

```
[grid@qr01dbadm01 network-config]$ chown grid:asmadmin
cellkey.ora
[grid@qr01dbadm01 network-config]$ chmod 640 cellkey.ora
[grid@qr01dbadm01 network-config]$ ls -l cellkey.ora
-rw-r----- 1 grid asmadmin 46 Jun  7 03:48 cellkey.ora
[grid@qr01dbadm01 network-config]$
```

16. Copy the `cellkey.ora` file to every server in the ASM cluster.

```
[grid@qr01dbadm01 network-config]$ scp cellkey.ora  
qr01dbadm02:/etc/oracle/cell/network-config  
cellkey.ora                                         100%    46      0.0KB/s   00:00  
[grid@qr01dbadm01 network-config]$
```

17. Use the `su` command to assume the privileges of the root user.

```
[grid@qr01dbadm01 network-config]$ su  
Password: ???????  
[root@qr01dbadm01 network-config]#
```

18. Restart the cluster.

```
[root@qr01dbadm01 network-config]# crsctl start cluster -all  
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm02'  
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm02'  
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm01'  
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm01'  
CRS-2676: Start of 'ora.cssdmonitor' on 'qr01dbadm02' succeeded  
...  
CRS-2676: Start of 'ora.asm' on 'qr01dbadm01' succeeded  
CRS-2672: Attempting to start 'ora.storage' on 'qr01dbadm01'  
CRS-2676: Start of 'ora.storage' on 'qr01dbadm01' succeeded  
CRS-2672: Attempting to start 'ora.crsd' on 'qr01dbadm01'  
CRS-2676: Start of 'ora.crsd' on 'qr01dbadm01' succeeded  
[root@qr01dbadm01 network-config]#
```

19. Verify that all the Oracle cluster resources restart using the following command. It may take a few minutes for all of the cluster resources to restart so periodically re-execute the command until all the resources start. **Do not proceed to the next step before all of the cluster resources restart.**

[root@qr01dbadm01 network-config]# crsctl stat res -w "TARGET = ONLINE" -t				
<hr/>				
Name	Target	State	Server	State details
<hr/>				
Local Resources				
<hr/>				
ora.DATA_QR01.dg	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.DBFS_DG.dg	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.LISTENER.lsnr	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.RECO_QR01.dg	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.asm	ONLINE	ONLINE	qr01dbadm01	Started, STABLE
	ONLINE	ONLINE	qr01dbadm02	Started, STABLE
ora.net1.network	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
ora.ons	ONLINE	ONLINE	qr01dbadm01	STABLE
	ONLINE	ONLINE	qr01dbadm02	STABLE
<hr/>				
Cluster Resources				
<hr/>				
ora.LISTENER_SCAN1.lsnr	1	ONLINE	ONLINE	qr01dbadm01
	1	ONLINE	ONLINE	STABLE
ora.LISTENER_SCAN2.lsnr	1	ONLINE	ONLINE	qr01dbadm01
	1	ONLINE	ONLINE	STABLE
ora.LISTENER_SCAN3.lsnr	1	ONLINE	ONLINE	qr01dbadm01
	1	ONLINE	ONLINE	STABLE
ora.cvu	1	ONLINE	ONLINE	qr01dbadm02
	1	ONLINE	ONLINE	STABLE
ora.dbm.db	1	ONLINE	ONLINE	qr01dbadm01
	1	ONLINE	ONLINE	Open, STABLE
	2	ONLINE	ONLINE	qr01dbadm02
	2	ONLINE	ONLINE	Open, STABLE
ora.oc4j	1	ONLINE	ONLINE	qr01dbadm02
	1	ONLINE	ONLINE	STABLE
ora.qr01dbadm01.vip	1	ONLINE	ONLINE	qr01dbadm01
	1	ONLINE	ONLINE	STABLE

```

ora.qr01dbadm02.vip
  1      ONLINE  ONLINE      qr01dbadm02      STABLE
ora.scan1.vip
  1      ONLINE  ONLINE      qr01dbadm01      STABLE
ora.scan2.vip
  1      ONLINE  ONLINE      qr01dbadm01      STABLE
ora.scan3.vip
  1      ONLINE  ONLINE      qr01dbadm01      STABLE
-----
[root@qr01dbadm01 network-config]#

```

20. Exit the root user session and change back to the grid user home directory.

```

[root@qr01dbadm01 network-config]# exit
exit
[grid@qr01dbadm01 network-config]$ cd
[grid@qr01dbadm01 ~]$

```

ASM-scoped security is now configured. The fact that ASM and Oracle Database restarted shows that the ASM environment can access the grid disks configured on the Exadata storage. To further prove this is the case, you will now create a disk group on some of the grid disks.

21. Using SQL*Plus, connect to ASM as an ASM administrator.

```

[grid@qr01dbadm01 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>

```

22. Create a new ASM disk group consuming the grid disks created in a previous practice (use the SQL script /home/oracle/labs/lab06-04-22.sql if you prefer).

```

SQL> create diskgroup data2_qr01_asm_sec normal redundancy
  2  disk 'o/*/DATA2_QR01*'
  3  attribute 'compatible.rdbms' = '12.1.0.2.0',
  4  'compatible.asm' = '12.1.0.2.0',
  5  'cell.smart_scan_capable' = 'TRUE',
  6  'au_size' = '4M';

Diskgroup created.

SQL>

```

23. Drop the newly created disk group and exit SQL*Plus.

```
SQL> drop diskgroup data2_gr01_asm_sec;  
  
Diskgroup dropped.  
  
SQL> exit  
Disconnected from Oracle Database 12c Enterprise Edition Release  
12.1.0.2.0 - 64bit Production...  
[grid@qr01dbadm01 ~] $
```

As expected, the ASM cluster is able to access the Exadata storage using ASM-scoped security. Now imagine that another ASM cluster is configured and some of the grid disks are assigned to it. In the next part of this practice you will reconfigure the Exadata storage and see the effect.

24. Return to your celladmin user session on qr01celadm01 and launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

25. Use the CREATE KEY command to generate another random hexadecimal key string. Then exit CellCLI.

```
CellCLI> create key  
4b03b5b2b54c871de54784b8064dabdd  
CellCLI> exit  
quitting  
  
[celladmin@qr01celadm01 ~] $
```

26. Use the ASSIGN KEY command to assign the security key generated in step 25 to another Oracle ASM cluster called +ASM2.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03  
"cellcli -e assign key for +ASM2='4b03b5b2b54c871de54784b8064dabdd'"  
qr01celadm01: Key for +ASM2 successfully created  
qr01celadm02: Key for +ASM2 successfully created  
qr01celadm03: Key for +ASM2 successfully created  
[celladmin@qr01celadm01 ~] $
```

27. Confirm the key assignment. Note that each cell now has two key assignments for different ASM clusters.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e list key
qr01celadm01: +ASM          aecacf517c96683eb33eaff589a59818
qr01celadm01: +ASM          4b03b5b2b54c871de54784b8064dabdd
qr01celadm02: +ASM          aecacf517c96683eb33eaff589a59818
qr01celadm02: +ASM          4b03b5b2b54c871de54784b8064dabdd
qr01celadm03: +ASM          aecacf517c96683eb33eaff589a59818
qr01celadm03: +ASM          4b03b5b2b54c871de54784b8064dabdd
[celladmin@qr01celadm01 ~]$
```

28. Drop the grid disks having prefix=DATA2_QR01.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e drop griddisk all prefix=DATA2_QR01
qr01celadm01: GridDisk DATA2_QR01_CD_00_qr01celadm01 successfully dropped
qr01celadm01: GridDisk DATA2_QR01_CD_01_qr01celadm01 successfully dropped
qr01celadm01: GridDisk DATA2_QR01_CD_02_qr01celadm01 successfully dropped
qr01celadm01: GridDisk DATA2_QR01_CD_03_qr01celadm01 successfully dropped
qr01celadm01: GridDisk DATA2_QR01_CD_04_qr01celadm01 successfully dropped
...
qr01celadm03: GridDisk DATA2_QR01_CD_07_qr01celadm03 successfully dropped
qr01celadm03: GridDisk DATA2_QR01_CD_08_qr01celadm03 successfully dropped
qr01celadm03: GridDisk DATA2_QR01_CD_09_qr01celadm03 successfully dropped
qr01celadm03: GridDisk DATA2_QR01_CD_10_qr01celadm03 successfully dropped
qr01celadm03: GridDisk DATA2_QR01_CD_11_qr01celadm03 successfully dropped
[celladmin@qr01celadm01 ~]$
```

29. Create a new set of grid disks with the availableTo attribute set to +ASM2.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e create griddisk all harddisk prefix=DATA2_QR01,
availableTo='+'+ASM2'\'"
qr01celadm01: GridDisk DATA2_QR01_CD_00_qr01celadm01 successfully created
qr01celadm01: GridDisk DATA2_QR01_CD_01_qr01celadm01 successfully created
qr01celadm01: GridDisk DATA2_QR01_CD_02_qr01celadm01 successfully created
qr01celadm01: GridDisk DATA2_QR01_CD_03_qr01celadm01 successfully created
qr01celadm01: GridDisk DATA2_QR01_CD_04_qr01celadm01 successfully created
...
qr01celadm03: GridDisk DATA2_QR01_CD_07_qr01celadm03 successfully created
qr01celadm03: GridDisk DATA2_QR01_CD_08_qr01celadm03 successfully created
qr01celadm03: GridDisk DATA2_QR01_CD_09_qr01celadm03 successfully created
qr01celadm03: GridDisk DATA2_QR01_CD_10_qr01celadm03 successfully created
qr01celadm03: GridDisk DATA2_QR01_CD_11_qr01celadm03 successfully created
[celladmin@qr01celadm01 ~]$
```

Note that the ALTER GRIDDISK command could have been used instead of dropping and recreating the grid disks. However, the ALTER GRIDDISK command can only be run against all the grid disks (regardless of prefix) or it can be used to modify an individual grid disk. Hence, using the ALTER GRIDDISK command in this case would require 36 separate commands (or equivalent scripting).

30. Confirm the availableTo attribute setting for all the grid disks.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e list griddisk attributes name,availableTo
qr01celadm01: DATA2_QR01_CD_00_qr01celadm01      +ASM2
qr01celadm01: DATA2_QR01_CD_01_qr01celadm01      +ASM2
qr01celadm01: DATA2_QR01_CD_02_qr01celadm01      +ASM2
qr01celadm01: DATA2_QR01_CD_03_qr01celadm01      +ASM2
qr01celadm01: DATA2_QR01_CD_04_qr01celadm01      +ASM2
...
qr01celadm03: RECO_QR01_CD_07_qr01celadm03      +ASM
qr01celadm03: RECO_QR01_CD_08_qr01celadm03      +ASM
qr01celadm03: RECO_QR01_CD_09_qr01celadm03      +ASM
qr01celadm03: RECO_QR01_CD_10_qr01celadm03      +ASM
qr01celadm03: RECO_QR01_CD_11_qr01celadm03      +ASM
[celladmin@qr01celadm01 ~]$
```

ASM-scoped security is now reconfigured. Now see what happens when +ASM attempts to use the grid disks assigned to +ASM2.

31. Return to your qr01dbadm01 terminal session. Using SQL*Plus, connect to ASM as an ASM administrator.

```
[grid@qr01dbadm01 ~]$ sqlplus / as sysasm
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

32. Create an ASM disk group referencing the grid disks assigned to +ASM2 (use the SQL script /home/oracle/labs/lab06-04-22.sql if you prefer). Note that the command fails with an error message indicating that the disks do not exist.

```
SQL> create diskgroup data2_qr01_asm_sec normal redundancy
  2  disk 'o/*/DATA2_QR01*'
  3  attribute 'compatible.rdbms' = '12.1.0.2.0',
  4  'compatible.asm' = '12.1.0.2.0',
  5  'cell.smart_scan_capable' = 'TRUE',
  6  'au_size' = '4M';
create diskgroup data2_qr01_asm_sec normal redundancy
*
ERROR at line 1:
ORA-15018: diskgroup cannot be created
ORA-15031: disk specification 'o/*/DATA2_QR01*' matches no disks

SQL>
```

33. Execute the following query to confirm that the disks are not visible to ASM. Exadata storage security limits the visibility of grid disks to the environments that are allowed to access them.

```
SQL> select * from v$asm_disk where path like '%DATA2_QR01%';  
  
no rows selected  
  
SQL>
```

34. Exit your SQL*Plus session.

```
SQL> exit  
Disconnected from Oracle Database 12c Enterprise Edition Release  
12.1.0.2.0 - 64bit Production...  
[grid@qr01dbadm01 ~]$
```

So far you have examined ASM-scoped security. Database-scoped security can only be implemented after ASM-scoped security is already in place. The configuration process for database-scoped security very similar to the process you have already used for ASM-scoped security. In the next part of this practice you will configure database-scoped security for one Oracle Database. In an Exadata environment with multiple databases you would be required to repeat the process for each database.

35. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01  
oracle@qr01dbadm01's password: ???????  
[oracle@qr01dbadm01 ~]$ . oraenv  
ORACLE_SID = [oracle] ? dbm  
The Oracle base has been set to /u01/app/oracle  
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1  
[oracle@qr01dbadm01 ~]$
```

36. Using SQL*Plus, connect as a database administrator.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba  
  
SQL*Plus: Release 12.1.0.2.0 Production...  
  
SQL>
```

37. Note the DB_UNIQUE_NAME setting for the database and then exit SQL*Plus.

```
SQL> show parameter unique

NAME                           TYPE        VALUE
-----
db_unique_name                 string      dbm
SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0 - 64bit Production...
[oracle@qr01dbadm01 ~]$
```

38. Use the su command to assume the privileges of the root user.

```
[oracle@qr01dbadm01 ~]$ su
Password: ????????
[root@qr01dbadm01 oracle]#
```

To implement database-scoped security you must also shut down the ASM cluster and any databases that are using it. However, in many cases it is easier to simply shut down the cluster across the Exadata Database Machine.

39. Shut down the cluster across your Exadata Database Machine environment.

```
[root@qr01dbadm01 oracle]# /u01/app/12.1.0.2/grid/bin/crsctl stop cluster -all
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm02'
CRS-2790: Starting shutdown of Cluster Ready Services-managed resources on
'qr01dbadm01'
CRS-2790: Starting shutdown of Cluster Ready Services-managed resources on
'qr01dbadm02'
...
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm01' succeeded
CRS-2677: Stop of 'ora.cssd' on 'qr01dbadm02' succeeded
CRS-2673: Attempting to stop 'ora.diskmon' on 'qr01dbadm02'
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm02' succeeded
[root@qr01dbadm01 oracle]#
```

40. Exit the root user session.

```
[root@qr01dbadm01 oracle]# exit
exit
[oracle@qr01dbadm01 ~]$
```

41. Return to your celladmin user session on qr01celadm01 and launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...

CellCLI>
```

42. Use the CREATE KEY command to generate a random hexadecimal key string. Then exit CellCLI.

```
CellCLI> create key
2877208d48fa273d86ee6492cd6fe331
CellCLI> exit
quitting

[celladmin@qr01celadm01 ~]$
```

43. Use the ASSIGN KEY command to assign the security key generated in step 42 to your Oracle Database on all the cells that you want the database to access. Use the DB_UNIQUE_NAME observed in step 37. Note that this is case-sensitive.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e assign key for dbm='2877208d48fa273d86ee6492cd6fe331'"
qr01celadm01: Key for dbm successfully created
qr01celadm02: Key for dbm successfully created
qr01celadm03: Key for dbm successfully created
[celladmin@qr01celadm01 ~]$
```

44. Use the ALTER GRIDDISK command to configure security on the grid disks. For database-scoped security you must set the availableTo attribute of each grid disk to include both the ASM environment and the database which are allowed to access the grid disk. Use the following command to make all the grid disks accessible to the dbm database. Note that in other environments you would typically assign groups of grid disks to different databases.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e alter griddisk all availableTo='+ASM,dbm'"
qr01celadm01: GridDisk DATA2_QR01_CD_00_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_01_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_02_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_03_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_04_qr01celadm01 successfully altered
...
qr01celadm03: GridDisk RECO_QR01_CD_07_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_08_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_09_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_10_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_11_qr01celadm03 successfully altered
[celladmin@qr01celadm01 ~]$
```

45. Return to your oracle user session on qr01dbadm01 and create a directory at \$ORACLE_HOME/admin/<DB_UNIQUE_NAME>/pfile where <DB_UNIQUE_NAME> represents the DB_UNIQUE_NAME setting for the database. Change into the newly created directory.

```
[oracle@qr01dbadm01 ~]$ mkdir -p $ORACLE_HOME/admin/dbm/pfile
[oracle@qr01dbadm01 ~]$ cd $ORACLE_HOME/admin/dbm/pfile
[oracle@qr01dbadm01 pfile]$
```

46. Create a `cellkey.ora` file containing the key value from step 42 and the `DB_UNIQUE_NAME` for the ASM cluster associated with the database.

```
[oracle@qr01dbadm01 pfile]$ cat << END > cellkey.ora
> key=2877208d48fa273d86ee6492cd6fe331
> asm=+ASM
> END
[oracle@qr01dbadm01 pfile]$
```

47. Confirm the contents of the `cellkey.ora` file.

```
[oracle@qr01dbadm01 pfile]$ cat cellkey.ora
key=2877208d48fa273d86ee6492cd6fe331
asm=+ASM
[oracle@qr01dbadm01 pfile]$
```

48. Set the file permissions and verify the settings. Note that on a Database Machine you would need to configure the `cellkey.ora` file on every database server associated with the database.

```
[oracle@qr01dbadm01 pfile]$ chmod 600 cellkey.ora
[oracle@qr01dbadm01 pfile]$ ls -l cellkey.ora
-rw----- 1 oracle oinstall 46 Jun  7 04:34 cellkey.ora
[oracle@qr01dbadm01 pfile]$
```

49. Copy the `cellkey.ora` file to every server in the database cluster.

```
[oracle@qr01dbadm01 pfile]$ ssh qr01dbadm02 "mkdir -p
/u01/app/oracle/product/12.1.0.2/dbhome_1/admin/dbm/pfile"
[oracle@qr01dbadm01 pfile]$ scp cellkey.ora
qr01dbadm02:/u01/app/oracle/product/12.1.0.2/dbhome_1/admin/dbm/pfile
cellkey.ora                                         100%   46      0.0KB/s   00:00
[oracle@qr01dbadm01 pfile]$
```

50. Use the `su` command to assume the privileges of the root user.

```
[oracle@qr01dbadm01 pfile]$ su
Password: ????????
[root@qr01dbadm01 pfile]#
```

51. Restart the cluster.

```
[root@qr01dbadm01 pfile]# /u01/app/12.1.0.2/grid/bin/crsctl start cluster -all
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm02'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm02'
...
CRS-2672: Attempting to start 'ora.storage' on 'qr01dbadm02'
CRS-2676: Start of 'ora.storage' on 'qr01dbadm02' succeeded
CRS-2672: Attempting to start 'ora.crsd' on 'qr01dbadm02'
CRS-2676: Start of 'ora.crsd' on 'qr01dbadm02' succeeded
[root@qr01dbadm01 pfile]#
```

52. Verify that all the Oracle cluster resources restart using the following command. It may take a few minutes for all of the cluster resources to restart so periodically re-execute the command until all the resources start. **Do not proceed to the next step before all of the cluster resources restart.**

```
[root@qr01dbadm01 pfile]# /u01/app/12.1.0.2/grid/bin/crsctl stat res -w
"TARGET = ONLINE" -t

-----
| Name      | Target | State   | Server          | State details |
|-----|
| Local Resources |          |          |                 |               |
|-----|
| ora.DATA_QR01.dg |        |          | qr01dbadm01    | STABLE         |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | STABLE         |
| ora.DBFS_DG.dg  |        |          | qr01dbadm01    | STABLE         |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | STABLE         |
| ora.LISTENER.lsnr |       |          | qr01dbadm01    | STABLE         |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | STABLE         |
| ora.RECO_QR01.dg |       |          | qr01dbadm01    | STABLE         |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | STABLE         |
| ora.asm          |       |          | qr01dbadm01    | Started, STABLE |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | Started, STABLE |
| ora.net1.network |       |          | qr01dbadm01    | STABLE         |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | STABLE         |
| ora.ons           |       |          | qr01dbadm01    | STABLE         |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | STABLE         |
|-----|
| Cluster Resources |          |          |                 |               |
|-----|
| ora.LISTENER_SCAN1.lsnr |     |          | qr01dbadm02    | STABLE         |
| 1      | ONLINE  | ONLINE   |                 |               |
| ora.LISTENER_SCAN2.lsnr |     |          | qr01dbadm01    | STABLE         |
| 1      | ONLINE  | ONLINE   |                 |               |
| ora.LISTENER_SCAN3.lsnr |     |          | qr01dbadm01    | STABLE         |
| 1      | ONLINE  | ONLINE   |                 |               |
| ora.cvu            |       |          | qr01dbadm01    | STABLE         |
| 1      | ONLINE  | ONLINE   |                 |               |
| ora.dbm.db          |       |          | qr01dbadm01    | Open, STABLE   |
| 1      | ONLINE  | ONLINE   |                 |               |
|                  | ONLINE  | ONLINE   | qr01dbadm02    | Open, STABLE   |
| ora.oc4j            |       |          | qr01dbadm01    | STABLE         |
| 1      | ONLINE  | ONLINE   |                 |               |
| ora.qr01dbadm01.vip |       |          | qr01dbadm01    | STABLE         |
| 1      | ONLINE  | ONLINE   |                 |               |
|-----|
```

```
ora.qr01dbadm02.vip
  1      ONLINE  ONLINE      qr01dbadm02      STABLE
ora.scan1.vip
  1      ONLINE  ONLINE      qr01dbadm02      STABLE
ora.scan2.vip
  1      ONLINE  ONLINE      qr01dbadm01      STABLE
ora.scan3.vip
  1      ONLINE  ONLINE      qr01dbadm01      STABLE
-----
[root@qr01dbadm01 pfile]#
```

53. Exit the root user session and change back to the oracle user home directory.

```
[root@qr01dbadm01 pfile]# exit
exit
[oracle@qr01dbadm01 pfile]$ cd
[oracle@qr01dbadm01 ~]$
```

Database-scoped security is now configured. The fact that ASM and Oracle Database restarted shows that the both environments can access the grid disks configured on the Exadata storage.

54. Confirm that the database can access its storage by connecting to the database and executing a query.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/???

SQL*Plus: Release 12.1.0.2.0 Production...

SQL> select count(*) from customers;

COUNT(*)
-----
3252128

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0 - 64bit Production...
[oracle@qr01dbadm01 ~]$
```

In the final part of the practice you will remove the Exadata storage security that you have configured during this practice.

55. Use the su command to assume the privileges of the root user.

```
[oracle@qr01dbadm01 ~]$ su
Password: ???????
[root@qr01dbadm01 oracle]#
```

56. Shut down the cluster.

```
[root@qr01dbadm01 oracle]# /u01/app/12.1.0.2/grid/bin/crsctl stop cluster -all
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm02'
CRS-2790: Starting shutdown of Cluster Ready Services-managed resources on
'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.LISTENER_SCAN2.lsnr' on 'qr01dbadm01'
...
CRS-2677: Stop of 'ora.cssd' on 'qr01dbadm01' succeeded
CRS-2673: Attempting to stop 'ora.diskmon' on 'qr01dbadm01'
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm02' succeeded
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm01' succeeded
[root@qr01dbadm01 oracle]#
```

57. Back in your celladmin session on qr01celadm01, use the following command to clear the availableTo grid disk attribute.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e alter griddisk all availableTo='\'"
qr01celadm01: GridDisk DATA2_QR01_CD_00_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_01_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_02_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_03_qr01celadm01 successfully altered
qr01celadm01: GridDisk DATA2_QR01_CD_04_qr01celadm01 successfully altered
...
qr01celadm03: GridDisk RECO_QR01_CD_07_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_08_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_09_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_10_qr01celadm03 successfully altered
qr01celadm03: GridDisk RECO_QR01_CD_11_qr01celadm03 successfully altered
[celladmin@qr01celadm01 ~]$
```

58. Clear the key assignment for the dbm database.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e assign key for dbm='\'"
qr01celadm01: Key for dbm successfully dropped
qr01celadm02: Key for dbm successfully dropped
qr01celadm03: Key for dbm successfully dropped
[celladmin@qr01celadm01 ~]$
```

59. Clear the key assignments for +ASM and +ASM2.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e assign key for +ASM='\'"
qr01celadm01: Key for +ASM successfully dropped
qr01celadm02: Key for +ASM successfully dropped
qr01celadm03: Key for +ASM successfully dropped
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
"cellcli -e assign key for +ASM2='\'"
qr01celadm01: Key for +ASM2 successfully dropped
qr01celadm02: Key for +ASM2 successfully dropped
qr01celadm03: Key for +ASM2 successfully dropped
[celladmin@qr01celadm01 ~]$
```

60. Return to your root session and remove the cellkey.ora files that you created earlier in the practice.

```
[root@qr01dbadm01 oracle]# rm
/u01/app/oracle/product/12.1.0.2/dbhome_1/admin/dbm/pfile/cellkey.ora
rm: remove regular file
`/u01/app/oracle/product/12.1.0.2/dbhome_1/admin/dbm/pfile/cellkey.ora'? y
[root@qr01dbadm01 oracle]# ssh qr01dbadm02 "rm
/u01/app/oracle/product/12.1.0.2/dbhome_1/admin/dbm/pfile/cellkey.ora"
root@qr01dbadm02's password: ????????
[root@qr01dbadm01 oracle]# rm /etc/oracle/cell/network-config/cellkey.ora
rm: remove regular file `/etc/oracle/cell/network-config/cellkey.ora'? y
[root@qr01dbadm01 oracle]# ssh qr01dbadm02 "rm /etc/oracle/cell/network-
config/cellkey.ora"
root@qr01dbadm02's password: ????????
[root@qr01dbadm01 oracle]#
```

61. Restart the cluster.

```
[root@qr01dbadm01 oracle]# /u01/app/12.1.0.2/grid/bin/crsctl start cluster -
all
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm02'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm02'
...
CRS-2672: Attempting to start 'ora.storage' on 'qr01dbadm02'
CRS-2676: Start of 'ora.storage' on 'qr01dbadm02' succeeded
CRS-2672: Attempting to start 'ora.crsd' on 'qr01dbadm02'
CRS-2676: Start of 'ora.crsd' on 'qr01dbadm02' succeeded
[root@qr01dbadm01 oracle]#
```

62. Exit all of your terminal sessions.

Practice 6-5: Cell user accounts

Overview

In this practice you exercise the privileges available to the `celladmin` and `cellmonitor` Exadata administration accounts.

Tasks

1. Establish a terminal connection to `qr01celadm01` as the `cellmonitor` user.

```
$ ssh cellmonitor@qr01celadm01  
cellmonitor@qr01celadm01's password: ???????  
[cellmonitor@qr01celadm01 ~]$
```

2. Launch the Exadata cell command-line interface (CellCLI).

```
[cellmonitor@qr01celadm01 ~]$ cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

The `cellmonitor` user can only view Exadata cell objects using the CellCLI `LIST` command.

3. Confirm that `cellmonitor` can view the Exadata cell attributes.

```
CellCLI> list cell detail
  name: qr01celadm01
  cellVersion: OSS_12.1.2.1.0_LINUX.X64_141206.1
  cpuCount: 2
  diagHistoryDays: 7
  fanCount: 0/0
  fanStatus: normal
  flashCacheMode: WriteThrough
  id: ef92136a-837c-4e1d-88d2-e01f5ab89b7b
  interconnectCount: 0
  interconnect1: ib0
  interconnect2: ib1
  iormBoost: 0.0
  ipAddress1: 192.168.1.105/24
  ipAddress2: 192.168.1.106/24
  kernelVersion: 2.6.39-400.243.1.el6uek.x86_64
  makeModel: Fake hardware
  memoryGB: 4
  metricHistoryDays: 7
  notificationMethod: mail
  notificationPolicy: critical,warning,clear
  offloadGroupEvents:
  offloadEfficiency: 791.1
  powerCount: 0/0
  powerStatus: normal
  releaseVersion: 12.1.2.1.0
  releaseTrackingBug: 17885582
  smtpFrom: "John Doe"
  smtpFromAddr: john.doe@example.com
  smtpServer: my_mail.example.com
  smtpToAddr: jane.smith@example.com
  status: online
  temperatureReading: 0.0
  temperatureStatus: normal
  upTime: 5 days, 2:53
  cellsrvStatus: running
  msStatus: running
  rsStatus: running

CellCLI>
```

4. Confirm that `cellmonitor` cannot modify the Exadata cell attributes.

```
CellCLI> alter cell smtpToAddr='admin@example.com'
CELL-01520: This command is not permitted in monitor mode.

CellCLI>
```

5. Confirm that `cellmonitor` cannot create or modify the Exadata cell objects.

```
CellCLI> create celldisk all harddisk
CELL-01520: This command is not permitted in monitor mode.

CellCLI> alter griddisk all comment="Here is a comment"
CELL-01520: This command is not permitted in monitor mode.

CellCLI>
```

6. Establish a terminal connection to the `qr01celadm01` Exadata cell as the `celladmin` user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~]$
```

7. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...

CellCLI>
```

In previous practices you have already seen how the `celladmin` user can create, modify and drop Exadata cell objects. In fact, the `celladmin` user can execute any CellCLI command except for the `CALIBRATE` command. The `CALIBRATE` command can only be executed by the `root` user.

8. Confirm that `celladmin` cannot run the `CALIBRATE` command.

```
CellCLI> calibrate
CELL-01522: CALIBRATE must be run as the root user id.

CellCLI>
```

9. Exit your CellCLI sessions.

Practice 6-6: Using the distributed command line utility (dcli)

Overview

The distributed command line utility (`dcli`) is a utility program which is provided with Database Machine. Its purpose is to provide a means to simultaneously execute monitoring and administration commands across multiple servers.

In earlier practices you used `dcli` to execute CellCLI commands across multiple Exadata cells. In this practice you will extend your use of `dcli` by performing the initial configuration required to enable `dcli` to issue commands to all of your cells from your database server (`qr01dbadm01`). You will also exercise some additional `dcli` functions.

Tasks

- Establish a terminal connection to `qr01dbadm01` as the `oracle` user.

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~] $
```

- Create a file named `mycells` which contains the names of your Exadata cells on separate lines.

```
[oracle@qr01dbadm01 ~] $ cat << END > mycells
> qr01celadm01
> qr01celadm02
> qr01celadm03
> END
[oracle@qr01dbadm01 ~] $
```

- Confirm the existence of an SSH private/public key pair for the `oracle` OS user. In situations where you want to configure `dcli` for a user without an SSH key pair, you would use the `ssh-keygen` command to create one.

```
[oracle@qr01dbadm01 ~] $ ls ~/.ssh/id_rsa*
/home/oracle/.ssh/id_rsa  /home/oracle/.ssh/id_rsa.pub
[oracle@qr01dbadm01 ~] $
```

- Execute the following command to configure SSH user-equivalence between your database server OS account (`oracle`) and the `celladmin` user on the cells specified in the `mycells` file.

```
[oracle@qr01dbadm01 ~] $ dcli -g mycells -k
celladmin@qr01celadm01's password: ????????
celladmin@qr01celadm03's password: ????????
celladmin@qr01celadm02's password: ????????
qr01celadm01: ssh key added
qr01celadm02: ssh key added
qr01celadm03: ssh key added
[oracle@qr01dbadm01 ~] $
```

You have now completed the one-time configuration required to enable dcli between the oracle user on qr01dbadm01 and the celladmin user on each Exadata cell. After dcli is executed once with the -k option, subsequent dcli commands between the same servers and user accounts do not require the -k option and do not require a password.

- The primary use for dcli is to simultaneously execute CellCLI commands across multiple cells. Use the following command to check on the status of your Exadata cells.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells cellcli -e list cell
qr01celadm01: qr01celadm01          online
qr01celadm02: qr01celadm02          online
qr01celadm03: qr01celadm03          online
[oracle@qr01dbadm01 ~]$
```

- dcli can also be used to execute any non-interactive operating system commands on multiple cells and/or database servers. You can use quotes to surround compound commands and commands that contain pipes. Execute the following example command or construct an alternative command of your own.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells "cat /proc/meminfo | grep Mem"
qr01celadm01: MemTotal:        4104976 kB
qr01celadm01: MemFree:         71316 kB
qr01celadm02: MemTotal:        4104976 kB
qr01celadm02: MemFree:         62508 kB
qr01celadm03: MemTotal:        4104976 kB
qr01celadm03: MemFree:         61516 kB
[oracle@qr01dbadm01 ~]$
```

- dcli is not just limited to monitoring. It is often used to ensure that consistent settings are applied across multiple systems. Use the following commands to view and adjust IORM settings on your Exadata cells.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells cellcli -e alter iormplan
objective=auto
qr01celadm01: IORMPLAN successfully altered
qr01celadm02: IORMPLAN successfully altered
qr01celadm03: IORMPLAN successfully altered
[oracle@qr01dbadm01 ~]$ dcli -g mycells cellcli -e list iormplan attributes
objective
qr01celadm01: auto
qr01celadm02: auto
qr01celadm03: auto
[oracle@qr01dbadm01 ~]$ dcli -g mycells cellcli -e alter iormplan
objective=basic
qr01celadm01: IORMPLAN successfully altered
qr01celadm02: IORMPLAN successfully altered
qr01celadm03: IORMPLAN successfully altered
[oracle@qr01dbadm01 ~]$ dcli -g mycells cellcli -e list iormplan attributes
objective
qr01celadm01: basic
qr01celadm02: basic
qr01celadm03: basic
[oracle@qr01dbadm01 ~]$
```

8. Sometimes dcli commands return a lot of output. The following command uses wildcards and a WHERE condition to return the current metric observations for small write I/O requests for every disk-based cell disk across all the cells. Execute the command and examine the output for your cells.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells "cellcli -e list metriccurrent where
name like '\'CD_IO_RQ_W_S.?\' and metricobjectname like '\'CD.*\'"
qr01celadm01: CD_IO_RQ_W_SM      CD_00_qr01celadm01      38,691 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_01_qr01celadm01      2,606 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_02_qr01celadm01      2,645 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_03_qr01celadm01      1,952 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_04_qr01celadm01      4,744 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_05_qr01celadm01      3,092 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_06_qr01celadm01      4,299 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_07_qr01celadm01      1,520 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_08_qr01celadm01      1,721 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_09_qr01celadm01      6,313 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_10_qr01celadm01      5,256 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_11_qr01celadm01      3,640 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_00_qr01celadm02      105,698 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_01_qr01celadm02      18,832 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_02_qr01celadm02      3,014 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_03_qr01celadm02      3,637 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_04_qr01celadm02      2,750 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_05_qr01celadm02      33,290 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_06_qr01celadm02      4,591 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_07_qr01celadm02      2,823 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_08_qr01celadm02      17,328 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_09_qr01celadm02      2,320 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_10_qr01celadm02      5,257 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_11_qr01celadm02      6,443 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_00_qr01celadm03      135,592 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_01_qr01celadm03      1,963 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_02_qr01celadm03      2,455 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_03_qr01celadm03      3,394 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_04_qr01celadm03      3,682 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_05_qr01celadm03      32,892 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_06_qr01celadm03      4,005 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_07_qr01celadm03      3,060 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_08_qr01celadm03      2,614 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_09_qr01celadm03      1,351 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_10_qr01celadm03      5,965 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_11_qr01celadm03      3,984 IO requests
[oracle@qr01dbadm01 ~]$
```

- This command is essentially the same as the command you just executed in step 8. It uses the `-r` option along with a regular expression string to specify which output `dcli` should delete from the output. The result is that only the output that does not match the `-r` regular expression is returned to the user. Execute the command and examine the output for your cells.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells -r '.*CD_0.*' "cellcli -e list metriccurrent where name like '\CD_IO_RQ_W_S.?\' and metricobjectname like '\CD.*\'"
.*CD_0.*: ['qr01celadm01', 'qr01celadm02', 'qr01celadm03']
qr01celadm01: CD_IO_RQ_W_SM      CD_10_qr01celadm01      5,256 IO requests
qr01celadm01: CD_IO_RQ_W_SM      CD_11_qr01celadm01      3,640 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_10_qr01celadm02      5,257 IO requests
qr01celadm02: CD_IO_RQ_W_SM      CD_11_qr01celadm02      6,443 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_10_qr01celadm03      5,965 IO requests
qr01celadm03: CD_IO_RQ_W_SM      CD_11_qr01celadm03      3,984 IO requests
[oracle@qr01dbadm01 ~]$
```

`dcli` can also be used to copy files to numerous remote systems. You will exercise this capability in the next series of steps.

- Create a small text file that contains a short message identifying you. Name the file according to your assigned student account. Confirm the existence and contents of the file.

```
[oracle@qr01dbadm01 ~]$ cat << END > message.txt
> Hello World!
> END
[oracle@qr01dbadm01 ~]$ cat message.txt
Hello World!
[oracle@qr01dbadm01 ~]$
```

- Use `dcli` with the `-f` option to copy your file to the default home directory of the `celladmin` user on your Exadata cells.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells -f message.txt
[oracle@qr01dbadm01 ~]$
```

- Use the following command to confirm the success of the operation in the previous step.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells cat message.txt
qr01celadm01: Hello World!
qr01celadm02: Hello World!
qr01celadm03: Hello World!
[oracle@qr01dbadm01 ~]$
```

In addition to copying a file to multiple remote locations, `dcli` can copy a file and execute it simultaneously on the specified remote systems. You will exercise this capability in the next series of steps.

13. Create a simple shell script such as the one shown below.

```
[oracle@qr01dbadm01 ~]$ cat << END > script.sh
> HST=\`hostname -s\`
> DTE=\`date\`
> echo -n \`cat message.txt\``
> echo " on \${HST} at \${DTE}."
> END
[oracle@qr01dbadm01 ~]$
```

14. Use the `chmod` command to make your newly created script file executable.

```
[oracle@qr01dbadm01 ~]$ chmod +x script.sh
[oracle@qr01dbadm01 ~]$
```

15. Use `dcli` with the `-x` option to copy and run the script you just created.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells -x script.sh
qr01celadm01: Hello World! on qr01celadm01 at Tue Jun  7 06:18:57 UTC 2016.
qr01celadm02: Hello World! on qr01celadm02 at Tue Jun  7 06:18:48 UTC 2016.
qr01celadm03: Hello World! on qr01celadm03 at Tue Jun  7 06:19:02 UTC 2016.
[oracle@qr01dbadm01 ~]$
```

Note that script files with the `.scl` extension are run by the CellCLI utility on the remote server.

16. Use `dcli` in conjunction with `rm` to delete the files you copied to your cells during this practice. Please be careful not to mistakenly delete any other files.

```
[oracle@qr01dbadm01 ~]$ dcli -g mycells rm -v message.txt script.sh
qr01celadm01: removed `message.txt'
qr01celadm01: removed `script.sh'
qr01celadm02: removed `message.txt'
qr01celadm02: removed `script.sh'
qr01celadm03: removed `message.txt'
qr01celadm03: removed `script.sh'
[oracle@qr01dbadm01 ~]$
```

17. Exit your terminal session.

Practices for Lesson 7: I/O Resource Management

Chapter 7

Practices for Lesson 7

There are no practices for this lesson.

Practices for Lesson 8: Recommendations for Optimizing Database Performance

Chapter 8

Practices for Lesson 8: Overview

Practices Overview

In these practices, you will explore the following performance optimization techniques and technologies:

- Configuring write back flash cache
- Using Exadata Hybrid Columnar Compression
- Testing index elimination

Practice 8-1: Configuring Write Back Flash Cache

Overview

In this practice you will reconfigure Exadata Smart Flash Cache so that write operations can be serviced by flash only, instead of using disks. This mode of operation is known as write back flash cache.

Tasks

Reconfiguring Exadata Storage Servers to enable write back flash cache can be achieved in a rolling manner (one cell at a time) or all-at-once. In this practice you will reconfigure all the cells at once, which requires that Oracle Database and Grid Infrastructure are shut down on all database servers. To configure write back flash cache in a rolling manner some additional steps and checks are recommended. Refer to My Oracle Support bulletin 1500257.1 for details.

- Establish a terminal connection to qr01dbadm01 as the root user.

```
$ ssh root@qr01dbadm01
root@qr01dbadm01's password: ????????
[root@qr01dbadm01 ~] #
```

- Shut down the cluster. **Do not proceed to the next step until this step completes.**

```
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/crsctl stop cluster -all
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm02'
CRS-2790: Starting shutdown of Cluster Ready Services-managed resources on
'qr01dbadm02'
CRS-2790: Starting shutdown of Cluster Ready Services-managed resources on
'qr01dbadm01'
...
CRS-2677: Stop of 'ora.cssd' on 'qr01dbadm01' succeeded
CRS-2673: Attempting to stop 'ora.diskmon' on 'qr01dbadm01'
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm02' succeeded
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm01' succeeded
[root@qr01dbadm01 ~] #
```

- Leave the root terminal session active and establish a separate terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~] $
```

4. Examine the cell flashCacheMode attribute setting on all of the cells. By default, each cell is configured in WriteThrough mode, which means that write operations must be persisted to disk regardless of whether or not the data resides inside Exadata Smart Flash Cache.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03  
cellcli -e list cell attributes flashCacheMode  
qr01celadm01: WriteThrough  
qr01celadm02: WriteThrough  
qr01celadm03: WriteThrough  
[celladmin@qr01celadm01 ~]$
```

5. Drop the existing Exadata Smart Flash Cache.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03  
cellcli -e drop flashcache  
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE successfully dropped  
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE successfully dropped  
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE successfully dropped  
[celladmin@qr01celadm01 ~]$
```

6. Stop cellsrv on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03  
cellcli -e alter cell shutdown services cellsrv  
qr01celadm01:  
qr01celadm01: Stopping CELLSRV services...  
qr01celadm01: The SHUTDOWN of CELLSRV services was successful.  
qr01celadm02:  
qr01celadm02: Stopping CELLSRV services...  
qr01celadm02: The SHUTDOWN of CELLSRV services was successful.  
qr01celadm03:  
qr01celadm03: Stopping CELLSRV services...  
qr01celadm03: The SHUTDOWN of CELLSRV services was successful.  
[celladmin@qr01celadm01 ~]$
```

7. Enable write back flash cache on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03  
cellcli -e alter cell flashCacheMode = WriteBack  
qr01celadm01: Cell qr01celadm01 successfully altered  
qr01celadm02: Cell qr01celadm02 successfully altered  
qr01celadm03: Cell qr01celadm03 successfully altered  
[celladmin@qr01celadm01 ~]$
```

8. Restart `cellsrv` on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e alter cell startup services cellsrv
qr01celadm01:
qr01celadm01: Starting CELLSRV services...
qr01celadm01: The STARTUP of CELLSRV services was successful.
qr01celadm02:
qr01celadm02: Starting CELLSRV services...
qr01celadm02: The STARTUP of CELLSRV services was successful.
qr01celadm03:
qr01celadm03: Starting CELLSRV services...
qr01celadm03: The STARTUP of CELLSRV services was successful.
[celladmin@qr01celadm01 ~]$
```

9. Re-create Exadata Smart Flash Cache on all the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e create flashcache all
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE successfully created
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE successfully created
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE successfully created
[celladmin@qr01celadm01 ~]$
```

10. Verify the `cell flashCacheMode` attribute setting on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e list cell attributes flashCacheMode
qr01celadm01: WriteBack
qr01celadm02: WriteBack
qr01celadm03: WriteBack
[celladmin@qr01celadm01 ~]$
```

Now that write back flash cache is enabled, each cache may contain updated data which is different from the data copy held on disk. This is called dirty data, and you can monitor the amount of dirty data inside Exadata Smart Flash Cache using cell metrics.

11. Use the following command to view the amount of dirty data currently inside Exadata Smart Flash Cache on each cell. Because the caches have only just been created and no databases are currently using the cells, the amount should be zero.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e list metriccurrent FC_BY_DIRTY
qr01celadm01: FC_BY_DIRTY    FLASHCACHE      0.000 MB
qr01celadm02: FC_BY_DIRTY    FLASHCACHE      0.000 MB
qr01celadm03: FC_BY_DIRTY    FLASHCACHE      0.000 MB
[celladmin@qr01celadm01 ~]$
```

12. Return to your root terminal session and restart the cluster.

```
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/crsctl start cluster -all
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm02'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm02'
...
CRS-2672: Attempting to start 'ora.storage' on 'qr01dbadm02'
CRS-2676: Start of 'ora.storage' on 'qr01dbadm02' succeeded
CRS-2672: Attempting to start 'ora.crsd' on 'qr01dbadm02'
CRS-2676: Start of 'ora.crsd' on 'qr01dbadm02' succeeded
[root@qr01dbadm01 ~]#
```

13. Wait for a few minutes until your database restarts. Periodically execute the following command to monitor the status of the database. **Proceed to the next step only after your database is started.**

```
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/srvctl status database -d dbm
Instance dbm1 is not running on node qr01dbadm01
Instance dbm2 is not running on node qr01dbadm02
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/srvctl status database -d dbm
Instance dbm1 is running on node qr01dbadm01
Instance dbm2 is running on node qr01dbadm02
[root@qr01dbadm01 ~]#
```

14. Return to your celladmin terminal session and view the amount of dirty data in each cell cache.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e list metriccurrent FC_BY_DIRTY
qr01celadm01: FC_BY_DIRTY          FLASHCACHE      1.281 MB
qr01celadm02: FC_BY_DIRTY          FLASHCACHE      1.234 MB
qr01celadm03: FC_BY_DIRTY          FLASHCACHE      1.297 MB
[celladmin@qr01celadm01 ~]$
```

At this point, you have configured write back flash cache and you have confirmed that it is being used. Over time you would see more dirty data reported in the cache as you transact against your databases.

In the final part of this practice, you will reconfigure the cells once more and revert back to write through flash cache.

15. Return to your root terminal session and shut down the cluster. **Do not proceed to the next step until this step completes.**

```
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/crsctl stop cluster -all
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.crsd' on 'qr01dbadm02'
CRS-2790: Starting shutdown of Cluster Ready Services-managed resources on
'qr01dbadm01'
CRS-2673: Attempting to stop 'ora.LISTENER_SCAN3.lsnr' on 'qr01dbadm01'
...
CRS-2677: Stop of 'ora.cssd' on 'qr01dbadm01' succeeded
CRS-2673: Attempting to stop 'ora.diskmon' on 'qr01dbadm01'
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm02' succeeded
CRS-2677: Stop of 'ora.diskmon' on 'qr01dbadm01' succeeded
[root@qr01dbadm01 ~]#
```

Switching back to write through flash cache involves essentially the same steps as switching to write back flash cache. However, because write back flash cache is currently enabled you must first flush the flash cache before dropping it. Flushing Exadata Smart Flash Cache ensures that all modified data is written to disk.

16. Flush the write back flash cache on all of the cells. Note that the flush operation may take a few minutes to complete. If you receive a message indicating that the flush operation timed out for some of the flash disks, repeat this step until your output matches the example shown below.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e alter flashcache all flush
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE altered successfully
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE altered successfully
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE altered successfully
[celladmin@qr01celadm01 ~]$
```

17. Drop the Exadata Smart Flash Cache on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e drop flashcache
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE successfully dropped
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE successfully dropped
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE successfully dropped
[celladmin@qr01celadm01 ~]$
```

18. Stop `cellsrv` on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e alter cell shutdown services cellsrv
qr01celadm01:
qr01celadm01: Stopping CELLSRV services...
qr01celadm01: The SHUTDOWN of CELLSRV services was successful.
qr01celadm02:
qr01celadm02: Stopping CELLSRV services...
qr01celadm02: The SHUTDOWN of CELLSRV services was successful.
qr01celadm03:
qr01celadm03: Stopping CELLSRV services...
qr01celadm03: The SHUTDOWN of CELLSRV services was successful.
[celladmin@qr01celadm01 ~]$
```

19. Set the `flashCacheMode` attribute back to `WriteThrough`.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e alter cell flashCacheMode = WriteThrough
qr01celadm01: Cell qr01celadm01 successfully altered
qr01celadm02: Cell qr01celadm02 successfully altered
qr01celadm03: Cell qr01celadm03 successfully altered
[celladmin@qr01celadm01 ~]$
```

20. Restart `cellsrv` on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e alter cell startup services cellsrv
qr01celadm01:
qr01celadm01: Starting CELLSRV services...
qr01celadm01: The STARTUP of CELLSRV services was successful.
qr01celadm02:
qr01celadm02: Starting CELLSRV services...
qr01celadm02: The STARTUP of CELLSRV services was successful.
qr01celadm03:
qr01celadm03: Starting CELLSRV services...
qr01celadm03: The STARTUP of CELLSRV services was successful.
[celladmin@qr01celadm01 ~]$
```

21. Re-create Exadata Smart Flash Cache on all the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e create flashcache all
qr01celadm01: Flash cache qr01celadm01_FLASHCACHE successfully created
qr01celadm02: Flash cache qr01celadm02_FLASHCACHE successfully created
qr01celadm03: Flash cache qr01celadm03_FLASHCACHE successfully created
[celladmin@qr01celadm01 ~]$
```

22. Verify the `cell flashCacheMode` attribute setting on all of the cells.

```
[celladmin@qr01celadm01 ~]$ dcli -c qr01celadm01,qr01celadm02,qr01celadm03
cellcli -e list cell attributes flashCacheMode
qr01celadm01: WriteThrough
qr01celadm02: WriteThrough
qr01celadm03: WriteThrough
[celladmin@qr01celadm01 ~]$
```

23. Return to your root terminal session and restart the cluster.

```
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/crsctl start cluster -all
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'qr01dbadm02'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm01'
CRS-2672: Attempting to start 'ora.evmd' on 'qr01dbadm02'
...
CRS-2672: Attempting to start 'ora.storage' on 'qr01dbadm02'
CRS-2676: Start of 'ora.storage' on 'qr01dbadm02' succeeded
CRS-2672: Attempting to start 'ora.crsd' on 'qr01dbadm02'
CRS-2676: Start of 'ora.crsd' on 'qr01dbadm02' succeeded
[root@qr01dbadm01 ~]#
```

24. Wait for a few minutes until your database restarts. Periodically execute the following command to monitor the status of the database. **Proceed to the next practice only after your database is started.**

```
[root@qr01dbadm01 ~]# /u01/app/12.1.0.2/grid/bin/srvctl status database -d dbm
Instance dbm1 is running on node qr01dbadm01
Instance dbm2 is running on node qr01dbadm02
[root@qr01dbadm01 ~]#
```

25. Exit all of your terminal sessions.

Practice 8-2: Using Exadata Hybrid Columnar Compression

Overview

In this practice, you will examine the performance of Exadata Hybrid Columnar Compression. You will compare predicted and actual compression ratios using an example dataset. You will also examine how bulk data loading and query operations are affected using the different compression modes.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

3. Configure the session to display server output and timing statistics.

```
SQL> set serveroutput on
SQL> set timing on
SQL>
```

4. Use `dbms_compression.get_compression_ratio` to predict the expected compression ratio for the MYCUSTOMERS table using all the different Exadata Hybrid Columnar Compression modes (use the SQL script `/home/oracle/labs/lab08-02-04.sql` if you prefer). Note that this step can take more than 10 minutes to complete in your laboratory environment.

```

SQL> declare
  2      b_cmp number;
  3      b_ucmp number;
  4      r_cmp number;
  5      r_ucmp number;
  6      cmp_ratio number(6,2);
  7      cmp_type varchar2(1024);
  8  begin
  9      dbms_compression.get_compression_ratio('USERS','SH',
10          'MYCUSTOMERS',NULL,DBMS_COMPRESSION.COMP_QUERY_LOW,
11          b_cmp,b_ucmp, r_cmp, r_ucmp, cmp_ratio, cmp_type);
12      dbms_output.put_line('Table: MYCUSTOMERS');
13      dbms_output.put_line('Compression Ratio: '||cmp_ratio);
14      dbms_output.put_line('Compression Type: '|| cmp_type);
15  end;
16 /
Compression Advisor self-check validation successful. select count(*) on both
Uncompressed and EHCC Compressed format = 1000001 rows
Table: MYCUSTOMERS
Compression Ratio: 2.5
Compression Type: "Compress Query Low"

PL/SQL procedure successfully completed.

Elapsed: 00:02:55.88
SQL> declare
  2      b_cmp number;
  3      b_ucmp number;
  4      r_cmp number;
  5      r_ucmp number;
  6      cmp_ratio number(6,2);
  7      cmp_type varchar2(1024);
  8  begin
  9      dbms_compression.get_compression_ratio('USERS','SH',
10          'MYCUSTOMERS',NULL,DBMS_COMPRESSION.COMP_QUERY_HIGH,
11          b_cmp,b_ucmp, r_cmp, r_ucmp, cmp_ratio, cmp_type);
12      dbms_output.put_line('Table: MYCUSTOMERS');
13      dbms_output.put_line('Compression Ratio: '||cmp_ratio);
14      dbms_output.put_line('Compression Type: '|| cmp_type);
15  end;
16 /
Compression Advisor self-check validation successful. select count(*) on both
Uncompressed and EHCC Compressed format = 1000001 rows

```

```

Table: MYCUSTOMERS
Compression Ratio: 4.2
Compression Type: "Compress Query High"

PL/SQL procedure successfully completed.

Elapsed: 00:01:40.31
SQL> declare
  2      b_cmp number;
  3      b_ucmp number;
  4      r_cmp number;
  5      r_ucmp number;
  6      cmp_ratio number(6,2);
  7      cmp_type varchar2(1024);
  8 begin
  9      dbms_compression.get_compression_ratio('USERS', 'SH',
10          'MYCUSTOMERS',NULL,DBMS_COMPRESSION.COMP_ARCHIVE_LOW,
11          b_cmp,b_ucmp, r_cmp, r_ucmp, cmp_ratio, cmp_type);
12      dbms_output.put_line('Table: MYCUSTOMERS');
13      dbms_output.put_line('Compression Ratio: '||cmp_ratio);
14      dbms_output.put_line('Compression Type: '|| cmp_type);
15  end;
16 /
Compression Advisor self-check validation successful. select count(*) on both
Uncompressed and EHCC Compressed format = 1000001 rows
Table: MYCUSTOMERS
Compression Ratio: 4.6
Compression Type: "Compress Archive Low"

PL/SQL procedure successfully completed.

Elapsed: 00:01:50.79
SQL> declare
  2      b_cmp number;
  3      b_ucmp number;
  4      r_cmp number;
  5      r_ucmp number;
  6      cmp_ratio number(6,2);
  7      cmp_type varchar2(1024);
  8 begin
  9      dbms_compression.get_compression_ratio('USERS', 'SH',
10          'MYCUSTOMERS',NULL,DBMS_COMPRESSION.COMP_ARCHIVE_HIGH,
11          b_cmp,b_ucmp, r_cmp, r_ucmp, cmp_ratio, cmp_type);
12      dbms_output.put_line('Table: MYCUSTOMERS');
13      dbms_output.put_line('Compression Ratio: '||cmp_ratio);
14      dbms_output.put_line('Compression Type: '|| cmp_type);
15  end;
16 /

```

```
Compression Advisor self-check validation successful. select count(*) on both
Uncompressed and EHCC Compressed format = 1000001 rows
Table: MYCUSTOMERS
Compression Ratio: 6.4
Compression Type: "Compress Archive High"

PL/SQL procedure successfully completed.

Elapsed: 00:02:29.60
SQL>
```

5. Exadata Hybrid Columnar Compression achieves its highest levels of compression with data that is direct-path inserted. Execute the following ALTER SESSION commands to ensure the use of direct-path inserts later in the practice.

```
SQL> alter session force parallel query;
Session altered.

Elapsed: 00:00:00.00
SQL> alter session force parallel ddl;
Session altered.

Elapsed: 00:00:00.00
SQL> alter session force parallel dml;
Session altered.

Elapsed: 00:00:00.01
```

6. Use the following commands (or execute the SQL script /home/oracle/labs/lab08-02-06.sql) to create compressed copies of the MYCUSTOMERS table. Notice the relative difference in the time taken to create each table by using the different compression modes.

```
SQL> create table mycust_query_low
  2  column store compress for query low
  3  nologging parallel 4
  4  as select * from mycustomers;
```

Table created.

Elapsed: 00:02:53.51

```
SQL> create table mycust_query_high
  2  column store compress for query high
  3  nologging parallel 4
  4  as select * from mycustomers;
```

Table created.

Elapsed: 00:00:34.43

```
SQL> create table mycust_archive_low
  2  column store compress for archive low
  3  nologging parallel 4
  4  as select * from mycustomers;
```

Table created.

Elapsed: 00:00:44.75

```
SQL> create table mycust_archive_high
  2  column store compress for archive high
  3  nologging parallel 4
  4  as select * from mycustomers;
```

Table created.

Elapsed: 00:01:22.92

```
SQL>
```

7. Use the following query (or execute the SQL script /home/oracle/labs/lab08-02-07.sql) to compare the size of the original uncompressed table with the newly created compressed copies, and to compare the actual compression ratios achieved with the ones predicted in step 4.

```
SQL> col segment_name format a30
SQL> select segment_name,MB,
  2  round((max(MB) over (partition by X))/MB,1) COMP_RATIO
  3  from (select segment_name,sum(bytes)/1024/1024 MB,1 X
  4  from user_segments
  5  where segment_name like 'MYCUST%'
  6  group by segment_name)
  7  order by 2 desc;

SEGMENT_NAME          MB COMP_RATIO
-----
MYCUSTOMERS           654      1
MYCUST_QUERY_LOW      260      2.5
MYCUST_QUERY_HIGH     160      4.1
MYCUST_ARCHIVE_LOW    150      4.4
MYCUST_ARCHIVE_HIGH   109      6

Elapsed: 00:00:01.20
SQL>
```

In the next part of the practice, you will compare direct path insert performance for compressed and uncompressed tables. On each occasion you will perform the same transaction twice. The first time will help to prime the system to ensure more consistent results. You should take particular note of the timings for the second insert command. This will help you to determine the impact of Exadata Hybrid Columnar Compression on bulk data loading operations.

8. As a baseline, execute the following transactions to load data into the uncompressed MYCUSTOMERS table. Note the time taken to perform the second insert.

```
SQL> insert /*+APPEND */ into mycustomers
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:22.06
SQL> commit;

Commit complete.

Elapsed: 00:00:00.10
SQL> insert /*+APPEND */ into mycustomers
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:06.85
SQL> commit;

Commit complete.

Elapsed: 00:00:00.06
SQL>
```

9. Execute the same insert transactions against the COMPRESS FOR QUERY LOW copy of the table. Note the time taken to perform the second insert. You may observe that the time for this insert is better than the uncompressed insert in step 8. In this case, the cost of performing the compression is offset by the lower number of I/O operations that are required. This characteristic is one of the reasons why query compression is well suited to data warehouse environments where large data loads exist.

```
SQL> insert /*+APPEND */ into mycust_query_low
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:03.99
SQL> commit;

Commit complete.

Elapsed: 00:00:00.04
SQL> insert /*+APPEND */ into mycust_query_low
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:03.84
SQL> commit;

Commit complete.

Elapsed: 00:00:00.03
SQL>
```

10. Execute the same insert transactions against the COMPRESS FOR QUERY HIGH copy of the table. Note the time taken to perform the second insert and compare it with the previous results.

```
SQL> insert /*+APPEND */ into mycust_query_high
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:05.00
SQL> commit;

Commit complete.

Elapsed: 00:00:00.04
SQL> insert /*+APPEND */ into mycust_query_high
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:04.46
SQL> commit;

Commit complete.

Elapsed: 00:00:00.08
SQL>
```

11. Execute the same insert transactions against the COMPRESS FOR ARCHIVE LOW copy of the table. Note the time taken to perform the second insert. You should observe that the load times are steadily increasing as more aggressive compression modes are used.

```
SQL> insert /*+APPEND */ into mycust_archive_low
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:05.27
SQL> commit;

Commit complete.

Elapsed: 00:00:00.04
SQL> insert /*+APPEND */ into mycust_archive_low
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:05.28
SQL> commit;

Commit complete.

Elapsed: 00:00:00.02
SQL>
```

12. Execute the insert transaction against the COMPRESS FOR ARCHIVE HIGH copy of the table. Note the time taken to perform the second insert. This time you should observe a more substantial cost for the data compression. This is because COMPRESS FOR ARCHIVE HIGH uses a more costly compression algorithm to achieve higher levels of compression. This extra cost is generally acceptable in archiving situations because the data does not change (or changes very little) after it is loaded.

```
SQL> insert /*+APPEND */ into mycust_archive_high
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:06.67
SQL> commit;

Commit complete.

Elapsed: 00:00:00.03
SQL> insert /*+APPEND */ into mycust_archive_high
  2  select * from seed_data;

500000 rows created.

Elapsed: 00:00:07.40
SQL> commit;

Commit complete.

Elapsed: 00:00:00.03
SQL>
```

In the final part of the practice, you will compare query performance for compressed and uncompressed tables.

13. Reconnect to your database as the `sh` user. This clears the session-level statistics, which will be used later to compare query performance.

```
SQL> connect sh/??  
Connected.  
SQL>
```

14. Execute the following test query against the uncompressed table.

```
SQL> select avg(cust_credit_limit) from mycustomers;  
  
AVG(CUST_CREDIT_LIMIT)  
-----  
7683.31668  
  
Elapsed: 00:00:10.93  
SQL>
```

15. Examine the I/O statistics for the query you just ran (use the SQL script /home/oracle/labs/lab08-02-15.sql if you prefer). This will provide a baseline for later comparison.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                MB
-----
physical read total bytes          849.617188
physical write total bytes         0
cell physical IO interconnect bytes      55.8248749
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload    849.429688
cell physical IO bytes saved by storage index        0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan   55.6373749
cell physical IO bytes saved by columnar cache       0
cell physical write bytes saved by smart file initialization 0

NAME                                MB
-----
cell IO uncompressed bytes          849.664063
cell physical write IO bytes eligible for offload        0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.10
SQL>
```

16. Reconnect to your database as the sh user.

```
SQL> connect sh/??
Connected.
SQL>
```

17. Execute the following test query against the COMPRESS FOR QUERY LOW copy of the table.

```
SQL> select avg(cust_credit_limit) from mycust_query_low;

AVG(CUST_CREDIT_LIMIT)
-----
7683.31668

Elapsed: 00:00:18.24
SQL>
```

18. Examine the I/O statistics for the query you just ran (use the SQL script /home/oracle/labs/lab08-02-15.sql if you prefer). Compare the statistics with the results observed in step 15. Note the substantial decrease in the I/O required to satisfy the query.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3 where a.statistic# = b.statistic# and
  4   (a.name in ('physical read total bytes',
  5               'physical write total bytes',
  6               'cell IO uncompressed bytes')
  7 or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes                340.734375
physical write total bytes                0
cell physical IO interconnect bytes      21.457222
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload    338.085938
cell physical IO bytes saved by storage index            0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 18.8087845
cell physical IO bytes saved by columnar cache          0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes                719.677283
cell physical write IO bytes eligible for offload        0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.05
SQL>
```

19. Reconnect to your database as the sh user.

```
SQL> connect sh/??  
Connected.  
SQL>
```

20. Execute the following test query against the COMPRESS FOR QUERY HIGH copy of the table.

```
SQL> select avg(cust_credit_limit) from mycust_query_high;  
  
AVG(CUST_CREDIT_LIMIT)  
-----  
7683.31668  
  
Elapsed: 00:00:16.40  
SQL>
```

21. Examine the I/O statistics for the query you just ran (use the SQL script /home/oracle/labs/lab08-02-15.sql if you prefer). Compare the statistics with the results observed previously. Note again the decline in the I/O required to satisfy the query.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes                210.578125
physical write total bytes               0
cell physical IO interconnect bytes     20.350296
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload    207.953125
cell physical IO bytes saved by storage index            0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 17.725296
cell physical IO bytes saved by columnar cache          0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes                720.139211
cell physical write IO bytes eligible for offload      0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.03
SQL>
```

22. Reconnect to your database as the sh user.

```
SQL> connect sh/??
Connected.
SQL>
```

23. Execute the following test query against the COMPRESS FOR ARCHIVE LOW copy of the table.

```
SQL> select avg(cust_credit_limit) from mycust_archive_low;

AVG(CUST_CREDIT_LIMIT)
-----
7683.31668

Elapsed: 00:00:13.80
SQL>
```

24. Examine the I/O statistics for the query you just ran (use the SQL script /home/oracle/labs/lab08-02-15.sql if you prefer). Compare the statistics with the results observed previously. Note the continued decline in the I/O required to satisfy the query.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes                196.335938
physical write total bytes               0
cell physical IO interconnect bytes     17.6317673
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload      194.0625
cell physical IO bytes saved by storage index            0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 15.3583298
cell physical IO bytes saved by columnar cache           0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes                722.061086
cell physical write IO bytes eligible for offload        0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.03
SQL>
```

25. Reconnect to your database as the sh user.

```
SQL> connect sh/??  
Connected.  
SQL>
```

26. Execute the following test query against the COMPRESS FOR ARCHIVE HIGH copy of the table. Compare the query performance using the uncompressed table and all of the different compressed versions of the table. Note that in some cases, the queries against the compressed tables outperformed the query against the uncompressed table. With compression, you can often observe improved query performance for scanning queries because less I/O is required.

```
SQL> select avg(cust_credit_limit) from mycust_archive_high;  
  
AVG(CUST_CREDIT_LIMIT)  
-----  
7683.31668  
  
Elapsed: 00:00:07.44  
SQL>
```

27. Examine the I/O statistics for the query you just ran (use the SQL script /home/oracle/labs/lab08-02-15.sql if you prefer). Compare the statistics with the results previously observed. Note again the decline in the I/O required to satisfy the query.

```

SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3  where a.statistic# = b.statistic# and
  4  (a.name in ('physical read total bytes',
  5              'physical write total bytes',
  6              'cell IO uncompressed bytes')
  7  or a.name like 'cell phy%');

NAME                                MB
-----
physical read total bytes          144.476563
physical write total bytes         0
cell physical IO interconnect bytes    18.5637817
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload      140.625
cell physical IO bytes saved by storage index            0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 14.7122192
cell physical IO bytes saved by columnar cache           0
cell physical write bytes saved by smart file initialization 0

NAME                                MB
-----
cell IO uncompressed bytes          721.553273
cell physical write IO bytes eligible for offload        0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.03
SQL>

```

28. Exit your SQL*Plus session.

Practice 8-3: Testing Index elimination

Overview

In this practice, you make an index invisible so that you can test the effect of removing the index on your queries without actually dropping the index.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

3. Configure your session to display timing statistics and execution plans. Then flush the database buffer cache to ensure consistent results in the following steps.

```
SQL> set timing on
SQL> set autotrace on explain
SQL> alter system flush buffer_cache;

System altered.

Elapsed: 00:00:01.20
SQL>
```

4. Execute the following query. Note that the execution plan uses an index range scan on the CUSTOMERS_PK index. Note also the time taken to execute the query using the index.

```
SQL> select avg(cust_credit_limit) from customers
  2  where cust_id between 200000 and 320000;

AVG(CUST_CREDIT_LIMIT)
-----
7696.89836

Elapsed: 00:00:05.99

Execution Plan
-----
Plan hash value: 3524092294

-----| Id  | Operation           | Name      | Rows | Bytes |
-----| 0   | SELECT STATEMENT    |           |       |       |
| 1   |   SORT AGGREGATE    |           |       |       |
| 2   |     TABLE ACCESS BY INDEX ROWID BATCHED| CUSTOMERS | 120K| 1171K|
|* 3   |       INDEX RANGE SCAN| CUSTOMERS_PK| 120K|       |
-----|* 3   |       INDEX RANGE SCAN| CUSTOMERS_PK| 120K|       |

Predicate Information (identified by operation id):
-----
3 - access ("CUST_ID">>=200000 AND "CUST_ID"<=320000)

SQL>
```

5. Reconfigure your session to disable the automatic output of execution plans.

```
SQL> set autotrace off
SQL>
```

6. Make the CUSTOMERS_PK index invisible. An invisible index still exists and is maintained by DML operations, but it is not used by the optimizer for queries.

```
SQL> alter index customers_pk invisible;
Index altered.

Elapsed: 00:00:00.16
SQL>
```

7. The index you have just made invisible is associated with a primary key constraint. Use the following query to check the status of the constraint. Note that even though the index is invisible, the associated constraint is still enabled.

```
SQL> select status from user_constraints  
2  where constraint_name='CUSTOMERS_PK';  
  
STATUS  
-----  
ENABLED  
  
Elapsed: 00:00:00.64  
SQL>
```

8. Reconfigure your session to automatically show execution plans.

```
SQL> set autotrace on explain  
SQL>
```

- Re-execute the query from step 4. Notice that an Exadata Smart Scan is used rather than an index range scan.

Compare the time taken to execute the query with and without the index. Note that in some cases, Exadata Smart Scan may deliver better query performance than using an index.

However, this may not always be the case. Even in cases where an index delivers better query performance you might choose to remove it if you determine that the un-indexed query performance is acceptable and the index is otherwise unnecessary. Removing unnecessary indexes saves space and improves DML performance by eliminating the maintenance operations associated with the index. If you decide not to remove the index, you can quickly and easily make it visible.

10. Make the index visible again.

```
SQL> alter index customers_pk visible;  
  
Index altered.  
  
Elapsed: 00:00:00.02  
SQL>
```

11. Exit your SQL*Plus session.

Practices for Lesson 9: Using Smart Scan

Chapter 9

Practices for Lesson 9: Overview

Practices Overview

In these practices, you will exercise Exadata Smart Scan and examine various statistics and wait events to determine what is occurring.

Practice 9-1: Monitoring Exadata Smart Scan

Overview

In this practice, you will examine various Exadata Smart Scan statistics and measures which can be observed within Oracle Database.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

3. Flush the buffer cache to ensure a consistent starting point for this practice, and reconnect to the database to reset the session statistics. Then, configure your session to display query execution plans and statement timings.

```
SQL> alter system flush buffer_cache;
System altered.

SQL> connect sh/??
Connected.
SQL> set autotrace on explain
SQL> set timing on
SQL>
```

4. Execute the following query. You can identify whether Smart Scan is possible by examining the query execution plan. Smart Scan is indicated for this query by the TABLE ACCESS STORAGE FULL operation. You can also see that the WHERE clause predicate (occupation = 'Farming') can be evaluated by Exadata.

```
SQL> select count(*) from cust_info where occupation = 'Farming';
```

```
COUNT (*)
```

```
-----  
27244
```

```
Elapsed: 00:00:05.84
```

```
Execution Plan
```

```
Plan hash value: 1273666552
```

Id	Operation	Name	Rows	Bytes	Cost (%CPU)
0	SELECT STATEMENT		1	7	8718 (1)
1	SORT AGGREGATE		1	7	
* 2	TABLE ACCESS STORAGE FULL	CUST_INFO	229K	1570K	8718 (1)

```
Predicate Information (identified by operation id):
```

```
2 - storage("OCCUPATION"='Farming')
      filter("OCCUPATION"='Farming')
```

```
SQL>
```

5. Reconfigure your session to disable the automatic output of execution plans.

```
SQL> set autotrace off
```

```
SQL>
```

6. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-01-06.sql) and examine the statistics for the current session. Since the query in step 4 is the only query that has been executed during this session we can safely assume that the statistics relate to that query. The statistics show that approximately 250 MB of IO was performed to scan the cust_info table (physical read total bytes), and that almost all of the IO was eligible for Smart Scan (cell physical IO bytes eligible for predicate offload). The statistics further show that Smart Scan returned approximately 400 KB of data back to the database server (cell physical IO interconnect bytes returned by smart scan).

```

SQL> SELECT s.name, m.value/1024/1024 MB FROM V$SYSSTAT s, V$MYSTAT m
  2 WHERE s.statistic# = m.statistic# AND
  3 (s.name LIKE 'physical%total bytes' OR s.name LIKE 'cell phys%' 
  4 OR s.name LIKE 'cell IO%');

NAME                                     MB
-----
physical read total bytes                250.132813
physical write total bytes               0
cell physical IO interconnect bytes      1.02911377
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload       249.515625
cell physical IO bytes saved by storage index                 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan   .41192627
cell physical IO bytes saved by columnar cache                0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes                249.515625
cell physical write IO bytes eligible for offload            0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.06
SQL>

```

7. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-01-07.sql) and examine the cell wait events associated with the current session. Note that the amount of time associated with the cell smart table scan wait event accounts for most of the execution time observed in step 4. This is normal for a query using Smart Scan. You may also see some other wait events that relate to other activities in the session, such as executing the statistics queries in this step and the prior step.

```
SQL> SELECT DISTINCT event, total_waits,
  2  time_waited/100 wait_secs, average_wait/100 avg_wait_secs
  3  FROM V$SESSION_EVENT e, V$MYSTAT s
  4  WHERE event LIKE 'cell%' AND e.sid = s.sid;

EVENT                                TOTAL_WAITS
----- -----
WAIT_SECS  AVG_WAIT_SECS
----- -----
cell single block physical read          91
      .28        .003

cell smart table scan                  255
      5.65        .0222

Elapsed: 00:00:00.28
SQL>
```

Examining the statistics and wait events associated with the query executed at step 4 indicates that the query did make efficient use of Exadata Smart Scan just as the query execution plan suggested. In the next part of this practice you will consider a scenario where the query execution plan indicates the use of Smart Scan but the statistics and wait events suggest something more.

8. Leave your current SQL session active and establish a second terminal connection to qr01dbadm01 as the oracle user. Configure this terminal to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

9. In the second terminal, connect to your database with SQL*Plus. Log in as the `sh` user and set the SQL prompt to `UPDATE>` so that you can easily distinguish this session from your other SQL session.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??  
  
SQL*Plus: Release 12.1.0.2.0 Production...  
  
SQL> set sqlprompt "UPDATE>"  
UPDATE>
```

10. In the second terminal, execute the following command to update a substantial number of customer records. Following the update, flush the buffer cache. This simulates a long running update transaction where the updated blocks (and associated rollback segment blocks) have been aged out of the buffer cache. **Leave the transaction in this terminal window uncommitted for now. Do not proceed to the next step until the update command completes and the buffer cache is flushed.**

```
UPDATE> update cust_info set  
2   affinity_card = 0  
3   where occupation = 'Farming';  
  
27244 rows updated.  
  
UPDATE> alter system flush buffer_cache;  
  
System altered.  
  
UPDATE>
```

11. Switch back to your first SQL session, leaving the second terminal session in the background for now.
12. Back in the first SQL session, reconnect to the database to establish a fresh database session as the `sh` user.

```
SQL> connect sh/??  
Connected.  
SQL>
```

13. Configure the session to display query execution plans.

```
SQL> set autotrace on explain  
SQL>
```

14. Re-execute the query from step 4. Notice again that the query execution plan indicates the use of Smart Scan. Notice also that the execution time increases substantially compared with step 4.

```
SQL> select count(*) from cust_info where occupation = 'Farming';
```

```
COUNT(*)
```

```
-----  
27244
```

```
Elapsed: 00:00:30.01
```

```
Execution Plan
```

```
-----  
Plan hash value: 1273666552
```

Id	Operation	Name	Rows	Bytes	Cost	(%CPU)
0	SELECT STATEMENT		1	7	8718	(1)
1	SORT AGGREGATE		1	7		
*	TABLE ACCESS STORAGE FULL	CUST_INFO	229K	1570K	8718	(1)

```
Predicate Information (identified by operation id) :
```

```
2 - storage("OCCUPATION"='Farming')  
filter("OCCUPATION"='Farming')
```

```
SQL>
```

15. Reconfigure your session to disable the automatic output of execution plans.

```
SQL> set autotrace off
```

```
SQL>
```

16. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-01-06.sql) and examine the statistics for the current session. Compare the output with the observations at step 6. This time the same amount of IO is eligible for Smart Scan (cell physical IO bytes eligible for predicate offload); however, substantially more data was transported to the database server (cell physical IO interconnect bytes returned by smart scan).

```

SQL> SELECT s.name, m.value/1024/1024 MB FROM V$SYSSTAT s, V$MYSTAT m
  2 WHERE s.statistic# = m.statistic# AND
  3 (s.name LIKE 'physical%total bytes' OR s.name LIKE 'cell phys%' 
  4 OR s.name LIKE 'cell IO%');

NAME                                     MB
-----
physical read total bytes                254.007813
physical write total bytes               0
cell physical IO interconnect bytes     147.894104
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload    249.515625
cell physical IO bytes saved by storage index            0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 143.401917
cell physical IO bytes saved by columnar cache          0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes              249.515625
cell physical write IO bytes eligible for offload      0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.05
SQL>

```

17. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-01-07.sql) and examine the cell wait events associated with the current session. Compare the output with the observations at step 7. Notice that this time a significant amount of time is associated with the cell single block physical read wait event. This is because the uncommitted update transaction has forced a substantial number of reads to be transferred to the traditional buffer cache read-consistency path and since the required blocks were not in the buffer cache a large number of single block physical reads were required. Notice also the amount of time associated with the different wait events and how they correlate with the overall query execution time. Clearly, the efficiency and performance of Smart Scan were severely compromised by the pending transaction.

```
SQL> SELECT DISTINCT event, total_waits,
  2  time_waited/100 wait_secs, average_wait/100 avg_wait_secs
  3  FROM V$SESSION_EVENT e, V$MYSTAT s
  4  WHERE event LIKE 'cell%' AND e.sid = s.sid;

EVENT                                TOTAL_WAITS
-----  
WAIT_SECS    AVG_WAIT_SECS
-----  
cell single block physical read          576
      21.58        .0375  
  
cell smart table scan                  160
      8.11        .0507  
  
Elapsed: 00:00:00.41
SQL>
```

In the final part of this practice, you will consider another scenario where the query execution plan indicates the use of Smart Scan but the statistics and wait events suggest something different.

18. Switch back to the second SQL session which contains the update transaction.
19. Commit the current transaction and then execute another update command to update a substantial number of customer records. This time, don't flush the buffer cache after the update command. **Like you did in step 10, leave the transaction in this terminal window uncommitted for now. Do not proceed to the next step until the update command completes.**

```
UPDATE> commit;  
  
Commit complete.  
  
UPDATE> update cust_info set  
      2  affinity_card = 1  
      3  where occupation = 'Farming';  
  
27244 rows updated.  
  
UPDATE>
```

20. Back in the first SQL session, reconnect to the database to establish a fresh database session as the sh user.

```
SQL> connect sh/??  
Connected.  
SQL>
```

21. Configure your newly created session to display query execution plans and summary statistics for each SQL command.

```
SQL> set autotrace on  
SQL>
```

22. Re-execute the query from step 4. Notice again that the query execution plan indicates the use of Smart Scan. However, this time the summary statistics show a very small number of physical reads (zero in the example shown below) and a comparatively large number of consistent gets, which indicates that most of the IO for this query was satisfied by using the buffer cache.

```
SQL> select count(*) from cust_info where occupation = 'Farming';
```

```
COUNT(*)
```

```
-----
```

```
27244
```

```
Elapsed: 00:00:01.12
```

```
Execution Plan
```

```
-----
```

```
Plan hash value: 1273666552
```

Id	Operation	Name	Rows	Bytes	Cost	(%CPU)
0	SELECT STATEMENT		1	7	8718	(1)
1	SORT AGGREGATE		1	7		
* 2	TABLE ACCESS STORAGE FULL	CUST_INFO	229K	1570K	8718	(1)

```
Predicate Information (identified by operation id):
```

```
-----
```

```
2 - storage("OCCUPATION"='Farming')
      filter("OCCUPATION"='Farming')
```

```
Statistics
```

```
-----
```

```
0 recursive calls
0 db block gets
104805 consistent gets
0 physical reads
1321072 redo size
544 bytes sent via SQL*Net to client
551 bytes received via SQL*Net from client
2 SQL*Net roundtrips to/from client
0 sorts (memory)
0 sorts (disk)
1 rows processed
```

```
SQL>
```

23. Reconfigure your session to disable automatic tracing.

```
SQL> set autotrace off
SQL>
```

24. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-01-06.sql) and examine the statistics for the current session. Now the statistics relate to the query at step 22. Notice that all the statistics show very little cell activity and no cell physical IO interconnect bytes returned by smart scan.

```
SQL> SELECT s.name, m.value/1024/1024 MB FROM V$SYSSTAT s, V$MYSTAT m
  2 WHERE s.statistic# = m.statistic# AND
  3 (s.name LIKE 'physical%total bytes' OR s.name LIKE 'cell phys%' 
  4 OR s.name LIKE 'cell IO%');

NAME                                     MB
-----
physical read total bytes                .125
physical write total bytes               0
cell physical IO interconnect bytes     .125
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload 0
cell physical IO bytes saved by storage index 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache 0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes               0
cell physical write IO bytes eligible for offload 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.03
SQL>
```

25. Execute the following query (or execute the SQL script `/home/oracle/labs/lab09-01-07.sql`) and examine the cell wait events associated with the current session. This time there are no wait events indicating the use of smart scan. Evidently the database kernel realized that the query could be satisfied using blocks in the buffer cache. So even though the query plan indicted the use of Smart Scan, the database kernel used the buffer cache at runtime and avoided nearly all IO against the cells.

```
SQL> SELECT DISTINCT event, total_waits,
  2  time_waited/100 wait_secs, average_wait/100 avg_wait_secs
  3  FROM V$SESSION_EVENT e, V$MYSTAT s
  4  WHERE event LIKE 'cell%' AND e.sid = s.sid;

EVENT                                TOTAL_WAITS
----- -----
WAIT_SECS  AVG_WAIT_SECS
----- -----
cell single block physical read      16
    .09        .0058

Elapsed: 00:00:00.39
SQL>
```

In this practice you have seen some scenarios where the optimizer indicated the use of Smart Scan. However, you have also seen that depending on the situation, the performance of Smart Scan may be impacted by other concurrent transactions, or Smart Scan may be skipped, partially or completely, if the database kernel can make use of information in the buffer cache to avoid IO operations.

26. Switch back to the second SQL session which contains the update transaction.
 27. Commit the transaction.

```
UPDATE> commit;
Commit complete.

UPDATE>
```

28. Exit all your terminal sessions.

Practice 9-2: Monitoring Cell Wait Events for Parallel Query

Overview

In this practice, you consider strategies for monitoring cell wait events when parallel query is used.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the sh user.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/??
SQL*Plus: Release 12.1.0.2.0 Production...
SQL>
```

3. Configure your session to display query execution plans and statement timings.

```
SQL> set autotrace on explain
SQL> set timing on
SQL>
```

4. Typically Exadata Smart Scan is used in conjunction with parallel query. Configure your session to force the use of parallel query.

```
SQL> alter session force parallel query parallel 2;
Session altered.

Elapsed: 00:00:00.00
SQL>
```

5. Execute the following query. The query execution plan indicates the use of parallel query and Exadata Smart Scan.

```
SQL> select count(*) from cust_info where occupation = 'Farming';

          COUNT(*)
-----
          27244

Elapsed: 00:00:06.27

Execution Plan
-----
Plan hash value: 3555626242

-----
| Id  | Operation           | Name    | Rows  | Bytes | Cost |
|---|---|---|---|---|---|
| 0  | SELECT STATEMENT   |         |       |       | 4838 |
| 1  |   SORT AGGREGATE   |         |       |       |       |
| 2  |   PX COORDINATOR   |         |       |       |       |
| 3  |     PX SEND QC (RANDOM) | :TQ10000 |       |       |       |
| 4  |     SORT AGGREGATE   |         |       |       |       |
| 5  |     PX BLOCK ITERATOR |         | 229K | 1570K | 4838 |
|* 6  |     TABLE ACCESS STORAGE FULL | CUST_INFO | 229K | 1570K | 4838 |

-----
Predicate Information (identified by operation id):
-----
6 - storage("OCCUPATION"='Farming')
      filter("OCCUPATION"='Farming')

Note
-----
- Degree of Parallelism is 2 because of session

SQL>
```

6. Reconfigure your session to disable the automatic output of execution plans.

```
SQL> set autotrace off
SQL>
```

7. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-02-07.sql) and examine the statistics for the current session. The statistics confirm the use of Smart Scan for the query in step 5.

```
SQL> SELECT s.name, m.value/1024/1024 MB FROM V$SYSSTAT s, V$MYSTAT m
  2 WHERE s.statistic# = m.statistic# AND
  3 (s.name LIKE 'physical%total bytes' OR s.name LIKE 'cell phys%'
  4 OR s.name LIKE 'cell IO%');

NAME                                     MB
-----
physical read total bytes           249.640625
physical write total bytes          0
cell physical IO interconnect bytes .543540955
cell physical IO bytes saved during optimized file creation 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes eligible for predicate offload    249.515625
cell physical IO bytes saved by storage index      0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan .418540955
cell physical IO bytes saved by columnar cache     0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes           249.515625
cell physical write IO bytes eligible for offload    0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

Elapsed: 00:00:00.05
SQL>
```

8. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-02-08.sql) and examine the cell wait events associated with the current session. Notice that there are very few (if any) waits.

```
SQL> SELECT DISTINCT event, total_waits,
  2  time_waited/100 wait_secs, average_wait/100 avg_wait_secs
  3  FROM V$SESSION_EVENT e, V$MYSTAT s
  4  WHERE event LIKE 'cell%' AND e.sid = s.sid;

EVENT                                TOTAL_WAITS
-----
WAIT_SECS  AVG_WAIT_SECS
-----
cell single block physical read      16
    .07        .0043

Elapsed: 00:00:00.22
SQL>
```

Based on the statistics in step 7, you might reasonably expect to see wait events for cell smart table scan in step 8. What happened? Because parallel query was used, the query IO was performed by parallel server processes. The associated wait events are connected to the parallel server sessions, not the current session. Note that this behavior is symptomatic of parallel query and is not Exadata-specific. So when parallel query is used, the wait events must be observed differently. The rest of the practice shows two alternative strategies for observing the wait events.

9. Execute the following query (or execute the SQL script /home/oracle/labs/lab09-02-09.sql) to display the cell wait events across the entire system.

```
SQL> col event format a35
SQL> select event, total_waits,
  2  time_waited/100 wait_secs, average_wait/100 avg_wait_secs
  3  from v$system_event where event like 'cell%';

EVENT          TOTAL_WAITS  WAIT_SECS  AVG_WAIT_SECS
-----
cell smart table scan      10299     312.97     .0304
cell statistics gather      117       .1       .0009
cell smart file creation    14047     116.76     .0083
cell single block physical read  10208      66.9      .0066
cell multiblock physical read 3199      44.27      .0138
cell list of blocks physical read 12       .06       .005

6 rows selected.

Elapsed: 00:00:00.05
SQL>
```

10. Re-execute the parallel query.

```
SQL> select count(*) from cust_info where occupation =
  'Farming';

  COUNT (*)
  -----
  27244

Elapsed: 00:00:00.69
SQL>
```

11. Re-execute the following query (or execute the SQL script /home/oracle/labs/lab09-02-09.sql) to again display the cell wait events across the entire system. Compare the output with the output from step 9. The differences are the cell wait events associated with the query at step 10.

```
SQL> select event, total_waits,
  2  time_waited/100 wait_secs, average_wait/100 avg_wait_secs
  3  from v$system_event where event like 'cell%';

EVENT                      TOTAL_WAITS  WAIT_SECS  AVG_WAIT_SECS
-----
cell smart table scan        10601      313.74     .0296
cell statistics gather       117        .1         .0009
cell smart file creation    14047      116.76     .0083
cell single block physical read 10208      66.9       .0066
cell multiblock physical read 3199       44.27     .0138
cell list of blocks physical read 12        .06        .005

6 rows selected.

Elapsed: 00:00:00.01
SQL>
```

Using system level wait event statistics is a simple way to monitor parallel query wait events as long as you are the only user of the system and you do not wish to monitor concurrent operations. Often this is not the case. The final part of this practice shows another method that can be used to isolate the wait events associated with a specific parallel query operation regardless of concurrency.

12. Execute the following query to determine the default trace file for the current session. Take note of the directory path since that location will also be the default location for other trace files.

```
SQL> select value from v$diag_info
  2  where name = 'Default Trace File';

VALUE
-----
/u01/app/oracle/diag/rdbms/dbm/dbm1/trace/dbm1_ora_86399.trc

Elapsed: 00:00:00.18
SQL>
```

13. Use the dbms_session.set_identifier procedure to set a client identifier (PQ1) for the current session. The client identifier will help to locate trace information associated with the current session and any parallel query sessions that perform work in behalf of the current session.

```
SQL> exec dbms_session.set_identifier(client_id=>'PQ1')

PL/SQL procedure successfully completed.

Elapsed: 00:00:00.17
SQL>
```

14. Use the dbms_monitor.client_id_trace_enable procedure to start recording trace information for the PQ1 client identifier. Notice that waits=>true is specified to ensure that wait information is recorded in the trace.

```
SQL> exec dbms_monitor.client_id_trace_enable(client_id=>'PQ1', waits=>true,
binds=>false)

PL/SQL procedure successfully completed.

Elapsed: 00:00:00.20
SQL>
```

15. Re-execute the parallel query.

```
SQL> select count(*) from cust_info where occupation =
  'Farming';

COUNT (*)
-----
27244

Elapsed: 00:00:00.68
SQL>
```

16. Stop the trace gathering started in step 14 and exit SQL*Plus.

```
SQL> exec dbms_monitor.client_id_trace_disable(client_id=>'PQ1')

PL/SQL procedure successfully completed.

Elapsed: 00:00:00.00
SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release 12.1.0.2.0...
[oracle@qr01dbadm01 ~]$
```

17. Change directories to the location of the trace file observed in step 12.

```
[oracle@qr01dbadm01 ~]$ cd /u01/app/oracle/diag/rdbms/dbm/dbm1/trace
[oracle@qr01dbadm01 trace]$
```

18. Search for trace files containing CLIENT ID: (PQ1). The resulting output will include the trace file for the client SQL session that was listed in the query output from step 12. It will also include trace files associated with any parallel query servers that performed work for the same client.

```
[oracle@qr01dbadm01 trace]$ grep "CLIENT ID:(PQ1)" *
dbm1_ora_86399.trc:*** CLIENT ID: (PQ1) 2016-06-09 04:28:48.093
dbm1_p000_114880.trc:*** CLIENT ID: (PQ1) 2016-06-09 04:29:01.215
dbm1_p001_114882.trc:*** CLIENT ID: (PQ1) 2016-06-09 04:29:01.215
[oracle@qr01dbadm01 trace]$
```

Note that trace files relating to your query may also exist on other nodes in your cluster if your parallel query was executed across multiple database servers.

19. Examine the trace files listed in step 18. The parallel query server trace files will display the cell smart table scan events associated with the parallel query.

```
[oracle@qr01dbadm01 trace]$ grep cell dbm1_p001_114882.trc
...
WAIT #139732971106048: nam='cell smart table scan' ela= 19
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180278511
WAIT #139732971106048: nam='cell smart table scan' ela= 492
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180279122
WAIT #139732971106048: nam='cell smart table scan' ela= 15
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180279227
WAIT #139732971106048: nam='cell smart table scan' ela= 563
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180279819
WAIT #139732971106048: nam='cell smart table scan' ela= 15
cellhash#=3097415979 p2=0 p3=0 obj#=20476 tim=610180279931
WAIT #139732971106048: nam='cell smart table scan' ela= 1702
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180281693
WAIT #139732971106048: nam='cell smart table scan' ela= 18
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180281843
WAIT #139732971106048: nam='cell smart table scan' ela= 2252
cellhash#=3097415979 p2=0 p3=0 obj#=20476 tim=610180284151
WAIT #139732971106048: nam='cell smart table scan' ela= 20
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180284255
WAIT #139732971106048: nam='cell smart table scan' ela= 734
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180285029
WAIT #139732971106048: nam='cell smart table scan' ela= 398
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180286970
WAIT #139732971106048: nam='cell smart table scan' ela= 5
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180287012
WAIT #139732971106048: nam='cell smart table scan' ela= 6737
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180293842
WAIT #139732971106048: nam='cell smart table scan' ela= 24
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180294037
WAIT #139732971106048: nam='cell smart table scan' ela= 2252
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180296392
WAIT #139732971106048: nam='cell smart table scan' ela= 16
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180296535
WAIT #139732971106048: nam='cell smart table scan' ela= 4280
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180300845
WAIT #139732971106048: nam='cell smart table scan' ela= 2790
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180303820
WAIT #139732971106048: nam='cell smart table scan' ela= 18
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180303932
WAIT #139732971106048: nam='cell smart table scan' ela= 9455
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180313415
WAIT #139732971106048: nam='cell smart table scan' ela= 972
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180314524
WAIT #0: nam='cell smart table scan' ela= 525
cellhash#=2877408282 p2=0 p3=0 obj#=20476 tim=610180316862
WAIT #0: nam='cell smart table scan' ela= 644
cellhash#=3097415979 p2=0 p3=0 obj#=20476 tim=610180317537
WAIT #0: nam='cell smart table scan' ela= 622
cellhash#=2271898598 p2=0 p3=0 obj#=20476 tim=610180318201
[oracle@qr01dbadm01 trace]$
```

20. Exit your terminal session.

Practices for Lesson 10: Consolidation Options and Recommendations

Chapter 10

Practices for Lesson 10

There are no practices for this lesson.

Practices for Lesson 11: Migrating Databases to Exadata Database Machine

Chapter 11

Practices for Lesson 11: Overview

Practices Overview

In this practice you will use Oracle Recovery Manager (RMAN), in conjunction with the transportable tablespace feature of Oracle Database, to migrate data from a big endian platform to Database Machine, a little endian platform.

Practice 11-1: Migrating to Databases Machine using Transportable Tablespaces

Overview

In this practice, you will migrate data from an AIX platform to Database Machine. You will use Oracle Recovery Manager (RMAN) to perform endian conversion on a data file and also to load the data file into ASM. You will then use the transportable tablespace feature of Oracle Database to make the data file part of your database on Database Machine.

Tasks

- Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

- From the oracle user home directory, change directory into the TTS subdirectory under the labs directory.

```
[oracle@qr01dbadm01 ~]$ cd labs/TTS
[oracle@qr01dbadm01 TTS]$
```

- List the contents of the TTS directory. You should see two files. soe_TTS_AIX.dbf is a data file sourced from an Oracle database running on AIX. It contains a tablespace called SOE which houses numerous database objects belonging to a schema named SOE. expSOE_TTS.dmp is a data pump export file, which contains the transportable tablespace metadata associated with the SOE tablespace.

```
[oracle@qr01dbadm01 TTS]$ ls -l
total 1230568
-rw-r--r-- 1 oracle oinstall      565248 Oct 15  2010 expSOE_TTS.dmp
-rw-r--r-- 1 oracle oinstall 1258299392 Oct 15  2010 soe_TTS_AIX.dbf
[oracle@qr01dbadm01 TTS]$
```

Note that the files associated with the transportable tablespace are staged on the filesystem of your database server. This arrangement is being used only to facilitate the practice in this classroom setting and is not a recommended practice for migrating data to Database Machine. Various solutions exist for staging data files in a real-world Database Machine setting, including using a database file system (DBFS). Configuring DBFS on Database Machine is examined in the lesson entitled *Bulk Data Loading with Database Machine*.

4. Connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 TTS] $ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

5. Execute the following query to confirm the Database Machine platform and endian format (or execute the SQL script /home/oracle/labs/lab11-01-05.sql). Note that Database Machine is a little endian format system.

```
SQL> select d.platform_name, endian_format
  2  from v$transportable_platform tp, v$database d
  3  where tp.platform_name = d.platform_name;

PLATFORM_NAME
-----
ENDIAN_FORMAT
-----
Linux x86 64-bit
Little

SQL>
```

6. Query V\$TRANSPORTABLE_PLATFORM to display all the platforms supported by the transportable tablespace feature along with each platform's endian format. Note that AIX is a big endian format system.

```
SQL> col platform_name format a40
SQL> select * from v$transportable_platform;

PLATFROM_ID PLATFORM_NAME          ENDIAN_FORMAT CON_ID
----- -----
      1 Solaris[tm] OE (32-bit)      Big           0
      2 Solaris[tm] OE (64-bit)      Big           0
      7 Microsoft Windows IA (32-bit) Little        0
     10 Linux IA (32-bit)          Little        0
      6 AIX-Based Systems (64-bit)    Big           0
      3 HP-UX (64-bit)             Big           0
      5 HP Tru64 UNIX              Little        0
      4 HP-UX IA (64-bit)          Big           0
     11 Linux IA (64-bit)          Little        0
     15 HP Open VMS               Little        0
      8 Microsoft Windows IA (64-bit) Little        0

PLATFROM_ID PLATFORM_NAME          ENDIAN_FORMAT CON_ID
----- -----
      9 IBM zSeries Based Linux      Big           0
     13 Linux x86 64-bit            Little        0
     16 Apple Mac OS               Big           0
     12 Microsoft Windows x86 64-bit Little        0
     17 Solaris Operating System (x86) Little        0
     18 IBM Power Based Linux      Big           0
     19 HP IA Open VMS             Little        0
     20 Solaris Operating System (x86-64) Little        0
     21 Apple Mac OS (x86-64)       Little        0

20 rows selected.

SQL>
```

7. Exit your SQL*Plus session. Then, launch Oracle Recovery Manager (RMAN) and connect to your database as shown below:

```
SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0...
[oracle@qr01dbadm01 TTS]$ rman target /

Recovery Manager: Release 12.1.0.2.0 - Production...

connected to target database: DBM (DBID=1355636031)

RMAN>
```

8. Use the CONVERT DATAFILE command as shown below to perform endian conversion on the AIX-based Oracle data file in your TTS directory. The command also loads the data file into ASM. Take note of the ASM file name for your converted data file.

```
RMAN> convert datafile
2> '/home/oracle/labs/TTS/soe_TTS_AIX.dbf'
3> to platform="Linux x86 64-bit"
4> from platform="AIX-Based Systems (64-bit)"
5> parallelism=1
6> format '+DATA_QR01';

Starting conversion at target at 09-JUN-16
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=43 instance=dbm1 device type=DISK
channel ORA_DISK_1: starting datafile conversion
input file name=/home/oracle/labs/TTS/soe_TTS_AIX.dbf
converted datafile=+DATA_QR01/DBM/DATAFILE/soe.274.914043297
channel ORA_DISK_1: datafile conversion complete, elapsed time:
00:02:15
Finished conversion at target at 09-JUN-16

RMAN>
```

9. Exit RMAN and connect to your database using SQL*Plus. Log in as the database administrator.

```
RMAN> exit

Recovery Manager complete.

[oracle@qr01dbadm01 TTS]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production ...

SQL>
```

10. When a transportable tablespace is mapped into a destination database, by default, all the database objects (such as tables and indexes) are created in the same user schema as in the source database, and those users must already exist in the destination database. Create a user named SOE and grant SOE the CONNECT and RESOURCE roles. Remember your chosen password as you will need to use it later in the practice.

```
SQL> create user soe identified by ??? account unlock;  
  
User created.  
  
SQL> grant connect,resource to soe;  
  
Grant succeeded.  
  
SQL>
```

11. Create a directory object that references the directory which houses your transportable tablespace export file. After the directory object is created, exit your SQL*Plus session.

```
SQL> create directory tts as '/home/oracle/labs/TTS';  
  
Directory created.  
  
SQL> exit  
Disconnected from Oracle Database 12c Enterprise Edition Release  
12.1.0.2.0 - 64bit Production...  
[oracle@qr01dbadm01 TTS]$
```

12. Execute the data pump import utility (`impdp`) to import the transportable tablespace metadata. Use the ASM file name you obtained in step 8 in your setting for the `transport_datafiles` parameter.

```
[oracle@qr01dbadm01 TTS]$ impdp system dumpfile=expSOE_TTS.dmp directory=tts
logfile=imp_SOE.log
transport_datafiles='+DATA_QR01/DBM/DATAFILE/soe.274.914043297'

Import: Release 12.1.0.2.0 - Production on Thu Jun 9 05:01:27 2016

Copyright (c) 1982, 2014, Oracle and/or its affiliates. All rights reserved.
Password: ????????

Connected to: Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 -
64bit Production
With the Partitioning, Real Application Clusters, Automatic Storage
Management, OLAP,
Advanced Analytics and Real Application Testing options
Master table "SYSTEM"."SYS_IMPORT_TRANSPORTABLE_01" successfully
loaded/unloaded
Source time zone version is 14 and target time zone version is 18.
import done in AL32UTF8 character set and AL16UTF16 NCHAR character set
export done in US7ASCII character set and AL16UTF16 NCHAR character set
Starting "SYSTEM"."SYS_IMPORT_TRANSPORTABLE_01": system/*********
dumpfile=expSOE_TTS.dmp directory=tts logfile=imp_SOE.log
transport_datafiles='+DATA_QR01/DBM/DATAFILE/soe.274.914043297
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type TRANSPORTABLE_EXPORT/TABLE
Processing object type TRANSPORTABLE_EXPORT/INDEX
Processing object type TRANSPORTABLE_EXPORT/CONSTRAINT/CONSTRAINT
Processing object type TRANSPORTABLE_EXPORT/INDEX_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/CONSTRAINT/REF_CONSTRAINT
Processing object type TRANSPORTABLE_EXPORT/INDEX/FUNCTIONAL_AND_BITMAP/INDEX
Processing object type
TRANSPORTABLE_EXPORT/INDEX/STATISTICS/FUNCTIONAL_AND_BITMAP/INDEX_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
Job "SYSTEM"."SYS_IMPORT_TRANSPORTABLE_01" successfully completed at Thu Jun 9
05:02:12 2016 elapsed 0 00:00:35

[oracle@qr01dbadm01 TTS]$
```

13. Transportable tablespaces are generated in read-only mode. Connect to your database by using SQL*Plus. Log in as the database administrator and restore your newly migrated SOE tablespace to read/write mode.

```
[oracle@qr01dbadm01 TTS] $ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL> alter tablespace soe read write;

Tablespace altered.

SQL>
```

14. Connect as the newly created SOE user.

```
SQL> connect soe/???

Connected.

SQL>
```

15. Query the data dictionary (or execute the SQL script /home/oracle/labs/lab11-01-15.sql) to view a summary of the database objects belonging to SOE.

```
SQL> select segment_type,tablespace_name,count(*)
  2  from user_segments
  3  group by segment_type,tablespace_name;

SEGMENT_TYPE          TABLESPACE_NAME          COUNT (*)
-----
TABLE PARTITION        SOE                  64
INDEX                 SOE                  19
TABLE                 SOE                  3
INDEX PARTITION       SOE                  64

SQL>
```

16. Query some of the migrated data to confirm that it is available. You have completed the migration of a tablespace to Database Machine.

```
SQL> select * from warehouses;

WAREHOUSE_ID WAREHOUSE_NAME          LOCATION_ID
-----        -----
1 Southlake, Texas                      1400
2 San Francisco                         1500
3 New Jersey                            1600
4 Seattle, Washington                   1700
5 Toronto                               1800
6 Sydney                                2200
7 Mexico City                           3200
8 Beijing                               2000
9 Bombay                                2100
10 Paris                                 3240
11 Warehouse Number 11                  1252

WAREHOUSE_ID WAREHOUSE_NAME          LOCATION_ID
-----        -----
12 Warehouse Number 12                 9176
13 Warehouse Number 13                 3766
14 Warehouse Number 14                 3766
15 Warehouse Number 15                 3766
16 Warehouse Number 16                 3766
17 Warehouse Number 17                 8971
18 Warehouse Number 18                 8971
19 Warehouse Number 19                 8971
20 Warehouse Number 20                 8971

20 rows selected.

SQL>
```

17. Exit your SQL*Plus session.

Practices for Lesson 12: Bulk Data Loading

Chapter 12

Practices for Lesson 12: Overview

Practices Overview

In this practice, you will perform a bulk data load on Database Machine.

Practice 12-1: Bulk Data Loading with Database Machine

Overview

In this practice, you will perform a bulk data load on Database Machine. You will configure a database file system (DBFS) and use it to stage a CSV formatted file. You will then use the external table feature of Oracle Database to reference the CSV file. Finally, you will use a CREATE TABLE AS SELECT statement to copy the CSV file data into a table in your database.

Note that this practice familiarizes students with the process required to configure DBFS in an Exadata environment using Linux as the database server OS, and some of the tasks performed during this practice are Linux-specific. Furthermore, this practice does not contain all of the optional steps for configuring DBFS on Exadata Database Machine. For information on additional configuration options see My Oracle Support note 1054431.1.

Tasks

- Establish a terminal connection to qr01dbadm01 as the root user.

```
$ ssh root@qr01dbadm01  
root@qr01dbadm01's password: ???????  
[root@qr01dbadm01 ~] #
```

- Configure the OS to enable the oracle user to use the Linux fuse (Filesystem in User Space) kernel module.

```
[root@qr01dbadm01 ~] # usermod -a -G fuse oracle  
[root@qr01dbadm01 ~] # echo user_allow_other > /etc/fuse.conf  
[root@qr01dbadm01 ~] # chmod 644 /etc/fuse.conf  
[root@qr01dbadm01 ~] #
```

Note that the configuration performed in this step is required on every database server where the DBFS will be mounted. In a production environment, you could repeat this step on each database server or use the dcli utility to perform the configuration at once across multiple database servers.

- Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance). **It is important that you create a fresh oracle user session after you perform step 2 so that the session can inherit the newly configured group membership. If you use a previously started terminal session then you will experience problems later in the practice.**

```
$ ssh oracle@qr01dbadm01  
oracle@qr01dbadm01's password: ???????  
[oracle@qr01dbadm01 ~] $ . oraenv  
ORACLE_SID = [oracle] ? dbm  
The Oracle base has been set to /u01/app/oracle  
[oracle@qr01dbadm01 ~] $ export ORACLE_SID=dbm1  
[oracle@qr01dbadm01 ~] $
```

4. Connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

5. Create a new tablespace to house your database file system (DBFS).

```
SQL> create bigfile tablespace dbfs
  2  datafile '+DBFS_DG' size 200M;

Tablespace created.

SQL>
```

Note that in this practice you will configure DBFS inside your assigned student database. This arrangement is only being used to facilitate the practice in this classroom setting and is not a recommended practice for configuring DBFS to facilitate bulk data loading on Database Machine. For bulk data loading in a real-world Database Machine setting, Oracle recommends that you create a separate dedicated database instance for DBFS on your Database Machine. See My Oracle Support notes 1054431.1 and 1191144.1 for specific recommendations.

6. Create a new database user to support DBFS and grant the database user the required system privileges and roles as shown below. Remember your chosen password as you will need to use it later in the practice. Exit your SQL*Plus session when you are finished.

```
SQL> create user dbfs identified by *****
  2  quota unlimited on dbfs;

User created.

SQL> grant create session, create table,
  2  create procedure, dbfs_role to dbfs;

Grant succeeded.

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0 - 64bit Production...
[oracle@qr01dbadm01 ~]$
```

7. Create a new directory named DBFS under the oracle user home directory. This directory will act as the anchor for your database file system mount point. Note that this directory needs to be created on every database server where the DBFS will be mounted.

```
[oracle@qr01dbadm01 ~]$ mkdir DBFS
[oracle@qr01dbadm01 ~]$
```

8. Change directory to \$ORACLE_HOME/rdbms/admin.

```
[oracle@qr01dbadm01 ~]$ cd $ORACLE_HOME/rdbms/admin  
[oracle@qr01dbadm01 admin]$
```

9. Connect to your database with SQL*Plus. Log in as the newly created dbfs user.

```
[oracle@qr01dbadm01 admin]$ sqlplus dbfs/????  
  
SQL*Plus: Release 12.1.0.2.0 Production...  
  
SQL>
```

10. Run the dbfs_create_filesystem script file to create the database objects for your DBFS store. The first parameter (dbfs) specifies the tablespace where the DBFS store is created. The second parameter (mydbfs) specifies the name of the DBFS store.

```
SQL> @dbfs_create_filesystem dbfs mydbfs  
...  
No errors.  
-----  
CREATE STORE:  
begin dbms_dbfs_sfs.createFilesystem(store_name => 'mydbfs', tbl_name =>  
'mydbfs', tbl_tbs => 'dbfs', lob_tbs => 'dbfs', do_partition => false,  
partition_key => 1, do_compress => false, compression => '', do_dedup =>  
false,  
do_encrypt => false); end;  
-----  
REGISTER STORE:  
begin dbms_dbfs_content.registerStore(store_name=> 'mydbfs', provider_name =>  
'sample1', provider_package => 'dbms_dbfs_sfs'); end;  
-----  
MOUNT STORE:  
begin dbms_dbfs_content.mountStore(store_name=>'mydbfs',  
store_mount=>'mydbfs');  
end;  
-----  
CHMOD STORE:  
declare m integer; begin m := dbms_fuse.fs_chmod('/mydbfs', 16895); end;  
No errors.  
SQL>
```

11. Exit SQL*Plus and change back to the oracle user's home directory.

```
SQL> exit  
Disconnected from Oracle Database 12c Enterprise Edition Release  
12.1.0.2.0 - 64bit Production...  
[oracle@qr01dbadm01 admin]$ cd  
[oracle@qr01dbadm01 ~]$
```

12. Create a file named `passwd.txt`, which contains the password for your DBFS database user.

```
[oracle@qr01dbadm01 ~]$ echo ???? > passwd.txt
[oracle@qr01dbadm01 ~]$
```

13. Launch the DBFS client (`dbfs_client`) by using the following command. Running `dbfs_client` in this manner mounts your database file system.

```
[oracle@qr01dbadm01 ~]$ nohup $ORACLE_HOME/bin/dbfs_client
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS < passwd.txt
&
[1] 5376
nohup: appending output to `nohup.out'

[oracle@qr01dbadm01 ~]$
```

Note that you have just started DBFS using the simplest and most direct method. Optional configuration steps can be performed to enable DBFS to use a wallet-based password and to enable DBFS to be managed automatically as a cluster resource. See My Oracle Support note 1054431.1 for details.

14. Use the `ps` command to locate your `dbfs_client` process.

```
[oracle@qr01dbadm01 ~]$ ps -ef | grep dbfs_client
oracle      5376 129147  0 05:46 pts/1    00:00:00
/u01/app/oracle/product/12.1.0.2/dbhome_1/bin/dbfs_client
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS
oracle      5580 129147  0 05:46 pts/1    00:00:00 grep
dbfs_client
[oracle@qr01dbadm01 ~]$
```

15. Use the `df` command to confirm that your database file system is mounted.

```
[oracle@qr01dbadm01 ~]$ df /home/oracle/DBFS
Filesystem      1K-blocks  Used Available Use% Mounted on
dbfs@dbm:/       198592    160    198432   1% /home/oracle/DBFS
[oracle@qr01dbadm01 ~]$
```

16. Normally you would transfer files into your DBFS staging area by using a network file transfer mechanism such as SCP or FTP, or by reading them off a mass storage device (such as magnetic tape for example) attached to your Database Machine. To facilitate this practice, a CSV formatted data file is already located in the `labs/CSV` directory under the `oracle` user home directory. Copy the CSV file into your DBFS staging area as shown below. Then change directory into your DBFS staging area and confirm the presence of the CSV data file.

```
[oracle@qr01dbadm01 ~]$ cp labs/CSV/customers.csv DBFS/mydbfs/
[oracle@qr01dbadm01 ~]$ cd DBFS/mydbfs/
[oracle@qr01dbadm01 mydbfs]$ ls -l
total 7376
-rw-r--r-- 1 oracle oinstall 7552705 Jun  9 05:48 customers.csv
[oracle@qr01dbadm01 mydbfs]$
```

17. Use the head command to show the first 10 lines of data inside the CSV file.

```
[oracle@qr01dbadm01 mydbfs] $ head customers.csv
55,"Bruce","Lange","hi","INDIA",1999,"Bruce.Lange@oracle.com",166
74,"Claude","Brown","d","SWITZERLAND",4737,"Claude.Brown@oracle.com",163
81,"Max","Capshaw","us","AMERICA",650,"Max.Capshaw@oracle.com",165
97,"Roy","Kazan","zhs","CHINA",2707,"Roy.Kazan@oracle.com",156
111,"Robert","Young","i","ITALY",4895,"Robert.Young@oracle.com",169
146,"Ridley","Schneider","th","THAILAND",3775,"Ridley.Schneider@oracle.com",16
8
245,"Matthias","Russell","i","ITALY",2839,"Matthias.Russell@oracle.com",158
252,"Edward","Hoskins","ja","JAPAN",2469,"Edward.Hoskins@oracle.com",153
262,"Grace","Sen","zhs","CHINA",500,"Grace.Sen@oracle.com",162
281,"Gtz","Peckinpah","th","THAILAND",1128,"Gtz.Peckinpah@oracle.com",151
[oracle@qr01dbadm01 mydbfs] $
```

Your CSV data file is now staged inside DBFS. In the next section of this practice, you will create an external table to reference the staged data.

18. Connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 mydbfs] $ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

19. Create a directory object that points to your DBFS staging directory.

```
SQL> create directory staging as '/home/oracle/DBFS/mydbfs';

Directory created.

SQL>
```

20. Grant read and write permissions on your newly created staging directory object to the sh user.

```
SQL> grant read, write on directory staging to sh;

Grant succeeded.

SQL>
```

21. Connect as the sh user.

```
SQL> connect sh/?
Connected.

SQL>
```

22. Create an external table that references the data in your DBFS-staged CSV data file. You can use the command shown below without any modifications (or execute the SQL script /home/oracle/labs/lab12-01-22.sql).

```
SQL> create table ext_customers
  2  (
  3    customer_id      number(12),
  4    cust_first_name  varchar2(30),
  5    cust_last_name   varchar2(30),
  6    nls_language     varchar2(3),
  7    nls_territory    varchar2(30),
  8    credit_limit     number(9,2),
  9    cust_email       varchar2(100),
 10    account_mgr_id  number(6)
 11  )
 12 organization external
 13 (
 14   type oracle_loader
 15   default directory staging
 16   access parameters
 17   (
 18     records delimited by newline
 19     badfile staging:'custtxt%a_%p.bad'
 20     logfile staging:'custtxt%a_%p.log'
 21     fields terminated by ',' optionally enclosed by "'"
 22     missing field values are null
 23   (
 24     customer_id, cust_first_name, cust_last_name, nls_language,
 25     nls_territory, credit_limit, cust_email, account_mgr_id
 26   )
 27   )
 28   location ('customers.csv')
 29 )
 30 parallel
 31 reject limit unlimited;
```

Table created.

```
SQL>
```

23. Configure your session to display query execution plans.

```
SQL> set autotrace on explain
SQL>
```

24. Execute the following query to display the number of records in the external table. Note that the full table scan of the external table is executed in parallel.

```
SQL> select count(*) from ext_customers;

COUNT(*)
-----
100000

Execution Plan
-----
Plan hash value: 3054877561

-----| Id  | Operation          | Name      | Rows  | Cost (%CPU) |
-----| 0   | SELECT STATEMENT   |           |       1 |    95 (2)  |
| 1   | SORT AGGREGATE     |           |       1 |             |
| 2   | PX COORDINATOR     |           |       1 |             |
| 3   |   PX SEND QC (RANDOM)| :TQ10000 |       1 |             |
| 4   |   SORT AGGREGATE    |           |       1 |             |
| 5   |   PX BLOCK ITERATOR |           | 102K  |    95 (2)  |
| 6   |   EXTERNAL TABLE ACCESS FULL| EXT_CUSTOMERS | 102K  |    95 (2)  |

Note
-----
- Degree of Parallelism is 4 because of table property

SQL>
```

25. Reconfigure your session to disable automatic query plan display.

```
SQL> set autotrace off
SQL>
```

26. Use a CREATE TABLE AS SELECT command to load the external table data contained in the CSV file into a new table in your database.

```
SQL> create table loaded_customers
  2  as select * from ext_customers;

Table created.

SQL>
```

27. Query your newly loaded table to confirm the number of records that were loaded and then exit SQL*Plus.

```
SQL> select count(*) from loaded_customers;

COUNT(*)
-----
100000

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0 - 64bit Production...
[oracle@qr01dbadm01 mydbfs] $
```

28. List the contents of your current directory (which should be your DBFS staging area). In addition to your CSV data file, you should now see a log file that was generated when you referenced the external table.

```
[oracle@qr01dbadm01 mydbfs] $ ls -l
total 7379
-rw-r--r-- 1 oracle oinstall 7552705 Jun  9 05:48 customers.csv
-rw-r--r-- 1 oracle asmadmin     2752 Jun  9 05:53 custxt000_8277.log
[oracle@qr01dbadm01 mydbfs] $
```

29. Examine the contents of the log file.

```
[oracle@qr01dbadm01 mydbfs] $ cat custxt000_8277.log
...
LOG file opened at 06/09/16 05:58:24

Field Definitions for table EXT_CUSTOMERS
Record format DELIMITED BY NEWLINE
Data in file has same endianness as the platform
Rows with all null fields are accepted

Fields in Data Source:

CUSTOMER_ID           CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
CUST_FIRST_NAME        CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
CUST_LAST_NAME         CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
NLS_LANGUAGE            CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
NLS_TERRITORY           CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
CREDIT_LIMIT             CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
CUST_EMAIL               CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
ACCOUNT_MGR_ID           CHAR (255)
Terminated by ","
Enclosed by """" and """
Trim whitespace same as SQL Loader
[oracle@qr01dbadm01 mydbfs] $
```

30. Change back to the `oracle` user's home directory.

```
[oracle@qr01dbadm01 mydbfs]$ cd
[oracle@qr01dbadm01 ~]$
```

31. Use the `fusermount -u` command to unmount your database file system.

```
[oracle@qr01dbadm01 ~]$ fusermount -u /home/oracle/DBFS
[1]+  Done                      nohup $ORACLE_HOME/bin/dbfs_client
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS < passwd.txt
[oracle@qr01dbadm01 ~]$
```

32. Unmounting your database file system terminates the `dbfs_client` process you started earlier. Use the `ps` command to verify that your `dbfs_client` process is no longer running.

```
[oracle@qr01dbadm01 ~]$ ps -ef|grep dbfs_client
oracle    18083 129147  0 06:33 pts/1    00:00:00 grep dbfs_client
[oracle@qr01dbadm01 ~]$
```

What do you think would happen if you referenced the external table (`EXT_CUSTOMERS`) now? Try it.

So far, you have mounted your DBFS exclusively on `qr01dbadm01`. In the final part of this practice you will mirror the configuration on `qr01dbadm02` and mount DBFS on both of your database servers.

33. Establish a separate terminal connection to `qr01dbadm02` as the `root` user.

```
$ ssh root@qr01dbadm02
root@qr01dbadm02's password: ????????
[root@qr01dbadm02 ~] #
```

34. Configure the OS to enable the `oracle` user to use the Linux fuse (Filesystem in User Space) kernel module.

```
[root@qr01dbadm02 ~]# usermod -a -G fuse oracle
[root@qr01dbadm02 ~]# echo user_allow_other > /etc/fuse.conf
[root@qr01dbadm02 ~]# chmod 644 /etc/fuse.conf
[root@qr01dbadm02 ~]#
```

35. Establish a new shell as the `oracle` OS user and create a new directory named `DBFS` to act as the anchor for your database file system mount point.

```
[root@qr01dbadm02 ~]# su - oracle
[oracle@qr01dbadm02 ~]$ mkdir DBFS
[oracle@qr01dbadm02 ~]$
```

36. Create a file named `passwd.txt`, which contains the password for your DBFS database user.

```
[oracle@qr01dbadm02 ~]$ echo ???? > passwd.txt
[oracle@qr01dbadm02 ~]$
```

37. Configure your OS environment to access the dbm database.

```
[oracle@qr01dbadm02 ~]$ . oraenv  
ORACLE_SID = [oracle] ? dbm  
The Oracle base has been set to /u01/app/oracle  
[oracle@qr01dbadm02 ~]$
```

38. Mount your database file system on qr01dbadm02.

```
[oracle@qr01dbadm02 ~]$ nohup $ORACLE_HOME/bin/dbfs_client  
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS < passwd.txt  
&  
[1] 81229  
nohup: appending output to `nohup.out'  
  
[oracle@qr01dbadm02 ~]$
```

39. Confirm the contents of the file system.

```
[oracle@qr01dbadm02 ~]$ ls -l DBFS/mydbfs  
total 7379  
-rw-r--r-- 1 oracle oinstall 7552705 Jun  9 05:48 customers.csv  
-rw-r--r-- 1 oracle asmadmin     2752 Jun  9 05:53 custxt000_8277.log  
[oracle@qr01dbadm02 ~]$
```

40. Create a new file in the file system.

```
[oracle@qr01dbadm02 ~]$ echo "Test" > DBFS/mydbfs/test.txt  
[oracle@qr01dbadm02 ~]$
```

41. Return to your qr01dbadm01 session and mount the database file system.

```
[oracle@qr01dbadm01 ~]$ nohup $ORACLE_HOME/bin/dbfs_client  
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS < passwd.txt  
&  
[1] 34148  
nohup: appending output to `nohup.out'  
  
[oracle@qr01dbadm01 ~]$
```

42. Confirm the contents of the file system, including the file you created on qr01dbadm02.

```
[oracle@qr01dbadm01 ~]$ ls -l DBFS/mydbfs  
total 7380  
-rw-r--r-- 1 oracle oinstall 7552705 Jun  9 05:48 customers.csv  
-rw-r--r-- 1 oracle asmadmin     2752 Jun  9 05:53 custxt000_8277.log  
-rw-r--r-- 1 oracle oinstall        5 Jun  9 07:05 test.txt  
[oracle@qr01dbadm01 ~]$ cat DBFS/mydbfs/test.txt  
Test  
[oracle@qr01dbadm01 ~]$
```

43. Unmount your database file system on qr01dbadm01.

```
[oracle@qr01dbadm01 ~]$ fusermount -u /home/oracle/DBFS  
[1]+ Done nohup $ORACLE_HOME/bin/dbfs_client  
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS < passwd.txt  
[oracle@qr01dbadm01 ~]$
```

44. Unmount your database file system on qr01dbadm02.

```
[oracle@qr01dbadm02 ~]$ fusermount -u /home/oracle/DBFS  
[1]+ Done nohup $ORACLE_HOME/bin/dbfs_client  
dbfs@dbm -o allow_other,direct_io /home/oracle/DBFS < passwd.txt  
[oracle@qr01dbadm02 ~]$
```

45. Exit your terminal sessions.

Practices for Lesson 13: Exadata Database Machine Platform Monitoring - Introduction

Chapter 13

Practices for Lesson 13

There are no practices for this lesson.

Practices for Lesson 14: Configuring Enterprise Manager Cloud Control to Monitor Exadata Database Machine

Chapter 14

Practices for Lesson 14: Overview

Practices Overview

In these practices, you will configure Enterprise Manager Cloud Control 12c to monitor Exadata Database Machine. You will also perform a selection of post-discovery configuration and verification tasks.

Practice 14-1: Configuring Enterprise Manager Cloud Control 12c to Monitor Exadata Database Machine

Overview

In this practice, you will configure Enterprise Manager Cloud Control 12c to monitor Exadata Database Machine. Specifically, you will:

- Deploy Management Agents to Database Machine servers
- Discover the Database Machine system components
- Discover Oracle Grid Infrastructure and Oracle Database software components
- Configure a Database Machine Services Dashboard

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Confirm that the dbm database is running on qr01dbadm01 and qr01dbadm02.

```
[oracle@qr01dbadm01 ~]$ srvctl status database -d dbm
Instance dbm1 is running on node qr01dbadm01
Instance dbm2 is running on node qr01dbadm02
[oracle@qr01dbadm01 ~]$
```

3. Establish a terminal session connected to em12c by using the oracle OS user. Ensure that you specify the -X option for ssh.

Note that you may see additional messages relating to server identities. Answer yes if you are prompted to acknowledge server authenticity.

```
$ ssh -X oracle@em12c
oracle@em12c password: ???????
[oracle@em12c ~]$
```

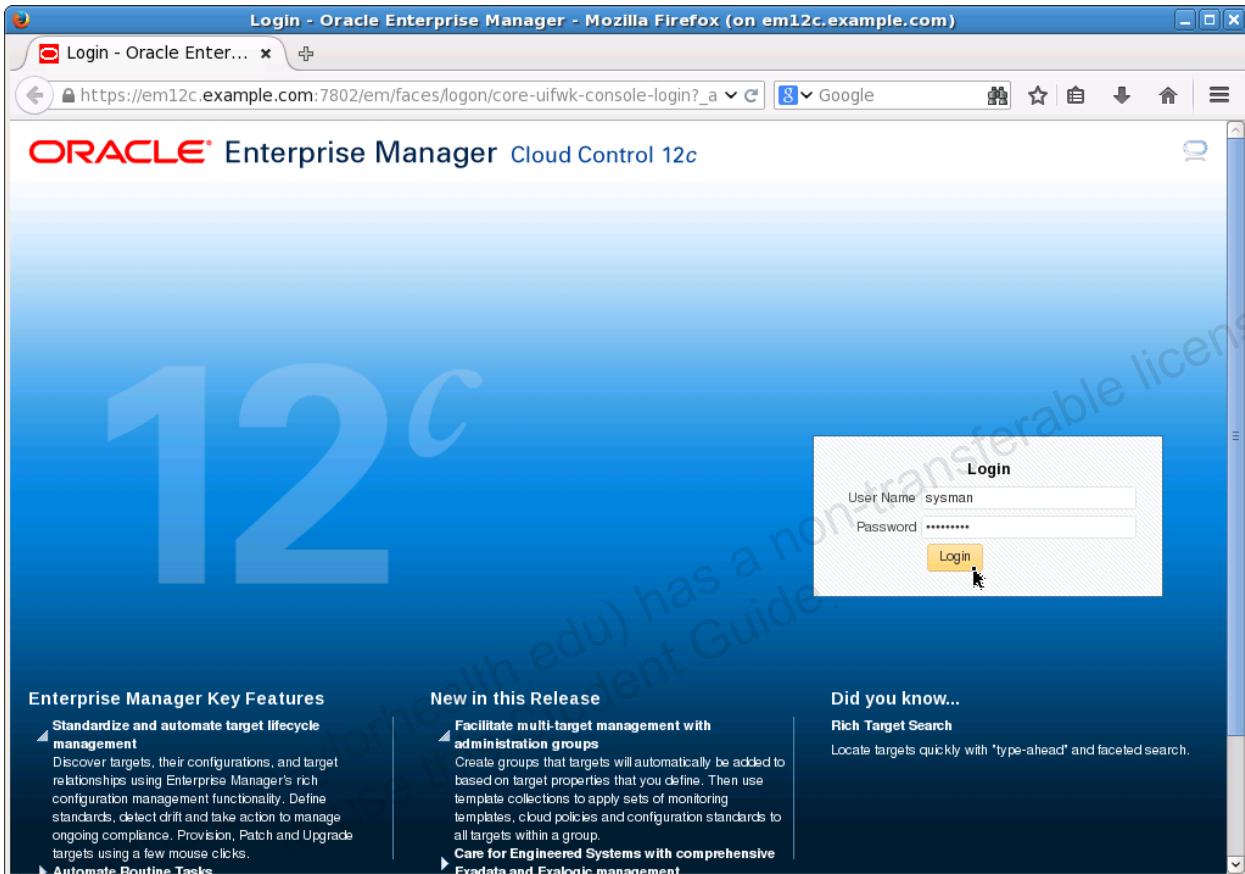
4. Verify that your Enterprise Manager environment is up and running.

```
[oracle@em12c ~]$ /u01/app/oracle/product/middleware/oms/bin/emctl status oms
Oracle Enterprise Manager Cloud Control 12c Release 4
Copyright (c) 1996, 2014 Oracle Corporation. All rights reserved.
WebTier is Up
Oracle Management Server is Up
[oracle@em12c ~]$
```

5. Start the Firefox web browser.

```
[oracle@em12c ~] $ firefox &
[1] 4953
```

6. Log in to Enterprise Manager Cloud Control 12c as the sysman user.



- When the Enterprise Summary page appears, you should notice that all the currently defined targets are under blackout. These targets relate to the Enterprise Manager Cloud Control 12c environment that you are using and they have been intentionally blacked out to eliminate the metric collection overhead associated with them. Apart from this change, the Enterprise Manager Cloud Control 12c environment that you are using is essentially the same as a fresh installation.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The main title bar reads "Enterprise Summary - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The browser address bar shows the URL "https://em12c.example.com:7802/em/faces/core-uifwk-console-overview?_afr". The page itself is titled "Enterprise Summary".

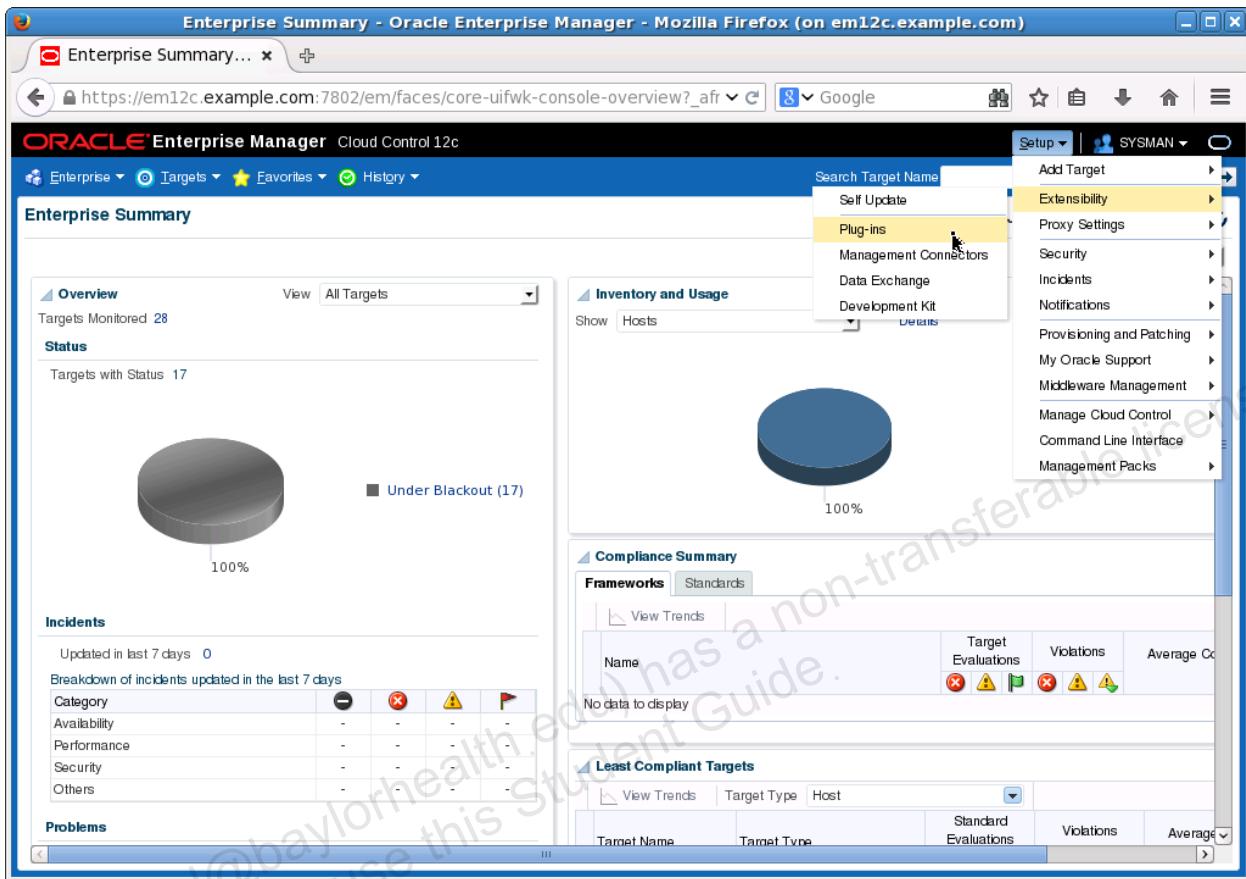
Overview: Targets Monitored: 28. Status: Targets with Status: 17. A pie chart indicates 100% Under Blackout (17).

Inventory and Usage: Shows a pie chart for Hosts, with one segment labeled "Oracle Linux Server" at 100%.

Compliance Summary: Frameworks tab selected. A table shows Target Evaluations and Violations for various categories like Availability, Performance, Security, and Others. The table includes columns for Name, Target Evaluations, Violations, and Average Compliance.

Least Compliant Targets: A table showing the least compliant targets across different target types and evaluations.

8. Before you commence configuring Cloud Control to monitor Exadata, confirm that the Exadata plug-in is available and ready to use. Select the Setup > Extensibility > Plug-ins menu command.



9. On the Plug-ins page, expand the Engineered Systems list item and confirm that the Oracle Exadata plug-in is available and installed on the Management Server.

Name	Version	Management Agent with Description
Databases		Elastic Cloud Infrastructure
Engineered Systems		Enterprise Manager for Big Data Appliance provides comprehensive management for Oracle Big Data Appliance and related targets of Hadoop
Exalogic Elastic Cloud Infrastru	12.1.0.2.0	Enterprise Manager for Engineered System Healthcheck
Oracle Big Data Appliance	12.1.0.4.0	provides proactive healthcheck alerts for Oracle Engineered Systems
Oracle Engineered System He	12.1.0.5.0	Enterprise Manager for Oracle Exadata provides
Oracle Exadata	12.1.0.6.0	comprehensive management for Oracle Exadata and related targets such as Database Machine, etc.

Oracle Exadata

General

Plug-in ID: oracle.sysman.xa	Versions Downloaded: 12.1.0.6.0, 12.1.0.5.0, 12.1.0.4.0, 12.1.0.3.0
Vendor: oracle	Supported versions on Management Agent: 12.1.0.6.0, 12.1.0.5.0, 12.1.0.4.0, 12.1.0.3.0
Version on Management Server: 12.1.0.6.0	Description: Enterprise Manager for Oracle Exadata provides comprehensive management for Oracle Exadata and related targets such as Database Machine, etc.
Latest Available Version: 12.1.0.6.0	

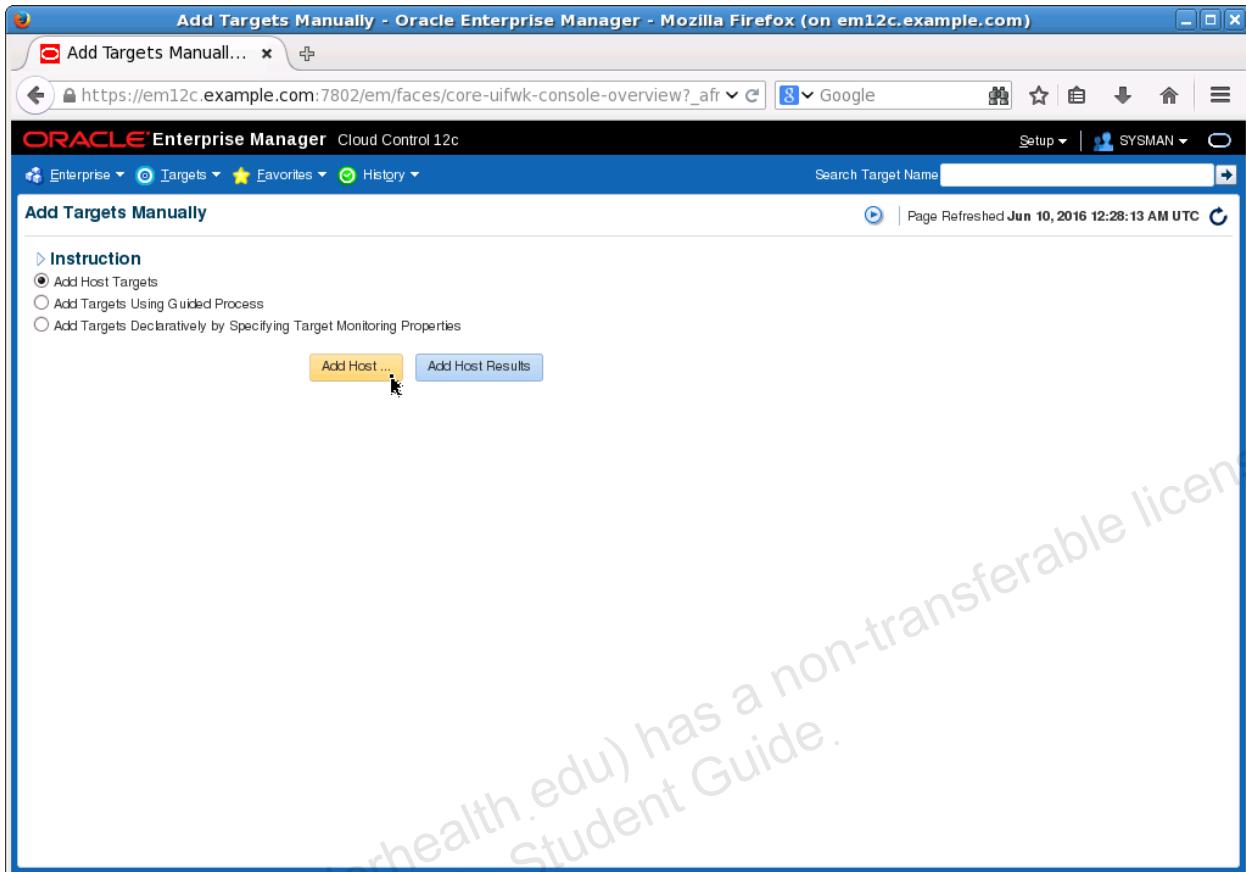
Versions Deployed On Management Agents

Versions	Management Agent with Plug-in	Managed Host Operating System
----------	-------------------------------	-------------------------------

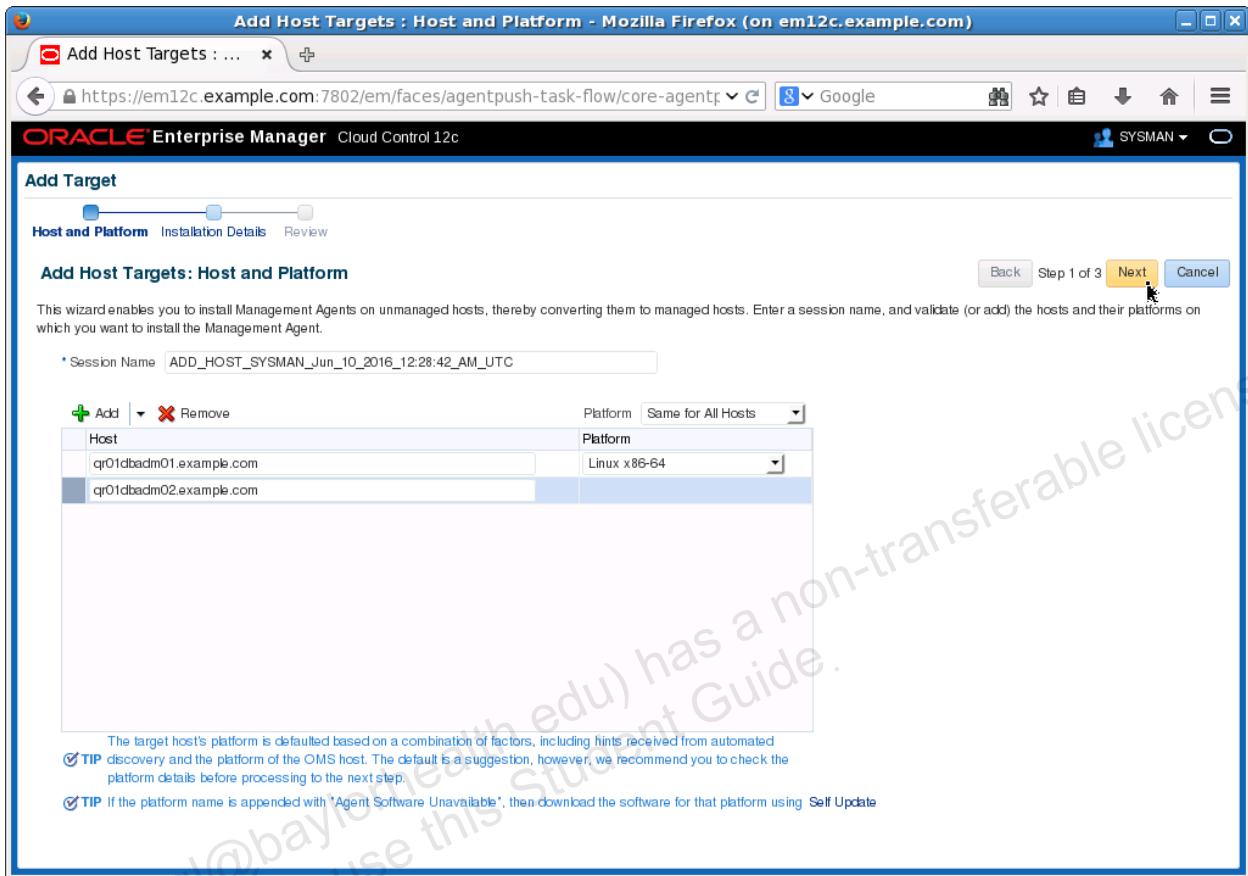
10. The first phase of configuration involves deploying the Enterprise Manager Agent to all the database server hosts on the Exadata Database Machine. To start this process, select the Setup > Add Target > Add Targets Manually menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The main menu bar includes 'Enterprise', 'Targets', 'Favorites', and 'History'. The top right corner shows 'SYSMAN'. A context menu is open over the 'Add Targets Manually' option in the 'Setup' dropdown, listing various management options like 'Configure Auto Discovery', 'Auto Discovery Results', 'Extensibility', 'Proxy Settings', 'Security', 'Incidents', 'Notifications', 'Provisioning and Patching', 'My Oracle Support', 'Middleware Management', 'Manage Cloud Control', 'Command Line Interface', and 'Management Packs'. Below the menu, the 'Plug-ins' section displays a table of available plug-ins, including 'Databases', 'Engineered Systems' (with sub-options for 'Exalogic Elastic Cloud Infrastructure', 'Oracle Big Data Appliance', and 'Oracle Engineered System Host'), and 'Oracle Exadata'. The 'Oracle Exadata' row is selected. The 'General' tab under 'Oracle Exadata' shows details such as 'Plug-in ID: oracle.sysman.xa', 'Vendor: oracle', 'Version on Management Server: 12.1.0.6.0', 'Latest Available Version: 12.1.0.6.0', 'Versions Downloaded: 12.1.0.6.0, 12.1.0.5.0, 12.1.0.4.0, 12.1.0.3.0', 'Supported versions on Management Agent: 12.1.0.6.0, 12.1.0.5.0, 12.1.0.4.0, 12.1.0.3.0', and 'Description: Enterprise Manager for Oracle Exadata provides comprehensive management for Oracle Exadata and related targets such as Database Machine, etc.'

11. Ensure that the Add Host Targets option is selected and click Add Host to proceed.



12. On the Host and Platform page, add host entries for qr01dbadm01.example.com and qr01dbadm02.example.com. Select “Same for All Hosts” in the Platform option list and ensure that Linux x86-64 is selected for both hosts. Finally, click Next to proceed.



13. On the Installation Details page, enter the following installation details:

- Installation Base Directory: /u01/app/oracle/product/12.1.0/agent
- Instance Directory: /u01/app/oracle/product/12.1.0/agent/agent_inst

Then, click the plus icon to add a new Named Credential.

Add Host Targets : Installation Details - Mozilla Firefox (on em12c.example.com)

ORACLE Enterprise Manager Cloud Control 12c

Add Target

Host and Platform Installation Details Review

Back Step 2 of 3 Next Cancel

Deployment Type: Fresh Agent Install

Platform	Agent Software Version	Hosts	Mandatory Inputs
Linux x86-64	12.1.0.4.0	qr01dbadm01.example.com, qr01dbadm02.example.com	

Linux x86-64: Agent Installation Details

* Installation Base Directory: /u01/app/oracle/product/12.1.0/agent

* Instance Directory: /u01/app/oracle/product/12.1.0/agent/agent_inst

* Named Credential: No Named Credentials defined.

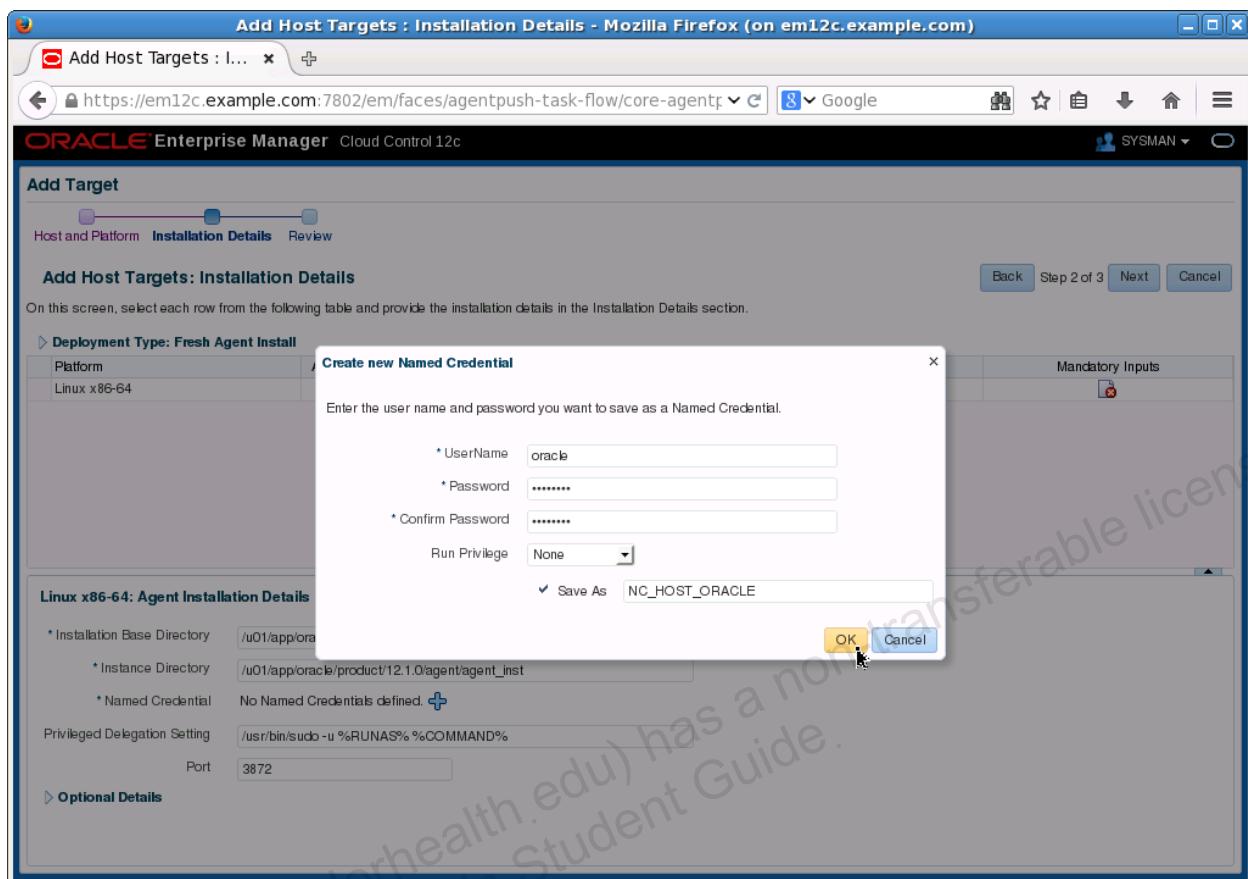
Privileged Delegation Setting: /usr/bin/sudo -u %RUNAS% %OC%

Port: 3872

Optional Details

https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-...formselection?_adf.ctrl-state=n94qj42w_80&_afrLoop=1480457642728#

14. Create a new named credential for the oracle user on the Exadata database servers.



15. Notice that the icon in the Mandatory Inputs column now includes a green check mark indicating that the required installation details have been supplied. Notice also that the Privileged Delegation Setting command uses the `sudo` utility. For this command to work, you must ensure that `sudo` is appropriately configured on the Exadata database servers. Leave your Enterprise Manager session running while you perform the required configuration in the following steps.

Platform	Agent Software Version	Hosts	Mandatory Inputs
Linux x86-64	12.1.0.4.0	qr01dbadm01.example.com, qr01dbadm02.example.com	

16. Establish a terminal session connected to `qr01dbadm01` as the system administrator (root OS user).

```
$ ssh root@qr01dbadm01
root@qr01dbadm01's password: ???????
[root@qr01dbadm01 ~] #
```

17. Execute the following command to add the required `sudo` configuration entries to `/etc/sudoers`. (Alternatively, use a text editor to modify the file if you prefer.)

```
[root@qr01dbadm01 ~] # cat << END >> /etc/sudoers
> oracle ALL=(ALL) NOPASSWD:ALL
> Defaults:oracle !requiretty
> END
[root@qr01dbadm01 ~] #
```

18. Verify that the required sudo configuration entries are in /etc/sudoers.

```
[root@qr01dbadm01 ~]# tail -2 /etc/sudoers
oracle ALL=(ALL) NOPASSWD:ALL
Defaults:oracle !requiretty
[root@qr01dbadm01 ~]#
```

At this point, you have configured sudo on one of your database servers. In the next three steps, you will replicate the same configuration on the other database server.

19. Establish a terminal session connected to qr01dbadm02 as the system administrator (root OS user).

```
$ ssh root@qr01dbadm02
root@qr01dbadm01's password: ???????
[root@qr01dbadm02 ~]#
```

20. Execute the following command to add the required sudo configuration entries to /etc/sudoers (alternatively, use a text editor to modify the file if you prefer).

```
[root@qr01dbadm02 ~]# cat << END >> /etc/sudoers
> oracle ALL=(ALL) NOPASSWD:ALL
> Defaults:oracle !requiretty
> END
[root@qr01dbadm02 ~]#
```

21. Verify that the required sudo configuration entries are in /etc/sudoers.

```
[root@qr01dbadm02 ~]# tail -2 /etc/sudoers
oracle ALL=(ALL) NOPASSWD:ALL
Defaults:oracle !requiretty
[root@qr01dbadm02 ~]#
```

22. After the sudo configuration is complete on qr01dbadm01 and qr01dbadm02, return to your Enterprise Manager session and click Next to proceed.

Add Host Targets : Installation Details - Mozilla Firefox (on em12c.example.com)

Add Target

Host and Platform **Installation Details** Review

Add Host Targets: Installation Details

On this screen, select each row from the following table and provide the installation details in the Installation Details section.

Deployment Type: Fresh Agent Install

Platform	Agent Software Version	Hosts	Mandatory Inputs
Linux x86-64	12.1.0.4.0	qr01dbadm01.example.com, qr01dbadm02.example.com	

Linux x86-64: Agent Installation Details

* Installation Base Directory: /u01/app/oracle/product/12.1.0/agent

* Instance Directory: /u01/app/oracle/product/12.1.0/agent/agent_inst

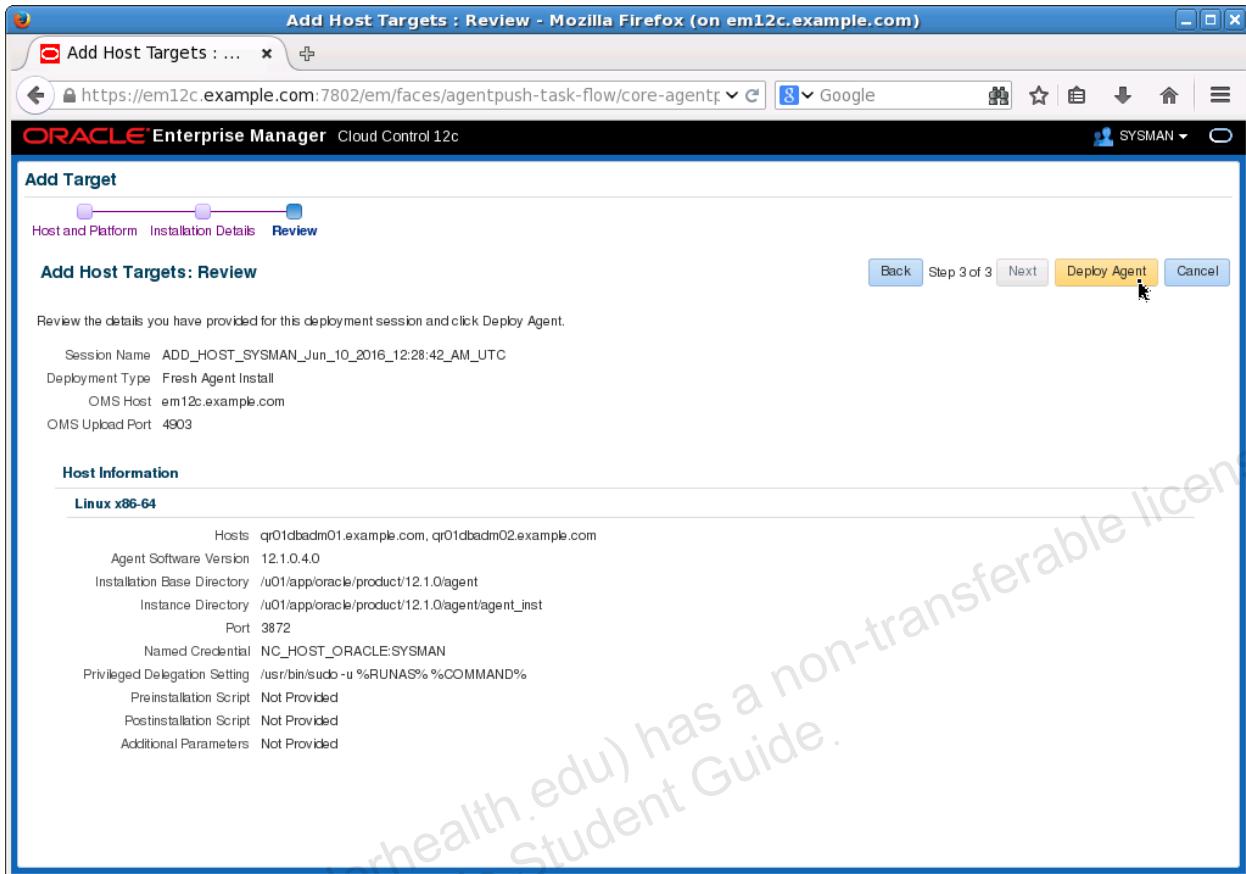
* Named Credential: NC_HOST_ORACLE(SYSMAN)

Privileged Delegation Setting: /usr/bin/sudo -u %RUNAS% %COMMAND%

Port: 3872

Optional Details

23. Review the agent deployment details that you provided and click Deploy Agent.



24. Agent deployment can take between 5 and 10 minutes in your laboratory environment. You can monitor agent deployment by using the Add Host Status page. Do not navigate away from this page during agent deployment.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Add Host Targets : Agent Deployment Details - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Add Host" and shows the "Agent Deployment Summary". There are two hosts listed:

Platform	Host	Initialization	Remote Prerequisite Check	Agent Deployment
Linux x86-64	qr01dbadm02.example.com	⌚	⌚	⌚
Linux x86-64	qr01dbadm01.example.com	⌚	⌚	⌚

Below the table, there is a section titled "Agent Deployment Details: qr01dbadm02.example.com" which includes tabs for "Initialization Details", "Remote Prerequisite Check Details", and "Agent Deployment Details".

25. When you receive a notification indicating that agent deployment succeeded, click Done.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Add Host Targets : Agent Deployment Details - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Agent Deployment Summary: ADD_HOST_SYSMAN_Jun_10_2016_12:28:42_AM_UTC". It displays a table of deployment status for two hosts:

Platform	Host	Initialization	Remote Prerequisite Check	Agent Deployment
Linux x86-64	qr01dbadm02.example.com	✓	✓	✓
Linux x86-64	qr01dbadm01.example.com	✓	✓	✓

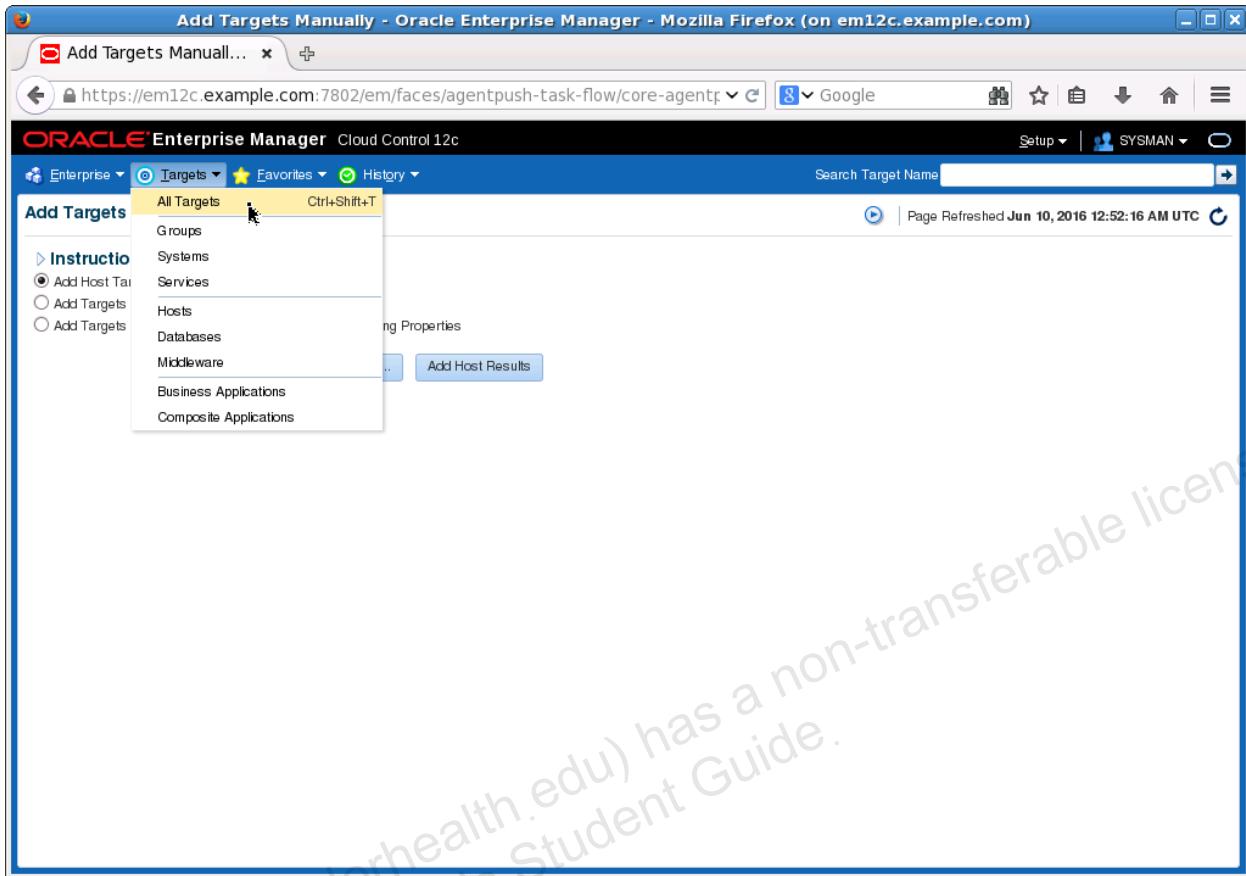
A green checkmark icon with the text "Agent Deployment Succeeded" is displayed above the table. A yellow "Done" button is located in the top right corner of the summary section. Below the summary, there is a detailed view for the first host:

Agent Deployment Details: qr01dbadm02.example.com

- Initialization Details**
- Remote Prerequisite Check Details**
- Agent Deployment Details**
 - OMS Log Location: em12c.example.com/u01/app/oracle/product/gc_inst/em/EMG_C_OMS1/sysman/agentpush/2016-06-10_00-28-42-AM/applogs/qr01dbadm02.example.com_deploy.log
 - Show only warnings and failures

Deployment Phase Name	Status	Error	Cause	Recommendation
Installation and Configuration	✓			
Secure Agent	✓			
Root.sh	✓			

26. Select the Targets > All Targets menu command.



27. In the Refine Search pane, select the Target Status > Up option.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar contains a 'Refine Search' section with categories like Target Type (Groups, Systems and Services, Middleware, Servers, Storage and Network, Others, Internal), Target Status (Under Blackout, Up, n/a), and Target Version (10.3.6.0, 11.1.1.7.0). The main content area displays a table of targets. The table has columns for Target Name, Target Type, and Target Status. The 'Up' status is selected in the Refine Search pane, so only targets marked as 'Up' are listed in the table. The table includes rows for various Oracle components like WebLogic Domain, WebLogic Server, Application Deployment, Metadata Repository, and Oracle Home.

Target Name	Target Type	Target Status
/EMG_C_G_CDomain/G_CDomain	Oracle WebLogic Domain	n/a
/EMG_C_G_CDomain/G_CDomain/EMG_C_ADMINSERVER	Oracle WebLogic Server	Up
/EMG_C_G_CDomain/G_CDomain/EMG_C_ADMINSERVER/FMW_Welcome_Page_Applic...	Application Deployment	Up
/EMG_C_G_CDomain/G_CDomain/EMG_C_ADMINSERVER/mds-owsm	Metadata Repository	n/a
/EMG_C_G_CDomain/G_CDomain/EMG_C_ADMINSERVER/mds-sysman_mds	Metadata Repository	n/a
/EMG_C_G_CDomain/G_CDomain/EMG_C_OMS1	Oracle WebLogic Server	Up
/EMG_C_G_CDomain/G_CDomain/EMG_C_OMS1/empbs	Application Deployment	Up
/EMG_C_G_CDomain/G_CDomain/EMG_C_OMS1/OCMRepeater	Application Deployment	Up
/EMG_C_G_CDomain/instance1/ohs1	Oracle HTTP Server	Up
agent12c1_11_em12c.example.com	Oracle Home	n/a
agent12c1_3_qr01badm01.example.com	Oracle Home	n/a
agent12c1_3_qr01badm02.example.com	Oracle Home	n/a
common12c1_23_em12c.example.com	Oracle Home	n/a
em12c.example.com	Host	Up
em12c.example.com:3872	Agent	Up
em12c.example.com:4889_Management_Service	Oracle Management Service	Up
em12c.example.com:4889_Management_Service_CONSOLE	OMS Console	Up
em12c.example.com:4889_Management_Service_PBS	OMS Platform	Up
EM_Cloud_Control_Targets	Group	n/a
EM_Console_Service	EM Service	Up
EMG_C_G_CDomain	Oracle Fusion Middleware Farm	n/a
EM_Job_Service	EM Service	Up

28. You should see the following targets:

- Host: qr01dbadm01.example.com
- Agent: qr01dbadm01.example.com:3872
- Host: qr01dbadm02.example.com
- Agent: qr01dbadm02.example.com:3872

If you do not see all these targets, wait for a few moments and refresh the page. Continue to wait until all four targets are displayed.

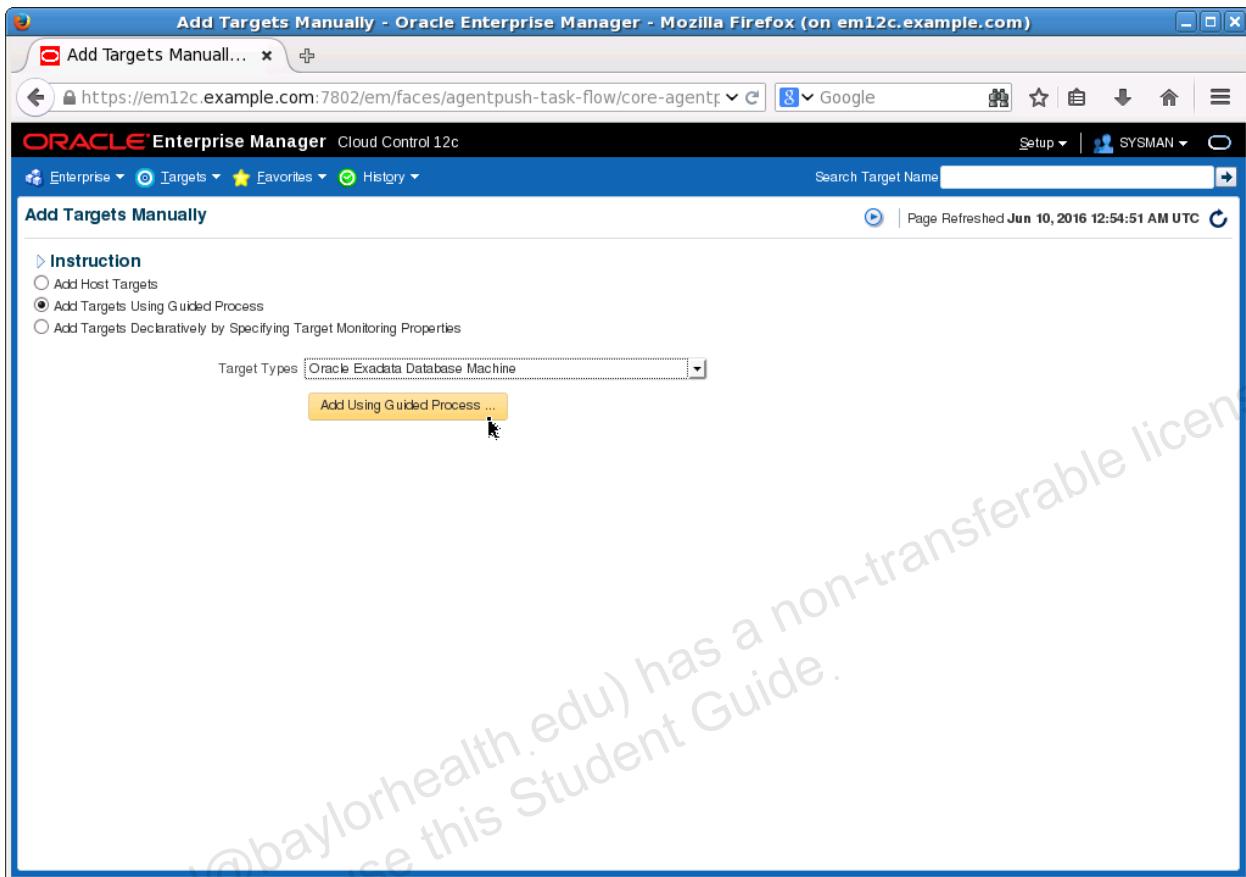
Target Name	Target Type	Target Status
qr01dbadm01.example.com	Host	Up
qr01dbadm01.example.com:3872	Agent	Up
qr01dbadm02.example.com	Host	Up
qr01dbadm02.example.com:3872	Agent	Up

At this point, you have successfully deployed the Enterprise Manager Agent to all the database server hosts on the Exadata Database Machine. Next, you will discover the Exadata Database Machine.

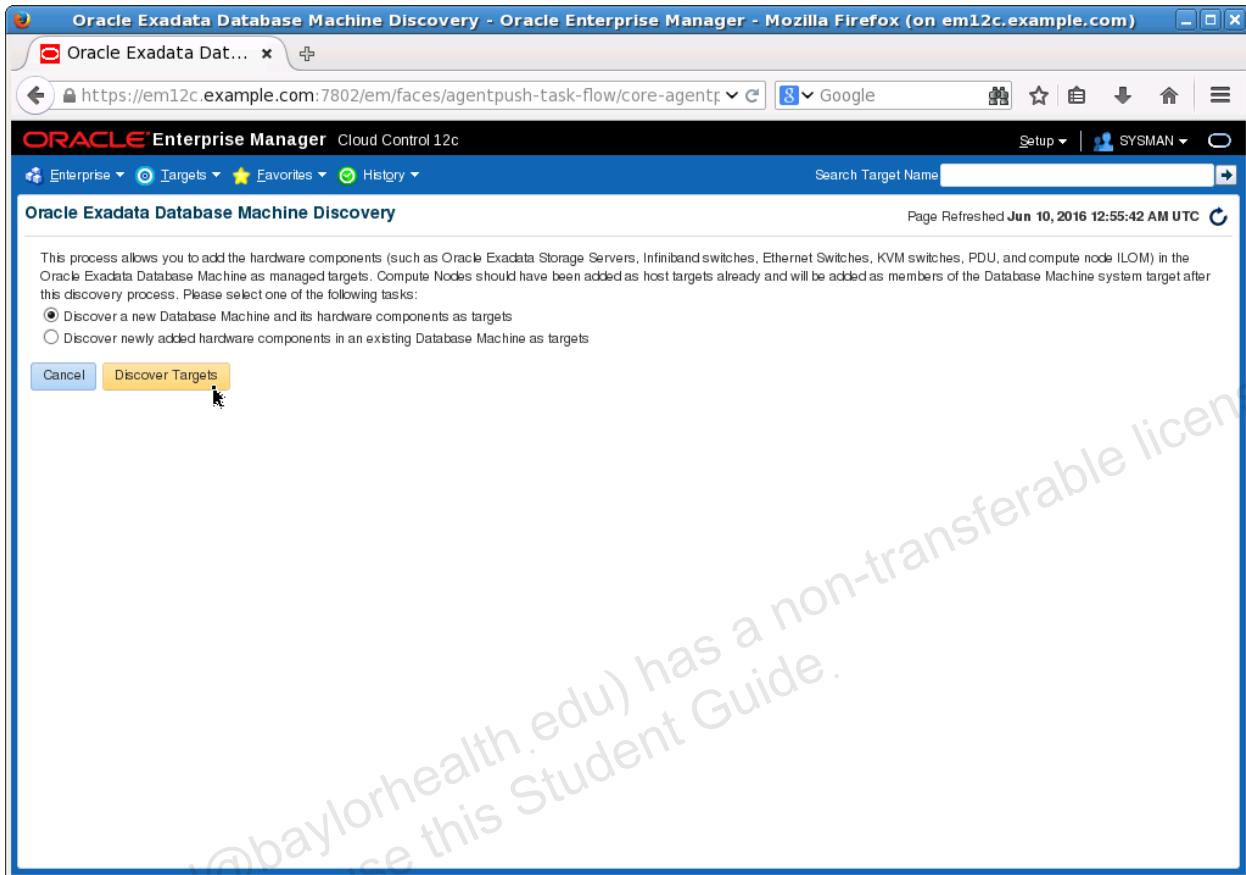
29. Select the Setup > Add Target > Add Targets Manually menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "All Targets - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main menu bar includes "Enterprise", "Targets", "Favorites", and "History". The "Targets" menu is currently selected. A sub-menu "Setup" is open, with "Add Targets Manually" highlighted. The central pane displays a table titled "All Targets" with a search bar at the top. The table has columns for "View", "Target Name", and "Actions". The "Target Name" column lists four entries: "qr01dbadm01.example.com", "qr01dbadm01.example.com:3872", "qr01dbadm02.example.com", and "qr01dbadm02.example.com:3872". The bottom right corner of the interface shows "Targets Not Promoted 5" and "Targets Found 4".

30. On the Add Targets Manually page, select the Add Targets Using Guided Process option. Then select Oracle Exadata Database Machine from the Target Types drop-down list. Finally, click Add Using Guided Process to start the discovery process.



31. On the Oracle Exadata Database Machine Discovery page, select the “Discover a new Database Machine and its hardware components as targets” option and click Discover Targets to proceed.



32. On the Discovery Inputs page, in the Discovery Agent section, specify the following:

- Agent URL: <https://qr01dbadm01.example.com:3872/emd/main/>

You can specify the Agent URL by clicking the magnifying glass icon and selecting the agent associated with qr01dbadm01.example.com if you prefer.

Note that you must specify the Agent URL for a database server that contains the Database Machine schematic file (typically databaseMachine.xml), which describes the Database Machine components and configuration settings. This file is generated during the Database Machine initial configuration process, and it typically resides on the first database server. Also, click Set Credential > All Hosts and select the named credential that you configured earlier in step 14.

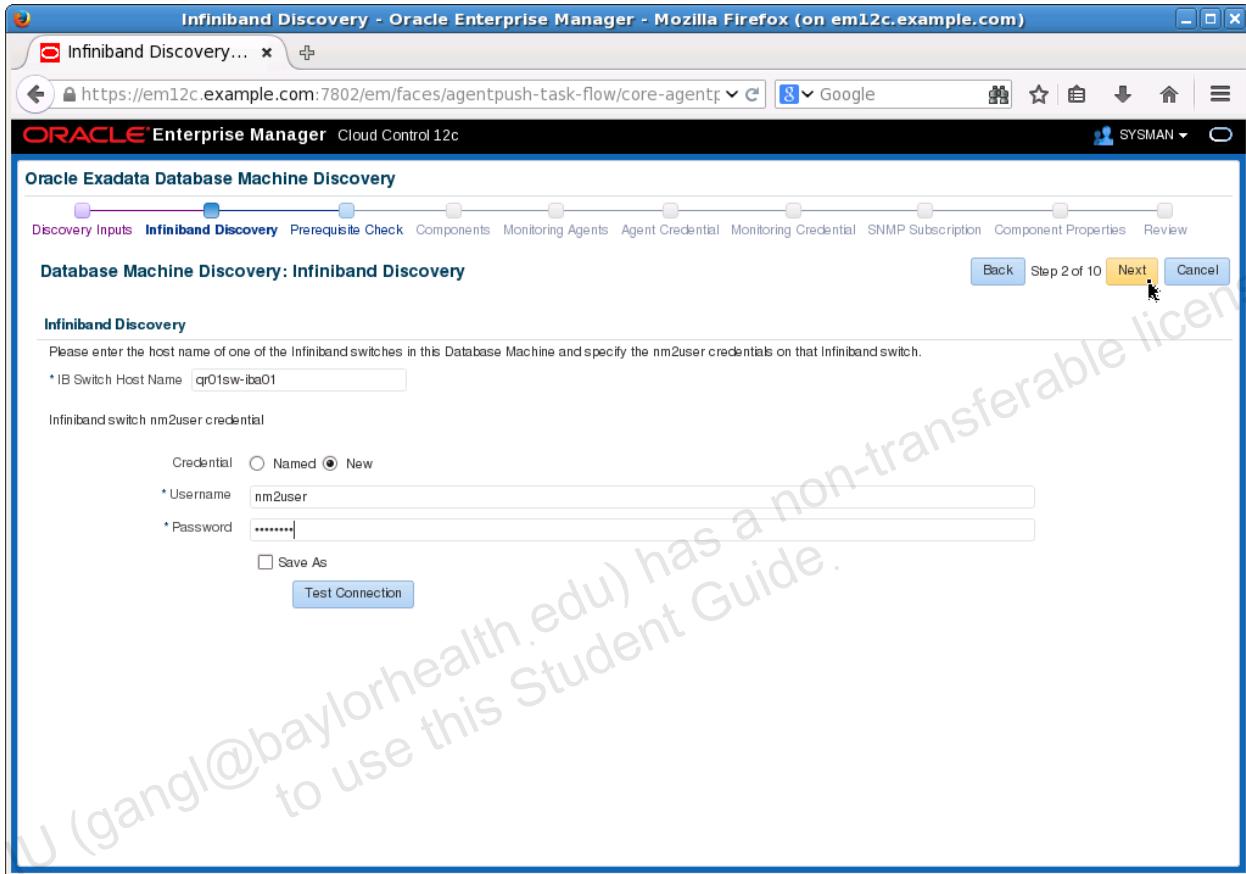
Finally, click Next to continue.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Discovery Agent - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Oracle Exadata Database Machine Discovery". The navigation bar at the top includes "Discovery Inputs", "Infiniband Discovery", "Prerequisite Check", "Components", "Monitoring Agents", "Agent Credential", "Monitoring Credential", "SNMP Subscription", "Component Properties", and "Review". The "Discovery Inputs" tab is selected. Below it, the "Database Machine Discovery: Discovery Inputs" page is displayed. The "Discovery Agent" section contains a note about selecting an agent and specifying the Oracle Home. The "Agent URL" field is filled with "https://qr01dbadm01.example.com:3872/emd/main/" and has a magnifying glass icon next to it. The "Schematic Files" section contains a table with the following data:

Host Name	Credential	File Location	Schematic File
qr01dbadm01.example.com	oracle/*	/opt/oracle.SupportTools/onecommand/	databaseMachine.xml

At the bottom right of the wizard, there are buttons for "Back", "Step 1 of 10", "Next", and "Cancel". A cursor is hovering over the "Next" button.

33. On the Infiniband Discovery page, the IB Switch Host Name should be automatically populated by using one of the InfiniBand switches defined in the Database Machine schematic file (`databasemachine.xml`). Select the option to create a new credential and specify the credentials for the `nm2user` user.
If you want, you can click Test Connection to verify that you have entered the credentials correctly. Finally, click Next to proceed.



34. Confirm that the prerequisite check status flag contains a green check mark indicating success. Click Next to proceed.

The screenshot shows a Firefox browser window titled "Prerequisite Check - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The address bar shows the URL <https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-agent>. The main content area is titled "Oracle Exadata Database Machine Discovery" and "Database Machine Discovery: Prerequisite Check". A progress bar at the top indicates Step 3 of 10. The "Prerequisite Check" tab is selected. A table lists a single prerequisite: "Schematic File /opt/oracle/SupportTools/onecommand/database-machine.xml on qr01dbadm01.example.com", which is marked as successful ("Status" column has a green checkmark). The "Next" button is highlighted in yellow at the bottom right of the screen.

35. The Components page shows all of the components listed in the Database Machine schematic file (`databasemachine.xml`). By default, all of the components are selected. You may optionally deselect components; however, those components will not be monitored by Enterprise Manager. Ensure that all of the components are selected and click Next to proceed.

The screenshot shows the Oracle Enterprise Manager interface for selecting components. The title bar reads "Select Components - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Oracle Exadata Database Machine Discovery" and shows the "Components" step of a ten-step wizard. The navigation bar at the top includes "Discovery Inputs", "Infiniband Discovery", "Prerequisite Check", "Components" (which is highlighted in blue), "Monitoring Agents", "Agent Credential", "Monitoring Credential", "SNMP Subscription", "Component Properties", and "Review". Below the navigation bar, there are sections for "Compute Node", "Compute Node ILOM", "Oracle Exadata Storage Server", and "Infiniband Switch". Each section contains a table with host names and their corresponding IP addresses or management IPs. The "Components" section has two rows:

Host Name	
qr01dbadm01.example.com	
qr01dbadm02.example.com	

The "Compute Node ILOM" section has two rows:

ILOM Name	IP Address
qr01dbadm01-ilom.example.com	192.0.2.106
qr01dbadm02-ilom.example.com	192.0.2.107

The "Oracle Exadata Storage Server" section has three rows:

Cell Name	Management IP
qr01celadm01.example.com	192.0.2.103
qr01celadm02.example.com	192.0.2.104
qr01celadm03.example.com	192.0.2.105

The "Infiniband Switch" section has one row:

Infiniband Switch Name	Description

At the bottom right of the page, there are buttons for "Back", "Step 4 of 10", "Next", and "Cancel".

36. Inside Enterprise Manager, Database Machine components are represented as management targets. Each target is monitored by one of the available agents, and each target is assigned a backup agent in case the primary agent is unavailable. The Monitoring Agents page allows you to assign primary and backup monitoring agents for each management target. By default, the targets are spread across all of the available agents. Alternatively, you can select specific agents to monitor each target. For this practice, accept the default assignments and click Next to proceed.

Target Name	Monitoring Agent	Backup Monitoring Agent
DB Machine qr01.example.com	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:3872/emd/main/
IB Network qr01.example.com	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:3872/emd/main/
Cell Name qr01celadm01.example.com	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:3872/emd/main/
qr01celadm02.example.com	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:3872/emd/main/
qr01celadm03.example.com	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:3872/emd/main/
Infiniband Switch Name qr01sw-iba01.example.com	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:3872/emd/main/
qr01sw-ibb01.example.com	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:3872/emd/main/
Ethernet Switch Name qr01sw-adm01.example.com	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:3872/emd/main/
ILOM Name qr01badm01-ilom.example.com	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:3872/emd/main/
qr01badm02-ilom.example.com	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:3872/emd/main/

37. The Agent Credential page enables you to specify the credentials used to access and control the management agents on each Exadata database server. Because you earlier used Enterprise Manager to configure the agents, the required credentials are already specified on the page. Click Next to proceed.

The screenshot shows the 'Agent Credential' configuration page in Oracle Enterprise Manager Cloud Control 12c. The title bar reads 'Agent Credential - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)'. The URL in the address bar is 'https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-agent?...'. The main header says 'ORACLE Enterprise Manager Cloud Control 12c'. A navigation bar at the top includes links for Discovery Inputs, Infiniband Discovery, Prerequisite Check, Components, Monitoring Agents, Agent Credential (which is highlighted in blue), Monitoring Credential, SNMP Subscription, Component Properties, and Review. Below the navigation bar, a progress bar shows Step 6 of 10 completed. The main content area is titled 'Database Machine Discovery: Agent Credential'. It contains instructions: 'Please specify whether the agent host users and passwords are the same for all agents. The agent users and passwords are needed to set up SSH user equivalence between the agents and the targets monitored by the agents (cells and Infiniband switches) and to configure the targets.' There are two radio button options: 'Same for all agents' (selected) and 'Different for all agents'. Under 'Agent Host Credential', there is a section for 'Credential Name' set to 'NC_HOST_ORACLE'. A table shows 'Attribute' and 'Value' for 'UserName' (oracle) and 'Password' (*****). A 'Test Connection' button is available. Below this, under 'Different for all agents', there are fields for 'Agent URL' containing 'https://qr01dbadm01.example.com:3872/emd/main/' and 'https://qr01dbadm02.example.com:3872/emd/main/'. To the right of these fields are 'Agent Host User' and 'Agent Host Password' fields, along with a 'Test Connections' button. At the bottom right of the page are 'Back', 'Step 6 of 10', 'Next' (highlighted in yellow), and 'Cancel' buttons.

38. The Monitoring Credential page enables you to specify the required credentials for Exadata Storage Servers, InfiniBand switches, and Oracle ILOM Servers.
Specify the Exadata Storage Server root user credentials.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Monitoring Credential - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Oracle Exadata Database Machine Discovery" and specifically "Database Machine Discovery: Monitoring Credential". A progress bar at the top indicates Step 7 of 10. The "Monitoring Credential" tab is selected. The "Cell Root Credential" section contains fields for "Username" (root) and "Password" (redacted). A "Test Connection" button is present. Below this, there is a table for "Infiniband Switch" with columns "Cell Name" and "Root Password", listing three entries: qr01celadm01.example.com, qr01celadm02.example.com, and qr01celadm03.example.com.

39. Scroll to the bottom of the Monitoring Credential page. Note that the InfiniBand Switch monitoring credentials are already populated with the details you supplied on the InfiniBand Discovery page. Next, specify the credentials for the ILOM user (`oemuser`).

Note that the ILOM user specified in this step must normally be created on each ILOM server before Database Machine discovery. However, because the ILOM interfaces in your laboratory environment are not fully functioning ILOM servers, you are unable to create the ILOM user, and instead the required user has been pre-created.

Click Next to proceed.

Infiniband Switch Name

qr01sw-iba01.example.com	Nm2user Password
qr01sw-ibb01.example.com	

ILOM

Please specify whether the Integrated Lights Out Managers (ILOM) user names and passwords are the same for all compute nodes. The ILOM user names and passwords are needed to monitor the ILOM.

Same for all ILOM

ILOM Credential

Credential Named New

* UserName: oemuser

* Password: *****

Save As

Test Connections

Different for all ILOM

ILOM Name	ILOM Username	ILOM Password
qr01dbadm01-ilom.example.com		
qr01dbadm02-ilom.example.com		

Next

40. The SNMP Subscription page enables you to automatically configure SNMP subscriptions for Enterprise Manager on the Exadata Storage Servers and the InfiniBand switches. Specify public for the Exadata Storage Server SNMP Community String. Because your laboratory environment does not contain fully functioning InfiniBand switches, deselect the option to automatically set up SNMP subscriptions for the InfiniBand switches. Finally, click Next to proceed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "SNMP Subscription - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Oracle Exadata Database Machine Discovery" and "Database Machine Discovery: SNMP Subscription". A progress bar at the top indicates Step 8 of 10. The "SNMP Subscription" step is highlighted. The configuration section for "Oracle Exadata Storage Server" includes a checkbox for "Set up SNMP subscription for cells automatically" which is checked. The "Infiniband Switch" section includes a checkbox for "Set up SNMP subscription for Infiniband switches automatically" which is unchecked. Both sections have a "SNMP Community String" input field set to "public". A note states: "Tip: This will overwrite any existing community string for the EM Agent subscription only." The "IB Switch Root Credential" section has a radio button for "Named" selected, with a note: "There are no named credentials defined." A "Test Connection" button is present. At the bottom, there are "Back", "Step 8 of 10", "Next", and "Cancel" buttons.

41. The Component Properties page enables you to specify various component property settings. In your laboratory environment, the default settings will suffice. So, click Next to proceed.

The screenshot shows the 'Component Properties' page in Oracle Enterprise Manager, specifically for 'Oracle Exadata Database Machine Discovery'. The navigation bar at the top includes links for Discovery Inputs, Infiniband Discovery, Prerequisite Check, Components, Monitoring Agents, Agent Credential, Monitoring Credential, SNMP Subscription, Component Properties (which is highlighted in blue), and Review. Below the navigation bar, there is a sub-navigation for 'Database Machine Discovery: Component Properties' with links for Back, Step 9 of 10, Next (which is highlighted in yellow), and Cancel. A message below the sub-navigation says 'Please specify the target properties of the different components.' The main content area is divided into sections for 'Oracle Exadata Storage Server', 'Ethernet Switch', 'PDU', and 'ILOM'. Each section contains a table with configuration details. The 'Component Properties' section has a progress bar with 10 steps, where step 9 is highlighted in yellow.

Cell Name	ILOM IP Address
qr01celadm01.example.com	192.0.2.108
qr01celadm02.example.com	192.0.2.109
qr01celadm03.example.com	192.0.2.110

Ethernet Switch Name	SNMP Timeout (seconds)	SNMP Community String
qr01sw-adm01.example.com	10	

PDU Name	PDU Module	SNMP Port	SNMP Timeout (seconds)	SNMP Community String
qr01sw-pdua01.example.com	Module 1	161	10	
qr01sw-pdub01.example.com	Module 1	161	10	

ILOM Name	Compute Node Host Name
qr01dbadm01-ilom.example.com	qr01dbadm01
qr01dbadm02-ilom.example.com	qr01dbadm02

42. The Review page displays the summary of the discovery session. Also, you can optionally specify customized Target Names in the System Target section. When you are satisfied, click Submit to create the Database Machine monitoring targets.

Oracle Exadata Database Machine Discovery

Discovery Inputs Infiniband Discovery Prerequisite Check Components Monitoring Agents Agent Credential Monitoring Credential SNMP Subscription Component Properties Review

Database Machine Discovery: Review

Please verify the following information. You can click on Back to revise the inputs or click on Submit to complete the discovery process.
The following options are selected:

- The monitoring agents have the same credential.

System Target

The following system targets will be added in EM. You can keep the pre-filled system target names or specify your own system target names. If you choose to use your own system target names, please make sure that 1) the system target names are unique in EM and 2) you use similar target names for the systems so that you can easily identify systems that are in the same DB Machine.

Target Name	Target Type	Monitoring Agent	Backup Monitoring Agent
DB Machine qr01.example.com	Oracle Exadata Database Machine	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:387
Exadata Grid qr01.example.com	Oracle Exadata Storage Server Grid	Agent not needed for repository target	Agent not needed for repository target
IB Network qr01.example.com	Oracle Infiniband Network	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:387

Compute Node

The following compute nodes will be added as members of the Database Machine target.

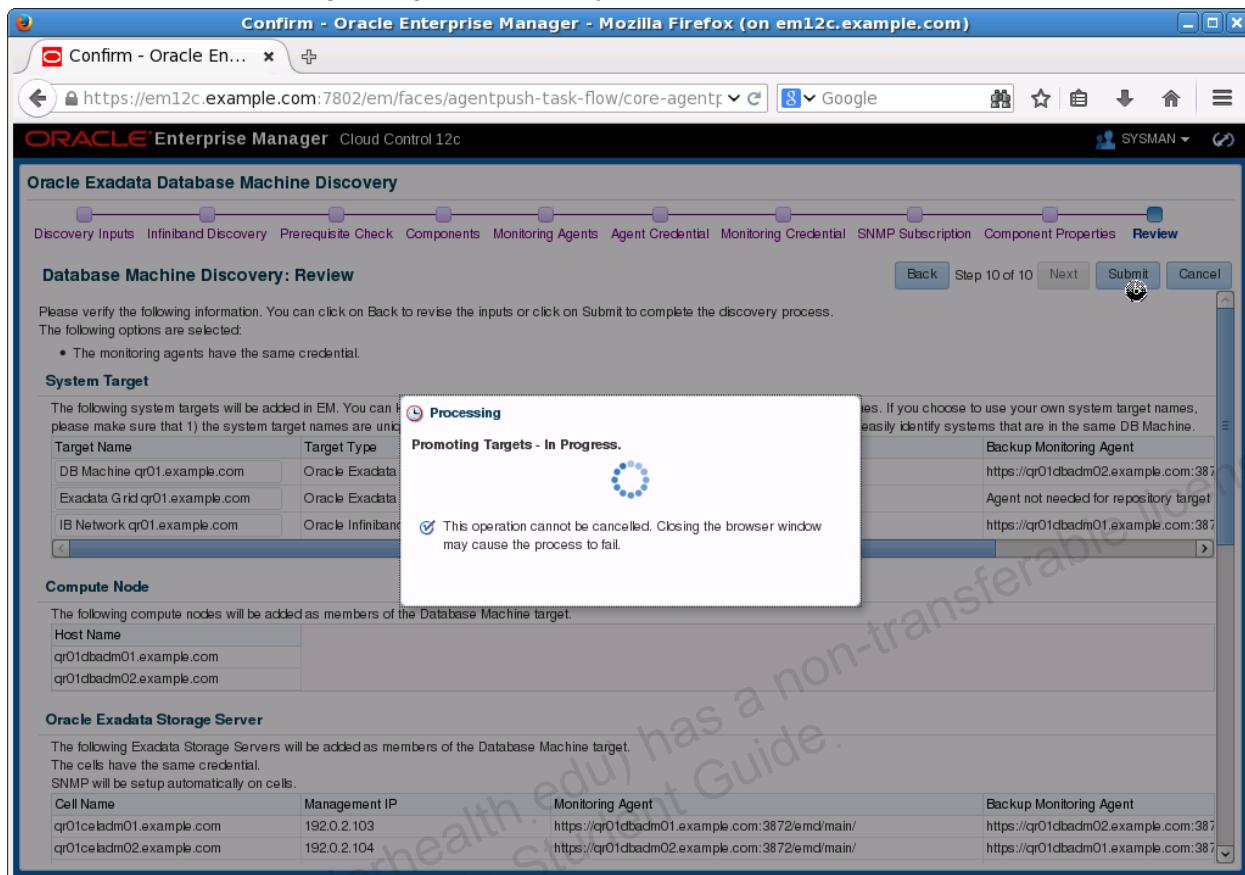
Host Name
qr01badm01.example.com
qr01badm02.example.com

Oracle Exadata Storage Server

The following Exadata Storage Servers will be added as members of the Database Machine target. The cells have the same credential. SNMP will be setup automatically on cells.

Cell Name	Management IP	Monitoring Agent	Backup Monitoring Agent
qr01celadm01.example.com	192.0.2.103	https://qr01badm01.example.com:3872/emd/main/	https://qr01badm02.example.com:387
qr01celadm02.example.com	192.0.2.104	https://qr01badm02.example.com:3872/emd/main/	https://qr01badm01.example.com:387

43. Wait while the Processing dialog box is displayed.



44. When the Target Creation Summary page appears, examine it to ensure that all the targets were successfully added to Enterprise Manager.

The screenshot shows the 'Target Creation Summary' page in Oracle Enterprise Manager Cloud Control 12c. At the top, there's a message: 'Target promotion succeeded.' Below this, a table lists 'System Target' additions:

Target Name	Target Type	Discovery Status
DB Machine qr01.example.com	Oracle Exadata Database Machine	<input checked="" type="checkbox"/> Successful
Exadata Grid qr01.example.com	Oracle Exadata Storage Server Grid	<input checked="" type="checkbox"/> Successful
IB Network qr01.example.com	Oracle Infiniband Network	<input checked="" type="checkbox"/> Successful

Below this, a section for 'Compute Node' shows two hosts added to the Database Machine target:

Host Name	Discovery Status
qr01dbadm01.example.com	<input checked="" type="checkbox"/> Successful
qr01dbadm02.example.com	<input checked="" type="checkbox"/> Successful

For 'Oracle Exadata Storage Server', three cells are listed as successful additions:

Cell Name	Management IP	Discovery Status
qr01celadm01.example.com	192.0.2.103	<input checked="" type="checkbox"/> Successful
qr01celadm02.example.com	192.0.2.104	<input checked="" type="checkbox"/> Successful
qr01celadm03.example.com	192.0.2.105	<input checked="" type="checkbox"/> Successful

The 'Infiniband Switch' section shows no entries.

45. At the bottom of the Target Creation Summary page, click Launch DB Machine Home.

The screenshot shows the Oracle Enterprise Manager Target Creation Summary page. At the top, it says "Target promotion succeeded". Below this, there are sections for Ethernet Switch, Compute Node ILOM, and PDU, each showing successful discovery status for listed components. At the bottom, there is a tip about discovering Cluster, Database, or ASM targets, followed by a "Launch DB Machine Home" button.

Ethernet Switch	IP Address	Discovery Status
qr01sw-adm01.example.com	192.0.2.111	Successful

Compute Node ILOM	IP Address	Discovery Status
qr01dbadm01-iom.example.com	192.0.2.106	Successful
qr01dbadm02-iom.example.com	192.0.2.107	Successful

PDU	IP Address	Discovery Status
qr01sw-pdua01.example.com	192.0.2.114	Successful
qr01sw-pdub01.example.com	192.0.2.115	Successful

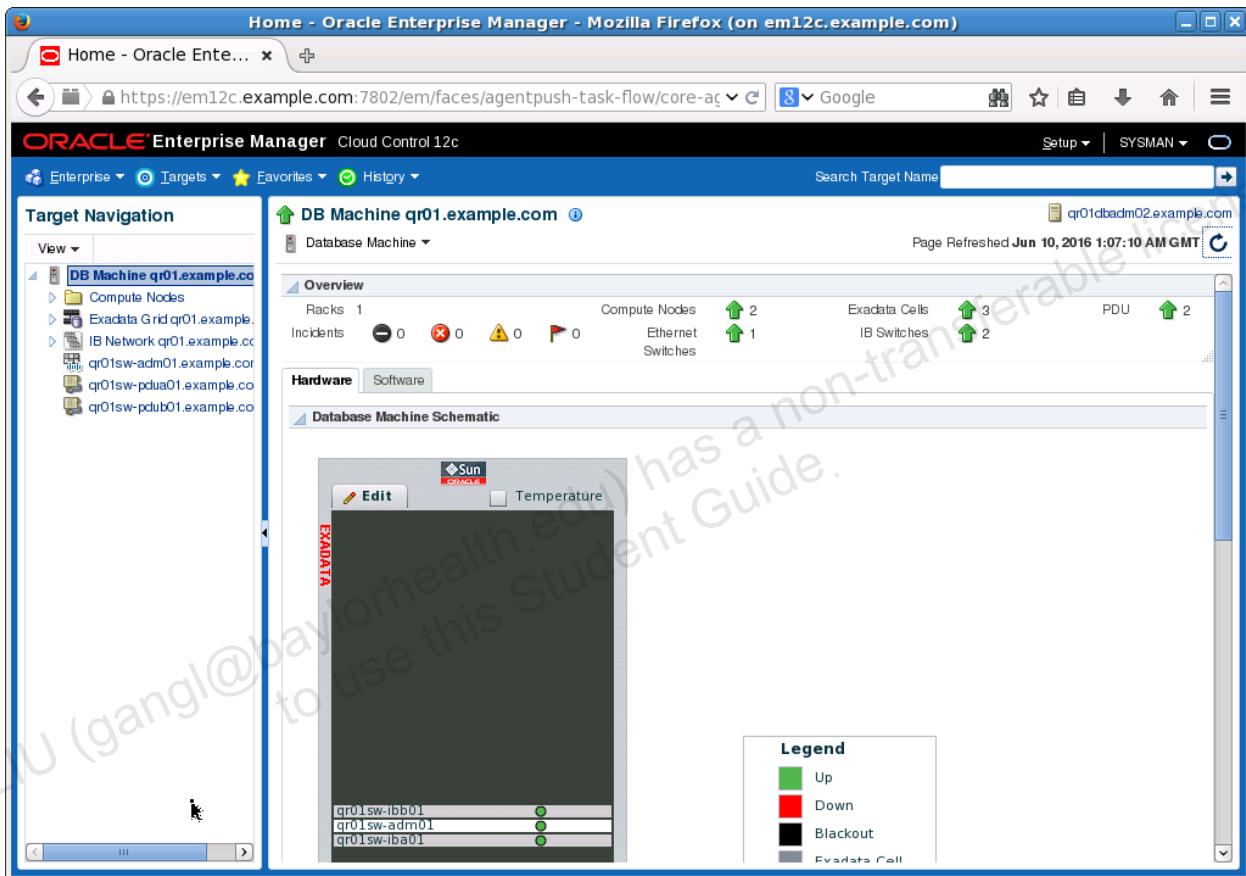
Launch DB Machine Home

Tip: If you have not discovered the Cluster, Database or ASM target stored on this Database Machine, click on the following link to first discover the cluster and then discover Database and ASM:

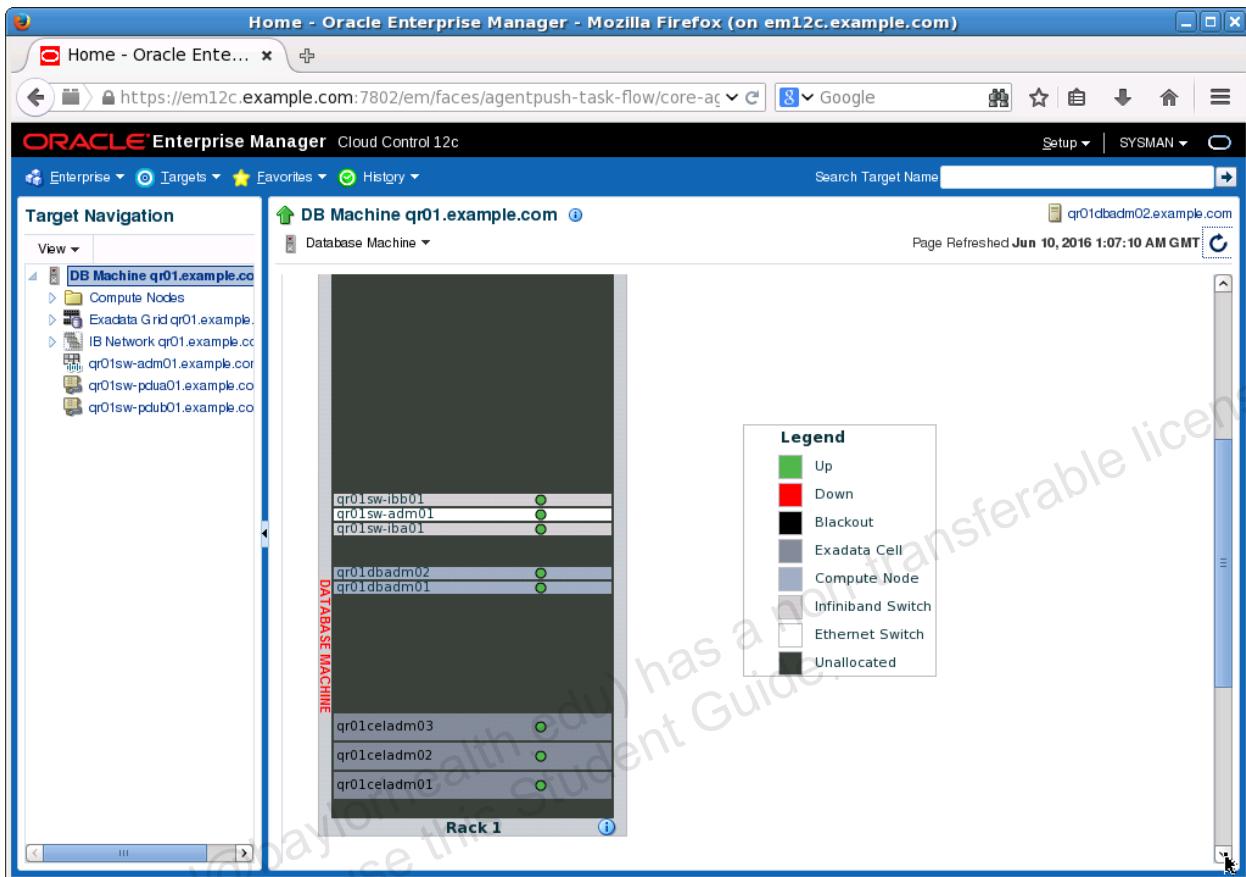
- Add Cluster Targets
- Add Database and ASM Targets

Congratulations! At this point, you have successfully discovered your Database Machine. In the next part of this practice, you will take a brief tour of the Database Machine home page.

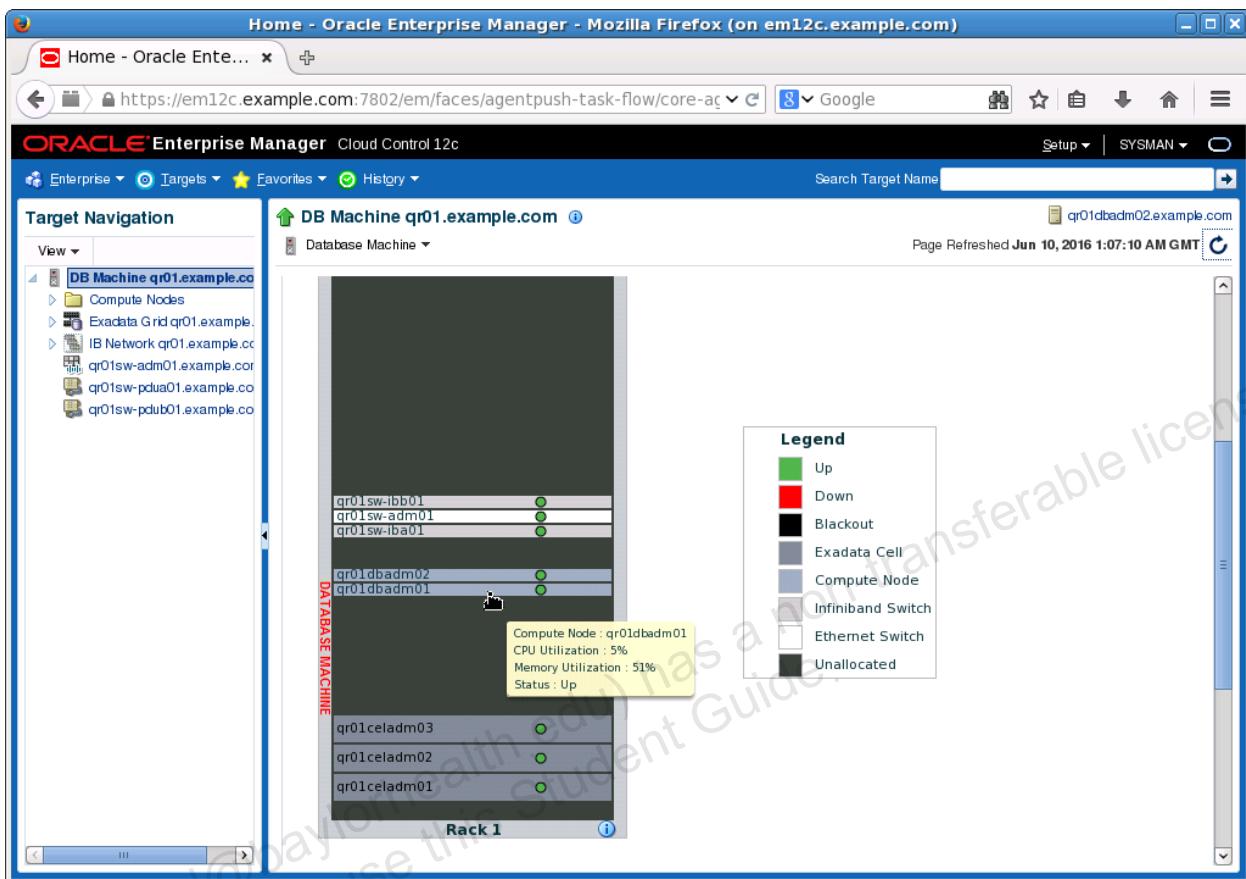
46. Examine the Database Machine home page. Notice that the various Database Machine components are organized in the Target Navigation pane. At the top of the main DB Machine pane, an Overview area summarizes any incidents and the component status. Below the overview, you will find the Database Machine Schematic, which is a diagrammatic representation of the Database Machine.
Note that it will take a few minutes for Enterprise Manager to fully update the status of the Database Machine components. Therefore, if any of the components are initially listed as down, periodically refresh the page until the status of the entire Database Machine is displayed as up.



47. Scroll down until the lower half of the Database Machine Schematic diagram is displayed. Here you will see a representation of the Database Machine hardware components arranged just as they are inside the rack.



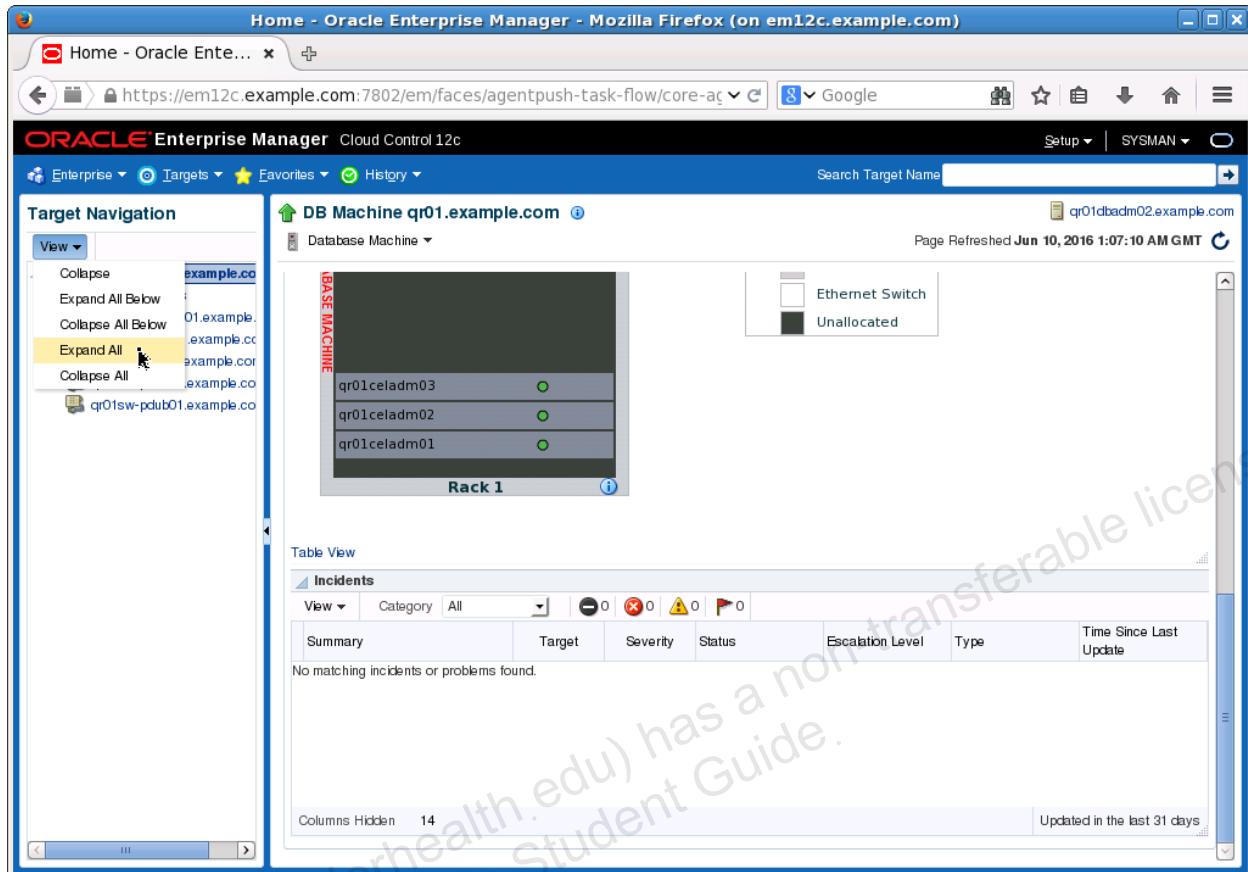
48. Hold the cursor over each component in the diagram to display key status information. Note that you may initially see zero values for the utilization metrics. This will change over time as the metric values are collected.



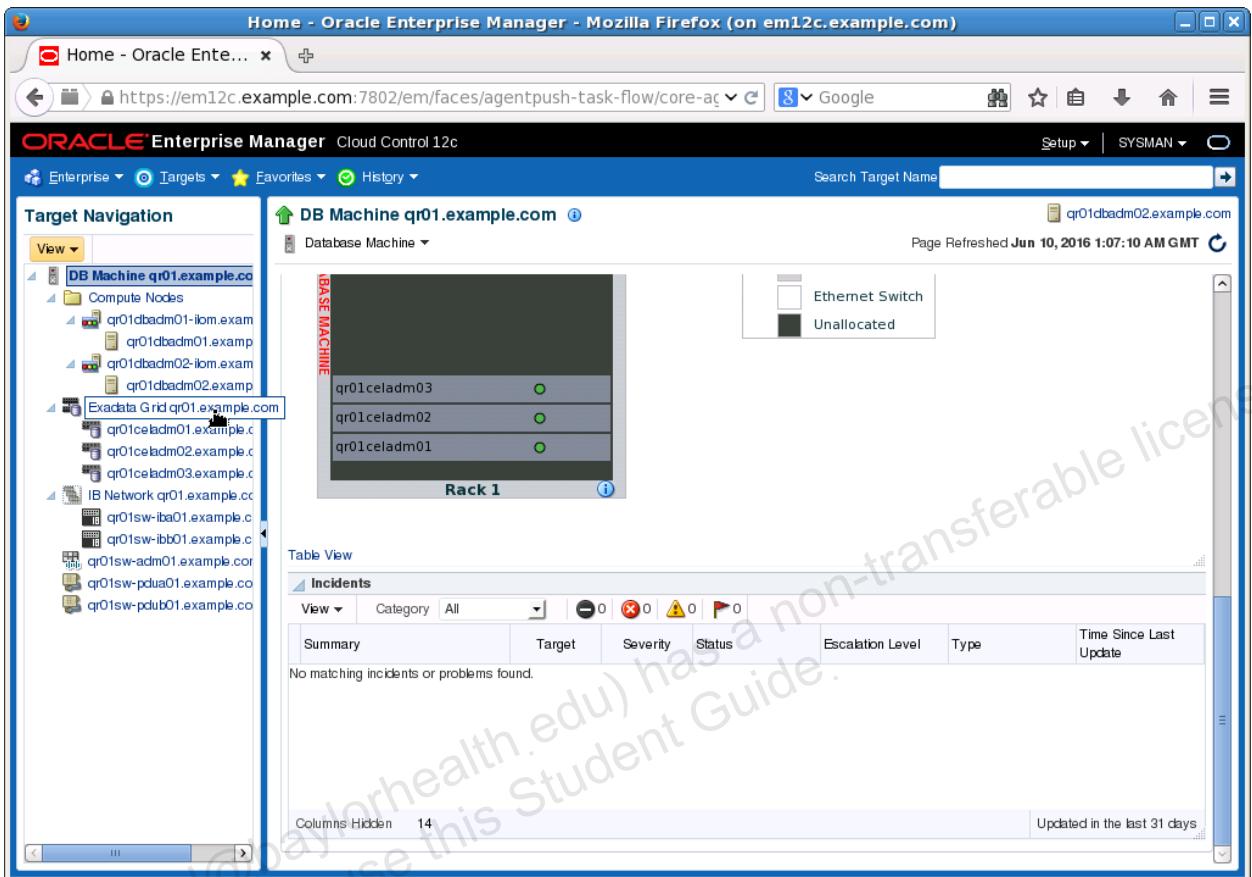
49. Scroll further down the page to reveal the Incidents area. Use the summary shown here to quickly ascertain if there are any incidents relating to the Database Machine.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface in Mozilla Firefox. The URL is https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-ac. The main content area displays the 'DB Machine qr01.example.com' view. On the left, the 'Target Navigation' pane lists various targets under 'DB Machine qr01.example.com'. In the center, a rack diagram titled 'Rack 1' shows three nodes: qr01celadm03, qr01celadm02, and qr01celadm01, all in green status. A legend indicates that white squares represent 'Ethernet Switch' and black squares represent 'Unallocated'. Below the rack diagram is a 'Table View' section for 'Incidents'. The 'Incidents' tab is selected, showing a summary table with columns: Category (All), Target, Severity, Status, Escalation Level, Type, and Time Since Last Update. The table displays the message 'No matching incidents or problems found.' At the bottom of the table, it says 'Columns Hidden 14' and 'Updated in the last 31 days'.

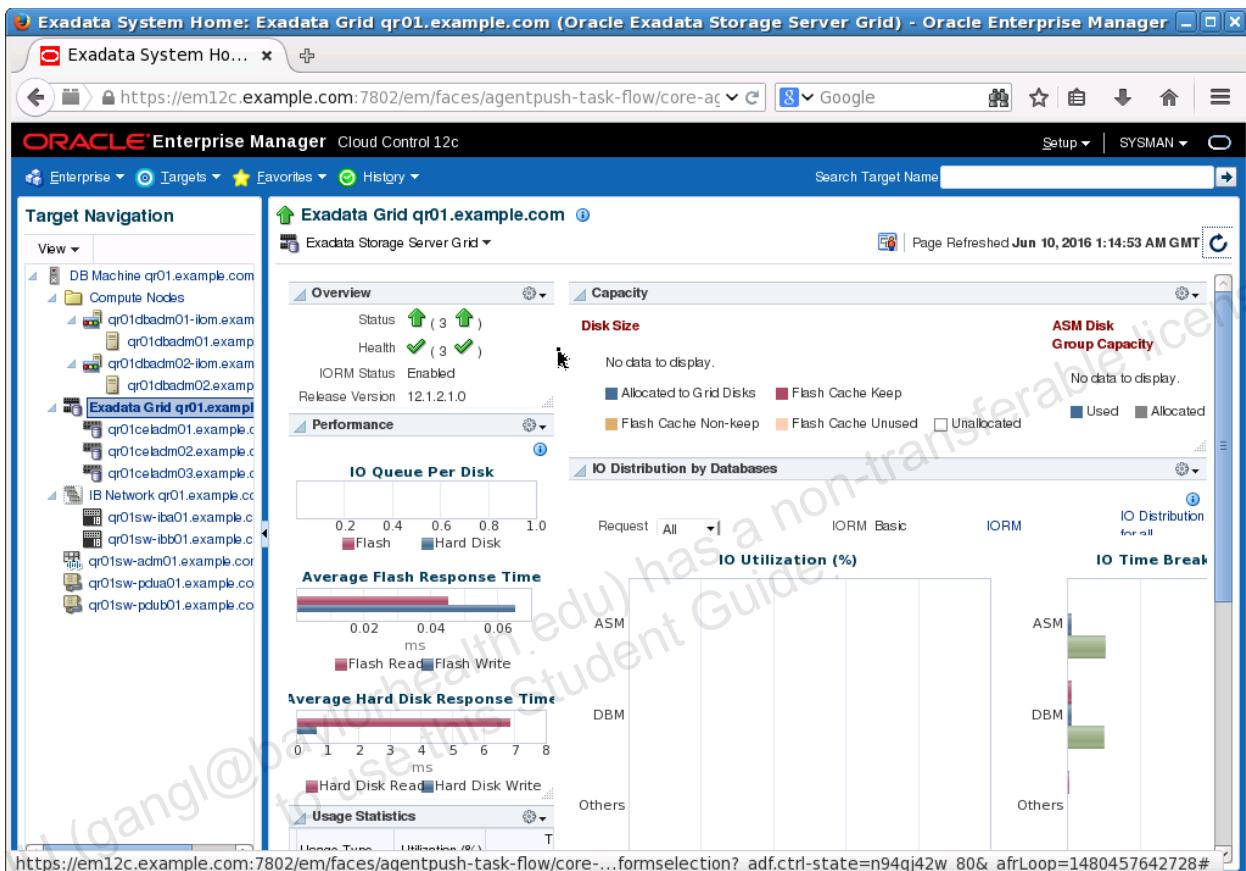
50. In the Target Navigation pane, select the View > Expand All menu command.



51. Now the Target Navigation pane lists all the monitoring targets associated with the Database Machine. At any time you can navigate to the target home page by clicking any of the listed targets. Click "Exadata Grid qr01.example.com."

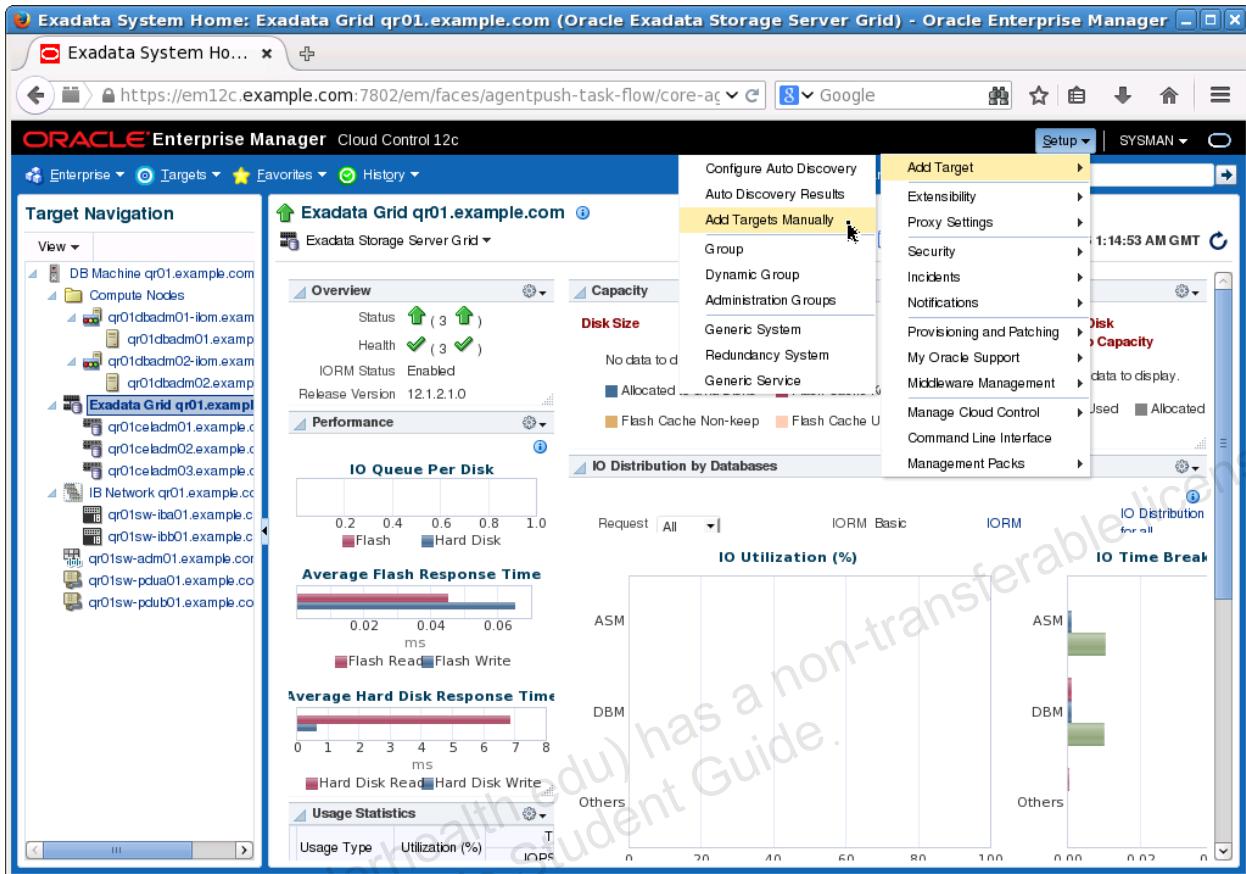


52. Now the Exadata Grid home page is displayed. This page summarizes key information about all the Exadata Storage Servers in the Database Machine. At this point, you can see that the storage grid consists of three Exadata Storage Servers. You can also notice that many of the summaries on the page are currently empty or contain zero values. Over time this will change as Enterprise Manager collects the underlying metrics and computes the summary values.

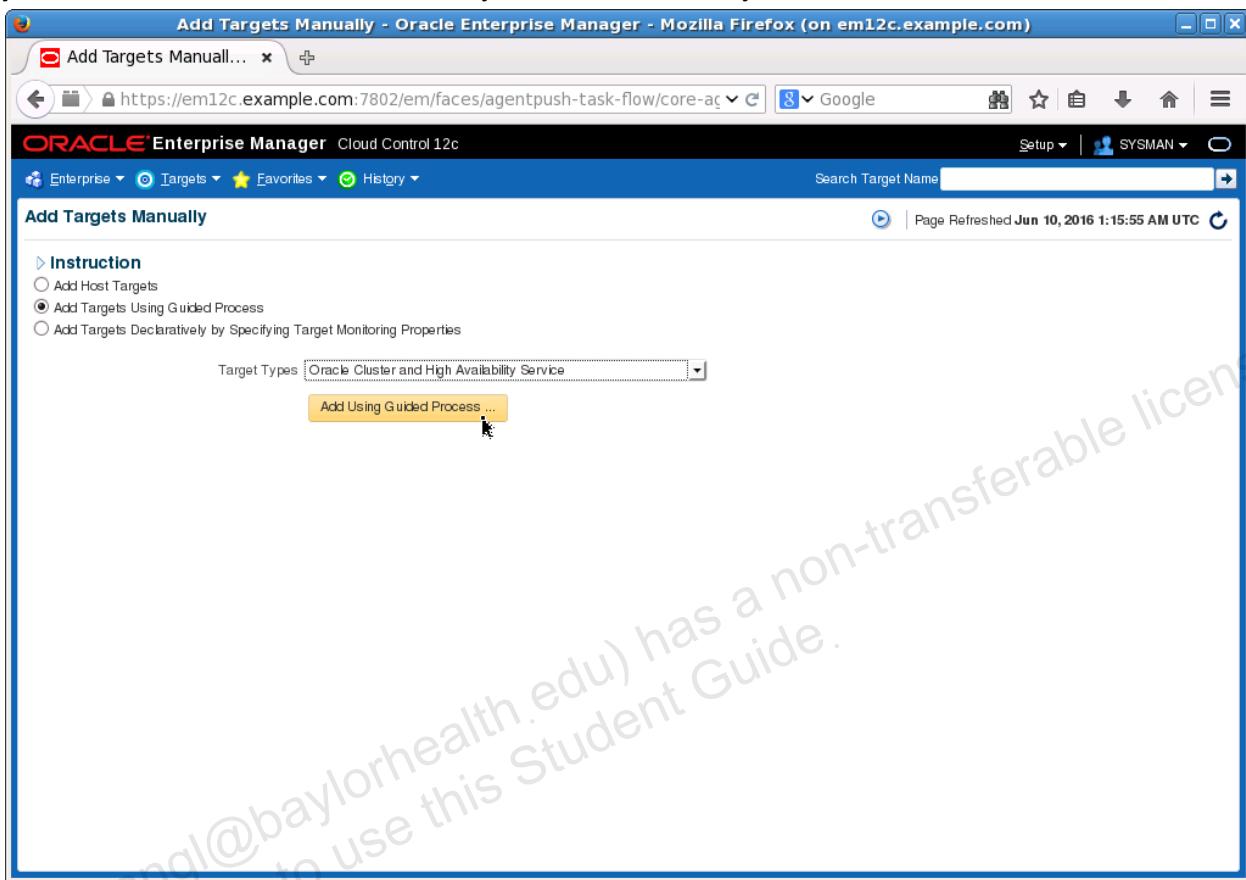


You may have noticed that the Database Machine home page contains no information about the databases and other software services running on the Database Machine. You will discover these separately in the next part of this practice.

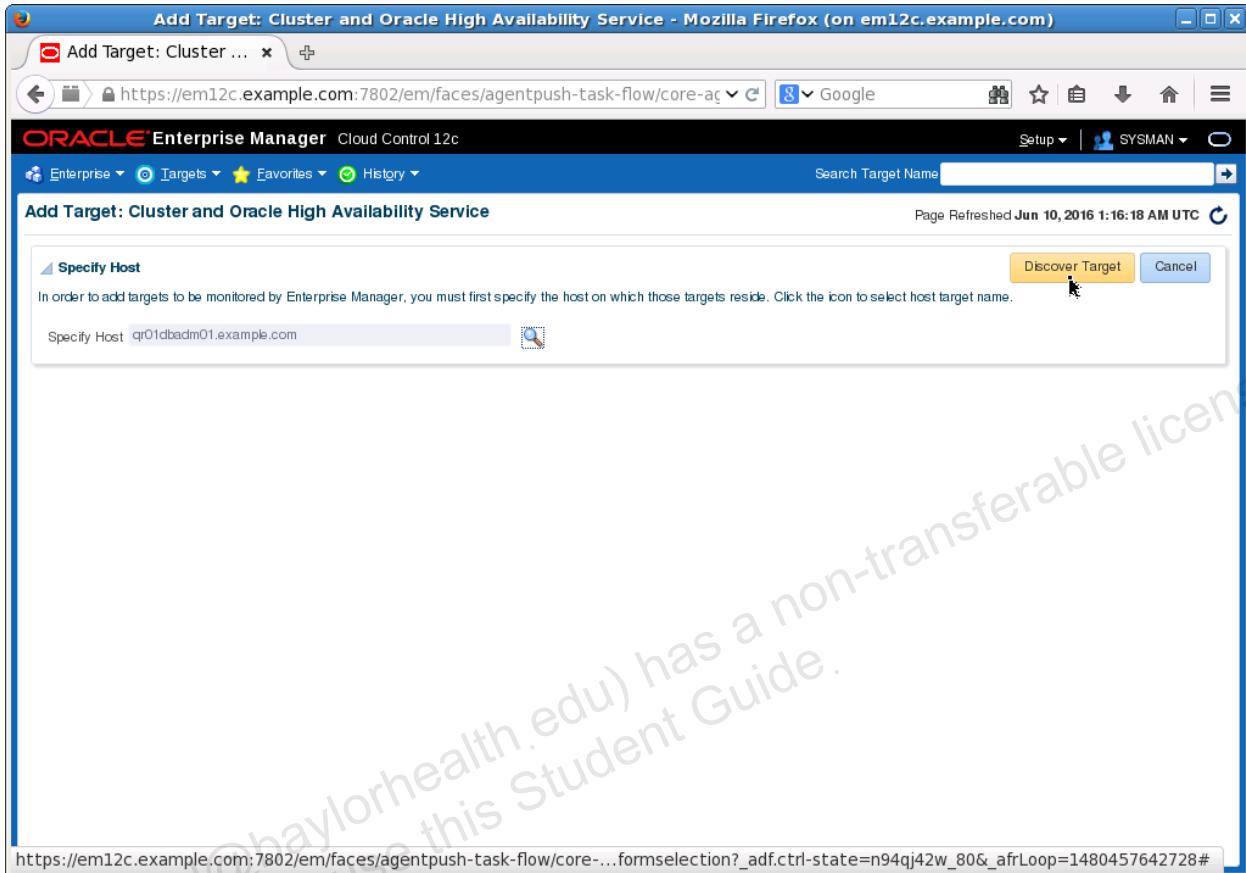
53. Select the Setup > Add Target > Add Targets Manually menu command.



54. On the Add Targets Manually page, select the Add Targets Using Guided Process option. Then select “Oracle Cluster and High Availability Service” from the Target Types drop-down list. Finally, click Add Using Guided Process to start the cluster discovery process. Note that you must discover the cluster before you can discover any databases.



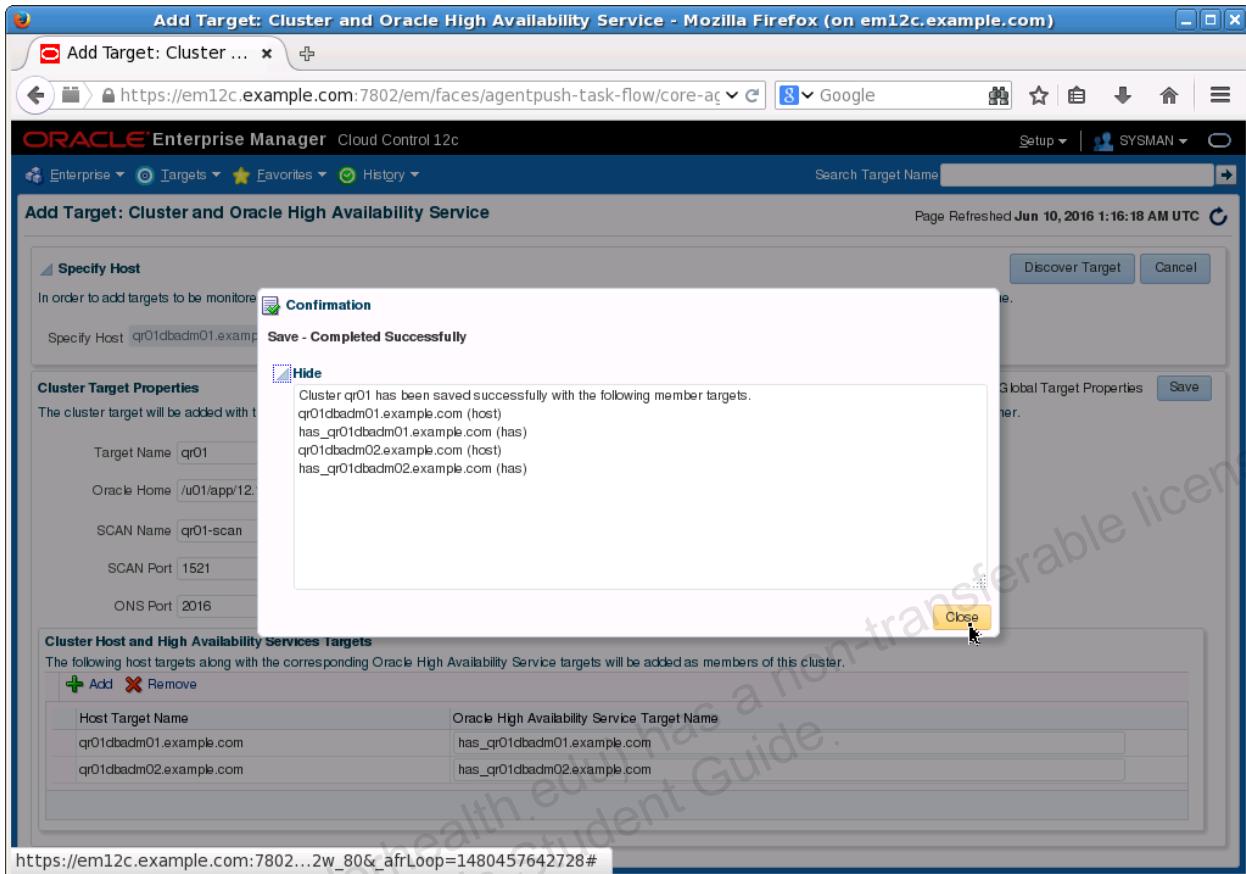
55. Enter the name of one of the database server hosts (`qr01dbadm01.example.com`) by clicking the magnifying glass icon and using the resulting dialog box to specify the host. Then click Discover Target to proceed.



56. The Add Target: Cluster and Oracle High Availability Service page should display various attributes of the cluster. Verify the accuracy of the cluster attributes and click Save to proceed.

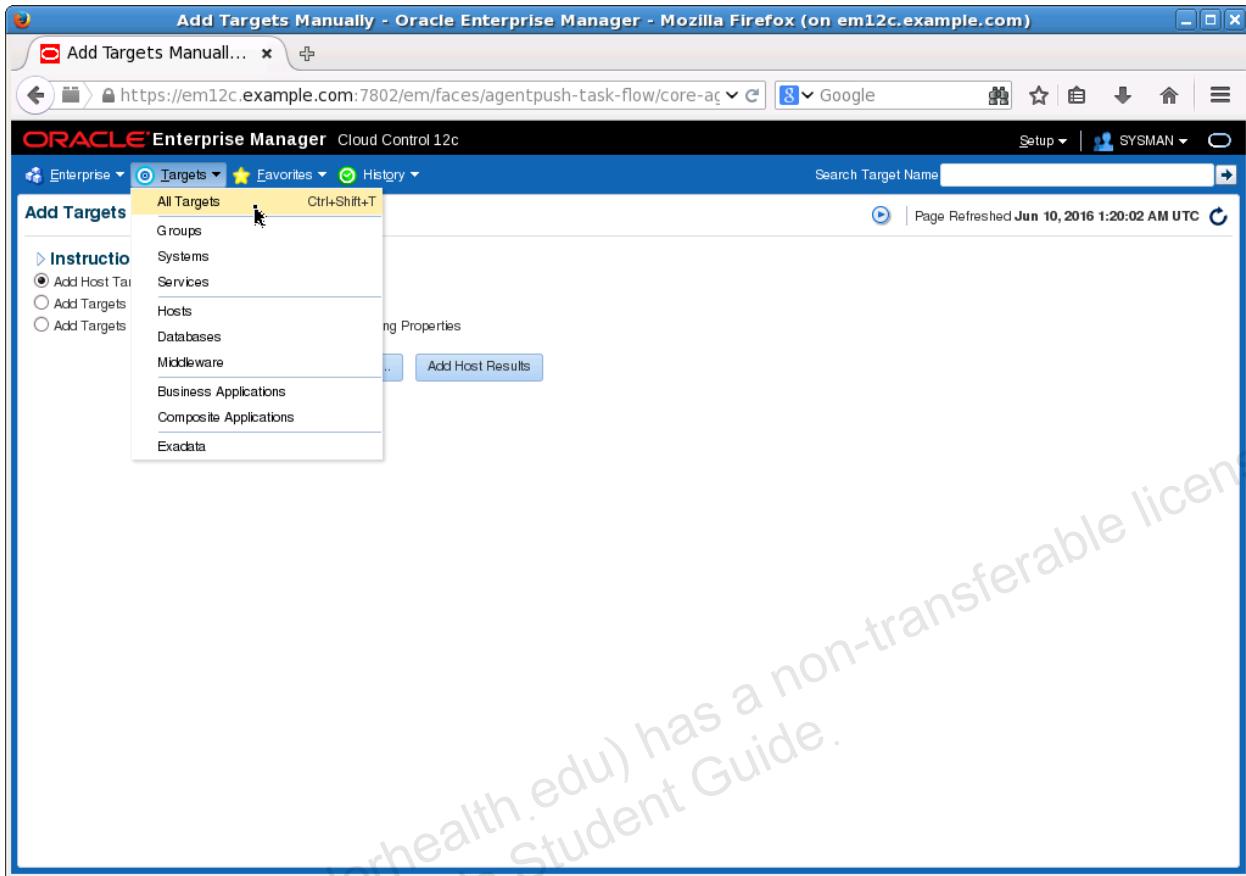
The screenshot shows the 'Add Target: Cluster and Oracle High Availability Service' page in Mozilla Firefox. The URL is https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-...formselection?_adf.ctrl-state=n94qj42w_80&_afrLoop=1480457642728#. The page title is 'Add Target: Cluster and Oracle High Availability Service - Mozilla Firefox (on em12c.example.com)'. The Oracle Enterprise Manager Cloud Control 12c navigation bar includes 'Enterprise', 'Targets', 'Favorites', 'History', 'Search Target Name', 'Setup', and 'SYSMAN'. The main content area has tabs for 'Specify Host' and 'Cluster Target Properties'. In 'Specify Host', the host 'qr01dbadm01.example.com' is specified. In 'Cluster Target Properties', target details are entered: Target Name 'qr01', Oracle Home '/u01/app/12.1.0.2/grid', SCAN Name 'qr01-scan', SCAN Port '1521', and ONS Port '2016'. A 'Save' button is highlighted. Below these, the 'Cluster Host and High Availability Services Targets' section lists two hosts: 'qr01dbadm01.example.com' and 'qr01dbadm02.example.com', each associated with an Oracle High Availability Service target name: 'has_qr01dbadm01.example.com' and 'has_qr01dbadm02.example.com' respectively. A 'Save' button is also present here.

57. When the results page is displayed. Ensure that there are no errors and click Close.



At this point, the cluster has been added to Enterprise Manager. Next, you will validate that all the cluster targets are up and available.

58. Select the Targets > All Targets menu command.



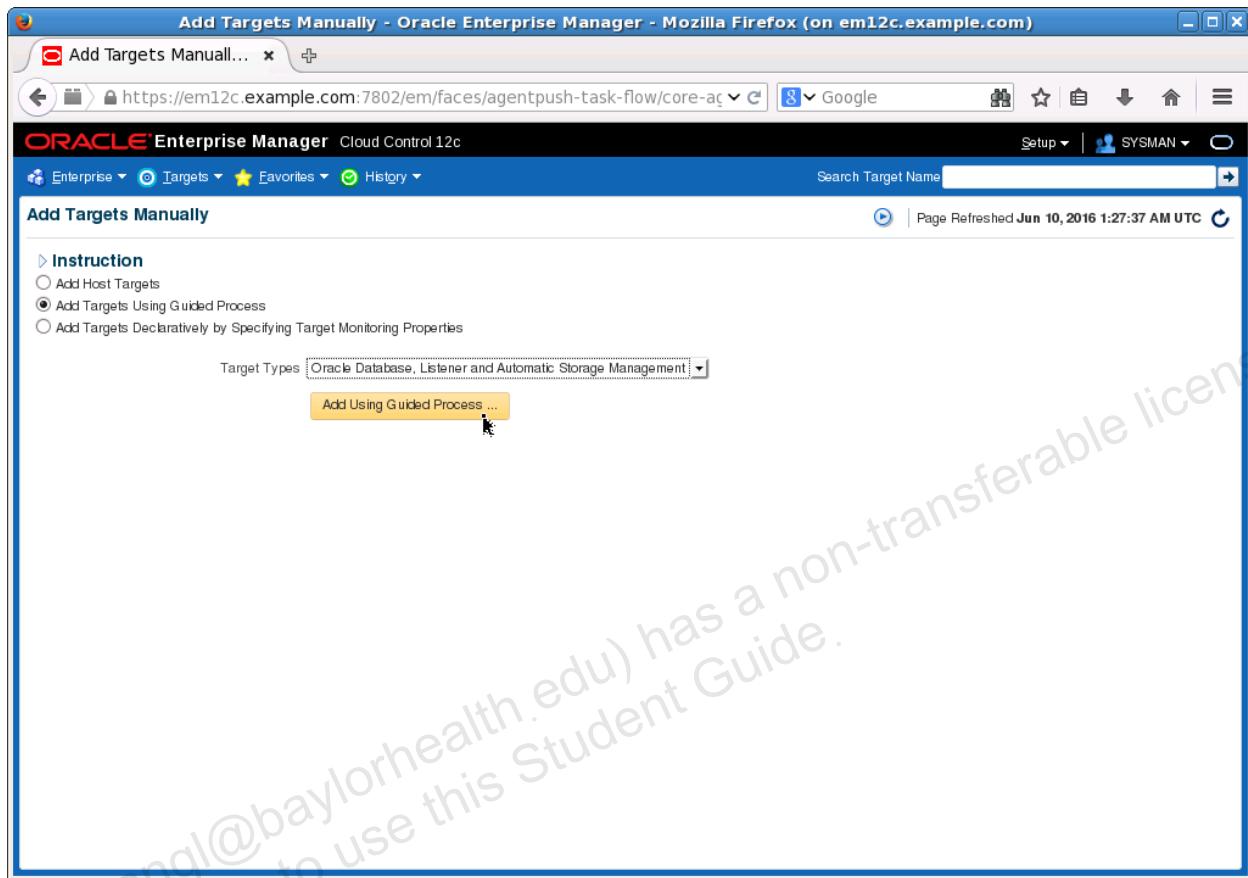
59. Examine the target list and confirm that the cluster target (qr01) and two high availability service targets (has_qr01dbadm01.example.com and has_qr01dbadm02.example.com) are up. If any of the targets are not up, periodically refresh the page until they appear in the list.

Target Name	Target Type	Target Status
DB Machine qr01.example.com	Oracle Exadata Database Machine	Up
Exadata Grid qr01.example.com	Oracle Exadata Storage Server Grid	Up
has_qr01dbadm01.example.com	Oracle High Availability Service	Up
has_qr01dbadm02.example.com	Oracle High Availability Service	Up
IB Network qr01.example.com	Oracle Infiniband Network	Up
qr01	Cluster	Up
qr01celadm01.example.com	Oracle Exadata Storage Server	Up
qr01celadm02.example.com	Oracle Exadata Storage Server	Up
qr01celadm03.example.com	Oracle Exadata Storage Server	Up
qr01dbadm01.example.com	Oracle Exadata Storage Server	Up
qr01dbadm01-ilom.example.com	Host	Up
qr01dbadm02.example.com	Agent	Up
qr01dbadm02-ilom.example.com	Oracle Engineered System ILOM Server	Up
qr01sw-adm01.example.com	Host	Up
qr01sw-iba01.example.com	Agent	Up
qr01sw-lbb01.example.com	Oracle Engineered System Cisco Switch	Up
qr01sw-pdua01.example.com	Oracle Infiniband Switch	Up
qr01sw-pdub01.example.com	Oracle Engineered System PDU	Up
	Oracle Engineered System PDU	Up

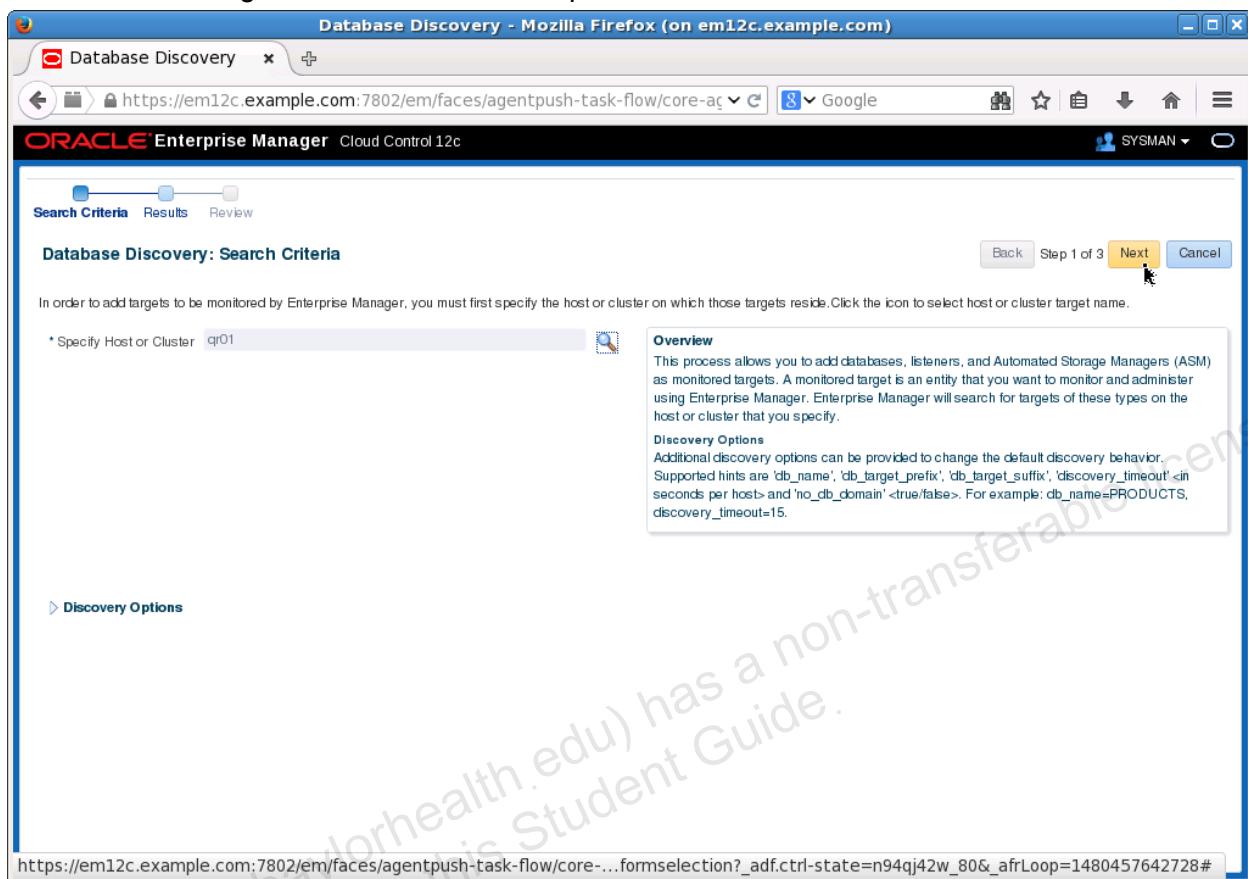
60. Now you are ready to discover the databases running on your Database Machine. To start this process, select the Setup > Add Target > Add Targets Manually menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "All Targets - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main menu bar includes "Enterprise", "Targets", "Favorites", and "History". On the right side, there is a "Setup" menu with several options: "Add Target", "Extensibility", "Proxy Settings", "Security", "Incidents", "Notifications", "Provisioning and Patching", "My Oracle Support", "Middleware Management", "Manage Cloud Control", "Command Line Interface", and "Management Packs". The "Add Targets Manually" option is highlighted with a yellow background. The central area displays a table titled "All Targets" with columns for "Target Name" and other details. The left sidebar contains a tree view of "Target Type" categories: Databases, Engineered Systems, Servers, Storage and Network, and Internal. The "Target Version" section lists versions 12.1.0.2.0, 12.1.0.4.0, 12.1.2.1.0, 2.1.6.2.0, and 2.2.0.0.0. At the bottom of the screen, a watermark reads "DANG LIU (gangliu@baystatehealth.edu) has a non-transferable license to use this Student Guide."

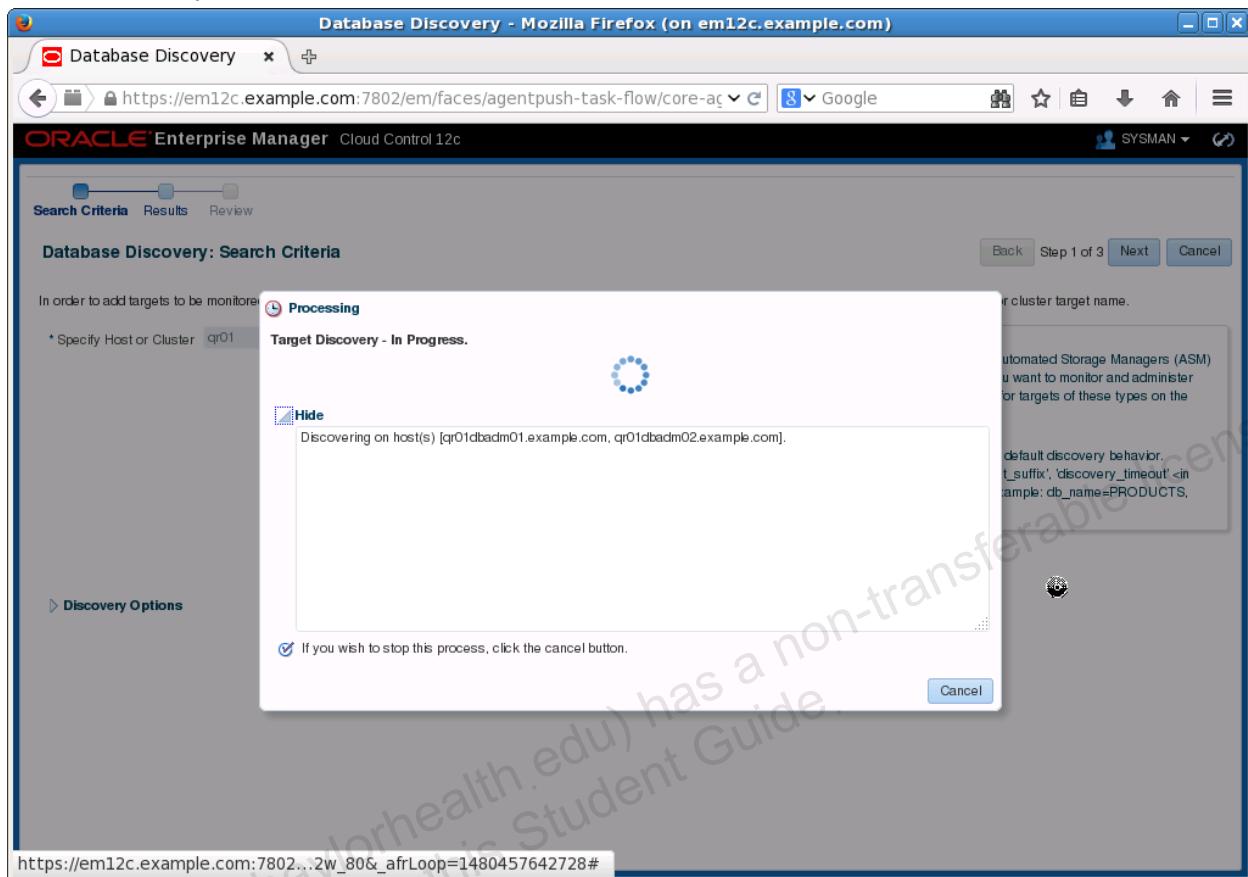
61. On the Add Targets Manually page, select the Add Targets Using Guided Process option. Then select “Oracle Database, Listener and Automatic Storage Management” from the Target Types drop-down list. Finally, click Add Using Guided Process to start the discovery process.



62. Enter the name of the cluster (qr01) by clicking the magnifying glass icon and selecting the cluster in the dialog box. Then click Next to proceed.



63. While target discovery is in progress proceed to the next steps to configure the monitoring credentials on your database.



64. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

65. Connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0...
SQL>
```

66. Execute the `ALTER USER` command to configure the monitoring credentials for the database and remember your specified password.

```
SQL> alter user dbsnmp account unlock identified by ???????;
User altered.

SQL>
```

67. Exit SQL*Plus.

```
SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition ...
[oracle@qr01dbadm01 ~] $
```

68. On the Database Discovery: Results page, click the check box beside the `dbm` database and enter the Monitor Password that you set in step 66.

Target Name	Monitor Username	Monitor Password	Role	Target Group
<input checked="" type="checkbox"/> dbm	dbsnmp	[redacted]	Normal	[redacted]

69. Scroll down the Database Discovery: Results page, click the check box beside the ASM target and enter the ASM Monitor Password.

Database Discovery: Results

Cluster ASM

Select	Target Name	Monitoring Credentials	Target Group
<input checked="" type="checkbox"/>	+ASM_qr01	Monitor Username: asmsnmp, Monitor Password: [REDACTED], Role: SYSDBA	
	+ASM1_qr01dbadm01.example.com		
	+ASM2_qr01dbadm02.example.com		

Listeners

Target Name	Listener Name	Machine Name	Target Group
LISTENER_qr01dbadm01.example.com	LISTENER	qr01db01-vip.example.com	
LISTENER_SCAN2_qr01	LISTENER_SCAN2	qr01-scan.example.com	
LISTENER_SCAN3_qr01	LISTENER_SCAN3	qr01-scan.example.com	
LISTENER_qr01dbadm02.example.com	LISTENER	qr01db02-vip.example.com	
LISTENER_SCAN1_qr01	LISTENER_SCAN1	qr01-scan.example.com	

70. Scroll to the bottom of the Database Discovery: Results page, click all of the check boxes beside all of the Listeners.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Database Discovery - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Database Discovery: Results".

Cluster ASM: A table lists discovered Cluster ASM targets. One target, "+ASM_qr01", is selected, and its monitoring credentials are shown: Monitor Username "asmsnmp", Monitor Password "*****", and Role "SYSDBA".

Select	Target Name	Monitor Username	Monitor Password	Role	Target Group
<input checked="" type="checkbox"/>	+ASM_qr01	asmsnmp	*****	SYSDBA	
	+ASM1_qr01dbadm01.example.com				
	+ASM2_qr01dbadm02.example.com				

Listeners: A table lists discovered listeners. All listeners are selected (indicated by checked checkboxes). The columns are Target Name, Listener Name, Machine Name, and Target Group.

View	Configure	Target Name	Listener Name	Machine Name	Target Group
<input checked="" type="checkbox"/>		LISTENER_qr01dbadm01.example.com	LISTENER	qr01db01-vip.example.com	
<input checked="" type="checkbox"/>		LISTENER_SCAN2_qr01	LISTENER_SCAN2	qr01-scan.example.com	
<input checked="" type="checkbox"/>		LISTENER_SCAN3_qr01	LISTENER_SCAN3	qr01-scan.example.com	
<input checked="" type="checkbox"/>		LISTENER_qr01dbadm02.example.com	LISTENER	qr01db02-vip.example.com	
<input checked="" type="checkbox"/>		LISTENER_SCAN1_qr01	LISTENER_SCAN1	qr01-scan.example.com	

71. Click Next to continue.

The screenshot shows the Oracle Enterprise Manager Database Discovery Results page in Mozilla Firefox. The URL is https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-aç. The page title is "Database Discovery - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Database Discovery: Results".

Cluster ASM: The section displays discovered Cluster ASM targets. A table lists the Target Name (+ASM_qr01, +ASM1_qr01dbadm01.example.com, +ASM2_qr01dbadm02.example.com), Monitoring Credentials (Monitor Username: asmsnmp, Monitor Password: *****, Role: SYSDBA), and Target Group. The "Select" column has a checked checkbox for +ASM_qr01.

Select	Target Name	Monitoring Credentials	Target Group
<input checked="" type="checkbox"/>	+ASM_qr01	asmsnmp ***** SYSDBA	
	+ASM1_qr01dbadm01.example.com		
	+ASM2_qr01dbadm02.example.com		

Listeners: The section displays discovered listeners. A table lists the Target Name (LISTENER_qr01dbadm01.example.com, LISTENER_SCAN2_qr01, LISTENER_SCAN3_qr01, LISTENER_qr01dbadm02.example.com, LISTENER_SCAN1_qr01), Listener Name (LISTENER, LISTENER_SCAN2, LISTENER_SCAN3, LISTENER, LISTENER_SCAN1), Machine Name (qr01db01-vip.example.com, qr01-scan.example.com, qr01-scan.example.com, qr01db02-vip.example.com, qr01-scan.example.com), and Target Group. The "Select" column has checked checkboxes for all listed listeners.

Select	Target Name	Listener Name	Machine Name	Target Group
<input checked="" type="checkbox"/>	LISTENER_qr01dbadm01.example.com	LISTENER	qr01db01-vip.example.com	
<input checked="" type="checkbox"/>	LISTENER_SCAN2_qr01	LISTENER_SCAN2	qr01-scan.example.com	
<input checked="" type="checkbox"/>	LISTENER_SCAN3_qr01	LISTENER_SCAN3	qr01-scan.example.com	
<input checked="" type="checkbox"/>	LISTENER_qr01dbadm02.example.com	LISTENER	qr01db02-vip.example.com	
<input checked="" type="checkbox"/>	LISTENER_SCAN1_qr01	LISTENER_SCAN1	qr01-scan.example.com	

72. On the summary page that appears, click Save to add the database, listener, and ASM targets to Enterprise Manager.

The screenshot shows the 'Database Discovery - Mozilla Firefox' window. The title bar says 'Database Discovery - Mozilla Firefox (on em12c.example.com)'. The address bar shows the URL 'https://em12c.example.com:7802/em/faces/agentpush-task-flow/core-ac'. The main content area is titled 'Database Discovery: Review'. It displays three sections: 'Database Systems', 'Other Targets', and 'Cluster ASM'. In 'Database Systems', there are four entries: 'dbm_sys' (Database System, Host: qr01dbadm01.example.com), 'dbm' (Cluster Database, Host: qr01dbadm01.example.com), 'dbm_dbm1' (Database Instance, Host: qr01dbadm01.example.com), and 'dbm_dbm2' (Database Instance, Host: qr01dbadm02.example.com). In 'Other Targets', there are five entries: 'LISTENER_qr01dbadm01.example.com' (Listener, Host: qr01dbadm01.example.com), 'LISTENER_SCAN2_qr01' (Listener, Host: qr01dbadm01.example.com), 'LISTENER_SCAN3_qr01' (Listener, Host: qr01dbadm01.example.com), 'LISTENER_qr01dbadm02.example.com' (Listener, Host: qr01dbadm02.example.com), and 'LISTENER_SCAN1_qr01' (Listener, Host: qr01dbadm02.example.com). In 'Cluster ASM', there is one entry: '+ASM_qr01' (Cluster ASM, Host: qr01dbadm01.example.com). At the bottom right, there are 'Back', 'Step 3 of 3', 'Next', 'Save' (highlighted in yellow), and 'Cancel' buttons.

73. Examine the results page to ensure that no errors are reported. Click Close to proceed.

The screenshot shows the Oracle Enterprise Manager Database Discovery Review page. A confirmation dialog box is overlaid on the main interface, stating "Target Saving - Completed Successfully". It lists the targets that have been saved, including various database systems, instances, and listeners across multiple hosts. The main page displays search criteria, results, and review steps, along with a table of targets and a cluster ASM section.

Confirmation
Target Saving - Completed Successfully
The following targets have been saved.
+ASM_qr01 (asm_cluster)
LISTENER_qr01dbadm01.example.com (oracle_listener)
LISTENER_SCAN2_qr01 (oracle_listener)
LISTENER_SCAN3_qr01 (oracle_listener)
dbm (rac_database)
LISTENER_qr01dbadm02.example.com (oracle_listener)
LISTENER_SCAN1_qr01 (oracle_listener)

Database Systems
Following Database systems will be

Target Name
dbm_sys
dbm
Instances
dbm_dbm1
dbm_dbm2

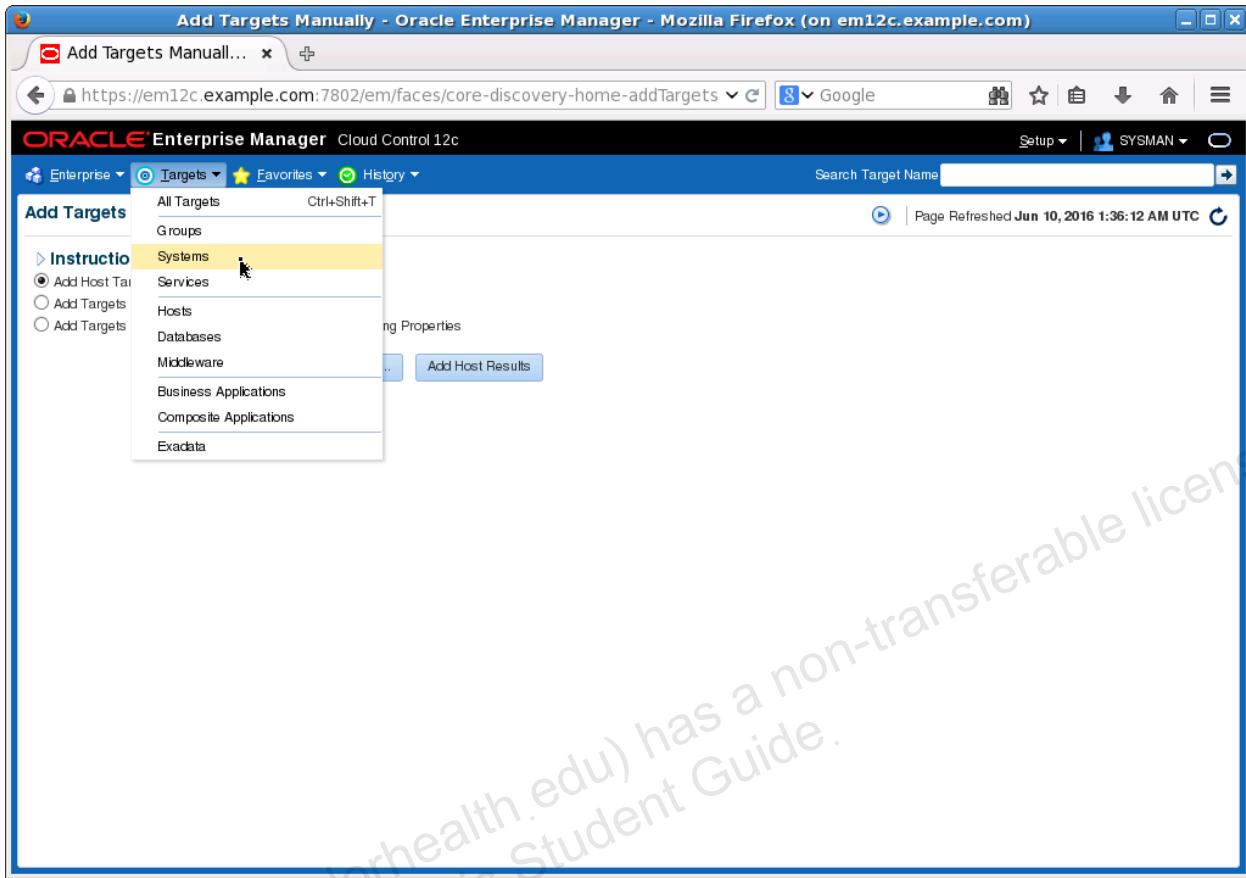
Other Targets
Following targets will not be part of a system

Target Name	Target Type	Host
LISTENER_qr01dbadm01.example.com	Listener	qr01dbadm01.example.com
LISTENER_SCAN2_qr01	Listener	qr01dbadm01.example.com
LISTENER_SCAN3_qr01	Listener	qr01dbadm01.example.com
LISTENER_qr01dbadm02.example.com	Listener	qr01dbadm02.example.com
LISTENER_SCAN1_qr01	Listener	qr01dbadm02.example.com

Cluster ASM
Targets

Target Name	Target Type	Host
+ASM_qr01	Cluster ASM	
+ASM1_qr01dbadm01.example.com	Automatic Storage Management	

74. Select the Targets > Systems menu command.



75. In Enterprise Manager, a System is a collection of related components. When you discovered the cluster database earlier in this practice, a Database System was implicitly created for you. Initially, the Database System will be associated with the cluster database and its database instances. Over time, Enterprise Manager will automatically add associations to other related entities, such as listeners and ASM. Examine the status of the dbm_sys system. Periodically refresh the page until the status is shown as up (displayed as a green upward pointing arrow).

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The main title bar reads "Systems - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The browser address bar shows the URL "https://em12c.example.com:7802/em/faces/core-discovery-home-addTargets". The main content area is titled "Systems". A search bar at the top left contains the text "Search All" and a "Save..." button. Below the search bar is a table with columns: Name, Privilege Propagation, Type, Status, Members, Member Status Summary, and Incidents. The "dbm_sys" system is listed in the table, highlighted with a yellow background. The "Status" column for "dbm_sys" shows a green upward-pointing arrow icon, indicating it is up. Other systems listed include "/EMG C_G CDome" (status n/a), "/EMG C_G CDome" (status up), and "/EMG C_G CDome" (status up). The "Member Status Summary" column for "dbm_sys" shows values 11, 4, and 4, all in green. The "Incidents" column for "dbm_sys" shows a value of 4, also in green.

At this point, you have configured your Database Machine and related software services in Enterprise Manager. In the final part of this practice, you will configure a Database Machine Services Dashboard. The dashboard provides a one-stop overview that enables you to quickly and easily monitor the key availability and performance metrics for your Database Machine and the related software services on one page.

76. To commence the dashboard creation process, select the Enterprise > Job > Activity menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left navigation bar has 'Job' selected, and 'Activity' is the active sub-menu. The main content area displays a table of system components with columns for Name, Privilege Propagation, Type, Status, Members, Member Status Summary, and Incidents. Components listed include Application Deployment, Oracle Home, Listener, Oracle Management Service, and various Oracle Fusion and Database instances.

Name	Privilege Propagation	Type	Status	Members	Member Status Summary	Incidents
/EMG C_G CDome	✓	Oracle WebLogic ...	n/a	Application Deployment (8) Metadata Repository (4) Oracle Home (4) More...	- - 12 - 8 - - -	- - - - - - - - -
/EMG C_G CDome	✓	Application Deploy...			- - - - - - - - -	- - - - - - - - -
/EMG C_G CDome	✓	Application Deploy...			- - - - - - - - -	- - - - - - - - -
/EMG C_G CDome	✓	Application Deploy...			- - - - - - - - -	- - - - - - - - -
/EMG C_G CDome	✓	Application Deploy...			- - - - - - - - -	- - - - - - - - -
dbm_sys	✓	Database System	✓	Listener (5), Oracle Home (4), Database Instance (2), More... Application Deployment (4) Metadata Repository (2) Oracle Home (2) More...	- 11 - - 4 - - 4	- - - - - - - - -
/EMG C_G CDome	✓	Oracle Fusion Md...	n/a		- - 7 - 5 - - -	- - - - - - - - -
Infrastructure Clo		Infrastructure Cloud	n/a		- - - - - - - - -	- - - - - - - - -
Management Ser	✓	OMS and Reposit...		Application Deployment (3) Host (1) Oracle Management Service (1) More...	- - 8 - - - - -	- - - - - - - - -

77. In the Create Job list, select the option to create a Database Machine Services Dashboard and click Go to proceed. Note that you may need to use the scroll bar along the bottom of the page to reveal the Go button.

Name	Status (Executions)	Scheduled	Targets	Target Type	Owner	Job Type
REFRESH_FROM_MY_ORACLE_SUPPORT_JOB	1 Scheduled	Jun 11, 2016 12:00:00 AM GMT+00:00			SYSMAN	Refresh From My Oracle Support
OPATCH_PATCH_UPDATE_JOB	1 Scheduled	Jun 11, 2016 12:00:00 AM GMT+00:00			SYSMAN	OPatch Update
DOWNLOAD_CVU	1 Scheduled	Jun 11, 2016 12:00:00 AM GMT+00:00			SYSMAN	DownloadCVU
REFRESH UPDATES FROM ORACLE	1 Scheduled	Jun 10, 2016 10:24:00 AM GMT			SYSMAN	Refresh Updates
MDADCSTATUSJOB	1 Scheduled	Jun 10, 2016 6:05:00 AM GMT+00:00			SYS	MDADCStatus
MDADATAPURGEJOB	1 Scheduled	Jun 10, 2016 6:05:00 AM GMT+00:00			SYS	MDADataMovementAndPurge
MDADATAMOVEMENTJOB	1 Scheduled	Jun 10, 2016 6:05:00 AM GMT+00:00			SYS	MDADataMovementAndPurge
SWLIBREFRESHLOCRESTATS	1 Scheduled	Jun 10, 2016 5:24:14 AM GMT+00:00			SYSMAN	Software Library Location Statistics Refresh
SWLIBPURGE	1 Scheduled	Jun 10, 2016 2:00:00 AM GMT+00:00			SYSMAN	Software Library Purge

78. On the resulting page, specify QR01_DASHBOARD as the job name. Also, add the DB Machine qr01.example.com target by clicking Add and selecting your Database Machine from the resulting dialog. Finally, click Submit to proceed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. A modal dialog box titled 'Create 'Database Machine Services Dashboard' Job' is open. The 'General' tab is selected. The 'Name' field contains 'QR01_DASHBOARD'. Below it is a large text area for 'Description'. Under 'Target Type', it says 'Oracle Exadata Database Machine'. The 'Target' section has a heading 'Add individual targets or one composite target, such as a Group.' It includes 'Remove' and 'Add' buttons, and dropdowns for 'Select All' and 'Select None'. A table lists a single target: 'DB Machine qr01.example.com' (Type: Oracle Exadata Database Machine, Host: qr01dbadm02.example.com, Time Zone: Greenwich Mean Time). At the bottom of the dialog are 'Cancel', 'Save to Library', and 'Submit' buttons.

79. On the Job Activity page, you should see a notification confirming that your dashboard creation job was submitted successfully. Click the QR01_DASHBOARD link associated with the confirmation message.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Job Activity - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Job Activity". A yellow-bordered box highlights a "Confirmation" message: "The job was created successfully" followed by a link "QR01_DASHBOARD". Below this, there is a search bar with "Status: Active" and "Name: [empty]" fields, and a "Go" button. A tip message says "TIP By default, results for the last 24 hours are displayed. Use 'Advanced Search' for more options." A table lists five scheduled jobs:

Select	Name	Status (Executions)	Scheduled	Targets	Target Type	Owner	Job Type
<input checked="" type="radio"/>	REFRESH_FROM_MY_ORACLE_SUPPORT_JOB	1 Scheduled	Jun 11, 2016 12:00:00 AM GMT+00:00			SYSMAN	Refresh From My Oracle Sup
<input type="radio"/>	OPATCH_PATCH_UPDATE_JOB	1 Scheduled	Jun 11, 2016 12:00:00 AM GMT+00:00			SYSMAN	OPatch Update
<input type="radio"/>	DOWNLOAD_CVU	1 Scheduled	Jun 11, 2016 12:00:00 AM GMT+00:00			SYSMAN	DownloadCVU
<input type="radio"/>	REFRESH_UPDATES FROM ORACLE	1 Scheduled	Jun 10, 2016 10:24:00 AM GMT			SYSMAN	Refresh Updates
<input type="radio"/>	MDADCSTATUSJOB	1 Scheduled	Jun 10, 2016 6:05:00 AM GMT+00:00			SYS	MDADCStatus

The URL in the browser address bar is <https://em12c.example.com:7802/em/console/jobs/runDetails?execId=34E3A31871DA2972E0530B0200C0F147>.

80. Examine the job status and periodically refresh the page until the job status is shown as Succeeded. Now the Database Machine Services Dashboard is created.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Job Run: QR01_DASHBOARD - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Job Run: QR01_DASHBOARD". It displays the following details:

- Scheduled: Jun 10, 2016 1:41:27 AM GMT+00:00
- Targets: DB Machine qr01.example.com
- Type: Database Machine Services Dashboard
- Owner: SYSMAN
- Description: (empty)

Below this, there is a section titled "Executions" with a search interface:

- Targets: [text input field]
- Status: [dropdown menu set to "All"]
- Go [button]

Under "Log Report", there is a table with the following data:

Select	Details	Targets	Status	Started	Ended	Elapsed Time
<input checked="" type="radio"/>	> Show	DB Machine qr01.example.com	Succeeded	Jun 10, 2016 1:41:27 AM GMT+00:00	Jun 10, 2016 1:41:34 AM GMT+00:00	7 seconds

At the bottom right of the main content area, there are buttons: "Delete Run", "Create Like", "Edit", and "View Definition".

81. To examine the Database Machine Services Dashboard, select the Enterprise > Reports > Information Publisher Reports menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar has a navigation menu with 'Reports' selected, and 'Information Publisher Reports' is highlighted. A tooltip provides details about the selected report: Type: Database Machine Services Dashboard, Owner: SYSMAN, and Description: Database Machine Services Dashboard. The main content area displays a table of job runs. One row is selected, showing the target as 'DB Machine qr01.example.com', status as 'Succeeded', start time as 'Jun 10, 2016 1:41:27 AM GMT+00:00', end time as 'Jun 10, 2016 1:41:34 AM GMT+00:00', and elapsed time as '7 seconds'. Action buttons for 'Delete Run', 'Create Like', 'Edit', and 'View Definition' are visible at the bottom of the table row.

Select	Details	Targets	Status	Started	Ended	Elapsed Time
<input checked="" type="radio"/>	> Show	DB Machine qr01.example.com	Succeeded	Jun 10, 2016 1:41:27 AM GMT+00:00	Jun 10, 2016 1:41:34 AM GMT+00:00	7 seconds

82. Enter qr01 in the Title search field and click Go.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Information Publisher Report Definitions - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Information Publisher Reports". In the search section, the "Title" field contains "qr01", the "Owner" dropdown is set to "All", and the "Target Type" dropdown is set to "All". A "Go" button is highlighted with a cursor. Below the search bar are buttons for "Delete", "Create Like", "Edit", and "Create". The results table has columns for "Select", "Title", "Description", "Date Generated", and "Owner". The table lists several report definitions:

Select	Title	Description	Date Generated	Owner
<input type="radio"/>	Information Publisher Reports			SYSMAN
<input type="radio"/>	Cisco			SYSMAN
<input type="radio"/>	Cisco Switch			SYSMAN
<input checked="" type="radio"/>	Network Information	Network information		SYSMAN
<input type="radio"/>	System Health	System health information		SYSMAN
<input type="radio"/>	Compliance			SYSMAN
<input type="radio"/>	Descriptions			SYSMAN
<input type="radio"/>	Compliance Group Library Summary	Compliance Group Library Summary		SYSMAN
<input type="radio"/>	Compliance Standard Library Summary	Compliance Standard Library Summary		SYSMAN
<input type="radio"/>	Compliance Standard Rule Summary	Compliance Standard Rule Summary		SYSMAN

83. Click the “DB Machine qr01.example.com_DASHBOARD_REPORT” link to run the Database Machine Services Dashboard.

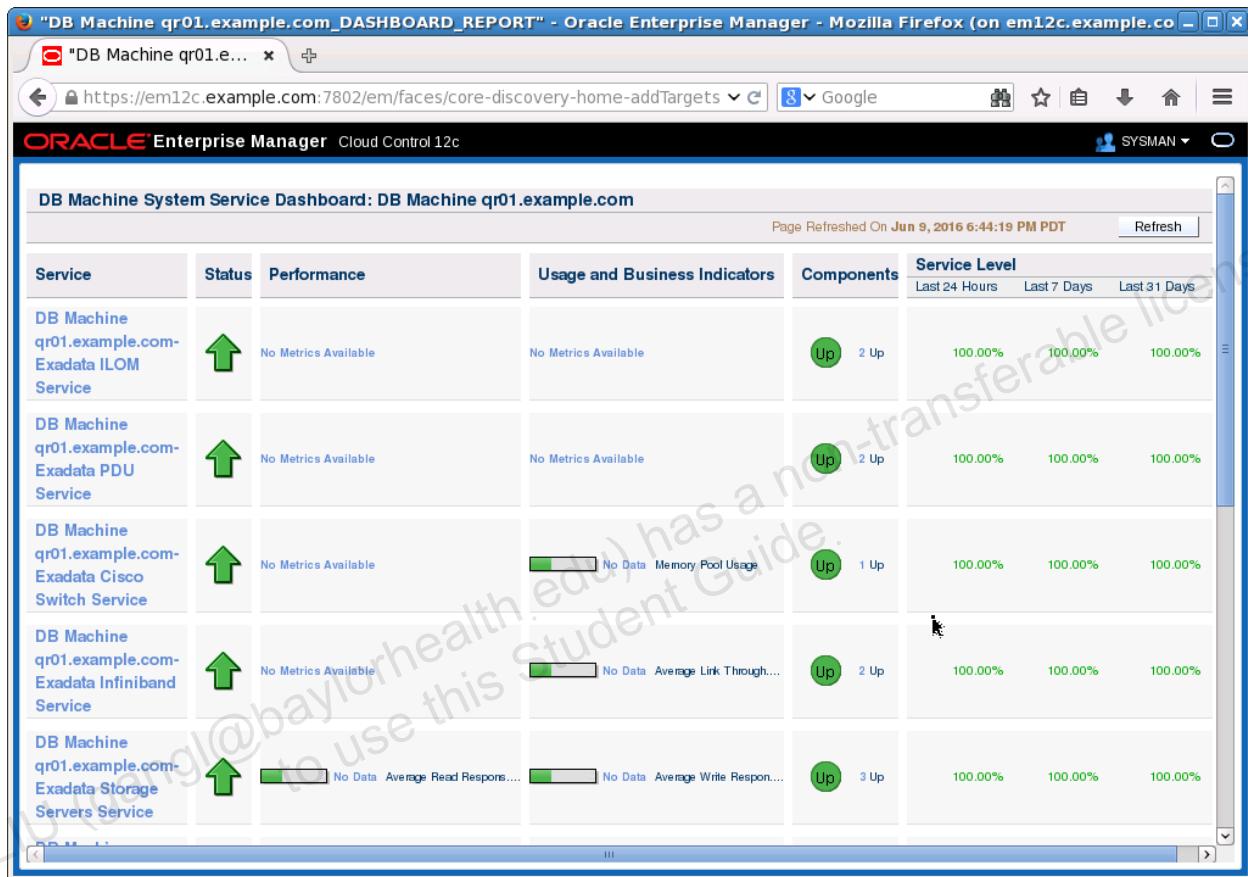
The screenshot shows the Oracle Enterprise Manager Information Publisher Report Definitions page. The search results table has the following data:

Select	Title	Description	Date Generated	Owner
<input type="radio"/>	Information Publisher Reports			
<input type="radio"/>	Monitoring			
<input type="radio"/>	Dashboards			
<input checked="" type="radio"/>	DB Machine qr01.example.com_DASHBOARD_REPORT	Dashboard for monitoring DB Machine:DB Machine qr01.example.com and its associated components		SYSMAN

A note at the bottom left states: "indicates an Oracle-provided report. Oracle-provided reports cannot be edited, but you can use Create Like to create a report that can be edited."

The URL in the browser's address bar is: <https://em12c.example.com:7802/em/console/reports/admin#>

84. Examine the Database Machine Services Dashboard. You should be able to quickly confirm that all the Database Machine hardware and software components are currently operational. You may also notice that currently many of the metrics are empty. In a production environment, this would quickly change as the metrics are gathered and displayed by Enterprise Manager. In this laboratory environment, some of the metrics will never be displayed because the components that would normally generate the metrics are not fully functional.



85. Along with providing a one-stop monitoring overview of all the Database Machine hardware and software components, the Database Machine Services Dashboard also enables you to drill into further details by clicking various links across the entire dashboard. Click “DB Machine qr01.example.com-Exadata Storage Servers Service” to examine further details about the Exadata Database Machine storage servers.

Service	Status	Performance	Usage and Business Indicators	Components	Service Level		
					Last 24 Hours	Last 7 Days	Last 31 Days
DB Machine qr01.example.com-Exadata ILOM Service		No Metrics Available	No Metrics Available		2 Up	100.00%	100.00%
DB Machine qr01.example.com-Exadata PDU Service		No Metrics Available	No Metrics Available		2 Up	100.00%	100.00%
DB Machine qr01.example.com-Exadata Cisco Switch Service		No Metrics Available	No Data Memory Pool Usage		1 Up	100.00%	100.00%
DB Machine qr01.example.com-Exadata Infiniband Service		No Metrics Available	No Data Average Link Through...		2 Up	100.00%	100.00%
DB Machine qr01.example.com-Exadata Storage Servers Service		No Data Average Read Respons...	No Data Average Write Respons...		3 Up	100.00%	100.00%

https://em12c.example.com:7802/em/faces/core-services-genSvcHome?...ta Storage Servers Service&type=generic_service&ctxType=Services

The resulting page shows further summary information about the Database Machine storage service.

Congratulations! You have now configured Enterprise Manager Cloud Control 12c to monitor and manage Exadata Database Machine.

86. Exit your terminal sessions and log out of Enterprise Manager.

Practice 14-2: Post-Discovery Configuration and Verification

Overview

In this practice, you perform some of the recommended post-discovery configuration and verification tasks. Specifically, you will:

- Configure SNMP forwarding on the Database Machine servers that host the Enterprise Manager Agent.
- Verify the SNMP configuration for the Exadata Storage Servers.

Note that other recommended post-discovery tasks cannot be performed in your laboratory environment. For more information about all of the recommended post-discovery tasks, refer to chapter 4 of the *Oracle Enterprise Manager Exadata Management Getting Started Guide*.

Assumptions

This practice relies on the configuration activities performed in the previous practice.

Tasks

SNMP is used extensively throughout Exadata Database Machine so that the various components can report monitoring information and alerts to network management systems, such as Enterprise Manager Cloud Control 12c. Enterprise Manager Agents listen for SNMP events (also known as traps) and propagate the trap information to the Oracle Management Server (OMS) so that it can be processed and displayed to administrators. Some Exadata components, such as the Cisco Ethernet switch, have no documented way to send SNMP traps to ports other than UDP 162. However, the Oracle Management Agent runs as the `oracle` user and cannot listen on UDP ports under 1024. Because of these restrictions, a trap forwarder must be configured so that the SNMP traps sent to port 162 are forwarded to Enterprise Manager through the Oracle Management Agent.

In the first part of this practice, you will configure SNMP forwarding on the Database Machine servers that host the Enterprise Manager Agent.

- Establish a terminal session connected to `qr01dbadm01` by using the `root` OS user.

```
$ ssh root@qr01dbadm01
root@qr01dbadm01's password: ????????
[root@qr01dbadm01 ~] #
```

- Confirm the port number used by the Enterprise Manager Agent. One way to do this is to examine the `EMD_URL` property in the `<AGENT_INST>/sysman/config/emd.properties` file. By default, the agent will listen on port 3872.

```
[root@qr01dbadm01 ~]# grep EMD_URL=
/u01/app/oracle/product/12.1.0/agent/agent_inst/sysman/config/emd.properties
EMD_URL=https://qr01dbadm01.example.com:3872/emd/main/
[root@qr01dbadm01 ~] #
```

3. Using the following command, confirm that the port you identified in the previous step is currently being used to listen for UDP messages. This is an indication that the agent is listening for SNMP traps.

```
[root@qr01dbadm01 ~]# netstat -an | grep 3872 | grep udp
udp        0      0 ::::3872          ::::*
[root@qr01dbadm01 ~]#
```

4. Ensure that the snmptrapd OS service is currently stopped.

```
[root@qr01dbadm01 ~]# service snmptrapd status
snmptrapd is stopped
[root@qr01dbadm01 ~]#
```

5. Using the following command, configure the snmptrapd OS service so that SNMP traps received on the default port (162) are forwarded to the Enterprise Manager Agent. Note that in a production environment, if you are using SNMP community values in your network, you should alter the configuration in this step to reflect your community values rather than using the default public community. Also, ensure that the port number at the end of the forward directive matches your agent port.

```
[root@qr01dbadm01 ~]# cat > /etc/snmp/snmptrapd.conf << END
> authcommunity log,execute,net public
> forward default udp:localhost:3872
> END
[root@qr01dbadm01 ~]#
```

6. Configure the snmptrapd OS service to make sure that it is automatically started on server reboot.

```
[root@qr01dbadm01 ~]# chkconfig snmptrapd on
[root@qr01dbadm01 ~]#
```

7. Start the snmptrapd OS service.

```
[root@qr01dbadm01 ~]# service snmptrapd start
Starting snmptrapd:                                     [ OK ]
[root@qr01dbadm01 ~]#
```

At this point, you have configured and started SNMP forwarding on qr01dbadm01.

8. Next, repeat the process on qr01dbadm02.

```
$ ssh root@qr01dbadm02
root@qr01dbadm02's password: ???????
[root@qr01dbadm02 ~]# grep EMD_URL=
/u01/app/oracle/product/12.1.0/agent/agent_inst/sysman/config/emd.properties
EMD_URL=https://qr01dbadm02.example.com:3872/emd/main/
[root@qr01dbadm02 ~]# netstat -an | grep 3872 | grep udp
udp          0          0 ::::3872                      ::::*
[root@qr01dbadm02 ~]# service snmptrapd status
snmptrapd is stopped
[root@qr01dbadm02 ~]# cat > /etc/snmp/snmptrapd.conf << END
> authcommunity log,execute,net public
> forward default udp:localhost:3872
> END
[root@qr01dbadm02 ~]# chkconfig snmptrapd on
[root@qr01dbadm02 ~]# service snmptrapd start
Starting snmptrapd:                                         [ OK ]
[root@qr01dbadm02 ~]#
```

Earlier, when you performed the Database Machine discovery process, your Exadata Storage Servers were configured to send alerts to Enterprise Manager by using SNMP. In the final part of this practice, you will confirm the SNMP configuration on your Exadata Storage Servers.

9. Establish a terminal session connected to qr01celadm01 by using the celladmin OS user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ???????
[celladmin@qr01celadm01 ~]$
```

10. Using the following command, examine the notificationMethod storage server attribute. Seeing snmp in the notification method, confirms that SNMP notifications are enabled.

```
[celladmin@qr01celadm01 ~]$ dcli -c
qr01celadm01,qr01celadm02,qr01celadm03 cellcli -e list cell
attributes notificationMethod
qr01celadm01: mail,snmp
qr01celadm02: snmp
qr01celadm03: snmp
[celladmin@qr01celadm01 ~]$
```

11. Using the following command, examine the `snmpSubscriber` storage server attribute. As shown in the example output below, your storage servers should be configured to send SNMP traps directly to all the Enterprise Manager agents. This eliminates the possibility of alert messages getting lost due to the loss or unavailability of a single agent.

```
[celladmin@qr01celadm01 ~]$ dcli -c
qr01celadm01,qr01celadm02,qr01celadm03 cellcli -e list cell
attributes snmpSubscriber

qr01celadm01:
((host=qr01dbadm02.example.com,port=3872,community=public),(host
=qr01dbadm01.example.com,port=3872,community=public))

qr01celadm02:
((host=qr01dbadm02.example.com,port=3872,community=public),(host
=qr01dbadm01.example.com,port=3872,community=public))

qr01celadm03:
((host=qr01dbadm02.example.com,port=3872,community=public),(host
=qr01dbadm01.example.com,port=3872,community=public))

[celladmin@qr01celadm01 ~]$
```

12. Using the following command, examine the `notificationPolicy` storage server attribute. Your storage server should be configured to deliver critical alerts, warning alerts, and alert clearance notifications, as shown in the example below.

```
[celladmin@qr01celadm01 ~]$ dcli -c
qr01celadm01,qr01celadm02,qr01celadm03 cellcli -e list cell
attributes notificationPolicy

qr01celadm01: critical,warning,clear
qr01celadm02: critical,warning,clear
qr01celadm03: critical,warning,clear

[celladmin@qr01celadm01 ~]$
```

13. Exit your terminal sessions.

Practices for Lesson 15: Monitoring Exadata Storage Servers

Chapter 15

Practices for Lesson 15: Overview

Practices Overview

In these practices, you will monitor Exadata Storage Server by using metrics, alerts, and active requests. You will also perform a variety of Exadata Storage Server monitoring and administration tasks by using Enterprise Manager Cloud Control 12c.

Practice 15-1: Metrics, Alerts, and Active Requests

Overview

In this practice, you will monitor Exadata Storage Server by using metrics, alerts, and active requests.

Tasks

- Establish a terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~]$
```

- Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...

CellCLI>
```

Metrics are recorded observations of important run-time properties or internal instrumentation values of the storage cell and its components, such as cell disks or grid disks.

- Execute the LIST METRICDEFINITION command to list every metric.

```
CellCLI> list metricdefinition
CD_BY_FC_DIRTY
CD_IO_BY_R_LG
CD_IO_BY_R_LG_SEC
CD_IO_BY_R_SCRUB
CD_IO_BY_R_SCRUB_SEC
...
SIO_IO_WR_HD_SEC
SIO_IO_WR_RQ_FC
SIO_IO_WR_RQ_FC_SEC
SIO_IO_WR_RQ_HD
SIO_IO_WR_RQ_HD_SEC

CellCLI>
```

4. Execute LIST METRICDEFINITION DETAIL to view more comprehensive information about all the metrics.

```
CellCLI> list metricdefinition detail
...
name: SIO_IO_WR_RQ_HD
description: "Cumulative number of write IO requests to
hard disk by smart IO"
metricType: Cumulative
objectType: SMARTIO
unit: "IO requests"

name: SIO_IO_WR_RQ_HD_SEC
description: "Number of write IO requests per second to
hard disk by smart IO"
metricType: Rate
objectType: SMARTIO
unit: IO/sec

CellCLI>
```

5. Add a WHERE condition to view information about specific metrics. Note the metrics CL_MEMUT and CL_FSUT, which you will use later in this practice.

```
CellCLI> list metricdefinition where name like 'CL_.*UT' detail
name: CL_CPUT
description: "Percentage of time over the previous minute
that the system CPUs were not idle."
metricType: Instantaneous
objectType: CELL
unit: %

name: CL_FSUT
description: "Percentage of total space on this file
system that is currently used"
metricType: Instantaneous
objectType: CELL_FILESYSTEM
unit: %

name: CL_MEMUT
description: "Percentage of total physical memory on this
server that is currently used"
metricType: Instantaneous
objectType: CELL
unit: %

CellCLI>
```

6. Execute LIST METRICCURRENT to view the most current metric observations.

```
CellCLI> list metriccurrent
...
SIO_IO_RV_OF_SEC           SMARTIO      0.000 MB/sec
SIO_IO_SI_SV               SMARTIO      0.000 MB
SIO_IO_SI_SV_SEC          SMARTIO      0.000 MB/sec
SIO_IO_WR_FC               SMARTIO      8,073 MB
SIO_IO_WR_FC_SEC          SMARTIO      0.000 MB/sec
SIO_IO_WR_HD               SMARTIO      2,280 MB
SIO_IO_WR_HD_SEC          SMARTIO      0.000 MB/sec
SIO_IO_WR_RQ_FC            SMARTIO      8,409 IO requests
SIO_IO_WR_RQ_FC_SEC       SMARTIO      0.0 IO/sec
SIO_IO_WR_RQ_HD            SMARTIO      2,332 IO requests
SIO_IO_WR_RQ_HD_SEC       SMARTIO      0.0 IO/sec

CellCLI>
```

7. Add a WHERE condition to view the most current metric observations for a subset of metrics.

```
CellCLI> list metriccurrent where objecttype = 'CELL'
CL_CPUT                   qr01celadm01  1.8 %
CL_CPUT_CS                qr01celadm01  10.4 %
CL_CPUT_MS                qr01celadm01  0.1 %
CL_FANS                   qr01celadm01  0
CL_IO_RQ_NODATA           qr01celadm01  0 IO requests
CL_IO_RQ_NODATA_SEC      qr01celadm01  0.0 IO/sec
CL_MEMUT                  qr01celadm01  98 %
CL_MEMUT_CS               qr01celadm01  38.8 %
CL_MEMUT_MS               qr01celadm01  12.7 %
CL_RUNQ                   qr01celadm01  0.2
CL_SWAP_IN_BY_SEC         qr01celadm01  0.0 KB/sec
CL_SWAP_OUT_BY_SEC        qr01celadm01  0.0 KB/sec
CL_SWAP_USAGE              qr01celadm01  3 %
CL_VIRTMEM_CS             qr01celadm01  5,868 MB
CL_VIRTMEM_MS             qr01celadm01  2,161 MB
IORM_MODE                 qr01celadm01  2
N_HCA_MB_RCV_SEC          qr01celadm01  0.000 MB/sec
N_HCA_MB_TRANS_SEC        qr01celadm01  0.000 MB/sec
N_NIC_KB_RCV_SEC          qr01celadm01  0.1 KB/sec
N_NIC_KB_TRANS_SEC        qr01celadm01  0.1 KB/sec

CellCLI>
```

8. Examine a specific metric by specifying the metric name.

```
CellCLI> list metriccurrent cl_memut
CL_MEMUT                  qr01celadm01  98 %

CellCLI>
```

9. Use the following command to determine if there are any metrics that are currently in an abnormal state. Normally, you should not expect any output from this command.

```
CellCLI> list metriccurrent where alertState != normal
CellCLI>
```

10. Show the current space utilization on the root (/) cell file system. Note the reported utilization value because you will need this value later in the practice.

```
CellCLI> list metriccurrent cl_fsut where metricObjectName = '/'
CL_FSUT          "/"      21 %
```

CellCLI>

The LIST METRICHISTORY command shows historical metric observations that are maintained in an internal repository on the cell. The retention period for metric history observations is specified by the metricHistoryDays cell attribute. The default retention period is 7 days and you can modify this setting with the CellCLI ALTER CELL command. You can display all the retained history for all the metrics by using LIST METRICHISTORY; however, doing so will output vast amounts of data so you should always use a filter to return more specific output.

11. Use the following command to determine if, and when, any metrics were in an abnormal state during the retention period. Normally, you should not expect any output from this command. Note that it may take quite a few seconds for this command to complete.

```
CellCLI> list metrichistory where alertState != normal
CellCLI>
```

Alerts represent events of importance occurring within Exadata, typically indicating that cell functionality is either compromised or in danger of failure.

12. Use the LIST ALERTHISTORY command to view all the alerts maintained in the alert repository. Normally you should expect to see no alerts.

```
CellCLI> list alerthistory
CellCLI>
```

13. Use the DROP ALERTHISTORY command to clear out old or unwanted alerts. If you want to focus on future alerts, you can clear the entire alert history by using DROP ALERTHISTORY ALL. Execute the DROP ALERTHISTORY ALL command.

```
CellCLI> drop alerthistory all
No alerts qualified for this drop operation
CellCLI>
```

An alert is automatically triggered when a predefined hardware or software issue is detected, or when a metric exceeds a threshold. In the next few steps, you will define a threshold, and then create a condition which will cause an alert.

14. List the thresholds currently defined on the Exadata cell. By default, there are no thresholds defined.

```
CellCLI> list threshold
```

```
CellCLI>
```

15. Create a warning threshold for file system utilization on the root (/) file system. Set the warning level to a value slightly larger than the utilization you observed in step 10.

```
CellCLI> create threshold cl_fsut."/ comparison='>', warning=22
```

```
Threshold cl_fsut."/ successfully created
```

```
CellCLI>
```

16. View the newly created threshold definition.

```
CellCLI> list threshold detail
```

name:	cl_fsut./
comparison:	>
warning:	22.0

```
CellCLI>
```

17. Exit CellCLI.

```
CellCLI> exit
```

```
quitting
```

```
[celladmin@qr01celadm01 ~]$
```

18. Execute the following command inside the cell operating system. It creates a 1 GB file on the root file system, which will increase the utilization metric. After the metric crosses the threshold you defined in step 15, an alert will be generated.

```
[celladmin@qr01celadm01 ~]$ dd if=/dev/zero of=/tmp/file.out  
bs=1024 count=1000000
```

```
1000000+0 records in
```

```
1000000+0 records out
```

```
1024000000 bytes (1.0 GB) copied, 7.47261 s, 137 MB/s
```

```
[celladmin@qr01celadm01 ~]$
```

19. Relaunch CellCLI.

```
[celladmin@qr01celadm01 ~]$ cellcli
```

```
CellCLI: Release 12.1.2.1.0 - Production...
```

```
CellCLI>
```

20. Execute the LIST ALERTHISTORY command. Do you see an alert? If you do not see any alerts, re-execute LIST ALERTHISTORY periodically until the alert appears. Usually an alert is generated within a few minutes of a threshold being exceeded.

```
CellCLI> list alerthistory
      1_1      2016-06-10T02:28:18+00:00      warning
"The warning threshold for the following metric has been
crossed. Metric Name      : CL_FSUT Metric Description :
Percentage of total space on this file system that is currently
used Object Name      : / Current Value      : 23.0 %
Threshold Value      : 22.0 %"
CellCLI>
```

21. List the detailed alert information associated with the alert. Note that the examinedBy attribute is empty.

```
CellCLI> list alerthistory detail
      name:          1_1
      alertDescription: "The warning threshold for
metric CL_FSUT has been crossed: current value 23.0 %, threshold
value 22.0 %"
      alertMessage:      "The warning threshold for the
following metric has been crossed. Metric Name      : CL_FSUT
Metric Description : Percentage of total space on this file
system that is currently used Object Name      : / Current
Value      : 23.0 % Threshold Value      : 22.0 %"
      alertSequenceID:    1
      alertShortName:     CL_FSUT
      alertType:          Stateful
      beginTime:         2016-06-10T02:28:18+00:00
      endTime:
      examinedBy:
      metricObjectName:   "/""
      metricValue:        23.0
      notificationState:  1
      sequenceBeginTime: 2016-06-10T02:28:18+00:00
      severity:          warning
      alertAction:        "Examine the metric value that
is violating the specified threshold, and take appropriate
actions if needed."
CellCLI>
```

22. Modify the alert to indicate that you have examined it.

```
CellCLI> alter alerthistory 1_1 examinedby='student'  
Alert 1_1 successfully altered  
  
CellCLI>
```

23. List the detailed alert information associated with the alert. Note that the examinedBy attribute is now set as you specified in the previous step.

```
CellCLI> list alerthistory detail  
      name:          1_1  
      alertDescription: "The warning threshold for  
metric CL_FSUT has been crossed: current value 23.0 %, threshold  
value 22.0 %"  
      alertMessage:    "The warning threshold for the  
following metric has been crossed. Metric Name : CL_FSUT  
Metric Description : Percentage of total space on this file  
system that is currently used Object Name : / Current  
Value   : 23.0 % Threshold Value : 22.0 %"  
      alertSequenceID: 1  
      alertShortName:  CL_FSUT  
      alertType:       Stateful  
      beginTime:      2016-06-10T02:28:18+00:00  
      endTime:  
      examinedBy:     student  
      metricObjectName:  "/"  
      metricValue:     23.0  
      notificationState: 1  
      sequenceBeginTime: 2016-06-10T02:28:18+00:00  
      severity:       warning  
      alertAction:     "Examine the metric value that  
is violating the specified threshold, and take appropriate  
actions if needed."  
  
CellCLI>
```

24. Exit CellCLI.

```
CellCLI> exit  
quitting  
  
[celladmin@qr01celadm01 ~]$
```

25. Delete the file you created in step 18. Be careful not to delete any other files.

```
[celladmin@qr01celadm01 ~]$ rm /tmp/file.out  
[celladmin@qr01celadm01 ~]$
```

26. Relaunch CellCLI.

```
[celladmin@qr01celadm01 ~]$ cellcli  
CellCLI: Release 12.1.2.1.0 - Production...  
  
CellCLI>
```

27. Examine the file system utilization and confirm that the root (/) file system utilization has fallen back below the warning threshold. If the metric still exceeds the warning threshold, re-execute the command periodically until the metric value is updated.

```
CellCLI> list metriccurrent cl_fsut where metricObjectName = '/'  
CL_FSUT          "/"      24 %  
  
CellCLI> list metriccurrent cl_fsut where metricObjectName = '/'  
CL_FSUT          "/"      21 %  
  
CellCLI>
```

28. Re-execute LIST ALERT HISTORY. Note that the alert is now listed as cleared.

```
CellCLI> list alerthistory  
1_1    2016-06-10T02:28:18+00:00      warning  
"The warning threshold for the following metric has been  
crossed. Metric Name      : CL_FSUT Metric Description :  
Percentage of total space on this file system that is currently  
used Object Name       : / Current Value      : 23.0 %  
Threshold Value       : 22.0 % "  
  
1_2    2016-06-10T02:30:18+00:00      clear  
"The warning threshold for the following metric has been  
cleared. Metric Name      : CL_FSUT Metric Description :  
Percentage of total space on this file system that is currently  
used Object Name       : / Current Value      : 21.0 %  
Threshold Value       : 22.0 % "  
  
CellCLI>
```

29. View the alert details to determine the period of the alert.

```
CellCLI> list alerthistory detail
      name:          1_1
      alertDescription: "The warning threshold for metric CL_FSUT has
been crossed: current value 23.0 %, threshold value 22.0 %"
      alertMessage:   "The warning threshold for the following
metric has been crossed. Metric Name : CL_FSUT Metric Description :
Percentage of total space on this file system that is currently used Object
Name : / Current Value : 23.0 % Threshold Value : 22.0 %"
      alertSequenceID: 1
      alertShortName:  CL_FSUT
      alertType:       Stateful
      beginTime:       2016-06-10T02:28:18+00:00
      endTime:         2016-06-10T02:30:18+00:00
      examinedBy:     student
      metricObjectName: "/"
      metricValue:    23.0
      notificationState: 1
      sequenceBeginTime: 2016-06-10T02:28:18+00:00
      severity:       warning
      alertAction:     "Examine the metric value that is violating
the specified threshold, and take appropriate actions if needed."
      name:          1_2
      alertMessage:   "The warning threshold for the following
metric has been cleared. Metric Name : CL_FSUT Metric Description :
Percentage of total space on this file system that is currently used Object
Name : / Current Value : 21.0 % Threshold Value : 22.0 %"
      alertSequenceID: 1
      alertShortName:  CL_FSUT
      alertType:       Stateful
      beginTime:       2016-06-10T02:30:18+00:00
      endTime:         2016-06-10T02:30:18+00:00
      examinedBy:     student
      metricObjectName: "/"
      metricValue:    21.0
      notificationState: 1
      sequenceBeginTime: 2016-06-10T02:28:18+00:00
      severity:       clear
      alertAction:     "The threshold value is no longer violated.
No further action is required for threshold CL_FSUT."/"."
CellCLI>
```

An active request provides a view of I/O requests that are currently being processed by a cell. In the next few steps, you will execute a database update and analyze the associated active requests.

30. Establish a separate terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance). Leave your CellCLI terminal session running in the background.

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

31. Connect to your database with SQL*Plus. Log in as the sh user and configure your new session to force parallel DML.

```
[oracle@qr01dbadm01 ~]$ sqlplus sh/?

SQL*Plus: Release 12.1.0.2.0 Production..


SQL> alter session force parallel dml;
Session altered.

SQL>
```

32. Execute the following long-running update statement. (Use the SQL script /home/oracle/labs/lab15-01-32.sql if you prefer.) **Continue to the next step while the update statement is processing.** If the update completes before you gather the information in the next step, commit the changes and re-execute the update statement.

```
SQL> update customers
  2  set cust_credit_limit=0.9*cust_credit_limit
  3  where cust_id < 500000;
```

33. Switch back to your original terminal session and execute the CellCLI LIST ACTIVEREQUEST DETAIL command. If necessary, re-execute the command until you see an active request that exhibits the following attributes:

- The ioGridDisk matches one of your DATA grid disks.
- The objectNumber is a positive value.
- The sqID is a non-zero value.

Note that you may see different types of active requests including many that relate to internal database I/O, such as recursive SQL or writes to the redo log files.

```
CellCLI> list activerequest detail
...
name: 445
asmDiskGroupNumber: 1
asmFileIncarnation: 874117569
asmFileName: 273
consumerGroupID: 17326
consumerGroupName: OTHER_GROUPS
dbID: 2080757153
dbName: DBM
dbRequestID: 445
fileType: Datafile
id: 445
instanceNumber: 2
ioBytes: 491520
ioBytessofar: 0
ioGridDisk: DATA_QR01_CD_00_qr01celadm01
ioOffset: 646096
ioReason: "BufferCache Read"
ioType: CacheGet
objectNumber: 20473
parentID: 445
pdbID: 0
requestState: "Queued for Disk Read"
sessionID: 817
sessionSerNumber: 52242
sqID: 6fkm917x69xs
tableSpaceNumber: 7
```

CellCLI>

34. Switch back to your SQL*Plus session. After the update from step 32 finishes, commit the transaction. Then use the object number and tablespace number from the output in step 33 to determine the identity of the database object associated with the active request. (Use the SQL script /home/oracle/labs/lab15-01-34.sql if you prefer.) Verify that the active request information you saw earlier is associated with an action on the CUSTOMERS table.

```
499999 rows updated.

SQL> commit;

Commit complete.

SQL> select distinct object_name, tablespace_name
  2  from v$segment_statistics
  3  where dataobj#=20473 and ts#=7;

OBJECT_NAME
-----
TABLESPACE_NAME
-----
CUSTOMERS
SH

SQL>
```

35. Query V\$SQL and use the sqlID from step 33 to verify that the active request information is in fact associated with the update you executed in step 32. (Use the SQL script /home/oracle/labs/lab15-01-35.sql if you prefer.)

```
SQL> select distinct sql_text, sql_id
  2  from v$sql where sql_id = '6fkm917x69xs';

SQL_TEXT
-----
SQL_ID
-----
update customers set cust_credit_limit=0.9*cust_credit_limit
where cust_id < 500000
6fkm917x69xs

SQL>
```

36. Exit all of your SQL*Plus and CellCLI sessions.

Practice 15-2: Exadata Storage Server Monitoring with Enterprise Manager

Overview

In this practice, you will exercise a variety of Exadata Storage Server monitoring and administration capabilities provided by Enterprise Manager Cloud Control 12c.

Assumptions

The practice relies on the configurations performed in Practice 14-1.

Tasks

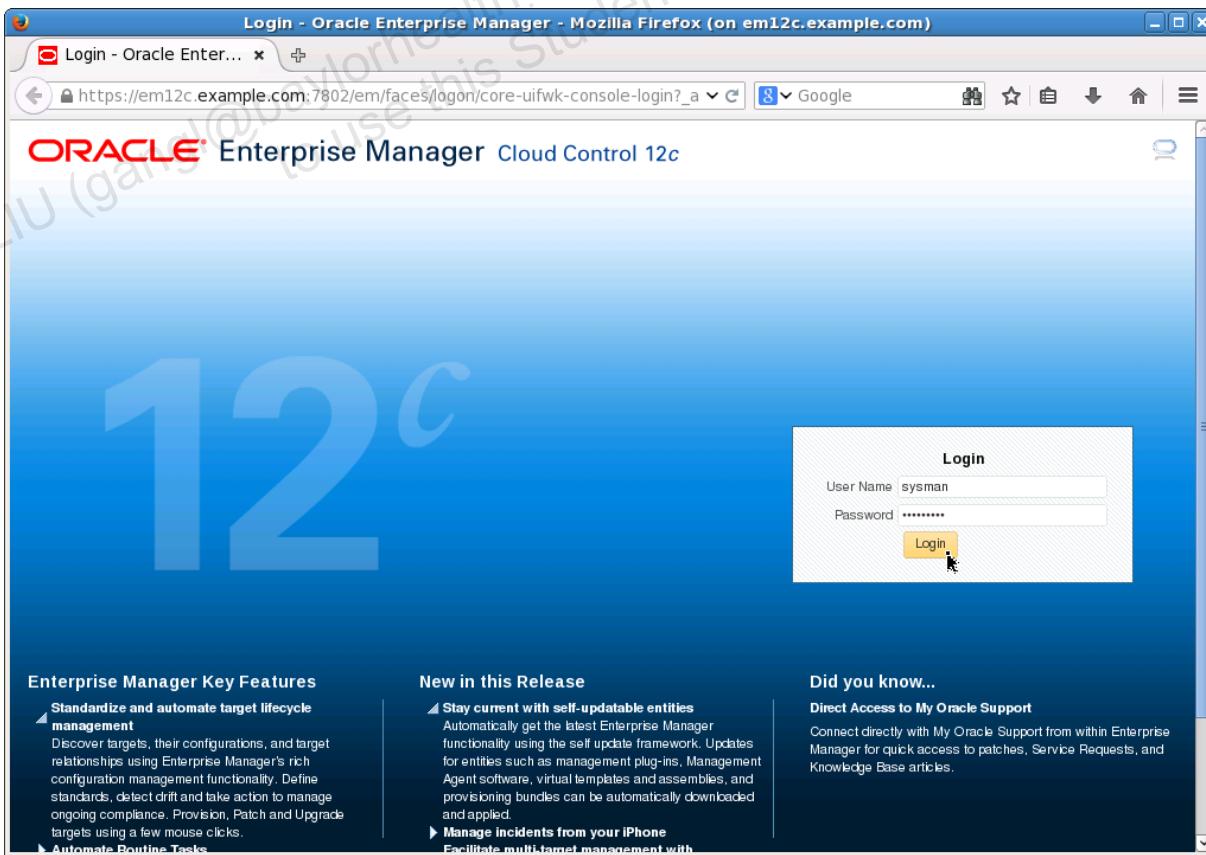
- Establish a terminal session connected to em12c by using the oracle OS user. Ensure that you specify the -X option for ssh.

```
$ ssh -X oracle@em12c
oracle@em12c password: ????????
[oracle@em12c ~]$
```

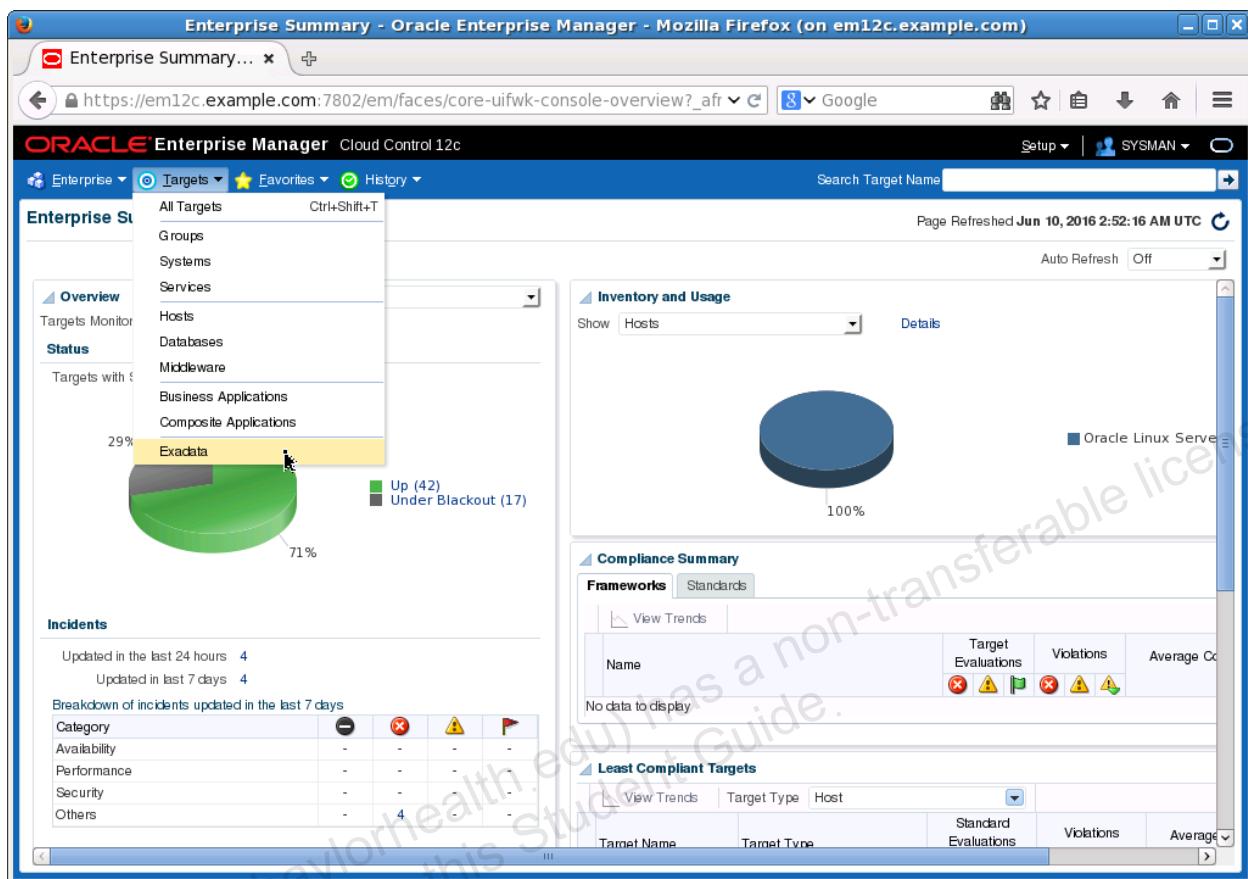
- Start the Firefox web browser.

```
[oracle@em12c ~]$ firefox &
[1] 30053
```

- Log in to Enterprise Manager Cloud Control 12c as the sysman user.



- To begin Exadata Storage Server monitoring, select the Targets > Exadata menu command.



5. Click the link corresponding to your Exadata Database Machine (DB Machine qr01.example.com).

The screenshot shows a Firefox browser window titled "Oracle Exadata Database Machines - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The address bar shows the URL https://em12c.example.com:7802/em/faces/core-uifwk-console-overview?_afr=rLoop=10096876929767&_afrWindowMode=0&_afrWindowId=sd5puv3f4_1#. The page header includes the ORACLE Enterprise Manager logo and "Cloud Control 12c". A search bar at the top right contains the placeholder "Search Target Name" with the date "Page Refreshed Jun 10, 2016 2:52:50 AM UTC". Below the header is a navigation menu with links for "Enterprise", "Targets", "Favorites", and "History". The main content area is titled "Oracle Exadata Database Machines" and features a search section with a "Search" button. A table lists database machines, with one row highlighted in yellow for "DB Machine qr01.example.com". The table columns are "Target Name", "Status", "Members", "Member Status Summary", and "Incidents". The "Members" column for the highlighted row shows "Cluster Database(1), Oracle Infiniband Switch(2), Oracle Infiniband Net" and a count of "17". The "Member Status Summary" column contains several status icons, including a red downward arrow, a green upward arrow, and other monitoring symbols.

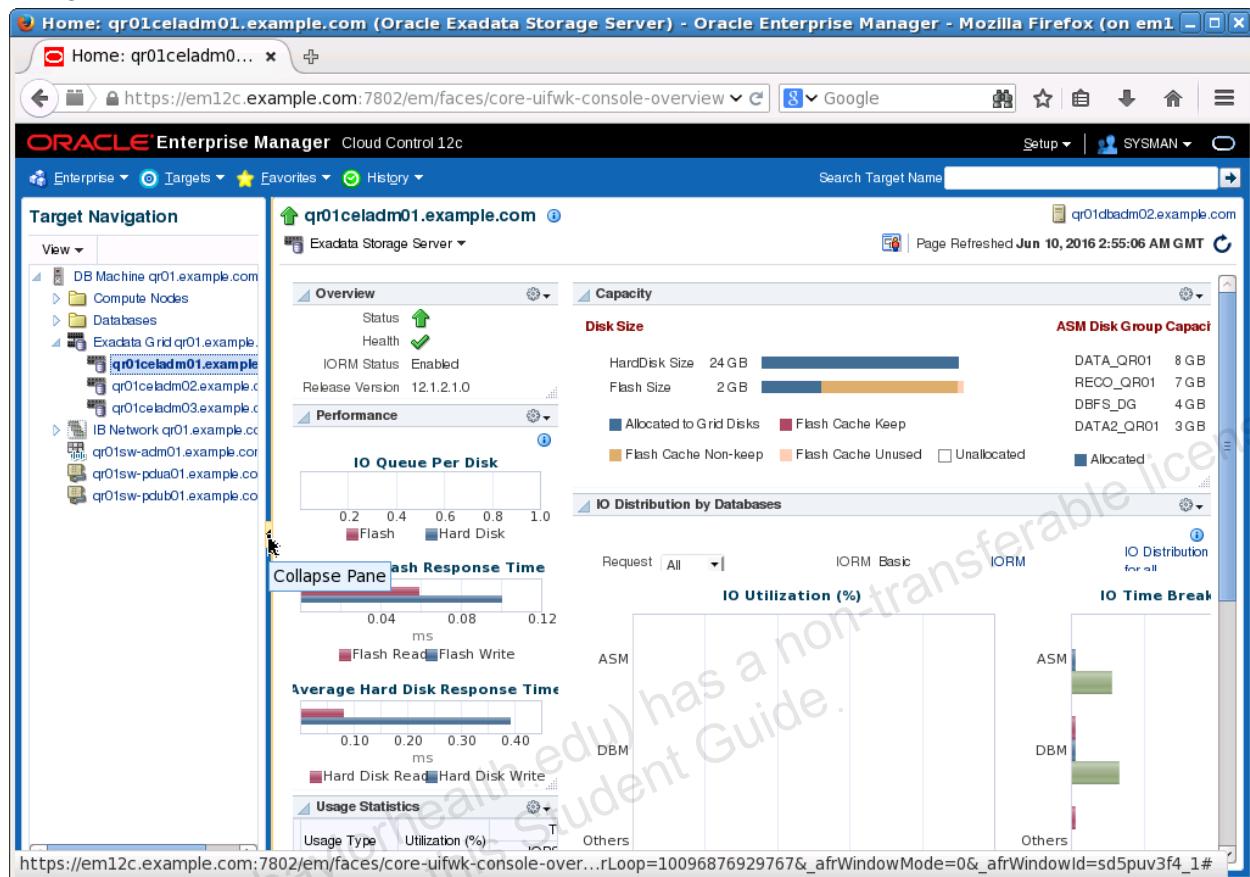
6. On the Database Machine home page, expand the Exadata Grid node in the Target Navigation pane.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface in Mozilla Firefox. The URL is <https://em12c.example.com:7802/em/faces/core-uifwk-console-overview>. The Target Navigation pane on the left is expanded to show the 'DB Machine qr01.example.com' node, which is further expanded to show 'Compute Nodes', 'Databases', 'Exadata Grid qr01.example.com', and 'IB Network qr01.example.com'. The main content area displays an 'Overview' section with metrics like Racks (1), Incidents (0), Compute Nodes (2 up, 1 down), Ethernet Switches (1 up), PDU (2 up), Exadata Cells (3 up), and IB Switches (2 up). Below this is a 'Database Machine Schematic' diagram showing three nodes: qr01sw-ibb01, qr01sw-adm01, and qr01sw-lba01, all marked as 'Up' (green dots). A legend indicates that green dots mean 'Up', red dots mean 'Down', and black dots mean 'Blackout'.

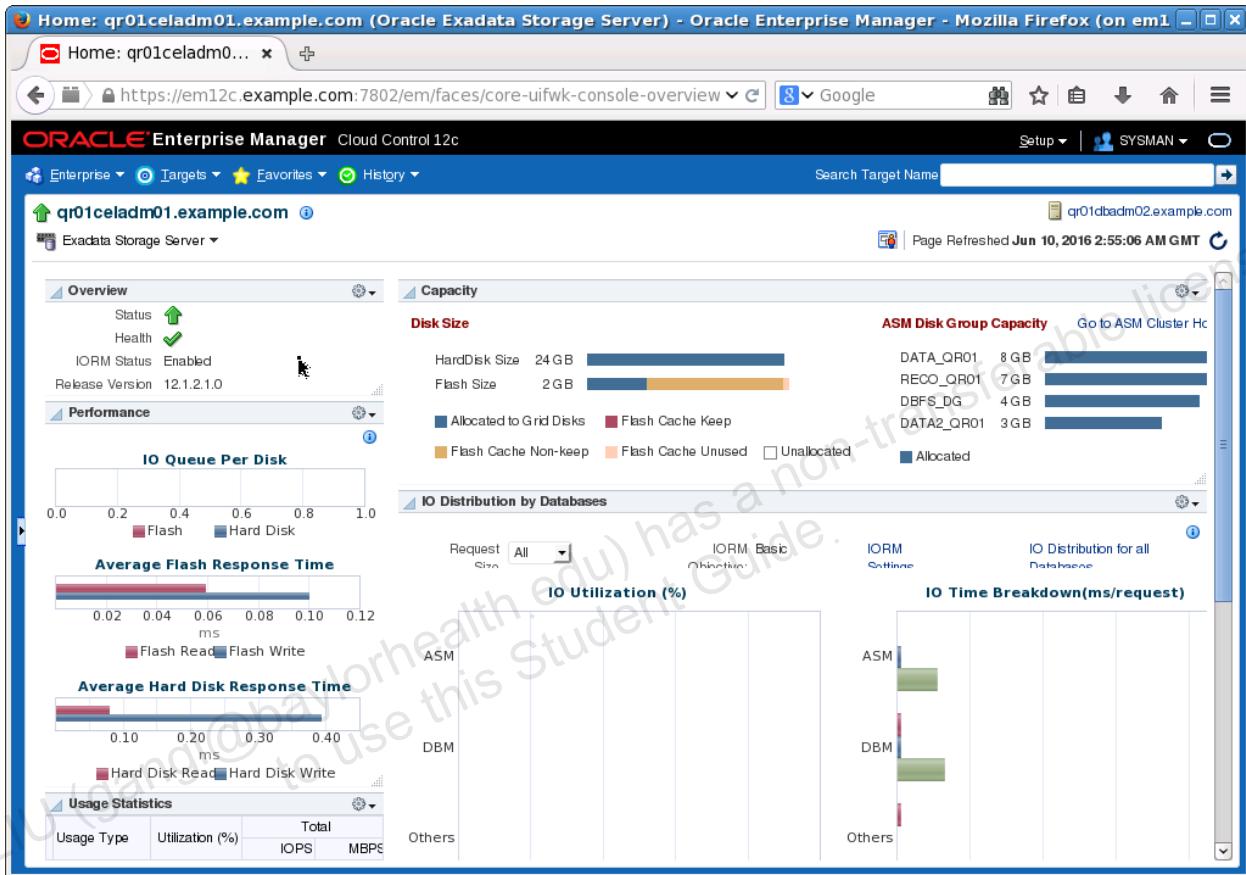
7. Now the Target Navigation pane shows the three Exadata Storage Servers contained in this Database Machine. Click the name of the first storage server (qr01celadm01.example.com).

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. In the Target Navigation pane on the left, under the DB Machine qr01.example.com section, the node qr01celadm01.example.com is selected. The main pane displays the DB Machine qr01.example.com details, including an Overview section with metrics like Racks (1), Incidents (0), Compute Nodes (2 up), Ethernet Switches (1 up), PDU (2 up), Exadata Cells (3 up), and IB Switches (2 up). Below this is a Database Machine Schematic diagram showing a rack with three nodes: qr01sw-ibb01, qr01sw-adm01, and qr01sw-lab01, all marked as 'Up' (green dots). A legend on the right defines the colors: green for Up, red for Down, black for Blackout, and grey for Exadata Cell.

8. On the Exadata Storage Server home page for qr01celadm01, collapse the Target Navigation pane.

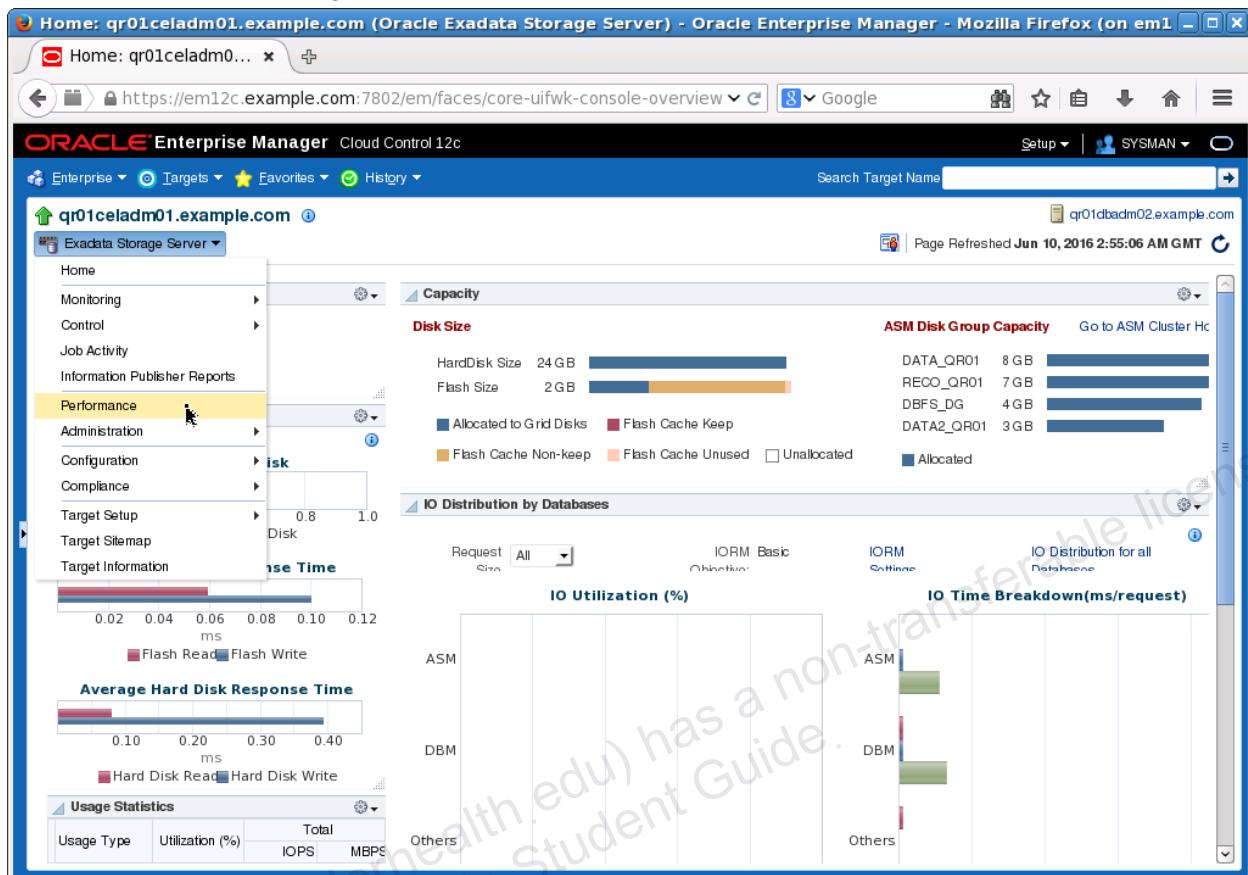


9. Take a moment to examine the Exadata Storage Server home page. Notice that the Overview area provides a quick visual indication of the status and health of the storage server. The other areas provide summary information relating to capacity, performance, and utilization of the cell. At the bottom of the page, the Incidents area displays alerts relating to the cell. You will investigate this area later in the practice. Note that the Size values reported on this page are accurate for your laboratory environment; however, they do not reflect the capacity of a real Exadata Storage Server.

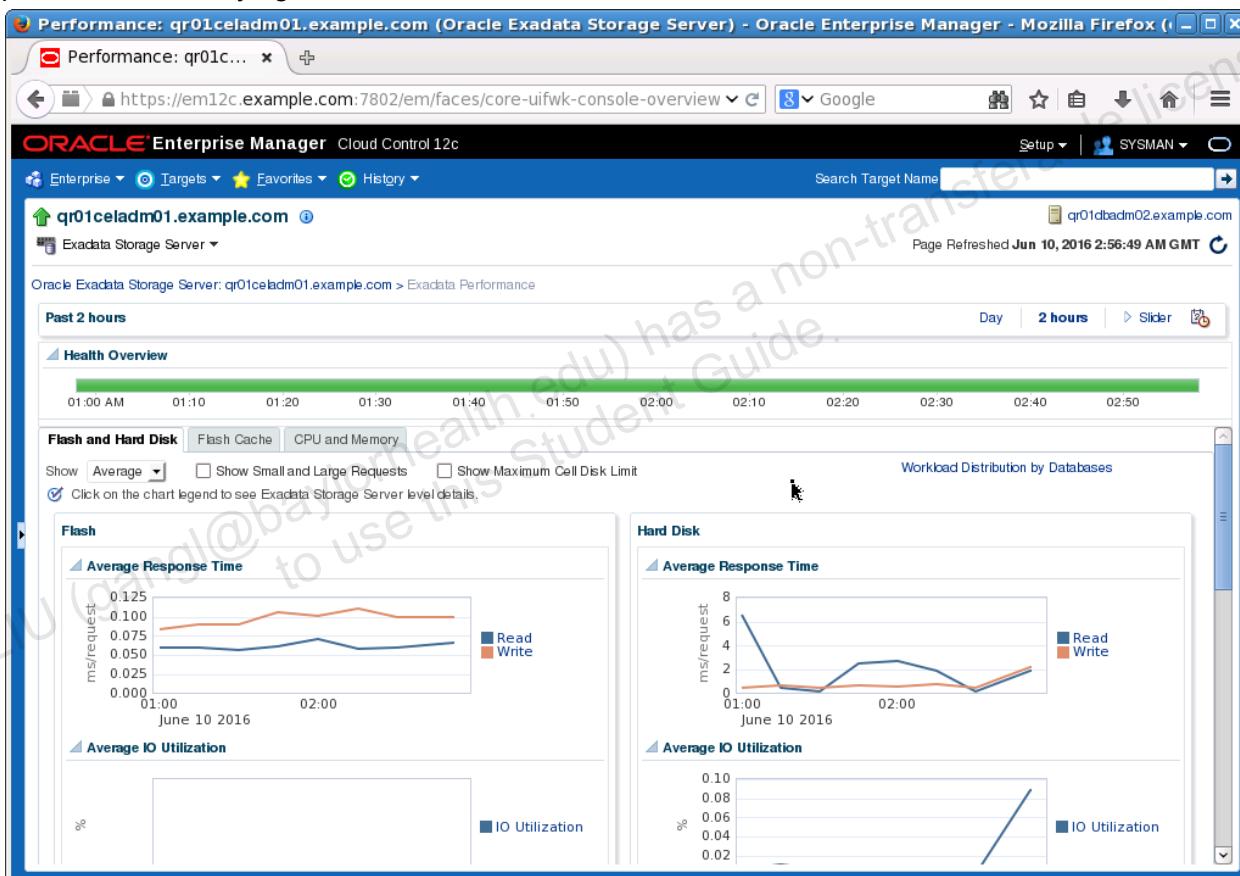


The Exadata Storage Server menu provides access to the other monitoring and administration functions provided by Enterprise Manager. In the next part of this practice, you will explore a number of these capabilities, starting with performance monitoring.

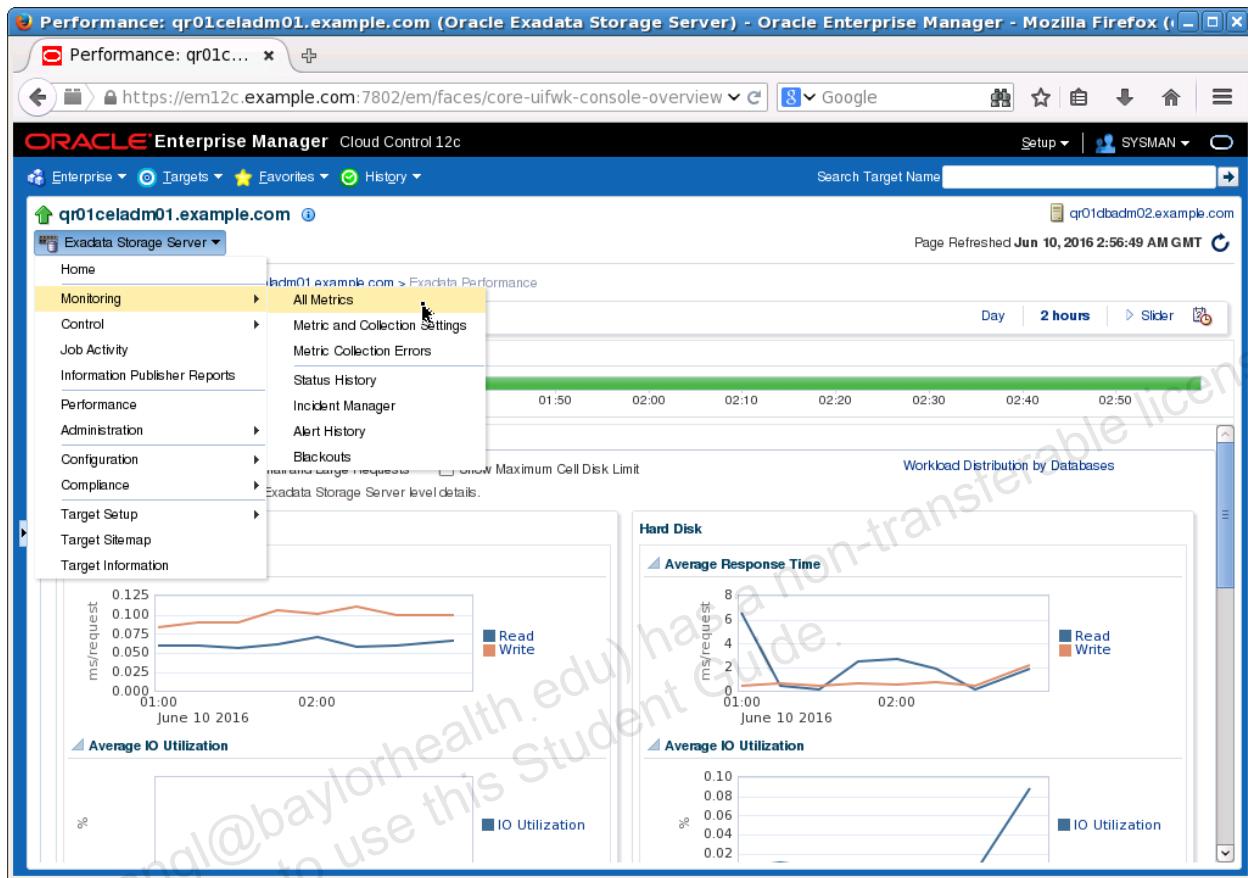
10. Select the Exadata Storage Server > Performance menu command.



11. You should now see the Exadata Storage Server Performance page for qr01celadm01. This page shows various performance metrics leading up to the current time. By default, you will see performance information relating to the past two hours. At the top of the page, you will see a visual indication of the cell health. A green band indicates a healthy cell over the corresponding time period. Below the Health Overview, a series of charts display key performance metrics associated with the cell. Take a moment to scroll down the page and examine all the performance charts. Note that the legend labels associated with each metric are links, which navigate to pages that contain more detailed information about the metric. Typically, administrators will gather an understanding of what this page should look like during normal system operation. Then they will check this page for abnormalities that could point to the underlying cause of an issue.



12. The Performance page gathers key cell performance metrics on a single page. However, these are not all the cell metrics gathered by Enterprise Manager. Select the Exadata Storage Server > Monitoring > All Metrics menu command to navigate to the All Metrics page.



13. The All Metrics page provides an interface for administrators to examine the metrics associated with a monitoring target. For Exadata Storage Servers, this page provides access to more than 100 metrics associated with each cell. The metrics are organized into groups, which are displayed in a hierarchical list on the left side of the page. Click the Aggregated Exadata CellDisk Metric group.

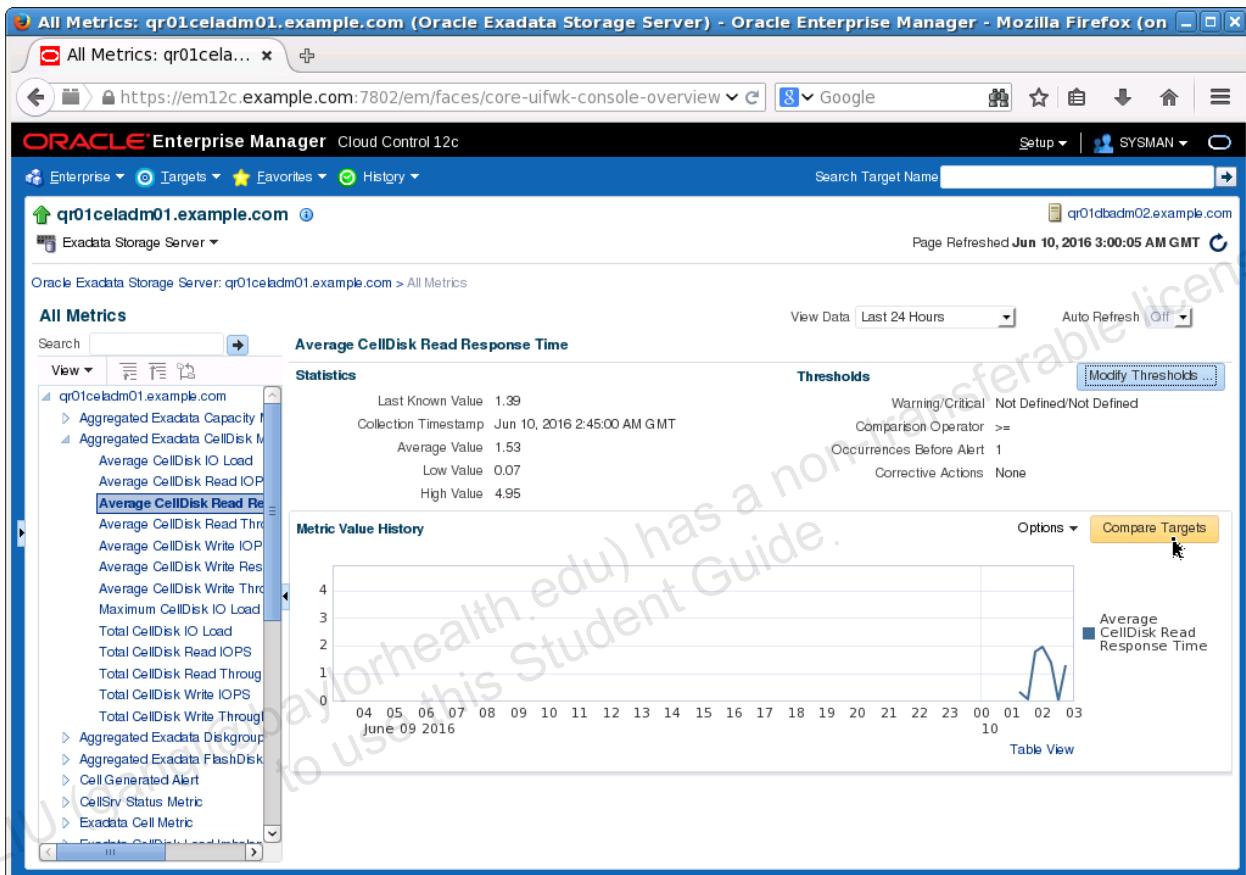
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar indicates the target is qr01celadm01.example.com. The main content area is titled 'All Metrics'. On the left, a tree view shows various metric categories under qr01celadm01.example.com, with 'Aggregated Exadata CellDisk Metric' currently selected. To the right of the tree view are two tables: 'Open Metric Events' and 'Top 5 alerting metrics (Last 7 days)', both of which show 'No data to display.'

14. Now you see the aggregated cell disk metrics. Notice that these metrics are collected every 15 minutes by default. Click the Average CellDisk Read Response Time metric.

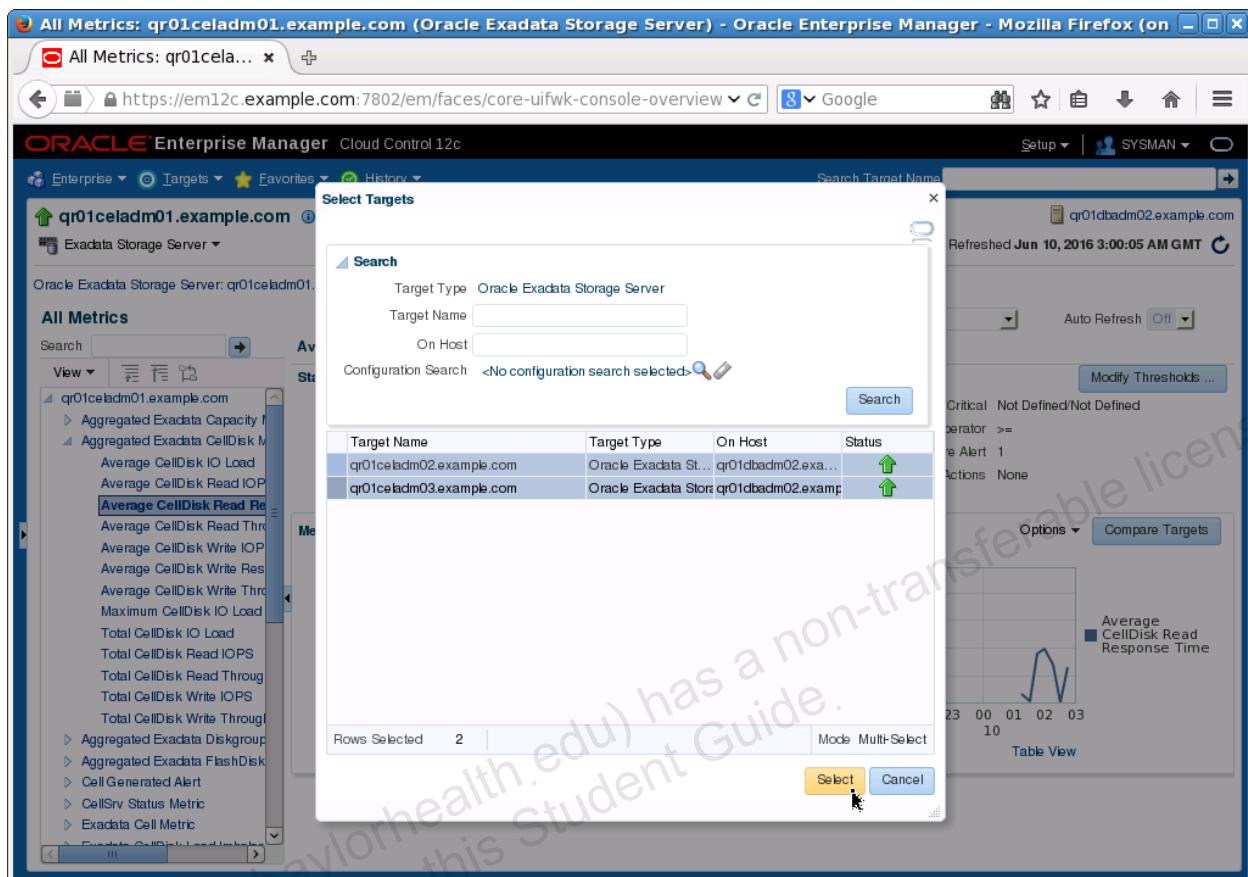
The screenshot shows the Oracle Enterprise Manager interface for an Exadata Storage Server. The left sidebar lists various metrics under the 'qr01celadm01.example.com' target. The main content area is titled 'Aggregated Exadata CellDisk Metric' and shows a table of metrics with their real-time values. The 'Average CellDisk Read Response Time' metric is highlighted in blue. The table includes columns for Metric, Thresholds, and Real Time Value. The 'Real Time Value' column for the highlighted metric shows a value of 0.63.

Metric	Thresholds	Real Time Value
Average CellDisk IO Load	Not Set	0
Average CellDisk Read IOPS	Not Set	0.63
Average CellDisk Read Response Time	Not Set	1.38
Average CellDisk Read Throughput	Not Set	0.02
Average CellDisk Write IOPS	Not Set	0.79
Average CellDisk Write Response Time	Not Set	1.67
Average CellDisk Write Throughput	Not Set	0.02
Maximum CellDisk IO Load	Not Set	0
Total CellDisk IO Load	Not Set	0.01
Total CellDisk Read IOPS	Not Set	10.08
Total CellDisk Read Throughput	Not Set	0.35
Total CellDisk Write IOPS	Not Set	12.7
Total CellDisk Write Throughput	Not Set	0.31

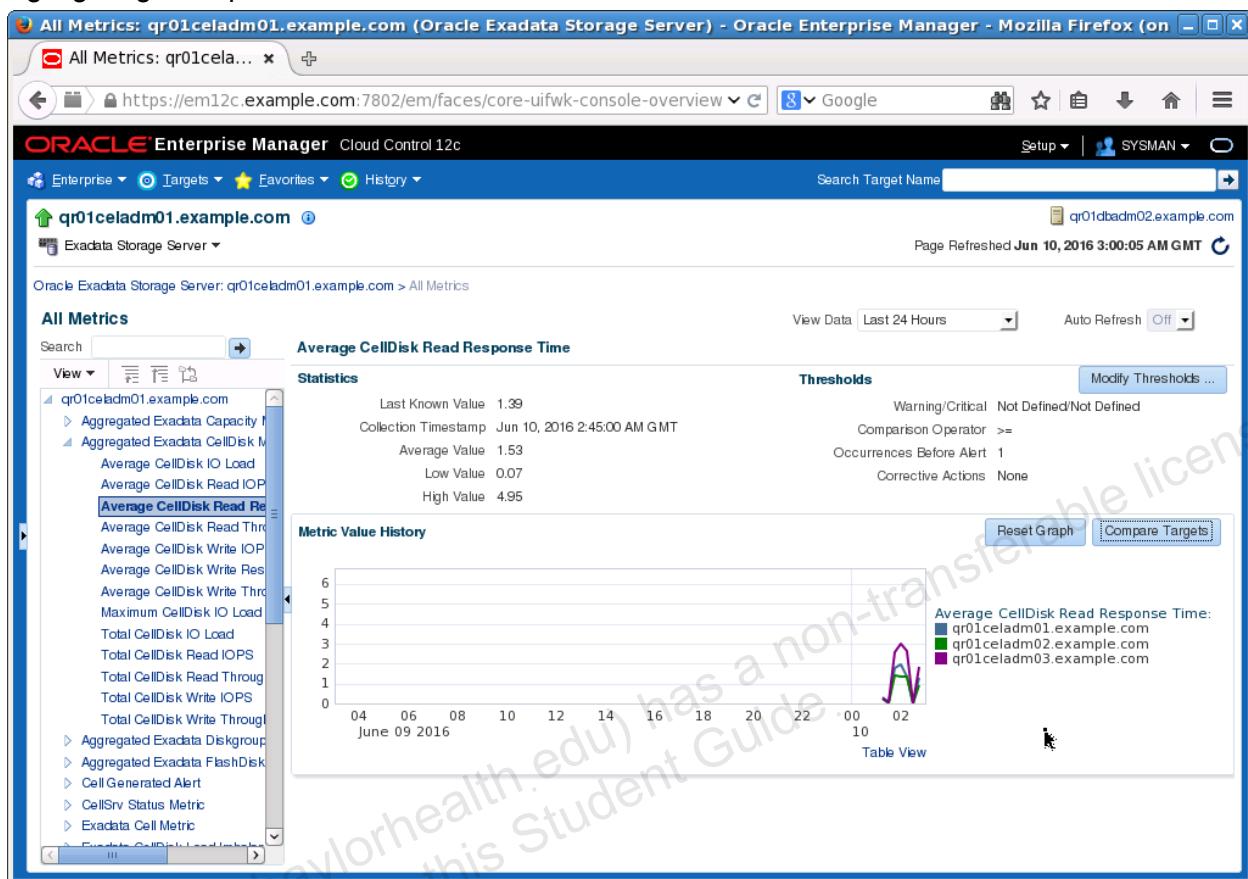
15. When you select an individual metric, you are provided with detailed information about the metric. For Average CellDisk Read Response Time, you can see various statistics along with the thresholds relating to the metric. From this page, you can also modify the threshold settings. A chart, graphing the metric value over time, is also provided. This chart also contains a useful function that enables administrators to compare the metric observation on this cell with the observations on other cells. Click Compare Targets to initiate the comparison.



16. In the dialog box that appears, select both the cells (shift-click qr01celadm02 and qr01celadm03) and click Select.



17. Now the chart displays the metric observations for all three cells. This can be very useful for highlighting cell-specific metric anomalies.



So far, you have seen the storage server performance page and interacted with storage server metrics. In the next part of this practice, you will modify some metric threshold settings.

18. Select the Exadata Storage Server > Monitoring > “Metric and Collection Settings” menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar has 'Monitoring' selected. A context menu is open over a chart titled 'Response Time'. The menu items are: All Metrics, Metric and Collection Settings (which is highlighted), Metric Collection Errors, Status History, Incident Manager, Alert History, and Blackouts. The main content area displays a line graph for 'Average CellDisk Read Response Time' from June 09, 2016, to June 10, 2016. The Y-axis ranges from 0 to 6. The X-axis shows hours from 04 to 02. Three data series are plotted: qr01celadm01.example.com (blue), qr01celadm02.example.com (green), and qr01celadm03.example.com (purple). The purple line shows a sharp peak around 02:00 on June 10th. Below the graph is a table titled 'Metric Value History' with columns for metric name, value, and timestamp.

Metric	Value	Timestamp
Average CellDisk Write Throughput	1.39	Jun 10, 2016 2:45:00 AM GMT
Maximum CellDisk IO Load	1.53	Jun 10, 2016 2:45:00 AM GMT
Total CellDisk IO Load	0.07	Low Value
Total CellDisk Read IOPS	4.95	High Value
Total CellDisk Read Throughput		
Total CellDisk Write IOPS		
Total CellDisk Write Throughput		
Aggregated Exadata Diskgroup		
Aggregated Exadata FlashDisk		
Cell Generated Alert		
CellSrv Status Metric		
Exadata Cell Metric		
Exadata Cell Diskgroup		

19. By default, the “Metric and Collection Settings” page shows the metrics that have associated threshold definitions. Select the option to view all metrics.

The screenshot shows the Oracle Enterprise Manager interface for managing metric and collection settings. The title bar indicates the target is qr01celadm01.example.com (Oracle Exadata Storage Server). The main content area is titled "Metric and Collection Settings". A dropdown menu under "View" is open, showing options like "Metrics with thresholds", "All metrics", "Metrics with Adaptive thresholds", and "Metrics with Time based Static thresholds". The "Metrics with thresholds" option is selected. The main table lists various metrics with their threshold definitions. The columns include:

Comparison Operator	Warning Threshold	Critical Threshold	Corrective Actions	Collection Schedule	Edit
=	WARNING	CRITICAL	None	Every 15 Minutes	
Matches		yes	None	Every 15 Minutes	
>=	10	1	None	Every 15 Minutes	
=		1	None	Every 15 Minutes	
=	1	1	None	Every 15 Minutes	

20. Scroll down until you see the group of metrics associated with Host Interconnect Statistics. Set the warning threshold to zero (0) for Host MB Dropped Per Sec and Host RDMA MB Dropped Per Sec. This setting will cause a warning to be generated if packets are dropped on the InfiniBand network. Click Every 15 Minutes to adjust the collection schedule for the Host Interconnect Statistics group of metrics.

The screenshot shows the Oracle Enterprise Manager interface for managing metrics on the target host qr01celadm01.example.com. The 'Metric and Collection Settings' page is displayed, showing various system metrics grouped under categories like HCA Port State (For Alerts) and Host Interconnect Statistics. For the Host Interconnect Statistics group, the 'Host MB Dropped Per Sec' metric is highlighted with its collection schedule set to 'Every 15 Minutes'. Other metrics shown include Host MB Received Per Sec, Host MB Resent Per Sec, Host MB Sent Per Sec, Host RDMA MB Dropped Per Sec, and Host RDMA Retry Latency (msec). The interface also includes sections for Response and Management Network Ping Status.

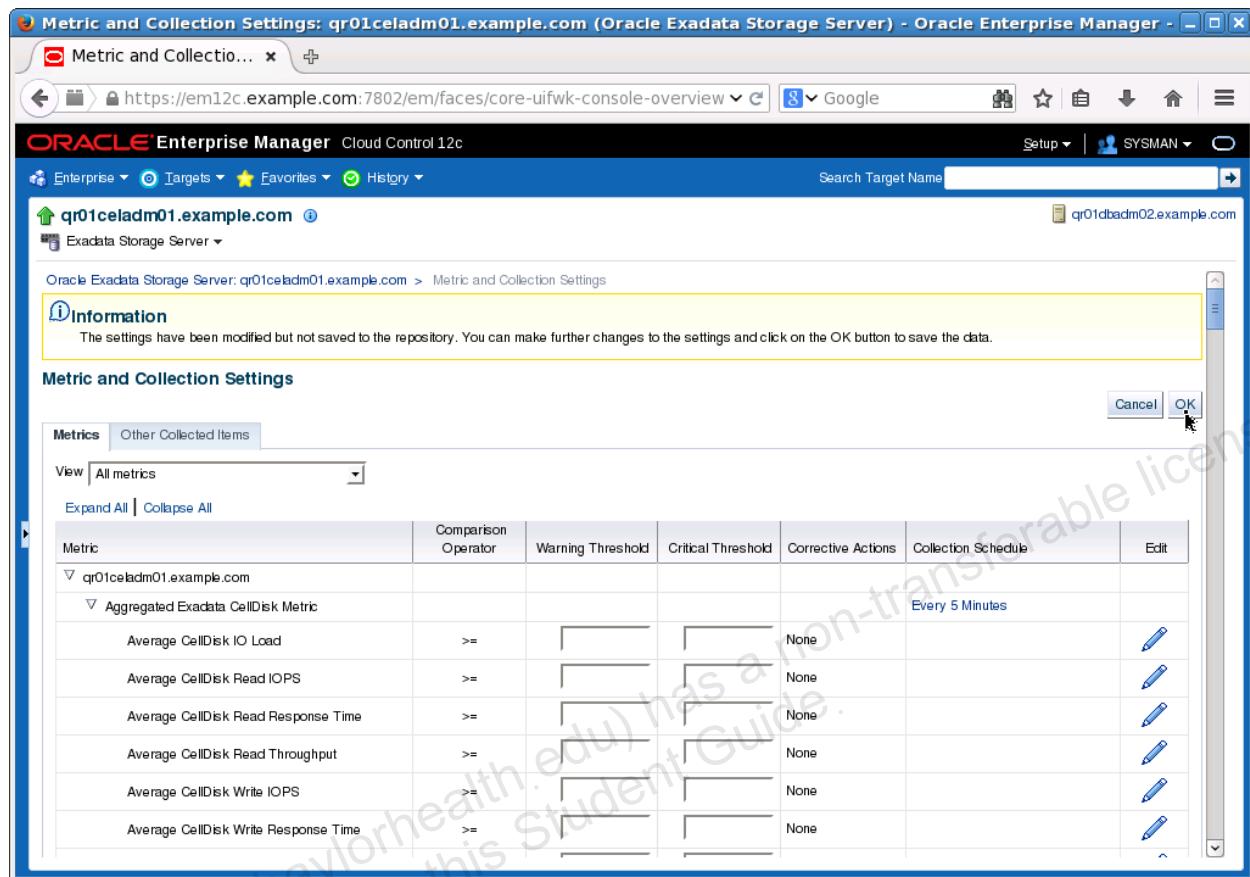
21. Make the following adjustments to the collection schedule:

- Repeat Every 5 Minutes
- Upload Interval 3 Collections

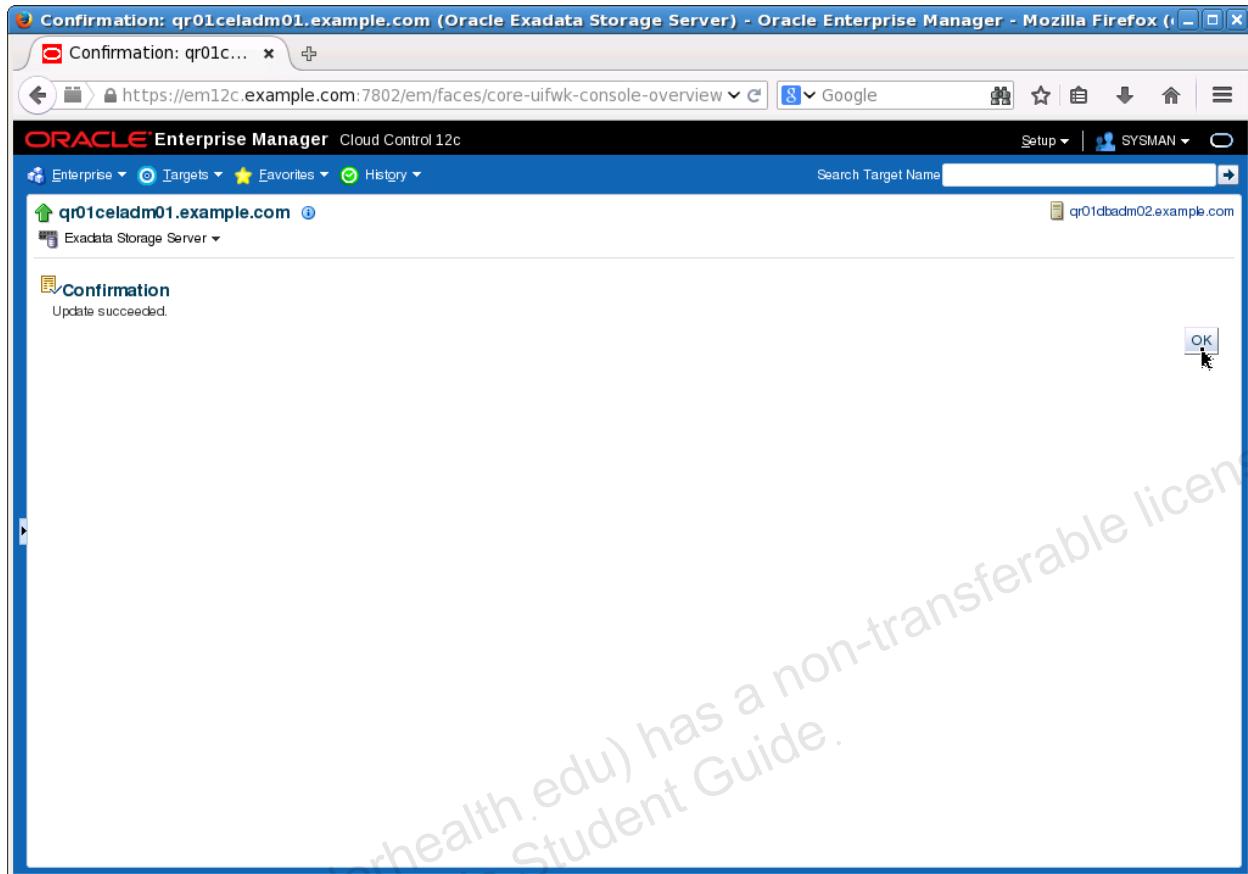
These settings will cause the metrics to be collected every 5 minutes and uploaded to the Management Repository every 15 minutes. Finally, click Continue to proceed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Edit Collection Settings: Host Interconnect Statistics: qr01celadm01.example.com (Oracle Exadata Storage Server) - Oracle". The main content area is titled "Edit Collection Settings: Host Interconnect Statistics".
Collection Schedule: Data Collection is set to Enabled. The Default Frequency is Every 15 Minutes.
Collection Frequency: Frequency Type is By Minutes, and Repeat Every is set to 5 Minutes.
Use of Metric Data: Alerting and Historical Trending is selected. Upload Interval is set to 3 Collections. A note explains that the Upload Interval determines how often a metric value is uploaded to the Management Repository.
Affected Metrics: A table lists three metrics: Aggregated Exadata CellDisk Metric, Aggregated Exadata FlashDisk and HardDisk Metric, and another unnamed entry. A navigation bar at the bottom right shows "Previous 1-10 of 13 Next 3".
At the top right of the main content area, there are "Cancel" and "Continue" buttons.

22. Click OK to save the thresholds and collection schedule settings, which you made in the previous steps.

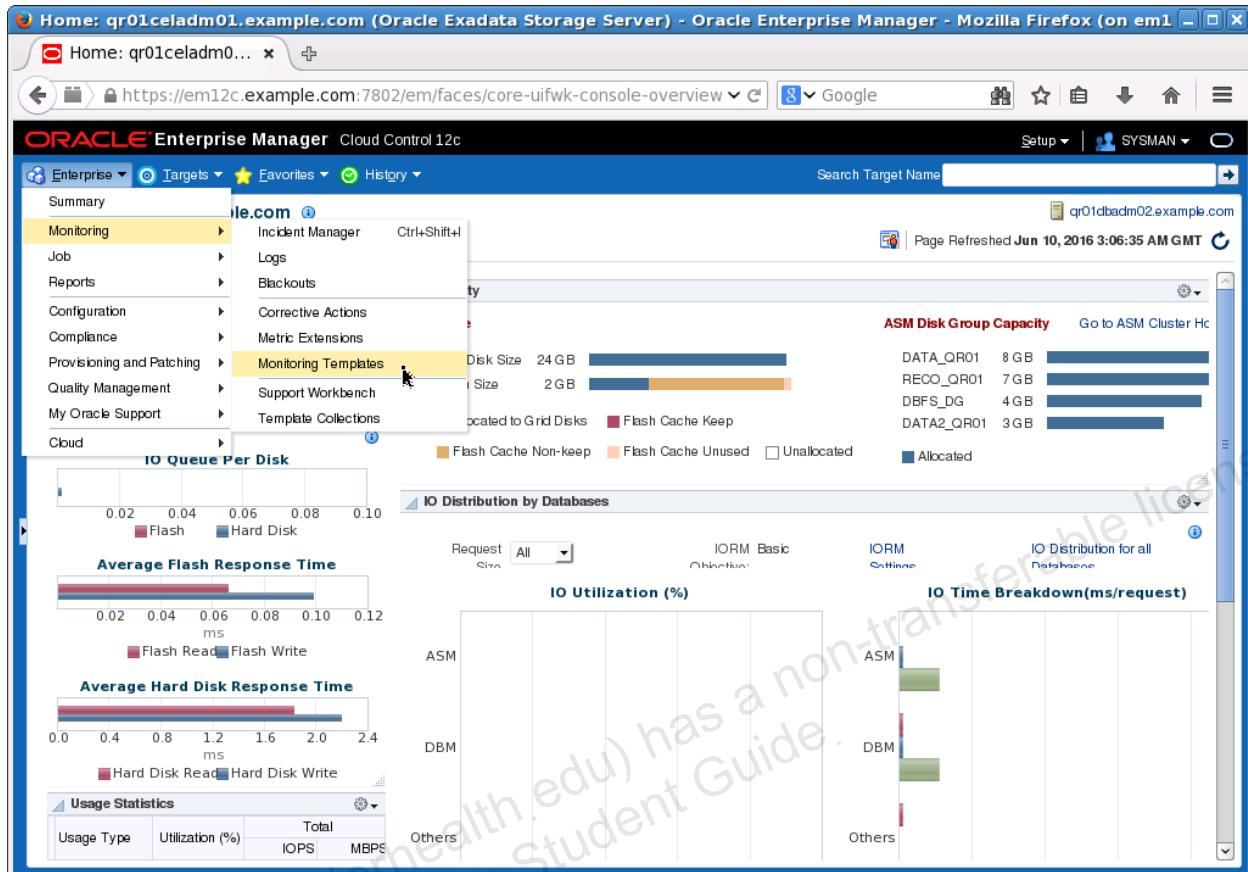


23. Click OK to acknowledge the update confirmation.



You have just seen how to adjust the Enterprise Manager thresholds and metric collection settings for one Exadata Storage Server. However, what if you have to replicate these settings across numerous Exadata Storage Servers? That is where Monitoring Templates can help. In the next part of this practice, you will examine Monitoring Templates and how they relate to Exadata Storage Servers. You will first create a monitoring template based on one of your existing cells, and then you will apply the template to your other cells.

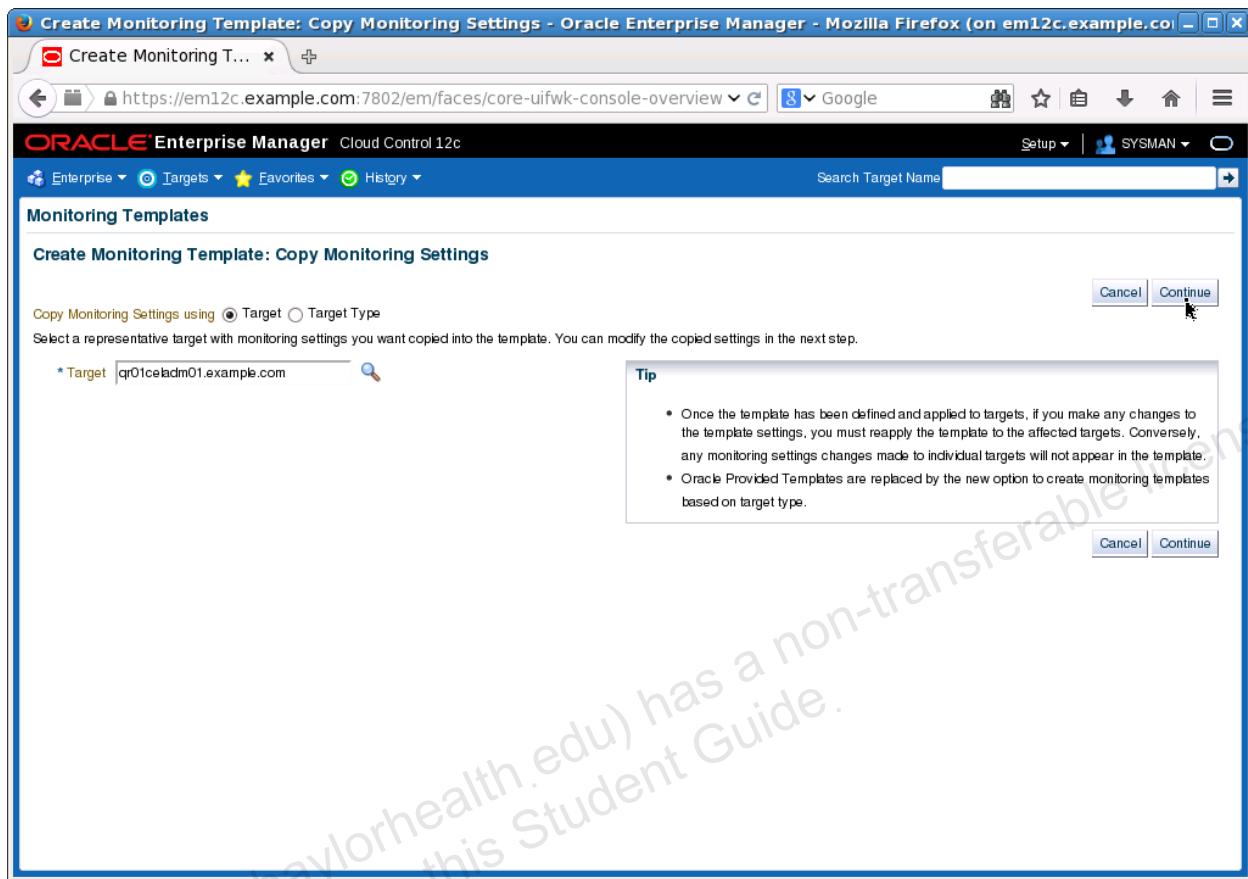
24. Select the Enterprise > Monitoring > Monitoring Templates menu command.



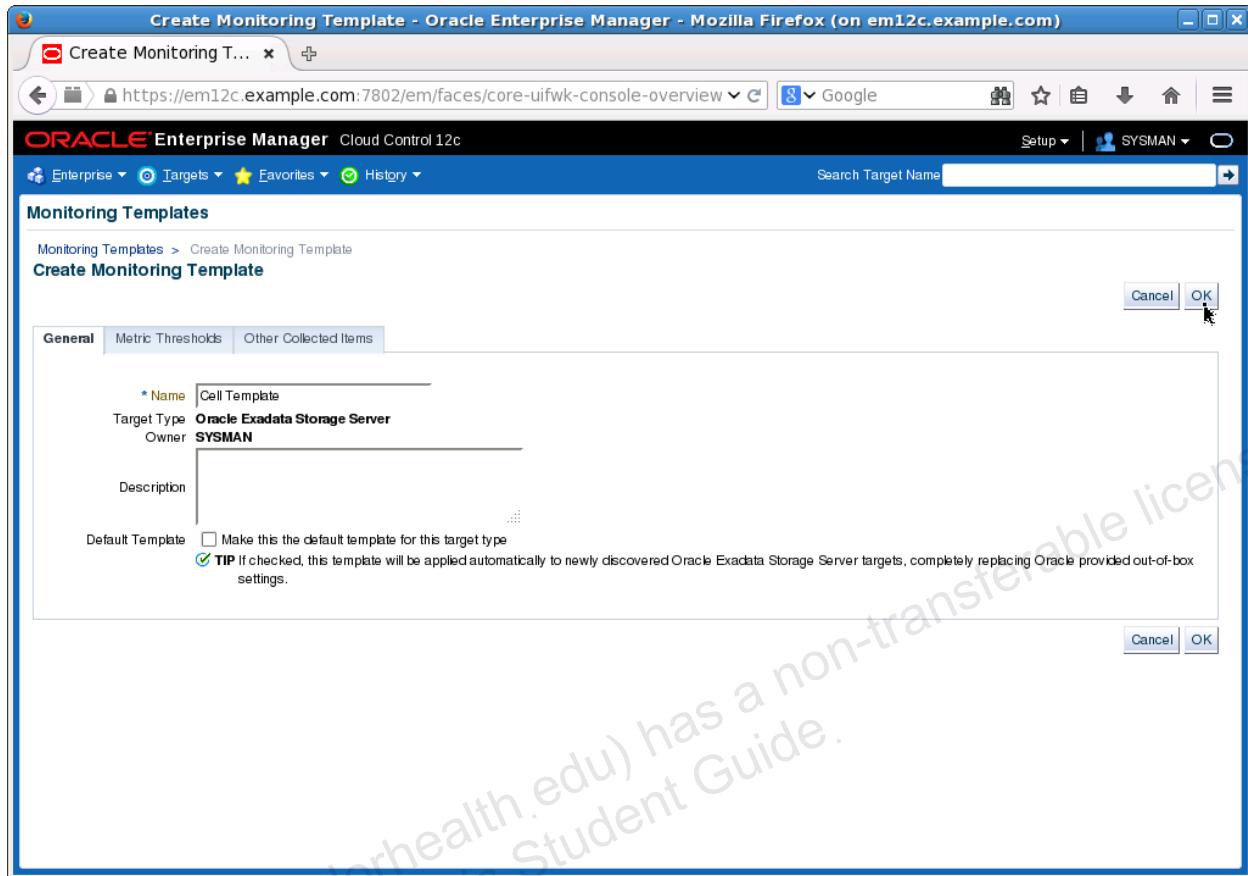
25. Click Create.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Monitoring Templates - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Monitoring Templates". It displays a search bar with fields for "Name" and "Target Type" (set to "All"), and a checkbox for "Display Oracle Certified Templates". Below the search bar is a toolbar with buttons for Actions, View, Create (which is highlighted in yellow), Edit, Delete..., Apply..., Compare Settings..., and View Past Apply Operations... . A table follows, with columns: Name, Target Type, Owner, and Status (Pending, Failed, Aborted). The status row shows "Total Rows: 0". At the bottom left, it says "Columns Hidden: 6". The URL in the browser's address bar is https://em12c.example.com:7802/em/faces/core-uifwk-console-over...rLoop=10096876929767&_afrWindowMode=0&_afrWindowId=sd5puv3f4_1#.

26. Specify the Exadata Storage Server `qr01celadm01.example.com` as the target and click Continue.



27. Specify Cell Template as the template name and click OK.



28. At this point, a confirmation message appears indicating the successful creation of your monitoring template. Based on the Exadata Storage Server qr01celadm01, this template includes the thresholds and metric collection settings that you customized earlier in the practice. Select the template and click Apply to start the process of applying this template to your other storage servers.

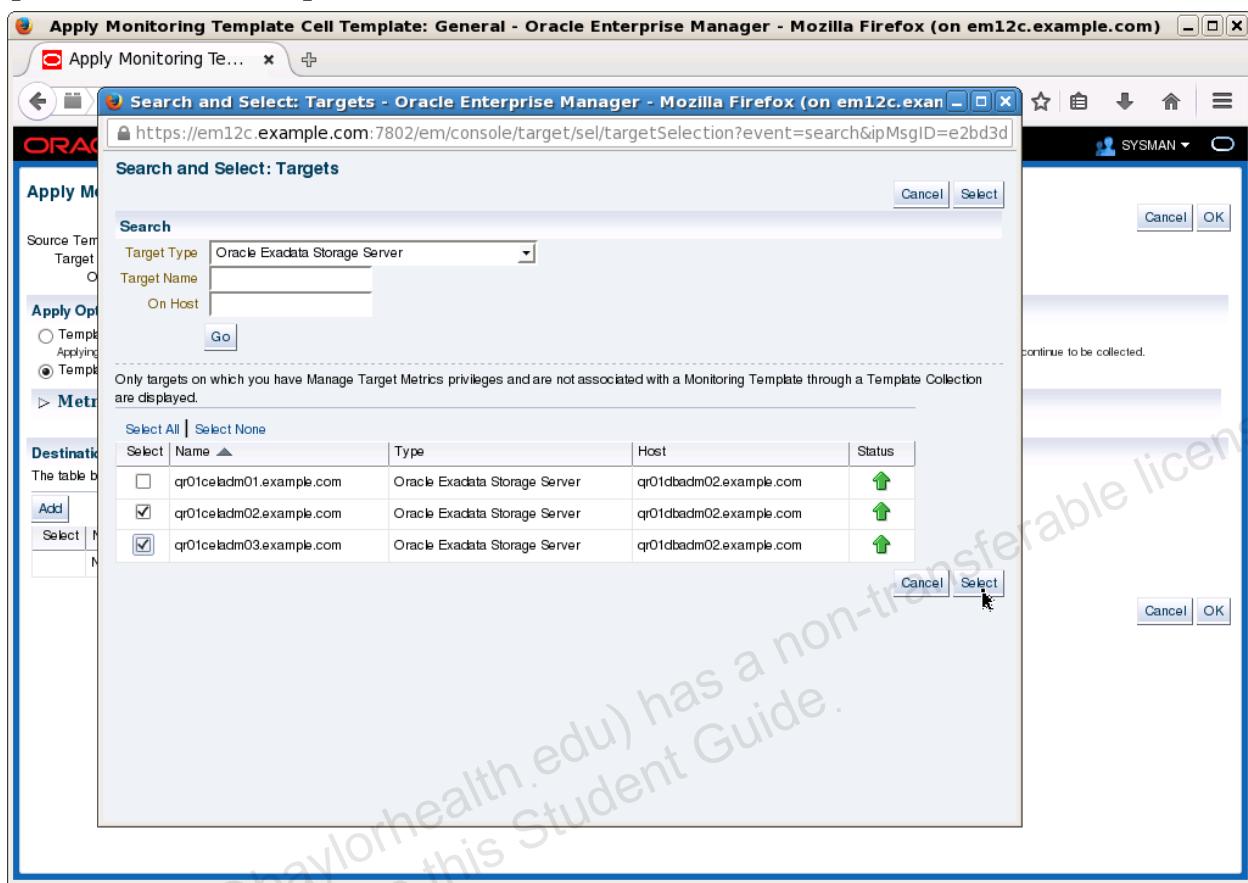
The screenshot shows the Oracle Enterprise Manager interface for Monitoring Templates. A confirmation message in a yellow box states: "Template Cell Template successfully created." Below this, a note explains that Monitoring Templates can be used to apply a subset of monitoring and collection settings to multiple targets. A table lists the created template: "Cell Template" (Target Type: Oracle Exadata Storage Server, Owner: SYSMAN). The "Status" row shows 0 Pending, 0 Failed, and 0 Aborted operations. The "Actions" bar at the top includes Create, Edit, Delete, and Apply buttons, with the Apply button being highlighted.

29. Click Add to specify the destination targets.

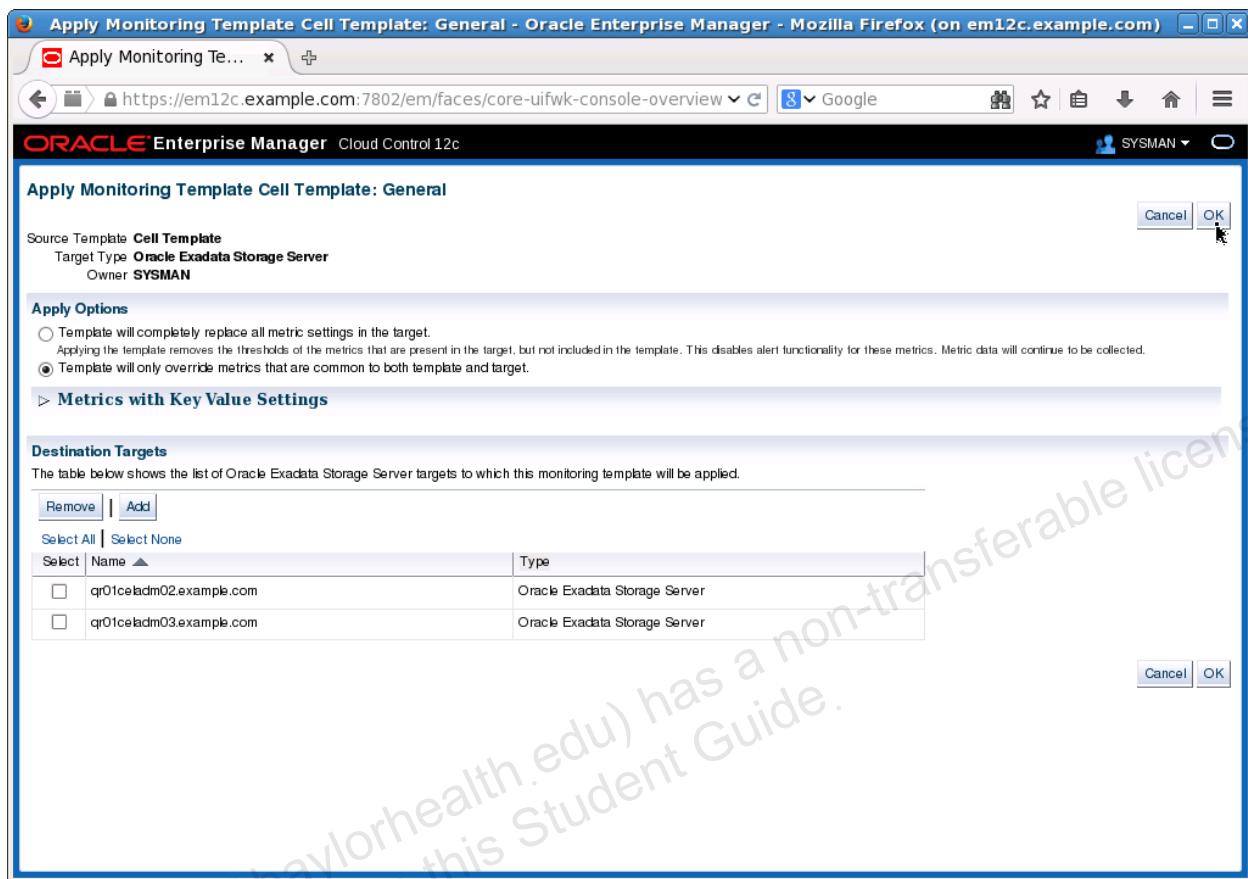
The screenshot shows the 'Apply Monitoring Template Cell Template: General' dialog box from Oracle Enterprise Manager. At the top, it displays the source template details: 'Source Template Cell Template', 'Target Type Oracle Exadata Storage Server', and 'Owner SYSMAN'. Below this, the 'Apply Options' section contains two radio button options: one for completely replacing target metrics and another for overriding common metrics. The 'Metrics with Key Value Settings' section is collapsed. The 'Destination Targets' section is expanded, showing a table with a single row labeled 'No data'. An 'Add' button is visible at the top left of the table area, which is highlighted with a cursor. The dialog box has 'Cancel' and 'OK' buttons at the bottom right.

Select	Name	Type
	No data	

30. Select the Exadata Storage Servers `qr01celadm02.example.com` and `qr01celadm03.example.com`, and then click **Select**.



31. Click OK to apply your monitoring template (based on qr01celadm01) to qr01celadm02 and qr01celadm03.



32. Application of the monitoring template occurs as a background task. Periodically, refresh the page while Pending shows a value greater than zero.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Monitoring Templates - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Monitoring Templates". A yellow-bordered message box at the top left says: "Confirmation: The apply of monitoring template Cell Template has been successfully submitted. There may be a delay before the template is applied to all targets. The Pending Apply Operations column indicates how many targets have not yet been updated." Below this message, a text block states: "Monitoring Templates can be used to apply a subset of monitoring and collection settings to multiple targets. This allows you to standardize monitoring across your enterprise. When a Monitoring Template is applied to a target, any monitoring settings not specified in the Monitoring Template remain unaffected on the target." A search bar with fields for "Name" and "Target Type" (set to "All") is present. Below the search bar is a checkbox for "Display Oracle Certified Templates". A toolbar with buttons for Actions (Create, Edit, Delete, Apply, Compare Settings), View, and "View Past Apply Operations..." is shown. A table lists monitoring templates with columns: Name, Target Type, Owner, Status (Pending, Failed, Aborted), and Description. One row is visible: "Cell Template" (Owner: SYSMAN) with Status: Pending (4), Failed (0), Aborted (0). The URL in the browser's address bar is: https://em12c.example.com:7802/em/faces/core-uifwk-console-over...rLoop=10096876929767&_afrWindowMode=0&_afrWindowId=sd5puv3f4_1#.

33. When Pending shows zero, the application process is finished.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Monitoring Templates - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Monitoring Templates". A search bar at the top left includes fields for "Name" and "Target Type" (set to "All"). Below the search bar is a checkbox for "Display Oracle Certified Templates". A toolbar below the search bar contains buttons for Actions (Create, Edit, Delete...), Apply..., Compare Settings..., and View Past Apply Operations... (which is highlighted). The main table displays monitoring templates. The columns are Name, Target Type, Owner, and Status (Pending, Failed, Aborted). A single row is shown: "Cell Template" under "Owner", with "Oracle Exadata Storage Server SYSMAN" under "Owner". The "Status" row shows 0 for Pending, Failed, and Aborted. The table footer indicates "Total Rows: 1".

Name	Target Type	Owner	Status		
			Pending	Failed	Aborted
Cell Template	Oracle Exadata Storage Server	SYSMAN	0	0	0

34. To confirm the application of the monitoring template, you can examine the cell threshold settings on `qr01celadm02` and verify that they match the settings from `qr01celadm01`. To commence this process, enter `qr01cel` in the Search Target Name field and click the Search button. Ensure that you use the search facility located on the right side of the menu bar at the top of the page and not the Search field inside the page.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Monitoring Templates - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Monitoring Templates". It displays a table with one row:

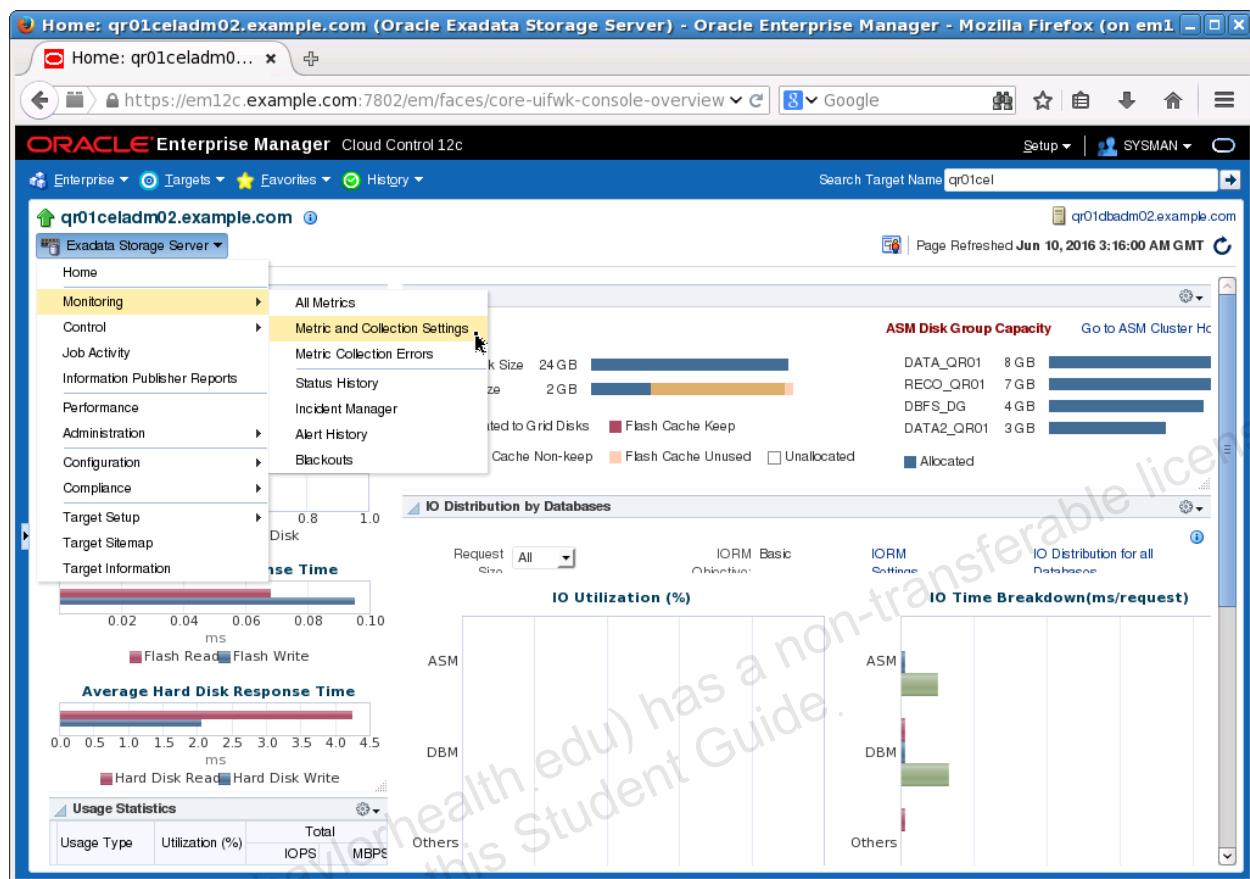
Name	Target Type	Owner	Status	Description
		Pending	Failed	Aborted
Cell Template	Oracle Exadata Storage Server SYSMAN	0	0	0

Below the table, there is a URL in the address bar: `https://em12c.example.com:7802/em/faces/core-uifwk-console-over...rLoop=10096876929767&_afrWindowMode=0&_afrWindowId=sd5puv3f4_1#`.

35. Click `qr01celadm02.example.com` to navigate to the Exadata Storage Server home page for `qr01celadm02`.

Target Name	Target Type	Target Status
qr01celadm01.example.com	Oracle Exadata Storage Server	Up
qr01celadm02.example.com	Oracle Exadata Storage Server	Up
qr01celadm03.example.com	Oracle Exadata Storage Server	Up

36. Select the Exadata Storage Server > Monitoring > “Metric and Collection Settings” menu command.



37. Scroll down the page until you see the thresholds associated with the metrics Host MB Dropped Per Sec and Host RDMA MB Dropped Per Sec. These threshold settings were created when the monitoring template was applied to this cell. Notice also that the collection schedule for these metrics is Every 5 Minutes, rather than the default (Every 15 Minutes). This is another consequence of applying the monitoring template.

Metric	Operator	Value	Collection Schedule
Is this port disconnected(yes/no)	=	yes	None
HCA Port Errors	>=	10	Every 15 Minutes
Total errors	>=	1	None
HCA Port State	=	1	Every 15 Minutes
Is the link degraded? (active speed or width less than enabled)	=	1	None
HCA Port State (For Alerts)	=	1	Every 15 Minutes
Is port disabled?	=	1	None
Is port in 'polling' state?	=	1	None
Host Interconnect Statistics	>	0	Every 5 Minutes
Host MB Dropped Per Sec	>	0	None
Host RDMA MB Dropped Per Sec	>	0	None
Response	=	Down	Every 5 Minutes
Response Status	=	None	

In the next part of this practice, you will examine the difference between thresholds set in the Exadata Storage Server and thresholds set in Enterprise Manager. You will also examine the different alerts generated when these thresholds are crossed. First, you will examine cell-based thresholds and how the associated alerts are propagated to Enterprise Manager.

38. Establish a terminal connection to the qr01celadm01 Exadata cell as the celladmin user.

```
$ ssh celladmin@qr01celadm01
celladmin@qr01celadm01's password: ????????
[celladmin@qr01celadm01 ~]$
```

39. Launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...
CellCLI>
```

40. Execute the DROP ALERTHISTORY ALL command to delete the cell alert history records.

```
CellCLI> drop alerthistory all
Alert 1_1 successfully dropped
Alert 1_2 successfully dropped

CellCLI>
```

41. Examine the current value of the metric relating to storage server memory utilization (cl_memut).

```
CellCLI> list metriccurrent cl_memut
CL_MEMUT          qr01celadm01      92 %

CellCLI>
```

42. Create a cell-based threshold for cl_memut. Configure the threshold so that a critical alert is generated when memory utilization exceeds 10% (which will always be the case in your laboratory environment).

```
CellCLI> create threshold cl_memut comparison='>', critical=10
Threshold cl_memut successfully created

CellCLI>
```

43. Execute the LIST ALERTHISTORY command. You should see an alert related to the threshold you created in the previous step. If you cannot see the expected alert, periodically re-execute the LIST ALERTHISTORY command until the alert is visible. After the alert becomes visible, leave your CellCLI session running and proceed to the next step.

```
CellCLI> list alerthistory
1_1    2016-06-10T03:23:18+00:00      critical
"The critical threshold for the following metric has been
crossed. Metric Name      : CL_MEMUT Metric Description :
Percentage of total physical memory on this server that is
currently used Object Name     : qr01celadm01 Current Value
: 93.0 % Threshold Value   : 10.0 %"

CellCLI>
```

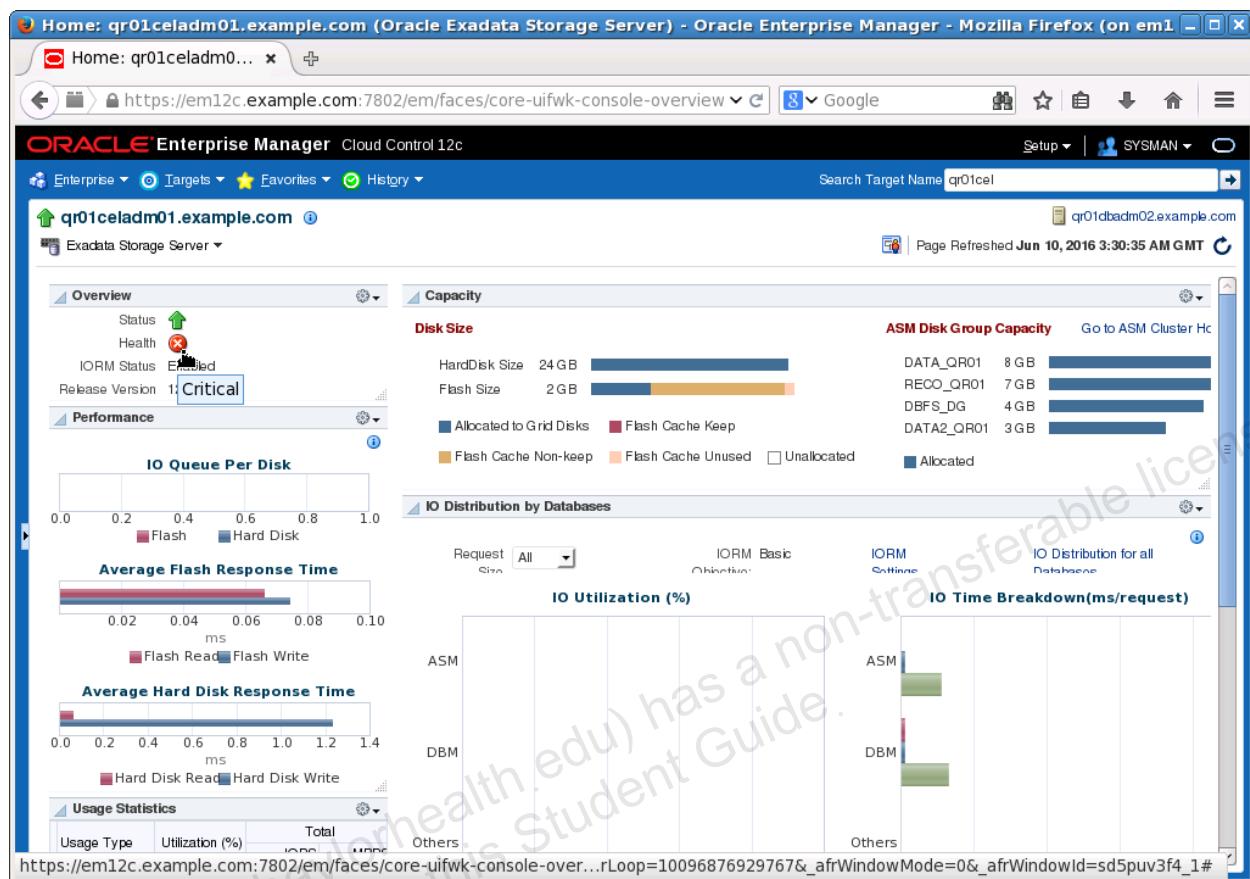
44. Back in your Enterprise Manager session, use the History menu to navigate back to the home page for qr01celadm01.example.com.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Metric and Collection Settings: qr01celadm02.example.com (Oracle Exadata Storage Server) - Oracle Enterprise Manager". The main area is titled "ORACLE Enterprise Manager Cloud Control 12c". The navigation bar includes "Enterprise", "Targets", "Favorites", and "History". The "History" tab is selected. A search bar at the top right says "Search Target Name qr01cel". Below the search bar, there's a dropdown menu showing "qr01celadm02.example.com" and "qr01celadm01.example.com" (which is highlighted). The main content area displays various metrics and their collection settings:

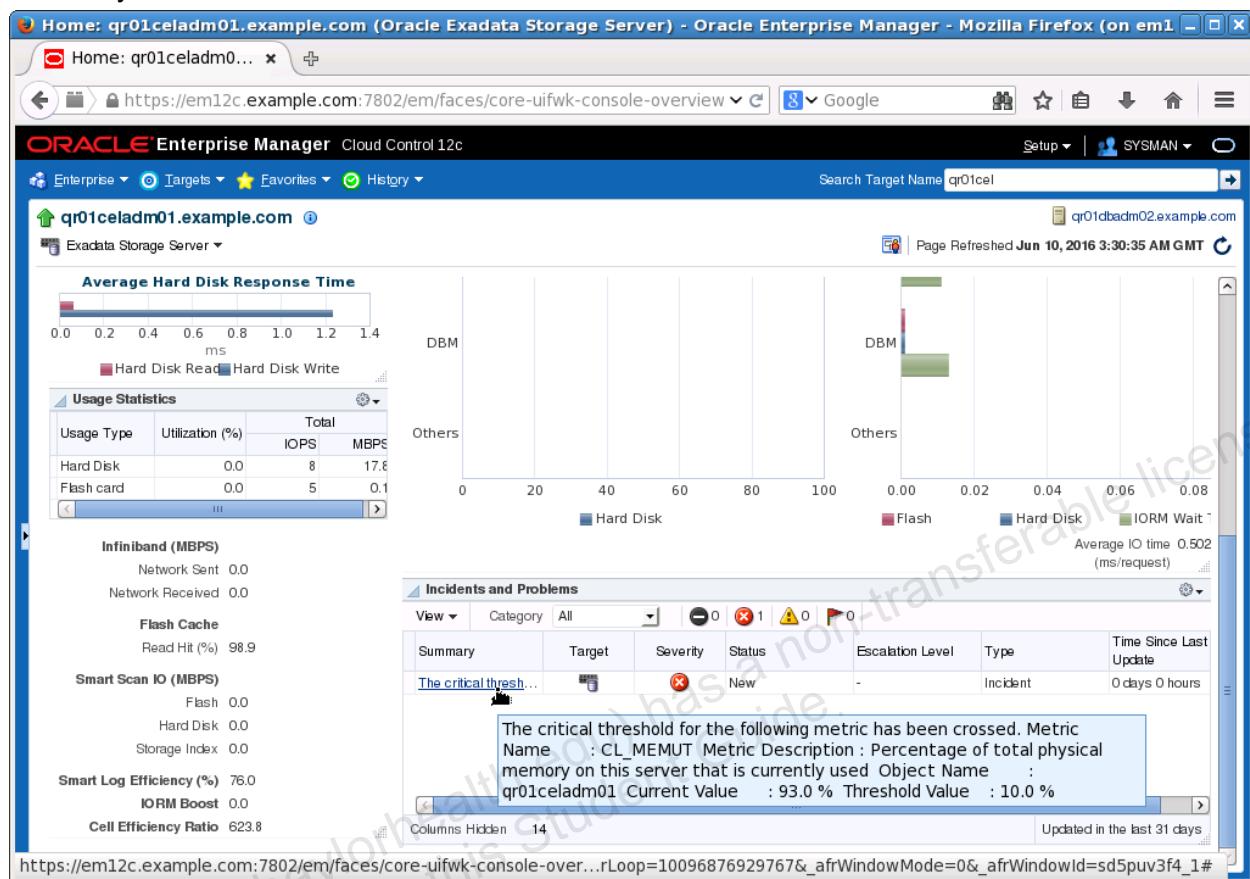
Metric	Value	Collection Interval	Action
DB Machine qr01.example.com	None	Every 15 Minutes	
DB Machine qr01.example.com-Exadata Storage Servers Service	None	Every 15 Minutes	
Exadata Grid qr01.example.com	None	Every 15 Minutes	
EM Cloud Control Targets	None	Every 15 Minutes	
EM Console Service	None	Every 15 Minutes	
Is this port disconnected(yes/no)	=	1	
HCA Port Errors	None	Every 15 Minutes	
Total errors	None	Every 15 Minutes	
HCA Port State	None	Every 15 Minutes	
Is the link degraded? (active speed or width less than enabled)	=	1	
HCA Port State (For Alerts)	None	Every 15 Minutes	
Is port disabled?	=	1	
Is port in 'polling' state?	=	1	
Host Interconnect Statistics	None	Every 5 Minutes	
Host MB Dropped Per Sec	>	0	
Host RDMA MB Dropped Per Sec	>	0	
Response	None	Every 5 Minutes	
Response Status	Down	None	

At the bottom left, there's a note: "TIP Empty Thresholds will disable alerts for that metric." At the bottom right, there are "Cancel" and "OK" buttons.

45. You should immediately notice that the Cell Health indicator is now showing a red alert icon.



46. Scroll to the bottom of the page and you should see an entry in the Incidents area. Click the Summary link to examine the incident details.



47. Examine the incident details. Note that the incident is associated with the cell-generated alert that was triggered earlier.

The screenshot shows the Oracle Enterprise Manager interface for Incident Details. A message at the top states: "The critical threshold for the following metric has been crossed. Metric Name : CL_MEMUT Metric Description : Percentage of total physical memory on this server that is currently used Object Name : qr01celadm01 Current Value : 93.0 % Threshold Value : 10.0 %". The "General" tab is selected. In the "Tracking" section, there is a note: "Incident created by rule (Name = Incident management rule set for all targets. Create incident for critical metric alerts [System generated rule]); on Jun 10, 2016 3:28:43 AM GMT". There is also a checked checkbox: "This incident will be automatically cleared when the underlying issue is resolved." Other sections like "Guided Resolution" and "Metric Data" are also visible.

48. Return to your CellCLI session and alter the `cl_memut` threshold. Set the critical threshold to 100%. This will clear the alert associated with the `cl_memut` metric.

```
CellCLI> alter threshold cl_memut comparison='>', critical=100
Threshold cl_memut successfully altered

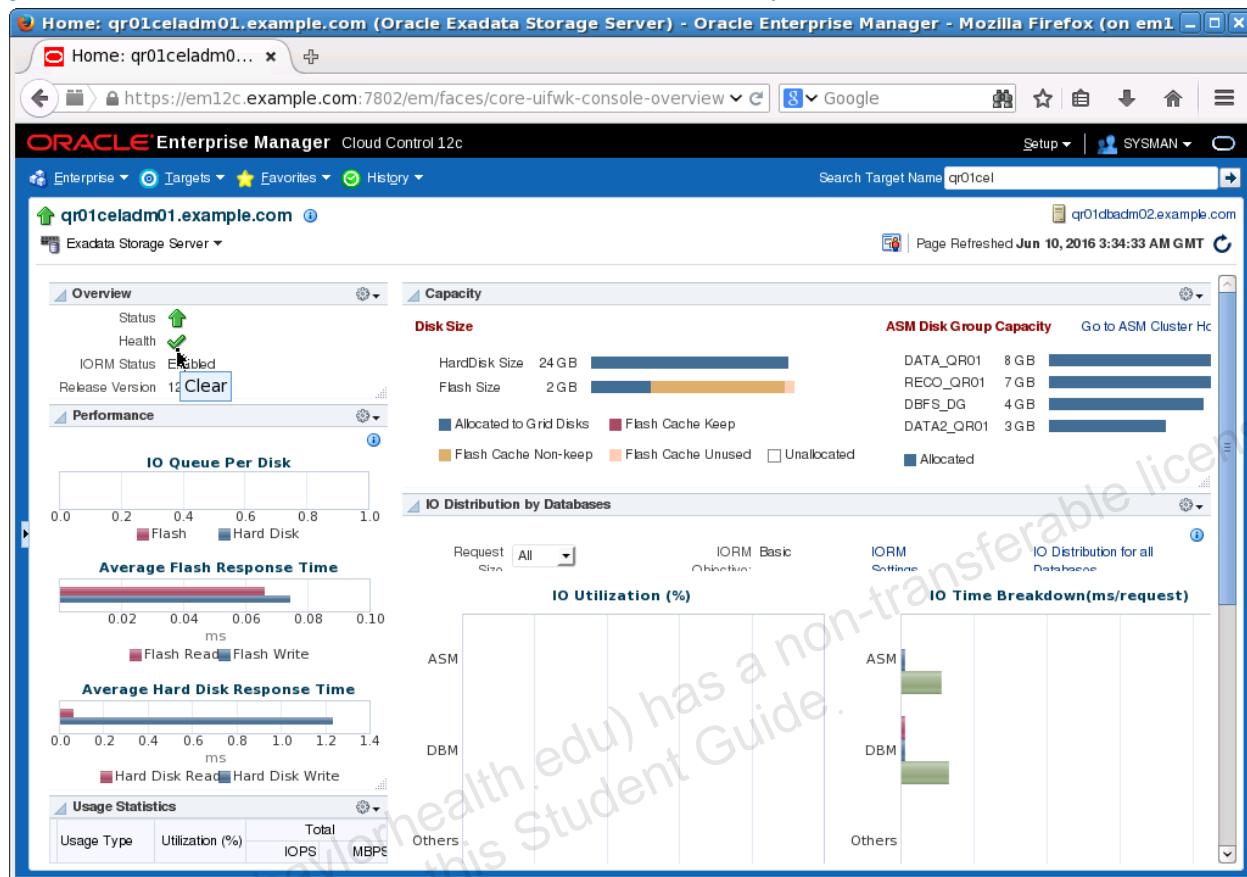
CellCLI>
```

49. Execute the LIST ALERTHISTORY command. You should see an entry indicating that the alert has cleared. If you cannot see the expected entry, periodically re-execute the LIST ALERTHISTORY command until it is visible. After the alert clearance becomes visible, leave your CellCLI session running and proceed to the next step.

```
CellCLI> list alerthistory
      1_1      2016-06-10T03:23:18+00:00      critical
      "The critical threshold for the following metric has been
      crossed. Metric Name      : CL_MEMUT Metric Description :
      Percentage of total physical memory on this server that is
      currently used Object Name      : qr01celadm01 Current Value
      : 93.0 % Threshold Value      : 10.0 % "
      1_2      2016-06-10T03:28:18+00:00      clear
      "The critical threshold for the following metric has been
      cleared. Metric Name      : CL_MEMUT Metric Description :
      Percentage of total physical memory on this server that is
      currently used Object Name      : qr01celadm01 Current Value
      : 93.0 % Threshold Value      : 100.0 % "
CellCLI>
```

50. Back in your Enterprise Manager session, use the History menu to again navigate to the home page for qr01celadm01.example.com.

51. Now that the alert has cleared, you should notice that the Cell Health indicator shows a green check mark. Also, the Incidents area should be empty.



You have just seen how cell-generated alerts are propagated to Enterprise Manager and how they can appear as incidents in Enterprise Manager. Normally, this process is very reliable; however, various problems could disrupt the process. Because of this, it is recommended that administrators who primarily use Enterprise Manager should also periodically check the cell alert history for undelivered alerts.

52. If an Exadata Storage Server cannot deliver an alert using any of the configured delivery channels, the notificationState for the alert will be set to 1. Back in your CellCLI session, use the following command to list any undelivered and previously unexamined alerts on this cell (qr01celadm01).

```
CellCLI> list alerthistory where notificationState != 1 and
examinedBy = ''
```

CellCLI>

53. Exit CellCLI.

```
CellCLI> exit
quitting

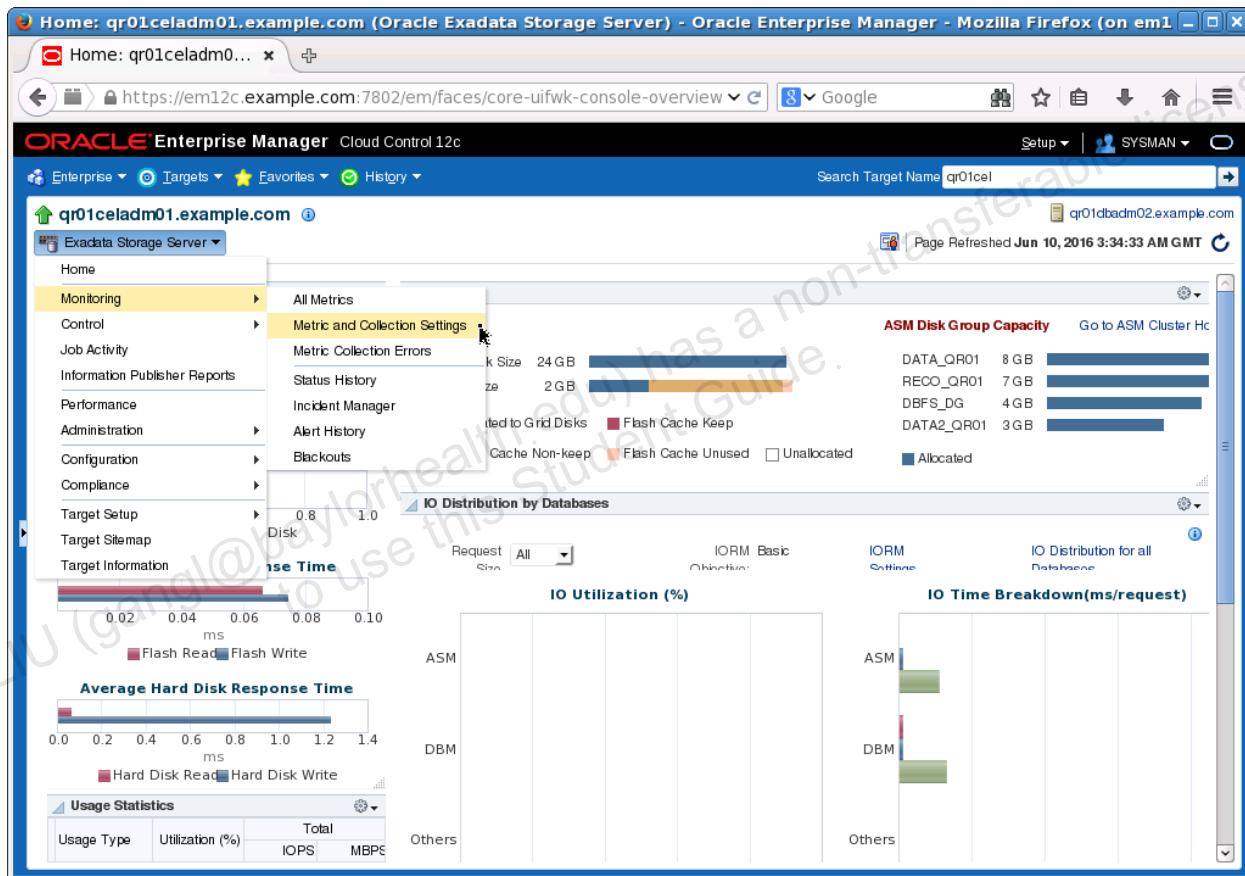
[celladmin@qr01celadm01 ~] $
```

54. Use the following command to check for undelivered and previously unexamined alerts across all your Exadata Storage Servers. Normally, when everything is working correctly, you should not see any output from this command.

```
[celladmin@qr01celadm01 ~]$ dcli -c
qr01celadm01,qr01celadm02,qr01celadm03 cellcli -e "list
alerthistory where notificationState != 1 and examinedBy = ''"
[celladmin@qr01celadm01 ~]$
```

In the next part of this practice, you will configure a threshold in Enterprise Manager and watch as an Incident is generated by using the threshold.

55. Back in your Enterprise Manager session, select the Exadata Storage Server > Monitoring > “Metric and Collection Settings” menu command.



56. Select the option to view all metrics.

The screenshot shows the Oracle Enterprise Manager interface for managing metric collection settings. The title bar indicates the target is qr01celadm01.example.com (Oracle Exadata Storage Server). The main content area is titled "Metric and Collection Settings". A dropdown menu under the "View" label is open, showing options like "Metrics with thresholds", "All metrics", "Metrics with Adaptive thresholds", and "Metrics with Time based Static thresholds". The "All metrics" option is currently selected. Below the dropdown, there is a table listing various metrics with their alert types, comparison operators, thresholds, corrective actions, and collection schedules. For example, "Is this port disconnected(yes/no)" is set to "Matches" with a threshold of "yes" and a collection schedule of "Every 15 Minutes". Another row shows "Total errors" with a threshold of "10" and a collection schedule of "Every 15 Minutes".

57. Scroll down to the group of Exadata cell metrics. Click Every 5 Minutes to adjust the collection schedule for the Exadata Cell Metric group of metrics.

The screenshot shows the Oracle Enterprise Manager interface for Cloud Control 12c. The title bar indicates the target is qr01celadm01.example.com (Oracle Exadata Storage Server). The main content area displays a table of metrics under the heading "Write Throughput (MBPS)".

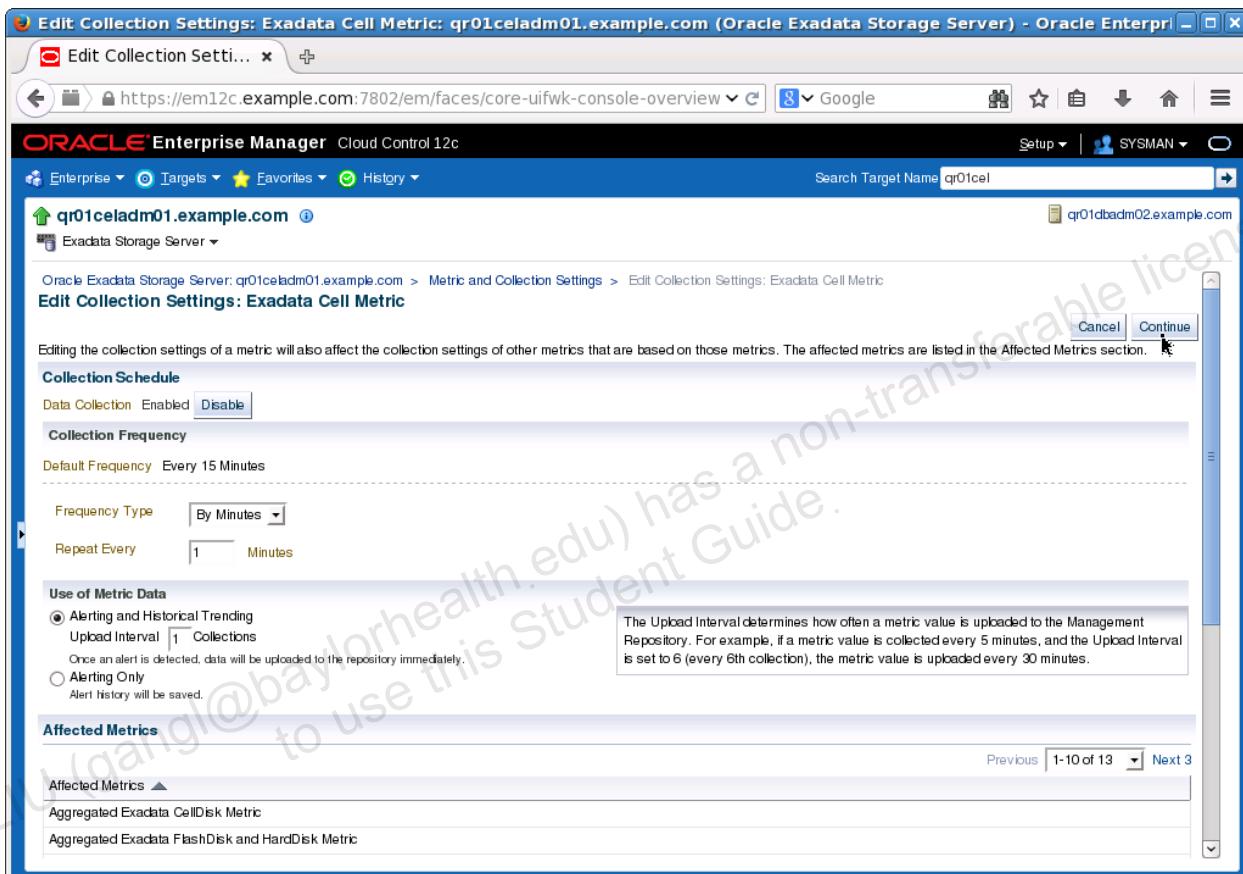
Metric Group	Metric Name	Operator	Current Collection Interval	Action
Exadata Cell Metric	CPU Utilization	>=	Every 5 Minutes	<input type="button" value="Edit"/>
	Disk I/O Objective	>	None	<input type="button" value="Edit"/>
	Exadata Run Queue Length	>	None	<input type="button" value="Edit"/>
	Exadata Temperature Lower Threshold	<=	None	<input type="button" value="Edit"/>
	Exadata Temperature Reading	<=	None	<input type="button" value="Edit"/>
	Exadata Temperature Upper Threshold	>=	None	<input type="button" value="Edit"/>
	IORM Boost	<=	None	<input type="button" value="Edit"/>
	LED Status	<=	None	<input type="button" value="Edit"/>
	Memory Utilization	>=	None	<input type="button" value="Edit"/>
	Network Received	<=	None	<input type="button" value="Edit"/>
Exadata Disk Status Metric	Network Sent	<=	None	<input type="button" value="Edit"/>
	Offload Efficiency	<	Every 1 Hour	<input type="button" value="Edit"/>
	Disk Status	=	None	<input type="button" value="Edit"/>
	Exadata Flash Cache Metric	<	Every 5 Minutes	<input type="button" value="Edit"/>

The URL at the bottom of the page is: https://em12c.example.com:7802/em/console/metrics/target/metric...et=qr01celadm01.example.com&type=oracle_exadata&_em.coIFR=true#

58. Make the following adjustments to the collection schedule:

- Repeat Every 1 Minutes
- Upload Interval 1 Collections

These settings will cause the metrics to be collected and uploaded every minute. Normally this would not be a recommended setting; however, you should use them for this practice to avoid waiting up to 5 minutes for the incident to be generated. Finally, click Continue to proceed.



59. Click Continue to acknowledge the warning message and proceed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Edit Collection Settings: Exadata Cell Metric: qr01celadm01.example.com (Oracle Exadata Storage Server) - Oracle Enterprise". The main content area is titled "Edit Collection Settings: Exadata Cell Metric". A yellow warning box states: "The repeat interval set is very low. This will cause additional load on the agent and the repository database. To proceed, press Continue after completing your changes." Below this, there are sections for "Collection Schedule" (Data Collection Enabled), "Collection Frequency" (Default Frequency: Every 15 Minutes, Frequency Type: By Minutes, Repeat Every: 1 Minutes), "Use of Metric Data" (Alerting and Historical Trending selected, Upload Interval: 1 Collections), and "Affected Metrics" (empty). At the bottom right, there are "Cancel" and "Continue" buttons, with "Continue" being the active button.

60. Scroll down the page and set the Critical Threshold for the Memory Utilization metric to 10.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for managing metrics on the target host qr01celadm01.example.com. The 'Metric and Collection Settings' page is displayed, specifically for the 'Exadata Storage Server' category. The 'Exadata Cell Metric' section is expanded, showing several metrics with their current thresholds:

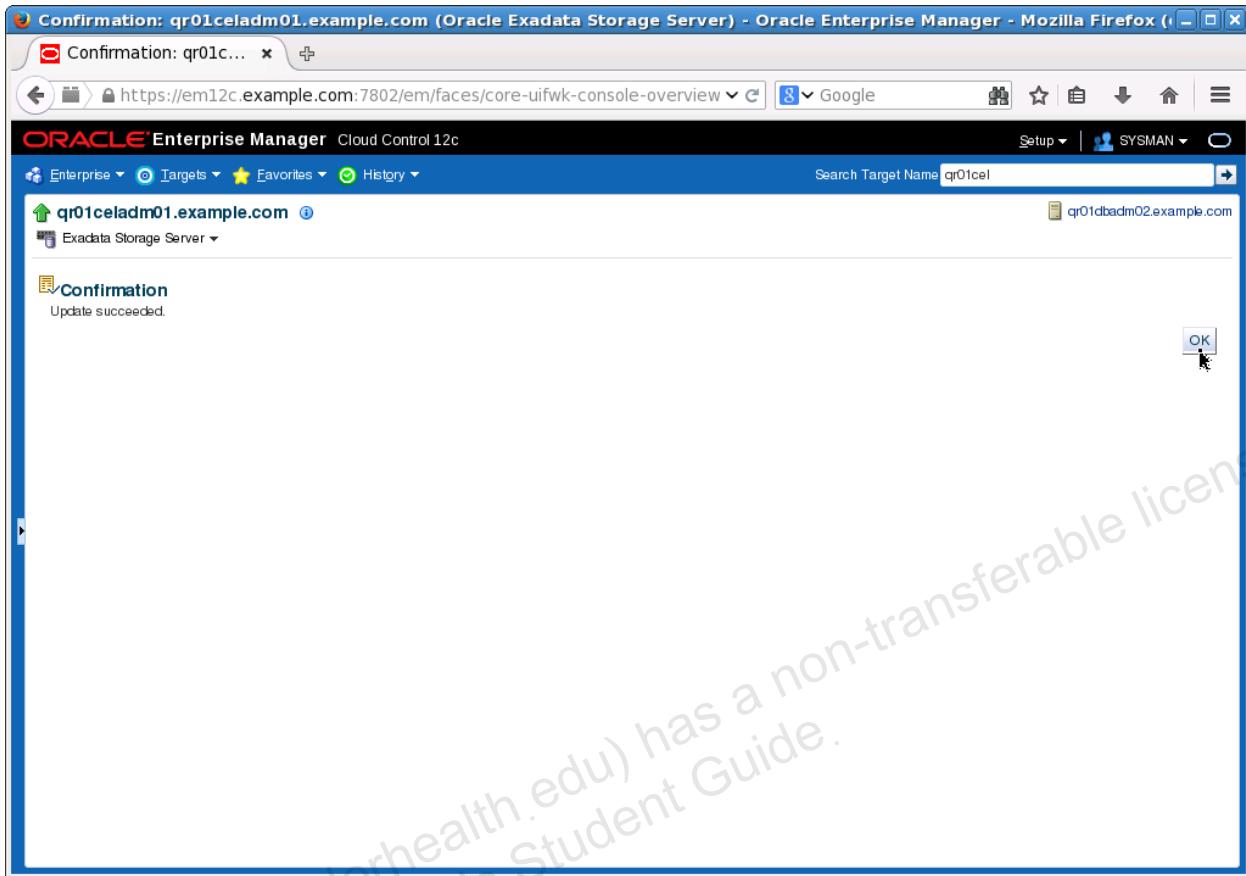
Metric	Operator	Current Threshold	Last Update	Action
CPU Utilization	\geq	None	Every 1 Minute	<input type="button" value="Edit"/>
Disk I/O Objective		None		<input type="button" value="Edit"/>
Exadata Run Queue Length	$>$	None		<input type="button" value="Edit"/>
Exadata Temperature Lower Threshold	\leq	None		<input type="button" value="Edit"/>
Exadata Temperature Reading		None		<input type="button" value="Edit"/>
Exadata Temperature Upper Threshold	\geq	None		<input type="button" value="Edit"/>
IORM Boost		None		<input type="button" value="Edit"/>
LED Status		None		<input type="button" value="Edit"/>
Memory Utilization	\geq	10	None	<input type="button" value="Edit"/>
Network Received		None		<input type="button" value="Edit"/>
Network Sent		None		<input type="button" value="Edit"/>
Offload Efficiency	\wedge	None	Every 1 Hour	<input type="button" value="Edit"/>
Disk Status	$=$	None	Every 1 Minute	<input type="button" value="Edit"/>
Exadata Flash Cache Metric		None		<input type="button" value="Edit"/>
Cell Name		None		<input type="button" value="Edit"/>

61. Scroll to the bottom of the page and click OK to save the metric and collection settings.

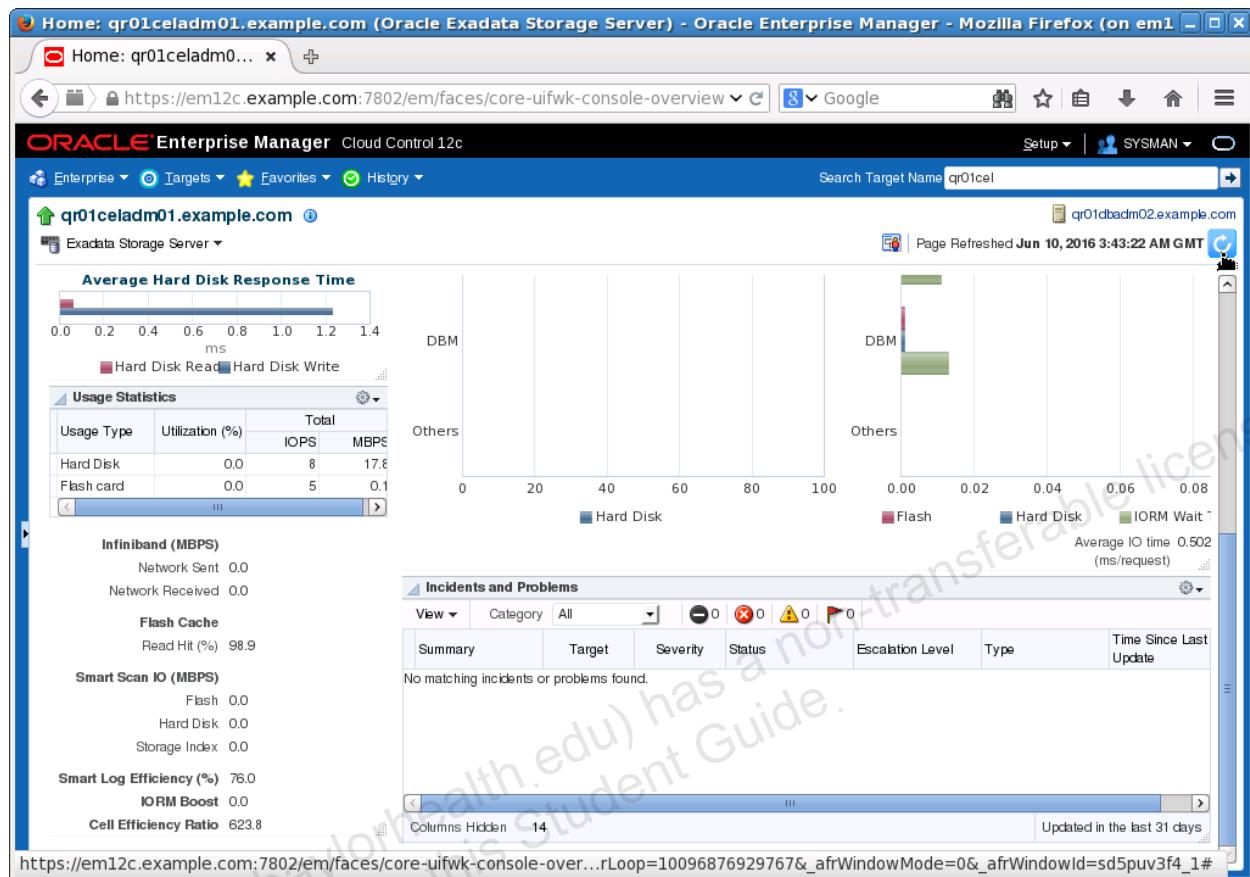
The screenshot shows the 'Metric and Collection Settings' page for the target 'qr01celadm01.example.com'. The page displays various metrics and their collection intervals. A tip at the bottom left states: 'TIP Empty Thresholds will disable alerts for that metric.' At the bottom right, there are 'Cancel' and 'OK' buttons, with 'OK' being highlighted.

Metric	Operator	Threshold 1	Threshold 2	Interval
Is port in 'polling' state?	=	/	/1	None
Host Interconnect Statistics				Every 1 Minute
Cell Name				
Host MB Dropped Per Sec	>	/0	/	None
Host MB Received Per Sec	>	/	/	None
Host MB Resent Per Sec	>	/	/	None
Host MB Sent Per Sec	>	/	/	None
Host RDMA MB Dropped Per Sec	>	/0	/	None
Host RDMA Retry Latency (msec)	>	/	/	None
Response				Every 5 Minutes
Mgmt Network Ping Status				
MS Status				
Response Status	=		Down	None

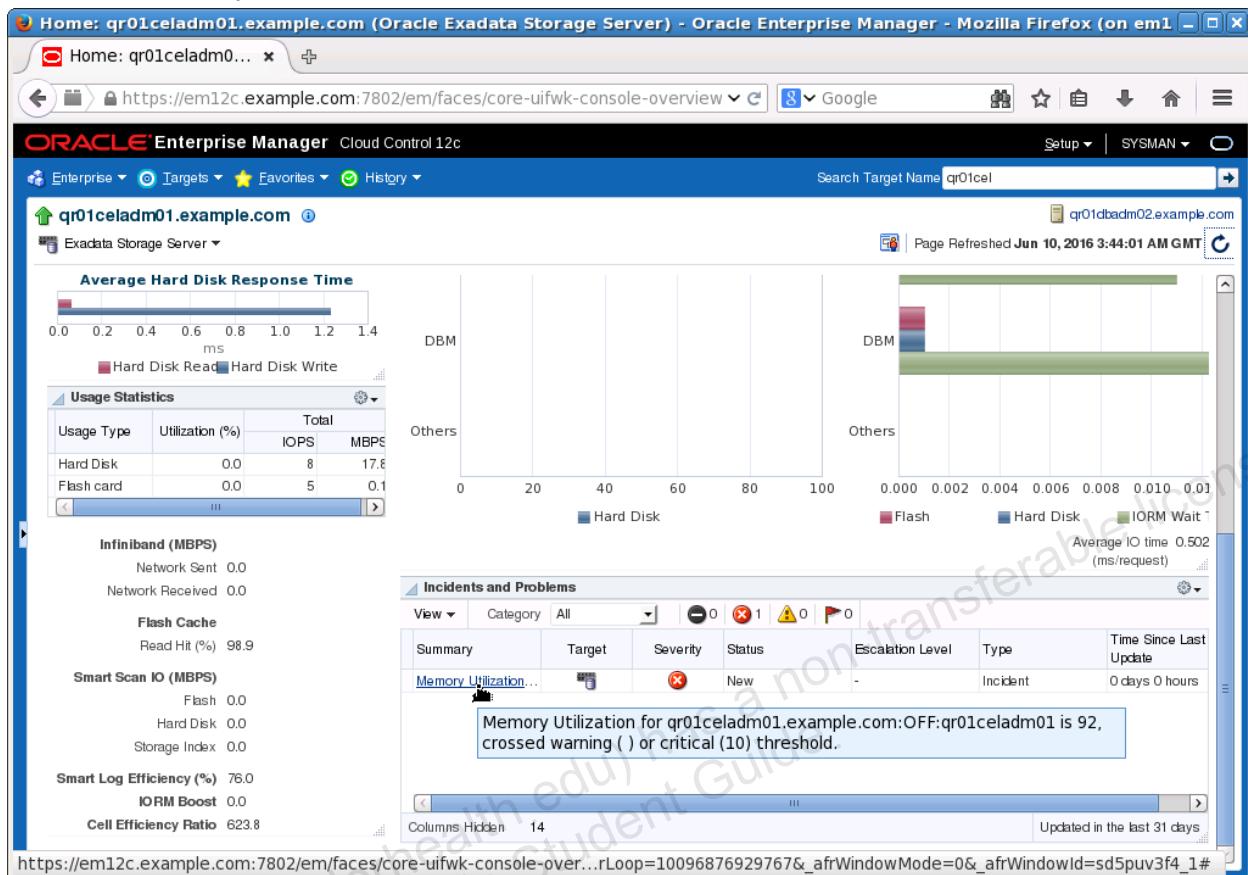
62. Click OK to acknowledge the update confirmation.



63. Examine the Incidents area on the Exadata Storage Server home page for qr01celadm01. Periodically, refresh the page until an incident appears.



64. Click the Summary link to examine the incident details.



65. Examine the incident details. You should observe that the incident is associated with the metric threshold you just created in Enterprise Manager and that it is very similar to the incident associated with the cell-generated alert that you saw earlier in the practice.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Incident Details - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Incident Manager" and shows a single incident entry:

Memory Utilization for qr01celadm01.example.com:OFF:qr01celadm01 is 92, crossed warning () or critical (10) threshold.

Unassigned , Not acknowledged

General Events Notifications My Oracle Support Knowledge All Updates Related Events Related Metrics

Incident Details

ID	236
Metric	Memory Utilization
Metric Group	Exadata Cell Metric
Target	qr01celadm01.example.com (Oracle Exadata Storage Server) (i)
Incident Created	Jun 10, 2016 3:43:24 AM GMT
Last Updated	Jun 10, 2016 3:43:24 AM GMT
Summary	Memory Utilization for qr01celadm01.example.com:OFF:qr01celadm01 is 92, crossed warning () or critical (10) threshold.
Internal Event	Cell_Metric:memory_utilization
Name	
Event Type	Metric Alert
Category	Capacity

Metric Data

Critical Threshold	10
Warning Threshold	Not Defined
Number of Occurrences	1
Last Known Value	92
Last Collection Timestamp	Jun 10, 2016 3:37:00 AM GMT

Tracking

Escalated	No	Owner	-
Priority	None	Acknowledged	No
Status	New		
Last Comment	Incident created by rule (Name = Incident management rule set for all targets, Create incident for critical metric alerts [System generated rule]): on Jun 10, 2016 3:43:24 AM GMT		
<input checked="" type="checkbox"/> This incident will be automatically cleared when the underlying issue is resolved.			

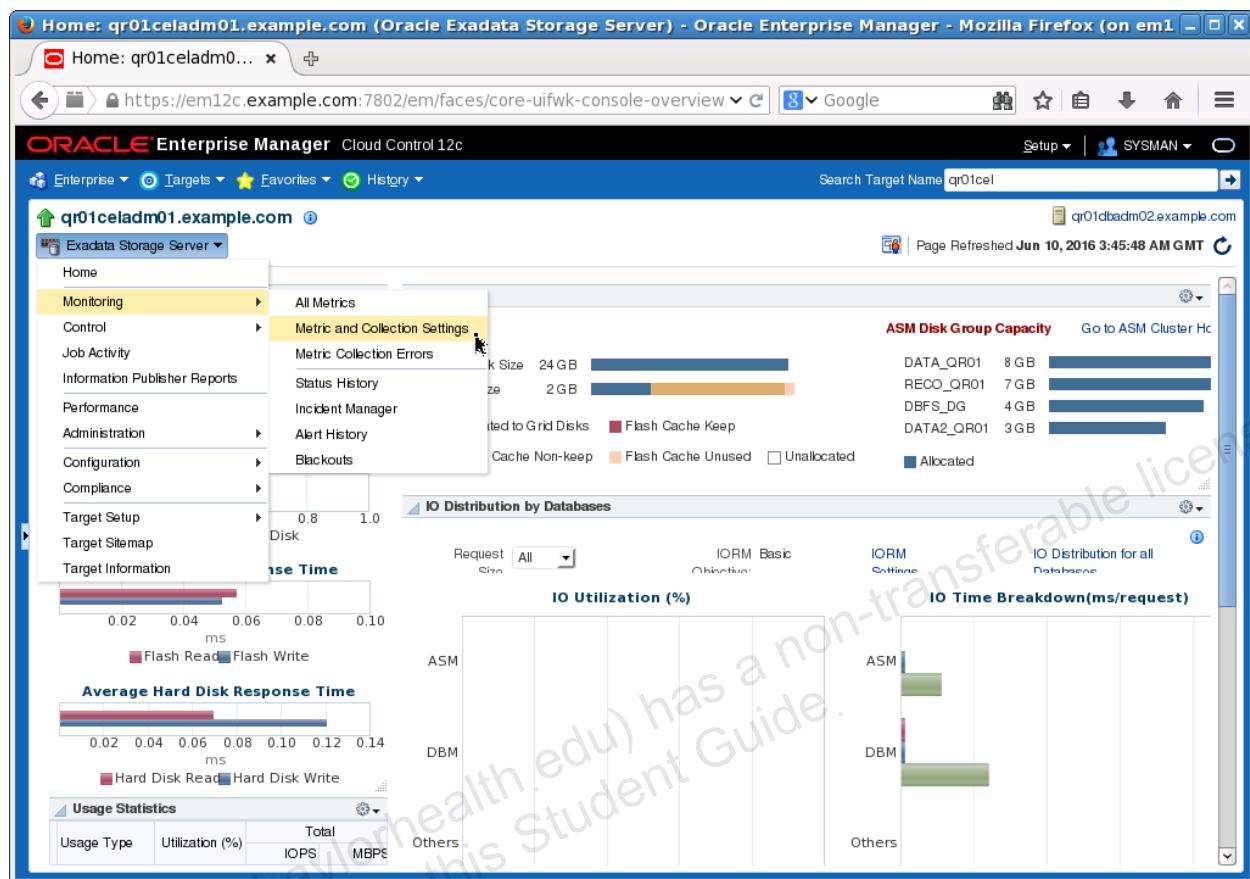
Guided Resolution

Diagnostics	Actions
Problem Analysis	Reevaluate Alert
View topology	Edit Thresholds
View recent configuration changes	
View Metric Help	

66. Use the History menu to return to the home page for qr01celadm01.example.com.

The screenshot shows the Oracle Enterprise Manager interface for Cloud Control 12c. The title bar reads "Incident Details - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "ORACLE Enterprise Manager Cloud Control 12c". In the top navigation bar, there are links for "Enterprise", "Targets", "Favorites", and "History". The "History" link is highlighted. A search bar at the top right says "Search Target Name qr01cel". Below the navigation, a list of targets is shown, with "qr01celadm01.example.com" selected. A message on the right says "warning () or critical (10) threshold." On the left, the "Incident Manager" section shows an unassigned incident for "Memory Utilization for qr01celadm01". The "General" tab is selected, displaying details like ID 236, Metric Memory Utilization, Metric Group Exadata Cell Metric, Target qr01celadm01.example.com (Oracle Exadata Storage Server), Incident Created Jun 10, 2016 3:43:24 AM GMT, Last Updated Jun 10, 2016 3:43:24 AM GMT, Summary Memory Utilization for qr01celadm01.example.com:OFF:qr01celadm01 is 92, crossed warning () or critical (10) threshold, Internal Event Cell_Metric:memory_utilization, Event Type Metric Alert, and Category Capacity. To the right, there are sections for "Tracking" (Escalated No, Priority None, Status New, Last Comment Create incident for critical metric alerts [System generated rule]): on Jun 10, 2016 3:43:24 AM GMT, Acknowledged No, Owner -, and a note that the incident will be automatically cleared when the underlying issue is resolved. There is also a "Guided Resolution" section with "Diagnostics" (Problem Analysis, View topology, View recent configuration changes, View Metric Help) and "Actions" (Reevaluate Alert, Edit Thresholds).

67. Select the Exadata Storage Server > Monitoring > “Metric and Collection Settings” menu command.



68. Clear the Critical Threshold value associated with the Memory Utilization metric. Then click Every 1 Minute to adjust the collection schedule for the Exadata Cell Metric group of metrics.

Metric	Comparison Operator	Warning Threshold	Critical Threshold	Corrective Actions	Collection Schedule	Edit
qr01celadm01.example.com	=	WARNING	CRITICAL	None	Every 1 Minute	Edit
Cell Generated Alert	=					Edit
Alert Type	=					Edit
Exadata Cell Metric	>=					Edit
Memory Utilization	>=			None	Every 15 Minutes	Edit
HCA Port Configuration Monitor	Matches		yes	None	Every 15 Minutes	Edit
Is this port disconnected(yes/no)						Edit
HCA Port Errors	>=	10		None	Every 15 Minutes	Edit
Total errors	>=					Edit
HCA Port State	=		1	None	Every 15 Minutes	Edit
Is the link degraded? (active speed or width less than enabled)	=					Edit

69. Make the following adjustments to revert the collection schedule to the default settings:

- Repeat Every 5 Minutes
- Upload Interval 3 Collections

Then, click Continue to proceed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar indicates 'Edit Collection Settings: Exadata Cell Metric: qr01celadm01.example.com (Oracle Exadata Storage Server) - Oracle Enterprise Manager'. The main content area is titled 'Edit Collection Settings: Exadata Cell Metric'. It displays the following configuration:

- Collection Schedule:** Data Collection Enabled: **Disable**.
- Collection Frequency:** Default Frequency: **Every 15 Minutes**.
 - Frequency Type: **By Minutes**.
 - Repeat Every: **5 Minutes**.
- Use of Metric Data:**
 - Alerting and Historical Trending:** Upload Interval: **3 Collections**.

Once an alert is detected, data will be uploaded to the repository immediately.
 - Alerting Only:** Alert history will be saved.
- Affected Metrics:** A note states: 'The Upload Interval determines how often a metric value is uploaded to the Management Repository. For example, if a metric value is collected every 5 minutes, and the Upload Interval is set to 6 (every 6th collection), the metric value is uploaded every 30 minutes.'

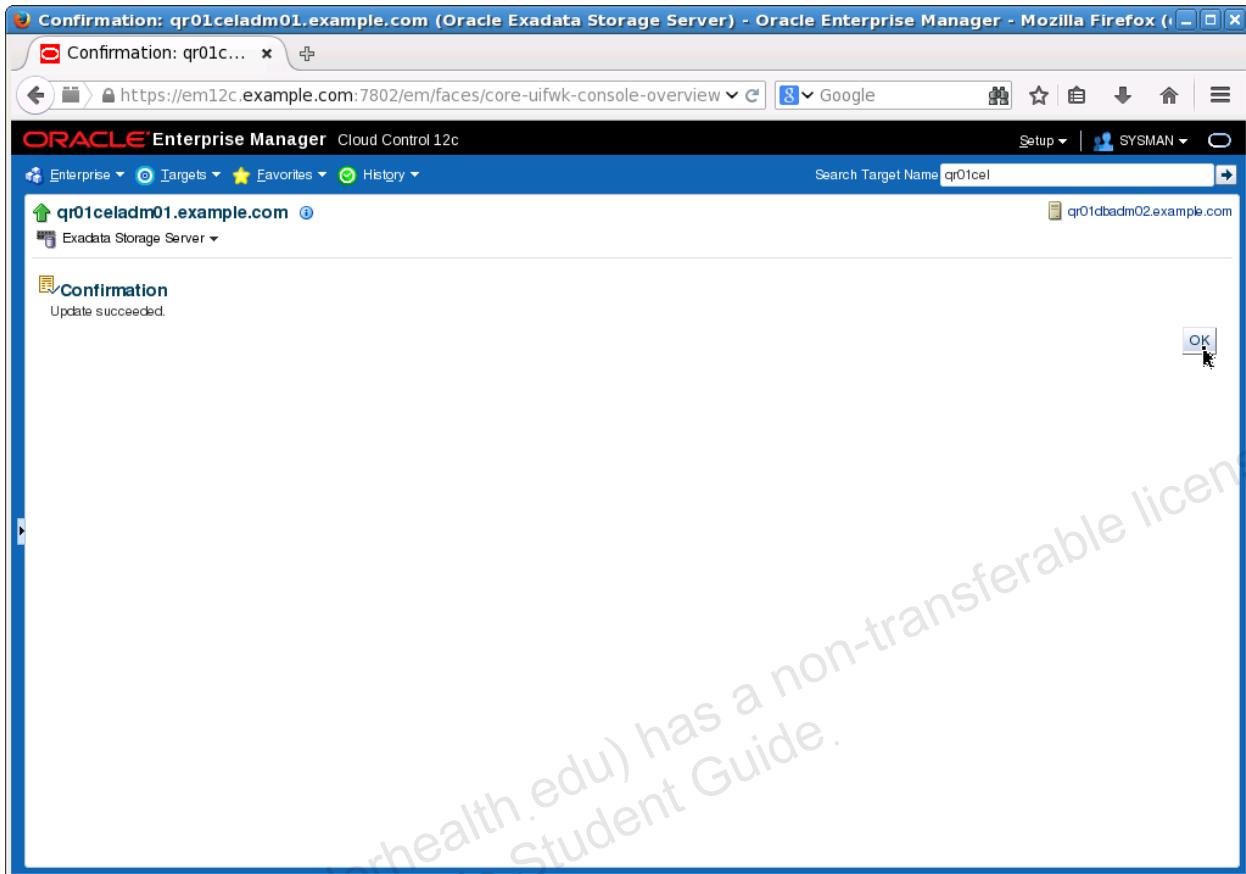
At the bottom right, there are 'Cancel' and 'Continue' buttons, with 'Continue' being the active button.

70. Click OK to save the threshold and collection schedule settings.

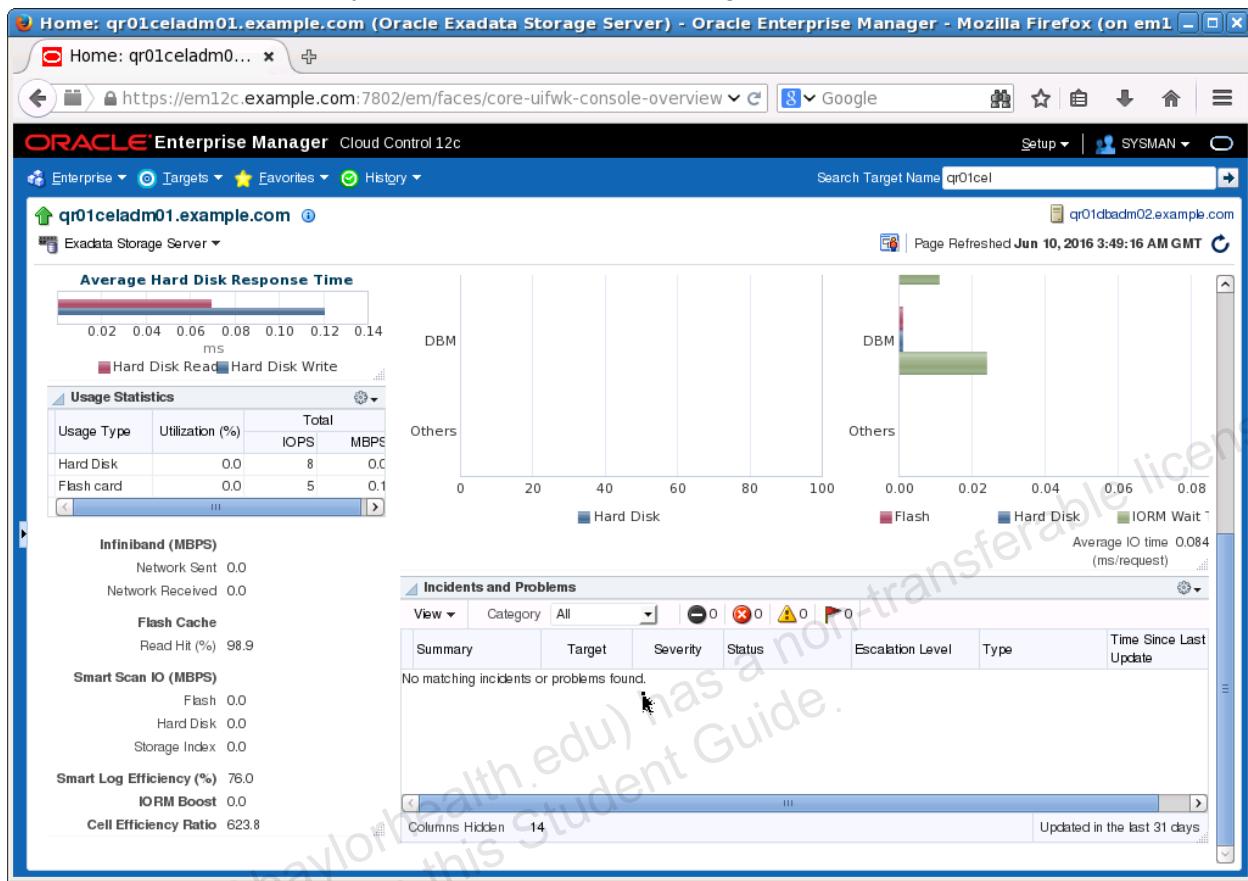
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Metric and Collection Settings: qr01celadm01.example.com (Oracle Exadata Storage Server) - Oracle Enterprise Manager". The main content area is titled "Metric and Collection Settings" and has a sub-tab "Metrics" selected. Below this, there's a table listing various metrics with their thresholds and collection schedules. A yellow box highlights the "Information" section at the top of the page, which contains the message: "The settings have been modified but not saved to the repository. You can make further changes to the settings and click on the OK button to save the data." The "OK" button is highlighted with a mouse cursor. The table rows include:

Metric	Comparison Operator	Warning Threshold	Critical Threshold	Corrective Actions	Collection Schedule	Edit
qr01celadm01.example.com	=	WARNING	CRITICAL	None	Every 15 Minutes	
Cell Generated Alert	Alert Type	Matches	yes	None	Every 15 Minutes	
HCA Port Configuration Monitor	Total errors	>=	10	None	Every 15 Minutes	
HCA Port Errors	Is the link degraded? (active speed or width less than enabled)	=	1	None	Every 15 Minutes	
HCA Port State						

71. Click OK to acknowledge the update confirmation.



72. When you return to the Exadata Storage Server home page for qr01celadm01, you should see that the memory utilization incident is no longer visible.



You have now seen cell-based and Enterprise Manager-based metrics, thresholds, alerts, and incidents in action. In the next part of this practice, you will exercise the configuration management capabilities in Enterprise Manager and you will see how they can be used to ensure that all of your Exadata Storage Servers have consistent configurations.

73. In the celladmin terminal session, which you started earlier in the practice, launch the Exadata cell command-line interface (CellCLI).

```
[celladmin@qr01celadm01 ~]$ cellcli
CellCLI: Release 12.1.2.1.0 - Production...
CellCLI>
```

74. Examine the IORM plan on qr01celadm01. Notice that by default, the IORM objective is set to basic.

```
CellCLI> list iormplan detail
      name:          qr01celadm01_IORMPLAN
      catPlan:
      dbPlan:
      objective:     basic
      status:        active

CellCLI>
```

75. Alter the IORM plan and set the IORM object to balanced.

```
CellCLI> alter iormplan objective=balanced
IORMPLAN successfully altered

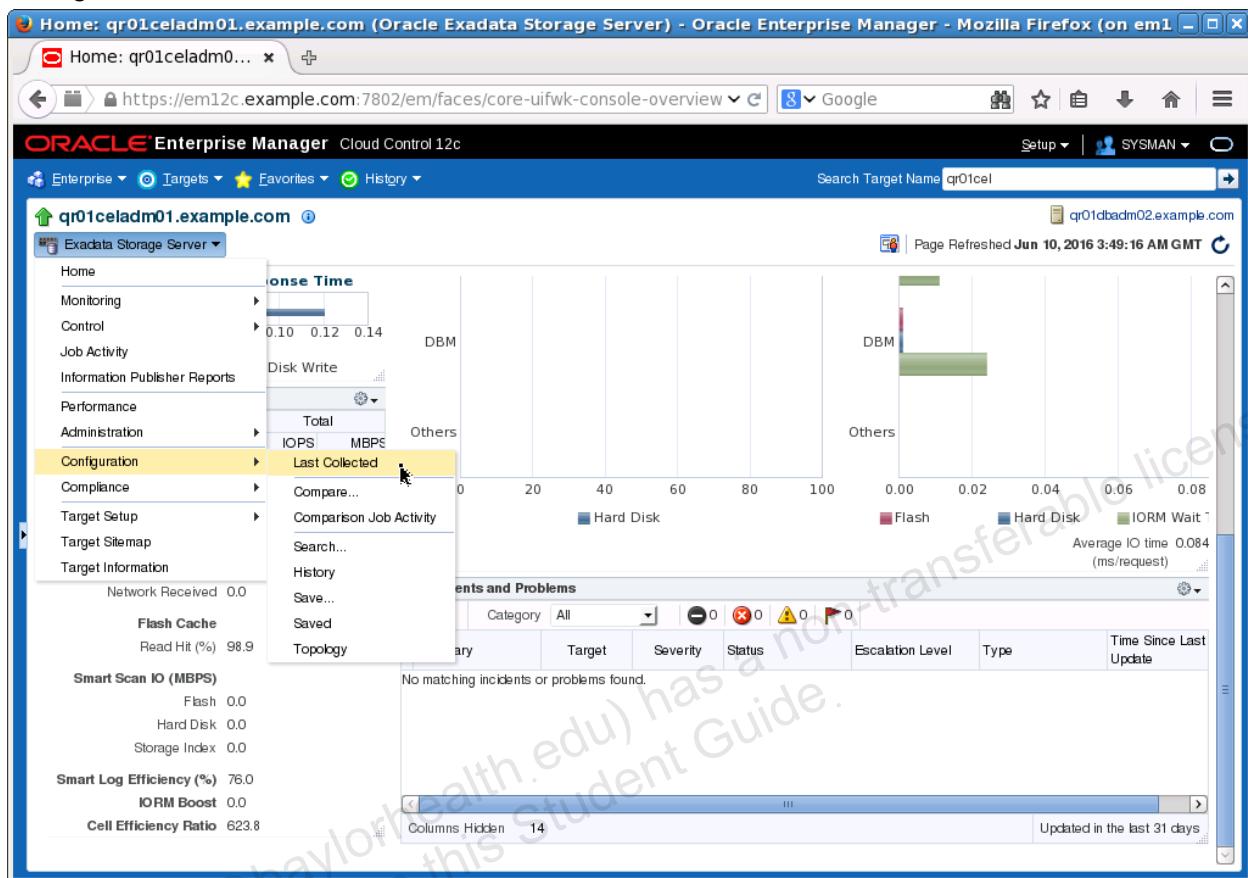
CellCLI>
```

76. Verify that the IORM objective is set to balanced on qr01celadm01.

```
CellCLI> list iormplan detail
      name:          qr01celadm01_IORMPLAN
      catPlan:
      dbPlan:
      objective:     balanced
      status:        active

CellCLI>
```

77. Back in your Enterprise Manager session, select the Exadata Storage Server > Configuration > Last Collected menu command.



78. You should now see the configuration browser page for `qr01celadm01.example.com`. The configuration browser allows administrators to examine the configuration settings associated with a management target. It is similar to the All Metrics page that you examined earlier. The main difference between metrics and configuration settings is that metric values are expected to constantly vary over time while configuration settings should be more stable. You can use the hierarchical list on the left side of the page to examine different groups of configuration settings.

The screenshot shows the Oracle Enterprise Manager Configuration Browser interface. The URL in the address bar is `https://em12c.example.com:7802/em/faces/core-uifwk-console-overview`. The main content area displays the configuration properties for the target `qr01celadm01.example.com`. The properties listed are:

Property Name	Property Value
Cell Name	qr01celadm01
Management IP Address	192.0.2.103
ILOM IP Address	192.0.2.108
Operating System	Linux
Platform	x86_64
Target Version	12.1.2.1.0

The sidebar on the left shows a hierarchical tree of configuration categories under `qr01celadm01.example.com`, including Infiniband HCA Configuration, Cell Configuration, CELL Grid Disk Configuration, CELL LUN Configuration, CELL Physical Disk Configuration, CELL IORM Configuration, and CELL Flashcache Configuration.

79. Click Refresh. This will cause Enterprise Manager to re-examine the storage server and refresh its configuration information.

The screenshot shows the Oracle Enterprise Manager interface for Cloud Control 12c. The left sidebar displays a tree view of configurations for the target 'qr01celadm01.example.com'. The 'Latest Configuration' section is selected, and a 'Refresh' button is highlighted with a cursor. The main panel shows the 'Configuration Properties' for the selected target. The properties listed are:

Property Name	Property Value
Cell Name	qr01celadm01
Management IP Address	192.0.2.103
ILOM IP Address	192.0.2.108
Operating System	Linux
Platform	x86_64
Target Version	12.1.2.1.0

At the top right, there is a note: 'Page Refreshed Jun 10, 2016 3:52:19 AM GMT'.

80. Wait until you see a message indicating that the configuration information has been refreshed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar lists various configuration categories for the target 'qr01celadm01.example.com'. The main pane displays the 'Latest Configuration' for this target. A confirmation message at the top states: 'Refresh operation for target qr01celadm01.example.com succeeded, and the refreshed configuration data is displayed.' Below this, the 'Configuration Properties' section shows the following details:

Property Name	Property Value
Cell Name	qr01celadm01
Management IP Address	192.0.2.103
ILOM IP Address	192.0.2.108
Operating System	Linux
Platform	x86_64
Target Version	12.1.2.1.0

At the bottom right of the main pane, it says 'Total Number of Rows 6'.

81. Click CELL IORM Configuration in the hierarchical list on the left side of the page.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar indicates the target is qr01celadm01.example.com. The left sidebar has a tree view of configurations under qr01celadm01.example.com, with 'CELL IORM Configuration' selected. The right panel shows the 'Configuration Properties' for this configuration. The properties listed are:

Property Name	Property Value
Cell Name	qr01celadm01
Management IP Address	192.0.2.103
ILOM IP Address	192.0.2.108
Operating System	Linux
Platform	x86_64
Target Version	12.1.2.1.0

At the bottom right of the properties panel, it says 'Total Number of Rows 6'.

82. Examine the CELL IORM Configuration. Verify that the IORM Objective is listed as balanced, reflecting the configuration change you made in step 75.

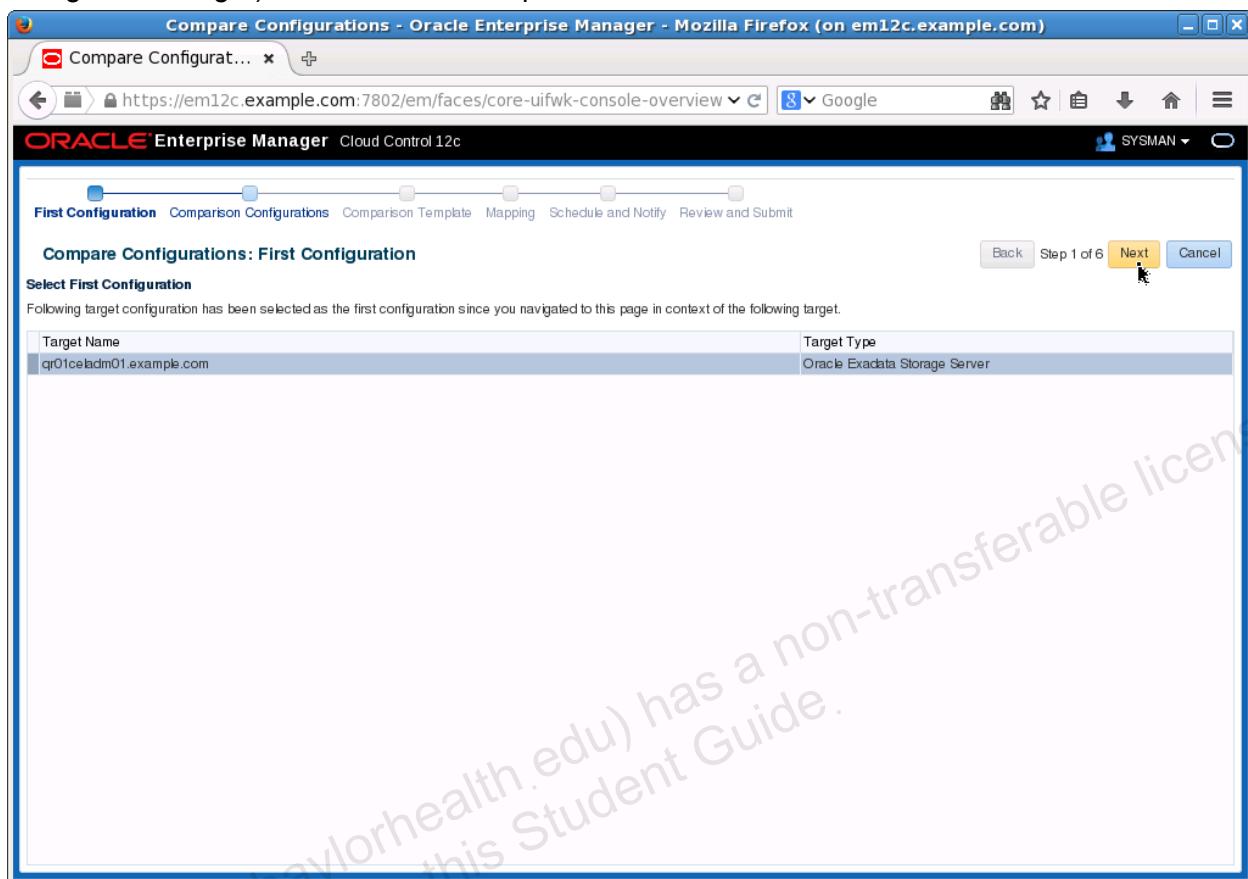
Config Key	Cell ID	IO Resource Plan Name	Cell Name	Category Plan	DB Plan	IORM Object
IORM Plan	ef92136a-837c-4e1d-88d2-e015ab89b7b	qr01celadm01_IOR...	qr01celadm01			balanced

At this point, you have adjusted the IORM objective on one cell (qr01celadm01) and you have verified that the adjusted setting is visible in Enterprise Manager. Next, you will compare the configuration of qr01celadm01 with your other cells to identify if there are any differences.

83. Select the Exadata Storage Server > Configuration > Compare... menu command.

Cell ID	IO Resource Plan Name	Cell Name	Category Plan	DB Plan	IORM Object
e192136a-837c-4e1d-88d2-e01f5ab89b7b	qr01celadm01_IO...	qr01celadm01	balanced		

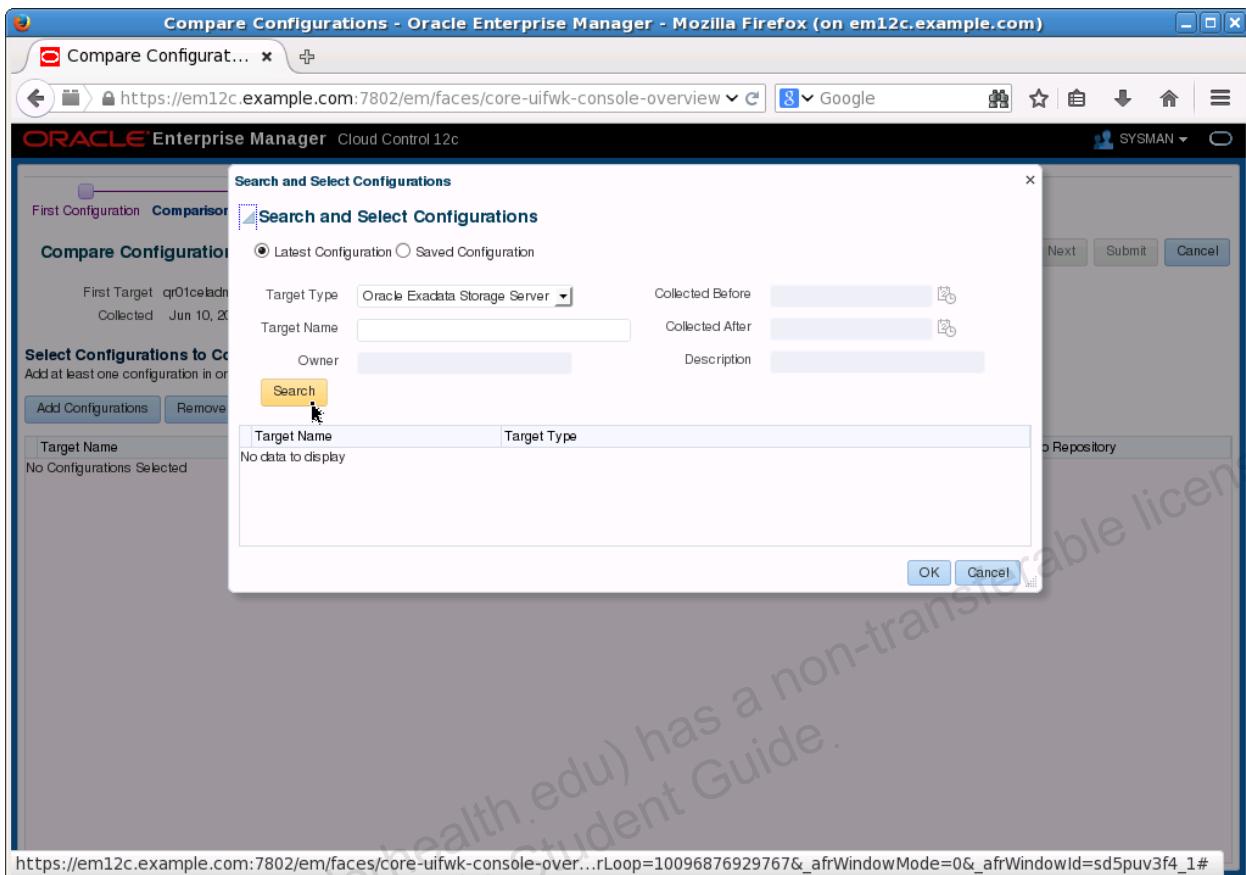
84. Confirm that qr01celadm01.example.com is selected as the comparison baseline (first configuration target). Then click Next to proceed.



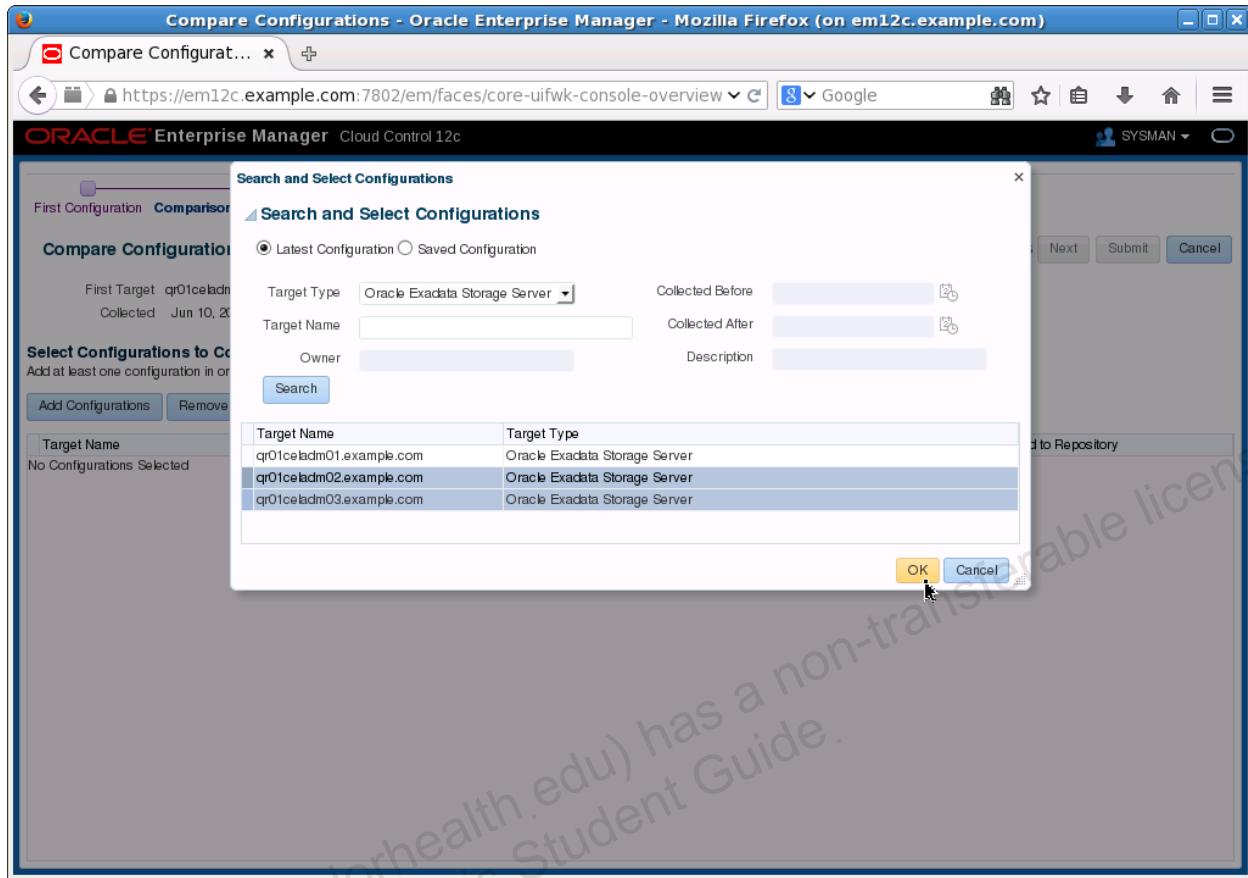
85. Click Add Configurations.

The screenshot shows the 'Compare Configurations' wizard in Oracle Enterprise Manager. The current step is 'Comparison Configurations'. At the top, there is a breadcrumb trail: First Configuration → Comparison Configurations → Comparison Template → Mapping → Schedule and Notify → Review and Submit. The main content area displays the 'First Target' as 'qr01ceadm01.example.com (Oracle Exadata Storage Server)' and the 'Collected' date as 'Jun 10, 2016 3:48:13 AM (Latest Configuration)'. Below this, a section titled 'Select Configurations to Compare with the First' instructs the user to 'Add at least one configuration in order to move to the next step.' There are two buttons: 'Add Configurations' (highlighted with a yellow background) and 'Remove'. A table below lists configurations with columns: Target Name, Target Type, Collected, Owner, and Saved to Repository. The table shows 'No Configurations Selected'. At the bottom right, there are buttons for 'Back', 'Step 2 of 6', 'Next', 'Submit', and 'Cancel'.

86. Click Search.



87. Select qr01celadm02.example.com and qr01celadm03.example.com, and click OK.



88. Confirm that qr01celadm02.example.com and qr01celadm03.example.com are selected as the comparison configurations. Then click Submit to proceed.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Compare Configurations - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Compare Configurations: Comparison Configurations". A progress bar at the top indicates the current step is "Comparison Configurations". Below the progress bar, it says "First Target: qr01celadm01.example.com (Oracle Exadata Storage Server)" and "Collected: Jun 10, 2016 3:48:13 AM (Latest Configuration)". A section titled "Select Configurations to Compare with the First" asks to "Add at least one configuration in order to move to the next step." There are "Add Configurations" and "Remove" buttons. A table lists the configurations:

Target Name	Target Type	Collected	Owner	Saved to Repository
qr01celadm02.example.com	Oracle Exadata Storage Server	Jun 10, 2016 1:01:40 AM		
qr01celadm03.example.com	Oracle Exadata Storage Server	Jun 10, 2016 1:01:45 AM		

At the bottom right, there are buttons for "Back", "Step 2 of 6", "Next", "Submit" (which is highlighted), and "Cancel".

89. On the resulting page, examine the Comparison Result. If the comparison is Scheduled or In Progress, periodically refresh the page until it completes.

The screenshot shows the 'Comparison Job Activity' page in Oracle Enterprise Manager. The URL is https://em12c.example.com:7802/em/faces/core-ecm-compare-activity?jobE+Fri+Jun+10+2016+03:59:26+UTC&_afrLoop=14127075156876#. The page displays a table of comparison jobs. The table has columns: Comparison Name, Comparison Result, Target Type, First Target, Second Target, Owner, Status, Scheduled Start, Comparison Run Date. There are three rows in the table, all labeled 'In Progress'. The first row's details are: Configuration Comparison Job Fri, Oracle Exadata Storage Server, qr01celadm01.ex..., qr01ce..., SYSMAN, Running, Jun 10, 2016 3:59:26 AM, Jun 10, 2016 3:59:26 AM. The second row's details are: Oracle Exadata Storage Server, qr01celadm01.ex..., qr01ce..., SYSMAN, Running, Jun 10, 2016 3:59:26 AM, Jun 10, 2016 3:59:26 AM. The third row's details are: Oracle Exadata Storage Server, qr01celadm01.ex..., qr01ce..., SYSMAN, Running, Jun 10, 2016 3:59:26 AM, Jun 10, 2016 3:59:26 AM.

Comparison Name	Comparison Result	Target Type	First Target	Second Target	Owner	Status	Scheduled Start	Comparison Run Date
CONFIGURATIO	In Progress	Oracle Exadata Storage Server	qr01celadm01.ex...	qr01ce...	SYSMAN	Running	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM
	In Progress	Oracle Exadata Storage Server	qr01celadm01.ex...	qr01ce...	SYSMAN	Running	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM
	In Progress	Oracle Exadata Storage Server	qr01celadm01.ex...	qr01ce...	SYSMAN	Running	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM

90. When the comparison completes, you should see that the Comparison Result is Different. Click the Expand icon beside the Comparison Name.

The screenshot shows the 'Comparison Job Activity' page in Oracle Enterprise Manager. The URL is https://em12c.example.com:7802/em/faces/core-ecm-compare-activity?jobE+Fri+Jun+10+2016+03:59:26+UTC&_afrLoop=14127075156876#. The page displays a table of comparison results. One row is highlighted in yellow, indicating a difference. The 'Comparison Result' column shows 'Different'. The 'First Target' and 'Second Target' columns show 'qr01celadm01.ex...' and 'SYSMAN' respectively. The 'Status' column shows 'Succeeded'. The 'Comparison Run Date' column shows 'Jun 10, 2016 3:59:26 AM'. An 'Expand' button is located below the table.

Comparison Name	Comparison Result	Target Type	First Target	Second Target	Owner	Status	Scheduled Start	Comparison Run Date
CONFIGURATIO	Different	Oracle Exadata Storage Server	qr01celadm01.ex...	qr0...	SYSMAN	Succeeded	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM

91. Click one of the available Different links.

The screenshot shows the 'Comparison Job Activity' page in Oracle Enterprise Manager. The table displays the following data:

Comparison Name	Comparison Result	Target Type	First Target	Second Target	Owner	Status	Scheduled Start	Comparison Run Date
CONFIGURATION	Different	Oracle Exadata Storage Server	qr01celadm01.ex...	qr0...	SYSMAN	Succeeded	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM
	Different	Oracle Exadata Storage Server	qr01celadm01.ex...	qr0...	SYSMAN	Succeeded	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM
	Different	Oracle Exadata Storage Server	qr01celadm01.examp...	qr01ce	SYSMAN	Succeeded	Jun 10, 2016 3:59:26 AM	Jun 10, 2016 3:59:26 AM

92. Examine the comparison result. You should see that the IORM Objective for the first configuration (qr01celadm01) is balanced, while it is listed as basic (the default setting) in the other cell.

The screenshot shows the 'Compare Result' page in Oracle Enterprise Manager. It displays a comparison between two configurations:

Result	Config Key
✗	IORM Plan

Result	Configuration Property Name	First	Second
✗	IORM Objective	balanced	basic

In the final part of this practice, you will use the IORM administration capabilities in Enterprise Manager to return your cells to a consistent configuration.

93. Select the Targets > Exadata menu command.

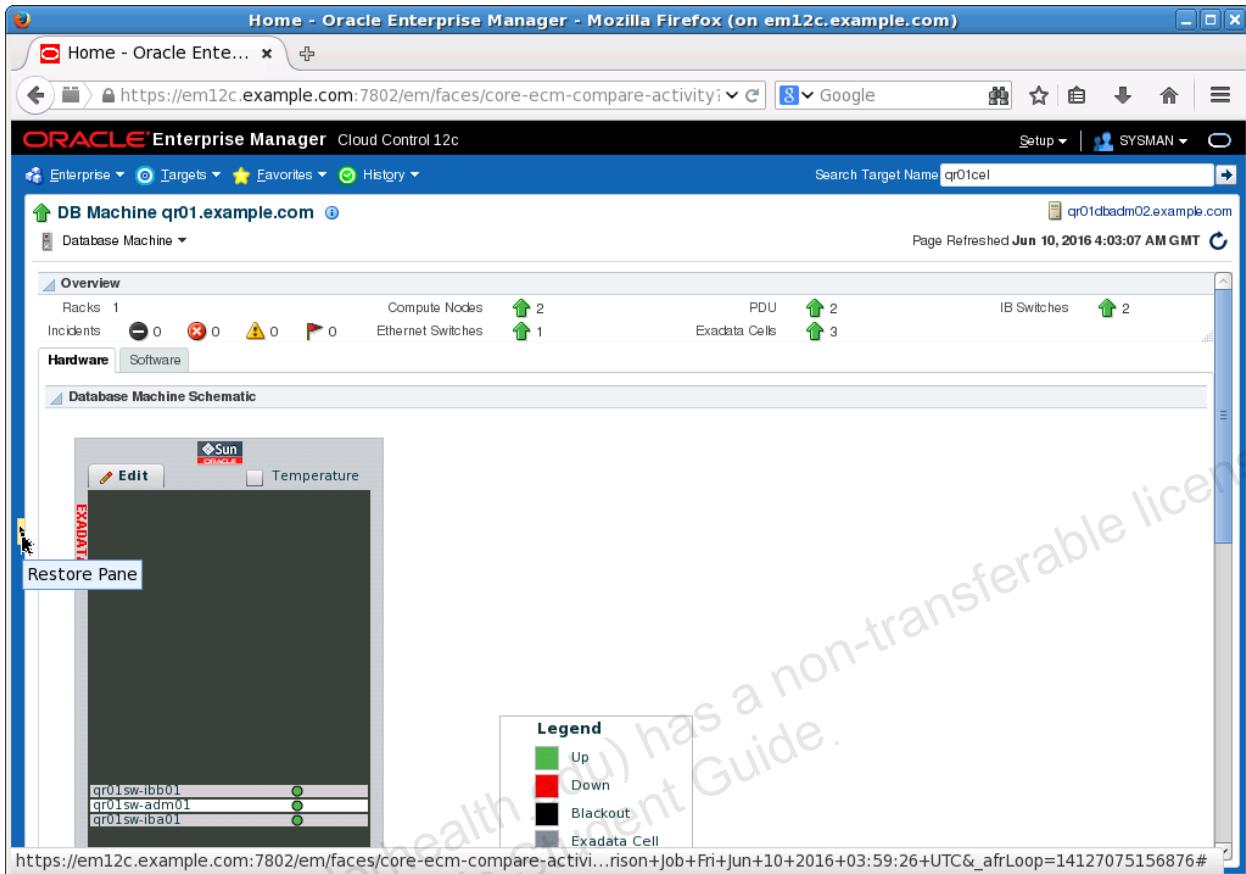
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Compare Result: Different - Mozilla Firefox (on em12c.example.com)". The left sidebar has a "Compare Result" section with a red error icon. The "Targets" dropdown menu is open, with "Exadata" highlighted. The main content area displays a comparison between two targets: "qr01celadm01.example.com (Oracle Exadata Storage Server)" (First Configuration) and "qr01celadm02.example.com (Oracle Exadata Storage Server)" (Second Configuration). The comparison date is "Jun 10, 2016 1:01:40 AM (Latest Configuration)". The results table shows a difference in the "CELL IORM Configuration" section, specifically for the "IORM Plan" and "IORM Objective" properties. The "Configuration Properties" table shows the following data:

Result	Configuration Property Name	First	Second
qr01celadm01	IORM Plan		
qr01celadm01	IORM Objective	balanced	basic

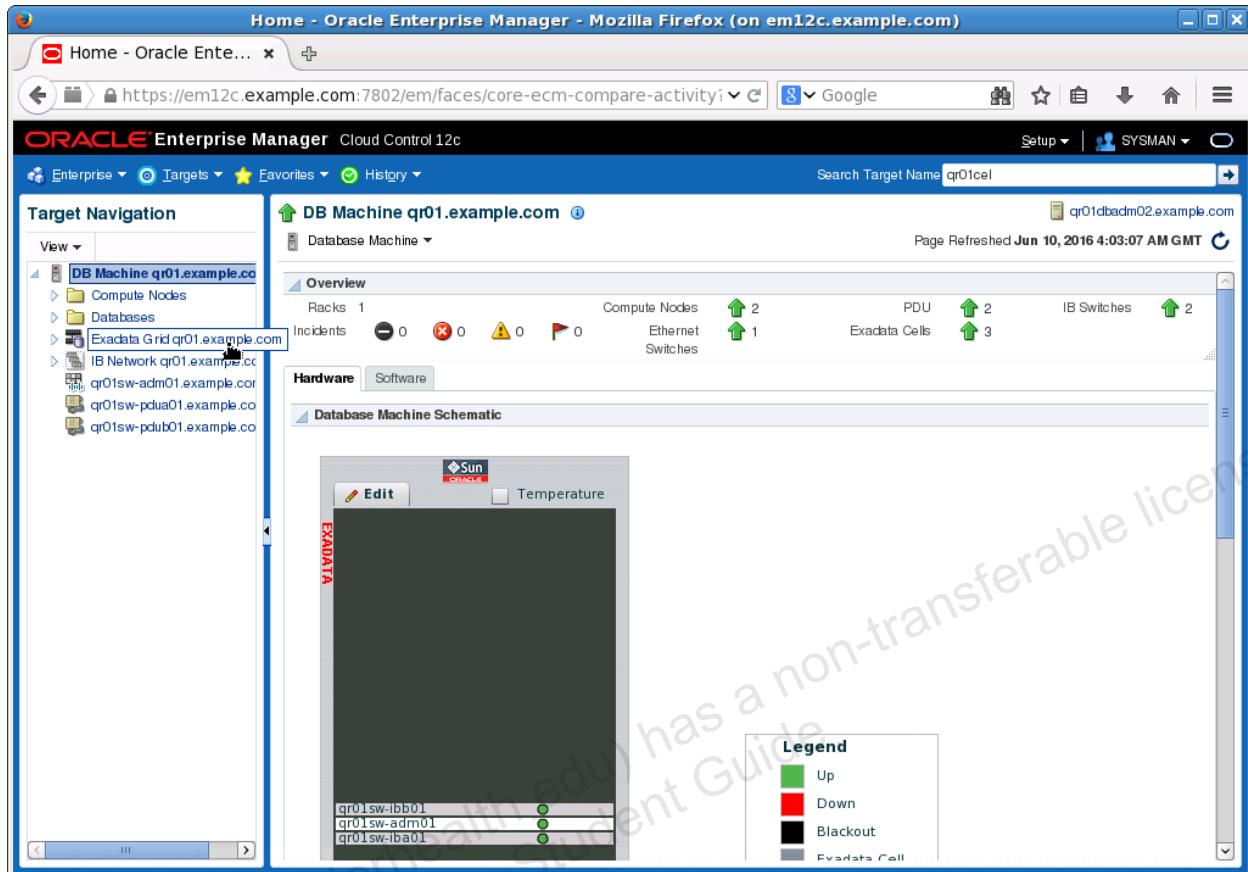
94. Click the link corresponding to your Exadata Database Machine (DB Machine qr01.example.com).

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Oracle Exadata Database Machines - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Oracle Exadata Database Machines". A search bar at the top left says "Enter the target name to search." Below it is a table with one row. The table columns are "Target Name", "Status", "Members", "Member Status Summary", and "Incidents". The first row contains "DB Machine qr01.example.com", "Up", "Cluster Database(1), Oracle Infiniband Switch(2), Oracle Infiniband Netw", "17", and a set of status icons. The URL in the browser bar is partially visible as https://em12c.example.com:7802/em/faces/core-ecm-compare-activity?jobE...rison+job+Fri+Jun+10+2016+03:59:26+UTC&_afrLoop=14127075156876#.

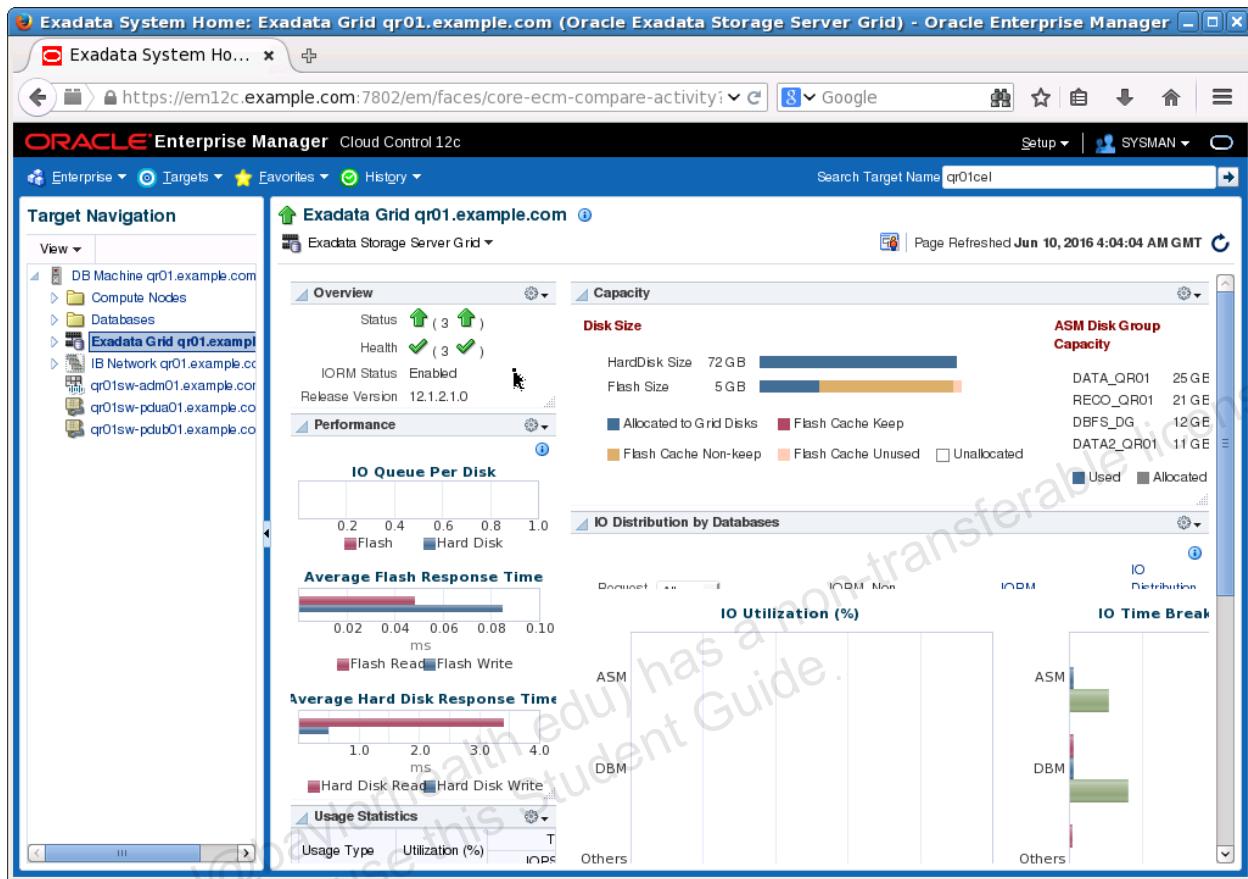
95. Restore the Target Navigation pane.



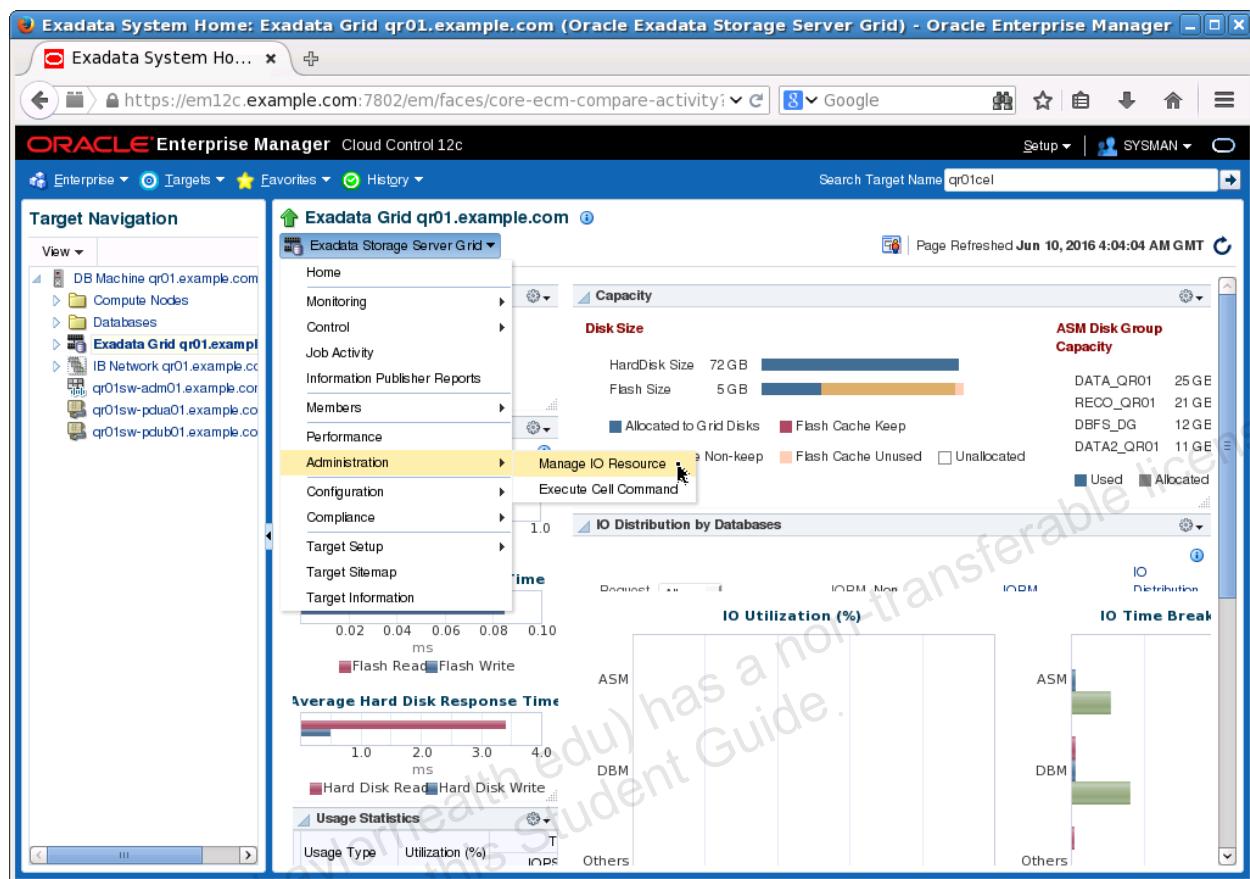
96. In the Target Navigation pane, click “Exadata Grid qr01.example.com”.



97. You now see the Exadata Storage Server Grid home page. This page is very similar to the home page for each individual Exadata Storage Server. However, the information presented on this page covers all the storage servers in the Exadata Database Machine.



98. Select the Exadata Storage Server Grid > Administration > Manage IO Resource menu command.



99. The resulting page provides administrators with an interface to manage IORM configuration settings across all the Exadata Storage Servers in the Exadata Database Machine. Notice that the page indicates a difference in the IORM objective across the cells.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar displays 'Target Navigation' with a tree view of targets, including 'DB Machine qr01.example.com', 'Compute Nodes', 'Databases', and 'Exadata Grid qr01.example.com'. The main content area is titled 'Exadata Grid qr01.example.com' and shows 'I/O Resource Manager (IORM) Settings'. It indicates that the configuration was refreshed on Jun 10, 2016, at 1:01:40 AM GMT. A table lists three targets: qr01celadm01.example.com, qr01celadm02.example.com, and qr01celadm03.example.com, all marked as 'Active'. Below this, there is an 'Inter-Database Plan' section with a radio button for 'Share based' selected. A note states that an inter-database plan is not configured on Exadata Storage Servers. There is also a 'Database Resource Management Settings' section with a time range of 'Past 2 hours' and a 'Slider' for data visualization.

100. Select Balanced as the IORM objective for all your cells.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar is titled "Target Navigation" and lists "DB Machine qr01.example.com", "Compute Nodes", "Databases", and "Exadata Grid qr01.example.com". The main content area is titled "Exadata Grid qr01.example.com" and shows "I/O Resource Manager (IORM) Settings". A table lists three storage servers: qr01celadm01.example.com, qr01celadm02.example.com, and qr01celadm03.example.com, all in "Active" status. To the right of the table is a dropdown menu with options: Basic, Auto, Low Latency, **Balanced**, and High Throughput. The "Balanced" option is highlighted with a blue background. Below the table, there is a note: "Oracle recommends the same IORM settings for the group of cells used by the same set of databases. Click on Update All button to change them." At the bottom, there is a "Database Resource Management Settings" section with a "Past 2 hours" time range and a "Slider" for setting thresholds.

101.Click Update All to update the IORM objective across all your cells.

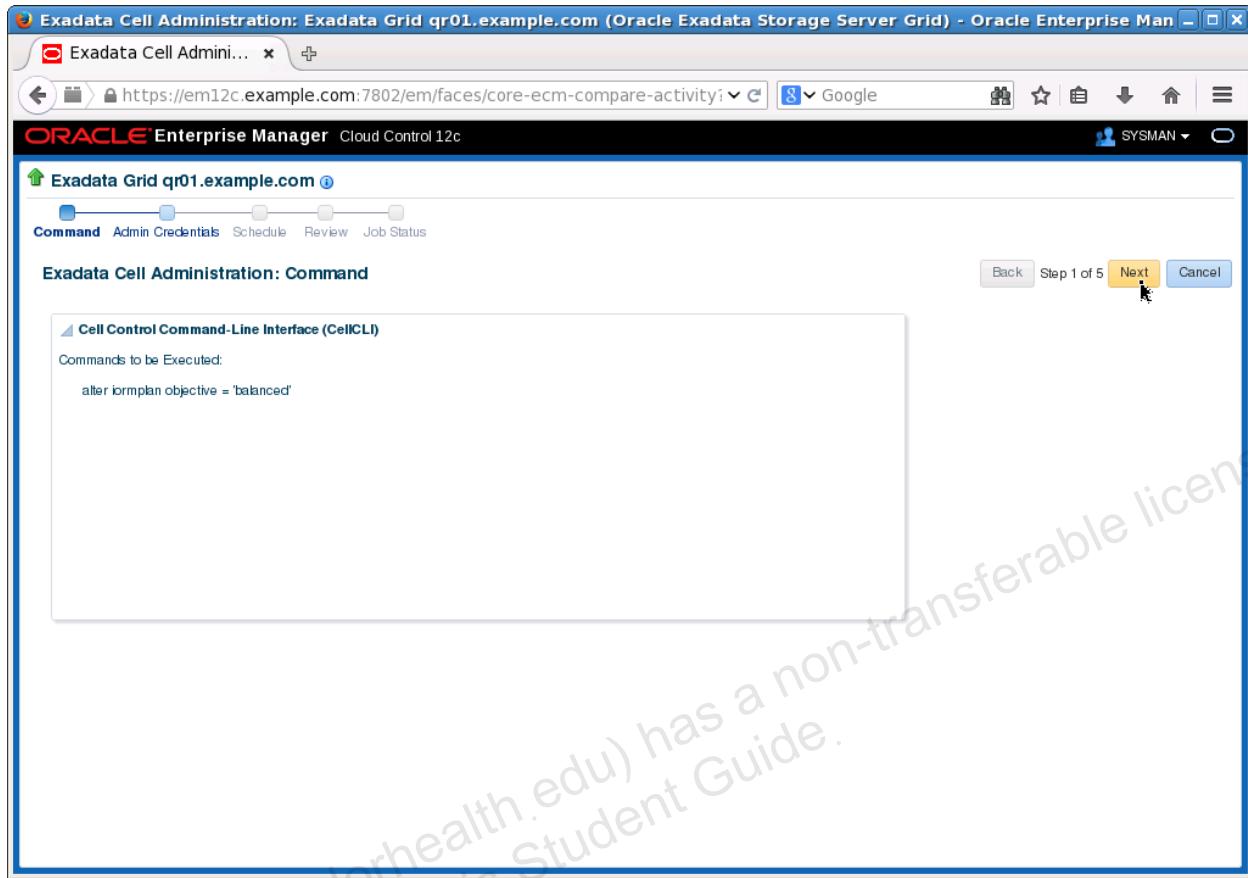
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar shows 'Target Navigation' with 'DB Machine qr01.example.com' selected. The main content area is titled 'Exadata Grid qr01.example.com'. Under 'I/O Resource Manager (IORM) Settings', there is a table showing database targets and their status:

Target	Status
qr01celadm01.example.com	Active
qr01celadm02.example.com	Active
qr01celadm03.example.com	Active

A tooltip over the 'Update All' button indicates: 'Click on Update All button to change the ion objective is not set on all cells'.

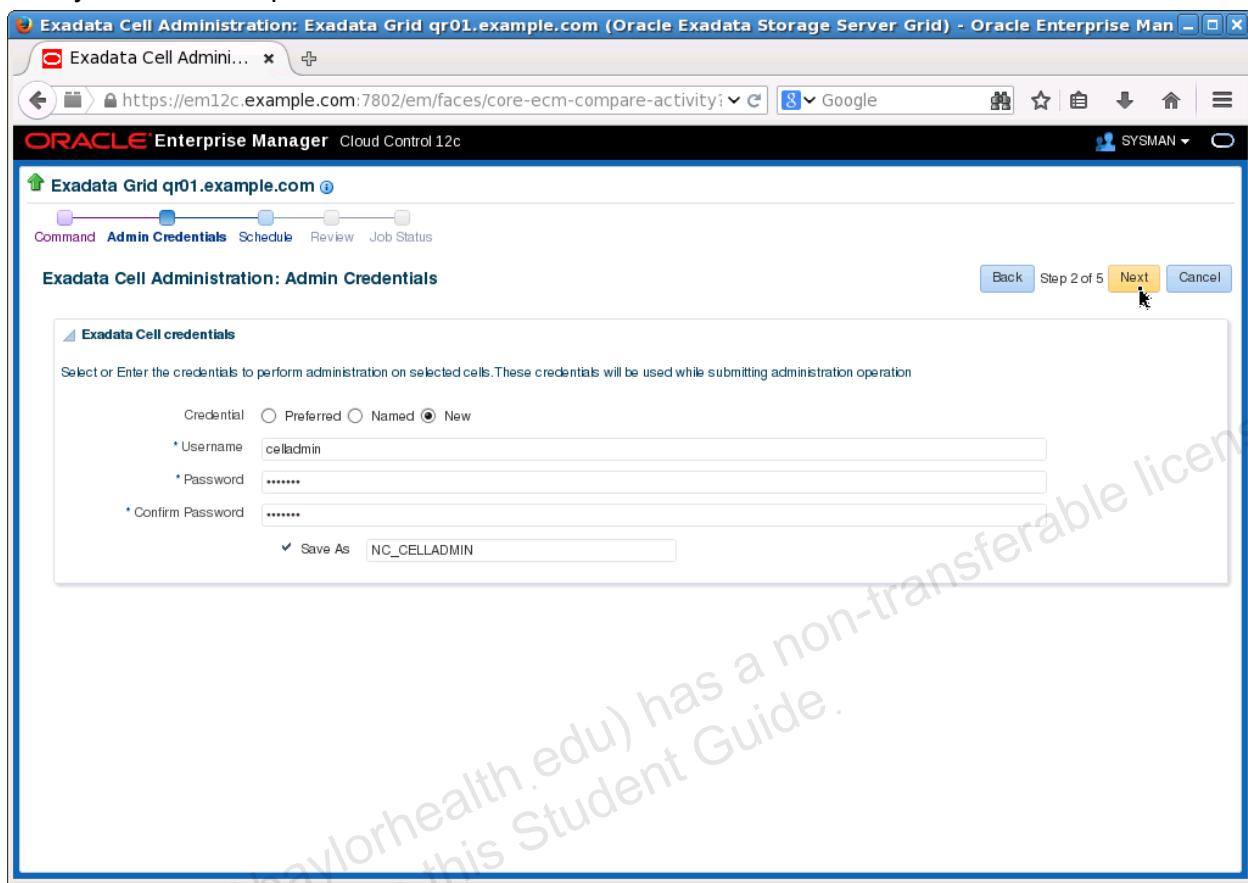
At the bottom, there is a note: 'Oracle recommends the same IORM settings for the group of cells used by the same set of databases. Click on Update All button to change them'.

102.Verify that the command matches your expectation. Then click Next to proceed.

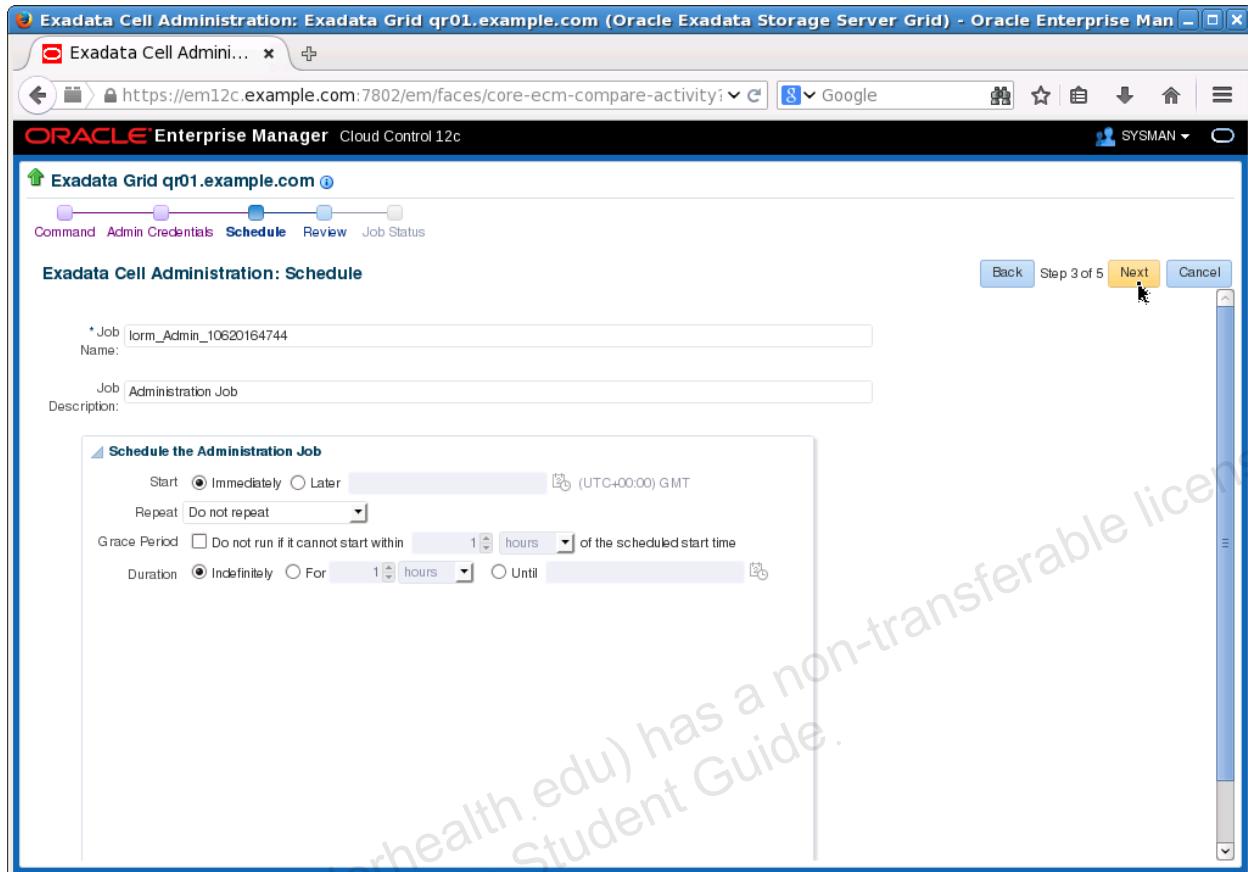


103.Specify new named credentials for the `celladmin` user.

Finally, click Next to proceed.



104.Accept the default schedule settings and click Next.



105. Review the “Job submit summary” and click Submit Command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for Exadata Cell Administration. The title bar indicates the session is for the Exadata Grid qr01.example.com. The main navigation bar includes links for Command, Admin Credentials, Schedule, Review (which is currently selected), and Job Status. Below the navigation is a sub-header for 'Exadata Cell Administration: Review'. A progress bar at the top right shows 'Step 4 of 5'. The central content area is titled 'Job submit summary' and contains the following information:

- Job Name: lorm_Admin_10620164744
- Job Description: Administration Job
- Command to Execute: alter iormplan objective = 'balanced'
- Job Scheduled: immediate
- Target Name: qr01celadm01.example.com
- Selected Cells: qr01celadm02.example.com
qr01celadm03.example.com

At the bottom right of the summary box are buttons for Back, Step 4 of 5, Submit Command (which is highlighted in yellow), and Cancel.

106. Confirm that job submission succeeded and click Return.

The screenshot shows a web browser window titled "Exadata Cell Administration: Exadata Grid qr01.example.com (Oracle Exadata Storage Server Grid) - Oracle Enterprise Man". The URL in the address bar is "https://em12c.example.com:7802/em/faces/core-ecm-compare-activity". The page header includes the "ORACLE Enterprise Manager Cloud Control 12c" logo and a "SYSMAN" link. The main content area has a title "Exadata Grid qr01.example.com" with a back arrow icon. Below the title is a navigation bar with tabs: Command, Admin Credentials, Schedule, Review, and Job Status. The "Job Status" tab is highlighted with a yellow border. A yellow box highlights the "Information" section which contains the message "Job submission succeeded!". At the bottom of the page, there is a "Job Status" section with the message: "Job lorm_Admin_10620164744 is submitted. To view the latest IORM settings, please wait for the job to complete and click on the 'Get Latest' button on the IORM page administration section. Use the link to launch the Job Run details page -- lorm_Admin_10620164744". There are "Back", "Step 5 of 5", and "Return" buttons at the bottom right.

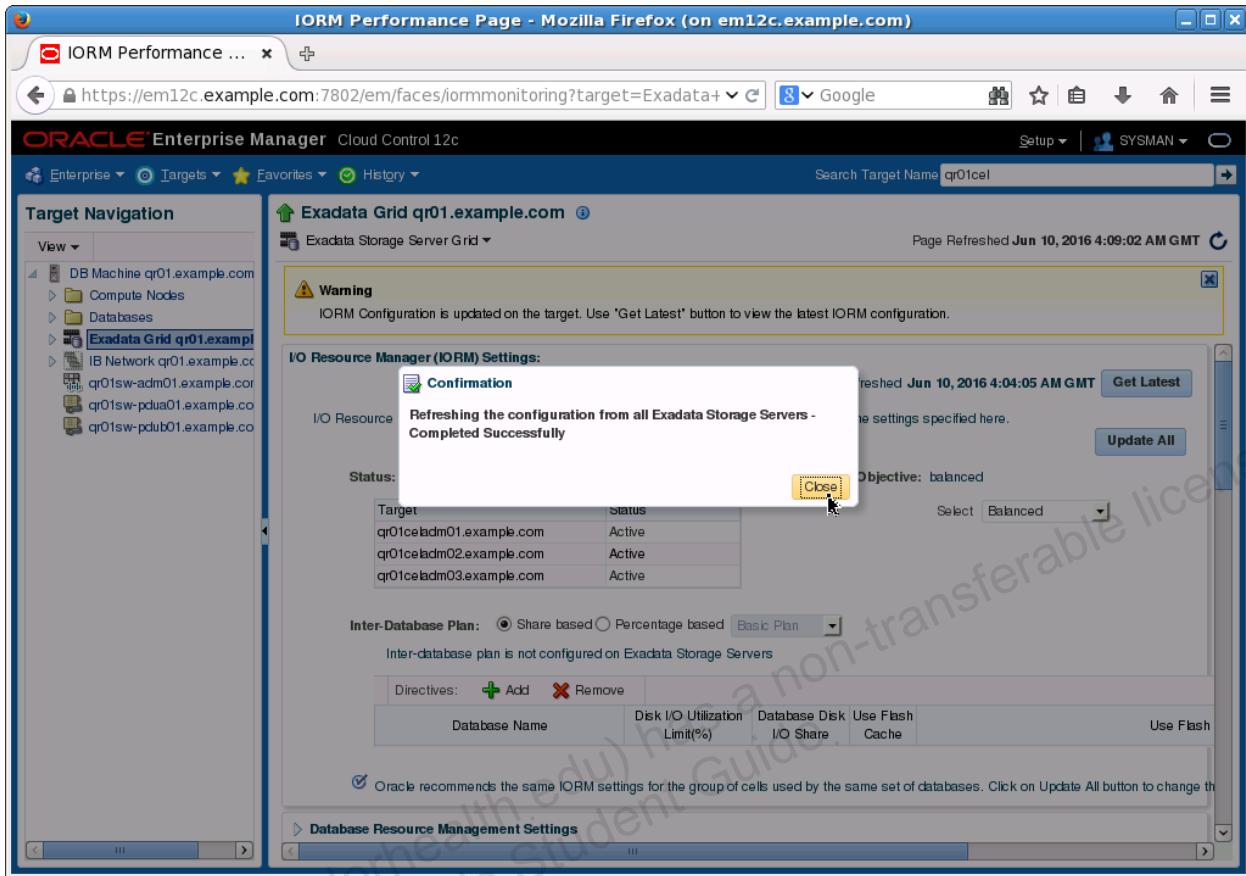
107. When you are returned to the IORM Settings page, you should notice that it still indicates that the Disk IO Objective is not common across all the cells. To update this page, click Get Latest.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "IORM Performance Page - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Exadata Grid qr01.example.com". A yellow warning box states: "Warning: IORM Configuration is updated on the target. Use 'Get Latest' button to view the latest IORM configuration." Below this, under "I/O Resource Manager (IORM) Settings:", there is a table showing database targets and their status:

Target	Status
qr01celadm01.example.com	Active
qr01celadm02.example.com	Active
qr01celadm03.example.com	Active

Below the table, it says "Disk I/O Objective: Common objective is not set on all cells". There is a "Get Latest" button and an "Update All" button. Under "Inter-Database Plan:", there is a radio button for "Share based" and a dropdown menu for "Basic Plan". A note says "Inter-database plan is not configured on Exadata Storage Servers". There is also a "Directives" section with "Add" and "Remove" buttons, and a table for "Database Name", "Disk I/O Utilization Limit(%)", "Database Disk I/O Share", "Use Flash Cache", and "Use Flash". A note at the bottom says "Oracle recommends the same IORM settings for the group of cells used by the same set of databases. Click on Update All button to change them".

108.Click Close to dismiss the confirmation dialog box.



- 109.Verify that the Disk I/O Objective is now listed as balanced. This confirms that the setting has been consistently applied across all your cells.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar displays 'Target Navigation' with nodes like DB Machine qr01.example.com, Compute Nodes, Databases, and Exadata Grid qr01.example.com. The main content area is titled 'IORM Performance Page - Mozilla Firefox (on em12c.example.com)'. It shows the 'Exadata Grid qr01.example.com' target. Under 'I/O Resource Manager (IORM) Settings', it indicates 'Status: Active' and 'Disk I/O Objective: balanced'. A table lists three database targets: qr01celadm01.example.com, qr01celadm02.example.com, and qr01celadm03.example.com, all marked as 'Active'. Below this, there's an 'Inter-Database Plan' section with a radio button for 'Share based' selected. A note says 'Inter-database plan is not configured on Exadata Storage Servers'. A 'Directives' table shows columns for Database Name, Disk I/O Utilization Limit(%), Database Disk I/O Share, Use Flash Cache, and Use Flash. A note at the bottom says 'Oracle recommends the same IORM settings for the group of cells used by the same set of databases. Click on Update All button to change them'. The bottom navigation bar includes 'Past 2 hours', 'Day', '2 hours', '15 minutes', and a 'Slider' icon.

Congratulations! You have performed a variety of storage server monitoring and administration tasks by using Enterprise Manager Cloud Control 12c.

Practices for Lesson 16: Monitoring Exadata Database Machine Database Servers

Chapter 16

Practices for Lesson 16: Overview

Practices Overview

In this practice, you will be introduced to the Exadata-specific database monitoring capabilities provided by Enterprise Manager Cloud Control 12c.

Practice 16-1: Exadata Database Monitoring with Enterprise Manager

Overview

Using Enterprise Manager to monitor Oracle databases on Exadata Database Machine is essentially the same as using it to monitor databases outside of Exadata. However, for Oracle databases running on Exadata Database Machine, Enterprise Manager does include some additional Exadata-specific information. In this practice you will be introduced to the Exadata-specific database monitoring capabilities provided by Enterprise Manager Cloud Control 12c.

Assumptions

The practice relies on the configurations performed in Practice 14-1.

Tasks

- Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

- Change into the labs/swingbench/bin directory.

```
[oracle@qr01dbadm01 ~]$ cd labs/swingbench/bin
[oracle@qr01dbadm01 bin]$
```

- Use the following command to execute a workload against your database. The workload consists of several long-running queries. Leave your terminal alone so that the workload can run to completion, which will take approximately 5 minutes.

```
[oracle@qr01dbadm01 bin]$ ./charbench -c sales.xml -rt 00:05
Author : Dominic Giles
Version : 2.5.0.971

Results will be written to results.xml.
Hit Return to Terminate Run...

Time          Users    TPM      TPS
4:54:55 AM     6        0        0
```

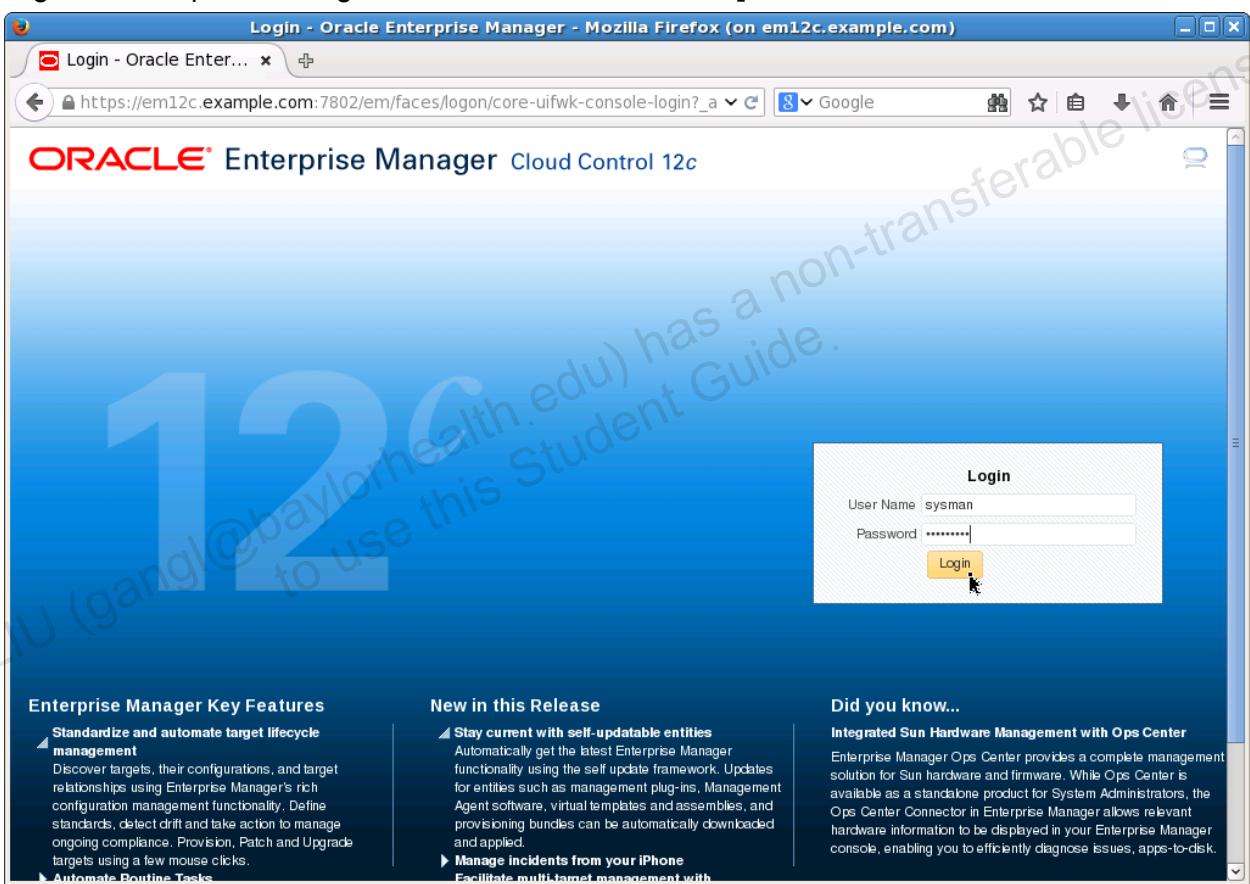
- Establish another terminal session connected to em12c using the oracle OS user. Ensure that you specify the -X option for ssh.

```
$ ssh -X oracle@em12c  
oracle@em12c password: ???????  
[oracle@em12c ~]$
```

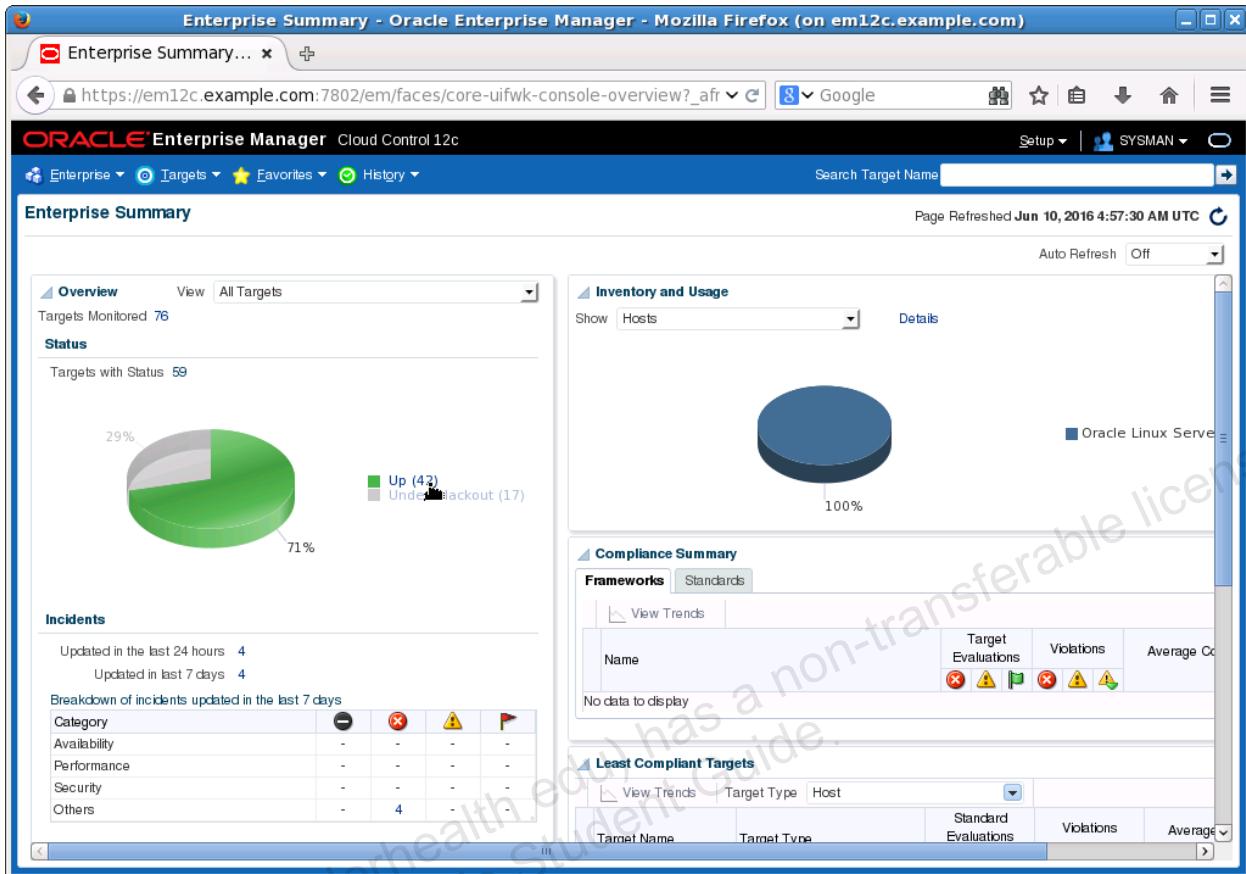
- Start the Firefox web browser.

```
[oracle@em12c ~]$ firefox &  
[1] 21592
```

- Log in to Enterprise Manager Cloud Control 12c as the sysman user.



7. On the Enterprise Summary page, click the Up legend entry beside the target status chart.



8. On the resulting target list, click the link associated with the database instance dbm_dbm1.

The screenshot shows the 'All Targets' page in Oracle Enterprise Manager. The URL is https://em12c.example.com:7802/em/faces/core-uifwk-console-overview?_afrLoop=17610976679629&_afrWindowMode=0&_afrWindowId=5j630wdx_11#. The page displays a table of targets with columns: Target Name, Target Type, and Target Status. A sidebar on the left shows a tree view of target types: Target Type (Databases, Cluster, Database Instance, Listener, Oracle High Availability Service), Engineered Systems, Groups, Systems and Services, and Servers, Storage and Network. The target 'dbm_dbm1' is selected and highlighted in yellow. The table data is as follows:

Target Name	Target Type	Target Status
+ASM_qr01	Cluster ASM	Up
+ASM1_qr01dbadm01.example.com	Automatic Storage Management	Up
+ASM2_qr01dbadm02.example.com	Automatic Storage Management	Up
dbm	Cluster Database	Up
dbm_celsys	Oracle Database Exadata Storage Server ...	Up
dbm_dbm1	Database Instance	Up
dbm_dbm2	Database Instance	Up
dbm_sys	Database System	Up
DB Machine qr01.example.com	Oracle Exadata Database Machine	Up
DB Machine qr01.example.com-Exadata ASM Service_dbm_sys_asm1	Generic Service	Up
DB Machine qr01.example.com-Exadata Cisco Switch Service	Generic Service	Up
DB Machine qr01.example.com-Exadata Database Service_dbm	Generic Service	Up
DB Machine qr01.example.com-Exadata Host Service	Generic Service	Up
DB Machine qr01.example.com-Exadata ILOM Service	Generic Service	Up
DB Machine qr01.example.com-Exadata Infiniband Service	Generic Service	Up
DB Machine qr01.example.com-Exadata Listener Service_dbm_sys_lsrr1	Generic Service	Up
DB Machine qr01.example.com-Exadata PDU Service	Generic Service	Up
DB Machine qr01.example.com-Exadata Storage Servers Service	Generic Service	Up
Exadata Grid qr01.example.com	Oracle Exadata Storage Server Grid	Up
has_qr01dbadm01.example.com	Oracle High Availability Service	Up
has_qr01dbadm02.example.com	Oracle High Availability Service	Up
IB Network qr01.example.com	Oracle Infiniband Network	Up

9. On the database instance home page for dbm_dbm1, collapse the Target Navigation pane.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "dbm_dbm1 (Database Instance) - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area displays the "dbm_dbm1" instance details. On the left, the "Target Navigation" pane is collapsed, indicated by a blue button labeled "Collapse Pane". The main content includes a "Summary" section with status metrics like Up Time (2 days, 22 hrs), Version (12.1.0.2.0), and Sessions (100). It also features a "Performance" chart showing Active Sessions over time, a "Resources" section, and an "SQL Monitor - Last Hour" table listing running SQL statements. The URL in the browser is https://em12c.example.com:7802/em/faces/core-uifwk-console-over...Loop=17610976679629&_afrWindowMode=0&_afrWindowId=5j630wdx_11#.

10. In the “SQL Monitor - Last Hour” area, you should see a list of SQL statements. Most of these statements should belong to the workload you executed at the beginning of this practice. Hover your mouse pointer over the SQL ID links in the list to reveal the SQL statement associated with each entry in the list. Find an interesting looking query that is based on the `sh` schema you have been using throughout all the practices in this course. Click the link associated with your selected query.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for database dbm_dbm1. The main navigation bar includes links for Enterprise, Targets, Favorites, History, Oracle Database, Performance, Availability, Security, Schema, and Administration. The left sidebar has sections for Summary, Status (Up Time: 2 days, 22 hrs; Version: 12.1.0.2.0; Load: 0.00 average active sessions; Total Sessions: 100; Last Backup: N/A; Available Space: N/A; Used Space: N/A; Total SGA: 1,504.00 MB), Diagnostics (ADDM Findings: 4, Incidents: 0), Compliance Summary (View Trends, Compliance Standard, Average Score: No data to display), and Jobs Running.

The central Performance section features a graph titled "Activity Class" showing Active Sessions over time (4:09 AM to 4:29 AM). The legend indicates four metrics: Wait (orange), User I/O (blue), CPU (green), and CPU Cores (red). A tooltip for a specific session shows the following SQL query:

```

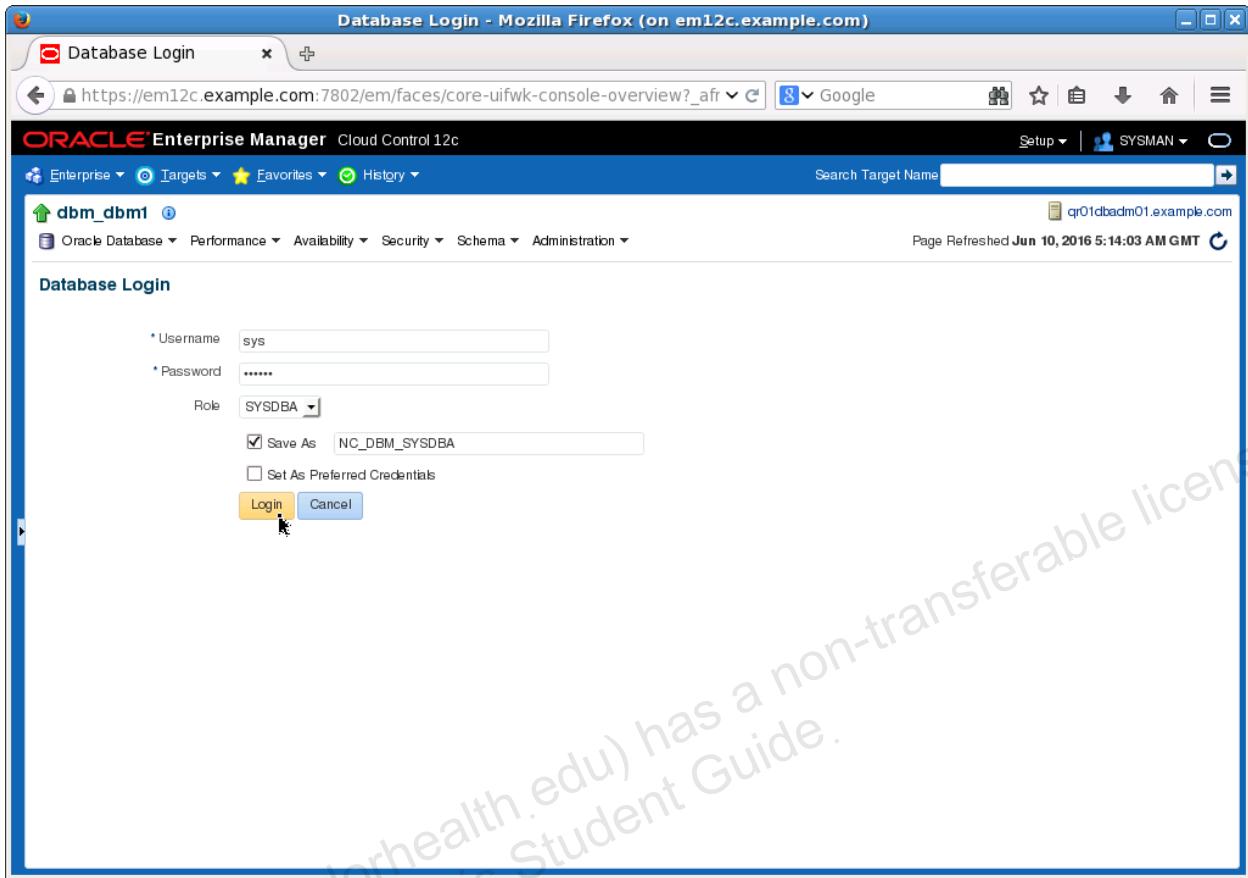
SELECT SUM(amount_sold),
       t.calendar_month_desc,
       t.calendar_week_number,
       c.country_name
  FROM sales s,
       times t,
       countries c,
       customers cu
 WHERE s.time_id      = t.time_id
   AND t.calendar_month_desc = '1996-06'
   AND cu.country_id    = c.country_id
   AND s.cust_id        = cu.cust_id
   AND c.country_iso_code = 'CN'
  group by t.calendar_month_desc,
           t.calendar_week_number,
           c.country_name

```

The SQL Monitor - Last Hour table lists several completed SQL statements with their status (OK), duration, and SQL ID. One row is highlighted with a tooltip showing the same complex query as above.

Status	Duration	SQL ID
OK	38.00 s	28kh2
OK	19.00 s	Oah0j
OK	12.00 s	g68br
OK	9.00 s	143ar
OK	17.00 s	8y36pcnrmaj7cn
OK	17.00 s	a8mm3wxgrucuw
OK	12.00 s	4ac3u3prsxbf6

11. Login to the database as the sys user.



12. On the Monitored SQL Execution Details page, you will see detailed information relating to your selected query. When the database resides on Exadata, some additional Exadata-specific information is also presented. Notice the Cell Offload Efficiency statistic. Hover your mouse pointer over the Cell Offload Efficiency value to reveal more detailed information.

Monitored SQL Execution Details: dbm_dbm1 (Database Instance) - Oracle Enterprise Manager - Mozilla Firefox (on em12c.e...)

Monitored SQL Exec... x +

https://em12c.example.com:7802/em/faces/core-uifwk-console-overview ↻ G Google

ORACLE Enterprise Manager Cloud Control 12c

Enterprise Targets Favorites History Search Target Name

Logged in as sys | SYSMAN

dbm_dbm1

Oracle Database Performance Availability Security Schema Administration

Monitored SQL Executions > Monitored SQL Execution Details: 8y36pcnrma7cn | Navigate to SQL Details

Save Page Refreshed 5:15:21 AM GMT

Overview

General

SQL Text: SELECT SUM(amount_sold), t.calendar_month_desc, t.cal...

Execution Plan: Resolved

Execution Started: Fri Jun 10, 2016 4:59:28 AM

Last Refresh Time: Fri Jun 10, 2016 4:59:35 AM

Execution ID: 16777216

User: SH

Fetch Calls: 1

Time & Wait Statistics

Duration	7.0s
Database Time	7.6s
PL/SQL & Java	0us
Wait Activity %	100

IO Statistics

Buffer Gets	107K
IO Requests	4,947
IO Bytes	693MB
Cell Offload Efficiency	97%

Cell Offload Efficiency: 97%
Bytes read from disks: 693MB
Bytes returned by Exadata: 20MB

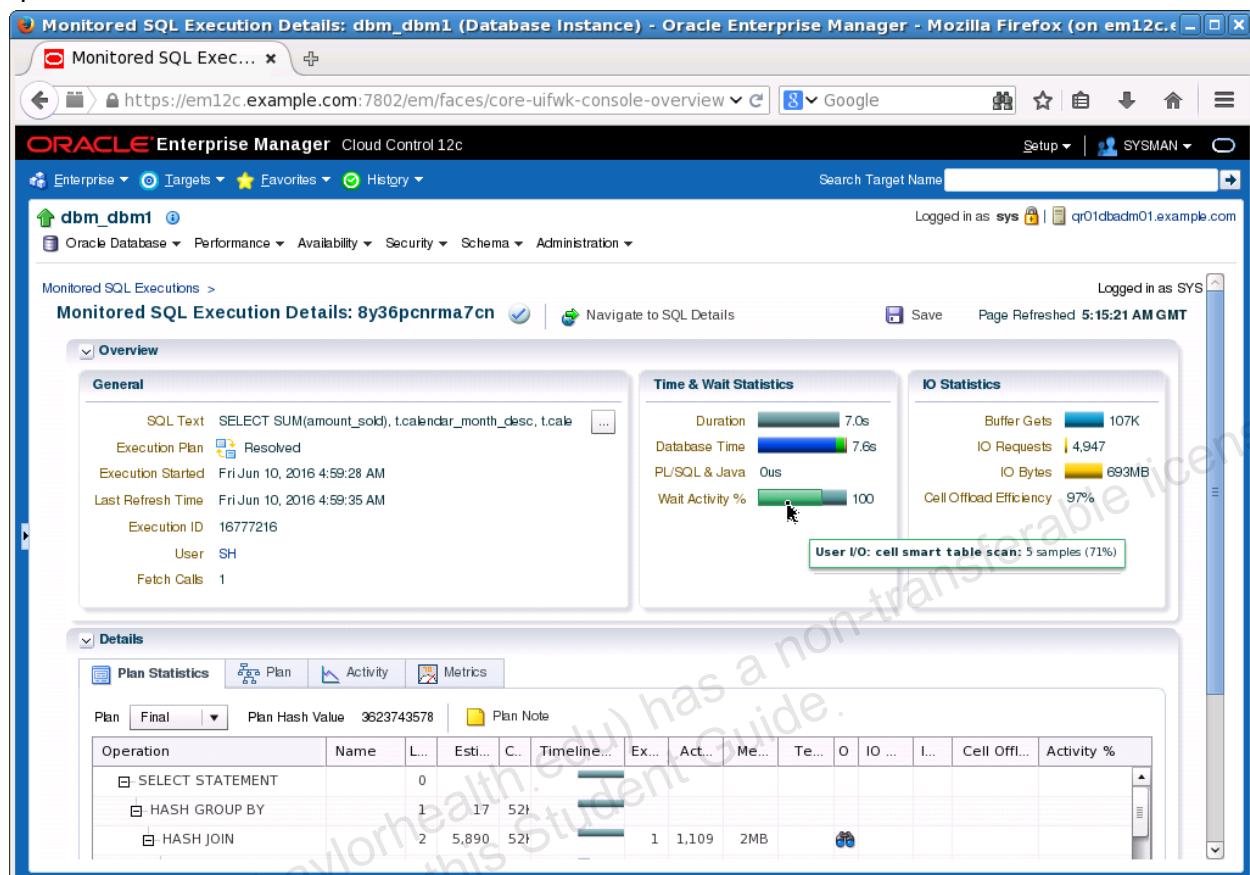
Details

Plan Statistics Plan Activity Metrics

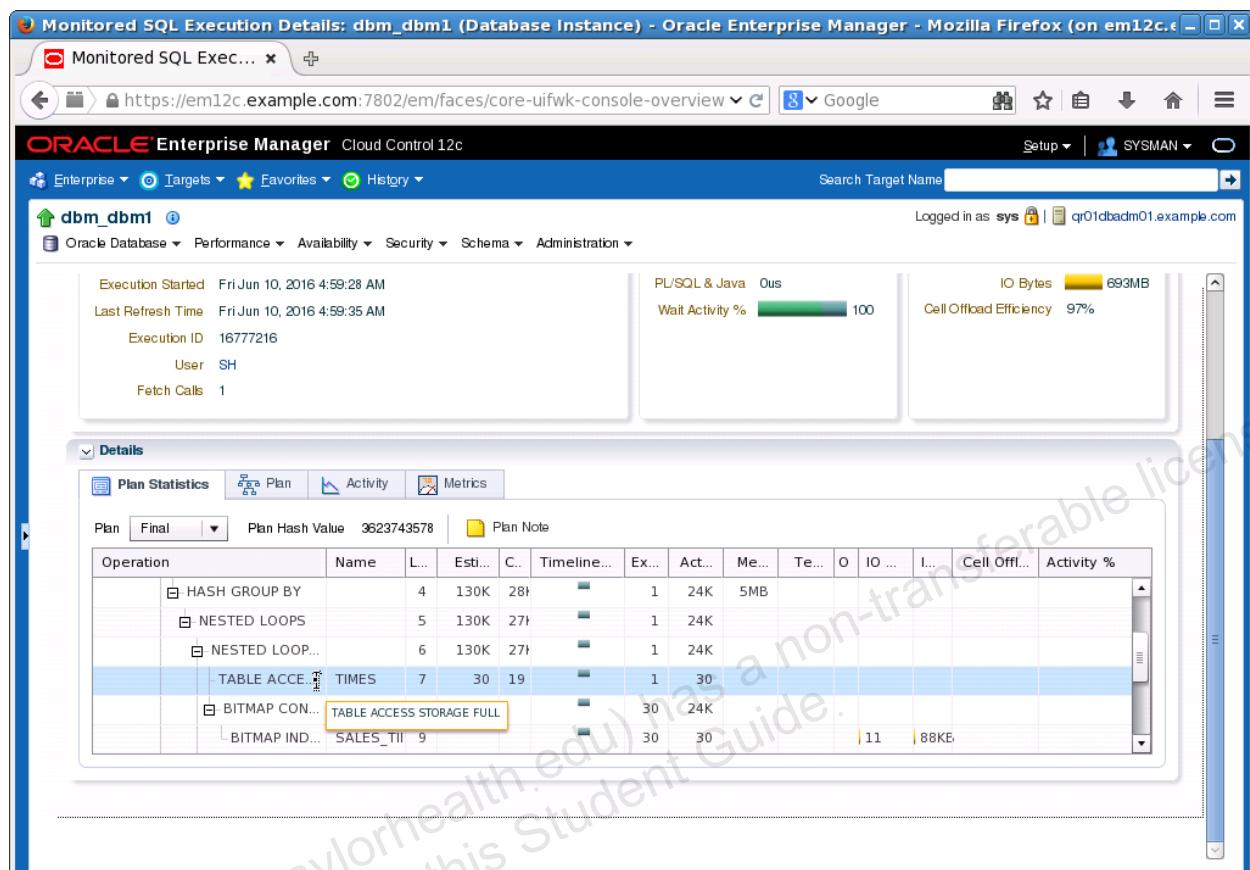
Plan Final Plan Hash Value: 3623743578 Plan Note

Operation	Name	L...	Esti...	C...	Timeline...	Ex...	Act...	Me...	Te...	O...	IO...	I...	Cell Offl...	Activity %
SELECT STATEMENT		0												
HASH GROUP BY		1	17	52										
HASH JOIN		2	5,890	52		1	1,109	2MB						

13. Hover your mouse pointer over the “Wait Activity %” bar and you should also see Exadata-specific wait event information.



14. Examine the query execution plan and take note of the Smart Scan operations that are included within it.

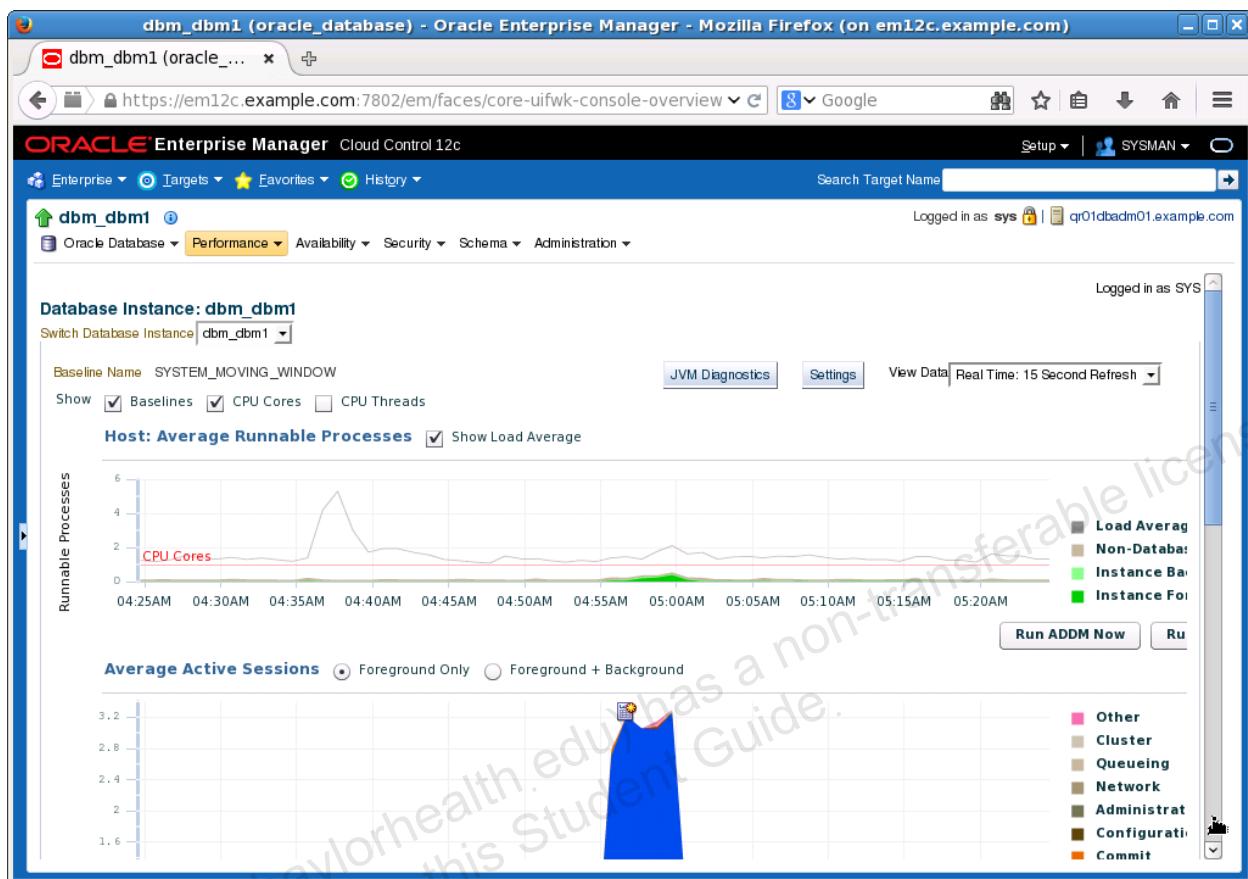


15. Select the Performance > Performance Home menu command.

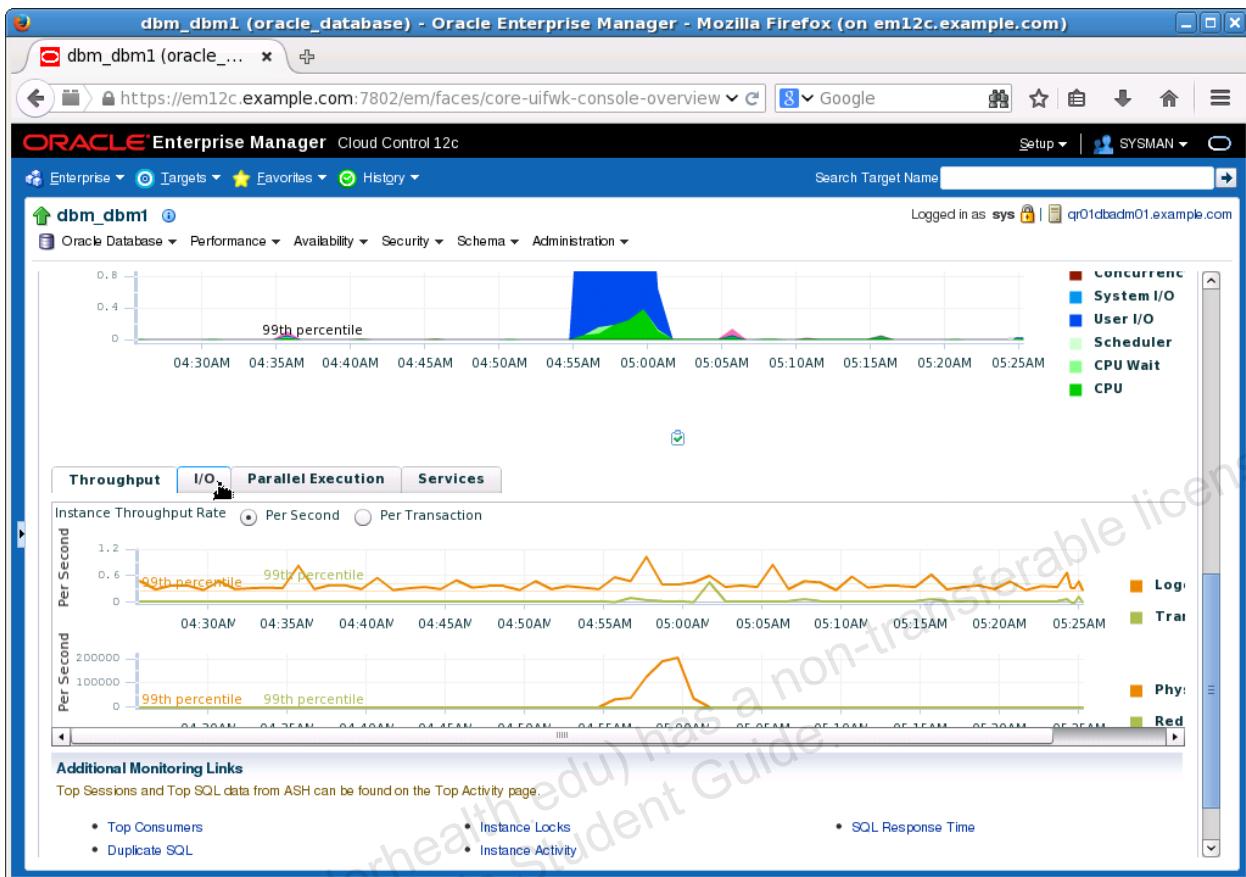
The screenshot shows the Oracle Enterprise Manager interface for the dbm_dbm1 database instance. The top navigation bar includes links for Monitored SQL Execution Details, Targets, Favorites, History, Setup, and SYSMAN. The main menu bar has Oracle Database, Performance (which is currently selected), Availability, Security, Schema, and Administration. The Performance menu is expanded, showing options like Top Activity, ASH Analytics, SQL Monitoring, SQL, AWR, Advisors Home, Emergency Monitoring, Adaptive Thresholds, Plan Status, Search Sessions, Blocking Sessions, and Database Replay. The Database Replay section displays a table of operations:

Operation	L...	Esti...	C...	Timeline...	Ex...	Act...	Me...	Te...	O...	IO ...	I...	Cell Offl...	Activity %
HASH GROUP BY	4	130K	28I		1	24K	5MB						
NESTED LOOPS	5	130K	27I		1	24K							
NESTED LOOP...	6	130K	27I		1	24K							
TABLE ACCE...	TIMES	7	30	19		1	30						
BITMAP CON...		8				30	24K						
BITMAP IND...	SALES_TII	9				30	30		11		88KE		

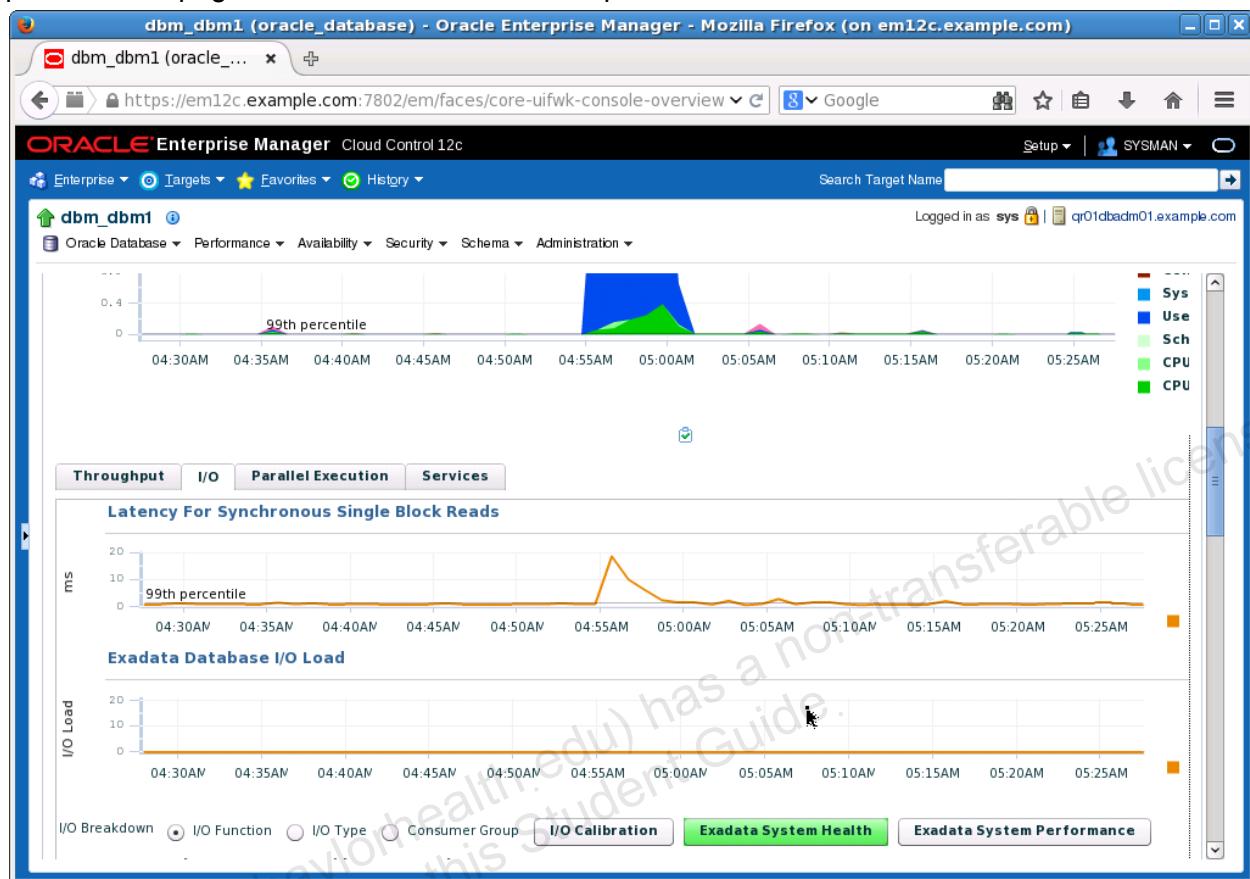
16. On the Database Instance performance home page, scroll down the page until you can see a series of tabs that include a tab labeled I/O.



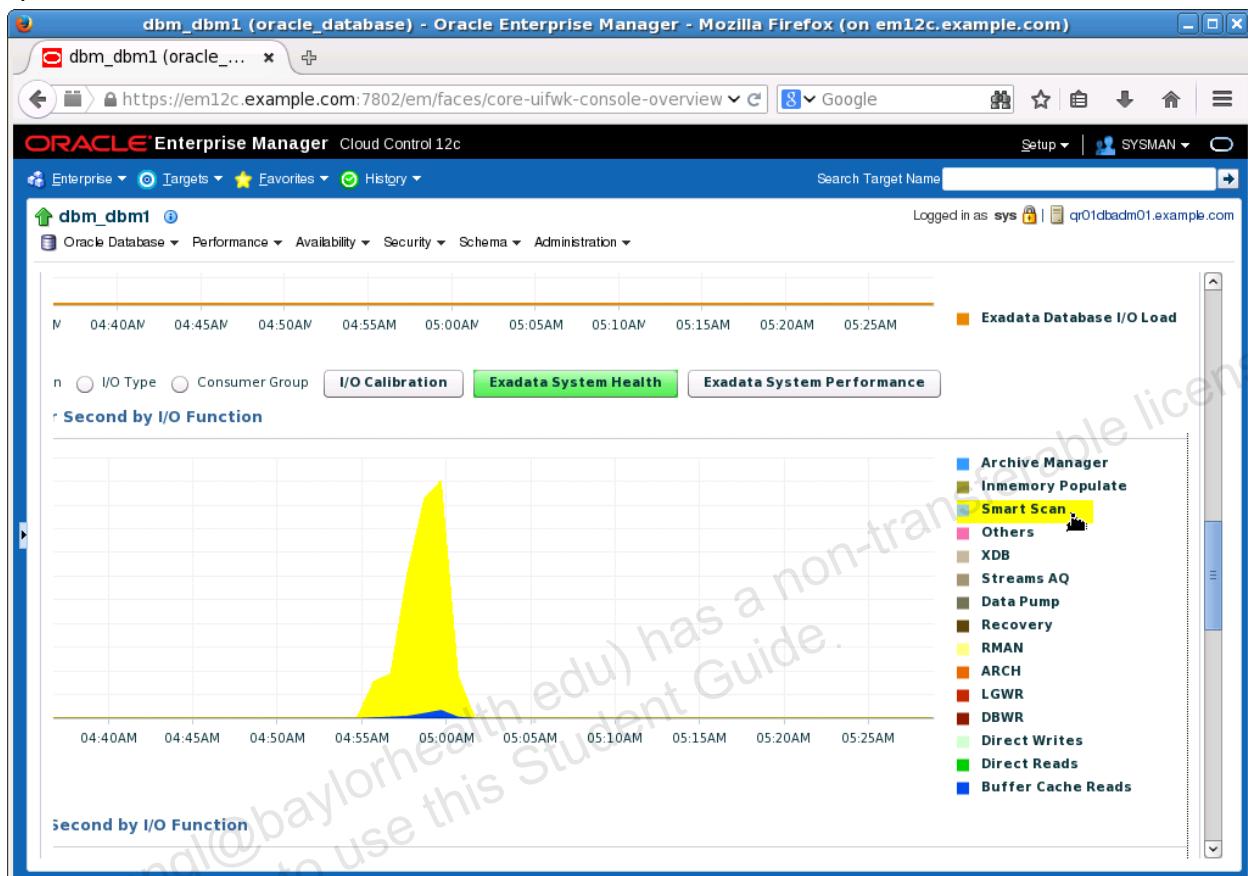
17. Click the I/O tab.



18. Notice that the IO performance information presented on the Database Instance performance page contains various Exadata-specific elements.



19. Hover your mouse pointer over the Smart Scan legend entry of the “I/O Megabytes per Second by I/O Function” chart. This will highlight the Smart Scan activity performed by the database instance and should clearly illustrate the amount of Smart Scan versus other IO operations on the instance.

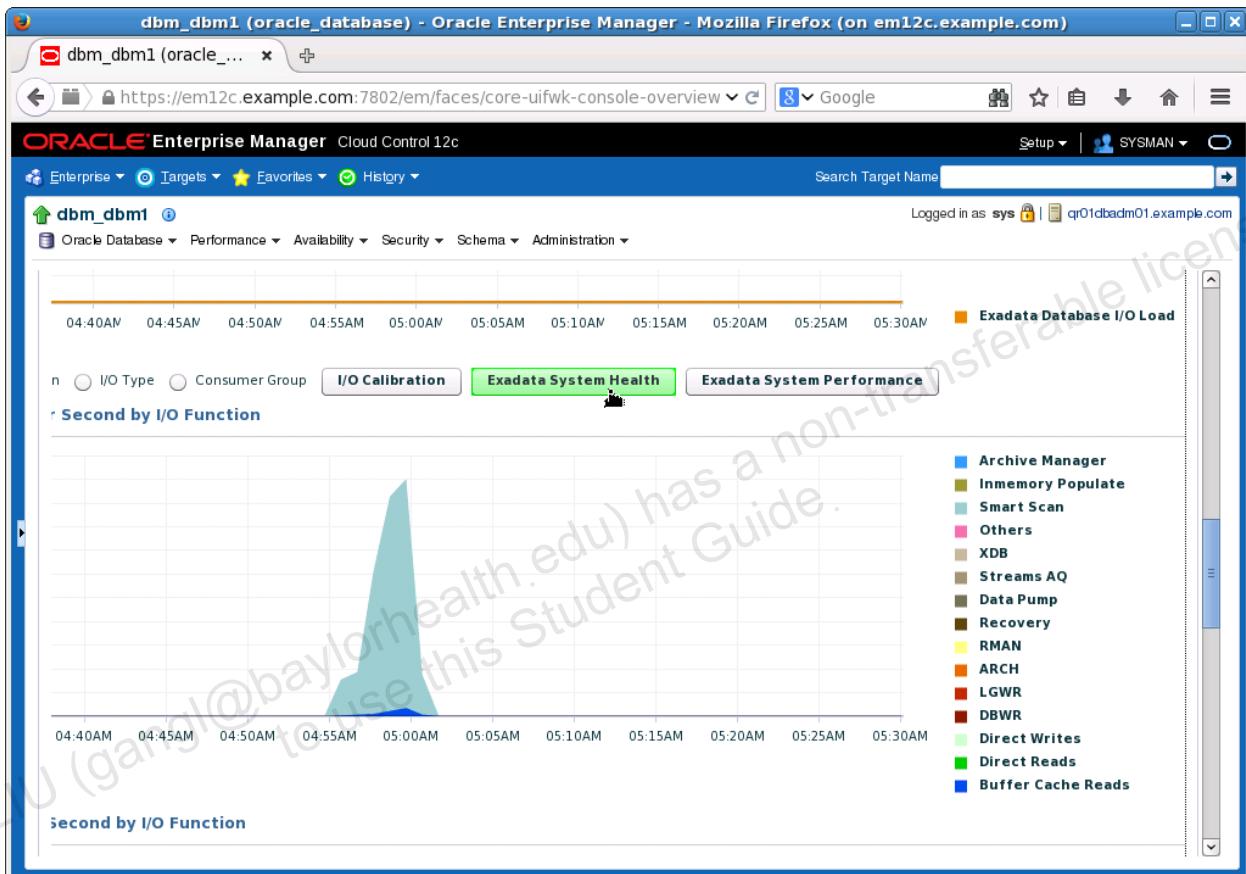


20. Notice also the two Exadata-specific buttons above the “I/O Megabytes per Second by I/O Function” chart.

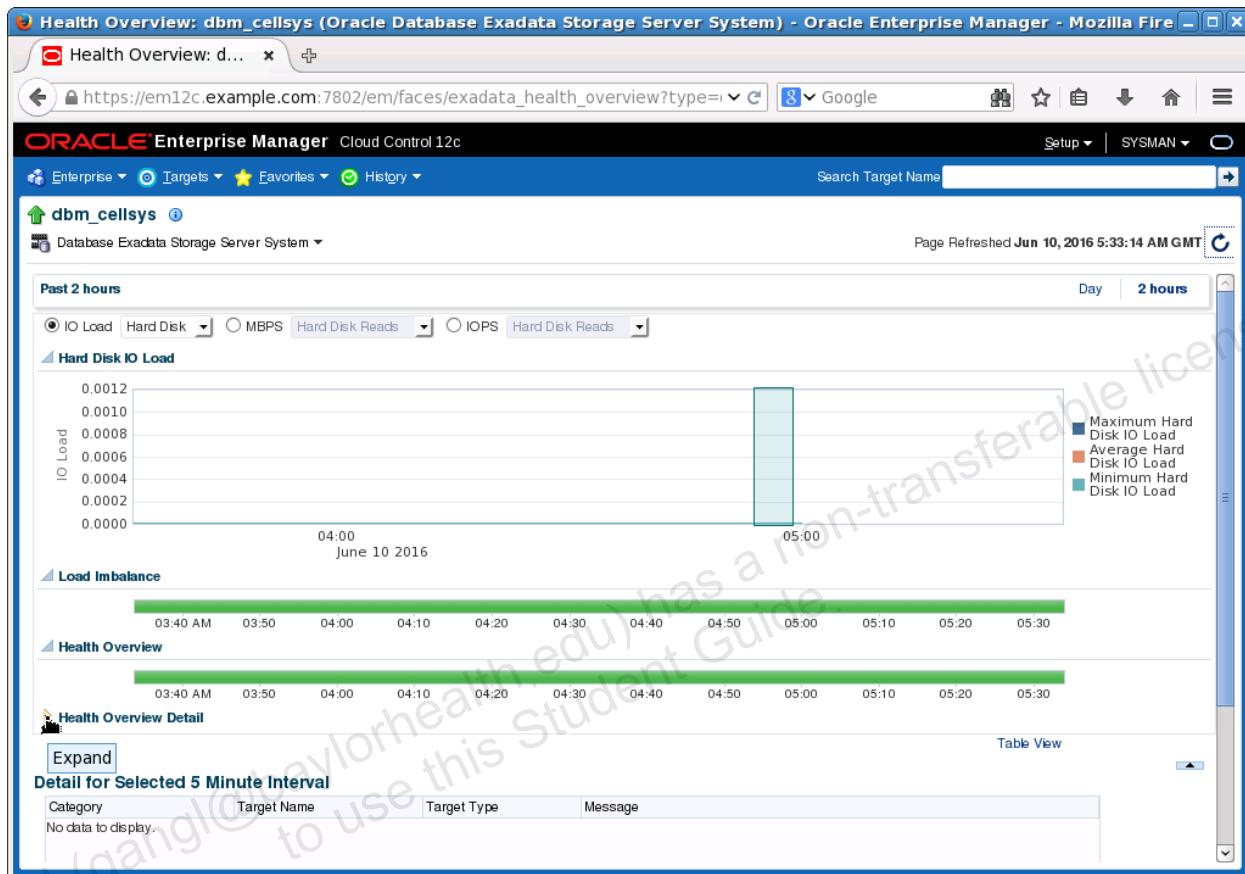
The Exadata System Health button provides a visual indication of the health of the storage servers associated with the database. If the button appears green (as shown below) then the cells are in a healthy state.

The Exadata System Performance button can be used to navigate to a performance overview page for the storage servers associated with the database.

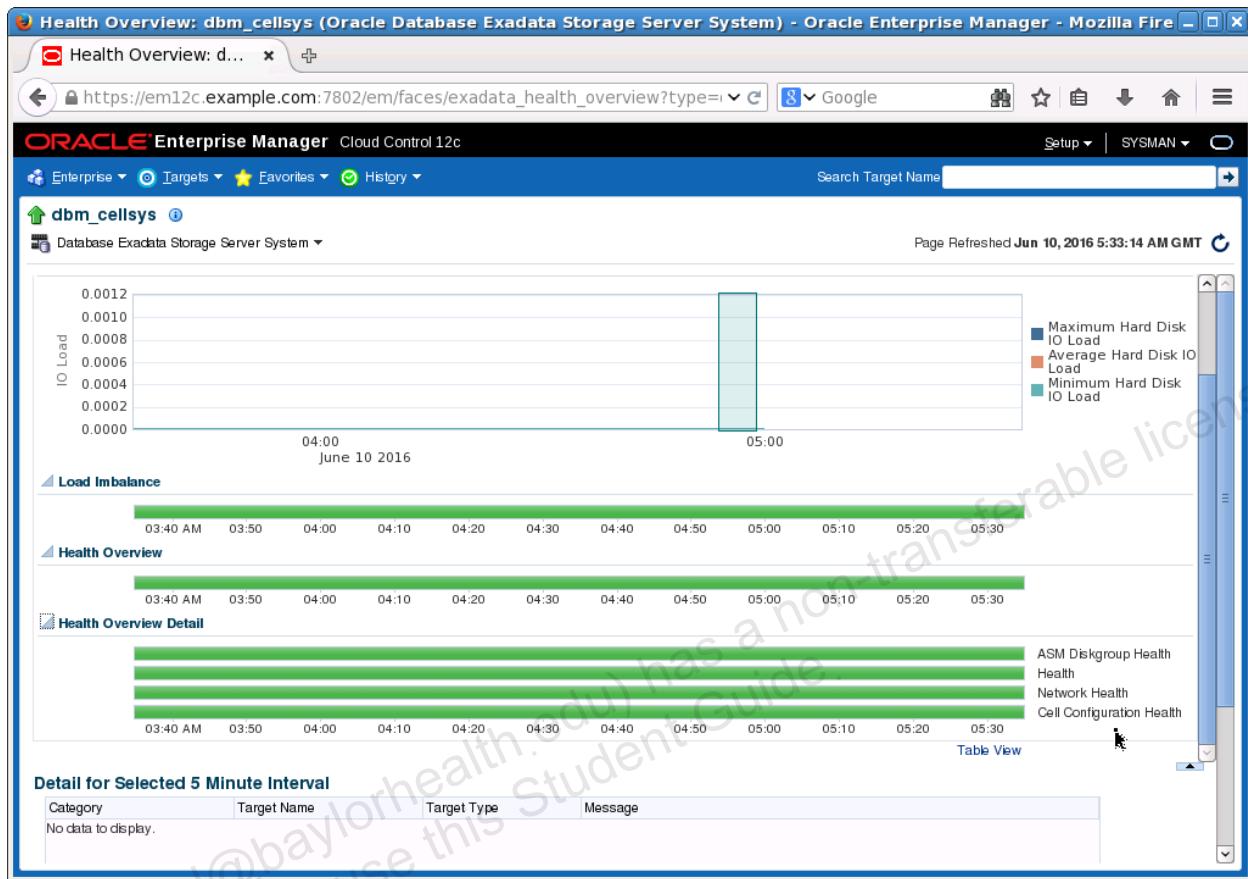
Click Exadata System Health.



21. Examine the Exadata System Health page. Because your laboratory environment isn't supporting a large user workload, you should expect to see mostly green bars in the timelines for Load Imbalance and Health Overview. These green bars indicate that the storage servers associated with your database are not reporting any problems. Expand the Health Overview Detail area.

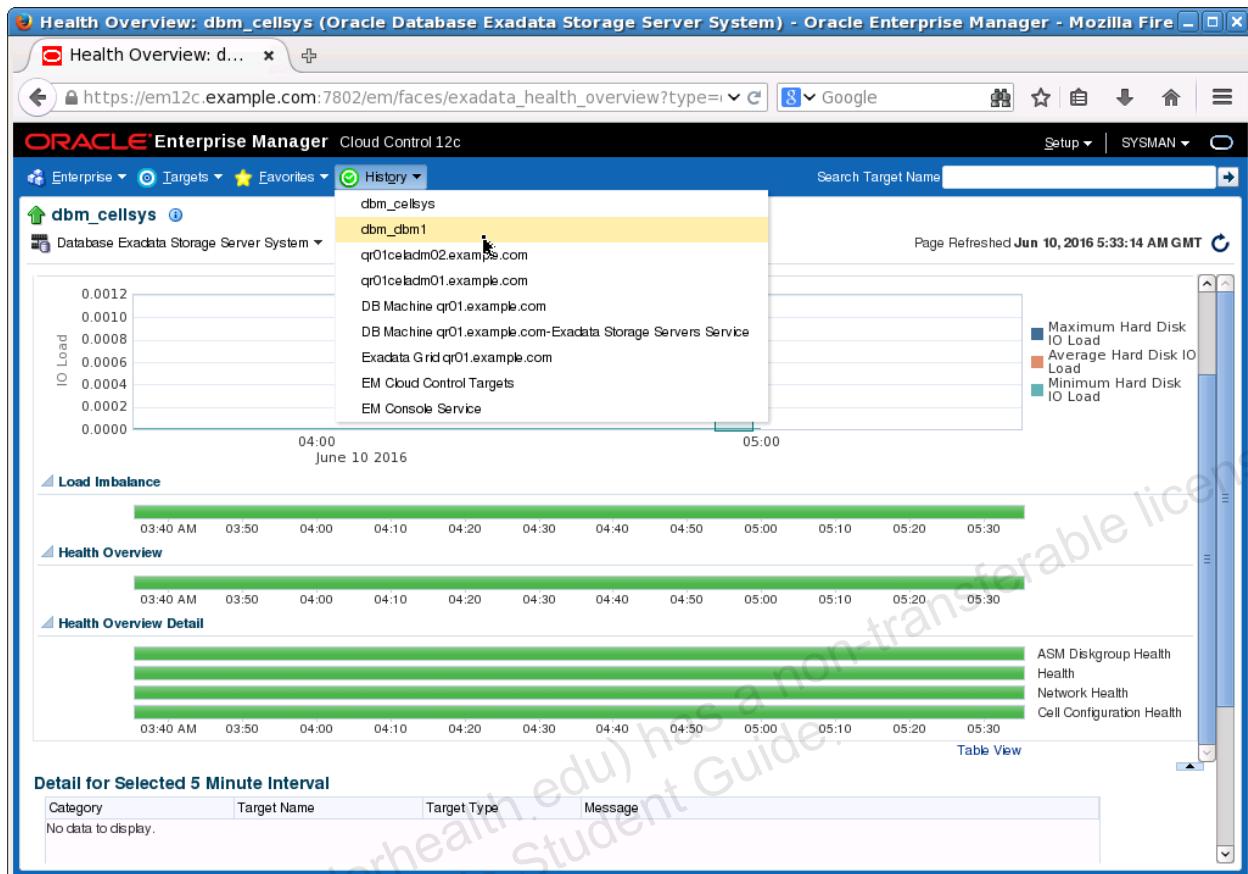


22. The Health Overview Detail area shows timelines and visual health indicators for key storage server components. Any area in these timelines that is not green indicates a warning or alert condition.

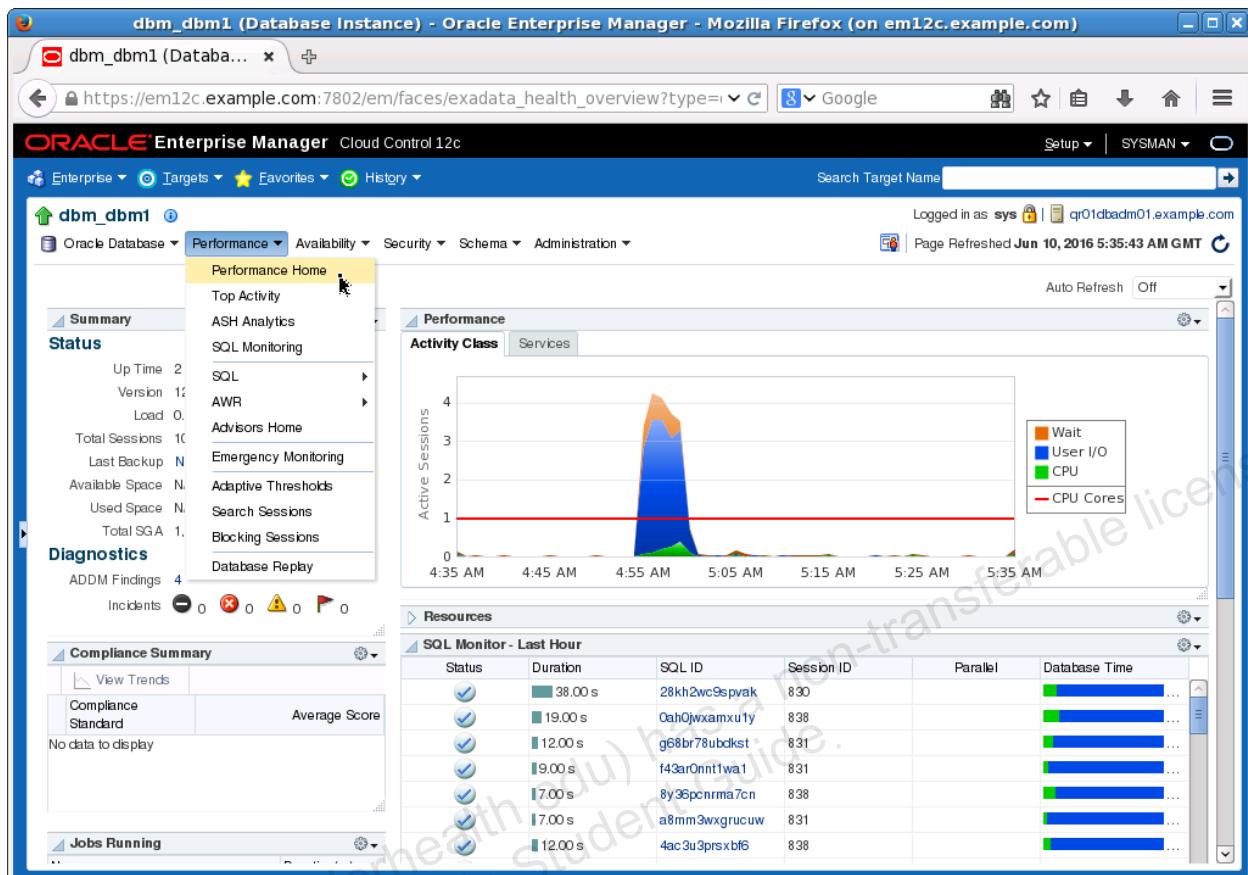


If you see any areas in the timelines that are not green, drag and drop the detail selector (the shaded box in the topmost chart, which is labeled Hard Disk IO Load by default) so that it covers the area of interest. Then look in the detail area (entitled Detail for Selected 5 Minute Interval by default) and examine the resulting messages to determine the reason for the condition.

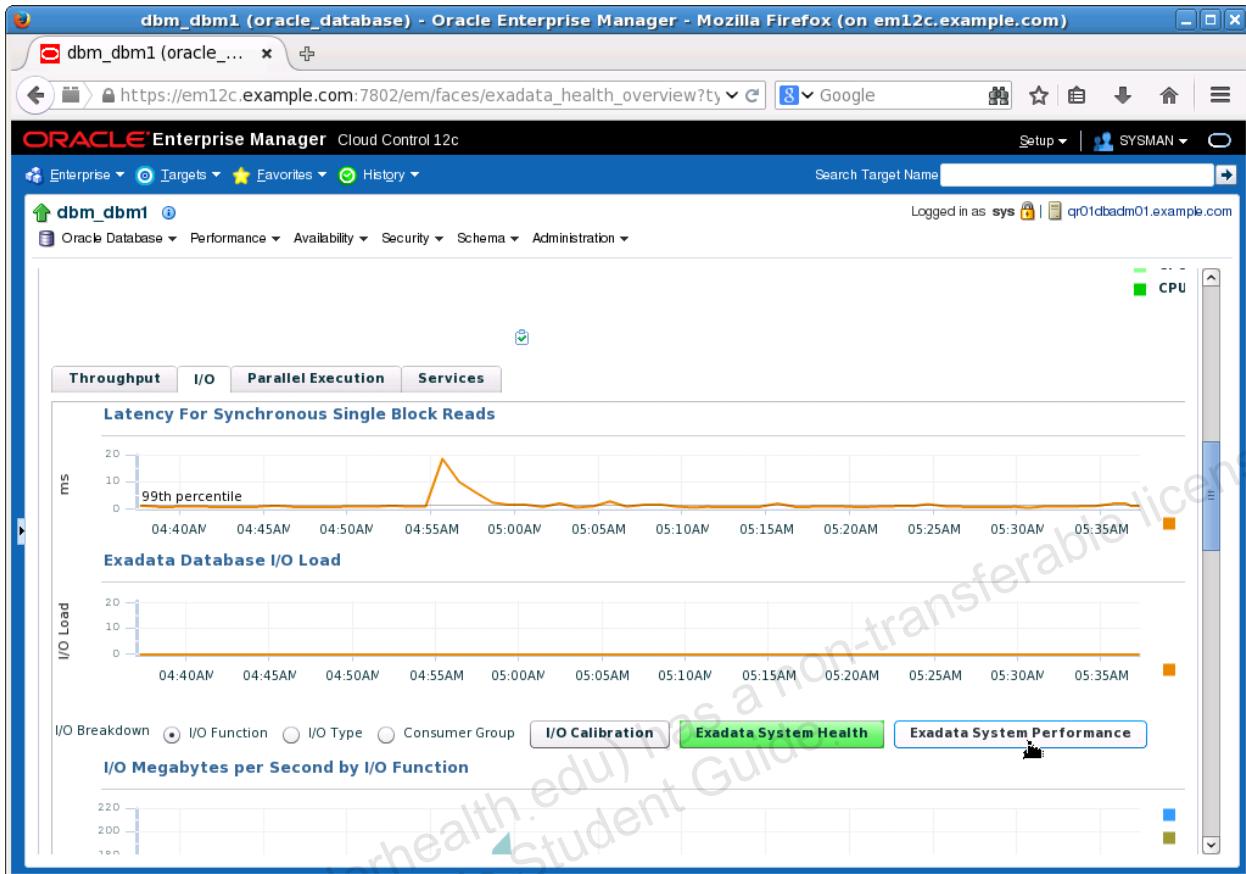
23. Use the History menu to navigate back to the database instance home page (dbm_dbm1).



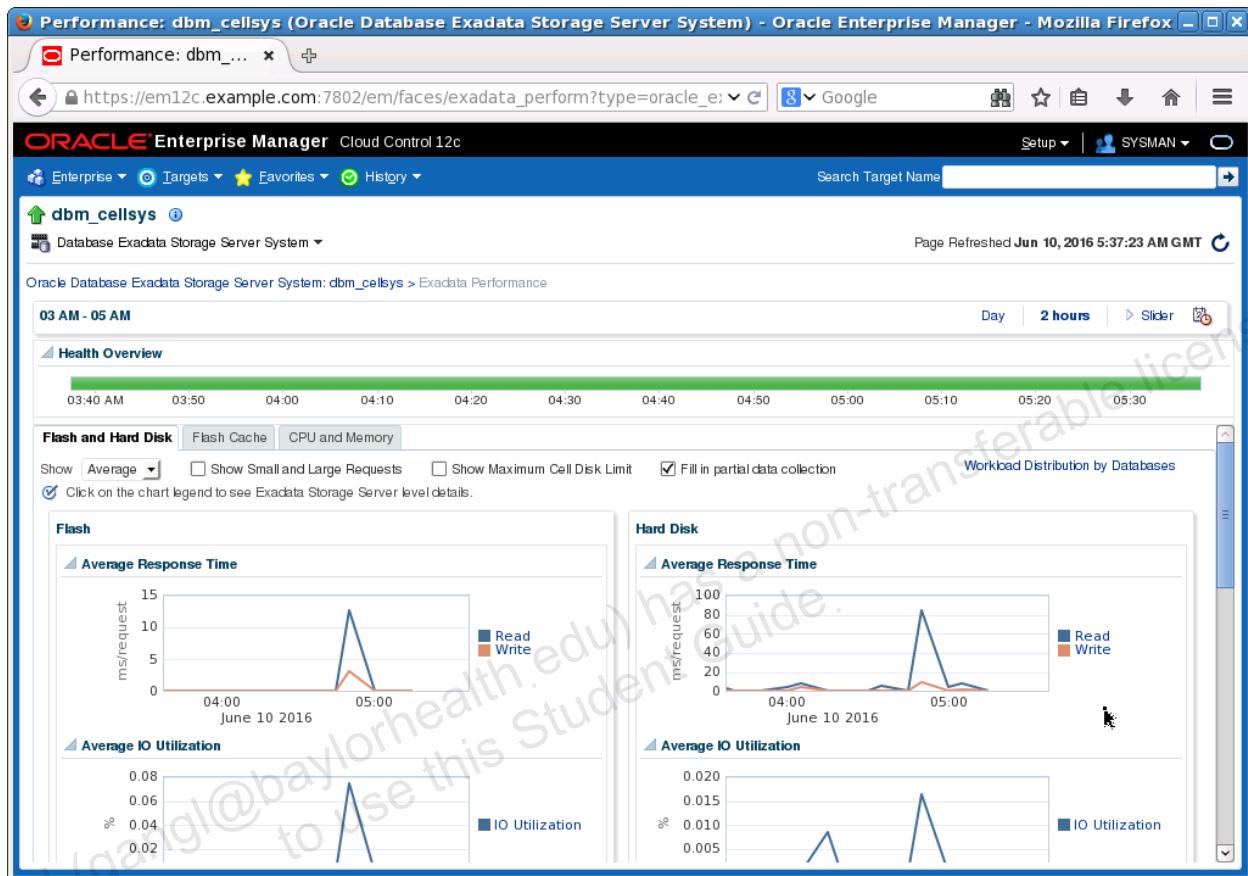
24. Select the Performance > Performance Home menu command.



25. Scroll down the database performance home page and click Exadata System Performance.



26. Here is the performance overview page for the storage servers associated with the database. It provides a series of charts that plot key Exadata Storage Server performance metrics over time for the storage servers associated with the database. It is very similar to the Exadata Storage Server Performance page that you examined in a previous practice. Take time to explore the page and the information it contains.



Congratulations! You have examined various Exadata-specific database monitoring capabilities provided by Enterprise Manager Cloud Control 12c.

Practices for Lesson 17: Monitoring the InfiniBand Network

Chapter 17

Practices for Lesson 17: Overview

Practices Overview

In this practice, you will examine the Exadata InfiniBand monitoring and administration capabilities provided by Enterprise Manager Cloud Control 12c.

Practice 17-1: Exadata InfiniBand Monitoring with Enterprise Manager

Overview

In this practice, you will examine the Exadata InfiniBand monitoring and administration capabilities provided by Enterprise Manager Cloud Control 12c.

Assumptions

The practice relies on the configurations performed in Practice 14-1.

Tasks

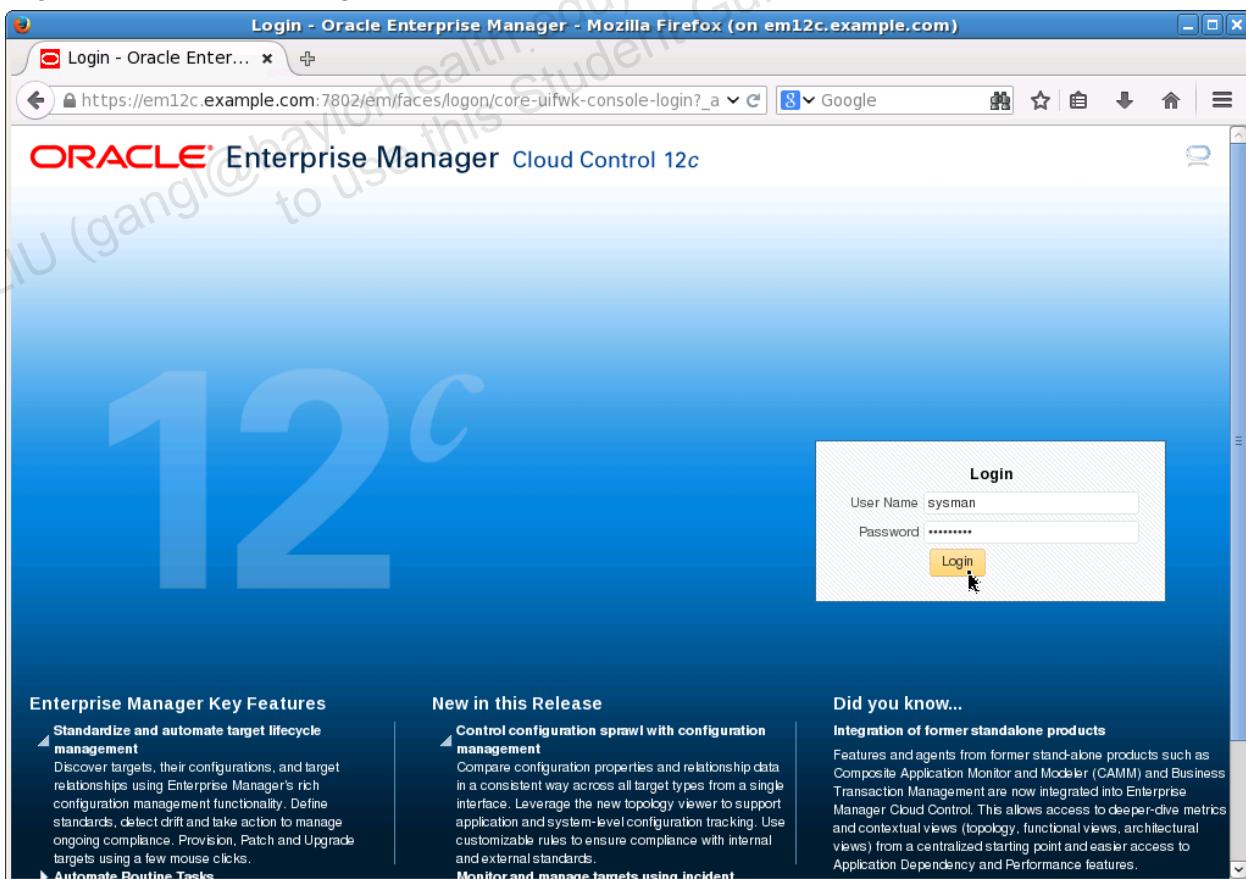
- Establish a terminal session connected to em12c by using the oracle OS user. Ensure that you specify the -X option for ssh.

```
$ ssh -X oracle@em12c
oracle@em12c password: ????????
[oracle@em12c ~] $
```

- Start the Firefox web browser.

```
[oracle@em12c ~] $ firefox &
[1] 30345
```

- Log in to Enterprise Manager Cloud Control 12c as the sysman user.



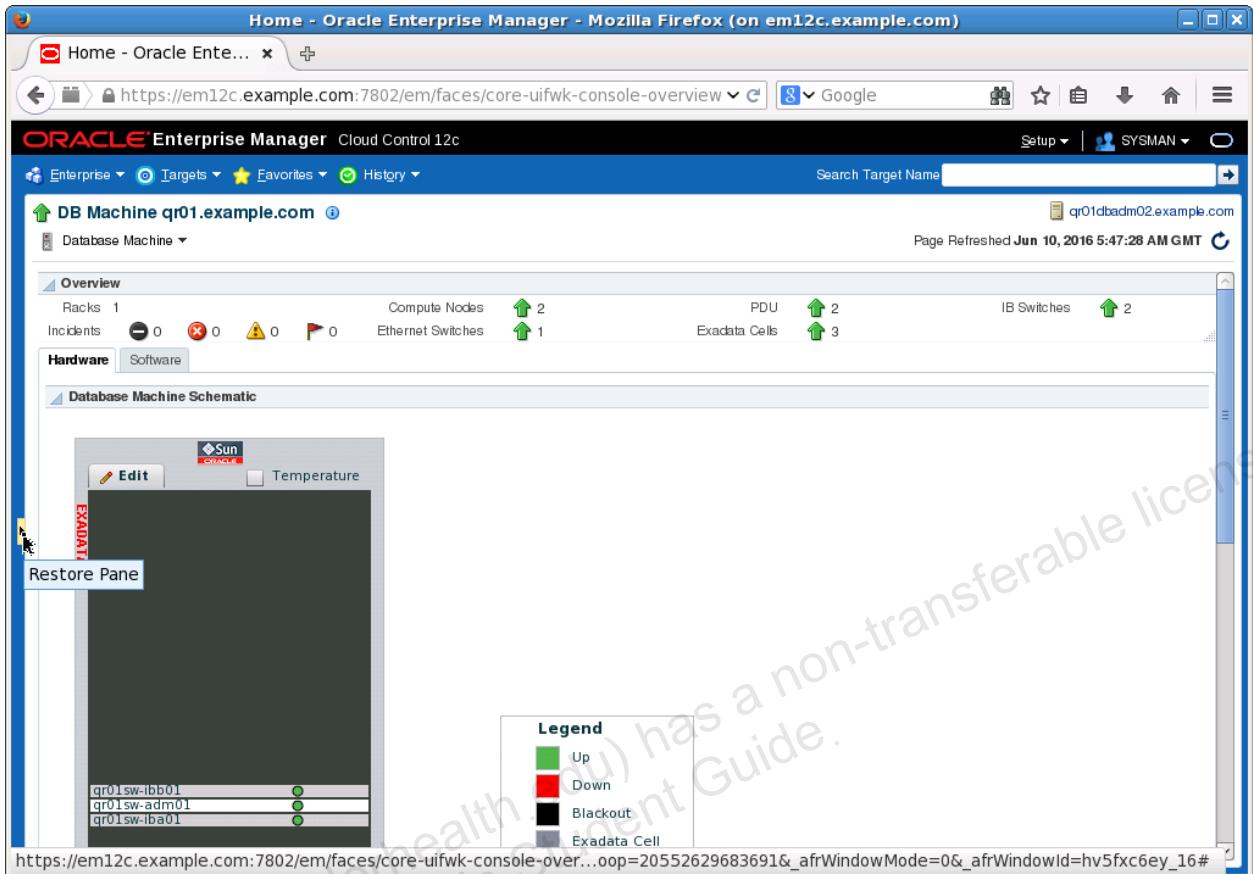
- On the Enterprise Summary page, select the Targets > Exadata menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The top navigation bar includes links for Enterprise, Targets, Favorites, History, Setup, and SYSMAN. The main content area is titled "Enterprise Summary". On the left, there's a sidebar with sections for Overview, Status (Targets Monitor, Targets with Status), and Incidents (Updated in last 24 hours: 4, Updated in last 7 days: 4). Below these are tabs for Overview, Status, and Incidents. A pie chart indicates 29% Exadata, 71% Up (42), and 17% Under Blackout (17). The right side features three main panels: "Inventory and Usage" showing a 100% blue circle for Oracle Linux Server; "Compliance Summary" showing no data to display; and "Least Compliant Targets" showing no data to display. The status bar at the bottom indicates the page was refreshed on Jun 10, 2016, at 5:46:31 AM UTC.

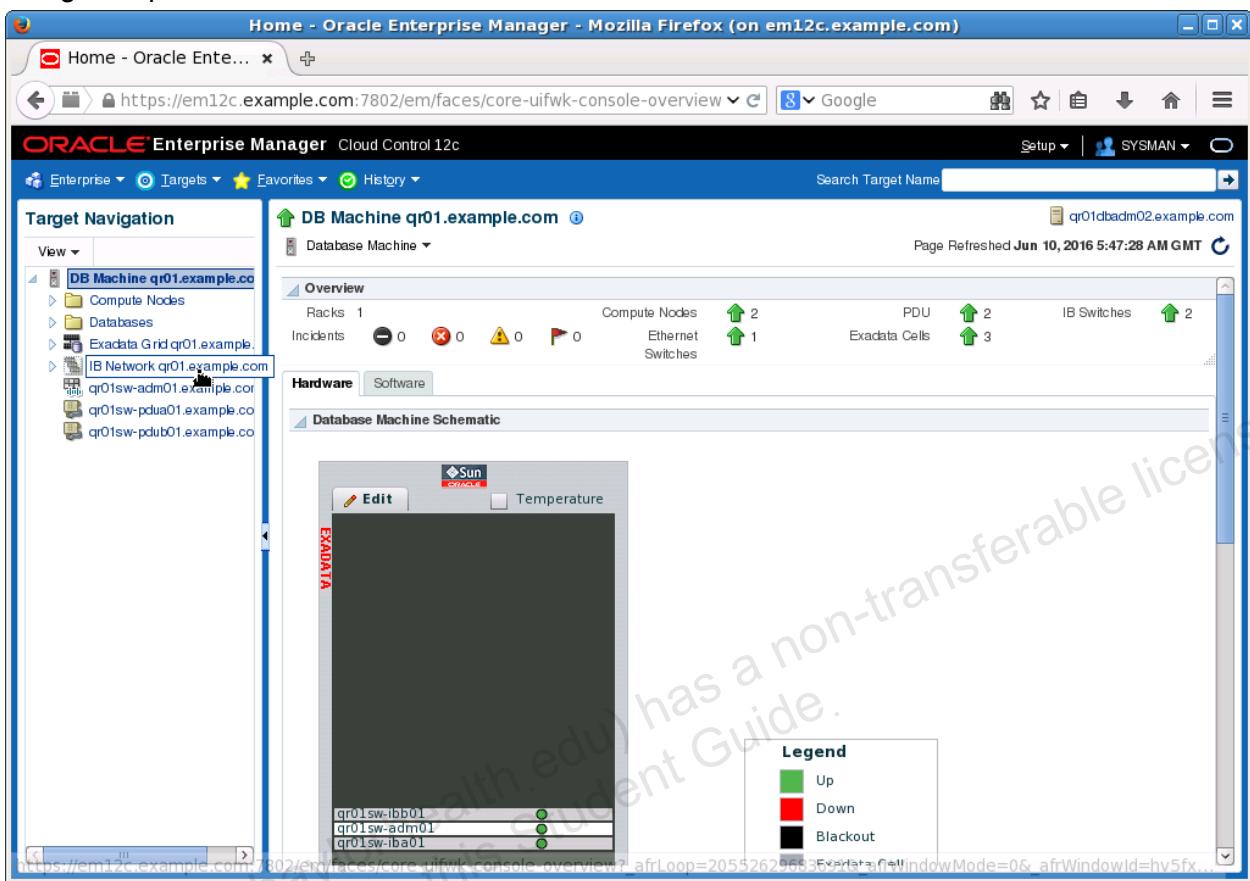
5. Click the link corresponding to your Exadata Database Machine (DB Machine qr01.example.com).

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Oracle Exadata Database Machines - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Oracle Exadata Database Machines". A search bar at the top left says "Enter the target name to search." Below it is a table with columns: Target Name, Status, Members, Member Status Summary, and Incidents. One row is selected, showing "DB Machine qr01.example.com" in the Target Name column, "Cluster Database(1), Oracle Infiniband Switch(2), Oracle Infiniband Netw" in the Members column, and a red error icon in the Member Status Summary column. The URL in the browser's address bar is https://em12c.example.com:7802/em/faces/core-uifwk-console-over...oop=20552629683691&_afrWindowMode=0&_afrWindowId=hv5fxc6ey_16#.

6. On the Database Machine home page, restore the Target Navigation pane.



7. On the Database Machine home page, click “IB Network qr01.example.com” in the Target Navigation pane.



8. On the IB Network home page, collapse the Target Navigation pane.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for monitoring an InfiniBand network. The browser title is "Infiniband Home - Mozilla Firefox (on em12c.example.com)". The main content area displays the "IB Network qr01.example.com" overview, including an "Overview" section with status icons for Subnet Manager on Switch (qr01sw-iba01.example.com), Switches (2), Compute Nodes (2), and Cells (3). A "Throughput" section shows "Total Network 0 Mbps". Below these are sections for "Switches" and "Nodes". The "Switches" section lists two switches: qr01sw-iba01.example.com (Leaf, 32 ports) and qr01sw-ibb01.example.com (Leaf, 32 ports). The "Nodes" section lists one node: qr01dbadm01.example.com (Host, HCA-1, IP 192.168.1.101). The left sidebar has a "Target Navigation" pane with a "View" dropdown set to "DB Machine qr01.example.com", showing various database and compute node components. The URL in the address bar is https://em12c.example.com:7802/em/faces/core-uifwk-console-overview?oop=20552629683691&_afrWindowMode=0&_afrWindowId=hv5fxc6ey_16#.

9. Take a moment to examine the IB Network home page. The Overview area provides a quick visual indication of the status and health of the InfiniBand network, including the switches, interfaces on the compute nodes (database servers), and cells (storage servers). The Throughput area summarizes the InfiniBand Network throughput. Below these lie areas that contain more detailed information about the InfiniBand switches and network interfaces. You will investigate these areas in greater detail later in the practice. At the bottom of the page, the Incidents area displays alerts related to the InfiniBand Network. **Note:** Your laboratory environment does not contain any real InfiniBand switches or network interfaces. Therefore, to facilitate this practice, your laboratory environment has been seeded with information from a real quarter-rack Exadata Database Machine. As a result, some parts of the Enterprise Manager InfiniBand monitoring and administration interfaces will contain incomplete data. For example, the Throughput area on the IB Network home page will always contain zero values in your laboratory environment.

IB Network qr01.example.com

Switches

Refresh	Name	Status	Type	Port Details																														
	qr01sw-iba01.example.com		Leaf	<table border="1"> <tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td></tr> <tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td></tr> </table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7																				
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8																				
	qr01sw-ibb01.example.com		Leaf	<table border="1"> <tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td></tr> <tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td></tr> </table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7																				
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8																				

Nodes

Refresh	Name	Status	Type	HCA	IP Address	Port Details		
	qr01dbadm01.example.com		Host	HCA-1	192.168.1.101, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm02.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.107, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							

10. Scroll down the IB Network home page to display the Switches and Nodes areas. Note that these areas provide a visual representation of the InfiniBand network ports on the InfiniBand switches and Host Channel Adapters (HCAs). Grey colored ports indicate ports that are in use and functioning normally. White colored ports are available ports that are not connected to anything else. If a problem is detected, the corresponding port will be colored red.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for monitoring InfiniBand networks. The top navigation bar includes links for Enterprise, Targets, Favorites, History, Setup, and SYSMAN. The main title is "Infiniband Home - Mozilla Firefox (on em12c.example.com)". Below the title, it says "IB Network qr01.example.com" and "Infiniband Network".

Switches:

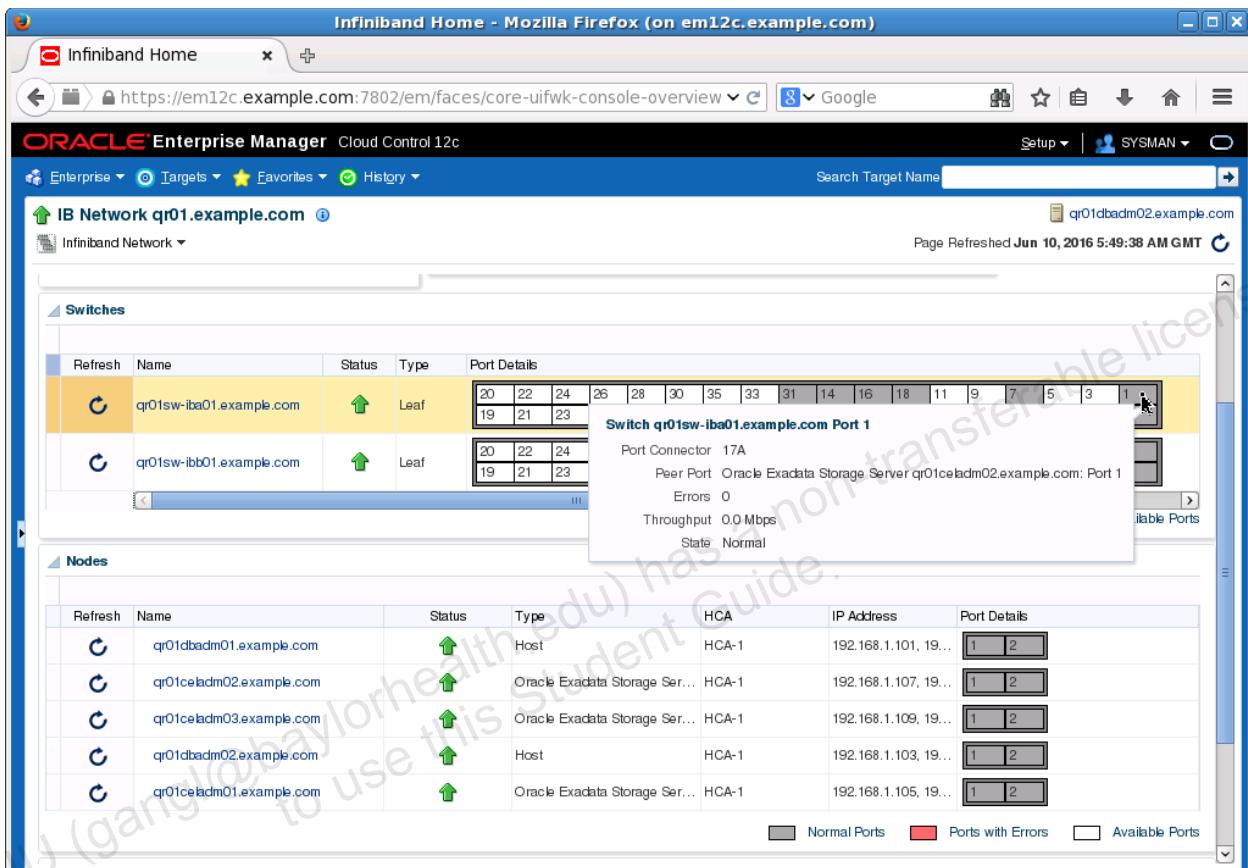
Refresh	Name	Status	Type	Port Details																																				
	qr01sw-iba01.example.com		Leaf	<table border="1"> <tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td></tr> <tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td></tr> </table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1																							
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2																							
	qr01sw-ibb01.example.com		Leaf	<table border="1"> <tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td></tr> <tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td></tr> </table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1																							
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2																							

Nodes:

Refresh	Name	Status	Type	HCA	IP Address	Port Details		
	qr01dbadm01.example.com		Host	HCA-1	192.168.1.101, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm02.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.107, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm03.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.109, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01dbadm02.example.com		Host	HCA-1	192.168.1.103, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm01.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.105, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							

Legend: Normal Ports (Grey), Ports with Errors (Red), Available Ports (White)

11. When you hover the cursor over the port diagram, a callout that contains detailed information about the port appears. If the port is in use, the callout also includes the details of the Peer Port; that is, the port at the other end of the connection. Using this information, you can determine the InfiniBand network topology. Hold the cursor over some of the switch ports. Can you determine which ports are connected to each of the database servers and Exadata Storage Servers? Can you determine which ports interconnect the switches?



12. Hover the cursor over the database server and storage server HCA ports. Can you determine which switch each port is connected to? Verify that the information associated with each port matches its peer port. For example, if port 1 on qr01sw-iba01 displays port 1 on qr01celadm02 as its peer port (as shown above), verify that port 1 on qr01celadm02 displays port 1 on qr01sw-iba01 as its peer port (as shown below).

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for monitoring InfiniBand networks. The top navigation bar includes links for Enterprise, Targets, Favorites, History, Setup, and SYSMAN. The main content area is titled "IB Network qr01.example.com".

Switches:

Refresh	Name	Status	Type	Port Details																																				
	qr01sw-iba01.example.com		Leaf	<table border="1"><tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td></tr><tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td></tr></table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1																							
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2																							
	qr01sw-ibb01.example.com		Leaf	<table border="1"><tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td></tr><tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td></tr></table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1																							
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2																							

Nodes:

Refresh	Name	Status	Type	HCA	IP Address	Port Details		
	qr01dbadm01.example.com		Host	HCA-1	192.168.1.101, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm02.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.107, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm03.example.com		Oracle Exadata			<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01dbadm02.example.com		Host			<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							
	qr01celadm01.example.com		Oracle Exadata			<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							

A tooltip for Node qr01celadm02.example.com Port 1 provides detailed information:

- Peer Port: Switch qr01sw-iba01.example.com: Port 1
- Errors: 0
- Throughput: 0.0 Mbps
- State: Normal

Legend at the bottom: Normal Ports (gray), Ports with Errors (red), Available Ports (white).

13. Scroll to the bottom of the IB Network home page to reveal the Incidents area. This is where you will see notification relating to problems and issues that are detected on the InfiniBand network.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for managing an InfiniBand network. At the top, the title bar reads "Infiniband Home - Mozilla Firefox (on em12c.example.com)". The main content area is titled "IB Network qr01.example.com".

Network Topology: A grid labeled "qr01sw-ibb01.example.com" shows port connections. The grid has columns 20 through 1 and rows 19 through 2. A legend at the bottom indicates: Normal Ports (gray), Ports with Errors (red), and Available Ports (white).

Nodes: A table lists five nodes:

Refresh	Name	Status	Type	HCA	IP Address	Port Details
	qr01dbadm01.example.com		Host	HCA-1	192.168.1.101, 19...	
	qr01celadm02.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.107, 19...	
	qr01celadm03.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.109, 19...	
	qr01dbadm02.example.com		Host	HCA-1	192.168.1.103, 19...	
	qr01celadm01.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.105, 19...	

Incidents: The "Incidents" section shows a summary table with no matching incidents found. It includes columns for Target, Severity, Status, Escalation Level, Type, and Time Since Last Update.

14. Select the Infiniband Network > Performance menu command.

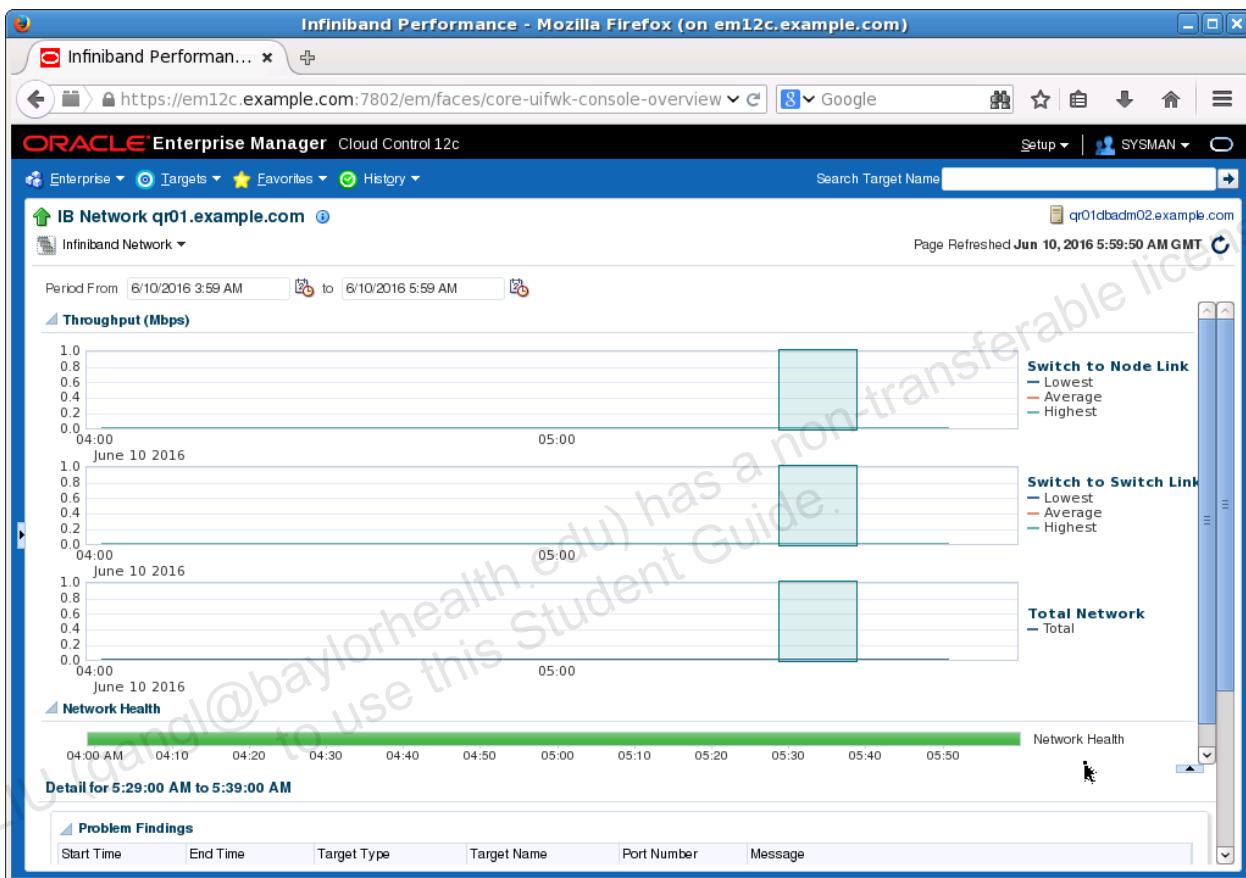
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Infiniband Home - Mozilla Firefox (on em12c.example.com)". The main navigation bar includes links for Enterprise, Targets, Favorites, and History, along with a search bar for "Search Target Name". A user icon labeled "SYSMAN" is also present. The left sidebar has a tree view with nodes like Home, Monitoring, Control, Job Activity, Information Publisher Reports, Members, and Performance (which is selected). Under Performance, there are sub-options: Topology, Administration, Configuration, Compliance, Target Setup, Target Sitemap, and Target Information. The main content area displays a network topology diagram with nodes numbered 20 through 1. Below the diagram is a table titled "Port Details" showing information for five nodes:

	Status	Type	HCA	IP Address	Port Details
Host	Up	Host	HCA-1	192.168.1.101, 19...	[1 2]
Oracle Exadata Storage Ser...	Up	Oracle Exadata Storage Ser...	HCA-1	192.168.1.107, 19...	[1 2]
Oracle Exadata Storage Ser...	Up	Oracle Exadata Storage Ser...	HCA-1	192.168.1.109, 19...	[1 2]
Host	Up	Host	HCA-1	192.168.1.103, 19...	[1 2]
Oracle Exadata Storage Ser...	Up	Oracle Exadata Storage Ser...	HCA-1	192.168.1.105, 19...	[1 2]

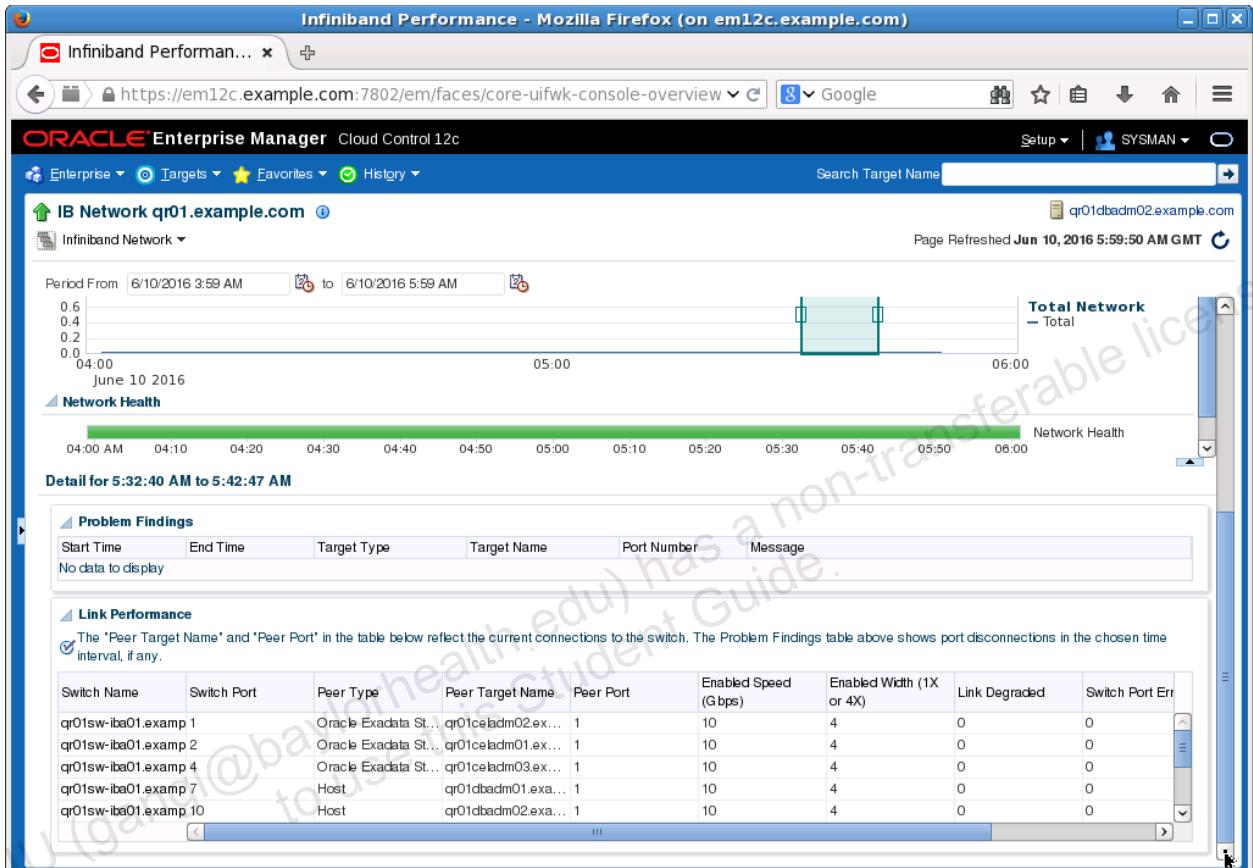
Below the table are legends for "Normal Ports" (gray), "Ports with Errors" (red), and "Available Ports" (white). The bottom section is titled "Incidents" and shows a summary table with columns: Summary, Target, Severity, Status, Escalation Level, Type, and Time Since Last Update. It indicates "No matching incidents or problems found." and was last updated in the last 31 days.

15. The InfiniBand network performance page displays a series of charts that plot InfiniBand network throughput over time. In your laboratory environment, these charts are essentially empty; however, in a production environment, administrators would use these charts to quickly identify if there is a significant variation in throughput on different parts of the network. Such a variation could indicate a problem with a network component or indicate an imbalance within the environment.

The InfiniBand network performance page also contains a visual indicator of the network health over time.



16. Scroll down the InfiniBand network performance page to reveal the details area. This area contains information related to the time interval highlighted in the throughput charts. If the throughput charts identify a significant variation, administrators can highlight a portion of the chart and investigate the details area to see if there are any associated problem findings, or if any of the links are degraded or showing errors. Note: If you see no data in the details area then try moving the highlighted area in the throughput charts.

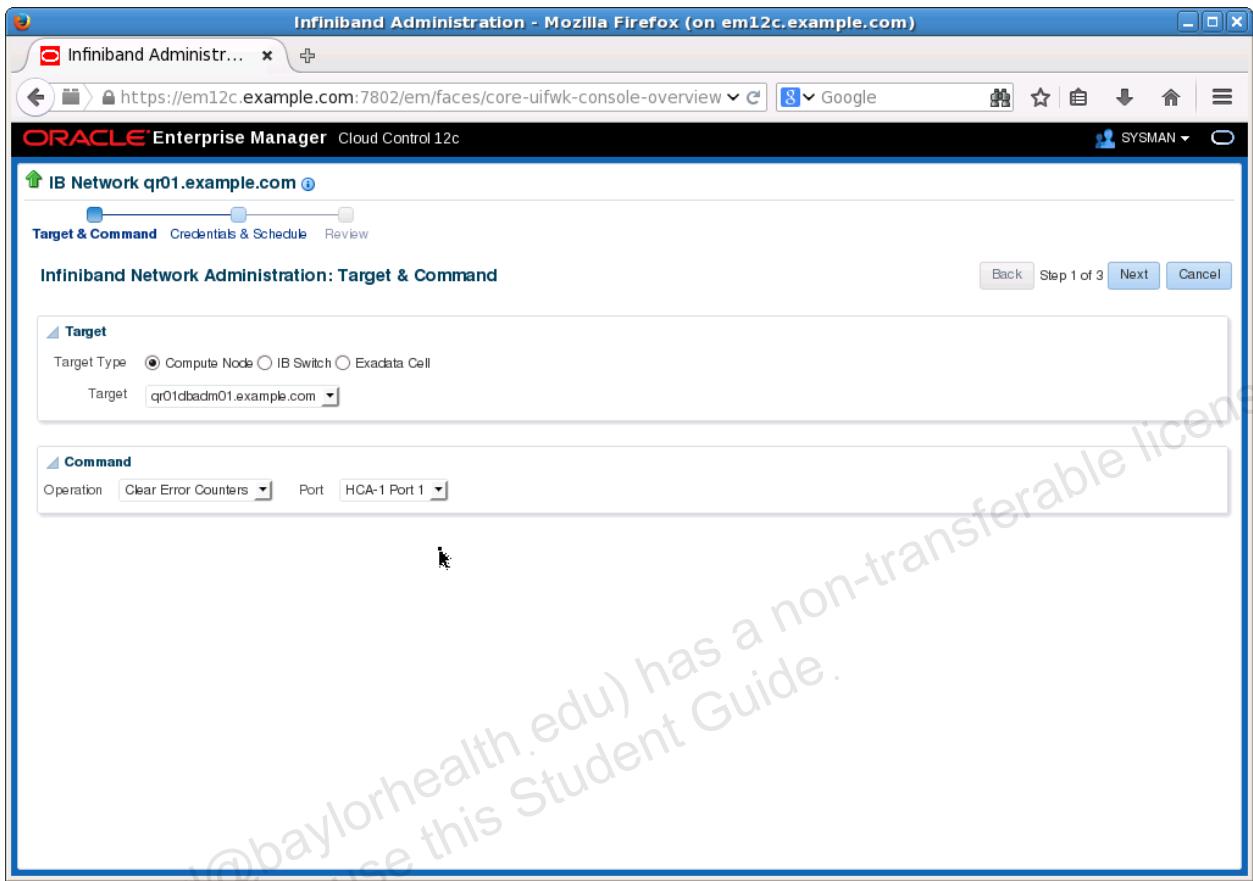


17. Select the Infiniband Network > Administration menu command.

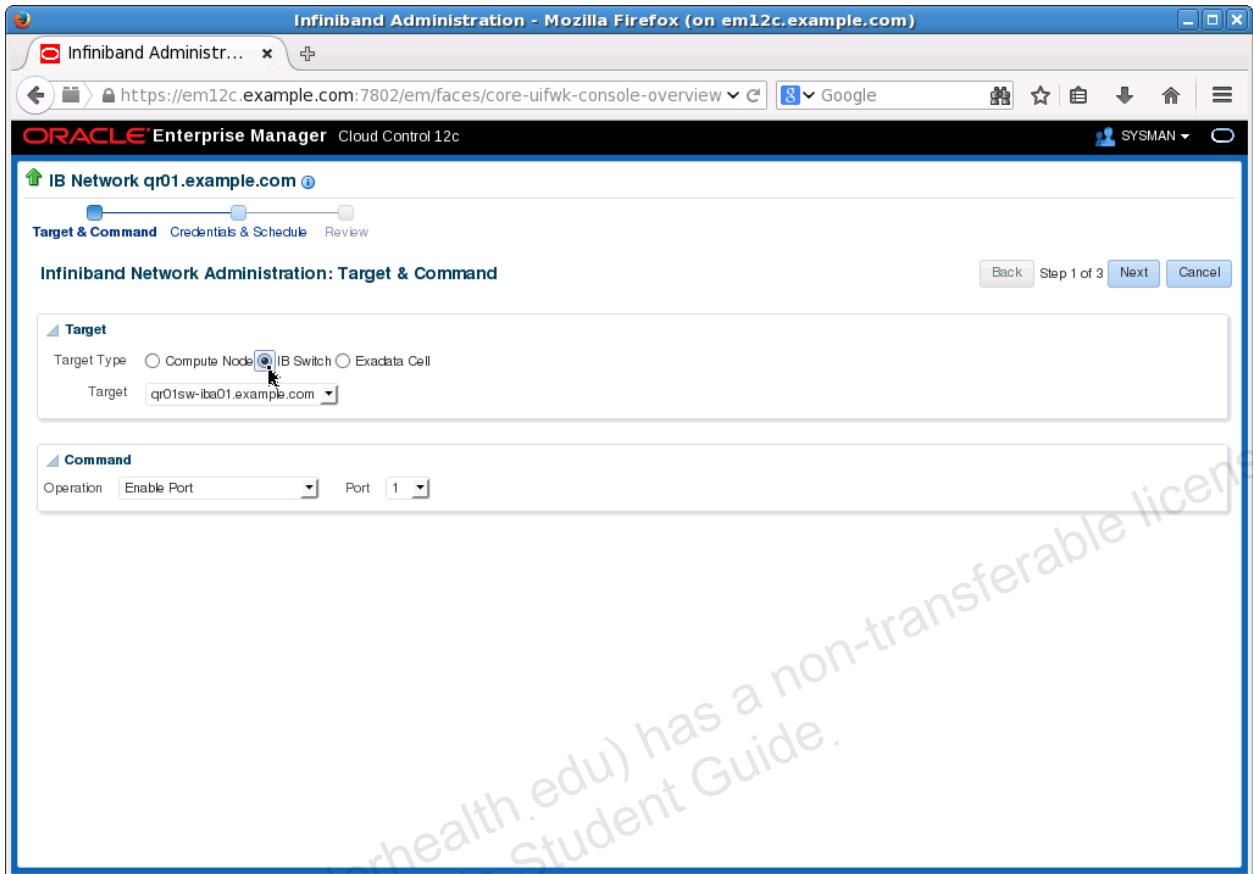
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "Infiniband Performance - Mozilla Firefox (on em12c.example.com)". The URL in the address bar is "https://em12c.example.com:7802/em/faces/core-uifwk-console-overview". The main navigation bar includes links for Enterprise, Targets, Favorites, History, Setup, and SYSMAN. The left sidebar has a tree view under "IB Network qr01.example.com" with nodes for Home, Monitoring, Control, Job Activity, Information Publisher Reports, Members, Performance, Topology, Administration (which is selected and highlighted in yellow), Configuration, Compliance, Target Setup, Target Sitemap, and Target Information. A message at the top of the main content area says, "The 'Peer Target Name' and 'Peer Port' in the table below reflect the current connections to the switch. The Problem Findings table above shows port disconnections in the chosen time interval, if any." Below this message is a table showing network connection details:

Switch Name	Switch Port	Peer Type	Peer Target Name	Peer Port	Enabled Speed (Gbps)	Enabled Width (1X or 4X)	Link Degraded	Switch Port Err
qr01sw-iba01.example.com	Oracle Exadata Storage Server	qr01celadm02.example.com	1	10	4	0	0	0
qr01sw-iba01.example.com	Oracle Exadata Storage Server	qr01celadm01.example.com	1	10	4	0	0	0
qr01sw-iba01.example.com	Oracle Exadata Storage Server	qr01celadm03.example.com	1	10	4	0	0	0
qr01sw-iba01.example.com	Host	qr01dbadm01.example.com	1	10	4	0	0	0
qr01sw-iba01.example.com	Host	qr01dbadm02.example.com	1	10	4	0	0	0

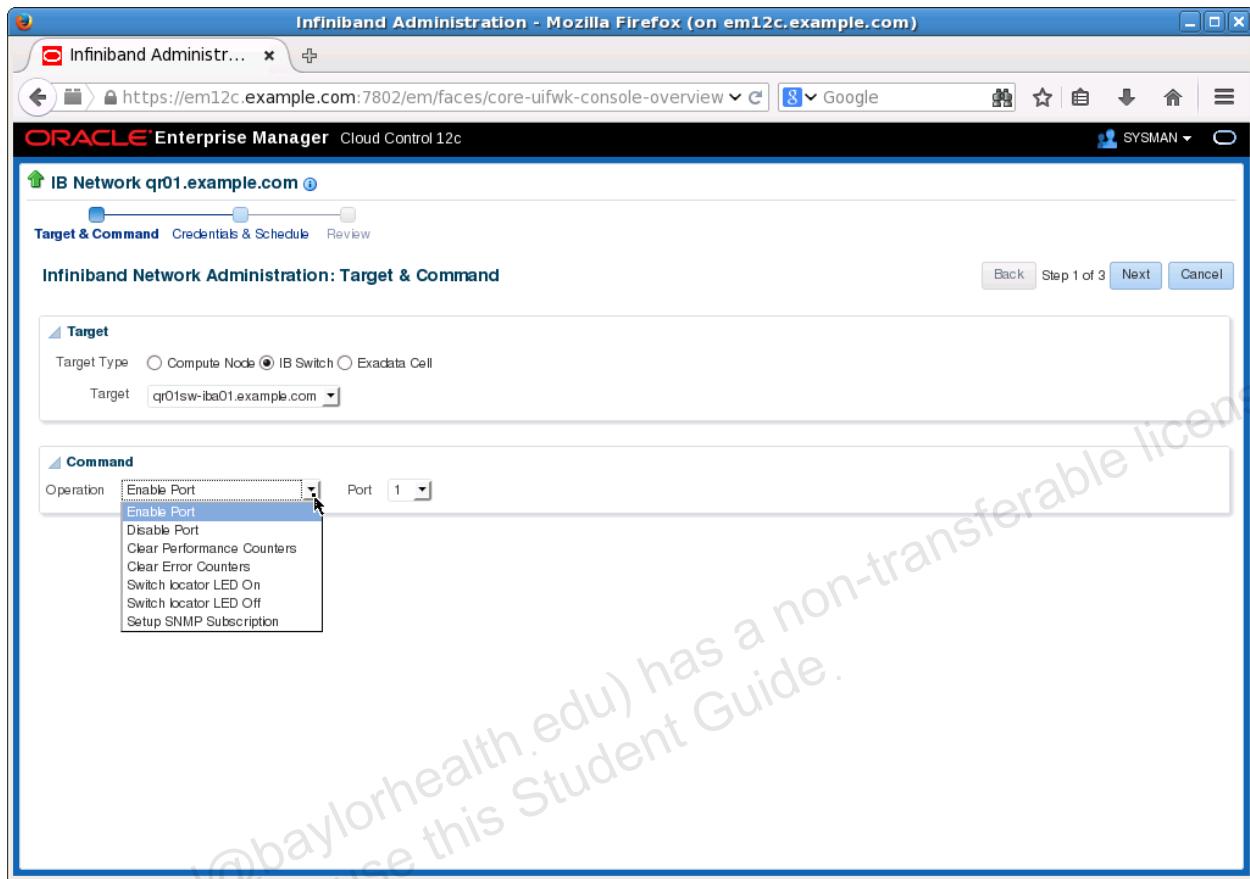
18. The first page of the Infiniband Network Administration Wizard appears. Using this wizard, you can perform an InfiniBand network administration task on an InfiniBand switch or server HCA.



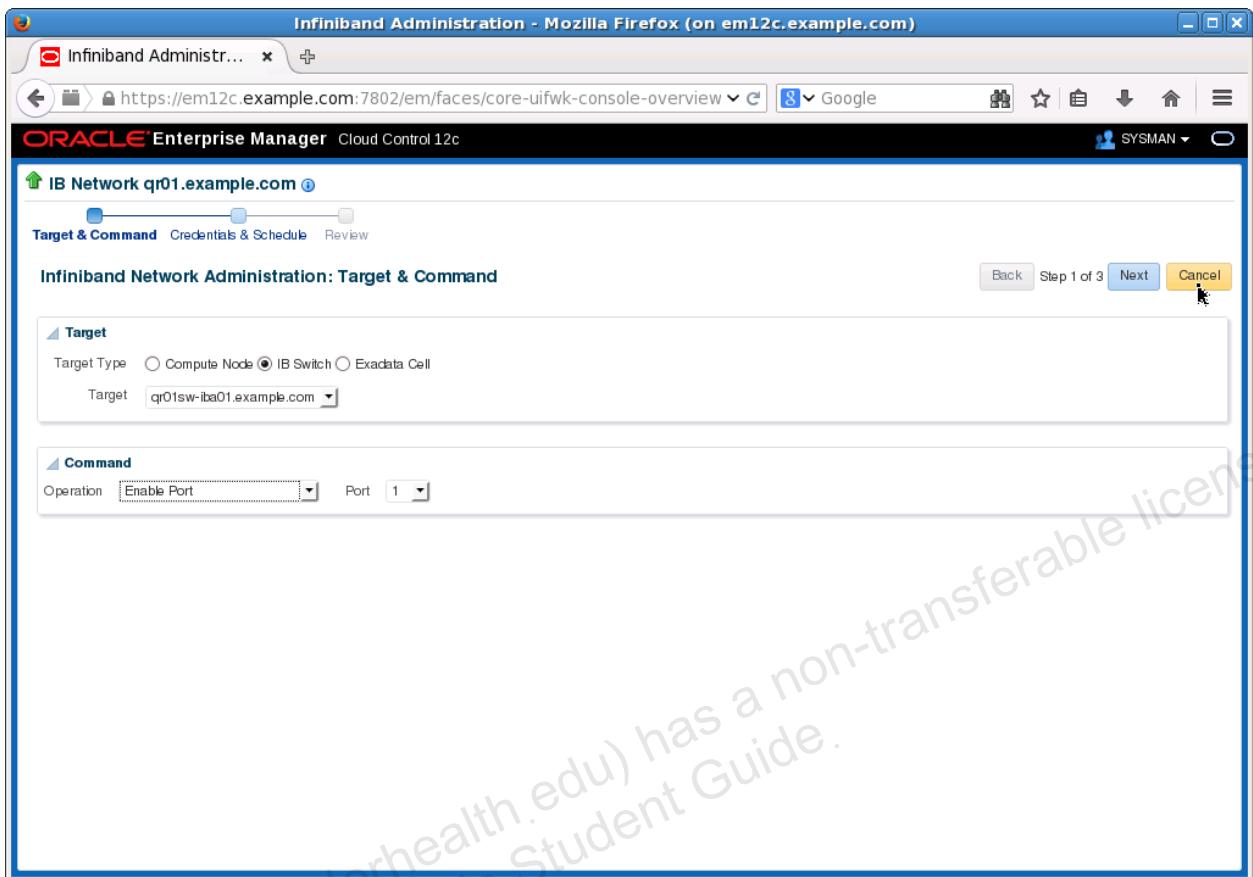
19. Select IB Switch as the Target Type.



20. Click the Operation drop-down list and examine the list of available options. This gives you an idea of the administration tasks that you can perform on InfiniBand switch ports by using the InfiniBand Network Administration Wizard.



21. Click Cancel to exit the Infiniband Network Administration Wizard.



22. Select the Infiniband Network > Configuration > Last Collected menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar has a tree view under 'Infiniband Network'. The 'Configuration' section is expanded, and the 'Last Collected' option is highlighted with a yellow background and a cursor icon. To the right, there's a 'Throughput' section with a table showing network link types and their performance metrics. Below it is an 'Inventory and Usage Details' section with two tables of port details. At the bottom, a table lists nodes with their names, statuses, types, HCA connections, IP addresses, and port details (showing two ports per node).

Link Type	Average (Mbps)	Lowest (Mbps)	Highest (Mbps)
Switch to Node Link	0.0	0.0	0.0
Switch to Switch Link	0.0	0.0	0.0

Port Details
20 22 24 26 28 30 35 33 31 14 16 18 11 9 7 5 3 1
19 21 23 25 27 29 36 34 32 13 15 17 12 10 8 6 4 2

Port Details
20 22 24 26 28 30 35 33 31 14 16 18 11 9 7 5 3 1
19 21 23 25 27 29 36 34 32 13 15 17 12 10 8 6 4 2

Refresh	Name	Status	Type	HCA	IP Address	Port Details
	qr01dbadm01.example.com		Host	HCA-1	192.168.1.101, 19...	
	qr01celadm02.example.com		Oracle Exadata Storage Ser...	HCA-1	192.168.1.107, 19...	

23. You should now see the configuration browser page for the InfiniBand network.

The screenshot shows the Oracle Enterprise Manager Configuration Browser interface. The title bar reads "Configuration Browser: IB Network qr01.example.com (Oracle Infiniband Network) - Oracle Enterprise Manager - Mozilla Firefox". The main content area displays the "IB Network qr01.example.com" configuration properties. On the left, a tree view shows the network structure: "IB Network qr01.example.com" > "Infiniband Network Connections" > "Members" > "Oracle Infiniband Switch Members" > "qr01sw-iba01.example.com" and "qr01sw-ibb01.example.com". The right panel shows the "Configuration Properties" tab selected, displaying the following data:

Property Name	Property Value
Infiniband Network	qr01.example.com
ID	
Operating System	Linux
Platform	x86_64

At the bottom right of the table, it says "Total Number of Rows 3". The status bar at the bottom right indicates "Page Refreshed Jun 10, 2016 6:04:38 AM GMT".

24. Click Infiniband Network Connections in the hierarchical list on the left of the page. This will display a table, which contains information about the InfiniBand network connections. This is the information that supports the port diagrams on the IB Network home page. Take a moment to examine the InfiniBand Network Connections along with any of the other available configuration information.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar displays a hierarchical tree under 'IB Network qr01.example.com' with 'Infiniband Network Connections' selected. The main content area is titled 'Infiniband Network Connections' and contains a table with the following data:

Switch GUID	Port Number	GUID on the other end of the link	Port if peer is Cell/Compute Node, Switch otherwise	Port number of the peer port	Type of the entity to which this port is connected
0x002128469324... 1		0x0021280001a1...	Port	2	Cell
0x002128469324a0a 2		0x0021280001a16d0	Port	2	Cell
0x002128469324... 4		0x0021280001a1...	Port	2	Cell
0x002128469324a0a 7		0x0021280001a13b2	Port	2	Compute Node
0x002128469324... 10		0x0021280001a1...	Port	2	Compute Node
0x002128469324a0a 13		0x0021286ccc4ca0	Switch	14	Switch
0x002128469324... 14		0x0021286ccc4c...	Switch	13	Switch
0x002128469324a0a 15		0x0021286ccc4ca0	Switch	16	Switch
0x002128469324... 16		0x0021286ccc4c...	Switch	15	Switch
0x002128469324a0a 17		0x0021286ccc4ca0a	Switch	18	Switch
0x002128469324... 18		0x0021286ccc4c...	Switch	17	Switch

Total Number of Rows 24

25. Select the Infiniband Network > Home menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar has a tree view under 'IB Network qr01.example.com' with 'Infiniband Network' expanded, and 'Home' selected. The main panel displays 'Infiniband Network Connections' with a search bar and a table of configuration properties. The table has columns: Switch GUID, Port Number, GUID on the other end of the link, Port if peer is Cell/Compute Node, Port number of the peer port, and Type of the entity to which this port is connected. The table lists 24 rows of data.

Switch GUID	Port Number	GUID on the other end of the link	Port if peer is Cell/Compute Node, Switch otherwise	Port number of the peer port	Type of the entity to which this port is connected
0x002128469324... 1	0x0021280001a1...	Port	2	Cell	
0x002128469324a0a 2	0x0021280001a1600	Port	2	Cell	
0x002128469324... 4	0x0021280001a1...	Port	2	Cell	
0x002128469324a0a 7	0x0021280001a13b2	Port	2	Compute Node	
0x002128469324... 10	0x0021280001a1...	Port	2	Compute Node	
0x002128469324a0a 13	0x0021286ccc4ca0a	Switch	14	Switch	
0x002128469324... 14	0x0021286ccc4...	Switch	13	Switch	
0x002128469324a0a 15	0x0021286ccc4ca0a	Switch	16	Switch	
0x002128469324... 16	0x0021286ccc4...	Switch	15	Switch	
0x002128469324a0a 17	0x0021286ccc4ca0a	Switch	18	Switch	
0x002128469324... 18	0x0021286ccc4...	Switch	17	Switch	

26. As you have already seen, the IB Network home provides an overview of the Database Machine InfiniBand network. In addition to this, each InfiniBand switch also has a home page associated with it. Click the link associated with the InfiniBand switch `qr01sw-iba01.example.com`.

Infiniband Home - Mozilla Firefox (on em12c.example.com)

ORACLE Enterprise Manager Cloud Control 12c

IB Network qr01.example.com

Subnet Manager on Switch: qr01sw-iba01.example.com

Switches: 2

Compute Nodes: 2

Cells: 3

Throughput

Total Network: 0 Mbps

Link Type	Average (Mbps)	Lowest (Mbps)	Highest (Mbps)
Switch to Node Link	0.0	0.0	0.0
Switch to Switch Link	0.0	0.0	0.0

Switches

Refresh	Name	Status	Type	Port Details																																				
	qr01sw-iba01.example.com	Up	Leaf	<table border="1"><tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td></tr><tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td></tr></table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1																							
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2																							
	qr01sw-ibb01.example.com	Up	Leaf	<table border="1"><tr><td>20</td><td>22</td><td>24</td><td>26</td><td>28</td><td>30</td><td>35</td><td>33</td><td>31</td><td>14</td><td>16</td><td>18</td><td>11</td><td>9</td><td>7</td><td>5</td><td>3</td><td>1</td></tr><tr><td>19</td><td>21</td><td>23</td><td>25</td><td>27</td><td>29</td><td>36</td><td>34</td><td>32</td><td>13</td><td>15</td><td>17</td><td>12</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td></tr></table>	20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1	19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2
20	22	24	26	28	30	35	33	31	14	16	18	11	9	7	5	3	1																							
19	21	23	25	27	29	36	34	32	13	15	17	12	10	8	6	4	2																							

Nodes

Refresh	Name	Status	Type	HCA	IP Address	Port Details		
	qr01dbadm01.example.com	Up	Host	HCA-1	192.168.1.101, 19...	<table border="1"><tr><td>1</td><td>2</td></tr></table>	1	2
1	2							

27. The InfiniBand switch home page for `qr01sw-iba01.example.com` appears. Like the IB Network home page, this page contains overview and throughput information, along with a port diagram for the switch. Below the port diagram, there is an area that lists port details, which administrators can use to quickly find information about a specific port.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface for managing an InfiniBand switch. The URL is `https://em12c.example.com:7802/em/faces/core-infiniband-home?target=IB`. The main content includes:

- Overview:** Status (Up), Subnet Manager (Yes), Switch Type (Leaf), Version (2.1.6-2), Number of connected ports (12), Number of ports with errors (0), Front temperature (38 °C).
- Throughput:** A table showing Link Type, Average (Mbps), Lowest (Mbps), and Highest (Mbps) for Switch to Node Link and Switch to Switch Link. Both show 0.0 Mbps.
- Port Overview:** A grid of 48 ports labeled 20 through 47. Port 10 is highlighted with a red border. A legend indicates that grey cells represent Errors and white cells represent Available Ports.
- Port Details:** A table listing Port Number, Peer Target Name, Peer Type, Peer Port, Link State, and Active status for each port. Port 31 is shown as active with a peer target of `qr01sw-iba01.example.com`.

28. Select the Infiniband Switch > Monitoring > All Metrics menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The browser title is "Infiniband Switch Home - Mozilla Firefox (on em12c.example.com)". The URL in the address bar is "https://em12c.example.com:7802/em/faces/core-infiniband-home?target=IB". The page header includes "ORACLE Enterprise Manager Cloud Control 12c" and "qr01sw-iba01.example.com". The left sidebar has a tree view with nodes like "Infiniband Switch", "Monitoring" (which is selected), "Control", "Job Activity", "Information Publisher Reports", "Configuration", "Compliance", "Target Setup", "Target Sitemap", and "Target Information". The main content area has two tabs: "All Metrics" (selected) and "Overview". Under "All Metrics", there are sections for "Metric and Collection Settings" and "Metric Collection Errors". A table shows "Status History" for "to Node Link" and "to Switch Link". Under "Overview", there is a "Blackouts" table with columns for port numbers 22 through 1. Below these tables is a "Port Details" section with a table showing port configuration for ports 20 to 31. The table columns include Port Number, Peer Target Name, Peer Type, Peer Port, Link Degraded, Active Width (1X or 4X), Enabled Width (1X or 4X), Active Speed (Gbps), Enabled Speed (Gbps), Symbol Errors, Received Packets with Errors, and a status column. Most ports are listed as "N/A" or "Oracle Infiniband ...".

29. The All Metrics page provides an interface for administrators to examine the metrics associated with a monitoring target. For InfiniBand switches, this page provides access to numerous metrics and sensors associated with each switch. The metrics are organized into groups, which are displayed in a hierarchical list on the left side of the page.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar reads "All Metrics: qr01sw-iba01.example.com (Oracle Infiniband Switch) - Oracle Enterprise Manager - Mozilla Firefox (on em12c)". The main content area is titled "All Metrics". On the left, there's a navigation tree under "qr01sw-iba01.example.com" with various metrics like Aggregate Sensors, FRU Removal Alerts, etc. To the right, there are two sections: "Open Metric Events" and "Top 5 alerting metrics (Last 7 days)", both of which show "No data to display".

30. Click the Switch Port Performance metric group. Examine the available switch port performance metrics. Remember that administrators can set thresholds for these metrics, so that they will be alerted when certain conditions exist.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar shows a tree view of metrics under 'qr01sw-iba01.example.com'. The 'Switch Port Performance' node is selected and highlighted in blue. The main content area displays a table titled 'Switch Port Performance' with the following columns: Port number, Link Throughput: bytes transmitted and received per sec (KBPS), Number of bytes received per sec (KBPS), Number of bytes transmitted per sec (KBPS), Number of packets received per sec, and Number of packets transmitted per sec. The table contains 20 rows, each corresponding to a port number from 33 down to 20. All values in the table are currently 0.

Port number	Link Throughput: bytes transmitted and received per sec (KBPS)	Number of bytes received per sec (KBPS)	Number of bytes transmitted per sec (KBPS)	Number of packets received per sec	Number of packets transmitted per sec
33	0	0	0	0	0
32	0	0	0	0	0
21	0	0	0	0	0
7	0	0	0	0	0
26	0	0	0	0	0
17	0	0	0	0	0
2	0	0	0	0	0
1	0	0	0	0	0
18	0	0	0	0	0
30	0	0	0	0	0
16	0	0	0	0	0
27	0	0	0	0	0
25	0	0	0	0	0
28	0	0	0	0	0
20	0	0	0	0	0

31. Click the Switch Temperatures metric group. The temperature readings are provided by various sensors contained inside the switch.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar shows a tree view of metrics under 'qr01sw-iba01.example.com' including 'Aggregate Sensors', 'FRU Removal Alerts', 'Fan Speed Sensor Alerts', 'Response', 'Switch Performance Summary', 'Switch Port Configuration Monitor', 'Switch Port Errors', 'Switch Port Performance', 'Switch Port State', 'Switch Port State (For Alerts)', 'Switch State Summary', 'Switch Temperatures' (which is selected and highlighted in blue), 'Temperature Sensor Alerts', 'Voltage Sensor Alerts', and 'Other collected items'. The main content area is titled 'Switch Temperatures' and displays a table of temperature metrics:

Metric	Thresholds	Real Time Value
Back of switch temperature	Not Set	39
Front of switch temperature	Not Set	38
Switch 14 chip temperature	Not Set	50
Switch Service Processor temperature	Not Set	53

Below the table, a note says 'Data shown in above table is collected in real time.'

32. Select the Infiniband Switch > Configuration > Last Collected menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar is titled 'Infiniband Switch' and contains several menu items: Home, Monitoring, Control, Job Activity, Information Publisher Reports, Configuration (which is highlighted), Compliance, Target Setup, Target Sitemap, Target Information, and a detailed section under 'Switch Port Configuration'. The 'Configuration' section is expanded, showing options like 'Switch Port Errors', 'Switch Port Performance', 'Switch Port State', 'Switch Port State (For Alerts)', 'Switch State Summary', 'Switch Temperatures' (which is also highlighted), 'Temperature Sensor Alerts', 'Voltage Sensor Alerts', and 'Other collected items'. On the right, there's a table titled 'Switch Temperatures' with columns 'Thresholds' and 'Real Time Value'. A note at the bottom says 'Data shown in above table is collected in real time.' The URL in the browser is https://em12c.example.com:7802/em/faces/core-infiniband-home?target=IB

33. You should now see the configuration browser page for `qr01sw-iba01.example.com`. The configuration browser allows administrators to examine the configuration settings associated with a management target. It is similar to the All Metrics page that you just examined. The main difference between metrics and configuration settings is that metric values are expected to constantly vary over time while configuration settings should be more stable.

The screenshot shows a Mozilla Firefox browser window titled "Configuration Browser: qr01sw-iba01.example.com (Oracle Infiniband Switch) - Oracle Enterprise Manager - Mozilla Firefox". The address bar shows the URL `https://em12c.example.com:7802/em/faces/core-infiniband-home?target=IB`. The main content area is titled "ORACLE Enterprise Manager Cloud Control 12c". A left sidebar lists "qr01sw-iba01.example.com" and "Infiniband Switch". The main panel is titled "Latest Configuration" and displays "Configuration Properties". The properties listed are:

Property Name	Property Value
Operating System	Linux
Platform	x86_64
Target Version	2.1.6.2.0
Infiniband G UID	0021286ccc4ca0a0
Host Name	qr01sw-iba01
Number of Ports	36
Vendor ID	0x2c9
Device ID	0xbdb36
Description	SUN DCS 36P QDR
Direct Metric Data Access Method	PubKeyAuthSSH

At the bottom right of the main panel, it says "Total Number of Rows 10".

34. Click Infiniband Switch Version in the hierarchical list on the left side of the page and examine the available configuration attributes.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar shows a tree view with 'qr01sw-iba01.example.com' expanded, and 'Infiniband Switch Version' selected. The main content area displays the 'Infiniband Switch Version' configuration properties. At the top of this section is a 'Configuration Properties' table:

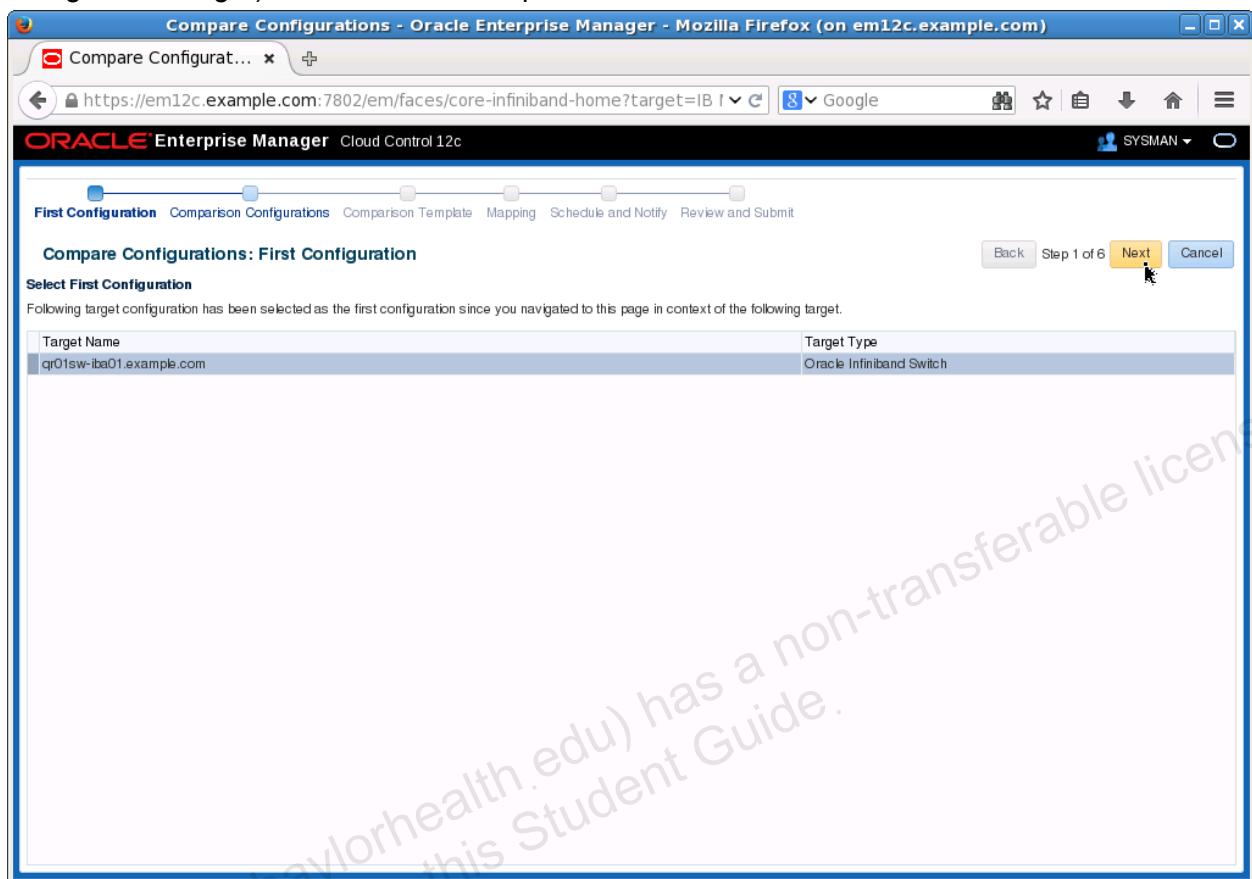
Name	Value
Model Name	SUN DCS 36p
Model Version	2.1.6-2
Serial Number	'NCDF31064'
Hardware Revision	0x0107
Firmware Revision	0x0000

Below this table, there are buttons for 'View', 'Export', and 'Detach'. A note at the bottom right of the table area says 'Total Number of Rows 5'.

35. In a previous practice, you compared the configuration of your Exadata Storage Servers to ensure consistency across them. You can perform a similar check across the InfiniBand switches. To commence this process, select the Infiniband Switch > Configuration > Compare menu command.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The left sidebar has a tree view with nodes like Home, Monitoring, Control, Job Activity, Information Publisher Reports, Configuration (which is selected and highlighted in yellow), Compliance, Target Setup, Target Sitemap, and Target Information. A context menu is open over the Configuration node, with 'Compare...' being the highlighted option. The main content area displays 'Infiniband Switch Version' and 'Actions' buttons. Below that is a 'Configuration Properties' section with a table showing the last collected time (Jun 10, 2016 1:07:11 AM) and various configuration details. The table includes columns for 'Value' and 'Revision'. At the bottom right of the table, it says 'Total Number of Rows 5'.

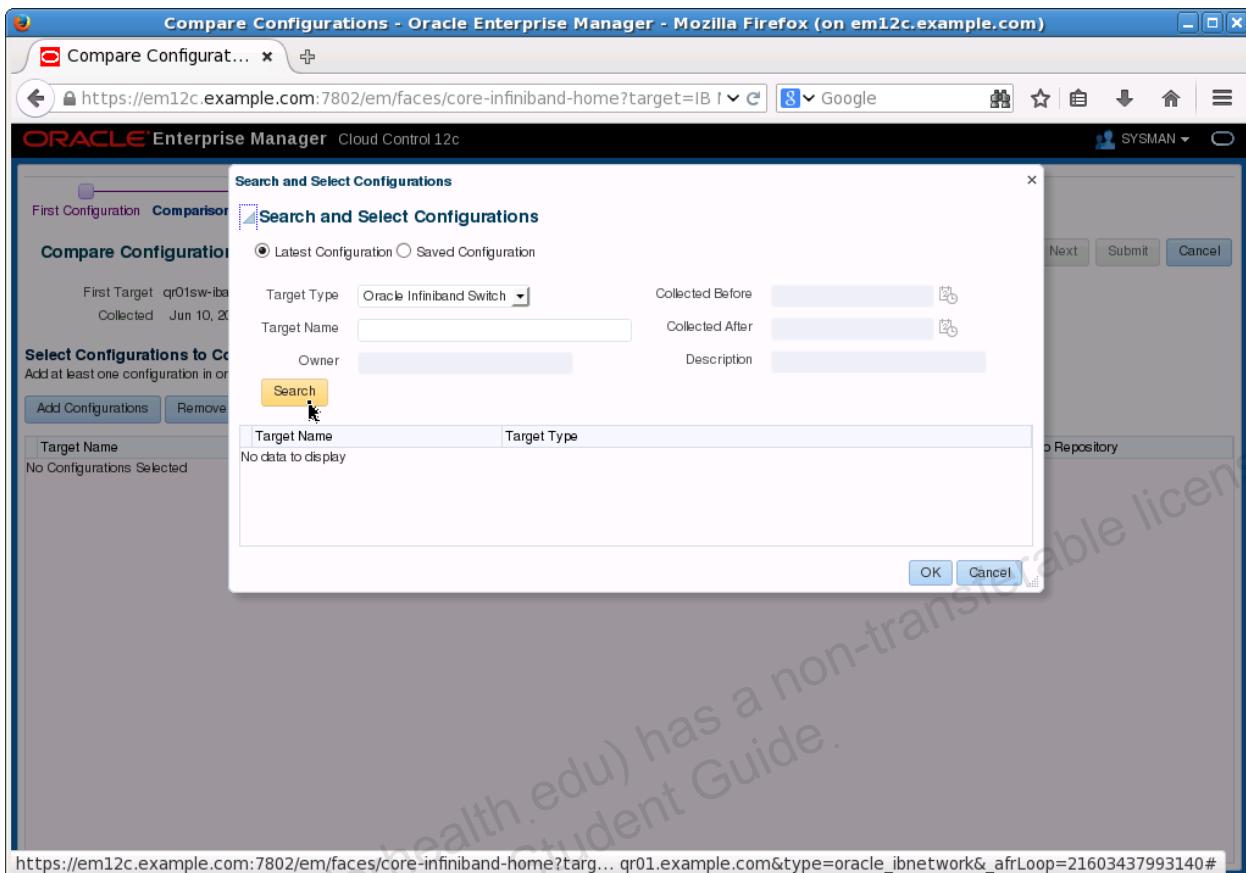
36. Confirm that qr01sw-iba01.example.com is selected as the comparison baseline (first configuration target). Then click Next to proceed.



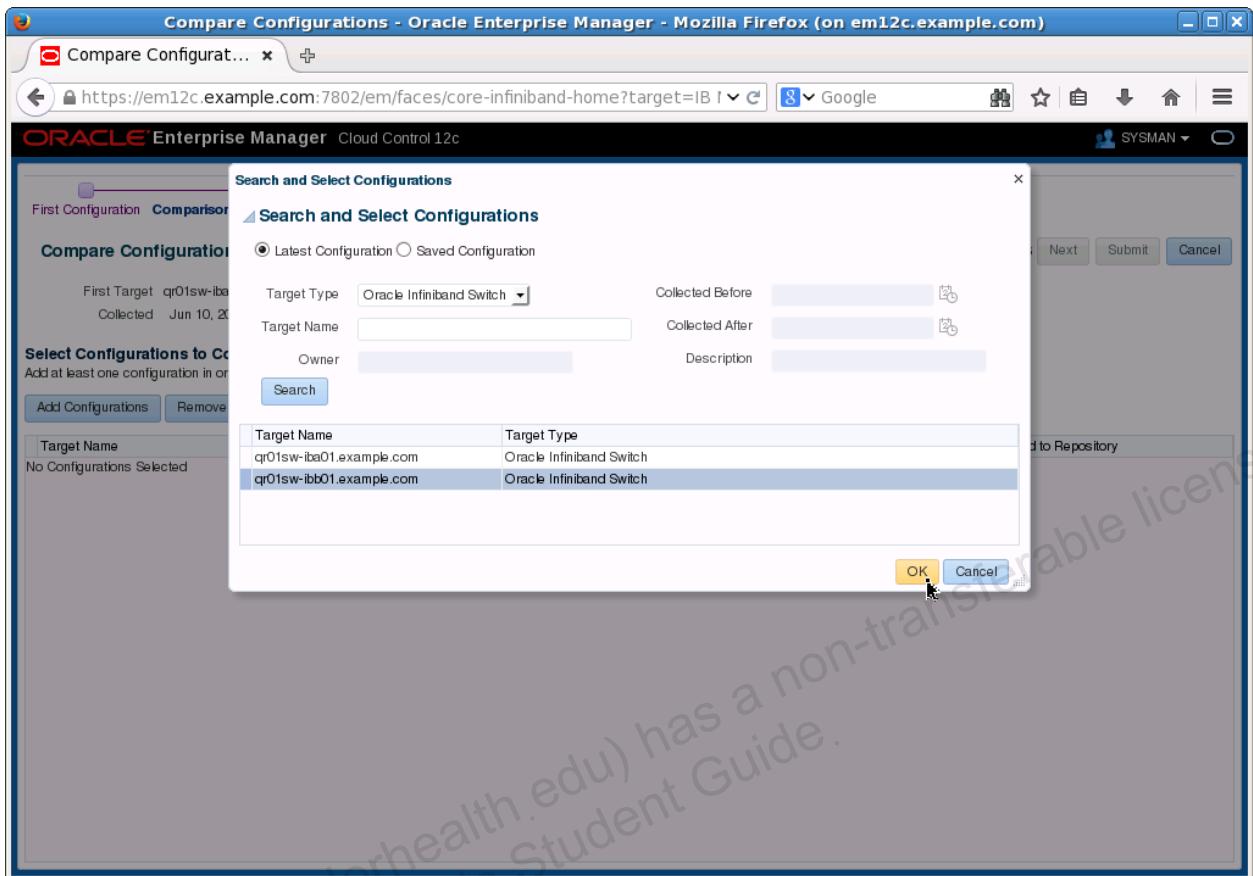
37. Click Add Configurations.

The screenshot shows the 'Compare Configurations' wizard in Oracle Enterprise Manager. The current step is 'Comparison Configurations'. At the top, there is a breadcrumb trail: First Configuration → Comparison Configurations → Comparison Template → Mapping → Schedule and Notify → Review and Submit. Below the breadcrumb, the title is 'Compare Configurations: Comparison Configurations'. It displays the 'First Target' as 'qr01sw-iba01.example.com (Oracle Infiniband Switch)' and the 'Collected' date as 'Jun 10, 2016 1:07:11 AM (Latest Configuration)'. A section titled 'Select Configurations to Compare with the First' instructs the user to 'Add at least one configuration in order to move to the next step.' There is a 'Target Name' input field, a 'Target Type' dropdown, and columns for 'Collected', 'Owner', and 'Saved to Repository'. A button labeled 'Add Configurations' is highlighted in yellow, while 'Remove' is in blue. Navigation buttons at the bottom include 'Back', 'Step 2 of 6', 'Next', 'Submit', and 'Cancel'.

38. Click Search.



39. Select qr01sw-ibb01.example.com and click OK.



40. Confirm that qr01sw-ibb01.example.com is selected as the comparison configuration and click Next to proceed.

The screenshot shows the 'Compare Configurations' wizard in Oracle Enterprise Manager. The title bar reads 'Compare Configurations - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)'. The main content area is titled 'Compare Configurations: Comparison Configurations'. It shows a table with one row of data:

Target Name	Target Type	Collected	Owner	Saved to Repository
qr01sw-ibb01.example.com	Oracle Infiniband Switch	Jun 10, 2016 1:07:11 AM		

Below the table, there are buttons for 'Add Configurations' and 'Remove'. At the bottom right of the page, there are buttons for 'Back', 'Step 2 of 6', 'Next', 'Submit', and 'Cancel'. A mouse cursor is hovering over the 'Next' button.

41. The comparison template defines how the comparison is performed. In the default comparison template for InfiniBand switches, serial number differences are ignored, which makes sense because the serial number should be unique for every switch.

Compare Configurations - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)

Compare Configurations

https://em12c.example.com:7802/em/faces/core-infiniband-home?target=IB

ORACLE Enterprise Manager Cloud Control 12c

SYSMAN

First Configuration Comparison Configurations **Comparison Template** Mapping Schedule and Notify Review and Submit

Back Step 3 of 6 Next Submit Cancel

Compare Configurations: Comparison Template

Target Type Oracle Infiniband Switch

Select the comparison template to be used for this comparison.

Comparison Template Default Infiniband Switch

Template Owner SYSMAN

Template Settings

Configuration Item	Compare
Infiniband Switch Version	✓
Infiniband Switch Configuration Summary	✓
Infiniband HCA Port Configuration	✓
Target Properties	✓

Property Settings

Property Name	Compare	Notify if different	Value Constraints
Firmware Revision	✓	—	—
Hardware Revision	✓	—	—
Model Name	✓	—	—
Model Version	✓	—	—
Serial Number	—	—	—

42. Click InfiniBand Switch Configuration Summary in the Template Settings area on the left side of the page.

The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The title bar says "Compare Configurations - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)". The main content area is titled "Compare Configurations: Comparison Template". A progress bar at the top indicates "Step 3 of 6".
Template Settings:
A table with columns "Configuration Item" and "Compare". The rows are:

- Infiniband Switch Version (checkbox checked)
- Infiniband Switch Configuration Summary** (checkbox checked, highlighted in yellow)
- Infiniband HCA Port Configuration (checkbox checked)
- Target Properties (checkbox checked)

Property Settings:
A table with columns "Property Name", "Compare", "Notify if different", and "Value Constraints". The rows are:

Property Name	Compare	Notify if different	Value Constraints
Firmware Revision	✓	—	—
Hardware Revision	✓	—	—
Model Name	✓	—	—
Model Version	✓	—	—
Serial Number	—	—	—

43. Here you can see that the default comparison template ignores a number of other differences. Depending on the goal of your comparison, this may make sense, or you may choose to modify the template and report the differences for a specific configuration property.

Compare Configurations: Comparison Template

Target Type Oracle Infiniband Switch

Select the comparison template to be used for this comparison.

Comparison Template Default Infiniband Switch

Template Owner SYSMAN

Template Settings

Configuration Item	Compare
Infiniband Switch Version	✓
Infiniband Switch Configuration Summary	✓
Infiniband HCA Port Configuration	✓
Target Properties	✓

Property Settings

Property Name	Compare	Notify if different	Value Constraints
Is subnet manager switch or not?	—	—	
Number of ports connected with a cable	—	—	
Spine or Normal switch. A spine switch is a switch that is not connected to any cell or compute node.	—	—	

44. Take a moment to examine the rest of the comparison template. When you are ready, click Submit.

Compare Configurations - Oracle Enterprise Manager - Mozilla Firefox (on em12c.example.com)

Compare Configuration

https://em12c.example.com:7802/em/faces/core-infiniband-home?target=IB

ORACLE Enterprise Manager Cloud Control 12c

SYSMAN

First Configuration Comparison Configurations Comparison Template Mapping Schedule and Notify Review and Submit

Compare Configurations: Comparison Template

Target Type Oracle Infiniband Switch

Select the comparison template to be used for this comparison.

Comparison Template Default Infiniband Switch

Template Owner SYSMAN

Template Settings

Configuration Item	Compare
Infiniband Switch Version	✓
Infiniband Switch Configuration Summary	✓
Infiniband HCA Port Configuration	✓
Target Properties	✓

Property Settings

Rules for Matching Configuration Items Rules for Including or Excluding Configuration Items

For properties not used for matching configuration items, identify which should be compared and alerted on, as appropriate. Key properties are used for matching items and as a result, not editable in the table. Value constraint rules are applied to the second set of targets in the comparison wizard.

Property Name	Compare	Notify if different	Value Constraints
Is subnet manager switch or not?	-	-	-
Number of ports connected with a cable	-	-	-
Spine or Normal switch. A spine switch is a switch that is not connected to any cell or compute node.	-	-	-

Back Step 3 of 6 Next Submit Cancel

45. When the comparison completes, the Compare Result page appears. Examine the comparison result. Verify that the comparison found no differences.

The screenshot shows the 'Compare Result' page in Oracle Enterprise Manager Cloud Control 12c. The page title is 'Compare Result: Same - Mozilla Firefox (on em12c.example.com)'. The URL in the address bar is <https://em12c.example.com:7802/em/faces/core-ecm-compare-result?jobExe>. The page header includes the Oracle logo and 'Enterprise Manager Cloud Control 12c'. The main content area is titled 'Compare Result' and shows the 'Result for job CONFIGURATION COMPARISON JOB FRI JUN 10 2016 06:20:53 UTC'. It details the comparison between two configurations: 'qr01sw-iba01.example.com (Oracle Infiniband Switch)' and 'qr01sw-ibb01.example.com (Oracle Infiniband Switch)'. Both configurations were collected on Jun 10, 2016, at 1:07:11 AM. Under 'Job Details', there is a checkbox 'Show Differences Only' which is checked, and a button 'Export All Differences'. A message 'No differences were found.' is displayed above a results table. The table has columns for 'Result', 'Configuration Property Name', 'First', and 'Second'. The message 'No data to display.' is shown in the first row of the table. There are also 'Filter Results' and 'Remove Filter' buttons for this table.

Congratulations! You have examined the Exadata InfiniBand monitoring and administration capabilities provided by Enterprise Manager Cloud Control 12c.

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Practices for Lesson 18: Monitoring Other Exadata Database Machine Components

Chapter 18

Practices for Lesson 18

There are no practices for this lesson.

Practices for Lesson 19: Other Useful Exadata Monitoring Tools

Chapter 19

Practices for Lesson 19

There are no practices for this lesson.

Practices for Lesson 20: Backup and Recovery

Chapter 20

Practices for Lesson 20: Overview

Practices Overview

In these practices, you will examine the backup and recovery optimizations that are enabled when Oracle Recovery Manager (RMAN) is used in conjunction with Exadata storage.

Practice 20-1: Backup Optimization

Overview

In this practice, you will see how Exadata optimizes the read I/O for an RMAN incremental backup.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

3. Create a new tablespace named PRACTICE20, which you will use during this practice.

```
SQL> create tablespace practice20 datafile '+DATA_QR01' size
500M;
Tablespace created.

SQL>
```

4. Execute the following query (or execute the SQL script /home/oracle/labs/lab20-01-04.sql). The statistics show one of the ways in which Exadata can optimize file creation. In this case, the database server instructed the Exadata cells to format the data file on its behalf, rather than sending empty formatted data blocks over the storage interconnect. This can be seen by the value for cell physical IO bytes saved during optimized file creation, and also the very low value for cell physical IO interconnect bytes compared with physical write total bytes.

```
SQL> select a.name, b.value/1024/1024 MB
  2  from v$sysstat a, v$mystat b
  3 where a.statistic# = b.statistic# and
  4 (a.name in ('physical read total bytes',
  5           'physical write total bytes',
  6           'cell IO uncompressed bytes')
  7 or a.name like 'cell phy%');

NAME                                     MB
-----
physical read total bytes                2.546875
physical write total bytes              1000.35938
cell physical IO interconnect bytes      3.59375
cell physical IO bytes saved during optimized file creation 1000
cell physical IO bytes saved during RMAN file restore        0
cell physical IO bytes eligible for predicate offload       1000
cell physical IO bytes saved by storage index                 0
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical IO bytes saved by columnar cache               0
cell physical write bytes saved by smart file initialization 0

NAME                                     MB
-----
cell IO uncompressed bytes                0
cell physical write IO bytes eligible for offload            0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>
```

5. Move the SH.CUST_INFO table into the PRACTICE20 tablespace;

```
SQL> alter table sh.cust_info move tablespace practice20;

Table altered.

SQL>
```

6. Enable block change tracking in your database and then query V\$BLOCK_CHANGE_TRACKING to confirm the setting.

```
SQL> alter database enable block change tracking;

Database altered.

SQL> select status, filename from v$block_change_tracking;

STATUS
-----
FILENAME
-----
ENABLED
+DATA_QR01/DBM/CHANGETRACKING/ctf.276.915085611

SQL>
```

7. Disconnect your SQL*Plus session, but leave SQL*Plus running.

```
SQL> disconnect
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0...
SQL>
```

8. Establish a second terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ???????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

9. Stop the dbm database. **Do not proceed until the database is stopped.**

```
[oracle@qr01dbadm01 ~]$ srvctl stop database -d dbm
[oracle@qr01dbadm01 ~]$ srvctl status database -d dbm
Instance dbm1 is not running on node qr01dbadm01
Instance dbm2 is not running on node qr01dbadm02
[oracle@qr01dbadm01 ~]$
```

10. Back in your SQL*Plus session, reconfigure your database to use archivelog mode by using the following sequence of commands:

```
SQL> connect / as sysdba
Connected to an idle instance.
SQL> startup mount
ORACLE instance started.

Total System Global Area 1577058304 bytes
Fixed Size                  2924832 bytes
Variable Size                973082336 bytes
Database Buffers            587202560 bytes
Redo Buffers                 13848576 bytes
Database mounted.
SQL> alter database archivelog;

Database altered.

SQL> alter database open;

Database altered.

SQL>
```

11. Back in your second terminal window, restart the dbm database on all of your Exadata database servers.

```
[oracle@qr01dbadm01 ~]$ srvctl start database -d dbm
[oracle@qr01dbadm01 ~]$ srvctl status database -d dbm
Instance dbm1 is running on node qr01dbadm01
Instance dbm2 is running on node qr01dbadm02
[oracle@qr01dbadm01 ~]$
```

12. Launch Oracle Recovery Manager (RMAN) and connect to your database as shown below:

```
[oracle@qr01dbadm01 ~]$ rman target /
 
Recovery Manager: Release 12.1.0.2.0 - Production...
 
connected to target database: DBM (DBID=1355636031)
 
RMAN>
```

13. Configure RMAN to use two parallel execution channels for backup and recovery commands.

```
RMAN> configure device type disk parallelism 2;

using target database control file instead of recovery catalog
new RMAN configuration parameters:
CONFIGURE DEVICE TYPE DISK PARALLELISM 2 BACKUP TYPE TO
BACKUPSET;
new RMAN configuration parameters are successfully stored

RMAN>
```

14. Execute a level 0 incremental backup of the PRACTICE20 tablespace.

In this practice, you will perform backups on a single-file tablespace. It is not required to perform all backups this way on Database Machine. All the concepts in this practice apply to backups with different scopes, such as full database backups, and so on.

```
RMAN> backup as backupset incremental level 0 tablespace practice20;

Starting backup at 21-JUN-16
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=816 instance=dbm1 device type=DISK
allocated channel: ORA_DISK_2
channel ORA_DISK_2: SID=43 instance=dbm1 device type=DISK
channel ORA_DISK_1: starting incremental level 0 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00009
name=+DATA_QR01/DBM/DATAFILE/practice20.275.915085511
channel ORA_DISK_1: starting piece 1 at 21-JUN-16
channel ORA_DISK_1: finished piece 1 at 21-JUN-16
piece
handle=+RECO_QR01/DBM/BACKUPSET/2016_06_21/nnndn0_tag20160621t063346_0.257.915
086029 tag=TAG20160621T063346 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:45
Finished backup at 21-JUN-16

RMAN>
```

15. Use the LIST BACKUP command to view details about the backup operation you just executed. Note the size of the backup and the amount of time required to perform the backup.

```
RMAN> list backup;

List of Backup Sets
=====

BS Key  Type LV Size      Device Type Elapsed Time Completion Time
-----  ---- - - -----
1       Incr 0   251.19M    DISK            00:00:42   21-JUN-16
      BP Key: 1   Status: AVAILABLE  Compressed: NO  Tag: TAG20160621T063346
      Piece Name:
+RECO_QR01/DBM/BACKUPSET/2016_06_21/nndn0_tag20160621t063346_0.257.915086029
      List of Datafiles in backup set 1
      File LV Type Ckp SCN      Ckp Time  Name
      ----- - - -----
      9     0   Incr 13553891  21-JUN-16
+DATA_QR01/DBM/DATAFILE/practice20.275.915085511

RMAN>
```

16. Leave your RMAN session running and return to your SQL*Plus terminal. Execute the following query (or execute the SQL script /home/oracle/labs/lab20-01-16.sql) to show a selection of statistics relating to your RMAN session. You should see similar values for physical read total bytes and physical write total bytes because the level 0 incremental backup you executed in step 14 is essentially a full backup of the PRACTICE20 tablespace.

```

SQL> select a.name, sum(b.value/1024/1024) MB
  2  from v$sysstat a, v$sesstat b, v$session c
  3  where a.statistic# = b.statistic# and
  4  b.sid = c.sid and
  5  upper(c.program) like 'RMAN%' and
  6  (a.name in ('physical read total bytes',
  7  'physical write total bytes',
  8  'cell IO uncompressed bytes')
  9  or a.name like 'cell phy%')
 10 group by a.name;

NAME                                MB
-----
cell physical IO bytes eligible for predicate offload      0
cell physical IO bytes saved by columnar cache            0
cell physical IO interconnect bytes                      1114.23242
cell physical IO bytes saved during optimized file creation 0
cell physical IO interconnect bytes returned by smart scan 0
cell physical write IO bytes eligible for offload          0
physical write total bytes                           412.633301
cell physical write bytes saved by smart file initialization 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes saved by storage index           0
cell IO uncompressed bytes                         0

NAME                                MB
-----
physical read total bytes                  446.96582
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>

```

17. Execute the following UPDATE command (or execute the SQL script /home/oracle/labs/lab20-01-17.sql) to modify a small subset of the customer records scattered throughout the table. Commit the changes once the UPDATE statement completes.

```
SQL> update sh.cust_info set
  2  affinity_card = 0
  3  where remainder(cust_id,1000)=0;

2986 rows updated.

SQL> commit;

Commit complete.

SQL>
```

18. Back in your RMAN terminal, exit your current RMAN session and launch a fresh one. This will enable you to examine a fresh set of session statistics later in the practice.

```
RMAN> exit

Recovery Manager complete.
[oracle@qr01dbadm01 ~]$ rman target /

Recovery Manager: Release 12.1.0.2.0...

connected to target database: DBM (DBID=1355636031)

RMAN>
```

19. Execute a level 1 incremental backup of the PRACTICE20 tablespace.

```
RMAN> backup as backupset incremental level 1 tablespace practice20;

Starting backup at 21-JUN-16
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=816 instance=dbm1 device type=DISK
allocated channel: ORA_DISK_2
channel ORA_DISK_2: SID=19 instance=dbm1 device type=DISK
channel ORA_DISK_1: starting incremental level 1 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00009
name=+DATA_QR01/DBM/DATAFILE/practice20.275.915085511
channel ORA_DISK_1: starting piece 1 at 21-JUN-16
channel ORA_DISK_1: finished piece 1 at 21-JUN-16
piece
handle=+RECO_QR01/DBM/BACKUPSET/2016_06_21/nnndn1_tag20160621t063717_0.258.915
086245 tag=TAG20160621T063717 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:15
Finished backup at 21-JUN-16

RMAN>
```

20. As before, use the LIST BACKUP command to view details about the backup operation you just executed. Note the size of the backup and the amount of time required to perform the backup.

```
RMAN> list backup;

List of Backup Sets
=====

BS Key  Type LV Size      Device Type Elapsed Time Completion Time
-----  ---- - - -----
1       Incr 0  251.19M    DISK        00:00:42   21-JUN-16
          BP Key: 1  Status: AVAILABLE  Compressed: NO  Tag: TAG20160621T063346
          Piece Name:
+RECO_QR01/DBM/BACKUPSET/2016_06_21/nndn0_tag20160621t063346_0.257.915086029
List of Datafiles in backup set 1
File LV Type Ckp SCN      Ckp Time  Name
-----  - - - - -
9      0  Incr 13553891  21-JUN-16
+DATA_QR01/DBM/DATAFILE/practice20.275.915085511

BS Key  Type LV Size      Device Type Elapsed Time Completion Time
-----  ---- - - -----
2       Incr 1  23.23M     DISK        00:00:10   21-JUN-16
          BP Key: 2  Status: AVAILABLE  Compressed: NO  Tag: TAG20160621T063717
          Piece Name:
+RECO_QR01/DBM/BACKUPSET/2016_06_21/nndn1_tag20160621t063717_0.258.915086245
List of Datafiles in backup set 2
File LV Type Ckp SCN      Ckp Time  Name
-----  - - - - -
9      1  Incr 13554098  21-JUN-16
+DATA_QR01/DBM/DATAFILE/practice20.275.915085511

RMAN>
```

21. Leave your RMAN session running and return to your SQL*Plus terminal. As you did in step 16, execute the following query (or execute the SQL script /home/oracle/labs/lab20-01-16.sql) to show a selection of statistics relating to your current RMAN session.

This time the value for physical read total bytes will be smaller than the value you observed in step 16. This because block change tracking enables RMAN to concentrate its read requests on areas that have changed since the last backup. In addition, you should see that Exadata Smart Scan further optimized the RMAN reads. Compare cell physical IO bytes eligible for predicate offload with cell physical IO interconnect bytes returned by smart scan to determine the effect of the optimization.

```
SQL> select a.name, sum(b.value/1024/1024) MB
  2  from v$sysstat a, v$sesstat b, v$session c
  3  where a.statistic# = b.statistic# and
  4  b.sid = c.sid and
  5  upper(c.program) like 'RMAN%' and
  6  (a.name in ('physical read total bytes',
  7  'physical write total bytes',
  8  'cell IO uncompressed bytes')
  9  or a.name like 'cell phy%')
 10 group by a.name;

NAME                                MB
-----
cell physical IO bytes eligible for predicate offload      253.015625
cell physical IO bytes saved by columnar cache            0
cell physical IO interconnect bytes                      418.904297
cell physical IO bytes saved during optimized file creation 0
cell physical IO interconnect bytes returned by smart scan 23.1953125
cell physical write IO bytes eligible for offload          0
physical write total bytes                            183.984863
cell physical write bytes saved by smart file initialization 0
cell physical IO bytes saved during optimized RMAN file restore 0
cell physical IO bytes saved by storage index            0
cell IO uncompressed bytes                          0

NAME                                MB
-----
physical read total bytes                439.442383
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>
```

22. Examine V\$BACKUP_DATAFILE by using the following query (or execute the SQL script /home/oracle/labs/lab20-01-22.sql). The BLOCKS_SKIPPED_IN_CELL value associated with the level 1 incremental backup shows the amount of I/O that was saved by the optimization.

```
SQL> select file#,incremental_level,datafile_blocks,
  2  blocks,blocks_read,blocks_skipped_in_cell
  3  from v$backup_datafile;

      FILE# INCREMENTAL_LEVEL DATAFILE_BLOCKS      BLOCKS BLOCKS_READ
----- -----
BLOCKS_SKIPPED_IN_CELL
-----
          9             0           64000       32149      32896
          0
          9             1           64000       2970        2970
         29417

SQL>
```

23. Exit your SQL*Plus and RMAN sessions.

Practice 20-2: Recovery Optimization

Overview

In this practice, you will exercise the recovery optimization that is provided by Exadata in conjunction with RMAN.

Assumptions

Before beginning this practice, you must complete Practice 20-1. Your ability to complete this practice depends on the existence of the backups that are created in practice 20-1.

Tasks

1. Establish a terminal connection to qr01dbadm01 as the oracle user, and configure your environment to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

2. Connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

3. Offline the PRACTICE20 tablespace and exit your SQL*Plus session.

```
SQL> alter tablespace practice20 offline;
Tablespace altered.

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.2.0...
[oracle@qr01dbadm01 ~]$
```

4. Use the following `su` command to launch the ASM command tool (ASMCMD) using the privileges of the grid OS user.

```
[oracle@qr01dbadm01 ~]$ su - grid -c ". oraenv;asmcmd -p"  
Password: ???????  
ORACLE_SID = [grid] ? +ASM1  
The Oracle base has been set to /u01/app/grid  
ASMCMD [+] >
```

5. Navigate to the directory inside ASM that houses your database files.

```
ASMCMD [+] > cd +DATA_QR01/dbm/datafile  
ASMCMD [+DATA_QR01/dbm/datafile] >
```

6. List your database files using the `ls` command. Note the name of the data file associated with the `PRACTICE20` tablespace.

```
ASMCMD [+DATA_QR01/dbm/datafile] > ls  
PRACTICE20.275.915085511  
SH.273.874117569  
SOE.274.915083869  
SYSAUX.261.874115745  
SYSTEM.260.874115729  
UNDOTBS1.262.874115757  
UNDOTBS2.264.874115775  
USERS.265.874115777  
ASMCMD [+DATA_QR01/dbm/datafile] >
```

7. Delete the data file associated with the `PRACTICE20` tablespace, then verify the deletion and exit ASMCMD.

```
ASMCMD [+DATA_QR01/dbm/datafile] > rm PRACTICE20.275.915085511  
ASMCMD [+DATA_QR01/dbm/datafile] > ls  
SH.273.874117569  
SOE.274.914043297  
SYSAUX.261.874115745  
SYSTEM.260.874115729  
UNDOTBS1.262.874115757  
UNDOTBS2.264.874115775  
USERS.265.874115777  
ASMCMD [+DATA_QR01/dbm/datafile] > exit  
[oracle@qr01dbadm01 ~]$
```

8. Launch Oracle Recovery Manager (RMAN) and connect to your database as shown below:

```
[oracle@qr01dbadm01 ~]$ rman target /  
  
Recovery Manager: Release 12.1.0.2.0 - Production...  
  
connected to target database: DBM (DBID=1355636031)  
  
RMAN>
```

9. Restore the PRACTICE20 tablespace.

```
RMAN> restore tablespace practice20;  
  
Starting restore at 21-JUN-16  
using target database control file instead of recovery catalog  
allocated channel: ORA_DISK_1  
channel ORA_DISK_1: SID=41 instance=dbm1 device type=DISK  
allocated channel: ORA_DISK_2  
channel ORA_DISK_2: SID=816 instance=dbm1 device type=DISK  
  
channel ORA_DISK_1: starting datafile backup set restore  
channel ORA_DISK_1: specifying datafile(s) to restore from backup set  
channel ORA_DISK_1: restoring datafile 00009 to  
+DATA_QR01/DBM/DATAFILE/practice20.275.915085511  
channel ORA_DISK_1: reading from backup piece  
+RECO_QR01/DBM/BACKUPSET/2016_06_21/nndn0_tag20160621t063346_0.257.915086029  
channel ORA_DISK_1: piece  
handle=+RECO_QR01/DBM/BACKUPSET/2016_06_21/nndn0_tag20160621t063346_0.257.915  
086029 tag=TAG20160621T063346  
channel ORA_DISK_1: restored backup piece 1  
channel ORA_DISK_1: restore complete, elapsed time: 00:00:55  
Finished restore at 21-JUN-16  
  
RMAN>
```

10. Recover the PRACTICE20 tablespace.

```
RMAN> recover tablespace practice20;

Starting recover at 21-JUN-16
using channel ORA_DISK_1
using channel ORA_DISK_2
channel ORA_DISK_1: starting incremental datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from backup set
destination for restore of datafile 00009:
+DATA_QR01/DBM/DATAFILE/practice20.275.915086505
channel ORA_DISK_1: reading from backup piece
+RECO_QR01/DBM/BACKUPSET/2016_06_21/nnndn1_tag20160621t063717_0.258.915086245
channel ORA_DISK_1: piece
handle=+RECO_QR01/DBM/BACKUPSET/2016_06_21/nnndn1_tag20160621t063717_0.258.915
086245 tag=TAG20160621T063717
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:07

starting media recovery
media recovery complete, elapsed time: 00:00:01

Finished recover at 21-JUN-16

RMAN>
```

11. Leave your RMAN session running and establish a second terminal connection to your database server. Configure the terminal session to access the dbm database (dbm1 instance).

```
$ ssh oracle@qr01dbadm01
oracle@qr01dbadm01's password: ????????
[oracle@qr01dbadm01 ~]$ . oraenv
ORACLE_SID = [oracle] ? dbm
The Oracle base has been set to /u01/app/oracle
[oracle@qr01dbadm01 ~]$ export ORACLE_SID=dbm1
[oracle@qr01dbadm01 ~]$
```

12. In your second terminal session, connect to your database with SQL*Plus. Log in as the database administrator.

```
[oracle@qr01dbadm01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 12.1.0.2.0 Production...

SQL>
```

13. Execute the following query (or execute the SQL script /home/oracle/labs/lab20-02-13.sql) to show a selection of statistics relating to your RMAN recovery session. You should see a value for cell physical IO bytes saved during optimized RMAN file restore. When RMAN restores a file, any blocks in the file that have not been altered since the file was first formatted can be re-created by Exadata. This optimization removes the need to transport empty formatted blocks across the storage network. Rather, RMAN is able to instruct Exadata to conduct the I/O on its behalf, which is similar to the way that optimized file creation is performed.

```

SQL> select a.name, sum(b.value/1024/1024) MB
  2  from v$sysstat a, v$sesstat b, v$session c
  3  where a.statistic# = b.statistic# and
  4  b.sid = c.sid and
  5  upper(c.program) like 'RMAN%' and
  6  (a.name in ('physical read total bytes',
  7  'physical write total bytes',
  8  'cell IO uncompressed bytes')
  9  or a.name like 'cell phy%')
 10 group by a.name;

NAME                                MB
-----
cell physical IO bytes eligible for predicate offload      11.71875
cell physical IO bytes saved by columnar cache            0
cell physical IO interconnect bytes                      1343.23389
cell physical IO bytes saved during optimized file creation    0
cell physical IO interconnect bytes returned by smart scan    0
cell physical write IO bytes eligible for offload          0
physical write total bytes                            530.328125
cell physical write bytes saved by smart file initialization 0
cell physical IO bytes saved during optimized RMAN file restore 11.71875
cell physical IO bytes saved by storage index            0
cell IO uncompressed bytes                          0

NAME                                MB
-----
physical read total bytes                304.796387
cell physical IO bytes sent directly to DB node to balance CPU 0
cell physical write IO host network bytes written during offloa 0

14 rows selected.

SQL>

```

14. Bring the PRACTICE20 tablespace back online.

```

SQL> alter tablespace practice20 online;

Tablespace altered.

```

15. Exit your SQL*Plus and RMAN sessions.

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Practices for Lesson 21: Exadata Database Machine Maintenance Tasks

Chapter 21

Practices for Lesson 21

There are no practices for this lesson.

Practices for Lesson 22: Patching Exadata Database Machine

Chapter 22

Practices for Lesson 22

There are no practices for this lesson.

Practices for Lesson 23: Exadata Database Machine Automated Support Ecosystem

Chapter 23

Practices for Lesson 23

There are no practices for this lesson.