Practice 2

Create Oracle 12c R1 Two-Node RAC Database

Practice Overview

In this practice you will create an Oracle 12c R1 two-node RAC database on the virtual machines that you created in the previous practice. To accomplish this target, you will perform the following:

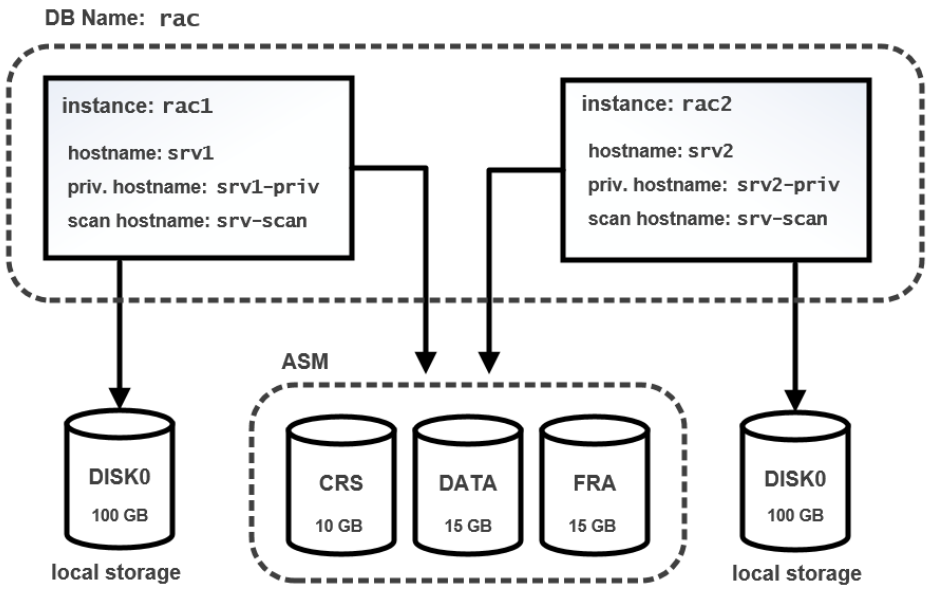
- Carry out OS preparation steps
- Install Grid Infrastructure software
- Create ASM Disk Groups
- Install Oracle Database software
- Create the Oracle RAC database
- Learn how to make a copy of the virtual machines for relocation
- Learn how to startup and shutdown Oracle RAC database
- Get the Enterprise Manager Database Express working in the VM

Practice Assumptions

The practice assumes that you have the virtual machines `srv1` and `srv2` up and running.

Practice Environment Architecture

The following diagram shows the Oracle RAC database architecture that you will create in this practice:



Practice Environment Preparation Procedure

A. Set the OS environment variables in the Oracle software user owner profiles

1. In a Putty session, login to srv1 and srv2 as oracle user

In srv1 and srv2, set the OS environment variables in the oracle user profile:

```
mv ~/.bash_profile ~/.bash_profile_bk
vi ~/.bash_profile
```

```
# .bash_profile
if [ -f ~/.bashrc ]; then
. ~/.bashrc
fi

ORACLE_SID=rac1; export ORACLE_SID
ORACLE_BASE=/u01/app/oracle; export ORACLE_BASE
ORACLE_HOME=$ORACLE_BASE/product/12.1.0/db_1; export ORACLE_HOME
ORACLE_TERM=xterm; export ORACLE_TERM
NLS_DATE_FORMAT="DD-MON-YYYY HH24:MI:SS"; export NLS_DATE_FORMAT
TNS_ADMIN=$ORACLE_HOME/network/admin; export TNS_ADMIN
PATH=.:${PATH}:$ORACLE_HOME/bin
PATH=${PATH}:/usr/bin:/bin:/usr/local/bin
export PATH
LD_LIBRARY_PATH=$ORACLE_HOME/lib
LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:$ORACLE_HOME/oracm/lib
LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:/lib:/usr/lib:/usr/local/lib
export LD_LIBRARY_PATH
THREADS_FLAG=native; export THREADS_FLAG
export TEMP=/tmp
export TMPDIR=/tmp
export EDITOR=vi
umask 022
```

2. In the .bash_profile file of the oracle account in srv2, change the value assigned to ORACLE_SID from rac1 to rac2.

3. In the terminal sessions connected to srv1 and srv2, switch to grid user.

4. In srv1 and srv2, set the OS environment variables in the grid user profile:

```
mv ~/.bash_profile ~/.bash_profile_bk
vi ~/.bash_profile
```

```
# .bash_profile
# OS User: grid

if [ -f ~/.bashrc ]; then
. ~/.bashrc
fi
ORACLE_SID=+ASM1; export ORACLE_SID
ORACLE_BASE=/u01/app/grid; export ORACLE_BASE
# it must not be under the ORACLE_BASE
ORACLE_HOME=/u01/app/12.1.0/grid; export ORACLE_HOME
ORACLE_TERM=xterm; export ORACLE_TERM
TNS_ADMIN=$ORACLE_HOME/network/admin; export TNS_ADMIN
PATH=.:${PATH}:$ORACLE_HOME/bin
PATH=${PATH}:/usr/bin:/bin:/usr/local/bin
export PATH
export TEMP=/tmp
export TMPDIR=/tmp
umask 022
```

5. In .bash_profile file of the grid account in srv2, change the value assigned to ORACLE_SID from +ASM1 to +ASM2.

B. Set the resource limits for the Oracle software installation owners

6. In srv1 and srv2, switch user to root and set the resource limits for the software installation owner users. It is set for oracle user. You need to set it the same for grid user.

```
# take backup of existing file:
mv /etc/security/limits.d/oracle-rdbms-server-12cR1-preinstall.conf
/etc/security/limits.d/oracle-rdbms-server-12cR1-preinstall.conf.bak

# create the file and paste the code below in it:
vi /etc/security/limits.d/oracle-rdbms-server-12cR1-preinstall.conf
```

```
# oracle-rdbms-server-12cR1-preinstall setting for nofile soft limit is 1024
oracle soft nofile 1024
grid soft nofile 1024

# oracle-rdbms-server-12cR1-preinstall setting for nofile hard limit is 65536
oracle hard nofile 65536
grid hard nofile 65536

# oracle-rdbms-server-12cR1-preinstall setting for nproc soft limit is 16384
# refer orabug15971421 for more info.
oracle soft nproc 16384
grid soft nproc 16384

# oracle-rdbms-server-12cR1-preinstall setting for nproc hard limit is 16384
oracle hard nproc 16384
grid hard nproc 16384

# oracle-rdbms-server-12cR1-preinstall setting for stack soft limit is 10240KB
oracle soft stack 10240
grid soft stack 10240

# oracle-rdbms-server-12cR1-preinstall setting for stack hard limit is 32768KB
oracle hard stack 32768
grid hard stack 32768

# oracle-rdbms-server-11gR2-preinstall setting for memlock hard limit is maximum
of {128GB (x86_64) / 3GB (x86) or 90 % of RAM}
oracle hard memlock 134217728
grid hard memlock 134217728

# oracle-rdbms-server-11gR2-preinstall setting for memlock soft limit is maximum
of {128GB (x86_64) / 3GB (x86) or 90% of RAM}
oracle soft memlock 134217728
grid soft memlock 134217728
```

7. In srv1 and srv2, set the number of processes a user can create to 2048

```
vi /etc/security/limits.d/90-nproc.conf
```

```
*          soft    nproc     2048
```

C. Install Grid Infrastructure Software

8. In the Oracle VirtualBox window, login as `grid` to `srv1`. Open a terminal window, change the current window to the GI installation files and start the installer.

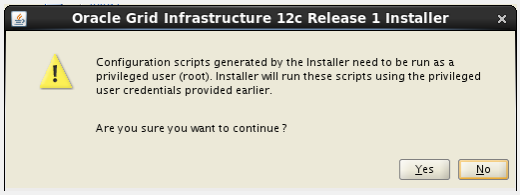
```
# the following source command is needed only if you were already logged on when
#  you edited the profile file.
source .bash_profile

cd /media/sf_staging/grid
./runInstaller
```

9. Respond to the Installer utility windows as follows:

Window	Response
Installation Option	Install and Configure Oracle Grid Infrastructure for a Cluster
Cluster Type	Configure a Standard Cluster
Installation Type	Advanced Installation
Product Language	English
Grid Plug and Play	Cluster Name: **rac** SCAN Name: **srv-scan** SCAN Port: **1521** **unmark** Configure GNS
Cluster Node Information	click on **Add** button Public Hostname: **srv2.localdomain** Virtual Hostname: **srv2-vip.localdomain** click on **OK** button click on **SSH Connectivity** button enter the **OS Password** (**oracle**) click on **Setup** button click on **Test** button **Note**: If the Setup was successful but the Test failed, you may need to restart the nodes and try again. Click on **Next** button
Network Interface Usage	eth0 : **select Public** eth1 : **select Private** eth2 : **select Do Not Use**
Storage Option	Use Standard ASM for Storage

Create ASM Disk Group	click on **Change Discovery Path** button enter Disk Discovery Path: **/dev/oracleasm/disks*** click on **OK** button Disk Group Name: **CRS** Redundancy: **External** Allocation Unit Size: **1MB** Mark **DISK1** click on **Next** button
ASM Password	select "**Use same password for these accounts**" Specify Password: **oracle** Confirm Password: **oracle**
Failure Isolation	select "Do not use Intelligent Platform Management Interface (IPMI)"
Management Options	click on **Next** button
Operating System Groups	OSASM Group **asmadmin** OSDBA for ASM Group **asmdba** OSOPER for ASM Group **blank**
Installation Location	Oracle Base /u01/app/grid Software Location /u01/app/12.1.0/grid **Note**: those values taken from the OS variables Click on **Next** button
Create Inventory	Inventory Directory /u01/app/oraInventory
Root script execution	Mark "**Automatically run configuration scripts**" Enter the root password: **111111**
Prerequisite Checks	The verification takes some time. Following warnings could be ignored: - Physical Memory - Swap Size - Device Checks for ASM - Task resolve.conf Integrity **Note**: If you receive other warnings, check their details. Resolve the issue and click on "Check Again" button. select **Ignore All** option select on **Next** button
Summary	click on **Install** button

At about %80 progress	You will receive the following message:  click on **Yes** button While the script is running, the progress bar does not pass the 84% value. Do not consider this a hanging status. It takes some time and it will eventually finish.
	In the end of the installation, you will receive the following error: "Oracle Cluster Verification Utility failed" The log file has details of the error causes. The following causes can be safely ignored: - Sufficient physical memory is not available on node ... - Sufficient swap size is not available on node ... - Group of device "/dev/oracleasm/disks/DISK1" did not match the expected group - Attempt to get udev information from node ...

10. In `srv1`, check the status of the running clusterware resources. The state of all the resources should be ONLINE.

```
crsctl status resource -t
```

11. Ensure that all the cluster services are up and running in all the cluster nodes.

```
crsctl check cluster -all
```

Note: in real life scenario, you are always advised to apply the latest patch set on the grid software home straight away after installing it. You will learn how to apply a PSU on Oracle Grid Infrastructure later in the course.

D. Mount the ASM Disk Groups

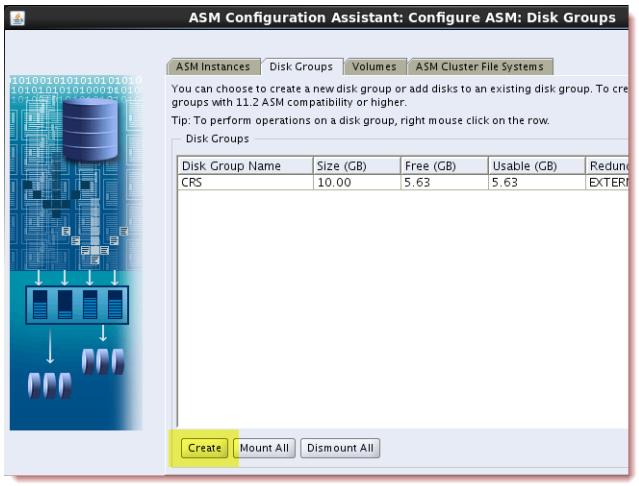
In this section of the practice, you will mount the DATA and FRA diskgroups in ASM.

12. In the Oracle VirtualBox window, make sure you are logged on as `grid` to `srv1`.

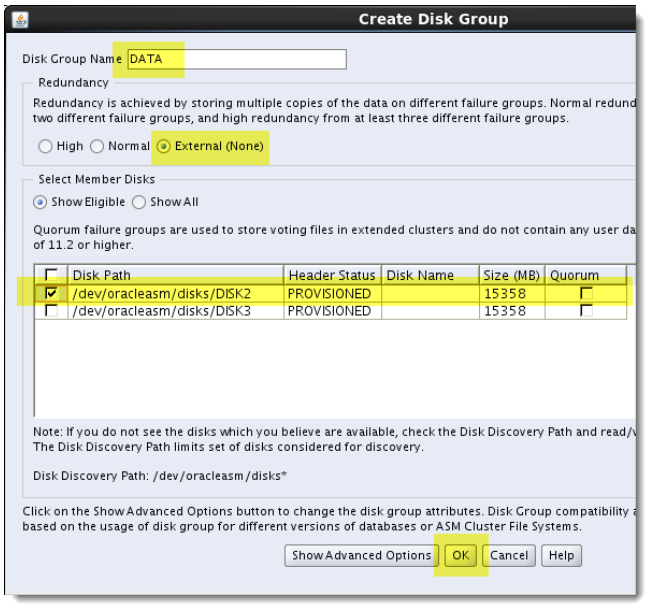
13. Open a terminal windows and start `asmca` utility.

```
asmca
```

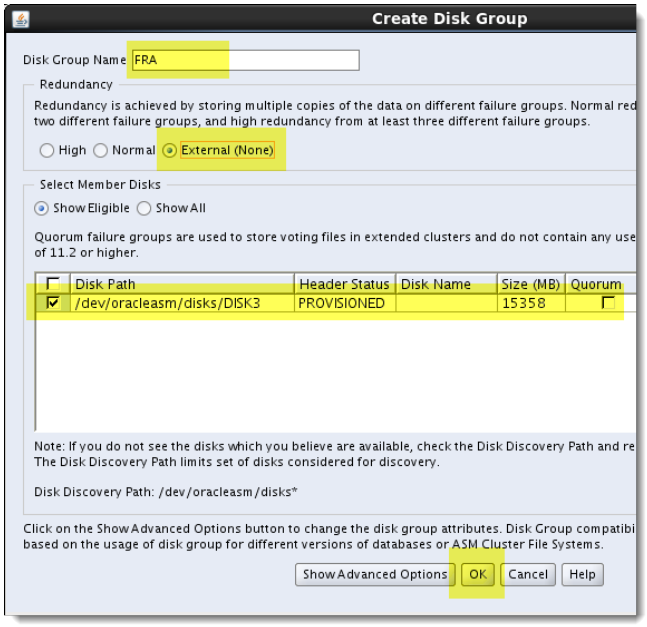
14. Click on **Create** button



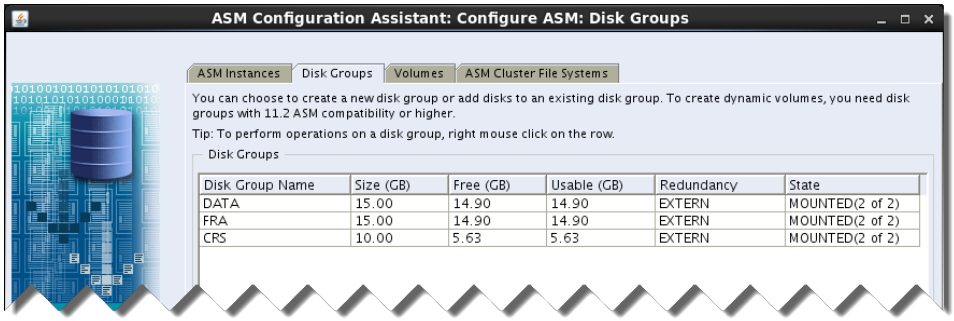
15. In the Disk Group Name field enter **DATA**, for Redundancy select "**External**", and mark **DISK2**, then click on **OK** button. You should see after a few seconds a diskgroup creation success message.



16. Similarly, create FRA diskgroup.



17. Eventually, the asmca window should look like the following screenshot. All the diskgroups must be mounted and see by the two nodes.



Click on **Exit** button.

E. Install Oracle Database Software

18. In the Oracle VirtualBox window, logout from `srv1` and login as `oracle`.

19. Create the `sqlnet.ora` file and add the following code in it.

```
mkdir -p $ORACLE_HOME/network/admin
vi $ORACLE_HOME/network/admin/sqlnet.ora
```

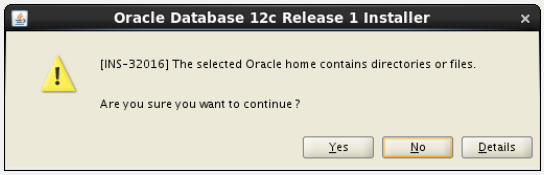
```
DIAG_ADR_ENABLED=ON
NAMES.DIRECTORY_PATH= (TNSNAMES, EZCONNECT)
```

20. Change the directory to the installation files directory and start the installer.

```
cd /media/sf_staging/database/
./runInstaller
```

21. Respond to the Installer utility windows as follows:

Window	Response
Configure Security Update	**Uncheck** the "**I wish to receive security updates...**" press **Next** button then **Yes** button
Installation Option	select "**Install database software only**" option
Grid Installation Options	select "**Oracle Real Application Clusters database installation**"
Nodes Selection	Make sure both nodes are selected. Press on **SSH Connectivity** enter **oracle** password click **Setup** button. After the SSH connectivity setup is finished, click on **Test** button to test it. click on **Next** button.
Product Language	Make sure English is selected click on **Next** button.
Database Edition	select **Enterprise Edition** option
Installation Location	Oracle Base /u01/app/oracle Software Location /u01/app/oracle/product/12.1.0/db_1 **Note**: those values taken from the OS variables Click on **Next** button

	You will receive the following message, click on **Yes** button: 
Operating System Groups	select **dba** group for all the options except OSOPER keep it blank
Prerequisite Checks	The following warnings could be ignored: - Swap Size - Task resolv.conf Integrity - Single Client Access Name (SCAN) **Note**: If you receive other warnings, check their details. Resolve the issue and click on "Check Again" button. Click on **Ignore All** option
Summary	click on **Install** button
Execute Configuration scripts	Execute the root script when prompted on both nodes. Execute the script in the second node only after it finishes execution in the first node. click on **Close** button

Note: as is the case with Oracle grid software, it is recommended to apply the latest patch sets on the Oracle software straight away after installing it. This is much faster than applying them after creating the database.

F. Create the Oracle RAC Database

22. In the Oracle VirtualBox window, make sure you are logged on as `oracle`.

23. Start the dbca utility

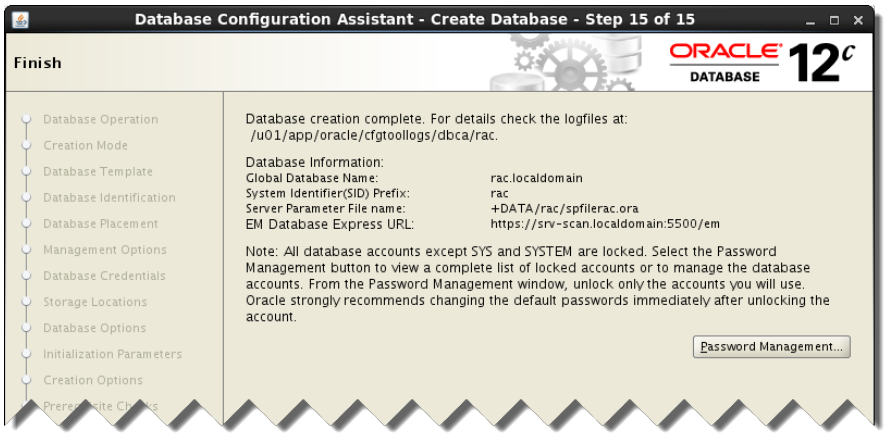
```
dbca
```

Note: observe that you do not create a listener in oracle home. The listener starts up from the grid home and controlled by the clusterware.

24. Respond to the dbca windows as follows:

Window	Response
Database Operation	select **Create Database** option
Creation Mode	select **Advanced Mode** option
Database Template	Make sure the Database Type is **Oracle Real Application Clusters (RAC) database** Change the Configuration Type to **Admin Managed** Make sure that the **General Purpose or Transaction Processing** option is selected.
Database Identification	Global Database Name: **rac.localdomain** SID Prefix: **rac** Make sure that the "Create As Container Database" checkbox is **not** marked.
Database Placement	Move the node **srv2** from the Available list to the Selected list
Management Options	Unmark the "**Run Cluster Verification Utility (CVU) Checks Periodically**" checkbox Mark the "**Configure Enterprise Manager (EM) Database Express**" checkbox
Database Credentials	set the password for the users
Storage Locations	Database files Storage Type: **ASM** Use Common Location for All Database Files: **+DATA** **Mark** the "Use Oracle-Managed Files" checkbox Recovery files Storage Type: **ASM** **Mark** the Specify Fast Recovery Area Fast Recovery Area: **+FRA** Fas Recovery Size: **12 GB** Make sure that the Enable Archiving checkbox is **Unmarked**
Database Options	**Mark** the **Sample Schemas** checkbox

Initialization Parameters	**Rise the Memory Slider to nearly 50%** then select the **Custom Settings**. The SGA size and the PGA size will automatically be filled. SGA Size: 1,500 M Bytes PGA Size: 512 M Bytes click on the **Sizing** tab Processes: **500** click on **Character Sets** tab select "**Use Unicode (AL32UTF8)**" option click on **Next** button
Creation Options	Make sure **"Create Database"** option is selected.
Prerequisite Checks	Ignore the following warnings - Single Client Access Name SCAN click on "**Ignore All**" option click on "**Next**" button
Summary	click on "**Finish**" button
Database Configuration Assistant	click on "**Close**" button



G. First examination on the Oracle RAC database

In this section of the practice, you will perform some initial checking on the create RAC database.

25. Log in as oracle to srv1 on a Putty session.

26. Make sure that the SCAN hostname replies to ping command.

```
ping -c 3 srv-scan
```

27. Issue the following commands and examine their output.

```
srvctl status database -d rac
srvctl config database -d rac
```

28. Identify the database instance names that are currently running on srv1 from the OS command shell.

```
ps -ef | grep -i pmon
```

29. Login as sysdba to the database and examine the contents of v$active_instances

```
sqlplus / as sysdba
col inst_name format a50
SELECT INST_NUMBER , INST_NAME FROM V$ACTIVE_INSTANCES;
```

30. Make sure the tnsnames.ora file has been configured for connecting to rac database. This has automatically been done by the dbca utility.

```
cat $TNS_ADMIN/tnsnames.ora
```

Note: Applications should connect to the RAC database using dynamic services. Services will be covered in a later practice.

31. In the following sub-steps, you will examine how the client sessions are distributed among the database instances. You will create multiple SQL*Plus sessions and check to which instance every session is connected to.

a. Connect to rac database as system using the password authentication.

```
sqlplus system/oracle@rac
```

b. Retrieve the instance name that the current SQL*Plus session is connected to.

```
SELECT INSTANCE_NAME FROM V$INSTANCE ;
```

c. Issue the following command in SQL*Plus. This command will open a new OS sub-shell. The SQL*Plus session is still active. When you exit from the OS sub-shell, you will get back to the SQL*Plus session.

```
!
```

d. Open another SQL*Plus session using the same credential.

```
sqlplus system/oracle@rac
```

e. Check the instance name that current SQL*Plus session is connected to.

f. Repeat the previous steps twice, and check the current instance name in each time. You will observe that the sessions are distributed in a round-robin fashion.

g. Exit from all the SQL*Plus sessions created above.

H. Shutdown the RAC database

In this section of the practice, you will learn the *clean* way of shutting down the Oracle RAC database and the Clusterware technology stack.

32. Make sure you are logged on as `oracle` to `srv1` in a Putty session then issue the following command to display help information about using `srvctl stop` command.

This is a handy way to remember the format of using the command when you forget it.

```
srvctl stop database -h
```

33. Use the `srvctl` to stop `rac` database. This command shuts down the instances in all the cluster nodes.

`-d` can be replaced with "`-database`", and "`-o`" is a shortcut to "`stop_options`"

```
srvctl stop database -d rac -o immediate
srvctl status database -d rac
```

34. Log in as `root` to `srv1` and issue the following command. This command shuts down the Clusterware technology stack.

Observe that the full path of the `crsctl` should be used. This is because that path of this utility is not included in the `PATH` variable defined for the root user. When you use the `crsctl` utility with `grid` user, you do not have to use the full utility pathname because it is included in the `PATH` value for the `grid` user.

Some clusterware commands should be executed by `root` and some of them should be run by `grid`.

```
/u01/app/12.1.0/grid/bin/crsctl stop crs
```

35. Log in as `root` to `srv2` and issue the same command as in the previous step to stop the Clusterware technology stack.

36. Shutdown all the virtual machines.

I. Making a Copy of the Virtual Machines for relocation

If you want to make a copy of the existing virtual machines to use them on another machine or move them to another disk drive, the traditional method of copying the virtual machine folders will not work. This is because the disk UID of the shared disks is registered in Oracle VirtualBox. If you just copy the disk file, Oracle VirtualBox will return an error complaining that the same disk UID is being used.

In the following steps, you will learn the steps that you should follow how to make a copy of the virtual machines.

Note: you do not have to perform this procedure. Refer to it only if you wish to relocate the system.

oifi90 If your target is to make a backup copy of the existing environment, you do not have to perform this procedure. Shutting down the machines and copying their parent folder is fair enough.

37. In the VirtualBox Manager open click on **File** menu | **Virtual Media Manager**. Then select the first shared disk used by the virtual machines (**DISK1**).

38. Click on the "**Release**" icon and then confirm in the pop-up window. Note that this disk now shows as "**Not attached**".

39. Perform the same previous two steps on the remaining two shared disks: **DISK2** and **DISK3**.

40. Select **DISK1** and then click on "**Copy**" to start the Disk Copying Wizard.

41. Accept the Virtual disk to copy and click on "**Next**".

42. Accept the VDI Virtual disk file type and click on "**Next**".

43. Select "**Fixed size**" and click on "**Next**".

44. On the next screen you can set the location and name of the new file. After that, click on "**Next**".

45. Click on "**Copy**" button to start copying the disk.

46. Perform the same steps to copy the remaining disks.

47. Close the Media Manager

48. Export `srv1` and `srv2` virtual machines: in the VirtualBox Manager select the VM, then click on **File** | **Export Appliance**.

   a. Select the virtual machines, click on **Next**
   b. Set the **location** where you want to export the appliances. Click on **Next**
   c. Accept the appliance settings, click on **Export**

49. You can now copy the exported file and the copy of the shared disks to the new location.

50. Re-attach the shared disks in `srv1`: in Oracle VirtualBox, select the virtual machine, click on **Settings**, select **Storage** option from the right pane, click on the **Sata Controller**, then click on **Add Hardisk**. Click on **Choose Existing Disk** option.

51. Perform the same pervious step on `srv2`.

52. Start `srv1` and `srv2`

J. Startup the RAC database

By default, when you boot up a cluster node, the Clusterware stack itself automatically starts up and it starts up the database service to its pervious open state. If the database was up when you shut down the node, the Clusterware starts up the database when you reboot the server. If the database was down when you shut down the node, the Clusterware will NOT start up the database when you reboot the server.

Note: You will learn the details of the auto-restart setting in the next lecture.

53. Login as grid to srv1 in a Putty session

54. Check the status of the crs resources.

```
crsctl status resource -t
```

55. Check the AUTO_START attribute value of the rac database service.

This attribute controls whether the resource should be automatically started when the machine is rebooted or not. Observe that this is different from the auto-restart mechanism in the single-instance database.

```
crsctl status res ora.rac.db -f | grep AUTO_START
```

The restore value means that the resource will be started to the same state that it was in when the server stopped. Oracle Clusterware attempts to restart the resource if the value of TARGET was ONLINE before the server stopped.

56. Make sure the autostart service is enabled (must be run as root).

```
su -
/u01/app/12.1.0/grid/bin/crsctl config has
```

57. Switch user to oracle then start up the database.

Note: You will learn the details of starting up a database in the next lecture.

```
su - oracle
srvctl start database -d rac
srvctl status database -d rac
```

K. Getting the Enterprise Manager Database Express Working in the VM

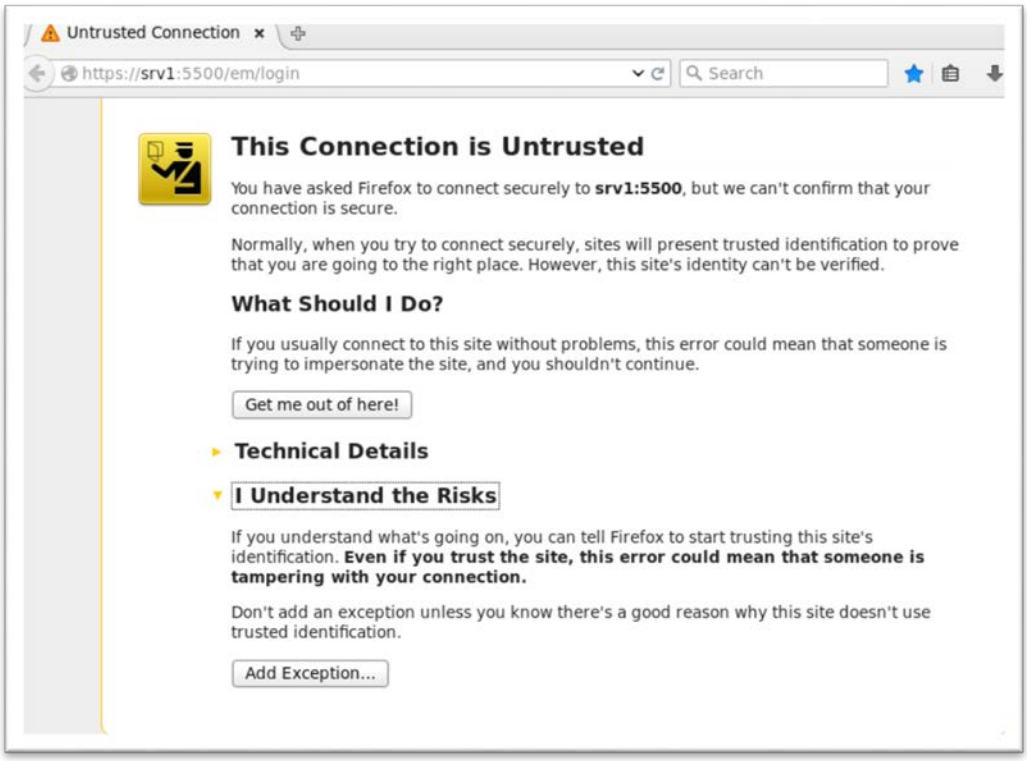
In this section of the practice, you will open the Oracle Enterprise Manager Database Express. Because the pre-installed Mozilla Firefox in the virtual appliance does not have the Adobe Flash plug-in installed in it by default, you need to install the plug-in in the browser.

58. In the VirtualBox window of `srv1`, login as `oracle` user.

59. Open the Mozilla Firefox browser and open the EM Database Express page using the following URL address:

```
https://srv-scan.localdomain:5500/em
```

60. You will receive a warning message about trusting the URL source, as follows:



61. Click on the "**Add Exception**" button. You will see the following message popping up:

62. Click on the "**Confirm Security Exception**" button.

63. You will see the following message in the browser:

64. If your VM appliance has access to the Internet, go to next step. If you VM appliance does not have a connection to the Internet, you can install the Flash plug-in manually by performing the following steps.

a. Download the file "flash_player_npapi_linux.x86_64.tar.gz" from the lecture downloadable resources.

b. Copy the file flash_player_npapi_linux.x86_64.tar.gz to the directory `/home/oracle/source`

c. Connect via Putty to the machine `srv1` as `root`

d. Extract the file

```
tar -xvzf flash_player_npapi_linux.x86_64.tar.gz
```

e. Copy the extracted so file to the plug-ins directory

```
cp /home/oracle/source/libflashplayer.so /usr/lib64/mozilla/plugins
```

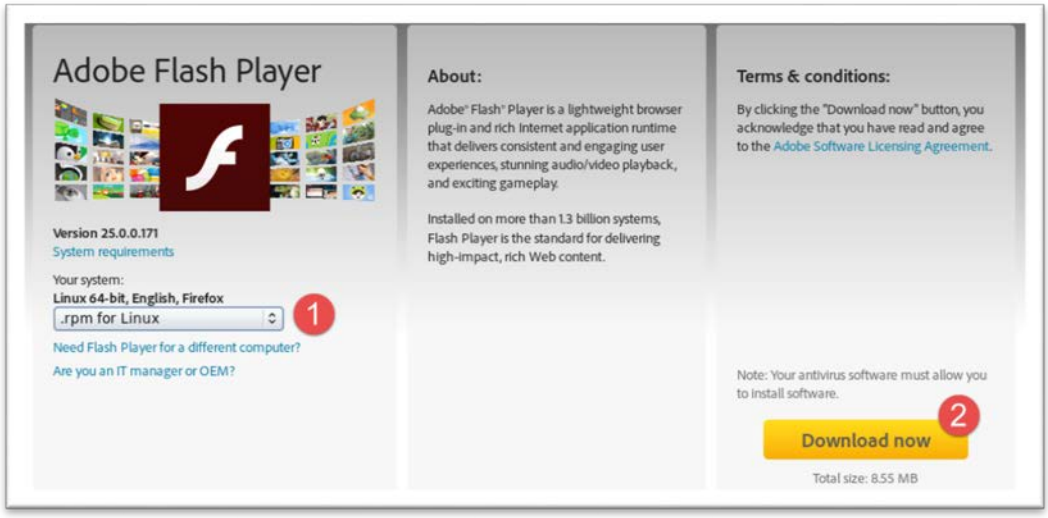
f. Change the permissions of the file as follows:

```
chmod 775 libflashplayer.so /usr/lib64/mozilla/plugins/libflashplayer.so
```

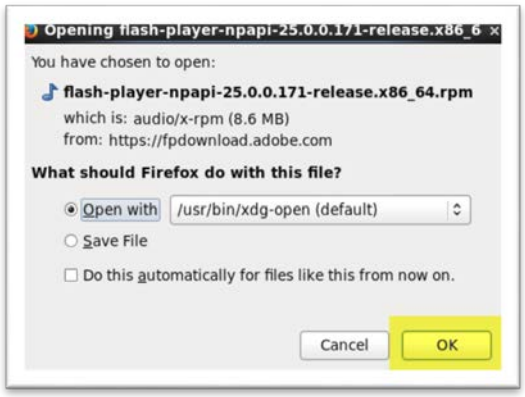
65. In the following steps you will download and install the Flash plug-in in the FireFox browser in `srv1` machine. Those steps assume that the machine has a connection to the Internet:

a. In the message that appeared to you, click on "**GetFlash**" link

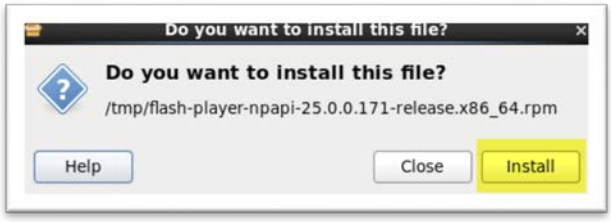
g. The page that follows appears in the browser. Select "**.rpm for Linux**" option from the drop list then click on **Download** button.



h. The following message appears to you. Click on **OK** button.



i. The following message appears to you. Click on **Install** button.

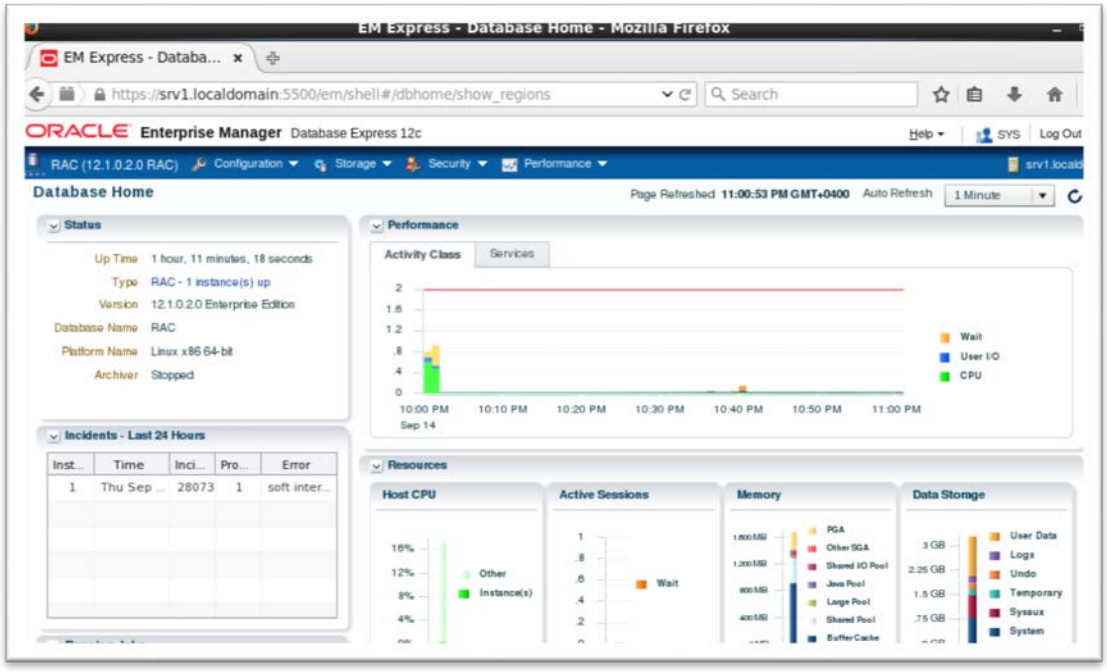


j. The following message appears to you. Enter the root **password** then click on **Authenticate** button

66. After the Flash plugin got installed, close the browser and open it again.

67. Enter the EM URL. You should be able to see the EM Database Express page as follows. Enter the sys username, its password, mark the "**as sysdba**" option then click on **Login** button.

68. You should see the EM Database Express opening and displaying a page similar to the following:



Summary

In this practice, you performed the following:

- Carry out OS preparation steps
- Install Grid Infrastructure software
- Create ASM Disk Groups
- Install Oracle Database Software
- Create the Oracle RAC database
- Learn how to make a copy of the virtual machines for relocation
- Learn how to startup and shutdown Oracle RAC database
- Get the Enterprise Manager Database Express working in the VM machine