

Practice 1

Preparing Practice Environment

Practice Overview

In this practice you will create two virtual appliances. You will then make some configuration changes on them so that you can use them in the course practices.

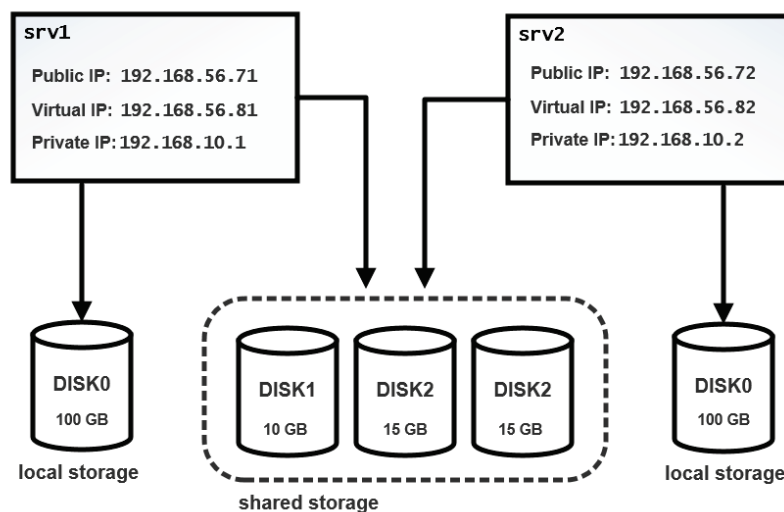
Practice Environment Requirements

To build up the course practice environment, you need a PC with the following specifications:

Item	Value
OS	Windows 7,8, or 10 64-bit
Memory	16 GB
Free HDD space	280 GB It is recommended not to use the C drive.
Connection	Connection to the Internet
Virtualization software	Oracle VirtualBox version 5

Practice Environment Architecture

The following diagram shows the architecture of the machines that you will create in this practice:



Practice Environment Preparation Procedure

A. Download Oracle Software Installation files

1. From Oracle site, download the following products:

- Oracle Database 12c Release 1 (12.1.0.2.0) for Linux x86-64.

At the time of this writing, the product can be downloaded from the following link:

<http://www.oracle.com/technetwork/database/enterprise-edition/downloads/index.html>

- Oracle Database 12c Release 1 Grid Infrastructure (12.1.0.2.0) for Linux x86-64

At the time of this writing, the product can be downloaded from the following link:

<http://www.oracle.com/technetwork/database/enterprise-edition/downloads/database12c-linux-download-2240591.html>

Why Oracle 12c R1 and not 12c R2?

You might be wondering, why we are building our database based on Oracle database release 12c R1 and not 12c R2?

The reason behind that is to give you the chance to practice the upgrade procedure on a RAC database. Later in the course, you will upgrade your Oracle RAC database from release 12c R1 to 12c R2.

Regarding the new features in 12c R2 RAC, there are actually only few of them. The fundamentals are still the same.

B. Install the required software

2. Download and install the following software products in your hosting PC:

- Oracle VirtualBox version 5 for Windows
- Putty utility

C. Create and configure an Oracle Linux 64-bit VirtualBox appliance

In the following steps, you will create the Oracle VirtualBox appliance `srv1`.

3. Create a Linux-based VirtualBox appliance with the specifications as shown in the table below. This is an Oracle VirtualBox appliance which has a fresh installation of Oracle Linux 6.7 installed on it.
 - You can download a pre-built copy of the appliance from my website at [this link](#) (3.3 GB). I implemented all the course practices from this pre-built copy. The root password is mentioned in the readme file.
 - Alternatively, follow the procedure to create it from scratch as documented [here](#), or you can watch the demo in my YouTube channel [over here](#).

Item	Value
Hostname	srv1
Memory	4 GB Note: I would recommend to make it 4.2 GB, if possible.
OS	Oracle Linux 6.7 64-bit
Storage	100 GB Note: this is a local storage. You will create the shared storage later in the practice.

Caution:

If you use the pre-built VirtualBox appliance, make sure to disable the **Linux Automatic Update** by performing the following: login as **root** -> **System** -> **Preferences** -> **Software updates**: Check for updates: **Never**, Automatically install: **Nothing**

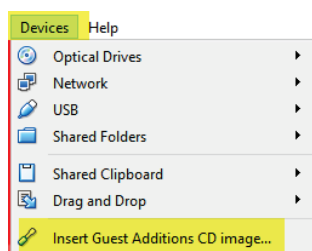
Linux Automatic Update makes the appliance so slow and may update a library that conflicts with downloaded Oracle software release.

4. If you are using a pre-built copy of the virtual machine (like the one available in my web site), make sure the Guest Additions version is upgraded to the version of the VirtualBox you are using.

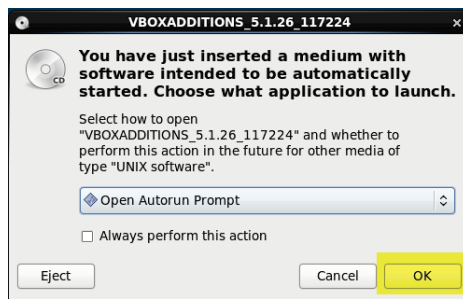
The pre-built virtual machine that is available in my site was created using version 5.1.12. If you are using a later version of Oracle VirtualBox, you should update its VirtualBox Guest Additions.

To Update the VirtualBox Guest Additions in the virtual machine, perform the following steps:

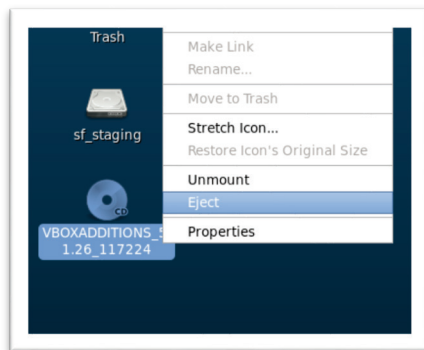
- a. In the VirtualBox window, login as root and click on **Devices** menu | **Insert Guest Additions CD image**.



- b. When the following window pops up, click on **OK** button



- c. Wait for the installation to finish.
- d. Reboot the machine and login to it as `root`.
- e. Right click on the VirtualBox Additions CD icon and select **Eject** option.

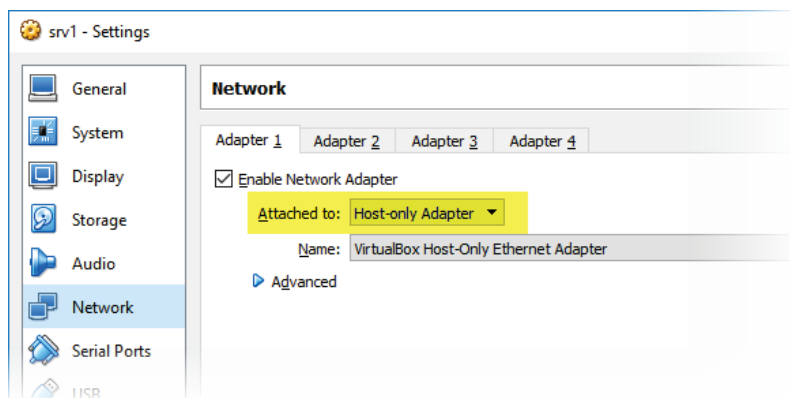


5. Shutdown `srv1` and add network adapters to it by performing the following steps:

Eventually, you will have three network adapters created in `srv1`. The first one will be used for public connection, the second one will be used for private connection, and the third one will be used for the Internet connection (it will get the Internet connection from your hosting PC).

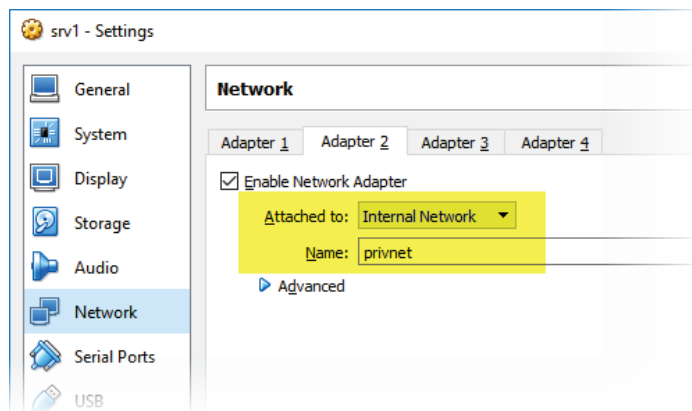
- a. In Oracle VirtualBox, go to the network settings of your virtual appliance. Change the value of the "**Attached To**" field to "**Host-only Adapter**".

"Host-only" connection in VirtualBox allows connecting the VM machine to other VM machines as well as to the hosting PC. This adapter will be used to configure the public connection in the practice RAC architecture.

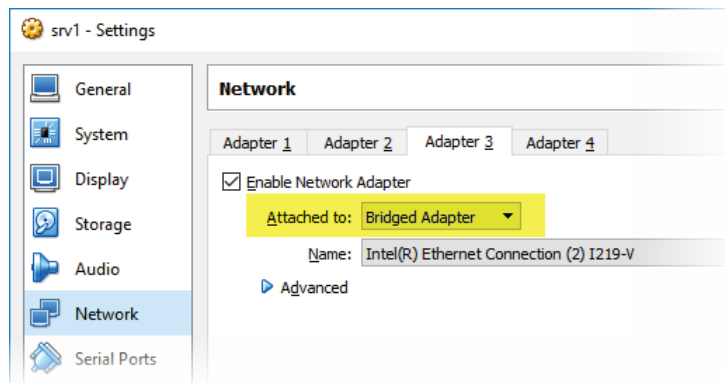


- b. Click on the "**Adapter 2**" tab and enable it and set it attached to "**Internal Network**". Name this network "**privnet**".

In VirtualBox, the "Internal Network" configuration allows the VM machine to connect only to other VM machines. This adapter will be used for private connection in the RAC architecture.

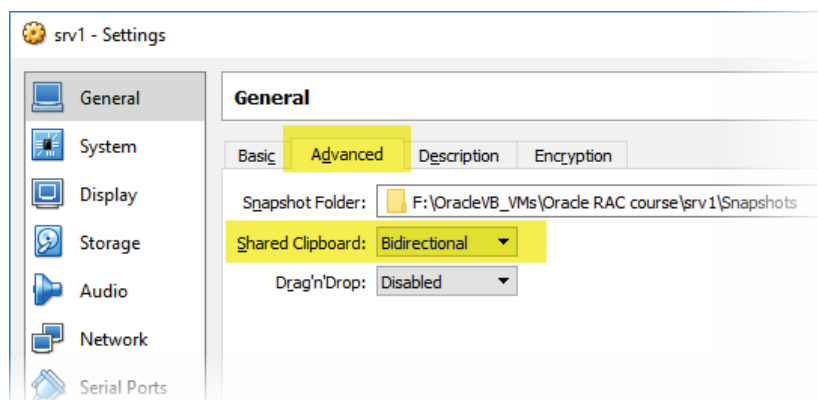


- c. Click on the "**Adapter 3**", enable it, and attach to "**Bridged Adapter**". This adapter will be used for connecting to the internet.

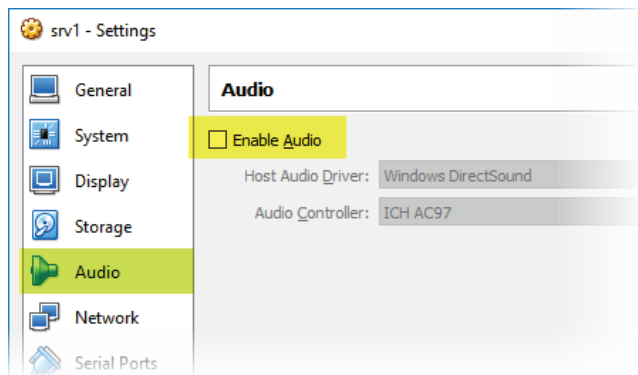


6. Proceed with making more modifications on the settings of `srv1` as follows:

- a. Click on "**General**", "**Advanced**" tab, and set the "**Shared Clipboard**" to "**Bidirectional**".



- b. Disable the audio card using **"Audio"** link (optional). Then press **"OK"** button.



7. If you have a firewall software installed into your hosting PC, configure it to allow the traffic to go to and come from Oracle VirtualBox application.

8. Start `srv1`, login to it as `root` and perform the following steps to set the network adapter IP addresses:

- a. In the VirtualBox appliance window, open the Network Connections window

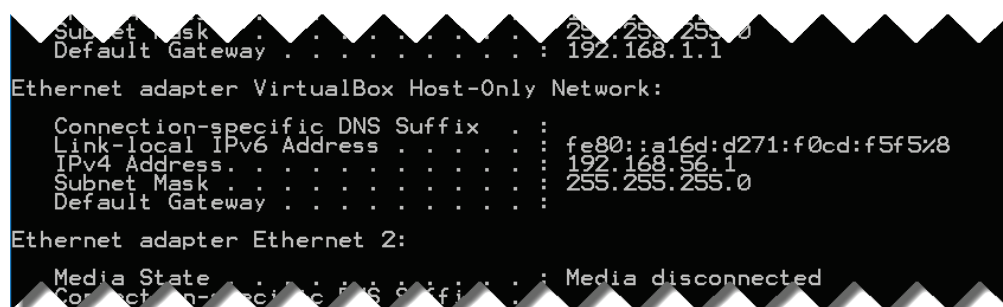
System | Preferences | Network Connections

- b. Rename the Network Adapters to **eth0**, **eth1**, and **eth2**. To rename an adapter, select it, click on **Edit** button, and enter its name in the **Connection Name** field. Then click on **Apply** button.
- c. Click on **eth0**, **Edit** button, **IPv4 Settings** tab, change Method to **"Manual"**
- d. Click **Add** and set the adapter IP address as follows then click on **Apply** button:

IP Address: 192.168.56.71 (it should always be less than 100)
 Netmask: 255.255.255.0
 Gateway: 0.0.0.0

Note: You use the 192.168.56.* subnet because this adapter is a "Host-only" adapter. For an adapter of this type to work, it should take the same subnet as the subnet of **"Ethernet adapter VirtualBox Host-Only Network"** in your hosting PC.

To display the IP address assigned to this adapter, in the command prompt of the hosting PC, issue the `ipconfig` command. Following is a screenshot of this command output in my PC:



- e. Click on **eth1**, **Edit** button, make sure the **Connect automatically** check box is marked, click on **IPv4 Settings** tab, change Method to "**Manual**"
- f. Click **Add** and set the adapter IP address as follows then click on **Apply** button. This adapter will be used for the private connection.

IP Address: 192.168.10.1

Netmask: 255.255.255.0

Gateway: 0.0.0.0

- g. Click on **eth2**, **Edit** button, make sure the **Connect automatically** check box is marked, click on **IPv4 Settings** tab, make sure the method is set to "**Automatic (DHCP)**". This adapter will take its IP address from your network and it should get the connection to the Internet through this connection.
- h. Close **Network Connections** window.
- i. reboot the virtual machine.
- j. Login to `srv1` as `root`, open a terminal window and, and to make sure that the VM machine is connected to the Internet, ping google.com

```
ping -c 3 google.com
```

9. Make sure the firewall is disabled: Linux Main menu | **System** | **Administration** | **Firewall**. Click on **Disable** icon, then on **Apply** button.

10. Modify the `hosts` file as follow:

In real life scenario, the SCAN addresses should not be defined in the `hosts` file. They should be defined on the DNS server to round-robin 3 addresses of the same subnet as the subnet of your public network. The same condition applies for the public IP address, hostname, and the VIP addresses. In the course practices, the `hosts` file is used as a replacement to the DNS server.

```
vi /etc/hosts

127.0.0.1    localhost.localdomain localhost
# Public
192.168.56.71    srv1.localdomain      srv1
192.168.56.72    srv2.localdomain      srv2

# Private
192.168.10.1     srv1-priv.localdomain  srv1-priv
192.168.10.2     srv2-priv.localdomain  srv2-priv

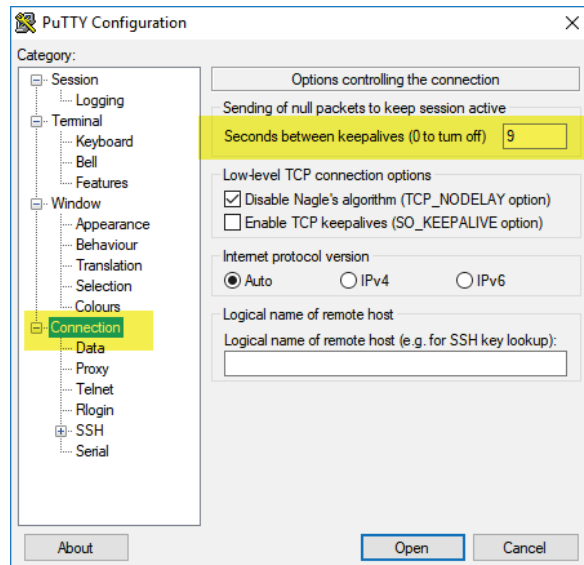
# Virtual
192.168.56.81    srv1-vip.localdomain   srv1-vip
192.168.56.82    srv2-vip.localdomain   srv2-vip

# SCAN (in production this should be configured in DNS)
192.168.56.91    srv-scan.localdomain   srv-scan
192.168.56.92    srv-scan.localdomain   srv-scan
192.168.56.93    srv-scan.localdomain   srv-scan
```

11. In the hosting PC, open a command prompt window and ping the `srv1` public IP address.

```
ping 192.168.56.71
```

12. Configure `srv1` in PuTTY. I recommend setting the “keepalives” option to 9 seconds, as shown in the following screenshot:



13. Open a Putty session to `srv1` and login as `root` user.

14. In the following steps, you will create Oracle software owner users and groups.

- a. Create the Oracle Grid Infrastructure home owner user (`grid`). Oracle database owner is already there (`oracle`).

```
groupadd asmadmin
groupadd asmdba
useradd -u 54323 -g oinstall -G asmadmin,asmdba grid
```

- b. Reset the `oracle` and `grid` user passwords. The practice documents assume that the passwords are set to "oracle".

```
passwd oracle
passwd grid
```

- c. Add `oracle` user to the `asmdba` group

```
usermod -a -G asmdba oracle
```

- d. Add `oracle` and `grid` accounts to `vboxsf` group.

The `vboxsf` group was created by VirtualBox Guest Additions and it allows its members to access the folders in the hosting machine.

```
usermod -a -G vboxsf oracle
usermod -a -G vboxsf grid
```


- 15.** Make sure that all the required libraries are installed.

```
/usr/bin/oracle-rdbms-server-12cR1-preinstall-verify

# if the command above reported any missing library, issue the following command:
yum install oracle-rdbms-server-12cR1-preinstall
```

- 16.** Install and configure the ASM required packages by performing the following steps as `root`:

- a. Install Oracle ASMLib package

```
yum install oracleasm-support

# the following command will take a few minutes to finish:
yum install kmod-oracleasm
```

- b. Configure and load the ASM kernel module

```
oracleasm configure -i

Configuring the Oracle ASM library driver.
This will configure the on-boot properties of the Oracle ASM library
driver. The following questions will determine whether the driver is
loaded on boot and what permissions it will have. The current values
will be shown in brackets ('[]'). Hitting <ENTER> without typing an
answer will keep that current value. Ctrl-C will abort.
Default user to own the driver interface []: grid
Default group to own the driver interface []: oinstall
Start Oracle ASM library driver on boot (y/n) [n]: y
Scan for Oracle ASM disks on boot (y/n) [y]: y
Writing Oracle ASM library driver configuration: done
```

- c. Load the `oracleasm` kernel module:

```
/usr/sbin/oracleasm init

Creating /dev/oracleasm mount point: /dev/oracleasm
Loading module "oracleasm": oracleasm
Configuring "oracleasm" to use device physical block size
Mounting ASMLib driver filesystem: /dev/oracleasm
```

- 17.** Create the directory in which the Oracle software will be installed.

```
mkdir -p /u01/app/oracle/product
chown -R oracle:oinstall /u01
chmod -R 775 /u01

mkdir -p /u01/app/grid
mkdir -p /u01/app/12.1.0/grid
chown -R grid:oinstall /u01/app/grid
chown -R grid:oinstall /u01/app/12.1.0/grid
chmod -R 775 /u01
```

18. Disable the NTP service.

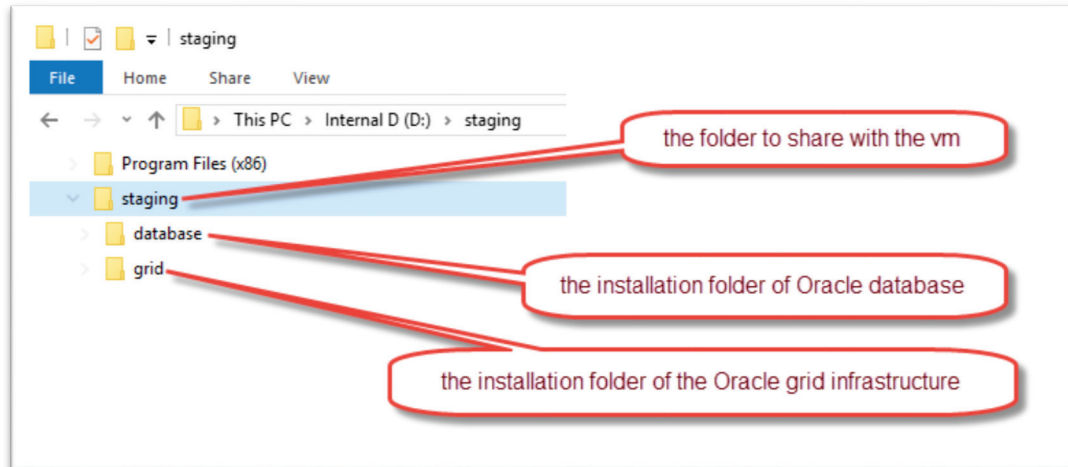
You either configure the NTP or you use the Oracle Cluster Time Synchronization Service (`ctssd`) which can synchronize the times among the RAC nodes. In our case we disable the NTP.

```
service ntpd status
chkconfig ntpd off
mv /etc/ntp.conf /etc/ntp.conf.orig
rm /var/run/ntpd.pid
```

D. Make the Oracle software installation files available to srv1

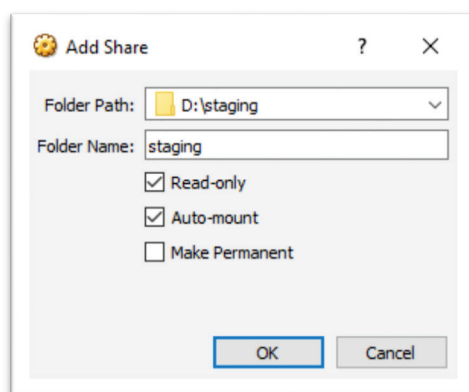
In the following steps, you will make the Oracle software installation files available to `srv1`. Instead of copying the installation files to the virtual machine, you will decompress the installation files in the hosting OS, then make the installation folders accessible to `srv1` filesystem. This method saves used disk space in `srv1`.

19. Decompress the Oracle installation files locally in the hosting PC. The code in this document assumes that they have been decompressed in the folder `D:\staging`. The directory structure in the testing environment looks like the following:



20. Shutdown `srv1`

21. In VirtualBox Manager, open the "**Settings**" of `srv1`, click on "**Shared Folders**" link in the right-hand pane. Add shared folder by pressing "**plus**" icon. Then select path to the location of the oracle software installation folder, and mark both boxes "**Read-only**" and "**Auto-mount**". You can change the "**Folder Name**", if you want to.



22. Start `srv1`

- 23.** Login in Putty to `srv1` as `root` and verify that the shared folder is accessible. The shared folder can be accessed in `srv1` in the directory `"/media/sf_<folder name>"`

```
[root@srv1 ~]# cd /media
[root@srv1 media]# ls
sf_staging
[root@srv1 media]# cd sf_staging
[root@srv1 sf_staging]# ls
database grid
```

E. Installing the `cvuqdisk` package for Linux

You need to install the operating system package `cvuqdisk`. A copy of this package is located in the `<Grid Installation Directory>/rpm`. Without this package, Cluster Verification Utility cannot discover shared disks.

- 24.** Set the environment variable `CVUQDISK_GRP` to point to the group that will own `cvuqdisk`, typically `oinstall`, then install the rpm.

If the rpm is already installed, a descriptive message will return to you.

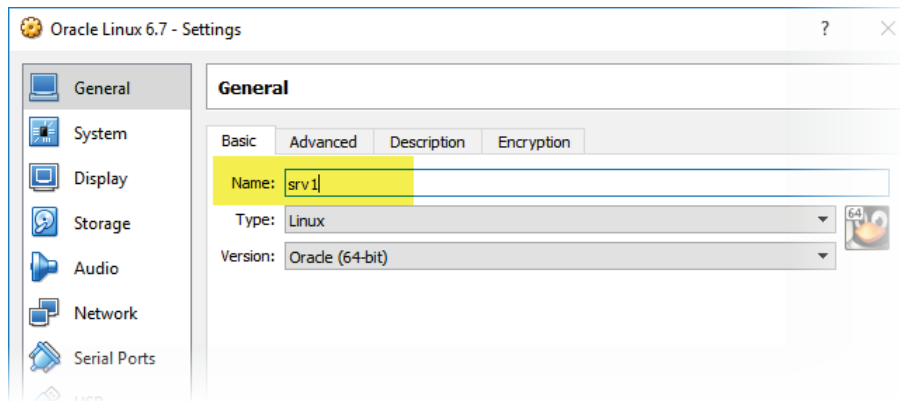
```
cd /media/sf_staging/grid/rpm
CVUQDISK_GRP=oinstall; export CVUQDISK_GRP
rpm -iv cvuqdisk-1.0.9-1.rpm
```

F. Build up and configure `srv2` by cloning `srv1`

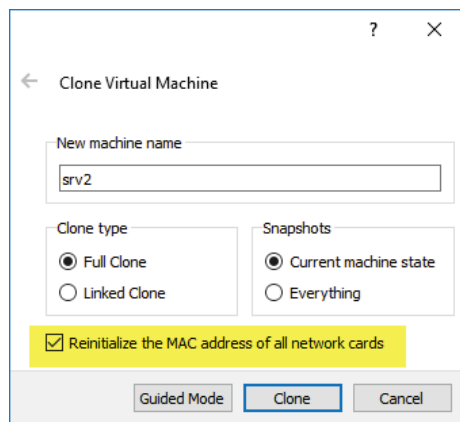
Instead of creating the second machine (`srv2`) from scratch, it is easier to build it up by cloning `srv1`. In the following steps, you will clone `srv1` and make changes on the cloned machine to convert it to `srv2`.

25. Shutdown `srv1`

26. In Oracle VirtualBox, change its name to `srv1`.



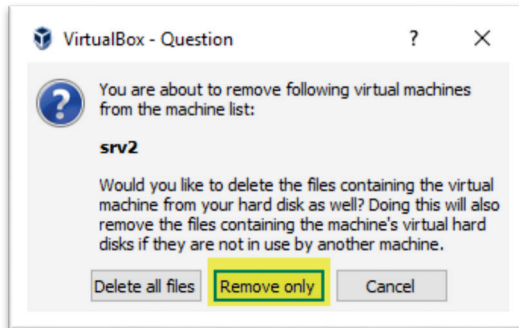
27. Make a clone of the virtual machine `srv1`. Give the new machine the name `srv2`. When you clone the machine, make sure to **initialize the network cards**.



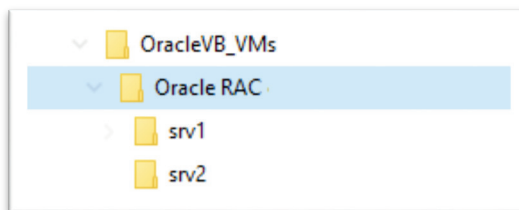
28. Move `srv2` folder to the parent folder of `srv1`.

The cloned machine will be created in the folder defined in **File** menu | **Preferences** | **Default Machine Folder**. Move the created virtual machine to the parent folder of `srv1`. To achieve this task, perform the following steps:

- a. Remove `srv2` from VirtualBox. When you remove it, select "**Remove only**" option.



- b. Move the folder containing `srv2` files to the parent folder of `srv1`. In my case, the structure looks like the following after moving the files:



- c. Add `srv2` back to the VirtualBox: **Machine** menu | **Add** | select the `vbox` file of `srv2`.

29. Fix the mac address issue in `srv2`.

When you re-initialize a network card in Oracle VirtualBox, it assigns a new mac address to the network card. This makes the network card not operational in the appliance.

To fix this issue, perform the following steps (make sure `srv1` is off):

- a. Take note of the new MAC addresses assigned to the network cards. You can obtain them from the **Settings** | **Network** link of `srv2`.
- b. Startup `srv2` and login as `root` in the VirtualBox window.
- c. Open a terminal window and edit the udev rule for network devices in the file **/etc/udev/rules.d/70-persistent-net.rules**

- d. Delete the new rules for eth3-5 added in the bottom of the file and fix the mac address in the line of your eth0-2 rules. Make sure you are fixing the mac address of the right adapter. The network cards eth0 to eth2 in the file are not necessarily ordered by their names.

The following is a screenshot of how the file looked like in my case.



- e. Edit the file `/etc/sysconfig/network-scripts/ifcfg-eth*` for the network cards eth0 to eth2 and fix the mac address in each.

The following is how the file looks like in my machine for the network card eth0. The bold text is the text to fix.

```
[root@srv2 ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth0

TYPE=Ethernet
NAME=eth0
BOOTPROTO=none
IPADDR=192.168.56.72
PREFIX=24
DEFROUTE=yes
IPV4_FAILURE_FATAL=yes
IPV6INIT=no
UUID=565ee263-0ba8-4f29-a2b3-c5c2f17b545d
ONBOOT=yes
HWADDR=08:00:27:75:34:38
GATEWAY=192.168.56.1
LAST_CONNECT=1504849110
```

- f. Reboot `srv2`.

30. Change the hostname and the IP Addresses of **eth0** and **eth1** in `srv2`.

To do it, perform the following:

- a. Login as root to the appliance VirtualBox window.
- b. Click on **System | Preferences | Network Connections**
- c. Fix the IP addresses of **eth0** and **eth1** as follows:

```
eth0:
192.168.56.72

eth1:
192.168.10.2
```

- d. Change the hostname to `srv2`

```
vi /etc/sysconfig/network
```

- e. Reboot `srv2`
- f. Start `srv1`
- g. Login to every machine as `root` and make sure that they can ping each other.

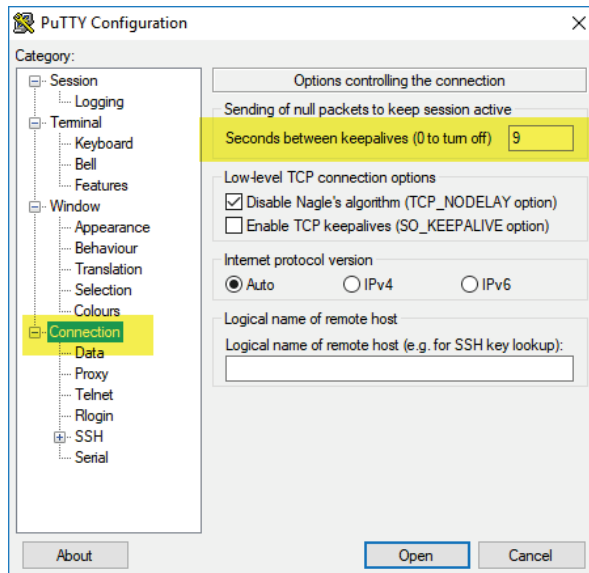
The ping command in Linux by default keeps displaying its reply output. To stop it, you can press the **[Ctl]+[c]** key combination. If you are using the command in a terminal window in a VirtualBox window, the **right [Ctl]+[c]** shortcut will be recognized by Oracle VirtualBox as a shortcut to switch the Scale mode. If you want to stop the output of the ping command, use the **Left [Ctl]+[c]** shortcut instead.

```
ping srv1
ping srv1.localdomain
ping srv1-priv
ping srv1-priv.localdomain

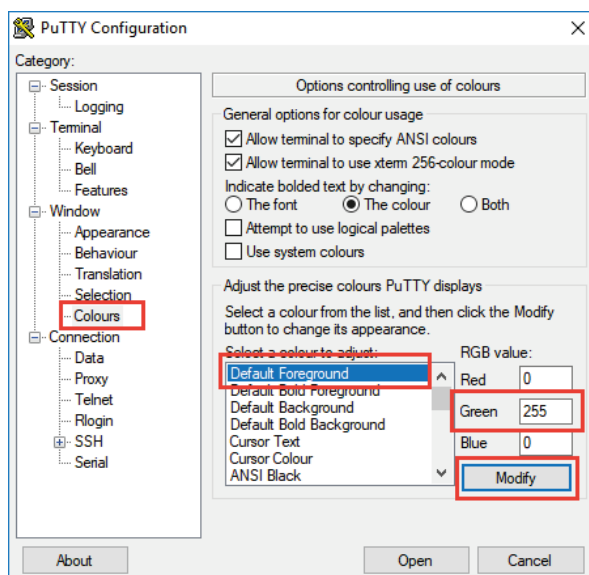
ping srv2
ping srv2.localdomain
ping srv2-priv
ping srv2-priv.localdomain
```


31. Open Putty and save a connection configuration of `srv2` in it as follows:

- Save the configuration of `srv2` in Putty. You can use the `srv2` public IP address to save its connection configuration in Putty.
- Set the **"Keepalives"** value to 9 seconds.



- Change the font text color of `srv2` connection to the light green. This is to make it easy for you to distinguish between windows connected to `srv1` and `srv2`.



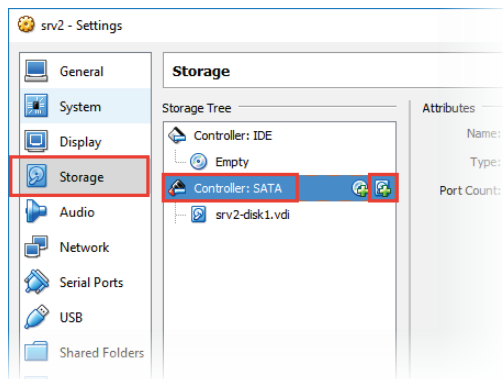
- Save the configuration.

G. Create and configure the Shared Disks

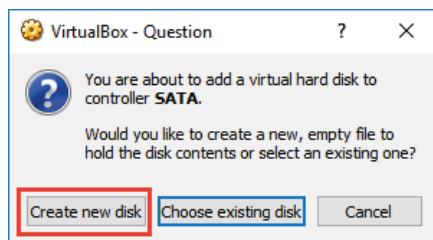
In this section of the practice, you will create three disks which will be shared by `srv1` and `srv2`. Those disks will later be configured to be used by the ASM.

32. Shut down both virtual machines `srv1` and `srv2`.

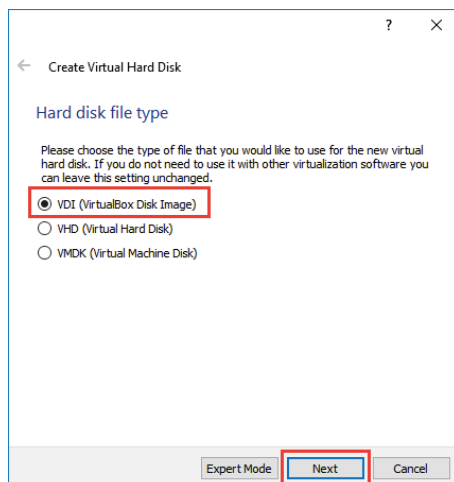
33. In Oracle VirtualBox, select `srv1` VM, then click on **"Settings"** | **"Storage"** link | **"SATA Controller"** icon | **"Add Hard Disk"** button.



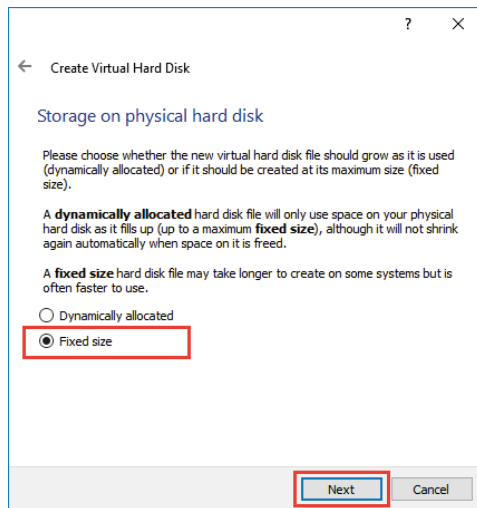
34. In the pop-up window, click on **"Create new disk"** button:



35. In the "Hard disk file type" window, select **"VDI (VirtualBox Disk Image)"** then click on **Next**:

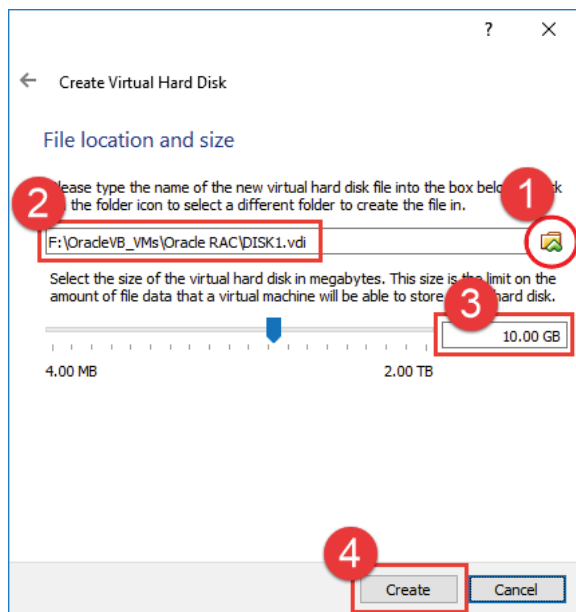


36. In the "**Storage on physical hard disk**" window, select "**Fixed size**" then click on **Next**:



37. In the "**File location and size**" window, click on the "**select folder**" icon (marked with step number 1 on the screenshot below), select the **parent folder** of the current virtual machine. Change the **disk name** to **DISK1.vdi**, set its size to **10 GB**, then click on "**Create**" button.

In the screenshot example below, instead of saving the disk in "F:\OracleVB_VMs\Oracle RAC\srv1", it is saved in the folder "F:\OracleVB_VMs\Oracle RAC".

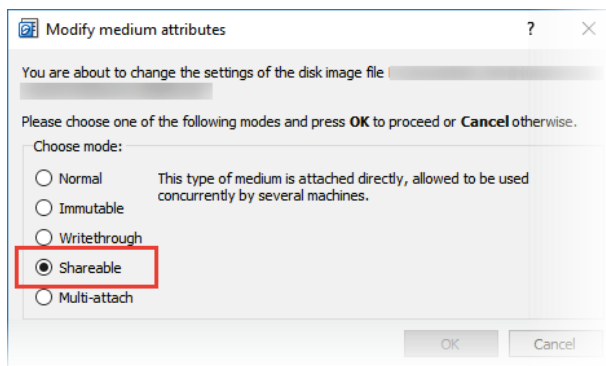


38. Repeat the steps above to create an additional two disks named "**DISK2**" and "**DISK3**", set the size of each to **15 GB**, and save them in the same parent folder where you created DISK1.
39. Click on **OK** button and close the storage settings.

40. You should end up with three shared disks, as follows:

Disk	Size	Used for which ASM Disk Group?
DISK1	10 GB	OCR
DISK2	15 GB	DATA
DISK3	15 GB	FRA

41. Change the type of the shared disks to "Shareable". Click on **File** menu | **Virtual Media Manager** (Ctrl+D) | select **DISK1** | click on **Modify** button | select **Shareable** option | click on **OK** button:



42. Change the type of the other two disks (**DISK2** and **DISK3**) to "Shareable".
43. Close the Virtual Media Manager window.
44. Attach the shared disks to the other VM using (`srv2`). In Oracle VirtualBox, select `srv2` machine, click on "**Storage**" page | click on the **SATA controller** | click on "**Add hardisk**" icon | click on "**Choose existing disk**" button | select the shared disk file
45. Start `srv1`
46. In a Putty command prompt, login as `root` to `srv1`.
47. List the disks as seen by `srv1`. You should see the shareable disks that have been added to the machine (`sdb`, `sdc`, and `sdd`).

```
ls /dev/sd*
```

- 48.** Use the `fdisk` utility to create partitions in the new disks `/dev/sdb`, `/dev/sdc` and `/dev/sdd`

The sequence of your answers should be "**n**", "**p**", "**1**", "**Return**", "**Return**" and "**w**".

Following is an example:

```
[root@srv1 ~]# fdisk /dev/sdb
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF
disklabel
Building a new DOS disklabel with disk identifier 0xe3033fca.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.

Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
        switch off the mode (command 'c') and change display units to
        sectors (command 'u').

Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-1305, default 1): [ENTER] pressed
Using default value 1
Last cylinder, +cylinders or +size{K,M,G} (1-1305, default 1305): [ENTER] pressed
Using default value 1305

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

- 49.** List the partitions that have been created.

```
ls /dev/sd*
```

- 50.** Create the ASM disks

```
oracleasm createdisk DISK1 /dev/sdb1
oracleasm createdisk DISK2 /dev/sdc1
oracleasm createdisk DISK3 /dev/sdd1
```

- 51.** Run the `oracleasm` command `scandisks` to refresh the ASMLib disk configuration.

```
oracleasm scandisks
```

- 52.** Verify that the disks are visible to ASM

```
oracleasm listdisks
```

- 53.** Start `srv2` and verify that the same disks are visible to ASM.

```
oracleasm listdisks
```

Summary

In this practice you have created two virtual machines and configured three shared storage disks connected to each of them.

You now have an environment ready to install Oracle Grid Infrastructure software, Oracle Database software, and create an Oracle RAC database.