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VM

Build a Complete Highly-Available Oracle VM Architecture from Server to App

Oracle VM, Oracle Linux, KSplice, Oracle Clusterware and MySQL

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Lab Objective & Introduction

"In this lab, you will learn from our field experts on best practices of implementing and using a complete Oracle VM high-available solution. This lab helps to demonstrate how Oracle products such as Oracle VM, Oracle Linux, KSplice and Oracle Clusterware (all products included with Oracle Linux and Oracle VM Support) allows to create a solution that is able to cover all the high-availability requirements. This lab also walks you through the managing, by Oracle Clusterware, of a custom web-application. The implementation of this lab helps to deploy an enterprise-proven high-available infrastructure software layer at zero license cost to your virtualization or Linux environment."

This hands-on lab takes you through the best practices on how to exploit all products mentioned above to build up a clustered solution without license costs.

Oracle VM is a free license product and it's the only virtualization x86 software solution certified for all Oracle products; Oracle server virtualization is designed to enable rapid enterprise application deployment and simplify lifecycle management.

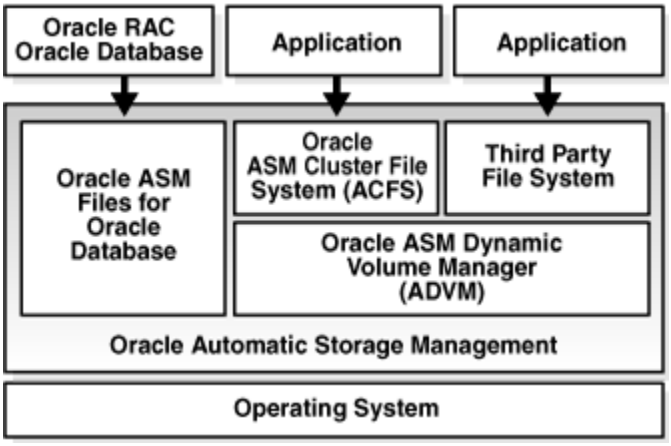
Oracle Linux, a Linux free provides the latest innovations, tools, and features that enable you to innovate, collaborate, and create solutions across traditional, cloud-based, and virtual environments.
Oracle Linux is easy to download, free to use, free to distribute, and free to update.
Oracle Linux offers zero-downtime kernel updates with **Ksplice**.
Linux management and high availability (by **Oracle Clusterware**) are provided to Oracle Linux support customers at no additional charge.

Ksplice is available for Oracle Linux, free of charge, for Oracle Linux customers with a Premier support subscription.
Ksplice lets you apply 100% of the important kernel security updates without rebooting. You don't need to stop any running applications and you don't need to reboot to install.

Oracle Clusterware 12c Release 1 is the integrated foundation for Oracle Real Application Clusters (RAC) and the High Availability (HA) and resource management framework for all applications on any major platform.

Oracle Grid Infrastructure Agents (XAG) is the framework that provides a complete, ready to use application HA solution that contains pre-defined Oracle Grid Infrastructure resource configurations and agents to integrate applications for complete application HA.

Oracle Automatic Storage Management Cluster File System (Oracle ACFS) is a multi-platform, scalable file system, and storage management technology that extends Oracle Automatic Storage Management (Oracle ASM) functionality to support customer files maintained outside of Oracle Database. Oracle ACFS supports many database and application files, including executables, database trace files, database alert logs, application reports, BFILEs, and configuration files:



MySQL is the world's most popular open source database, enabling the cost-effective delivery of reliable, high-performance and scalable Web-based and embedded database applications.

Preparation (Must be done before lab)

In order to exercise this lab in the one hour time slot, there are pre-lab set up steps that must be performed. There are 2 options to perform the pre-lab set up.

Option 1: Download the pre-configured *.OVA files for the lab. The *.OVA files are VMs that have been pre-configured and pre-installed with Oracle VM Server, Oracle VM Manager and guest operating system Oracle Linux. There are 3 OVA files for this lab. They can be downloaded from here:
http://www.oracle.com/technetwork/server-storage/vm/downloads/index.html

OVA1: ovmm.oow.local.ova 24GB

OVA2: ovs01.oow.local.ova 540MB

OVA3: ovs02.oow.local.ova 483 MB

Option 2: Download the software components and follow the Pre-lab set up steps below:

Pre-lab set up:

- Install Oracle Linux 6.5 (64 bits) on the laptop.
- Install Oracle VM VirtualBox 4.2.x + extensions on the laptop.
- Add host-only Networks vboxnet0 and vboxnet1 on VirtualBox configuration.
- Install and configure an Oracle VM Manager 3.3.1 server in a VirtualBox virtual machine.
- Install and configure two Oracle VM Server 3.3.1 servers in two VirtualBox virtual machines.
- Create a clustered Oracle VM server pool.
- Configure networks dedicated for each role.
- Create an Oracle VM repository that will guest virtual machines (60gb in our example).
- Create two Oracle Linux 6.5 virtual-machines starting from Oracle VM Templates.
- Configure Oracle Linux 6.5 virtual machines.
- Configure the storage (virtual-disks) on Oracle VM virtual machines.
- Install and configure Oracle Clusterware 12c.
- Install and configure Oracle Clusterware 12c agents to manage MySQL database.
- Install and configure Oracle KSplice.
- Install and configure Oracle MySQL Enterprise 5.6.
- Configure Oracle ACFS Cluster filesystem.
- Install Mediawiki demo application.
- Proceed with clustering all applications such as VIP, MySQL database and custom web-app (mediawiki)

Note: to run this lab at home of office

- Requirements:
  - Have an X86 machine with at least 16GB of RAM and 4 cores CPU.
  - Any X86 Operating System supported by Oracle VM VirtualBox is OK (Microsoft Windows, Most linux distributions, Oracle Solaris X86, Apple Mac OSX, …)
- Read appendix A

Summary of steps

In this lab, we will execute the following steps:

1) Connect to Oracle VM Manager and become familiar with the product.
2) Connect to Oracle VM Servers and verify that everything is ready to accommodate the lab.
3) Connect to Oracle VM guests and become familiar with Oracle Linux and Oracle Clusterware.
4) High availability general concepts: understand what we are going to demonstrate.
5) Demonstrate high-availability features covered by Oracle KSplice
6) Use Ksplice to update UEK, rollback and re-update while verifying Kernel release online.
7) Demonstrate high-availability features covered by Oracle Clusterware.
8) Use Oracle Clusterware to execute a managed service switchover (MySQL and WebApps).
9) Simulate a process failure within the guest (managed by Oracle Clusterware)
10) Simulate a virtual-guest fault (managed by Oracle Clusterware)
11) Understand which high-availability features are covered by Oracle VM.
12) Use Oracle VM to execute a guest live-migration.
13) Simulate a physical server fault (managed by Oracle VM and Oracle Clusterware)

Start the servers (VirtualBox VMs)

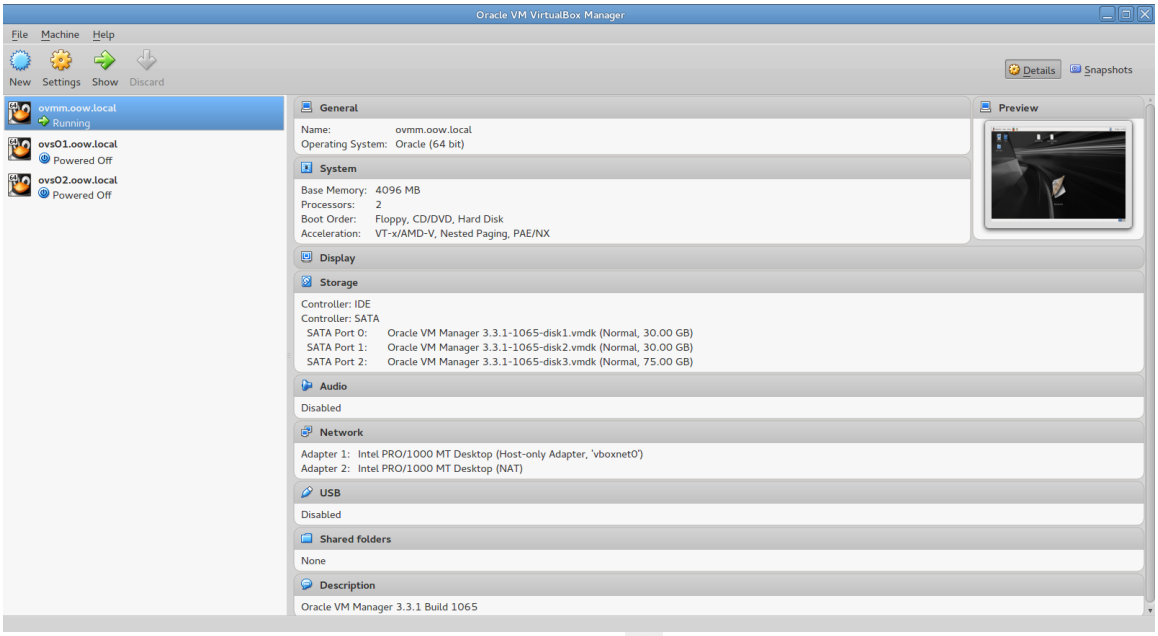
As previously explained, we will use Oracle VM VirtualBox to host the 3 servers (Oracle VM Manager and two Oracle VM Servers) on a single laptop.

Those 3 servers were pre-installed and preconfigured before this lab to same time. Thus, you just have to start them here.

IMPORTANT: Since the VMs startup can take time, we advise you to do this as soon as possible following the steps below and then take time to read this documentation.

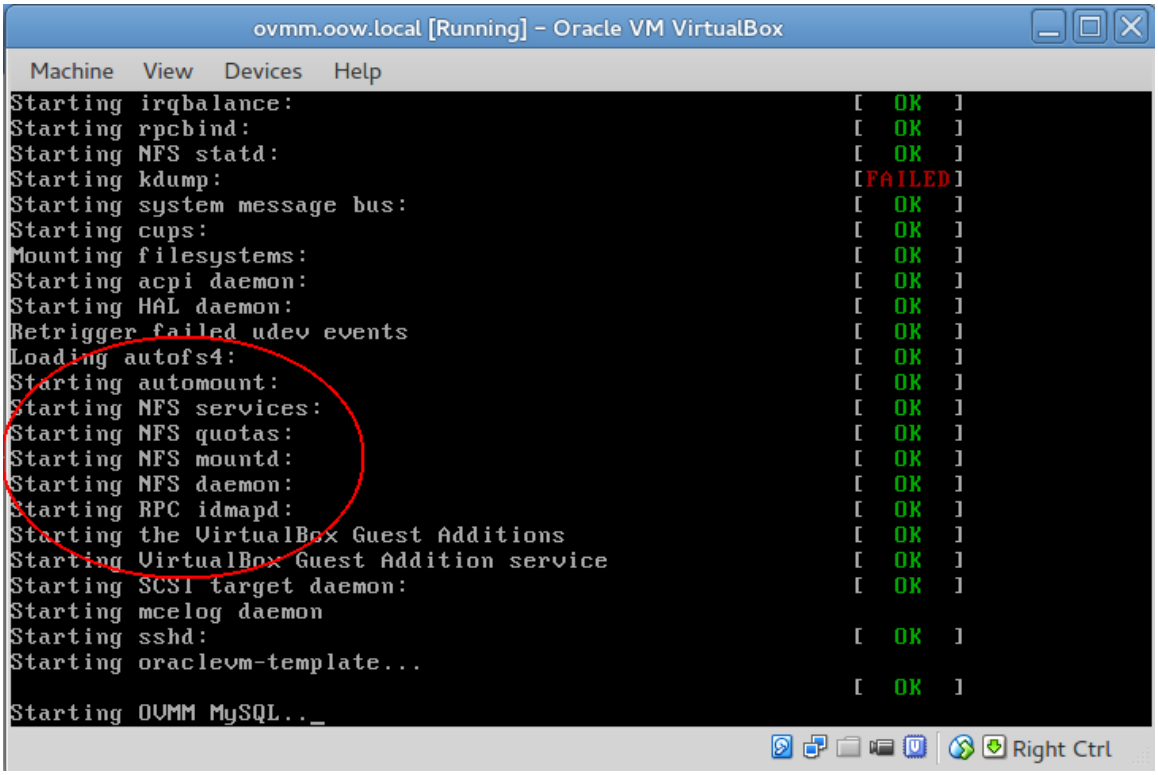
a) Start the Oracle VM VirtualBox console if not yet started by clicking on icon 

b) In this console, you should see the 3 VMs we will use in this lab.



c) Select the VM called "**ovmm.oow.local**" and click on the icon to start it

d) Verify its console and wait that the network and nfs-services are started as show in the figure below (press ESC to obtain console details):



e) Select the VM called "**ovs01.oow.local**" and click on the icon to start it

f) Select the VM called "**ovs02.oow.local**" and click on the icon  to start it

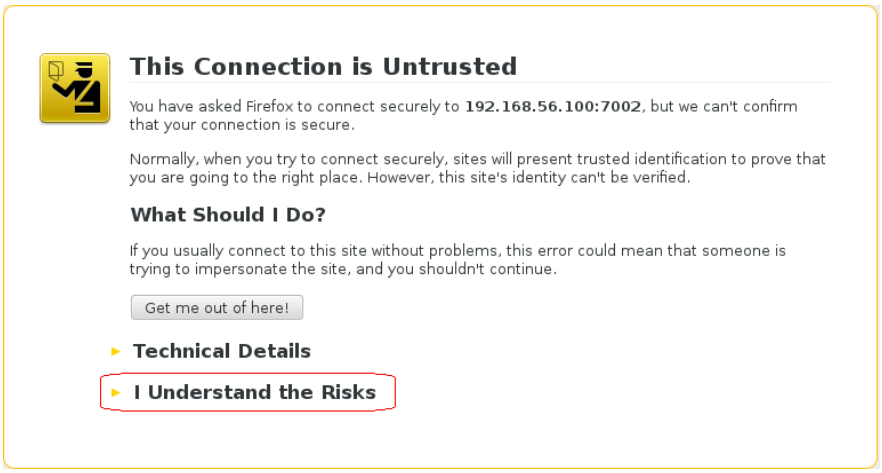
g) Wait for the 3 VMs to be ready
   - Wait for the prompt (desktop started) on "**ovmm.oow.local**" VM console
   - When this prompt is displayed, all VMs are ready (since Oracle VM Manager is the longest to start)

Connect to the Oracle VM Manager 3.3.1 and become familiar with the product

a) On your Linux physical desktop open a Firefox browser and connect to the **Oracle VM Manager 3.3.1** console using URL https://192.168.56.200:7002/ovm/console

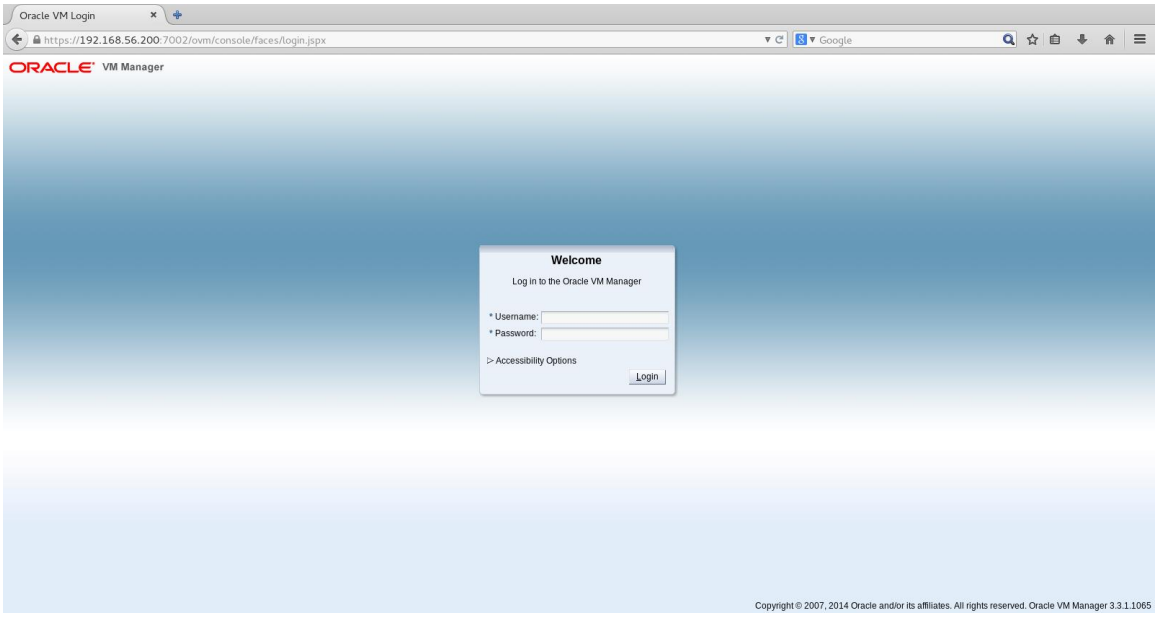
In the case that you receive some warnings proceed as described in the following screens:

Click on "**I Understand the Risks**" and on "**Add exception**":



Finally click on "Confirm Security Exception":

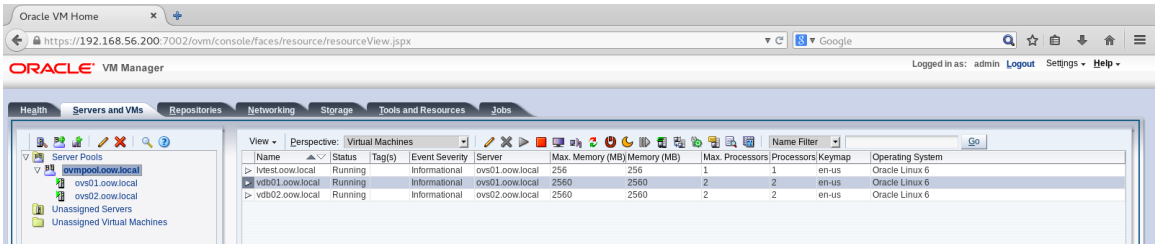
After security exception managed you should get the following login window:



b) Log in using the following credentials:
Login : **admin** (default Oracle VM Manager Administrator)
Password: **Welcome1** (W is uppercase)

a) Once logged in the Oracle VM Manager console, go to the "**Servers and VMs**" tab, expand and select **ovmpool.oow.local**, select it, change perspective view to "**Virtual Machines**" and verify the status of Oracle VM pool and Server; everything should be as in this picture.

You need to see also that virtual-guests **vdb01**, **vdb02** and **lvtest** are active and running.

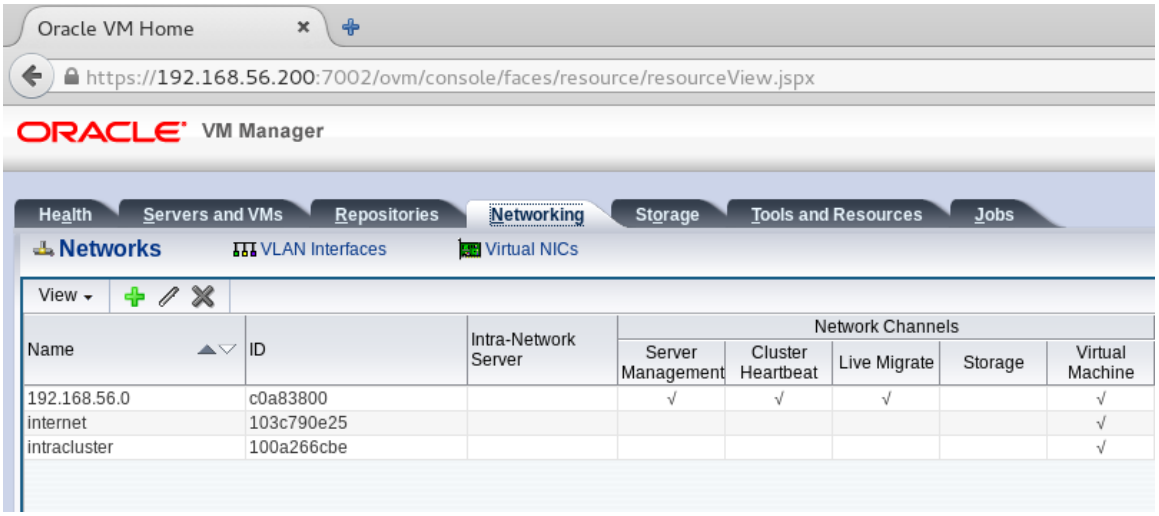


b) Click on "**Networking**" tab and verify defined networks and their roles:

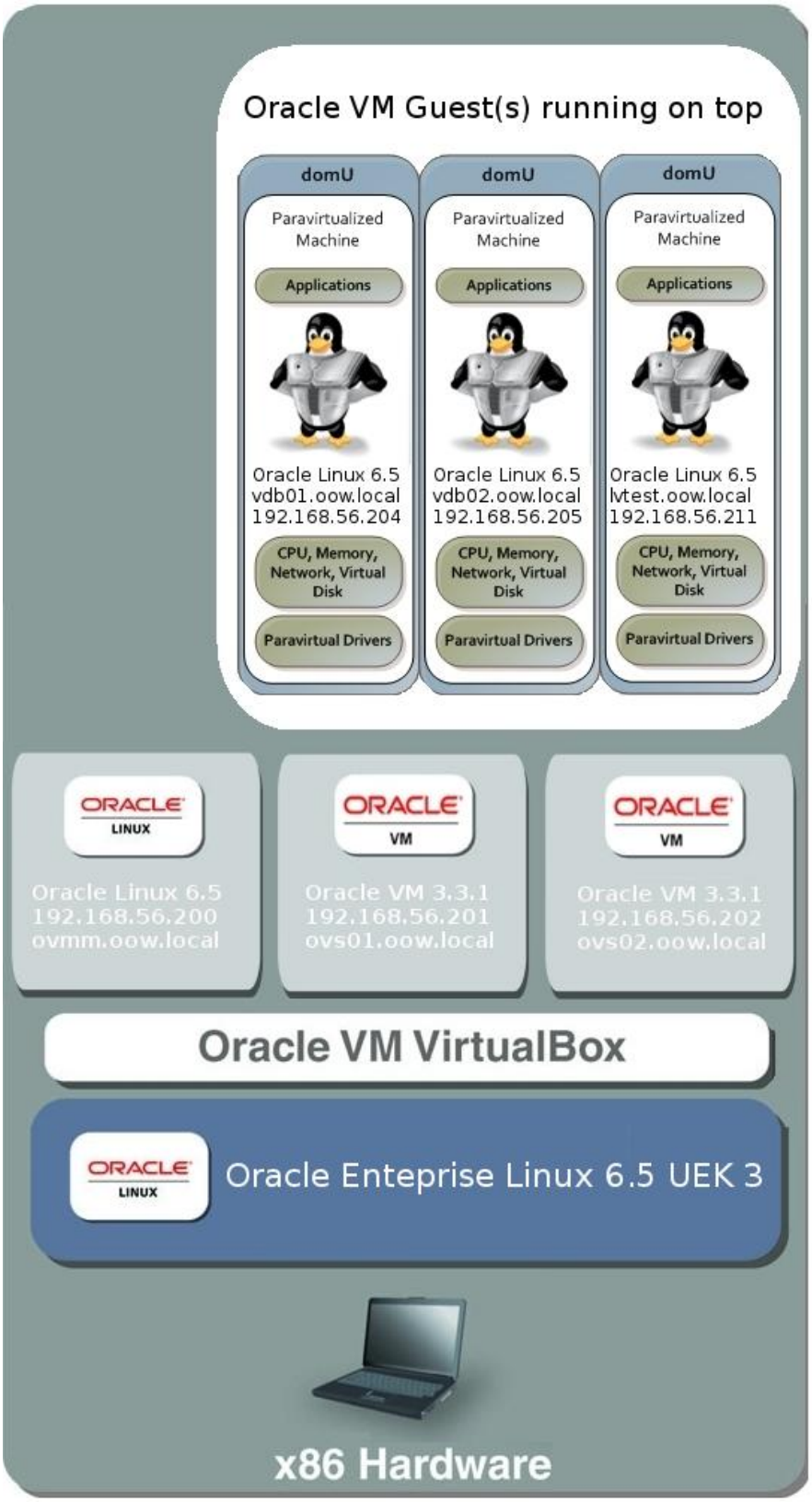
192.168.56.0 = VirtualBox host-only Network used for default management, heartbeat and live-migrate network;also guests servers use this network to obtain access from our laptop

Internet = VirtualBox NAT network to allows guests to reach public and external sites

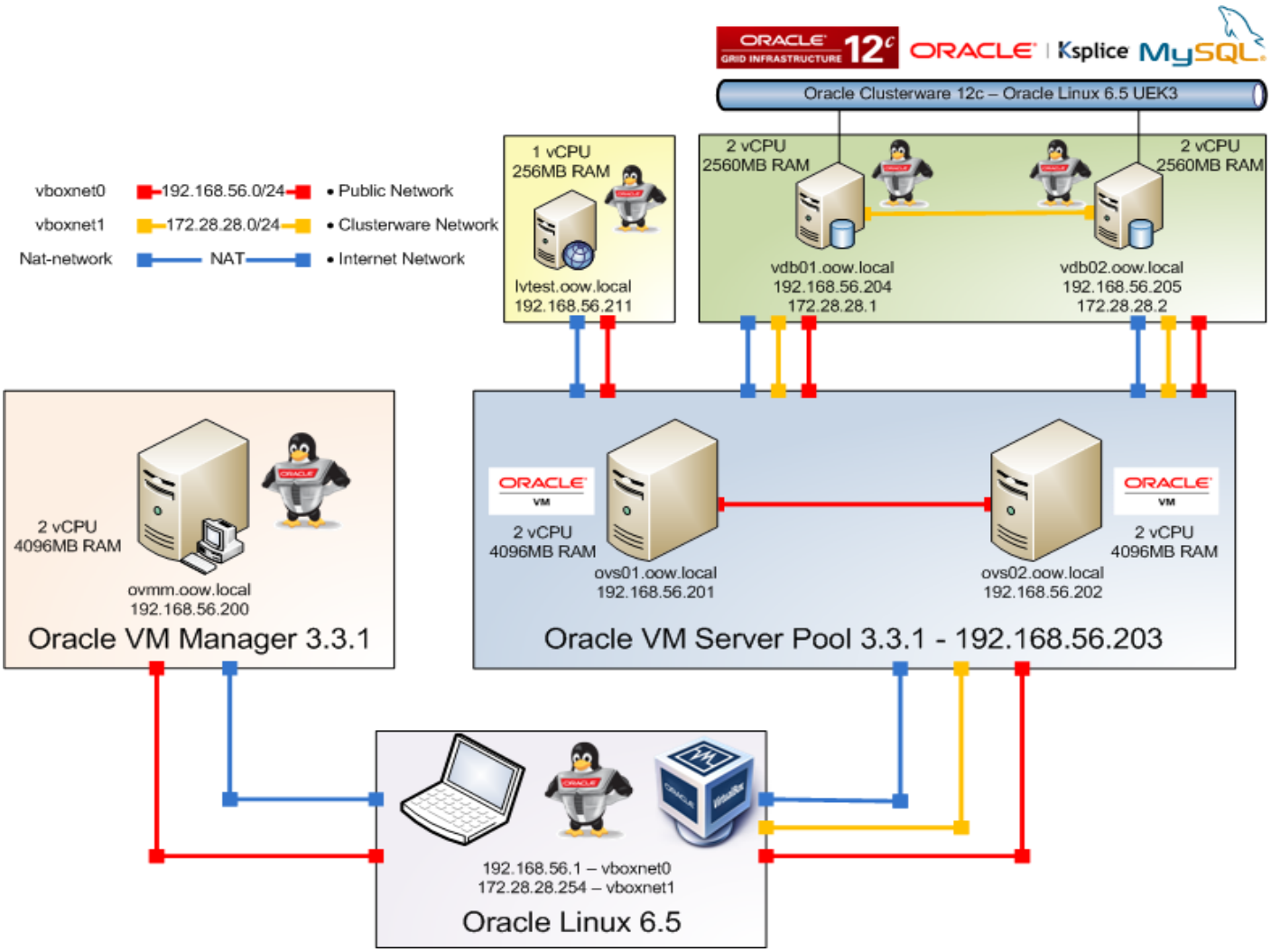
Intracluster = VirtualBox host-only Network used for intracluster on Oracle Clusterware



The architecture built for this lab :


Oracle VM Guest(s) running on top
domU
Paravirtualized Machine
Applications
Oracle Linux 6.5
vdb01.oow.local
192.168.56.204
CPU, Memory, Network, Virtual Disk
Paravirtual Drivers
domU
Paravirtualized Machine
Applications
Oracle Linux 6.5
vdb02.oow.local
192.168.56.205
CPU, Memory, Network, Virtual Disk
Paravirtual Drivers
domU
Paravirtualized Machine
Applications
Oracle Linux 6.5
lvtest.oow.local
192.168.56.211
CPU, Memory, Network, Virtual Disk
Paravirtual Drivers
ORACLE LINUX
Oracle Linux 6.5
192.168.56.200
ovmm.oow.local
ORACLE VM
Oracle VM 3.3.1
192.168.56.201
ovs01.oow.local
ORACLE VM
Oracle VM 3.3.1
192.168.56.202
ovs02.oow.local
Oracle VM VirtualBox
ORACLE LINUX
Oracle Enteprise Linux 6.5 UEK 3
x86 Hardware

Detailed architecture of the Lab

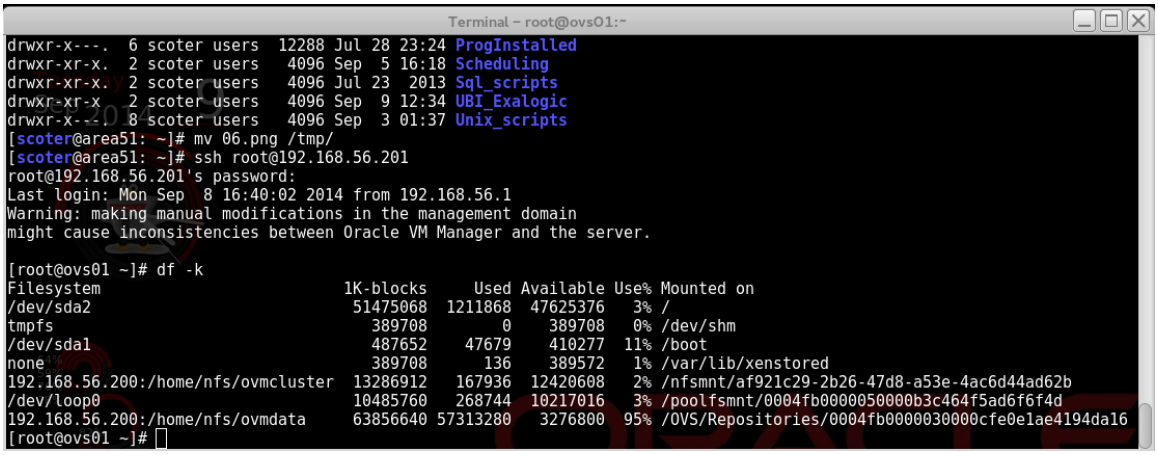


Connect to the Oracle VM Servers and verify that everything is ready to accommodate the lab

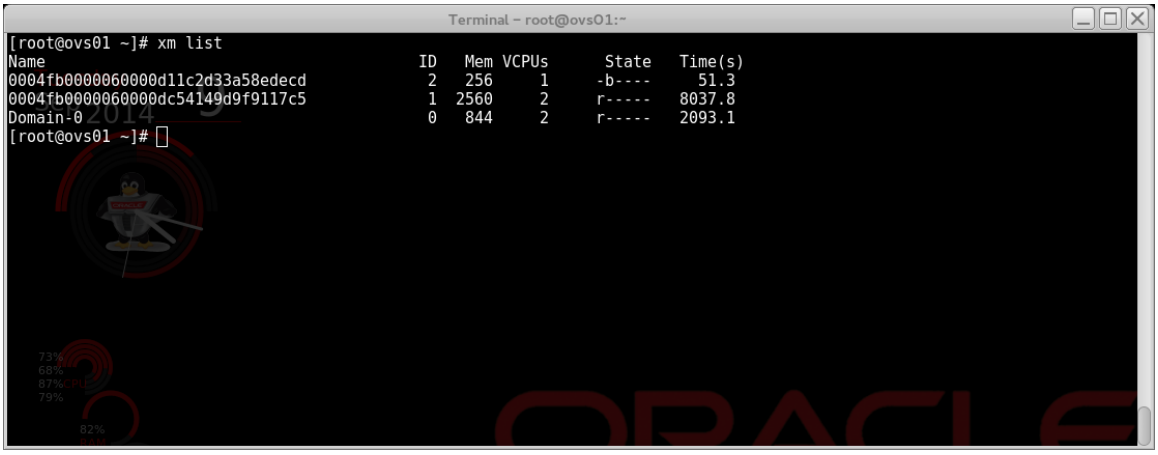
Connect by ssh to **ovs01.oow.local** / **ovs02.oow.local** and verify that Oracle VM guests are really running:
Open a terminal on your linux desktop and execute:

ssh root@192.168.56.201 (password is ovsroot)
ssh root@192.168.56.202 (password is ovsroot)

Once connected to both Oracle VM Servers, verify that Oracle VM repository is correctly mounted with the command "**df -k**"; the output should be the same as the figure below (verify on both Oracle VM servers):



Verify that Oracle VM guests are running by executing the command "**xm list**" (on both Oracle VM Servers).
You will find two guests running on server ovs01 and one guest running on ovs02.



Connect to the Oracle VM guests and become familiar with Oracle Linux and Oracle Clusterware (Grid Infrastructure)

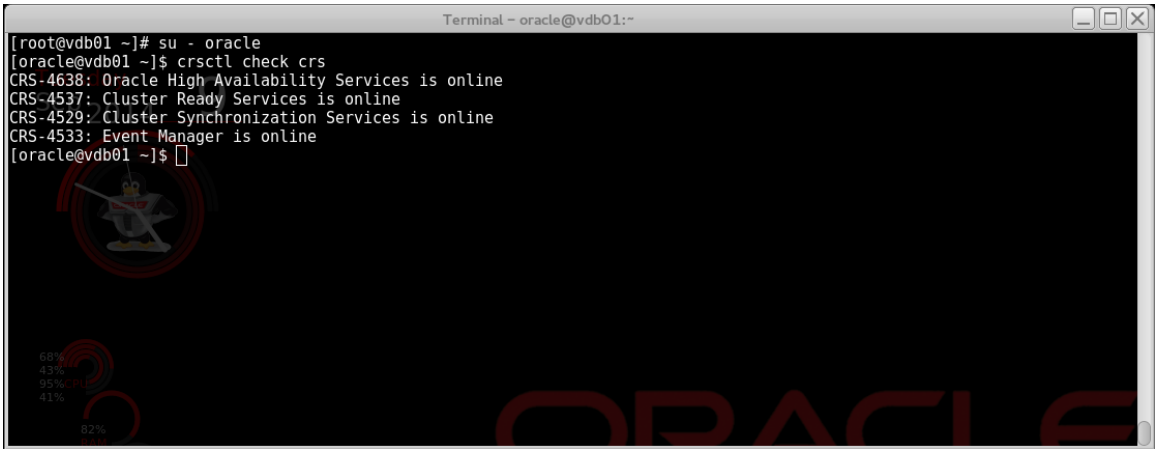
Connect by ssh to **vdb01.oow.local** / **vdb02.oow.local** and verify all Oracle Cluster managed resources are up and running:
Open a terminal on your linux desktop and execute:

ssh root@192.168.56.204 (password is ovsroot)
ssh root@192.168.56.205 (password is ovsroot)

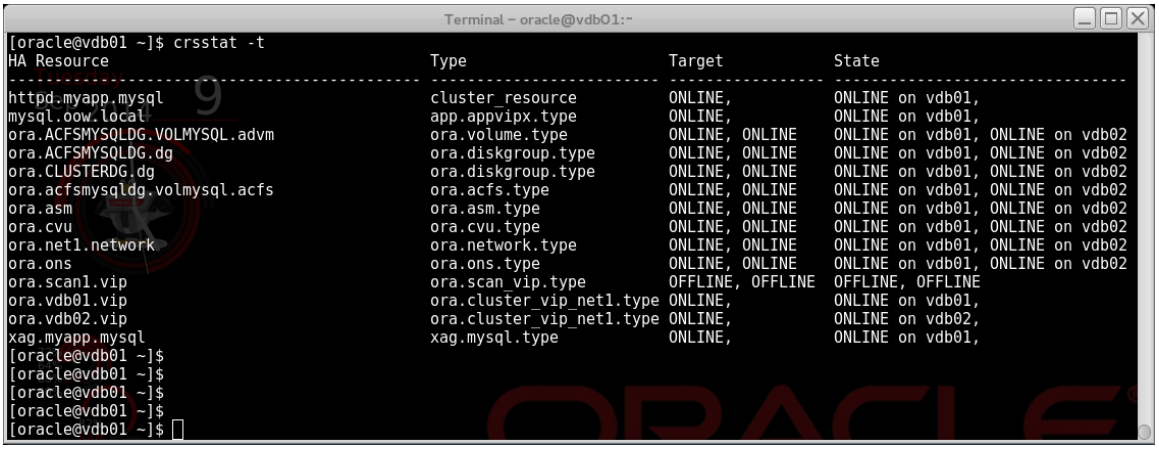
Once connected to both Oracle VM guests, verify that Oracle Clusterware is up and running and, at the same time, that all resource managed by Oracle Clusterware are correctly working (execute the commands on both guests):

1) Switch user to Oracle Cluster owner (oracle):
   # su - oracle

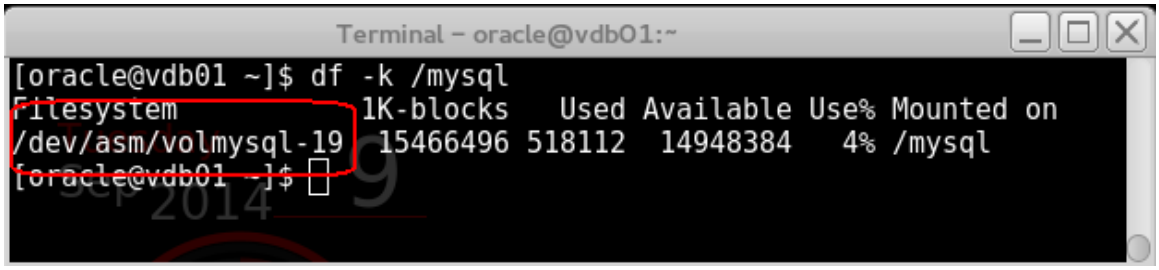
2) Verify that Oracle Clusterware services are up and running
   # crsctl check crs
   The output should be the same as shown in the figure below:



3) Verify that all Oracle Clusterware managed resource are correctly running
   # crsctl status resources
   You will find a script that wrap the output of the command above; execute "**crsstat -t**".



4) Verify that ACFS cluster filesystem is mounted on both servers
df -k /mysql

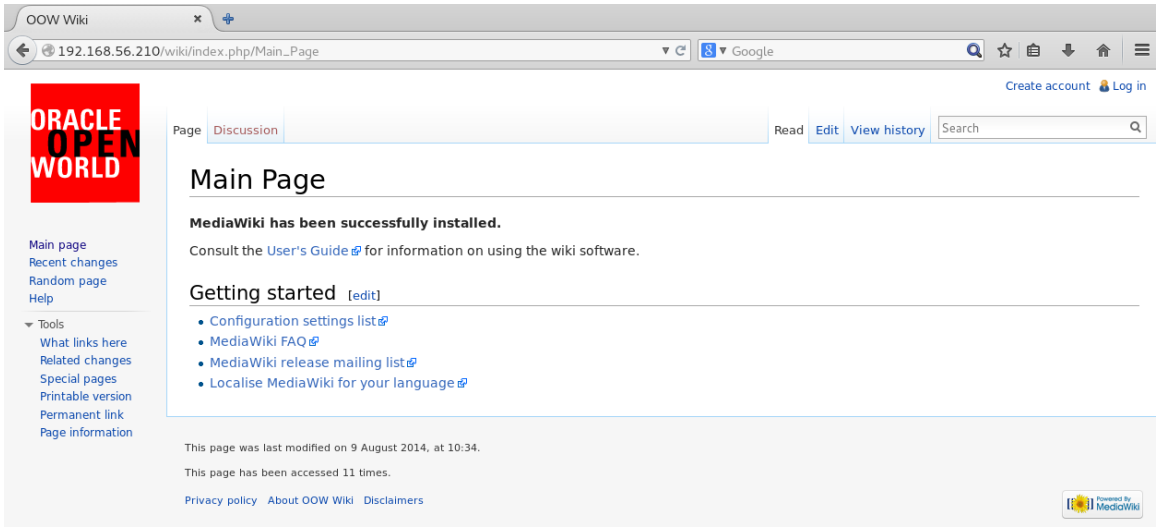


5) Verify that clustered demo web application is running

On your laptop open a browser and connect to the following URL:

http://192.168.56.210/wiki

The web page should be similar to the picture below



High availability general concepts: understand what we are going to demonstrate

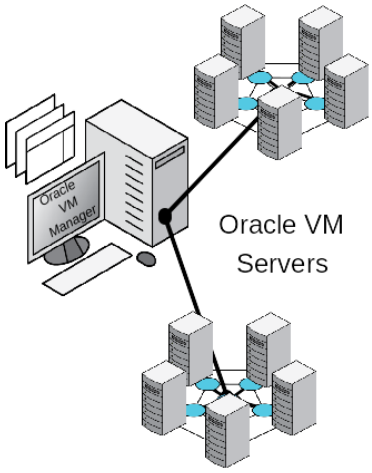
The architecture proposed in this lab is based on:

- Oracle VM 3.3.1
- Oracle Linux 6.x
- Oracle Ksplice
- Oracle Grid Infrastructure 12c (Clusterware)
- Oracle Grid Infrastructure Agents 5.1 (Clusterware agents to manage MySQL)
- Oracle MySQL Enterprise 5.6
- Demo web application

Oracle VM

Oracle VM is an enterprise-class server virtualization solution comprised of Oracle VM Server for x86, Oracle VM Server for SPARC and Oracle VM Manager. Oracle VM 3 reflects Oracle strategic commitment to deliver Application Driven Virtualization, the Virtualization that makes the entire enterprise software and hardware stack easier to deploy, manage, and support so IT and business can be more agile.

Oracle VM Server is based on the Xen hypervisor. Oracle VM Server can be managed using Oracle VM Manager, or as a standalone product with OpenStack.



Oracle Linux

Oracle Linux is an open-source operating system available under the GNU General Public License (GPLv2). Suitable for general purpose or Oracle workloads, it benefits from rigorous testing of more than 128,000 hours per

day with real-world workloads and includes unique innovations such as Ksplice for zero-downtime kernel patching, DTrace for real-time diagnostics, the powerful Btrfs file system, and more.

Oracle Ksplice

Ksplice Uptrack lets you apply 100% of the important kernel security updates released by your Linux vendor without rebooting.

Ksplice Uptrack is available for Oracle Linux, free of charge, for Oracle Linux customers with a Premier support subscription.

Running Red Hat Enterprise Linux? Get a taste of one of the many features Oracle Linux Premier Support has to offer with our free 30-day Ksplice trial for RHEL systems. Give it a try and bring your Linux kernel up to date without rebooting (not even once to install it!)

Oracle Clusterware

Oracle Clusterware 12c Release 1 is the integrated foundation for Oracle Real Application Clusters (RAC) and the High Availability (HA) and resource management framework for all applications on any major platform. Oracle Clusterware 12c builds on the innovative technology introduced with Oracle Clusterware 11g by providing comprehensive multi-tiered HA and resource management for consolidated environments. The idea is to leverage Oracle Clusterware in the cloud to provide enterprise-class resiliency where required and dynamic, online allocation of compute resources where needed, when needed.

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Oracle MySQL Enterprise

MySQL Enterprise Edition includes the most comprehensive set of advanced features, management tools and technical support to achieve the highest levels of MySQL scalability, security, reliability, and uptime. It reduces the risk, cost, and complexity in developing, deploying, and managing business-critical MySQL applications.

All this components, from the virtualization layer (Oracle VM) to the managed application (Oracle MySQL) are supplied by Oracle and, at the same time, are included in Oracle Premier Support.

These components allows to build up a complete high-available architecture that is able to grant an high service-level with a reduced TCO; at the same time, these products are able to supply enterprise features such as:

- Virtualization Layer that allows to create guest servers on x86 platforms (Microsoft, Linux, Solaris)

- Virtualization layer features such as hot-clone, snapshots, live-migrate, distributed resource scheduling and dynamic power management
- Enterprise Linux Operating System and Unbreakable Linux Kernel
- Kernel updates without disruptive server reboots
- Active resource monitoring and high-availability Oracle Clusterware

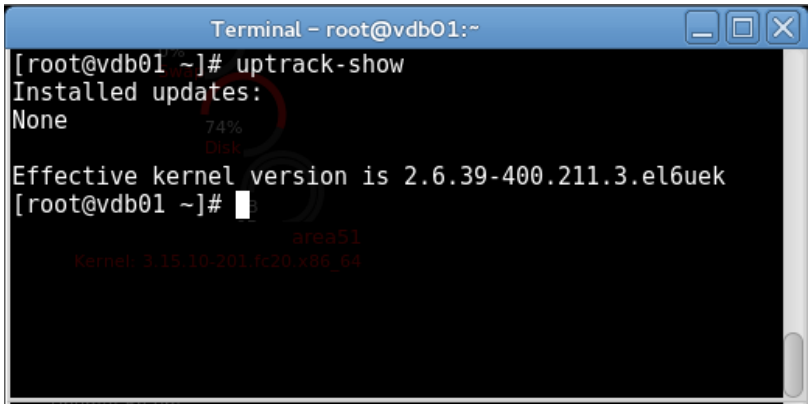
Demonstrate high-availability features covered by Oracle Ksplice

Oracle Ksplice lets you apply kernel-updates on your linux servers without reboot them.
On our demo environment we will proceed to update kernels on virtual servers named "**vdb01.oow.local**" and "**vdb02.oow.local**".

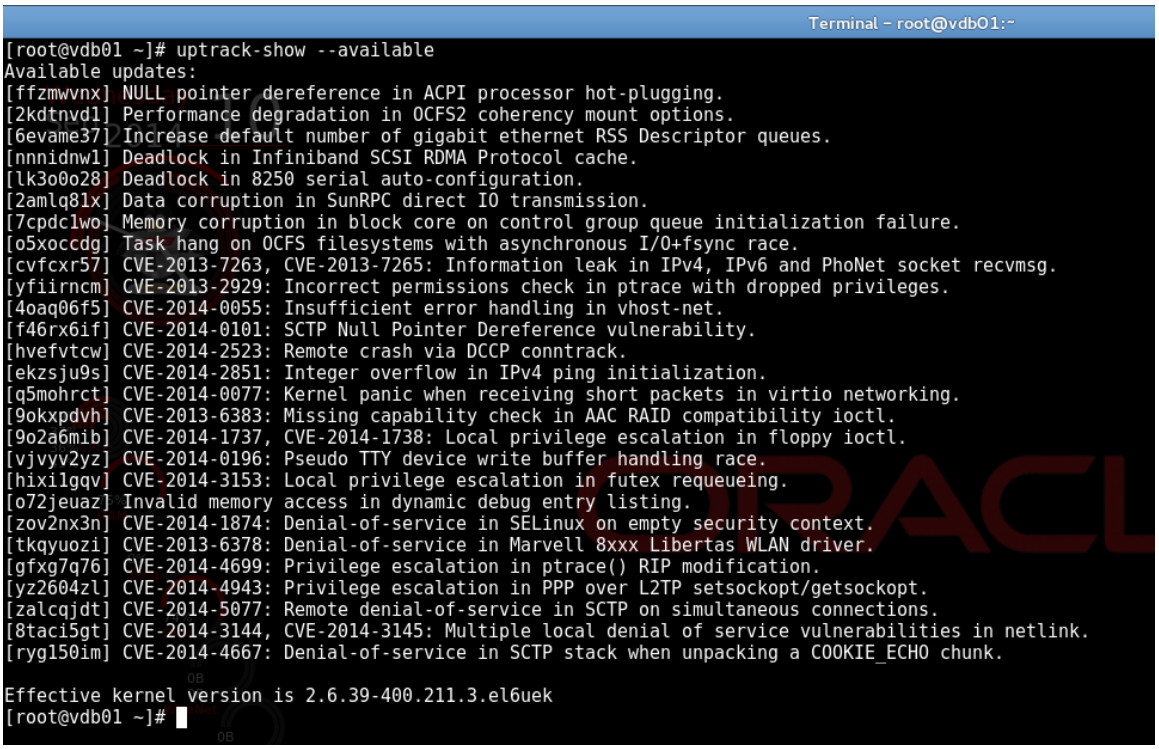
To update kernel on the servers specified above execute the following steps:

1. Connect to by ssh to the server "vdb01.oow.local"
   ssh root@192.168.56.204

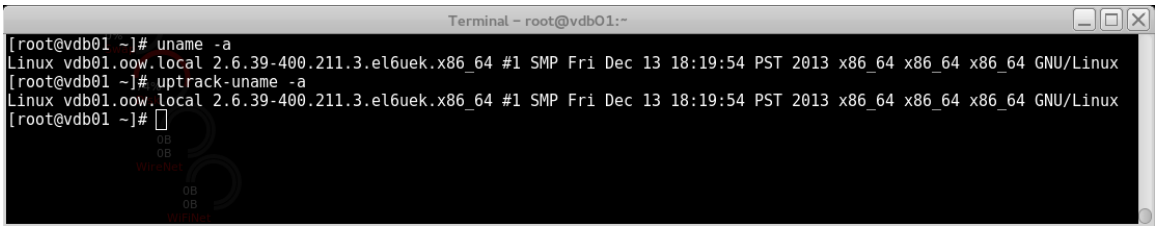
2. Show which Ksplice kernel updates are already installed by executing "**uptrack-show**"



3. Show which Ksplice kernel updates are available to be installed "**uptrack-show - - available**"

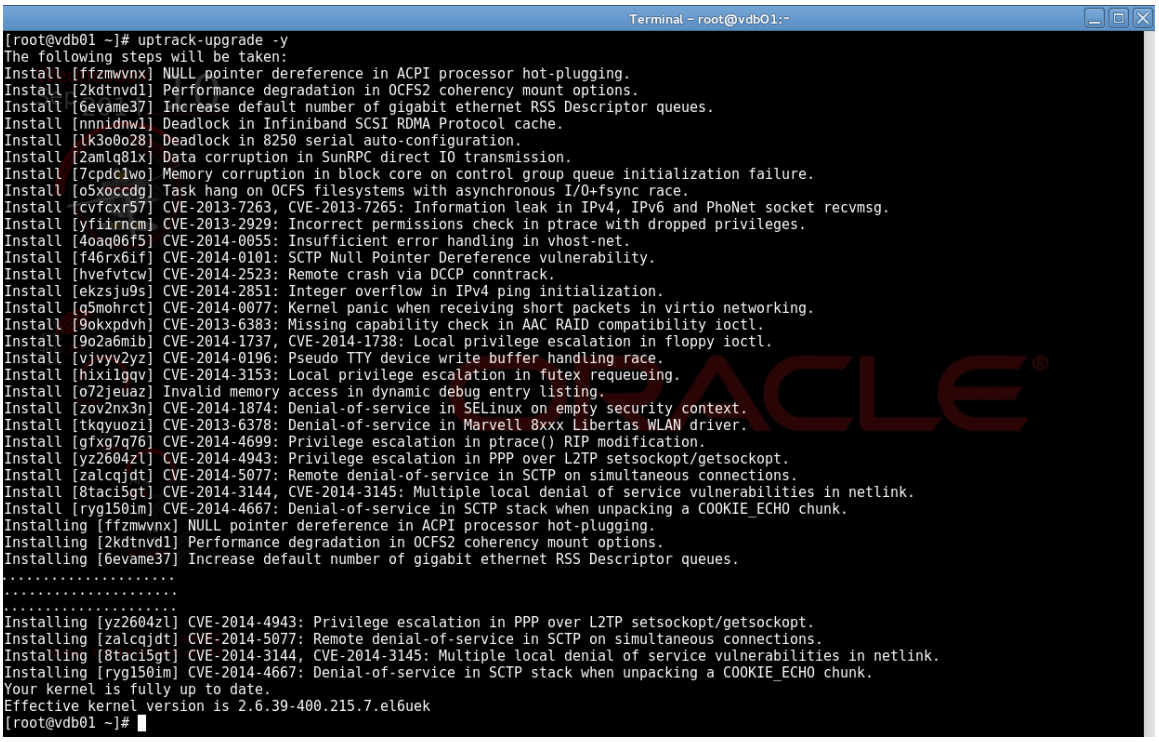


4. Verify actual kernel version installed and actual kernel version in memory by executing “uname -a” and “uptrack-uname -a”.

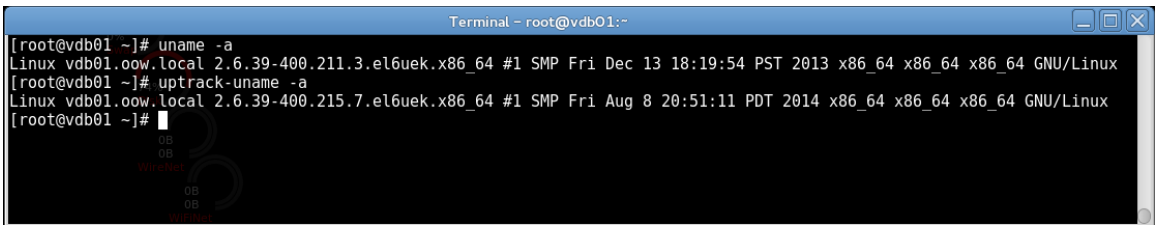


As you can see, actually, kernel installed and kernel-in-memory has the same version 2.6.39-400.211.3

5. Proceed to upgrade the kernel on your server by the command “**uptrack-upgrade –y**”.



6. Verify different kernel version between installed and in-memory “uname -a” and “uptrack-uname -a”

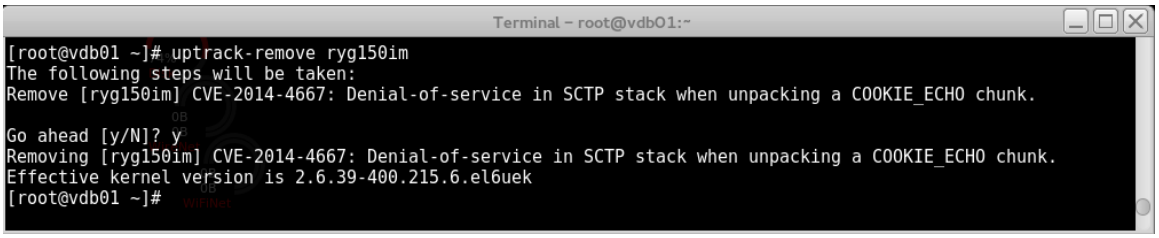


As you can see, actually:

- kernel installed is 2.6.39-400.211.3
- kernel actually in memory is 2.6.39-400.215.7

7. You can also evaluate to uninstall a single update as reported in the figure blow (confirm with Y).

   Example: # **uptrack-remove ryg150im**

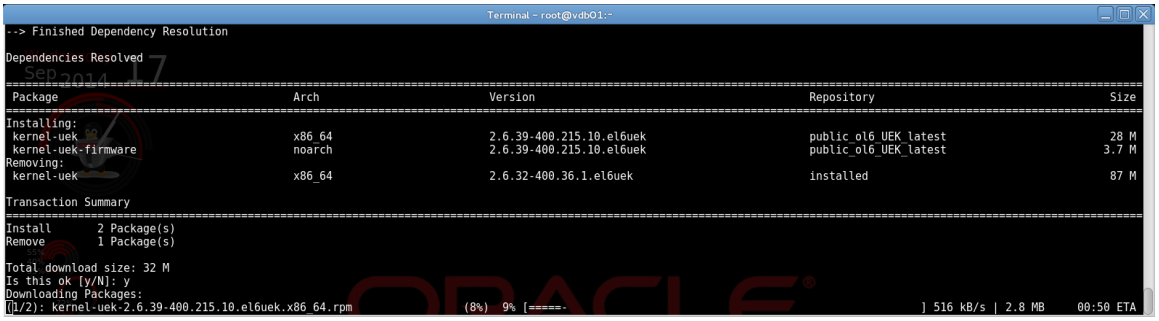


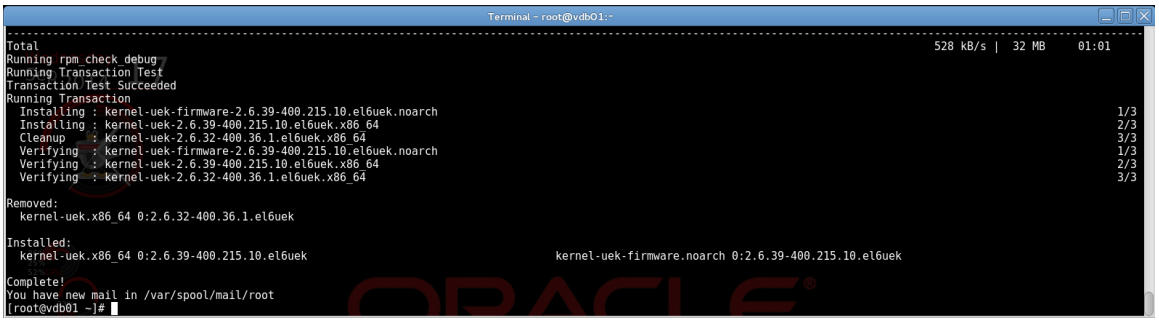
As you can see now the kernel-version moved back to 2.6.39-400.215.6 (it was with a final .7)
This part of the lab demonstrate how, on Oracle Linux, you can update the kernel without reboots; the feature supplied by Ksplice allows you also to install important security kernel fixes without any kind of impact on services supplied by your servers.

If you are going to reboot your server managed by Ksplice remember, also, to completely install the new kernel; this installation will allow you to have the new kernel in standard mode after the reboot (the alternative is that a Linux service named “uptrack” while booting will re-apply all kernel fixes in memory).

8. Following **Oracle Ksplice** best-practices we also need to physically install the newer kernel on our filesystem; this will alows, after a scheduled reboot, that the *machine restarts with the newer kernel without re-apply all the Ksplice updates*.
   To update UEK Oracle Linux Kernel, execute the command:

   # **yum update kernel-uek kernel-uek-firmware**

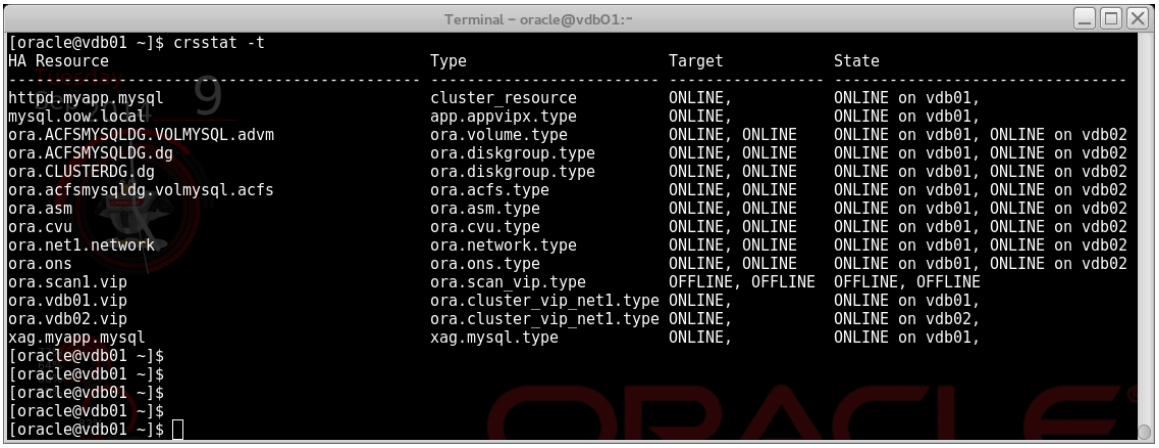




Demonstrate high-availability features covered by Oracle Clusterware

Oracle Clusterware is an enterprise clustering software included in Oracle Linux Premier Support.
With Oracle Clusterware you also obtain ACFS (**ASM Cluster file system**), a real posix compliant cluster filesystem.
ACFS allows to maintain software and application data on a cluster filesystem mounted, at the same time, on all servers that take part in Oracle Clusterware.
On our demo environment we will proceed to simulate a managed switchover of the resources (such as user-vip – virtual address and mysql database), one unmanaged failover of the resources and a resource-restart on the same node (all base activities covered by a clustering software solution).

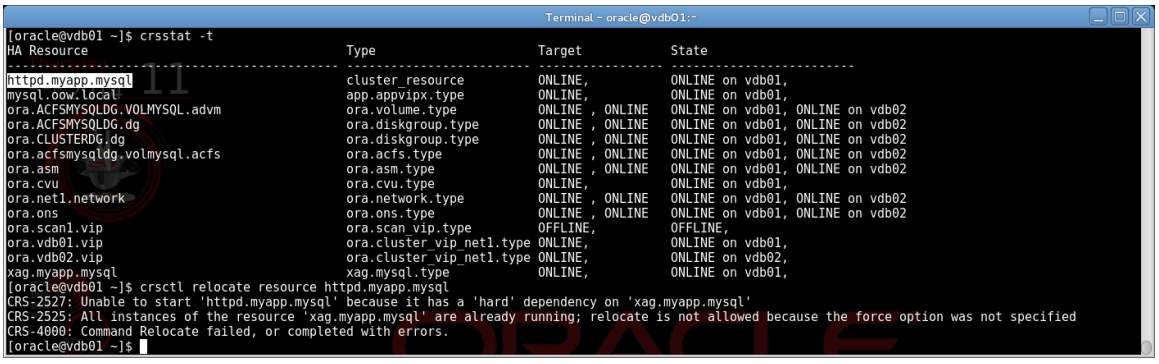
1. Verify actual status of the resources on server “vdb01.oow.local”
   With user “**oracle**” execute the command wrapped script “**crsstat -t**”:



   As shown in the figure above all resources (except “ora.scan1.vip” must be ONLINE) and our *service resources are all active on node “**vdb01**”*.

2. Try to relocate all service on the other node by executing, as user oracle:

   # crsctl relocate resource httpd.myapp.mysql



   The message obtained is:

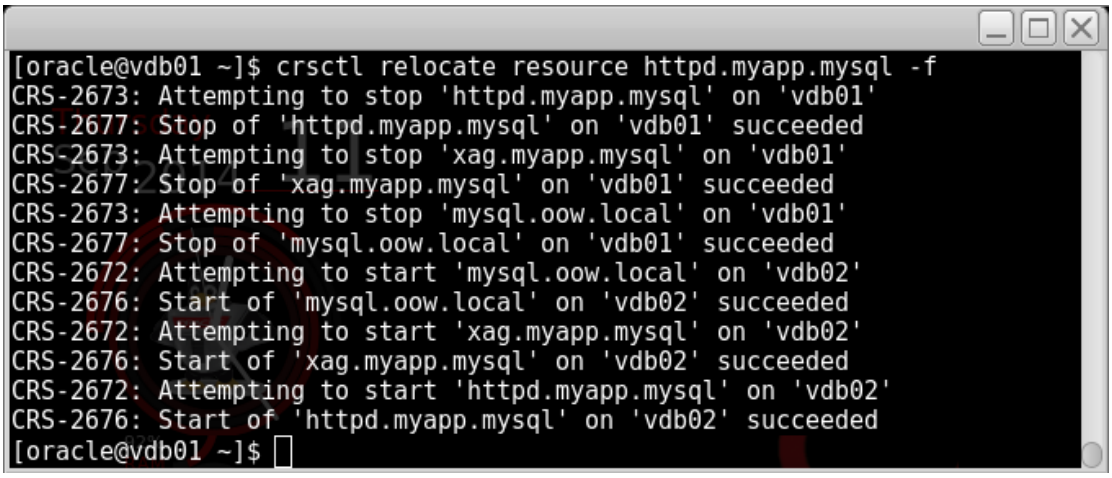
   CRS-2527: Unable to start 'httpd.myapp.mysql' because it has a 'hard' dependency on 'xag.myapp.mysql'
   CRS-2525: All instances of the resource 'xag.myapp.mysql' are already running; relocate is not allowed because the force option was not specified
   CRS-4000: Command Relocate failed, or completed with errors.

This is due to the fact that Oracle Clusterware managed resources have dependencies each other; so, a “force” option is needed to complete the operation.

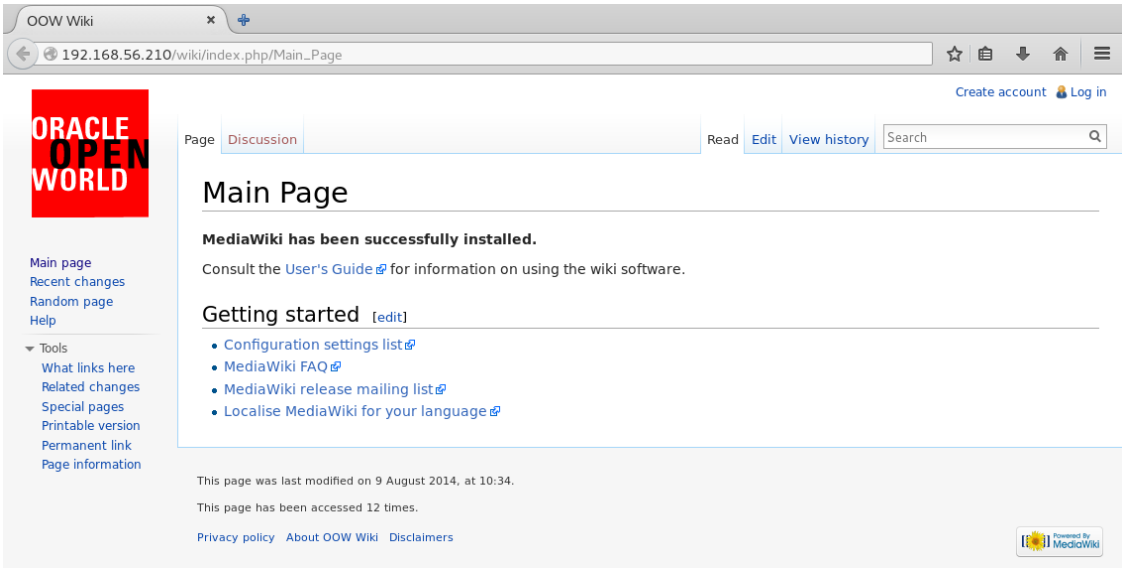
Service resources have the following dependencies:

Resource Name	Description	Dependency
mysql.oow.local (192.168.56.210)	User Virtual IP address	Network, ACFS filesystem
xag.myapp.mysql	MySQL database named myapp	mysql.oow.local (user-vip)
httpd.myapp.mysql	Apache server	xag.myapp.mysql (MySQL db)

3. Relocate services and verify that web-application continues working (a little seconds outage is expected)

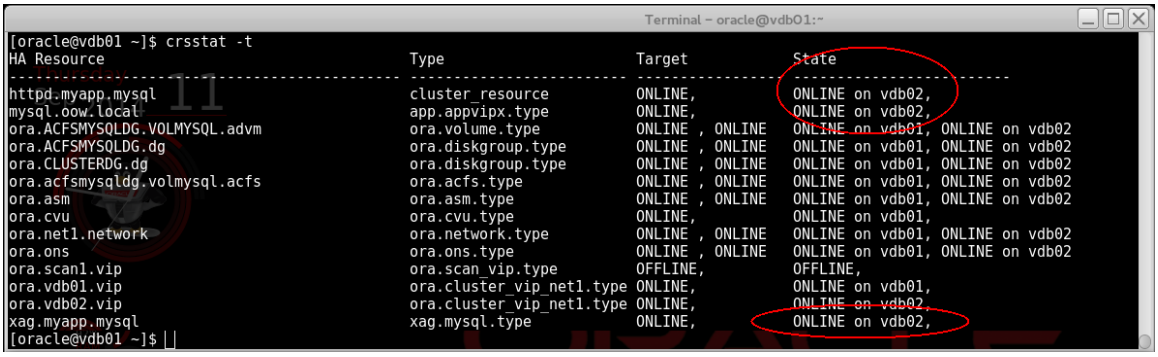


Verify application URL is reachable (you can open from your laptop browser): http://192.168.56.210/wiki



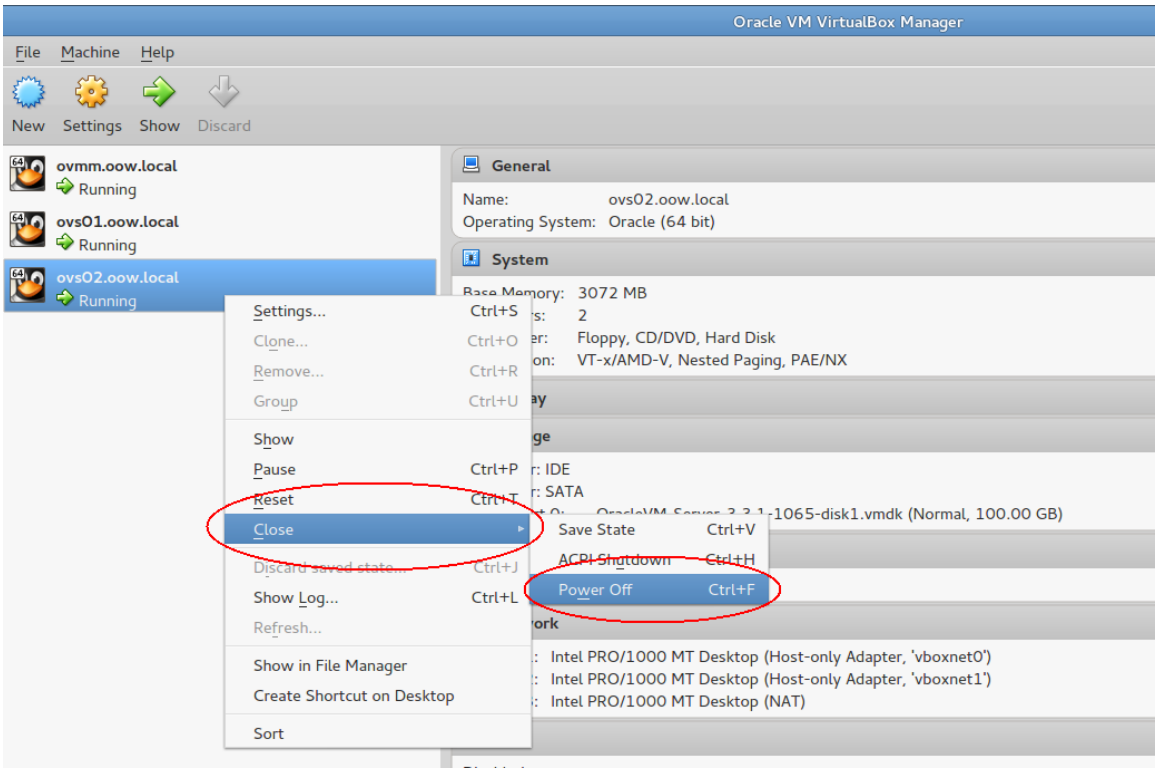
4. Verify actual resource distribution on the cluster with the command “crsstat -t”

nb: remember that "crsstat" is a wrapped script that executes "crsctl status resources -t"



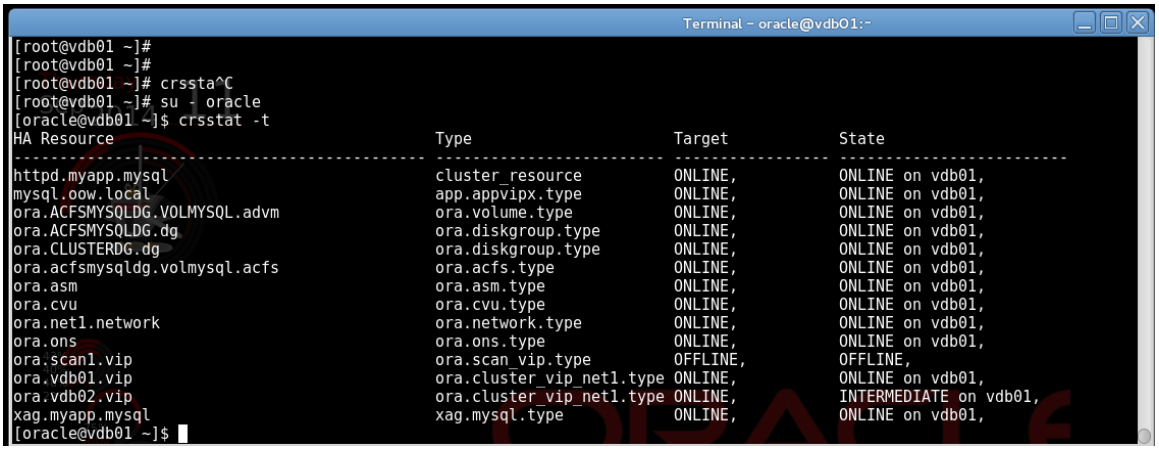
As you can see service resources are now active on node "**vdb02.oow.local**".

5. Shutdown (simulating a plug remove) Virtual-Box server named "ovs02.oow.local" that is the server that actually host "vdb02.oow.local" (the active node in the cluster).
   To power-off the server, open "**VirtualBox console**", right-click on the server "**ovs02.oow.local**", choose "**Close**" and "**Poweroff**".

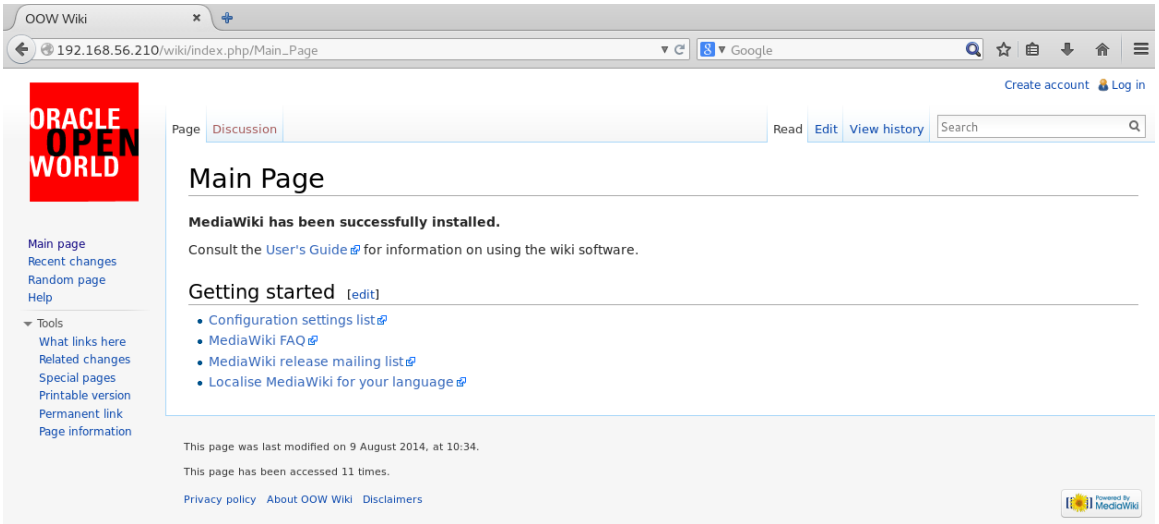


Confirm to brutally shutdown the server "**ovs02.oow.local**"

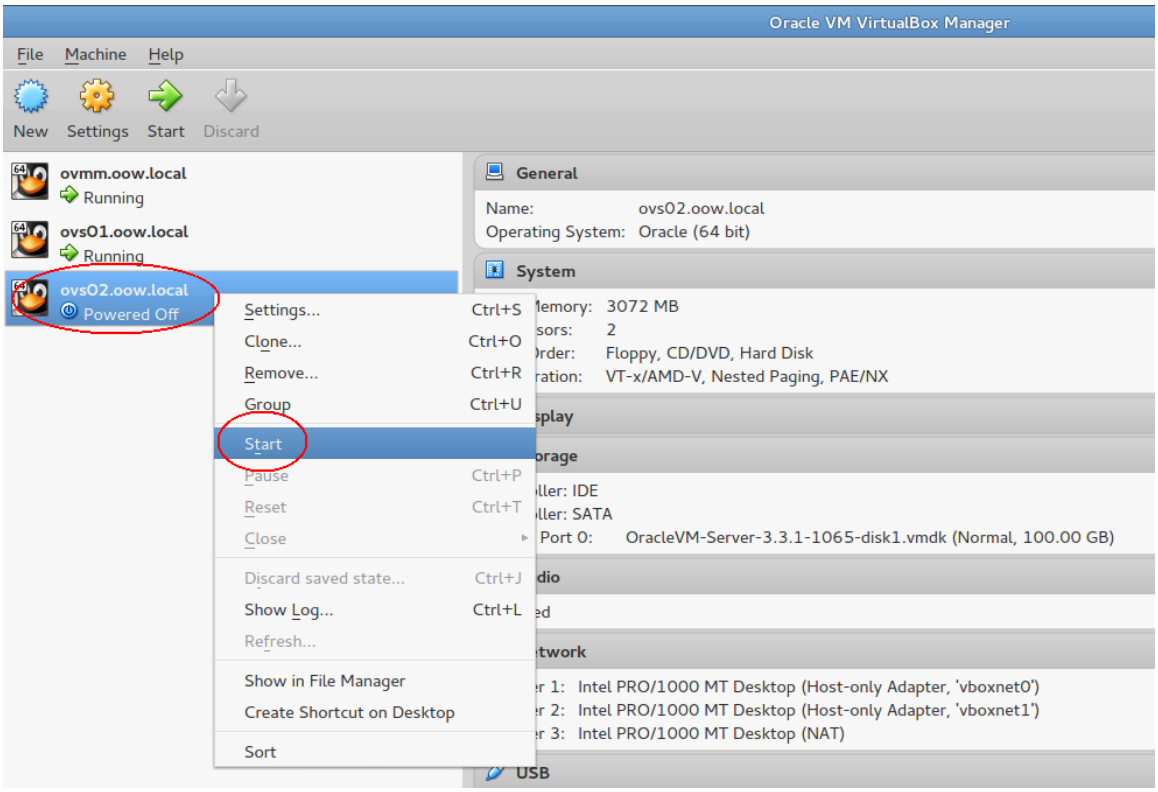
6. Verify actual resource distribution on the cluster with the command “crsstat -t” and, at the same time, with the laptop browser (Mozilla Firefox) verify that web-demo application is available.
You’ll see that, actually, only one node of the cluster is active and that all service resources are active on node “**vdb01.oow.local**”.



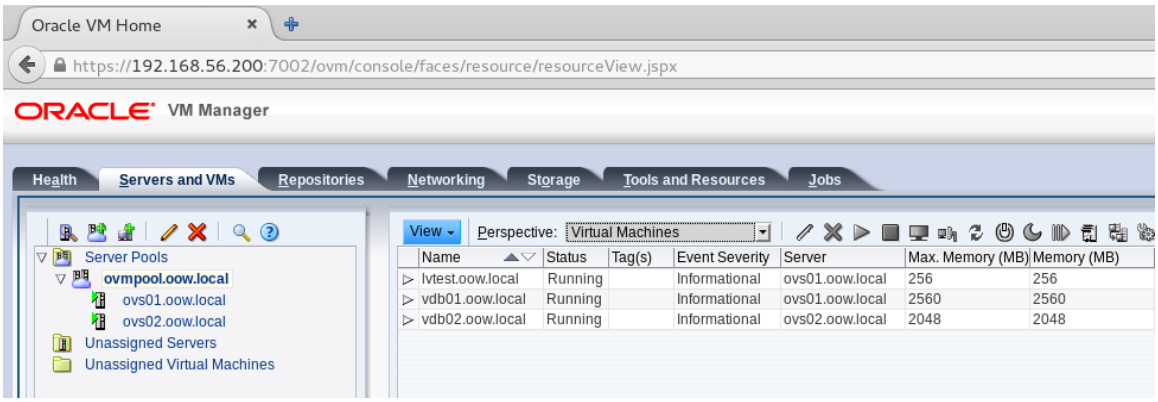
Verify application URL is reachable (you can open from your laptop browser): http://192.168.56.210/wiki



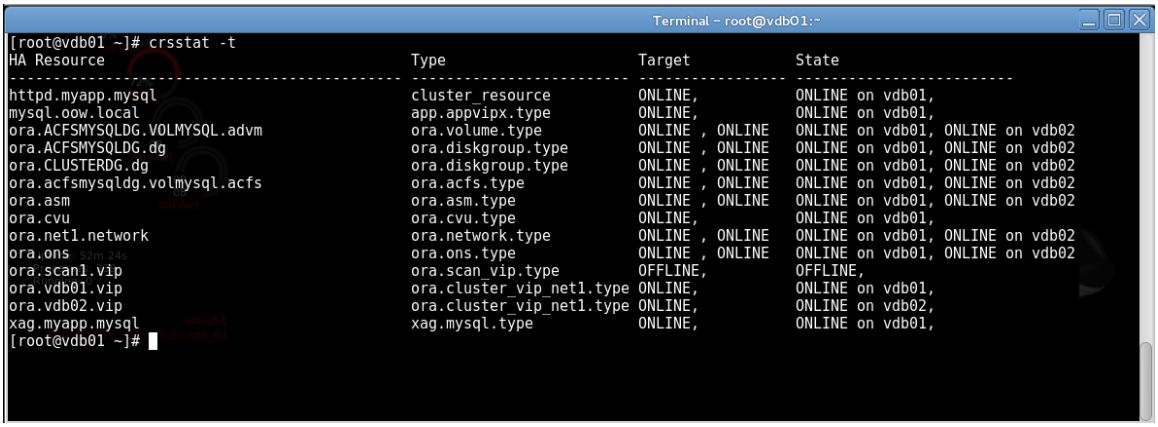
7. Restart VirtualBox server named “ovs02.oow.local”
   Open **VirtualBox console**, right-click on “**ovs02.oow.local**” and the select “**Start**”



8. Connect to the “**Oracle VM Manager**” console, go to the “**Servers and VMs**” tab, expand and select “**ovmpool.oow.local**”, select it, change perspective view to “**Virtual Machines**” and verify the status of Oracle VM pool and Server; everything should be as in the picture below.
   You need to see also that virtual-guests **vdb01**, **vdb02** and **lvtest** are active and running.

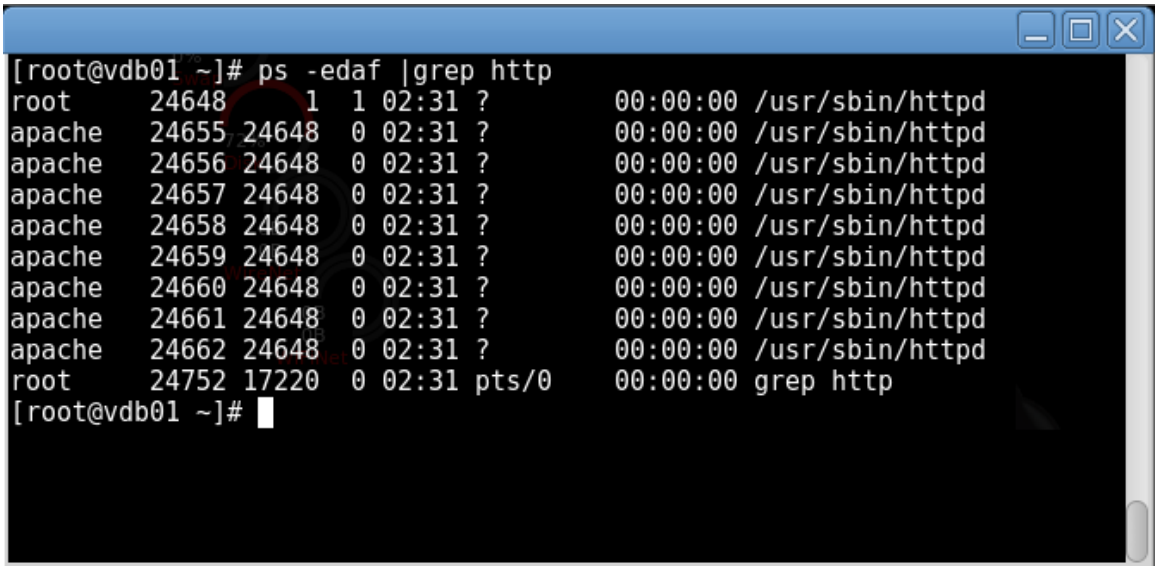


9. Connect to the virtual-guest “**vdb01.oow.local**” (192.168.56.204) by ssh and verify, by clusterware commands, if the “**vdb02.oow.local**” re-joined the cluster.



Wait for “vdb02.oow.local” join the cluster before proceeed with the steps below.

10. Connect, as **root**, to the node where our managed resources are active (it should be **vdb01.oow.local**) and verify which are processes of our “httpd” daemon (process number and hour/date) with the command:
    # ps -edaf |grep http

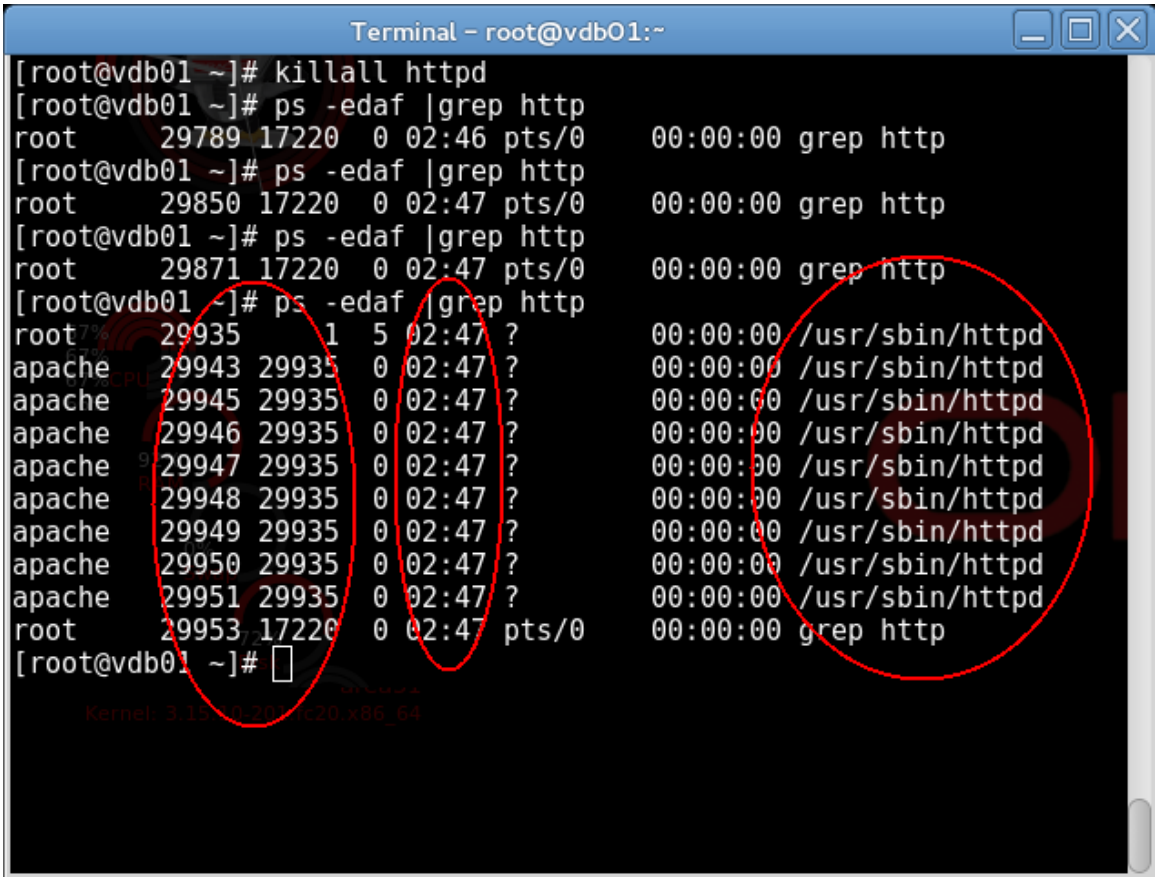


11. Kill all httpd daemon processes, verify that no “httpd” processes are active and wait for the clusterware intervention.
    Oracle Clusterware should take care in some seconds of this faulty situation.
    The sequence of commands to execute, as root, is:

    # **killall httpd**
    # **ps -edaf |grep http** ==> waiting for Oracle Clusterware restart the daemon

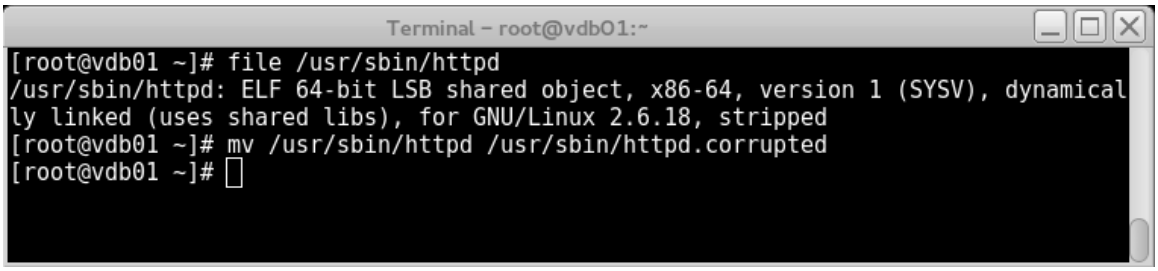
    Initially all httpd processes will die and, after some seconds, Oracle Clusterware will arrange for restart of the daemon; after that verify that web-demo application is available at the following URL:

    http://192.168.56.210/wiki

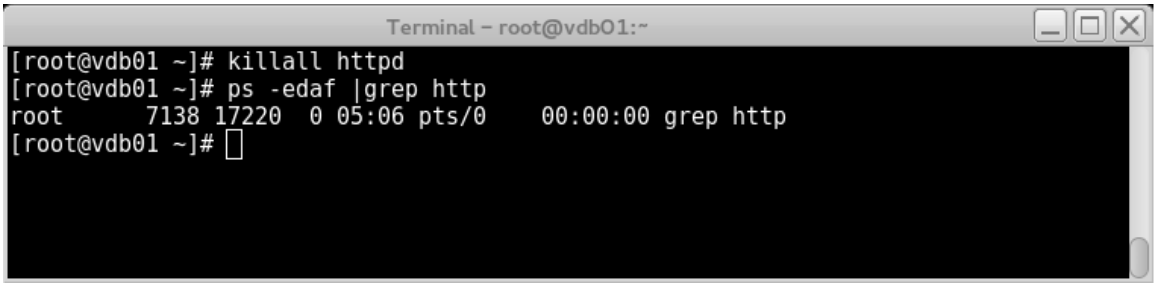


12. With these step we will simulate a file system corruption with the loss of the binary “httpd”; Oracle Clusterware will be able to identify that it’s not possible to restart the daemon on the current node and will proceed to a complete fail-over of the service (migrating all managed services from node “vdb01” to “vdb02”).
    The steps to execute, as **root**, on node “**vdb01**” (node actually owning all resources) are:

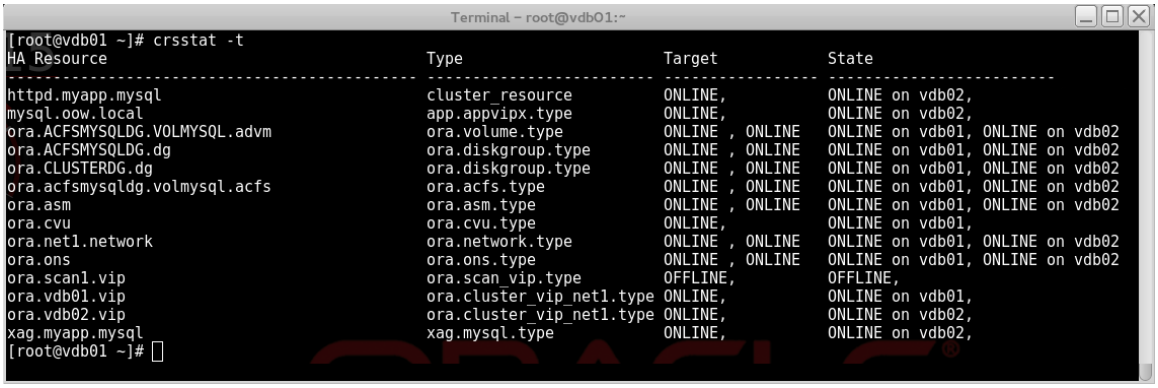
    Rename httpd binary on the filesystem
    # **mv /usr/sbin/httpd /usr/sbin/httpd.corrupted**



    Kill all httpd processes
    # **killall httpd**



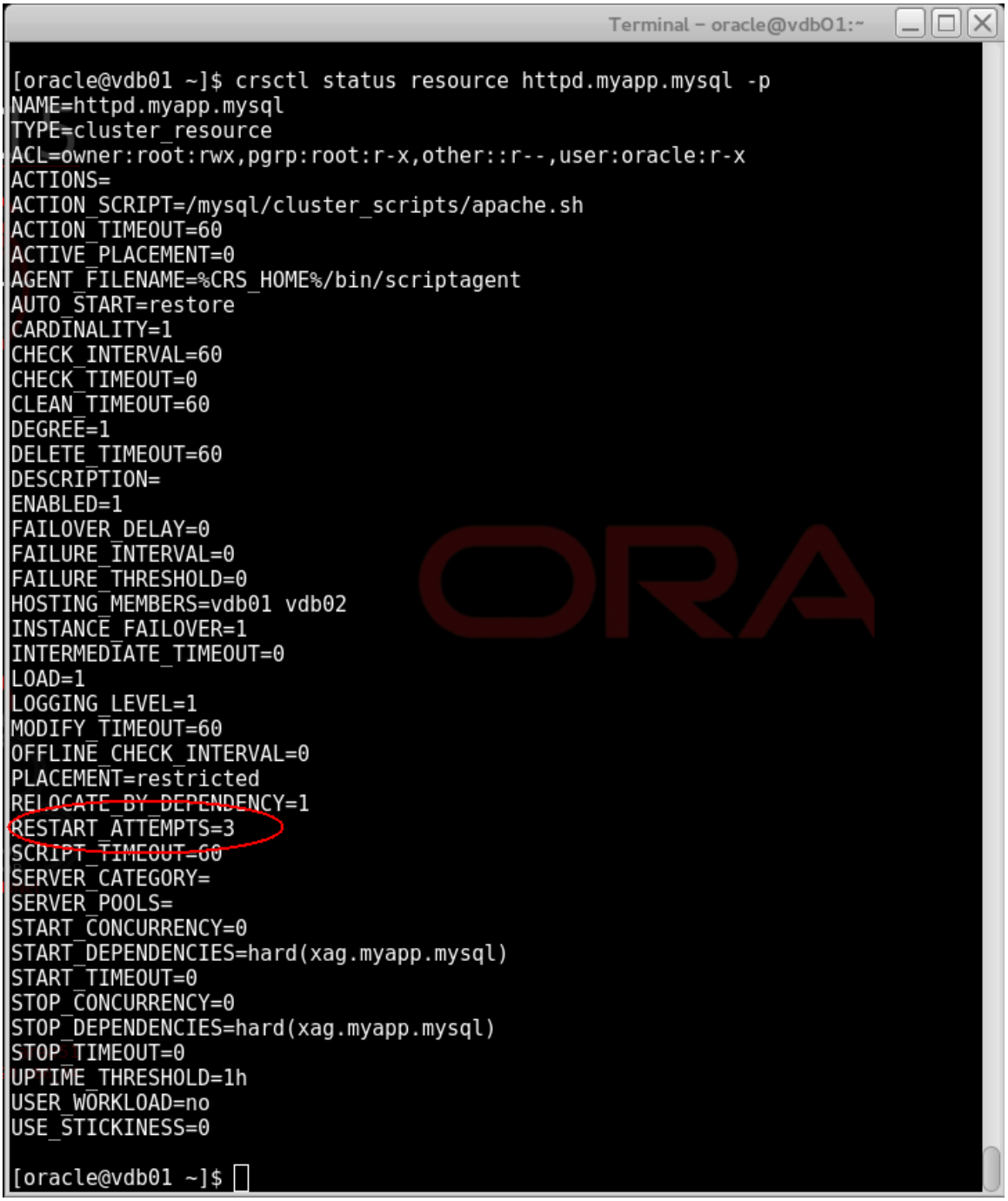
Verify managed service status by the wrapped script (wait until everything is running on node "**vdb02**"):
crsstat –t



Oracle Clusterware was not able to restart "httpd daemon" on the same node so, after three attempts, restarted all the service resources that have dependencies each-other on the other node.
The number of attempts is configured within the "failed" resource and you can check the configuration with the following command (connected as **oracle** user, the real owner of the cluster)

crsctl status resource <resource_name> -p
crsctl status resource httpd.myapp.mysql –p

In the picture below we can see that the "**RESTART_ATTEMPTS**" is **3**; after this event, Oracle Clusterware proceed to migrate that resource and all dependencies on the other node.



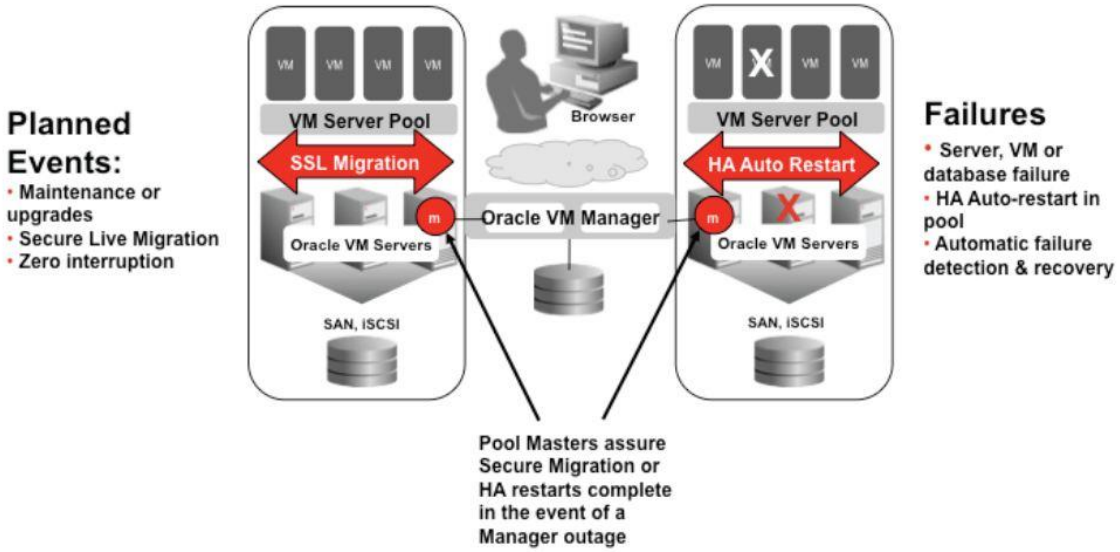
When the test is finished, please fix the simulated corruption on guest "**vdb01.oow.local**", as root, with:
mv /usr/sbin/httpd.corrupted /usr/sbin/httpd

Demonstrate high-availability features covered by Oracle VM

Oracle VM high-availability consists of two main features:

- Oracle VM High-Availability
- Oracle VM Live-Migration

Here a picture that could better describe these features H/A features for Planned events and Failures :



Oracle VM Live-Migrate

Live migration is a process to move a running virtual machine from one Oracle VM Server to another, while applications on the existing virtual machine continue to run. Live migration ensures high availability of virtual machines. This feature is important, and useful, when the existing Oracle VM Server may be out of commission, or on a planned shutdown for maintenance purposes.
You can only migrate one virtual machine at a time. Cross-server pool live migration is not allowed. You can only migrate virtual machines from one Oracle VM Server to another within the same server pool.

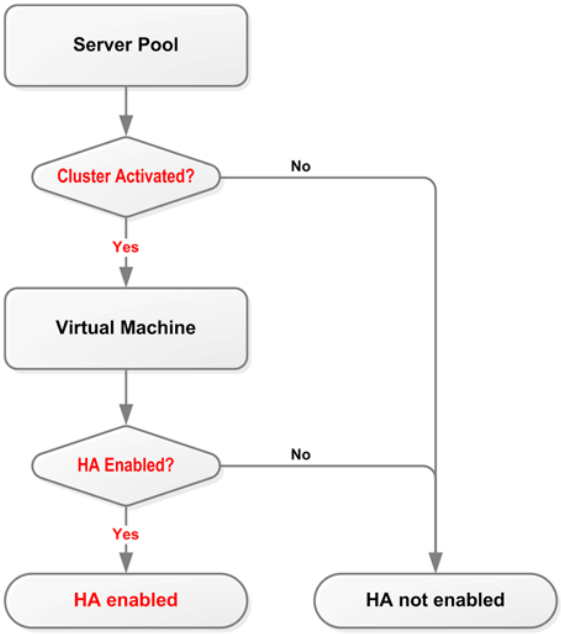
Oracle VM High-Availability

You can set up High-Availability to help ensure the uninterrupted availability of a virtual machine. If HA is configured and a Oracle VM Server is restarted or shut down, the virtual machines running on it are either restarted on, or migrated to, another Oracle VM Server.

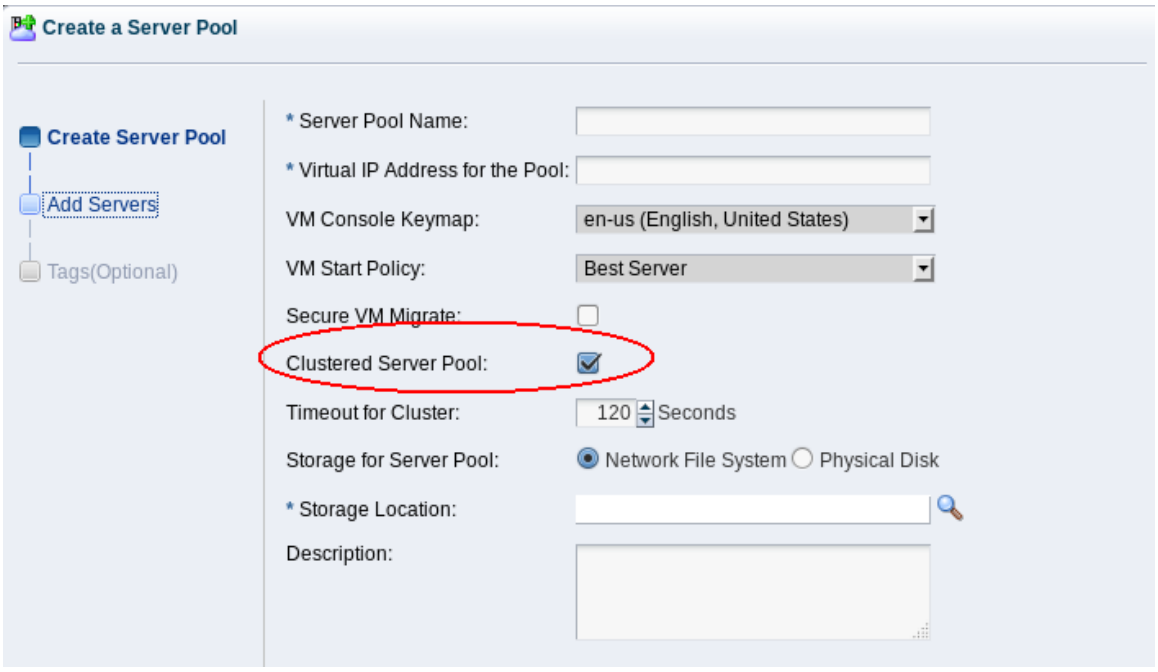
The following prerequisites are requirement to implement HA:

- The server pool must contain multiple Oracle VM Servers.
  HA cannot be implemented with a stand-alone Oracle VM Server.
- All Oracle VM Servers must be Oracle VM Server Release 3.0 or above.
- Oracle VM Pool needs to be “clustered”

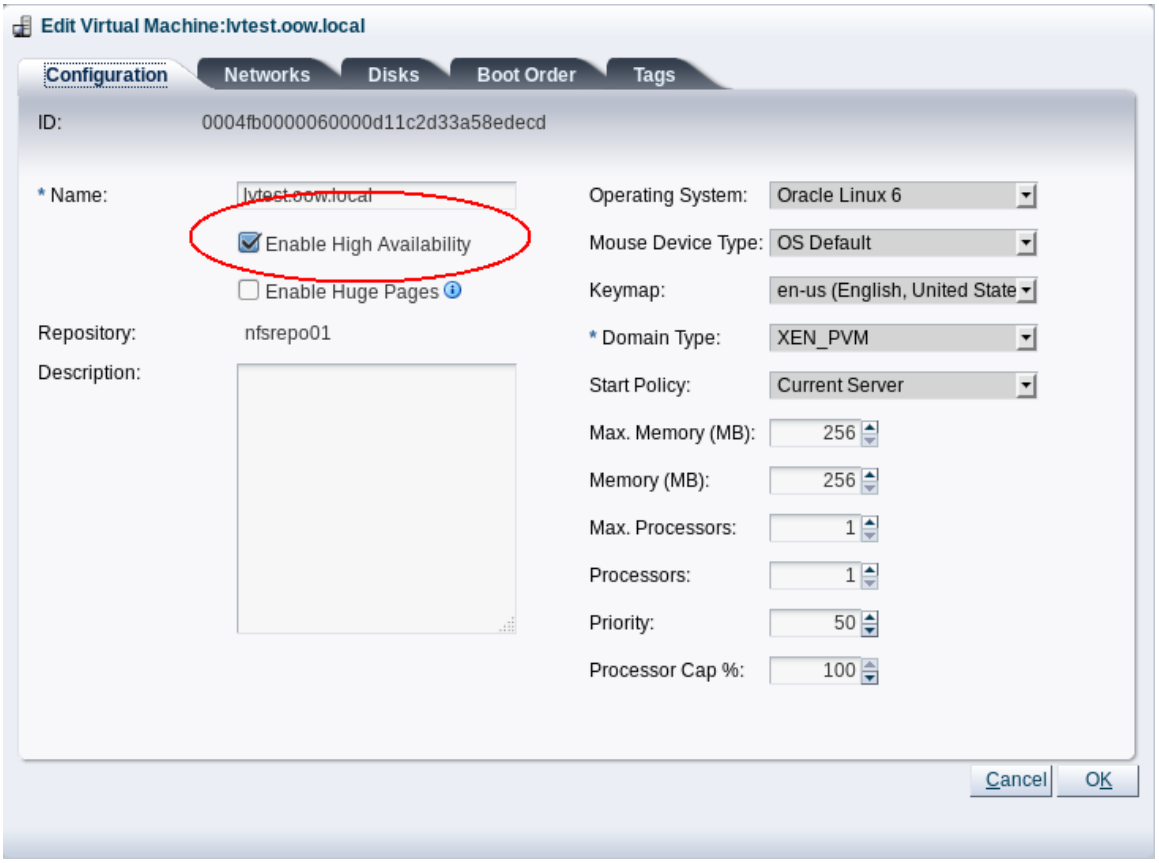
The following chart will better explain requirements of Oracle VM High Availability:



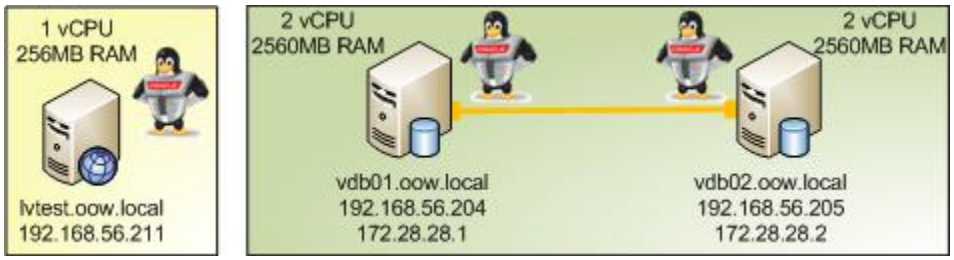
To use HA, you have to configure a clustered Oracle VM Server Pool:



To use HA, you have to enable High-Availability option on the Oracle VM Guest (virtual-server) :



On our architecture we have three virtual-servers (guests):

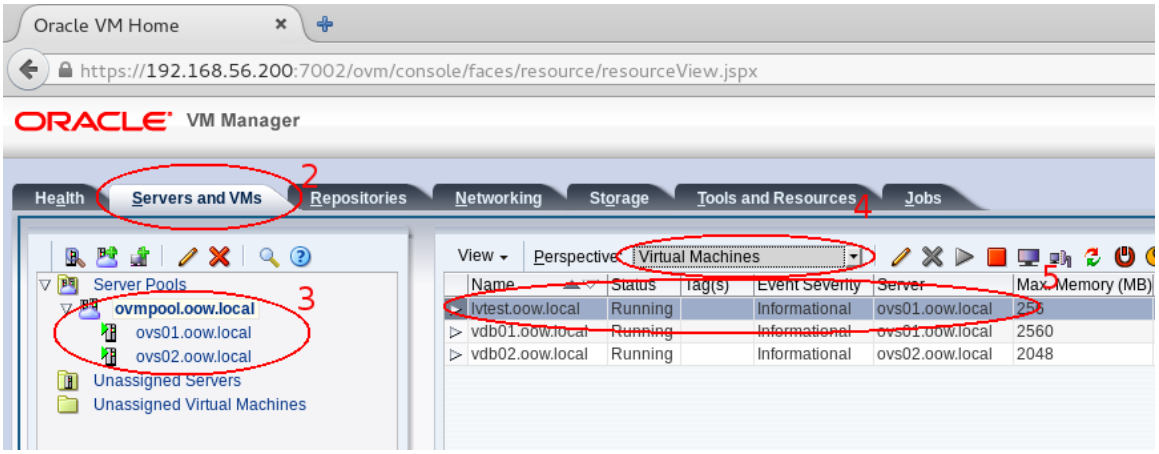


On our H/A tests, due to the reduced amount of resources available on our system,(mainly RAM), we will demonstrate both Oracle VM High-Availability and Oracle VM Live-Migrate using the guest named "**lvtest.oow.local**".

To demonstrate Oracle VM Live-Migrate features execute the following steps:

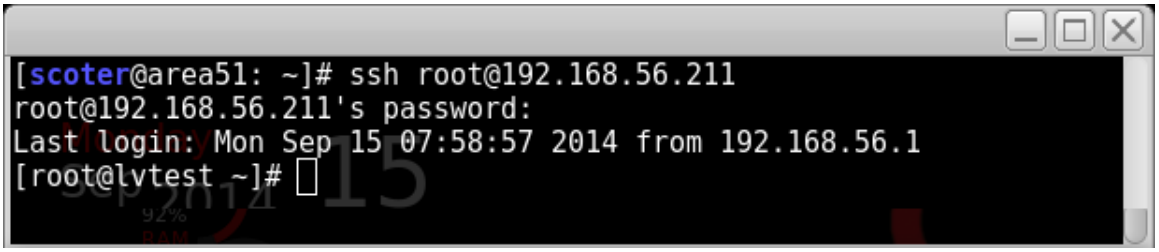
1. Connect to Oracle VM Manager and verify the status of the guest named "lvtest.oow.local".
   Oracle VM Manager URL: https://192.168.56.200:7002/ovm/console
   Username: admin
   Password: Welcome1
2. Select "**Servers & VMs tab**"
3. Expand and select pool named "**ovmpool.oow.local**"
4. Select perspective "**Virtual Machine**"

5. Verify the status of the virtual-server "**lvtest**" and which Oracle VM Server owns it.

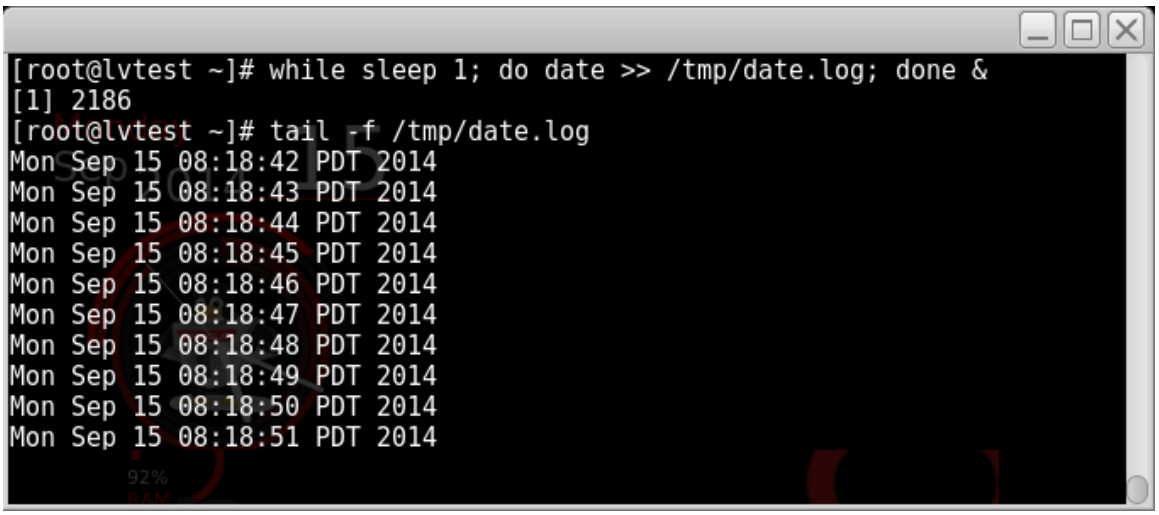


In the case above the guest "**lvtest.oow.local**" is running on Oracle VM Server "**ovs01.oow.local**".

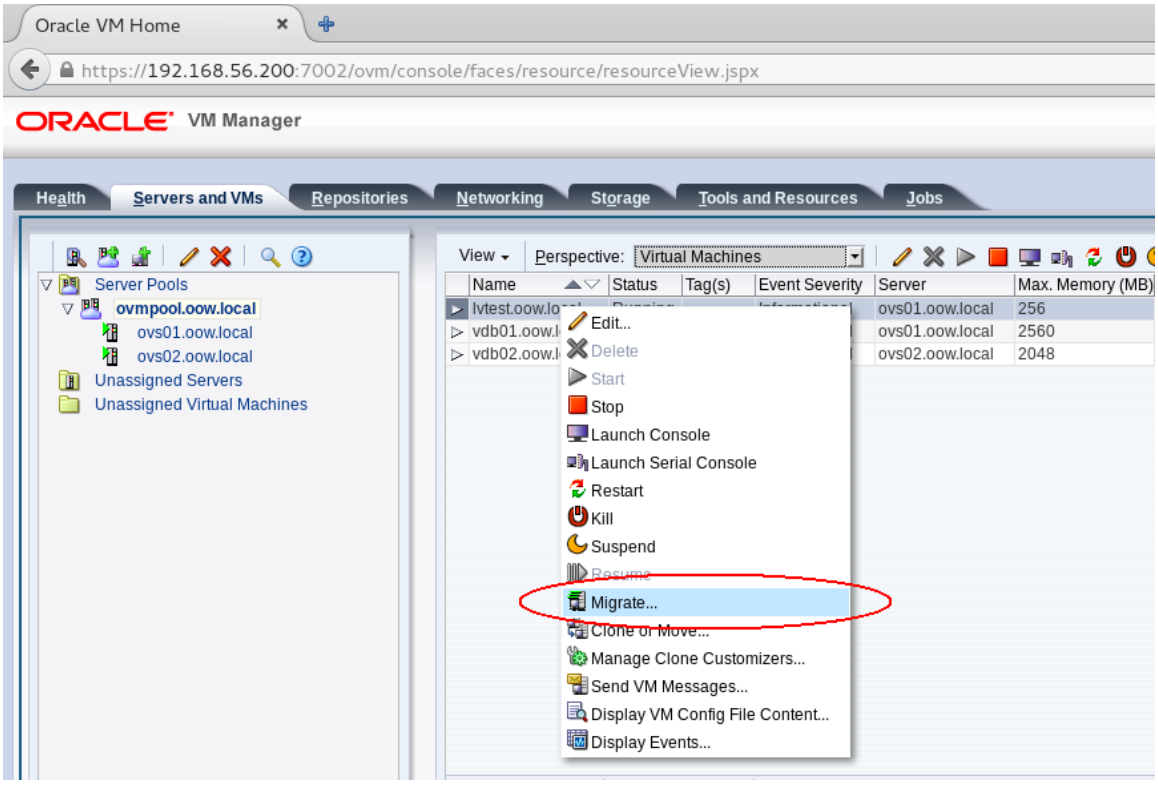
6. Connect, by ssh, to the server "**lvtest.oow.local**"
ssh root@192.168.56.211 (password is ovsroot)



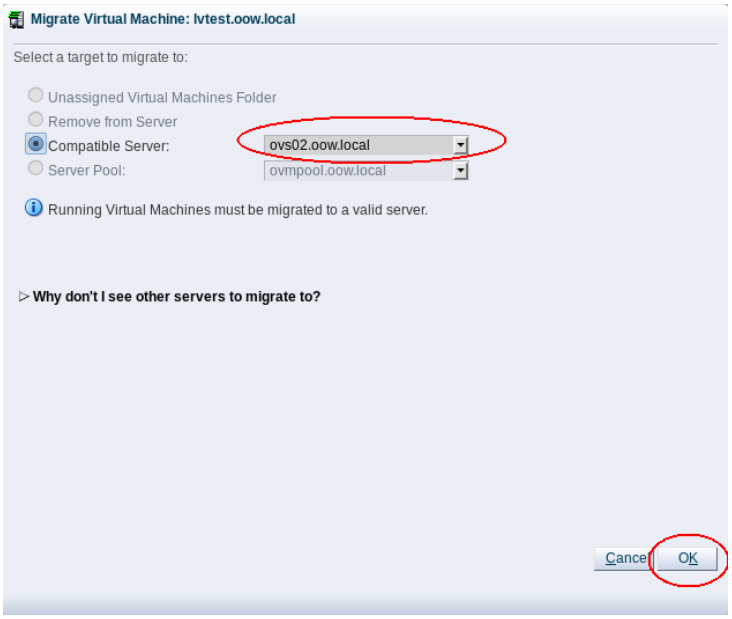
7. Launch a command that will show the date of the server updated every one second.
while sleep 1; do date >> /tmp/date.log; done &
 # tail -f /tmp/date.log



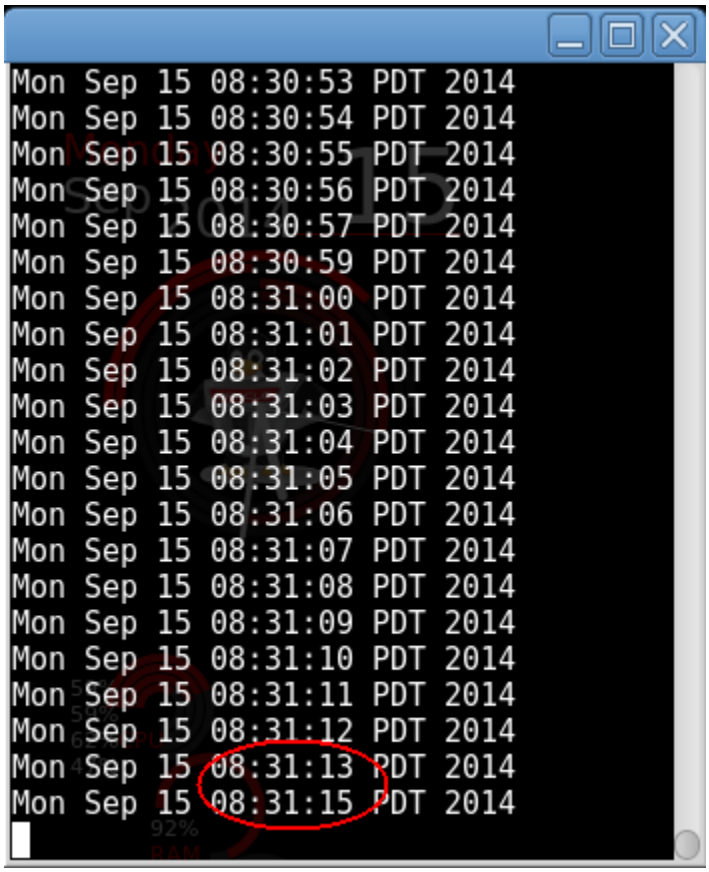
8. While this script is running, execute the live-migrate of the guest by Oracle VM Manager. Re-open the **Oracle VM Manager console**, select guest named "**lvtest.oow.local**", **right-click** and select "**Migrate**".



9. Select "compatible-server" "ovs02.oow.ocal" and confirm with "OK".

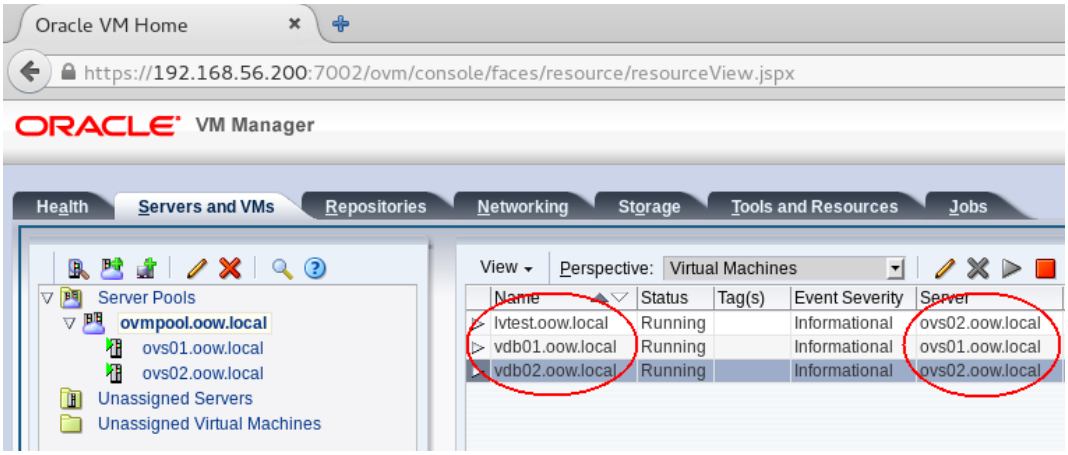


10. While migration is running, verify the output of the command executed at point (7) of this section and verify the sequentiality of the output; *in the worse case you'll lost only 1 second of the output and this is a very nice result for a demo environment built on top of VirtualBox.*



To demonstrate Oracle VM High-Availability features execute the following steps:

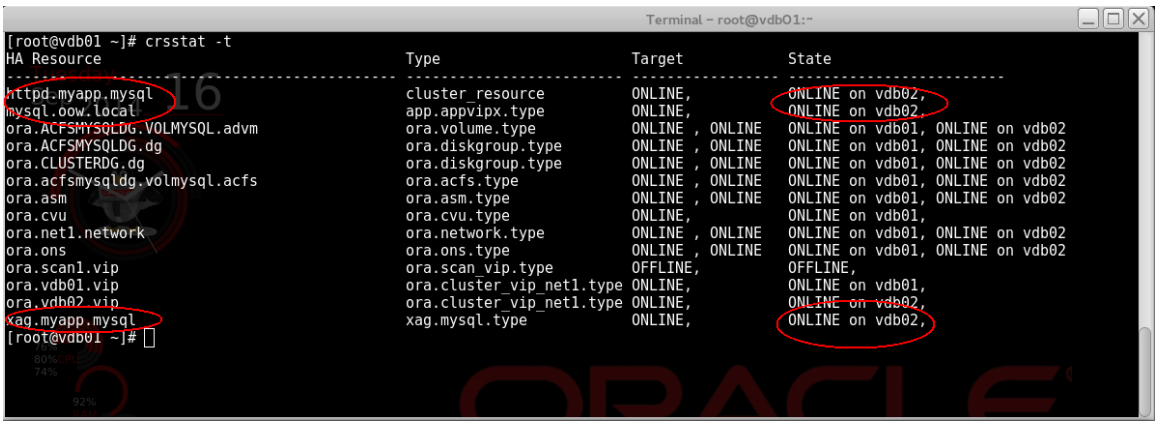
1. Connect to Oracle VM Manager and verify:
   - All three guests are in "Running" state
   - Which physical server owns the guest named "lvtest.oow.local"



In the example above:

- Guests "**lvtest**" and "**vdb02**" are running on physical server **ovs02.oow.local**
- Guest "**vdb01**" is running on physical server **ovs01.oow.local**

2. To simulate a complete outage, verify which of the clustered servers owns the mysql/webdemo service by connecting on one of them:
   ssh root@192.168.56.204
   crsstat –t

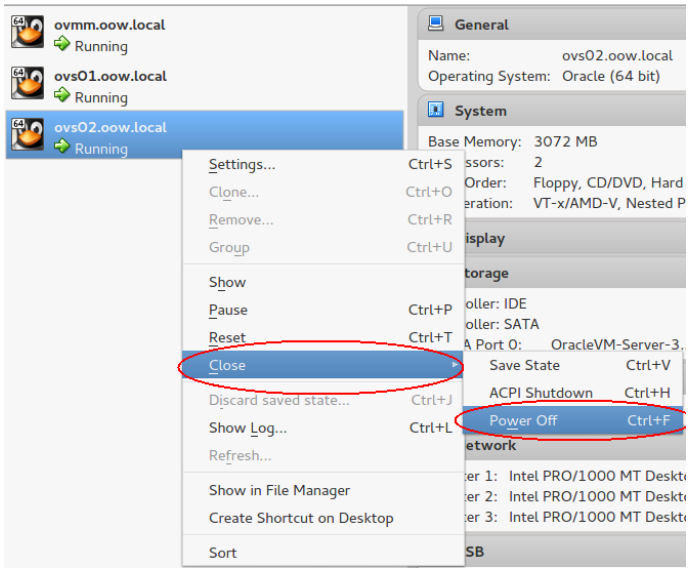


In the case above we have that:

- **web/mysql** services are active on guest **vdb02**
- guests **vdb02** and **lvtest** are active on Oracle VM Server **ovs02.oow.local**

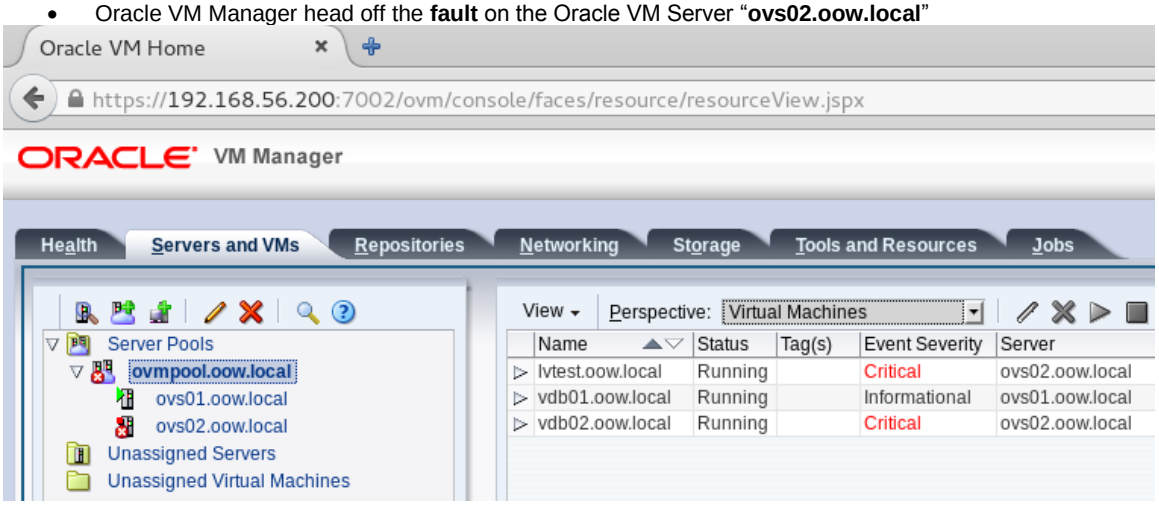
The target of this test is to **simulate a crash of the Oracle VM Server that owns**, at the same time, both guests **lvtest** and **vdb0(?)** that owns the **web/mysql services** (if you need to move services between cluster-nodes, you can use the steps reported in this document at the section "Demonstrate high-availability features covered by Oracle Clusterware"). This latest test will demonstrate how both components (Oracle VM and Oracle Clusterware) will together work to maintain the highest service-level possible.

3. Kill "Oracle VM Server" that owns all active web/mysql services and guest named "lvtest"
   Open "**VirtualBox Console**", right click on the server and choose "**Close**", "**Poweroff**".

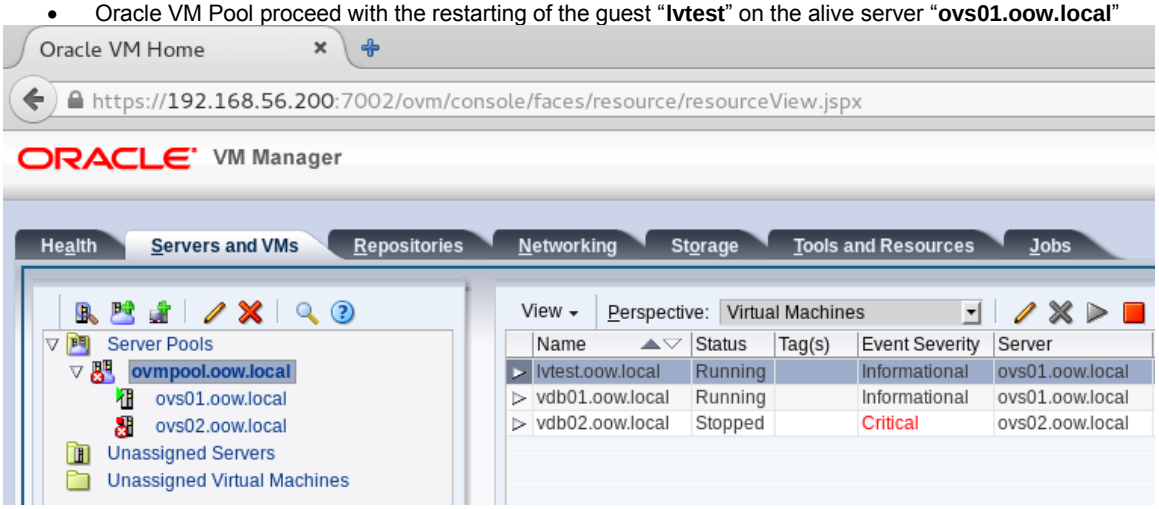


Next steps to exercise on the environment will be:

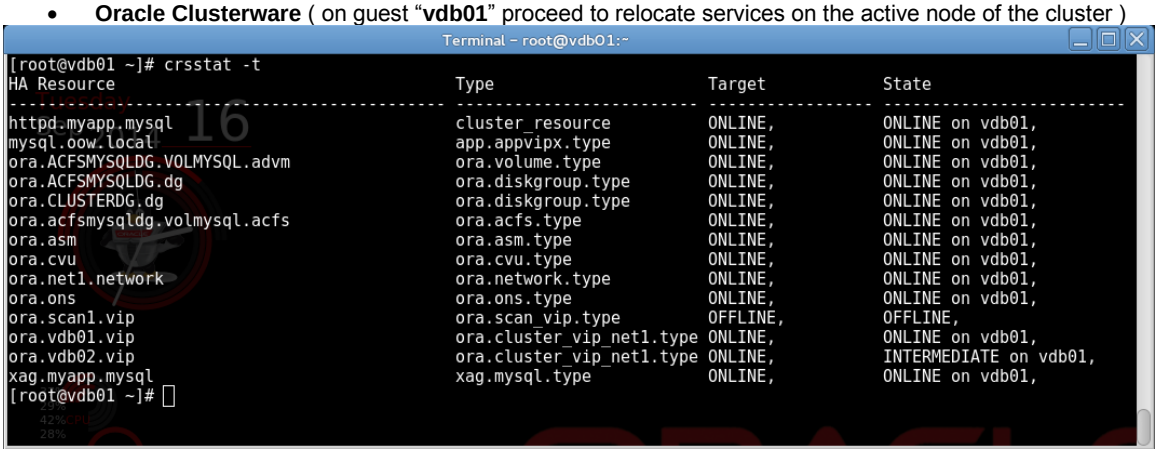
- Oracle VM Manager head off the **fault** on the Oracle VM Server "**ovs02.oow.local**"



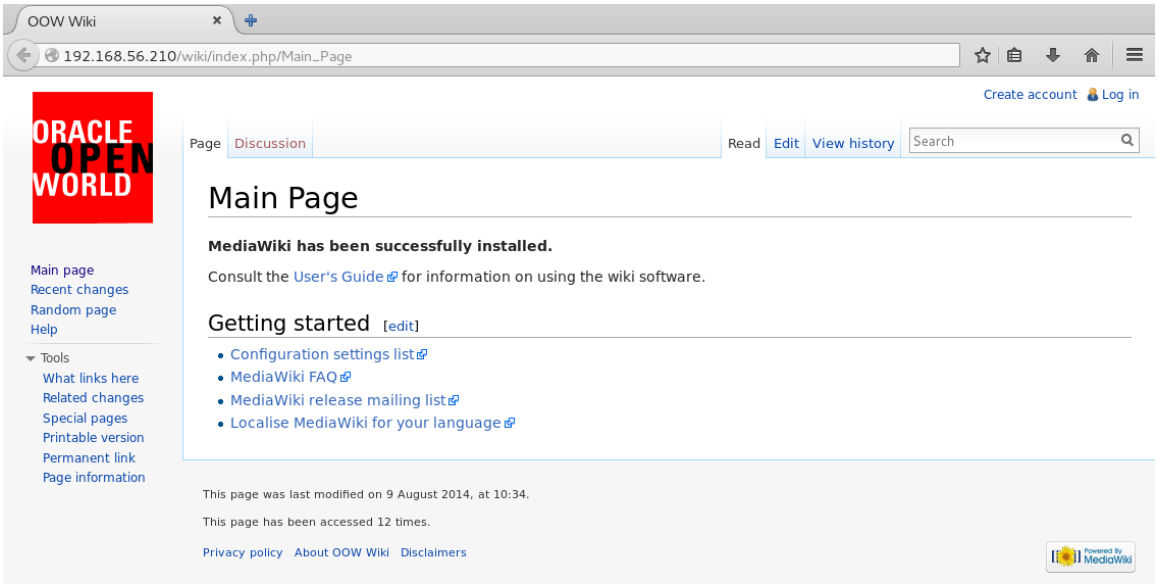
- Oracle VM Pool proceed with the restarting of the guest "**lvtest**" on the alive server "**ovs01.oow.local**"



- **Oracle Clusterware** (on guest "**vdb01**" proceed to relocate services on the active node of the cluster)



- Verify that web-demo application is still available connecting to its URL (http://192.168.56.210/wiki)



Upshot: Oracle VM High Availability

Summarizing what we saw during this lab we can say that an infrastructure of this type has high-availability functionality built in at every level, where:

- Oracle VM is able to automatically recover from a physical-server fault restarting a guest machine on an other node
- Oracle VM allows to schedule physical server maintenance (and/or replacement) without inefficiency thanks to live-migrate
- Oracle Clusterware allows to protect MySQL Server and any further application type with Grid Infrastructure Agents or with custom scripts; it's complementary to Oracle VM but it's also able to identify a fault within the guest (ex. Process dies, process fault and/or local filesystem corruption).
- Ksplice allows to update kernel-in-memory without disruption or server maintenance

This kind of architecture, obviously, is applicable to all Oracle and non-Oracle products on top of guest virtual-machines.

Appendix A: preparation of the environment before the lab

Purpose

This section explains how to prepare the environment to run this lab. It is useful if you want to run this lab at home or office.

The first step is to find an X86 machine (server, desktop or labtop) with the required resources (4 vcpus, 16 GB of ram, and 100 GB of disk space) and install Oracle VM VirtualBox on it.

Then, there are 3 servers to install (3 VirtualBox virtual machines in fact):

- Oracle VM Server (1 of 2)
- Oracle VM Server (2 of 2)
- Oracle VM Manager

Download required binaries

This section lists the required binaries and explains how to download them.

For your X86 machine:

1) **Oracle VM VirtualBox 4.3.x binaries (4.3.12 during writing of this document)**
   Download the version for your OS from https://www.virtualbox.org/wiki/Downloads

2) **Oracle VM VirtualBox extension Pack 4.3.x**
   Download from https://www.virtualbox.org/wiki/Downloads (same file for all OSes)

For Oracle VM Server:

3) **VirtualBox template for Oracle VM Server 3.3.1 (to update – SCOTER)**
   Download from http://www.oracle.com/technetwork/server-storage/vm/template-1482544.html
   Direct link: http://download.oracle.com/otn/vm/OracleVMServer3.2.4-b525.ova
   Filename: OracleVMServer.3.2.4-b525.ova (size 249 MB)

For Oracle VM Manager:

4) **VirtualBox template for Oracle VM Manager 3.3.1 (to update – SCOTER)**
   Download from http://www.oracle.com/technetwork/server-storage/vm/template-1482544.html

For Oracle VM guest Template:

5) **Oracle VM VirtualBox template for Oracle Linux 6.5 x86-64**
   Download for Oracle E-delivery Linux/Oracle VM platform (https://edelivery.oracle.com/oraclevm)
   Select Product Pack "**Oracle VM Templates**" and Platform "**x86 64 bit"**, then Click Go
   Select "Oracle Linux 6 Update 5 template (OVF) - Paravirtualized x86_64 (64 bit)"

Installation of Oracle VM VirtualBox

1) Find an x86 machine (desktop, laptop, server) matching the following prerequisites:
   - At least 16 GB of RAM
   - x86-64 CPU (Intel or AMD) - at least 4 cpus threads with Virtualization Extensions
   - OS supported by VirtualBox
   - 100 GB of disk space

2) Install the Oracle VM VirtualBox 4.3.x binaries on your x86 machine

3) Start the Oracle VM VirtualBox console

4) If not already created, create a two host only network in VirtualBox using following details:

- vboxnet0
  subnet = 192.168.56.0/24
  VBox Machine ip = 192.168.56.1

- vboxnet1
  subnet = 172.28.28.0/24
  VBox Machine ip = 172.28.28.254

5) Choose the folder you want to use to store the virtual machines files.
(go to File, Preferences, General, Default Machine Folder)

6) Install the Oracle VM VirtualBox extension Pack
(go to File, Preferences, Extensions)

Installation of Oracle VM Server (2 servers to install)

a) In the Oracle VM VirtualBox console, import the VM from the Oracle VM Server template
- File
- Import Appliance
- Select the file OracleVMServer.3.3.1-b1065.ova
- Next
- Change the name of the System 1 from "**Oracle VM Server 3.3.1-b1065**" to "**ovs01.oow.local**"
  The name for the second server is "**ovs02.oow.local**"
- Import

a) Modify the settings of the virtual machine "**ovs01.oow.local**" and "**ovs02.oow.local**"
- Configure the network
  - Network, Adapter 1, Attached to Host only Adapter, vboxnet0
  - Network, Adapter 2, Attached to Host only Adapter, vboxnet1
  - Network, Adapter 3, Attached to NAT
    All Virtual-NICS need the Promiscous-Mode (advanced section) set to "**Allow ALL**"

- Memory: **4096 MB**

- Configure the storage:
  - Enable Host I/O cache on the SATA Controller

b) Start the virtual machine "**ovs01.oow.local**"

c) Configure the virtual machine (in the VM console)
- Configure network
  - IP address : **192.168.56.201**
  - Netmask : **255.255.255.0**
  - Gateway : **192.168.56.1**
  - DNS server : **192.168.56.1**
    (we will not use DNS, but we have to give an IP address here)
  - Hostname : **ovs01.oow.local**
- Wait for the end of boot

d) Start the virtual machine "**ovs02.oow.local**"

e) Configure the virtual machine (in the VM console)
- Configure network
  - IP address : **192.168.56.202**
  - Netmask : **255.255.255.0**
  - Gateway : **192.168.56.1**
  - DNS server : **192.168.56.1**
    (we will not use DNS, but we have to give an IP address here)

- Hostname : **ovs02.oow.local**
- Wait for the end of boot

f) Open a terminal on your Unix/Linux x86 machine and connect to both VMs with ssh (you can use Putty on Microsoft Windows)
$ **ssh root@192.168.56.201** (password is ovsroot)
$ **ssh root@192.168.56.202** (password is ovsroot)

g) Add the following lines to the /etc/hosts file

```
# vm guest ip addresses
192.168.56.204    vdb01.oow.local vdb01
192.168.56.205    vdb02.oow.local    vdb02
192.168.56.206    vdb01-vip.oow.local        vdb01-vip
192.168.56.207    vdb02-vip.oow.local        vdb02-vip
# Scan-Vip Disabled
# 192.168.56.208  vdb-scan.oow.local         vdb-scan
192.168.56.210    mysql.oow.local    mysql
192.168.56.211    lvtest.oow.local   lvtest

# host ip addresses
192.168.56.200    ovmm.oow.local     ovmm
192.168.56.201    ovs01.oow.local    ovs01
192.168.56.202    ovs02.oow.local    ovs02
192.168.56.202    ovmpool.oow.local ovmpool
```

Installation of Oracle VM Manager

a) In the Oracle VM VirtualBox console, import the VM from the Oracle VM Manager template
- File
- Import Appliance
- Select the file OracleVMManager.3.3.1-b1065.ova
- Next
- Change the name of the System from "**Oracle VM Manager 3.3.1-b1065**" to "**ovmm.oow.local"**
- Import

b) Modify the settings of the virtual machine "**ovmm.oow.local**"
- Configure the network
  - Network, Adapter 1, Attached to Host only Adapter, vboxnet0
  - Network, Adapter 2, Attached to NAT

  All Virtual-NICS need the Promiscous-Mode (advanced section) set to "**Allow ALL**"

- Memory: **4096 MB**
- Storage**: add a new virtual-disk of 80 GB**

c) Start the virtual machine "**ovmm.oow.local**"

d) Configure the virtual machine (in the VM console)
- Set root password to **ovsroot**
- Configure network
  - IP address : **192.168.56.200**
  - Netmask : 255.255.255.0
  - Gateway : 192.168.56.1
  - DNS server : **192.168.56.1**
    (we will not use DNS, but we have to give an IP address here)
  - Hostname : ovmm.oow.local
- Wait for the end of boot

e) Open a terminal on your Unix/Linux x86 machine and connect to the VM with ssh (you can use Putty on Microsoft Windows)

$ **ssh root@192.168.56.200**

f) Add the following lines to the file /etc/hosts

```
# vm guest ip addresses
192.168.56.204    vdb01.oow.local vdb01
192.168.56.205     vdb02.oow.local     vdb02
192.168.56.206     vdb01-vip.oow.local          vdb01-vip
192.168.56.207     vdb02-vip.oow.local          vdb02-vip
# Scan-Vip Disabled
# 192.168.56.208  vdb-scan.oow.local          vdb-scan
192.168.56.210     mysql.oow.local     mysql
192.168.56.211     lvtest.oow.local     lvtest

# host ip addresses
192.168.56.200     ovmm.oow.local     ovmm
192.168.56.201     ovs01.oow.local     ovs01
192.168.56.202     ovs02.oow.local     ovs02
192.168.56.202     ovmpool.oow.local ovmpool
```

g) Create a new Volume-Group, two logical-volumes and create filesystems.

```
# fdisk -l
# fdisk /dev/sdc
# pvcreate /dev/sdc1
# vgcreate vgOVM /dev/sdc1
# lvdisplay
# lvcreate -L 13G -n ovspool vgOVM
# lvcreate -l 100%FREE -n ovsrepo vgOVM
# lvdisplay
# ls -l /dev/mapper/
# mkfs.ext4 /dev/mapper/vgOVM-ovspool
# mkfs.ext4 /dev/mapper/vgOVM-ovsrepo
```

h) Get logical-volume Block-ID and edit "/etc/fstab" and insert the new entries:

```
[root@ovmm ~]# blkid /dev/mapper/vgOVM-ovspool
/dev/mapper/vgOVM-ovspool: UUID="8df452d7-0b12-4a56-8b95-b30cd4bf491b" TYPE="ext4"
[root@ovmm ~]# blkid /dev/mapper/vgOVM-ovsrepo
/dev/mapper/vgOVM-ovsrepo: UUID="b854a663-04ec-45af-b021-250322866e8a" TYPE="ext4"

[root@ovmm ~]# cat /etc/fstab
#
# /etc/fstab
# Created by anaconda on Fri Jul 18 05:00:12 2014
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/mapper/VolGroup-lv_root /                       ext4    defaults        1 1
UUID=ea6616bd-14b7-46f6-8499-41ce4d56513a /boot                   ext4    defaults        1 2
UUID=81d05ca6-037b-4f53-90d0-274d067e2908 /u01                    ext4    defaults        1 2
UUID=8df452d7-0b12-4a56-8b95-b30cd4bf491b /home/nfs/ovmcluster     ext4  defaults      1 2
UUID=b854a663-04ec-45af-b021-250322866e8a /home/nfs/ovmdata       ext4  defaults      1 2
/dev/mapper/VolGroup-lv_swap swap                    swap    defaults        0 0
tmpfs                   /dev/shm                tmpfs   defaults        0 0
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
sysfs                   /sys                    sysfs   defaults        0 0
proc                    /proc                   proc    defaults        0 0
```

i) Mount new filesystems and verify that they are exported by NFS protocol.

```
# mount –a
```

cat /etc/exports
service nfs status

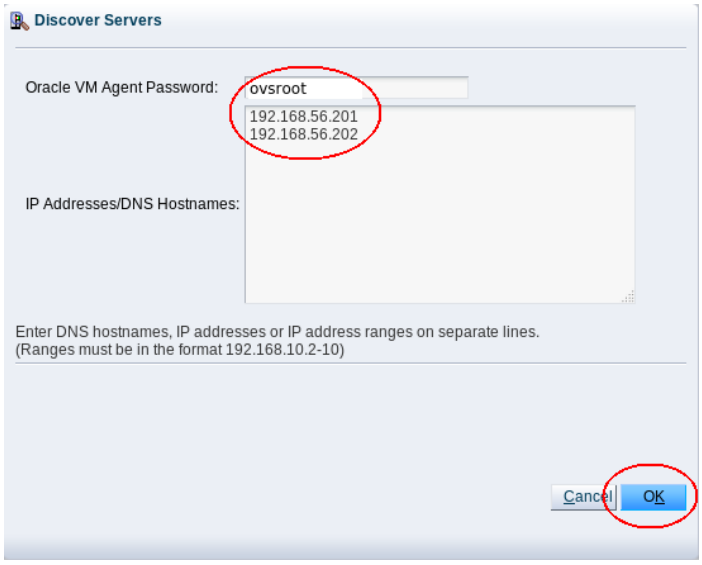
Example:
[root@ovmm ~]# cat /etc/exports
/home/nfs/ovmcluster *(rw,no_root_squash)
/home/nfs/ovmdata *(rw,no_root_squash)
[root@ovmm ~]# service nfs status
rpc.svcgssd is stopped
rpc.mountd (pid 1789) is running...
nfsd (pid 1806 1805 1804 1803 1802 1801 1800 1799) is running...
rpc.rquotad (pid 1785) is running...

Discover Oracle VM Servers, add the file server by Oracle VM Manager, create the Server Pool

Discover Oracle VM Servers installed with the following steps:

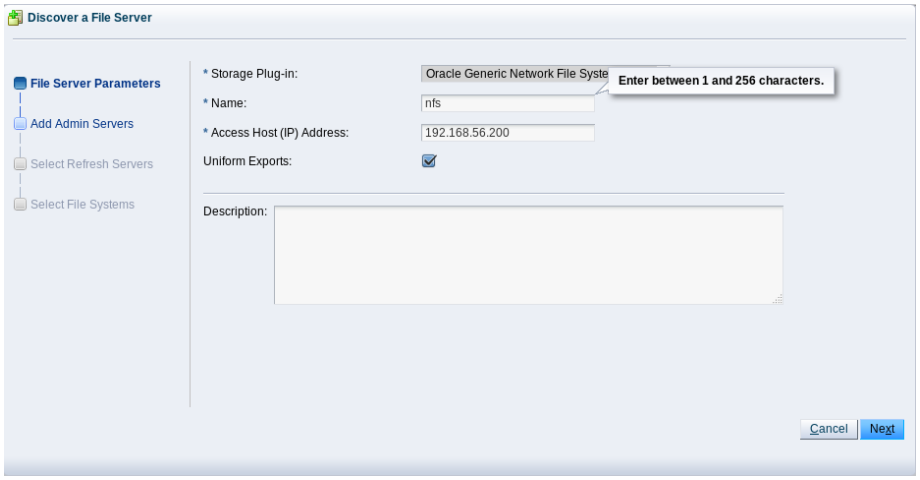
a) Click on the icon “Discover Servers...”

b) Insert values:
Oracle VM Agent Password: ovsroot
IP Addresses: 192.168.56.201 and 192.168.56.202

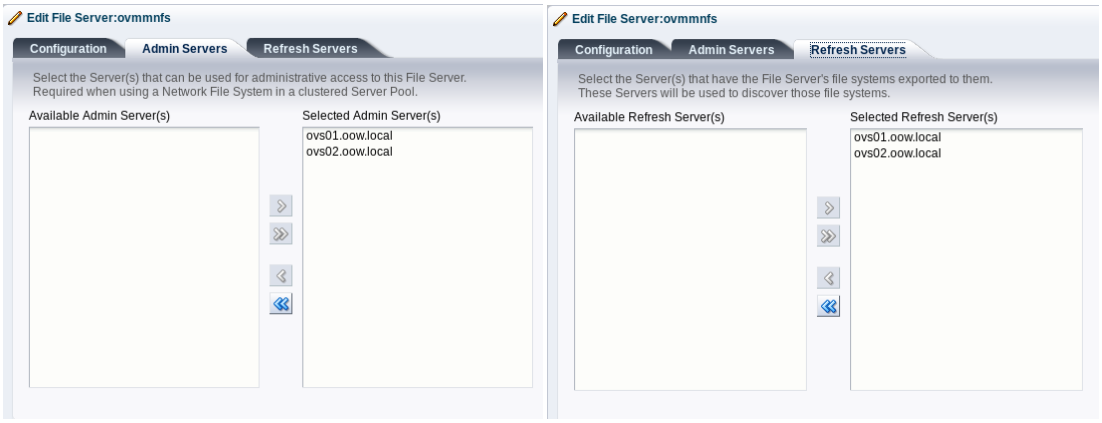


c) Add the file-server that will guest all nfs-filesystems needed

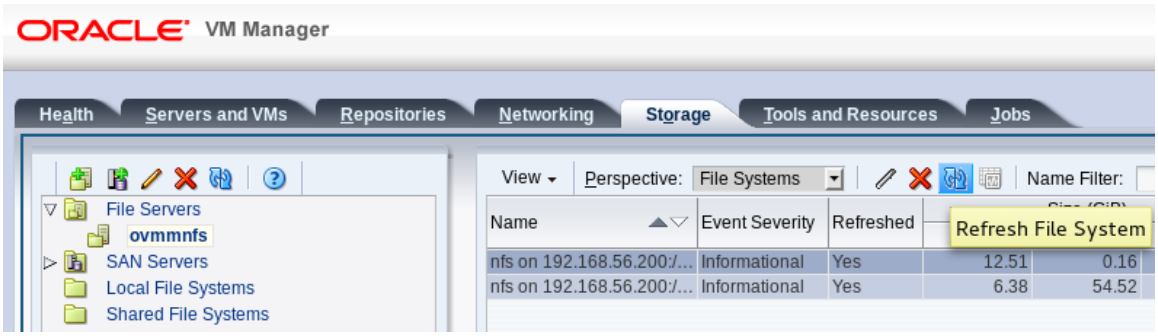
d) Insert nfs values:
Name: nfs
Access Host IP: 192.168.56.200



e) Verify that in the "**Admin**" and "**Refresh**" server both "**ovs01**" and "**ovs02**" exist.

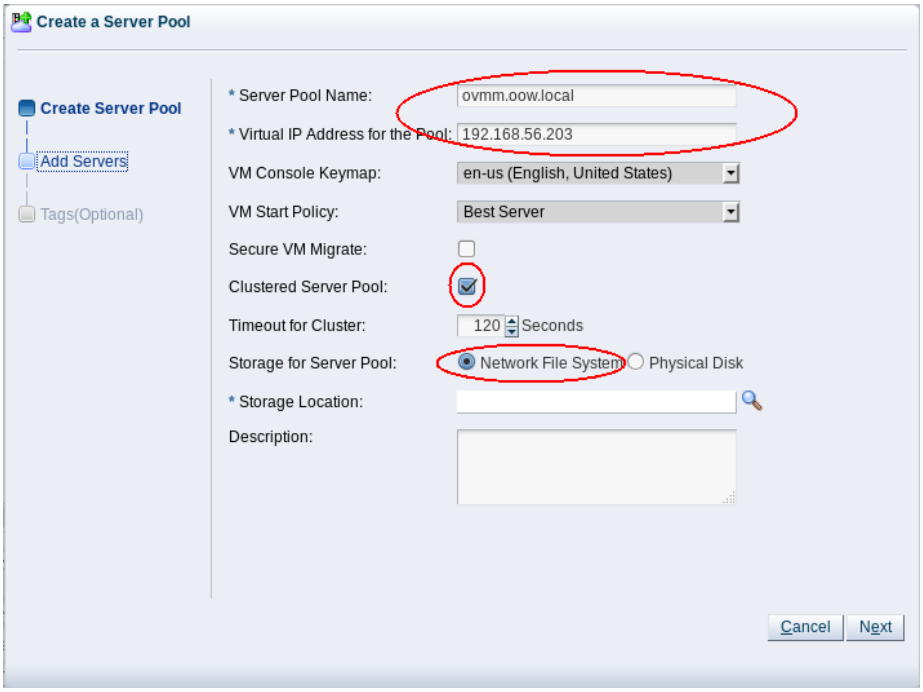


f) Refresh both NFS-Filesystem presented.



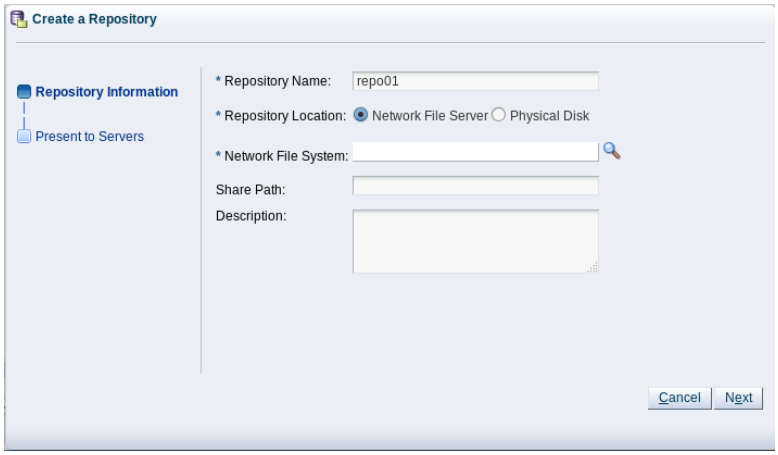
g) Create a clustered server-pool
Select “Servers and VMs” tab and click on the “Create Server Pool” icon.

h) Insert the following informations (“Storage Location” choose the ~12GB NFS-Filesystem)
In the next screen choose both servers and proceed with the pool creation.



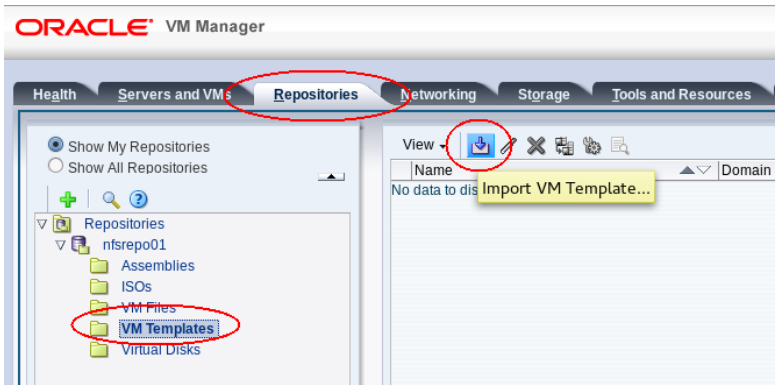
i) Create a new storage repository that will guest our vservers.

Insert the following informations, choose :
“Repository Location” : Network File Server
“Network File System”: filesystem with a size of at least 80gb

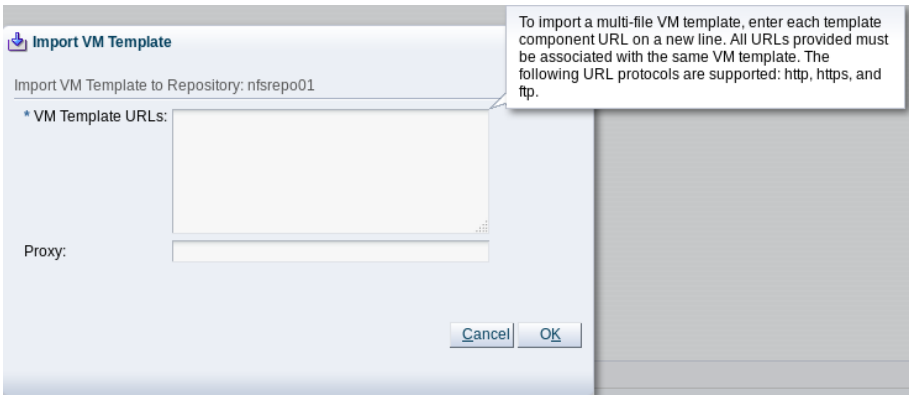


Import the “Oracle VM Template” Oracle Linux 6.5 x86-64

a) To import an Oracle VM Template proceed as shown in the following picture:



You can download this template at http://edelivery.oracle.com
To import an Oracle VM Template you have to supply an http/https/ftp URL:

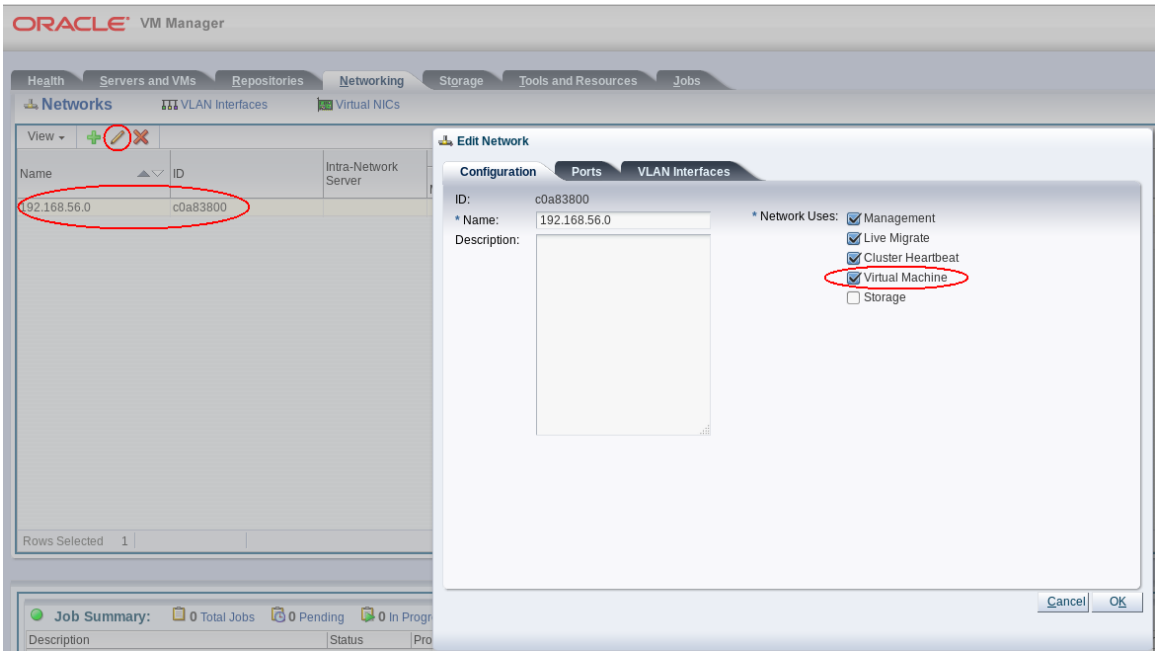


Modify the network configuration

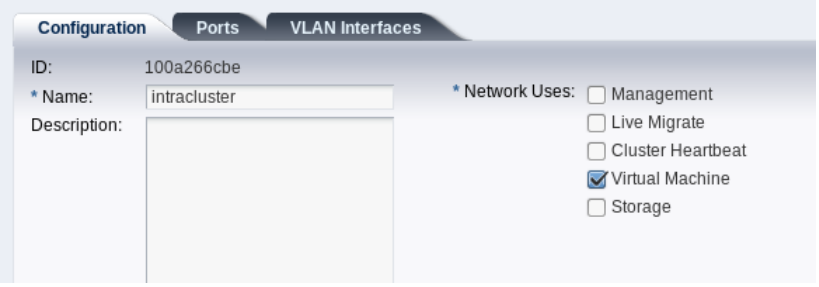
Each “Oracle VM Server” has three network-interfaces; their role will be:

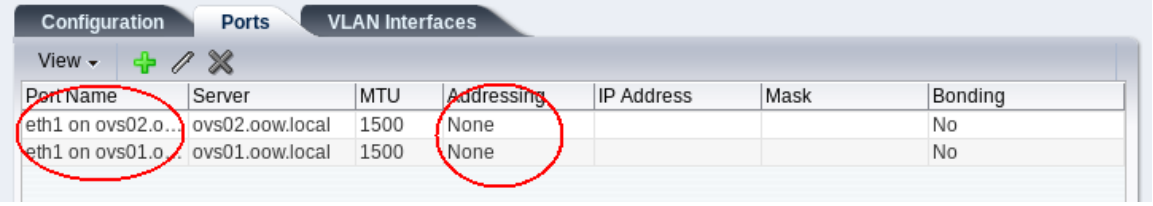
- eth0 = network dedicated to Network Management, Live Migrate, Cluster Heartbeat roles and Virtual-Machine public-Network.
- eth1 = network dedicated to guest intracluster Network
- eth2 = network dedicated to guest internet-access Network (DHCP)

a) On the “Networking” Tab, edit the “default” network and add the role “Virtual Machine”

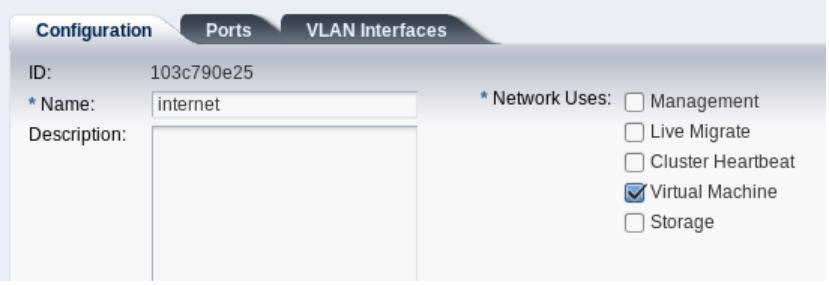


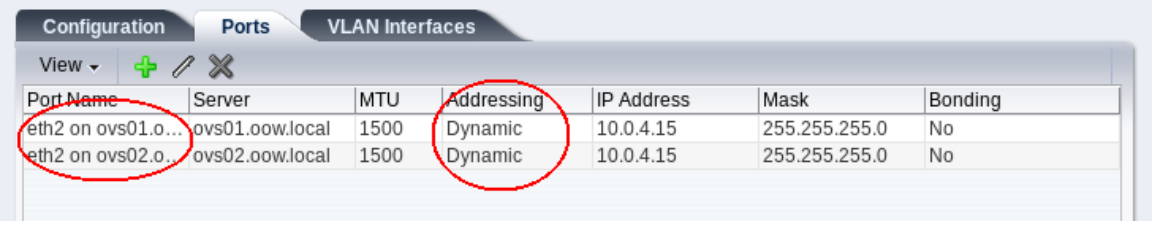
b) Create a new network named “Intracluster” and assign NICs “eth1” to it.





c) Create a new network named “Internet” and assign NICs “eth2” to it.





Create three new guest(s) servers

- vdb01.oow.local = node(1) of the Oracle Clusterware
- vdb02.oow.local = node(2) of the Oracle Clusterware
- lvtest.oow.local = spare-node dedicated to live-migration test(s).

To create these new three guests you can use the Oracle VM Templated imported in the steps before.

Here the guest(s) details:

vdb01.oow.local

Processors: 2
Max Processors: 2
Memory: 2560 MB
Max Memory: 2560 MB
Disk(s): default OS disk of 13GB, one more local virtual-disk of 15GB

Network: first NIC network "**192.168.56.0**", second NIC network "**intracluster**", third NIC network "**internet**".

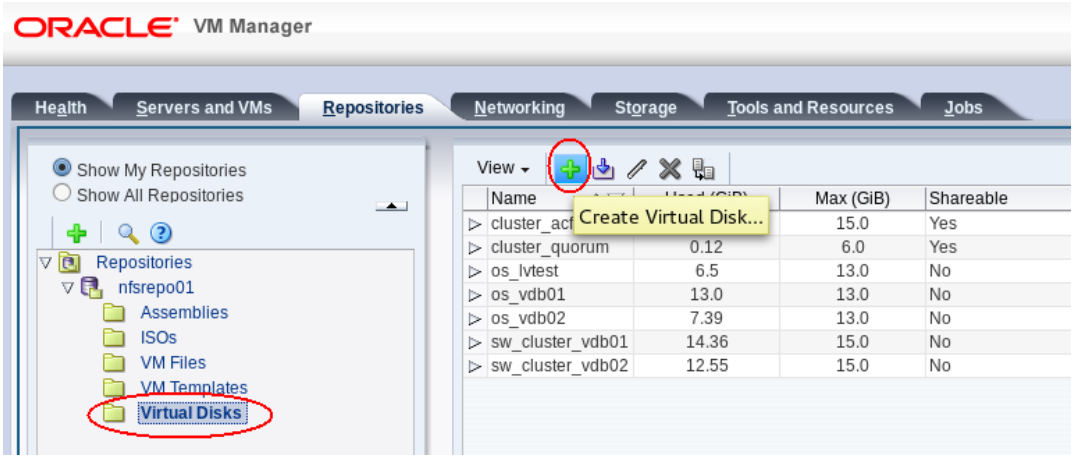
vdb02.oow.local

Processors: 2
Max Processors: 2
Memory: 2560 MB
Max Memory: 2560 MB
Disk(s): default OS disk of 13GB, one more local virtual-disk of 15GB
Network: first NIC network "**192.168.56.0**", second NIC network "**intracluster**", third NIC network "**internet**".

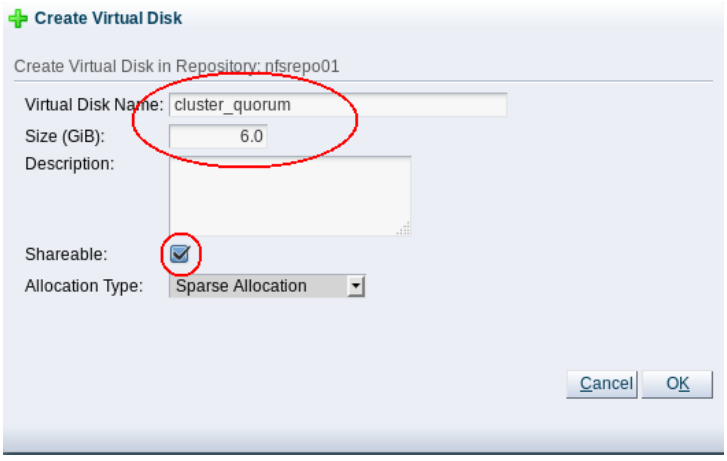
lvtest.oow.local

Processors: 1
Max Processors: 1
Memory: 256 MB
Max Memory: 256 MB
Disk(s): default OS disk of 13GB
Network: first NIC network "**192.168.56.0**", third NIC network "**internet**".

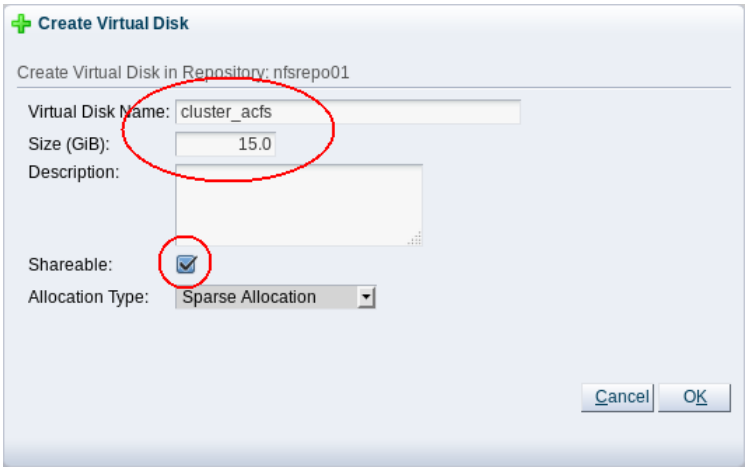
Create additional virtual-disks that will be dedicated to Oracle Clusterware; on the "Repository" tab, expand your repository, choose "Virtual Disks" and add two new virtual-disks like in the example below:



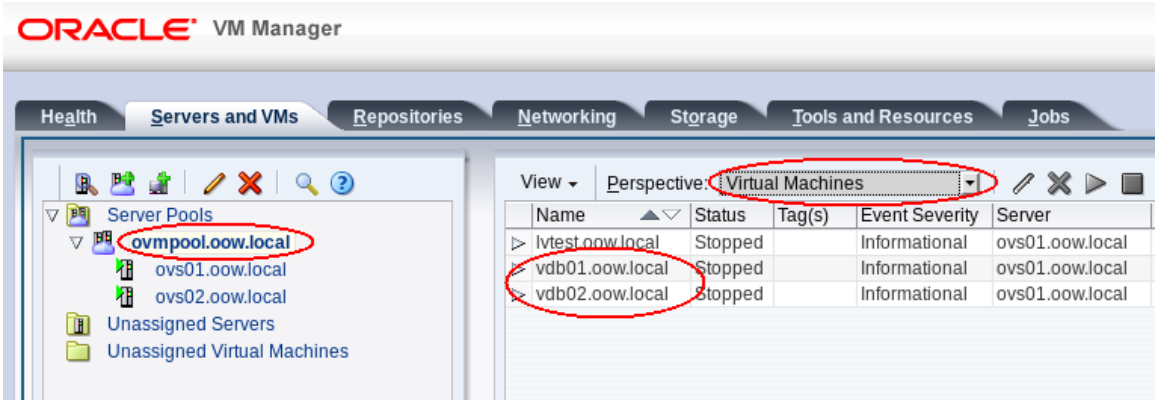
Add one **shared** disk of 6 GB named "**cluster_quorum**" with the following details:



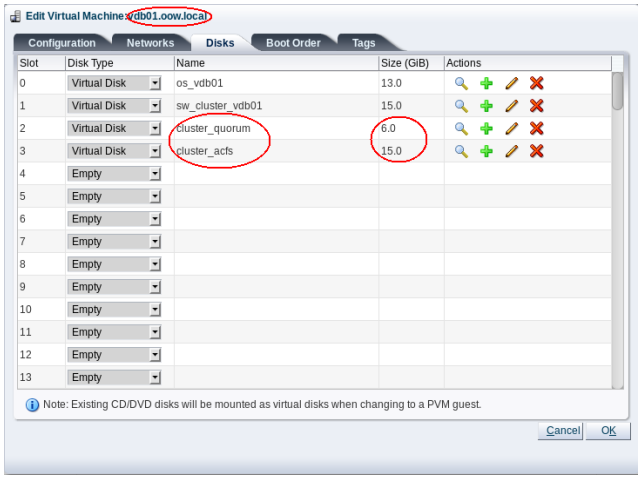
Add one **shared** disk of 15 GB named "**cluster_acfs**" with the following details:



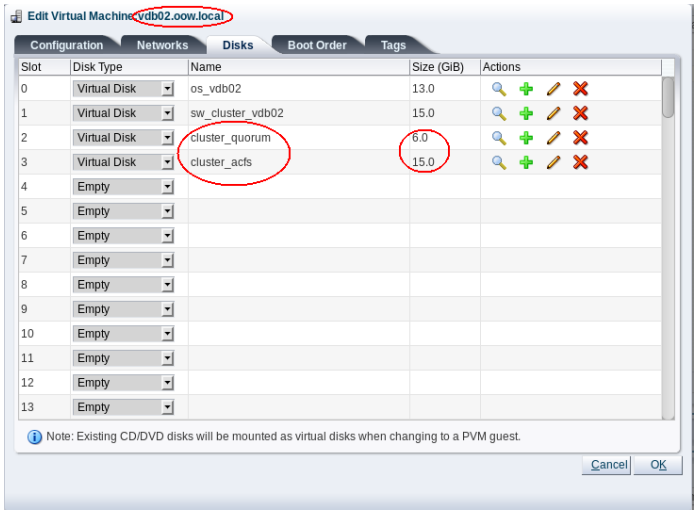
Present these two shared virtual disks to both **vdb0(x)** guests**;** select "**Server and VMs**" tab, expand and select your pool, select "**Virtual Machine**" perspective and edit both **vdb01/vdb02** guests:



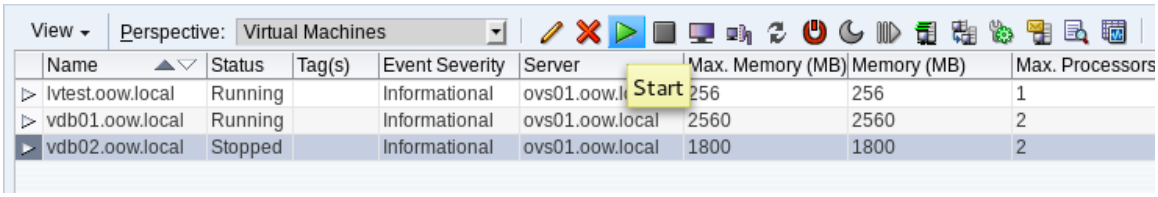
Select and edit guest named "**vdb01.oow.local**":



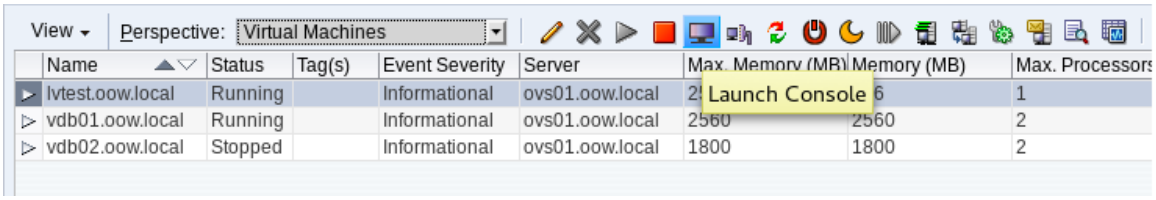
Select and edit guest named “**vdb02.oow.local**”:



Start all the guests and supply the first configuration by “**Oracle VM Guest console**”.

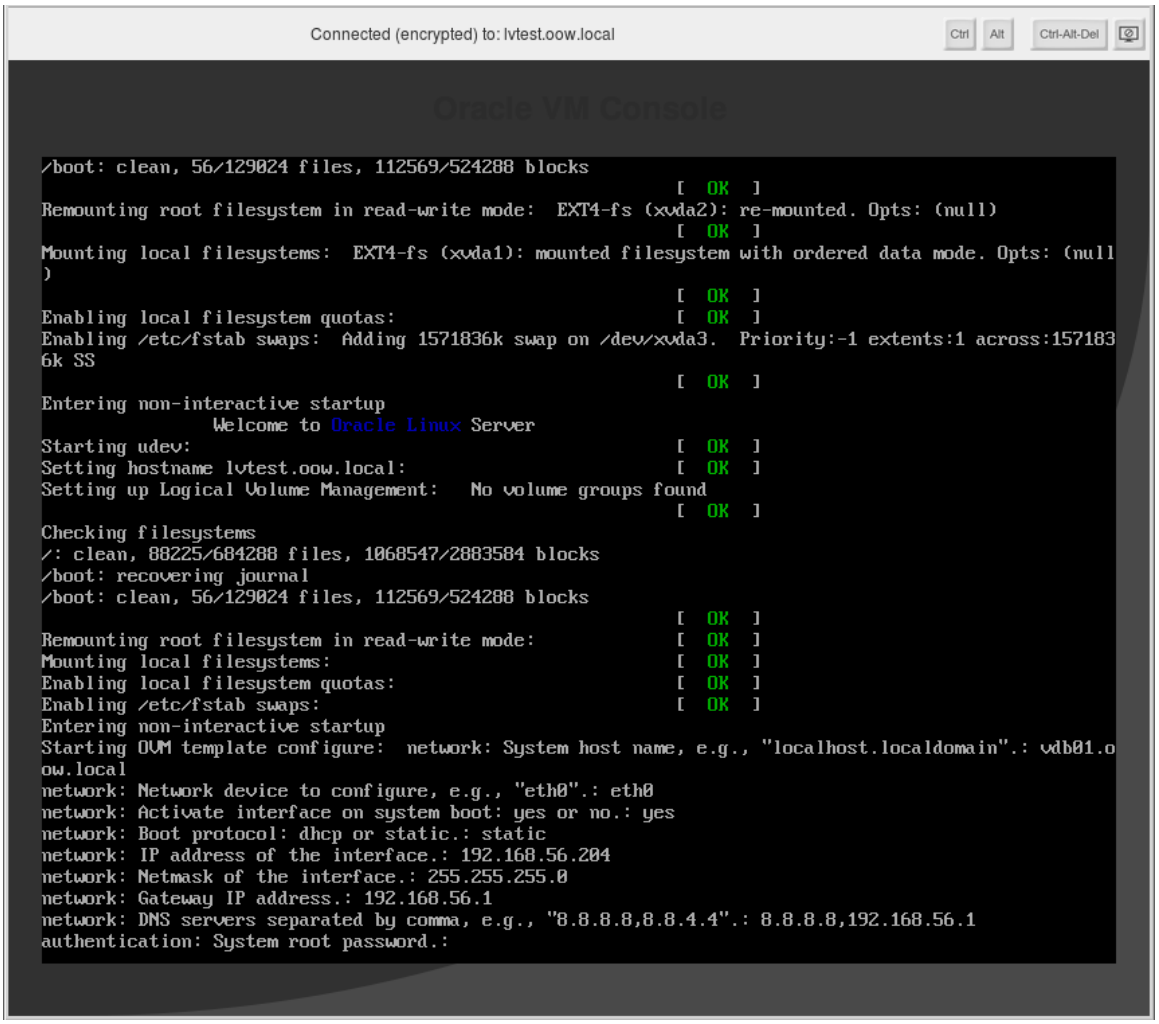


Open the **console** of each guest.



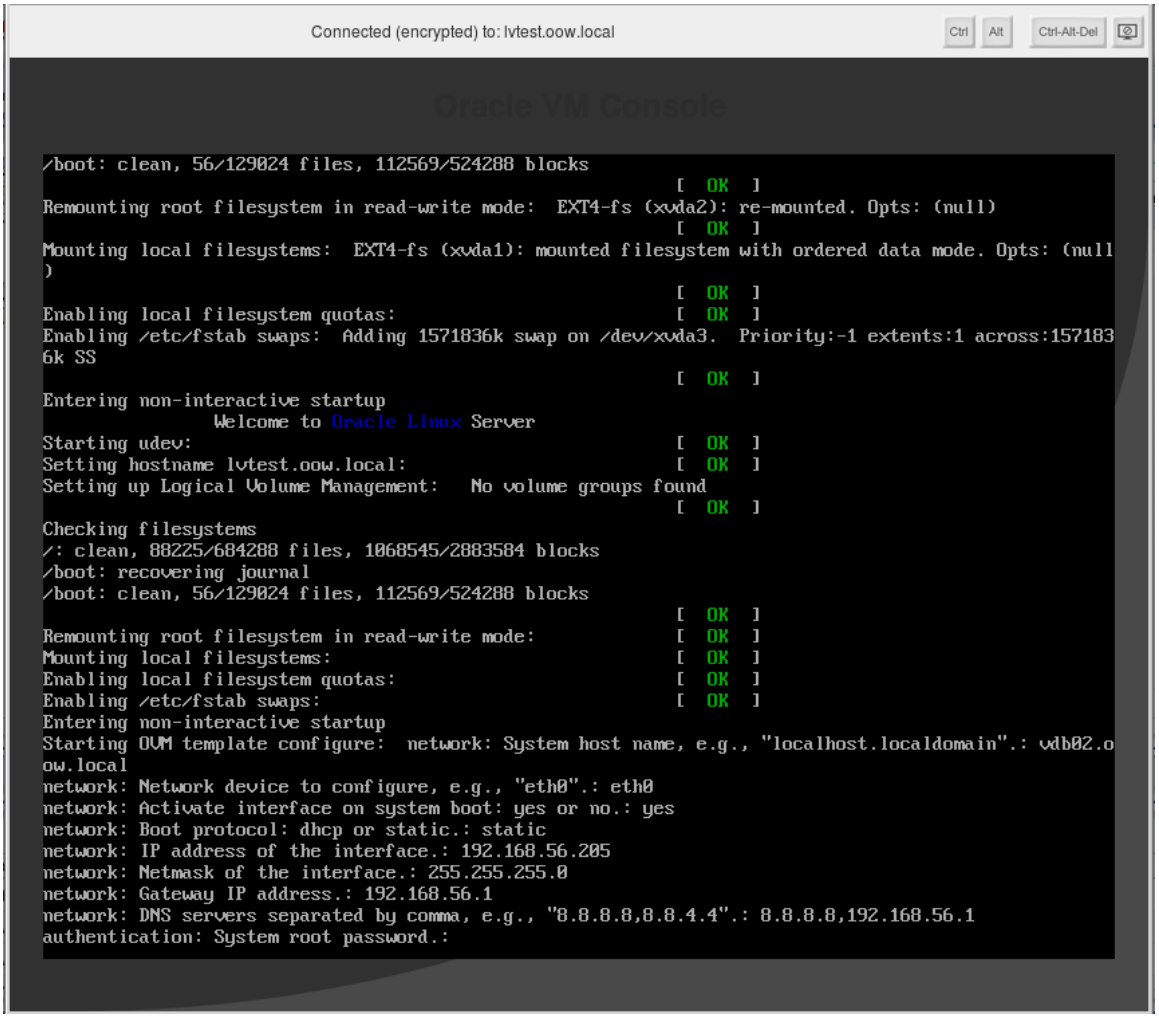
vdb01.oow.local details:

Hostname: **vdb01.oow.local**
Network device to configure: **eth0**
Activate interface on system boot: **yes**
Boot protocol: **static**
IP address for the interface: **192.168.56.204**
Netmask of the interface: **255.255.255.0**
Gateway IP address: **192.168.56.1**
DNS servers separated by comma: **8.8.8.8,192.168.56.1**
System Root Password: < *password containing uppercase, minorcase and at least one number* > ex **SimonCoter1**



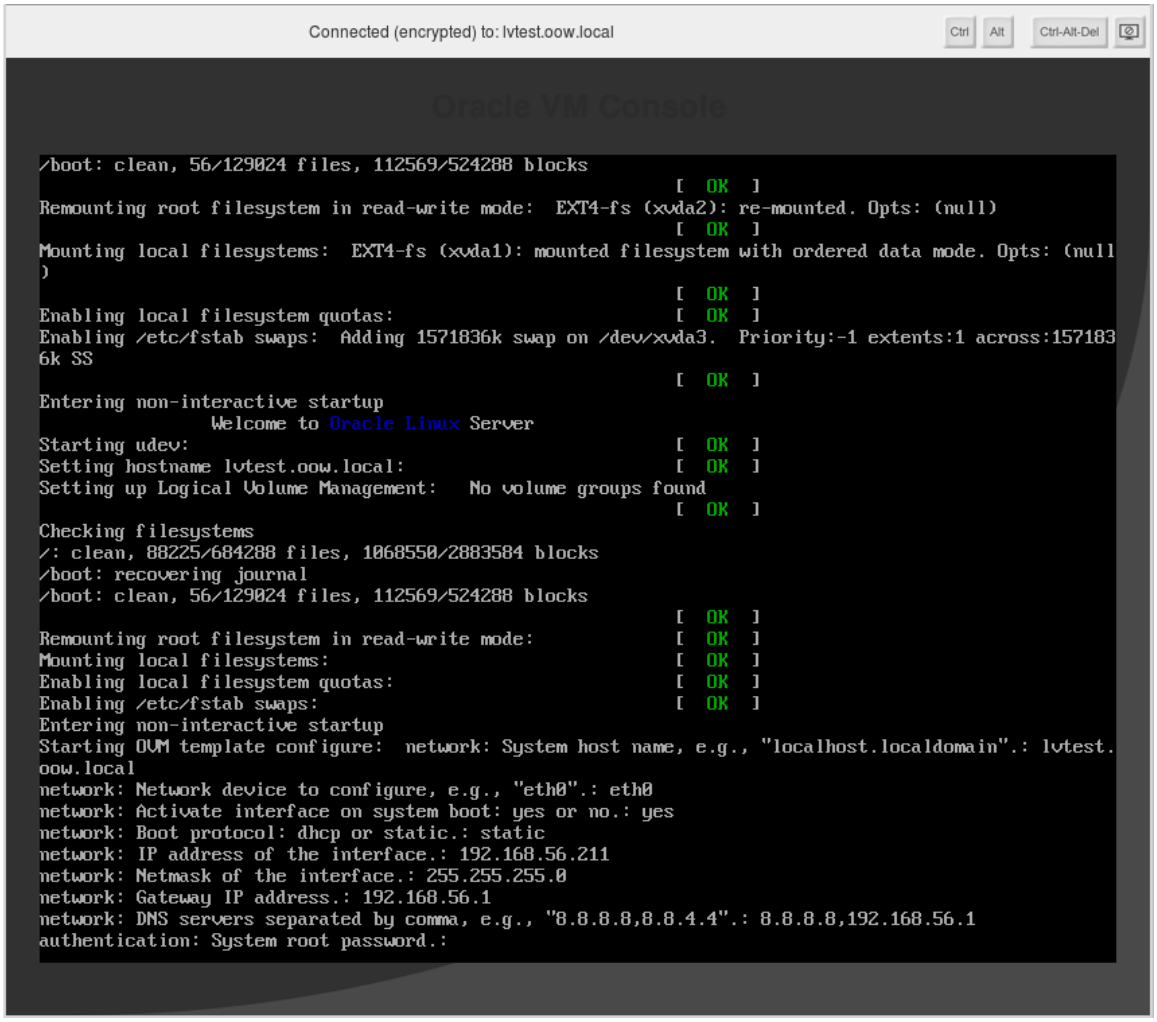
vdb02.oow.local details:

Hostname: **vdb02.oow.local**
Network device to configure: **eth0**
Activate interface on system boot: **yes**
Boot protocol: **static**
IP address for the interface: **192.168.56.205**
Netmask of the interface: **255.255.255.0**
Gateway IP address: **192.168.56.1**
DNS servers separated by comma: **8.8.8.8,192.168.56.1**
System Root Password: < *password containing uppercase, minorcase and at least one number* > ex **SimonCoter1**



lvtest.oow.local details:

Hostname:**lvtest.oow.local**
Network device to configure: **eth0**
Activate interface on system boot: **yes**
Boot protocol: **static**
IP address for the interface: **192.168.56.211**
Netmask of the interface: **255.255.255.0**
Gateway IP address: **192.168.56.1**
DNS servers separated by comma: **8.8.8.8,192.168.56.1**
System Root Password: < *password containing uppercase, minorcase and at least one number* > ex **SimonCoter1**



Connect to guests “**vdb01.oow.local**” and “**vdb02.oow.local**” and apply following changes:

Network

vdb01.oow.local
Under path “**/etc/sysconfig/network-scripts**” create the following files:

Ifcfg-eth1
#########
NETMASK=255.255.255.0
IPADDR=172.28.28.1
BOOTPROTO=static
ONBOOT=yes
NM_CONTROLLED=no
DEVICE=eth1
IPV6INIT=no

Ifcfg-eth2
#########
DNS2=8.8.8.8
DNS1=192.168.56.1
BOOTPROTO=dhcp
ONBOOT=yes
NM_CONTROLLED=no
DEVICE=eth2
IPV6INIT=no

After that execute the following comnand:
 # nohup service network restart &

and verify that all ip addresses are up and running.

vdb02.oow.local
Under path “**/etc/sysconfig/network-scripts**” create the following files:

Ifcfg-eth1
#########
NETMASK=255.255.255.0
IPADDR=172.28.28.2
BOOTPROTO=static
ONBOOT=yes
NM_CONTROLLED=no
DEVICE=eth1
IPV6INIT=no

Ifcfg-eth2
#########
DNS2=8.8.8.8
DNS1=192.168.56.1
BOOTPROTO=dhcp
ONBOOT=yes
NM_CONTROLLED=no
DEVICE=eth2
IPV6INIT=no

After that execute the following comnand:
 # nohup service network restart &

and verify that all ip addresses are up and running.

Add the following entries in "**/etc/hosts**" of both nodes:

```
# vm guest ip addresses
192.168.56.204  vdb01.oow.local vdb01
192.168.56.205  vdb02.oow.local vdb02
192.168.56.206  vdb01-vip.oow.local     vdb01-vip
192.168.56.207  vdb02-vip.oow.local     vdb02-vip
192.168.56.208  vdb-scan.oow.local      vdb-scan
192.168.56.210  mysql.oow.local mysql
192.168.56.211  lvtest.oow.local        lvtest
# host ip addresses
192.168.56.200  ovmm.oow.local  ovmm
192.168.56.201  ovs01.oow.local ovs01
192.168.56.202  ovs02.oow.local ovs02
192.168.56.202  ovmpool.oow.local       ovmpool
```

Packages

Execute on both nodes (**vdb01** and **vdb02**) the following command***:

 # yum install oracle-rdbms-server-12cR1-preinstall oracleasm-support -y

*** your laptop need an internet connection to allow both guests download that packages.

Selinux and firewall (iptables)

On both nodes (**vdb01** and **vdb02**):

- Verify or edit the file "**/etc/selinux/config**" and verify that its flag is set, at least, as "**permissive**".
- Stop and disable "**iptables**" service with the following commands:
  # service iptables stop
  # chkconfig iptables off

NTPD configuration

Edit on both nodes (**vdb01** and **vdb02**) the file "/etc/sysconfig/ntpd" and add the option "-x":

OPTIONS="-x -u ntp:ntp -p /var/run/ntpd.pid"

Restart **ntpd** service:
 # service ntpd restart

Create filesystem /u01 on both nodes (vdb01 and vdb02)

The filesystem will be created on the second local-disk of 15 GB size, with the following commands:

fdisk /dev/xvdb1 (options => n, p, 1, <return>, <return>)
mkfs.ext4 /dev/xvdb1

Mount filesystem "/u01" on both nodes (vdb01 and vdb02)

Edit file "**/etc/fstab**" and insert the following line:

/dev/xvdb1 /u01   ext4   defaults 0 0

Mount the filesystem and verify that it's mounted:

 # mount –a

 # df –k

Output example of "**df –k**":

```
[root@vdb01 ~]# df -k
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/xvda2            11362480   4207728   6593872  39% /
tmpfs                  8388608    647796   7740812   8% /dev/shm
/dev/xvda1              508004    100015    386090  21% /boot
/dev/xvdb1            15480816  10597608   4096828  73% /u01
```

Prepare "oracleasm" disks to be used by Oracle Clusterware

As "**root**" on first server (**vdb01**) execute:

```
# fdisk /dev/xvdc1 ( options n, p, 1, <return>, <return> )
# fdisk /dev/xvdd1 ( options n, p, 1, <return>, <return> )
# oracleasm createdisk CLUSTER01 /dev/xvdc1
# oracleasm createdisk ACFSMYSQL01 /dev/xvdd1
```

As "root" on second server (vdb02) execute:

```
# partprobe /dev/xvdc
# partprobe /dev/xvdd
# oracleasm scandisks
```

Check on **both nodes** the output of the command "**oracleasm listdisks**":

Set pasword for user "oracle" on nodes "vdb01" and "vdb02".

On both nodes, as "**root**" execute:
 # passwd oracle
** choose "**oracle**" as default password*

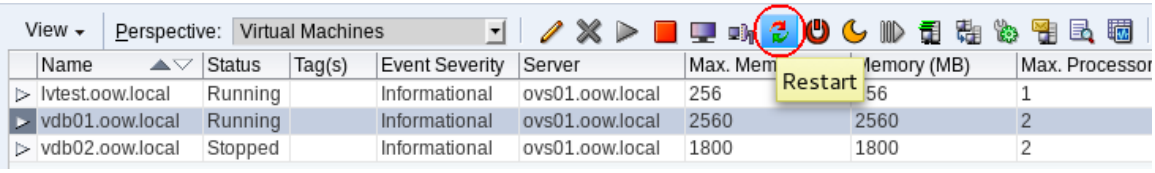
Environment files

As "**oracle**" user edit the file "**/home/oracle/.bash_profile**" and add the following envs:

```
################
vdb01.oow.local
################
# User specific environment and startup programs
ORACLE_HOME=/u01/cluster/12.1.0/grid
ORACLE_BASE=/u01/app/oracle
ORACLE_SID=+ASM1
XAG_HOME=/u01/cluster/12.1.0/xag
PATH=$XAG_HOME/bin:$ORACLE_HOME/bin:$PATH:$HOME/bin

export ORACLE_BASE ORACLE_HOME ORACLE_SID PATH

################
vdb02.oow.local
```

```
###############
# User specific environment and startup programs
ORACLE_HOME=/u01/cluster/12.1.0/grid
ORACLE_BASE=/u01/app/oracle
ORACLE_SID=+ASM2
XAG_HOME=/u01/cluster/12.1.0/xag
PATH=$XAG_HOME/bin:$ORACLE_HOME/bin:$PATH:$HOME/bin

export ORACLE_BASE ORACLE_HOME ORACLE_SID PATH
```

By "**Oracle VM Manager**" reboot your guests and verify that every change (network, filesystem, firewall, etc) is correctly working.



Download from your laptop the software(s) at the following URL:

http://www.oracle.com/technetwork/database/database-technologies/clusterware/downloads/index.html

Download Oracle Grid Infrastructure Rel. 12.1.0.1

Download Oracle Grid Infrastructure Standalone Agents

And put the software on your virtual-guest "**vdb01.oow.local**".

Install Oracle Grid Infrastructure 12c on nodes "vdb01.oow.local" and "vdb02.oow.local"

To install you need a graphical interface; to do that execute the following steps.

1. Install a vnc-server on your server "vdb01.oow.local".

   # yum install xorg-x11-utils.x86_64 xorg-x11-server-Xorg.x86_64 xorg-x11-server-utils.x86_64 -y

   # yum install tigervnc-server.x86_64 -y

2. Start a vnc-server as user "**oracle**" and supply a vnc-password.

   # vcnserver :1

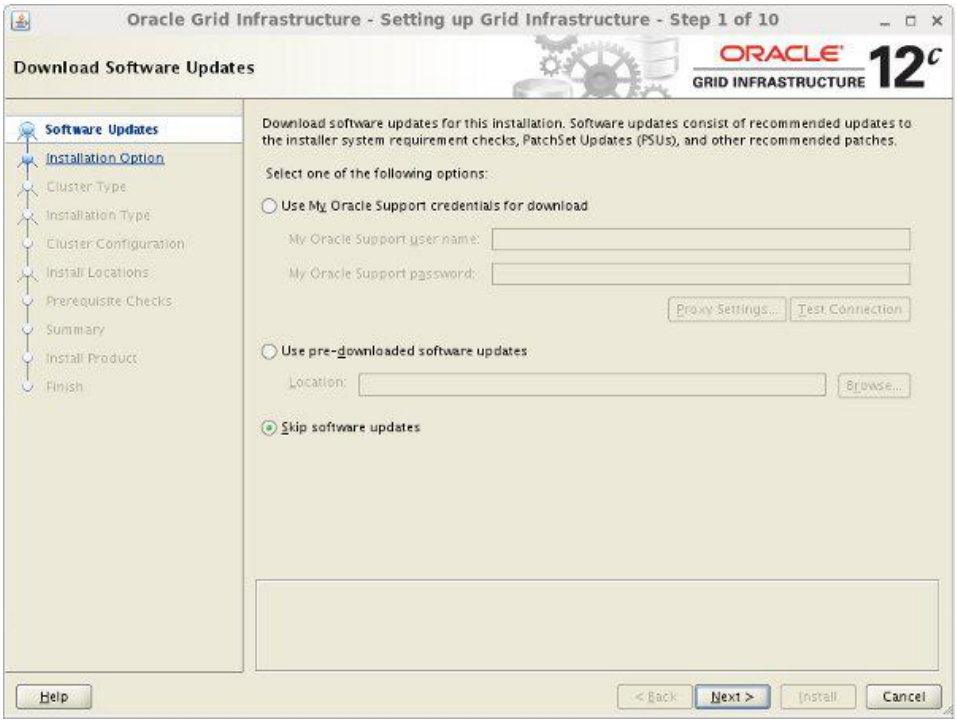
3. Connect, from your laptop, to your vnc-session

   vncviewer 192.168.56.204:1

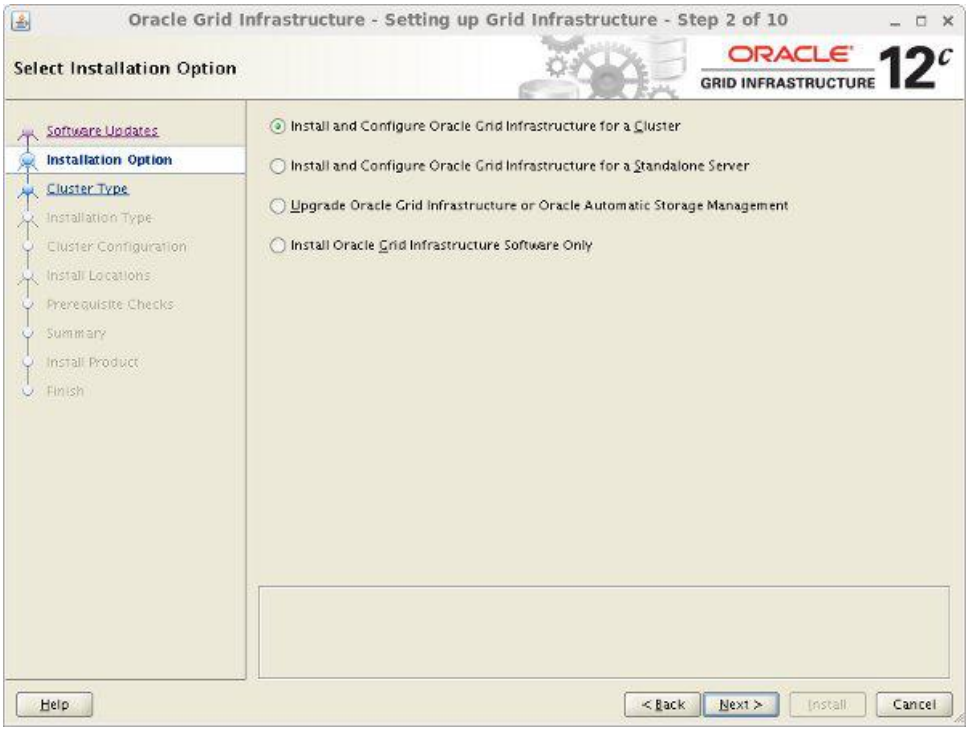
Unzip the software downloaded, change directory to the software install path and execute

 # ./runInstaller

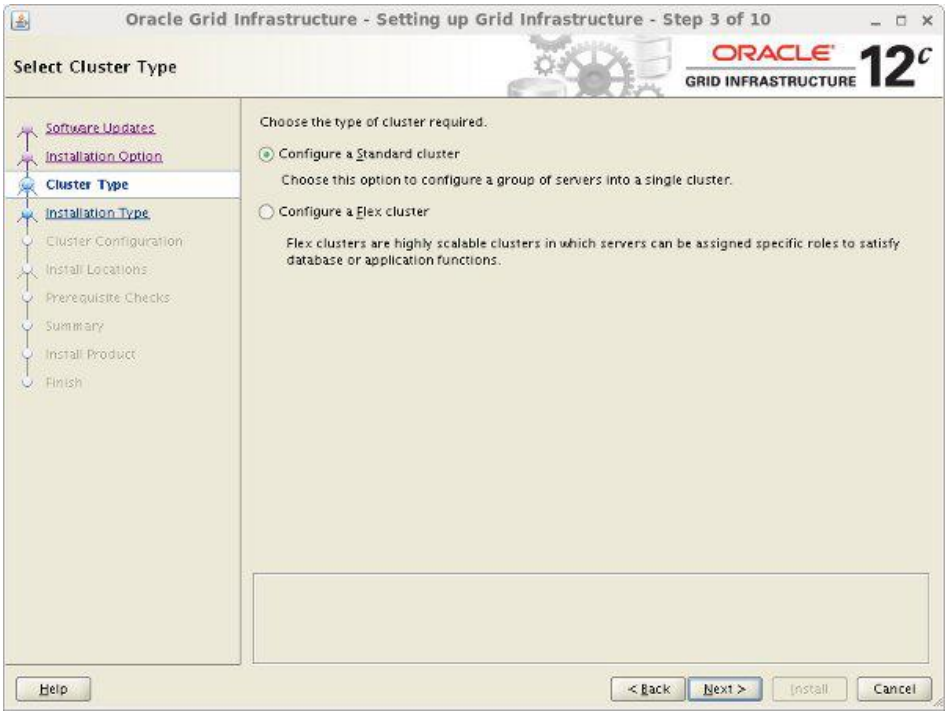
1. Select the "Skip software updates" option, then click the "Next" button.



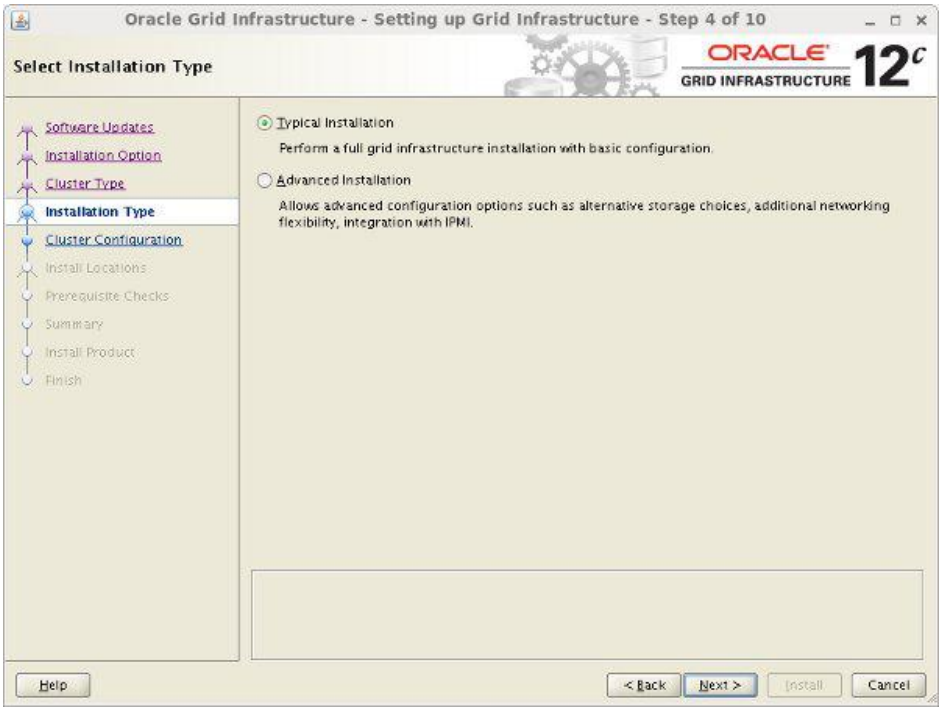
2. Select the "**Install and Configure Oracle Grid Infrastructure for a Cluster**".



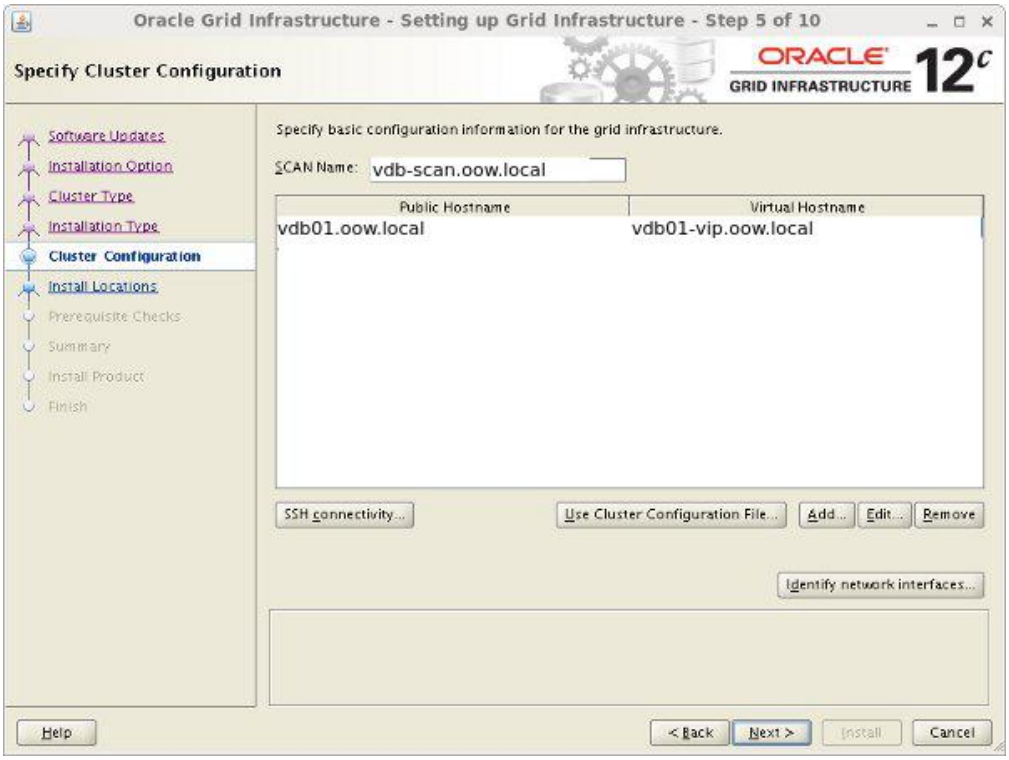
3. Accept the "**Configure a Standard cluster**" option by clicking the "Next" button.



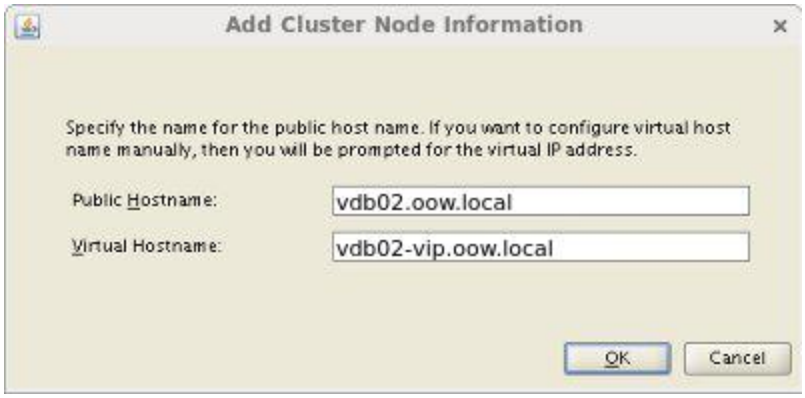
4. Select the "**Typical Installation**" option, then click the "**Next**" button.



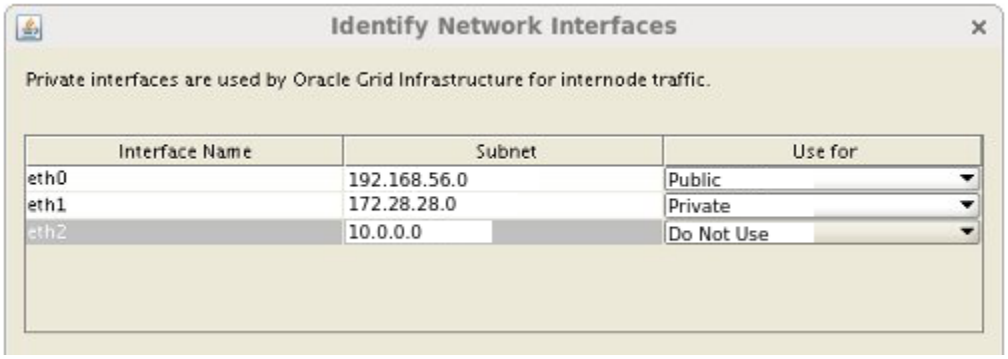
5. On the "**Specify Cluster Configuration**" screen, enter the correct **SCAN Name** and click the "**Add**" button to add the second node information**.**



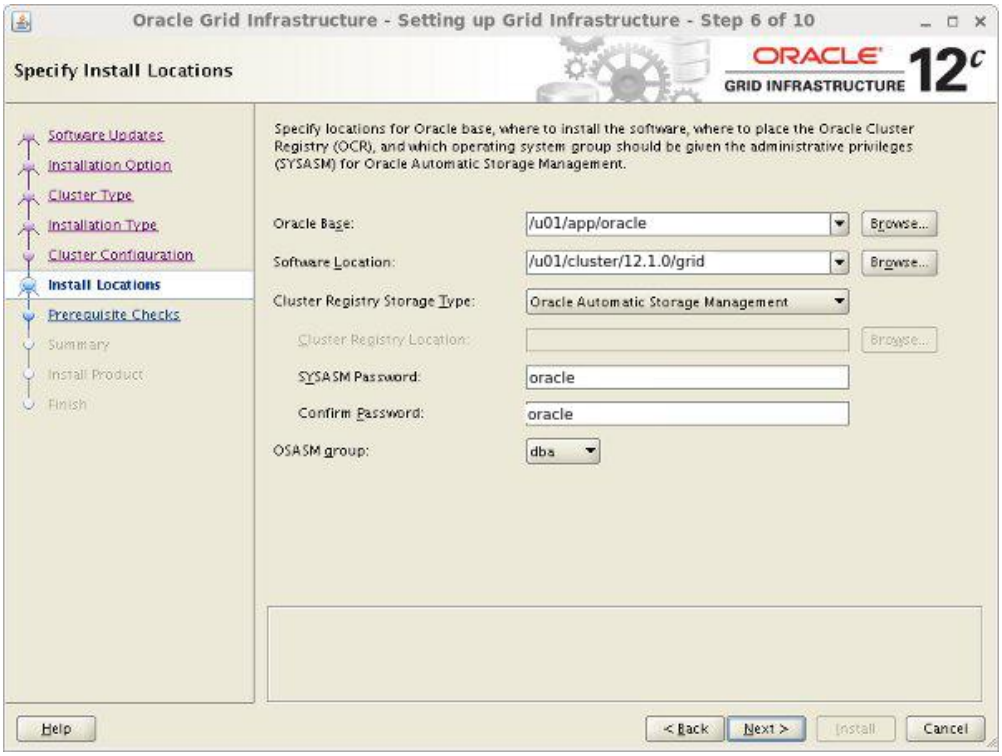
6. Enter the details of the **second node** in the cluster, then click the "**OK**" button.



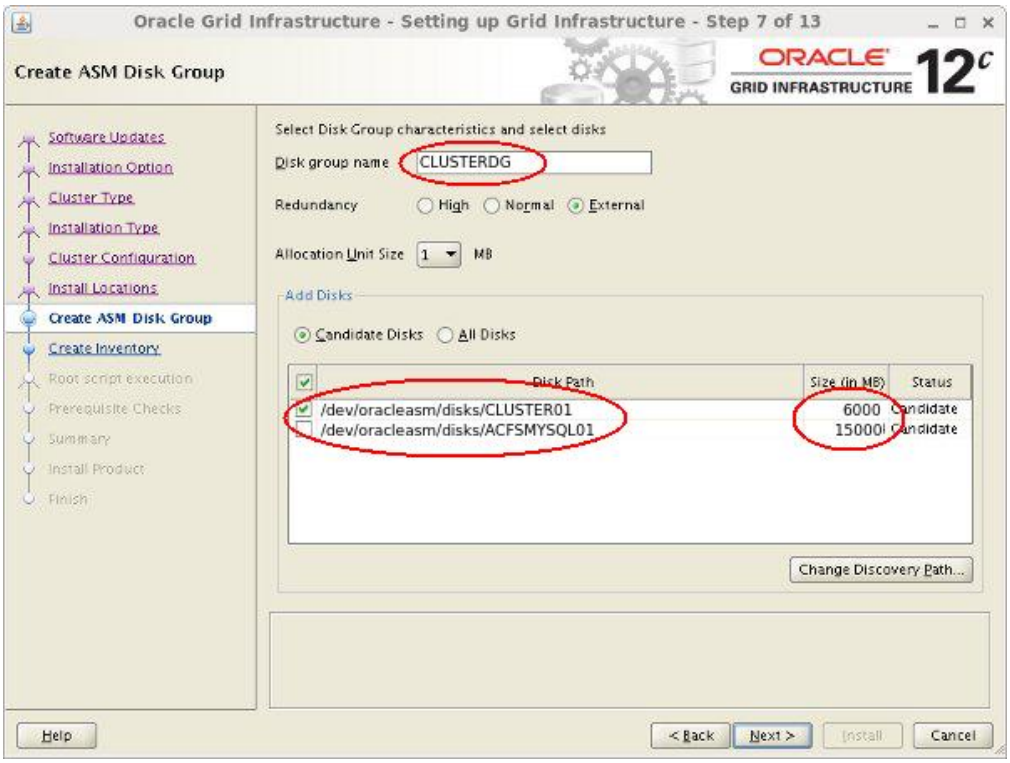
7. Click the "**SSH Connectivity...**" button and enter the password for the "**oracle**" user. Click the "**Setup**" button to **configure SSH connectivity**, and the "**Test**" button to test it once it is complete.
8. Click the "**Identify network interfaces...**" button and check the public and private networks are specified correctly. Remember to mark the **NAT interface as "Do Not Use"**. Once everything is good, click the "**OK**" button and the "**Next**" button on the previous screen.



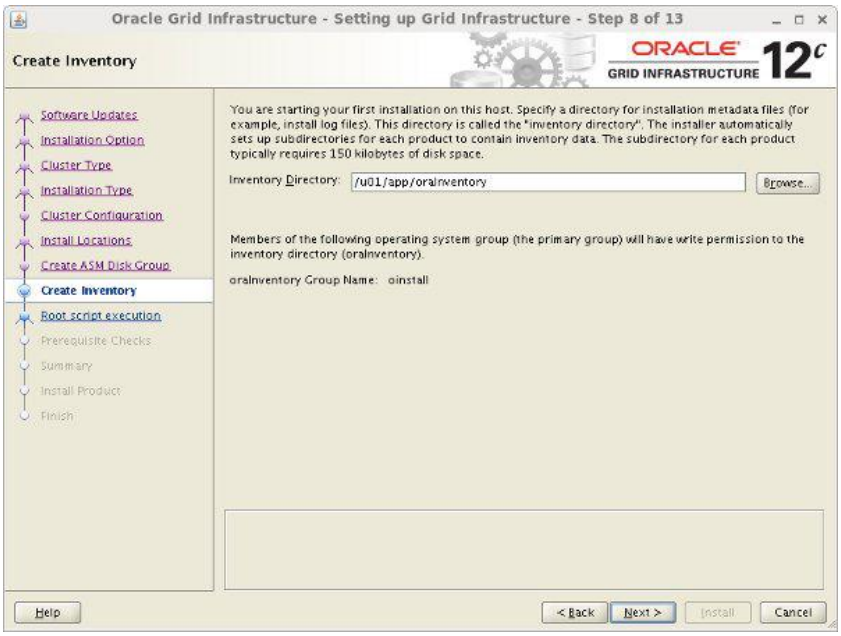
9. Enter "**/u01/cluster/12.1.0.1/grid**" as the software location and "**Automatic Storage Manager**" as the cluster registry storage type. Enter the **ASM password** (oracle), select "**dba**" as the group and click the "**Next**" button.



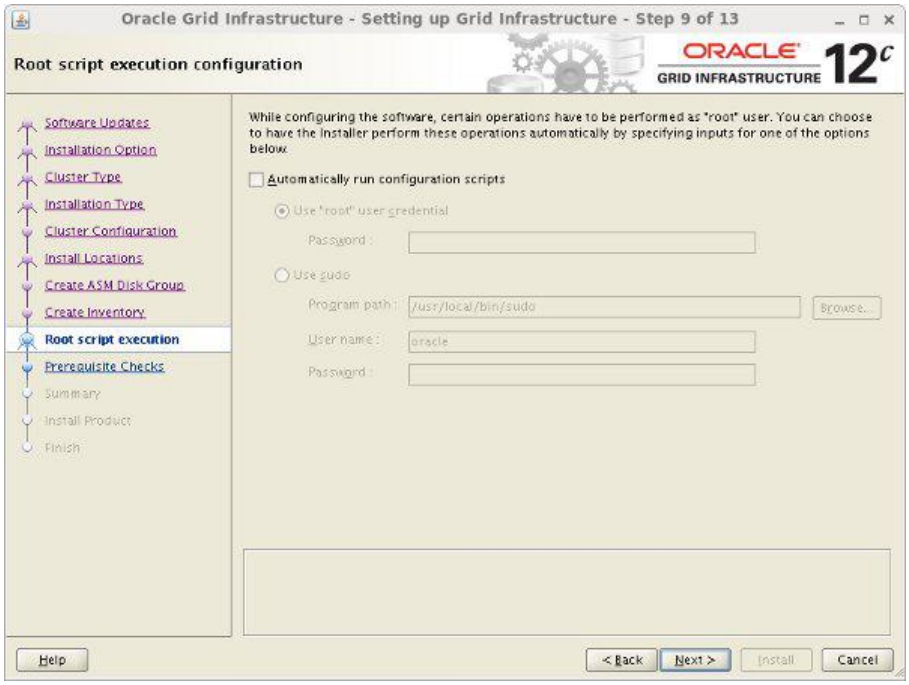
10. Set the redundancy to "**External**", click the "**Change Discovery Path**" button and set the path to "**/dev/oracleasm/disks/***". Return the main screen and select the disk named "**CLUSTER01**".



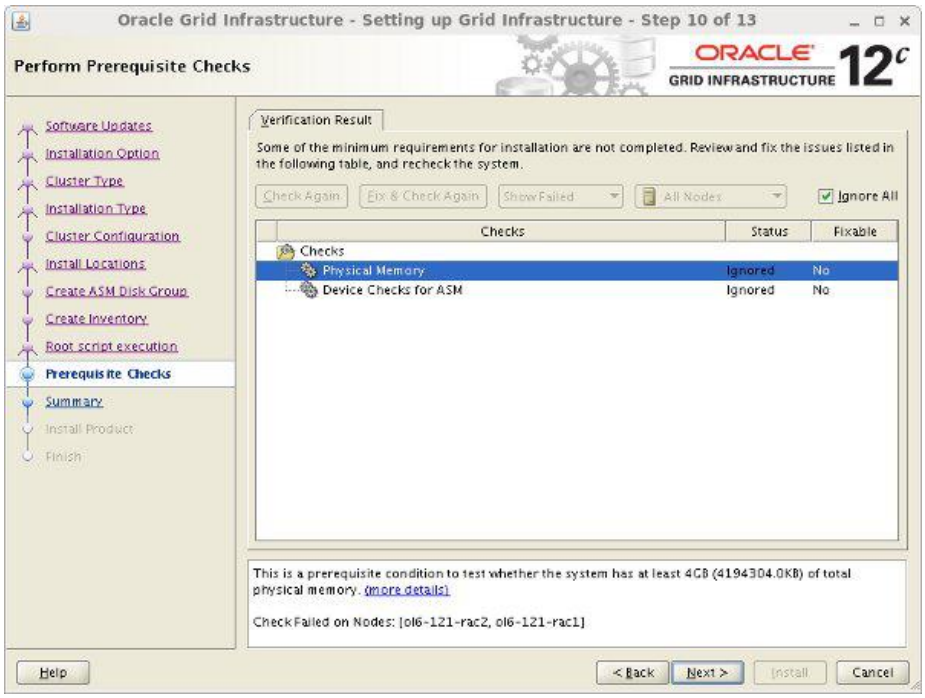
11. Accept the **default inventory** directory by clicking the "**Next**" button.



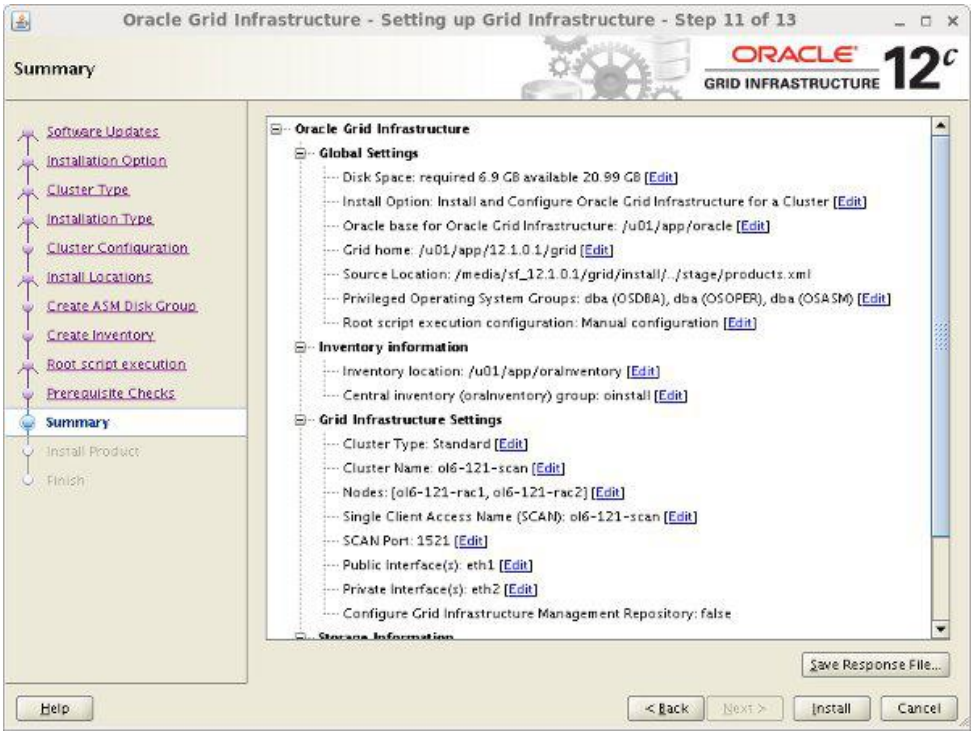
12. Select to run "**root scripts**" manually and click the "**Next**" button.



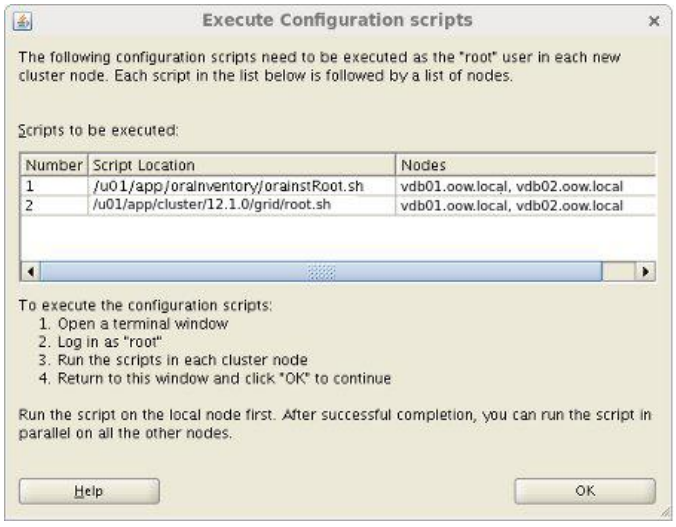
13. Wait while the prerequisite checks complete. If you have any issues, either fix them or check the "**Ignore All**" checkbox and click the "**Next**" button. It is likely the "**Physical Memory**" and "**Device Checks for ASM**" and "**Swap Size**" tests will fail for this type of installation.



14. If you are happy with the **summary information**, click the "**Install**" button.



15. When prompted, run the **configuration scripts** on each node.



Install Oracle Grid Infrastructure standalone Agents on clustered nodes

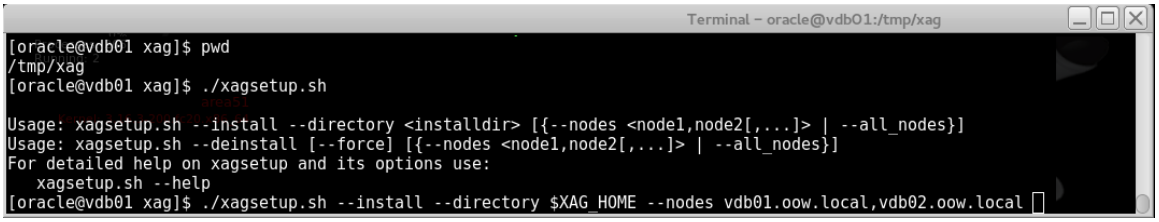
1. Connect on node "**vdb01.oow.local**" and **unzip "xagpack_5.zip"** file under a temporary directory
2. As "**oracle**" user create the directory that will guest "Standalone Agents" on both nodes:

   # mkdir $XAG_HOME

3. Install on the cluster the "standalone Agents" :

   # cd <xag_unzipped_folder>

   # ./xagsetup.sh --install --directory $XAG_HOME --nodes vdb01.oow.local, vdb02.oow.local



Download and install Oracle MySQL 5.6 Community Edition

1. Download and install "**Oracle MySQL yum repository**" configuration rpm (you need an Oracle Web Account) at the following link:

   http://dev.mysql.com/downloads/file.php?id=450542

2. Install the **Yum configuration file for Oracle MySQL 5.6** on both nodes (**vdb01** and **vdb02**):

   # rpm –ihv mysql-community-release-el6-5.noarch.rpm

3. Install "**MySQL**" and "**rpm packages**" on both clustered nodes (**vdb01** and **vdb02**) that will be used for the web-app.

   # yum install httpd httpd-tools php php-mysql php-gd mysql-server php-xml mysql -y

Create ASM Clustered Filesystem (ACFS) for application-tier

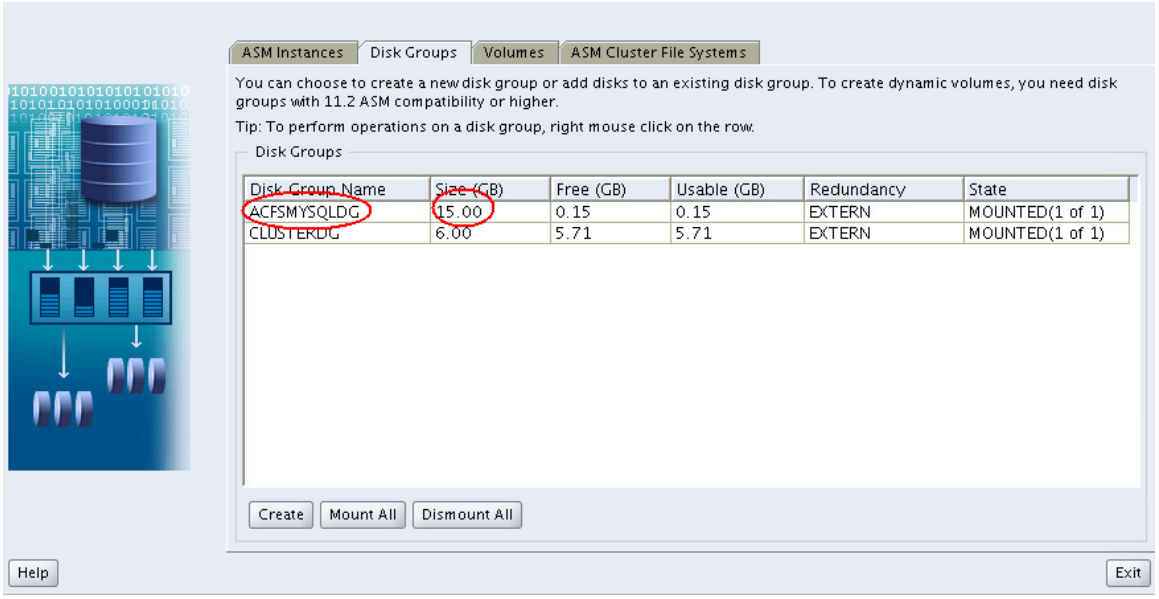
1. Connect to the vnc session opened with "**oracle**" account.

   # vncviewer 192.168.56.201:1

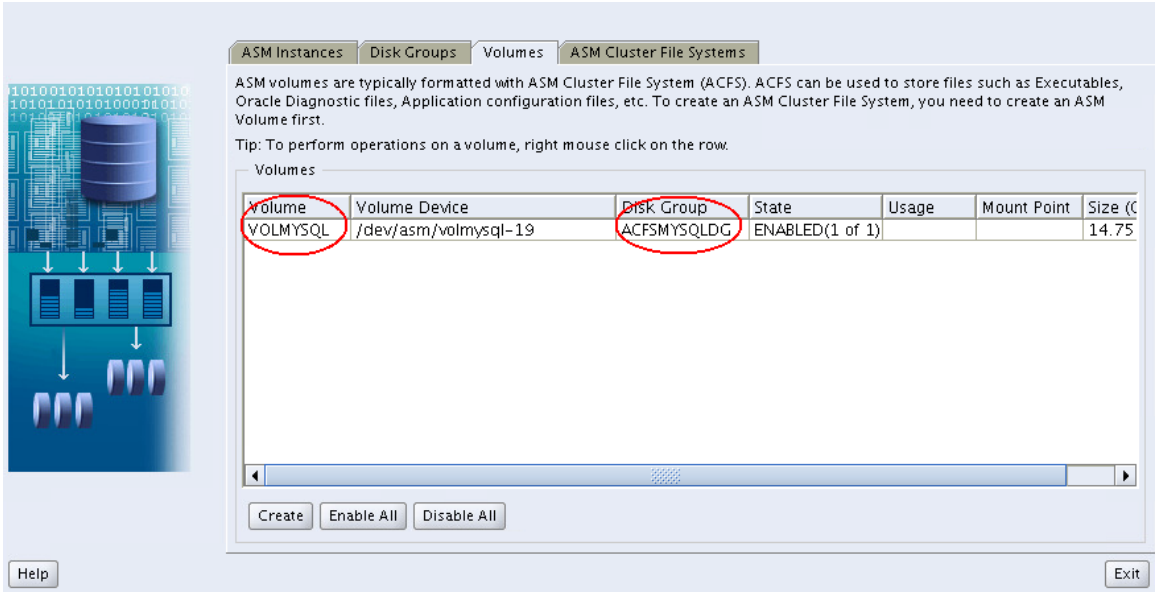
2. Launch command "**asmca**" **ASM Creation Assistant**.

   # asmca

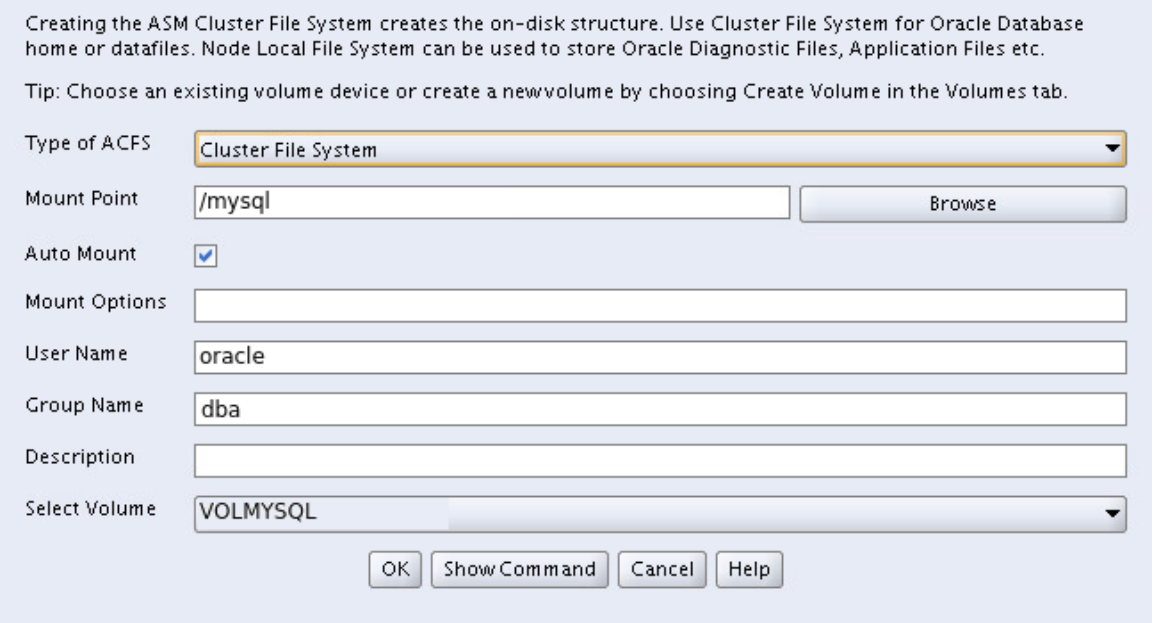
3. Create a new diskgroup named "**ACFSMYSQLDG**" using the 15 GB disk named "**ACFSMYSQL01**"



4. Create a new **Volume of 14.75 GB** named "**VOLMYSQL**" using the **diskgroup created at step #3**



5. Create a new **ACFS clustered filesystem** with the following details



Apply custom changes to the environment for the future resource clustering

Execute the following commands as "**root**":

Node "**vdb01.oow.local**"

 # mv /etc/httpd /mysql

 # ln –s /mysql/httpd /etc/httpd

 # mv /etc/my.cnf /mysql

 # ln –s /mysql/my.cnf /etc/my.cnf

Node "**vdb02.oow.local**"

 # mv /etc/httpd /etc/httpd.old

 # ln –s /mysql/httpd /etc/httpd

 # mv /etc/my.cnf /etc/my.cnf.old

 # ln –s /mysql/my.cnf /etc/my.cnf

On node "vdb01.oow.local" create a demo MySQL database

mysqladmin –u root –p create myapp

Nb: verify that the service "mysqld" had been started, otherwise start it.

service mysqld status

service mysqld start (if not already started)

On node “vdb01.oow.local” install a demo web-app

1. Log into MySQL monitor:
   # mysql -u root –p

2. Create the wiki user:
   # CREATE USER 'wiki'@'localhost' IDENTIFIED BY 'wiki';

3. Create MySQL database dedicated to mediawiki.
   # CREATE DATABASE myapp;
   # SHOW DATABASES;

4. Grant privileges:
   # GRANT ALL PRIVILEGES ON myapp.* TO 'wiki'@'localhost' IDENTIFIED BY ‘wiki’ WITH GRANT OPTION;
   # FLUSH PRIVILEGES;
   # exit

5. Manually start “**httpd**” daemon on node “**vdb01.oow.local**”
   # service httpd start

6. As “**root**” download “**mediawiki**” package and move it under “**/mysql**” filesystem.
   # cd /tmp
   # wget http://releases.wikimedia.org/mediawiki/1.23/mediawiki-1.23.4.tar.gz
   # mkdir –p /mysql/html
   # cd /mysql/html
   # tar xvfz /tmp/mediawiki-1.23.4.tar.gz
   # mv mediawiki-1.23.4 wiki

7. On boh nodes (**vdb01** and **vdb02**) create the following symbolic links:
   # ln –s /mysql/html/wiki /var/www/html/wiki

8. Connect to the following URL and proceed with the “Wikimedia” configuration.

   http://192.168.56.204/wiki
   nb: you have the supply all the details of the MySQL database created above.

9. When the “**wikimedia**” setup is completed stop both “**MySQL**” and “**httpd**” services.
   # service httpd stop
   # service mysqld stop

Create an user app-vip clustered with Oracle Grid Infrastructure 12c

This VIP (Virtual IP) will be used for both MySQL and WebApp.

To create the clustered VIP resource execute the following commands:

 # export ORACLE_HOME=/app/cluster/12.1.0/grid
 # export PATH=$ORACLE_HOME/bin:$PATH
 # appvipcfg create -network=1 -ip 192.168.56.210 -vipname mysql.oow.local -user=oracle

To start the clustered VIP execute the following command as “**oracle**” :
 # crsctl start resource mysql.oow.local

Configure MySQL to be managed by Oracle Clusterware 12c

1. Create a dedicated account for Clusterware monitoring agent.

   # service mysqld start
   # mysql -u root –p
   # CREATE USER oracle@localhost IDENTIFIED BY 'oracle';

2. Edit "**/mysql/my.cnf**" file and add a section for "**mysqladmin**":

   [mysqladmin]
   user=oracle
   password=oracle

3. Stop "**MySQL**" daemon
   # service mysqld stop

4. Add **MySQL** database "**myapp**" as clustered resource by Oracle Clusterware 12c
   As "**root**", execute the following commands:

   # . /home/oracle/.bash_profile
   # agctl add mysql_server myapp --mysql_home /usr --datadir /mysql --mysql_type MYSQL --
   mysql_lib /mysql --vip_name mysql.oow.local

Configure Apache "httpd" to be managed by Oracle Clusterware 12c

1. Create a resource-script to manage httpd-daemon, as "root":

   # mkdir /mysql/cluster_scripts
   # vi /mysql/cluster_scripts/apache.sh
   # content of the script:

```
############################################################
#!/bin/bash
#
ORA_CRS_HOME=/u01/cluster/12.1.0/grid
CRS_HOME_SCRIPT=/mysql/cluster_scripts
HTTP_VIP=192.168.56.210
HTTP_PORT=80
ORACLE_BASE=/app/em
ORACLE_USER=oracle

# See how we were called.
case "$1" in
  start)
            /etc/init.d/httpd start
            ;;
  stop)
            /etc/init.d/httpd stop
            ;;
  clean)
             killall -u apache
            sleep 2
            killall -u apache
             ;;
  check)
            nc -z $HTTP_VIP $HTTP_PORT
            num=`echo $?`
            exit $num
            ;;
  restart)
```

```
        stop
        sleep 3
        start
        ;;
 *)
        echo $"Usage: $0 {start|stop|clean|restart|check}"
        exit 1
esac
############################################################
```

2. As "**root**" add a custom resource to Oracle Clusterware to manage "**httpd daemon**".

   Create the configuration file for the resource with the following details:
   # vi /app/cluster/12.1.0/grid/crs/public/httpd.myapp.mysql.attr

```
############################################################
NAME=httpd.myapp.mysql
TYPE=cluster_resource
ACL=owner:root:rwx,pgrp:root:r-x,other::r--,user:oracle:r-x
ACTIONS=
ACTION_SCRIPT=/mysql/cluster_scripts/apache.sh
ACTION_TIMEOUT=60
ACTIVE_PLACEMENT=0
AGENT_FILENAME=%CRS_HOME%/bin/scriptagent
AUTO_START=restore
CARDINALITY=1
CHECK_INTERVAL=60
CHECK_TIMEOUT=0
CLEAN_TIMEOUT=60
DEGREE=1
DELETE_TIMEOUT=60
DESCRIPTION=
ENABLED=1
FAILOVER_DELAY=0
FAILURE_INTERVAL=0
FAILURE_THRESHOLD=0
HOSTING_MEMBERS=vdb01 vdb02
INSTANCE_FAILOVER=1
INTERMEDIATE_TIMEOUT=0
LOAD=1
LOGGING_LEVEL=1
MODIFY_TIMEOUT=60
OFFLINE_CHECK_INTERVAL=0
PLACEMENT=restricted
RELOCATE_BY_DEPENDENCY=1
RESTART_ATTEMPTS=3
SCRIPT_TIMEOUT=60
SERVER_CATEGORY=
SERVER_POOLS=
START_CONCURRENCY=0
START_DEPENDENCIES=hard(xag.myapp.mysql)
START_TIMEOUT=0
STOP_CONCURRENCY=0
STOP_DEPENDENCIES=hard(xag.myapp.mysql)
STOP_TIMEOUT=0
UPTIME_THRESHOLD=1h
USER_WORKLOAD=no
USE_STICKINESS=0
############################################################
```

As “root” add the resource to the Oracle Clusterware configuration with the following command.
 # crsctl add resource httpd.myapp.mysql -type cluster_resource -file /app/cluster/12.1.0/grid/crs/public/httpd.myapp.mysql.attr

Configure Clusterware resources permission(s) to allow “oracle” account to manage them

Use the following syntax to grant correct permission(s):
 # crsctl setperm resource mysql.oow.local -u user:oracle:r-x
 # crsctl setperm resource xag.myapp.mysql -u user:oracle:r-x
 # crsctl setperm resource httpd.myapp.mysql -u user:oracle:r-x

Add a wrapped script to see clusterware resources status

The standard command to see resources status is:
 # crsctl status resource
 # crsctl status resource -t

Create the following script under path “**/usr/local/bin**” on both nodes (**vdb01** and **vdb02**):
 # vi /usr/local/bin/crsstat

```
################################################################################
#!/bin/bash
RSC_KEY=$1
AWK=/usr/bin/awk    # if not available use /usr/bin/awk
ORA_CRS_HOME=/u01/cluster/12.1.0/grid

#support -t -v -p

if [ "$1" == "-t" ] ; then

if [ "$2" == "-v" -o "$2" == "-q" -o "$3" == "-v" -o "$3" == "-q" ] ; then
$ORA_CRS_HOME/bin/crsctl status resource $*
exit

fi

shift

RSC_KEY=

# Table header:echo ""
$AWK \
  'BEGIN {printf "%-45s %-25s %-17s %-25s\n", "HA Resource", "Type", "Target", "State";
        printf "%-45s %-25s %-17s %-25s\n", "----------------------------------------------", "-------------------------", "--
---------------", "-------------------------";}'

# Table body:
$ORA_CRS_HOME/bin/crsctl status resource $* | sed -e 's/  //g' | $AWK \
'BEGIN { FS="[=,]"; state = 0; }
  $1~/NAME/ && $2~/'$RSC_KEY'/ {appname = $2; state=1;}
  $1~/TYPE/ && state == 1 {apptype = $2; state=2;}
  $1~/TARGET/ && state == 2 {apptarget = $2","$3; state=3;}
  $1~/STATE/ && state == 3 {appstate = $2","$3; state=4;}
  state == 4 {printf "%-45s %-25s %-17s %-25s\n", appname, apptype, apptarget, appstate; state=0;}'

elif [ "$2" == "-t" ] ; then

if [ "$3" == "-v" -o "$4" == "-q" -o "$3" == "-v" -o "$4" == "-q" ] ; then

$ORA_CRS_HOME/bin/crsctl status resource $*
exit
```

```
fi

shift 2

# Table header:echo ""
$AWK \
  'BEGIN {printf "%-45s %-25s %-17s %-25s\n", "HA Resource", "Type", "Target", "State";
          printf "%-45s %-25s %-17s %-25s\n", "--------------------------------------------", "-------------------------", "--
---------------", "-------------------------";}'

# Table body:
$ORA_CRS_HOME/bin/crsctl status resource $* | sed -e 's/  //g' | $AWK \
'BEGIN { FS="[=,]"; state = 0; }
  $1~/NAME/ && $2~/'$RSC_KEY'/ {appname = $2; state=1;}
  $1~/TYPE/ && state == 1 {apptype = $2; state=2;}
  $1~/TARGET/ && state == 2 {apptarget = $2","$3; state=3;}
  $1~/STATE/ && state == 3 {appstate = $2","$3; state=4;}
  state == 4 {printf "%-45s %-25s %-17s %-25s\n", appname, apptype, apptarget, appstate; state=0;}'

else

$ORA_CRS_HOME/bin/crsctl status resource $*

fi
###############################################################################
            # chown root:dba /usr/local/bin/crsstat
            # chmod 750 /usr/local/bin/crsstat
```

Oracle Ksplice subscription and activation

To enable Ksplice uptrack you have to get a subscription (with an option of 30-days trial) at the following link:

https://www.ksplice.com

You can find installation and configuration instructions at the following link:

https://www.ksplice.com/uptrack/install

Document Location:

The complete document of this lab can be downloaded from here:

https://www.oracle.com/technetwork/server-storage/vm/hol-oraclevm-ha-2349885.pdf

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