White Paper

DⅇLL™

Dell Reference Configuration

Deploying Oracle® VM Release 2.1 on Dell™ PowerEdge™ Servers and DELL/EMC Storage

Abstract

This white paper provides an architectural overview and configuration guidelines for deploying Oracle VM Release 2.1 on Dell PowerEdge servers with DELL/EMC FC storage. Using the knowledge gained through joint development, testing and support with Oracle, this Dell Reference Configuration documents "best practices" that can help speed Oracle solution implementation and help simplify operations, improve performance and availability.

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Introduction

Virtualization has become a key technology for enterprises to enable server consolidation and to help make data centers more energy efficient. Most existing Database deployments are not only oversized but also with ever increasing CPU and overall system performance, system hardware is underutilized. Virtualization can result in lower total cost of ownership (TCO) while maintaining availability and increasing resource utilization. Oracle VM enables data centers to run multiple *virtual* machines on a single piece of hardware. The bare-metal hardware runs software which enables you to install multiple instances of operating systems which are able to run simultaneously and independently, in their own secure environment, with minimal reduction in performance. Each virtual machine has its own virtual CPU, network interfaces, storage and operating system. The Oracle VM Server platform is built upon an updated version of the underlying Xen™ hypervisor technology. Dell™ PowerEdge™ servers and DELL/EMC FC SAN storage systems are ideal choices for deploying highly reliable virtualization solutions including Oracle VM. This Reference Configuration white paper is intended to help IT professionals design and configure Oracle VM release 2.1 using Dell servers and storage using "best practices" derived from laboratory and real-world experiences. This white paper documents Dell's recommended approach for implementing a tested and validated solution for Oracle VM 2.1 on Dell PowerEdge 10th generation servers, DELL/EMC FC SAN storage systems and Enterprise Linux® 5.1 as the guest OS (EL 5) to run Oracle 11g R1 databases.

Definition of Terms used in the paper:

Term	Definition
Virtualization	The ability to run multiple *virtual* machines on a single piece of hardware. The hardware runs software which enables you to install multiple operating systems which are able to run simultaneously and independently, in their own secure environment, with minimal reduction in performance. Each virtual machine has its own virtual CPU, network interfaces, storage and operating system.
11g	Oracle Database 11g
10g	Oracle Database 10g
Oracle VM	A platform that provides a fully equipped environment for better leveraging the benefits of virtualization technology. It has the following components: **Oracle VM Manager** **Oracle VM Server** **Oracle VM Agent**
OVM	Oracle VM Manager: Provides the user interface, which is a standard ADF (Application Development Framework) web application, to manage Oracle VM Servers. Manages virtual machine lifecycle, including creating virtual machines from installation media or from a virtual machine template, deleting, shutting down, uploading, deployment and live migration of virtual machines. Manages resources, including ISO files, virtual machine images, virtual machine templates and shared hard disks.
OVS	Oracle VM Server: an updated version of the underlying Xen hypervisor technology, and the Oracle VM Agent
OVA	Oracle VM Agent: Oracle VM Manager communicates with Oracle VM Agent to create and manage guests on an Oracle VM Server.
DomU	User Domain: The unprivileged domains with no direct access to the hardware or device drivers. Each domU is started by Oracle VM Server in dom0
Dom0	Domain zero: The management domain
hypervisor	A small, lightweight, software virtual machine monitor, for x86-compatible computers. controls only the most basic resources of the system, including CPU

	and memory usage, privilege checks, and hardware interrupts
Server Pools	A server pool is logically an autonomous region that contains one or more physical servers. A server pool must contain the virtual servers belonging to the similar processor architecture (Intel or AMD).
Server Pool Master function	Acts as the contact point of the server pool to the outside world, and also as the dispatcher to other servers from within the server pool. Can be the same server as the OVS server with a performance penalty.
Utility Server function	The Utility Server is responsible for I/O related operations such as, copying, or moving files. Its function focuses on the creation, removal, and renaming operations of virtual machines, servers, and server pools. There can be one or more Utility Servers in a server pool.
Virtual Machine Server function	The primary function of the virtual machine server is to run virtual machines
PVM	Para-Virtualized Machine or guests: The guest operating system is recompiled before being installed on a virtual machine. Also, the virtual machine does not need to trap privileged instructions. Trapping is a method used to handle unexpected or unallowable conditions, which is time-consuming and can impact operating system performance. Without trapping privileged instructions, the paravirtualized operating system runs at near native speed.
HVM	Hardware Virtual Machine or fully virtualized guests: the unmodified guest operating system runs on the virtual machine. It traps and emulates every I/O and hardware instruction. To apply the fully virtualized mode, either Intel-VT or AMD-V should be available on the host. For example, it is possible to run Microsoft Windows® as a guest operating system unmodified, using the fully virtualized method provided by Intel-VT technology or AMD-V technology.
FC	Fibre-Channel
SAS	Serial Attached SCSI
iSCSI	SCSI over IP
HB A	Host Bus Adapter
LUN	Logical Unit Number
NIC	Network Interface Card
OEL4	Oracle Enterprise Linux 4
OEL5	Oracle Enterprise Linux 5
RHEL4	Red Hat® Enterprise Linux 4.
RHEL5	Red Hat Enterprise Linux 5
SAN	Storage Area Network

Table 1: Definition of terms

Figure 1 provided below depicts the Oracle VM architecture with various components of underlying Xen technology and Oracle VM value add components such Oracle VM Manager, Oracle VM Manager, Dispatcher, and Unser Interface for management of the infrastructure.
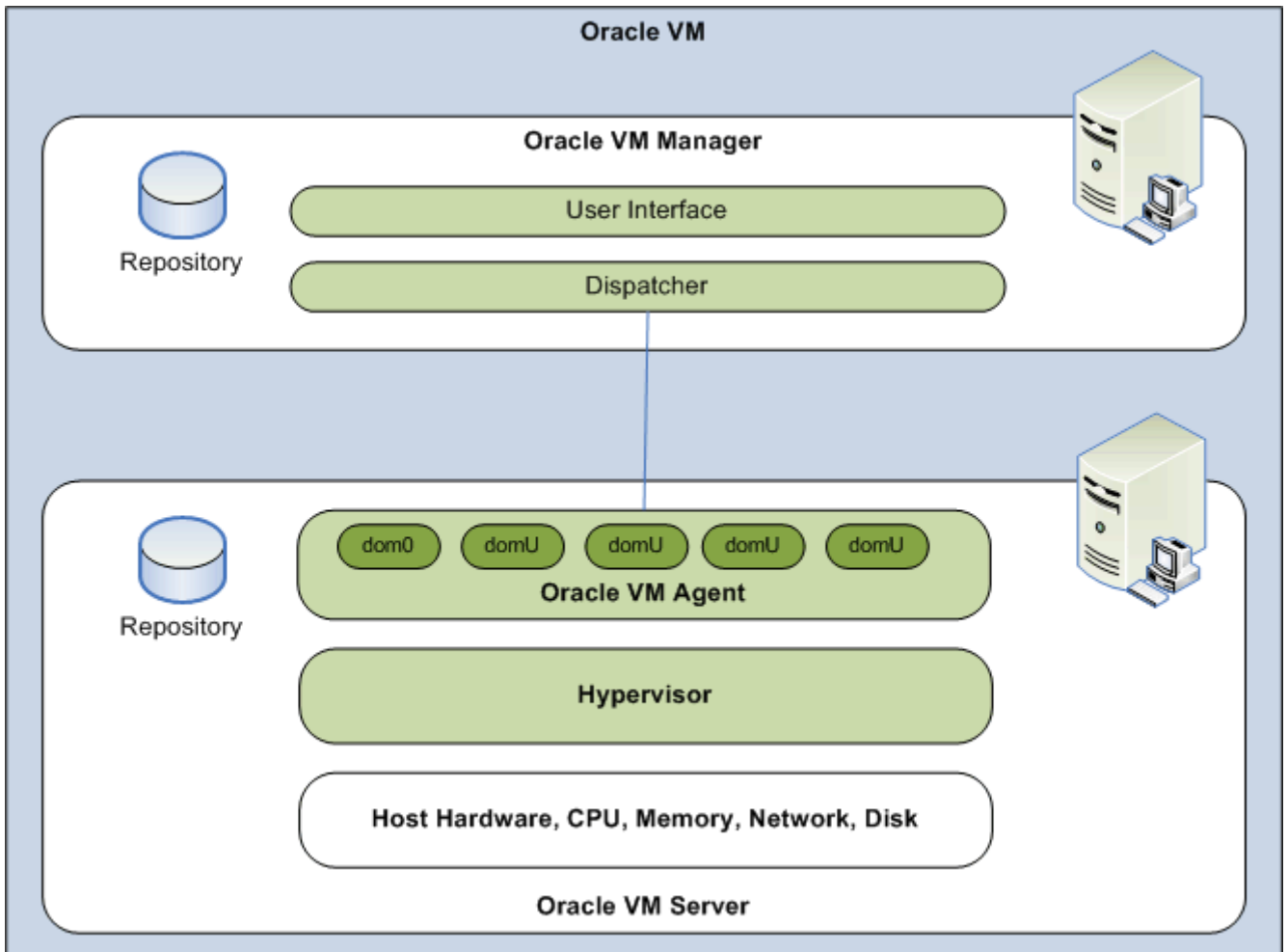
Figure 1: Oracle VM Architecture

The rest of this white paper will provide the reader with a detailed view of the Dell Reference Configuration for Oracle VM 2.1 with Dell R900, R905 and R805 servers, DELL/EMC FC SAN storage, best practices for configuring the hardware and software components, and pointers for obtaining more information. The sections will be divided into:

1. Architecture Overview
2. Hardware setup
3. VM Server installation,
4. VM Manager installation and configuration
5. VM Creation.

Architecture Overview - Dell Solution for Oracle VM 2.1 with Dell Servers and DELL/EMC FC Storage

An architectural overview of the Dell Solution for Oracle VM 2.1using DELL/EMC FC SAN is shown in Figure 2 below. This architecture is made of the following components:

- Oracle VM Manager running on Dell PowerEdge 1950 server running OEL 5.1
- Two-node Dell R900 and R905/805 Server pools with one server acting as the Server Pool Master as well as the Oracle VM Server and the other R900 server acting as the utility server as well as the Oracle VM server host both running Oracle VM Release 2.1. It is depicted as the Server Pool R900 (Intel) in the figure below.
- Gigabit Ethernet switch for OCFS2 heartbeat network
- Gigabit Ethernet switch for public network
- Fibre Channel switches and DELL/EMC FC SAN in a redundant configuration.

PowerEdge1950 OEL4.5 OVM Manager
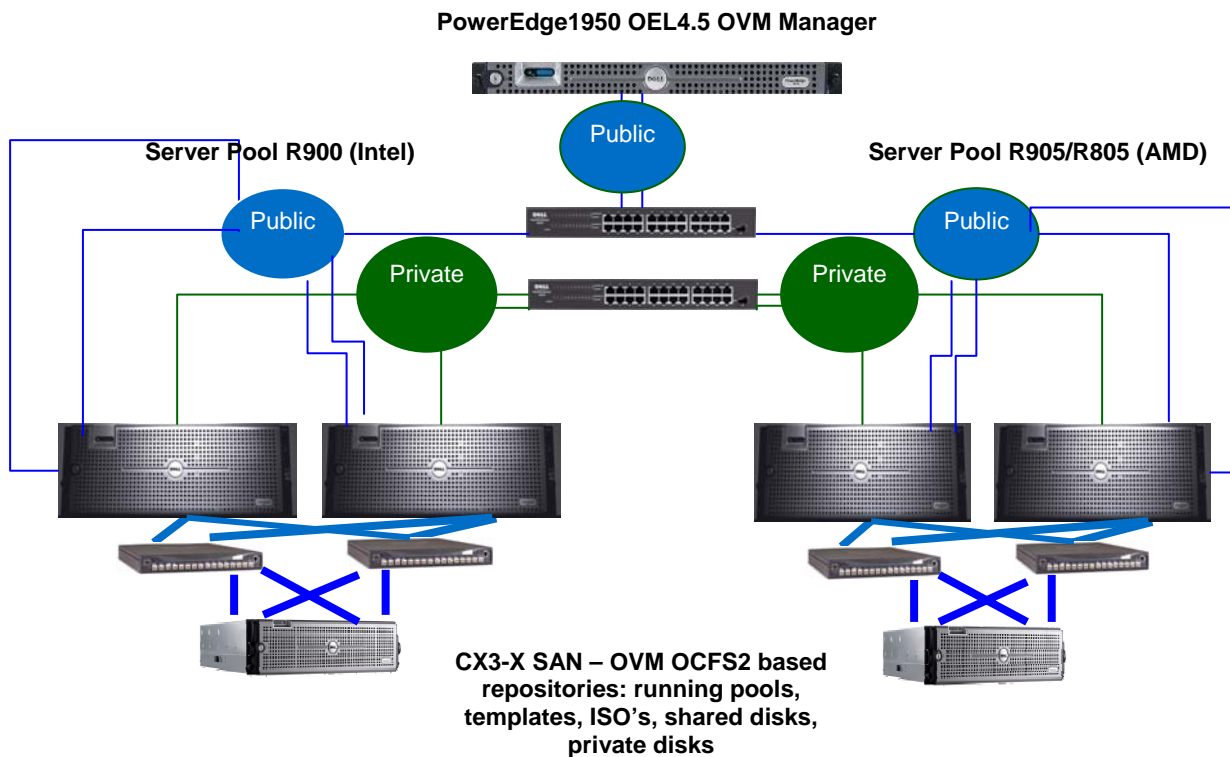
Figure 2 - Architectural Overview of Oracle VM Server Pools attached to DELL/EMC Storage

The Dell Reference Configuration for Oracle VM Release 2.1 on Dell PowerEdge servers with DELL/EMC FC storage is intended to validate the following solution components:

	Hardware	Software
Servers & Storage	**Server Pool 1 (Intel)** 2X Dell PowerEdge R900 servers • 4 X Quad Core CPU • 32GB RAM • 4 x LOM • 2 x QLE2460 OR Emulex® 1150e HBAs **Server Pool 2 (AMD)** 2X Dell PowerEdge R905 servers • 4 X Quad Core CPU • 32GB RAM • 4 x LOM • 2 x QLE2460 OR Emulex 1150e HBAs **Server Pool 3 (AMD)** 2X Dell PowerEdge R805 servers • 2 X Quad Core CPU • 32GB RAM • 4 x LOM • 2 x QLE2460 OR Emulex 1150e HBAs **Oracle VM Manager** 1 x Dell PowerEdge 2950 or 1950 • 2.8GHz P4 processors • 16GB RAM • 2 x 1Gb LOM **Storage** • CX3-10,20,40,80 series FC storage **Network** • 1 X Gigabit Ethernet Switch (OCFS2 heartbeat) • 1 X Gigabit Ethernet Switch (Public LAN)	• Oracle VM Server 2.1 (X86-64) • Oracle VM Manager 2.1 (X86-64) • Oracle database 11g R1 (X86-64) • Oracle Enterprise Linux 5.1 (X86_64) For Oracle VM Manager OS • Oracle OEL 5.1 PVM guest OS (X86-64) • Oracle OEL 5.1 HVM guest OS (X86-64) • Red Hat Enterprise Linux 5.1 PVM guest OS • Red Hat 5.1 Enterprise Linux HVM guest OS

Table2: Hardware and software details

Oracle VM Server Installation

1. Create a RAID1 logical volume for the OVM server binaries on the host machine.
2. Enable Virtualization technology for the CPU's
    a. F2 to Enter the System Setup program
    b. Enter CPU Information
    c. Enable Virtualization Technology option, save and exit BIOS menu.

   NOTE: Installing Oracle VM Server deletes any previous operating system and data on the computer.

3. Boot the computer on which you want to Oracle VM Server with your Oracle VM Server CD.
    a. At the boot prompt, press **Enter**.
4. The **CD Found** screen is displayed. **Skip** the media testing and follow on screen instructions to continue with the install.
5. The Oracle VM Server login prompt is displayed. Log into Oracle VM Server as root, with the password you set during the install. The Oracle VM Server installation is complete. The Oracle VM Agent is started automatically and restarts each time the computer is rebooted.

Post Installation

Dom0 Memory Settings
The Dom0 memory is configured to be 512 MB by default. Change this setting to 1024 MB by modifying the dom0_mem kernel parameter in the /boot/grub/menu.lst file.

Status of Oracle VM Agent

Make sure that the Oracle VM agent is running. It is required that the agent is always running for the Oracle VM Manager to communicate with the Oracle VM hosts to manage, migrate, deploy, and to create and configure virtual machines. To check the status of the Oracle VM Agent:

service ovs-agent status

Installing the Hypervisor patch for PVM Guests:

Oracle has provided hypervisor patch to fix live migration issues associated with paravirtualized guests. Under heavy load, live migration of paravirtualized guests may cause kernel panic on the Oracle VM server. This patch needs to be installed on Oracle VM Server installation (Dom0). After applying the patch Dom0 need to be rebooted.

Patch Installation steps

1. Download following packages form
   http://www.oracle.com/technology/software/products/virtualization/vm_templates_other.html

   xen-3.1.1-0.0.36.el5.i386.rpm
   xen-64-3.1.1-0.0.36.el5.noarch.rpm
   xen-tools-3.1.1-0.0.36.el5.i386.rpm
   xen-devel-3.1.1-0.0.36.el5.i386.rpm

2. Upgrade above mentioned the packages on dom0:
   rpm -Uvh xen-3.1.1-0.0.36.el5.i386.rpm
   rpm -Uvh xen-64-3.1.1-0.0.36.el5.noarch.rpm

```
rpm -Uvh  xen-devel-3.1.1-0.0.36.el5.i386.rpm
rpm -Uvh  xen-tools-3.1.1-0.0.36.el5.i386.rpm
```

Existing Version	Updated Version
xen-tools-3.1.1-0.0.35.el5	xen-3.1.1-0.0.36.el5.i386.rpm
xen-devel-3.1.1-0.0.35.el5	xen-64-3.1.1-0.0.36.el5.noarch.rpm
xen-3.1.1-0.0.35.el5	xen-devel-3.1.1-0.0.36.el5.i386.rpm
xen-64-3.1.1-0.0.35.el5	xen-tools-3.1.1-0.0.36.el5.i386.rpm

Upgrading the PowerEdge Raid Controller (megaraid_sas) driver:

The default PERC5/PERC6 driver installed may require an upgrade to at least megaraid_sas 3.09 from the default version present on Oracle VM 2.1 CD. The source of the driver is available from:

http://support.us.dell.com/support/downloads/format.aspx?releaseid=R149489&c=us&l=en&cs=&s=gen

Follow instructions provided in the README file to build the driver on an OEL 5.0 or RHEL 5.0 system. Follow these instructions to update the driver:

1. Build the driver from the source
2. On your OVM machines, go to /lib/modules/2.6.18-8.1.6.0.18.el5xen/kernel/drivers/scsi/megaraid/
3. Rename the megaraid_sas.ko file to megaraid_sas.ko.orig
4. Copy over the downloaded megaraid_sas.ko file into this directory.
5. Change directory to /boot

NOTE: This new megaraid_sas.ko must be now built into the initrd.
6. mkinitrd –f ./initrd-2.6.18-8.1.6.0.18.elxen.img `uname –r`

Oracle VM Manager Installation:

Pre-installation Tasks:

1. Make sure libaio.rpm is installed. It is required for the asynchronous IO support.
   rpm -qa|grep libaio
   libaio-0.3.105-2
   libaio-0.3.105-2
   libaio-devel-0.3.105-2

2. Ensure that port numbers 8888 and 8899 are not being used since Oracle VM Manager uses these ports for cumminications with the Oracle VM host agent and its services. The following should not return any lines.
   netstat -a |grep 8899
   netstat -a |grep 8888

3. Before installing Oracle VM Manager, make sure that there are no other oc4j processes running on the host that use port 23791. To verify, perform the following steps:
4.
   1. Enter the following command to check the status of OC4J:
       ps -ef | grep oc4j
   2. If OC4J is running, then enter the following command to stop it.

      service oc4j stop

Oracle VM Manager Installation Steps:
Dell Reference Configuration for Oracle VM Release 2.1 on Dell PowerEdge Servers and DELL/EMC FC

1. Start up the operating system on the computer on which you want to install Oracle VM Manager.
2. Insert and mount the Oracle VM Manager CD.
3. As root start the Oracle VM Manager installation script:

   sh runInstaller.sh

4. Follow the prompts to install Oracle VM Manager.

See the *Oracle VM Manager Installation Guide* for detailed information on installing Oracle VM Manager. The following messages shows at the end of a successful installation:

The console feature is not enabled by default. For detailed setup, refer to Oracle VM Manager User's Guide: http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10901/toc.htm

Once the installation has successfully completed, you should see "Installation of Oracle VM Manager completed successfully."

Accessing Oracle VM Manager home page:

For local access: http://127.0.0.1:8888/OVS
For remote access: http://hostname:8888/OVS

Default user is 'admin' with password 'oracle'.
It is recommended that you change the password immediately.
For detailed instructions on setting up an environment to manage virtual machines and to start using Oracle VM Manager, see *Oracle VM Manager User's Guide*:
http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10901/toc.htm

Post Installation Tasks:

1. On Windows or other non-Linux operating systems, the VM Manager needs the tightvnc Java plugin. This plugin is needed to use Oracle VM Manager's web based console to start VNC sessions to connect to the guests running on the Oracle VM servers.
   This RPM can be downloaded from:
   http://oss.oracle.com/oraclevm/manager/RPMS/
   rpm -ivh tightvnc-java-1.3.9-3.noarch.rpm

2. To enable the console button in Oracle VM Manager for Mozilla/Firefox browser on Linux, ovm-console RPM needs to be installed. This RPM can be downloaded from:
   http://oss.oracle.com/oraclevm/manager/RPMS
   rpm -ivh ovm-console-1.0.0-2.x86_64.rpm
   OR
   rpm -ivh ovm-console-1.0.0-2.i386.rpm if the OEL OS is 32bit.

Hardware Configuration - Dell Solution for Oracle VM 2.1

Network Configuration for DELL/EMC FC SAN

Please refer to **Figure 1 - Architectural Overview of Oracle VM Server Pools attached to DELL/EMC Storage** for network connectivity. Dell PowerEdge R900, R905 and R805 servers have 4 onboard NICs each. It is recommended to have one of the NICs dedicated to OCFS2 heartbeat traffic via a separate Gigabit switch between server pool nodes. The rest of the NIC's can be connected to the public switches to provide Guest OS connectivity to the outside world via the XEN bridges. In our example, we have the following configuration:
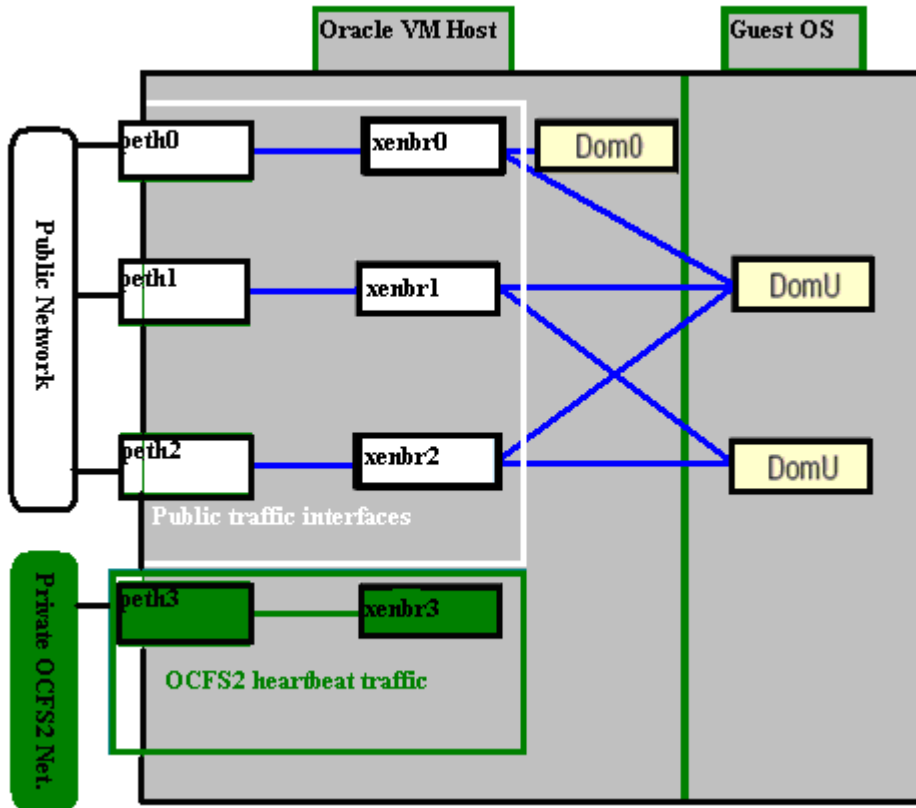
Figure 3: Oracle VM networking

In Oracle VM which is based on Xen Hypervsor technology, a bridge is equivalent to a virtual switch presented to the guest domains/virtual machines. Each physical server can have several bridges according to the availability of the physical NICs. Each physical NIC is assigned a XEN bridge. One can have multiple guest domains attached to each bridge or vice versa. By default, Oracle VM presents number of bridges equal to the physical network interface cards on the host. Each bridge is named xenbr*x (*where *x* corresponds to the number of the physical network interface). The host domain (dom0) and new domains (domUs) are attached to the default xenbr0 Bridge unless otherwise specified while creating the guest domains using Oracle VM Manager.

Bridges typically consist of a connection to a physical interface (an uplink) and a virtual interface (a patch to a server). The physical interface can be any network adapter in the server; the virtual interface corresponds to the domain Ethernet interface, as shown in Figure 4 below which represents a guest OS with domain ID=2 connected to a Xen bridge 2 and virtual interface vif<domain ID>.<guest interface 0> on the VM host:
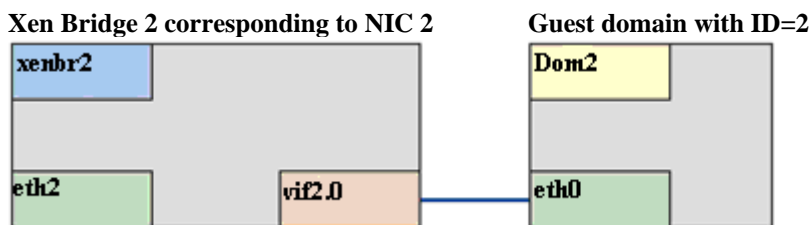
Figure 4: example of a guest OS attached to a XEN bridge

To verify the available bridges on your host, type the following: 'brctl show'

bridge name	bridge id	STP enabled	interfaces
xenbr0	8000.feffffffffff	no	vif1.0
			peth0
			vif0.0
xenbr1	8000.feffffffffff	no	peth1
			vif0.1
xenbr2	8000.feffffffffff	no	peth2
			vif0.2
xenbr3	8000.feffffffffff	no	peth3
			vif0.3

Table 3: showing bridge configuration information on Oracle VM host

In the above example, xenbr0 which consists of physical interface peth0 and virtual interface vif0.0 has a virtual interface vif1.0 which has connection to a guest domain with ID=1.

Shared Storage Configuration for DELL/EMC FC SAN

Please refer to **Figure 2 - Architectural Overview of Oracle VM Server Pools attached to DELL/EMC Storage** for storage connectivity. Configure your FC SAN by zoning the Oracle VM Server HBA's and switches, creating the desired storage groups and adding LUN's to the storage groups. The details of setting up the SAN connectivity are beyond the scope of this paper. Please refer to your storage documentation for details. It is recommended that each Oracle VM server should have two HBA ports with each port connected to a separate FC switch as shown in the figure 1. In this configuration, the host must have a multipath solution in place to handle multiple paths to the same storage device for the purpose of providing high availability and load balancing. In the following section we will discuss how Linux default multipath solution called device mapper is configured on the hosts.

Device Mapper Configuration:

1. Install the device mapper multipath RPM from the Oracle VM server 2.1 CD.
    rpm -ivh device-mapper-multipath-0.4.7-8.el5.i386.rpm

2. Find SCSI unique ID of your internal hard disk which should be excluded from multipath configuration:

    Example: scsi_id -g -s /block/sda
    36001c230d9c564000ef38b1f24980cd7
3. Edit the /etc/multipath.conf file and make sure that the SCSI unique ID of the internal disks found in the last step are listed under devnode_blacklist section as shown below:

devnode_blacklist

{
    wwid 36001c230d9c564000ef38b1f24980cd7
    devnode "^(ram|raw|loop|fd|md|dm-|sr|scd|st)[0-9]*"
devnode "^hd[a-z][0-9]*"
devnode "^cciss!c[0-9]d[0-9]*[p[0-9]*]"

Following is a sample file for Dell | EMC storage arrays:

devnode_blacklist
{
    wwid 36001c230d9c564000ef38b1f24980cd7
    devnode "^(ram|raw|loop|fd|md|dm-|sr|scd|st)[0-9]"*

```
devnode "^hd[a-z][0-9]*"
devnode "^cciss!c[0-9]d[0-9]*[p[0-9]*]"
}
defaults
{
user_friendly_names yes
}
devices
{
        device
        {
        vendor "DGC "
        product "*"
        path_grouping_policy group_by_prio
        getuid_callout "/sbin/scsi_id -g -u -s /block/%n"
        prio_callout "/sbin/mpath_prio_emc /dev/%n"
        path_checker emc_| EMC
        path_selector "round-robin 0"
        features "1 queue_if_no_path"
        no_path_retry 300
        hardware_handler "1 emc"
        failback immediate
        }
}
```

4. Start the multipath daemon service by typing the following command:
    service multipathd start

5. Verify that all the paths are visible and the configuration is correct by issuing the following command:
    multipath -v2 –d

    A listing with all the storage devices and the available paths should appear. Following is an example of a of a 500GB and 250GB LUN on the clarion array with two paths from each HBA port:

    ```
    create: 3600601607a431000aca17c7fddc2dc11 DGC,RAID 0
    [size=500G][features=1 queue_if_no_path][hwhandler=1 emc]
    \_ round-robin 0 [prio=6][undef]
     \_ 11:0:0:0 sdc 8:32   [undef][ready]
     \_ 11:0:1:0 sdf 8:80   [undef][ready]
    \_ round-robin 0 [prio=0][undef]
     \_ 11:0:2:0 sdi 8:128  [undef][ready]
     \_ 12:0:2:0 sdu 65:64  [undef][ready]
    create: 3600601607a43100036a27498ddc2dc11 DGC,RAID 0
    [size=250G][features=1 queue_if_no_path][hwhandler=1 emc]
    \_ round-robin 0 [prio=6][undef]
     \_ 11:0:0:1 sdd 8:48   [undef][ready]
     \_ 11:0:1:1 sdg 8:96   [undef][ready]
    \_ round-robin 0 [prio=0][undef]
     \_ 11:0:2:1 sdj 8:144  [undef][ready]
     \_ 12:0:2:1 sdv 65:80  [undef][ready]
    ```

6. If the listing is appropriate, commit the configuration as follows by executing the multipath command.
    multipath -v2

7. List and verify that all the multipath modules are loaded by issuing the 'lsmod' command.
   # lsmod |grep dm
   Following is the list of expected modules that should be loaded:

   dm_emc   9793 1
   dm_round_robin   7489 1
   dm_multipath   21449 3 dm_emc,dm_round_robin
   dm_mirror   30225 0
   dm_mod   56537 7 dm_multipath,dm_mirror

8. To get a listing of the current setup:
   multipath -ll

   Here is an example of the previous two LUN configuration with two paths to each LUN.

   mpath1 (3600601607a431000aca17c7fddc2dc11) dm-0 DGC,RAID 0
   [size=500G][features=1 queue_if_no_path][hwhandler=1 emc]
   _ round-robin 0 [prio=6][active]
    _ 11:0:0:0 sdc 8:32   [active][ready]
    _ 11:0:1:0 sdf 8:80   [active][ready]
   _ round-robin 0 [prio=0][enabled]
   _ 11:0:2:0 sdi 8:128 [active][ready]
    _ 12:0:2:0 sdu 65:64 [active][ready]
   mpath2 (3600601607a431000fe6de1a1ddc2dc11) dm-2 DGC,RAID 0
   [size=250G][features=1 queue_if_no_path][hwhandler=1 emc]
   _ round-robin 0 [prio=6][active]
    _ 11:0:0:2 sde 8:64   [active][ready]
    _ 11:0:1:2 sdh 8:112 [active][ready]
   _ round-robin 0 [prio=0][enabled]
    _ 11:0:2:2 sdk 8:160 [active][ready]
    _ 12:0:2:2 sdw 65:96 [active][ready]

9. Enable automatic startup of the multipath service on reboot:

   chkconfig multipathd on

10. To list the available multipath devices, type the following command:
    dmsetup ls
    mpath1 (253, 0)
    mpath2 (253, 1)

11. Perform steps 1-10 on the other nodes in the server pool.
    The devices appear in the folder /dev/mapper. We can now proceed to create desired partitions on the
    multipath devices and then create the OCFS2 file system for shared access by all nodes in the server
    pool.

12. To create the partitions, type: fdisk /dev/mapper/mpath1

13. User KPARTX to view and add the newly created partitions to the multipath configuration:

    kpartx -a /dev/mapper/mpath1
    On the other nodes in the pool, perform:
    kpartx –l /dev/mapper/mpath1
    kpartx –a /dev/mapper/mpath1

14. Verify that the partition was created properly:

```
ls -l /dev/mapper/
crw------- 1 root root  10, 62 Jan  9 07:53 control
brw-rw---- 1 root disk 253,  0 Jan 15 11:01 mpath1
brw-rw---- 1 root disk 253,  3 Jan 15 11:05 mpath1p1
brw-rw---- 1 root disk 253,  1 Jan 15 10:40 mpath2
```

Diagnostics:
[root@ovmp1s1 Server]# multipath -v2 –ll (For partial diagnostic information)
[root@ovmp1s1 Server]# multipath –v3 –ll (For full diagnostic information)

Configuring Oracle Cluster File System for VM repositories

1. Create /etc/ocfs2/cluster.conf file on all server pool nodes. The following is a sample cluster.conf file for a two node server pool:
   node:
       ip_port = 7777
       ip_address = 192.168.5.30
       number = 0
       name = ovmp1s1
       cluster = ocfs2
   node:
       ip_port = 7777
       ip_address = 192.168.5.31
       number = 1
       name = ovmp1s2
       cluster = ocfs2
   cluster:
       node_count = 2
       name = ocfs2

NOTE: Make sure there are **no extra/empty lines** in the cluster.conf file. Otherwise, the service O2CB will fail to start.

2. unmount the existing OCFS2 local volume:
   umount /OVS
3. stop the service 'o2cb'
   service o2cb stop
4. configure service O2CB. The network idle time out value had to be set to 60000 to allow the network timeout during xend network reconfiguration at boot time.
   service o2cb configure

   Load O2CB driver on boot (y/n) [y]:
   Cluster to start on boot (Enter "none" to clear) [ocfs2]:
   Specify heartbeat dead threshold (>=7) [70]: 100
   Specify network idle timeout in ms (>=5000) [30000]:60000 (required to overcome network timeout during xend startup which performs bridge configuration)
   Specify network keepalive delay in ms (>=1000) [1000]:
   Specify network reconnect delay in ms (>=2000) [2000]:
   Writing O2CB configuration: OK
   O2CB cluster ocfs2 already online

5. Perform the steps 1-4 on the other nodes in the pool
6. Format the shared disk volume from either one of the servers in the cluster
   mkfs.ocfs2 -b 4k -C 64k -L ovs /dev/mapper/mpath1p1

7. Change /etc/fstab to have the shared volume mounted at boot

```
#/dev/sda6              /OVS/          ocfs2  defaults                      1 0
/dev/mapper/mpath1p1    /OVS/          ocfs2  _netdev,datavolume,nointr     0 0
```

8. Mount all the OCFS2 volumes:
   mount –a –t ocfs2

NOTE: Execute /usr/bin/system-config-securitylevel to disable firewall otherwise the mount of OCFS2 volumes will fail.

Adding the Oracle VM Servers to Oracle VM Manager

You can use Oracle VM Manager to create and manage virtual machines on Oracle VM Server. To create a virtual machine using Oracle VM Manager, you must first set up a Server Pool containing a Server Pool Master, a Utility Server and a Virtual Machine Server. To do this, you must complete the following steps:

1. Open a web browser and log into the Oracle VM Manager Web interface. The default administrator username is 'admin' with the password 'oracle'. The URL is:
   http://*hostname*:8888/OVS
   hostname is the name or IP address of the Oracle VM Manager host computer.
2. Add the Oracle VM Server to the Server Pool. Select whether the Oracle VM Server is to be used as a Server Pool Master, a Utility Server, and/or a Virtual Machine Server. In our two node server pool, we assigned the dual roles of Server Pool Master and Virtual Machine Server to one host and the utility server and Oracle VM server role to the other host.

Managing Resources

Resources include virtual machine templates, virtual machine images, ISO files, and virtual disks.

Virtual machine templates

Virtual machine templates imported to Oracle VM Manager can be used by users to create virtual machines. A virtual machine template contains basic configuration information such as number of CPUs, memory size, disk size, and network interface card (NIC).
If the virtual machine you want to create shares the same attributes with an existing template, you can create the virtual machine based on this existing template. The virtual machine inherits the attributes of this template. Oracle provides OEL 5.1 and OEL 4.5 templates and virtual machine images for Oracle 11g R1 on their website at:
http://www.oracle.com/technology/software/products/virtualization/vm_templates.html
You can either choose one of those existing templates or create your own Virtual Machine to configure Oracle 11g database.

Virtual machine images

Virtual machine images imported to Oracle VM Manager can be used directly without the process of creation, and configuration.

Importing Existing (Internal) Virtual Machines:

- Copy the image and the vm.cfg file to /OVS/running_pool/VM_name on the Oracle VM server.
- Modify //OVS/running_pool/VM_name /vm.cfg file to indicate the correct location of the image file:
  disk = ['file:/OVS/running_pool/Vm_name/System.img,hda,w',',hdc:cdrom,r',]

- From the Oracle VM Manager console, click Virtual Machine Images → Import and follow instructions to import the image to the configuration.

ISO files

ISO files imported to VM Manager can be used to create virtual machines in **fully virtualized** mode. From the Oracle VM Manager console, click on ISO files → import and follow instructions to import internal or external ISO images to the Oracle VM manager configuration.

Shared and Private virtual disks

The shared and private virtual disks are created to add additional storage capacity to the existing virtual machine. The private virtual disks can only be used by a single virtual machine unlike the shared virtual disks.

Creating Virtual Machines

Virtual machines can be created either as paravirtualized guests or as hardware virtualized guests. Oracle VM Manager can be used to create either type of guests. There are a number of ways to create a virtual machine using Oracle VM Manager:
- Using a virtual machine template
- Using installation media
- Importing a virtual machine

See the *Oracle VM Server User's Guide* and the *Oracle VM Manager User's Guide* for more information.

Fully Virtualized or hardware virtualized Machine Creation example:

Please refer to instructions below for step by step guide on creating the fully virtualized guest. We recommend that at least 15GB be used as the virtual disk size for further installation and configuration of Oracle 11g database software in the guest domain.

1. Once logged into the Oracle VM Manager, select Server Pools tab and click on the Create Pool button.
2. Fill out the Server Information with node one having all three options checked for Server Type: Server Pool Master, Utility Server (fill out Additional information about Utility Server), and Virtual Machine Server. Then click Add.
3. Add remaining node with Server Type containing options: Utility Server and Virtual Machine Server.
4. At the User Information screen, select user admin and proceed by clicking Next.
5. At the General Information screen, enter a Server Pool Name and click Next.
   At the Confirmation screen, click Confirm.

   NOTE: The ISOs for the particular OS you will be installing, need to be under the example path of the master node /OVS/iso_pool/OEL5/ where OVS is the label for /dev/mapper/mpath1p1:

6. Go to the Oracle VM Manager Home page, and select the Resources tab and select ISO Files.
7. The ISOs from your master node should be listed with a pending status. Please Approve the ISOs so they can be available for your VM installation.
8. Go to the Oracle VM Manager Home page, and select the Virtual Machines tab.

9. At the Creation Method screen, select Create from installation media
10. At the Server Pool screen, select the Server Pool that you wish to use.
11. At the Source screen, Fully Virtualized should be selected as Virtualization method and you're your OS ISO CD1 is selected. Click Next
12. At the Virtual Machine Info screen, fill out the VM information. Our example specifications were
    Number of CPU: 4
    Memory Size(MB):8000
    Virtual Disk Size (MB): 15000
13. At the confirmation screen, review the information and select confirm.
14. The VM will be created and once you select Power On you can go through the rest of the installation procedures according to your application requirements.

NOTE: After creating the Fully Virtualized Machine, download and install the HVM guest packages from:
http://www.oracle.com/technology/software/products/virtualization/vm_templates_other.html

The HVM guest packages provide fixes to the following issues:

- Kernels for Hardware Virtualized (HVM) guests are provided to reduce clock skew issues.
- Paravirtualized drivers (xen-pvhvm packages) are provided to reduce system overhead in an HVM guest

The following additional RPM's may need to be installed if they were not selected during the initial install for Oracle 11g R1 software installation in the guest:

binutils<version>
binutils-<version>.x86_64
compat-db-<version>
control-center-<version>
elfutils-libelf-devel-<version>
elfutils-libelf-<version>
gcc-<version>
gcc-c++-<version>
glibc-<version>
glibc-common-<version>
libaio-<version>
libaio-devel-<version>
libstdc++-<version>
libstdc++-devel-<version>
make-<version>

Para-virtualized Machine Creation example

NOTE: Currently for the paravirtualized mode, only Oracle Enterprise Linux 4 Update 5, and Oracle Enterprise Linux 5or later are supported.

The paravirtualized machines cannot be created using the CD ISO images from the ISO pools. You have to loop back mount the ISO images to a remote machine or the OVM server machine and then export the mount points as NFS, HTTP or FTP shares. In this example, an OEL 5.1 PVM guest is created. The ISO images comprised of 5 CD's were loop back mounted and then NFS exported for installation from the OVM Manager machine:

In the following example an http location is configured for PVM guest installation:

Loopback mount all the OEL 5.1 ISO images to Disk1, Disk2, Disk3, Disk4 and Disk5:
mount -o loop /var/www/html/oel51/Enterprise-R5-U1-Server-x86_64-disc1.iso /media/iso/Disk1
mount -o loop /var/www/html/oel51/Enterprise-R5-U1-Server-x86_64-disc2.iso /media/iso/Disk2

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mount -o loop /var/www/html/oel51/Enterprise-R5-U1-Server-x86_64-disc3.iso /media/iso/Disk3
 mount -o loop /var/www/html/oel51/Enterprise-R5-U1-Server-x86_64-disc4.iso /media/iso/Disk4
 mount -o loop /var/www/html/oel51/Enterprise-R5-U1-Server-x86_64-disc5.iso /media/iso/Disk5

Create a folder oel51/install-x86_64 under /var/www/html:
mkdir –p /var/www/html/oel51/ install-x86_64

Create a new directrory install-x86_64 and copy all Disks under that folder by using the append option:
cp -R /media/iso/Disk1/* /var/www/html/oel51/ install-x86_64
cp -R /media/iso/Disk2/* /var/www/html/oel51/ install-x86_64
cp -R /media/iso/Disk3/* /var/www/html/oel51/ install-x86_64
cp -R /media/iso/Disk4/* /var/www/html/oel51/ install-x86_64
cp -R /media/iso/Disk5/* /var/www/html/oel51/ install-x86_64

Restart the httpd service to perform installation using http method as shown below:
service httpd restart

Switch over to your Oracle VM Manager machine:

1. Go to the Oracle VM Manager Home page, and select the Virtual Machines tab.
2. At the Creation Method screen, select Create from installation media
3. At the Server Pool screen, select the Server Pool that you wish to use.
4. At the Source screen, ParaVirtualized should be selected as Virtualization method. The Resource Location should be: http://<hostname>/oel51/install-x86-64/. Click Next
5. At the Virtual Machine Info screen, fill out the VM information. Our example specifications were
     Number of CPU: 4
     Memory Size(MB):8000
     Virtual Disk Size (MB): 15000
6. At the confirmation screen, review the information and select confirm.
7. The VM will be created and once you select Power On you can go through the rest of the installation procedures according to your application requirements.

NOTE: After creating the Paravirtualized Machine, download and install the PVM guest packages for x86-64 from:
http://www.oracle.com/technology/software/products/virtualization/vm_templates_other.html

PVM guest packages provide fixes to the following issues:

- Paravirtualized kernels are provided to improve the stability of software running in a Paravirtualized (PV) guest

NOTE: For live migration make sure to use 2.6.18-53.1.13.9.1.el5xen Paravirtulaized kernel or higher available from the oracle virtualization technology website given above.

The following additional RPM's may need to be installed if they were not selected during the initial install for Oracle 11g R1 software installation in the guest:

binutils<version>
binutils-<version>.x86_64
compat-db-<version>
control-center-<version>
elfutils-libelf-devel-<version>
elfutils-libelf-<version>
gcc-<version>
gcc-c++-<version>
glibc-<version>
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glibc-common-<version>
libaio-<version>
libaio-devel-<version>
libstdc++-<version>
libstdc++-devel-<version>
make-<version>

Performance Characteristics

In this section, performance comparison of Oracle 11G R1 running both in a PVM and an HVM guest environment is provided. Oracle 11g was configured to run an OLTP and CPU intensive workload.
As we can see from the results provided below, the best performance was achieved by using PVM guest. Also, for Oracle databases, it is advisable to use physical block devices attached to the guest domain for database storage for best performance. Configuration of Oracle 11g running in the PVM guest with physical disks for data storage using ASM results in performance vey close to Oracle running on physical servers. Although using block devices gives best performance, live migration feature will require device consistency on all nodes in the server pool and makes guest OS management more involved. Table 5 below provides performance test bed information. Table 6 lists the details about the kernel versions, ASM library drivers, storage configuration and Oracle database configuration used for the tests.

Configuration Details

Component	Model	Configuration			Function
Server	PowerEdge R900	2x 4socket quad core	32GB of RAM	Quad port LOM	OVM Servers: Intel pool
Server	PowerEdge 1950	1X2 Core CPU's	16GB RAM	Dual port LOM	OVM Manager: OEL 4.5
Storage	CX3-20	15x73GB 350GB LUN R10 Data 150GB R10 VM Repo	2X2048 MB cache 4Gb/s RAID controllers	Device mapper	OCFS2 File System for shared access to VM's
Networking	Public Network	1x16 port GigE			xenbr0, xenbr3 for VM public access
	Private Network	1x16 port GigE			eth1 private for OCFS2 heartbeat
Guest OS configuration Oracle release	Virtual Machines	OEL5.1 PVM, HVM guests; 15GB	Oracle 11g R1	4 VCPU's; 8GB RAM	Testing both with virtual disks and physical disks attached using ASM

Table 5: Test Bed Hardware Setup
Software Components and storage configuration:

OS	OEL 5.1 PVM, OEL 5.1 HVM, RH 5.1 Phy; all configured with 4cores(vCPU), 8GB RAM; ASM DATA 30GB, FLASH 20GB
Oracle	Oracle 11g R1 X64
PV Kernel	2.6.18-53.1.6.0.1.el5xen
HVM Kernel	2.6.18-53.1.6.0.1.el5
Phy Kernel	2.6.18-53.el5Largesmp on PowerEdge 2950 dual core

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VM Server	Dell PowerEdge R900 with 2 Quad core CPU's; 32 GB RAM; 4 onboard NIC's
OVM Release	2.1 with hypervisor patch installed
HVM Guest Packages	xen-pvhvm-2.6.18-53.0.0.100.1.el5-3.1.1-0.0.34.el5
ASMLib PVM Guest	oracleasmlib-2.0.3-1.el5 oracleasm-support-2.0.4-1.el5 oracleasm-2.6.18-53.1.6.0.1.el5xen-2.0.4-1.el5
ASMLib HVM Guest	oracleasm-2.6.18-53.1.6.0.1.el5-2.0.4-1.el5 oracleasmlib-2.0.3-1.el5 oracleasm-support-2.0.4-1.el5
Storage Configuration	Dell | EMC CX; 16 spindle RAID10; 100GB LUN;device mapper; Partitioned in 50/50GB; 50GB Physical given to the each Guest; Partitioned as 30GB DATA; 20GB Flash diskgroups; 300 warehouse TPCC (25GB); 3000 scale for CPU intensive workload (20GB)

Table 6: Test Bed software and database setup

Performance Comparisons (OLTP workload)

Figure 5 provided below gives the number of transactions per seconds (TPS) achieved Vs the number of users connected and performing queries (userload) against the database.

NOTE: These are normalized numbers in a lab environment only and are intended only to show the relative difference in performance.
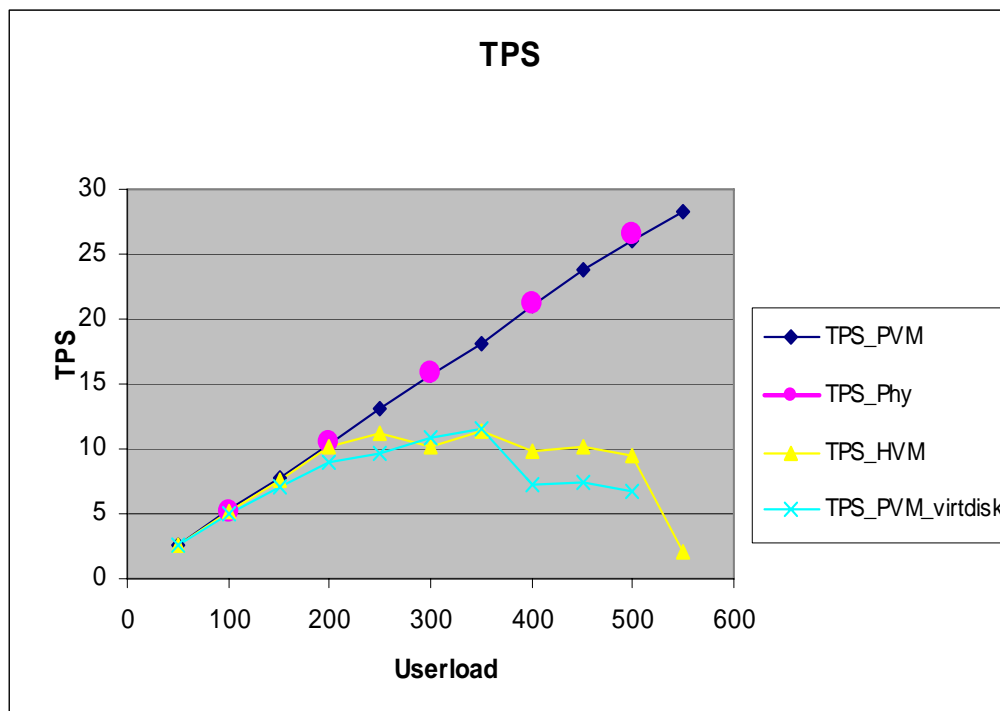
Figure 5: OLTP performance Vs number of users performing queries

Performance Comparisons (CPU Intensive workload)

Figure 6 provided below gives the number of transactions per seconds (TPS) achieved Vs the number of users connected and performing queries (userload) against the database using a workload consisting of complex CPU intensive Oracle queries.

NOTE: These are normalized numbers in a lab environment only and are intended only to show the relative difference in performance.
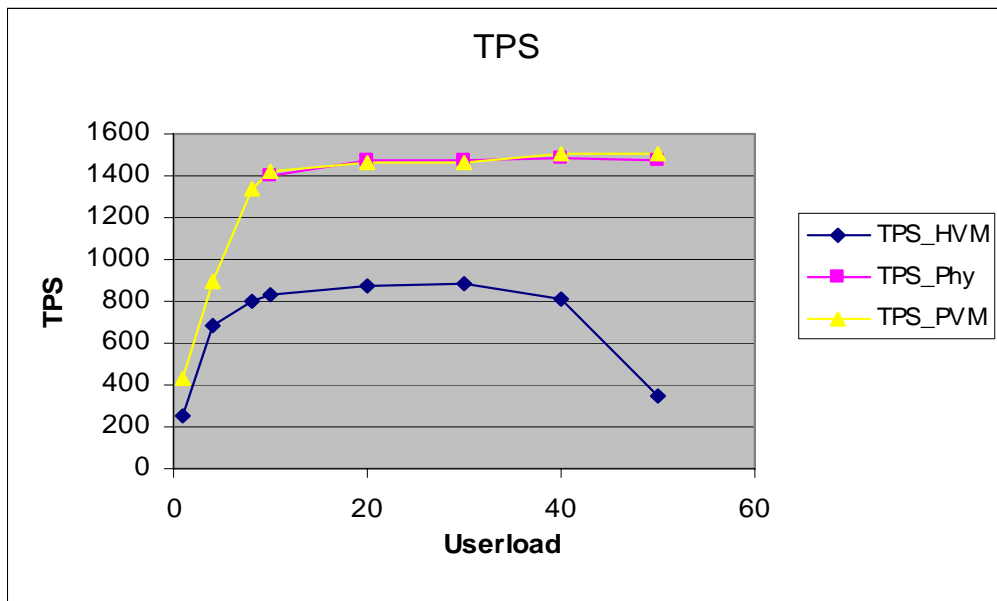

Figure 5: OLTP performance Vs number of users performing queries

Configuration Deliverables List - Dell Solution for Oracle VM 2.1 on DELL/EMC FC Storage

This section contains the Solution Deliverables List (SDL) for the Dell Solution for Oracle VM 2.1. It contains a detailed listing of server and storage hardware configurations, firmware, driver, OS, and database versions.

Recommended Hardware/Software Requirements		
(For details, see below)		
	Validated Component(s)	**Minimum OVM Node Configuration**
PowerEdge Nodes	Dell PowerEdge R900, R905, R805	1
Memory	All valid Dell PowerEdge R900/R905/R805 memory configurations	8Gig (per node)

Dell EMC FC SAN array	CX3-10,20,40,80	1
Ethernet Ports	Intel or Broadcom® Gigabit NICs	4
Ethernet Switches (For Private Interconnect)	Any Dell PowerConnect™ Gigabit-only Switches	2
Raid Controllers (Used for internal storage only)	PERC 6/i	1 (Per Node)
Internal Drive	All valid Dell R900, R905, R805 internal storage configurations	73 Gig/node
Oracle VM software	Oracle VM 2.1, Oracle VM Manager 2.1	
Oracle Software & Licenses	Oracle 11*g* R1 11.1.0.6 Standard Edition (Base) or EE	Single node
Guest Operating Systems	Red Hat Enterprise Linux Server 5 Update 1, OEL 5 Update 1	
Recommended Support Contract	Dell Gold or Platinum Plus Enterprise Support	

Table 1 – Solution Minimal Hardware/Software Requirements

Validated Servers				
PowerEdge Servers	**Model**	**BIOS[*]**	**ESM/BMC Firmware[*]**	**Notes**
	R900	1.5.1	1.33	
	R905	1.0.1	2.01	
	R805	1.0.1		
Internal Disks RAID				
PERC6/i	Firmware version = 6.0.2-0002; Driver version = 00.00.03.09			
Network				
Broadcom NetXtreme II Gigabit Ethernet Driver	Driver version = 10.5/T3.5			
Direct Attached SAS Storage				
Storage	CX3 series Flare = 26 Emulex driver = 8.1.10.3 Qlogic® Driver = 8.01.07-k6			
Software				

Oracle	11g R1 11.1.0.6 Standard Edition (Base) or EE
PV Kernel	2.6.18-53.1.13.9.1.el5xen
HVM Kernel	2.6.18-53.1.6.0.1.el5
HVM Guest Packages	kmod-pvhvm-EL-3.1.1-0.0.37.el5.x86_64.rpm
OVM Release	2.1 with hypervisor patch installed (xen 3.1.1)
Device Mapper	device-mapper-1.02.13-1.el5 device-mapper-multipath-0.4.7-8.el5

Table 2 – Solution Detailed Firmware, Driver and Software Versions

NOTES:
*: Minimum BIOS and ESM/BMC versions. For the latest BIOS updates go to http://support.dell.com
*: The deployment of this solution on Dell/EMC Clariion storage products requires an RPQ

Conclusion

The Oracle VM 2.1 configurations running on Dell Servers and Storage as described in this paper are designed to help optimize performance and to simplify the deployment and operations of solutions such as Oracle 11g databases in a virtualized environment. Oracle VM 2.1 using the Dell infrastructure provides the flexibility of adding additional resources as needed as the workload demands increase by adding additional servers or hardware resources to the server pools level or at the VM guest level.

Dell Solutions for Oracle 10g are designed to simplify operations, improve utilization and cost-effectively scale as your needs grow over time. This reference configuration white paper provides a blueprint for setting up an Oracle 11g database with Red Hat Enterprise Linux 5 or Oracle Enterprise Linux 5 on Dell servers and DELL/EMC SANs.

The best practices described here are intended to help achieve optimal performance of Oracle 11g running in a virtualized environment. To learn more about deploying Oracle 10g and 11g database on PowerEdge server and Dell storage, please visit www.dell.com/oracle or contact your Dell representative for up-to-date information on Dell servers, storage, and services for Oracle 10g and 11g solutions.

References

- VM Quick Start Guide:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10960/toc.htm

- VM Server Release Notes:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10900/toc.htm

- VM Manager Release Notes:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10903/toc.htm

- VM Server Installation Guide:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10899/toc.htm

- VM Manager Installation Guide:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10902/toc.htm

- VM Server User's Guide:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10898/toc.htm

- VM Manager User's Guide:
  http://download.oracle.com/docs/cd/E11081_01/doc/doc.21/e10901/toc.htm