Oracle Virtual Machine Live Migration with EMC Symmetrix V-Max

Applied Technology

Abstract

This white paper presents a comprehensive set of procedures for deployment of Oracle VM 2.x with EMC Symmetrix V-Max™ storage.

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Executive summary

The EMC® Symmetrix V-Max™ Series with Enginuity™ is the newest offering in the Symmetrix® product line. Built on the strategy of simple, intelligent, modular storage, it incorporates a new Virtual Matrix™ interface that connects and shares resources across all nodes, allowing the storage array to seamlessly grow from an entry-level configuration into the world’s largest storage system. Symmetrix V-Max provides improved performance and scalability for demanding enterprise database environments while maintaining support for EMC’s broad portfolio of software offerings. With the release of Enginuity 5874, Symmetrix V-Max systems now deliver new software capabilities that improve ease of use, business continuity, Information Life Management (ILM), virtualization of small to large environments, and security.

Oracle VM is a Xen architecture-based server virtualization software that offers scalable, highly efficient, and low-cost server virtualization. Oracle VM makes the deployment, management, and support of enterprise applications easy and quick. It offers an extensive set of features such as web services APIs, live migration of virtual machines, a management graphic user interface, fast deployment by using ready-made VM Templates, and more.

Oracle VM with EMC Symmetrix V-Max storage is an ideal choice for deploying a highly reliable virtualization solution.

Symmetrix V-Max

In addition to Symmetrix V-Max’s enhanced performance, scalability, and availability, Enginuity 5874 introduces new ease of use, virtualization, and ILM functionalities. With Symmetrix V-Max Auto-provisioning Groups, mapping devices to small or large Oracle VM (OVM) Server environments becomes fast and easy. Devices, HBA WWNs, or storage ports can be easily added or removed, and automatically these changes are propagated through the Auto-provisioning Group, thus improving and simplifying complex storage provisioning for any physical or virtual environment. With Symmetrix V-Max Enhanced Virtual LUN Technology, Oracle applications data can be migrated between storage tiers seamlessly, such as Enterprise Flash Drives, Fibre Channel drives, and SATA drives. The data migration takes place inside the storage array while the database is active, thus allowing the placement of data on the storage tier that best matches its performance and cost requirements. As database performance requirements change, it is easy and efficient to move the appropriate LUNs to their new storage tier. Symmetrix V-Max Virtual LUN migration doesn’t consume host or SAN resources; it improves return on investment (ROI) by using the correct storage tiering strategy, and it reduces complexity as there is no need to change backup or DR plans since the host devices don’t change. Additional enhancements to availability, scalability, and ease of use, including EMC TimeFinder® and Symmetrix Remote Data Facility (SRDF®), which have been widely deployed with Oracle databases, are fully described in the EMC Symmetrix V-Max Series Product Guide.

TimeFinder provides the ability to create and manage multiple snapshots and clones of the storage devices, thus providing a quick way to create gold copies, and test, development, and staging data environments. SRDF provides remote replication for the storage devices across any distance to increase physical and virtual environment availability, and create a disaster recovery solution.

Note: At the time of publication EMC does not provide support for layered software with Oracle VM, such as EMC PowerPath® or EMC Solutions Enabler®, and therefore this paper demonstrates the use of the native Linux multipathing software instead. In addition, Symmetrix storage management activities using Solutions Enabler or Symmetrix Management Console should be done from a management host (not under Oracle VM).

Oracle VM

Virtualization has become a key technology for enterprises to enable server consolidation, make data centers more energy- and resource-efficient, enhance speed and ease of deployment, reduce costs, and improve availability. Virtualization also has the advantage for ease of management, online configuration changes, and operation speed relative to physical environments. Oracle VM, a Xen architecture-based server virtualization software, enables data centers to run multiple virtual machines on a single piece of hardware. The bare-metal hardware runs software that enables users to install multiple instances of...
operating systems that 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. With Oracle VM, it is easy to load balance workload across virtual machines to make sure that resources are fully utilized, and move live virtual machines from one physical server to another without experiencing downtime.

Oracle VM supports two types of virtual machines:
- Hardware virtualized: The guest operating system does not need to be modified. It is available only on Intel VT and AMD SVM CPUs.
- Paravirtualized: The guest operating system is recompiled for the virtual environment for optimal performance.

Oracle VM consists of three main components:
- Oracle VM Manager: Provides a standard Application Development Framework (ADF) web application to manage Oracle VM-based virtual machines. It also provides an API for OVM Server.
- Oracle VM Server: Provides a virtualization environment designed to provide a self-contained, secure, server-based platform for running virtualized guests. Oracle VM Agent is included for communication with Oracle VM Manager.
- Oracle virtual machines: From one to many virtual Windows or Linux servers that share the OVM Server physical resources and can be managed using Oracle VM Manager.

Introduction

This white paper provides a comprehensive set of procedures when deploying Oracle VM 2.1.2, and Oracle Database 10g and 11g with EMC Symmetrix V-Max.

Audience

The primary audience of this white paper is database and system administrators, storage administrators, and system architects who are responsible for implementing, managing, and supporting Oracle VM virtual infrastructures, and Oracle databases and storage systems. It is assumed that readers have some familiarity with Oracle VM, Oracle database aspects, and EMC Symmetrix, and are interested in achieving server and database virtualization, as well as higher database availability and protection.

OVM Server installation

Hardware and software

The hardware setup consists of setting up the Fibre Channel connectivity between the Symmetrix V-Max storage, switches, and servers, and setting up the network interconnectivity for the cluster. The main guidelines during this step are to maximize hardware redundancy such as using two switches, more than a single HBA, multipath for dynamic path failover, and load balancing.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrix V-Max</td>
<td>Enginuity 5874</td>
</tr>
<tr>
<td>2 x Sun Fire X4100 server</td>
<td>2 x dual core, 16 GB RAM</td>
</tr>
<tr>
<td>4 x Express (2 HBA ports</td>
<td></td>
</tr>
<tr>
<td>used per server)</td>
<td></td>
</tr>
</tbody>
</table>
### Preparations

#### Disconnect storage prior to local OS install

If the Linux OS is installed on the local disk (doesn’t boot from storage), it is recommended to disconnect the HBA ports from the storage prior to installation of the OS. This will eliminate the discovery and prompt to partition each of the storage SCSI devices. Once the installation is completed, connectivity should be restored and the system rebooted. If booting from the SAN it is recommended to only mask (make visible) the boot device for ease of installation and only later present the rest of the devices. The tests described in the paper used local OS install.

#### Paravirtualization vs. hardware-assisted

There are two installation options to choose from that will have an important effect on the guest’s machines later. Hardware-assisted virtualization means that the guest operating system is not modified for virtualization. However, it requires special CPU BIOS support. Paravirtualization means that the guest operating system was modified to work as a virtual machine and doesn’t require special CPU support. The installation described in this paper will be based on paravirtualization.

### Install OVM Server

The installation procedures that were followed are documented below. The steps are provided as an example. Customers may choose to use different installation choices, based on their environment and preferences.

1. Download ISO images for OVM Server (64-bit) and Oracle VM Manager from [http://edelivery.oracle.com/oraclevm](http://edelivery.oracle.com/oraclevm).
2. Boot the server with the Install CD. Since paravirtualization is used (rather than hardware-assist virtualization) the BIOS setting for virtualization is disabled.
3. The Oracle VM Server installation screen is displayed as shown in Figure 1. To begin the installation, press **Enter**. (When the first screen appears, press **Enter** to start the installation.)

---

<table>
<thead>
<tr>
<th>Software</th>
<th>Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server Operating System</td>
<td>Oracle VM Server 2.1.2</td>
</tr>
<tr>
<td>Guest OS</td>
<td>Oracle Enterprise Linux Release 5 Update 2</td>
</tr>
<tr>
<td>VM Manager</td>
<td>Oracle VM Manager 2.1.2</td>
</tr>
<tr>
<td>Oracle</td>
<td>11.1.07 database linux32</td>
</tr>
</tbody>
</table>
4. After loading drivers, the installer will suggest verifying the media (choose to skip).
5. Choose **US English** for Keyboard selection
6. The system will search for a previous OVM Server installation. If one is found, select **Reinstall System** to overwrite the existing installation.
7. For partitions, choose the custom layout, as shown in Figure 2.

8. Create swap space to match the server cache size. The rest can be used for a root partition or alternatively additional partitions can be created. Review the partition layout, and make changes if needed, then save your changes, select **OK** and press **Enter**.
9. Place the boot loader on the Master Boot Record (MBR) as the location to install the boot loader as shown in Figure 4. Select **OK** and press **Enter**.

10. Select the management network interface. eth0 is selected in this case. Provide the network configuration, DNS configuration, as well as hostname configuration, as shown in Figure 5 and Figure 6.
11. Select the correct time zone.
12. Provide the password for the Oracle VM Agent, which is used by Oracle VM Manager to manage and monitor OVM Server, and the guests created and running within it. Provide the password for the root user, as well.
13. The installation will begin by formatting the boot file system, followed by transferring the install image to the host’s hard drive, and configuring OVM Server.
14. Reboot the host once the installation is completed, and log in to the OVM Server as root after reboot, as shown in Figure 7.
15. This completes the installation of OVM Server. The Oracle VM Agent starts automatically, and restarts each time the machine is rebooted.

For live migration between physical servers, install OVM Server on another physical host with the same hardware architecture, and same make and model, as required for Oracle VM live migration.

**Set up multipath, storage, and OCFS2 for OVM Servers**

Configure your FC SAN by zoning and masking the OVM Server HBAs to storage. The Symmetrix V-Max Auto-provisioning Groups feature makes masking operations much quicker and easier to manage. It is recommended that each OVM Server should have two HBA ports with each port connected to a separate FC switch for increased availability. In such a configuration, the host must use a multipathing solution to handle multiple paths to the same storage device for the purpose of providing high availability and load balancing. This paper shows the use of the Linux native multipath solution, device mapper, to configure both OVM hosts.

**Configure device mapper**

1. Install the device mapper multipath RPM from the OVM Server if not already installed:
   
   ```bash
   rpm -q device-mapper-multipath
   rpm -ivh device-mapper-multipath-0.4.7-17.el5
   ```

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

   ```bash
   scsi_id -g -s /block/sda
   3500000e011f685c0
   scsi_id -g -s /block/sdb
   3500000e0120d8350
   ```

3. Edit the `/etc/multipath.conf` file and make sure that the SCSI unique ID of the internal disks found in the previous step are listed under the “blacklist” section as shown here:
blacklist {
     wwid 3500000e011f685c0
     wwid 3500000e0120d8350
 }

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 50 GB LUN on a Symmetrix V-Max array with two paths from each HBA port:

```
create: mpath14 (360000970000192601261533030374134) EMC,SYMMETRIX
    [size=50G][features=0][hwhandler=0]
    \ round-robin 0 [prio=2][active]
    \ 1:0:0:23 sdas 66:192 [active][ready]
    \ 2:0:0:23 sdbd 67:112 [active][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_round_robin          7617  1
    dm_mirror               30225  0
    dm_multipath            21577  2 dm_round_robin
    dm_mod                  56665  81 dm_mirror,dm_multipath
```

8. To get a listing of the current setup:

```
    multipath -ll
```

Here is an example of the 50 GB LUN configuration with two paths to each LUN.

```
mpath14 (360000970000192601261533030374134) dm-14 EMC,SYMMETRIX
    [size=50G][features=0][hwhandler=0]
    \ round-robin 0 [prio=2][active]
    \ 1:0:0:23 sdas 66:192 [active][ready]
    \ 2:0:0:23 sdbd 67:112 [active][ready]
```

```
mpath25 (360000970000192601261533030373942) dm-14 EMC,SYMMETRIX
    [size=50G][features=0][hwhandler=0]
    \ round-robin 0 [prio=2][active]
    \ 2:0:0:14 sdr 65:16 [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
    mpath14 (253, 3)
    ...
    ```

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 the following command:

    ```
    fdisk /dev/mapper/mpath14
    ```

    Note: EMC strongly recommends to align Linux partitions to a 64 KB Symmetrix track size boundary. To do this, simply start fdisk as shown above, and once the partitions are created, type “x” to enter Expert mode. Type “p” to show (print) the current partition table, including the offset in block units. Type “b” to change any partition offset. For example, move partition 1 from its default offset of 32 blocks to 128. Since each block is 512 bytes, then 128 x 512 bytes = 64 KB offset. If more than one partition is created on the LUN, verify that the rest of the partitions are aligned, or follow a similar step to change their offset to a number that is 128 blocks (64 KB) aligned.

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

    ```
    kpartx -a /dev/mapper/mpath14
    ```

    On the other nodes in the pool, perform:

    ```
    kpartx -l /dev/mapper/mpath14
    kpartx -a /dev/mapper/mpath14
    ```

14. Verify that the partition was created properly:

    ```
    ls -l /dev/mapper/
    crw------- 1 root root 10, 62 Mar 9 07:53 control
    brw-rw---- 1 root disk 253, 3 Mar 15 11:01 mpath14
    brw-rw---- 1 root disk 253, 33 Mar 15 11:05 mpath14p1
    ...
    ```

    Diagnostics:

    ```
    multipath -v2 -ll (For partial diagnostic information)
    multipath -v3 -ll (For full diagnostic information)
    ```

**Configure shared Oracle Cluster File System for VM repositories**

If you want to perform live migration of virtual machines to other OVM Servers, you need create a shared virtual disk to be used for the live migration. You can set up a shared virtual disk in the OVM Server in the following configurations:
• Oracle Cluster File System (OCFS2) using the iSCSI network protocol
• OCFS2 using a storage area network (SAN)
• Network File System (NFS)

We chose to create a shared virtual disk using the OCFS2 with SAN configuration

Create a shared virtual disk using OCFS2 on SAN

1. Create an OCFS2 configuration file as /etc/ocfs2/cluster.conf 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 = 10.243.159.23
   number = 0
   name = licoe023
   cluster = ocfs2

   node:
   ip_port = 7777
   ip_address = 10.243.159.22
   number = 2
   name = licoe022
   cluster = ocfs2

   cluster:
   node_count = 2
   name = ocfs2
   ```

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

2. Unmount the local OCFS2 volume (umount /OVS) if there is one.

3. Review the status of the OCFS2 cluster service, and stop the service “o2cb” (service o2cb stop) if it is already running.

   ```
   service o2cb status
   service o2cb stop
   ```

4. Load the OCFS2 module:

   ```
   service o2cb load
   ```

5. Set the OCFS2 service to be online:

   ```
   Service o2cb online
   ```

6. Configure the service O2CB. The network idle timeout 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

7. Perform steps 1-4 on the other nodes in the pool.
8. Review the partitions by checking /proc/partitions:
   ```
cat /proc/partitions
   ```
9. Format the shared disk volume from either one of the servers in the cluster:
    ```
    mkfs.ocfs2 -b 4k -C 64k -L ovs /dev/mapper/mpath14p1
    ```
10. Change /etc/fstab to have the shared volume mounted at boot:
    ```
    /dev/mapper/mpath14p1 /OVS/running_pool/ovm02 ocfs2 defaults 1 0
    ```
11. Mount all the OCFS2 volumes:
    ```
    mount -a -t ocfs2
    ```

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

### Set up a paravirtualized VM guest OS for VM Manager

We will use the `virt-install` command-line interactive tool to create the guest on the OVM Server. To prepare the environment:

1. Connect to the OVM Server as root. Note: When connecting to the OVM Server as root, you are connecting to “dom0”.

2. Create the following directories to implement Oracle VM Manager at a later time. Note: The install of OVM Server will have created a /OVS directory.
    ```
    mkdir /OVS/running_pool
    mkdir /OVS/iso_pool
    ```

3. Make the directories /media/iso and /OEL52x32 (or another valid OEL distribution):
    ```
    mkdir /media/iso
    mkdir -p /OEL52x32
    ```

   Directory /media/iso will be used as the mount point for the ISO files. Directory /OEL52x32 will contain the operating system installation software and will be exported to the virtual machine.

   **Note:** During the installation of the operating system for a paravirtualized machine, the location of the install media cannot be changed. As a result, installing directly from multiple CD ISO files is not possible.

4. The install can be made directly from a single ISO file such as the DVD ISO of OEL52x32:
a. Download the ISO files for Oracle Enterprise Linux 5 Update 2.

b. Move the CD ISO files to the directory /OVS/iso_pool.

We cannot create guests using CD-ROM or from the hard drive; however we can create an installation tree on the host operating system (Oracle VM Server), and mount it from the Oracle VM serving as an NFS share.

5. Mount the first Oracle Enterprise Linux 5 ISO file to /media/iso:

```
mount -t iso9660 -o ro,loop /OVS/iso_pool/Enterprise-R5-U2-
Server-i386-disc1.iso /media/iso/
```

6. Change the directory to /media/iso. Copy the contents of /media/iso to /OEL52x32 using the --var option:

```
cd /media/iso/
cp --var * /OEL52x32
```

7. Change to another directory and umount the /media/iso directory:

```
cd
umount /media/iso/
```

8. Repeat steps 5 to 7 for each ISO file (1-5). If prompted to overwrite a file reply no with “n”.

---

**NFS mount Oracle Enterprise Linux ISO files for guest installation**

1. Make certain the services related to NFS are started:

```
service portmap start
service nfs start
```

2. Export the mount point to make it available to domU. The first command below exports the directory. The second and third commands verify the export.

```
exportfs *:/OEL52x32
exportfs
showmount -e licoe009
showmount -e 10.243.159.22
```

3. Create the directory that will contain the virtual machine files:

```
mkdir /OVS/running_pool/OVManager
```

**Create a guest using virt-install interactively**

1. Create the virtual machine by executing the command virt-install. The output generated when virt-install was executed is as follows:

```
virt-install
```
What is the name of your virtual machine? OVManager

How much RAM should be allocated (in megabytes)? 2048

What would you like to use as the disk (path)?
   /OVS//running_pool/OVManager/system.img

How large would you like the disk (/OVS/running_pool/OVManager/system.img) to be (in gigabytes)? 16

Would you like to enable graphics support? (yes or no) no

What is the install location? nfs:10.243.159.22:/OEL52x32

Starting install...

2. The guest operating system installer starts and a text-based installer is displayed.

![Image of text-based installer](image.png)

**Figure 8. Installer begins**

3. For configuring TCP/IP choose **Enable IPV4 support** with **Manual configuration** and disable IPv6 support.
4. The Enterprise Linux installer will then prompt for configuring the hard drive. Choose the **Create custom layout** option. Create swap space to match the server cache size. The rest can be used for the root partition (Figure 10) or alternatively additional partitions can be created.

5. Choose the GRUB boot loader.
6. Install the boot loader in the Master Boot Record.
7. Configure the network interface eth0.
Figure 11. Configure eth0

9. Configure the Gateway and the DNS.

Figure 12. Configure the Gateway and DNS

10. Provide the hostname for the guest.
11. Enter the password for root.

In this example no additional packages for the guest were selected.

12. After the dependency check is performed, the formatting of the file system begins.
13. After the formatting completes, the system goes for a reboot and then comes up with the guest login prompt and the installation of a paravirtualized VM completes.

**Figure 15. Installation completes**

Note: In this example the No firewall option was selected and SELinux disabled.

Repeat the same steps to create more guest VMs. We created another guest, ovm02, on the OCFS2 virtual volume, /OVS/running_pool/ovm02, shared by the source and target OVM Servers in the cluster for live migration.

**Configure OEL and shared disks for Oracle**

**Configure shared virtual disks for an OEL guest**

Prepare shared block devices as virtual disks

Symmetrix V-Max devices are mapped and masked to both OVM Servers, and these devices are shared among the OVM Servers. Here we attach the multipath-enabled devices mpath15, 16, and 17 shared by both OVM Servers as sdi, sdj, sdk devices, respectively, to the OVM guest host as block devices using the “xm block-attach” command:

```
xm block-attach ovm02 phy:/dev/mapper/mpath15 /dev/sdi w!
xm block-attach ovm02 phy:/dev/mapper/mpath16 /dev/sdj w!
xm block-attach ovm02 phy:/dev/mapper/mpath17 /dev/sdk w!
```

Edit the vm.cfg file and add the specified physical devices to the configure file, so that they would be permanent to the guest host.

```
'phy:/dev/mapper/mpath15,sdi,w',
'phy:/dev/mapper/mpath16,sdj,w',
'phy:/dev/mapper/mpath17-sdk,w',
```

Prepare OCFS2 file system devices as virtual disks

You can also create OCFS2 file system devices, instead of block devices, as virtual disks for an OEL guest.

1. Create an OCFS file system on multipath-enabled devices as shared virtual disks for an OEL guest. Follow the procedures as described in the section “Set up multipath, storage, and OCFS2 for OVM Servers” for both OVM Servers.

2. Mount the OCFS2 file system to the desired mount point by editing the /etc/fstab system file in both OVM Servers to have the shared volumes mounted at boot, as described in the section “Set up multipath, storage, and OCFS2 for OVM Servers.” The following are the mount points for the newly created OCFS2 file systems.
3. Prepare the virtual disk image file by running `dd` for the appropriate size. Here we create a virtual disk image file with a size of 50 GB:

   ```
   dd if=/dev/zero of=/OVS/share/data1/data1.img bs=1M count=50000
   dd if=/dev/zero of=/OVS/share/data1/data1.img bs=1M count=50000
   dd if=/dev/zero of=/OVS/share/data1/data1.img bs=1M count=50000
   ```

4. Create a symbolic link from "/OVS/running_pool/VMName/fileX.img" to the newly created file on the OCFS2 mountpoint(s):

   ```
   ln -s /OVS/share/data1/data1.img /OVS/running_pool/ovm02/data1.img
   ln -s /OVS/share/data2/data2.img /OVS/running_pool/ovm02/data2.img
   ln -s /OVS/share/data3/data3.img /OVS/running_pool/ovm02/data3.img
   ```

5. Attach the OCFS2 file devices to the OVM guest host as file devices using the “`xm block-attach`” command:

   ```
   xm block-attach ovm02 file:/OVS/running_pool/ovm02/data1.img /dev/xvdb w!
   xm block-attach ovm02 file:/OVS/running_pool/ovm02/data2.img /dev/xvdc w!
   xm block-attach ovm02 file:/OVS/running_pool/ovm02/data3.img /dev/xvdd w!
   ```

6. Edit the `vm.cfg` file and add the specified OCFS2 file devices to the configure file, so that they would be permanent to the guest host.

   ```
   'file:/OVS/running_pool/ovm02/data1.img,xvdb,w',
   'file:/OVS/running_pool/ovm02/data2.img,xvdc,w',
   'file:/OVS/running_pool/ovm02/data3.img,xvdd,w',
   ```

**Partition OEL guest virtual disks**

Create disk partitions on the shared virtual device (for example, /dev/sdi to /dev/sdk, and /dev/xvdb to /dev/xvdd) from the guest host as in the “Configure device mapper” section, and align the partitions on a 64 KB boundary (128 blocks) with expert mode in partition.

**Configure OEL for Oracle**

1. Create Oracle user groups and accounts for installing and maintaining Oracle 10g on OVM. The user account will be “oracle” and the groups will be “dba”:

   ```
   groupadd -g 501 dba
   useradd -g dba -u 10001 -d /u01/app/oracle oracle
   id oracle
   uid=10001(oracle) gid=501(dba) groups=501(dba)
   ```

2. Configure the kernel parameters by login as root and edit the `/etc/sysctl.conf` file with the values shown below:

   ```
   sysctl -p
   net.ipv4.ip_forward = 0
   net.ipv4.conf.default_rp_filter = 1
   net.ipv4.conf.default.accept_source_route = 0
   net.ipv4.ip_local_port_range = 1024 65000
   net.core.rmem_default = 262144
   net.core.wmem_default = 262144
   net.core.rmem_max = 1048536
   net.core.wmem_max = 1048536
   kernel.sysrq = 0
   kernel.core_uses_pid = 1
   net.ipv4.tcp_syncookies = 1
   ```
kernel.msgmnb = 65536
kernel.msgmax = 65536
kernel.shmmax = 4294967295
kernel.shmall = 268435456
kernel.shmmni = 4096
kernel.sem = 250 32000 100 128
fs.file-max = 6553600

3. Set the shell limits for the oracle user. As user root append the /etc/security/limits.conf file as shown below.

    oracle  soft    nproc   2047
    oracle  hard    nproc   16384
    oracle  soft    nofile  1024
    oracle  hard    nofile  65536

4. As root, modify the /etc/pam.d/login file as shown below

    # PAM-1.0
    auth [user_unknown=ignore success=ok ignore=ignore default=bad]
    pam_securetty.so
    auth include system-auth
    account required pam_nologin.so
    account include system-auth
    password include system-auth
    # pam_selinux.so close should be the first session rule
    session required pam_selinux.so close
    session include system-auth
    session required pam_loginuid.so
    session optional pam_console.so
    # pam_selinux.so open should only be followed by sessions to be executed in the user context
    session required pam_selinux.so open
    session optional pam_keyinit.so force revoke
    session required /lib/security/pam_limits.so

5. As root, modify the /etc/profile as shown below.

    if [ \$USER = "oracle" ]; then
    if [ \$SHELL = "/bin/ksh" ]; then
        ulimit -p 16384
        ulimit -n 65536
    else
        ulimit -u 16384 -n 65536
    fi
    umask 022
    fi

**Oracle software installation**

**Install Oracle 11gR1**

**Oracle silent installation**

From the OEL guest host perform the following steps:

1. Unzip the Oracle package as an oracle user. After unzipping the file we would get a directory called database, for example, $DISTRIB_ORACLE=/download/11gR1/database.
2. Prepare a response file for silent install. We would be performing the Enterprise Edition installation and hence using the ee.rsp file present at the $DISTRIB_ORACLE/install/response/ directory. We would be performing only the database software installation and not the database creation so that we can apply the patches before the database is created. Create a new Oracle home, for example, SORACLE_HOME=/u01/app/oracle/db.

Modify the following parameters of the file as shown below.

```
UNIX_GROUP_NAME=dba
FROM_LOCATION="$DISTRIB_ORACLEstage/products.xml" (eg: /download/11gR1/database/stage/products.xml)
ORACLE_HOME=SORACLE_HOME (eg: /u01/app/oracle/db)
ORACLE_HOME_NAME=oral1gDBhome
RESTART_SYSTEM=false
RESTART_REMOTE_SYSTEM=false
s_nameForDBAGrp="dba"
s_nameForOPERGrp="oper"
n_configurationOption=3
```

3. Run the installer as user oracle.

```
./runInstaller -silent -ignoreSysPrereqs -responseFile /download/11gR1/11gR1/database/install/response/ee.rsp
```

```
Installation in progress (Mon May 11 15:04:09 EDT 2009)
..............................................................  7% Done.
.............................................................. 14% Done.
.............................................................. 21% Done.
.............................................................. 28% Done.
.............................................................. 35% Done.
.............................................................. 43% Done.
.............................................................. 50% Done.
.............................................................. 57% Done.
.............................................................. 64% Done.
.............................................................. 71% Done.
.............................................................. 78% Done.
.............................................................. 83% Done.
Install successful
Linking in progress (Mon May 11 15:06:56 EDT 2009)
.............................................................. 83% Done.
Link successful
Setup in progress (Mon May 11 15:08:04 EDT 2009)
.............................................................. 100% Done.
Setup successful
```

End of install phases. (Mon May 11 15:08:11 EDT 2009)

WARNING: A new inventory has been created in this session. However, it has not yet been registered as the central inventory of this system. To register the new inventory please run the script '/u01/app/oraInventory/orainstRoot.sh' with root privileges.
If you do not register the inventory, you may not be able to update or patch the products you installed.
The following configuration scripts need to be executed as the 'root' user.
```
#!/bin/sh
# Root script to run
/u01/app/oraInventory/orainstRoot.sh
/u01/app/oracle/db/root.sh
To execute the configuration scripts:
1. Open a terminal window
2. Log in as 'root'
3. Run the scripts
```

Oracle Virtual Machine Live Migration with EMC Symmetrix V-Max
Applied Technology
The installation of Oracle Database 11g was successful.

Apply software patches and upgrade Oracle 11gR1

Oracle silent installation

Modify the following parameters in the patchset.rsp file present at the $DISTRIBUT_PATCH/response directory. Supply the $ORACLE_HOME value in the ORACLE_HOME directory as shown below.

```
UNIX_GROUP_NAME=dba
FROM_LOCATION=$DISTRIBUT_PATCH/stage/products.xml
(eg:/download/patch/Disk1/stage/products.xml)
ORACLE_HOME=$ORACLE_HOME (eg:/u01/app/oracle/db/)
ORACLE_HOME_NAME=ora11gDBhome
RESTART_SYSTEM=false
```

```
./runInstaller -silent -ignoreSysPrereqs -responseFile
/download/11gR1/11gR1p7/Disk1/response/patchset.rsp
```

Deinstall in progress (Monday, May 11, 2009 4:14:45 PM EDT) 100% Done.
Deinstall successful
Installation in progress (Monday, May 11, 2009 4:14:46 PM EDT) 90% Done.
Install successful
Linking in progress (Monday, May 11, 2009 4:17:17 PM EDT) 90% Done.
Link successful
Setup in progress (Monday, May 11, 2009 4:18:23 PM EDT) 100% Done.
Setup successful
End of install phases. (Monday, May 11, 2009 4:18:29 PM EDT)

WARNING:
The following configuration scripts need to be executed as the "root" user.
```
#!/bin/sh
#Root script to run
```
/u01/app/oracle/db/root.sh
To execute the configuration scripts:
  1. Open a terminal window
  2. Log in as "root"
  3. Run the scripts

The installation of Oracle Database 11g Patch Set 1 was successful.

Now the OEL guest host is ready for manually creating an Oracle 11gR1 ASM instance and database.

Create an Oracle 11gR1 ASM instance and database

Configure Oracle Cluster Synchronization Services (CSS)

Run the $ORACLE_HOME/bin/localconfig script to manually configure Oracle Cluster Synchronization Services (css) for ASM.

```
$ su
# $ORACLE_HOME/bin/localconfig all

/etc/oracle does not exist. Creating it now.
Successfully accumulated necessary OCR keys.
Creating OCR keys for user 'root', privgrp 'root'.
Operation successful.
Configuration for local CSS has been initialized

Adding to inittab
Startup will be queued to init within 90 seconds.
Checking the status of new Oracle init process...
Expecting the CRS daemons to be up within 600 seconds.

CSS is active on these nodes.
licoe024
CSS is active on all nodes.
Oracle CSS service is installed and running under init(1M)
```

Create an ASM instance

1. Change the ownership of partitioned virtual disks to the Oracle user.

2. Create an ASM instance. We use the following init+ASM.ora init parameter file and cr_asm.sh script to create an ASM instance:

   This is the content of the init+ASM.ora file:
   ```
   instance_type=ASM
   large_pool_size=12M
   asm_diskstring='/dev/xvdb*'
   asm_diskgroups='REDO', 'DATA', 'FRA'
   ```

   This is the cr_asm.sh script to create an ASM instance:
   ```bash
   #!/bin/bash
   export ORACLE_SID=+ASM

   sqlplus "/ as sysdba" << !
   drop diskgroup DATA;
   drop diskgroup FRA;
   drop diskgroup REDO;
   shutdown abort;
   !
   ```
sqlplus "/ as sysdba" << !
set echo on;
column path format a20;
column label format a10;
column failgroup format a20;
startup nomount

create diskgroup DATA1 external redundancy disk '/dev/xvdb1';
create diskgroup DATA2 external redundancy disk '/dev/xvdc1';
create diskgroup REDO external redundancy disk'/dev/xvdd1';
create diskgroup FRA external redundancy disk'/dev/xvdc2';
select path, label, failgroup from v$asm_disk;
quit
!

Now you can create an Oracle database with size and init parameters to meet the desired database workload and performance requirements.

**Install and configure Oracle VM Manager**

Oracle VM Manager is a server-based interface that enables you to create, clone, deploy, and run virtual machines. It is also possible to register and manage existing virtual machines to implement a working environment.

**Prerequisites**

- A host running Red Hat Enterprise Linux 4 Update 5
- A web browser supported by Oracle VM Manager: Mozilla Firefox 1.5 or later

Oracle Database 10g Express Edition (Oracle XE) is used as the management data repository for Oracle VM Manager. As a result, you must ensure that the libaio.rpm package is installed:

```
/bin/rpm -q libaio.i386
libaio-0.3.105-2
```

Ensure that port numbers 8888 and 8899 are available:

```
netstat -na |grep 8888
netstat -na |grep 8899
```

**Installation process**

1. Log in to the guest that will act as the Manager host, as root. Mount the OVM Manager ISO file onto an existing directory using the following commands:

```
mount -o loop,ro /root/ovm/OracleVM-Manager-2.1.2.iso /mnt/temp
```

2. To start the installation, run the installer script:

```
sh runInstaller.sh
```
3. Choose the default ports for HTTP as well as the database listener. Next, specify the password to be used for the database accounts.

4. Enable Oracle Database 10g Express Edition to start at boot and enter the OVS account password.
5. After the OVM Manager schema is created enter the password for the “oc4jadmin” account.

6. Next enter the password for the “admin” account as well as the hostname of the SMTP server and the e-mail address of the admin.

The installation is now complete.
Figure 21. Installation completes

7. The manager home page can be accessed using Internet Explorer with the URL http://licoe011:8888/OVS.

Figure 22. OVM Manager home page

**Configure OVM server pools**

You can use Oracle VM Manager to create and manage virtual machines on OVM Server. To create and manage 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. An Oracle VM server pool is a logical, autonomous region that contains one or more physical Oracle VM Servers. Server pools are essential for creating and managing new VMs.

**Prerequisites**

Before creating a server pool, ensure that the following is in place:

- An OVM Server that will deploy as the server pool master, the utility server, or the virtual machine server
- A repository that can be used for live migration of virtual machines and for local storage on the OVM Servers
- IP address or host names of the VM Servers
- Passwords to access the Oracle VM Agents installed on the VM Servers

**Create a server pool**

To create a server pool, carry out the following procedure:
1. Launch Oracle VM Manager. In the Server Pools page, click **Create Pool**. Then type in the Oracle VM Server information. Click **Next** to provide the server pool name:

![Figure 23. Oracle VM Manager: Create a server pool](image)

2. Give the server pool name, and both the server pool and OVM Server will be shown in the server pool table:

![Figure 24. Oracle VM Manager: Server to be added to the server pool](image)

3. To view detailed information about the server, click the Server Host/IP hyperlink for that server.
Import a virtual machine image to Oracle VM Manager

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

Before beginning the import, copy all virtual machine images to the /OVS/running_pool/VM_Name/ directory. Make sure that you rename the virtual machine configuration file to vm.cfg.

In the following example, virtual machine ovm02 is copied to the /OVS/running_pool/ovm02 folder, and virtual machine OVManager is copied to the /OVS/running_pool/OVManager folder on the virtual machine server. Each virtual machine configuration file has to be copied and renamed to vm.cfg to its virtual machine image directory:

```
mv /etc/xen/ovm02 /OVS/running_pool/vm02/vm.cfg
```

Modify the /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'],
```

Access a virtual machine console

Oracle VM Manager requires a VNC browser plug-in to enable remote access to the virtual machine (guest) consoles.

Linux users who access virtual machines using Mozilla Firefox must download and install the ovm-console package on the client side before running Oracle VM Manager. Download it at http://oss.oracle.com/oraclevm/manager/RPMS.

- For an i386 computer, download ovm-console-1.0.0-2.i386.rpm.
- For an x86_64 computer, download ovm-console-1.0.0-2.x86_64.rpm.

To enable non-Linux users to access the virtual machine consoles, download tightvnc-java-1.2.9-3.noarch.rpm from http://oss.oracle.com/oraclevm/manager/RPMS and install it on the Oracle VM Manager host.
To import a virtual machine into OVM Manager, using the OVM Console, you must apply the following packages:

```
rpm -ivh ovm-console-1.0.0-2.i386.rpm
Preparing... ########################################### [100%]
1:ovm-console ########################################### [100%]
```

Select a VM image from the server pool
To select an existing virtual machine image from the server pool and to register it in Oracle VM Manager, perform the following steps:

1. In Oracle VM Manager navigate to Resources > Virtual Machine Images. Click Import.
2. Choose Select from Server Pool (Discover and register).
3. Type in the server details. Click Next.
4. The Confirmation screen is displayed. Click Confirm.

![Figure 26. Oracle VM Manager: Importing a VM image](image_url)

**Add a server to a server pool for live migration**
To add a utility server or a virtual machine server to an existing server pool, perform the following:

1. On the Servers page, click Add Server.
2. Search and select a server pool, and then click Next.
3. Enter the Oracle VM Server parameters. After adding the server, click Next.

4. Confirm the information you have entered.

You can use OVM Manager to view and monitor server running status, performance level of the CPU, memory, and virtual disk storage information of an existing server. You can also manage VM server restart, shutdown, or live migration through OVM Manager.
Domain live migration

Oracle domain live migration is a process to migrate a running virtual machine from one virtual machine 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 virtual machine server may be out of commission, or on a planned shutdown for maintenance purposes.

To perform live migration of domains, both source and destination hosts must have the same hardware architecture, and the same make and model. Both source and destination hosts must have the same Oracle VM Server release installed, and must be within the same server pool. You must create a shared virtual disk to be used during the live migration. As described in the section “Configure shared Oracle Cluster File System for VM repositories”, we created an OCFS2 virtual volume, /OVS/running_pool/ovm02, shared by the source (licoe022) and target (licoe023) OVM Servers in a cluster for live migration of the guest domain, ovm02. The disk image of the guest domain to be migrated is located on the shared /OVS repositories, accessible from both source and destination hosts.

Live migration of the guest on OVM Server using the command line

Start live migration

In this example, ovm02 is the installed guest on the source host for migration. This OEL guest is running the Oracle 11gR1.0.7.0 ASM database instance with online transactions, as described in the section “Create an Oracle 11gR1 ASM instance and database.”

```
xm list
Name   ID   Mem VCPUs     State   Time(s)
Domain-0  0   665     4     r-----   2702.7
OVMManager  2  2048     1     -b----   1411.2
ovm02     4  2048     1     -b----     22.0
```

Issue the following command on the source host licoc022 to perform live migration:

```
xm migrate --live <guest domain> <IP of the destination host | host name>
```

where --live is migrating the domain without shutting down the domain.

The command line below will migrate the guest, ovm02, to the target host, licoe023:

```
xm migrate --live ovm02 licoe023
```

Verify the migration on the destination

On the destination host, licoe023, check the active guest by:

```
xm list
Name   ID   Mem VCPUs      State   Time(s)
Domain-0  0   665     4      r----- 152353.6
ovm02     1  2048     1      -b----   1232.5
```

You could access the console to verify if the guest is working properly, for example:

```
xm console ovm02
```

Enterprise Linux Enterprise Linux Server release 5.2 (Carthage)
Kernel 2.6.18-92.el5xen on an i686
Live migration of the guest on OVM Server using OVM Manager

You can also perform live migration using OVM Manager. To migrate a virtual machine from OVM Manager:

1. Click the Virtual Machines tab.

2. On the Virtual Machines page, select the running virtual machine. In the More Actions list, select Live Migration, and click Go, as shown in Figure 29.

![Figure 29. OVM Manager: VM Live Migration](image)

3. Select the virtual machine server to which you want to migrate the virtual machine. Click Next.

4. Check the virtual machine information, and click Confirm, as shown in Figure 30.

![Figure 30. VM Live Migration: source and destination hosts](image)

The virtual machine is migrated from the source VM Server, licoe022, to the destination VM server, licoe023, as shown in Figure 31.
Conclusion

Symmetrix V-Max introduces new hardware features such as the scalable Virtual Matrix design that allows the storage array to seamlessly grow into the world’s highest-capacity storage system. The Symmetrix V-Max system running the Enginuity operating environment, and used in conjunction with Solutions Enabler, provides many new features and functionality including Auto-provisioning Groups and Enhanced Virtual LUN Technology to allow ease of storage provisioning to server virtualization, improve data center efficiency, and improve the ROI of modern virtualization environments.

Oracle VM combines the benefits of server clustering and server virtualization technologies, delivering integrated clustering, virtualization, storage, and management for grid computing. Symmetrix V-Max together with Oracle VM allow virtualized databases and applications to be deployed rapidly, safely, and with ease.

References

The following documents are available on EMC’s Powerlink® website:

- *EMC Solutions Enabler Symmetrix Array Controls CLI Version 7.0 Product Guide*

- *EMC Symmetrix V-Max Series Product Guide*

The following Oracle VM documentation is available on Oracle.com:

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

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

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

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