Oracle® VM

User's Guide for Release 3.1.1

E27309-04
January 2013

Oracle® VM: User's Guide for Release 3.1.1

Abstract

Document generated on: 2013-01-29 (revision: 2455)

Table of Contents

Preface

Table of Contents

The preface contains information on how to use the Oracle VM User's Guide.

1. Audience

The Oracle VM User's Guide is intended for system administrators and end users who want to learn the fundamentals of virtualization, Oracle VM, and the provision and management of virtual machines.

2. Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.

3. Related Documents

For more information, see the following documents in the Oracle VM Release 3.1.1 documentation set:

- *Oracle VM Release Notes*
- *Oracle VM Installation and Upgrade Guide*
- *Oracle VM Getting Started Guide*
- *Oracle VM Windows Paravirtual Drivers Installation Guide*
- *Oracle VM Utilities Guide*

You can also get the latest information on Oracle VM by going to the Oracle VM Web site:

http://www.oracle.com/us/technologies/virtualization/oraclevm

4. Command Syntax

Oracle Linux command syntax appears in `monospace` font. The dollar character ($), number sign (#), or percent character (%) are Oracle Linux command prompts. Do not enter them as part of the command. The following command syntax conventions are used in this guide:

Convention	Description

backslash \	A backslash is the Oracle Linux command continuation character. It is used in command examples that are too long to fit on a single line. Enter the command as displayed (with a backslash) or enter it on a single line without a backslash:
	`dd if=/dev/rdsk/c0t1d0s6 of=/dev/rst0 bs=10b \`
	`count=10000`

braces { }	Braces indicate required items: `.DEFINE {macro1}`
brackets [ ]	Brackets indicate optional items: `cvtcrt termname [outfile]`
ellipses ...	Ellipses indicate an arbitrary number of similar items: `CHKVAL fieldname value1 value2 ... valueN`
italics	Italic type indicates a variable. Substitute a value for the variable: `library_name`
vertical line |	A vertical line indicates a choice within braces or brackets: `FILE filesize [K|M]`

5. Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

Chapter 1. Introduction to Virtualization

Table of Contents

This chapter provides introductory information on virtualization. It discusses why you would want to use virtualization, the technology provided, and a high level overview of Oracle VM.

1.1. Introduction to Virtualization

The IT industry's focus on virtualization technology has increased considerably in the past few years. However, the concept has been around much longer, as you can read in the brief history below. This section also provides a high level view of the virtualization technology and methods that exist today, and highlights a number of reasons why organizations are embracing virtualization more and more.

1.1.1. Brief History of Virtualization

The concept of virtualization is generally believed to have its origins in the mainframe days in the late 1960s and early 1970s, when IBM invested a lot of time and effort in developing robust time-sharing solutions. Time-sharing refers to the shared usage of computer resources among a large group of users, aiming to increase the efficiency of both the users and the expensive computer resources they share. This model represented a major breakthrough in computer technology: the cost of providing computing capability dropped considerably and it became possible for organizations, and even individuals, to use a computer without actually owning one. Similar reasons are driving virtualization for industry standard computing today: the capacity in a single server is so large that it is almost impossible for most workloads to effectively use it. The best way to improve resource utilization, and at the same time simplify data center management, is through virtualization.

Data centers today use virtualization techniques to make abstraction of the physical hardware, create large aggregated pools of logical resources consisting of CPUs, memory, disks, file storage, applications, networking, and offer those resources to users or customers in the form of agile, scalable, consolidated virtual machines. Even though the technology and use cases have evolved, the core meaning of virtualization remains the same: to enable a computing environment to run multiple independent systems at the same time.

1.1.2. Hypervisor

If virtualization is defined as enabling multiple operating systems to run on a single host computer, then the essential component in the virtualization stack is the hypervisor. This hypervisor, also called Virtual Machine Monitor (VMM), creates a virtual platform on the host computer, on top of which multiple guest operating systems are executed and monitored. This way, multiple operating systems, which are either multiple instances of the same operating system, or different operating systems, can share the hardware resources offered by the host.

Hypervisors are commonly classified as one of these two types, as show in Table 1.1, “Hypervisor Types”.

Table 1.1. Hypervisor Types

Classification	Characteristics and Description
Type 1: *native* or *bare metal*	Native hypervisors are software systems that run directly on the host's hardware to control the hardware, and to monitor the guest operating systems. Consequently, the guest operating system runs on a separate level above the hypervisor. Examples of this classic implementation of virtual machine architecture are Oracle VM, Microsoft Hyper-V, VMWare ESX and Xen.
Type 2: *hosted*	Hosted hypervisors are designed to run within a traditional operating system. In other words, a hosted hypervisor adds a distinct software layer on top of the host operating system, and the guest operating system becomes a third software level above the hardware. A well-known example of a hosted hypervisor is Oracle VM VirtualBox. Others include VMWare Server and Workstation, Microsoft Virtual PC, KVM, QEMU and Parallels.

1.2. Reasons to Use Virtualization

There are many different good reasons for companies and organizations to invest in virtualization today, but it is probably safe to assume that financial motivation is number one on the list: virtualization can save a lot of money. Below is an overview of the key benefits of virtualization.

Table 1.2. Reasons to Use Virtualization

Item	Description
Resource optimization	Today's enterprise level computer resources are so powerful that they often have excess capacity. By virtualizing the hardware and allocating parts of it based on the real needs of users and applications, the available computing power, storage space and network bandwidth can be used much more effectively. Computers no longer need to be idle or performing below their capabilities because there are fewer connected users, or because the hosted application happens to be less demanding than the server can handle. Virtual machines offer software developers isolated, constrained, test environments. Rather than purchasing dedicated physical hardware, virtual machines can be created on the existing hardware. Because each virtual machine is independent and isolated from all the other servers, programmers can run software without having to worry about affecting other applications, or external components affecting the execution of their code.
Consolidation	It is common practice to dedicate individual computers to a single application. If several applications only use a small amount of processing power, the administrator can consolidate several computers into one server running multiple virtual environments. For organizations that own hundreds or thousands of servers, consolidation can dramatically reduce the need for floor space, HVAC, A/C power, and co-location resources. This means the cost of ownership is reduced significantly, since less physical servers and floor and rack space are required, which in turn leads to less heat and power consumption, and ultimately a smaller carbon footprint.
Maximizing Uptime	Agility is all about being able to respond to changing requirements as quickly and flexibly as possible. Virtualization brings new opportunities to data center administration, allowing users to enjoy: • Guaranteed uptime of servers and applications; speedy disaster recovery if large scale failures do occur.

Item	Description
	• Instant deployment of new virtual machines or even aggregated pools of virtual machines via template images. • Elasticity, that is, resource provisioning when and where required instead of keeping the entire data center in an *always-on* state. • Reconfiguration of running computing environments without impacting the users.
Automatically Protect Applications from Server Failure	Server virtualization provides a way to implement redundancy without purchasing additional hardware. Redundancy, in the sense of running the same application on multiple servers, is a safety measure: if for any reason a server fails, another server running the same application takes over, thereby minimizing the interruption in service. This kind of redundancy works in two ways when applied to virtual machines: • If one virtual system fails, another virtual system takes over. • By running the redundant virtual machines on separate physical hardware you can also provide better protection against physical hardware failure.
Easily Migrate Workloads as Needs Change	Migration refers to moving a server environment from one place to another. With most virtualization solutions it is possible to move a virtual machine from one physical machine in the environment to another. With physical servers this was originally possible only if both physical machines ran on the same hardware, operating system and processor. In the virtual world, a server can be migrated between physical hosts with entirely different hardware configurations. Migration is typically used to improve reliability and availability: in case of hardware failure the guest system can be moved to a healthy server with limited downtime, if any. It is also useful if a virtual machine needs to scale beyond the physical capabilities of the current host and must be relocated to physical hardware with better performance.
Protect Investment in Existing, Legacy Systems	Server hardware will eventually become obsolete, and switching from one system to another can be difficult. In order to continue offering the services provided by these legacy systems, you can run it as a virtual machine on new, modern hardware, while the legacy system itself still behaves as if it were running on the same legacy hardware. From an application perspective, nothing has changed. In fact, its performance may well benefit from the newer underlying hardware. This gives the organization the time to transition to new processes without worrying about hardware issues, particularly in situations where the manufacturer of the legacy hardware no longer exists or cannot fix broken equipment.

1.3. Xen™ Technology

Oracle VM is built upon Xen technology, using the Xen hypervisor. The Xen hypervisor is a small, lightweight bare metal hypervisor for x86-compatible computers. The Xen hypervisor securely executes multiple virtual machines on one host computer. Each virtual machine has its own guest operating system with almost native performance. The Xen hypervisor was originally created by researchers at Cambridge University, and derived from work done on the Linux kernel.

Oracle VM insulates users and administrators from the underlying virtualization technology and allows daily operations to be conducted using goal-oriented GUI interfaces.

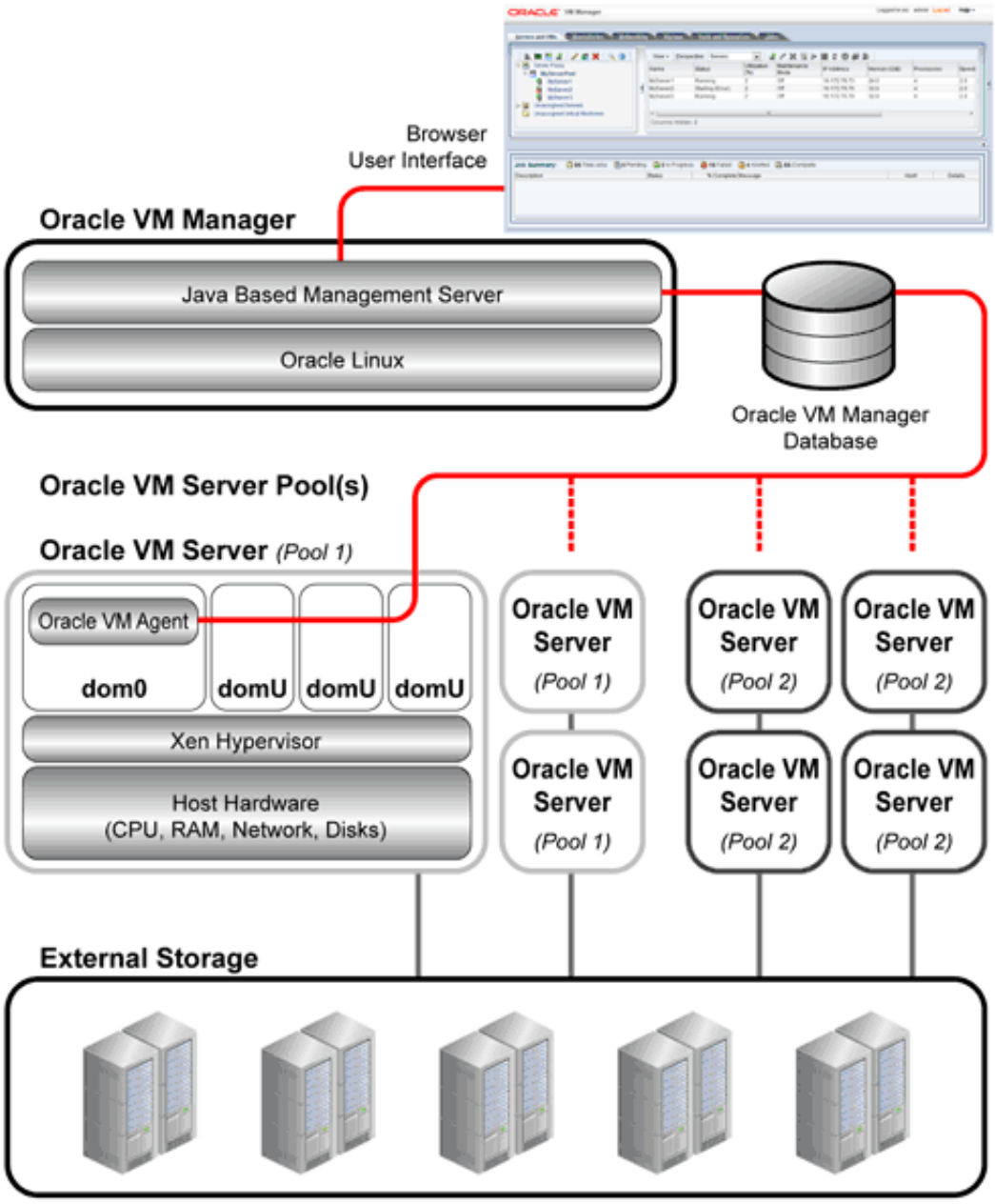
1.4. Oracle VM for x86

Oracle VM for x86 (Oracle VM) is a platform that provides a fully equipped environment with all the latest benefits of virtualization technology. Oracle VM enables you to deploy operating systems and application software within a supported virtualization environment. The components of Oracle VM are:

- **Oracle VM Manager**: Provides the graphical user interface, which is an Application Development Framework (ADF) application, with a familiar web-browser based interface, to manage Oracle VM Servers, virtual machines, and resources. Use Oracle VM Manager to:
  - Create virtual machines
  - Create server pools
  - Power on and off virtual machines
  - Manage networks and storage
  - Import virtual machines, ISO files, and templates
  - Manage high availability of Oracle VM Servers, server pools, and virtual machines
  - Perform live migration of virtual machines
- **Oracle VM Server**: A managed virtualization environment or part of such an environment, designed to provide a lightweight, secure, server-based platform for running virtual machines. Oracle VM Server is based upon an updated version of the underlying Xen hypervisor technology, and includes Oracle VM Agent.

Figure 1.1, “Oracle VM Architecture” shows the components of Oracle VM.

Figure 1.1. Oracle VM Architecture



Oracle VM Manager is an Oracle WebLogic Server application running on Oracle Linux. This can be a standalone computer, or part of a virtual machine running on an instance of Oracle VM Server.

Oracle VM Server is installed on a bare metal computer, and contains the Oracle VM Agent to manage communication with Oracle VM Manager. Dom0 is an abbreviation for *domain zero*, the management domain with privileged access to the hardware and device drivers. DomU is an unprivileged domain with no direct access to the hardware or device drivers. A user-domain (domU) is started and managed on an Oracle VM Server by dom0.

1.4.1. Oracle VM Integrated Support

Oracle has a unique position in the virtualization market as an Enterprise application, operating system and hardware vendor that delivers technologies across the stack. Owning the entire stack has various advantages:

- integration and centralized management of all components
- the ability to pre-package and distribute Oracle technologies via Oracle VM templates
- integrated enterprise support across the entire technology stack, from application to hardware

Oracle VM support is an add-on component of Oracle's enterprise support package that offers an end-to-end single vendor support solution from the application to the disk. A single support call covers the entire Oracle stack which expedites problem resolution. Using Oracle support allows an Oracle support service request (SR) to transition between support teams with issues that require cross stack collaboration. For example, if you open a service request for an application issue and the root cause is at the virtualization layer then the service request will transition between the application and virtualization teams.

Chapter 2. Introduction to Oracle VM

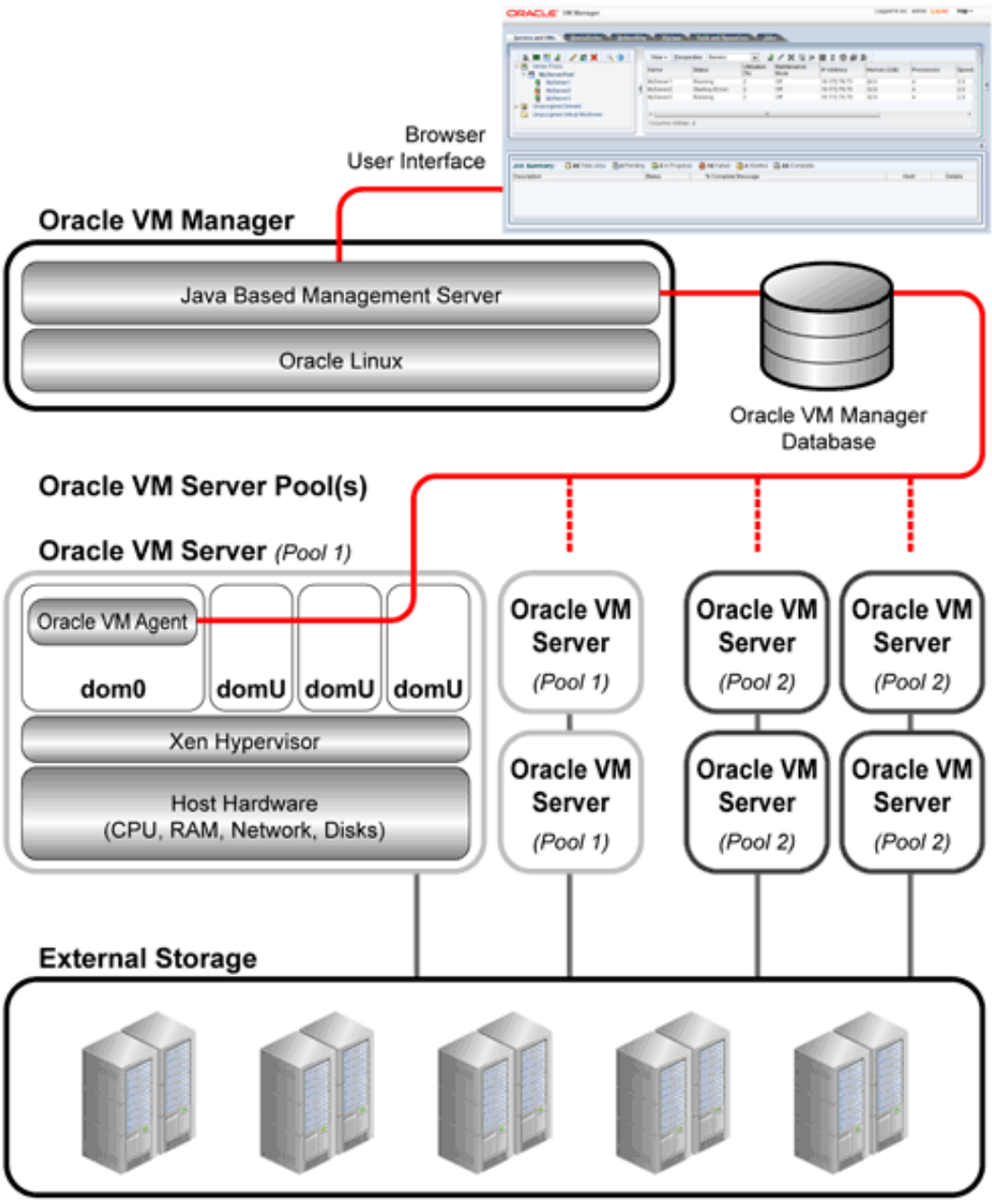
Table of Contents

This chapter contains introductory information about Oracle VM, its components, architecture, and deployment options.

2.1. Introduction to Oracle VM

Oracle VM is a platform that provides a fully equipped environment with all the latest benefits of virtualization technology. Oracle VM enables you to deploy operating systems and application software within a supported virtualization environment. The components of Oracle VM are shown in Figure 2.1, “Oracle VM Architecture”.

Figure 2.1. Oracle VM Architecture



- **Oracle VM Manager**: Provides the command line interface or shell, as well as the graphical user interface (GUI). The GUI is an Application Development Framework (ADF) web application you use simply through your browser to manage Oracle VM Servers, virtual machines, and resources. Use Oracle VM Manager to:
  - Configure and manage Oracle VM Servers
  - Configure and manage networks
  - Configure and manage storage

    - Configure and manage resources such as virtual machine images, virtual machine templates, assemblies, and installation media
    - Create virtual machines from installation media, a virtual machine template, an assembly, or a virtual machine image
    - Manage virtual machines, including powering on and off, deleting, and live migrating
    - Import virtual machines created with Oracle VM or another solution for server virtualization
- **Oracle VM Server**: A managed virtualization environment providing a lightweight, secure, server platform which runs virtual machines. At least one Oracle VM Server is required, but several are needed to take advantage of clustering. Oracle VM Server is based upon an updated version of the underlying Xen hypervisor technology, and includes Oracle VM Agent. It also includes a Linux kernel with support for a broad array of devices, file systems, and software RAID volume management. The Linux kernel is run as dom0 to manage one or more domU virtual machines, each of which could be Linux, Oracle Solaris, or Microsoft Windows.

2.2. Oracle VM Features

This section gives an overview of the Oracle VM Manager features used to manage Oracle VM Servers, virtual machines, storage repositories, networks, and resources. Oracle VM Manager provides the following main capabilities:

- Manages the physical Oracle VM Servers and can, for example, reboot or rediscover the physical hardware.
- Creates and configures server pools.
- Creates and manages Oracle VM Server logical networks, for example, NIC port bonding, and configuring VLAN networks.
- Creates and manages storage repositories.
- Manages resources, including ISO files, virtual machine templates, virtual machine images, and virtual machine assemblies.
- Manages the virtual machine life cycle. This includes creating virtual machines from either installation media or from templates, starting, logging in, shutting down, and deleting virtual machines.
- Imports, clones and migrates virtual machines.
- Performs load balancing of virtual machines in server pools.
- Manages jobs in the Oracle VM environment.
- Manages policies such as High Availability, Distributed Resource Scheduling, and Distributed Power Management.

2.3. Terminology

This section contains definitions for the terms used throughout this Guide and terms used within Oracle VM.

2.3.1. Hypervisor

The hypervisor present on each Oracle VM Server is an extremely small-footprint virtual machine manager and scheduler. It is designed so that it is the only fully privileged entity in the system. It controls only the most basic resources of the system, including CPU and memory usage, privilege checks, and hardware interrupts.

2.3.2. Domains, Guests and Virtual Machines

The terms "domain", "guest" and "virtual machine" are often used interchangeably, but they have subtle differences. A *domain* is a configurable set of resources, including memory, virtual CPUs, network devices and disk devices, in which virtual machines run. A domain is granted virtual resources and can be started, stopped and restarted independently. A *guest* is a virtualized operating system running within a domain. A guest operating system may be paravirtualized or hardware virtualized. Multiple guests can run on the same Oracle VM Server. A *virtual machine* is a guest operating system and its associated application software. See Section 7.2, “Virtualization Modes (Domain Types)” for information on virtualization modes.

2.3.3. Management Domain (dom0)

Most of the responsibility of hardware detection in a Oracle VM Server environment is passed to the management domain, referred to as domain zero (or dom0). The dom0 kernel is actually a small-footprint Linux kernel with support for a broad array of devices, file systems, and software RAID and volume management. In Oracle VM Server, the dom0 is tasked with providing access to much of the system hardware, creating, destroying and controlling guest operating systems, and presenting those guests with a set of common virtual hardware.

2.3.4. Domains (domU)

Guest operating systems each have their own management domain called a "user domain", abbreviated to "domU". These domains are unprivileged domains with no direct access to the hardware or device drivers. Each domU is started by Oracle VM Server in dom0.

2.3.5. Storage and Storage Repositories

A storage repository is a central location where various resources to build virtual machines are stored. These resources include templates, ISO files, VM files and so on. Oracle VM Servers have shared access to storage repositories for optimized usage of available disk space in the environment, as well as easy reallocation of virtual machines in case a physical server should malfunction.

However, storage in Oracle VM is more than repositories: it also encompasses server pool file systems for clustered server pools, physical disks, or LUNs, in storage arrays, and local physical disks on the Oracle VM Servers. All these storage elements are used in various ways and managed centrally through Oracle VM Manager.

2.3.6. Server Pools

A server pool is a required entity in Oracle VM, even if it contains a single Oracle VM Server. In practice, several Oracle VM Servers will form a server pool, and an Oracle VM environment may contain one or several server pools. Server pools are typically clustered, although an unclustered server pool is theoretically possible.

Server pools have shared access to storage repositories and exchange and store vital cluster information in the server pool file system. In a server pool, a Master server is elected, which is responsible for centralized communication with the Oracle VM Manager. If necessary, any other member of the server

pool can take over the Master role. Even in case of server failure, the server pool remains accessible at its virtual IP address, which all servers in the pool share.

Within a server pool, virtual machines can be live-migrated for load balancing purposes or for scheduled maintenance. If a pool member disappears for whatever reason, its virtual machines can be recovered and brought back up on another Oracle VM Server because all necessary resources are available on shared storage.

2.3.7. Networks

The networking infrastructure in the Oracle VM environment comprises connections between Oracle VM Servers, between Oracle VM Servers and Oracle VM Manager, between the Oracle VM Servers and their storage sub-systems, as well as communications among virtual machines deployed in the environment, and between virtual machines and external private or public networks. These networking connections can leverage features supported by Oracle VM, such as networked file systems, clustering, redundancy and load balancing, bridging, and support for Virtual LANs (VLANs).

The physical network is the collection of physical connections in Oracle VM Manager and all Oracle VM Servers, and the switches and routers that allow information to reach its destination. A logical network in Oracle VM is built on top of these physical connections. When you create an Oracle VM network, you map available network ports to a set of logical Ethernet networks. You perform this mapping in Oracle VM Manager.

In Oracle VM a network can perform one or more network functions. Oracle VM has the following network functions: server management, live migrate, cluster heartbeat, virtual machine, and storage. Functions can be combined or spread over several different networks; this design decision depends on the available physical network infrastructure, such as the number of NICs in each server.

2.3.8. Jobs and Events

Jobs are a sequence of operations usually triggered by a user action. For example: discovering a server, presenting a repository, creating a VM, and so on. These jobs appear in the Jobs Summary pane at the bottom of the Oracle VM Manager user interface and their status is refreshed according to their progress. Some jobs are not the result of a specific user action but are a recurring system operation, such as checking the YUM repository for updates. A history of all jobs in the environment is available in the Jobs tab, where you can view and filter the job list and display details of each job: status, execution time stamps, operations executed as part of the job, etc.

Events are often also related to user actions, but their main function from a user perspective is to register status information of "objects" for future reference or to make problems easier to trace back. Events are displayed in the Servers and VMs, Repositories, and Storage tabs in Oracle VM Manager and the list of events depends on the object selected in the tree view of the Navigation pane. For example, the events list of a VM shows you when it was created, at what point it was started and stopped, when it was migrated, and so on. If you select a server or server pool in the same tree view, different types of events appear, related to that particular object. Events have no status but a severity level: most events will be informational, but they can also be warnings, errors or other situations that require your attention. You must acknowledge an error event to clear the error. See Section B.1.10, “Acknowledging Events/Errors” for information on acknowledging events.

2.4. Servers and Server Pools

An Oracle VM environment is built up out of an extensible set of Oracle VM Servers, which are controlled by a single Oracle VM Manager. The Oracle VM Manager runs the database that contains all information about both the physical and the virtual infrastructure. In addition, it hosts the web browser interface that is

used to configure and manage the entire environment. Communication between the Oracle VM Manager and the Oracle VM Servers, in order to execute operations on and through the servers, is relayed via the Oracle VM Agent, which is present on all the servers in the environment.

From within the Oracle VM Manager user interface, servers are discovered based on their IP address or host name. Additional servers can be installed and discovered at any time as the need for capacity grows. The Oracle VM Servers provide computing capacity to the virtual machines they host: CPU and RAM. They also host the storage plug-ins that are used to connect with shared, attached file-based and block-based storage offered by other hardware in the data center. For more details, see Section 2.5, “Storage” in this chapter, and Chapter 4, *Managing Storage*.

Oracle VM Servers are members of a server pool. Server pools use a virtual IP address and elect one master server that handles interactions with the Oracle VM Manager. If the master server goes down, another server in the pool immediately takes over the master function and the server pool remains reachable at the virtual IP address. Virtual machines running on a failing server can be restored on another server in the pool. This is possible because all members of the server pool have access to the same shared storage, where virtual machine configuration, disks, templates etc. are stored.

In a clustered server pool, which is the typical configuration, high availability is enabled for the servers as well as the virtual machines they host. Clustered server pools use a shared ocfs2 pool file system for the cluster heartbeating function, configuration and other clustering information. Clustering and ocfs2 enable important advanced functionality such as shared block-based storage access, policies for fail over, load balancing and power management, etc. For details about server pools, clustering and ocfs2, see Chapter 6, *Managing Server Pools*.

An Oracle VM environment can consist of several server pools. This is a design decision: like in any data center it may be preferred to subdivide resources into groups, isolate these from each other, and assign them to different users (departments, teams, administrators, customers and so on).

2.5. Storage

To cover all aspects of Oracle VM storage we must discuss both the provisioning and the consumption side of the storage functionality. The following sections provide an answer to two major questions:

- How does Oracle VM connect to its storage?
- What storage elements are available within the Oracle VM environment?

2.5.1. Plug-in-based Implementation

The entire Oracle VM storage implementation is based on Oracle Storage Connect plug-ins. The plug-ins are packaged and distributed as RPM packages and deployed on the Oracle VM Servers. They are divided in two major categories: storage array plug-ins for any block based storage, and file system plug-ins for any network file system based storage.

For both categories, generic plug-ins are included. They offer standard functionality to discover, register and use NFS storage, iSCSI or Fibre Channel SANs, and local storage For more information about the types of storage supported in Oracle VM, see Section 4.2, “Storage Types”. The standard operations allowed via generic plug-ins are "passive", in the sense that they can detect and use storage elements offered to the Oracle VM Servers. Interactive management operations on the storage hardware is not possible with generic plug-ins.

In addition, Oracle cooperates with storage partners and invites storage hardware vendors to develop Oracle Storage Connect plug-ins for their specific hardware. These vendor-specific plug-ins can only be

used with a specific brand or product line of storage hardware but they offer additional operations from within Oracle VM Manager compared to generic plug-ins. For example, a generic storage array plug-in can only detect LUNs on the storage host and has only a single access group to define which servers can access the storage elements. In contrast, a vendor-specific storage array plug-in allows interactive operations such as creating and modifying LUNs, and can configure various access groups for finer-grained storage access management. For detailed information about Oracle Storage Connect plug-ins, see Section 4.3, “Storage Connect Plug-ins”.

The main benefits of the plug-in approach are:

- **Flexibility.** Use and integrate with your existing storage infrastructure, choose between file-based and block-based solutions, and use local storage for testing purposes or virtual machines of minor importance. Use generic or vendor-specific plug-ins depending on your available hardware or any new hardware you select.
- **Scalability.** Add more storage providers of your preferred type and present them to your server pools as your need for storage increases. Reduce the amount of storage again if the higher storage requirements are temporary. Provision your storage with redundancy and multipathing according to your requirements and preferences.
- **Extensibility.** If you upgrade your storage, consider the added functionality of vendor-specific plug-ins. If you select hardware for which Oracle Storage Connect plug-ins are available, ask the manufacturer for the RPM and install the plug-in on the Oracle VM Servers with access to this storage hardware.

2.5.2. Usage of Storage Elements

Whatever the Oracle VM Server configuration in your environment is, Oracle VM always requires a location to store environment resources that are essential to the creation and management of virtual machines. These resources include VM templates and assemblies, ISO files (virtual DVD images), VM configuration files and VM virtual disks. The location of such a group of resources is called a storage repository. You present a storage repository to the Oracle VM Servers that need access to those resources; typically all servers in a server pool.

Storage repositories can be configured on an NFS file system or on a physical disk (LUN) of a storage array. However, for storage repositories on physical disk, the servers with access to it must be members of a *clustered* server pool. For unclustered server pools only file server storage is available. For details about the use of storage repositories, see Section 4.8, “Preparing and Configuring Storage Repositories”.

Clustering adds another storage element to the environment: the server pool file system. During server pool creation, the server pool file system specified for the new server pool is accessed and formatted as an OCFS2 file system, whether the file system is accessed by the Oracle VM Servers as an NFS share, a FC LUN or iSCSI LUN. This formatting creates several management areas on the file system including a region for the global disk heartbeat. The server pool file system plays a key role in clustering and therefore in the high-availability configuration of the Oracle VM environment. For details about server pool clustering, see Section 6.2, “Server Pool Clusters”.

The storage element that is most tangible and visible to all users of Oracle VM is the virtual machine disk. A VM disk is either a disk image file in a storage repository or a raw physical disk. If a physical disk (LUN) is used, it is attached directly to the VM in the same way it would be to a physical machine. For details about virtual machine operation, see Chapter 7, *Managing Virtual Machines*. Again, the availability of VM disks in a storage location with shared access from all Oracle VM Servers in the server pool is essential for VM high-availability.

2.6. Networking

The networking infrastructure in the Oracle VM environment comprises connections between Oracle VM Servers, between Oracle VM Servers and Oracle VM Manager, between the Oracle VM Servers and their storage sub-systems, as well as communications among virtual machines deployed in the environment, and between virtual machines and external private or public networks.

These networking connections can leverage features supported by Oracle VM, such as networked file systems, clustering, redundancy and load balancing, bridging, and support for Virtual LANs (VLANs).

In Oracle VM Manager, network configuration is the mapping of available network interfaces to a set of logical Ethernet networks. The physical network is the collection of physical connections in Oracle VM Manager and all Oracle VM Servers, and the switches and routers that allow information to reach its destination. A logical network in Oracle VM is built on top of these physical connections. Before you define the logical networks in Oracle VM Manager, you have to review the physical network configuration that you intend to use, such as VLAN and subnet usage. You also take into account the number of network interfaces available to your Oracle VM Servers. The minimum recommended number of ports required on a single Oracle VM Server is two, although one would suffice for test or demonstration purposes. If you have more than two ports on your Oracle VM Servers, you can design more redundancy or traffic isolation in your environment.

Oracle VM identifies different network functions: server management, live migrate, cluster heartbeat, virtual machine, and storage. All network functions can either be on dedicated or shared physical networks (except for the virtual machine intra-server network). For example, a physical network can be dedicated to Virtual Machine or Storage only, or can be dedicated for all network functions. For details about network functions, see Section 5.2, “Network Usage”.

After reviewing your physical network environment and deciding on the logical distribution and grouping of these physical objects, you create the logical constructs in Oracle VM Manager to implement your network design. These logical constructs include network bonds, VLAN groups, networks and bridges. If your network design includes interface bonding, or aggregations of two ports, you create these network bonds first. These bonds are often used in conjunction with VLANs, when traffic from several VLANs is allowed to use the same bond. If your network environment comprises VLANs, your next step is to create VLAN Groups, determining which port or bond, on each Oracle VM Server, will accept traffic from more which VLANs.

After careful evaluation of the available network building blocks and required network functions, you create the necessary logical networks by choosing one of these types:

- network with bonds and ports
- network with VLANs only
- hybrid network connecting bonds and ports, as well as VLAN interfaces
- logical network on a single server (intra-server VM network)

For details, see Section 5.3, “Building a Network Environment”, and the subsequent sections in the chapter.

2.7. High Availability, Load Balancing and Power Management

Oracle VM has high-availability (HA) functionality built in at every level. Even though there is only one Oracle VM Manager in the environment, it distributes vital information over the servers it manages, so that in case of failure the Oracle VM Manager and its infrastructure database can be rebuilt. At the Oracle VM Server and virtual machine level, HA is based on clustering. Members of a clustered server pool use an exchangeable Master server role and a virtual IP to make sure the cluster remains reachable if an Oracle

VM Server goes down. If a server is lost, another server can recover the same VM because all required data is available on shared storage. In case of predictable failures or scheduled maintenance, virtual machines can be moved to other members of the server pool using live migration.

In addition, Oracle VM supports HA networking and storage, but these are configurations the system administrator must implement outside Oracle VM Manager (RAID, multipathing, etc.).

Clustered server pools also support advanced management policies called Dynamic Power Management (DPM) and Dynamic Resource Scheduler (DRS). DPM is a policy that optimizes the use of the server pool members to conserve power. When DPM is enabled, the policy will periodically look for Oracle VM Servers that are under utilized and then live-migrate the virtual machines on that server to other servers in the pool. When live migration is complete, the server is shut down, conserving power. Conversely, if a server becomes overloaded, the policy will look for other servers to off load virtual machines from the busy server. If no other powered up Oracle VM Servers are available, then the policy will start up a powered-down server using its Wake-On-LAN capability, and begin live-migrating virtual machines to balance the overall load. It is a prerequisite that all the servers that participate in DPM have Wake-On-LAN enabled in the BIOS for the physical network interface that connects to the dedicated management network. Dynamic Resource Scheduler (DRS) uses the same underlying code as DPM. The difference is that DRS will only react to servers that exceed their thresholds for CPU and network usage, and take action to move virtual machines off servers. These thresholds are configurable in the DRS policy, which runs at a specified interval and monitors CPU and network usage over a sample time period. The calculated average load is compared to the threshold and determines if migrations need to be performed.

2.8. Virtual Machines

A virtual machine (VM) can be defined as a virtualized operating system with its associated software and applications. It runs in one of three virtualization modes, also named domain types:

- **Hardware virtualized (HVM).** An unmodified guest operating system executes in complete isolation. Instructions are trapped and emulated at the hardware level (Intel VT-x/VT-i and AMD-V), allowing excellent performance thanks to limited overhead for guest modifications.
- **Paravirtualized (PVM).** A software interface similar but not identical to the underlying hardware is presented to the guest operating system. Paravirtualization provides hooks for guest instructions so that complicated tasks can be performed by the host instead of the virtual machine, where performance is worse. Paravirtualization requires that the guest kernel is ported to be made aware of the virtual environment.
- **Hardware virtualized with paravirtualized drivers (PVHVM).** Similar to HVM but with additional paravirtualized drivers to off load more processes to the host and increase VM performance. This domain type is typically used to run Microsoft Windows guests with a limited performance penalty.

Virtual machines can be created from different types of resources: either from a template or assembly containing preconfigured virtual machines, or from scratch using an ISO file (image) of an installation DVD. Booting a VM via PXE, or network boot for a PVM guest, is also possible.

The creation of a VM from template is based on cloning: the template is imported as an archive, unpacked and stored as a VM configuration file with images of its disks, which are cloned to create a new instance in the form of a VM. In the same way, an existing VM can be cloned to create a new VM, and to a new template as well. Cloning is discussed in further detail in Section 7.8, “Cloning a Virtual Machine or Template”.

Assemblies can be described as a template of a group of virtual machines, or a collection of multiple VM templates. In Oracle VM Manager, templates and assemblies appear in different tabs of the storage

repository, but their VM configuration files and disk images are stored in the same location as those of other virtual machines and templates.

Creating a VM from a virtual DVD (image file, ISO) is different depending on the virtualization mode. When creating an HVM guest, you can assign an ISO file located on a storage repository so that the new VM immediately boots from the virtual DVD. Conversely, a PVM guest cannot simply boot from DVD out of nothing, and uses an ISO file mounted remotely, accessing it via NFS, HTTP or FTP.

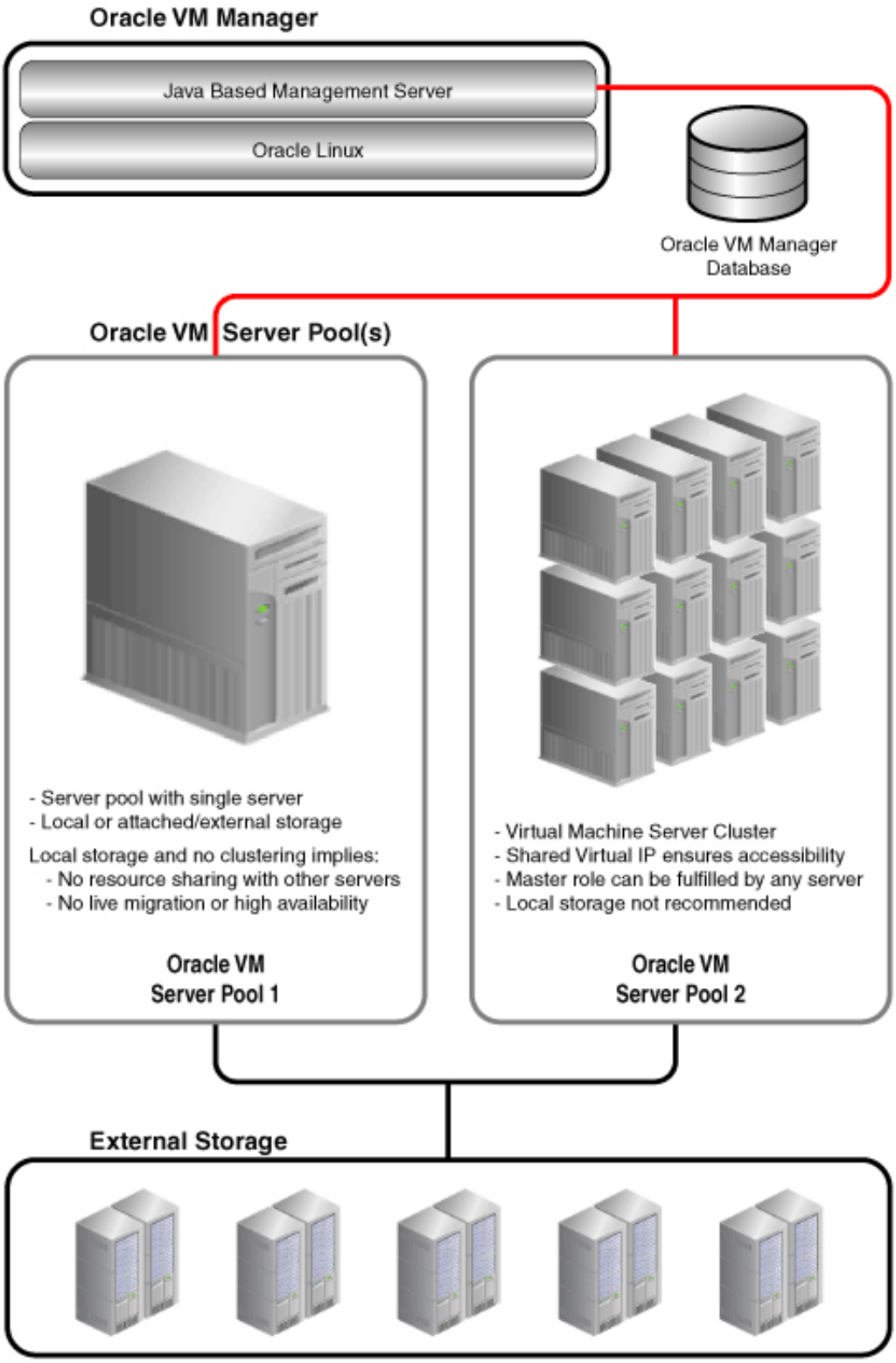
As mentioned in this section and in Section 2.5, “Storage”, virtual machine resources are stored in storage repositories. The contents and structure of storage repositories is described in detail in Section 7.5, “Virtual Machine Resources”.

Once a VM is running, it can be accessed through a VNC console, which allows it to be used as a regular pc. All operations on the VM are executed through Oracle VM Manager, as described in Section 7.9, “Managing Virtual Machines”.

2.9. Deployment Options

This section gives an overview of the deployment options for Oracle VM.

Figure 2.2. Oracle VM Deployment



As shown in Figure 2.2, “Oracle VM Deployment”, an Oracle VM deployment, involves these components:

- **Oracle VM Manager:** The host machine on which Oracle VM Manager is installed is known as the Oracle VM Manager host. It provides the interface where all virtual machine management tasks are performed. Operational commands are sent to the Oracle VM Servers through the Oracle VM Agent.
- **Oracle VM Server(s):** An Oracle VM Server must always belong to a server pool, even if it is the only member.

  The information needed to keep the server pool operational is kept in shared storage and is available to all cluster nodes.
- **Server Pools:** A server pool is an autonomous region that contains one or more Oracle VM Servers. A server pool presents a unified view of the storage in which the virtual machines reside. When clustering is activated, a server pool must have its own shared storage, unless an NFS share is used, as an NFS share can span multiple server pools.
- **Storage:** A shared storage resource is mounted on each Oracle VM Server in a server pool to store virtual machines, external resources, and other data files. In order to perform live migration of virtual machines, each Oracle VM Server involved must have shared access to storage.

  See Chapter 4, *Managing Storage* for more information on creating different types of shared storage.

2.10. Oracle VM Pre-built Templates

Oracle VM templates are self-contained and pre-configured virtual machines with key Oracle technologies. Each Oracle VM template is packaged using Oracle best practices, which eliminates installation and configuration costs, reduces risk and dramatically shortens deployment time lines.

Oracle VM templates of many key Oracle products are available for download, including Oracle Linux, Oracle Solaris, Oracle Database, Fusion Middleware, and many more.

Oracle VM template licensing includes a free download and free trial use with the option to purchase a product license. Oracle VM templates do not have time limits or feature limitations, that is, Oracle VM templates are full featured and do not have expiration dates. Oracle VM templates can be quickly transitioned from evaluation into production by purchasing Oracle technology licenses.

You can download Oracle VM templates from the Oracle Technology Network:

http://www.oracle.com/technetwork/server-storage/vm/templates-101937.html

The password for the *root* user of all Oracle VM templates is *ovsroot*. The password for the *oracle* account in the OVM_*os_version*_ORACLE_11G template is *oracle*.

Before using the downloaded templates, you must import them into Oracle VM Manager. See Section 7.5.3.2, “Importing a Virtual Machine Template” for information on importing templates.

For more information on these templates, see

http://download.oracle.com/otn_software/virtualization/README.templates

2.11. Managing Oracle VM using Oracle Enterprise Manager 12*c*

You can manage your Oracle VM environment using Oracle Enterprise Manager 12*c*. Using Oracle Enterprise Manager 12*c* you can discover Oracle VM Servers, discover storage servers and file systems, create and edit server pools, set up networks and create storage repositories. For more information, see the Oracle Enterprise Manager 12*c* documentation at:

http://docs.oracle.com/cd/E24628_01/doc.121/e28814/cloud_setup.htm

Chapter 3. Using Oracle VM Manager

Table of Contents

Management for the Oracle VM environment is provided by Oracle VM Manager, a transaction-based framework that also includes an integrated database and a web-based management user interface.

This chapter discusses using the Oracle VM Manager user interface.

3.1. Logging into the User Interface

To open the Login page of Oracle VM Manager, enter the following address in a Web browser:

http[s]://*`hostname`*:*`port`*/ovm/console

Where, *`hostname`* refers to the host name or IP address of the Oracle VM Manager host, and *`port`* refers to the port number on which Oracle VM Manager is listening.

To connect to Oracle VM Manager using Secure Sockets Layer (SSL) on a host named example.com, use:

https://example.com:7002/ovm/console

To connect to Oracle VM Manager on a host named example.com, use:

http://example.com:7001/ovm/console

Enter your Oracle VM Manager administration username in the **Username** field. This is the administration username you create during the Oracle VM Manager install. Enter the password for the Oracle VM Manager administration username in the **Password** field.

To manage the local instance of Oracle VM Manager (installed on localhost), leave the **Management Server URI** field as the default, `tcp://localhost`.

tcps://example.com

If you want to manage a remote instance of Oracle VM Manager, enter the hostname or IP address for that machine using the TCPS protocol. You must set up secure access on the remote instance of Oracle VM Manager to use this remote login feature. For example:

tcps://example.com

For information on setting up secure remote access, see Enabling Remote Log Ins.

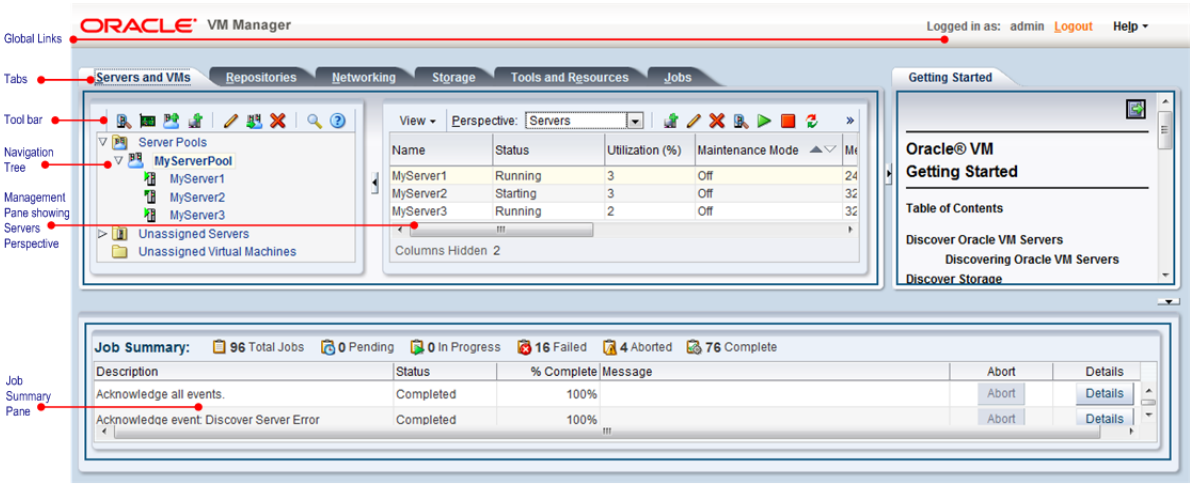
Now you are logged in, you can add Oracle VM Servers, add storage, create storage repositories and import resources into them, create server pools, and create virtual machines.

The user interface displays context sensitive information, relevant to the selection in the navigator and content panes.

3.2. User Interface Overview

The Oracle VM Manager user interface provides a set of tabs, work areas (management panes), icons, and toolbars, for access to various functions and configuration screens. Figure 3.1, “Oracle VM Manager User Interface” shows the main components of the Oracle VM Manager user interface.

Figure 3.1. Oracle VM Manager User Interface



The components of the Oracle VM Manager user interface are described in more detail in Table 3.1, “Oracle VM Manager User Interface components”.

Table 3.1. Oracle VM Manager User Interface components

User Interface Item	Description
Global Links	Contain navigation and resources which are relevant to the whole Oracle VM Manager user interface. See Section 3.3, “Using the Global Links” for information on each global link.
Tabs	The tabs available are **Servers and VMs**, **Repositories**, **Networking**, **Storage**, **Tools and Resources**, **Jobs**,and **Getting Started**. See Section 3.4, “Using the Tabs” for information on each tab.
Toolbar	Allows quick access to a group of task icons. The icons in the toolbar change depending on the selected tab. See Section 3.5, “Using the Toolbar” for information on the toolbar.
Navigation Pane	Contains the navigation tree. See Section 3.6, “Using the Navigation Tree” for more information on the navigation objects.

User Interface Item	Description
Navigation Tree	Shows hierarchy of physical and virtual components. Click on a component to open its default pane and related management panes. See Section 3.6, “Using the Navigation Tree” for more information on the navigation tree.
Management Pane	Contains the management panes for the selected tab. The management pane change depending on the selected sub-tab or **Perspective** in the drop-down list in the management pane toolbar. The management panes that can be displayed are described in each tab. See Section 3.4, “Using the Tabs” for a list of the panes that can be displayed in each tab.
Job Summary Pane	The Job Summary pane provides a summary of jobs; Total Jobs, Pending, In Progress, Failed, Aborted and Complete Jobs. Click an icon to open a dialog box showing the tasks. The dialog box lets you export a list of the jobs to a spreadsheet file, view details of a job, or abort a job. See Section 3.4.6, “Jobs Tab” for more information on jobs.

The sections that follow describe each set of controls and their relationship to one another, in more detail.

3.3. Using the Global Links

The global links are available on every page. The global links are as shown in Table 3.2, “Global Link Item Descriptions”:

Table 3.2. Global Link Item Descriptions

Global Link	Description
Logged in as *username*	Displays the username of the user currently logged in.
Logout	Logs out of the Oracle VM Manager user interface and displays the Oracle VM Manager log in screen.
Help	The drop-down list contains the **Oracle VM Help**, **Getting Started**, **Oracle.com** and **About** menu items. See Section 3.3.1, “Help Menu” for more information on the Help menu.

3.3.1. Help Menu

Use the **Help** menu to display the Oracle VM Manager online help, Getting Started chapter of the online help, release number, and go to Oracle's home page. The **Help** menu options are as shown in Table 3.3, “Help Menu Options”.

Table 3.3. Help Menu Options

Help Menu Option	Icon	Description
Oracle VM Manager Help		Opens a new web browser window which contains the Oracle VM Manager online help system.
Getting Started		Opens a new web browser window which contains the Getting Started chapter of the online help system. Read this section to quickly get started using Oracle VM Manager.
Oracle.com		Opens a new web browser window which contains the Oracle home page.
About		Displays the **About Oracle VM** dialog box which contains the release number.

3.4. Using the Tabs

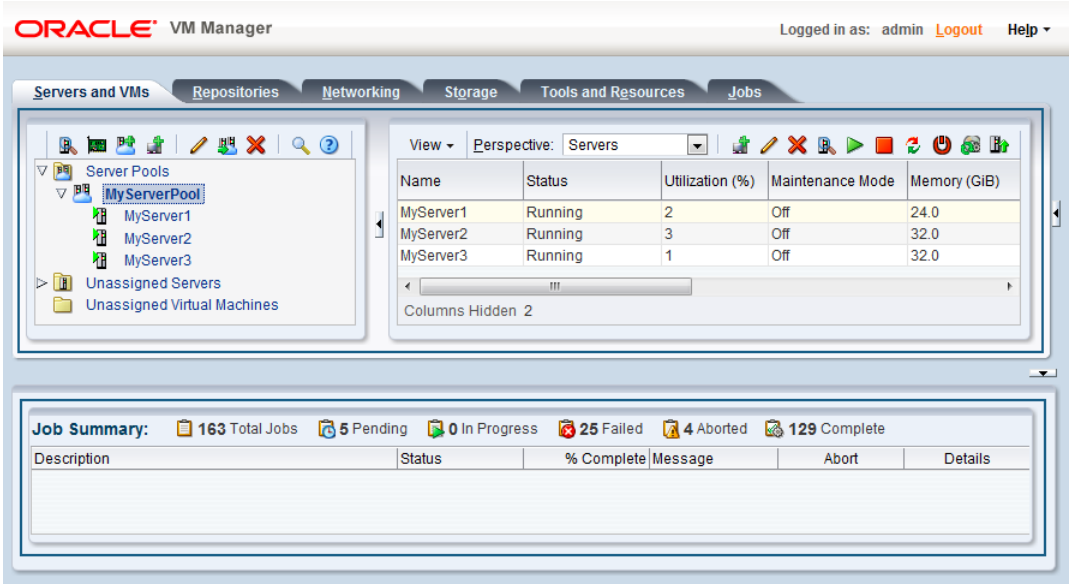
Each tab defines different objects and functional areas of operations that can be performed in Oracle VM Manager. When you select a tab the default management pane for that tab is displayed. The management pane change depending on the selected object in the navigation tree and the **Perspective** selected in the drop-down list in the management pane toolbar. The tabs in Oracle VM Manager are **Servers and VMs**, **Repositories**, **Networking**, **Storage**, **Tools and Resources**, **Jobs** and **Getting Started**.

3.4.1. Servers and VMs Tab

Use the **Servers and VMs** tab to discover Oracle VM Servers, create and manage server pools and virtual machines, assign Oracle VM Servers to server pools, and create and configure virtual machines in server pools.

Figure 3.2, “Servers and VMs Tab” shows the **Servers and VMs** tab.

Figure 3.2. Servers and VMs Tab



The Servers and VMs tab contains the Perspectives set out in Table 3.4, “Servers and VMs Tab Perspective”.

Table 3.4. Servers and VMs Tab Perspective

Management Pane Perspective	Description
Server Pools	Displays information about the server pools. Use this tab to edit server pool policies, add or remove Oracle VM Servers from a server pool, edit information about a server pool, and delete a server pool. Select the **Server Pools** folder in the navigation tree and then select **Server Pool** in the **Perspective** drop-down list to display this pane. For more information about managing server pools, see Section 6.8, “Managing Server Pools”.
Servers	Lists the Oracle VM Servers in the server pool. You can perform actions on the Oracle VM Servers using the tab's toolbar, such as start, stop, and edit. You

Management Pane Perspective	Description
	can also use the tab's toolbar to discover an Oracle VM Server and create a virtual machine on a selected Oracle VM Server. When an Oracle VM Server is discovered, it is listed in the **Unassigned Servers** folder. When an Oracle VM Server is added to a server pool, it is listed in the **Server Pools** folder. Select a server pool in the navigation tree and then select **Servers** in the **Perspective** drop-down list to display this pane. See Section 6.9, “Managing Oracle VM Servers” for information on managing Oracle VM Servers.
Virtual Machines	Displays information about the virtual machines in the server pool, or on the Oracle VM Server. You can perform actions on the virtual machines using the tab's toolbar, such as start, stop, edit, migrate and clone. Select a server pool or Oracle VM Server in the navigation tree and then select **Virtual Machines** in the **Perspective** drop-down list to display this pane. The Virtual Machines pane is also displayed when you select the **Unassigned Virtual Machines** folder in the navigation tree. See Section 7.9, “Managing Virtual Machines” for information on managing virtual machines.
Anti-Affinity Group	Displays information about the anti-affinity groups defined to keep selected virtual machines on separate Oracle VM Servers. You can perform actions on the anti-affinity groups using the tab's toolbar, such as create, edit and delete. Select a server pool in the navigation tree and then select **Anti-Affinity Group** in the **Perspective** drop-down list to display this pane. See Section 6.6, “Anti-Affinity Groups” for information on anti-affinity groups.
Policies	Displays information about server pool power and resource management policies; Distributed Resource Scheduler (DRS), or Distributed Power Management (DPM). You can define or edit a policy for the server pool using the tab's toolbar. Select a server pool in the navigation tree and then select **Policies** in the **Perspective** drop-down list to display this pane. See Section 6.5, “Server Pool Policies” for information on managing server pool policies.
Ethernet Ports	Lists the Ethernet ports on the selected Oracle VM Server that can be used for network bridges. Use this tab to edit the type of addressing (none, DHCP or static IP address) used for the Ethernet port. Select an Oracle VM Server in the navigation tree and then select **Ethernet Ports** in the **Perspective** drop-down list to display this pane. For more information on network bridges, see Section 5.5, “Network Bridges”.
Bond Ports	Lists the bonded Ethernet ports on the selected Oracle VM Server. Use this tab to create, edit and delete bonds on Ethernet ports.

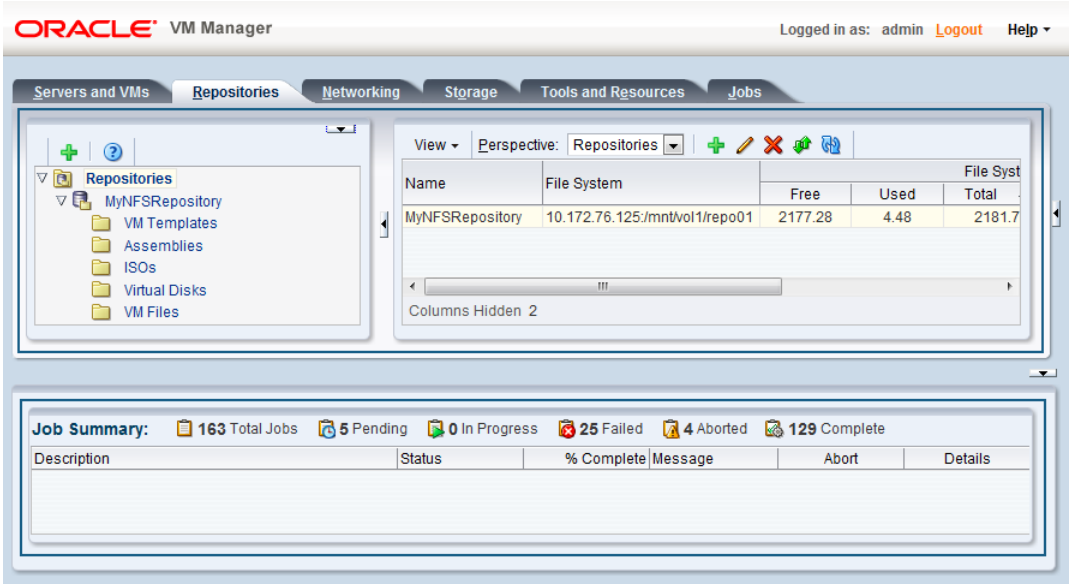
Management Pane Perspective	Description
	Select an Oracle VM Server in the navigation tree and then select **Bond Ports** in the **Perspective** drop-down list to display this pane. For more information on network bonding, see Section 5.4, “Network Bonding”.
Physical Disks	Lists the local storage available on the selected Oracle VM Server. Use this tab to edit, rescan, clone, refresh, delete and display events for local storage. You can also use this tab to create or delete an OCFS2 file system on local storage. Select an Oracle VM Server in the navigation tree and then select **Physical Disks** in the **Perspective** drop-down list to display this pane. For more information on local storage, see Section 4.2.1, “Local Storage”.
Storage Initiators	Lists the storage initiators available on the Oracle VM Server in your environment. Use this tab to view access groups for selected storage initiators. Select an Oracle VM Server in the navigation tree and then select **Storage Initiators** in the **Perspective** drop-down list to display this pane.
Control Domains	Displays information about the control domain, such as CPU, memory, operating system and agent version. You can also use this tab to view which version of Oracle VM Manager the server is running before and after an upgrade using the server update management (YUM) repository. See Section 6.9.11, “Updating and Upgrading Oracle VM Servers” for more information on Oracle VM Server update management. Select an Oracle VM Server in the navigation tree and then select **Control Domains** in the **Perspective** drop-down list to display this pane.
Repository Exports	List the export file servers used by backup and restore applications to access OCFS2 file systems. Use this tab to create, edit and delete repository export file servers. Select an Oracle VM Server in the navigation tree and then select **Repository Exports** in the **Perspective** drop-down list to display this pane.
Info	Displays a high-level view of the selected object. The Info pane contents change to reflect information about the object selected in the navigation tree. You can use this pane to view information about repositories in your environment. Select **Info** in the **Perspective** drop-down list to display the Info pane.
Events	Events are displayed for each object in the navigation tree and displays events related to that object. Select **Events** in the **Perspective** drop-down list to display the Events pane.

3.4.2. Repositories Tab

Use the **Repositories** tab to create and configure storage repositories and their content; assemblies, VM templates, ISO files, virtual disks and virtual machine configuration files.

Figure 3.3, “Repositories Tab” shows the **Repositories** tab.

Figure 3.3. Repositories Tab



The Repositories tab contains the Perspectives set out in Table 3.5, “Repositories Tab Perspective”.

Table 3.5. Repositories Tab Perspective

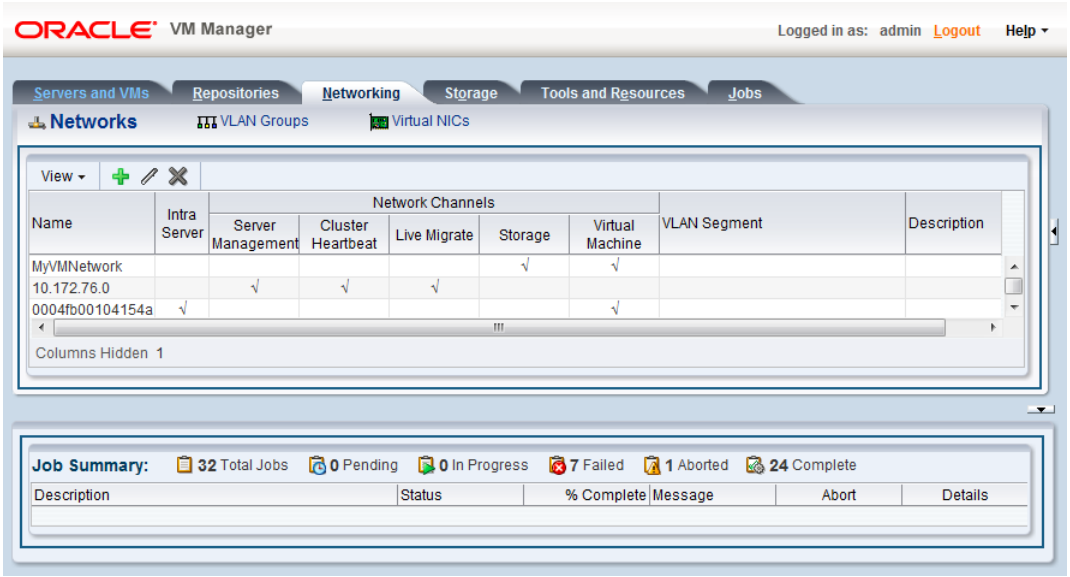
Management Pane Perspective	Description
Repositories	Displays information about the storage repositories, and the resources in each repository. Use this tab to view, create, edit, present/unpresent, refresh and delete storage repositories. You can also use this tab to create and manage the contents of storage repositories; assemblies, ISO files, template files, virtual disks and virtual machine configuration files. To view the contents of each storage repository, select it in the navigation tree, and then select **Repositories** in the **Perspective** drop-down list. See Chapter 4, *Managing Storage* for more information on managing storage.
Info	Displays a high-level view of the selected object. The Info pane contents change to reflect information about the object selected in the navigation tree. You can use this pane to view information about repositories in your environment. Select **Info** in the **Perspective** drop-down list to display the Info pane.
Events	Events are displayed for each object in the navigation tree and displays events related to that object. Select **Events** in the **Perspective** drop-down list to display the Events pane.

3.4.3. Networking Tab

Use the **Networking** tab to manage networks and their functions in your environment, create, edit and delete networks and VLAN groups, and create virtual NICs which can be used by virtual machines.

Figure 3.4, “Networking Tab” shows the Networking tab.

Figure 3.4. Networking Tab



The Networking tab contains the sub-tabs set out in Table 3.6, “Networking Sub-Tabs”.

Table 3.6. Networking Sub-Tabs

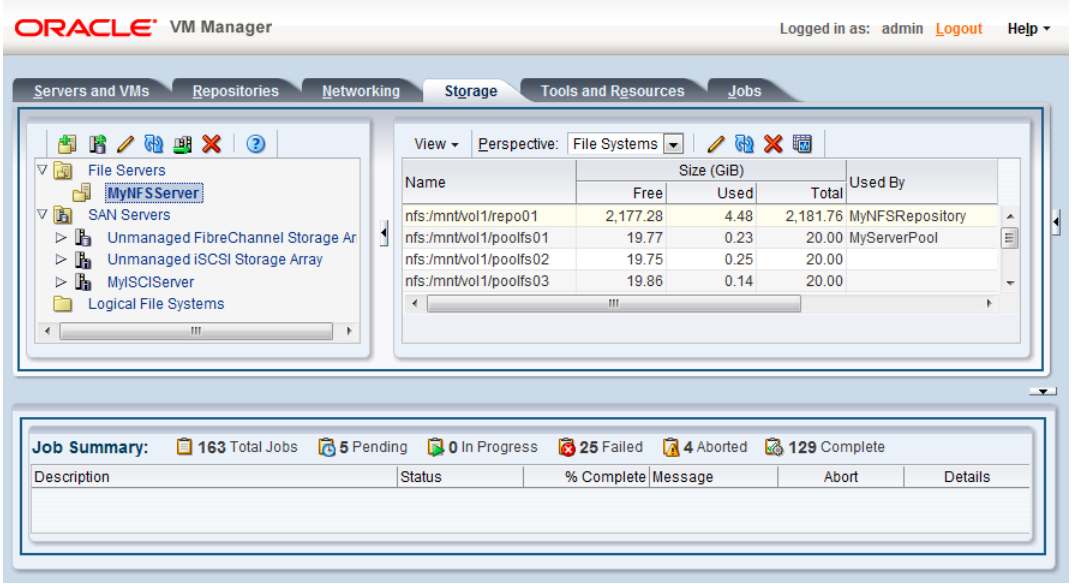
Sub-Tab	Description
Networks	Displays information about the networks available to server pools. Use this tab to create, edit, and delete networks. Select the **Networks** sub-tab to display this pane. Select a network in the table to view and edit information about the network ports and VLAN segments used in a network. See Chapter 5, *Managing Networks* for more information on managing networks.
VLAN Groups	Displays information about the VLAN Groups available to the server. Use this tab to create, edit and delete VLAN Groups. Select the **VLAN Groups** sub-tab to display this pane. Select a VLAN Group in the table to view and edit information about the ports and VLAN Segments used in a VLAN Group. See Section 5.9, “Managing VLAN Groups” for more information on managing VLAN groups.
Virtual NICs	Displays information about virtual NICs which can be used by virtual machines. Use this tab to create and delete virtual NICs for virtual machines. See Section 7.6, “Creating VNICs” for more information on managing virtual NICs.

3.4.4. Storage Tab

Use the **Storage** tab to manage, discover and edit file servers and SAN servers (storage arrays), physical disks, access groups and volume groups.

Figure 3.5, “Storage Tab” shows the **Storage** tab.

Figure 3.5. Storage Tab



The Storage tab contains the Perspectives set out in Table 3.7, “Storage Tab Perspective”.

Table 3.7. Storage Tab Perspective

Management Pane Perspective	Description
File Servers	Lists the file servers which contain file-based storage. Use this tab to register, edit, delete and discover file-based storage. Select **File Servers** in the navigation tree to display this tab. See Section 4.2, “Storage Types” for more information on file-based storage.
File Systems	Lists the file systems available on the file server. Use this tab to discover edit, refresh, delete and display events for file systems. Select a file server in the navigation tree and then select **File Systems** in the **Perspective** drop-down list to display this tab.
Logical File Systems	Lists the logical file systems available on the file server. Use this tab to refresh and delete logical file systems. Select the **Logical File Systems** folder in the navigation tree to display this tab.
SAN Servers	Lists the SAN servers (storage arrays). Use this tab to register, edit, delete, refresh and discover SAN servers. Select **SAN Servers** in the navigation tree to display this tab. See Section 4.2, “Storage Types” for more information on storage arrays.
Physical Disks	Lists the physical disks on the storage array. Use this tab to create, edit, clone, delete, refresh and display events for physical disks.

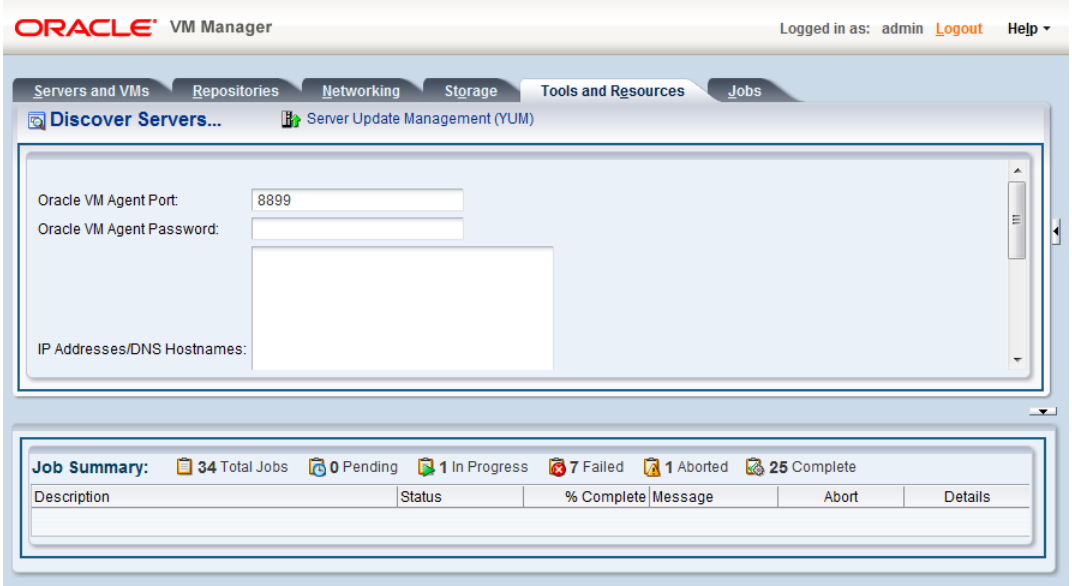
Management Pane Perspective	Description
	Select a storage array in the navigation tree and then select **Physical Disks** in the **Perspective** drop-down list to display this tab.
Access Groups	Lists the access groups for the storage array. Use this tab to create, edit, delete, present/unpresent and display events for storage array access groups. Also use this tab to grant access to physical disks in the storage array to Oracle VM Servers using the access groups. Select a storage array in the navigation tree and then select **Access Groups** in the **Perspective** drop-down list to display this tab. See Section 4.6.3.2, "Configuring Storage Array Access through Access Groups" for more information on access groups.
Volume Groups	Lists the volume groups for the storage array. Use this tab to create, edit and delete storage array volume groups. Also use this tab to grant access to physical disks in the storage array to Oracle VM Servers using the volume groups. Select a storage array in the navigation tree and then select **Volume Groups** in the **Perspective** drop-down list to display this tab.
Info	Displays a high-level view of the selected object. The Info pane contents change to reflect information about the object selected in the navigation tree. You can use this pane to view information about repositories in your environment. Select **Info** in the **Perspective** drop-down list to display the Info pane.
Events	Events are displayed for each object in the navigation tree and displays events related to that object. Select **Events** in the **Perspective** drop-down list to display the Events pane.

3.4.5. Tools and Resources Tab

Use the **Tools and Resources** tab to discover Oracle VM Servers and configure Server Update Management (YUM) repositories for automatic updates of the Oracle VM Servers being managed by Oracle VM Manager.

Figure 3.6, "Tools and Resources Tab" shows the **Tools and Resources** tab.

Figure 3.6. Tools and Resources Tab



The Tool and Resources tab contains the sub-tabs set out in Table 3.8, “Tool and Resources Sub-Tabs”.

Table 3.8. Tool and Resources Sub-Tabs

Sub-Tab	Description
Discover Servers	Displays the Discover Servers dialog box. Use this tab to discover Oracle VM Servers. When an Oracle VM Server is discovered, it is listed in the **Unassigned Servers** folder. When an Oracle VM Server is added to a server pool, it is listed in the **Server Pools** folder. See Section 6.9.1, “Discovering Oracle VM Servers” for more information on discovering Oracle VM Servers.
Server Update Management (YUM)	Displays the Server Update Management (YUM) dialog box. Use this tab to configure YUM repositories for automatic updates of the Oracle VM Servers being managed by Oracle VM Manager. See Section 6.9.11, “Updating and Upgrading Oracle VM Servers” for more information on Oracle VM Server update management.

3.4.6. Jobs Tab

Use the **Jobs** tab for information on current and past tasks, or *jobs*. A job is a set of one or more operations made in Oracle VM Manager. See Section B.1, “Working with the Jobs Framework” for more information on managing jobs.

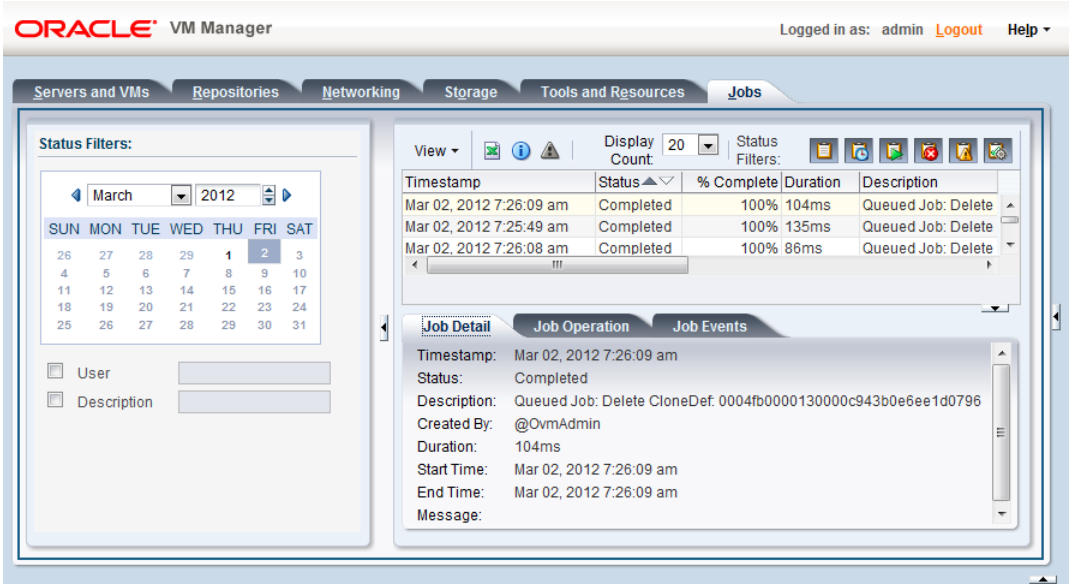
The Jobs tab provides comprehensive information on all completed and in-progress jobs in the virtualization environment. The Jobs tab is used to get a global view on jobs, to evaluate information on jobs completed or aborted, or to cancel a job in progress.

Jobs can be displayed for all users, or just for the administrator.

The Jobs calendar enables you to display the jobs for a particular date. Select a date in the Jobs calendar and the jobs for that date are displayed in the Jobs table.

Figure 3.7, “Jobs Tab” shows the Jobs tab.

Figure 3.7. Jobs Tab



The Jobs tab contains the sub-tabs set out in Table 3.9, “Jobs Sub-Tabs”.

Table 3.9. Jobs Sub-Tabs

Management Pane Tab	Sub-tab	Description
Jobs		Displays information on all jobs in a time-stamped list in the Jobs table. Jobs can be sorted and viewed by any column in the Jobs table. Click a column heading to resort the table content. The table contents can be reordered using **View** > **Reorder Columns** in the Jobs tab toolbar. The columns listed in the Jobs table can be selected using **View** > **Columns** in the Jobs tab toolbar. You can select which columns to view, and order the columns in the Jobs table using the View drop-down list. Click **Export to Excel** to save a list of the jobs to a spreadsheet file. Select a job in the table and click **Details...** to see the details of the job. To abort a job, select the job in the table and click **Abort Job**. Use the **Status Filters** icons to view **Total Jobs**, **Pending**, **In Progress**, **Failed**, **Aborted** and **Complete Jobs**. Click the icons to open a dialog box showing the tasks. The dialog box lets you export a list of the jobs to a spreadsheet file, view details of a job, or abort a job. See Section B.1, “Working with the Jobs Framework” for more information on jobs.

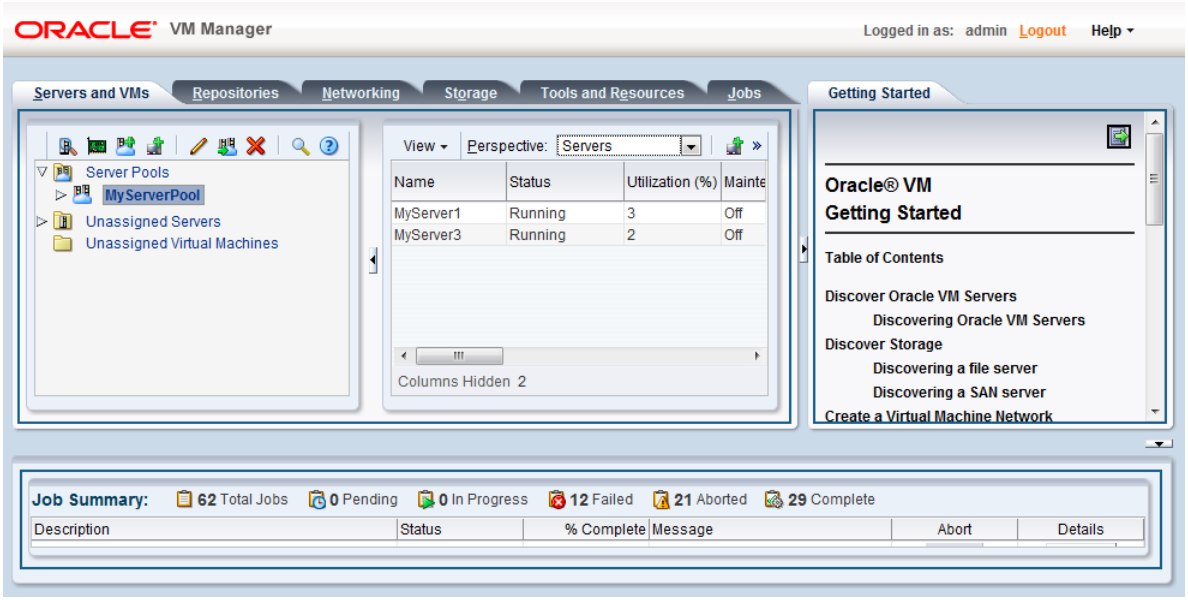
Management Pane Tab	Sub-tab	Description
	Job Detail	This tab is displayed on the Jobs tab. The Job detail tab displays all the available information about the job selected in the Jobs table. If a message is associated with the job detail, it is displayed in the message pane.
	Job Operation	This tab is displayed on the Jobs tab. The Job operations tab displays the operations performed as part of the job.
	Job Events	This tab is displayed on the Jobs tab. The Job events tab displays a list of the events performed during the job.

3.4.7. Getting Started Tab

When you first log in to Oracle VM Manager the **Getting Started** tab is displayed on the right side of the management pane. The **Getting Started** tab contains a tutorial that describes how to get started with Oracle VM Manager, and walks you through discovering Oracle VM Servers, registering storage, setting up networking, setting up a storage repository and importing resources into it, creating a server pool and creating virtual machines. To show or hide the tutorial, click the arrow to the right of the management pane.

Figure 3.8, “Getting Started tab” shows the **Getting Started** tab.

Figure 3.8. Getting Started tab



3.5. Using the Toolbar

The toolbar is positioned just below the tabs. The icons in the toolbar are arranged to support the work-flow required to perform tasks associated with the object selected in the navigation pane.

The toolbar is used to perform specific actions. Depending on the selected tab, the icons in the toolbar change. For example, if you select an Oracle VM Server in the **Servers and VMs** tab , the toolbar icons to manage Oracle VM Servers are displayed.

3.5.1. Toolbar Options

The toolbar options are context-sensitive, and change to display actions related to the object selected in the navigator. The toolbar in the management pane change depending on the object selected in the navigation tree and the selected **Perspective** in the drop-down list in the management pane. Many of the toolbar options are also available as right-click menu options.

The toolbar icon options are discussed in Table 3.10, “Toolbar Icon Options”.

Table 3.10. Toolbar Icon Options

Toolbar Icon Option	Icon	Description
Discover Servers...		Displays the **Discover Servers** dialog box. Use this option to discover Oracle VM Servers. Select the **Servers and VMs** tab to enable this option.
Create VNICs...		Displays the **Create Virtual NICs** dialog box. Use this option to create virtual NICs for virtual machines. Select the **Servers and VMs** tab to enable this option.
Create Server Pool...		Displays the **Create a Server Pool** wizard. Use this option to create a server pool for Oracle VM Servers. Select the **Servers and VMs** tab to enable this option.
Create Virtual Machine...		Displays the **Create Virtual Machine** wizard. Use this option to create a virtual machine in the selected server pool. Select the **Servers and VMs** tab to enable this option.
Edit Server Pool...		Displays the **Edit Server Pool** wizard. Use this option to edit a server pool. Select a server pool in the **Servers and VMs** tab to enable this option.
Add/Remove Servers...		Displays the **Add/Remove Servers from Server Pool** dialog box. Use this option to add or remove Oracle VM Servers from a server pool. Select a server pool in the **Servers and VMs** tab to enable this option.
Change Servers Agent Password		Displays the **Change Agent Password for All Servers within the Server Pool** dialog box. Use this option to set a new Oracle VM Agent password for all Oracle VM Servers in a server pool. Select a server pool in the **Servers and VMs** tab to enable this option.
Define Policy for Server Pool...		Displays the **Configure DRS/DPM** wizard. Use this option to set or edit resource policies for the server pool. Select a server pool in the **Servers and VMs** tab to enable this option.

Toolbar Icon Option	Icon	Description
Edit Server		Displays the **Edit Server** dialog box. Use this option to edit the name and description for an Oracle VM Server. This is also used to put the Oracle VM Server into maintenance mode, take ownership of it, and to configure remote management of the Oracle VM Server using IPMI (Intelligent Platform Management Interface). Select an Oracle VM Server in the **Servers and VMs** tab to enable this option. Note that placing an Oracle VM Server in maintenance mode is indicated in the navigation pane with this icon: 
Rediscover Server		Rediscovers the Oracle VM Server. Use this to refresh information about the Oracle VM Server. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Start Server		Starts a stopped Oracle VM Server. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Stop Server		Stops a running Oracle VM Server. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Restart Server		Restarts a running Oracle VM Server. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Kill Server		Powers off an Oracle VM Server. This is the equivalent of physically pushing the Off button on the hardware. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Rescan Physical Disks		Rescans the local storage on an Oracle VM Server. Use this option to rescan the storage presented to an Oracle VM Server when the storage configuration is changed, for example, a new storage array is added. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Update Server		Updates or upgrades the Oracle VM Server if an update is available in the YUM repository. Select an Oracle VM Server in the **Servers and VMs** tab to enable this option.
Edit Virtual Machine		Displays the **Edit Virtual Machine** wizard. Use this option to edit a virtual machine.

Toolbar Icon Option	Icon	Description
		In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree and then select **Virtual Machines** in the **Perspective** drop-down list to enable this option.
Start Virtual Machine		Starts up a stopped virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree, and then select **Virtual Machines** in the **Perspective** drop-down list. Select a stopped virtual machine in the table to use this option.
Stop Virtual Machine		Shuts down a virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree, and then select **Virtual Machines** in the **Perspective** drop-down list. Select a running virtual machine in the table to use this option.
Restart Virtual Machine		Restarts a running virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree, and then select **Virtual Machines** in the **Perspective** drop-down list. Select a running virtual machine in the table to use this option.
Kill Virtual Machine		Shuts down a running virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree, and then select **Virtual Machines** in the **Perspective** drop-down list. Select a running virtual machine in the table to use this option.
Suspend Virtual Machine		Suspends (pauses) a running virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree, and then select **Virtual Machines** in the **Perspective** drop-down list. Select a running virtual machine in the table to use this option.
Resume Virtual Machine		Resumes (unpauses) a suspended virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree, and then select **Virtual Machines** in the **Perspective** drop-down list. Select a suspended virtual machine in the table to use this option.
Migrate Virtual Machine		Migrates a virtual machine to another Oracle VM Server. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree and then select

Toolbar Icon Option	Icon	Description
		Virtual Machines in the **Perspective** drop-down list to use this option.
Clone or Move Virtual Machine		Displays the **Clone or Move Virtual Machine** dialog box. Use this option to clone a virtual machine to create another virtual machine. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree and then select **Virtual Machines** in the **Perspective** drop-down list to use this option.
Launch Console		Launches the virtual machine console to access the virtual machine. Use this option to connect to a virtual machine's console and access the virtual machine directly. In the **Servers and VMs** tab, select a server pool or Oracle VM Server in the navigation tree and then select **Virtual Machines** in the **Perspective** drop-down list to enable this option.
Create New Repository...		Displays the **Create a Data Repository** wizard. Use this option to create a new repository and make it available to Oracle VM Servers. Select the **Repositories** tab to enable this option.
Edit Selected Repository...		Displays the **Edit Repository** dialog box. Use this option to edit a repository. Select the **Repositories** tab and then select a repository in the table to enable this option.
Delete Selected Repository...		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected repository. Select the **Repositories** tab and then select a repository in the table to enable this option.
Present-Unpresent Selected Repository...		Displays the **Present this Repository to Servers** dialog box. Use this option to select which Oracle VM Servers the selected repository should be presented or not presented to. Select the **Repositories** tab and then select a repository in the table to enable this option.
Refresh Selected Repository...		Refreshes the selected repository. Use this option to detect changes to the disk content of the selected repository. Select the **Repositories** tab and then select a repository in the table to enable this option.
Import VM Template...		Displays the **Import VM Template** dialog box. Use this option to import a virtual machine template into Oracle VM Manager and make it available to server pools.

Toolbar Icon Option	Icon	Description
		Select the **Repositories** tab and then select the **VM Templates** folder to enable this option.
Create VM Template...		Displays the **Create VM Template** wizard. Use this option to create a new virtual machine template or clone from an existing virtual machine template. Select the **Repositories** tab and then select the **VM Templates** folder to enable this option.
Edit Selected VM Template...		Displays the **Edit VM Template** dialog box. Use this option to change the configuration, networking, disks and boot order for a virtual machine template. In the **Repositories** tab, select the **VM Templates** folder and then select a template in the table to enable this option.
Delete Selected VM Template		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected virtual machine template. In the **Repositories** tab, select the **VM Templates** folder and then select a template in the table to enable this option.
Clone or Move VM Template...		Displays the **Clone or Move Template** dialog box. Use this option to create a clone of the virtual machine template or move a template, including repository and disk locations. In the **Repositories** tab, select the **VM Templates** folder and then select a template in the table to enable this option.
Manage Clone Customizers...		Displays the **Manage Clone Customizer** dialog box. The clone customizer lets you set up clone parameters, such as networking, disks and ISO resources. Use this option to create, edit or delete a clone customizer. In the **Repositories** tab, select the **VM Templates** folder and then select a template in the table to enable this option.
Import VM Assembly...		Displays the **Import VM Assembly** dialog box. Use this option to import a virtual machine assembly into Oracle VM Manager and make it available to server pools. In the **Repositories** tab, select the **VM Assemblies** folder to enable this option.
Create VM Assembly...		Displays the **Create VM Assembly** wizard. Use this option to create a new virtual machine assembly. Select the **Repositories** tab and then select the **Assemblies** folder to enable this option.
Edit Selected VM Assembly...		Displays the **Edit VM Assembly** dialog box. Use this option to edit the selected virtual machine assembly.

Toolbar Icon Option	Icon	Description
		In the **Repositories** tab, select the **Assemblies** folder and then select a virtual machine assembly in the table to enable this option.
Delete Selected VM Assembly		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected virtual machine assembly. In the **Repositories** tab, select the **Assemblies** folder and then select a virtual machine assembly in the table to enable this option.
Refresh Selected VM Assembly		Refreshes the selected VM assembly. Use this option refresh the selected virtual machine assembly. In the **Repositories** tab, select the **Assemblies** folder and then select an assembly in the table to enable this option.
Import ISO...		Displays the **Import ISO** dialog box. Use this option to import a virtual machine ISO file into Oracle VM Manager and make it available to server pools. In the **Repositories** tab, select the **ISOs** folder to enable this option.
Edit Selected ISO...		Displays the **Edit ISO** dialog box. Use this option to edit the selected ISO file. In the **Repositories** tab, select the **ISOs** folder and then select an ISO file in the table to enable this option.
Delete Selected ISO		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected ISO file. In the **Repositories** tab, select the **ISOs** folder and then select an ISO file in the table to enable this option.
Clone ISO		Displays the **Clone ISO** dialog box. Use this option to clone the selected ISO file. In the **Repositories** tab, select the **ISOs** folder and then select an ISO file in the table to enable this option.
Import Virtual Disk		Displays the **Import Virtual Disk** dialog box. Use this option to import a virtual disk into Oracle VM Manager and make it available to server pools. In the **Repositories** tab, select the **ISOs** folder to enable this option.
Create Virtual Disk...		Displays the **Create Virtual Disk** wizard. Use this option to create a new virtual disk. Select the **Repositories** tab and then select the **Virtual Disks** folder to enable this option.
Edit Selected Virtual Disk...		Displays the **Edit Virtual Disk** dialog box. Use this option to edit the selected virtual disk.

Toolbar Icon Option	Icon	Description
		In the **Repositories** tab, select the **Virtual Disks** folder and then select a virtual disk in the table to enable this option.
Delete Selected Virtual Disk		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected virtual disk. In the **Repositories** tab, select the **Virtual Disks** folder and then select a virtual disk in the table to enable this option.
Clone Virtual Disk		Displays the **Clone Virtual Disk** dialog box. Use this option to clone the selected virtual disk. In the **Repositories** tab, select the **Virtual Disks** folder and then select a virtual disk in the table to enable this option.
Create New Network...		Displays the **Create New Network** dialog box. Use this option to create a new network. Select the **Networking** tab and then select the **Networks** subtab to enable this option.
Edit Selected Network...		Displays the **Edit Network** dialog box. Use this option to edit the selected network. Select the **Networking** tab, select the **Networks** subtab and then select a network in the table to enable this option.
Delete Selected Network...		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected network. Select the **Networking** tab, select the **Networks** subtab and then select a network in the table to enable this option.
Create New VLAN Group...		Displays the **Create New VLAN Group** wizard. Use this option to create a new VLAN group. Select the **Networking** tab and then select the **VLAN Groups** subtab to enable this option.
Edit Selected VLAN Group...		Displays the **Edit VLAN Group** wizard. Use this option to edit a VLAN group. Select the **Networking** tab, select the **VLAN Groups** subtab and then select a VLAN group in the table to enable this option.
Delete Selected VLAN Group...		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected VLAN group. Select the **Networking** tab, select the **VLAN Groups** subtab and then select a VLAN group in the table to enable this option.

Toolbar Icon Option	Icon	Description
Virtual NICs		Displays the **Create Virtual NICs** dialog box. Use this option to create virtual NICs for virtual machines. Select the **Networking** tab and then select the **Virtual NICs** subtab to enable this option.
Discover File Server...		Displays the **Discover File Server** wizard. Use this option to discover a new file server. Select the **Storage** tab to enable this option.
Edit File Server...		Displays the **Edit File Server** dialog box. In the **Storage** tab, select the **File Servers** folder and then select a file server in the table to enable this option.
Delete File Server		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected file server. Select the **Storage** tab, select the **File Servers** folder and then select a file server in the table to enable this option.
Refresh File Server		Refreshes the list of storage elements made available by the selected file server. Use this option to rescan a file server after making changes to its configuration. This updates the storage information known to Oracle VM Manager. Since refreshing storage may be time consuming, a confirmation dialog box is displayed before the operation is launched. In the **Storage** tab, select the **File Servers** folder and then select a file server in the table to enable this option.
Refresh File System		Refreshes the file system presented by a file server. Use this option to rescan the configuration of a file system. In the **Storage** tab, select a file server in the **File Servers** folder, select **File Systems** in the **Perspective** drop-down, and then select a file system in the table to enable this option.
Add/Remove Admin Servers...		Displays the **Add/Remove Admin Servers** dialog box. Use this option to select the admin servers for each of your file servers. In the **Storage** tab, select the **SAN Servers** folder and then select a file server in the table to enable this option.
Discover SAN Server...		Displays the **Discover SAN Server** wizard. Use this option to discover a new SAN server. Select the **Storage** tab to enable this option.
Edit SAN Server...		Displays the **Edit SAN Server** dialog box.

Toolbar Icon Option	Icon	Description
		In the **Storage** tab, select the **SAN Servers** folder and then select a SAN server in the table to enable this option.
Delete SAN Server		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected SAN server. Select the **Storage** tab, select the **SAN Servers** folder and then select a SAN server in the table to enable this option.
Refresh SAN Server		Refreshes the list of storage elements made available by the selected SAN server. Use this option to rescan a SAN server after making changes to its configuration. This updates the storage information known to Oracle VM Manager. Since refreshing storage may be time consuming, a confirmation dialog box is displayed before the operation is launched. In the **Storage** tab, select the **SAN Servers** folder and then select a SAN server in the table to enable this option.
Add/Remove Admin Servers...		Displays the **Add/Remove Admin Servers** dialog box. Use this option to select the admin servers for each of your SAN servers. In the **Storage** tab, select the **SAN Servers** folder and then select a SAN server in the table to enable this option.
Create Physical Disk		Displays the **Create Physical Disk** dialog box. Use this option to create a new physical disk in the selected volume group of the storage array of your choice. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, then select **Physical Disks** in the **Perspective** drop-down list, and the select a volume group of a SAN server in the table to enable this option.
Edit Physical Disk...		Displays the **Edit Physical Disk** dialog box. Use this option to change the name, size, provisioning and share ability of the selected physical disk. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Physical Disks** in the **Perspective** drop-down list to enable this option.
Clone Physical Disk		Displays the **Clone Physical Disk** dialog box. Use this option to clone a physical disk to another physical disk or to a disk image on a file server. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Physical Disks** in the **Perspective** drop-down list to enable this option.

Toolbar Icon Option	Icon	Description
Refresh Physical Disk		Refreshes the physical disk presented by a SAN server. Use this option to rescan the configuration of a physical disk. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Physical Disks** in the **Perspective** drop-down list to enable this option.
Edit Volume Group		Displays the **Edit Volume Group** dialog box. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Volume Groups** in the **Perspective** drop-down list, and the select a volume group of a SAN server in the table to enable this option.
Create Access Group		Displays the **Create Access Group** dialog box. Use this option to create a new access group. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Access Groups** in the **Perspective** drop-down list to enable this option.
Edit Access Group		Displays the **Edit Access Group** dialog box. Use this option to edit access group settings such as name, description, selected storage initiators and physical disks. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Access Groups** in the **Perspective** drop-down list to enable this option.
Delete Access Group		Displays the **Delete Confirmation** dialog box. Use this option to delete the selected access group. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Access Groups** in the **Perspective** drop-down list to enable this option.
Present/Unpresent Physical Disk		Displays the **Present/Unpresent Physical Disk** dialog box. Use this option to change the selection of physical disks to which an access group has access. In the **Storage** tab, select a SAN server in the **SAN Servers** folder, and then select **Access Groups** in the **Perspective** drop-down list to enable this option.
Abort Job		Aborts and cancels a job. Select a running job in the **Job Summary** pane or in the **Jobs** tab to enable this option.
Find		Displays the Find dialog box. Use this option to search for server pools, Oracle VM Servers, and virtual machines. For example, if you search for a virtual machine, it is displayed and selected in the first row in the Virtual Machines table when it is found. The Oracle VM Server it belongs to is also selected in the navigation tree.

Toolbar Icon Option	Icon	Description
Help		Opens a new web browser window which contains the Oracle VM Manager online help system.

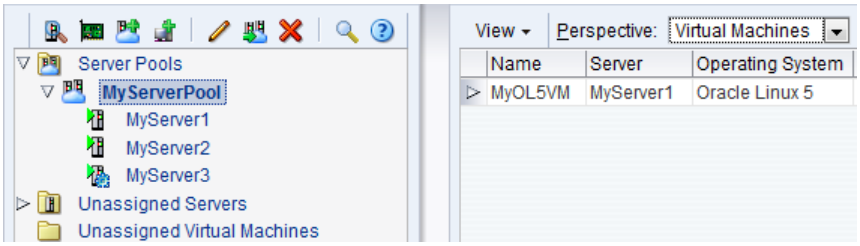
3.6. Using the Navigation Tree

The navigation tree shows the relationship between managed objects. These objects are both physical and virtual, and include Oracle VM Servers, server pools, virtual machines and so on, created using Oracle VM Manager. For example, the relationships between server pools, Oracle VM Servers, and the virtual machines hosted on those Oracle VM Servers. If you select a server pool in the navigation tree, the Oracle VM Servers in that server pool is displayed in the navigation tree. Any virtual machines hosted on the Oracle VM Server is listed in the virtual machines perspective in the management pane.

The content of the navigation tree changes, depending on the object you select in the navigation tree.

A sample of the navigation tree is shown in figure Figure 3.9, “Navigation tree”.

Figure 3.9. Navigation tree



In this example, the server pool named MyServerPool contains three Oracle VM Servers, named MyServer1, MyServer2, and MyServer3. A virtual machine named MyOL5VM is hosted on MyServer1, and MyServer3 is in maintenance mode.

3.7. Object Icon Colors

The icon for an object may be one of three colors: gray, yellow or red. These colors represent the status of the object and the color meanings are listed in table Table 3.11, “Object Icon Colors”.

Table 3.11. Object Icon Colors

Icon Color	Icon Example	Status
Gray		Normal. No warning or error events.
Yellow		The object has a warning event associated with it.
Red		The object has an error event associated with it.

To see the events associated with an object, select the object in the navigation tree. Select **Events** in the management pane's **Perspective** drop-down list. All the events for that object is listed in the table.

3.8. Drag and Drop

Oracle VM Manager allows you to drag and drop Oracle VM Servers and virtual machines to and from server pools, the **Unassigned Servers** folder and the **Unassigned Virtual Machines** folder in the navigation tree. You can drag and drop Oracle VM Servers from the servers table in the management pane

to a server pool or the **Unassigned Servers** folder in the navigation tree. You can also drag and drop virtual machines from the virtual machines table in the management pane to an Oracle VM Server or to the **Unassigned Virtual Machines** folder in the navigation tree. If you drag and drop an Oracle VM Server or virtual machine to an invalid destination an error message is displayed.

3.9. Right-Click Action Menus

You can right-click inside a table in a tab's management pane to bring up the action menu. The right-click action menu options are context-sensitive, and change to display actions related to the selected tab's management pane table. For example, if you click the **Servers and VMs** tab and select a server pool in the navigation tree and then right-click on an Oracle VM Server in the management pane table, the action menu for the Oracle VM Server is displayed.

Many of the toolbar options are also available as right-click menu options. See Section 3.5, “Using the Toolbar” for more information on the toolbar.

Chapter 4. Managing Storage

Table of Contents

To set up and configure the storage providers for your Oracle VM environment you need to be aware of the concepts and design ideas behind the entire storage architecture. That is precisely the information provided in the first topics of this chapter. Next, you will find the necessary instructions to prepare, configure and start using storage elements with Oracle VM.

For information on managing and working with the contents of a storage repository, such as virtual machine templates, ISO files, assemblies, and so on, see Section 7.5, “Virtual Machine Resources”.

4.1. Storage Overview

The particular way in which Oracle VM approaches storage is through plug-ins: Oracle has made storage configuration and integration as flexible and modular as possible by creating a Storage Connect plug-in for each different category and type of storage. These plug-ins are discussed in further detail in Section 4.3, “Storage Connect Plug-ins”.

Storage in Oracle VM refers to two different types of disk storage: the space available for environment resources such as templates and ISO files, and the logical or physical disks used by virtual machines.

Note

In addition there is also disk space used for the pool file systems of clustered server pools, but that is not the focus of this section.

For virtual machine disks Oracle VM offers you two choices:

- **Virtual disks**: disk image files on a file system.
- **Raw physical disks**: LUNs accessed directly by the virtual machine.

The design decision of virtual versus physical storage access depends on your server virtualization use cases as well as the existing storage hardware at your disposal. Virtual storage enables quick and easy on-the-fly configuration but introduces a higher level of abstraction. Physical storage access implies that virtual machine disk storage is mapped directly onto the LUNs configured in the physical storage hardware, which is exactly like the way physical servers access their storage. The advantage here is that existing procedures and storage management practices can be maintained.

Storage can be configured locally, specifically using an OCFS2 file system on a local disk of the Oracle VM Server. However, it is far more performant and reliable to use a separate location for a storage repository, so that it can be addressed by and attached to all Oracle VM Servers in the server pool. This is also essential for live migration and HA configurations. Storage is configured with any of the following technologies:

- Local disks
- Shared Network Attached Storage - NFS
- Shared iSCSI SANs: abstracted LUNs or raw disks accessible over existing network infrastructure
- Fibre Channel SANs connected to one or more host bus adapters (HBAs)

Note

OCFS2 (Oracle Cluster File System) is used in the storage configurations that are not based on NFS.

To enable HA or live migration, you must make sure all Oracle VM Servers have access to the same storage resources. Specifically for live migration the Oracle VM Servers also must be part of the same server pool. Also note that clustered server pools require access to a shared file system where server pool information is stored and retrieved, for example in case of failure and subsequent server role changes. The server pool file system can either be on an NFS share or on a LUN of a SAN server. For more information about setting up file servers and SAN servers, see Section 4.6, “Preparing and Configuring Storage”.

4.2. Storage Types

Oracle VM was designed to allow you to use a wide variety of storage types so you can adapt your configuration to your needs. Whether you have a limited hardware setup or a full rack of servers, whether you perform an installation for testing and temporary internal use or design a production environment that requires high availability in every area, Oracle VM offers support for a suitable storage solution.

Making use of both generic and vendor-specific Storage Connect plug-ins, Oracle VM allows you to use the following types of storage:

- Local Storage
- Shared Network Attached Storage (NFS)
- iSCSI Storage Attached Network
- Fibre Channel Storage Attached Network

4.2.1. Local Storage

Local storage consists of hard disks installed locally in your Oracle VM Server. In a default installation, Oracle VM Server will only use the first disk (*/dev/sda*), leaving other disks available for storage.

As long as no partition and data are present the device will be detected as a raw disk. The choice is yours to use the local disks either to provision logical storage volumes as disks for virtual machines or to install a storage repository. If you place a storage repository on the local disk, an OCFS2 file system is installed.

Note

Local storage can never be used for a server pool file system.

Local storage is fairly easy to set up because no special hardware for the disk subsystem is required. Since the virtualization overhead in this setup is limited, and disk access is internal within one physical server, local storage offers reasonably high performance.

However, the downsides are quickly revealed when you think about configurations with multiple Oracle VM Servers. Local storage by definition remains local and cannot be shared between different servers. Therefore, even if you set up a pool of multiple servers and use the advantages of clustering, virtual machines using local storage can never benefit from high availability: they cannot be migrated from one server to another.

Note

In Oracle VM, sharing a local physical disk between VMs is possible but not recommended.

4.2.2. Shared Network Attached Storage (NFS)

Network Attached Storage – typically NFS – is a commonly used file-based storage system that is very suitable for the installation of Oracle VM storage repositories. Storage repositories contain various categories of resources such as templates, virtual disk images, DVD iso files and virtual machine configuration files, which are all stored as files in the directory structure on the remotely located, attached file system.

With Oracle VM you discover NFS storage via the server IP or host name and typically present storage to all the servers in a server pool to allow them to share the same resources. This, along with clustering, helps to enable high availability of your environment: virtual machines can be easily migrated between host servers for the purpose of load balancing or protecting important virtual machines from going off-line due to hardware failure.

NFS storage is exposed to Oracle VM Servers in the form of shares on the NFS server which are mounted onto the Oracle VM Server's file system. Since mounting an NFS share can be done on any server in the network segment to which NFS is exposed, it is possible not only to share NFS storage between servers of the same pool but also across different server pools.

In terms of performance, NFS is slower for virtual disk I/O compared to a logical volume or a raw disk. This is due mostly to its file-based nature. For better disk performance you should consider using block-based storage, which is supported in Oracle VM in the form of iSCSI or Fibre Channel SANs.

4.2.3. iSCSI Storage Attached Network

With Internet SCSI, or iSCSI, you can connect storage entities to client machines, making the disks behave as if they are locally attached disks. iSCSI enables this connectivity by transferring SCSI commands over existing IP networks between what is called an initiator (the client) and a target (the storage provider).

To establish a link with iSCSI SANs, all Oracle VM Servers can use configured network interfaces as iSCSI initiators. It is the user's responsibility to:

- configure the disk volumes (iSCSI LUNs) offered by the storage servers

- discover the iSCSI storage through Oracle VM Manager
- set up access groups, which are groups of iSCSI initiators, through Oracle VM Manager, in order to determine which LUNs are available to which Oracle VM Servers

Performance-wise an iSCSI SAN is better than file-based storage like NFS and it is often comparable to direct local disk access. Because iSCSI storage is attached from a remote server it is perfectly suited for a clustered server pool configuration where high availability of storage and the possibility to live migrate virtual machines are important factors.

Provisioning of iSCSI storage can be done through open source target creation software at no additional cost, with dedicated high-end hardware or with anything in between. The generic iSCSI Storage Connect plug-in allows Oracle VM to use virtually all iSCSI storage providers. In addition, vendor-specific Storage Connect plug-ins exist for certain types of dedicated iSCSI storage hardware, allowing Oracle VM Manager to access additional interactive functionality otherwise only available through the management software of the storage provider. Examples are creating and deleting LUNs, extending existing LUNs and so on. Check with your storage hardware supplier if a Storage Connect plug-in is available. For installation and usage instructions, consult your supplier's plug-in documentation.

4.2.4. Fibre Channel Storage Attached Network

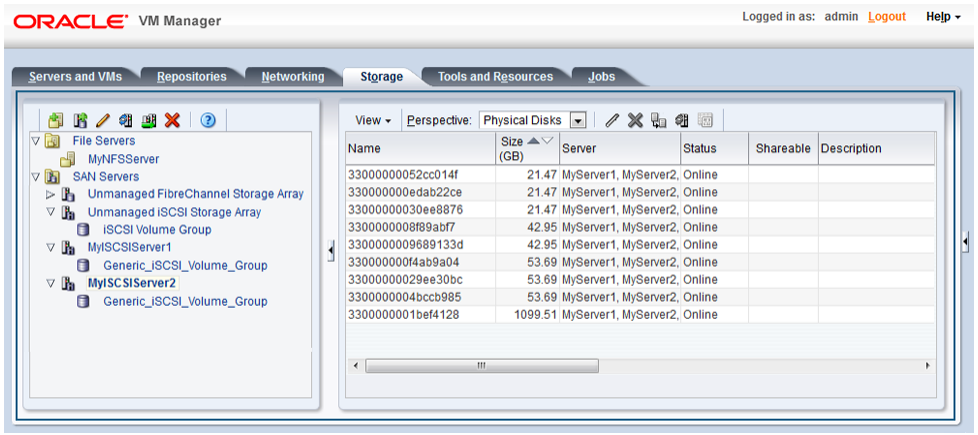
Functionally, a fibre channel SAN is hardly different from an iSCSI SAN. Fibre channel is actually older technology and uses dedicated hardware instead: special controllers on the SAN hardware, host bus adapters or HBAs on the client machines, and special fibre channel cables and switches to interconnect the components.

Like iSCSI, the Fibre Channel Protocol (FCP) is used to transfer SCSI commands between initiators and targets and establishes a connectivity that is almost identical to direct disk access. The same concepts from the iSCSI SAN, as described above, apply equally to the Fibre Channel SAN. Again, generic and vendor-specific Storage Connect plug-ins exist. Your storage hardware supplier will provide proper documentation with the Storage Connect plug-in.

4.3. Storage Connect Plug-ins

Oracle VM Manager communicates with all storage through a set of plug-ins, which are part of the Storage Connect framework. These plug-ins are not actually run from the Oracle VM Manager but rather live on some or all of the Oracle VM Servers. You can see these plug-in files in the local file system of an Oracle VM Server in the */opt/storage-connect/* directory. In the user interface of Oracle VM Manager you select an available plug-in when creating and configuring storage elements for use in your environment.

Figure 4.1. Storage tab in Oracle VM Manager



As you can see in the **Storage** tab in Figure 4.1, “Storage tab in Oracle VM Manager”, storage elements are logically divided in File Servers and SAN Servers. This distinction refers to the difference between file-based storage and block-based storage, or raw disks. Both types of storage are supported and Storage Connect plug-ins are available for each category described in Section 4.2, “Storage Types”.

Furthermore, Storage Connect plug-ins are split up according to the functionality they offer: there are generic plug-ins and non-generic plug-ins, also referred to as vendor-specific plug-ins. Generic plug-ins offer a limited set of standard storage operations on virtually all storage hardware, such as discovering and operating on existing storage resources. We categorize these operations as 'passive' in the sense that they do not interact with the storage management but simply detect the available storage architecture and allow it to be used in the Oracle VM environment.

Vendor-specific plug-ins include a much larger set of operations, which also includes direct, active interventions on the storage hardware: snapshot, clone, create LUNs, resize, and so on. To execute generic storage plug-in operations, only an access host or fibre channel connectivity is required (for iSCSI: typically a host name or IP address with a port number). The non-generic plug-in operations require an additional admin host, with optional administrative user name and password, granting Oracle VM Servers, with the appropriate plugin installed, direct access to the configuration of the storage hardware.

The following plug-ins are included with Oracle VM Manager:

- Oracle Generic NFS Plug-in.
- Oracle Generic SCSI Plug-in.
- Sun ZFS Storage Appliance SCSI Plug-in.
- Oracle NetApp Filer Plug-in.

To install vendor-specific plug-ins, see Section 4.3.1, “Installing Storage Connect Plug-ins”.

4.3.1. Installing Storage Connect Plug-ins

Vendor-specific (non-generic) storage connect plug-ins are available directly from your storage vendor.

A complete list of vendor-specific plug-ins is available here:https://wikis.oracle.com/display/oraclevm/Oracle+VM+Storage+Connect+Plugins.

Storage connect plug-ins are delivered as an RPM, usually a single RPM, but your storage vendor may provide multiple RPMs. When you have the storage connect plug-in RPM from your storage vendor, install the RPM on your Oracle VM Servers.

Note

You must install the RPM on all the Oracle VM Servers that will use the particular storage.

To install the storage plug-in RPM, on the command line of the Oracle VM Server, enter

```
# rpm -ivh filename.rpm
```

If you are upgrading an existing storage connect plug, use the RPM upgrade parameter:

```
# rpm -Uvh filename.rpm
```

Read the install and configuration documentation for the storage connect plug-in from your storage vendor before you install and use it. There may be extra configuration required that is not documented here.

4.4. Storage Repositories

For file-based storage abstraction, Oracle VM uses the concept of storage repositories. A storage repository is essentially logical disk space made available through a file system on top of physical storage hardware. If the storage repository is created on a file server, for example an NFS share, then a file system is already present; if the repository is created on a LUN, an OCFS2 file system is created first.

A storage repository defines where Oracle VM resources may reside. Resources include virtual machine configuration files, templates for virtual machine creation, virtual machine assemblies, ISO files (DVD image files), shared and unshared virtual disks, and so on.

Warning

Never manually copy Oracle VM resources such as virtual machine configuration files from one repository to another, as this can cause duplication of UUIDs within the Oracle VM environment and can cause Oracle VM to malfunction. Always use the tools provided by Oracle VM Manager to move resources. For instance, to move a virtual machine configuration from one storage repository to another use the Move Virtual Machine wizard described in Section 7.9.9, “Moving Virtual Machines Between Repositories”.

Before you begin configuring a storage repository, make sure that these requirements are met:

- **NFS-based repository:** At least one Oracle VM Server must be discovered. For the creation of the storage repository the Oracle VM Agent on the server will act as the worker component performing the instructions given through Oracle VM Manager.
- **LUN-based repository:** By design, a storage repository on a LUN is linked to a clustered server pool, because of the nature of the OCFS2 file system it uses. Consequently, a server pool must exist with clustering enabled, and at least one server must be present in the clustered pool.

  A repository on a local server storage also belongs in this category, since local disks are always discovered as LUNs. For more information about local storage and repositories, see Section 4.6.4, “Using Local Storage”.

Note

Only NFS storage repositories can be shared by multiple server pools.

For detailed instructions about the configuration and management of storage repositories, see Section 4.8, “Preparing and Configuring Storage Repositories”.

4.5. Storage Configuration Guidelines

It is important to plan your storage configuration in advance of deploying virtual infrastructure. Here are some guidelines to keep in mind:

- Take care when adding, removing, and resizing LUNs as it may require a physical server reboot. Do not resize LUNs that are used as part of Logical disks; instead, create a new LUN and add it to the disk group.
- Test your configuration, especially fail over, in a test environment before rolling into production. If your (SAN) array firmware is at a different release number than we have tested, confirm whether there are any differences. You may need to make changes to the multipath configuration files of Oracle VM Server.
- Plan the size and type of storage that you are using by workload. For example:

    - Boot volumes can typically be on higher capacity drives as most operating systems have minimal I/O activity on the boot disk, but some of that I/O is memory paging, which is sensitive to response times.
    - Applications can be on larger, slower drives (e.g. RAID 5) unless they perform a lot of I/O. Write-intensive workloads should use RAID 10 on medium to fast drives. Ensure that log files are on different physical drives than the data they are protecting.
    - Infrastructure servers such as DNS tend to have low I/O needs. These servers can have larger, slower drives.
- If using storage server features such as cloning and snapshots, use raw disks.
- While it may be tempting to create a very large LUN when using logical disks, this can be detrimental to performance as each virtual machine queues I/Os to the same disks. Oracle recommend that storage repositories do not exceed 2TB.
- Be sure to leave some disk space available to create smaller storage entities of, at least, 12GB each to use as server pool file systems. The server pool file system is used to hold the server pool and cluster data, and is also used for cluster heartbeating. You create space for server pool file systems the same way as you create storage entities for storage repositories. For more information about the use and management of clusters and server pools, see Chapter 6, *Managing Server Pools*.
- Place server pool file systems on a separate NFS server or use a small LUN, if possible. The OCFS2 heartbeating function can be disturbed by I/O-intensive operations on the same physical storage. For example: importing a template or cloning a VM in a storage repository on the same NFS server where the server pool file system resides may cause a time-out in the heartbeat communication, which in turn leads to server fencing and reboot. To avoid unwanted rebooting, it is recommended that you choose a server pool file system location with sufficient and stable I/O bandwidth.
- Disable read and write caching on the underlying disk systems to guarantee I/O synchronization. Caching may result in data loss if the Oracle VM Server or a virtual machine fails abruptly. To disable write caching, change the applicable settings in the RAID controller BIOS. Alternatively, use the `sg_wr_mode` command or use the SCSI disk class directly: `echo "write through" > /sys/class/scsi_disk/scsi-device-id/cache_type`.

4.6. Preparing and Configuring Storage

As described in Section 4.1, “Storage Overview”, Oracle VM Manager distinguishes between File Servers and SAN Servers in the **Storage** tab. Depending on your hardware and networking configuration, external storage may be detected during discovery of the Oracle VM Servers or a rescan of their physical disks. Local storage is always detected during this discovery operation.

An external storage element is created on storage hardware: a server configured for NAS offering NFS shares, generic iSCSI targets and LUNs, or SAN devices from your preferred storage vendors. The server or disk subsystem offering the storage simply needs to be reachable by the Oracle VM Servers in the Oracle VM environment through a Fibre Channel or Ethernet network. The external storage is offered as a mount point (NFS share) or LUN (iSCSI and fibre channel) which can be discovered through Oracle VM Manager as a potential location for a repository, or a raw disk for use with a VM.

The typical way to attach external storage to the Oracle VM environment is to create a new storage entity in Oracle VM Manager and point to the location of the external storage provider while selecting the appropriate Storage Connect plug-in.

Subsequently, you may choose to configure a storage repository on one or more of the discovered storage entities in order to make storage resources available to servers and server pools in the Oracle VM environment.

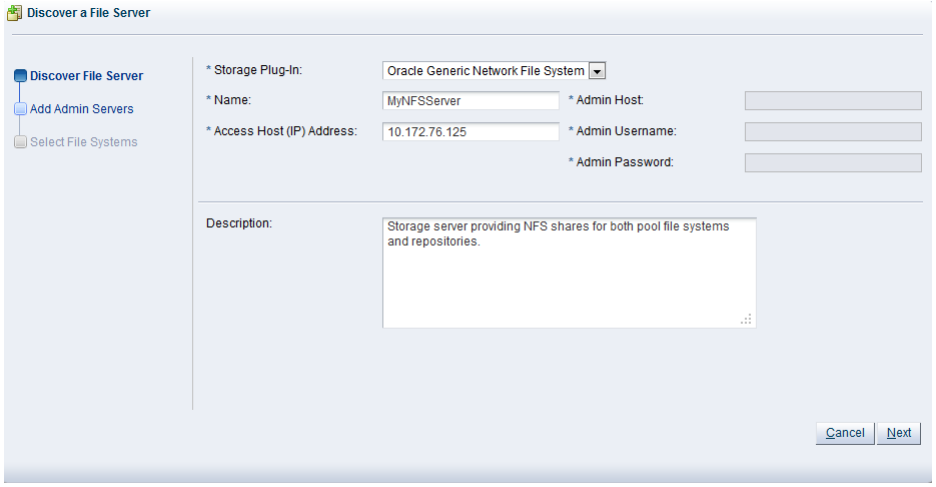
These preparation and configuration steps are covered in the following topics. Storage repository configuration is covered in Section 4.8, “Preparing and Configuring Storage Repositories”.

4.6.1. Discovering File Servers

In Oracle VM, the term *file server* is used to indicated file-based storage made available to the environment from another physical server, as opposed to local storage. Describing the technology used to expose file systems, NFS shares and so on, is beyond the scope of this guide. The procedure below explains how you can bring the exposed file-based storage into Oracle VM, prepare it for the installation of a storage repository, and configure the file server and discovered file systems.

To discover a file server:

1. Make sure that your storage server exposes a writable file system to the storage network of your server pool.
2. In Oracle VM Manager open the **Storage** tab.
3. In the toolbar above the navigation pane, click **Discover File Servers** . The **Discover a File Server** dialog box is displayed, where you enter the information necessary for Oracle VM Manager to discover the external storage mount points.

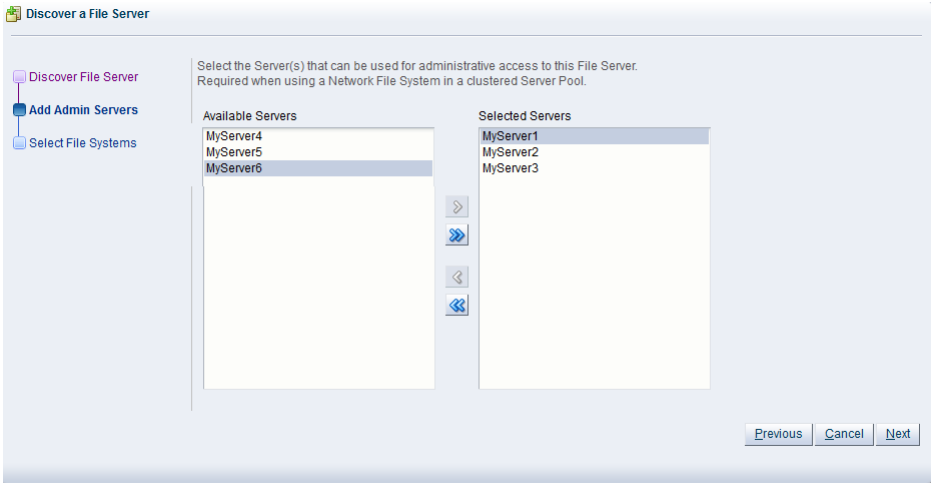


4. Always enter the following information:
   - **Storage Plug-in:** The storage plug-in corresponding to the type of file server (generic NFS or vendor-specific).
   - **Name:** The name you wish to use to identify the file server.
   - **Access Host:** The host name or IP address of the server offering the file system.
   - **Description:** Optional information you would like to add about this file server.
5. If you are adding a non-generic file server, for example a Sun ZFS Storage Appliance, also enter the additional plug-in options to enable Oracle VM Manager to access the file server's configuration management functions:
   - **Admin Host:** The host name or IP address where administrative access to the file server is allowed with appropriate credentials.
   - **Admin User Name:** A user name with administrator access to the file server.

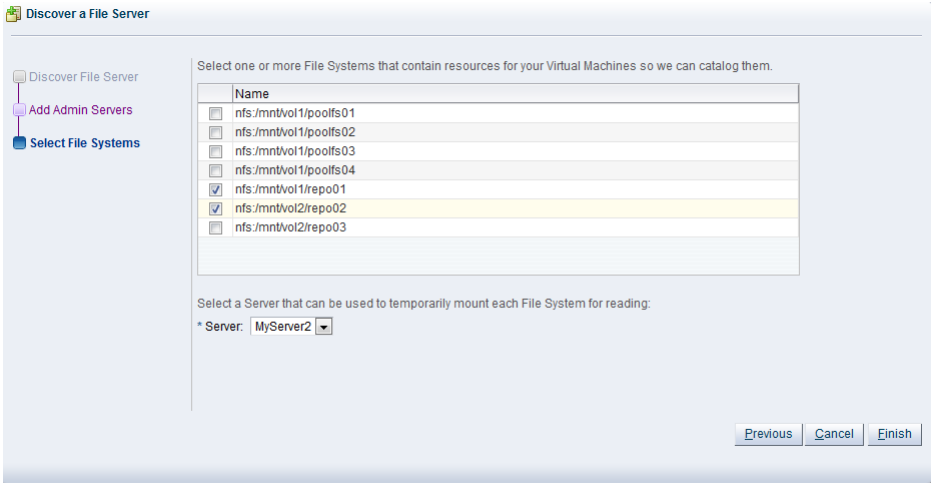
- **Admin Password:** The administrator password for the user name you entered.

6. Click **Next** to proceed to the admin server selection screen. If you are working with a non-clustered server pool, you may skip this screen.

7. Use the arrow buttons to move the required Oracle VM Servers to the **Selected Servers** box.



8. Click **Next** to proceed to the file systems selection screen. If certain file systems contain existing virtual machine resources, select the corresponding check boxes and choose a server from the list below to read the content of the selected file systems. This allows Oracle VM Manager to add the existing resources to the system.



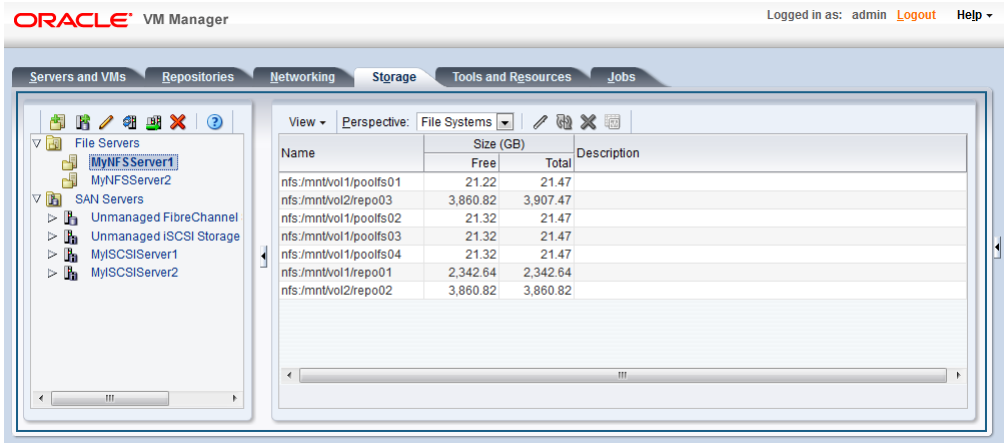
9. Click **Finish** to complete the file server registration. The new file server appears in the navigation pane, under **File Servers**.

Note

If you created shares to be used as server pool file systems, these are discovered in the same process. Since these file systems are relatively small, be sure to keep those available for the server pools and create storage repositories on the higher capacity file systems.

At the end of the file server registration a refresh operation is triggered to make sure all file systems available on the file server appear in Oracle VM Manager. When the operation is complete, and if you

select the file server in the navigation pane, the available file systems appear in the **File Systems** overview table in the management pane.



Your file server and file systems are now ready to be used either for storage repositories or as server pool file systems. A server pool file system is selected during the creation of the server pool; to create storage repositories on your file systems, see Section 4.8, “Preparing and Configuring Storage Repositories”.

Of course, you can always make changes to the storage configuration you just registered. The steps and options to do so are described below.

To change the registered file server configuration:

1. If you need to modify a file server, select it in the navigation pane and use the applicable buttons in the toolbar above. Alternatively, right-click the file server and choose one of these corresponding options:

   - **Edit File Server:** Change file server settings such as name, access host, description and plug-in options; change admin server settings in the second section of the wizard.
   - **Refresh File Server:** Request an update of the file server configuration in case changes have been made to the disks and file systems.
   - **Add/Remove Admin Server:** Determine which Oracle VM Servers are responsible for information exchange with this file server.
   - **Delete File Server:** Remove the selected file server from your Oracle VM environment.

2. If you need to modify a file system, select the file server it belongs to, and make sure the perspective of the management pane is set to **File Systems**. Select the file system in the overview table and click the appropriate button in the toolbar above to choose one of these options:

   - **Edit File System:** Change the name and description of the file system.
   - **Refresh File System:** Request an update of the file system information to see if changes have been made to the size and contents.
   - **Delete File System:** Stop using the selected file system in your Oracle VM environment.

4.6.2. Handling Unmanaged Storage Arrays

The purpose of listing unmanaged storage arrays is that Oracle VM warns you when it detects storage in the environment for which no particular management mechanism is available or in case the appropriate management mechanism cannot be determined. In other words, the unmanaged storage arrays, for iSCSI

and for fibre channel, are placeholders for physical disks of which the appropriate location in the storage management tree is unclear.

It should be noted that the unmanaged arrays behave differently for iSCSI and fibre channel. For iSCSI the use of the unmanaged array in practice is temporary, but for fibre channel the situation is different. Because generic fibre channel arrays are simply detected when they are connected to the storage network, there is no mechanism to place them under a separate storage array based on a specific access host. Consequently, generic fibre channel LUNs will remain in the unmanaged fibre channel storage array, which has no access group.

Warning

You must always configure an admin server when using generic fibre channel storage with Oracle VM. The admin server is required for discovery and administrative operations. For example, rescanning the physical disks of an array will not produce any results if no admin server is set. Configure the admin server(s) as described in Section 4.6.3.3, “Updating the Configuration of a Storage Array”.

You may choose to delete the unmanaged storage elements from the Oracle VM environment in case you do not intend to use it. In the case of generic iSCSI storage arrays, it is preferable to register them in the correct way by following the procedures in Section 4.6.3, “Discovering SAN Servers”. To properly register the storage entries, you should remove them from the unmanaged array. After registration these entries are displayed under a managed storage array of the appropriate type.

Vendor-specific storage, which does not use a generic Storage Connect plug-in, must always be registered with its dedicated plug-in and appears under its own storage array entry in the storage management tree.

4.6.3. Discovering SAN Servers

In Oracle VM, the term *SAN server* is used to indicate block-based storage made available to the environment from another physical server. The storage entities are also referred to as *storage arrays* and include external as well as local storage volumes. Describing the technology used to expose raw disk space in the form of iSCSI targets and LUNs or the configuration of a SAN (storage attached network), is beyond the scope of this guide. The procedure below explains how you can bring the exposed block-based storage into Oracle VM and configure the storage array and physical disks either for the installation of a storage repository or direct attachment as physical disk to a VM (virtual machine).

Note

Oracle VM has a default *Unmanaged Fibre Channel Storage Array*. Since only a single generic fibre channel storage array can exist, no additional arrays of this type can be created. Consequently, the instructions below apply to SAN servers and storage arrays using the following types of Storage Connect plug-ins:

- Generic iSCSI.
- Vendor-specific iSCSI.
- Vendor-specific fibre channel.

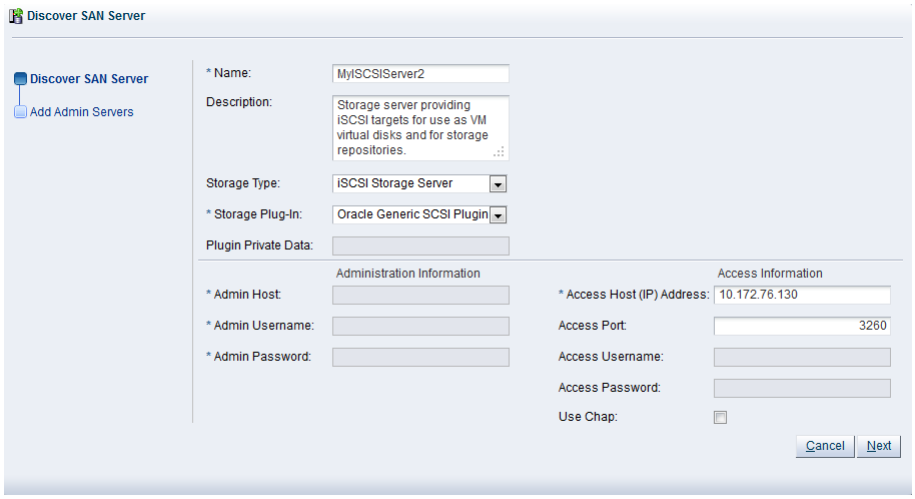
The end-to-end procedure is broken down into three phases, discussed in the following sections.

4.6.3.1. Discovering a Storage Array

This first phase covers purely the discovery and registration part, meaning how you discover the container of the storage elements you intend to use in your environment.

To discover a storage array:

1. Make sure that your storage server exposes raw disks (Fibre Channel SAN volumes, iSCSI targets and LUNs) to the storage network of your server pool.
2. In Oracle VM Manager open the **Storage** tab.
3. In the toolbar above the navigation pane, click **Discover SAN Server** . The **Discover SAN Server** dialog box is displayed, where you enter the information necessary for Oracle VM Manager to discover the external storage elements.



4. Enter the following information:
   - **Name:** The name you wish to use to identify the SAN server.
   - **Description:** Optional information you would like to add about this SAN server.
   - **Storage Type:** The array is either a SAN or an iSCSI storage server.
   - **Storage Plug-in:** The storage plug-in corresponding to the type of storage array, which is either generic iSCSI, or a vendor-specific iSCSI or fibre channel plug-in.
   - **Access Host:** The host name or IP address of the server or SAN hardware offering the storage elements.

Note

This is not applicable to fibre channel storage arrays.

When adding iSCSI storage, add the access port as well. The default access port for iSCSI is 3260.

5. Depending on the selected storage type and plug-in, you may be required to enter additional information when registering your storage array:

Table 4.1. Required Information for Registering Different Storage Types

Information Field Required	Generic iSCSI	Vendor-specific iSCSI	Generic Fibre Channel	Vendor-specific Fibre Channel
Access host and port	Yes	Yes	No	No

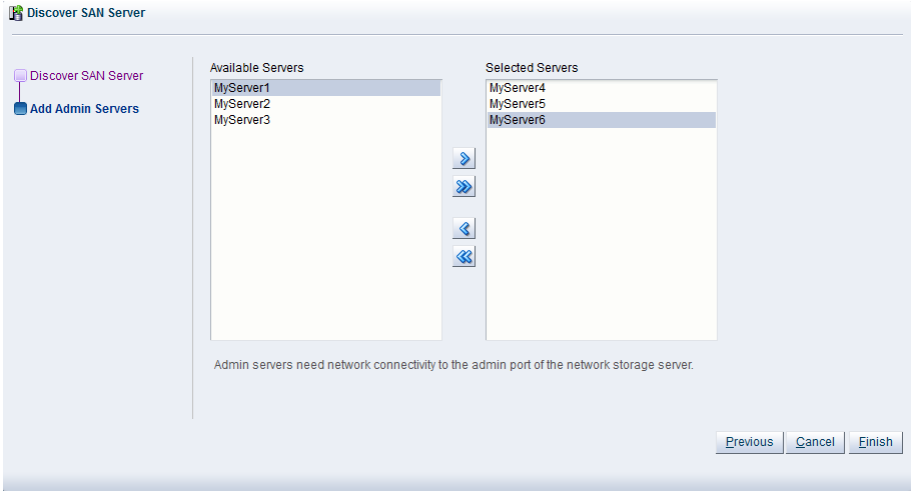
Information Field Required	Generic iSCSI	Vendor-specific iSCSI	Generic Fibre Channel	Vendor-specific Fibre Channel
Access credentials/Chap	No	Optional	No	No
Administration information	No	Yes	No	Yes
Plug-in private data	No	Optional	No	Optional

Note

When registering a vendor-specific storage array, be sure to double-check the information you entered in the plug-in private data field. Once the storage array is registered, this field can no longer be modified. If you need to update the plug-in private data, you must unregister and re-register the storage array.

6. Click **Next** to proceed to the admin server selection screen. If you are working with a non-clustered server pool, you may skip this screen.

7. Use the arrow buttons to move the required Oracle VM Servers to the **Selected Servers** box. Click **Finish** to complete the storage array registration.



The new storage array appears in the navigation pane, under SAN Servers. At this point, the Storage Connect plug-in has established a link to the storage location. No new storage elements have been detected yet. The storage elements or physical disks only appear in the management pane when at least one Oracle VM Server has been granted access once to the storage array. Access is configured through access groups, as described in the next section. The exception to this rule is again the unmanaged fibre channel storage array, which offers its LUNs to all Oracle VM Servers connected to the fibre channel storage network.

4.6.3.2. Configuring Storage Array Access through Access Groups

This section explains the second phase of storage array configuration, which is how you make the discovered storage usable by your Oracle VM Servers.

Except for generic storage arrays, it is possible to create multiple access groups in order to arrange and restrict physical disk access according to your requirements. The generic iSCSI storage arrays have a single access group available by default, where you can simply add or remove storage initiators from your Oracle VM Servers.

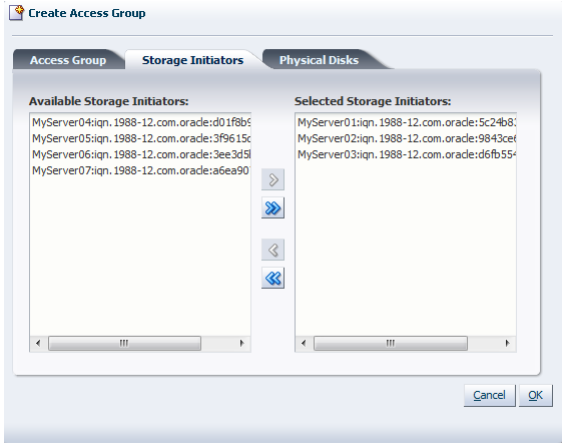
Note that generic fibre channel storage has no access groups and is always listed under the Unmanaged Fibre Channel Storage Array.

Select the appropriate procedure for your type of storage array.

To configure an access group for a non-generic iSCSI storage array:

1. In the navigation pane, select your SAN server. In the management pane, select the Perspective **Access Groups**.
2. Click **Create Access Group** ✚ . The **Create Access Group** dialog box appears.
3. In the **Access Group** tab, enter a name for your new access group and optionally provide a description.

4. Select the **Storage Initiators** tab. It contains the available storage initiators for this type of storage on the Oracle VM Servers in your environment.
5. Use the arrow buttons to move the required initiators to the **Selected Storage Initiators** box.



Note

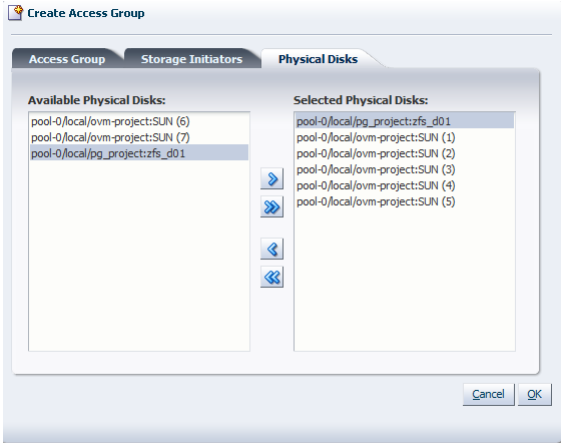
You can also use the **Storage Initiators** perspective in the **Servers and VMs** tab to view and configure storage initiators on an individual Oracle VM Server. See Section 6.9.13, “Managing Access Groups and Storage Initiators on an Oracle VM Server” for more information on using this method.

6. Select the **Physical Disks** tab. It contains the available storage elements on the storage array you are registering.

Note

If this is the first time you are configuring access to this storage array, the list of available physical disks may be empty. You may have to edit the access group afterwards to select physical disks. See Section 4.8.4, “Deleting a Storage Repository” for details.

7. Use the arrow buttons to move the required disks to the **Selected Physical Disks** box. These disks will be presented to the Oracle VM Servers of which the iSCSI initiator is part of the access group.



8. Click **OK** to create the new access group with the selected initiators and physical disks. The new access group now appears in the **Access Groups** table. If you change the **Perspective** of the management pane to **Physical Disks**, the list of presented physical disks appear in the table.

9. After configuring the access group it is advisable to refresh the SAN server to make sure that the current storage layout and access rules are in effect.

The selected physical disks in your non-generic storage array are now available to the Oracle VM Servers in this access group. The access group configuration of a generic iSCSI storage array is simpler, as you can see below.

To configure the access group for a generic iSCSI storage array:

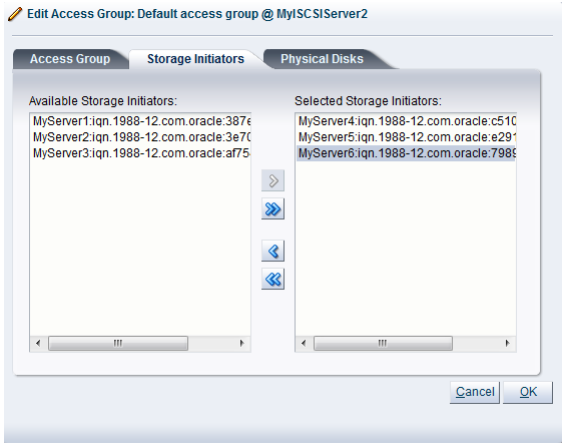
1. In the navigation pane, select your SAN server. In the management pane, select the Perspective **Access Groups**. The default access group for this storage array is already present.

2. Select the default access group and click **Edit Access Group** . The **Edit Access Group** dialog box appears.

3. In the **Access Group** tab, you cannot modify the name of the default access group, but if required, you can provide a description for the access group.

4. Select the **Storage Initiators** tab. It contains the available storage initiators for this type of storage on the Oracle VM Servers in your environment.

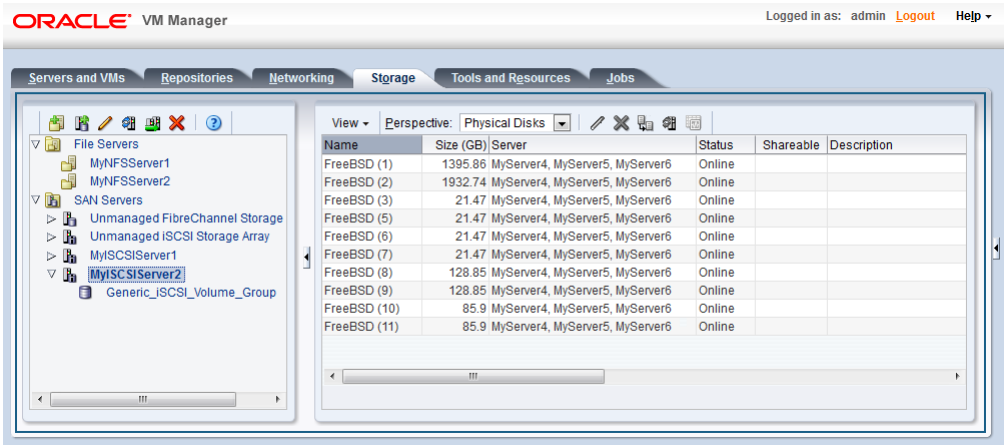
5. Use the arrow buttons to move the required initiators to the **Selected Storage Initiators** box.



Note

You can also use the **Storage Initiators** perspective in the **Servers and VMs** tab to view and configure storage initiators on an individual Oracle VM Server. See Section 6.9.13, “Managing Access Groups and Storage Initiators on an Oracle VM Server” for more information on using this method.

6. For a generic storage array you can skip the **Physical Disks** tab. Click **OK** to save your changes to the default access group. If you change the **Perspective** of the management pane to **Physical Disks**, the list of presented physical disks appears in the table. All these disks are all automatically presented to the selected Oracle VM Servers.



7. After configuring the access group it is advisable to refresh the storage array to make sure that the current storage layout and access rules are in effect.

The Oracle VM Servers in this access group now have the necessary permissions to use the physical disks of the storage array; they can be deployed either as disks for virtual machines (VMs) or for storage repositories. To create storage repositories on your physical disks, see Section 4.8, “Preparing and Configuring Storage Repositories”.

Of course, you can always make changes to the storage configuration you just registered. The steps and options to do so are described below.

4.6.3.3. Updating the Configuration of a Storage Array

The third and final phase of this section discusses the update options available after a storage array has been registered through Oracle VM Manager.

To change the registered storage array configuration:

1. If you need to modify the registered SAN server, select it in the tree structure in the navigation pane and click the appropriate button in the toolbar above to select one of these options:

   - **Edit SAN Server:** Change SAN server settings such as name, description, access host and port; change admin server settings in the second section of the wizard.
   - **Refresh SAN Server:** Request an update of the storage array configuration in case changes have been made to the available physical disk configuration on the server.
   - **Add/Remove Admin Server:** Determine which Oracle VM Servers are responsible for information exchange with this SAN server.
   - **Delete SAN Server:** Remove the selected SAN server from your Oracle VM environment.

2. If you need to modify a physical disk on a storage array, select the SAN server or its volume group in the tree structure in the navigation pane, and make sure that the **Perspective** of the management pane is set to **Physical Disks.** Select the physical disk of your choice in the overview table, and click the appropriate button in the toolbar above to select one of these options:

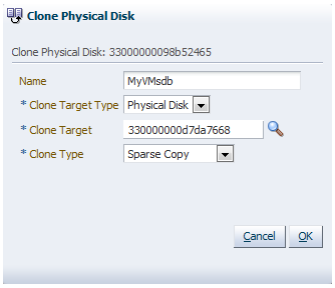
   - **Edit Physical Disk:** Change the name, description and extra information of the physical disk or make it shareable.
   - **Delete Physical Disk:** Stop using the selected physical disk in your Oracle VM environment.

Warning

If you effectively delete a LUN from a registered storage array, make sure that you delete it in Oracle VM Manager first, before you physically delete it from the storage server. If you do not respect this order of operations, the system will go into an unknown state, which can only be resolved by rebooting the Oracle VM Servers the deleted LUN is connected to.

- **Clone Physical Disk:** Create a thin clone, sparse copy or non-sparse copy of the physical disk on the selected target. The options are explained in the table below:

Clone Target	Thin Clone	Sparse Copy	Non-sparse Copy
Physical Disk			Yes
Storage Array	Yes		
Storage Repository		Yes	Yes



This applies specifically to a physical disk; for more information about VM cloning, see Section 7.8, “Cloning a Virtual Machine or Template”.

For a definition of these clone target types, see Glossary.

- **Refresh Physical Disk:** request an update of the physical disk information to see if changes have been made to the size and configuration.

Caution

If a physical disk that is not an extended physical disk has been shrunk and it has an OCFS2 file system on the disk, a critical event will be generated and the repository will be put in an error state. To put the repository back to a normal state you need to extend the physical disk to a size equal or larger than the OCFS2 file system size and then acknowledge the event in repository events table. See Section B.1.10, “Acknowledging Events/Errors” for information on acknowledging events.

3. If you need to modify the way Oracle VM Servers access the physical disks in your storage array, select the SAN server in the tree structure in the navigation pane, set the management pane **Perspective** to **Access Groups**, and select the access group you wish to modify. Using the toolbar buttons near the top of the tab, choose one of these options:

   - **Edit Access Group:** Change access group settings such as name, description, selected storage initiators and physical disks.

- **Present/Unpresent Physical Disk:** Change the selection of physical disks to which this access group has access.
- **Delete Access Group:** Remove the selected access group configuration.

Note

For generic iSCSI storage arrays, only the selected storage initiators can be modified. Other properties cannot be changed.

4.6.3.4. Removing File Systems from Physical Disks

When discovering the physical disks or LUNs of a SAN storage array, you may find some that contain unwanted file systems. Oracle VM expects physical disks and LUNs to be entirely clean, without any file system information on them, and Oracle VM Manager offers the functionality to remove a file system from a physical disk.

To remove a file system from a physical disk via the Servers and VMs tab:

1. In Oracle VM Manager, open the **Servers and VMs** tab.
2. In the navigation pane, select a server to which the physical disk with the unwanted file system is presented.
3. Change the Perspective of the management pane to **Physical Disks**.
4. In the table, select the physical disk from which you want to remove the file system. And click **Delete File System**
5. Click **OK** to confirm the deletion of the file system and destroy the data stored on the physical disk.

To remove a file system from a physical disk via the Storage tab:

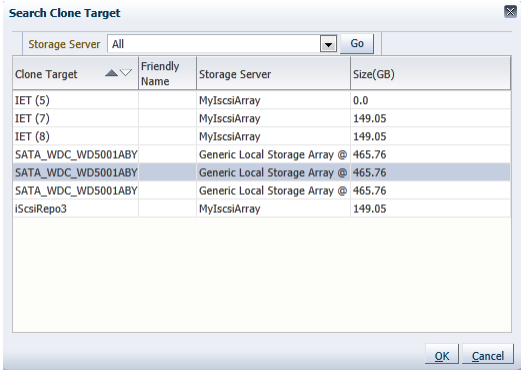
1. In Oracle VM Manager, open the **Storage** tab.
2. In the navigation pane, select the **Shared File Systems** folder.
3. In the table in the management pane, select the file system that corresponds with the storage device you need to clean.
4. Click **Delete File System**
5. Click **OK** to confirm the deletion of the file system and destroy the data stored on the physical disk.

When the file system is removed from the physical disk, it can be used to create a storage repository or as a raw physical disk for a virtual machine.

4.6.4. Using Local Storage

If an Oracle VM Server has unused hard disks, they can be used as local storage for your environment. On condition that these spare disks are completely empty, meaning they have no partitions or file systems, they are included automatically in the local storage array of the Oracle VM Server.

Note that local storage arrays are not listed under the **Storage** tab. You can, however, see the local storage entities in locations where you can use them; for example when you create a storage repository, select a physical disk for a VM, list the physical disks accessible to an Oracle VM Server, or select a physical clone target.



Local storage has the advantage that it is fast and easy to use, but users must be aware that there is no possibility to share this type of storage and that it cannot be used in a high-availability configuration. Consequently, if you need to store important data and run important virtual machines that require virtually uninterrupted uptime with a high degree of data loss prevention, it is recommended not to use local storage but to invest in attached storage with proper redundancy instead.

In addition, local storage lacks flexibility in a clustered setup with multiple Oracle VM Servers in a server pool. Resources and VM disks that live on local storage cannot be shared with other servers, even if they are within the same server pool. This means that you cannot use a template, ISO or VM disk stored on a local repository on another Oracle VM Server, and that live migration of VMs with locally stored disks is impossible. We strongly advise you to take this into account when designing your Oracle VM environment.

The configuration where local storage is most useful is where you have an unclustered server pool that contains only one Oracle VM Server. By configuring a storage repository (see Section 4.8, “Preparing and Configuring Storage Repositories”) on local storage you can set up an Oracle VM virtualized environment quickly and easily on a single server: all your resources, virtual machines and their disks are stored locally. Since there is only one Oracle VM Server, access to resources is guaranteed.

Note

Some properties of local storage elements may be edited through the Oracle VM Server management pane: go to the **Servers and VMs** tab, select the appropriate server in the navigation pane and set the management pane **Perspective** to **Physical Disks**. Disks available to this server are displayed, and available operations can be executed via the toolbar buttons above.

4.6.5. Removing Storage

Before you can remove a storage server, you should delete any storage repositories and server pool file systems on it.

If there is a storage repository on the storage server, all virtual machine resources such as virtual machine templates, virtual disks, assemblies and ISO files must be removed from the repository. If the storage repository is on a file server (NFS server), you should also release ownership of the storage repository before you delete the repository. Deleting an unowned storage repository only removes it from the Oracle VM Manager database; it does not delete any files in the repository. If the storage repository is on a storage array (physical disk), all of the contents of the storage repository must be deleted. Then the file system on which the storage repository resides must also be deleted.

If there is a server pool file system on the storage server, the server pool must be deleted to delete the server pool file system.

The storage server may now be shut down and decommissioned.

For more information on working with virtual machine resources, see Section 7.5, “Virtual Machine Resources”. For more information on deleting a server pool, see Section 6.8.6, “Deleting a Server Pool”. For more information on releasing ownership of a storage repository, see Section 4.8.3, “Editing a Storage Repository”. For more information on deleting a storage repository, see Section 4.8.4, “Deleting a Storage Repository”.

4.7. Enabling Multipath I/O Support

Multipathing is the technique of creating more than one physical path between the server CPU and its storage devices. It results in better fault tolerance and performance enhancement. Oracle VM supports multipath I/O out of the box. Oracle VM Servers are installed with multipathing enabled because it is a requirement for SAN disks to be discovered by Oracle VM Manager.

Note

Any system disks (disks that contain / or /boot) are blacklisted by Oracle VM Manager and are not available for use in an Oracle VM environment.

Multipath configuration information is stored in `/etc/multipath.conf` and contains specific settings for Oracle VM along with an extensive set of configuration details for commonly used SAN hardware. In most cases the user should not need to modify this file and is advised not to. Examining the contents of the file may be useful to better understand how it works in Oracle VM and what may need to be configured if your SAN is not using multipathing and your LUNs are not appearing.

In case user action is required to enable multipathing, this sections explains how to do so. The required steps depend on the storage hardware implemented. Consequently, the steps below are intended as a guideline and priority should be given to the SAN hardware documentation.

Note

Not all steps apply to your environment. Consult the SAN hardware vendor's documentation for a complete list of steps, the order in which to execute them, and their relevance to your specific environment.

General steps to configure multipathing:

1. Design and document the multipathing configuration you intend to apply to the SAN hardware used in your Oracle VM environment.
2. Ensure that the drivers for your Host Bus Adapters (HBAs) are present. If not, install the drivers.
3. Configure the appropriate zoning on the fibre channel switches.
4. Configure LUN masking on the storage arrays.
5. Configure path optimization features (ALUA or similar) on your disk subsystem, if so instructed by your vendor's documentation.
6. Check the fabric information on each Oracle VM Server that has access to the SAN hardware. Use `multipath -ll` and related commands.
7. Make the necessary changes to the file `/etc/multipath.conf` on the Oracle VM Servers.

Note

You must make the exact same changes to the multipath configuration file on all Oracle VM Servers in your environment.

8. Restart the multipath daemon (multipathd).
9. Check the fabric information again to verify the configuration.
10. If so instructed by the vendor's documentation, rebuild initrd.
11. Reboot the Oracle VM Servers to verify that the SAN and multipathing configuration come up properly after a restart.

For detailed information and instructions, consult the SAN hardware vendor's documentation.

Note

Booting from a multipath SAN is supported.

4.8. Preparing and Configuring Storage Repositories

You use Oracle VM Manager to create and configure storage repositories, and to present one or more storage repositories to Oracle VM Servers in a server pool. This chapter discusses the flow of the operations you perform after the discovery of your physical storage hardware, LUNs, file systems and so on, in order to make a storage repository available to the Oracle VM Servers in your server pool. Once the storage repository is accessible, you can start adding storage resources and building VMs with those resources.

Depending on the configuration of Oracle VM Servers in your environment, restrictions may apply to the creation of storage repositories:

- When using server pools without clustering functionality, two storage options are available: file servers (NFS) and local physical disks in a local storage array. Remember that local storage imposes severe restrictions, as described in Section 4.6.4, “Using Local Storage”.
- Local storage, or unused disks in your Oracle VM Servers, are discovered as LUNs in a local storage array. If you want to use a single-server setup with local storage, be sure to deactivate clustering in your server pool. This eliminates the need for a server pool file system, which cannot be on a local disk by definition.
- Only a server pool with multiple servers, active clustering and attached storage (NFS, iSCSI, fibre channel) can offer high availability, load balancing and similar advanced functionality.

Oracle VM Manager allows you to perform a number of management operations on the storage repositories under its control. Table 4.2, “Storage Repository Management Operations” describes the possible operations at the level of a storage repository. To access these functions in Oracle VM Manager, open the **Repositories** tab, use the tree view in the navigation pane to select repositories, then choose the appropriate button from the toolbar above.

Note

Storage repositories are presented to individual servers, meaning that not all repositories are necessarily available for example when you deploy a VM on a specific Oracle VM Server. To see which servers have access to a storage repository, select the repository in the navigation pane and verify the access status in the management pane with the **Perspective** set to **Info**.

Table 4.2. Storage Repository Management Operations

Operation	Description
Create repository	See Section 4.8.1, “Creating a Storage Repository”.

Operation	Description
Present repository	1. Select a repository in the tree view and click **Present/Unpresent** in the toolbar above. 2. In the **Present Repository** dialog box, use the arrow buttons to determine to which Oracle VM Servers the current repository should be presented (or not presented). 3. Click **OK** to save your changes. See Section 4.8.2, “Presenting or Unpresenting a Storage Repository”.
Edit repository	1. Select a repository in the tree view and click **Edit Selected Repository** in the toolbar above. 2. In the **Edit Repository** dialog box you can make the following changes: **Name:** Edit the name of the selected repository. **Description:** Optionally enter a more elaborate description of the selected repository. **Release Ownership:** Select this check box to allow the repository to be used by another Oracle VM Manager. 3. Click **OK** to save the changes to the storage repository. See Section 4.8.3, “Editing a Storage Repository”.
Delete repository	1. Select a repository in the table and click **Delete Selected Repository** in the toolbar above. 2. Click **OK** to execute the delete operation. See Section 4.8.4, “Deleting a Storage Repository”.
Refresh and resync repository	Select a repository in the table and click **Refresh and Resync Selected Repository** in the toolbar above. Oracle VM Manager re-checks the disk contents of the selected repository. Any detected changes will be reflected in the various content tabs (Assemblies, ISO files, ...) of the storage repository.

4.8.1. Creating a Storage Repository

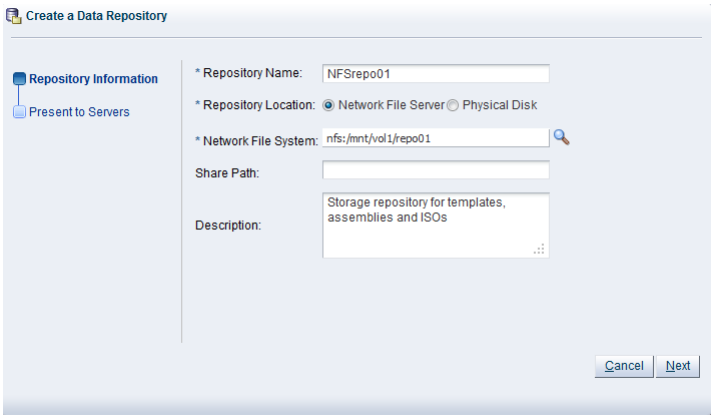
After you complete the preparation phase described above in Section 4.6.1, “Discovering File Servers” and Section 4.6.3, “Discovering SAN Servers”, Oracle VM Manager is fully aware of the underlying physical storage providers available for use as a storage repository.

> **Important**
>
> A storage repository should be at least 10GB in size. In addition to this minimum size requirement, you should include enough storage space for virtual machines, templates, ISO files and other virtual machine resources.

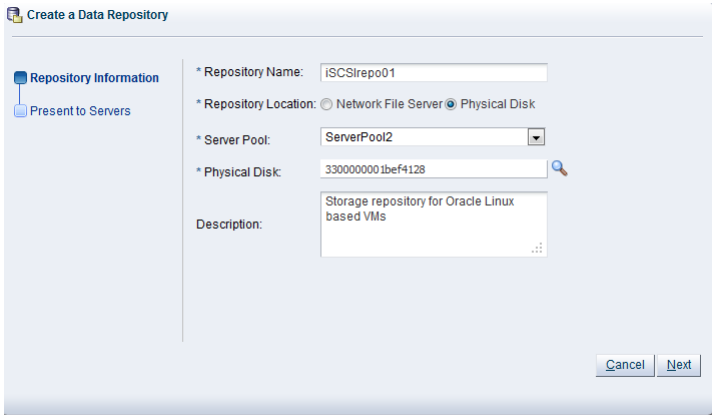
To create a storage repository for your server pool:

1. In Oracle VM Manager, open the **Repositories** tab.

2. In the toolbar above the navigation pane, click **Create New Repository** .
3. In the **Create a Data Repository** dialog box, enter the following information:
   - **Repository Name:** The name you wish to use to identify the repository.
   - **Repository Location:** Either a network file server or a physical disk.
4. If you selected **Physical Disk** as location, proceed to Physical Disk as the Repository Location [70].
   If you selected **Network File Server** as location, click **Search** to select a location in the **Select Network File System** dialog box:
   - Select a **Network File Server** from the list. The available file systems appear. Note that only a refreshed file system can be used.
   - Select the file system you wish to install the storage repository on. Click **OK**.



5. Optionally provide this additional information:
   - **Share Path:** Path to a subdirectory on the selected file system.
   - **Description:** Information you would like to add about this storage repository.
   - Proceed to Present the storage repository to servers [71].
6. If you selected **Physical Disk** as the **Repository Location**, click **Search** to select a location in the **Select Physical Disk** dialog box:
   - Select a **Storage Array** and, if applicable, a **Volume Group** from the respective lists. The available disks appear.
   - Select the physical disk you wish to install the storage repository on. Click **OK**.



7. Select from the list to which **Server Pool** this storage repository should be provided. Optionally enter additional information about this storage repository in the **Description** field.

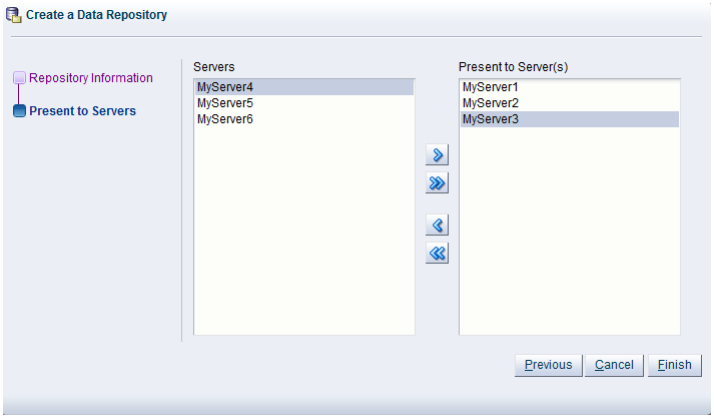
Note

When you create a storage repository on a LUN, only clustered server pools can be selected.

8. Click **Next** to proceed to the second section of the wizard: **Present to Servers**.

   When the storage repository is prepared and created, it must also be made available for use by your Oracle VM Servers before it can be populated. Typically you present the storage repository to all the Oracle VM Servers in the server pool. However, should you wish to set up storage differently, Oracle VM Manager allows you to present a repository to a selection of Oracle VM Servers instead of the entire server pool. See also Section 4.8.2, “Presenting or Unpresenting a Storage Repository”

9. In the **Present to Servers** dialog box, use the arrow buttons to move the required Oracle VM Servers from the left to the right pane.



10. Click **Finish** to create the new storage repository and present it to the selected Oracle VM Servers. The new storage repository is displayed in the **Repositories** table in the management pane.

At this point, the storage repository has been created, Oracle VM Manager has taken ownership, and the selected Oracle VM Servers have access in order to store virtual machines, ISO files, templates and so on. To modify the configuration of servers with access to the storage repository, see Section 4.8.2, “Presenting or Unpresenting a Storage Repository”.

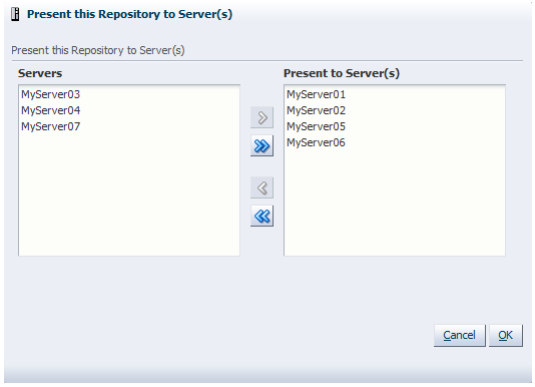
4.8.2. Presenting or Unpresenting a Storage Repository

As part of the storage repository creation you can select the Oracle VM Servers to which the repository must be made available. However, you can modify this selection afterwards and present the repository to new servers or unpresent it from servers already selected earlier.

Presenting the storage repository to an Oracle VM Server is the equivalent of mounting a file system. Essentially, when you present the repository to the Oracle VM Servers in your server pool, the repository file system is mounted by the *root* user on each Oracle VM Server. This is an essential factor in the HA configuration of the Oracle VM setup.

To present a storage repository to your Oracle VM Servers:

1. Open the **Repositories** tab and select the repository of your choice in the navigation pane.
2. Click **Present/Unpresent** in the toolbar above to change the list of servers the repository is presented to.
3. In the **Present Repository** dialog box, use the arrow buttons to move the required Oracle VM Servers between the presented and unpresented panes.



4. In the **Present Repository** dialog box, use the arrow buttons to move the required Oracle VM Servers between the presented and unpresented panes.
5. Click **OK** to present the storage repository to the selected Oracle VM Servers.

Note

NFS-based storage repositories can be shared by multiple server pools controlled by the same Oracle VM Manager. OCFS2-based storage repositories always belong to a single clustered server pool. Therefore only members of that server pool appear in either pane.

Your external storage setup is now complete. The storage repository is available to your Oracle VM Servers. When the server pool is ready you can start creating virtual machines. For more information, see Chapter 6, *Managing Server Pools*.

4.8.3. Editing a Storage Repository

To edit a storage repository:

1. Select the repository in the tree view in the navigation pane and click **Edit Selected Repository** in the toolbar above.
2. In the **Edit Repository** dialog box you can make the following changes:

   Server Pool: This option is available if your repository location is a **Physical Disk**. It allows you to change the server pool that the repository is associated with. This option makes it simple to move

OCFS2 repositories from one server pool to another. Usually after changing server pool association, you should change the servers or server pool where the repository is presented. See Section 4.8.2, “Presenting or Unpresenting a Storage Repository” for more information on this.

Name: Edit the name of the selected repository.

Description: Optionally enter a more elaborate description of the selected repository.

Release Ownership: Select this check box to allow the repository to be used by another Oracle VM Manager.

3. Click **OK** to save the changes to the storage repository.

4.8.4. Deleting a Storage Repository

To delete an owned storage repository:

1. Make sure that all content has been removed from the storage repository you wish to delete.
2. Select the repository in the tree view in the navigation pane and click **Delete Selected Repository** in the toolbar above.
3. Confirm that you wish to delete this storage repository: click **OK** to continue.

To delete a storage repository without removing the contents:

1. Select the repository in the tree view in the navigation pane and click **Present/Unpresent** in the toolbar above.
2. In the **Present Repository** dialog box, unpresent the storage repository from all Oracle VM Servers. Click **OK**.
3. Select the repository in the tree view in the navigation pane and click **Edit Selected Repository** in the toolbar above. Select the **Release Ownership** check box and click **OK**.
4. Select the now unowned repository in the table and click **Delete**.
5. Confirm that you wish to delete this storage repository: click **OK** to continue.

When your server pool is fully configured with Oracle VM Servers, network and storage, you use Oracle VM Manager for all management and maintenance operations on the storage repository. The storage resources residing in the repository (ISO files, templates, and so on) are also managed through Oracle VM Manager. Management operations on the storage resources inside a storage repository are discussed in detail in a separate chapter: Section 7.5, “Virtual Machine Resources”. Detailed instructions for the use of different types of storage entities with virtual machines are discussed in Chapter 7, *Managing Virtual Machines*.

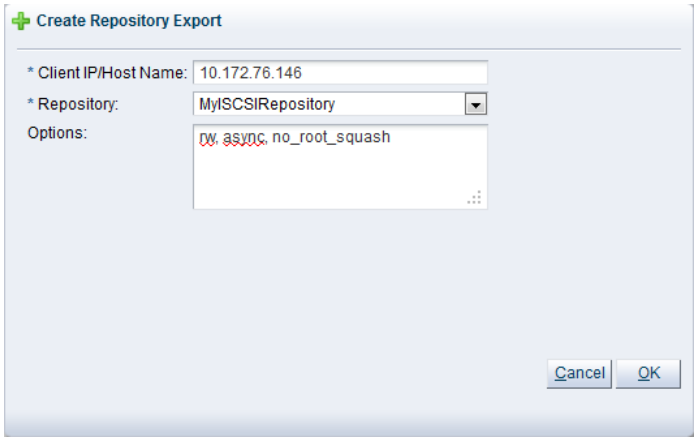
4.8.5. Enabling Storage Repository Back Ups

A Oracle VM Server can be configured to enable third party applications to perform a back up on the contents of a storage repository. To enable this, an Oracle VM Server is configured to provide an NFS share that a third party back up tool can use to access the contents of the repository. The Oracle VM Server must be in a clustered server pool and have the OCFS2-based storage repository presented to it.

When you have created a repository export, use the **Repository Path** (displayed in the management pane table) and the Oracle VM Server hostname or IP address to connect to the NFS mount point from the third party back up software.

To create a repository export:

1. Click the **Servers and VMs** tab.
2. In the navigation pane, select the Oracle VM Server on which you want to create the repository export location.
3. Select **Repository Exports** from the **Perspective** drop-down list in the management pane.
4. Click **Create Repository Export..** in the toolbar.
5. The **Create Repository Export** dialog box is displayed.



   Enter or select the following:

   - **Client IP/Host Name:** The IP address or hostname of the computer for which to grant access to the repository contents. This is likely to be the machine on which the third party back up and restore software is running.
   - **Repository:** An OCFS2-based storage repository presented to the Oracle VM Server. This is the repository you want to back up.
   - **Options:** The parameters to include in the NFS mount configuration, for example:

     ```
     rw, async, no_root_squash
     ```

     Click **OK**.

6. To edit a repository export, select the entry in the table in the management pane and click **Edit Repository Export..** in the toolbar.
7. To delete a repository export, select the entry in the table in the management pane and click **Delete Repository Export** in the toolbar.

Chapter 5. Managing Networks

Table of Contents

Networking is a very broad concept with many different interpretations. Data center administrators typically have their own idea about what the best network configuration is in terms of performance, security and cost-effectiveness. In some cases physical network connections are readily available so bonding is preferred for fail over or higher bandwidth, while other configurations use VLANs for network segregation or to compensate for the lack of free NICs. Some will use Ethernet connections for storage while others have dedicated fibre channel hardware at their disposal.

Generally speaking, data center operators tend to think essentially in terms of hardware: switches, routers, firewalls, cables, NICs (Network Interface Cards), and so on. The only widespread network virtualization concept to date is VLAN (Virtual LAN) technology. VLANs are also very frequently used in Oracle VM networking.

The networking infrastructure in the Oracle VM environment comprises connections between Oracle VM Servers, between Oracle VM Servers and Oracle VM Manager, between the Oracle VM Servers and their storage sub-systems, as well as communications among virtual machines deployed in the environment, and between virtual machines and external private or public networks.

These networking connections can leverage features supported by Oracle VM, such as networked file systems, clustering, redundancy and load balancing, bridging, and support for Virtual LANs (VLANs).

This chapter discusses creating and using Oracle VM networks.

5.1. Oracle VM Networking Overview

When you create an Oracle VM network, you map available network ports to a set of logical Ethernet networks. You perform this mapping in Oracle VM Manager.

The physical network is the collection of physical connections in Oracle VM Manager and all Oracle VM Servers, and the switches and routers that allow information to reach its destination.

A logical network in Oracle VM is built on top of these physical connections. Each physical connection is called a network port. Other names for this physical connection include network interface card, or NIC, or network interface.

You define a name or alias for each logical network that you create. When you have created your networks, you connect the physical network ports to the logical networks.

Before you define the logical networks in Oracle VM Manager, you have to review the physical network configuration that you intend to use, such as VLAN and subnet usage. You also take into account the number of network ports, or NICs, available to your Oracle VM Servers. The minimum recommended number of ports required on a single Oracle VM Server is two, although one would suffice for test or demonstration purposes. If you have more than two ports on your Oracle VM Servers, you can design more redundancy or traffic isolation in your environment.

Oracle VM supports both 1Gbit and 10Gbit NICs. All network functions can either be on dedicated or shared physical networks, except for the virtual machine intra-server. For example, a physical network can be dedicated to Virtual Machine or Storage only, or can be used for all network functions.

5.2. Network Usage

In Oracle VM a network can perform one or more network functions. Oracle VM has the following network functions:

- **Server Management**: is used to manage the physical Oracle VM Servers in a server pool, for example, to update the Oracle VM Agent on the different Oracle VM Servers.

  Note

  In Oracle VM the management network interface and the public interface (i.e. default route) are expected to be the same on each Oracle VM Server. Other types of network usage are allowed on the same interface, for example through the use of VLANs and/or network bridges.

- **Cluster Heartbeat**: is used to verify if the Oracle VM Servers in a clustered server pool are up and running. The heartbeat function has a network component, where a TCP/IP communication channel is created with each Oracle VM Server. Each Oracle VM Server sends regular keep-alive packets and these packets are used to determine if each Oracle VM Server is alive.

  Note

  It is recommended to separate the cluster heartbeat function from networks with high load, such as storage and live migration networks. If bandwidth drops too low, heartbeating connectivity might be interrupted, which could lead to rebooting of virtual machines and Oracle VM Servers.

- **Live Migrate**: is used to migrate virtual machines from one Oracle VM Server to another in a server pool, without changing the status of the virtual machine.

- **Storage**: is used for all storage transport in a server pool. It is used by the Oracle VM Servers to connect to Ethernet-based storage repositories and server pool file systems. As with the Virtual Machine role, it is possible to have multiple networks with the Storage role.

- **Virtual Machine**: is used for the network traffic between the different virtual machines in a server pool. The virtual machine role can be either standard Inter-Server (routable through standard switches), or

Intra-Server (without a route to an external physical network and dedicated to the selected Oracle VM Server).

Note that it is possible, and very likely, to have multiple networks with the Virtual Machine role in one Oracle VM Manager.

The first step in configuring your Oracle VM environment is to discover your Oracle VM Servers. This step assumes that the Oracle VM Manager host and all of the Oracle VM Servers can communicate over the same network, though the Oracle VM Servers and Oracle VM Manager can reside in different subnets. When you discover the first Oracle VM Server, the management network is created automatically and takes its name from the subnet to which the Oracle VM Server is connected. Each additional Oracle VM Server discovered from the Oracle VM Manager either adds an entry into the existing management network or creates a new management network if the server is connected to a subnet where no Oracle VM Server was previously discovered. Each server in your Oracle VM environment can only have one interface designated for management, belonging to a single management network object in the Oracle VM Manager's database.

Warning

Although the Oracle VM Manager and its discovered and owned Oracle VM Servers may be on different subnets as long as they can reach each other, Network Address Translation (NAT) is not supported in this configuration. NAT would lead to a discrepancy between the actual management IP of the Oracle VM Server and the IP provided during discovery.

A network port on every Oracle VM Server is designated as the management interface during the installation of the Oracle VM Server and is configured as a bonded interface. Ports can be added to this bond or removed from it. Once a management network is created, it can only be deleted again if no servers have ports in the management network anymore.

After your management networks are in place, you plan for the creation of other types of network. Note that once a port is selected for a particular network, it cannot be selected again when creating additional networks. You can use a combination of network bonding and VLAN Groups to create all the networks needed for your environment, using your existing ports. Network bonding is covered in Section 5.3, “Building a Network Environment”; VLAN Groups are covered in Section 5.6, “VLAN Groups and VLAN Segments”.

Figure 5.1. Oracle VM Networking Example

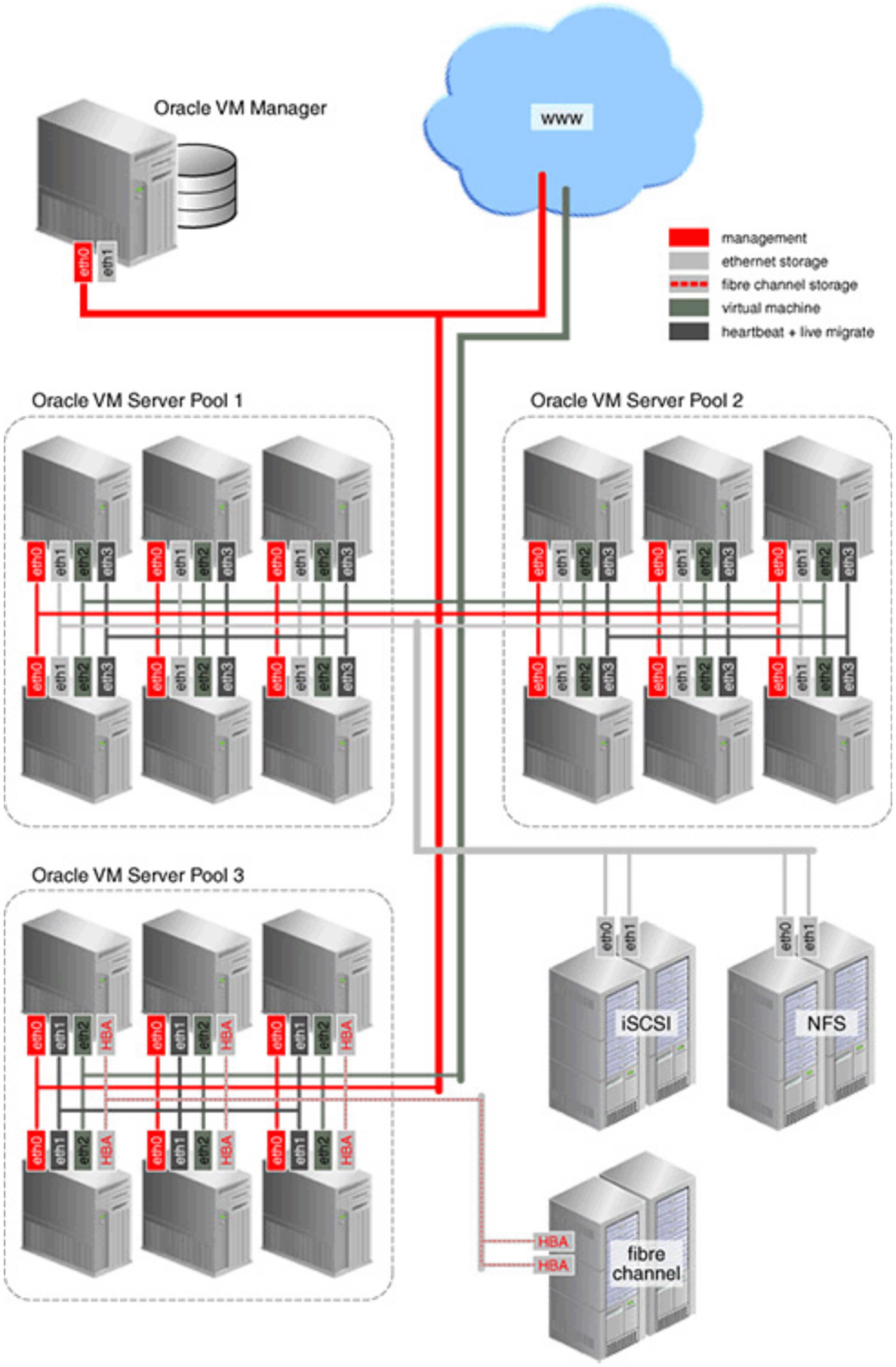


Figure 5.1, “Oracle VM Networking Example” shows an example of an Oracle VM environment with split network functions. Each Oracle VM Server is connected to the management network, regardless of which server pool they belong to.

Each server pool has a separate network for heartbeating functionality and live migration. Since this type of network traffic occurs at the level of an individual server pool, the network does not need a gateway. Though you may create several networks for the heartbeating and live migration functions, a server can only belong to one network for each function.

Virtual machine (VM) traffic is often routed over a dedicated network, although it can be combined with the other network functions. In this example the dedicated VM network has a route to the internet (or corporate wide area network). You can create as many virtual machine networks as permitted by your network infrastructure.

The first two server pools are connected to a storage network with Ethernet based storage providers. Ethernet based storage is provided as either NFS file servers or iSCSI LUNs. Server Pool 3 has dedicated fibre channel storage, which requires a fibre channel switch and host bus adapters (HBAs) in all connected hardware components. Similar to networks for virtual machines, you create as many storage networks as needed to implement your storage strategy.

5.3. Building a Network Environment

When you create a new network, you choose a network function and network elements to build this network. These network elements include network ports, bonds, or VLAN segments if VLANs are used in your environment. These network elements as well as the networks you create are stored as networking objects in the Oracle VM Manager database. Your Oracle VM Servers are unaware of these Oracle VM Manager network objects. Creating and managing network objects in Oracle VM Manager results in the configuration or deletion of the network devices (for example: ports, VLAN devices, bridges) present on Oracle VM Servers.

After reviewing your physical network environment and deciding on the logical distribution and grouping of these physical objects, you create the logical constructs in Oracle VM Manager to implement your network design. These logical constructs include:

- Network bonds
- VLAN groups
- Networks
- Bridges

Note

Bridges are associated with networks. Network bridges are automatically created when creating networks for virtual machines.

A short description of these objects and their usage is given below in the following sections.

If your network design includes interface bonding, you create these network bonds first. A bond is the aggregation of network ports – in Oracle VM a maximum of two – to provide redundancy and depending on the bonding mode, to increase performance. These bonds are often used in conjunction with VLANs, when traffic from several VLANs is allowed to use the same bond.

If your network environment comprises VLANs, your next step is to create VLAN Groups. With VLAN Groups, you determine which port or bond, on each Oracle VM Server, will accept traffic from more than one VLAN. Next, you specify the VLAN segments, as VLAN IDs, that are part of the VLAN Group.

Once these network building blocks are in place, you are ready to create networks using Oracle VM Manager. For each network, you must answer two questions:

- What is the expected network function for your new network?

  Network functions are discussed in Section 5.2, “Network Usage”.

- What are the building blocks for your new network?

These building blocks determine the network type in Oracle VM Manager. The choices when creating a network are:

- Create a network with ports and bonds
- Create a network with VLANs only
- Create a network with ports and bonds, and VLANs
- Create a logical network on a single server

If you create a network with ports, these ports, located on the Oracle VM Servers that will participate in the network, cannot be part of an already existing network. If you intend to use port bonding, create the bond(s) before creating your network. If you intend to allow traffic from several VLANs on a single port or bond, create the VLAN Groups before creating the network.

When creating a VLAN Group, you provide the following information:

- The port or bond for each server participating in the network
- The VLAN ID for each VLAN allowed to use the network
- IP addressing is desired, the IP address to assign to each port or VLAN interface specified respectively in the bullet points above.

You can also create a network using a combination of VLAN interfaces, ports and bonds. If you choose this type of network, the bonds must be created first and the VLAN interfaces must already be part of an existing VLAN Group.

Finally, you can create a network which is intended for a single server. This type of network allows communication between the virtual machines running on a single Oracle VM Server, and does not allow external network traffic. A computing environment made up of several virtual machines, where the virtual machines provide services to each other over the network, could benefit from this type of network, without requiring additional network ports on the Oracle VM Server.

The next topics provide more information about network bonding, network bridges, VLAN Groups and VLAN segments. To create VLAN Groups, see Section 5.9, “Managing VLAN Groups”. To create networks, see Section 5.10, “Managing Networks”.

5.4. Network Bonding

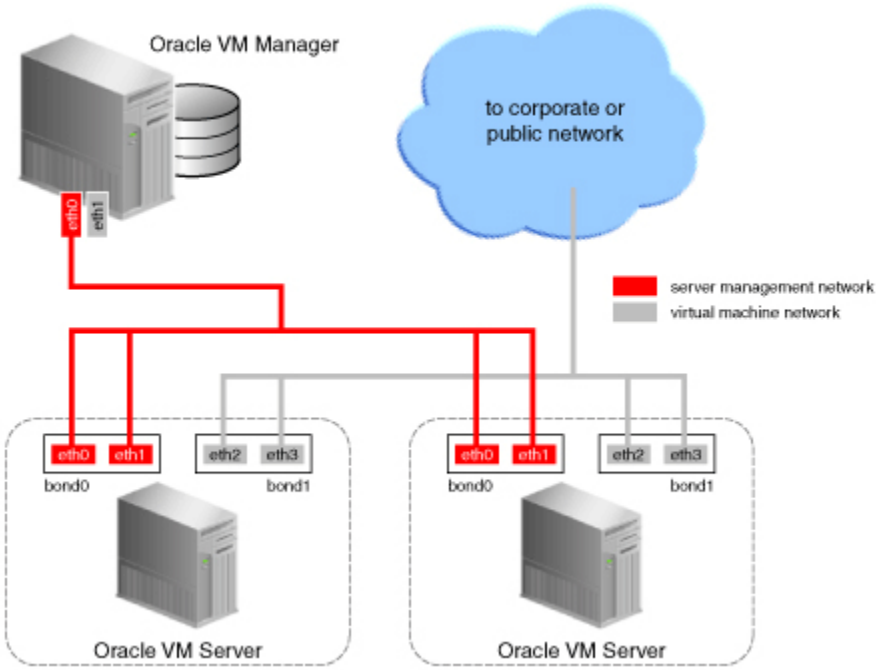
Network bonding refers to the combination of network interfaces on one host for redundancy and/or increased throughput. Redundancy is the key factor: we want to protect our virtualized environment from loss of service due to failure of a single physical link. This network bonding is the same as the Linux network bonding. Using network bonding in Oracle VM may require some switch configuration.

In Oracle VM, there are three modes of network bonding:

- **Active-Passive**: there is one NIC active while another NIC is asleep. If the active NIC goes down, another NIC becomes active.

- **Link Aggregation**: aggregated NICs act as one NIC which results in a higher throughput.
- **Load Balanced**: the network traffic is equally balanced over the NICs of the machine.

Figure 5.2. Network bonding



During installation of Oracle VM Server, the network interface (selected when prompted for the management port) is configured as a bonded interface. The bond is created with only one interface. This is done because the reconfiguration of the management interface on the Oracle VM Servers is not supported. You can add a second interface to the already existing bond device without affecting the configuration of the original interface. This is illustrated in Figure 5.2, “Network bonding”, where a second network interface is added to bond0, the network bond created during installation. By default, the bonding mode is set to active-passive for the management network.

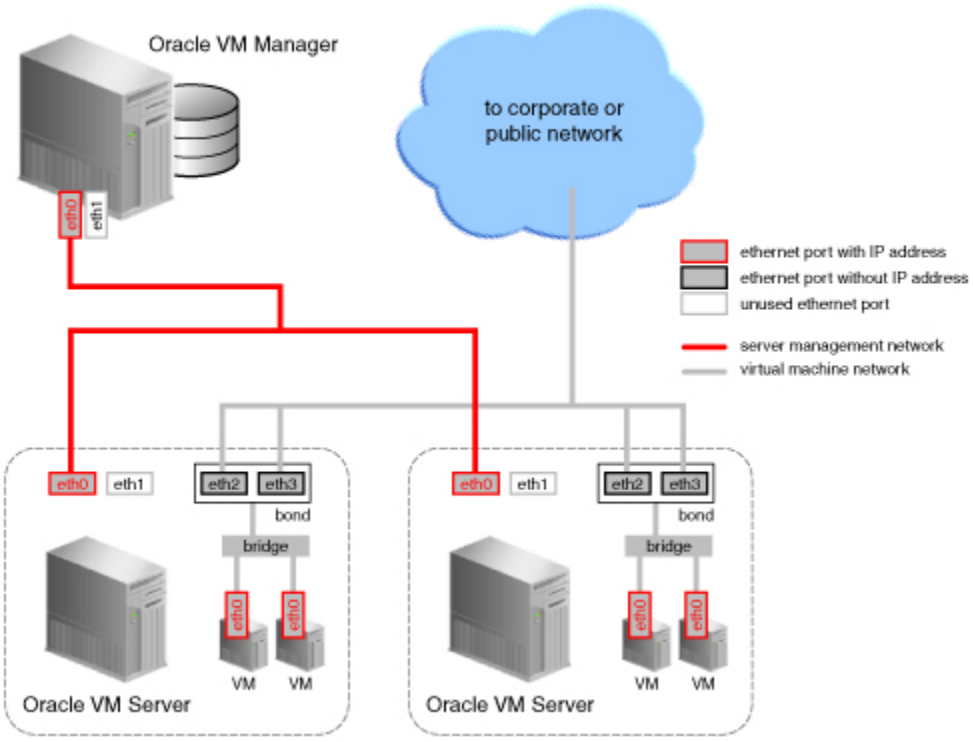
Figure 5.2, “Network bonding” also illustrates the configuration of a second bonded interface, bond1, which can be used for other network usage, such as the virtual machine function.

5.5. Network Bridges

When creating a network with the virtual machine role, a bridge is created automatically on the port or bond added to the network for each Oracle VM Server participating in this network. All network packets generated by the virtual machines are sent to the bridge configured for the virtual machines' network. The bridge acts as a Layer 2 switch, and directs packets to other virtual machines running on the Oracle VM Server, or to the port or bond, if the packets' destination is outside of the Oracle VM Server.

Though each virtual machine deployed within a network is usually assigned an IP address, either static or assigned using DHCP, there is no need to configure an IP address for the bridge on the Oracle VM Servers. When configuring your Virtual Machine network, if you specify an IP address for the port or bond you selected for this network, it is assigned to the bridge. You can choose not to assign an IP address to the selected port or bond. In this case, the bridge does not acquire an address but still functions as a Layer 2 switch.

Figure 5.3. Network bridge



In Figure 5.3, “Network bridge”, two network ports are specified for the network with the virtual machine role. Therefore, these ports should be configured as a bonded interface. Since this network is configured with the virtual machine role, a bridge is automatically created on each Oracle VM Server in the network. Neither the bridge nor the ports in the virtual machine network, have IP addresses assigned to them, though you may assign IP addresses if you wish during network creation.

Bridges are only created for networks with the virtual machine role.

5.6. VLAN Groups and VLAN Segments

Oracle VM supports multiple virtual LANs, or VLANs, on the same network port or bond. Each VLAN is essentially an independent logical network operating with other VLANs over the same physical connection. This means that virtual machines deployed on different networks, connected through the same Oracle VM Server port (or bond), can have traffic directed to different VLANs. This feature is implemented using VLAN groups.

Configuring VLANs involves creating one or more VLAN Groups, each of which can house multiple VLANs. Each VLAN is assigned a distinct VLAN identification. The VLAN ID is used by an attached VLAN switch to segregate traffic among the different VLANs operating on the same link. When a VLAN is configured, it functions exactly like a separate physical connection.

5.6.1. Configuring VLANs

You must configure the VLANs needed to support your network before you can use them. This is usually accomplished using switch trunking. Trunking involves configuring ports on the switch to allow multiple VLAN traffic on these ports, to ensure that packets are correctly transmitted to their final destination. Consult your switch vendor's documentation for information regarding trunking.

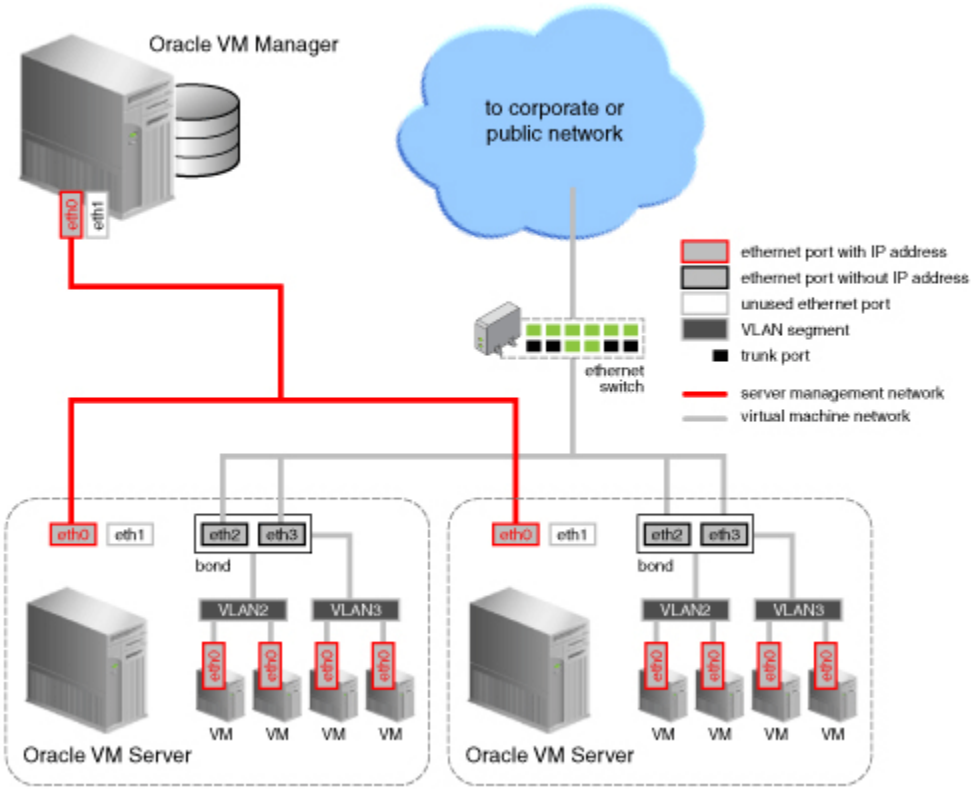
5.6.2. Configuring VLAN Groups

A VLAN Group is a logical grouping of VLANs, either tagged or untagged. If a VLAN is tagged, each packet transmitted to and from this VLAN contains a VLAN ID. Network traffic can contain a mix of tagged and untagged packets. If a packet does not contain a VLAN tag, the packet is destined to an untagged VLAN.

You create a VLAN group to direct the traffic from several VLANs onto a single port or bond on each Oracle VM Server in the server pool. For example, if a port or bond is expected to carry traffic for VLAN with ID 2 and for VLAN with ID 3, you create a VLAN Group and specify the two VLANs, VLAN 2 and VLAN 3. These VLANs appear as VLAN segments in the VLAN Group. After creating the VLAN Group, you create a network and specify one of the VLAN segments present in the VLAN Group. Each packet transmitted from virtual machines on this network is tagged with the VLAN Id for the VLAN segment specified during network creation. If you specify untagged during network creation, the packets can still flow through the port or bond defined in the VLAN groups, but the packets are untagged. The Ethernet switch, to which the Oracle VM Servers are connected, is responsible to transmit the packets to the appropriate VLAN, tagged or untagged.

Figure 5.4, “Networks with VLANs and VLAN Group” illustrates the case of two virtual machine networks, whose network traffic flows through the same bonded interface.

Figure 5.4. Networks with VLANs and VLAN Group



The VLAN Group needed to support the configuration shown in Figure 5.4, “Networks with VLANs and VLAN Group” contains two VLANs, with ID 2 and 3. The VLAN Group also contains two ports for each Oracle VM Server in the network. On each server, the ports are configured as a bond device. Once the VLAN Group is created, two virtual machine networks are added: the first network specifies the VLAN segment with ID 2 and the second network specifies the VLAN segment with ID 3, where both segments

are defined in the VLAN Group. For each network, a bridge is defined for the specified VLAN segment, without an IP address since none is specified during configuration. Network packets from virtual machines deployed on VLAN segment 2 travel through the bridge and acquire a tag which identifies the packets as belonging to VLAN 2. Similarly, the packets issued from the virtual machines deployed on the network for VLAN segment 3 are tagged for VLAN3 with ID 3. The packets from both networks use either path to the switch if the bond is configured as active-active. The receiving ports on the Ethernet switch are configured using trunking or similar program to recognize network traffic for the two VLANs in the configuration. As such, the trunk ports will direct the packets to the correct VLAN on the switch, or other connected switches.

5.7. Creating Additional Networks

Depending on the number of available network ports on your Oracle VM Servers, and whether or not you use VLANs, you can create additional networks and assign network functions to them. The exception would be the Management function, which is already assigned, and cannot be removed from the management network(s) created when the Oracle VM Servers were discovered. For example, if your Oracle VM Servers have two NICs, you create a second network with the Virtual Machine role. If your storage is connected to the Management network, you can add the Storage role to your Management network if your storage is connected to the same network as defined by the Management network.

If you have more than two ports on your Oracle VM Servers, or if you are using VLANs, you can create additional networks with the Storage role. These networks connect your Oracle VM Servers to either iSCSI or NFS-based storage. Generally, all Oracle VM Servers that belong to the same pool access the same storage. For each network created, you select a port, bond or VLAN interface on each Oracle VM Server to participate in this network.

You can also create a separate network for the Live Migrate function. After the initial server discovery, the Live Migrate role is assigned to the Management network. Oracle VM encrypts migration traffic using SSL, to protect sensitive data from exploitation and to eliminate the requirement for a dedicated network. Nonetheless, if you have sufficient network resources on your Oracle VM Servers within a server pool, you can choose to create a separate network for live migration.

Similarly, the Cluster Heartbeat network function is assigned to the Management network upon discovering the first Oracle VM Server. The heartbeat communication does not generate a lot of traffic on the network, and therefore does not have much impact on the Management network. It is however susceptible to latency. For this reason, you can choose to create a separate network for the cluster heartbeat function.

Note

Though you can create several networks for the heartbeat and live migration functions, each Oracle VM Server can only participate in one heartbeat and live migration network.

Network configuration is independent of your server pool configuration, but both entities must be taken into account when designing your overall networking infrastructure. Oracle VM Manager communicates with all Oracle VM Servers in the environment, using the management port, independent of how Oracle VM Servers are grouped to form server pools. Some network configuration in your environment might be dependent on the storage available to specific server pools. Virtual machines deployed from separate server pools might use the same external network. For this reason, it is best to plan your network design based on current network and storage setup as well as anticipated growth. Each server in a server pool should have identical network configuration.

The next sections of this chapter describe how to use Oracle VM Manager to translate the network structure of your Oracle VM environment into VLAN Groups and networks. If you expect to use bonding of network ports in your environment, create those first. If your environment contains VLANs, create the

VLAN Groups to support your VLAN setup. You can then specify the VLAN segments contained in these VLAN Groups when creating your networks.

5.8. Managing Bonded Interfaces

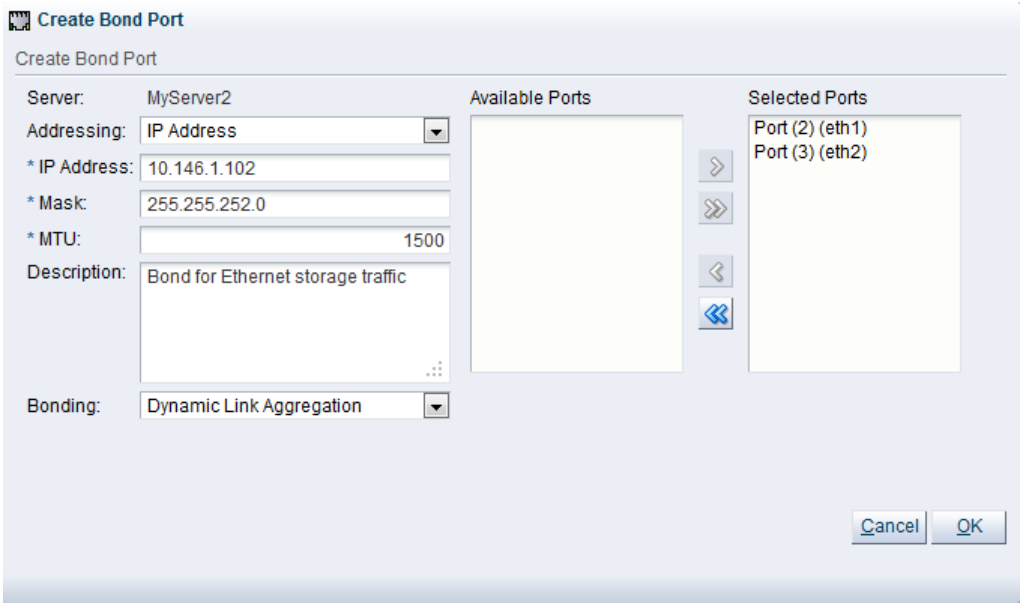
The management port on each Oracle VM Server is specified at installation time and is automatically configured as a bonded interface. You create additional bonds to add redundancy and if desired, load-balancing to your network environment. Once created, these bonds can be used as building blocks when building VLAN Groups or networks. This section discusses managing bonded interfaces.

To create a bond port:

1. In Oracle VM Manager, select the **Servers and VMs** tab.
2. In the navigation pane, select the Oracle VM Server on which the bond port is to be created. If the Oracle VM Server is already part of a server pool, it is listed under **Server Pools**. Otherwise, find and select the Oracle VM Server in the **Unassigned Servers** folder.
3. In the management pane, set the **Perspective** to **Ethernet Ports**. Make sure that the selected Oracle VM Server's ports to be used for the bond port are not part of an existing bond, network or VLAN group. Verify that the ports are available.
4. In the management pane, set the Perspective to **Bond Ports**. In the toolbar above, click **Create Bond Port** to start the Bond Port Creation wizard.
5. In the right part of the **Create Bond Port** window, select the ports to be part of the new bond. Do this by moving ports from the **Available Ports** pane to the **Selected Ports** pane by means of the arrow buttons.

   Note: You cannot add a port to a bond if the port has an IP address.

   You can also assign an IP address to this bond now, or wait to assign an IP address later, when using the bond to create VLAN Groups or networks. If you choose to assign an IP address now, select the **Addressing** type, and if applicable, the IP address and netmask.



6. If necessary, set a Maximum Transfer Unit size in the **MTU** field. If your network supports jumbo frames, increase the MTU value to the required size. The MTU is set to 1500 by default, and can be

between 1500 and 9000 for a 1GbE NIC, and 1500 and 64000 for a 10GbE NIC. Setting the MTU field sets the maximum transmission rate, so a packet size of 5000 can be sent and received if the MTU is set to 9000 for a 1GbE NIC.

7. Optionally, add a description for this bond.

8. Specify the bonding mode from the **Bonding** list. See Section 5.4, “Network Bonding”, for more information regarding network bonding modes.

9. Click **OK** to complete the operation.

When you have created the bond port, you can make changes to its configuration. You can update its bonding mode, and add or remove ports as well as changing its description and IP addressing.

To edit a bond port:

1. In Oracle VM Manager, select the **Servers and VMs** tab.

2. In the navigation pane, select the Oracle VM Server on which the bond port is to be created. If the Oracle VM Server is already part of a server pool, it is listed under **Server Pools**. Otherwise, find and select the Oracle VM Server in the **Unassigned Servers** folder.

3. In the management pane, set the **Perspective** to **Bond Ports** and select the bond you wish to update. In the toolbar above, click **Edit Selected Port** . The **Edit Port** dialog box appears.

4. You can set or change the IP addressing, the bonding mode, the MTU, the description, or the ports that are part of the bond.

5. Click **OK** to save and apply your changes.

If the bond port is no longer in use in any VLAN Group or network, it can be deleted.

To delete a bond port:

1. In Oracle VM Manager, select the **Servers and VMs** tab.

2. In the navigation pane, select the Oracle VM Server on which the bond port is to be created. If the Oracle VM Server is already part of a server pool, it is listed under **Server Pools**. Otherwise, find and select the Oracle VM Server in the **Unassigned Servers** folder.

3. In the management pane, set the **Perspective** to **Bond Ports** and select the bond you wish to delete. In the toolbar above, click **Delete Selected Port** .

4. In the **Delete Confirmation** dialog box, click **OK** to delete the bond port.

5.9. Managing VLAN Groups

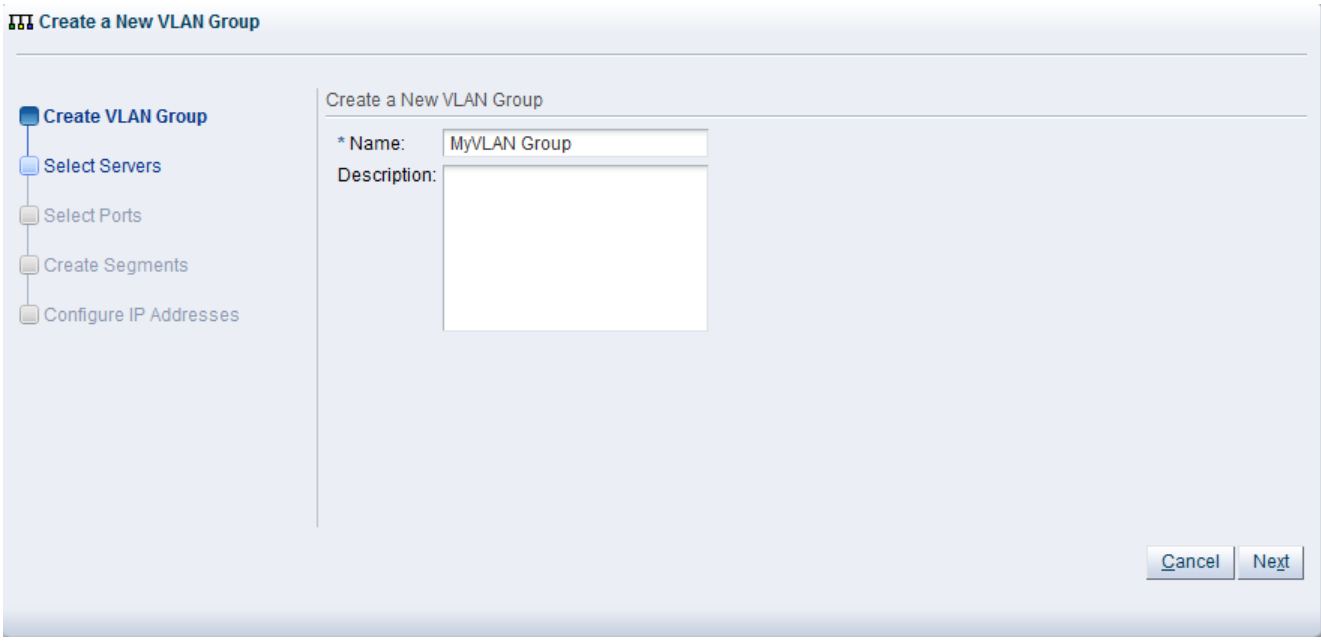
Oracle VM supports multiple virtual LANs (VLANs) on the same NIC port. Each VLAN is essentially an independent logical network operating with other VLANs over the same physical connection. Using VLANs in an ideal way to minimize the number of required physical connections and NICs while concurrently separating traffic. Configuring networks to support VLAN traffic involves creating one or more VLAN Groups, each of which can house multiple VLANs. Each VLAN is assigned a distinct VLAN identification. The VLAN ID is used by an attached VLAN switch to segregate traffic among the different VLANs operating on the same link. When a VLAN is configured, it functions exactly like a separate physical connection.

VLANs need to be configured in the physical switches before you can use them. See Section 5.6, “VLAN Groups and VLAN Segments” for more information about using VLANs in your networking environment.

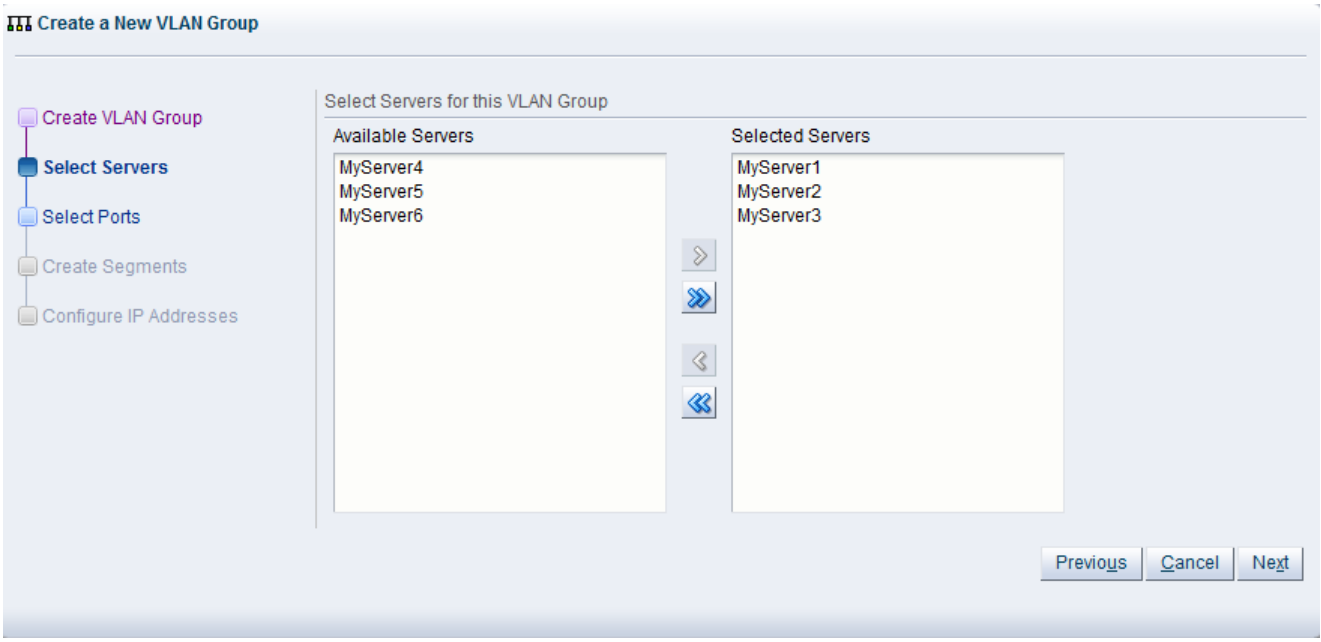
5.9.1. Creating a VLAN Group

To create a VLAN Group:

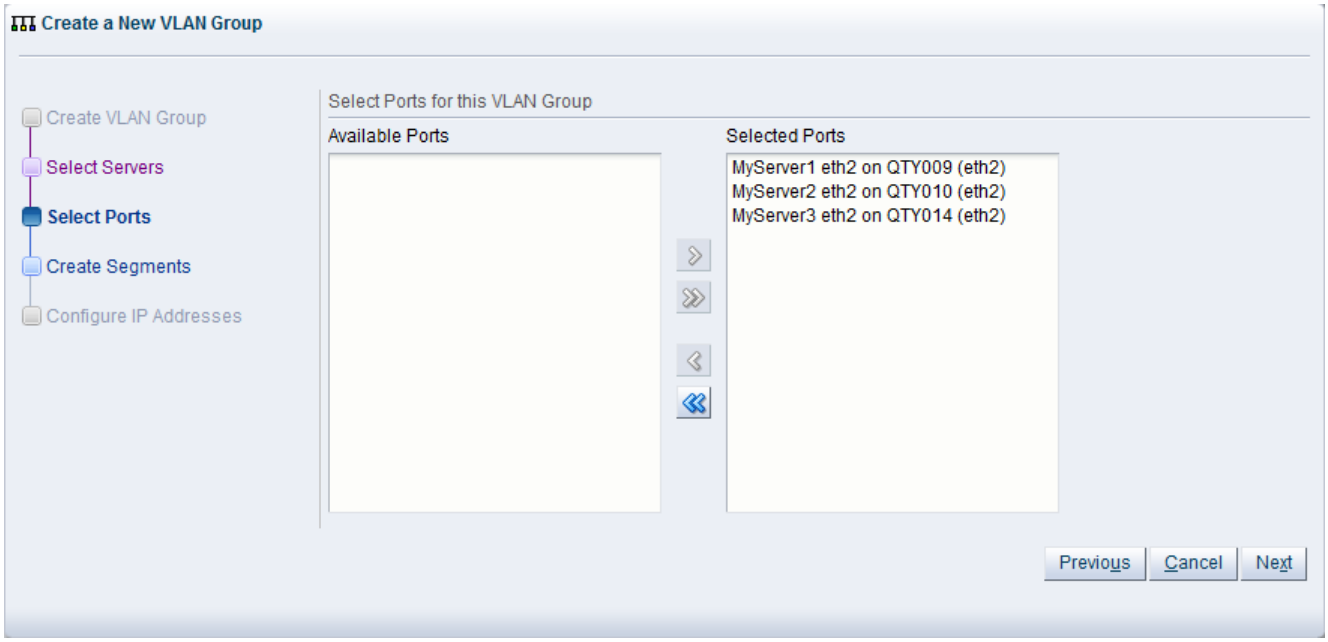
1. In Oracle VM Manager, select the **Networking** tab. Click **VLAN Groups** to display the VLAN Groups screen.
2. In the VLAN Groups toolbar, click **Create New VLAN Group** to start the VLAN Group Creation wizard.
3. Enter a name in the **Name** field, and optionally a description in the **Description** field for the VLAN group and click **Next**.



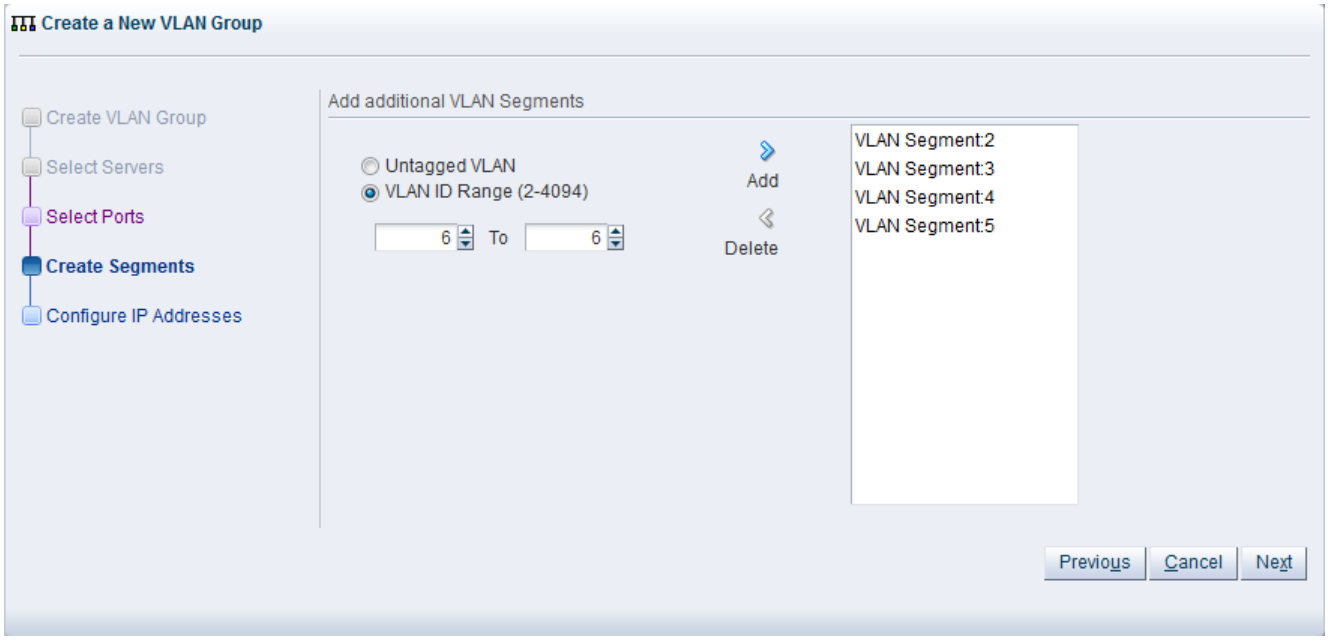
4. Select the Oracle VM Servers that have ports or bonds for this VLAN group and click **Next**.



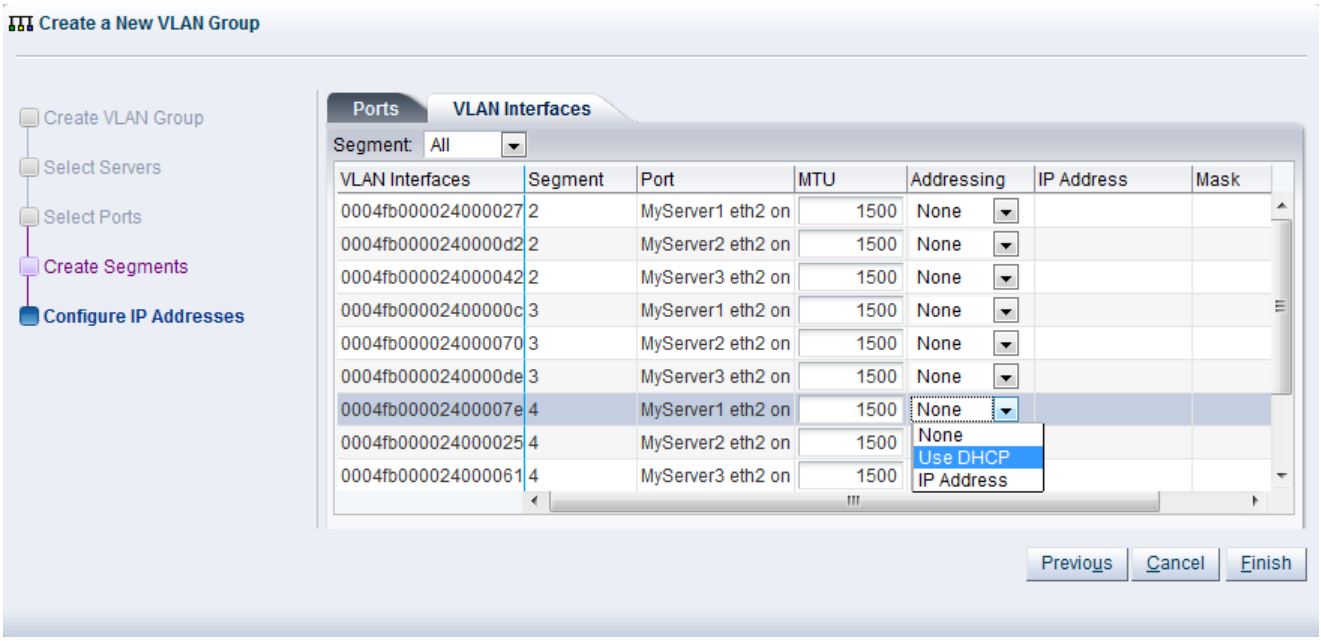
5. Select the port or bond of each Oracle VM Server that belongs to the network and click **Next**. The number between brackets next to the name of the Oracle VM Server corresponds with the NIC of the Oracle VM Server.



6. Add all VLAN IDs which belong to the VLAN group, and optionally select **Untagged VLAN**. Each selected VLAN ID appears as a separate VLAN segment in the VLAN Group.



7. In the next screen, you can set IP addressing to either the ports and bonds or to the VLAN interfaces that are part of this new VLAN Group. Generally, you do not specify IP addresses to VLAN interfaces that are part of a network for virtual machines.



8. Click **Finish** to complete the operation.

5.9.2. Editing a VLAN Group

To edit a VLAN Group:

1. In Oracle VM Manager, select the **Networking** tab. Click **VLAN Groups** to display the VLAN Groups screen.

2. In the VLAN Groups table, select the VLAN group you wish to edit, and in the toolbar above, click **Edit Selected VLAN Group** . The Edit VLAN Group dialog box appears. The screens in the wizard are identical to the ones displayed in Section 5.9.1, “Creating a VLAN Group”.

3. In the **Edit VLAN Group** screen you can change the name in the **Name** field, and the description in the **Description** field. Click **Next**.

4. In the **Select Servers** screen, you can add or remove Oracle VM Servers participating in this VLAN group. Click **Next**.

5. In the **Select Ports** screen, you can add or remove ports or bonds for the Oracle VM Servers in this VLAN Group. The number between brackets next to the name of the Oracle VM Server corresponds with the port of the Oracle VM Server. Click **Next**.

6. In the **Edit Segments** screen, you can add or remove VLAN IDs from the VLAN Group and optionally select **Untagged VLAN**. Each selected VLAN ID appears as a separate VLAN segment in the VLAN Group. It is possible to combine VLAN IDs with Untagged VLANs, so, first select the proper **VLAN IDs**, and then select **Untagged VLAN**.

7. In the **Configure IP Address** screen, you can update information for the ports or bond ports and for the VLAN interfaces that are currently part of the VLAN Group.

   Select the **Ports** tab to modify the IP addressing of ports or bond ports that are part of the VLAN Group. You can update the IP addressing type, the IP address if selecting a static address, and the netmask. If the VLAN Group contains bond ports, you can also modify the bonding mode for the bond ports.

Select the **VLAN Interfaces** tab to modify the IP addressing of the VLAN interfaces that are part of the VLAN Group. You can update the IP addressing type, the IP address if selecting a static address, and the netmask.

8. Click **Finish** to complete the update.

5.9.3. Deleting a VLAN Group

You can only delete a VLAN Group if none of the VLAN segments in the VLAN Group are currently being used by a network.

To delete a VLAN Group:

1. In Oracle VM Manager, select the **Networking** tab. Click **VLAN Groups** to display the VLAN Groups screen.
2. In the VLAN Groups table, select the VLAN group you wish to edit, and in the toolbar above, click **Delete Selected VLAN Group** ✖ .
3. In the **Delete Confirmation** dialog box, click **OK** to delete the VLAN Group. The VLAN Group is deleted.

5.10. Managing Networks

The initial Oracle VM Server installation configures the bare minimum network configuration. This allows Oracle VM Servers to set up their networking sufficiently to establish communication with Oracle VM Manager.

User created network devices (VLAN or a bond) on an Oracle VM Server are discovered by Oracle VM Manager, but these network devices are not associated with logical networks.

The management network, created during the Oracle VM installation, has the following network functions:

- Server Management
- Live Migrate
- Cluster Heartbeat

When an Oracle VM Server is discovered, the port on which the Oracle VM Manager discovers the Oracle VM Server is added to this management network, and the port is configured as a bonded interface. See Section 5.4, “Network Bonding” for details about network bonding. You can add a port to this bond, and you can add or remove network functions for this network other than the management role. You can also remove the Oracle VM Server management interfaces from the management network temporarily if you wish to add them to a VLAN group and configure VLAN interfaces for management traffic and other network functions separately. You can make the allowed changes to the configuration of the management network at any time using Oracle VM Manager. See Section 5.11, “Editing Network Data” for details about changing a network configuration in Oracle VM Manager.

Note

In Oracle VM the management network interface and the public interface (i.e. default route) are expected to be the same on each Oracle VM Server. Other types of network usage are allowed on the same interface, for example through the use of VLANs and/or network bridges.

Additional Oracle VM network configuration beyond what is done through the discovery process must be done using Oracle VM Manager. Do not edit the network configuration files on Oracle VM Servers manually, instead, use Oracle VM Manager.

All network configurations are persistent on the Oracle VM Servers to allow HA to work without requiring Oracle VM Manager. This includes enough logical information to allow the configuration to be recreated on Oracle VM Manager in the event that the Oracle VM Manager database is lost. All network configuration is also persistent on Oracle VM Manager.

When you build a new network, you use ports, bond ports or VLAN interfaces as building blocks for the network. For more information on network building blocks, see Section 5.3, “Building a Network Environment”. You must also select the network usage for your new network. For a discussion of network functions and rules associated with them, consult Section 5.7, “Creating Additional Networks”.

This section discusses managing networks.

5.10.1. Creating a Network

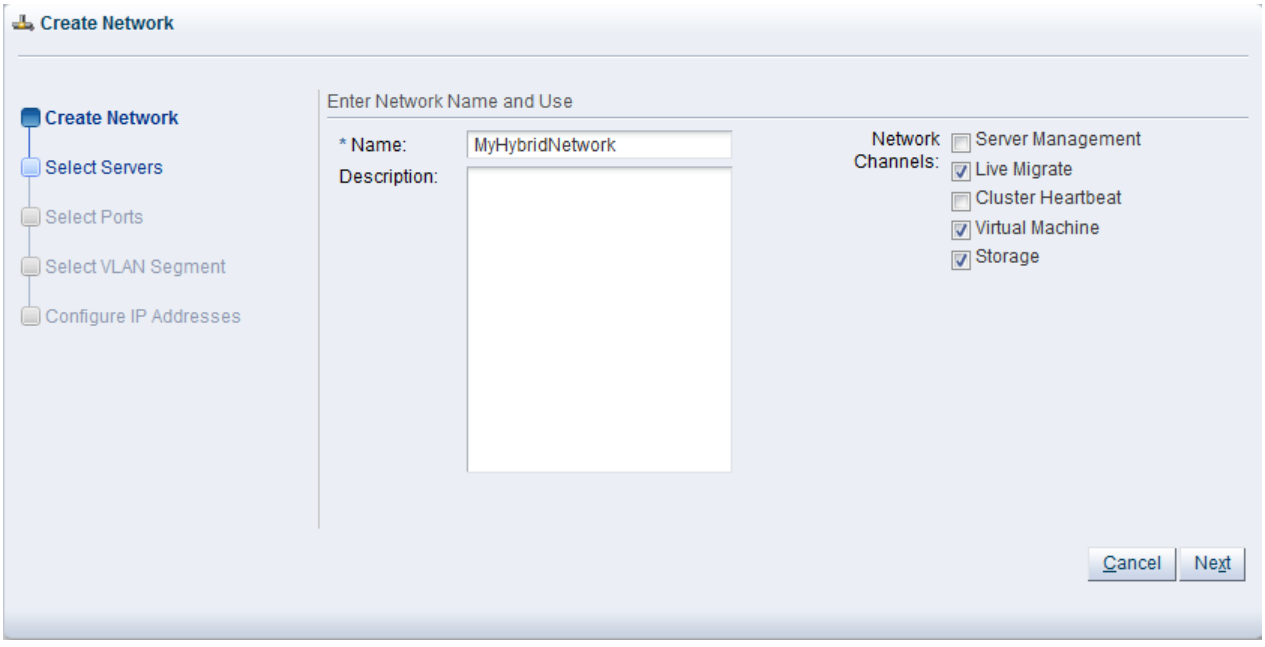
To create a network:

1. In Oracle VM Manager, select the **Networking** tab.
2. Click **Create New Network** ✚ to start the **Create Network** wizard. The wizard offers the following choices:
   - Create a network with bonds/ports only
   - Create a network with VLANs only
   - Create a hybrid network with bonds/ports and VLANs
   - Create a logical network on a single server

3. Select the type of network to create, based on your network infrastructure.
   - If you have created bonds previously, you can now use them to create a network.

- If you select to create a network with VLANs only, you must have created a VLAN Group previously. See Section 5.8, “Managing Bonded Interfaces” for details on how to create a VLAN Group.
- You can also choose to create a network with a combination of bonds and ports, and VLANs.
- The last selection, to create a logical network on a single server, creates an intra-server on a single Oracle VM Server. See Section 5.3, “Building a Network Environment” for information about intra-server networks. To create a logical network on a single server, proceed with creating a logical network for a single Oracle VM Server [96]. For all other network types, continue with entering network information [92].

4. Enter the following network information:
   - **Name:** A name for the network.
   - **Description:** A description of the network. This is an optional field.
   - **Network Usage:** Select one or more network functions:
     - Server Management
     - Live Migrate
     - Cluster Heartbeat
     - Virtual Machine
     - Storage

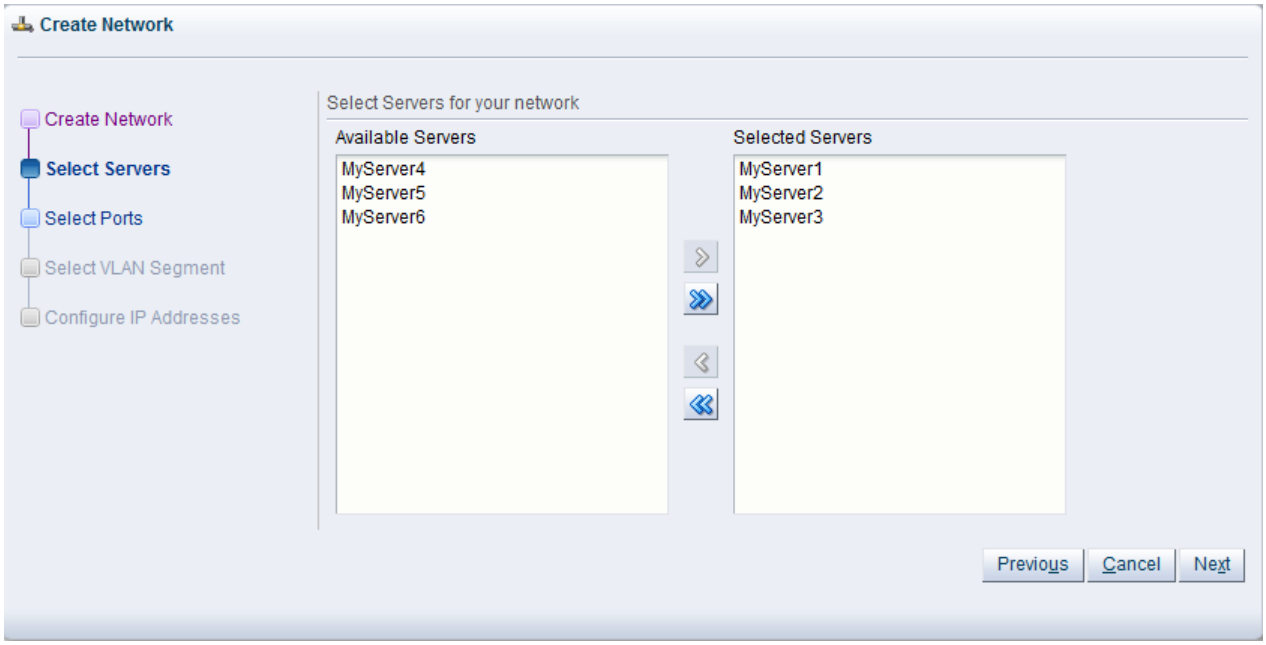


   See Section 5.2, “Network Usage” for more information regarding network functions.

5. Depending on the network type you selected to create, fill out the applicable screens in the wizard as described below:
   - **Select Servers** screen

(applies to network type: bonds/ports, hybrid – skip for type VLAN only)

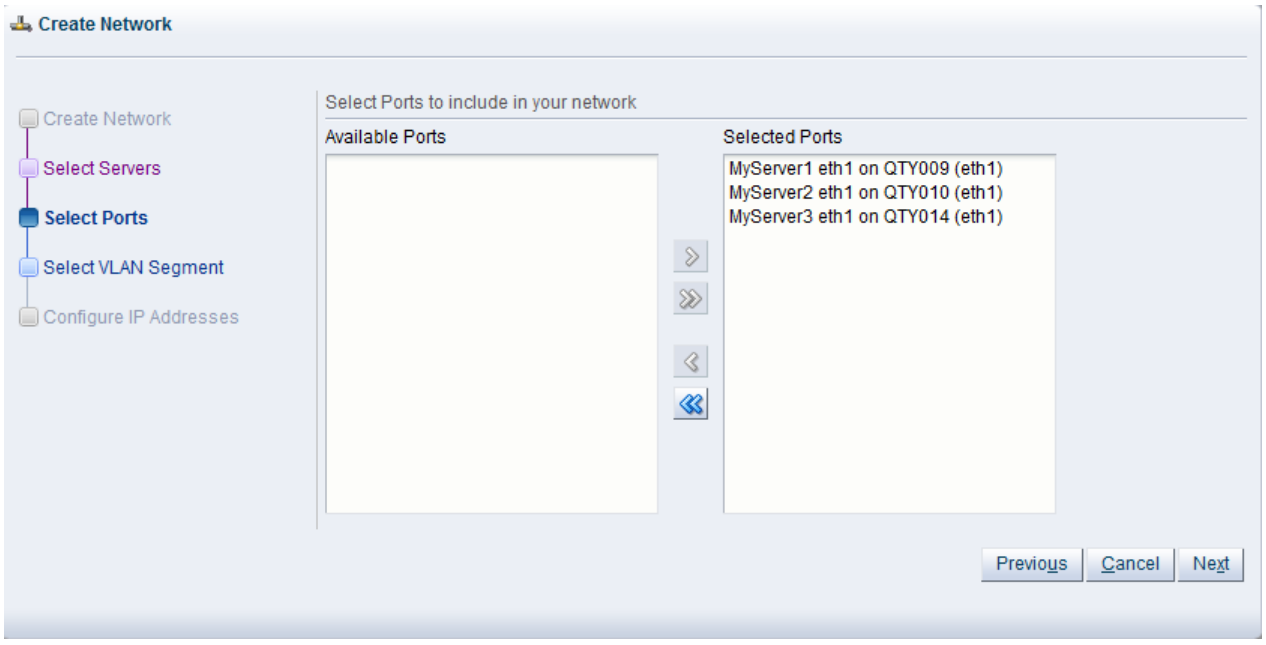
Add the servers participating in this network. Click **Next**.



- **Select Ports** screen

  (applies to network type: bonds/ports, hybrid – skip for type VLAN only)

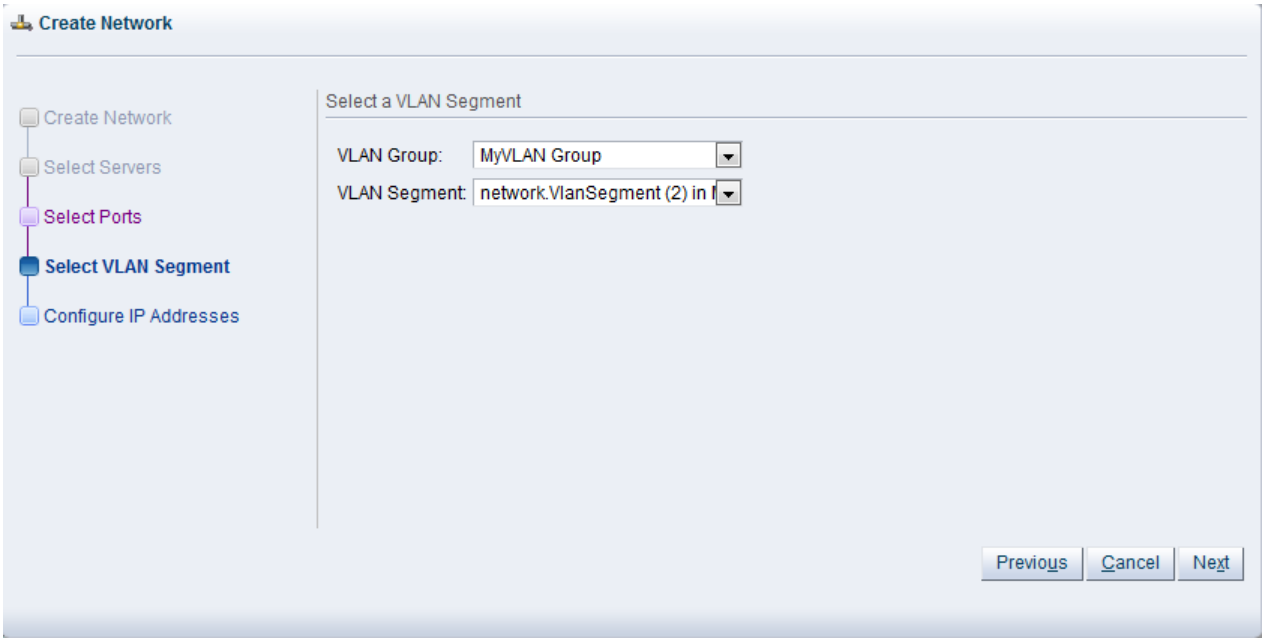
  Select the ports or bonds of each Oracle VM Server that participates in this network. The number between brackets next to the name of the Oracle VM Server corresponds with the NIC of the Oracle VM Server. Click **Next**.



- **Select VLAN Segment** screen

(applies to network type: VLAN only, hybrid – skip for type bonds/ports)

Select the VLAN Group from the list, then select the VLAN segment from the list. All VLAN Groups are available for selection, but VLAN segments already in use do not appear in the drop-down list. Click **Next**.



- **Configure IP Addresses** screen – **Ports** tab

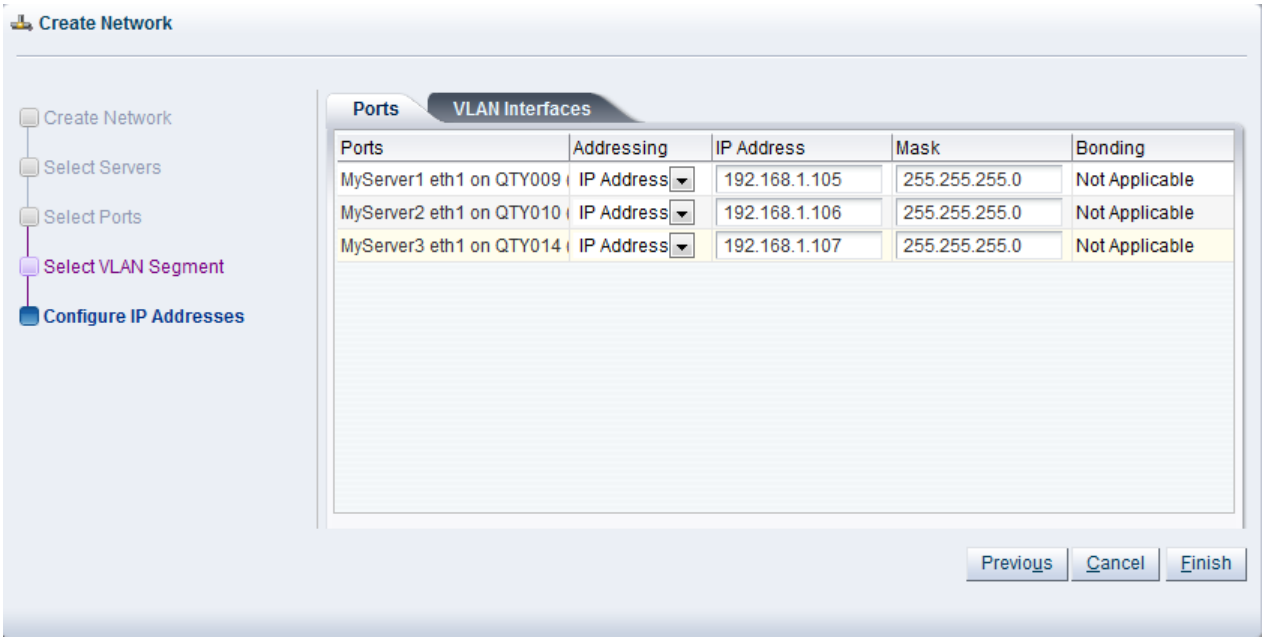
  (applies to network type: bonds/ports, hybrid – select other tab for VLAN only)

  Set the IP configuration for each port or bond. If you use static IP addresses, set the IP address, netmask and gateway. If you select DHCP, you still need to setup a DHCP server in your Oracle VM environment, since Oracle VM does not act as a DHCP server.

  If your network has the virtual machine function, you do not have to define the IP data, which is required for all other network functions. See Section 5.5, “Network Bridges” for details on creating bridges for virtual machine networks.

  If bonding is active, select the Bonding mode. See Section 5.4, “Network Bonding” for a description of the bonding modes.

  If you are creating a hybrid type network, select the VLAN Interfaces tab. If you are creating a network with bonds and ports only, click **Finish** to close the wizard and complete the network creation.



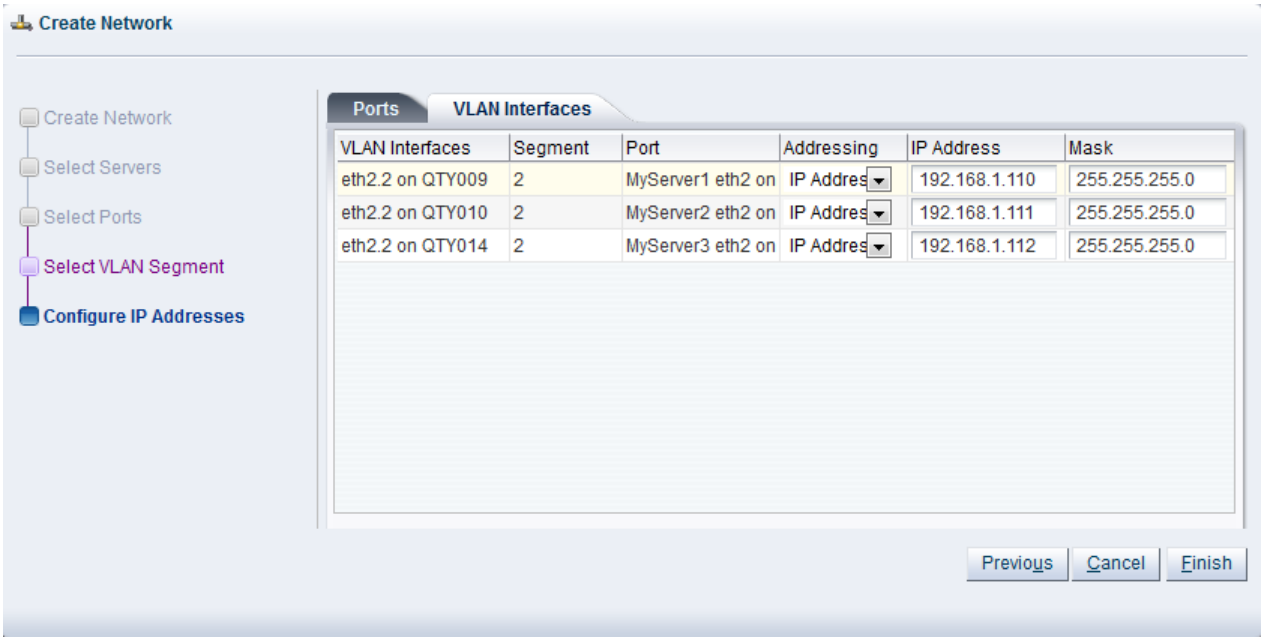
- **Configure IP Addresses** screen – **VLAN Interfaces** tab

  (applies to network type: VLAN only, hybrid – skip for type bonds/ports)

  The VLAN interface selected for each port is listed, along with the IP addressing information. If IP information was supplied when creating the VLAN Group, this IP information is displayed. If no IP information was supplied when creating the VLAN Group, none is displayed.

  If the network you are creating contains the virtual machine network function only, you *cannot* change the IP information from the VLAN Interfaces tab. If the network you are creating contains any other network function, alone, or combined with the virtual machine network function, you *can* edit the IP information from the VLAN Interfaces tab.

  Click **Finish** to close the wizard and complete the network creation.



6. If you are creating a logical network for a single Oracle VM Server:
   - In the **Create Network** screen, enter a name and optional description for the new network.
   - In the **Select Server** screen, choose the server from the drop-down list.

Note

The virtual machines deployed on a logical network for a single server, also called an intra-server network, are only accessible through their console if no other network is available.

7. Click **Finish** to complete the network creation.

5.10.2. Editing a Network

The following applies to all types of network except logical networks on a single server (intra-server networks).

To edit a network:

1. In Oracle VM Manager, select the **Networking** tab.
2. Select the network you wish to edit and click **Edit Selected Network** to start the **Edit Network** wizard.
3. Edit the network information and configuration as follows:
   - **Name:** Change the name of the network.
   - **Description:** Add or change a description for the network. This is an optional field.
   - **Network Usage:** Select or deselect one or more network functions:
     - Server Management

- Live Migrate
- Cluster Heartbeat
- Virtual Machine
- Storage

See Section 5.2, “Network Usage” for more information regarding network functions.

4. Depending on the network type you selected to edit, make changes in the applicable screens as described below. The screens in the wizard are identical to the ones displayed in Section 5.10.1, “Creating a Network”.

   - **Select Servers** screen

     (applies to network type: bonds/ports, hybrid – skip for type VLAN only)

     Select or deselect the servers participating in this network. Click **Next**.

   - **Select Ports** screen

     (applies to network type: bonds/ports, hybrid – skip for type VLAN only)

     Select or deselect the ports or bonds of each Oracle VM Server that participates in this network. The number between brackets next to the name of the Oracle VM Server corresponds with the NIC of the Oracle VM Server. Click **Next**.

   - **Select VLAN Segment** screen

     (applies to network type: VLAN only, hybrid – skip for type bonds/ports)

     Select the VLAN Group from the list, then select the VLAN segment from the list. All VLAN Groups are available for selection, but VLAN segments already in use do not appear in the drop-down list. Click **Next**.

   - **Configure IP Addresses** screen – **Ports** tab

     (applies to network type: bonds/ports, hybrid – select other tab for VLAN only)

     Set or update the IP configuration for each port or bond. If you use static IP addresses, set the IP address, netmask and gateway. If you select DHCP, you still need to setup a DHCP server in your Oracle VM environment, since Oracle VM does not act as a DHCP server.

     If your network has the virtual machine function, you do not have to define the IP data, which is required for all other network functions. See Section 5.5, “Network Bridges” for details on creating bridges for virtual machine networks.

     If bonding is active, select the Bonding mode. See Section 5.4, “Network Bonding” for a description of the bonding modes.

     If you are editing a hybrid type network, select the VLAN Interfaces tab. If you are editing a network with bonds and ports only, skip the second tab and proceed completing the network updates [98].

   - **Configure IP Addresses** screen – **VLAN Interfaces** tab

     (applies to network type: VLAN only, hybrid – skip for type bonds/ports)

The VLAN interface selected for each port is listed, along with the IP addressing information. If IP information was supplied when creating the VLAN Group, this IP information is displayed. If no IP information was supplied when creating the VLAN Group, none is displayed.

If the network you are creating contains the virtual machine network function only, you *cannot* change the IP information from the VLAN Interfaces tab. If the network you are creating contains any other network function, alone, or combined with the virtual machine network function, you *can* edit the IP information from the VLAN Interfaces tab.

5. After verifying or making the necessary changes to the network, click **Finish** to complete the network updates.

Note

For logical networks on a single Oracle VM Server, you can only edit the **Description** field. If you want to change servers, delete the network and re-create it with a different server.

5.10.3. Deleting a Network

It may occur that a logical network becomes obsolete in Oracle VM. To keep your Oracle VM environment clean, it is recommended to remove all obsolete data, such as obsolete networks.

Note

You cannot remove a virtual machine network if there are running virtual machines using the network.

To delete a network:

1. In Oracle VM Manager, select the **Networking** tab.
2. Select the network to be deleted and click **Delete Selected Network** ✖ .
3. In the **Delete Confirmation** dialog box, click **OK** to delete the network. The network is deleted.

5.10.4. Configuring the Management Network on a VLAN

During the installation of the Oracle VM Servers you configure a management interface on each server. These interfaces are added to the default management network when the servers are discovered by Oracle VM Manager. During server installation you have two configuration options for the management network interface: standard or as part of a tagged VLAN.

Caution

The only supported method to obtain a management network on a tagged VLAN is to specify the VLAN tag during the installation. For more information, see Installing Oracle VM Server in the Oracle VM Installation and Upgrade Guide.

In case you installed the Oracle VM Servers with a management interface on a standard network, not on a VLAN, discovering the servers leads to the creation of a default management network with management IP addresses assigned to a bond0 port containing one Ethernet network interface each. You can use Oracle VM Manager to change this configuration and use the untagged VLAN for the management network. The procedure is described below.

Warning

Once the VLAN is associated with the management network, this association cannot be broken. The original state of the management network and interfaces cannot be restored. Plan this reconfiguration carefully.

To reconfigure the management network from physical to untagged VLAN:

1. In Oracle VM Manager, select the **Networking** tab.
2. Select the management network and click **Edit Selected Network** to start the **Edit Network** wizard.
3. Remove the management interfaces of the Oracle VM Servers from the management network.
4. Click **VLAN Groups** to display the VLAN Groups screen. In the VLAN Groups toolbar, click **Create New VLAN Group** to start the VLAN Group Creation wizard.
5. In the new VLAN group, add the network ports you removed from the management network earlier. Create the untagged VLAN segment you need for the management network. Include any additional VLAN segments for other networks for which you want to use a VLAN over the same network interface. Click **Next**.
6. With the untagged VLAN the IP addresses must be assigned to the underlying network ports. The management IP address cannot be changed, so you may skip this wizard step and Click **Finish**.
7. Return to the **Networking** screen and edit the management network again. Select the VLAN segment you wish to associate with the management network, which is the untagged VLAN segment.

   The restriction for the untagged VLAN still applies: the IP address must be on the underlying port, so it cannot be assigned to the VLAN interface. The physical network interface is now available to add other tagged VLAN interfaces to include in other networks.

In case you installed the Oracle VM Servers with a management interface on a tagged VLAN, the bond0 ports are included in a VLAN group during server discovery. The VLAN group is then associated with the management network via the appropriate VLAN tag or segment. Changing this configuration, for example to use the untagged VLAN or a physical network for the management network, is not supported in Oracle VMRelease 3.1.1.

5.10.5. Dealing with Failed Network Operations

Network configuration is a complex operation involving many different elements in the physical and logical environment. A large number of instructions is sent to the Oracle VM Servers in the process, and in case one instruction in a whole sequence goes wrong, the resulting state of the network configuration is unpredictable. To avoid badly or partly configured network objects, which become unusable, Oracle VM Manager has a mechanism in place that is triggered when a network operation fails: a network discovery is launched for each Oracle VM Server that participated in the operation, and the commands that completed successfully are reflected in the network model displayed in the Oracle VM Manager user interface.

Note

The automatic network discovery is not instantaneous. The operations start as soon as the job fails, but could take some time to finish: from a few seconds to a couple of minutes. This will depend on how complicated the network configuration is and how many Oracle VM Servers are involved.

To avoid resource locking issues and further failing operations, it is recommended that you wait for the discovery operation to complete before you resume the reconfiguration of the network.

In case your network configuration returns a failed job, you have to manually go through all the physical and logical network elements involved and make the necessary changes one by one in Oracle VM Manager. Typical network elements include: network interfaces, Ethernet ports, bond ports, VLAN groups, VLAN segments and IP addresses. The amount of manual reconfiguration depends on the complexity of your network configuration and the number of Oracle VM Servers involved.

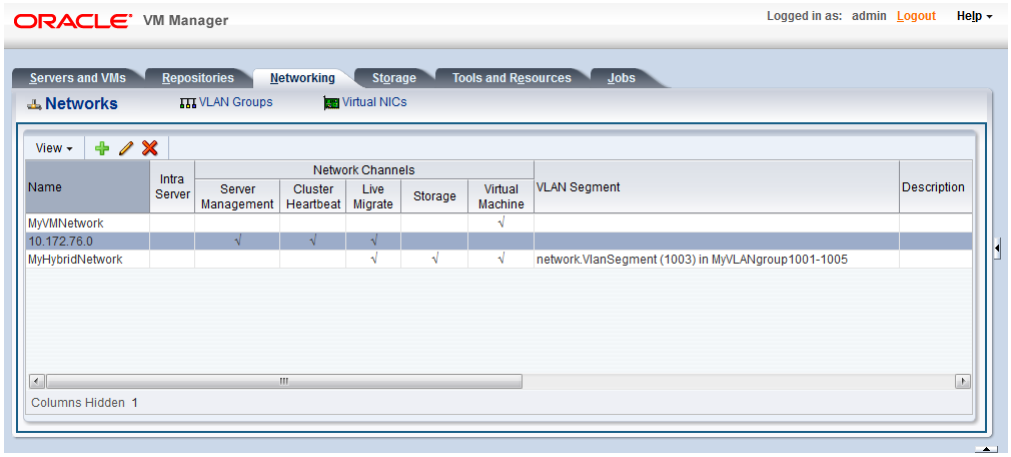
5.11. Editing Network Data

To edit networking data, for example adding or removing network functions or updating port definitions, VLAN IDs, and so on, you use the **Edit** button in the respective screens of the **Networking** tab of Oracle VM Manager.

To go to the Network Configuration and VLAN Groups wizards:

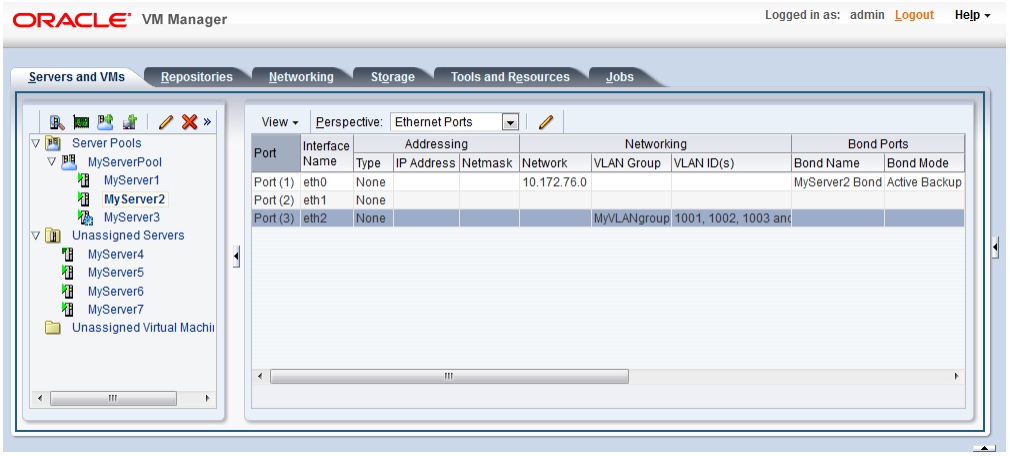
1. Select the **Networking** tab in Oracle VM Manager.

2. Select the **Networks** or **VLAN Groups** screen in the **Networking** tab to view the respective management panes.



Editing a network or VLAN group via **Edit** (in the toolbar launches the same wizard as creating networks or VLAN Groups. Update the data in the respective steps of the wizards. They are described in detail in the previous sections: Section 5.9, “Managing VLAN Groups” and Section 5.10, “Managing Networks”.

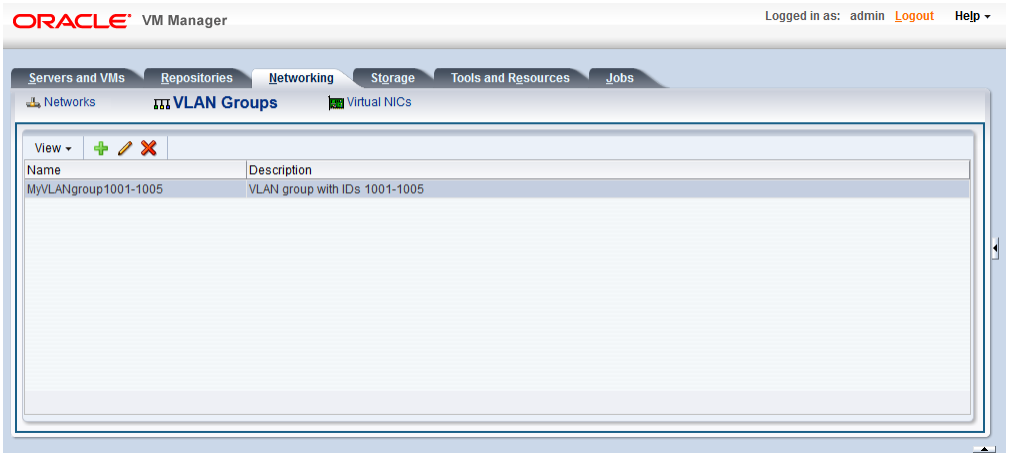
In addition, you can modify networking configuration data outside these wizards by going into the detailed perspectives of the **Servers and VMs** tab instead of editing the top level network resources step by step.



The table below describes some specific actions to take when editing network ports and bonds. You can update the IP address of ports, and add, remove, and delete bond ports in a network. The following table describes the methods to use for each type of network update.

Function	Method
Update IP information for ports	In the **Servers and VMs** tab, select the server which owns the port under **Server Pools** or under **Unassigned Servers**. In the management pane, set the **Perspective** to **Ethernet Ports** and select the port you wish to update. Click **Edit Selected Port** to update the IP information. **Note:** You can remove Ethernet ports.
Update bond information	In the **Servers and VMs** tab, select the server which owns the bond under **Server Pools** or under **Unassigned Servers**. In the management pane, set the **Perspective** to **Bond Ports** and select the bond you wish to update. Click **Edit Selected Port** to update the bond. You can update the IP information for the bond, the ports which are part of the bond and the bonding mode.
Add a bond	In the **Servers and VMs** tab, select the server for which you wish to add a bond. In the management pane, set the **Perspective** to **Bond Ports** and click **Create Bond Port** to create the bond. You provide the IP information for the bond, the ports which are part of the bond and the bonding mode.
Delete a bond	In the **Servers and VMs** tab, select the server for which you want to delete a bond. In the management pane, set the **Perspective** to **Bond Ports** and click **Delete Selected Port** to remove the bond.

The VLAN configuration, in contrast, can only be edited via the wizard, which is accessible through the **VLAN Groups** screen of the **Networking** tab.



In the **Servers and VMs** tab you can see the VLAN group and associated VLAN IDs for a given Ethernet port. However, to make changes, for example edit the address information, you must edit the VLAN group and set a static IP or DHCP in the last step of the wizard.

Chapter 6. Managing Server Pools

Table of Contents

A server pool is a domain of physical and virtual resources to host virtual machines, perform virtual machine migration, HA, and so on.

This chapter describes how to create and manage server pools.

6.1. Server Pool Overview

A server pool consists of one or more Oracle VM Servers, and represents a logical view of the storage where the virtual machines reside.

A server pool is scalable. If you find a server pool does not have sufficient resources, such as CPU or memory, to run the virtual machines, you can expand the server pool by adding more Oracle VM Servers. See Section 6.8.1, “Adding an Oracle VM Server to a Server Pool”.

Oracle VM's deployment architecture utilizes server pools, with shared access to storage across Oracle VM Servers in the server pool. Virtual machines are stored on the shared storage and placed on one of the Oracle VM Servers to balance the workloads of the server pool.

Since the virtual machines are not bound to any specific Oracle VM Server in the server pool, virtual machines are not prevented from starting up simply because an individual Oracle VM Server happens to be down for maintenance or otherwise unavailable at the time. Further, since the load-balancing algorithm assures that a virtual machine is placed on the Oracle VM Server with the most resources available, it also helps assure the maximum aggregate performance from the server pool.

6.2. Server Pool Clusters

Oracle VM works in concert with Oracle OCFS2 to provide shared access to server pool resources residing in an OCFS2 file system. This shared access feature is crucial in the implementation of high availability (HA) for virtual machines running on the Oracle VM Servers that belong to a server pool with clustering enabled.

OCFS2 is a cluster file system for Linux, which allows multiple nodes (Oracle VM Servers) to access the same disk at the same time. OCFS2, which provides both performance and HA, is used in many applications that are cluster-aware or that have a need for shared file system facilities. With Oracle VM, OCFS2 ensures that Oracle VM Servers belonging to the same server pool access and modify resources in the shared repositories in a controlled manner.

The OCFS2 software includes the core file system, which offers the standard file system interfaces and behavioral semantics and also includes a component which supports the shared disk cluster feature. The shared disk component resides mostly in the kernel and is referred to as the O2CB cluster stack. It includes:

- A disk heartbeat to detect live servers
- A network heartbeat for communication between the nodes
- A Distributed Lock Manager (DLM) which allows shared disk resources to be locked and released by the servers in the cluster

OCFS2 also offers several tools to examine and troubleshoot the OCFS2 components. For detailed information on OCFS2, see the OCFS2 documentation at:

http://oss.oracle.com/projects/ocfs2/documentation/

Oracle VM decouples storage repositories and clusters so that if a storage repository is taken off-line, the cluster is still available. A loss of one heartbeat device does not force an Oracle VM Server to self fence.

When you create a server pool, you have a choice to activate the cluster function which offers these benefits:

- Shared access to the resources in the repositories accessible by all Oracle VM Servers in the cluster.
- Protection of virtual machines in the event of a failure of any Oracle VM Server in the server pool.

To configure the server pool cluster and enable HA in a server pool, select the **Clustered Server Pool** check box when you create or edit a server pool. See Section 6.7, “Creating a Server Pool” and Section 6.8.3, “Editing a Server Pool” for more information on creating and editing a server pool.

When you create a server pool, you specify:

- Server pool name and description
- A virtual IP address
- Whether or not to activate the cluster
- A server pool file system for the global heartbeat and other cluster information

During server pool creation, the server pool file system specified for the new server pool is accessed and formatted as an OCFS2 file system. This formatting creates several management areas on the file system including a region for the global disk heartbeat. Oracle VM formats the server pool file system as an OCFS2 file system whether the file system is accessed by the Oracle VM Servers as an NFS share, a FC LUN or iSCSI LUN.

The virtual IP address is used by Oracle VM Manager to communicate with the server that is designated as the Master in the server pool. If the master changes, the virtual IP address is transferred to the new Master, insuring that Oracle VM Manager continues to communicate with the Master.

The next step is to add Oracle VM Servers to the newly created server pool. When Oracle VM Servers are added, Oracle VM:

1. Selects a Master Oracle VM Server.
2. Configures the Virtual IP address selected during pool creation as a virtual network interface on top of the management interface for the Master Oracle VM Server.
3. Creates the cluster configuration file and the cluster time-out file.
4. Pushes the configuration files to all Oracle VM Servers in the server pool.
5. Starts the cluster.

On each Oracle VM Server in the cluster, the cluster configuration file is located at /etc/ocfs2/cluster.conf, and the cluster time-out file is located at /etc/sysconfig/o2cb.

Starting the cluster activates several services and processes on each of the Oracle VM Servers in the cluster. The most important processes and services are discussed in Table 6.1, “Cluster services ”.

Table 6.1. Cluster services

Service	Description
02net	The o2net process creates TCP/IP intra-cluster node communication channels on port 7777 and sends regular keep-alive packages to each node in the cluster to validate if the nodes are alive. The intra-cluster node communication uses the network with the Cluster Heartbeat role. By default, this is the Server Management network. You can however create a separate network for this function. See Section 5.2, “Network Usage” for information about the Cluster Heartbeat role. Make sure the firewall on each Oracle VM Server in the cluster allows network traffic on the heartbeat network. By default, the firewall is disabled on Oracle VM Servers after installation.
o2hb-*diskid*	The server pool cluster also employs a disk heartbeat check. The o2hb process is responsible for the global disk heartbeat component of cluster. The

Service	Description
	heartbeat feature uses a file in the hidden region of the server pool file system. Each pool member writes to its own block of this region every two seconds, indicating it is alive. It also reads the region to maintain a map of live nodes. If a server pool member's block is no longer updated, the Oracle VM Server is considered dead. If an Oracle VM Server dies, the Oracle VM Server is fenced. Fencing forcefully removes dead members from the server pool to make sure active pool members are not obstructed from accessing the fenced Oracle VM Server's resources.
o2cb	The o2cb service is central to cluster operations. When an Oracle VM Server boots, the o2cb service starts automatically. This service must be up for the mount of shared repositories to succeed.
ocfs2	The ocfs2 service is responsible for the file system operations. This service also starts automatically.
ocfs2_dlm and ocfs2_dlmfs	The DLM modules (ocfs2_dlm, ocfs2_dlmfs) and processes (user_dlm, dlm_thread, dlm_wq, dlm_reco_thread, and so on) are part of the Distributed Lock Manager. OCFS2 uses a DLM to track and manage locks on resources across the cluster. It is called distributed because each Oracle VM Server in the cluster only maintains lock information for the resources it is interested in. If an Oracle VM Server dies while holding locks for resources in the cluster, for example, a lock on a virtual machine, the remaining Oracle VM Servers in the server pool gather information to reconstruct the lock state maintained by the dead Oracle VM Server.

Warning

Do not manually modify the cluster configuration files, or start and stop the cluster services. Oracle VM Manager automatically starts the cluster on Oracle VM Servers that belong to a server pool. Manually configuring or operating the cluster may lead to cluster failure.

When you create a repository on a shared disk, an OCFS2 file system is created on the shared disk. This occurs for local repositories as well. The resources in the repositories, for example, virtual machine configuration files, virtual disks, ISO files, templates and assemblies, can then be shared safely across the server pool. When a server pool member stops or dies, the resources owned by the departing server are recovered, and the change in status of the server pool members is propagated to all the remaining Oracle VM Servers in the server pool.

Figure 6.1, “Server Pool clustering with OCFS2 features” illustrates server pool clustering, the disk and network heartbeats, and the use of the DLM feature to lock resources across the cluster.

Figure 6.1. Server Pool clustering with OCFS2 features

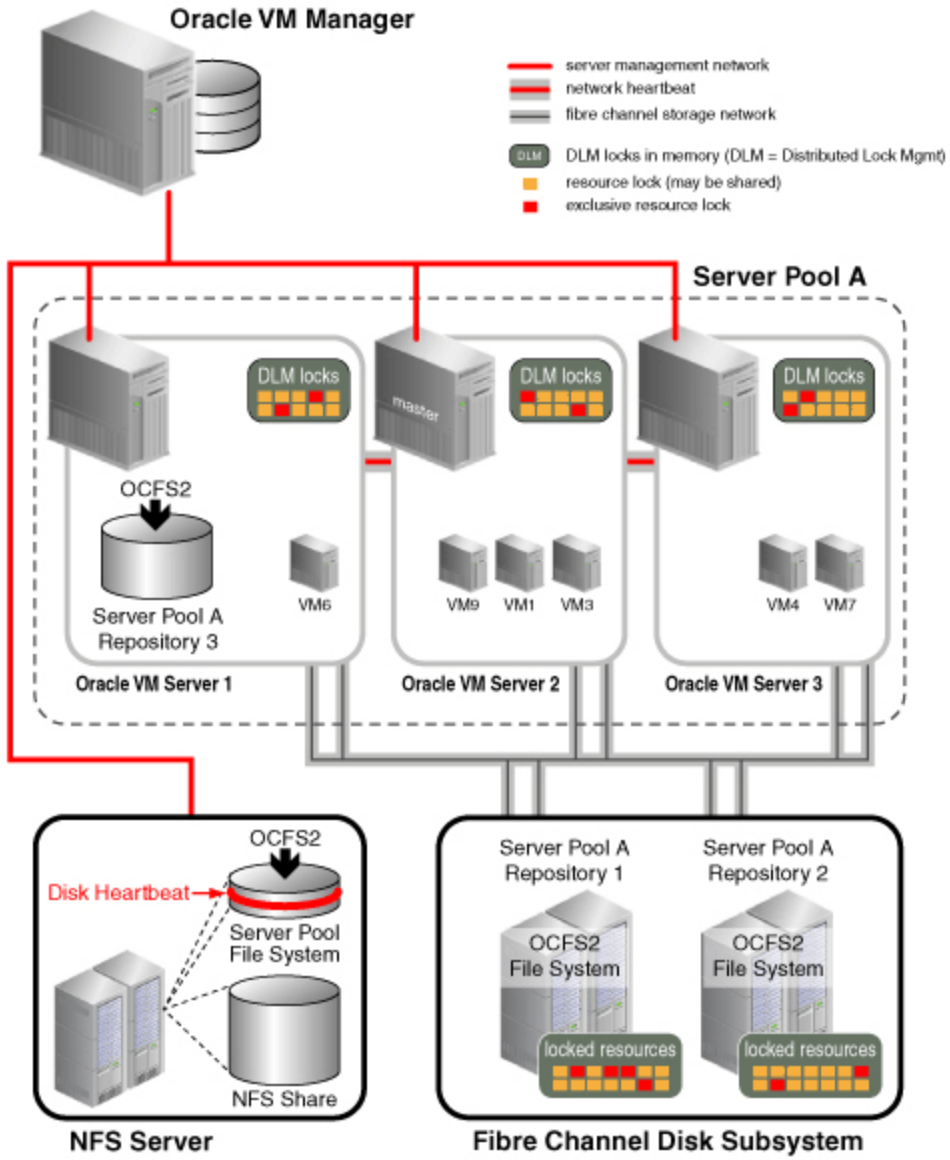


Figure 6.1, “Server Pool clustering with OCFS2 features” represents a server pool with three Oracle VM Servers. The server pool file system associated with this server pool resides on an NFS share. During server pool creation, the NFS share is accessed, a disk image is created on the NFS share and the disk image is formatted as an OCFS2 file system. This technique allows all Oracle VM server pool file systems to be accessed in the same manner, using OCFS2, whether the underlying storage element is an NFS share, an iSCSI LUN or a Fibre Channel LUN.

After the server pool is created, the Oracle VM Servers are added to the server pool. At that time, the cluster configuration is created, and the cluster state changes from *off-line* to *heartbeating*. Finally, the server pool file system is mounted on all Oracle VM Servers in the cluster and the cluster state changes from *heartbeating* to *DLM ready*. As seen in Figure 6.1, “Server Pool clustering with OCFS2 features”, the heartbeat region is global to all Oracle VM Servers in the cluster, and resides on the server pool file system. The network heartbeat, which is illustrated as a private network connection between the Oracle VM Servers, is configured before creating the first server pool in your Oracle VM environment. Using

the network heartbeat, the Oracle VM Servers establish communication channels with other Oracle VM Servers in the cluster, and send keep-alive packets to detect any interruption on the channels.

For each newly added repository on a physical storage element, an OCFS2 file system is created on the repository, and the repository is usually presented to all Oracle VM Servers in the pool. Figure 6.1, “Server Pool clustering with OCFS2 features” shows one repository, Repository 3, which is accessible by Oracle VM Server 1 only. Any virtual machine whose resources reside on this repository cannot take advantage of the high availability feature afforded by the server pool.

Note that repositories built on NFS shares are not formatted as OCFS2 file systems. See Section 4.8, “Preparing and Configuring Storage Repositories” for more information on repositories.

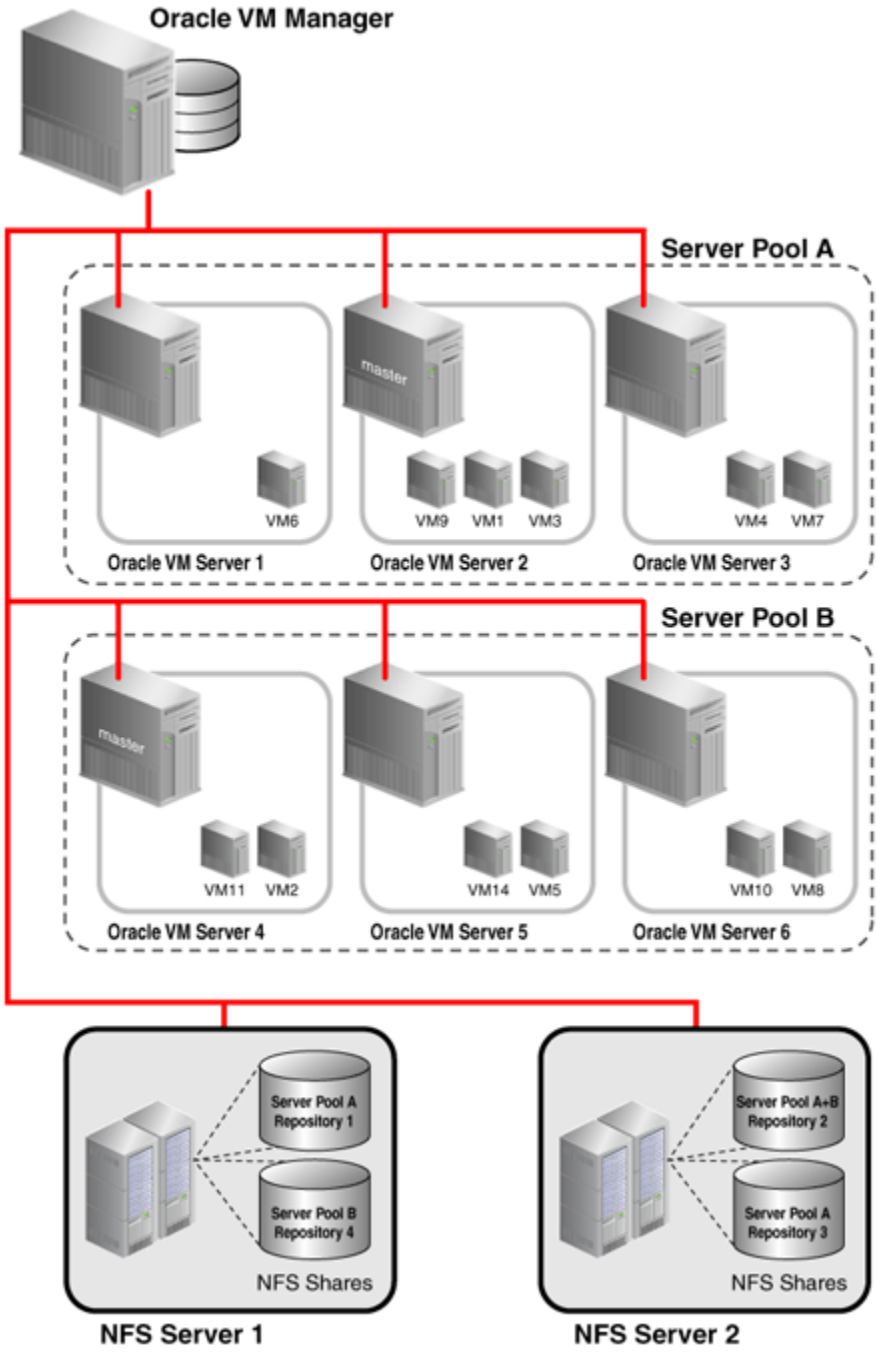
Figure 6.1, “Server Pool clustering with OCFS2 features” shows several virtual machines with resources in shared Repositories 1 and 2. As virtual machines are created, started, stopped, or migrated, the resources for these virtual machines are locked by the Oracle VM Servers needing these resources. Each Oracle VM Server ends up managing a subset of all the locked resources in the server pool. A resource may have several locks against it. An exclusive lock is requested when anticipating a write to the resource while several read-only locks can exist at the same time on the same resource. Lock state is kept in memory on each Oracle VM Server as shown in the diagram. The distributed lock manager (DLM) information kept in memory is exposed to user space in the synthetic file system called dlmfs, mounted under /dlm. If an Oracle VM Server fails, its locks are recovered by the other Oracle VM Servers in the cluster and virtual machines running on the failed Oracle VM Server are restarted on another Oracle VM Server in the cluster. If an Oracle VM Server is no longer communicating with the cluster via the heartbeat, it can be forcibly removed from the cluster. This is called fencing. An Oracle VM Server can also fence itself if it realizes that it is no longer part of the cluster. The Oracle VM Server uses a machine reset to fence. This is the quickest way for the Oracle VM Server to rejoin the cluster.

6.3. Unclustered Server Pools

When creating a server pool, you specify whether the servers in the pool will be part of a cluster or not. In most cases, you create a clustered server pool. You can create a non-clustered pool when all servers in the pool are expected to use only NFS shares as repositories. If your Oracle VM Servers are also expected to access repositories on physical disks, then these servers should be part of a clustered server pool.

Figure 6.2, “Unclustered Server Pools Using Only NFS Storage” illustrates server pools in an unclustered configuration, with shared access to resources on NFS storage but no HA features for the servers.

Figure 6.2. Unclustered Server Pools Using Only NFS Storage



Non-clustered server pools do not require a server pool file system, though a Virtual IP is still required and the Master function is also assigned to one of the server pool members.

A non-clustered server pool does not support HA for virtual machines deployed on its servers. If a server fails, the virtual machines on this server have to be restarted manually on a server in this server pool, or possibly on a server in another server pool, if that server pool also has access to the repositories needed for deploying the virtual machines on the failed server. Live Migration is supported between servers in a non-clustered pool if the servers have the same CPU affinity (same family and type of CPU). One cannot create a repository on a physical disk local to a server if that server does not belong to a clustered server

pool. If you want to create a pool with one server, and use a physical disk attached to that server as a repository, you have to create a clustered pool and add this single server to the newly defined clustered pool.

Note

Converting non-clustered server pools to clustered server pools is not supported in Release 3.1.1 of Oracle VM.

6.4. High Availability (HA)

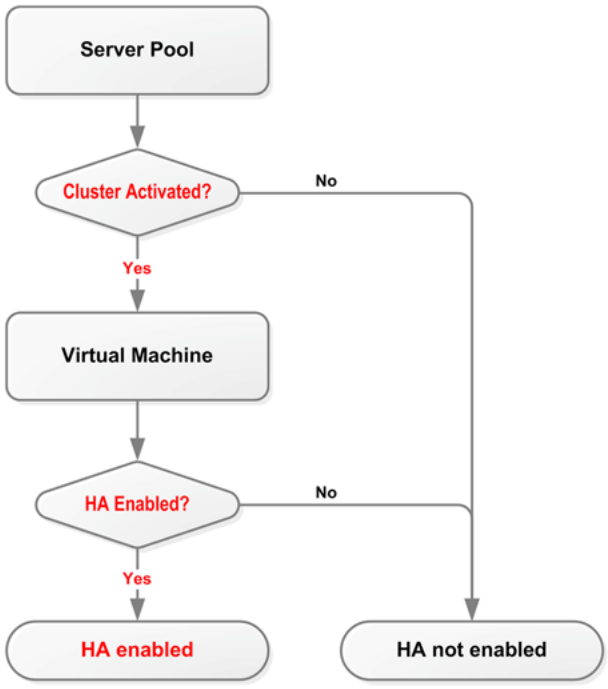
You can set up HA to help ensure the uninterrupted availability of a virtual machine. If HA is configured and a Oracle VM Server is restarted or shut down, the virtual machines running on it are either restarted on, or migrated to, another Oracle VM Server.

The following prerequisites are requirement to implement HA:

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

To use HA, you must first enable HA on the server pool, then on all virtual machines, as shown in Figure 6.3, “Enabling HA”. If you enable HA on the server pool and then for virtual machines, when an Oracle VM Server is shut down or fails, the virtual machines are migrated or restarted on another available Oracle VM Server. HA must be enabled for **both** the server pool **and** for virtual machines.

Figure 6.3. Enabling HA



To automatically configure the server pool cluster and enable HA in a server pool, select the **Clustered Server Pool** check box when you create or edit a server pool. See Section 6.7, “Creating a Server Pool” and Section 6.8.3, “Editing a Server Pool” for more information on creating and editing a server pool.

To enable HA on a virtual machine, select the **Enable High Availability** check box when you create or edit a virtual machine. See Section 7.7, “Creating a Virtual Machine” and Section 7.9.2, “Editing a Virtual Machine” for more information on creating and editing a virtual machine.

If HA is enabled and you want to restart, shut down, or delete an Oracle VM Server in Oracle VM Manager, you must first migrate the running HA-enabled virtual machines to another available Oracle VM Server. For information on migrating virtual machines, see Section 7.9.10, “Migrating a Virtual Machine”.

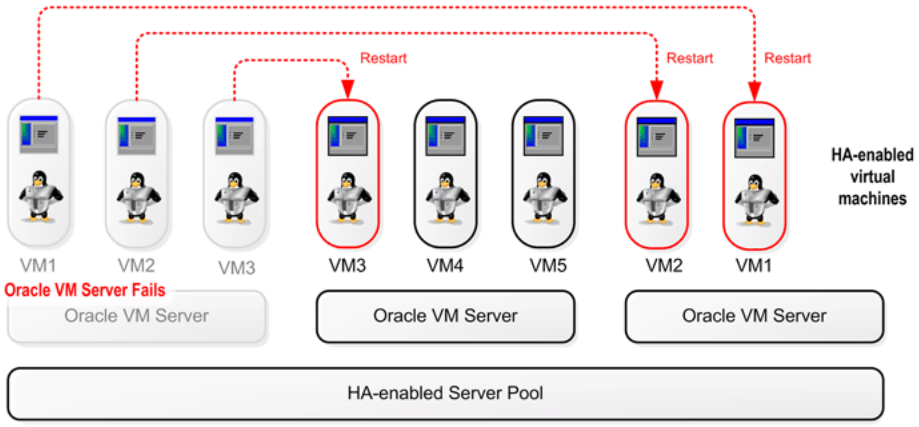
If there are no Oracle VM Servers available, the virtual machines are shut down (Powered Off) and are restarted when an Oracle VM Server becomes available.

The possible HA scenarios are:

- If you want to shut down or restart an Oracle VM Server in Oracle VM Manager, you must first migrate the HA-enabled virtual machines to another Oracle VM Server. For information on migrating virtual machines, see Section 7.9.10, “Migrating a Virtual Machine”.
- If an Oracle VM Server fails, all running virtual machines are restarted automatically on another available Oracle VM Server.
- If an Oracle VM Server fails and no other Oracle VM Servers are available, all running virtual machines are restarted when an Oracle VM Server becomes available.

Figure 6.4, “HA in effect for an Oracle VM Server failure” shows an Oracle VM Server failing and the virtual machines restarting on other Oracle VM Servers in the server pool.

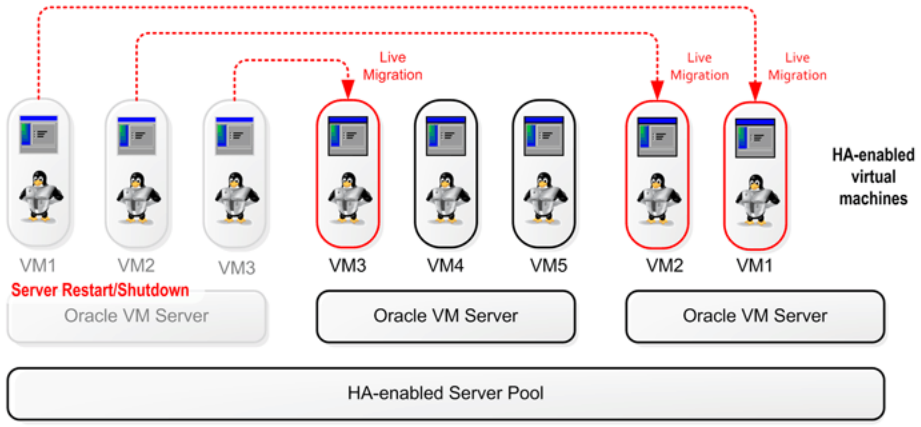
Figure 6.4. HA in effect for an Oracle VM Server failure



You should test your HA configuration to ensure it is properly configured in the event of a real failure.

Figure 6.5, “HA in effect for an Oracle VM Server restart or shut down” shows an Oracle VM Server restarting or shutting down and the virtual machines migrating to other Oracle VM Servers in the server pool.

Figure 6.5. HA in effect for an Oracle VM Server restart or shut down



6.5. Server Pool Policies

This section discusses the policies you can set to manage server pools, the Oracle VM Servers and virtual machines in server pools, and the networks used in a server pool.

6.5.1. Distributed Resource Scheduler (DRS)

The Distributed Resource Scheduler (DRS) optimizes virtual machine resource utilization in a server pool. DRS automatically moves running virtual machines to another Oracle VM Server in a server pool if any of the Oracle VM Servers exceed a specified CPU threshold for a specified period of time. DRS continuously samples performance data from every Oracle VM Server and every virtual machine.

The movement of virtual machines is policy-driven. When a threshold is reached, Oracle VM Manager live migrates the running virtual machine from one Oracle VM Server to another, without down time. Oracle VM Manager allows you to specify a DRS threshold for each server pool, and to choose which Oracle VM Servers participate in the policy.

See Section 6.8.5, “Editing Server Pool Policies” for information on enabling and configuring the DRS in a server pool.

6.5.2. Distributed Power Management (DPM)

Distributed Power Management (DPM) is used when there are periods of relative low resource utilization to increase the consolidation ratio on fewer Oracle VM Servers. DPM dynamically migrates virtual machines from under-utilized Oracle VM Servers. When there are Oracle VM Servers without virtual machines running the Oracle VM Server can be powered off, conserving power until the Oracle VM Server is needed again.

DPM aims to keep only the minimum necessary number of Oracle VM Servers running. If a periodic check reveals that a Oracle VM Server's CPU utilization is operating at below a user-set level, virtual machines are live migrated to other Oracle VM Servers in the same server pool.

When all virtual machines are migrated, the Oracle VM Server is shut down.

If an Oracle VM Server exceeds the DPM policy CPU threshold, Oracle VM Manager looks for other Oracle VM Servers to migrate virtual machines to from the busy Oracle VM Server. If no powered Oracle VM

Servers are available, Oracle VM Manager finds and starts a powered-off Oracle VM Server to power on. When that Oracle VM Server is running, Oracle VM Manager off-loads the virtual machines from the busy Oracle VM Server to the newly started Oracle VM Server.

Oracle VM Manager allows you to specify a DPM threshold for each server pool, and to choose which Oracle VM Servers participate in the policy.

See Section 6.8.5, “Editing Server Pool Policies” for information on enabling and configuring DPM in a server pool.

6.5.3. DRS/DPM Network Policies

Both the DRS and DPM policies can also be set for the networks used by Oracle VM Servers in a server pool. When a network used by an Oracle VM Server exceeds its threshold, virtual machines are migrated to other Oracle VM Servers to either balance the resources used (DRS), or reduce the power used (DPM). Each network on an Oracle VM Server can have a threshold set. The threshold applies to either the received data or the transmitted data. If the threshold is set to say 50%, when an Oracle VM Server's receive or transmit traffic on that network exceeds 50% of the theoretical capacity of the network, the Oracle VM Server is deemed to be over the threshold. The theoretical capacity of a network on an Oracle VM Server is equal to the port speed of the physical Ethernet adapter on the Oracle VM Server. If the network is bonded in a fail-over configuration, then the port capacity is equal to the port speed of one of the Ethernet adapters. If the network is bonded on a Oracle VM Server with link aggregation, then the network capacity is equal to the sum of the speed of the bonded Ethernet adapters.

You set the network policies for DRS and DPM when you set up the server pool policy. See Section 6.8.5, “Editing Server Pool Policies” for information on enabling and configuring network DRS and DPM policies in a server pool.

6.6. Anti-Affinity Groups

Anti-affinity groups specify that specific virtual machines should never run on the same Oracle VM Server. An anti-affinity group applies to all the Oracle VM Servers in a server pool. You may want to set up anti-affinity groups when you want to build-in redundancy or load balancing of specific applications in your environment.

If you add a virtual machine to an anti-affinity group that already has a virtual machine in the group running on the same Oracle VM Server, the job is aborted and the virtual machine is not added to the group. To add the virtual machine to the anti-affinity group, migrate it to another Oracle VM Server, then add it to the group.

6.6.1. Creating an Anti-Affinity Group

To create an anti-affinity group:

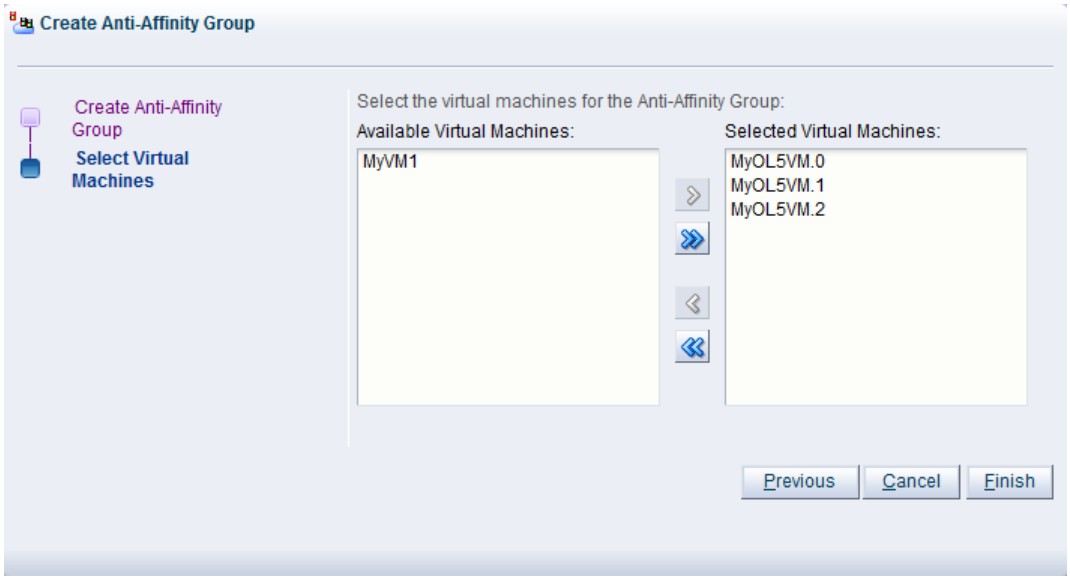
1. Click the **Servers and VMs** tab. Select a server pool in the navigation pane.
2. From the **Perspective** field in the management pane, select **Anti-Affinity Group** from the drop-down list. Click **Create New Anti-Affinity Group...** + in the management pane toolbar.
3. The **Create Anti-Affinity Group** wizard is displayed.

Enter the anti-affinity group information:

- **Anti-Affinity Group Name:** Enter the name of the anti-affinity group.
- **Description:** A description of the anti-affinity group.

Click **Next**.

4. The **Select Virtual Machines** step of the **Create Anti-Affinity Group** wizard is displayed.



Select the virtual machines to include in the anti-affinity group and move them from the **Available Virtual Machines** column to the **Selected Virtual Machines** column.

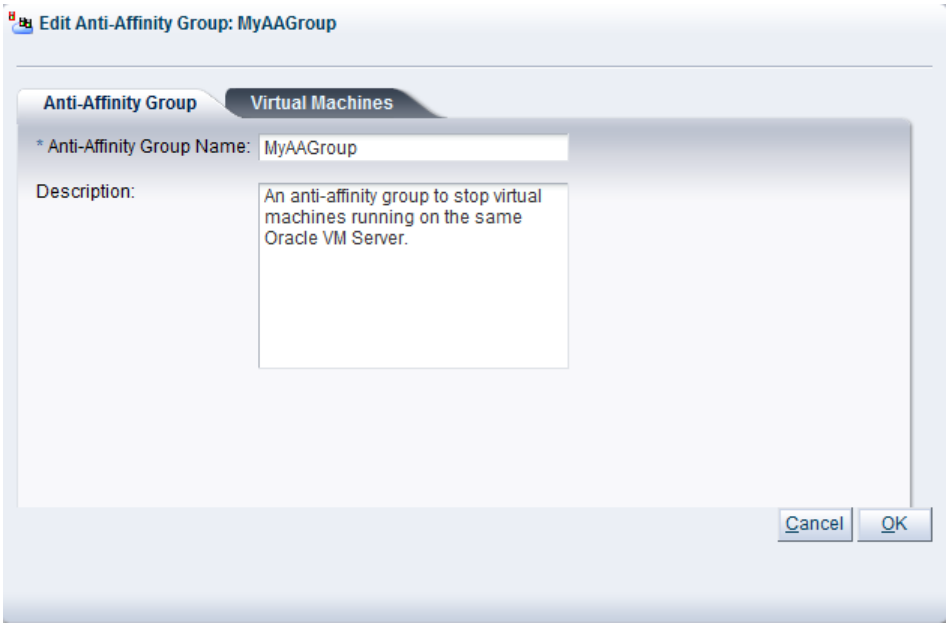
Click **Finish**.

The anti-affinity group is created and listed in the **Anti-Affinity Group** table in the management pane.

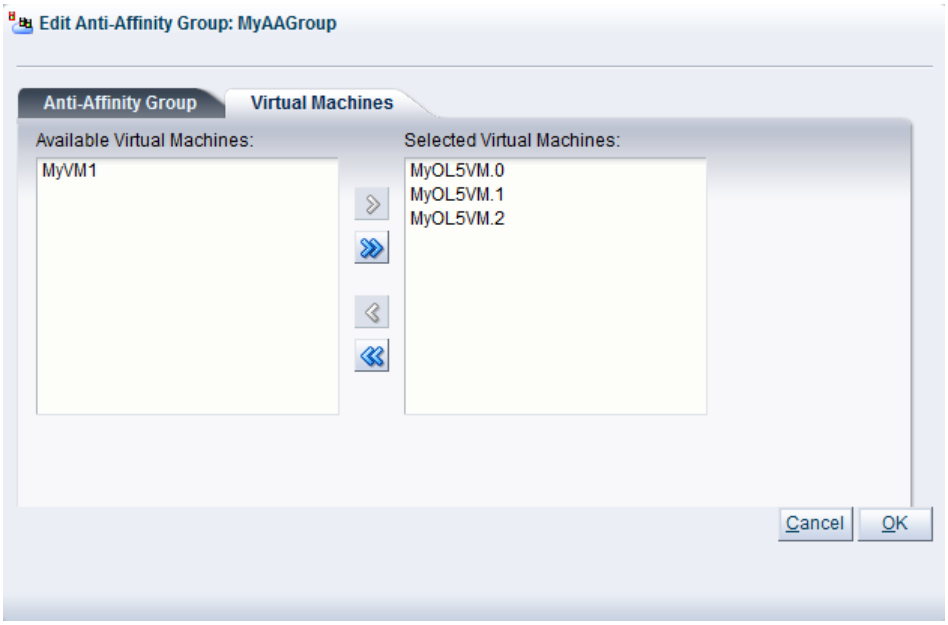
6.6.2. Editing an Anti-Affinity Group

To edit an anti-affinity group:

1. In the **Servers and VMs** tab, select the server pool to which the anti-affinity group belongs in the navigation pane.
2. From the **Perspective** field in the management pane, select **Anti-Affinity Group** from the drop-down list. Select the anti-affinity group in the **Anti-Affinity Group** table and click **Edit Anti-Affinity Group...** in the management pane toolbar.
3. The **Modify Anti-Affinity Group:** ***group_name*** dialog box is displayed.



Edit the anti-affinity group as required. To edit the virtual machines in the anti-affinity group, click the **Virtual Machines** tab.



For more information on the tabs in this wizard, see Section 6.6.1, “Creating an Anti-Affinity Group”.

Click **OK**.

The anti-affinity group is edited and displayed in the **Anti-Affinity Group** table in the management pane.

6.6.3. Deleting an Anti-Affinity Group

To delete an anti-affinity group:

1. In the **Servers and VMs** tab, select the server pool to which the anti-affinity group belongs in the navigation pane.
2. From the **Perspective** field in the management pane, select **Anti-Affinity Group** from the drop-down list. Select the anti-affinity group in the **Anti-Affinity Group** table and click **Delete Anti-Affinity Group...** ✖ in the management pane toolbar.
3. A confirmation dialog box is displayed. Click **OK** to delete the anti-affinity group.

The anti-affinity group is deleted.

6.7. Creating a Server Pool

A server pool consists of at least one, but usually multiple Oracle VM Servers. All Oracle VM Servers in a server pool should have CPUs in the same CPU family and of the same type. If they are not in the same CPU family and type, some operations such as live migration may fail. Though the CPUs should be in the same CPU family, they may have differing configurations, such as different number of cores. Other hardware components on the host computer may also differ, such as the amount of RAM, the number and size of disk drives, and so on.

Although the host computers may have differing configurations, Oracle recommends that all Oracle VM Servers in a server pool are identical. Oracle VM Manager contains rules for processor compatibility groups. If live migration is attempted between incompatible processors, an error message is displayed.

Before creating a server pool, you must have:

- IP addresses for the Oracle VM Servers.
- IP address to use as the virtual IP address.
- Password to access the Oracle VM Agent installed on the Oracle VM Server(s).

Note

The Oracle VM Agent password must be the same on each Oracle VM Server in a server pool. For information on changing the Oracle VM Agent password on your Oracle VM Servers, see Section 6.8.4, “Changing Oracle VM Agent Passwords on Oracle VM Servers”.

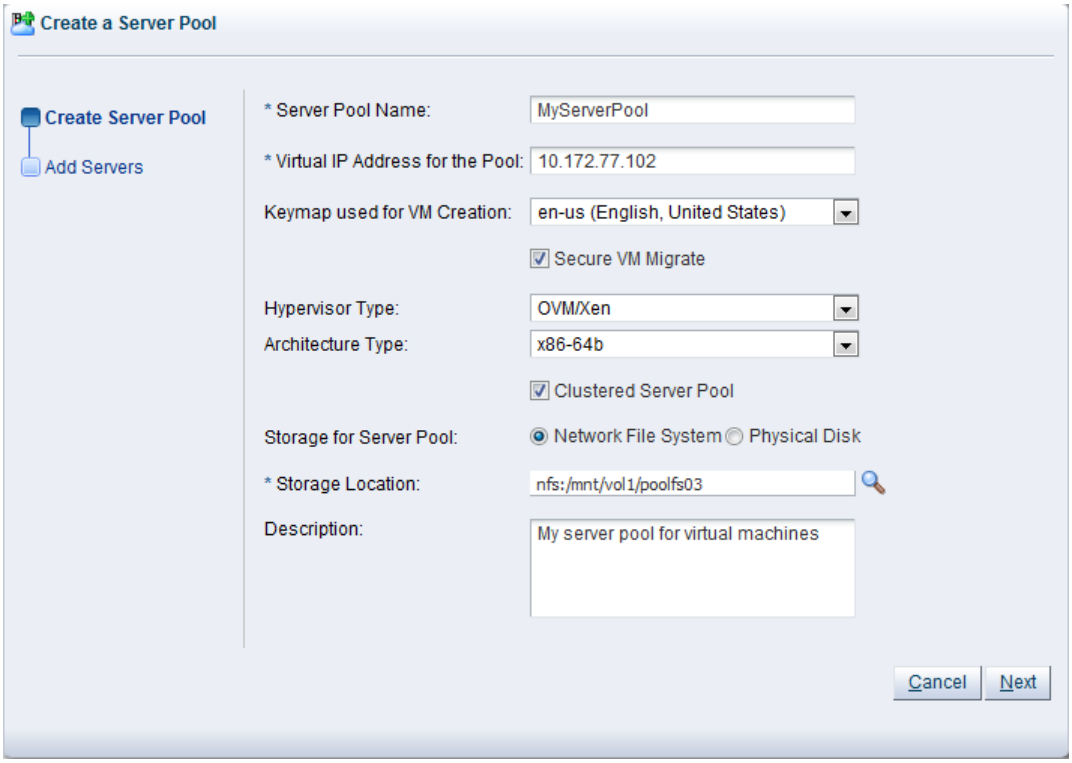
A server pool should have a dedicated file system (either a NAS export, or a LUN) to use as the server pool's file system. Oracle recommends that you create this storage with a size of at least 10 GB.

If any errors are encountered when you create a server pool, the Oracle VM Servers are returned to the unconfigured state.

To create a server pool:

1. Click the **Servers and VMs** tab.

2. Click **Create Server Pool** in the toolbar to start the **Create Server Pool** wizard.
3. The **Create Server Pool** step is displayed in the wizard.



Enter the server pool information:

- **Server Pool Name:** The name of the server pool. The maximum length of a server pool name is 256 characters and may contain any character.
- **Virtual IP Address for the Pool:** An IP address used to identify the master Oracle VM Server, which controls the other Oracle VM Server in the server pool. In the event that the master Oracle VM Server fails or is placed into maintenance mode, another Oracle VM Server is selected to perform the master role, and this IP address is then assigned to the new host.
- **Keymap used for VM Creation:** The key mapping to be used when connecting to a virtual machine's console.
- **Secure VM Migrate:** Select whether to enable encrypted migration of virtual machines. When Secure VM Migrate is checked, virtual machines are migrated using SSL to protect the data during the migration process. Secure migration of a virtual machine may effect the time taken to perform the migration as the encryption and decryption of data requires more system resources and time.
- **Hypervisor Type:** Select the hypervisor type to use for the server pool.

  Note

  Only `OVM/Xen` is supported in this release.

- **Architecture Type:** Select the architecture type to use for the server pool.

Note

Only `x86-64b` is supported in this release.

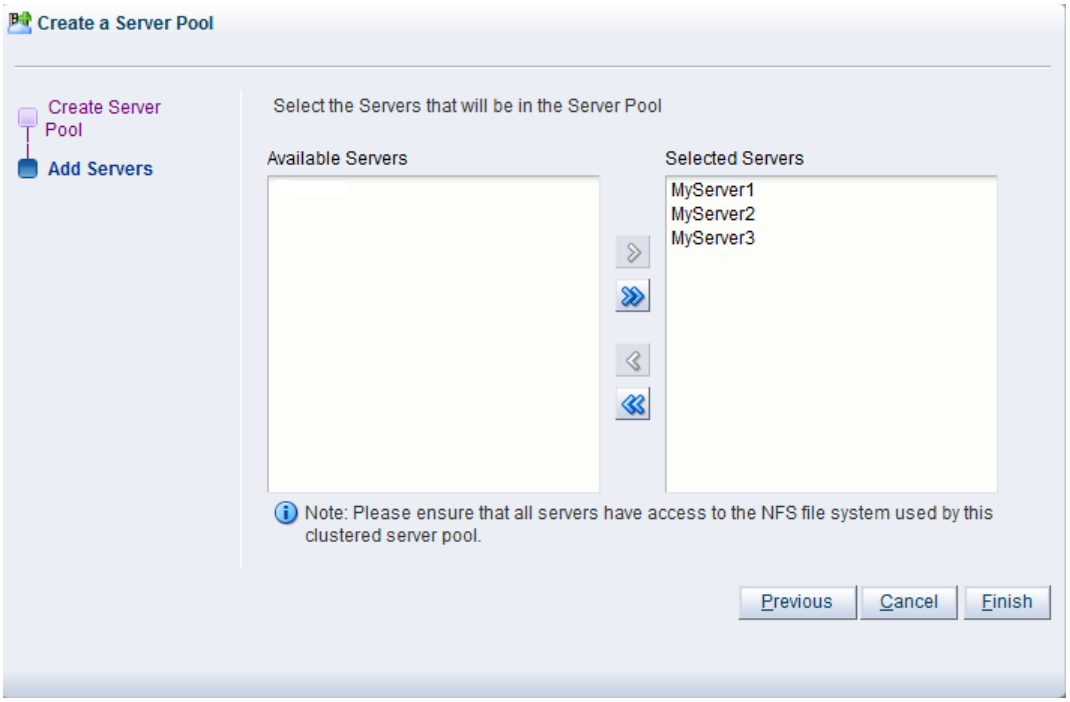
- **Clustered Server Pool:** Select whether to enable clustering of the Oracle VM Servers in the server pool to enable HA. See Section 6.4, “High Availability (HA)” for more information on HA policies and configuration.
- **Storage for Server Pool:** Select the file system type to use for the server pool, either a **Network File System**, or a **Physical Disk**. The server pool file system is used to hold the server pool and cluster data, and is also used for cluster heartbeating. Oracle recommends that you create this storage with a size of at least 12 GB, as a NAS export or LUN.

  A server pool file system is exclusive, just like other storage. That is, in the same way that you cannot create two storage repositories on the same export path, the server pool file system cannot be shared with other server pools, or with storage repositories. Each fully qualified export path (for example, /export/myexport/one, /export/myexport/two) must be used for one, and only one, purpose, that is, for a storage repository, or a server pool file system.

  For information on creating storage, see Chapter 4, *Managing Storage*.
- **Network File System:** The file system to use as the pool file system. Click **Search** in the **Storage Location** field to search for a network file system. This field is displayed if you select Network File System in the previous field.
- **Physical Disk:** The file system to use as the pool file system. Click **Search** in the **Storage Location** field to search for a physical disk. This field is displayed if you select Physical Disk in the previous field.
- **Description:** A description of the server pool. This field is optional.

Click **Next**.

4. The **Add Servers** step is displayed in the wizard.



Select the Oracle VM Servers to add to the server pool from the **Available Servers** column and move them to the **Selected Servers** column.

Click **Finish**.

The server pool is created.

6.8. Managing Server Pools

When you have created a server pool, you can perform a number of actions on it, like adding and removing Oracle VM Servers, and editing server pool policies. This section discusses the actions you can perform on a server pool.

6.8.1. Adding an Oracle VM Server to a Server Pool

When you need more resources in a server pool (such as the number of CPUs and the size of memory), you can add more Oracle VM Servers. For example, when you want to run more virtual machines and the resources in the server pool are reaching capacity, you can add more Oracle VM Servers which increases the available resources.

Adding Oracle VM Servers to a server pool requires the modification of both the cluster configuration information and the server pool information, on all Oracle VM Servers. This is performed automatically.

Adding Oracle VM Servers to a server pool may trigger pending HA operations if there were previously insufficient resources to run all HA virtual machines.

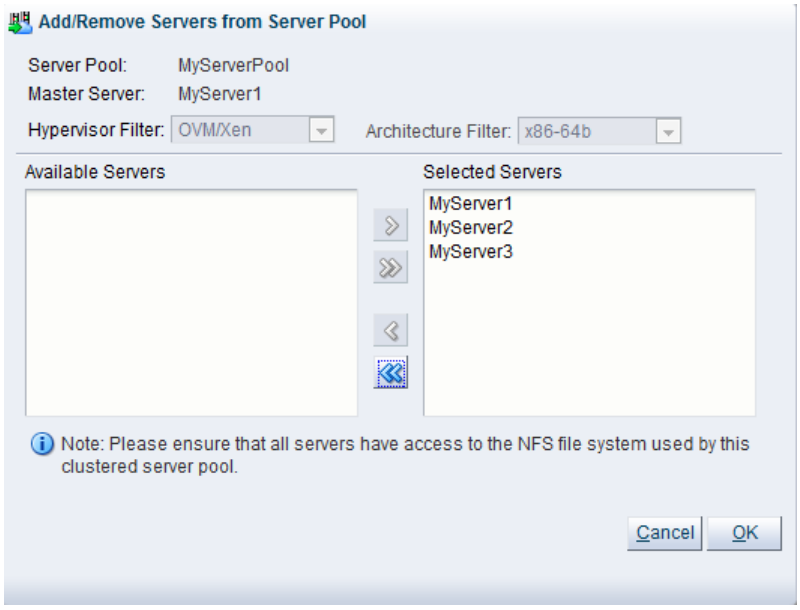
Note

All Oracle VM Servers in a server pool must have the same Oracle VM Agent password.

To add Oracle VM Servers to a server pool:

1. Click the **Servers and VMs** tab.

2. Select the server pool in the **Server Pools** folder in the navigation pane. Click **Add/Remove Servers from Server Pool...** in the toolbar. The **Add/Remove Servers from Server Pool** dialog box is displayed.



3. Select the Oracle VM Servers you want to add to the server pool from the **Available Servers** list box and move them to the **Selected Servers** list box. Click **OK**.

The server pool is updated to include new Oracle VM Servers.

6.8.2. Removing an Oracle VM Server from a Server Pool

When you want to remove resources in a server pool, perhaps to be used elsewhere, you can remove an Oracle VM Server from a server pool. Removing an Oracle VM Server from a server pool does not delete it, but places it in the unconfigured state.

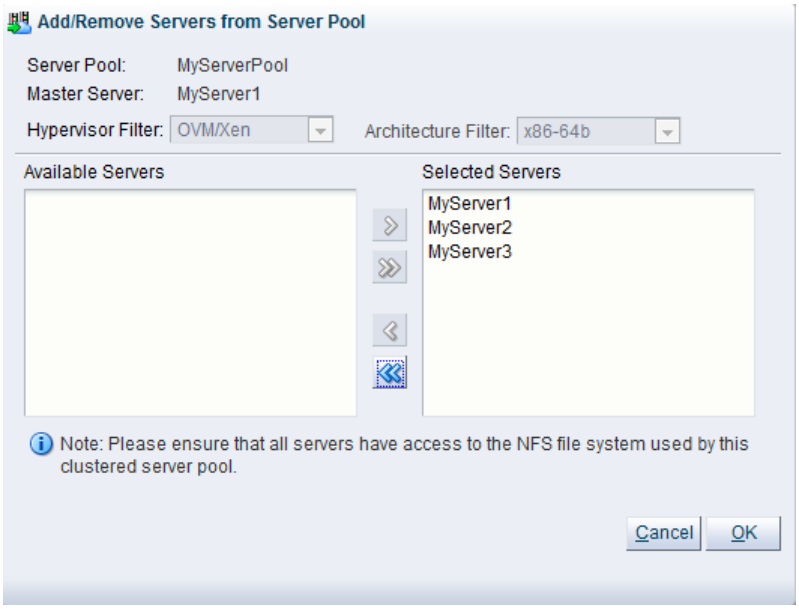
Before you can remove an Oracle VM Server from a server pool, it must be suspended from participating in all server pool roles and all virtual machines stopped or migrated. To automatically migrate the running virtual machines and suspend all server pool roles, place the Oracle VM Server in maintenance mode. See Section 6.9.10, “Placing an Oracle VM Server into Maintenance Mode” for information on putting an Oracle VM Server into maintenance mode.

Removing an Oracle VM Server from a server pool requires modification of both cluster configuration information and server pool information on all Oracle VM Servers in the server pool. This is performed automatically.

To remove Oracle VM Servers from a server pool:

1. Click the **Servers and VMs** tab.

2. Select the server pool in the **Server Pools** folder in the navigation pane. Click **Add/Remove Servers from Server Pool...** in the toolbar. The **Add/Remove Servers from Server Pool** dialog box is displayed.



3. Select the Oracle VM Servers you want to remove from the server pool from the **Selected Servers** list box and move them to the **Available Servers** list box. Click **OK**.

The server pool is updated and the Oracle VM Servers are removed and placed in the Unassigned Servers folder in the navigation tree.

6.8.3. Editing a Server Pool

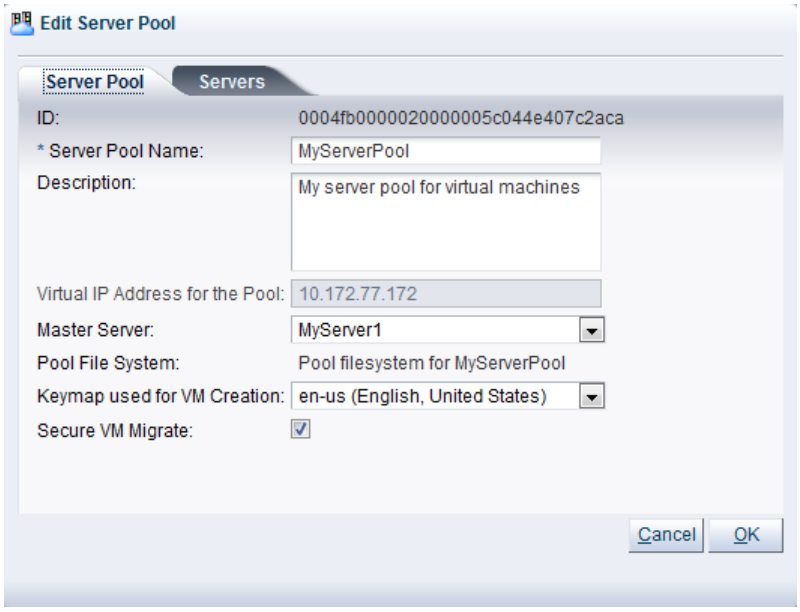
You can edit the configuration information of a server pool, including the server pool name, description, and key mapping. You can also change the master server, which controls the cluster, as well as whether the virtual machines are migrated securely. You cannot change the virtual IP address or the file system used for the server pool.

To add or remove Oracle VM Servers from a server pool, see Section 6.8.1, “Adding an Oracle VM Server to a Server Pool” and Section 6.8.2, “Removing an Oracle VM Server from a Server Pool”.

To edit a server pool:

1. Click the **Servers and VMs** tab.

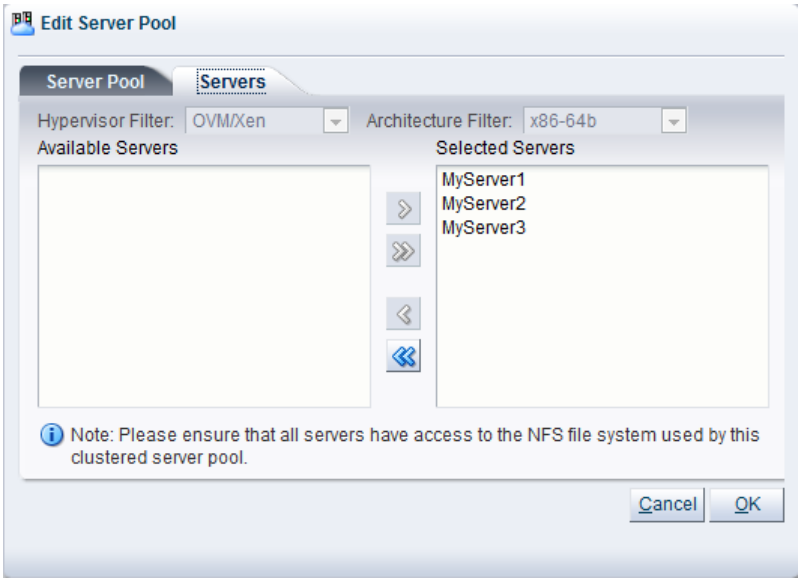
2. Select the server pool in the **Server Pools** folder in the navigation pane. Click **Edit Selected Server Pool...** in the toolbar. The **Edit Server Pool** dialog box is displayed.



3. Edit the server pool information:

   - **Server Pool Name:** The name of the server pool. The maximum length of a server pool name is 256 characters and may contain any character.
   - **Description:** A description of the server pool.
   - **Virtual IP Address for the Pool**: This field cannot be modified.
   - **Master Server:** The master server that handles interactions with Oracle VM Manager.
   - **Pool File System:** This field cannot be modified.
   - **Keymap used for VM Creation**: The key mapping to use in the consoles for all virtual machines in the server pool.
   - **Secure VM Migrate:** Select whether to enable encrypted migration of virtual machines.

   To edit the servers in the server pool, select the server in the navigation pane and click the **Servers** tab.



For more information on the tabs in this wizard, see Section 6.7, “Creating a Server Pool”.

Click **OK**.

The server pool changes are automatically propagated to all Oracle VM Servers in the server pool by the master server.

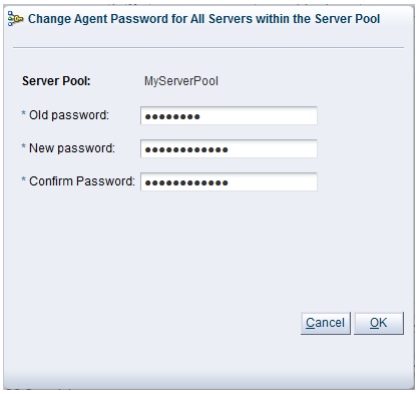
6.8.4. Changing Oracle VM Agent Passwords on Oracle VM Servers

Oracle VM Manager allows you to change the password for the Oracle VM Agent running on each Oracle VM Server. However, you must change the Oracle VM Agent password for all Oracle VM Servers in a server pool. This is why the password change can only be executed at the server pool level and is applied to all Oracle VM Servers in the server pool at the same time.

To change the Oracle VM Agent password for all Oracle VM Servers in a server pool:

1. Click the **Servers and VMs** tab.

2. In the navigation pane, select the server pool for which you want to change the Oracle VM Agent password. Click **Change Servers Agent Password** in the toolbar. The **Change Agent Password for All Servers within the Server Pool** dialog box is displayed.



3. Enter the current password first. Then enter a new password and confirm it in the respective fields.

4. Click **OK** to complete the operation. Oracle VM Manager logs into each Oracle VM Server in the server pool and changes the Oracle VM Agent password.

6.8.5. Editing Server Pool Policies

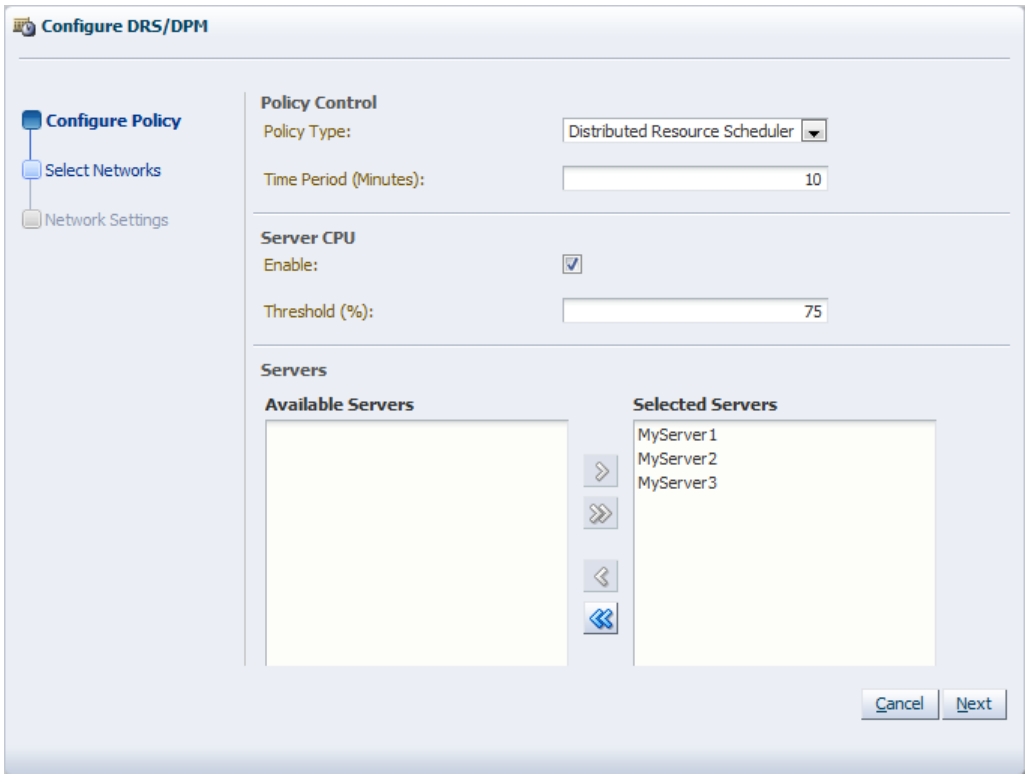
When you select a server pool in the navigation pane, the **Policies** view is available in the **Perspective** field in the management pane showing the power and resource utilization policy settings for the server pool. The two policies you can set are for:

- Distributed Resource Scheduler (DRS): Optimizes virtual machine resource utilization in a server pool.
- Distributed Power Management (DPM): Increases the consolidation ratio to use fewer Oracle VM Servers during periods of relative low resource utilization.

The policy is also able to be set for networks used in a server pool. You can set the server pool to use either DRS, or DPM, but not both at the same time.

See Section 6.5, “Server Pool Policies” for more information on these server pool policies.

To set or edit a server pool policy:

1. Click the **Servers and VMs** tab.
2. Select the server pool in the **Server Pools** folder in the navigation pane.
3. From the **Perspective** field in the management pane, select **Policies** from the drop-down list. Click **Edit** in the toolbar. The **Configure Policy** step of the **Configure DRS/DPM** wizard is displayed.
4. 

   Enter the server pool policy information:

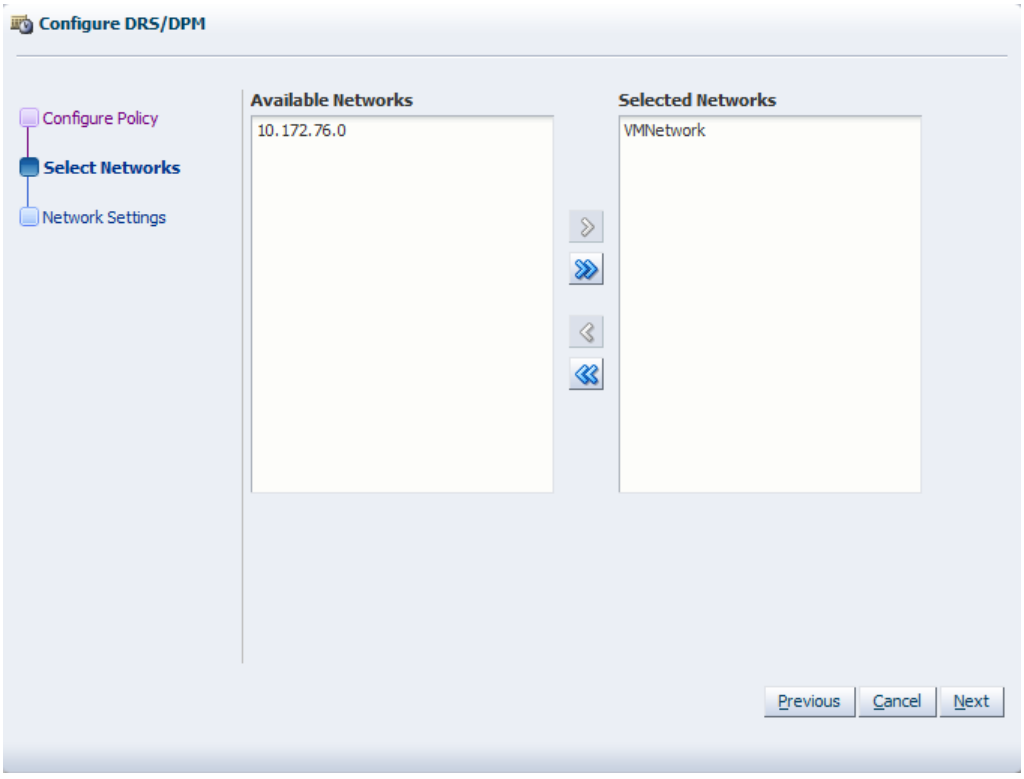
   - **Policy Control:**

- **Policy Type:** You can choose from either DRS, DPM, or none. You cannot set both DRS and DPM to be active at the same time.
- **Time Period (Minutes):** The time period for the policy job to run. This sets the policy job to run every *n* minutes, for example, 10 sets the policy job to run every 10 minutes. You can enter a number between 1 and 60.

- **Server CPU:**
  - **Enable:** Set whether to enable or disable logging of CPU performance and utilization.
  - **Threshold (%):** The maximum amount of CPU percentage usage allowed before the policy must be enacted. You can enter between 0 and 99.
- **Servers:** Select the Oracle VM Servers for which the policy is to be enabled by moving the selected Oracle VM Servers from the **Available Servers** to the **Selected Servers** shuttle box.

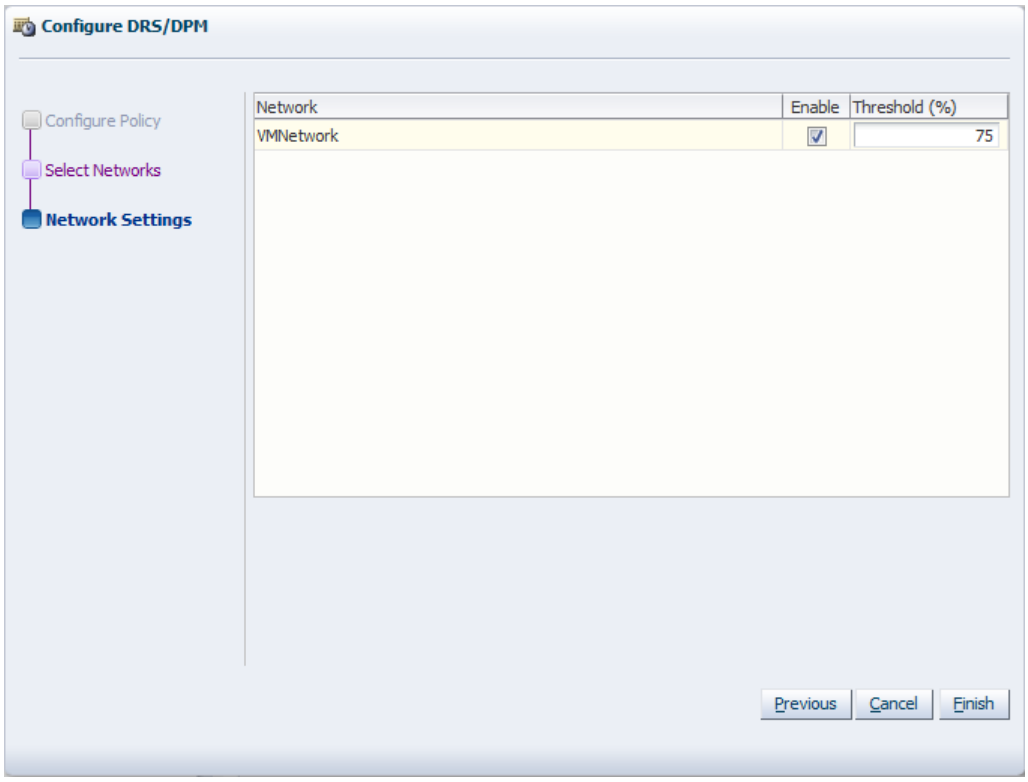
Click **Next**.

5. The **Select Networks** step of the **Configure DRS/DPM** wizard is displayed.



Select the networks to be included in the policy. Click **Next**.

6. The **Network Settings** step of the **Configure DRS/DPM** wizard is displayed.



Select whether to enable the policy on the network, and select the threshold at which the policy is to be enacted for the network. Click **Finish**.

The policy is set for the server pool.

6.8.6. Deleting a Server Pool

Before you can delete a server pool, you must delete all virtual machines and remove all Oracle VM Servers from the server pool.

To delete a virtual machine, see Section 7.9.11, “Deleting a Virtual Machine”. To remove an Oracle VM Server from a server pool, see Section 6.8.2, “Removing an Oracle VM Server from a Server Pool”.

To delete a server pool:

1. Click the **Servers and VMs** tab.
2. Select the server pool in the **Server Pools** folder in the navigation pane. Click **Delete** ✖ in the toolbar.

   The **Delete Confirmation** dialog box is displayed.
3. Click **OK** to delete the server pool.

The server pool is deleted.

Tip

To delete a server pool which is HA-enabled, you must have an Admin server assigned to any NFS file server-based storage. See Section 4.6.1, “Discovering File Servers” for information on editing a file server to add an Admin server.

6.9. Managing Oracle VM Servers

Use Oracle VM Manager to manage Oracle VM Servers. Do not manage Oracle VM Servers directly using the Oracle VM Server command line unless directed to do so by a My Oracle Support document, or by Oracle Support.

A server pool must contain at least one Oracle VM Server. After installing an Oracle VM Server, you must discover it in Oracle VM Manager before it can be added to a server pool.

Before you discover Oracle VM Servers and add them to a server pool, you must:

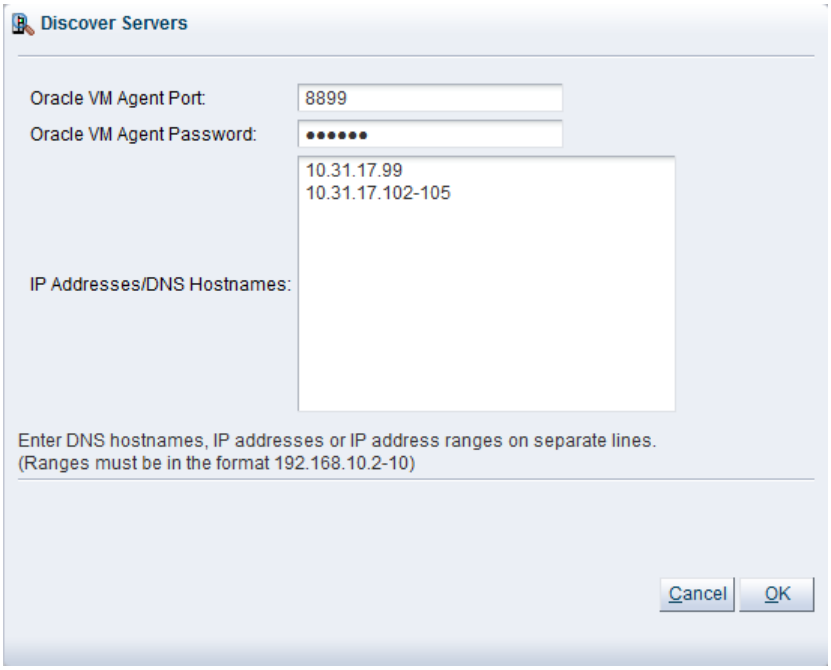
- Identify the IP address of the Oracle VM Server(s). If you installed Oracle VM Server with a static IP address (recommended), this is the IP address you use. If you installed Oracle VM Server with a dynamic IP address, log onto the Oracle VM Server and determine the IP address.
- Identify the password to access the Oracle VM Agent installed on the Oracle VM Server.

6.9.1. Discovering Oracle VM Servers

When an Oracle VM Server is installed and starts up, it listens for Oracle VM Manager server pool discovery events. Before you can add an Oracle VM Server to a server pool, it must first be discovered.

To discover an Oracle VM Server:

1. Click the **Servers and VMs** tab.
2. Click **Discover Servers** in the toolbar. The **Discover Servers** dialog box is displayed.



Note

You can also use the **Discover Servers...** subtab in the **Tools and Resources** tab to discover Oracle VM Servers. The fields in that screen are identical to those discussed in this procedure.

3. Enter information about the Oracle VM Server(s) to be discovered:

- **Oracle VM Agent Port**: The port on which the Oracle VM Agent is listening. This is most likely the default port **8899**.
- **Oracle VM Agent Password**: The password to connect to the Oracle VM Agent. The password must be the same on all Oracle VM Servers.
- **IP Addresses/DNS Hostnames**: Enter the IP address(es), IP ranges or DNS hostnames of the Oracle VM Server(s) to be discovered. You can paste a list of multiple IP addresses or multiple DNS hostnames. If you enter an IP range it must be in the format 192.168.10.2-10. For example, if you enter 192.168.10.2-4 Oracle VM Manager will discover 192.168.10.2, 192.168.10.3 and 192.168.10.4. IP addresses, IP ranges and DNS host names must be entered on separate lines.

Note

Invalid entries may result in a job that will fail to complete and may need to be aborted. See Section B.1.8, “Aborting A Job” for information on aborting a job.

Click **OK**.

The Oracle VM Servers are discovered and added to the Unassigned Servers folder. The newly discovered Oracle VM Server contains some basic information about itself, and about any immediate connectivity to a shared SAN, but it is considered to be in an unconfigured state. The Oracle VM Server cannot be used to perform any virtual machine, or active cluster operations. Physical network and storage configuration can be performed, and any subsequent storage discovery operations may also be performed.

When an Oracle VM Server is discovered, it is configured to use the Oracle VM Manager host computer as the Network Time Protocol (NTP) time source. This ensures that all Oracle VM Servers are in sync with each other in the Oracle VM Manager environment.

Caution

Time synchronization only works if the NTP service is configured correctly on the Oracle VM Manager host. For more information and instructions, see Configuring the NTP Service in the *Oracle VM Installation and Upgrade Guide*.

The **Utilization %** column in the **Servers** perspective in the management pane does not report the utilization statistics of an Oracle VM Server that is in the **Unassigned Servers** folder. This field does not report utilization statistics unless an Oracle VM Server is included in a server pool.

Note

Discovered Oracle VM Servers do not use a Virtual IP address until they are properly configured by being included in a server pool.

When an Oracle VM Server has been discovered, it can be added to a server pool. See Section 6.8.1, “Adding an Oracle VM Server to a Server Pool” for information on adding an Oracle VM Server to a server pool.

6.9.2. Rediscovering an Oracle VM Server

If the physical state of an Oracle VM Server changes, you should discover it again to update the configuration information in Oracle VM Manager.

To rediscover an Oracle VM Server:

1. Click the **Servers and VMs** tab.

2. Select the Oracle VM Server in the navigation pane. Click **Rediscover Server** in the management pane toolbar.

The configuration information about the Oracle VM Server is updated in Oracle VM Manager.

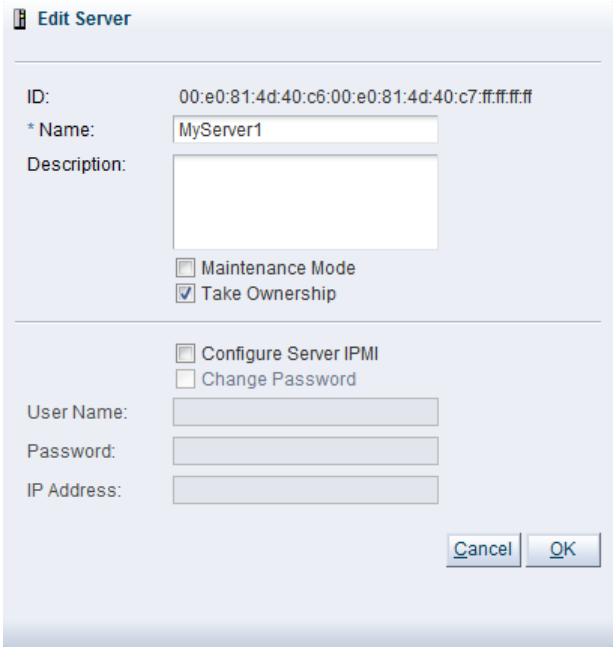
6.9.3. Taking Ownership of an Oracle VM Server

By default, the user who adds the Oracle VM Server to Oracle VM Manager has ownership of that Oracle VM Server. If an Oracle VM Server is in the Unassigned Servers folder and does not have ownership by your user, you need perform the following steps to take ownership and use the Oracle VM Server in a server pool.

To take ownership of an Oracle VM Server:

1. Click the **Servers and VMs** tab.

2. Select the Oracle VM Server in the **Unassigned Servers** folder in the navigation pane. Click **Edit Server** in the toolbar. The **Edit Server** dialog box is displayed.



3. Select the **Take Ownership** check box to take ownership of the Oracle VM Server. Click **OK**.

To relinquish ownership of the Oracle VM Server, repeat the same procedure and uncheck the **Take Ownership** check box.

You cannot relinquish ownership of an Oracle VM Server while it is in a server pool, you must first remove it from a server pool. See Section 6.8.2, “Removing an Oracle VM Server from a Server Pool” for information on removing an Oracle VM Server from a server pool.

6.9.4. Viewing Oracle VM Server Information and Events

You can view basic information about an Oracle VM Server, or drill down for more detailed information. The basic Oracle VM Server information is what you are likely to want to see on a regular basis for system monitoring, for example, the status (running, starting, stopped), utilization, IP address, memory, CPUs, and whether a software update is available. If this information is not enough, you can drill down to the more detailed information.

To view basic Oracle VM Server information:

1. Click the **Servers and VMs** tab, and select the server pool on which the Oracle VM Server resides in the navigation tree.
2. Select **Servers** in the **Perspective** drop-down list in the management pane. General information about the Oracle VM Servers in the server pool is displayed in the management pane.

To view detailed Oracle VM Server information:

1. Click the **Servers and VMs** tab, and select the Oracle VM Server in the navigation tree.
2. Select **Info** in the **Perspective** drop-down list in the management pane. Detailed information about the Oracle VM Server is displayed in the management pane. Expand any arrows for more information.

To view Oracle VM Server events:

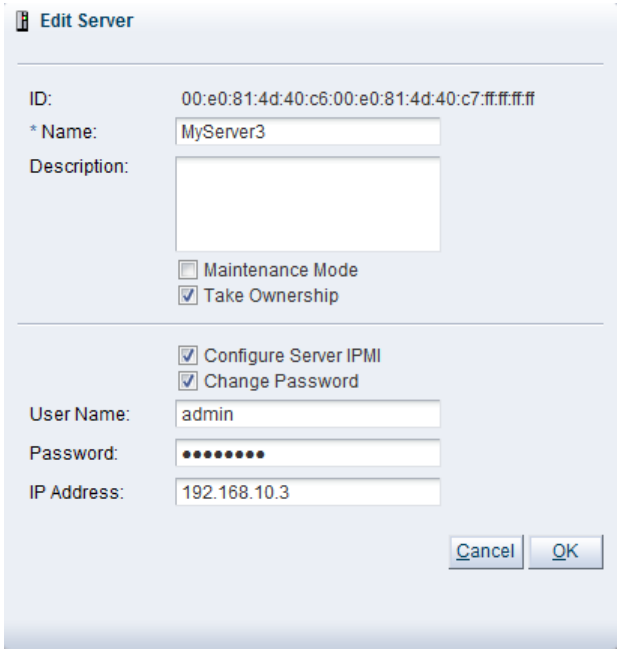
1. Click the **Servers and VMs** tab, and select the Oracle VM Server in the navigation tree.
2. Select **Events** from the **Perspective** drop-down list. A list of the events associated with the Oracle VM Server are displayed in the management pane table. Select an event in the table, and expand the arrow for more information about the event.
3. If an Oracle VM Server has error event associated with it you must acknowledge the event to clear the error. See Section B.1.10, “Acknowledging Events/Errors” for information on acknowledging events.

6.9.5. Editing Oracle VM Server Information

You can edit the configuration information for an Oracle VM Server to change the name, description, any server pool roles, and to take it off-line to perform system maintenance.

To edit the configuration information of an Oracle VM Server:

1. Click the **Servers and VMs** tab.
2. Select the Oracle VM Server in the navigation pane. Click **Edit Server** in the toolbar. The **Edit Server** dialog box is displayed.



3. Edit the information about the Oracle VM Server:

   - **Name:** The name of the Oracle VM Server.
   - **Description:** A description of the Oracle VM Server.
   - **Maintenance Mode:** Select whether to place the Oracle VM Server in maintenance mode. See Section 6.9.10, “Placing an Oracle VM Server into Maintenance Mode” for more information about Oracle VM Server maintenance mode.
   - **Take Ownership:** Select to take ownership of the Oracle VM Server. See Section 6.9.3, “Taking Ownership of an Oracle VM Server” for information on ownership of an Oracle VM Server.

     Tip

     You cannot edit the ownership of an Oracle VM Server if it is included in a server pool.

   - **Configure Server IPMI:** Select to enable the Intelligent Platform Management Interface (IPMI). IPMI allows you to remotely power off an Oracle VM Server, and to send a *wake on lan* message to power on an Oracle VM Server without having to physically press the power button. To configure IPMI enter the following information in the fields:

     - **User Name:** The user name for the IPMI.
     - **Password:** The password for the IPMI.

       To set or modify the IPMI password, you must also select the **Change Password** check box.

     - I**P Address:** The IP address of the IPMI.

   Click **OK**. The Oracle VM Server is updated.

6.9.6. Starting an Oracle VM Server

When you start an Oracle VM Server, it is started using the Intelligent Platform Management Interface (IPMI), or Wake-on-LAN (WOL). If neither IPMI nor WOL have been configured, the job to start the Oracle VM Server cannot be completed. The Oracle VM Server must then be powered on manually. See Section 6.9.5, “Editing Oracle VM Server Information” for information on configuring IPMI.

To start an Oracle VM Server:

In the **Servers and VMs** tab, select the Oracle VM Server in the navigation pane. Click **Start Server** ▶ in the management pane toolbar.

The Oracle VM Server is started.

6.9.7. Stopping an Oracle VM Server

When you stop an Oracle VM Server, it is stopped using the Intelligent Platform Management Interface (IPMI), or a system power off command. Before you can stop an Oracle VM Server, you must stop any running virtual machines, or place the Oracle VM Server into maintenance mode to automatically migrate the running virtual machines.

Warning

Make sure that the IPMI is properly configured on the Oracle VM Server, otherwise it cannot be started again remotely. See Section 6.9.5, “Editing Oracle VM Server Information” for IPMI configuration.

Alternatively, make sure that the Oracle VM Server are on the same subnet and activate the Wake-on-LAN (WOL) feature in the Oracle VM Server BIOS. If an Oracle VM Server cannot start through IPMI or WOL, it must be power-cycled manually.

To stop an Oracle VM Server:

1. Stop or migrate any running virtual machines. To stop the virtual machines see Section 7.9.4, “Stopping (Shutting Down) a Virtual Machine”. To automatically migrate the virtual machines to other Oracle VM Servers in the server pool, place the Oracle VM Server into maintenance mode , see Section 6.9.10, “Placing an Oracle VM Server into Maintenance Mode” .
2. In the **Servers and VMs** tab, select the Oracle VM Server in the navigation pane. Click **Stop Server** in the management pane toolbar.

The Oracle VM Server is powered off.

6.9.8. Restarting an Oracle VM Server

When you restart an Oracle VM Server, an operating system restart command is sent and the Oracle VM Server is restarted. Before you can restart an Oracle VM Server, you must stop any running virtual machines, or place the Oracle VM Server into maintenance mode to automatically migrate the running virtual machines.

When the Oracle VM Server is restarted and rejoins the server pool, the master Oracle VM Server initiates any pending HA operations in the server pool. When Oracle VM Manager is notified that the Oracle VM Server is online and available, any pending state changes are reconciled before any policy actions are resumed.

To restart an Oracle VM Server:

1. Stop or migrate any running virtual machines. To stop the virtual machines see Section 7.9.4, “Stopping (Shutting Down) a Virtual Machine”. To automatically migrate the virtual machines to other Oracle VM Servers in the server pool, place the Oracle VM Server into maintenance mode , see Section 6.9.10, “Placing an Oracle VM Server into Maintenance Mode” .
2. In the **Servers and VMs** tab, select the Oracle VM Server in the navigation pane. Click **Restart** in the management pane toolbar.

The Oracle VM Server is restarted.

6.9.9. Selecting the Master Oracle VM Server

You can select which Oracle VM Server performs the master Oracle VM Server role in a server pool with the Edit the Server Pool dialog box. See Section 6.8.3, “Editing a Server Pool” for information on using the Edit the Server Pool dialog box.

6.9.10. Placing an Oracle VM Server into Maintenance Mode

An Oracle VM Server can be placed into *maintenance mode* to perform hardware or software maintenance. When an Oracle VM Server is placed in maintenance mode, any virtual machines running on the Oracle VM Server are automatically migrated to other Oracle VM Servers in the server pool, if they

are available, otherwise they are stopped. If the Oracle VM Server is the master Oracle VM Server in the server pool, this role is moved to another Oracle VM Server in the server pool, if available.

To place an Oracle VM Server into maintenance mode:

1. In the **Servers and VMs** tab, select the Oracle VM Server in the navigation pane. Click **Edit Server** in the management pane toolbar.
2. The **Edit Server** dialog box is displayed. Select the **Maintenance Mode** check box to place the Oracle VM Server into maintenance mode. Click **OK**.

The Oracle VM Server is placed into maintenance mode. In the navigation pane, you can recognize a server in maintenance mode by its different icon: .

When you have finished performing maintenance on the Oracle VM Server and you are ready for it to rejoin the server pool, perform the same procedure and uncheck the **Maintenance Mode** check box.

6.9.11. Updating and Upgrading Oracle VM Servers

Updates and upgrades to Oracle VM Servers can be automatically performed using a Yum repository. To access patch updates for Oracle VM, you should contact Oracle to purchase an Oracle VM Support contract and gain access to the Unbreakable Linux Network (ULN) which contains updates for Oracle VM. If you have access to ULN you can use this to set up your own Yum repository to use when updating your Oracle VM Servers. Setting up a Yum repository is beyond the scope of this documentation, however you can read about setting one up in an OTN article "*Yum Repository Setup*" at:

http://www.oracle.com/technetwork/topics/linux/yum-repository-setup-085606.html

Tip

Make sure you subscribe to the Oracle VM Release 3.1.1 channel on ULN when you set up your Yum repository.

If you have a Yum repository configured for Oracle VM Server updates, you add this to Oracle VM Manager and perform updates using Oracle VM Manager.

Tip

To see which version of Oracle VM Manager the Oracle VM Server is running before and after an upgrade, click the **Servers and VMs** tab, select the Oracle VM Server in the navigation tree and then select **Control Domains** in the **Perspective** drop-down list.

To add a Yum repository:

1. Click the **Tools and Resources** tab.
2. Click the **Server Update Management (YUM)** sub-tab.
3. Enter the following information about the Yum repository:
   - **YUM Base URL:** The URL to access the Yum repository, for example:

     ```
     http://example.com/OVM3/Server/
     ```

Note

The YUM Base URL should contain the RPMs and the repodata directory created by the createrepo tool. If you are copying the RPMs from the Oracle

> VM Server ISO media, or loop mounting the ISO file, make sure to include the `Server` directory (which includes the `repodata` directory), for example:
>
> http://example.com/OVM3/Server/

- **Enable GPG Key:** Whether to use a GPG key for the Yum repository. The GPG key (or GnuPG key) is the key used in the GNU project's implementation of the OpenPGP key management standard. The GPG key is used to check the validity of the Yum repository, and any packages (RPMs) downloaded from the repository.
- **YUM GPG Key:** The GPG key for the Yum repository, for example:

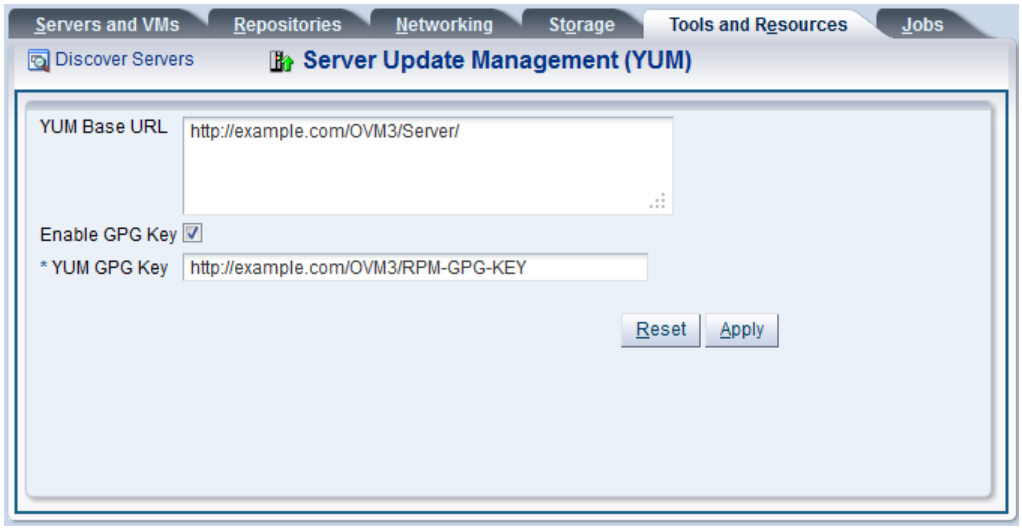
  ```
  http://example.com/OVM3/RPM-GPG-KEY
  ```

  The GPG key must be available via one of HTTP, FTP, FILE or HTTPS protocols.

  The GPG key for Oracle-signed updates from ULN is pre-installed on Oracle VM Server at /etc/pki/rpm-gpg/RPM-GPG-KEY-oracle. If you want to use this GPG key, enter:

  ```
  file:///etc/pki/rpm-gpg/RPM-GPG-KEY-oracle
  ```

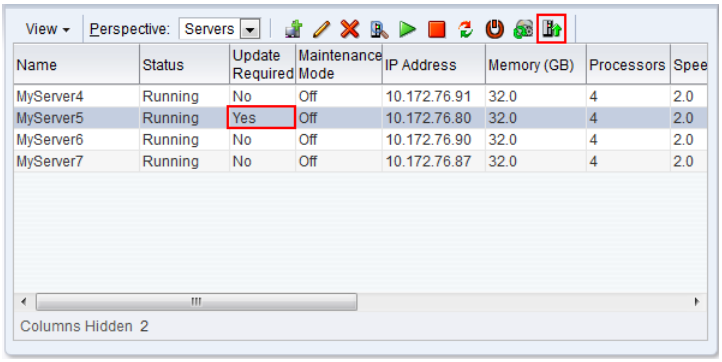
  This field is only enabled when you select **Enable GPG Key**.



Click **Apply**.

The YUM repository is added and ready to use to update Oracle VM Servers.

When an Oracle VM Server update is available, an event is posted to the Oracle VM Server and displayed in the **Update Required** column in the **Servers** perspective in the management pane. The YUM repository is checked for updates every 6 hours, so there may be a delay between the YUM repository being updated and the notification being displayed in Oracle VM Manager.



To update an Oracle VM Server, the virtual machines on the Oracle VM Server must first be migrated to another Oracle VM Server. You can manually migrate the virtual machines if you prefer, or have the upgrade server job perform the virtual machine migration automatically.

To update an Oracle VM Server:

1. Click the **Servers and VMs** tab, and select the server pool on which the Oracle VM Server resides in the navigation tree.

2. Select **Servers** in the **Perspective** drop-down list in the management pane.

3. Select the Oracle VM Server in the management pane table and click **Update Server** from the management pane toolbar.

   A confirmation dialog is displayed. Click **OK**. The Oracle VM Server is placed into maintenance mode, and the update performed. Any virtual machines on the Oracle VM Server are automatically migrated to another Oracle VM Server when it is put into maintenance mode. If the Oracle VM Server is a master Oracle VM Server, the master role is transferred to another Oracle VM Server in the server pool. When the update is complete the Oracle VM Server is restarted and remains in maintenance mode.

4. To have the Oracle VM Server rejoin the server pool as a fully functioning member, edit the Oracle VM Server and take it out of maintenance mode.

For information on manually migrating virtual machines, see Section 7.9.10, “Migrating a Virtual Machine”. For information on taking an Oracle VM Server out of maintenance mode, see Section 6.9.10, “Placing an Oracle VM Server into Maintenance Mode”.

6.9.12. Managing Ethernet Ports and Network Bonding on an Oracle VM Server

To view and edit the Ethernet ports and network bonding on an Oracle VM Server, select the **Servers and VMs** tab, the Oracle VM Server in the navigation tree, then the **Ethernet Ports** and **Bond Ports** options in the **Perspective** drop-down list. You can view which ports are bonded to which networks and VLAN groups, and set network addressing and the MTU (Maximum Transmission Unit) on a port. You can also configure the network bonding of each Ethernet port. For information on managing Ethernet ports and bonding on an Oracle VM Server see Section 5.8, “Managing Bonded Interfaces”.

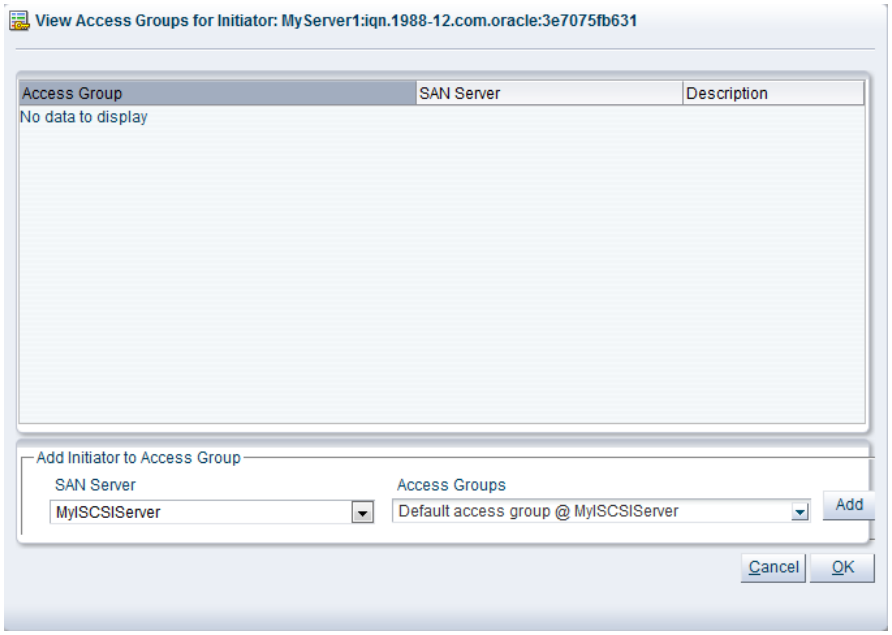
6.9.13. Managing Access Groups and Storage Initiators on an Oracle VM Server

In order to access SAN server storage, an access group must be created, and a storage initiator configured on the Oracle VM Server. Storage initiators are added to an Oracle VM Server during discovery, based on your storage configuration. You configure access groups to bind storage initiators to physical

disks. For information on creating access groups, see Section 4.6.3.2, “Configuring Storage Array Access through Access Groups”. You can also view and configure existing storage initiators for a particular Oracle VM Server.

To view storage initiators on an Oracle VM Server:

1. Click the **Servers and VMs** tab, and select the Oracle VM Server in the navigation tree.
2. Select **Storage Initiators** in the **Perspective** drop-down list in the management pane. The storage initiators configured on the Oracle VM Server are listed in the management pane table.
3. Select a storage initiator in the table, and click **View access groups for selected initiator** .
4. The **View Access Groups for Initiator** dialog box is displayed.



   Select the **SAN Server** and **Access Groups** from the drop-down lists and click **Add**. Click **OK**.

See Section 4.6.3.2, “Configuring Storage Array Access through Access Groups” for more information on managing SAN server access groups.

6.9.14. Managing Physical Disks on an Oracle VM Server

You can view and manage the physical disks on an Oracle VM Server, as well as those available to it from a SAN server. You can also refresh the physical disks on an Oracle VM Server when SAN server disks have been added or removed.

To refresh the physical disks on an Oracle VM Server:

1. Click the **Servers and VMs** tab, and select the server pool on which the Oracle VM Server resides in the navigation tree.
2. Select **Servers** in the **Perspective** drop-down list in the management pane.
3. Select the Oracle VM Server in the management pane table and click **Rescan Physical Disks** in the management pane toolbar.
4. A confirmation dialog box is displayed. Click **OK**.

To view and manage the physical disks on an Oracle VM Server:

1. Click the **Servers and VMs** tab, and select the Oracle VM Server in the navigation tree.
2. Select **Physical Disks** in the **Perspective** drop-down list in the management pane.
3. A list of the physical disks accessible by the Oracle VM Server is displayed in the table in the management pane and the management functions you can perform on the disk are available as icons in the management pane toolbar. Some management options are only available to SAN server disks that use a non-generic storage connect plug-in. The physical disk management options available are listed in Table 6.2, "Oracle VM Server Physical Disks Toolbar Icon Options".

Table 6.2. Oracle VM Server Physical Disks Toolbar Icon Options

Toolbar Icon Option	Icon	Description
Rescan Physical Disks		Request an update of the all the physical disks available to the Oracle VM Server to see if changes have been made.
Edit Physical Disk		Change the name, description and extra information of the physical disk, or make it shareable.
Delete Physical Disk		Stop using the selected physical disk in your Oracle VM environment.  **Warning** If you effectively delete a LUN from a registered storage array, make sure that you delete it in Oracle VM Manager first, before you physically delete it from the storage server. If you do not respect this order of operations, the system will go into an unknown state, which can only be resolved by rebooting the Oracle VM Servers the deleted LUN is connected to.
Clone Physical Disk		Create a thin clone, sparse copy or non-sparse copy of the physical disk on the selected target.
Delete File System		Delete the file system and contents of the physical disk.
Refresh Physical Disk		Request an update of the physical disk information to see if changes have been made to the size and configuration.
Display Selected Storage Element Events...		Display the Events dialog box which contains the job events associated with the physical disk.

For more information on managing SAN servers and their contents, see Section 4.6.3, "Discovering SAN Servers". For more information on using storage, see Chapter 4, *Managing Storage*.

6.9.15. Viewing Oracle VM Server Operating System Information and Control Domains

You can view information about the underlying operating system and hardware on an Oracle VM Server using the Control Domains perspective when you select an Oracle VM Server. This perspective lists each control domain and information about it. Xen has only one control domain, whereas other hypervisors may

have multiple control domains. This information may be useful when talking to Oracle Support Services, as you can find out the exact version of Oracle VM Server, Oracle VM Agent, and the hypervisor kernel installed on the machine.

To view control domain information:

1. Click the **Servers and VMs** tab, and select the Oracle VM Server in the navigation tree.

2. Select **Control Domains** in the **Perspective** drop-down list in the management pane. The control domain is listed in the management pane table. Expand the table row for more information about the control domain.

6.9.16. Deleting an Oracle VM Server

When you delete an Oracle VM Server, it is removed from the Oracle VM Manager repository and becomes unmanaged. The Oracle VM Server is not stopped, nor is anything physically done to the Oracle VM Server.

Before you can delete an Oracle VM Server, you must stop any running virtual machines, or place the Oracle VM Server into maintenance mode to automatically migrate the running virtual machines. You must also remove the Oracle VM Server from the server pool.

To delete an Oracle VM Server and remove it from Oracle VM Manager:

1. Stop or migrate any running virtual machines. To stop the virtual machines see Section 7.9.4, “Stopping (Shutting Down) a Virtual Machine”. To automatically migrate the virtual machines to other Oracle VM Servers in the server pool, place the Oracle VM Server into maintenance mode, see Section 6.9.10, “Placing an Oracle VM Server into Maintenance Mode”.

2. Remove the Oracle VM Server from the server pool. See Section 6.8.2, “Removing an Oracle VM Server from a Server Pool” for information on removing Oracle VM Server from server pools.

3. In the **Servers and VMs** tab, select the **Unassigned Servers** folder in the navigation pane. Select the Oracle VM Server and Click **Delete** ✖ in the toolbar.

4. The **Delete Confirmation** dialog box is displayed. Click **OK**.

The Oracle VM Server is deleted from Oracle VM Manager.

Chapter 7. Managing Virtual Machines

Table of Contents

In this chapter we describe in detail all types of virtual machine activities. A virtual machine is a guest operating system, for example, Linux, Windows, or Solaris, and its associated application software. A virtual machine runs on an Oracle VM Server in a server pool. Full management of a virtual machine is performed using Oracle VM Manager.

This chapter describes how to create and use virtual machines.

7.1. Virtual Machines Overview

The terms domain, guest and virtual machine are often used interchangeably, but they have subtle differences. A *domain* is a configurable set of resources, including memory, virtual CPUs, network devices and disk devices, in which virtual machines run. A domain is granted virtual resources and can be started, stopped and restarted independently. A *guest* is a virtualized operating system running within a domain. A guest operating system may be paravirtualized, hardware virtualized, or hardware virtualized with paravirtualized drivers. Multiple guests can run on the same Oracle VM Server. A *virtual machine* is a

guest operating system and its associated application software. For the sake of simplicity, in this Guide we use the term *virtual machine* to encompass domain, guest and virtual machine. They are synonymous with each other and may be used interchangeably.

Virtual machines can be created using:

- ISO files in a repository (hardware virtualized only)
- Mounted ISO files on an NFS, HTTP or FTP server (paravirtualized only)
- Virtual machine templates (by cloning a template)
- Existing virtual machine (by cloning the virtual machine)
- Virtual machine assemblies

Virtual machines require most installation resources to be in a storage repository, managed by Oracle VM Manager, with the exception of mounted ISO files for paravirtualized guests. See Section 7.5, “Virtual Machine Resources” for information on importing and managing virtual machine resources.

Before you create a virtual machine that requires network connectivity, or a paravirtualized machine which requires network connectivity to perform the operating system install, you should generate some virtual network interfaces using the VNIC Manager. See Section 7.6, “Creating VNICs” for information on using the VNIC Manager.

7.2. Virtualization Modes (Domain Types)

Virtual machines may run in one of two main modes, paravirtualized (PVM) or hardware virtualized (HVM). In paravirtualized mode, the kernel of the guest operating system is recompiled to be made aware of the virtual environment. This allows the paravirtualized guest to run at near native speed, since most memory, disk and network accesses are optimized for maximum performance.

If support for hardware virtualization is available (either Intel VT or AMD-V), the guest operating system may run completely unmodified. This hardware virtualized guest is carefully monitored and trapped by Oracle VM Server when any instruction is executed which would violate the isolation with other guests or dom0. In the current implementation, there may be performance penalty for certain types of guests and access types, but hardware virtualization also allows many Microsoft Windows™ operating systems and legacy operating systems to run unmodified.

The third virtualization mode is hardware virtualized, with paravirtualized drivers (PVHVM). This mode is identical to hardware virtualized, but with additional paravirtualized drivers installed in the guest's operating system to improve virtual machine performance.

Oracle recommends you create paravirtualized virtual machines if possible, as the performance of a paravirtualized virtual machine is superior to that of a hardware virtualized guest.

There are a number of virtual machine virtualization modes, or domain types, as shown in Table 7.1, “Domain Types”. When you create a virtual machine using the Virtual Machine wizard you must select which mode to use.

Table 7.1. Domain Types

Domain Type	Description
Hardware virtualized (HVM)	Hardware virtualization, or fully virtualized. When you create an HVM guest, you must supply an ISO file in a repository from which to create the virtual

Domain Type	Description
	machine. See Section 7.5.5, “ISO Files (CD/DVD Images)” for information on importing an ISO file into a repository. To create HVM guests, you may need to activate the hardware virtualization in the BIOS of the server on which you install the Oracle VM Server.
Hardware virtualized, with paravirtualized drivers (PVHVM)	Identical to HVM, but with additional paravirtualized drivers for improved performance of the virtual machine. See Section 7.11, “Converting to Paravirtualized Guests or Installing Paravirtualized Drivers” for more information about using paravirtualized drivers. This Domain Type is used to run Microsoft Windows guest operating systems with an acceptable performance level.
Paravirtualized (PVM)	Paravirtualized. Enables you to select a location for the mounted ISO file from which to create the virtual machine. Before you create the virtual machine using the paravirtualized method, mount the ISO file on an NFS share, or HTTP or FTP server. You supply the location of the mounted ISO file in the Boot Options step of the wizard. For information on creating a mounted ISO file, see Section 7.4, “Virtual Machine Installation Media”.
Oracle VM Server for SPARC (OVM/SPARC)	This mode should be selected if the server pool and hypervisors use Oracle VM Server for SPARC as the hypervisor instead of Oracle VM Server for x86.

7.3. Supported Guest Operating Systems

An operating system installed in a virtual machine is known as a guest operating system. Oracle VM supports a variety of guest operating systems. For a list of the supported guest operating systems, see the *Oracle VM Release Notes*.

7.4. Virtual Machine Installation Media

Virtual machines require some form of installation media, whether it be a template, assembly, ISO file, or mounted ISO file. Different domain types may require slightly different installation source files. Table 7.2, “Virtual machine installation sources” lists the installation sources available for HVM and PVM guests.

Table 7.2. Virtual machine installation sources

Installation Source	HVM	PVM
Template (clone)	Yes	Yes
ISO file in repository	Yes	No
Mounted ISO file on NFS, HTTP or FTP server	No	Yes
Assembly	Yes	Yes

When you create an HVM guest from an ISO file, you must supply an ISO file which has been preloaded into a storage repository that is presented to the Oracle VM Server on which the virtual machine is to be deployed. See Section 7.5.5, “ISO Files (CD/DVD Images)” for information on importing ISO files.

When you create a PVM guest from an ISO file, you cannot use an ISO file from a repository to install the operating system. Instead, you must use a mounted ISO file. A mounted ISO file explodes the contents of the ISO file on to disk and makes the operating system installation tree available to the virtual machine. The mounted ISO file can be made available via an NFS, HTTP or FTP server. When you specify the

location of the installation media in the **Network Boot Path** field in the **Create Virtual Machine** wizard, you enter the NFS, HTTP or FTP path to the mounted ISO file. The following examples show how to create and use mounted ISO files on an NFS share, and on an HTTP server.

Example 7.1. Creating an installation tree on an NFS share

This example creates an installation tree for paravirtualized guests by mounting an ISO file. The installation tree is made available via an NFS share. On the NFS server, enter

```
# mkdir -p /isos/EL5u6-x86_64
# mount -o ro,loop /path/Enterprise-R5-U6-Server-x86_64-dvd.iso /isos/EL5u6-x86_64
# exportfs *:/isos/EL5u6-x86_64/
```

When you create the virtual machine, enter the installation location in the **Network Boot Path** field in the **Create Virtual Machine** wizard as:

```
nfs:example.com:/isos/EL5u6-x86_64
```

Example 7.2. Creating an installation tree on an HTTP server

This example creates an installation tree from an ISO file that can be accessed via HTTP. On the HTTP server, enter

```
# cd /var/www/html
# mkdir EL5u6-x86_64
# mount -o ro,loop /path/Enterprise-R5-U6-Server-x86_64-dvd.iso EL5u6-x86_64
```

When you create the virtual machine, enter the installation location in the **Network Boot Path** field in the **Create Virtual Machine** wizard as:

```
http://example.com/Enterprise-R5-U6-Server-x86_64-dvd.iso/
```

Tip

If you have multiple ISO files (CDs), you can mount each ISO file (CD) and copy the contents into a single directory. All the ISO files are then available from the same location.

7.5. Virtual Machine Resources

The resources required to create virtual machines are stored in a storage repository. This section provides information on the structure of storage repositories, and describes how you manage virtual machine resources in storage repositories.

7.5.1. Overview of Virtual Machine Resources in a Storage Repository

A storage repository is used to store virtual machine resources, so that these resources can be made available to Oracle VM Servers in a server pool, without having to copy the resources to each Oracle VM Server. The Oracle VM Servers in a server pool gain access to these virtual machine resources by having the storage repository *presented* to the them. If your storage is file-based storage, you can present a storage repository to multiple server pools.

The types of virtual machine resources can be categorized as:

- **Virtual machine templates:** Reusable virtual machine templates used to create multiple virtual machines.
- **Assemblies:** Template containing a configuration of multiple virtual machines with their virtual disks and the inter connectivity between them.

- **ISO files:** DVD/CD image files used to create virtual machines from scratch using the installation media.
- **Virtual disks:** Virtual disks used by virtual machines to perform boot operations, to run the operating system, and to extend the storage capability of virtual machines.
- **Virtual machine files:** Configuration files of your virtual machines.

You access and manage virtual machine resources in a storage repository using the **Repositories** tab.

To enable third party backup tools to access the contents of a storage repository, see Section 4.8.5, “Enabling Storage Repository Back Ups”.

The following sections describe the structure of a storage repository, and how to manage their contents.

7.5.2. Storage Repository Contents and Structure

Each storage repository has a predefined structure, which is visible in Oracle VM Manager, and maps to the directory structure of the underlying physical storage. Figure 7.1, “Graphical User Interface view of storage repository contents” shows the repository as seen through the Oracle VM Manager user interface. The directory structure is listed in Table 7.3, “Storage Repository Directory Structure”.

Figure 7.1. Graphical User Interface view of storage repository contents

The directories listed in Table 7.3, “Storage Repository Directory Structure” are subdirectories of a storage repository file system. On disk they are, in fact, located under the path:

/OVS/Repositories/*repository_id*/...

Table 7.3. Storage Repository Directory Structure

Directory Name	Description
Templates	This is the directory that contains guest virtual machine templates. See Section 7.5.3, “Virtual Machine Templates” for information on working with virtual machine templates.
Assemblies	Contains preconfigured sets of virtual machines, typically created with Oracle Assembly Builder. See Section 7.5.4, “Assemblies” for information on working with assemblies.
ISO files	Contains ISO files that can be mounted as virtual CD/DVD drives on virtual machines. See Section 7.5.5, “ISO Files (CD/DVD Images)” for information on working with ISO files.

Directory Name	Description
VirtualDisks	Contains virtual disks, which can be either dedicated to a virtual machine or shared by multiple virtual machines. See Section 7.5.6, “Virtual Disks” for information on working with virtual disks.
VirtualMachines	Contains virtual machine configuration files. See Section 7.5.7, “Virtual Machine Configuration Files” for information on working with virtual machine configuration files.

7.5.3. Virtual Machine Templates

A virtual machine template is a fully pre-installed, pre-configured virtual machine that can be repeatedly used to create new virtual machines. Typically, a virtual machine template might contain:

- An operating system.
- A file which contains the basic configuration information, such as the number of virtual CPUs, the amount of memory, the size of disk, and so on.
- Pre installed applications.

Virtual machine templates contain the configuration of a single virtual machine. Virtual machine templates are shared among users to create new virtual machines. New virtual machines inherit the same contents and configuration from the template. Typically, a virtual machine template contains basic configuration, such as the number of virtual CPUs, the size of memory, virtual disks, virtual network interfaces (VIFs), and so on. It may also contain some software applications.

You can obtain or create a virtual machine template by:

- Downloading an Oracle VM template from the Oracle Technology Network, and importing it into Oracle VM Manager. See Section 2.10, “Oracle VM Pre-built Templates” for more information on downloading a template. See Section 7.5.3.2, “Importing a Virtual Machine Template” for information on importing a template.
- Downloading an Oracle VM template that contains an assembly file (.ovf file) from the Oracle Technology Network, and importing it into Oracle VM Manager as an assembly, then creating a template from the assembly. See Section 7.5.4, “Assemblies” for more information on importing an assembly.
- Cloning an existing virtual machine or template as a template in Oracle VM Manager. For information on cloning virtual machine templates, see Section 7.8, “Cloning a Virtual Machine or Template”.
- Creating a template from scratch. See Section 7.5.3.3, “Creating a Virtual Machine Template” for information on creating a template.

7.5.3.1. Using a Virtual Machine Template

A virtual machine template can be used to create virtual machines, and to create new templates based on the original. To create a virtual machine from a template, see Section 7.7, “Creating a Virtual Machine”.

7.5.3.2. Importing a Virtual Machine Template

A virtual machine template contains virtual machine configuration information, virtual disks that contain the operating system and any application software, packaged as anOracle VM template file. An assembly is the similar to a virtual machine template, but in the open standard Open Virtualization Format (OVF) format. Older Oracle VM template files were packaged as Oracle VM template files, and the more recent templates are packaged in OVF format as assemblies. If the template you are importing uses the OVF

format, see Section 7.5.4, “Assemblies” for information on importing an assembly and creating a template from the assembly.

Before you can use a virtual machine template, you must import it into Oracle VM Manager and make it available to your server pool(s). Virtual machine templates are stored in the server pool's storage repository by importing them from a web server into Oracle VM Manager.

In a storage repository, templates are typically imported as an archive (.tgz, .tar or other). The archive contains a virtual machine configuration file (.cfg) file, and at least one virtual disk image (.img file).

On disk, a template archive is unpacked after import. The .cfg file of the virtual machine is always referenced from the Templates folder, but the virtual disk image files (.img) are placed in the VirtualDisks folder. This makes the creation of virtual machines from template a lot faster, which also applies to cloning of virtual machines.

If you downloaded an Oracle VM template from the Oracle Software Delivery Cloud which contains an *template*.tgz file, you should use this procedure to import the template. This format of a template is the older format used by Oracle to publish Oracle VM templates.

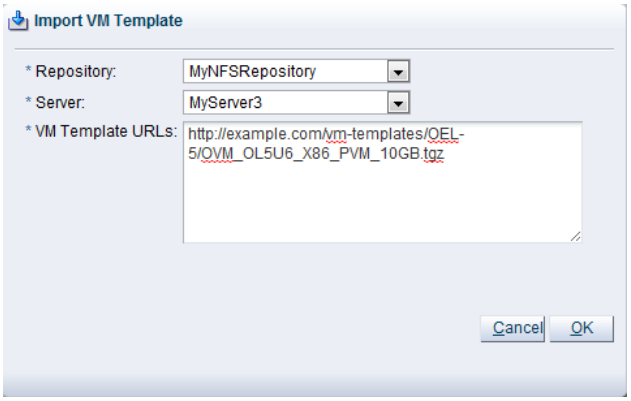
To import a virtual machine template:

1. Place the archive containing the Oracle VM template in a location accessible from your Oracle VM environment using either of these protocols: HTTP, HTTPS or FTP.

2. Click the **Repositories** tab. Select the repository in which to store the template. Select **VM Templates** in the navigation tree.

3. Select **Import VM Template...** in the toolbar in the management pane.

4. The **Import VM Template** dialog box is displayed.



   Select or edit the following:

   - **Repository:** The storage repository in which to import the template.
   - **Server:** The Oracle VM Server to use the perform the template import.
   - **VM Template URLs:** The URLs for the templates. The URL protocols supported are HTTP, HTTPS, and FTP. To import a template using FTP, use the standard FTP syntax, for example:

     ftp://*user*:*password*@*server*/*path*/*filename*.tgz

     Each template component should be listed on a new line. Each URL must be a reference to a complete file. If your template files are split into multiple compressed files, concatenate those files

and enter the URL for the concatenated file, for example to concatenate a number of compressed files to one compressed file, enter

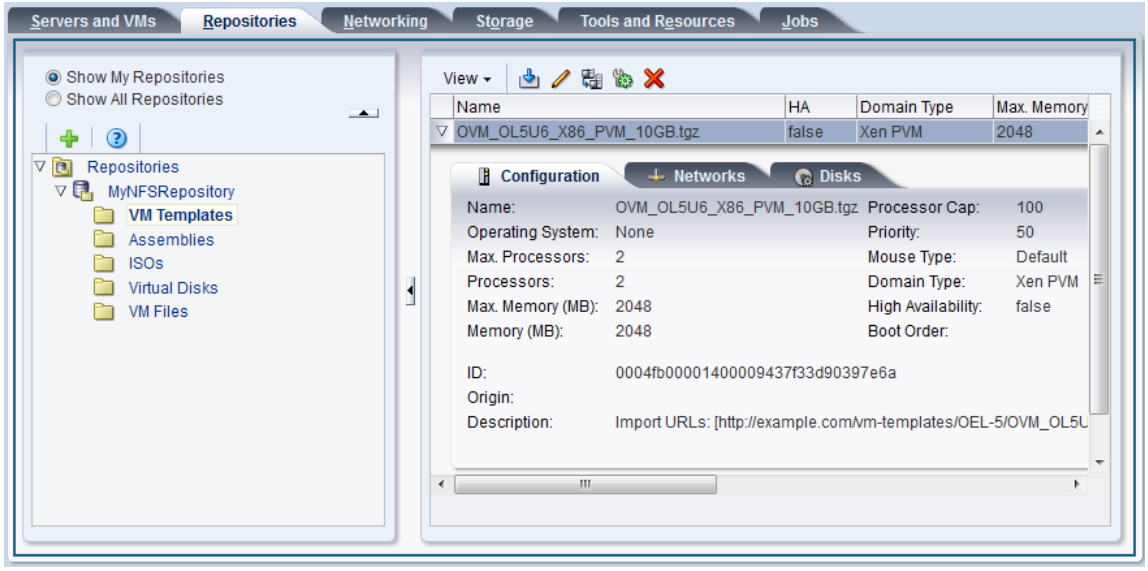
```
$ cat template.tgz.1of3 template.tgz.2of3 template.tgz.3of3 > template.tgz
```

Then enter the URL to the single compressed template file, in this case, template.tgz.

To import a template that is not compressed as a single file, each component must be a complete file (if not, concatenate them to one file), for example to enter a virtual disk image and a virtual machine configuration file that together make up a complete template, you could enter:

```
http://myexample.com/System-sda.img
http://myexample.com/vm.cfg
```

Click **OK** to import the template. When the import job is complete, the new template is displayed in the table in the management pane. Expand the table row to see more information about the template.



For information about creating a virtual machine from a template, see Section 7.8, “Cloning a Virtual Machine or Template”.

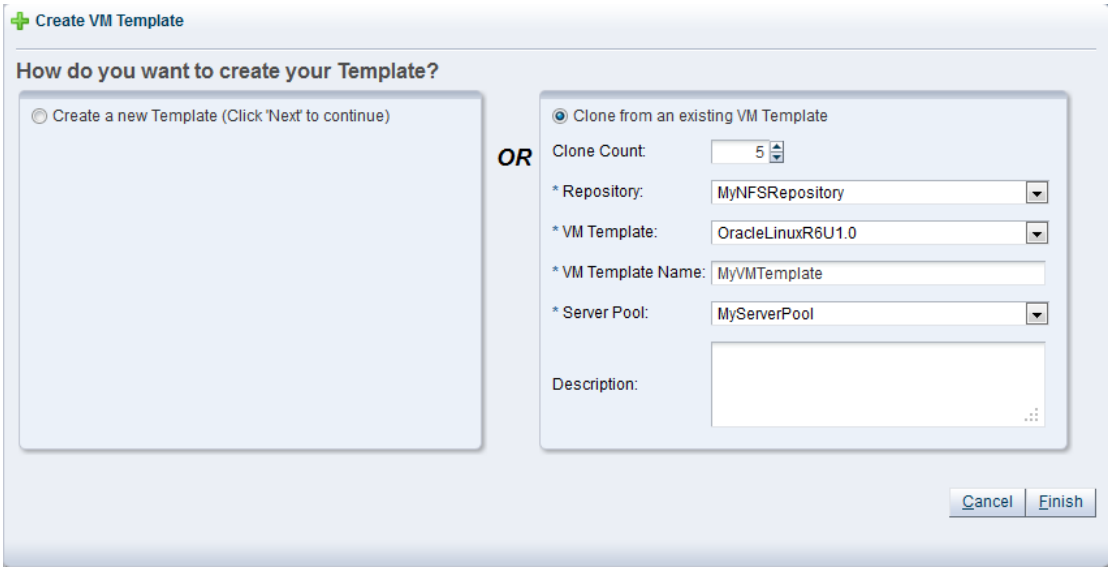
7.5.3.3. Creating a Virtual Machine Template

To create a virtual machine template, you can specify all the parameters in the same way you would to create a virtual machine, or you can clone an existing template. This section discusses the two methods of creating a virtual machine template.

You can also create a template from a virtual machine by cloning it as a template. For information on creating a template from a virtual machine, see Section 7.8, “Cloning a Virtual Machine or Template” .

To create a template using a template:

1. Click the **Repositories** tab. Select the repository in which the template is to be created. Click **VM Templates** in the navigation tree.
2. Click **Create VM Template...** .
3. The **Create VM Template** wizard is displayed.



Select the **Clone from an existing VM Template** option.

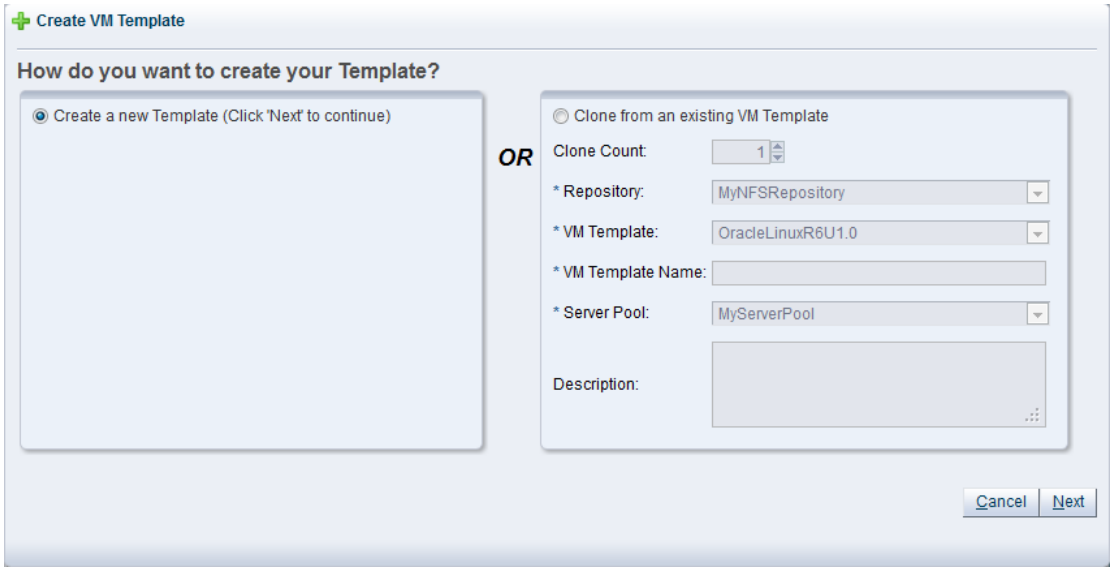
Enter or select the following:

- **Clone Count:** The number of templates to create from the template.
- **Repository:** Select the repository in which to create the virtual machine configuration files.
- **VM Template:** The template to use to create the templates.
- **VM Name:** A name for the template. The maximum name length is 256 characters and may contain any character. The name need not be unique. Each clone is suffixed with a dot and the clone number, starting with 0, for example MyVMTemplate.0, MyVMTemplate.1 and so on.
- **Server Pool:** The server pool in which to deploy the virtual machines.
- **Description:** A description of the templates.

Click **Finish**. The templates are created and saved in the repository.

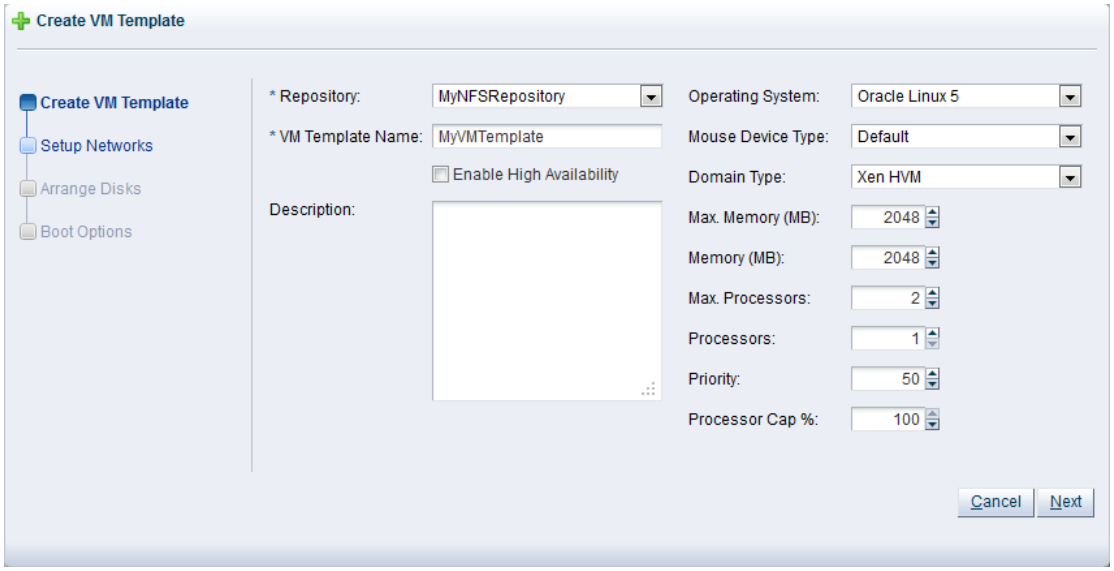
To create a new template:

1. Click the **Repositories** tab. Select the repository in which the template is to be created. Click **VM Templates** in the navigation tree.
2. Click **Create VM Template...** .
3. The **Create VM Template** wizard is displayed.



Select the **Create a new Template** option. Click **Next**.

4. The **Create VM Template** step of the wizard is displayed.



Enter or select the following:

- **Repository:** Select the repository in which to create the virtual machine configuration file.
- **VM Template Name:** A name for the template. The maximum name length is 256 characters and may contain any character. The name need not be unique.
- **Enable High Availability:** Select to enable HA. See Section 6.4, “High Availability (HA)” for more information on HA.
- **Description:** A description of the template.
- **Operating System**: The operating system of the template. This setting enables or disables certain virtual machine settings that your guest operating system may require.

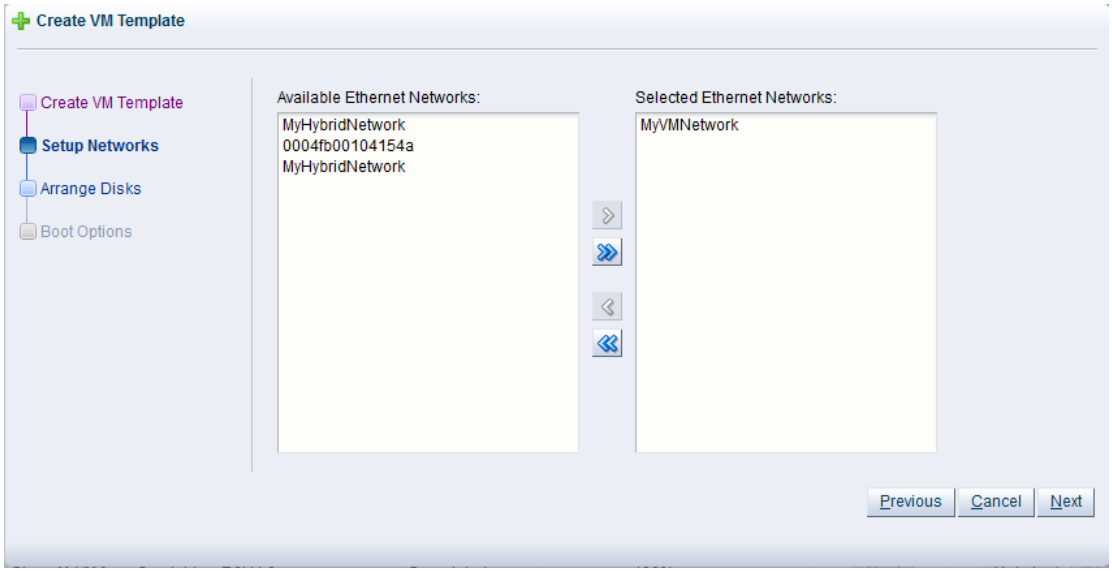
- **Mouse Device Type**: The mouse type to use for the template. Select one of:
  - Default
  - PS2 Mouse
  - USB Mouse
  - USB Tablet
- **Domain Type**: The domain type of the template. Oracle recommends you create paravirtualized virtual machines if possible, as the performance of a paravirtualized virtual machine is superior to that of a hardware virtualized guest.
  - **Xen HVM:** Hardware virtualization, or fully virtualized. When you select this option you must supply an ISO file in a repository (in the Create Storage step of the wizard) from which to create the virtual machine. See Section 7.5.5, “ISO Files (CD/DVD Images)” for information on importing an ISO file into a repository.
  - **Xen HVM, PV Drivers:** Identical to Xen HVM, but with additional paravirtualized drivers for improved performance of the virtual machine. See Section 7.11, “Converting to Paravirtualized Guests or Installing Paravirtualized Drivers” for more information about using paravirtualized drivers. This Domain Type is used to run Microsoft Windows guest operating systems with an acceptable performance level.
  - **Xen PVM:** Paravirtualized. Enables you to select a location for the mounted ISO file from which to create the virtual machine. Before you create the virtual machine using the paravirtualized method, mount the ISO file on an NFS share, or HTTP or FTP server. You supply the location of the mounted ISO file in the **Network Boot Path** field in the **Boot Options** step of the wizard. For information on creating a mounted ISO file, see Section 7.4, “Virtual Machine Installation Media”.
  - **OVM/SPARC:** This domain type should be selected if the server pool and hypervisors use Oracle VM Server for SPARC as the hypervisor instead of Oracle VM Server for x86.
  - **Unknown:** This hypervisor should be selected if the domain type is unknown.
- **Max. Memory (MB):** The maximum size of the memory the virtual machine is to be allocated. When you edit a running virtual machine, this is the maximum amount of memory that can be allocated.
- **Memory (MB):** The size of the memory the virtual machine is to be allocated. This is the memory allocation to use when starting the virtual machine. You can change this when editing a running virtual machine, up to the value of the maximum memory set in the previous field. For HVM guests, increasing or decreasing the memory requires a restart of the virtual machine. For PVM guests, no restart is required.
- **Max Processors:** The maximum number of processors to be used by the virtual machine. The number of processors is expressed in number of physical CPU cores, and is limited to 128.
- **Processors:** The number of processors to be used by the virtual machine. The number of processors is expressed in number of physical CPU cores, and is limited to 128.
- **Priority**: The CPU priority of the virtual machine. You can select a high (100), intermediate (50), or low (1) priority for the virtual CPUs, or a self-defined priority, by moving the slider. The higher the priority, the more physical CPU cycles are given to the virtual machine.

- **Processor Cap %**: Increase or decrease the percentage to which the virtual CPUs can receive scheduled time. This parameter defines the maximum percentage to which the virtual CPUs can receive scheduled time. You can select a high (100), intermediate (50), or low (1) percentage of scheduled time for the virtual CPUs, or a custom percentage, by moving the slider. Use this parameter to keep low priority virtual machines from consuming too many CPU cycles on a Virtual Machine Server.

The **Priority** and **Processor Cap%** parameters are passed to the hypervisor, which determines the percentage. These two parameters are always combined by the hypervisor and are a key factor for the performance of the virtual machine.

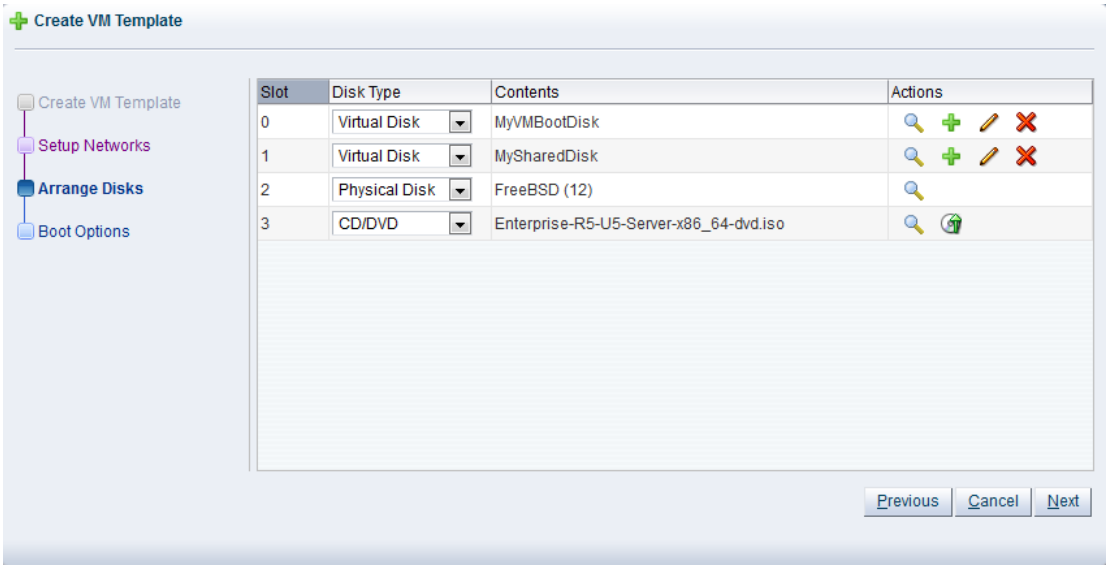
Click **Next**.

5. The **Setup Networks** step is displayed in the wizard.



Select the network to use from the **Available Ethernet Networks** field and add it to the **Selected Ethernet Networks** field. Click **Next**.

6. The **Arrange Disks** step of the wizard is displayed.



Select the desired storage configuration of your template, such as virtual disks, physical disks, and ISO files. On a separate slot, add one or more of the following disk types:

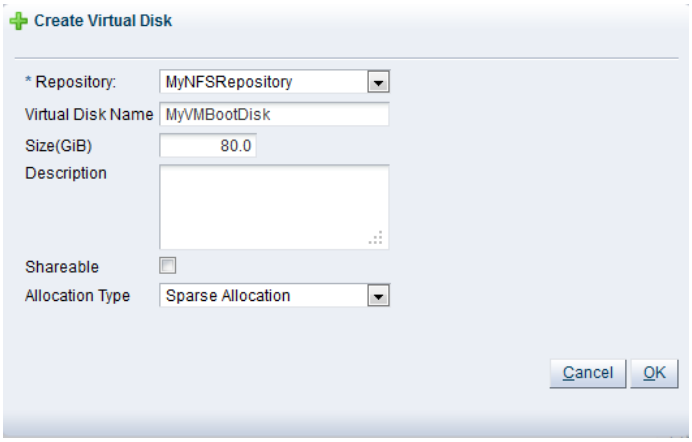
- **Empty** A empty slot.
- **Virtual Disk:** This allows you to add or create a virtual disk. Virtual disks can be shared by virtual machines.
- **Physical Disk** The physical disks are the disks in a storage array. Physical disks can be shared by virtual machines.
- **CD/DVD:** This adds an ISO file in a storage repository and can be used to create HVM and PVHVM virtual machines. When creating a virtual machine from an ISO file, you must use a single file. Installations that span multiple ISO files are not supported. ISO files cannot be used to create PVM virtual machines.

Add or create any virtual disks to use as the virtual machine's hard disk, select any physical disks to add, and select any ISO files to use to create the virtual machine. Add the disks in the order they should appear in the virtual machine. The disk with the boot partition or installation media should be the first disk listed. An HVM guest can have up to four disks, including empty CD/DVD drives. A PVM or PVHVM guest can have up to 52 disks. Only one slot can contain an empty CD/DVD.

To create or add a virtual disk:

a. To create a virtual disk, select **Virtual Disk** from the **Disk Type** drop-down list and click **Create a Virtual Disk** .

b. The **Create Virtual Disk** dialog box is displayed.

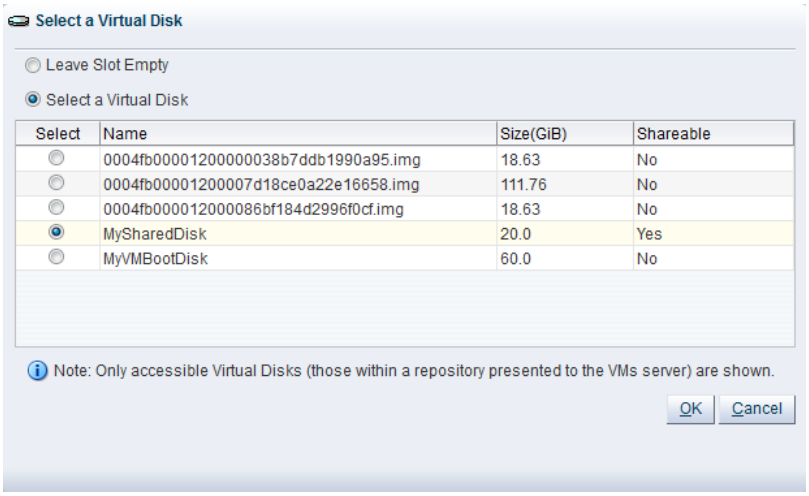


Enter or select the following to create a virtual disk:

- **Repository:** The repository in which the virtual disk is to be created.
- **Virtual Disk Name:** The name of the virtual disk to be created and made available to the virtual machine. See Section 7.5.6, “Virtual Disks” for more information about using virtual disks.
- **Size (GiB):** The disk size in GiB of the virtual disk.
- **Description:** A description of the virtual disk.
- **Shareable:** Whether the virtual disk should be shareable (read/write) with other virtual machines.
- **Allocation Type:** Whether to use a **Sparse Allocation** or **Non-sparse Allocation**. Sparse Allocation creates a sparse disk, so the size of the disk is initially small and increases as it is used. Sparse allocation is faster than using Non-Sparse Allocation when creating a virtual machine. Non-Sparse Allocation creates the entire disk when the virtual machine is created, and so is slower than creating a sparse disk.

Click **OK**.

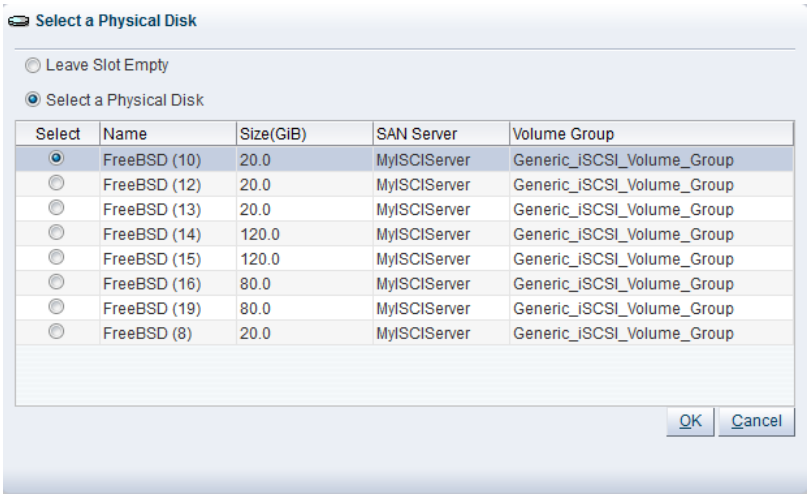
c. To search for an existing virtual disk to add to the virtual machine, click **Select a Virtual Machine Disk** . The **Select a Virtual Machine Disk** dialog box is displayed.



Select the virtual disk to use and Click **OK**.

To add a physical disk:

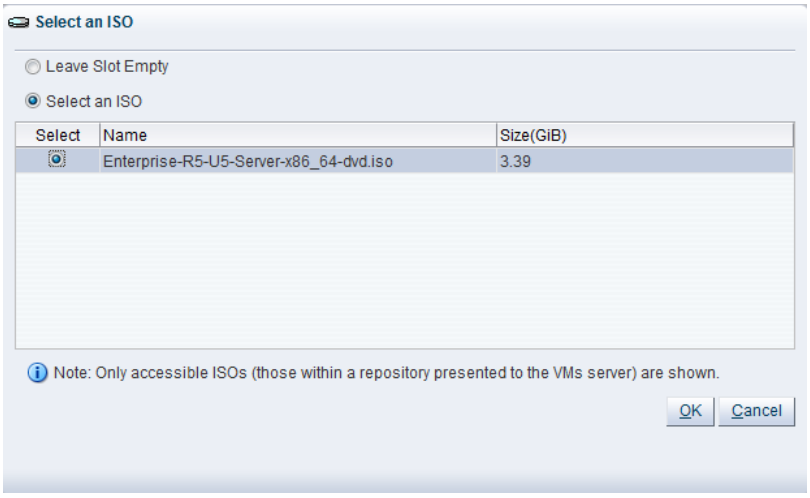
a. To add a physical disk to the virtual machine, select **Physical Disk** from the **Disk Type** drop-down list. Click **Select a Virtual Machine Disk** . The **Select a Physical Disk** dialog box is displayed.



Select a physical disk and click **OK**.

To add an ISO file:

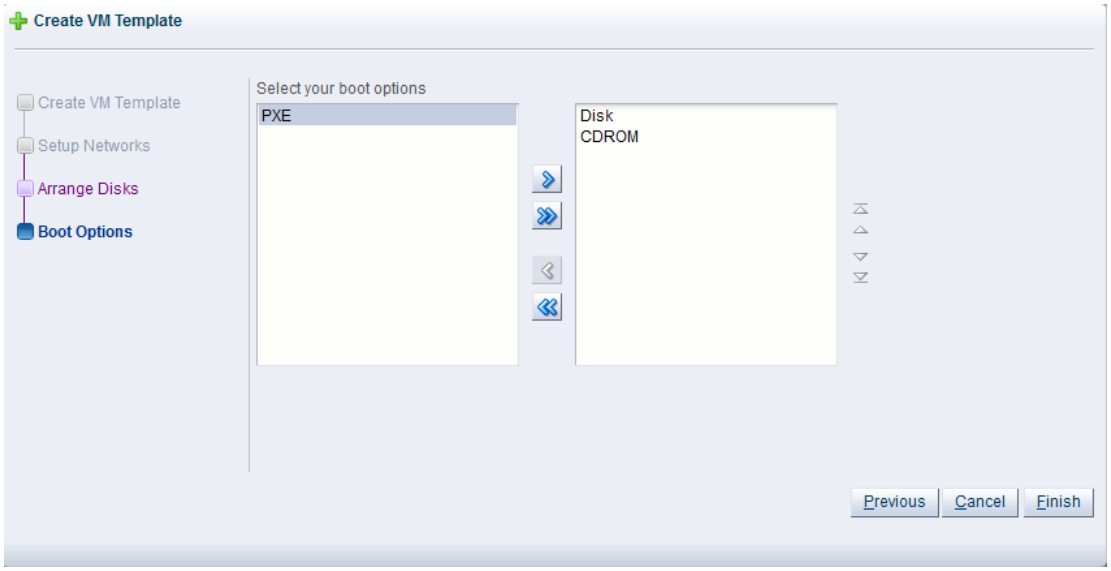
a. To add an ISO file to the virtual machine, select **CD/DVD** from the **Disk Type** drop-down list. Click **Select a Virtual Machine Disk** . The **Select an ISO** dialog box is displayed.



Select an ISO file and click **OK**.

When you have set up the virtual machine's disks, click **Next**.

7. The **Boot Options** step is displayed in the wizard.



Select the boot media order for your virtual machine.

If you are creating a hardware virtualized virtual machine (HVM), you can choose the **PXE** boot option. If so, remember to put PXE first in the **Select your boot options** field, and change the boot order again after installation and before rebooting the virtual machine. To use PXE, you must configure a PXE/tftp environment to offer the necessary boot media and instructions to the virtual machine.

If you are creating a paravirtualized virtual machine (PVM), you also have the **Network** option available (not shown in here). If so, specify **Network** to be at the top of the right-hand-side column, and enter the location of the mounted ISO file from which to perform the operating system installation in the **Network Boot Path** field (also not shown in here), for example

```
http://example.com/Enterprise-R6-U1-Server-x86_64-dvd.iso/
```

For information on creating a mounted ISO file, see Section 7.4, “Virtual Machine Installation Media”.

You cannot use the **Network Boot Path** field to boot a virtual machine using PXE. This field can only be used to specify the path to a mounted ISO file to use when installing a PVM guest.

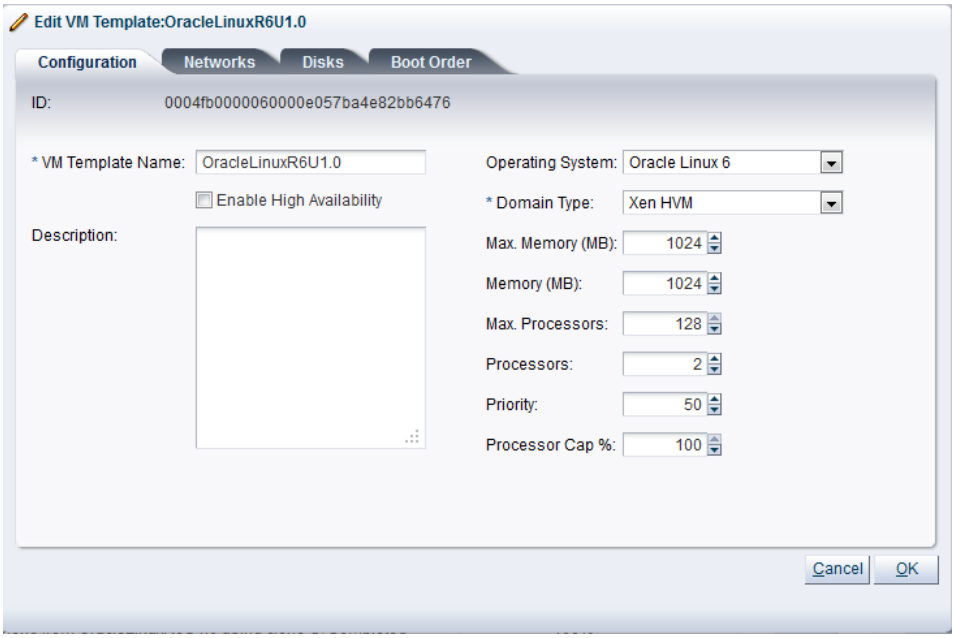
Click **Finish**. The template is created and saved in the repository.

7.5.3.4. Editing a Virtual Machine Template

You can edit a virtual machine template to change the configuration, networking, disks and boot order.

To edit a virtual machine template:

1. Click the **Repositories** tab. Select the repository in which the template is saved. Click **VM Templates** in the navigation tree.
2. Select the template to edit in the table in the management pane and click **Edit Selected VM Template...** .
3. The **Edit VM Template** dialog box is displayed.



Make any required changes to the template and click **OK** to save the template. For detailed information on each field in this dialog box, see Section 7.5.3.3, “Creating a Virtual Machine Template” .

7.5.3.5. Deleting a Virtual Machine Template

You can delete a virtual machine template, and the virtual disks associated with it.

To delete a virtual machine template:

1. Click the **Repositories** tab. Select the repository in which the template is saved. Click **VM Templates** in the navigation tree.
2. Select the template to edit in the table in the management pane and click **Delete Selected VM Template...** .
3. The **Delete Confirmation** dialog box is displayed. Select the virtual disks associated with the template you want to delete, if any. Click **OK** to delete the template.

7.5.3.6. Cloning a Virtual Machine Template

You can clone a virtual machine template to create new templates or virtual machines from the original template. See Section 7.8, “Cloning a Virtual Machine or Template” for information on cloning a template.

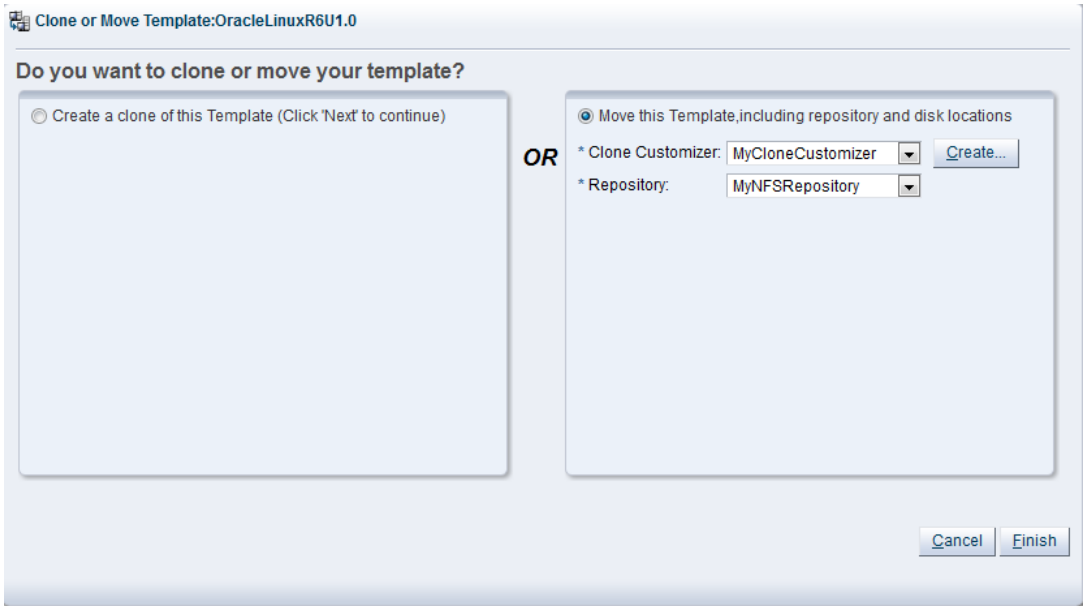
7.5.3.7. Moving a Virtual Machine Template

You can move a virtual machine template's resources (virtual disks, virtual machine configuration files) to a different storage repository, or change the location of the disks and network used in the template. You can change the location of disks and the network to use when you move a virtual machine using a clone customizer.

To move a virtual machine template:

1. Click the **Repositories** tab. Select the repository in which the template is saved. Click **VM Templates** in the navigation tree.
2. Select the template to move in the table in the management pane and click **Clone or Move** .

3. The **Clone or Move Template** dialog box is displayed.



Select **Move this Template**.

Select a clone customizer from the **Clone Customizer** drop-down list. If no clone customizers are displayed or you want to create a new one, click **Create**. See Section 7.8.1.1, “Creating a Clone Customizer” for information on creating a clone customizer.

Select a repository from the **Repository** drop-down list. The repository is where the template's virtual machine configuration file is moved to.

Click **Finish** to move the template.

7.5.3.8. Managing Virtual Machine Template Clone Customizers

To create, edit or delete clone customizers, see Section 7.8.1, “Managing Clone Customizers”.

7.5.4. Assemblies

An assembly is a kind of infrastructure template containing a configuration of one or more virtual machines with their virtual disks and even the inter connectivity between them. Assemblies can be created as a set of .ovf (Open Virtualization Format) and .img (disk image) files, or may all be contained in a single .ova (Open Virtualization Format Archive) file.

To use an assembly, you must first import it into a repository, then create one or more templates from the assembly. You create one virtual machine template for each virtual machine in the assembly. You can then use the template(s) to deploy the virtual machines that originated from the assembly. You cannot deploy all virtual machines in an assembly in one step; you must deploy each virtual machine individually. To perform deployment of all virtual machines, including the associated networking configuration, you should use Oracle Enterprise Manager.

For ease of use, you should use a single .ova file when working with assemblies in Oracle VM. You can also use the .ovf format with the associated disk image files, but you must import all the disk files individually as virtual disks, then import the .ovf file as an assembly before you can use the assembly to create a template.

To import an assembly:

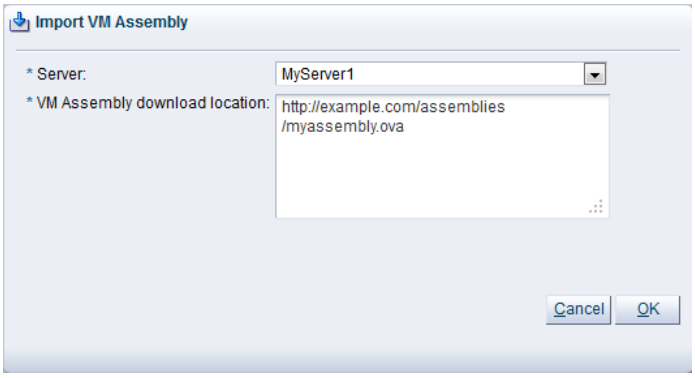
1. Create or locate an assembly file. This should be a single .ova file, which contains the .ovf descriptive file(s), and disk image file(s) for the assembly. If you do not have the assembly in the archive (.ova) format, but instead have a series of virtual disk images and the .ovf file, you must first import all the virtual disk files, then continue with this procedure to import the .ovf file. See Section 7.5.6, “Virtual Disks” for information on importing virtual disk files.

2. Place the assembly file in a location accessible from your Oracle VM Manager host computer using either of these protocols: HTTP, HTTPS or FTP.

3. Click the **Repositories** tab. Select the repository in which to store the assembly file. Select **Assemblies** in the navigation tree.

4. Select **Import VM Assembly...** in the toolbar in the management pane.

5. The **Import VM Assembly** dialog box is displayed.



   Select or edit the following:

   - **Server:** The Oracle VM Server to use the perform the assembly file import.
   - **VM Assembly download location:** The URL for the assembly file. The URL protocols supported are HTTP, HTTPS, and FTP. For example:

     http://example.com/assemblies/myassembly.ova

   Click **OK** to import the assembly file. When the import job is complete, the new assembly is displayed in the table in the management pane.

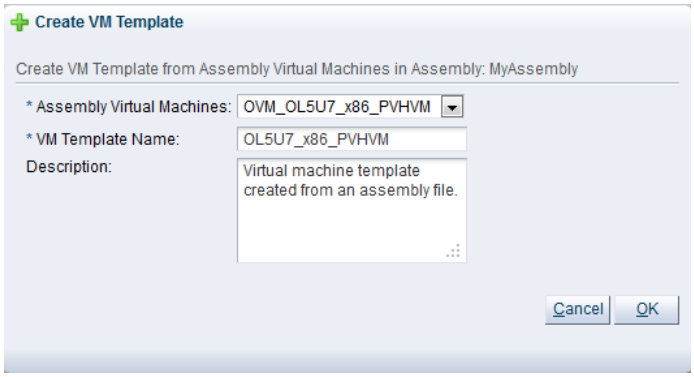
6. To display the virtual machines contained in an assembly, expand the table row in the management pane.

To create a virtual machine template from an assembly:

1. Click the **Repositories** tab. Select the repository in which the assembly file is located. Select **Assemblies** in the navigation tree.

2. Select **Create VM Template...** in the toolbar in the management pane.

3. The **Create VM Template** dialog box is displayed.



Select or edit the following:

- **Assembly Virtual Machines:** The virtual machine in the assembly from which to create a template.
- **VM Template Name:** A name for the template.
- **Description:** An option text description of the template.

Click **OK** to create the template. The template is created in the same repository as the original assembly is located. When you have created a template from the assembly, you can use the template to create and deploy virtual machines. See Section 7.5.3.1, “Using a Virtual Machine Template” for information on using a template to create virtual machines.

To edit an assembly file:

1. Click the **Repositories** tab. Select the repository in which the assembly file is located. Select **Assemblies** in the navigation tree.
2. Select the assembly in the table in the management pane. Click **Edit Selected VM Assembly...** in the management pane toolbar.
3. Edit the **Name** or **Description**. Click **OK**.

To delete an assembly file:

1. Click the **Repositories** tab. Select the repository in which the assembly file is located. Select **Assemblies** in the navigation tree.
2. Select the assembly file in the table in the management pane. Click **Delete Selected VM Assembly** in the management pane toolbar.
3. The **Delete Confirmation** dialog box is displayed. Click **OK**.

To refresh an assembly file:

1. Click the **Repositories** tab. Select the repository in which the assembly file is located. Select **Assemblies** in the navigation tree.
2. Select the assembly file in the table in the management pane. Click **Refresh Selected VM Assembly** in the management pane toolbar.
3. The contents of the assembly are refreshed from the storage repository.

7.5.5. ISO Files (CD/DVD Images)

Virtual machines have no access to the physical DVD or CD-ROM drive. You can assign virtual drives to virtual machines by offering ISO files containing the image of a DVD or CD-ROM. These image files can be found in the ISOs folder in a storage repository.

You import ISO files from a web server into Oracle VM Manager. You can then select the installation media as an ISO file when you create a virtual machine. To create a virtual machine using an ISO file, see Section 7.7, “Creating a Virtual Machine”.

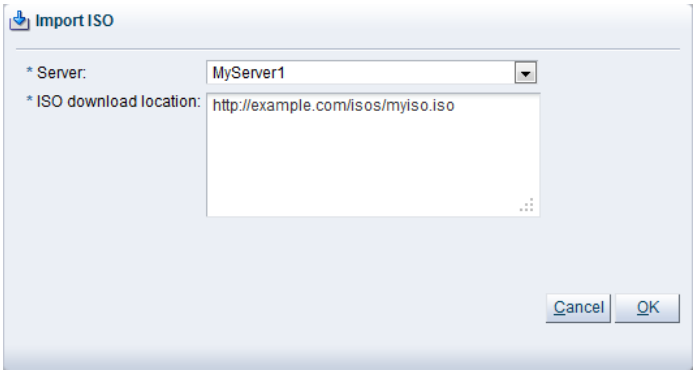
To be able to use an ISO file with your virtual machine you must first import the file into an appropriate storage repository, namely one that can be accessed by the server pool where the virtual machine is to be created. If your storage repository uses file-based storage, you can the make repository available to multiple server pools, therefore making an ISO file available to multiple server pools. If you are using storage array-based storage, you can only make a repository available to a single server pool. Virtual machines can only access ISO files that have been assigned to the server pool to which they belong.

To copy an ISO file to the same repository, another repository, a file system, or a storage array, you *clone* the ISO file. To clone an ISO file, it must not be in use by any running virtual machines or other clone job.

To delete an ISO file, it must not be in use by any virtual machines. To see which virtual machines use an ISO file, select it in the management pane and expand the table row.

To import an ISO file:

1. Click the **Repositories** tab. Select the repository in which to store the ISO file. Select **ISOs** in the navigation tree.
2. Select **Import ISO...** in the toolbar in the management pane.
3. The **Import ISO** dialog box is displayed.



Select or edit the following:

- **Server:** The Oracle VM Server to use the perform the ISO file import.
- **ISO download location:** The URL for the ISO file. The URL protocols supported are HTTP, HTTPS, and FTP. For example:

  http://example.com/isos/myiso.iso

Click **OK** to import the ISO file. When the import job is complete, the new ISO is displayed in the table in the management pane.

To edit an ISO file:

1. Click the **Repositories** tab. Select the repository in which the ISO file is located. Select **ISOs** in the navigation tree.

2. Select the ISO in the table in the management pane. Click **Edit Selected ISO** in the management pane toolbar.
3. The Edit ISO dialog box is displayed.

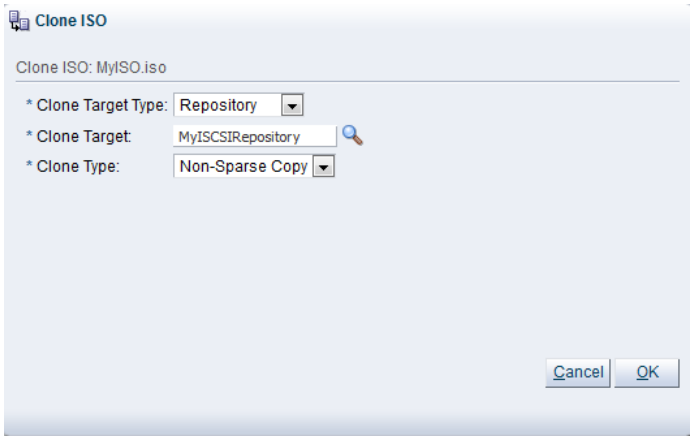
   Edit the **ISO Name** or **Description**. Click **OK**.

To delete an ISO file:

1. Click the **Repositories** tab. Select the repository in which the ISO file is located. Select **ISOs** in the navigation tree.
2. Select the ISO file in the table in the management pane. Click **Delete Selected ISO** in the management pane toolbar.
3. The **Delete Confirmation** dialog box is displayed. Click **OK**.

To clone an ISO file:

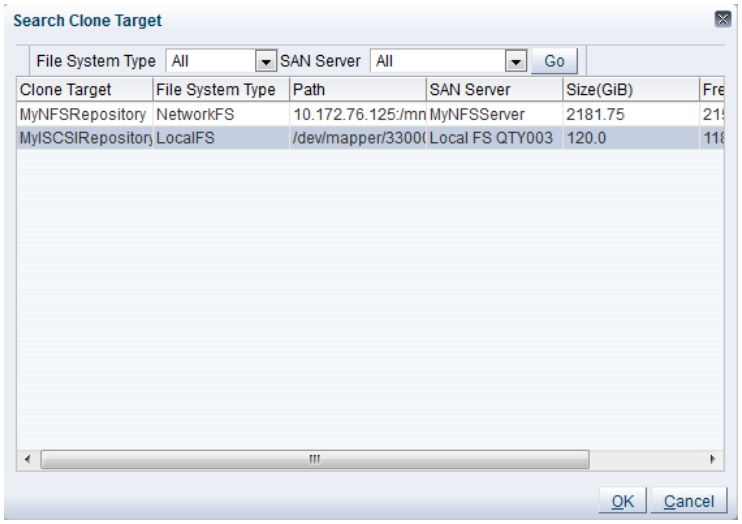
1. Click the **Repositories** tab. Select the repository in which the ISO is located. Select **ISOs** in the navigation tree.
2. Select the ISO in the table in the management pane. Click **Clone ISO** in the management pane toolbar.
3. The **Clone ISO** dialog box is displayed.



   Select or edit the following:

   - **Clone Target Type:** The destination storage type for the cloned ISO, either:
     - Repository
     - Physical Disk
     - Storage Array
   - **Clone Target:** The destination location for the cloned ISO. Click **Search Clone Target** to select the destination.

     The **Search Clone Target** dialog box is displayed.



Select the location on which to clone the ISO and click **OK**.

- **Clone Type:** Whether to use a **Sparse Copy** or **Non-sparse Copy**. Sparse Copy creates a sparse disk, so the size of the disk is smaller than the original. Sparse copy is faster than using Non-Sparse Copy. Non-Sparse Copy copies the entire ISO, and so is slower than creating a sparse disk.

Click **OK** to clone the ISO file.

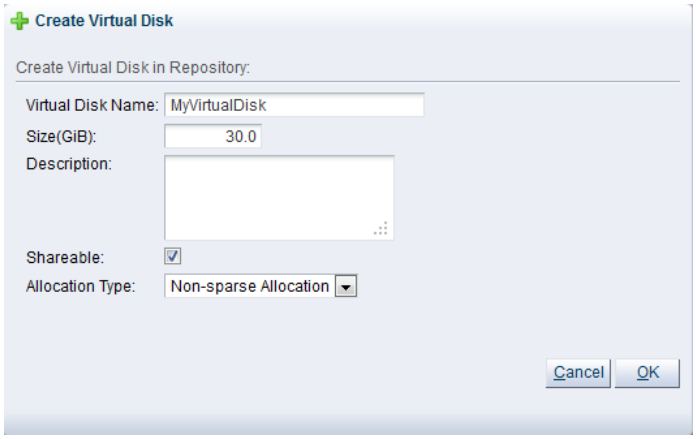
7.5.6. Virtual Disks

A virtual machine needs at least one disk – that is, a disk to boot from and to run the operating system. Virtual disks can be part of a template, assembly, can be created as part of the virtual machine creation process, or can be created independently inside the storage repository. Virtual disks can be shared across virtual machines, or dedicated to one virtual machine. All virtual disks available in the storage repository appear in **Virtual Disks** in the navigation tree when you select a storage repository, regardless of how they are created.

When you create a virtual machine from scratch, you are given the opportunity to either create a new virtual disk or use an existing one. This section lists how to create, import, edit, delete and clone virtual disks. For more information about creating a virtual machine from scratch, see Section 7.7, “Creating a Virtual Machine”.

To create a new virtual disk:

1. Click the **Repositories** tab. Select the repository in which to store the virtual disk. Select **Virtual Disks** in the navigation tree.
2. Click **Create Virtual Disk...** in the management pane toolbar.
3. The **Create Virtual Disk** dialog box is displayed.



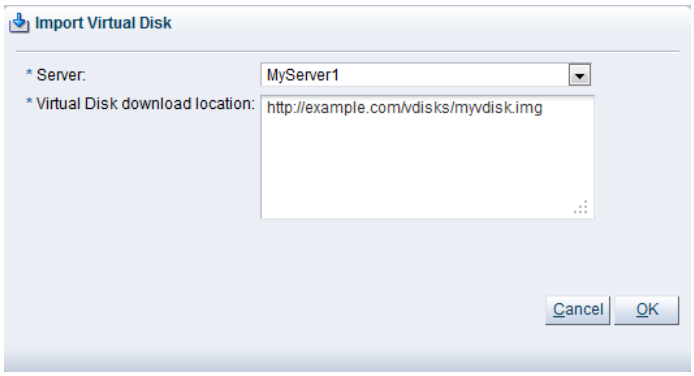
Enter or select the following:

- **Virtual Disk Name:** A name for the virtual disk.
- **Size (GiB):** The size of the disk, in GiB.
- **Description:** A description of the virtual disk.
- **Shareable:** Whether the virtual disk is shareable. Shareable disks have read/write privileges in multiple virtual machines and should be used with caution.
- **Allocation Type:** Whether to create a sparse or non-sparse virtual disk.

Click **OK** to create the new disk. To display which virtual machines use a disk, expand the table row in the management pane.

To import a virtual disk:

1. Click the **Repositories** tab. Select the repository in which to store the virtual disk. Select **Virtual Disks** in the navigation tree.
2. Click **Import Virtual Disk...** in the management pane toolbar.
3. The **Import Virtual Disk** dialog box is displayed.



Select or edit the following:

- **Server:** The Oracle VM Server to use the perform the virtual disk file import.

- **Virtual Disk download location:** The URL for the virtual disk file. The URL protocols supported are HTTP, HTTPS, and FTP. For example:

  http://example.com/vdisks/myvdisk.img

Click **OK** to import the virtual disk file. When the import job is complete, the new virtual disk is displayed in the table in the management pane.

To edit a virtual disk:

1. Click the **Repositories** tab. Select the repository in which the virtual disk is located. Select **Virtual Disks** in the navigation tree.
2. Select the virtual disk in the table in the management pane. Click **Edit Virtual Disk...** in the management pane toolbar.
3. The **Edit Virtual Disk** dialog box is displayed.

Enter or select the following:

- **Virtual Disk Name:** A name for the virtual disk.
- **Size (GiB):** The size of the disk, in GiB.
- **Description:** A description of the virtual disk.
- **Shareable:** Whether the virtual disk is shareable. Shareable disks have read/write privileges in multiple virtual machines and should be used with caution.

Click **OK** to save the changes.

Warning

When resizing a disk there is always a risk of data corruption. Also, the file system on the virtual disk may not be aware of the resize operation, so you may have to perform operating specific procedures to make the guest virtual machine aware of the change in disk size.

To delete a virtual disk:

1. Click the **Repositories** tab. Select the repository in which the virtual disk is located. Select **Virtual Disks** in the navigation tree.

2. Select the virtual disk in the table in the management pane. Click **Delete Selected Virtual Disk** in the management pane toolbar.

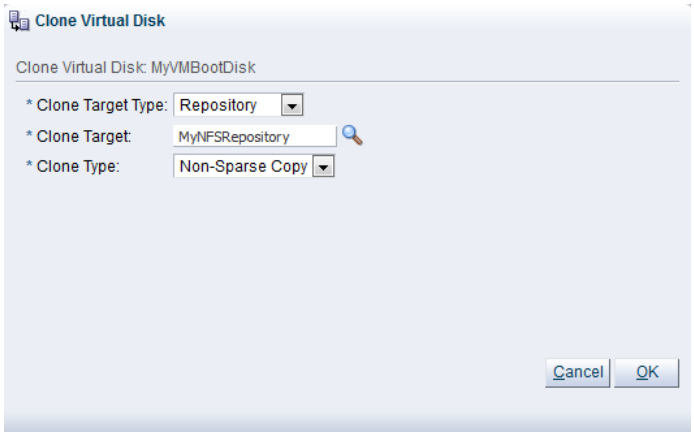
3. The **Delete Confirmation** dialog box is displayed. Click **OK**.

To clone a virtual disk:

1. Click the **Repositories** tab. Select the repository in which the virtual disk is located. Select **Virtual Disks** in the navigation tree.

2. Select the virtual disk in the table in the management pane. Click **Clone Virtual Disk** in the management pane toolbar.

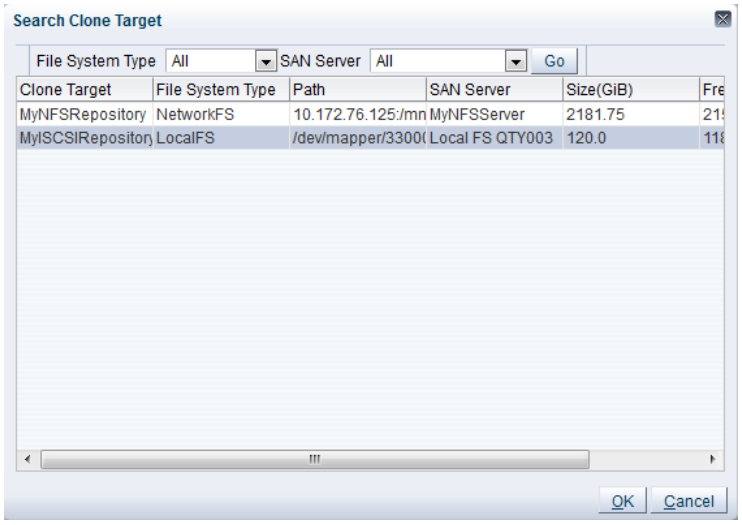
3. The **Clone Virtual Disk** dialog box is displayed.



Select or edit the following:

- **Clone Target Type:** The destination storage type for the cloned virtual disk, either:
  - Repository
  - Physical Disk
  - Storage Array
- **Clone Target:** The destination location for the cloned virtual disk. Click **Search Clone Target** to select the destination.

  The **Search Clone Target** dialog box is displayed.



Select the location on which to clone the virtual disk and click **OK**.

- **Clone Type:** Whether to use a **Sparse Copy** or **Non-sparse Copy**. Sparse Copy creates a sparse disk, so the size of the disk is smaller than the original. Sparse copy is faster than using Non-Sparse Copy. Non-Sparse Copy copies the entire virtual disk, and so is slower than creating a sparse disk.

Click **OK** to clone the virtual disk.

7.5.7. Virtual Machine Configuration Files

The final folder in a storage repository navigation tree is **VM Files**. This folder lists all the virtual machine configuration files in the storage repository. In the Create Virtual Machine wizard you specify which storage repository to use to store the configuration file of your virtual machine. Consider the VM Files folder to be the home location of all the virtual machines that have been created in the selected storage repository. You cannot perform any actions to the virtual machine configuration files. If you want to rename, move or delete any of these files, you should perform those operations on the virtual machine, not just the virtual machine configuration file. See Section 7.9.2, “Editing a Virtual Machine” for information on editing a virtual machine, and Section 7.9.11, “Deleting a Virtual Machine” for information on deleting a virtual machine.

7.6. Creating VNICs

A VNIC is used by a virtual machine to provide virtual network interfaces by defining a range of MAC addresses. Each MAC address corresponds with a single virtual NIC, which is used by a virtual machine. You can create a VNIC when you create a virtual machine, or you can create VNICS at any time using the **Virtual NICs** subtab of the **Networking** tab.

To create VNICs:

1. Click the **Networking** tab. Click the **Virtual NICs** subtab.

Note

You can also click **Create VNICs...** in the toolbar in the **Servers and VMs** tab to create VNICs.

2. In the **Create Virtual NICs** area, enter a MAC address in the **Initial Address** field, or click **(Auto Fill)** to randomly select the first MAC address to use.

3. Select the number of addresses that you want to create in the **Create** list, and click **Create**. The VNICs are created and listed in the Virtual NIC table.

After the creation of the VNICs you are able to use them when you create virtual machines. For more information on creating virtual machines, see Section 7.7, “Creating a Virtual Machine”.

Caution

If you run more than one Oracle VM Manager instance, you must not have overlapping MAC address ranges. If you create a MAC address that is already in the Oracle VM Manager database, an error message is displayed.

7.7. Creating a Virtual Machine

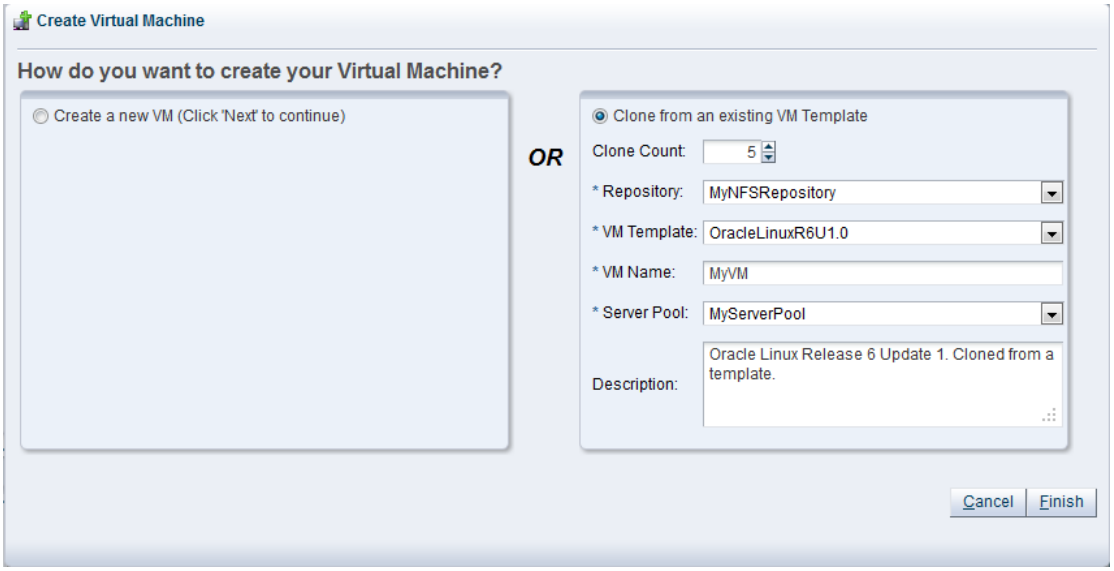
Before you create a new virtual machine, make sure that the following resources are available:

- A server pool. See Section 6.7, “Creating a Server Pool” for information on creating server pools.
- An Oracle VM Server as part of the server pool.
- Source file(s) in a repository from which to create the virtual machine. The source files can be any of the following:
  - Imported ISO file. See Section 7.5.5, “ISO Files (CD/DVD Images)” for more information on how to import ISO files.
  - Virtual machine template. See Section 7.5.3, “Virtual Machine Templates” for more information on how to import a virtual machine template.
  - Virtual machine assembly. See Section 7.5.4, “Assemblies” for more information on how to import an assembly.

This section discusses creating a virtual machine using a template, and creating a virtual machine from an ISO file, or from physical or virtual disks.

To create a virtual machine using a template:

1. Click the **Servers and VMs** tab.
2. Click **Create Virtual Machine** in the toolbar.
3. The **Create Virtual Machine** wizard is displayed.



Select the **Clone from an existing VM Template** option.

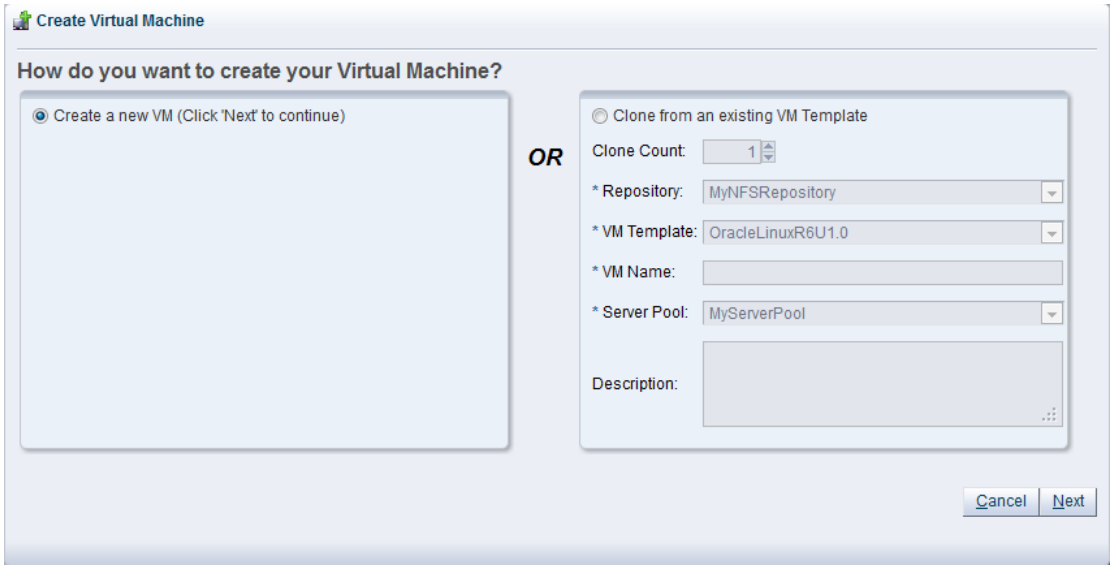
Enter or select the following:

- **Clone Count:** The number of virtual machines to create from the template.
- **Repository:** Select the repository in which to create the virtual machine configuration files.
- **VM Template:** The template to use to create the virtual machines.
- **VM Name:** A name for the virtual machines. The maximum name length is 256 characters and may contain any character. The name need not be unique. Each clone is suffixed with a dot and the clone number, starting with 0, for example MyVM.0, MyVM.1 and so on.
- **Server Pool:** The server pool in which to deploy the virtual machines.
- **Description:** A description of the virtual machines.

Click **Finish**. The virtual machines are created and deployed to the server pool.

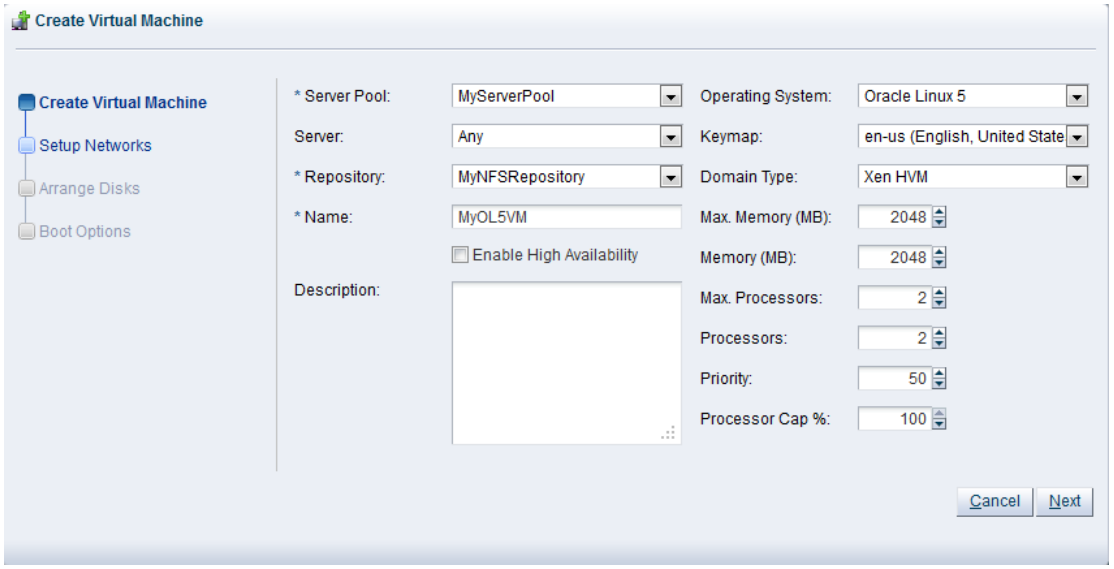
To create a virtual machine using all other media:

1. Click the **Servers and VMs** tab.
2. Click **Create Virtual Machine** in the toolbar.
3. The **Create Virtual Machine** wizard is displayed.



Select the **Create a new VM** option. Click **Next**.

4. The **Create Virtual Machine** step is displayed in the wizard.



Enter or select the following:

- **Server Pool:** The server pool on which to create the virtual machine.
- **Server:** A Oracle VM Server on which to run the virtual machine. If you do not have a preference as to which Oracle VM Server to use, select **Any** and the Oracle VM Server with the most available resources is selected to host the virtual machine.
- **Repository:** Select the repository in which to create the virtual machine configuration file.
- **Name:** A name for the virtual machine. The maximum name length is 256 characters and may contain any character. The name need not be unique.

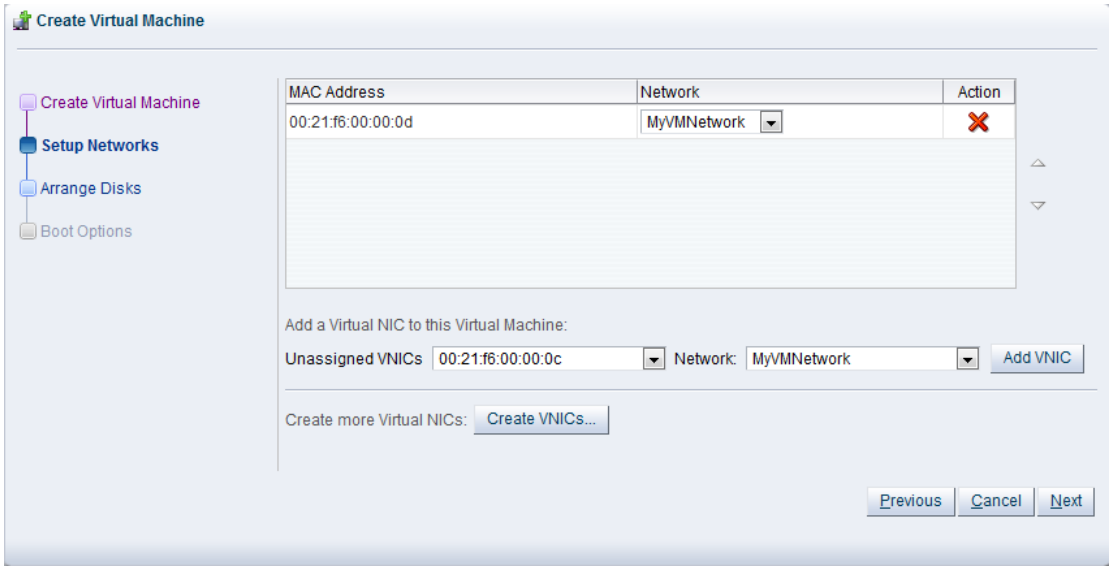
- **Enable High Availability:** Select to enable HA. See Section 6.4, “High Availability (HA)” for more information on HA.
- **Description:** A description of your virtual machine.
- **Operating System**: The operating system of your virtual machine. This setting enables or disables certain virtual machine settings that your guest operating system may require.
- **Keymap**: The keyboard mapping to use for the virtual machine.
- **Domain Type**: The domain type of the virtual machine. Oracle recommends you create paravirtualized virtual machines if possible, as the performance of a paravirtualized virtual machine is superior to that of a hardware virtualized guest.
  - **Xen HVM:** Hardware virtualization, or fully virtualized. When you select this option you must supply an ISO file in a repository (in the Create Storage step of the wizard) from which to create the virtual machine. See Section 7.5.5, “ISO Files (CD/DVD Images)” for information on importing an ISO file into a repository.
  - **Xen HVM, PV Drivers:** Identical to Xen HVM, but with additional paravirtualized drivers for improved performance of the virtual machine. See Section 7.11, “Converting to Paravirtualized Guests or Installing Paravirtualized Drivers” for more information about using paravirtualized drivers. This Domain Type is used to run Microsoft Windows guest operating systems with an acceptable performance level.
  - **Xen PVM:** Paravirtualized. Enables you to select a location for the mounted ISO file from which to create the virtual machine. Before you create the virtual machine using the paravirtualized method, mount the ISO file on an NFS share, or HTTP or FTP server. You supply the location of the mounted ISO file in the **Network Boot Path** field in the **Boot Options** step of the wizard. For information on creating a mounted ISO file, see Section 7.4, “Virtual Machine Installation Media”.
  - **OVM/SPARC:** This domain type should be selected if the server pool and hypervisors use Oracle VM Server for SPARC as the hypervisor instead of Oracle VM Server for x86.
  - **Unknown:** This hypervisor should be selected if the domain type is unknown.
- **Max. Memory (MB):** The maximum memory size the virtual machine can be allocated.
- **Memory (MB):** The memory size the virtual machine is allocated. When creating a virtual machine, this is the memory allocation used when starting the virtual machine. You can change this when editing a running PVM and no virtual machine restart is required. For HVM guests, increasing or decreasing the memory requires the virtual machine to be stopped.
- **Max. Processors:** The maximum number of processors the virtual machine can be allocated. The number of processors is expressed in number of physical CPU cores, and is limited to 128. This cannot be changed when editing a running virtual machine. To edit this value, you must first stop the virtual machine.
- **Processors:** The number of processors the virtual machine is allocated. The number of processors is expressed in number of physical CPU cores, and is limited to 128. You can change this when editing a running virtual machine, up to the value of Max. Processors.
- **Priority**: The CPU priority of the virtual machine. The higher the priority, the more physical CPU cycles are given to the virtual machine.

- **Processor Cap %**: Increase or decrease the percentage to which the virtual CPUs can receive scheduled time. This parameter defines the maximum percentage to which the virtual CPUs can receive scheduled time. Use this parameter to keep low priority virtual machines from consuming too many CPU cycles on a Virtual Machine Server.

The **Priority** and **Processor Cap%** parameters are passed to the hypervisor, which determines the percentage. These two parameters are always combined by the hypervisor and are a key factor for the performance of the virtual machine.

Click **Next**.

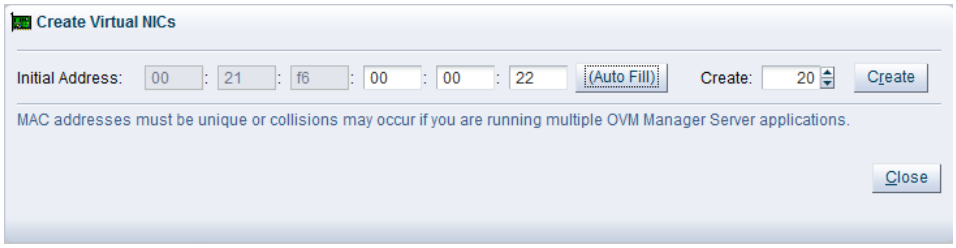
5. The **Setup Networks** step is displayed in the wizard.



For each VNIC you want to add to the virtual machine, select a VNICs from the **Unassigned VNICs** drop-down list. Select the network to use from the **Network** drop-down list, and click **Add VNIC**.

If you are editing the networking of an existing stopped virtual machine, you can change the network to which the VNIC belongs using the **Network** drop-down list.

If no VNICs are available in the **Unassigned VNICs** drop-down list, click **Create VNICs** to display the **Create Virtual NICs** dialog box.

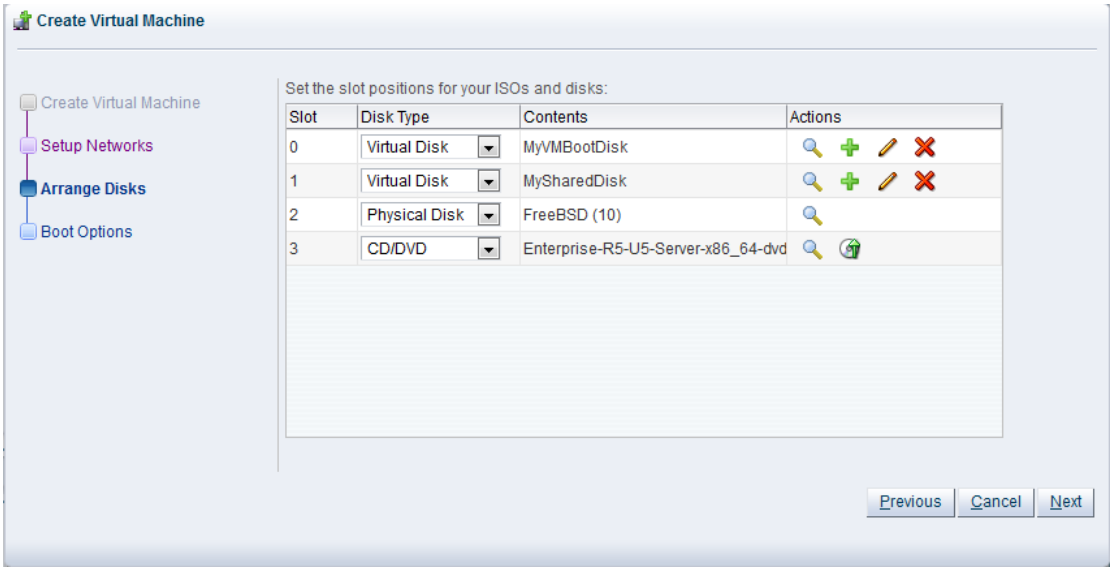


Click **(Auto Fill)**, then **Create** to create VNICs. Click **Close**.

A virtual machine can have up to eight virtual network interfaces for emulated guests and up to 31 for PVM guests. A PVM guest requires network connectivity to perform the operating system install and must have a VNIC.

Click **Next**.

6. The **Arrange Disks** step of the wizard is displayed.



Select the desired storage configuration of your virtual machine, such as virtual disks, physical disks, and ISO files. On a separate slot, add one or more of the following disk types:

- **Empty** A empty slot.
- **Virtual Disk:** This allows you to add or create a virtual disk. Virtual disks can be shared by virtual machines.
- **Physical Disk** The physical disks are the disks in a storage array. Physical disks can be shared by virtual machines.
- **CD/DVD:** This adds an ISO file in a storage repository and can be used to create HVM and PVHVM virtual machines. When creating a virtual machine from an ISO file, you must use a single file. Installations that span multiple ISO files are not supported. ISO files cannot be used to create PVM virtual machines.

Add or create any virtual disks to use as the virtual machine's hard disk, select any physical disks to add, and select any ISO files to use to create the virtual machine. Add the disks in the order they should appear in the virtual machine. The disk with the boot partition or installation media should be the first disk listed. An HVM guest can have up to four disks, including empty CD/DVD drives. A PVM or PVHVM guest can have up to 52 disks. Only one slot can contain an empty CD/DVD.

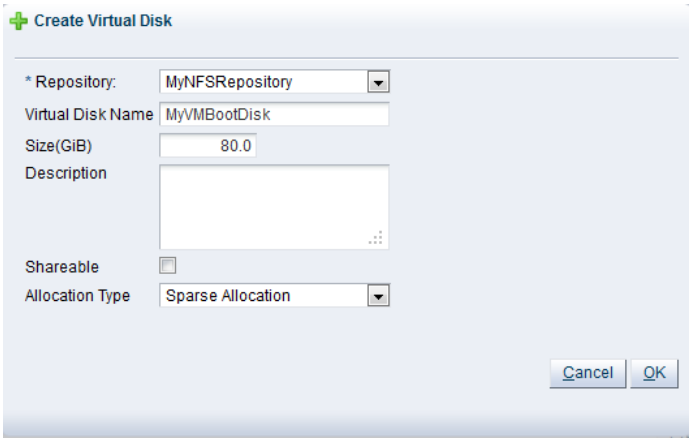
Tip

When editing a running virtual machine, you can change the CD/DVD using this dialog box and the CD/DVD is mounted in the operating system.

To create or add a virtual disk:

a. To create a virtual disk, select **Virtual Disk** from the **Disk Type** drop-down list and click **Create a Virtual Disk** ✚ .

b. The **Create Virtual Disk** dialog box is displayed.

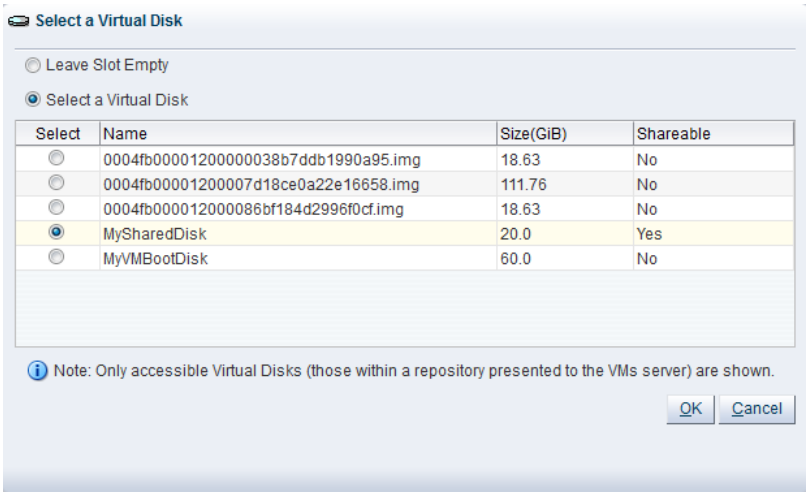


Enter or select the following to create a virtual disk:

- **Repository:** The repository in which the virtual disk is to be created.
- **Virtual Disk Name:** The name of the virtual disk to be created and made available to the virtual machine. See Section 7.5.6, “Virtual Disks” for more information about using virtual disks.
- **Size (GiB):** The disk size in GiB of the virtual disk.
- **Description:** A description of the virtual disk.
- **Shareable:** Whether the virtual disk should be shareable (read/write) with other virtual machines.
- **Allocation Type:** Whether to use a **Sparse Allocation** or **Non-sparse Allocation**. Sparse Allocation creates a sparse disk, so the size of the disk is initially small and increases as it is used. Sparse allocation is faster than using Non-Sparse Allocation when creating a virtual machine. Non-Sparse Allocation creates the entire disk when the virtual machine is created, and so is slower than creating a sparse disk.

Click **OK**.

c. To search for an existing virtual disk to add to the virtual machine, click **Select a Virtual Machine Disk** . The **Select a Virtual Machine Disk** dialog box is displayed.



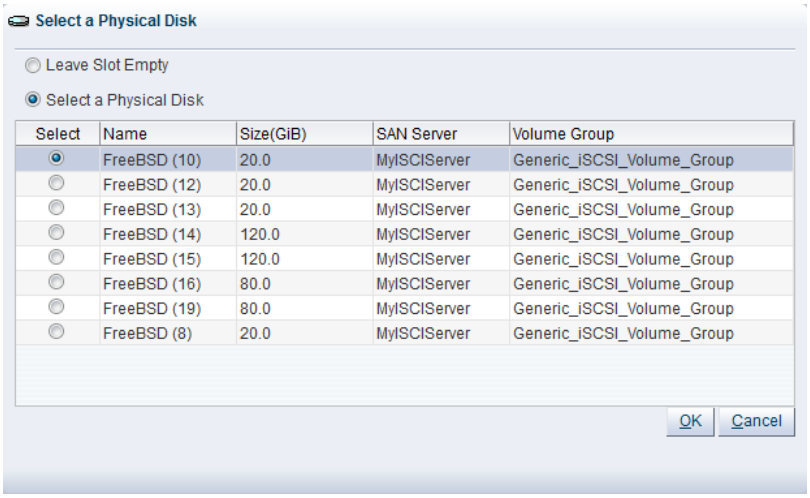
Select the virtual disk to use and Click **OK**.

Note

If your virtual machine needs more than one disk, you can create the disk(s) afterwards in the repository, and add them to the virtual machine. See Section 7.5.6, “Virtual Disks” for more information.

To add a physical disk:

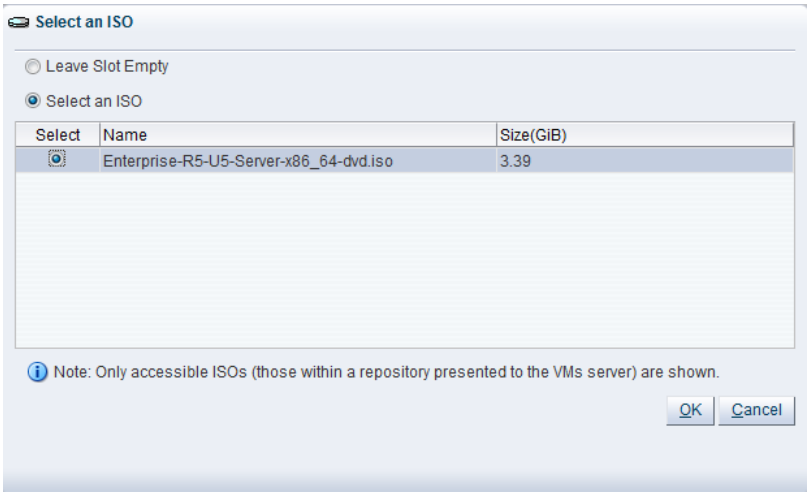
a. To add a physical disk to the virtual machine, select **Physical Disk** from the **Disk Type** drop-down list. Click **Select a Virtual Machine Disk** . The **Select a Physical Disk** dialog box is displayed.



Select a physical disk and click **OK**.

To add an ISO file:

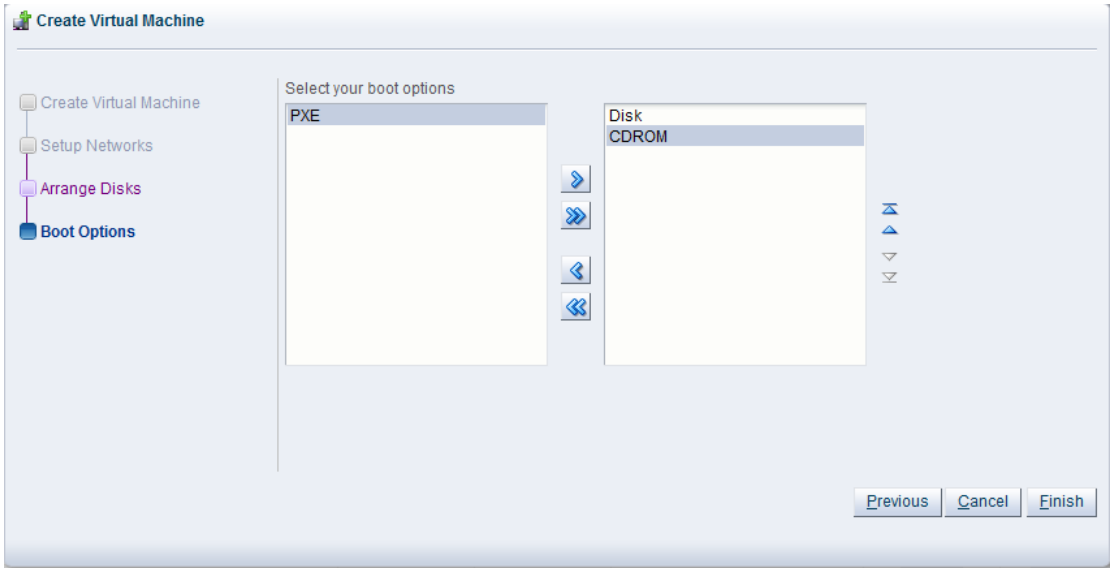
a. To add an ISO file to the virtual machine, select **CD/DVD** from the **Disk Type** drop-down list. Click **Select a Virtual Machine Disk** . The **Select an ISO** dialog box is displayed.



Select an ISO file and click **OK**.

When you have set up the virtual machine's disks, click **Next**.

7. The **Boot Options** step is displayed in the wizard.



Select the boot media order for your virtual machine.

If you are creating a hardware virtualized virtual machine (HVM), you can choose the **PXE** boot option. If so, remember to put PXE first in the **Select your boot options** field, and change the boot order again after installation and before rebooting the virtual machine. To use PXE, you must configure a PXE/tftp environment to offer the necessary boot media and instructions to the virtual machine.

If you are creating a paravirtualized virtual machine (PVM), you also have the **Network** option available (not shown in here). If so, specify **Network** to be at the top of the right-hand-side column, and enter the location of the mounted ISO file from which to perform the operating system installation in the **Network Boot Path** field (also not shown in here), for example

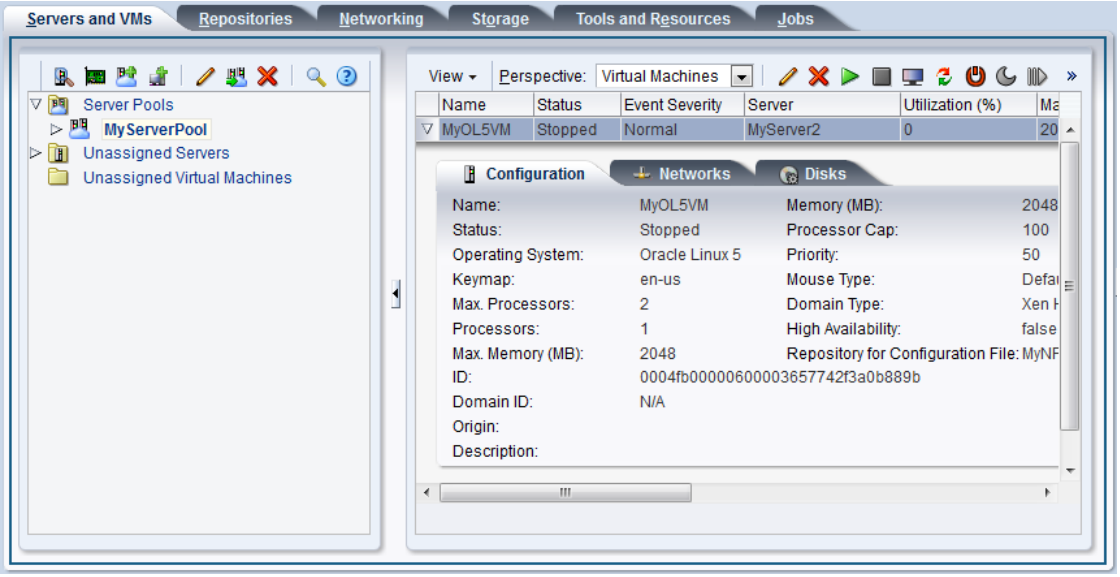
```
http://example.com/Enterprise-R6-U1-Server-x86_64-dvd.iso/
```

For information on creating a mounted ISO file, see Section 7.4, “Virtual Machine Installation Media”.

You cannot use the **Network Boot Path** field to boot a virtual machine using PXE. This field can only be used to specify the path to a mounted ISO file to use when installing a PVM guest.

Click **Finish**. The virtual machine is created and deployed to the server pool.

To access the virtual machine, select the server pool on which the virtual machine was created in the navigation tree, and select **Virtual Machines** in the **Perspective** drop-down list in the management pane. Select the virtual machine in the table to perform operations on it. Expand the virtual machine in the table to see more detailed configuration information.



If you created a PVM, there are some steps you should take after the operating system installation is completed:

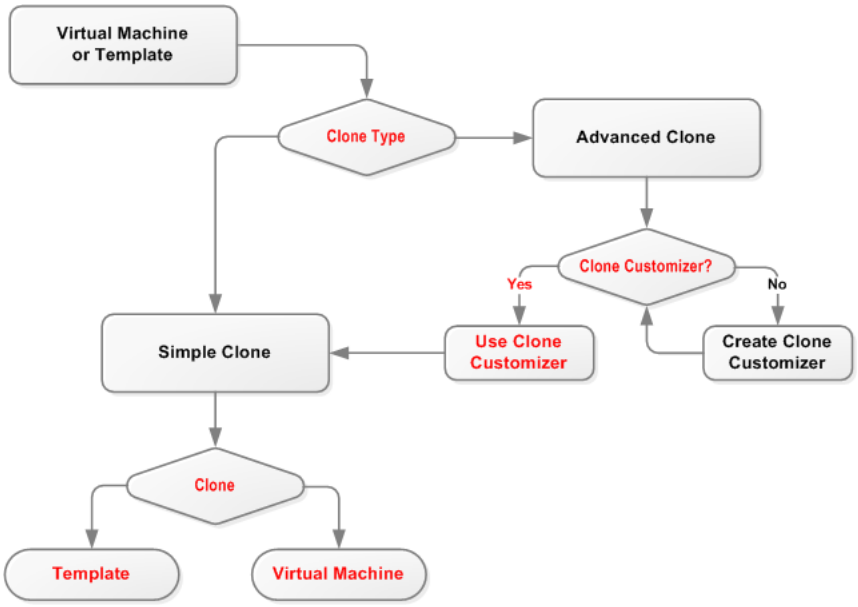
1. Stop the virtual machine.
2. Edit the virtual machine and remove **PXE** from the **Boot Order** column in the **Boot Options** step of the **Edit Virtual Machine** wizard.
3. Start the virtual machine and complete the installation if necessary.

To edit the virtual machine configuration information, see Section 7.9.2, “Editing a Virtual Machine”.

7.8. Cloning a Virtual Machine or Template

Cloning a virtual machine or template enables you to create multiple virtual machines or templates based on the original. There are two methods of cloning; a simple clone, and an advanced clone. A simple clone sets up the clone with the same configuration information as the original. An advanced clone enables you to create and use a clone customizer with differing configuration from the original. For example, you can use a clone customizer to have the clone deploy to a different server pool or repository, with changed memory, virtual CPU number, network settings, and so on. Figure Figure 7.2, “Cloning a virtual machine or template” shows the process of creating a clone of a virtual machine or template.

Figure 7.2. Cloning a virtual machine or template



To modify the clone parameters, such as virtual disks, network, memory, and so on, you should use a clone customizer, and use that clone customizer to perform cloning. See Section 7.8.1, “Managing Clone Customizers” to create a clone customizer to during cloning.

A *cold* clone is a clone created from a *stopped* virtual machine. A cold clone performs a clone of the virtual machine, with safe and consistent virtual disk status. This is useful for creating a virtual machine or template from the original virtual machine. A *hot* clone is created from a *running* virtual machine. A hot clone is only available on OCFS2-based file systems, so you must use either iSCSI- or fibre channel-based storage for the source and target repositories. A hot clone creates a clone with inconsistent disk status, and should only be used as a *snapshot* or back up of a virtual machine, perhaps on a virtual machine that requires 100% uptime and cannot be shut down. If you want to use the hot-cloned virtual machine, you should first repair any virtual disks, using a disk repair utility such as `fsck`. Do not use hot cloning for virtual machines running an Oracle Database. Instead, you should use an Oracle Database backup strategy, such as the `rman` utility.

A *thin* clone means copies the virtual machine files and only take up the amount of disk space actually used, not the full specified disk size. Thin cloning can only be used when cloning from and to the same repository, and when the storage used for the storage repository is non-generic (for example, a Sun 7000 or NetApp Storage Connect plug in). Thin cloning is the fastest and most efficient cloning method.

A clone can also be performed using two other file copy methods: *sparse* copy, and *non-sparse* copy. These two cloning methods can be used when cloning from and to different repositories, and when the storage used for the storage repository uses a generic Storage Connect plug in. These cloning methods are slower than thin cloning, but more versatile.

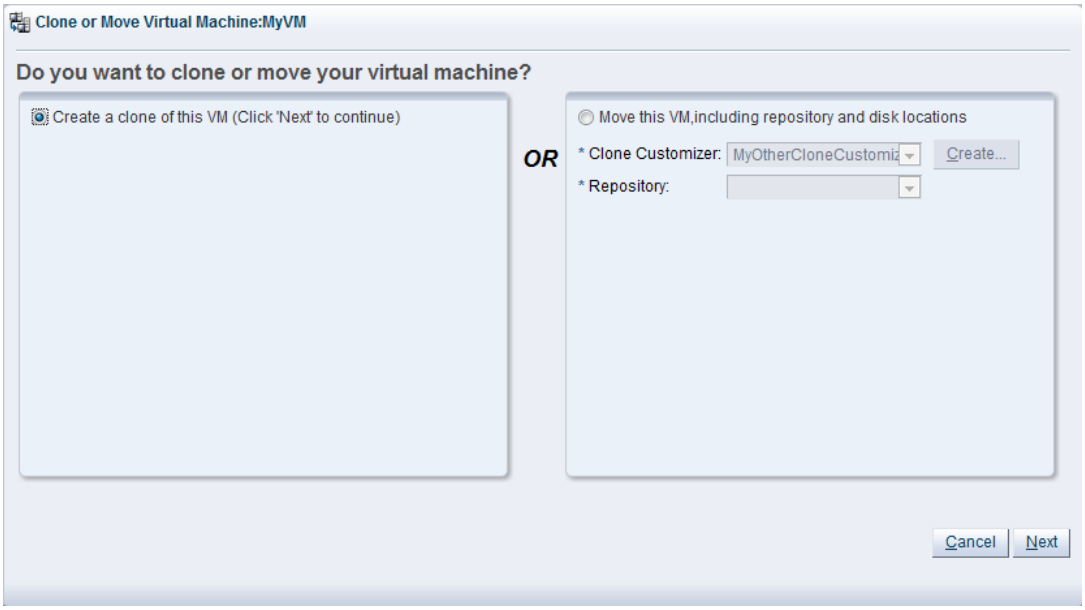
To create a clone of a virtual machine or template:

1. Select the virtual machine or template to clone and display the **Clone or Move** dialog box. You display this dialog box from different locations, depending on whether you are cloning a virtual machine or a template.

   - **Virtual Machine:** Click the **Servers and VMs** tab. Select the server pool on which the virtual machine resides in the navigation tree. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to clone in the management pane, and click **Clone or Move** .

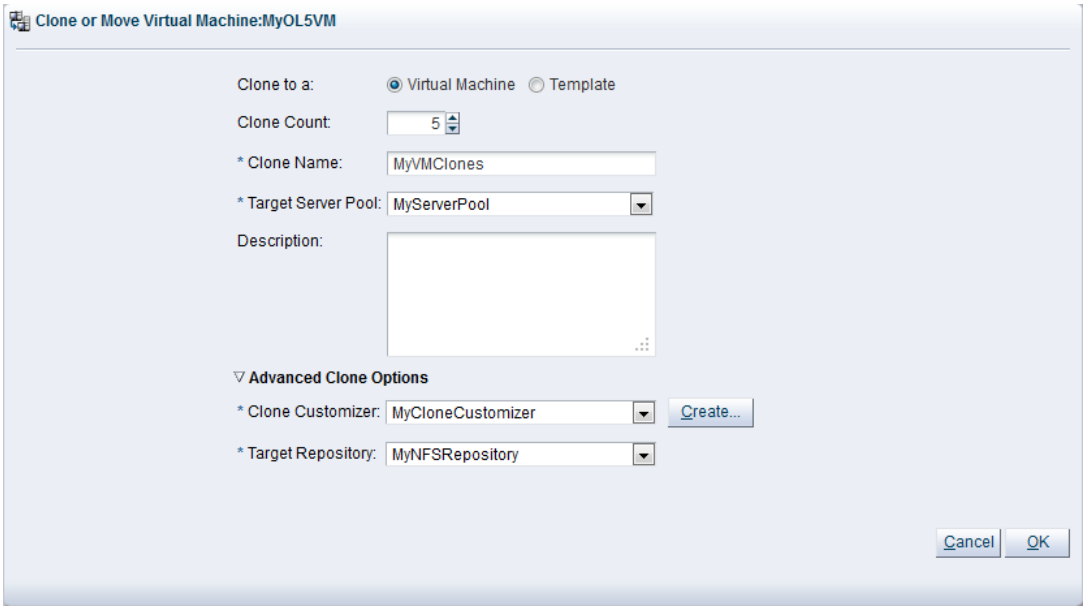
- **Virtual Machine Template:** Click the **Repositories** tab. In the navigation tree, select the repository in which the template resides, then **VM Templates**. Select the template in the management pane and click **Clone or Move Template...** .

2. The **Clone or Move** dialog box is displayed.



Select the **Create a clone of this (VM or Template)** option. Click **Next**.

3. The **Clone or Move (Virtual Machine or Template)** dialog box is displayed.



Select or enter the following:

- **Clone to a:** Select the clone type, either **Virtual Machine** or **Template**, to specify the objects to create from the clone.
- **Clone Count:** The number of clones to create.

- **Clone Name:** A name for the virtual machines or templates.
- **Target Server Pool:** The server pool on which the clone is to be deployed.
- **Description:** A description for the virtual machines or templates.
- **Advanced Clone Options**
  - **Clone Customizer:** The clone customizer to use to create the clones. Click **Create...** to create a new clone customizer. See Section 7.8.1, “Managing Clone Customizers” for information on creating a clone customizer.
  - **Target Repository:** The repository to store the cloned files, such as virtual disks.

Tip

If you clone a virtual machine or template without using a clone customizer, the storage repository is locked for the duration of the cloning job; this may be some time in some circumstances. To quickly create clones and not lock the storage repository, use a clone customizer.

Click **OK**.

The virtual machines are created and deployed to the server pool. The templates are created in the storage repository.

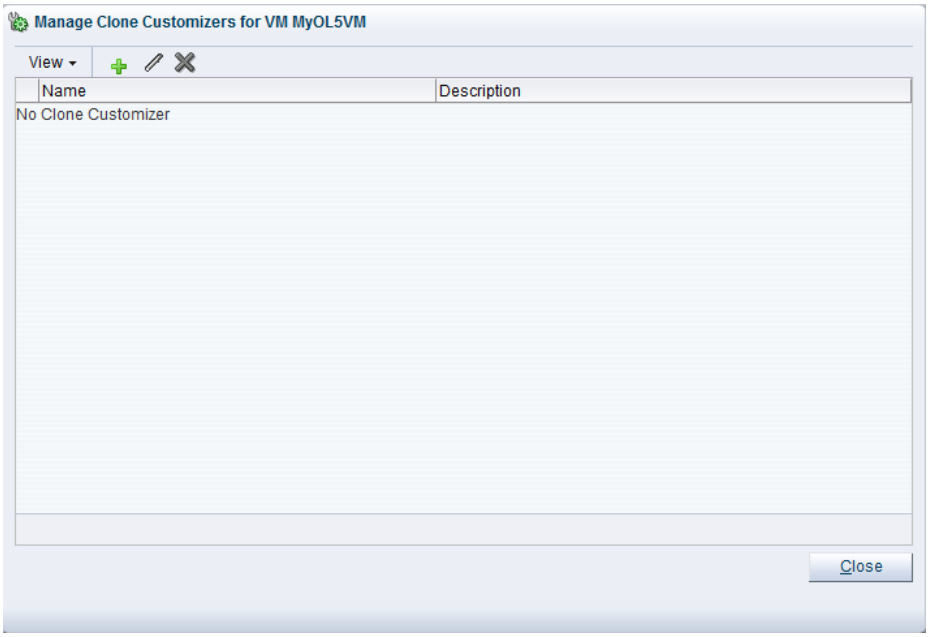
7.8.1. Managing Clone Customizers

Cloning a virtual machine or template means making a copy of it, so that you can create multiple virtual machines or templates from the original. You can create a clone customizer to set up the clone parameters, such as networking, and the virtual disk, and ISO resources. A clone customizer is also used when moving a virtual machine or template.

7.8.1.1. Creating a Clone Customizer

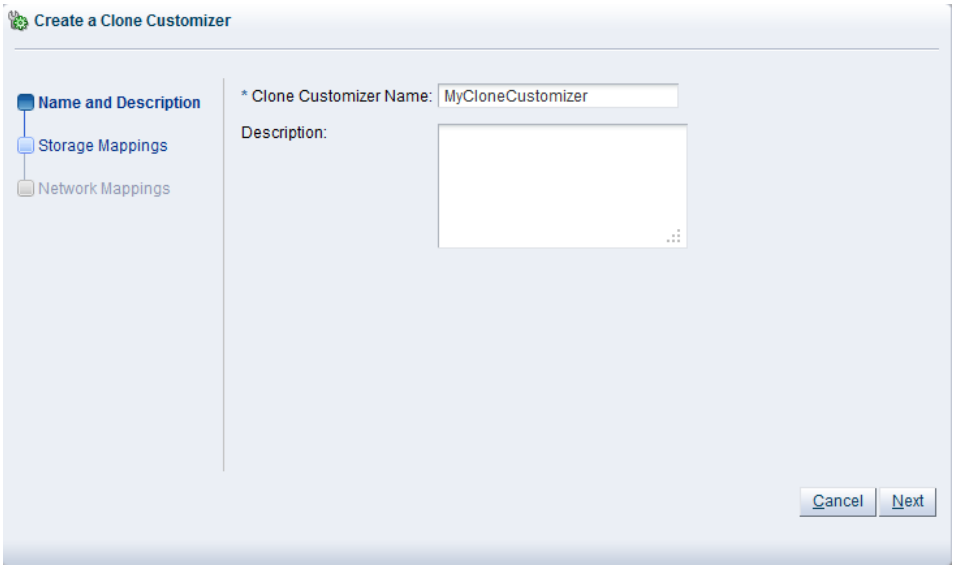
To create a clone customizer:

1. Select the virtual machine or template and display the **Manage Clone Customizers for (Virtual Machine or Template)** dialog box by:
   - **Virtual Machine:** Click the **Servers and VMs** tab. Select the server pool on which the virtual machine resides in the navigation tree. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to clone in the management pane, and click **Manage Clone Customizers...** .
   - **Virtual Machine Template:** Click the **Repositories** tab. In the navigation tree, select the repository in which the template resides, then **VM Templates**. Select the template in the management pane and click **Manage Clone Customizers** .



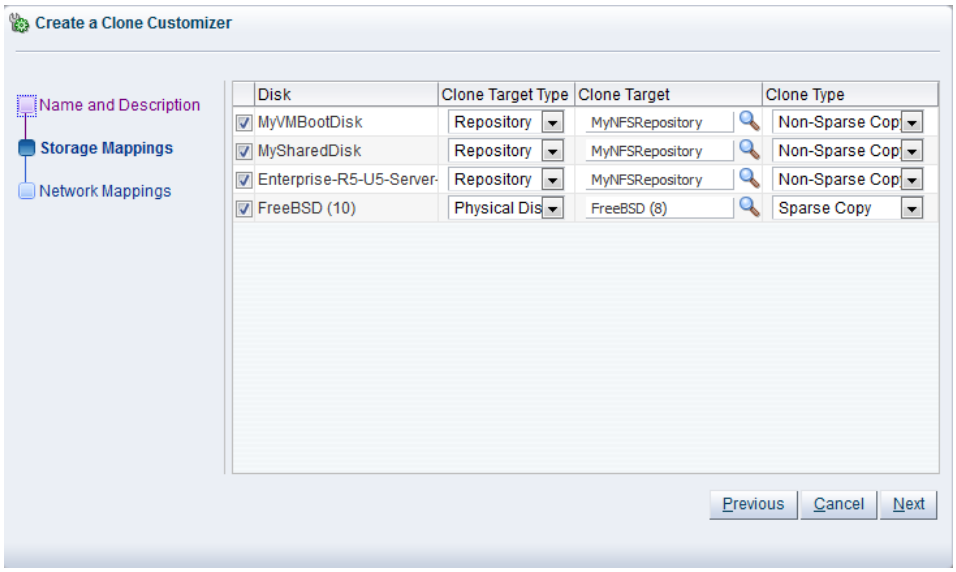
2. Select **Create Clone Customizer...** .

3. The **Create a Clone Customizer** wizard is displayed.



   In the **Name and Description** step of the wizard, enter a **Name** and **Description** for the clone customizer, and click **Next**.

4. The **Storage Mappings** step of the wizard is displayed.

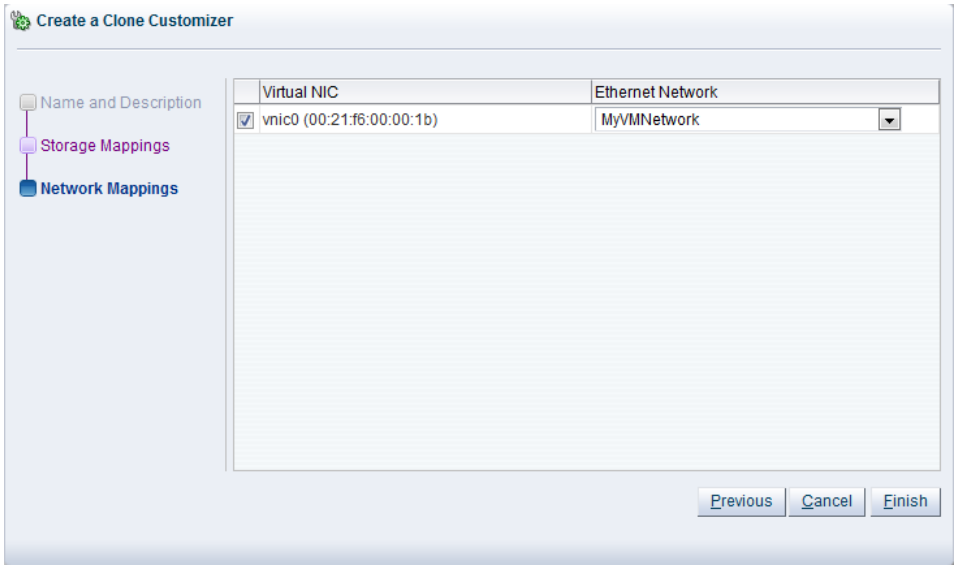


Select the following storage mappings:

- **Disk:** The disks to include in the clone.
- **Clone Target Type:** The type of storage location where the disk is to be created, either a **Repository** or a **Physical Disk**.
- **Clone Target:** The location on the storage type where the disk is to be created.
- **Clone Type:** Whether to use a sparse or non-sparse files for the disk.

Click **Next**.

5. The **Network Mappings** step of the wizard is displayed.



Select the **Virtual NICs** to include in the clone customizer, and the **Ethernet Network** to which they should belong.

Note

The network configuration is not changed when moving a virtual machine or template. It is only used when cloning a virtual machine or template.

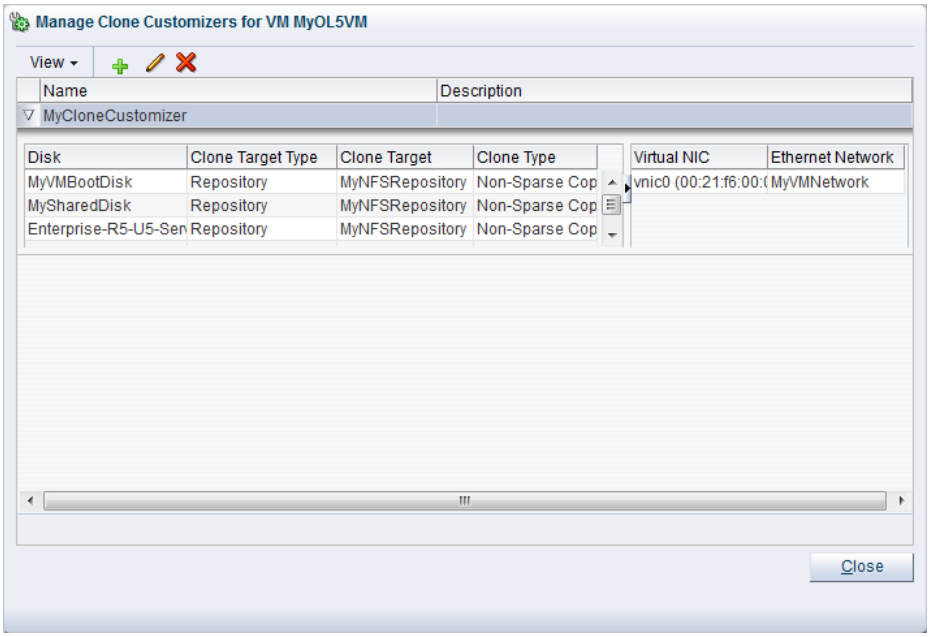
Click **Finish**.

The clone customizer is now available to use to create a virtual machine, or template. See Section 7.8, “Cloning a Virtual Machine or Template” for information on using the clone customizer to create a virtual machine or template.

7.8.1.2. Editing a Clone Customizer

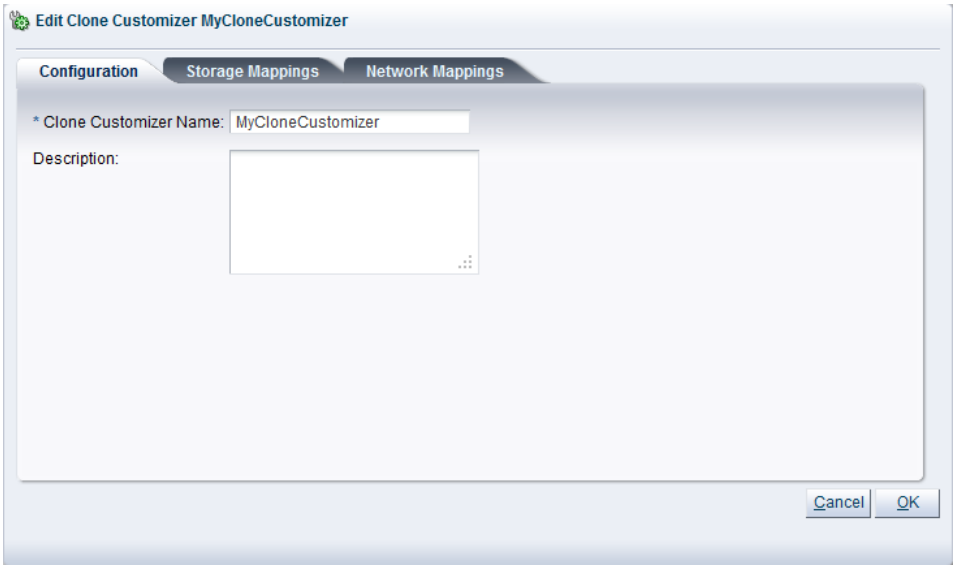
To edit a clone customizer:

1. Select the object to which the clone customizer belongs, either a virtual machine, or a virtual machine template. Click **Manage Clone Customizers...** .
2. The **Manage Clone Customizers for (VM or Template)** dialog box is displayed.



Select the clone customizer to edit and click **Edit Clone Customizer...** .

3. The **Edit Clone Customizer** dialog box is displayed.



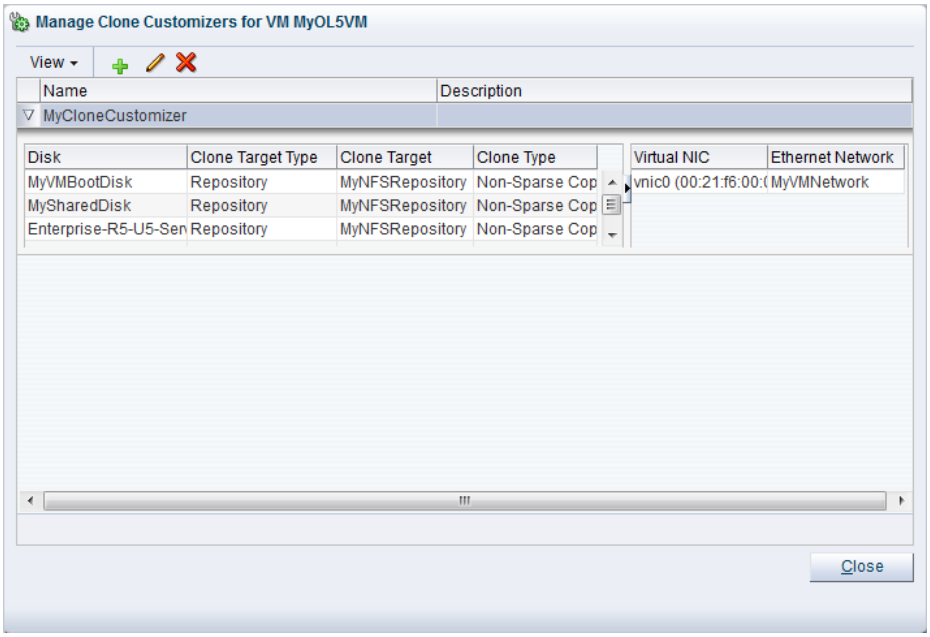
Edit the clone customizer. For details on each clone customizer option, see Section 7.8.1.1, “Creating a Clone Customizer”.

Click **OK**. The changes to the clone customizer are saved.

7.8.1.3. Deleting a Clone Customizer

To delete a clone customizer:

1. Select the object to which the clone customizer belongs, either a virtual machine, or a virtual machine template. Click **Manage Clone Customizers...** .
2. The **Manage Clone Customizers for (VM or Template)** dialog box is displayed.



Select the clone customizer to delete and click **Delete Clone Customizer** .

3. A dialog box is displayed to confirm you want to delete the clone customizer. Confirm you want to delete the clone customizer and click **OK**. The clone customizer is deleted.

7.9. Managing Virtual Machines

When you have created a virtual machine, there are a number of actions you can perform on them in Oracle VM Manager. This section describes the actions you can perform on virtual machines.

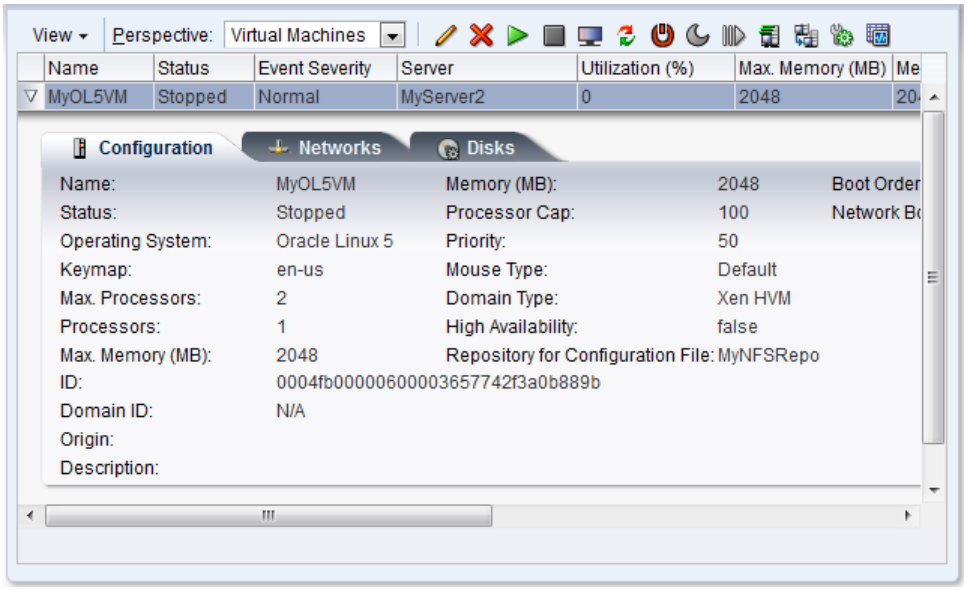
7.9.1. Viewing Virtual Machine Information and Events

You can view about the configuration, networks, disks, and jobs associated with the virtual machine.

To edit the virtual machine details, see Section 7.9.2, “Editing a Virtual Machine”.

To view virtual machine details:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine in the management pane.
4. Click the expand arrow to the left of the virtual machine name in the table.



Three tabs displaying information about the virtual machine are displayed. Click each tab to view the following information about the virtual machine:

- **Configuration:** General information about the virtual machine, such as the minimum and maximum memory and processors, operating system, domain type, high availability status, and so on.
- **Networks:** Networks and vNICs used.

Note

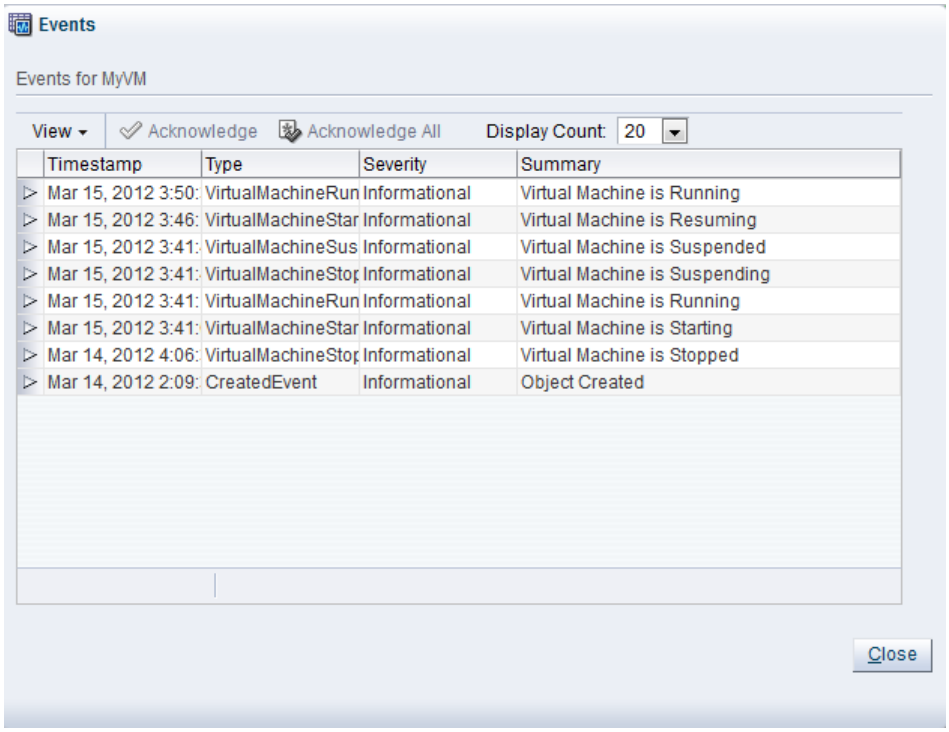
The IP address for a virtual machine is only displayed if the paravirtual drivers are installed. See Section 7.11, “Converting to Paravirtualized Guests or

Installing Paravirtualized Drivers" for information on installing the paravirtual drivers.

- **Disks:** Virtual and physical disks and ISOs attached to the virtual machine.

To view virtual machine events:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine in the management pane, and click **Display Selected VM Events** in the management pane toolbar
4. The **Events** dialog box is displayed.

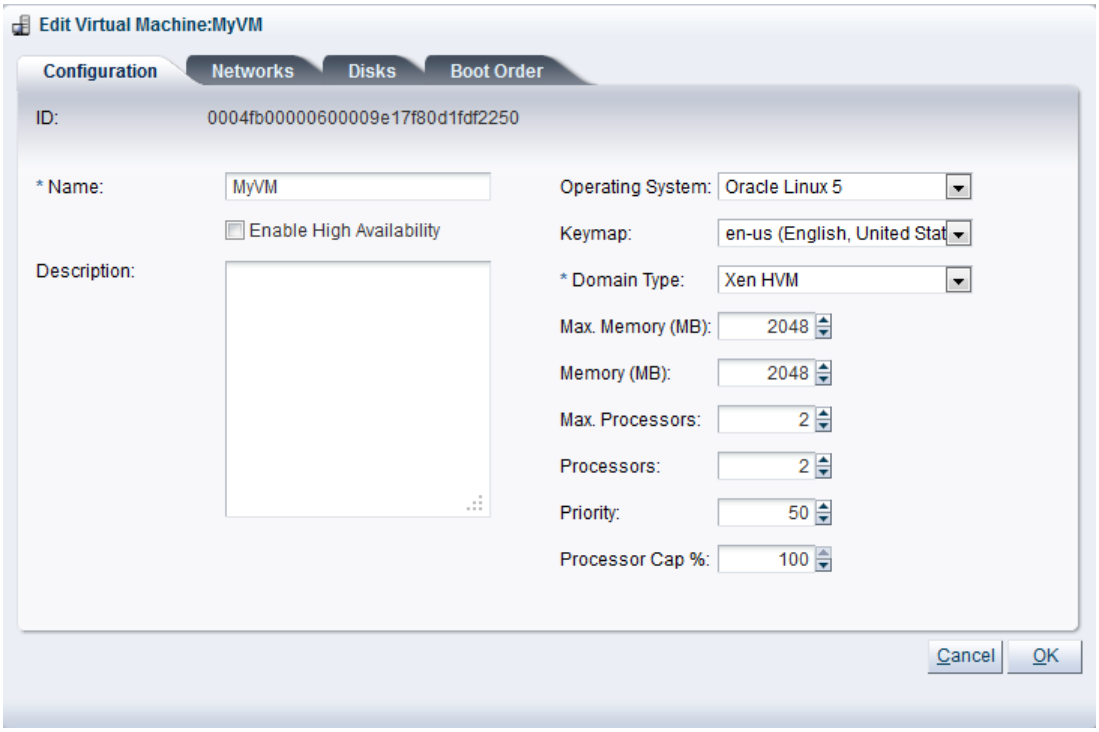


If a virtual machine has error event associated with it you must acknowledge the event to clear the error. See Section B.1.10, "Acknowledging Events/Errors" for information on acknowledging events. Click **Close** to close the dialog box.

7.9.2. Editing a Virtual Machine

To edit a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine in the management pane, and click **Edit...** in the management pane toolbar
4. The **Edit Virtual Machine** dialog box is displayed.



Select each tab to edit the virtual machine configuration. See Section 7.7, “Creating a Virtual Machine” for the details of each tab. Click **OK** to save the changes.

7.9.3. Starting a Virtual Machine

After a virtual machine is created, you can start it. Starting a virtual machine is analogous to starting a computer by pressing the **Power On** button.

To start a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Start** ▶ .

The virtual machine is started.

7.9.4. Stopping (Shutting Down) a Virtual Machine

When a virtual machine is not in use, you should shut it down to release system resources. Stopping a virtual machine is analogous to a normal shutdown of a physical computer.

If you want to save the state of the virtual machine, you should suspend it. See Section 7.9.7, “Suspending a Virtual Machine” for information on suspending a virtual machine.

To stop a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.

3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Stop** .

Note

You can also shut down a virtual machine from within your virtual machine, the same way you shut down a physical computer.

After issuing the stop command, the status of the virtual machine is changed to *Stopped*. However, this only indicates that the command was acknowledged. There is no guarantee that the virtual machine is effectively shut down correctly. This is expected behavior since an operating system running on a physical PC may also *hang* during the shutdown sequence.

If the virtual machine fails to shut down, you can power it off using the kill virtual machine option, which is similar to unplugging the power cable from a physical machine. To perform a power off (kill) of a virtual machine, see Section 7.9.5, “Killing a Virtual Machine”.

7.9.5. Killing a Virtual Machine

To kill a virtual machine is equivalent to performing a power off of a virtual machine, similar to unplugging the power cable from a physical machine. This is not the recommended method of shutting down a virtual machine, but may be used if the shut down command fails to shut down the virtual machine.

To kill a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Kill** .

The virtual machine is powered off.

7.9.6. Restarting a Virtual Machine

Restarting a virtual machine is analogous to rebooting a computer. You may need to restart a virtual machine if an operating system update requires you to restart the virtual machine, for example Microsoft Windows updates.

To restart a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Restart** .

The virtual machine is restarted.

7.9.7. Suspending a Virtual Machine

Suspending a virtual machine is analogous to putting a computer into sleep mode. When a virtual machine is suspended, the current state of the operating system, and applications is saved, and the virtual machine put into a suspended mode. When you resume the virtual machine, the operating system and applications continue from the same point you suspended the virtual machine.

The Oracle VM Server resources used by the virtual machine are not released. If you want to release these resources, you should shut down the virtual machine.

To suspend a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Suspend** .

The virtual machine state is saved and the virtual machine suspended.

To resume the virtual machine, see Section 7.9.8, “Resuming a Virtual Machine”.

7.9.8. Resuming a Virtual Machine

Resuming a suspended virtual machine is analogous to waking up a computer that has been in sleep mode. When you resume a suspended virtual machine, the operating system and applications continue from the same point you suspended the virtual machine.

The Oracle VM Server resources used by the virtual machine are not released. If you want to release these resources, you should shut down the virtual machine.

To resume a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Resume** .

The virtual machine state is retrieved and the virtual machine started.

7.9.9. Moving Virtual Machines Between Repositories

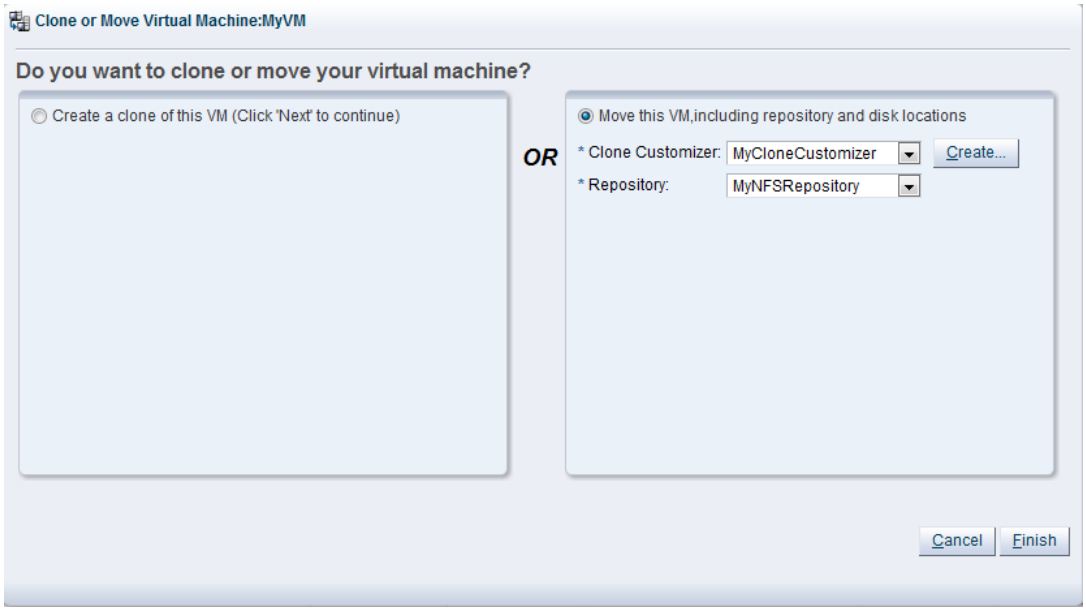
> **Important**
>
> You should never manually move the files for a virtual machine from one repository to another. This can result in duplicate UUIDs for a virtual machine which can cause problems within your Oracle VM environment. If you need to move a virtual machine to another storage repository, alway use the tools provided within Oracle VM Manager.

You can move a non-running virtual machine from one repository to another. During the move you can specify where the disks should be moved to using a clone customizer. If you keep the clone customizers to the default settings (the same as the original virtual machine), a move is essentially the same as migrating the virtual machine to another Oracle VM Server. You can change the location of disks and the virtual machine configuration file to another storage repository when you move a virtual machine using a clone customizer.

> **Note**
>
> The network information is not changed when moving a virtual machine, so you cannot move VNICs between networks. Any network changes you make in a clone customizer are ignored when moving a virtual machine. This allows you to preserve the virtual machine in its original state, while moving the configuration file and storage to a different repository.

To move a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine in the management pane, and click **Clone or Move** .
4. The **Clone or Move** dialog box is displayed.



Select **Move this VM**.

Select a clone customizer from the **Clone Customizer** drop-down list. If no clone customizers are displayed or you want to create a new one, click **Create**. See Section 7.8.1.1, “Creating a Clone Customizer” for information on creating a clone customizer.

Select a repository from the **Target Repository** drop-down list. This is the location of the new virtual machine configuration file.

Click **Finish** to move the virtual machine.

7.9.10. Migrating a Virtual Machine

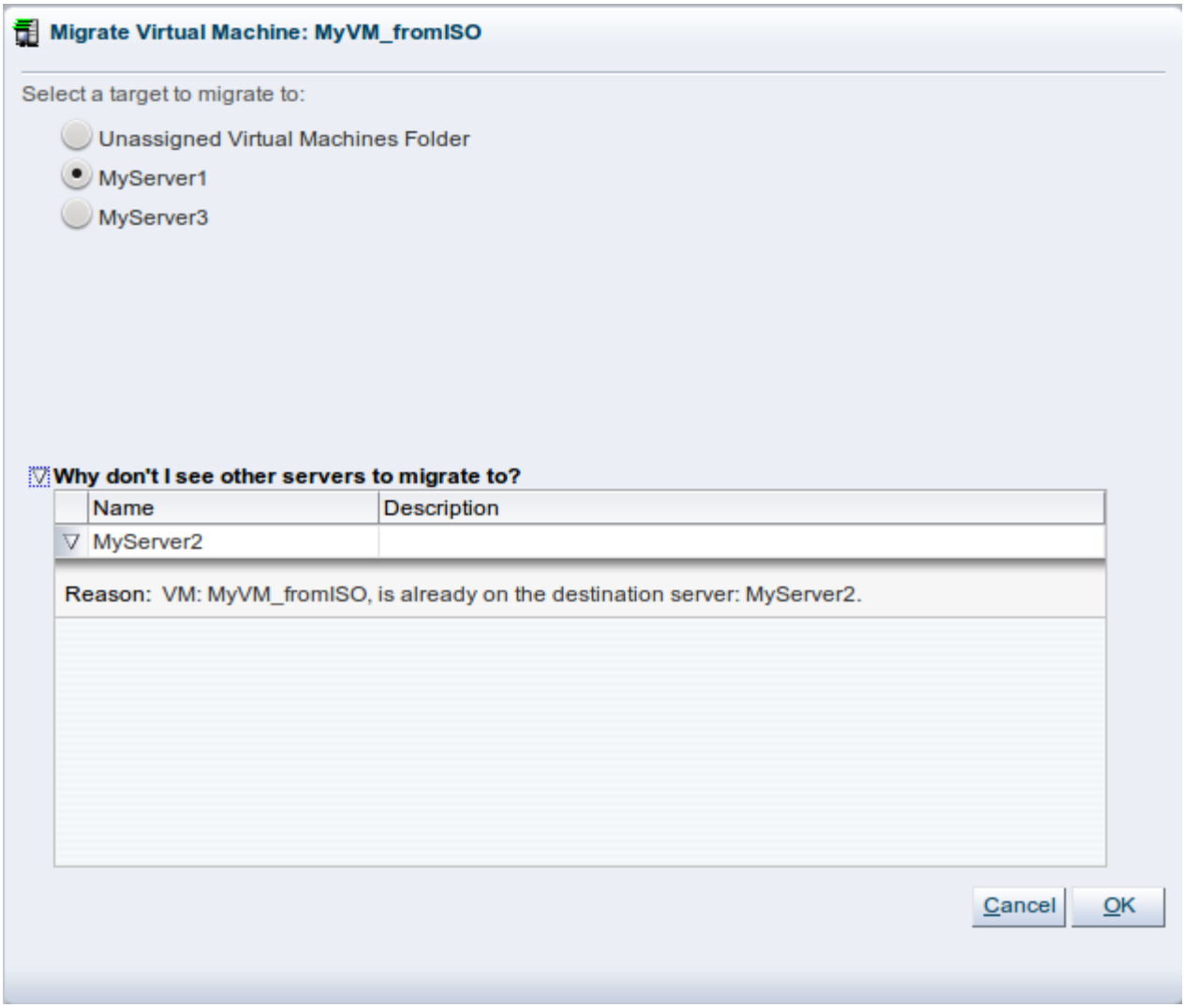
Migrating a virtual machine is a process to move a virtual machine from one Oracle VM Server to another. If the virtual machine is running during the migration, the applications continue to run, uninterrupted. Migrating a virtual machine ensures high availability of virtual machines. This feature is important, and useful, when the existing Oracle VM Server may be out of commission, or on a planned shutdown for maintenance purposes.

You can only migrate one virtual machine at a time. Cross-server pool live migration is not allowed. You can only migrate virtual machines from one Oracle VM Server to another within the same server pool. CPU family and model number of the source and destination computers must be the same in order to perform live migration.

To migrate a virtual machine:

1. Click the **Servers and VMs** tab.

2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine to start in the management pane, and click **Migrate** .
4. The **Migrate Virtual Machine** dialog box is displayed.



Select the Unassigned Virtual Machines folder to remove the virtual machine from the server pool, or select the Oracle VM Server to which you want to migrate your virtual machine and click **OK**.

If the Oracle VM Server you want is not listed in the radio list at the top of the dialog box, click the arrow next to **Why don't I see other servers to migrate to?**. A list of all Oracle VM Servers registered with Oracle VM Manager is displayed. Click the arrow next to the Oracle VM Server you want for an explanation as to why it is not available as a migration target.

The virtual machine is migrated.

7.9.11. Deleting a Virtual Machine

When you delete a virtual machine, all the files and data associated with this virtual machine are removed from Oracle VM Manager. Before deleting a virtual machine, make sure you do not need it any longer. You can only delete a virtual machine when the virtual machine status is **Stopped** or **Error**.

To delete a virtual machine:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine in the management pane, and click **Delete** in the management pane toolbar
4. The **Delete Confirmation** dialog box is displayed. Select any virtual disks associated with the virtual machine that you want to delete. Click **OK** to delete the virtual machine and the selected virtual disks.

7.10. Connecting to a Virtual Machine

You can connect to a virtual machine using its *console*. The console is the remote control system of Oracle VM, and enables you to work and interact with your virtual machines.

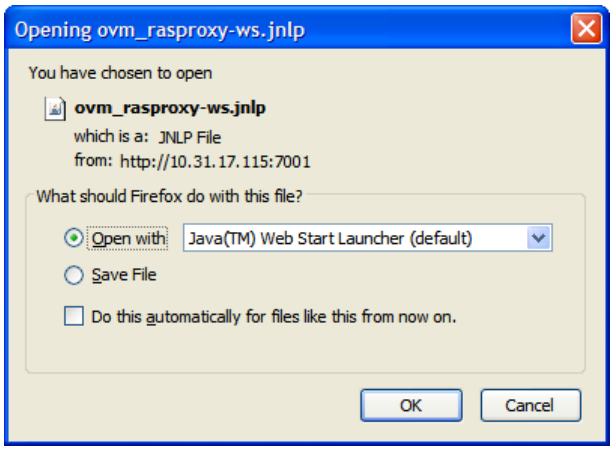
If you have VNC Viewer (from RealVNC), or TightVNC Viewer installed on your client computer, the Oracle VM Manager user interface finds the installation and uses it to create the connection with the virtual machine. Oracle recommends you install RealVNC on the client computer as it renders more quickly, has better keyboard support, and has less mouse control issues than Tight VNC.

If no client viewer is available, the Oracle VM Manager user interface looks for TightVNC on the Oracle VM Manager host computer and uses this to create the connection with the virtual machine. See *Oracle VM Installation and Upgrade Guide* for information on installing TightVNC on the Oracle VM Manager host computer.

The key mapping for each VNC session is set when you create or edit a virtual machine, in the Keymap field. See Section 7.7, “Creating a Virtual Machine” and Section 7.9.2, “Editing a Virtual Machine” for information on creating and editing a virtual machine.

To connect to a virtual machine's console:

1. Click the **Servers and VMs** tab.
2. Select the server pool on which the virtual machine resides in the navigation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list. Select the virtual machine in the management pane, and click **Launch Console** in the management pane toolbar
4. A dialog box may be displayed requesting to start a Java proxy to connect to the virtual machine. Click **OK**.



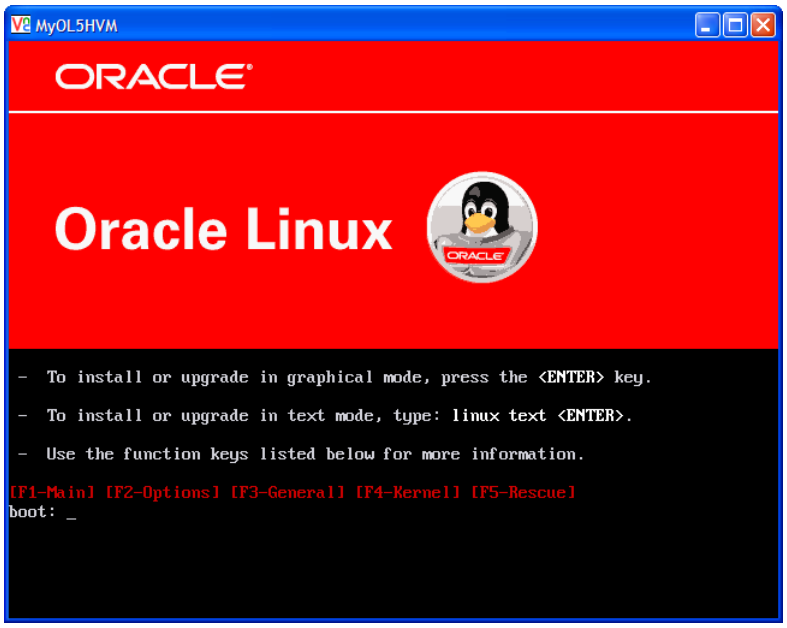
5. If a VNC viewer is found, it is started. You can configure which VNC viewer to use with the **Options** > **Configuration** menu item of the Java proxy window. Enter the path to the VNC client on the host computer and click **OK**. Use quotes around the path if it contains spaces.

Tip

If the console does not start, check that your web browser allows pop-ups to be displayed. If you are using Microsoft Internet Explorer, add the base URL of Oracle VM Manager (for example, `http://example.com`) to the list of trusted sites in the security settings. You may also need to downgrade the security level from medium to medium-low for the Trusted sites zone.

If the virtual machine's console is in use by another user, a message is displayed asking if you want to take over the connection. If you take over the connection, the other user's session is disconnected and the VNC session is started on your client computer.

The virtual machine console is displayed. Log in and interact with the virtual machine as you would through any other VNC session. This example shows the initial installation screen for a virtual machine created with an Oracle Linux operating system ISO file.



If required, enter the user name and password of the guest operating system to log in to the operating system.

Depending on the method by which you created the virtual machine, you may need to continue with some further tasks before you can use the virtual machine.

- If you created the virtual machine based on a template, you can directly use the guest operating system and applications installed in advance, without any further configuration.
- If you created the virtual machine using the fully virtualized method, the installation of the guest operating system is triggered after your first login. Follow the installation wizard to install the guest operating system. For more information on creating virtual machines using the fully virtualized method, see Section 7.7, “Creating a Virtual Machine”.

Note

You must install the guest operating system using a single ISO file. If your operating system installer consists of multiple ISO files, you cannot install it.

For information on the supported guest operating systems, see the *Oracle VM Release Notes*.

7.11. Converting to Paravirtualized Guests or Installing Paravirtualized Drivers

For optimized performance, you can install paravirtualized drivers on hardware virtualized machines. Paravirtual drivers are optimized and improve the performance of the operating system in a virtual machine. These drivers enable high performance throughput of I/O operations in guest operating systems on top of the Oracle VM Server hosts.

Creating hardware virtualized machines may require that you install paravirtual drivers for your hardware on the guest operating system.

The Oracle Solaris 10 and Oracle Solaris 11 operating system runs as a hardware virtual machine (HVM), which requires HVM support (Intel VT or AMD-V) on the underlying hardware platform. By default, Oracle Solaris 10 or Oracle Solaris 11 operating system already has the required paravirtualized drivers installed as part of the operating system.

You can continue using HVM guest, but leverage the paravirtualized I/O drivers. For more information, see Comparison of Guest Virtualisation Modes; HVM, PVM and PVHVM. Configuration, Mode Validation and Conversion to PVHVM.

To install the paravirtual drivers for Microsoft Windows operating systems, see the *Oracle VM Windows Paravirtual Drivers Installation Guide* .

To install paravirtual drivers on an Oracle Linux guest operating system:

1. Download the paravirtualized kernel on the virtual machine, for example for an Oracle Enterprise Linux 5.5 64-bit guest, download:

   http://public-yum.oracle.com/repo/EnterpriseLinux/EL5/5/base/x86_64/kernel-xen-2.6.18-194.el5.x86_64.rpm

2. Install the paravirtualized kernel on the virtual machine:

```
# rpm -ivh kernel-xen-version.type.rpm
 Preparing...                ########################################### [100%]
```

```
    1:kernel-xen            ########################################### [100%]
```

3. Back up the old initrd file, and make the new one with xennet, xenblk driver:

```
# mv initrd-oldversion.el5xen.img initrd-oldversion.el5xen.img.old
# mkinitrd initrd-newversion.el5xen.img newversion.el5xen --with=xenblk --with=xennet
  --preload=xenblk --preload=xennet
```

4. Edit the /boot/grub/grub.conf file to be:

```
default=0
timeout=5
splashimage=(hd0,0)/grub/splash.xpm.gz
hiddenmenu
title Enterprise Linux Enterprise Linux Server (version.el5xen)
        root (hd0,0)
        kernel /vmlinuz-version.el5xen ro root=LABEL=/
        initrd /initrd-version.el5xen.img
```

5. Modify the /etc/modprobe.conf file to include:

```
alias scsi_hostadapter xenblk
alias eth0 xennet
```

6. Shut down the virtual machine. See Section 7.9.4, “Stopping (Shutting Down) a Virtual Machine” for information on shutting down a virtual machine.

7. Edit the virtual machine and change the **Domain Type** to **Xen PVM**. See Section 7.9.2, “Editing a Virtual Machine” for information on editing a virtual machine.

8. Start the virtual machine. See Section 7.9.3, “Starting a Virtual Machine” for information on starting a virtual machine.

7.12. Setting Hard Partitioning for Virtual Machine CPUs

Oracle VM offers an advanced feature for hard partitioning, also known as CPU pinning. Hard partitioning means binding a virtual machine CPU to a physical CPU or core, and preventing it from running on other physical cores than the ones specified. This is done for Oracle CPU licensing purposes, since Oracle VM is licensed on a per-CPU basis.

For more information about special Oracle licensing policies, see the Oracle Technology Network and open the PDF document on the subject of *Partitioning* located at:

http://www.oracle.com/us/corporate/pricing/specialty-topics/index.html

As a specialist topic, hard partitioning is described in its own whitepaper. For more information about hard partitioning, see the PDF document titled Hard Partitioning With Oracle VM Server for x86 located at:

http://www.oracle.com/technetwork/server-storage/vm/ovm-hardpart-168217.pdf

Warning

Live-migration of CPU pinned virtual machines to another Oracle VM Server is not permitted under the terms of the license. Consequently, DRS and DPM policies should not be enabled for server pools containing CPU pinned guests.

Note

If your Oracle VM Servers support NUMA (non-uniform memory access), make sure that the systems are running correctly in NUMA mode. In a clustered setup, a CPU

can access its local memory faster than non-local and shared memory. To make full use of the performance advantages of NUMA, be sure to pin the virtual VCPUs to the same physical CPU on an Oracle VM Server. For more information about NUMA, consult your server hardware documentation.

Chapter 8. Converting Hosts

Table of Contents

This chapter discusses creating hardware virtualized guest images from existing physical computers running any of the operating systems supported by Oracle VM.

8.1. Converting a Host

You can convert the operating system and application software on a computer to an Oracle VM hardware virtualized guest image using the Physical to Virtual (P2V) conversion utility. The P2V utility is included on the Oracle VM Server CD. The operating system must be one of the Oracle VM supported guest operating systems. See the *Oracle VM Release Notes* for a list of the supported guest operating systems. To perform a P2V conversion, the host computer must have a CPU that supports PAE (Physical Address Extension).

The P2V conversion process creates a virtual machine configuration file (vm.cfg), allows you to make some modifications in terms of sizing of the virtual machine hardware, and then replicates the physical image and transfers it over the network to a storage repository using Oracle VM Manager. The image on your physical computer is not changed in any way.

The P2V utility converts disks on the computer to virtual disk images. The first four virtual disk images are created as IDE disks (hda, hdb, hdc, and hdd) on the guest, using the original disk names. Up to seven additional disks are created as SCSI devices (sda, sdb, sdc, and so on). The disk entries in the vm.cfg file look similar to:

```
disk = ['file:System-sda.img,hda,w',
'file:System-sdb.img,hdb,w',
'file:System-sdc.img,hdc,w',
'file:System-sdd.img,hdd,w',
'file:System-sde.img,sda,w',
'file:System-sdf.img,sdb,w',
'file:System-sdg.img,sdc,w',
'file:System-sdh.img,sdd,w',
'file:System-sdi.img,sde,w',
'file:System-sdj.img,sdf,w',
'file:System-sdk.img,sdg,w',
]
```

The hardware virtualized guest created by the P2V utility must have it's own network configuration. If you use the same network configuration as the original computer, a network clash may occur as two computers on the network may have the same IP and MAC address. When the guest is started, make sure the network device is detected and a new network device is configured.

You can run the P2V utility interactively, or as an automated process using a kickstart configuration file. When you use the P2V utility with a kickstart file, no user intervention is required.

8.1.1. Using the P2V Utility

When you use the P2V utility, you are prompted for all required information.

To create a virtual machine image of a computer:

1. Insert the Oracle VM Server CDROM into the CDROM drive of the computer you want to image.

Note

This procedure is for 64-bit computers. If you want to convert a 32-bit host computer to a virtual machine template, you must use the Oracle VM 2.*x* CD.

2. Start the computer with the Oracle VM Server CDROM.

3. The **Oracle VM Server** screen is displayed.

At the `boot:` prompt, enter:

```
p2v
```

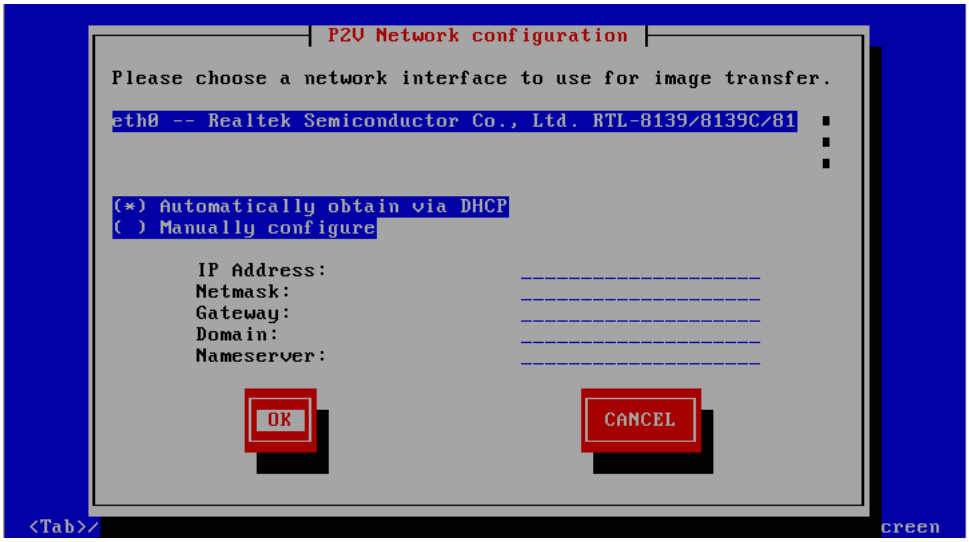
Press **Enter**.

4. The **CD Found** screen is displayed.

If you want to make sure the CDROM is error free, you can have the installer test it for errors. To test the CDROM, select **OK** and press **Enter**. The CDROM is tested and any errors are reported.

To skip media testing and continue with the installation, select **Skip** and press **Enter**.

5. The **P2V Network Configuration** screen is displayed.



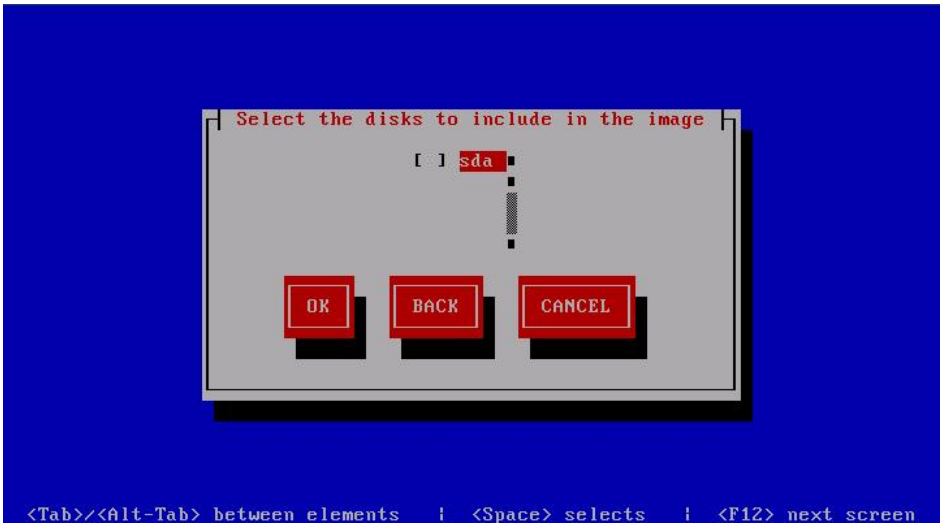
Select your Ethernet driver from the list displayed.

If your computer uses DHCP to assign its IP address, select **Automatically obtain via DHCP**.

If your computer uses a static IP address, select **Manually configure**, and enter the IP address and netmask, gateway, domain and name server for your computer.

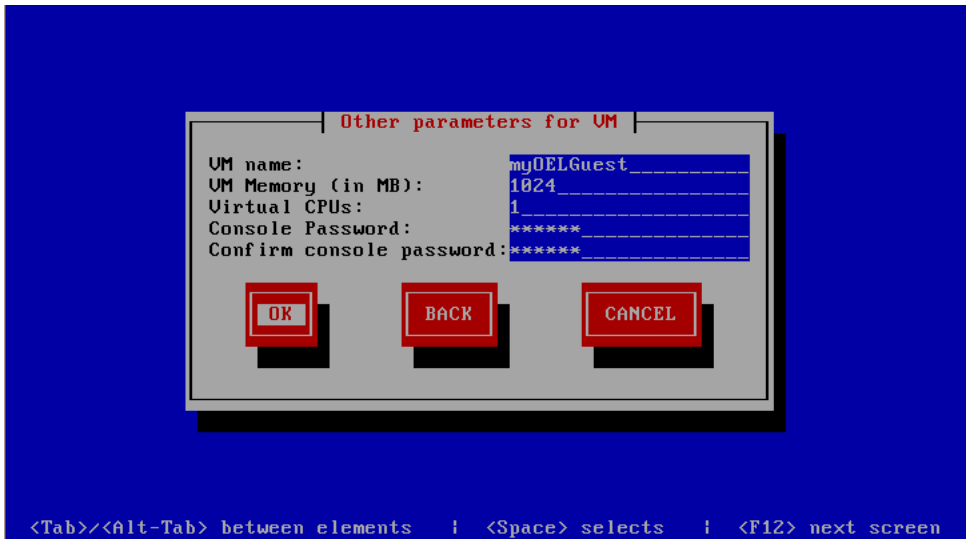
Select **OK** and press **Enter**.

6. The disk selection screen is displayed.



Select the disk partition(s) on the computer to include in the guest image. Select **OK** and press **Enter**.

7. The **Other parameters for VM** screen is displayed.

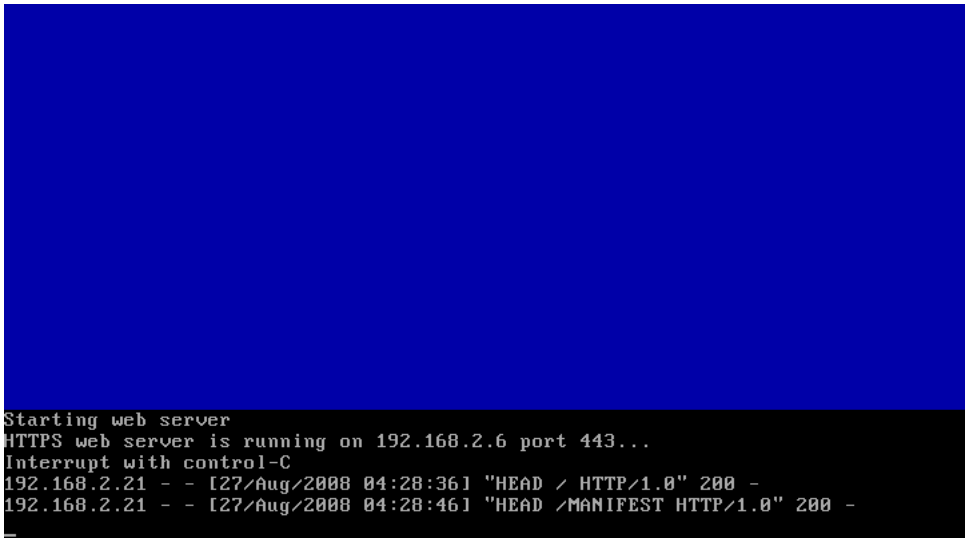


Enter information about the guest image for:

- VM (guest) name
- VM (guest) memory
- Number of virtual CPUs
- Console password. This is no longer required, but you must enter a value.

Select **OK** and press **Enter**.

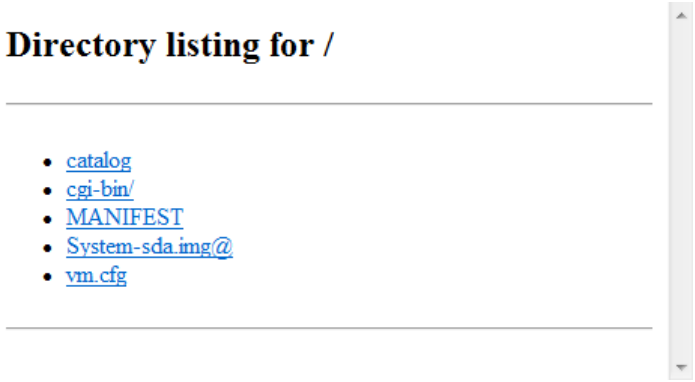
8. A secure web server (HTTPS) is started. The IP address of the computer, and port number the web server is available on is displayed.



Open a web browser on another computer and enter the URL created using the information displayed on the computer running the P2V utility, for example

https://192.168.2.6/

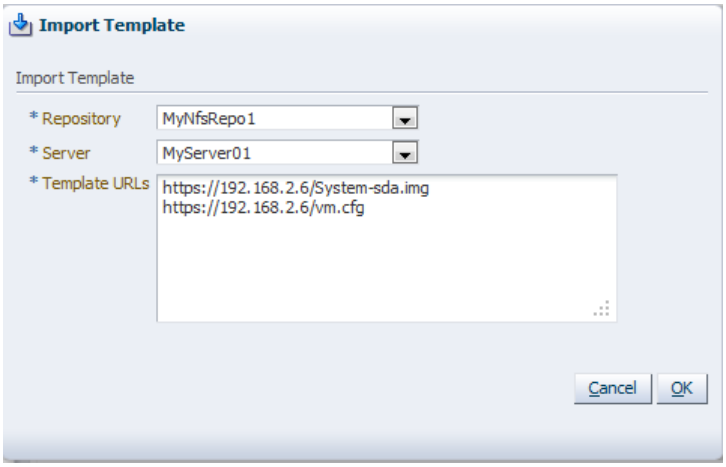
You do not need to enter the port number as this is the default port number for HTTPs connections. A directory listing is displayed which contains the files created by the P2V utility. Take a note of the URLs for the vm.cfg and *.img files as you use them in the next step when importing the virtual machine into Oracle VM Manager.



Log in to Oracle VM Manager and import the guest using the import template feature. When you import the guest, you should add the URLs for each virtual disk image and the virtual machine configuration file on a new line in the **Template URLs** field in the **Import Template** dialog, for example:

```
https://192.168.2.6/System-sda.img
```

```
https://192.168.2.6/vm.cfg
```



See Section 7.5.3.2, “Importing a Virtual Machine Template” for information on importing templates.

9. When the virtual machine template is added to the repository, you should terminate the P2V utility on the host computer. Press **Control**+**C** to terminate the P2V utility on the computer. Remove the Oracle VM Server CDROM from your CDROM drive. Restart the computer.

The guest image is created and available in the repository as a hardware virtualized virtual machine template.

8.1.2. Using the P2V Utility with a Kickstart File

You can use a kickstart file to automate the creation of a guest image of a physical computer using the P2V utility. When you use the P2V utility with a kickstart file, no user intervention is required. If there are any missing parameters in the kickstart file, you are prompted to enter them.

To use a P2V kickstart file, you must create a file with the P2V configuration options and parameters and place it on a kickstart server. The kickstart server can be made available using NFS, FTP, or HTTP. The kickstart server is set up in the same way as a standard Oracle Linux or Red Hat kickstart server and is beyond the scope of this book.

The following example P2V kickstart file starts sends the guest image to an instance of Oracle VM Manager via network device eth0, which obtained an IP address via DHCP:

```
p2v
cdrom
lang en_US.UTF-8
keyboard us
target --ovmmanager
network --device eth0 --bootproto dhcp
diskimage --device /dev/sda --type IDE
vm_options --name myGuest --mem 1024 --vcpus 1 --consolepasswd mypassword
```

See Appendix A, *P2V Parameters* for detailed information on the P2V kickstart file options and parameters.

To create an Oracle VM virtual machine image of a computer using the P2V utility with a kickstart file:

1. Create a P2V kickstart file and copy it to your kickstart server.
2. Insert the Oracle VM Server CDROM into your CDROM drive of the computer you want to image.
3. Restart the computer with the Oracle VM Server CDROM.
4. The **Oracle VM Server** screen is displayed. At the `boot:` prompt, enter `p2v` and the protocol and location for the kickstart file. For example, to use a kickstart file called *ks.cfg* on an HTTP server named *http://example.com*, enter:

   ```
   p2v ks=http://example.com/mypath/ks.cfg
   ```

   Press **Enter**.
5. If there are any missing parameters in the kickstart file, you are prompted to enter them.
6. If the kickstart file includes the directive to import the guest image to Oracle VM Manager, a secure web server (HTTPS) is started. A screen is displayed giving the IP address of the computer, and port number the web server is available on. Log in to Oracle VM Manager and import the guest using the import template feature as described in Section 8.1.1, “Using the P2V Utility”.
7. When the virtual machine template is added to the repository, you should terminate the P2V utility on the host computer. Press **Control**+**C** to terminate the P2V utility on the computer. Remove the Oracle VM Server CDROM from your CDROM drive. Restart the computer.

The guest image is created and available in the repository as a hardware virtualized virtual machine template.

Appendix A. P2V Parameters

Table of Contents

This appendix contains information about the Physical to Virtual (P2V) conversion utility and details the usage, syntax and parameters.

A.1. P2V

The P2V conversion utility enables you to convert a computer's operating system (Linux and Windows) and applications to an Oracle VM hardware virtualized guest image. The P2V utility is included on the Oracle VM Server CD. You can access the P2V utility by restarting a computer with the Oracle VM Server CD. The Oracle VM Server startup screen is displayed. At the `boot:` prompt, enter:

```
p2v
```

You can use a P2V kickstart file to automate creation of hardware virtualized guest images from physical computers. This section discusses the options and parameters of the P2V kickstart file.

The P2V utility converts disks on the computer to virtual disk images. The virtual disk images are created as IDE disks (hda, hdb, hdc, hdd, and so on) on the guest, using the original disk names. When you use a P2V kickstart file, up to four disks are automatically deployed in the guest. Any extra disks are converted and added to the guest configuration file (vm.cfg), although they are not deployed. To deploy the additional disks in the guest, edit the guest configuration file, remove the comments from the disk entries, and map the additional disks to SCSI device names, for example, sda, sdb, and sdc. The boot disk must always be mapped to device hda. Any files on the guest which contain references to these devices must also be changed, for example, the /etc/fstab file may contain references to /dev/hda1, /dev/sda1, and so on.

When you use a P2V kickstart file, at least one network interface must use DHCP. This is required for the computer running the P2V utility to read the kickstart file over the network. The network configuration for this network interface cannot be modified from the kickstart file.

If you want the P2V utility's web server to listen using a network interface other than the one used to initiate the kickstart session, the network configuration (DHCP or static IP address) for that network interface can be specified in the kickstart file.

A number of screens may be displayed prior to the P2V utility starting with a kickstart file. You can suppress these screens to fully automate the P2V utility. Prior to the P2V utility starting, you may see up to four screens:

- P2V Network Configuration screen
- Language selection screen
- Keyboard selection screen
- Installation source screen

The following examples show how to suppress these screens.

Example A.1. Suppressing the P2V Network Configuration Screen

To suppress the P2V Network Configuration screen, supply the Ethernet device on the command line, for example:

```
p2v ks=http://example.com/ks.cfg ksdevice=eth0
```

Example A.2. Suppressing the Language Selection Screen

To suppress the Language selection screen, supply the language kickstart parameter, for example:

```
lang en_US.UTF-8
```

Example A.3. Suppressing the Keyboard Selection Screen

To suppress the Keyboard selection screen, supply the keyboard kickstart parameter, for example:

```
keyboard us
```

Example A.4. Suppressing the Installation Source Screen

To suppress the Installation source screen, supply the source kickstart parameter, for example:

```
cdrom
```

Example A.5. P2V Kickstart File

An example P2V kickstart file follows:

```
p2v
cdrom
lang en_US.UTF-8
keyboard us
target --ovmmanager
network --device eth0 --bootproto dhcp
diskimage --device /dev/sda --type IDE
vm_options --name myGuest --mem 1024 --vcpus 1 --consolepasswd mypassword
```

A.1.1. Options

The following parameters are accepted in a P2V kickstart file.

`p2v`

Indicates the kickstart file is intended to automate a P2V conversion. This parameter is required in order to perform an automated P2V conversion and should be supplied at the Oracle VM Server `boot:` prompt instead of `install`, `update`, or `rescue`. It accepts no parameters.

`target [option]`

Sets the end destination for the guest image.

The *`option`* parameter can only contain the following:

```
--ovmmanager
```

Sets the P2V utility to operate in HTTPS server mode to transfer the guest image to a running instance of Oracle VM Manager.

`diskimage [option...]`

Denotes a disk to be included in the guest image. The P2V utility uses device mapper-based snapshotting to copy the disk as a `system-*.img` file on the target computer. There may be multiple `diskimage` directives in a P2V kickstart file, each resulting in a disk image in the guest image. The `--device` parameter must always be used with the `diskimage` directive to indicate which device should be imaged.

The *`option`* parameter is one or more of the following:

```
--device path
```

The device to image. `path` must be the full path to the device. For example:

```
diskimage --device /dev/sda
```

```
--type [IDE | SCSI | LVM | MDRAID]
```

Sets the type of disk. Must be one of `IDE`, `SCSI`, `LVM`, or `MDRAID`. Devices /dev/hda, /dev/hdb, /dev/hdc, and /dev/hdd should be `IDE`. Devices /dev/sd[a-zz] should be `SCSI`. A logical volume should be `LVM`. Devices /dev/md[a-zz] should be `MDRAID`. For example:

```
diskimage --device /dev/hda --type IDE
```

`network [option...]` Configures network information for the computer.

The *`option`* parameter is one or more of the following:

```
--bootproto [dhcp | bootp | static]
```

Sets the method by which the network configuration is determined. Must be `dhcp`, `bootp`, or `static`. The default is `dhcp`. `bootp` and `dhcp` are treated as the same.

`dhcp` uses a DHCP server to obtain the networking configuration, for example:

```
network --bootproto dhcp
```

`static` requires all the necessary networking information. As the name implies, this information is static and is used during and after the installation. The entry for static networking is more complex, as you must include all network configuration information on one line. You must specify the IP address, netmask, gateway, and nameserver, for example:

```
network --bootproto static --ip 10.0.2.15 --netmask 255.255.255.0
--gateway 10.0.2.254 --nameserver 10.0.2.1
```

The `static` method has the following restrictions:

- All static networking configuration information must be specified on one line; you cannot wrap lines using a backslash.
- You can only specify one nameserver.

```
--ip ipaddress
```

The IP address for the computer.

```
--gateway ipaddress
```

The IP address for the default gateway.


```
--nameserver ipaddress
```

The IP address for the primary nameserver.

```
--netmask netmask
```

The netmask for the computer.

`vm_options [option...]` Sets the configuration options for the guest.

```
--name name
```

The name of the guest.

```
--mem size
```

The memory allocation for the guest in Mb.

```
--vcpus number
```

The number of VCPUs for the guest.

```
--consolepasswd password
```

The console password for the guest. For example:

```
vm_options --name myGuest --mem 1024 --vcpus 1
--consolepasswd mypassword
```

Appendix B. Troubleshooting

Table of Contents

This chapter contains information on using the jobs framework, and troubleshooting Oracle VM.

For additional information, see the Oracle support-oriented Web sites:

- My Oracle Support, http://support.oracle.com
- Oracle Virtualization Forum, http://forums.oracle.com/forums/forum.jspa?forumID=823

B.1. Working with the Jobs Framework

Oracle VM Manager uses a job operations framework that supports a flexible approach to the configuration of physical and virtual objects. Oracle VM Manager maintains an accurate and consistent view of the virtualization environment while users perform separate and simultaneous jobs. Each configuration change (a transaction performed by a single user) is considered a *job.*

The following sections describe jobs, and how resources are locked and released at the start and conclusion of each job, and how to manage jobs.

B.1.1. Jobs Overview

A job is a configuration change that affects one or more physical or virtual objects. Examples of user operations that can be included in a job are:

- Adding or deleting a server pool
- Adding a VNIC to a virtual machine

A single job can contain one or many individual operations. When a job is in progress, a yellow lock appears to the left of the resources included in the job.

B.1.2. Jobs and Resource Locking

A single job can contain one or many individual operations. When a job is in progress, a yellow lock appears to the left of the resources included in the job.

Objects involved in a job are locked to all other Oracle VM Manager users until the job is completed or aborted. Only a user with the same permission level on the object can unlock it. This assures that a consistent and accurate view is maintained for all users.

The state of locked objects cannot be known until the locks are cleared. The state of Oracle VM Manager is always accurately reflected by the state of objects that are not locked.

B.1.3. Locks and Multiple Users

A number of different users may perform jobs simultaneously, provided they are performed on different objects. For example, suppose User A has created a Finance-One server pool and begins a job by moving Oracle VM Servers into another server pool. At the same time, User B modifies the resources of the Commodities server pool. Each user has a separate job pane for jobs, and would see each other's objects as locked. The objects remain locked until the jobs are completed.

Prior to completing a job, a lock can be cleared in two ways:

- By logging out the user who initiated the lock. This action can be performed by the user, or by an Oracle VM Manager administrator.
- By direct action of an Oracle VM Manager administrator.

As a job completes, its progress is shown in the Jobs tab. All locks are cleared when a job completes.

B.1.4. Job Failure and Rollback

Job operations are validated by Oracle VM Manager as they are added to the Job tab. The failure of any operation causes the following to happen:

- The job is cancelled.
- All operations specified by the job are cancelled.
- The state of Oracle VM Manager is rolled back to the state it was prior to the start of the job.
- All locks in the operation are released.

B.1.5. Jobs and Events

When a job operation fails, one or more events may be generated and displayed in Oracle VM Manager. Events are flagged with yellow or red icons in the navigation tree. To clear the errors you need to acknowledge the event. To acknowledge events, see Section B.1.10, “Acknowledging Events/Errors”.

To get information on failed events, click **Failed** in the **Jobs** tab or in the **Job Summary** pane.

B.1.6. Job States

A job listed in the Job tab can have any of the states defined in Table B.1, “Job states”.

Table B.1. Job states

Job State	Definition
Completed	The job has completed.
In Progress	The job is in progress.
Aborted	The job has been aborted. Oracle VM Manager has rolled-back to its previous state and all locks have been released.
Failed	The job has failed. Oracle VM Manager has rolled-back to its previous state and all locks have been released.

B.1.7. Starting A Job

A job begins when you make any change in Oracle VM Manager. Each change you make appears in the Job Summary pane as a discrete operation. Job operations can be comparatively minor actions, such as renaming a virtual machine. Operations may also have a wider scope, such as the creation of a new network or storage device. Performing any of these actions changes the configuration of Oracle VM Manager. When a new job is started, information about the job is displayed in the Job Summary pane at the bottom of the management pane to show the job's progress.

B.1.8. Aborting A Job

If a job is running or fails to complete, you can abort the job to cancel it. For example, a virtual machine or Oracle VM Server may be in an unresponsive state and fail to respond to a start or stop request. The appropriate action is to abort the job. Administrators can abort the jobs of all users.

If you abort a job, all queued operations roll back to the pre-job state. Some job operations, such as renaming an object, complete quickly. Others, such as adjusting the memory used by a virtual machine, take longer.

There are two ways to abort a job:

- Using the Jobs tab
- Using the Job Summary pane.

Both procedures for aborting jobs are listed below.

To abort a job using the Jobs tab

1. Select the **Jobs** tab.
2. Select the job in the **Jobs** table.
3. Click **Abort Job** in the toolbar.

To abort a job using the Job Summary pane:

1. Select the job in the **Job Summary** pane.
2. Click **Abort** in the **Abort** column.

B.1.9. Determining the Cause of a Job Failure

If a job succeeds, all operations associated with it performed in Oracle VM Manager. A **Job Succeeded** message appears in the **Job Progress** area.

If a job fails, the state of Oracle VM Manager returns to its pre-job state. Click **Details** to see high-level information on all operations in the job.

Jobs may *hang* or remain *in progress* every time a virtual machine is started or stopped. A virtual machine may be in an unresponsive state for a variety of reasons and consequently fail to respond to a start or stop request. The appropriate action in this case is to abort the job. For example, when starting a PVM virtual machine using PXE type boot with an invalid network URL, this causes the virtual machine status to be *in progress* indefinitely. To resolve this, abort the virtual machine start job. Edit the virtual machine and provide the correct URL.

B.1.10. Acknowledging Events/Errors

If an object has an error event associated with it you must acknowledge the event to clear the error and return the object to normal operations. For example, this can occur if an Oracle VM Server or virtual machine appear as Stopped (Error) in the status. The object in error is flagged with a red icon in the navigation tree. Oracle VM Servers, virtual machines, repositories and storage objects can have error events associated with them. The following procedures show you how to clear errors and return the object to normal operations.

To acknowledge Oracle VM Server error events:

1. Click the **Servers and VMs** tab.
2. Select the Oracle VM Server in the nagivation tree.
3. Select **Events** from the **Perspective** drop-down list in the management pane.
4. Select the error event and click **Acknowledge** , or click **Acknowledge All** to clear all errors.

To acknowledge virtual machine error events:

1. Click the **Servers and VMs** tab.
2. Select the server pool, or Oracle VM Server on which the virtual machine resides in the nagivation tree.
3. Select **Virtual Machines** from the **Perspective** drop-down list in the management pane.
4. Select the virtual machine in the management pane table. Click **Display Selected VM Events...** .
5. The **Events** dialog box is displayed. Select the error event and click **Acknowledge** , or click **Acknowledge All** to clear all errors. Click **Close**.

To acknowledge storage repository error events:

1. Click the **Repositories** tab.
2. Select the repository in the nagivation tree.
3. Select **Events** from the **Perspective** drop-down list in the management pane.
4. Select the error event and click **Acknowledge** , or click **Acknowledge All** to clear all errors.

To acknowledge storage error events:

1. Click the **Storage** tab.

2. Select **File Servers**, **SAN Servers**, or a storage server in the navigation tree..
3. Select **Events** from the **Perspective** drop-down list in the management pane.
4. Select the error event and click **Acknowledge** , or click **Acknowledge All** to clear all errors.

B.2. Troubleshooting Oracle VM Server

This section describes some problems you may encounter when using Oracle VM Server, and explains how to resolve them.

If you need to contact Oracle Support Services, you will be asked to supply the log files mentioned in this section. You may also be required to provide the exact version of each Oracle VM component. To find the version of Oracle VM Manager, click the **Help** menu, then **About**. To find the version of Oracle VM Server and Oracle VM Agent, see Section 6.9.15, “Viewing Oracle VM Server Operating System Information and Control Domains”.

B.2.1. Debugging Tools

If virtual machine creation fails, check the Oracle VM Server log files and use the command-line tools to help you find the cause of a problem. There are a number of useful command-line tools, important directories, and log files that you should check when troubleshooting problems with Oracle VM Server. This section discusses:

- Oracle VM Server directories
- Oracle VM Server log files
- Oracle VM Server command-line tools

B.2.1.1. Oracle VM Server Directories

The important Oracle VM Server directories you should check when troubleshooting problems with Oracle VM Server are listed in Table B.2, “Oracle VM Server directories”

Table B.2. Oracle VM Server directories

Directory	Purpose
/etc/xen	Contains Oracle VM Server configuration files for the Oracle VM Server daemon and virtualized guests.
/etc/xen/scripts	Contains networking related scripts.
/var/log	Contains the Oracle VM Agent log file, ovs-agent.log. Contains the ovmwatch.log, which logs virtual machine life cycle events. Contains the ovm-consoled.log, which logs remote VNC console access, and all communication with Oracle VM Manager.
/var/log/xen	Contains Oracle VM Server log files.
/var/log/messages	Contains Oracle VM Server messages.

B.2.1.2. Oracle VM Server Log Files

The Oracle VM Server log files you should check when troubleshooting problems with Oracle VM Server are listed in Table B.3, “Oracle VM Server log files”

Table B.3. Oracle VM Server log files

Log File	Purpose
xend.log	Contains a log of all the actions of the Oracle VM Server daemon. Actions are normal or error conditions. This log contains the same information as output using the `xm log` command. This file is located in the /var/log/xen directory.
xend-debug.log	Contains more detailed logs of the actions of the Oracle VM Server daemon. This file is located in the /var/log/xen directory.
xen-hotplug.log	Contains a log of hotplug events. Hotplug events are logged if a device or network script does not start up or become available. This file is located in the /var/log/xen directory.
qemu-dm.*pid*.log	Contains a log for each hardware virtualized guest. This log is created by the quemu-dm process. Use the ps command to find the *pid* (process identifier) and replace this in the file name. This file is located in the /var/log/xen directory.
ovs-agent.log	Contains a log for Oracle VM Agent. This file is located in the /var/log/ directory.
osc.log	Contains a log for Oracle VM Storage Connect Plug-ins. This file is located in the /var/log/ directory.
ovm-consoled.log	Contains a log for the Oracle VM virtual machine console. This file is located in the /var/log/ directory.
ovmwatch.log	Contains a log for the Oracle VM watch daemon. This file is located in the /var/log/ directory.

B.2.1.3. Oracle VM Server Command-Line Tools

The Oracle VM Server command-line tools you should use when troubleshooting problems with Oracle VM Server are listed in Table B.4, “Oracle VM Server command-line tools”.

Table B.4. Oracle VM Server command-line tools

Command-Line Tool	Purpose
xentop	Displays real-time information about Oracle VM Server and domains.
xm dmesg	Displays log information on the hypervisor.
xm log	Displays log information of the Oracle VM Server daemon.

A further set of Oracle VM command line utilities are available for download, separate to the Oracle VM Server in-built utilities. These Oracle VM utilities are a collection of command line scripts that allow you to perform a set of basic management tasks on Oracle VM Servers and virtual machines in an Oracle VM environment. These utilities are particularly useful to administrators who need to execute certain operations quickly and/or repeatedly. Using the command line scripts makes these tasks quicker and easier to perform. See the *Oracle VM Utilities Guide* for more information on these utilities.

B.2.2. Using DHCP

It is recommended that you install Oracle VM Server on a computer with a static IP address. If your computers uses DHCP you should configure your DHCP server to assign static DHCP addresses. This makes sure your host always receives the same IP address. The behavior of the Oracle VM Server host is undefined if used in an environment where your IP address may change due to DHCP lease expiry.

B.2.3. Setting the Guest's Clock

Paravirtualized guests may perform their own system clock management, for example, using the NTPD (Network Time Protocol daemon), or the hypervisor may perform system clock management for all guests.

You can set paravirtualized guests to manage their own system clocks by setting the `xen.independent_wallclock` parameter to `1` in the /etc/sysctl.conf file. For example

```
"xen.independent_wallclock = 1"
```

If you want to set the hypervisor to manage paravirtualized guest system clocks, set `xen.independent_wallclock` to `0`. Any attempts to set or modify the time in a guest will fail.

You can temporarily override the setting in the /proc file. For example

```
"echo 1 > /proc/sys/xen/independent_wallclock"
```

Note

This setting does not apply to hardware virtualized guests.

B.2.4. Wallclock Time Skew Problems

Additional parameters may be needed in the boot loader (grub.conf) configuration file for certain operating system variants after the guest is installed. Specifically, for optimal clock accuracy, Linux guest boot parameters should be specified to ensure that the *pit* clock source is utilized. Adding `clock=pit nohpet nopmtimer` for most guests will result in the selection of *pit* as the clock source for the guest. Published templates for Oracle VM include these additional parameters.

Proper maintenance of virtual time can be tricky. The various parameters provide tuning for virtual time management and supplement, but do not replace, the need for an *ntp* time service running within guest. Ensure that the `ntpd` service is running and that the /etc/ntpd.conf configuration file is pointing to valid time servers.

B.2.5. Mouse Pointer Tracking Problems

If your mouse pointer fails to track your cursor in a VNC Viewer session in a hardware virtualized guest, add the following to the Oracle VM Server configuration file located at /etc/xen/xend-config.sxp to force the device model to use absolute (tablet) coordinates:

```
usbdevice='tablet'
```

Restart the Oracle VM Server for the changes to take effect. You may need to do this for each Oracle VM Server in the server pool.

B.2.6. Hardware Virtualized Guest Stops

When running hardware virtualized guests, the QEMU process (qemu-dm) may have its memory usage grow substantially, especially under heavy I/O loads. This may cause the hardware virtualized guest to stop as it runs out of memory. If the guest is stopped, increase the memory allocation for dom0, for example from 512MB to 768MB.

B.2.7. Hardware Virtualized Guest Devices Not Working as Expected

Some devices, such as sound cards, may not work as expected in hardware virtualized guests. In a hardware virtualized guest, a device that requires physical memory addresses instead uses virtualized

memory addresses, so incorrect memory location values may be set. This is because DMA (Direct Memory Access) is virtualized in hardware virtualized guests.

Hardware virtualized guest operating systems expect to be loaded in memory starting somewhere around address 0 and upwards. This is only possible for the first hardware virtualized guest loaded. Oracle VM Server virtualizes the memory address to be 0 to the size of allocated memory, but the guest operating system is actually loaded at another memory location. The difference is fixed up in the shadow page table, but the operating system is unaware of this.

For example, a sound is loaded into memory in a hardware virtualized guest running Windows at an address of 100MB may produce garbage through the sound card, instead of the intended audio. This is because the sound is actually loaded at 100MB *plus* 256MB. The sound card receives the address of 100MB, but it is actually at 256MB.

An IOMMU (Input/Output Memory Management Unit) in the computer's memory management unit would remove this problem as it would take care of mapping virtual addresses to physical addresses, and enable hardware virtualized guests direct access to the hardware.

B.2.8. Firewall Blocks NFS Access

Oracle VM Server blocks NFS access from any external computer (or guest) by default. This may cause problems when trying to create a guest using an NFS connection. To resolve this, disable the firewall with the following command:

```
# service iptables stop
```

B.2.9. Migrating Virtual Machines

You cannot migrate virtual machines on computers with hardware that is not identical. To migrate a virtual machines, you must have hardware that is the same make and model and the CPU must be in the same CPU family. You must also have the same Oracle VM Server release number.

B.3. Troubleshooting Oracle VM Manager

This section describes some problems you may encounter when using Oracle VM Manager, and explains how to resolve them.

B.3.1. Log File

Oracle VM Manager error messages are displayed in the User Interface, in the Jobs tab, or in the object's Events list. These messages are also logged in the following file on the Oracle VM Manager host computer:

/u01/app/oracle/ovm-manager-3/machine1/base_adf_domain/servers/AdminServer/logs

This log is also the Oracle WebLogic Server log, which also contains any Oracle WebLogic Server application errors.

B.3.2. Command Line Tools

A set of Oracle VM command line utilities are available for download. These Oracle VM utilities are a collection of command line scripts that allow you to perform a set of basic management tasks on Oracle VM Servers and virtual machines in an Oracle VM environment. These utilities are particularly useful to administrators who need to execute certain operations quickly and/or repeatedly. Using the command

line scripts makes these tasks quicker and easier to perform. See the *Oracle VM Utilities Guide* for more information on these utilities.

B.3.3. Cannot Start Virtual Machine Console

If you launch the console of a virtual machine in Oracle VM Manager, and an error is displayed, you may not have installed the VNC viewer on the Oracle VM Manager host computer. To resolve this problem, install a VNC viewer on the Oracle VM Manager host. See Installing and Configuring a VNC Viewer for more information.

You can also install a VNC viewer on the client accessing the Oracle VM Manager user interface. Oracle recommends you also install a VNC viewer on the Oracle VM Manager host computer so that if a client does not have a VNC viewer, this problem does not occur.

B.3.4. Cannot Create a Virtual Machine from Installation Media

The following message is displayed: "Error: There is no server supporting hardware virtualization in the selected server pool."

To solve this problem, make sure the Oracle VM Server supports hardware virtualization.

Follow these steps to check:

a. Run the following command to check if hardware virtualization is supported by the CPU:

```
# cat /proc/cpuinfo |grep -E 'vmx|smx'
```

If any information that contains `vmx` or `smx` is displayed, it means that the CPU supports hardware virtualization. Here is an example of the returned message:

```
flags : fpu tsc msr pae mce cx8 apic mtrr mca cmov pat pse36 clflush dts acpi mmx fxsr
sse sse2 ss ht tm pbe nx lm constant_tsc pni monitor ds_cpl vmx est tm2 cx16 xtpr lahf_lm
```

Note

The **/proc/cpuinfo** command only shows virtualization capabilities starting with Linux 2.6.15 (Intel) and Linux 2.6.16 (AMD). Use the **uname -r** command to query your kernel version.

b. Make sure you have enabled hardware virtualization in the BIOS.

c. Run the following command to check if the operating system supports hardware virtualization:

```
# xm info |grep hvm
```

The following is an example of the returned message:

```
xen_caps : xen-3.0-x86_64 xen-3.0-x86_32p hvm-3.0-x86_32 hvm-3.0-x
```

If the CPU does not support hardware virtualization, use the paravirtualized method to create the virtual machine. See Section 7.7, “Creating a Virtual Machine”.

B.3.5. Cannot Change CD in the Virtual Machine

To change the CD in a virtual machine:

a. Unmount the first CD:

```
# umount mount-point
```

b. Select the second ISO file, and click **Change CD**.

c. Mount the second CD:

```
# mount /dev/cdrom mount-point
```

Appendix C. Third Party Licenses

Table of Contents

This Appendix includes the software licenses for third party software products included as part of Oracle VM.

C.1. Open-OVF

Open-ovf is included with Oracle VM Server.

The following files are available in source code form under the Eclipse Public License at:

http://www.eclipse.org/org/documents/epl-v10.php

The EPL license is reproduced below.

All past Contributors to the Open-OVF disclaim all warranties and conditions, express and implied, including warranties or conditions of title and non-infringement, and implied warranties or conditions of merchantability and fitness for a particular purpose. In addition, such Contributors are not liable for any damages, including direct, indirect, special, incidental and consequential damages, such as lost profits.

Oracle has modified the following files:

setup.py
py/ovf/__init__.py
py/ovf/Ovf.py
py/ovf/OvfCertificate.py
py/ovf/OvfPlatform.py
py/ovf/OvfFile.py
py/ovf/OvfManifest.py
py/ovf/OvfReferencedFile.py
py/ovf/OvfSet.py
py/ovf/OvfLibvirt.py
py/ovf/OvfTransport.py
py/ovf/env/EnvironmentSection.py
py/ovfapi/__init__.py
py/ovfapi/ovfapi.py
py/ovfapi/ovfova.py
py/scripts/chovf
py/scripts/lsovf
py/scripts/mkovf
py/scripts/rmovf
py/scripts/ova
schemas/README.ORACLE

schemas/ovf-envelope.xsd
schemas/ovf-environment.xsd
schemas/CIM_ResourceAllocationSettingData.xsd
schemas/CIM_VirtualSystemSettingData.xsd
schemas/ovf-envelope-ovm.xsd

The modifications made to the files are:

- Update version and schemas to OVF spec 1.1.0
- Support OVM extensions
- Add XML namespace to elements in envelope and environment files
- Support chunksize/compression attribute of File element
- Support certificate file creation with user supplied X509 certificate and private key
- Verify certificate as part of ova package validation
- Extract the contents of the appliance to a specified location after validating the appliance
- Add Oracle VM specific VirtualSystemTypes
  - 'DMTF:Oracle:OracleVM:PVM' for xenpv
  - 'DMTF:Oracle:OracleVM:HVM' for xenfv
- Remove libvirt dependency
- Other minor fixes

Eclipse License

```
Eclipse Public License - v 1.0

THE ACCOMPANYING PROGRAM IS PROVIDED UNDER THE TERMS OF THIS ECLIPSE PUBLIC
LICENSE ("AGREEMENT"). ANY USE, REPRODUCTION OR DISTRIBUTION OF THE PROGRAM
CONSTITUTES RECIPIENT'S ACCEPTANCE OF THIS AGREEMENT.

1. DEFINITIONS

"Contribution" means:

   a) in the case of the initial Contributor, the initial code and
   documentation distributed under this Agreement, and

   b) in the case of each subsequent Contributor:
    i) changes to the Program, and
    ii) additions to the Program;

where such changes and/or additions to the Program originate from and are
distributed by that particular Contributor. A Contribution 'originates' from a
Contributor if it was added to the Program by such Contributor itself or
anyone acting on such Contributor's behalf. Contributions do not include
additions to the Program which: (i) are separate modules of software
distributed in conjunction with the Program under their own license agreement,
and (ii) are not derivative works of the Program.

"Contributor" means any person or entity that distributes the Program.

"Licensed Patents " mean patent claims licensable by a Contributor which are
necessarily infringed by the use or sale of its Contribution alone or when
combined with the Program.
```

```
"Program" means the Contributions distributed in accordance with this
Agreement.

"Recipient" means anyone who receives the Program under this Agreement,
including all Contributors.

2. GRANT OF RIGHTS

   a) Subject to the terms of this Agreement, each Contributor hereby grants
   Recipient a non-exclusive, worldwide, royalty-free copyright license to
   reproduce, prepare derivative works of, publicly display, publicly perform,
   distribute and sublicense the Contribution of such Contributor, if any, and
   such derivative works, in source code and object code form.

   b) Subject to the terms of this Agreement, each Contributor hereby grants
   Recipient a non-exclusive, worldwide, royalty-free patent license under
   Licensed Patents to make, use, sell, offer to sell, import and otherwise
   transfer the Contribution of such Contributor, if any, in source code and
   object code form. This patent license shall apply to the combination of the
   Contribution and the Program if, at the time the Contribution is added by
   the Contributor, such addition of the Contribution causes such combination
   to be covered by the Licensed Patents. The patent license shall not apply
   to any other combinations which include the Contribution. No hardware per
   se is licensed hereunder.

   c) Recipient understands that although each Contributor grants the
   licenses to its Contributions set forth herein, no assurances are provided
   by any Contributor that the Program does not infringe the patent or other
   intellectual property rights of any other entity. Each Contributor
   disclaims any liability to Recipient for claims brought by any other
   entity based on infringement of intellectual property rights or otherwise.
   As a condition to exercising the rights and licenses granted hereunder,
   each Recipient hereby assumes sole responsibility to secure any other
   intellectual property rights needed, if any. For example, if a third party
   patent license is required to allow Recipient to distribute the Program,
   it is Recipient's responsibility to acquire that license before
   distributing the Program.

   d) Each Contributor represents that to its knowledge it has sufficient
   copyright rights in its Contribution, if any, to grant the copyright
   license set forth in this Agreement.

3. REQUIREMENTS

A Contributor may choose to distribute the Program in object code form under
its own license agreement, provided that:

   a) it complies with the terms and conditions of this Agreement; and

   b) its license agreement:
    i) effectively disclaims on behalf of all Contributors all warranties
    and conditions, express and implied, including warranties or conditions of
    title and non-infringement, and implied warranties or conditions of
    merchantability and fitness for a particular purpose;

    ii) effectively excludes on behalf of all Contributors all liability
    for damages, including direct, indirect, special, incidental and
    consequential damages, such as lost profits;

    iii) states that any provisions which differ from this Agreement are
    offered by that Contributor alone and not by any other party; and

    iv) states that source code for the Program is available from such
    Contributor, and informs licensees how to obtain it in a reasonable manner
    on or through a medium customarily used for software exchange.
```

When the Program is made available in source code form:

   a) it must be made available under this Agreement; and

   b) a copy of this Agreement must be included with each copy of the Program.

Contributors may not remove or alter any copyright notices contained within the Program.

Each Contributor must identify itself as the originator of its Contribution, if any, in a manner that reasonably allows subsequent Recipients to identify the originator of the Contribution.

4. COMMERCIAL DISTRIBUTION

Commercial distributors of software may accept certain responsibilities with respect to end users, business partners and the like. While this license is intended to facilitate the commercial use of the Program, the Contributor who includes the Program in a commercial product offering should do so in a manner which does not create potential liability for other Contributors. Therefore, if a Contributor includes the Program in a commercial product offering, such Contributor ("Commercial Contributor") hereby agrees to defend and indemnify every other Contributor ("Indemnified Contributor") against any losses, damages and costs (collectively "Losses") arising from claims, lawsuits and other legal actions brought by a third party against the Indemnified Contributor to the extent caused by the acts or omissions of such Commercial Contributor in connection with its distribution of the Program in a commercial product offering. The obligations in this section do not apply to any claims or Losses relating to any actual or alleged intellectual property infringement. In order to qualify, an Indemnified Contributor must: a) promptly notify the Commercial Contributor in writing of such claim, and b) allow the Commercial Contributor to control, and cooperate with the Commercial Contributor in, the defense and any related settlement negotiations. The Indemnified Contributor may participate in any such claim at its own expense.

For example, a Contributor might include the Program in a commercial product offering, Product X. That Contributor is then a Commercial Contributor. If that Commercial Contributor then makes performance claims, or offers warranties related to Product X, those performance claims and warranties are such Commercial Contributor's responsibility alone. Under this section, the Commercial Contributor would have to defend claims against the other Contributors related to those performance claims and warranties, and if a court requires any other Contributor to pay any damages as a result, the Commercial Contributor must pay those damages.

5. NO WARRANTY

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, THE PROGRAM IS PROVIDED ON AN "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, EITHER EXPRESS OR IMPLIED INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OR CONDITIONS OF TITLE, NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Each Recipient is solely responsible for determining the appropriateness of using and distributing the Program and assumes all risks associated with its exercise of rights under this Agreement , including but not limited to the risks and costs of program errors, compliance with applicable laws, damage to or loss of data, programs or equipment, and unavailability or interruption of operations.

6. DISCLAIMER OF LIABILITY

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, NEITHER RECIPIENT NOR ANY CONTRIBUTORS SHALL HAVE ANY LIABILITY FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING WITHOUT LIMITATION LOST PROFITS), HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OR DISTRIBUTION OF THE PROGRAM OR THE EXERCISE OF ANY RIGHTS GRANTED HEREUNDER, EVEN IF ADVISED OF THE POSSIBILITY

```
OF SUCH DAMAGES.

7. GENERAL

If any provision of this Agreement is invalid or unenforceable under
applicable law, it shall not affect the validity or enforceability of the
remainder of the terms of this Agreement, and without further action by the
parties hereto, such provision shall be reformed to the minimum extent
necessary to make such provision valid and enforceable.

If Recipient institutes patent litigation against any entity (including a
cross-claim or counterclaim in a lawsuit) alleging that the Program itself
(excluding combinations of the Program with other software or hardware)
infringes such Recipient's patent(s), then such Recipient's rights granted
under Section 2(b) shall terminate as of the date such litigation is filed.

All Recipient's rights under this Agreement shall terminate if it fails to
comply with any of the material terms or conditions of this Agreement and does
not cure such failure in a reasonable period of time after becoming aware of
such noncompliance. If all Recipient's rights under this Agreement terminate,
Recipient agrees to cease use and distribution of the Program as soon as
reasonably practicable. However, Recipient's obligations under this Agreement
and any licenses granted by Recipient relating to the Program shall continue
and survive.

Everyone is permitted to copy and distribute copies of this Agreement, but in
order to avoid inconsistency the Agreement is copyrighted and may only be
modified in the following manner. The Agreement Steward reserves the right to
publish new versions (including revisions) of this Agreement from time to
time. No one other than the Agreement Steward has the right to modify this
Agreement. The Eclipse Foundation is the initial Agreement Steward. The
Eclipse Foundation may assign the responsibility to serve as the Agreement
Steward to a suitable separate entity. Each new version of the Agreement will
be given a distinguishing version number. The Program (including
Contributions) may always be distributed subject to the version of the
Agreement under which it was received. In addition, after a new version of the
Agreement is published, Contributor may elect to distribute the Program
(including its Contributions) under the new version. Except as expressly
stated in Sections 2(a) and 2(b) above, Recipient receives no rights or
licenses to the intellectual property of any Contributor under this Agreement,
whether expressly, by implication, estoppel or otherwise. All rights in the
Program not expressly granted under this Agreement are reserved.

This Agreement is governed by the laws of the State of New York and the
intellectual property laws of the United States of America. No party to this
Agreement will bring a legal action under this Agreement more than one year
after the cause of action arose. Each party waives its rights to a jury trial
in any resulting litigation.


 _____________________________________________
```

C.2. Python-hashlib

Python-hashlib is included with Oracle VM Server.

Oracle has not modified any files.

Python Software Foundation License

```
PYTHON SOFTWARE FOUNDATION LICENSE VERSION 2
--------------------------------------------

1. This LICENSE AGREEMENT is between the Python Software Foundation
("PSF"), and the Individual or Organization ("Licensee") accessing and
otherwise using this software ("Python") in source or binary form and
its associated documentation.
```

```
2. Subject to the terms and conditions of this License Agreement, PSF
hereby grants Licensee a nonexclusive, royalty-free, world-wide
license to reproduce, analyze, test, perform and/or display publicly,
prepare derivative works, distribute, and otherwise use Python
alone or in any derivative version, provided, however, that PSF's
License Agreement and PSF's notice of copyright, i.e., "Copyright (c)
2001, 2002, 2003, 2004, 2005, 2006 Python Software Foundation; All Rights
Reserved" are retained in Python alone or in any derivative version
prepared by Licensee.

3. In the event Licensee prepares a derivative work that is based on
or incorporates Python or any part thereof, and wants to make
the derivative work available to others as provided herein, then
Licensee hereby agrees to include in any such work a brief summary of
the changes made to Python.

4. PSF is making Python available to Licensee on an "AS IS"
basis.  PSF MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR
IMPLIED.  BY WAY OF EXAMPLE, BUT NOT LIMITATION, PSF MAKES NO AND
DISCLAIMS ANY REPRESENTATION OR WARRANTY OF MERCHANTABILITY OR FITNESS
FOR ANY PARTICULAR PURPOSE OR THAT THE USE OF PYTHON WILL NOT
INFRINGE ANY THIRD PARTY RIGHTS.

5. PSF SHALL NOT BE LIABLE TO LICENSEE OR ANY OTHER USERS OF PYTHON
FOR ANY INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES OR LOSS AS
A RESULT OF MODIFYING, DISTRIBUTING, OR OTHERWISE USING PYTHON,
OR ANY DERIVATIVE THEREOF, EVEN IF ADVISED OF THE POSSIBILITY THEREOF.

6. This License Agreement will automatically terminate upon a material
breach of its terms and conditions.

7. Nothing in this License Agreement shall be deemed to create any
relationship of agency, partnership, or joint venture between PSF and
Licensee.  This License Agreement does not grant permission to use PSF
trademarks or trade name in a trademark sense to endorse or promote
products or services of Licensee, or any third party.

8. By copying, installing or otherwise using Python, Licensee
agrees to be bound by the terms and conditions of this License
Agreement.

_____________________________________________
```

C.3. Python-zope-interface

Python-zope-interface is included with Oracle VM Server.

Oracle has not modified any files.

Zope License

```
Zope Public License (ZPL) Version 2.1

A copyright notice accompanies this license document that identifies the
copyright holders.

This license has been certified as open source. It has also been designated
as GPL compatible by the Free Software Foundation (FSF).

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions are met:

   1. Redistributions in source code must retain the accompanying copyright
      notice, this list of conditions, and the following disclaimer.
   2. Redistributions in binary form must reproduce the accompanying copyright
```

```
      notice, this list of conditions, and the following disclaimer in the
      documentation and/or other materials provided with the distribution.
   3. Names of the copyright holders must not be used to endorse or promote
      products derived from this software without prior written permission from
      the copyright holders.
   4. The right to distribute this software or to use it for any purpose does
      not give you the right to use Servicemarks (sm) or Trademarks (tm) of the
      copyright holders. Use of them is covered by separate agreement with the
      copyright holders.
   5. If any files are modified, you must cause the modified files to carry
      prominent notices stating that you changed the files and the date of any
      change.

Disclaimer

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS ``AS IS'' AND ANY EXPRESSED
OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF
MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO
EVENT SHALL THE COPYRIGHT HOLDERS BE LIABLE FOR ANY DIRECT, INDIRECT,
INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT
LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR
PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF
LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE
OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF
ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.
```

C.4. Multiprocessing

Multiprocessing is included with Oracle VM Server.

Multiprocessing License

```
Multiprocessing
Copyright (c) 2006-2008, R Oudkerk and Contributors

All rights reserved.

Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions
are met:

1. Redistributions of source code must retain the above copyright
   notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright
   notice, this list of conditions and the following disclaimer in the
   documentation and/or other materials provided with the distribution.
3. Neither the name of author nor the names of any contributors may be
   used to endorse or promote products derived from this software
   without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE AUTHOR AND CONTRIBUTORS "AS IS" AND
ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE
IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE
ARE DISCLAIMED.  IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE
FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL
DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS
OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION)
HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT
LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
SUCH DAMAGE.
```

C.5. Python-twisted-core

Python-twisted-core is included with Oracle VM Server.

Python-twisted-core License

```
python-twisted-core:
Copyright (c) 2001-2008
Allen Short
Andrew Bennetts
Apple Computer, Inc.
Benjamin Bruheim
Bob Ippolito
Canonical Limited
Christopher Armstrong
David Reid
Donovan Preston
Eric Mangold
Itamar Shtull-Trauring
James Knight
Jason A. Mobarak
Jean-Paul Calderone
Jonathan Lange
Jonathan D. Simms
Jürgen Hermann
Kevin Turner
Mary Gardiner
Matthew Lefkowitz
Massachusetts Institute of Technology
Moshe Zadka
Paul Swartz
Pavel Pergamenshchik
Ralph Meijer
Sean Riley
Software Freedom Conservancy
Travis B. Hartwell
Thomas Herve
Eyal Lotem
Antoine Pitrou
Andy Gayton

Permission is hereby granted, free of charge, to any person obtaining
a copy of this software and associated documentation files (the
"Software"), to deal in the Software without restriction, including
without limitation the rights to use, copy, modify, merge, publish,
distribute, sublicense, and/or sell copies of the Software, and to
permit persons to whom the Software is furnished to do so, subject to
the following conditions:

The above copyright notice and this permission notice shall be
included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND
NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE
LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION
OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION
WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
```

C.6. PyYAML

PyYAML is included with Oracle VM Server and Oracle VM Manager.

PyYAML License

```
PyYAML

Copyright (c) 2006 Kirill Simonov
```

```
Permission is hereby granted, free of charge, to any person obtaining a copy of
this software and associated documentation files (the "Software"), to deal in
the Software without restriction, including without limitation the rights to
use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies
of the Software, and to permit persons to whom the Software is furnished to do
so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all
copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY,
FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE
AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER
LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,
OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE
SOFTWARE.
```

C.7. Unzip

Unzip is included with Oracle VM Server.

Unzip License

```
This is version 2009-Jan-02 of the Info-ZIP license.
The definitive version of this document should be available at
ftp://ftp.info-zip.org/pub/infozip/license.html indefinitely and
a copy at http://www.info-zip.org/pub/infozip/license.html.


Copyright (c) 1990-2009 Info-ZIP.  All rights reserved.

For the purposes of this copyright and license, "Info-ZIP" is defined as
the following set of individuals:

   Mark Adler, John Bush, Karl Davis, Harald Denker, Jean-Michel Dubois,
   Jean-loup Gailly, Hunter Goatley, Ed Gordon, Ian Gorman, Chris Herborth,
   Dirk Haase, Greg Hartwig, Robert Heath, Jonathan Hudson, Paul Kienitz,
   David Kirschbaum, Johnny Lee, Onno van der Linden, Igor Mandrichenko,
   Steve P. Miller, Sergio Monesi, Keith Owens, George Petrov, Greg Roelofs,
   Kai Uwe Rommel, Steve Salisbury, Dave Smith, Steven M. Schweda,
   Christian Spieler, Cosmin Truta, Antoine Verheijen, Paul von Behren,
   Rich Wales, Mike White.

This software is provided "as is," without warranty of any kind, express
or implied.  In no event shall Info-ZIP or its contributors be held liable
for any direct, indirect, incidental, special or consequential damages
arising out of the use of or inability to use this software.

Permission is granted to anyone to use this software for any purpose,
including commercial applications, and to alter it and redistribute it
freely, subject to the above disclaimer and the following restrictions:

    1. Redistributions of source code (in whole or in part) must retain
       the above copyright notice, definition, disclaimer, and this list
       of conditions.

    2. Redistributions in binary form (compiled executables and libraries)
       must reproduce the above copyright notice, definition, disclaimer,
       and this list of conditions in documentation and/or other materials
       provided with the distribution.  Additional documentation is not needed
       for executables where a command line license option provides these and
       a note regarding this option is in the executable's startup banner.  The
       sole exception to this condition is redistribution of a standard
       UnZipSFX binary (including SFXWiz) as part of a self-extracting archive;
```

```
      that is permitted without inclusion of this license, as long as the
      normal SFX banner has not been removed from the binary or disabled.

   3. Altered versions--including, but not limited to, ports to new operating
      systems, existing ports with new graphical interfaces, versions with
      modified or added functionality, and dynamic, shared, or static library
      versions not from Info-ZIP--must be plainly marked as such and must not
      be misrepresented as being the original source or, if binaries,
      compiled from the original source.  Such altered versions also must not
      be misrepresented as being Info-ZIP releases--including, but not
      limited to, labeling of the altered versions with the names "Info-ZIP"
      (or any variation thereof, including, but not limited to, different
      capitalizations), "Pocket UnZip," "WiZ" or "MacZip" without the
      explicit permission of Info-ZIP.  Such altered versions are further
      prohibited from misrepresentative use of the Zip-Bugs or Info-ZIP
      e-mail addresses or the Info-ZIP URL(s), such as to imply Info-ZIP
      will provide support for the altered versions.

   4. Info-ZIP retains the right to use the names "Info-ZIP," "Zip," "UnZip,"
      "UnZipSFX," "WiZ," "Pocket UnZip," "Pocket Zip," and "MacZip" for its
      own source and binary releases.
```

C.8. GPL and LGPL Licenses

The following products are included with Oracle VM Server under the GPL (GNU General Public License) and LGPL (GNU Lesser General Public License) licenses:

- liblockfile
- lsscsi
- pypxeboot
- python-crypto
- python-paramiko
- python-pycurl
- python-urlgrabber
- socat
- udhcp

For binaries (i) that you receive from Oracle on physical media or where the source code was not available when you downloaded the binaries and (ii) that are licensed under any version of the GNU General Public License (GPL) or the GNU LGPL, you can receive a complete machine-readable copy of the source code by sending a written request to:

Oracle America, Inc. Attn: Associate General Counsel, Development and Engineering Legal 500 Oracle Parkway, 7th Floor Redwood Shores, CA 94065

Your request should include (i) the name of the covered binary, (ii) the name and version number of the Oracle product containing the covered binary, (iii) your name, (iv) your company name (if applicable), and (v) your return mailing and email address (if available).

We may charge you a nominal fee to cover the cost of the media and distribution.

Your request must be sent within three (3) years of the date you received the physical media containing the GPL or LGPL covered binary.

For your convenience, some or all of the source code may also be found at the following URLs:

https://edelivery.oracle.com/oraclevm

http://oss.oracle.com/oraclevm/server/3.0/SRPMS

Election to use GPL v2 or LGPL v 2.1 instead of GPL v3 or LGPL v3 where applicable

Oracle elects to use only the GNU Lesser General Public License version 2.1 (LGPL)/GNU General Public License version 2 (GPL) for any software where a choice of LGPL/GPL license versions are made available with the language indicating that LGPLv2.1/GPLv2 or any later version may be used, or where a choice of which version of the LGPL/GPL applies is unspecified. Where a choice is available between the GPL or the LGPL and any other license, and no specific election has been made with respect to that particular component, Oracle chooses the other license.

GNU License

```
                    GNU GENERAL PUBLIC LICENSE
                       Version 2, June 1991

 Copyright (C) 1989, 1991 Free Software Foundation, Inc.,
 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA
 Everyone is permitted to copy and distribute verbatim copies
 of this license document, but changing it is not allowed.

                            Preamble

  The licenses for most software are designed to take away your
freedom to share and change it.  By contrast, the GNU General Public
License is intended to guarantee your freedom to share and change free
software--to make sure the software is free for all its users.  This
General Public License applies to most of the Free Software
Foundation's software and to any other program whose authors commit to
using it.  (Some other Free Software Foundation software is covered by
the GNU Lesser General Public License instead.)  You can apply it to
your programs, too.

  When we speak of free software, we are referring to freedom, not
price.  Our General Public Licenses are designed to make sure that you
have the freedom to distribute copies of free software (and charge for
this service if you wish), that you receive source code or can get it
if you want it, that you can change the software or use pieces of it
in new free programs; and that you know you can do these things.

  To protect your rights, we need to make restrictions that forbid
anyone to deny you these rights or to ask you to surrender the rights.
These restrictions translate to certain responsibilities for you if you
distribute copies of the software, or if you modify it.

  For example, if you distribute copies of such a program, whether
gratis or for a fee, you must give the recipients all the rights that
you have.  You must make sure that they, too, receive or can get the
source code.  And you must show them these terms so they know their
rights.

  We protect your rights with two steps: (1) copyright the software, and
(2) offer you this license which gives you legal permission to copy,
distribute and/or modify the software.

  Also, for each author's protection and ours, we want to make certain
that everyone understands that there is no warranty for this free
software.  If the software is modified by someone else and passed on, we
want its recipients to know that what they have is not the original, so
that any problems introduced by others will not reflect on the original
authors' reputations.
```

```
  Finally, any free program is threatened constantly by software
patents.  We wish to avoid the danger that redistributors of a free
program will individually obtain patent licenses, in effect making the
program proprietary.  To prevent this, we have made it clear that any
patent must be licensed for everyone's free use or not licensed at all.

  The precise terms and conditions for copying, distribution and
modification follow.

                    GNU GENERAL PUBLIC LICENSE
   TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

  0. This License applies to any program or other work which contains
a notice placed by the copyright holder saying it may be distributed
under the terms of this General Public License.  The "Program", below,
refers to any such program or work, and a "work based on the Program"
means either the Program or any derivative work under copyright law:
that is to say, a work containing the Program or a portion of it,
either verbatim or with modifications and/or translated into another
language.  (Hereinafter, translation is included without limitation in
the term "modification".)  Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not
covered by this License; they are outside its scope.  The act of
running the Program is not restricted, and the output from the Program
is covered only if its contents constitute a work based on the
Program (independent of having been made by running the Program).
Whether that is true depends on what the Program does.

  1. You may copy and distribute verbatim copies of the Program's
source code as you receive it, in any medium, provided that you
conspicuously and appropriately publish on each copy an appropriate
copyright notice and disclaimer of warranty; keep intact all the
notices that refer to this License and to the absence of any warranty;
and give any other recipients of the Program a copy of this License
along with the Program.

You may charge a fee for the physical act of transferring a copy, and
you may at your option offer warranty protection in exchange for a fee.

  2. You may modify your copy or copies of the Program or any portion
of it, thus forming a work based on the Program, and copy and
distribute such modifications or work under the terms of Section 1
above, provided that you also meet all of these conditions:

    a) You must cause the modified files to carry prominent notices
    stating that you changed the files and the date of any change.

    b) You must cause any work that you distribute or publish, that in
    whole or in part contains or is derived from the Program or any
    part thereof, to be licensed as a whole at no charge to all third
    parties under the terms of this License.

    c) If the modified program normally reads commands interactively
    when run, you must cause it, when started running for such
    interactive use in the most ordinary way, to print or display an
    announcement including an appropriate copyright notice and a
    notice that there is no warranty (or else, saying that you provide
    a warranty) and that users may redistribute the program under
    these conditions, and telling the user how to view a copy of this
    License.  (Exception: if the Program itself is interactive but
    does not normally print such an announcement, your work based on
    the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole.  If
identifiable sections of that work are not derived from the Program,
```

```
and can be reasonably considered independent and separate works in
themselves, then this License, and its terms, do not apply to those
sections when you distribute them as separate works.  But when you
distribute the same sections as part of a whole which is a work based
on the Program, the distribution of the whole must be on the terms of
this License, whose permissions for other licensees extend to the
entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest
your rights to work written entirely by you; rather, the intent is to
exercise the right to control the distribution of derivative or
collective works based on the Program.

In addition, mere aggregation of another work not based on the Program
with the Program (or with a work based on the Program) on a volume of
a storage or distribution medium does not bring the other work under
the scope of this License.

  3. You may copy and distribute the Program (or a work based on it,
under Section 2) in object code or executable form under the terms of
Sections 1 and 2 above provided that you also do one of the following:

    a) Accompany it with the complete corresponding machine-readable
    source code, which must be distributed under the terms of Sections
    1 and 2 above on a medium customarily used for software interchange; or,

    b) Accompany it with a written offer, valid for at least three
    years, to give any third party, for a charge no more than your
    cost of physically performing source distribution, a complete
    machine-readable copy of the corresponding source code, to be
    distributed under the terms of Sections 1 and 2 above on a medium
    customarily used for software interchange; or,

    c) Accompany it with the information you received as to the offer
    to distribute corresponding source code.  (This alternative is
    allowed only for noncommercial distribution and only if you
    received the program in object code or executable form with such
    an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for
making modifications to it.  For an executable work, complete source
code means all the source code for all modules it contains, plus any
associated interface definition files, plus the scripts used to
control compilation and installation of the executable.  However, as a
special exception, the source code distributed need not include
anything that is normally distributed (in either source or binary
form) with the major components (compiler, kernel, and so on) of the
operating system on which the executable runs, unless that component
itself accompanies the executable.

If distribution of executable or object code is made by offering
access to copy from a designated place, then offering equivalent
access to copy the source code from the same place counts as
distribution of the source code, even though third parties are not
compelled to copy the source along with the object code.

  4. You may not copy, modify, sublicense, or distribute the Program
except as expressly provided under this License.  Any attempt
otherwise to copy, modify, sublicense or distribute the Program is
void, and will automatically terminate your rights under this License.
However, parties who have received copies, or rights, from you under
this License will not have their licenses terminated so long as such
parties remain in full compliance.

  5. You are not required to accept this License, since you have not
signed it.  However, nothing else grants you permission to modify or
distribute the Program or its derivative works.  These actions are
```

```
prohibited by law if you do not accept this License.  Therefore, by
modifying or distributing the Program (or any work based on the
Program), you indicate your acceptance of this License to do so, and
all its terms and conditions for copying, distributing or modifying
the Program or works based on it.

  6. Each time you redistribute the Program (or any work based on the
Program), the recipient automatically receives a license from the
original licensor to copy, distribute or modify the Program subject to
these terms and conditions.  You may not impose any further
restrictions on the recipients' exercise of the rights granted herein.
You are not responsible for enforcing compliance by third parties to
this License.

  7. If, as a consequence of a court judgment or allegation of patent
infringement or for any other reason (not limited to patent issues),
conditions are imposed on you (whether by court order, agreement or
otherwise) that contradict the conditions of this License, they do not
excuse you from the conditions of this License.  If you cannot
distribute so as to satisfy simultaneously your obligations under this
License and any other pertinent obligations, then as a consequence you
may not distribute the Program at all.  For example, if a patent
license would not permit royalty-free redistribution of the Program by
all those who receive copies directly or indirectly through you, then
the only way you could satisfy both it and this License would be to
refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under
any particular circumstance, the balance of the section is intended to
apply and the section as a whole is intended to apply in other
circumstances.

It is not the purpose of this section to induce you to infringe any
patents or other property right claims or to contest validity of any
such claims; this section has the sole purpose of protecting the
integrity of the free software distribution system, which is
implemented by public license practices.  Many people have made
generous contributions to the wide range of software distributed
through that system in reliance on consistent application of that
system; it is up to the author/donor to decide if he or she is willing
to distribute software through any other system and a licensee cannot
impose that choice.

This section is intended to make thoroughly clear what is believed to
be a consequence of the rest of this License.

  8. If the distribution and/or use of the Program is restricted in
certain countries either by patents or by copyrighted interfaces, the
original copyright holder who places the Program under this License
may add an explicit geographical distribution limitation excluding
those countries, so that distribution is permitted only in or among
countries not thus excluded.  In such case, this License incorporates
the limitation as if written in the body of this License.

  9. The Free Software Foundation may publish revised and/or new versions
of the General Public License from time to time.  Such new versions will
be similar in spirit to the present version, but may differ in detail to
address new problems or concerns.

Each version is given a distinguishing version number.  If the Program
specifies a version number of this License which applies to it and "any
later version", you have the option of following the terms and conditions
either of that version or of any later version published by the Free
Software Foundation.  If the Program does not specify a version number of
this License, you may choose any version ever published by the Free Software
Foundation.
```

```
  10. If you wish to incorporate parts of the Program into other free
programs whose distribution conditions are different, write to the author
to ask for permission.  For software which is copyrighted by the Free
Software Foundation, write to the Free Software Foundation; we sometimes
make exceptions for this.  Our decision will be guided by the two goals
of preserving the free status of all derivatives of our free software and
of promoting the sharing and reuse of software generally.

                            NO WARRANTY

  11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY
FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW.  EXCEPT WHEN
OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES
PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED
OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF
MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.  THE ENTIRE RISK AS
TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU.  SHOULD THE
PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING,
REPAIR OR CORRECTION.

  12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING
WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR
REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES,
INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING
OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED
TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY
YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER
PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE
POSSIBILITY OF SUCH DAMAGES.

                     END OF TERMS AND CONDITIONS

            How to Apply These Terms to Your New Programs

  If you develop a new program, and you want it to be of the greatest
possible use to the public, the best way to achieve this is to make it
free software which everyone can redistribute and change under these terms.

  To do so, attach the following notices to the program.  It is safest
to attach them to the start of each source file to most effectively
convey the exclusion of warranty; and each file should have at least
the "copyright" line and a pointer to where the full notice is found.

    <one line to give the program's name and a brief idea of what it does.>
    Copyright (C) <year>  <name of author>

    This program is free software; you can redistribute it and/or modify
    it under the terms of the GNU General Public License as published by
    the Free Software Foundation; either version 2 of the License, or
    (at your option) any later version.

    This program is distributed in the hope that it will be useful,
    but WITHOUT ANY WARRANTY; without even the implied warranty of
    MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
    GNU General Public License for more details.

    You should have received a copy of the GNU General Public License along
    with this program; if not, write to the Free Software Foundation, Inc.,
    51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA.

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this
when it starts in an interactive mode:

    Gnomovision version 69, Copyright (C) year name of author
    Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
```

```
    This is free software, and you are welcome to redistribute it
    under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate
parts of the General Public License.  Of course, the commands you use may
be called something other than `show w' and `show c'; they could even be
mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your
school, if any, to sign a "copyright disclaimer" for the program, if
necessary.  Here is a sample; alter the names:

  Yoyodyne, Inc., hereby disclaims all copyright interest in the program
  `Gnomovision' (which makes passes at compilers) written by James Hacker.

  <signature of Ty Coon>, 1 April 1989
  Ty Coon, President of Vice

This General Public License does not permit incorporating your program into
proprietary programs.  If your program is a subroutine library, you may
consider it more useful to permit linking proprietary applications with the
library.  If this is what you want to do, use the GNU Lesser General
Public License instead of this License.
```

Glossary

A

affinity
: Specify that specific virtual machines should always run on the same host.

anti-affinity
: Specify that specific virtual machines should never run on the same host.

assembly
: An infrastructure template containing a configuration of multiple virtual machines with their virtual disks, and the inter-connectivity between them. Assemblies can be created as a set of .ovf (Open Virtualization Format) and .img (disk image) files, or may all be contained in a single .ova (Open Virtualization Format Archive) file.

C

clone
: The action or result of making an exact copy of an object. The object may be a virtual machine, virtual machine template, ISO file, or virtual disk. Cloning is analogous to copying and maintains the integrity of the original object, while creating a new object based on the original. A clone customizer may be used to define cloning options to specify details of where the object components may reside when cloned, such as in a different storage repository.

control domain
: A privileged domain that creates and manages other logical domains and services.

D

dom0
: An abbreviation for *domain zero*. The management domain with privileged access to the hardware and device drivers. Dom0 is the first domain started by the Oracle VM Server at boot time. Dom0 has more privileges than domU. It can access the hardware directly and can manage the device drivers for other domains. It can also start new domains.

domain
: A configurable set of resources, including memory, virtual CPUs, network devices and disk devices, in which virtual machines run. A domain is granted virtual resources and can be started, stopped and rebooted independently.
  See Also dom0, domU.

domU
: An unprivileged domain with no direct access to the hardware or device drivers. Each domU is started by Oracle VM Server in dom0.

G

guest
: A guest operating system that runs within a domain in Oracle VM Server. A guest may be paravirtualized or hardware virtualized. Multiple guests can run on the same Oracle VM Server.

H

hardware virtualized machine (HVM)
: A virtual machine with an unmodified guest operating system. It is not recompiled for the virtual environment. There may be substantial performance penalties running as a hardware virtualized guest. Enables Microsoft Windows™ operating system to be run, as well as legacy operating systems. Hardware virtualization is only available on Intel VT or AMD SVM CPUs.

host computer
: The physical computer on which Oracle VM Server is installed.

hypervisor
: The hypervisor, monitor, or Virtual Machine Manager (VMM). It is the only fully privileged entity in the system. It controls only the most basic resources of the system, including CPU and memory usage, privilege checks, and hardware interrupts.

L

logical domain
: A virtual machine comprised of a discrete logical grouping of resources, which has its own operating system and identity within a single computer system. Also called a domain.
See Also domain.

M

management domain
: See dom0.

master Oracle VM Server
: A component of Oracle VM Agent. An application that acts as the contact point to Oracle VM Manager, and to other Oracle VM Agents. Provides virtual machine host load-balancing, and local persistence for Oracle VM Server.

  There is only one master Oracle VM Server in a server pool. A physical server can perform as the master Oracle VM Server, Utility Server and Virtual Machine Server simultaneously.

migrate
: The act of moving a virtual machine from one Oracle VM Server to another, or to the Unassigned Virtual Machines folder. Migration can be performed on either a running or a stopped virtual machine.

move
: The act of moving an object from one location to another. This may be moving a stopped virtual machine from one Oracle VM Server to another, moving a virtual machine template from one storage repository to another, or moving an ISO file or virtual disk to another storage location.

N

non-sparse copy
: A clone of the type "non-sparse copy" is a disk image file of a physical disk, taking up the space equivalent to the full specified disk size, including empty blocks.
See Also sparse copy.

O

Oracle VM Agent
: An application installed with Oracle VM Server. It communicates with Oracle VM Manager for management of virtual machines. Oracle VM Manager manages the virtual machines running on Oracle VM Server by communicating with Oracle VM Agent. It contains three components: master Oracle VM Server, Utility Server, and Virtual Machine Server.

Oracle VM Manager
: Provides the user interface, which is an Application Development Framework (ADF) web application, to manage Oracle VM Server pools. Manages virtual machine life cycle, including creating virtual machines from templates or from installation media, deleting, powering off, uploading, deployment and live migration of virtual machines. Manages resources including ISO files, templates and shared virtual disks.

Oracle VM Server
: A self-contained virtualization environment designed to provide a lightweight, secure, server-based platform for running virtual machines. Oracle VM Server is based upon an updated version of the Xen hypervisor technology. Includes Oracle VM Agent to enable communication with Oracle VM Manager.

P

paravirtualized machine (PVM)
: A virtual machine with a kernel that is recompiled to be made aware of the virtual environment. Runs at near native speed, with memory, disk and network access optimized for maximum performance.

Q

QEMU
: Also referred to as qemu-dm, which is the process name. The virtualization process which allows full virtualization of a PC system within another PC system.

S

server pool
: Logically an autonomous region that contains one or more physical Oracle VM Servers. Presents a unified view of the storage where the virtual machines reside, and groups the users of these virtual machines into a single community called a *group*, in which each user is a server pool member.

service domain
: Logical domain that provides devices, such as virtual switches, virtual console connectors, and virtual disk servers, to other logical domains.

sparse copy
: A clone of the type "sparse copy" is a disk image file of a physical disk, taking up only the amount of space actually in use; not the full specified disk size.
See Also non-sparse copy.

T

thin clone
: A thin clone is a clone of a physical disk that takes up only the amount of disk space actually in use; not the full specified disk size.

U

Utility Server
: A component of Oracle VM Agent. An application that handles I/O intensive operations for virtual machines, server pools and servers, for example, copying, moving and renaming files.

  There can be more than one Utility Server in a server pool. A physical server can perform as the master Oracle VM Server, Utility Server and Virtual Machine Server simultaneously.

V

vif
: A virtual network interface for bridging network interfaces between domUs and dom0. When a domU is started it is assigned a number. This number is used to bridge the network interface from eth*n* to vif*n.0*.

virtual disk
: A file or set of files, usually on the host file system although it may also be a remote file system, that appears as a physical disk drive to the guest operating system.

virtual machine (VM)
: A guest operating system and the associated application software that runs within Oracle VM Server. May be paravirtualized or hardware virtualized machines. Multiple virtual machines can run on the same Oracle VM Server.

Virtual Machine Manager (VMM)
: See hypervisor.

Virtual Machine Server
: A component of Oracle VM Agent. An application which runs Oracle VM Server virtual machines. It can start and stop virtual machines, and collect performance data for the host and guest operating systems. Enables communication between the master Oracle VM Server, Utility Server and Virtual Machine Servers.

  There can be more than one Virtual Machine Server in a server pool. A physical server can perform as the master Oracle VM Server, Utility Server and Virtual Machine Server simultaneously.

virtual machine template
: A template of a virtual machine. Contains basic configuration information such as the number of CPUs, memory size, hard disk size, and network interface card (NIC). Create virtual machines based on a virtual machine template using Oracle VM Manager.

VMM
: See Virtual Machine Manager (VMM) .

X

Xen™
: The Xen hypervisor is a small, lightweight, software virtual machine monitor, for x86-compatible computers. The Xen hypervisor securely executes multiple virtual machines on one physical system. Each virtual machine has its own guest operating system with almost native performance. The Xen hypervisor was originally created by researchers at Cambridge University, and derived from work done on the Linux kernel.

Index

Symbols

A

B

C

D

E

O

P

Q

R

S

T

U

V

W

X

Y