Oracle® Linux Virtualization Manager
Architecture and Planning Guide
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About this document

This document is part of the documentation for Oracle Linux Virtualization Manager, which is available at: http://docs.oracle.com/en/virtualization/oracle-linux-virtualization-manager/index.html

The documentation consists of the following items:

**Oracle Linux Virtualization Manager Release Notes**

This document provides a summary of the new features, changes, fixed bugs, and known issues in the Oracle Linux Virtualization Manager. It contains last-minute information, which may not be included in the main body of documentation.

Read this document before you install your environment.

**Oracle Linux Virtualization Manager Architecture and Planning Guide**

This document provides an architectural overview of Oracle Linux Virtualization Manager, prerequisites, and planning information for your environment.

Read this document before you install your environment.

**Oracle Linux Virtualization Manager Installation Guide**

This document provides an overview of the Oracle Linux Virtualization Manager and explains how to install the Oracle Linux Virtualization Manager environment, including important information, such as system requirements, for planning your virtualization environment.

**Oracle Linux Virtualization Manager Getting Started Guide**

This document explains how to get started with the Oracle Linux Virtualization Manager. It provides an example scenario that covers some of the basic procedures for setting up the environment, such as, adding hosts, adding storage, creating virtual machines, and so on.

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Chapter 1 Architecture

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The following information gives you an architectural overview of the Oracle Linux Virtualization Manager. For general planning information, see Chapter 3, Planning Your Environment.

Based on the open source oVirt project, Oracle Linux Virtualization Manager is a server virtualization management platform that can be used to configure, monitor, and manage an Oracle Linux Kernel-based Virtual Machine (KVM) environment, including hosts, virtual machines, storage, networks, and users. The Manager is accessed through the Administration Portal or VM Portal, web-based portals that are available from a Oracle Linux Virtualization Manager landing page.

Oracle Linux Virtualization Manager also provides a Representational State Transfer (REST) Application Programming Interface (API) for managing your Oracle Linux KVM infrastructure, allowing you to integrate the Manager with other management systems or to automate repetitive tasks with scripts. For most day to day operations, many users will rely on the administrative portal or the lighter weight VM portal.
The workhorse of Oracle Linux Virtualization Manager is the engine (ovirt-engine) which is a JBoss-based Java application that runs as a web service and provides centralized management for server and desktop virtualization. The engine provides many features including:

- Managing the Oracle Linux KVM hosts
- Creating, deploying, starting, stopping, migrating, and monitoring virtual machines
- Adding and managing logical networks
- Adding and managing storage domains and virtual disks
• Configuring and managing cluster, host, and virtual machine high availability
• Migrating and editing live virtual machines
• Continuously balancing loads on virtual machines based on resource usage and policies
• Monitoring all objects in the environment such as virtual machines, hosts, storage, networks

The engine communicates with the Virtual Desktop and Server Manager (VDSM) service which is a host agent that runs as a daemon on the KVM compute hosts. The engine communicates directly with the VDSM service on Oracle Linux KVM hosts to perform tasks such as managing virtual machines and creating new images from templates.

The majority of tasks you can do through the Administration Portal. Additionally, you can perform a subset of tasks using the VM Portal or Cockpit.

**Host Architecture**

The oVirt engine runs on an Oracle Linux server and provides the administration tools for managing the Oracle Linux Virtualization Manager environment. Oracle Linux KVM hosts provide the compute resources for running virtual machines.

For more information, see Hosts.
Figure 1.2 Basic Host Architecture

As a loadable kernel module, KVM
Host Architecture

- provides full virtualization through the use of hardware extensions.
- allows a host to make its physical hardware available to virtual machines.
- runs in the kernel space and the virtual machines running on it run as individual QEMU processes in the user space.

QEMU enables KVM to become a complete hypervisor by emulating the hardware for the virtual machines, such as the CPU, memory, network, and disk devices.

KVM enables QEMU to execute code in the virtual machine directly on the host CPU. This allows a virtual machine's operating system direct access to the host's resources without any modification.

Host Agent and libvirt

The Virtual Desktop and Server Manager (VDSM) service is a host agent that covers all functionality required by the engine for managing hosts, virtual machines, networks and storage. All communication between the engine and the KVM hosts is handled by the VDSM service that runs on the KVM hosts.

The **libvirt daemon** runs as a service (**libvirtd**) on Oracle Linux KVM hosts and it provides an application programming interface (API) for managing various hypervisors, including Oracle Linux KVM. VDSM uses **libvirt** to manage the complete life cycle of virtual machines and their virtual devices on the host, and to collect statistics about them.

Guest Agent

The guest agent runs inside the VM, and provides information on resource usage to the oVirt engine. Communication between the guest agent and engine (oVirt engine) is done over a virtualized serial connection.

The guest agent provides:

- information, notifications, and actions between the engine and the guest.
- the guest machine name, guest operating system, and other details to the engine, including associated IP addresses, installed applications, and network and RAM usage.
- a single sign-on so an authenticated user to the engine does not need to authenticate again when connected to a virtual machine.
There are two Postgres databases in Oracle Linux Virtualization Manager. The engine configuration creates a PostgreSQL database called `engine`. If you elect to install the `ovirt-engine-dwh` package, a second database called `ovirt_engine_history` is created:

- The engine database (`engine`) stores persistent information about the state of the Oracle Linux Virtualization Manager environment, its configuration, and its performance. The historical configuration information and statistical metrics are collected every minute.
The data warehouse database is a management history database (ovirt_engine_history) that can be used by any application to retrieve historical configuration information and statistical metrics for data centers, clusters, and hosts.

The data warehouse service (ovirt-engine-dwd):
- extracts data from the engine database, performs ETL, and inserts it into the ovirt_engine_history database.
- tracks three types of changes:
  - When a new entity is added to the engine database, ovirt-engine-dwd service replicates the change to the ovirt_engine_history database.
  - When an existing entity is updated, ovirt-engine-dwd service replicates the change to the ovirt_engine_history database.
  - When an entity is removed from the engine database, a new entry in the ovirt_engine_history database flags the corresponding entity as removed.

Both the history and engine databases can run on a remote host to reduce the load on the engine host. Running these databases on a remote hosts are currently technology preview features, see Technology Preview.

Administration Interfaces

Oracle Linux Virtualization Manager provides two portals you can use to configure and manage your environment: Administration Portal and VM Portal.

The Administration Portal is the graphical administration interface of the oVirt Engine server. Administrators can monitor, create, and maintain all elements of the virtualized environment from web browsers. Tasks that can be performed from the Administration Portal include:
- Creation and management of virtual infrastructure (networks, storage domains)
- Installation and management of hosts
- Creation and management of logical entities (data centers, clusters)
- Creation and management of virtual machines
- oVirt user and permission management

The Cockpit web interface enables you to monitor a KVM compute host's resources and to perform administrative tasks. Cockpit must be installed and enabled separately. You can access a host's Cockpit web interface from the Administration Portal or by connecting directly to the host.

Directory Services

You can use Active Directory, OpenLDAP, and 389d as an external directory server to provide user account and authentication services. If an external directory server is being used, the oVirt engine uses these directory services to receive user and group information when assigning permissions for roles.

Consoles

You can use either Virtual Network Computing (VNC) or Remote Desktop Protocol (RDP) to provide graphical consoles for virtual machines. From the console, you can work and interact directly with your virtual machines as you would with physical machines.
VNC

When using VNC, either use the Remote Viewer application or a VNC client to open a console to a virtual machine.

RDP (Windows only)

RDP is only available when you access virtual machines from a Windows machine on which the Microsoft Remote Desktop application has been installed. You must also set up remote sharing on the virtual machine and ensure the firewall is configured to allow remote desktop connections before you can connect to a Windows virtual machine using RDP.

Figure 1.4 Client Consoles Connected to Linux KVM Host
Chapter 2 Prerequisites and Scalability Limits

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The following information provides detailed requirements for your Oracle Linux Virtualization Manager installation as well as scalability limitations.

Manager Host Requirements

The following are the minimum system requirements for Oracle Linux Virtualization Manager hosts:

- Oracle Linux 7 Update 6
  - Select Minimal Install as the base environment for the installation.
- Unbreakable Enterprise Kernel Release 5 Update 1 or later
- 64-bit dual-core CPU
  - Recommended: 64-bit quad core or greater CPU
- 4 GB RAM
  - Recommended: 16 GB or greater
- 1 network interface card (NIC) with bandwidth of at least 1 Gbps
  - Recommended: 2 or more NICs with bandwidth of at least 1 Gbps
- 25 GB local writable hard disk
  - Recommended: 50 GB or greater

For information about x86-based servers that are certified for Oracle Linux with UEK, see the Hardware Certification List for Oracle Linux and Oracle VM at https://linux.oracle.com/hardware-certifications.

For more details about system requirements and known issues with installation, see:

- The Oracle Linux 7 Installation Guide at https://docs.oracle.com/en/operating-systems/oracle-linux/7/install/.

Important

Oracle does not support Oracle Linux Virtualization Manager on systems where the ol7_preview, ol7_developer, ol7_developer_kvm_utils, or ol7_developer_EPEL repositories are enabled, or where software from these repositories is currently installed on the systems where the Manager will run. Even if you follow the instructions in this document, you may render your platform unsupported if these repositories or channels are enabled or software from these channels or repositories is installed on your system.
KVM Compute Host Requirements

The following are the minimum system requirements for Oracle Linux KVM compute hosts:

- Oracle Linux 7 Update 6 or later
  Select **Minimal Install** as the base environment for the installation.
- Unbreakable Enterprise Kernel Release 5 Update 1 or later
- 64-bit dual-core CPU
  **Recommended:** Multiple CPUs

The CPUs must support either the Intel VT-x or the AMD AMD-V hardware virtualization extensions and the extensions must be enabled in the host's BIOS. The CPUs must also support the No eXecute flag (NX).

- 2 GB RAM
  **Maximum Tested:** 2 TB

The amount of RAM required varies depending on guest operating system requirements, guest application requirements, and guest memory activity and usage.

- 1 network interface card (NIC) with bandwidth of at least 1 Gbps
  **Recommended:** 2 or more NICs with bandwidth of at least 1 Gbps

Multiple NICs are recommended so that NICs can be dedicated for network intensive activities, such as virtual machine migration.

- 45 GB local writable hard disk allocated as follows:

<table>
<thead>
<tr>
<th>Allocation</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ (root)</td>
<td>6 GB</td>
</tr>
<tr>
<td>/home</td>
<td>1 GB</td>
</tr>
<tr>
<td>/tmp</td>
<td>1 GB</td>
</tr>
<tr>
<td>/boot</td>
<td>1 GB</td>
</tr>
<tr>
<td>/var</td>
<td>15 GB</td>
</tr>
<tr>
<td>/var/log</td>
<td>8 GB</td>
</tr>
<tr>
<td>/var/log/audit</td>
<td>2 GB</td>
</tr>
<tr>
<td>swap</td>
<td>1 GB</td>
</tr>
</tbody>
</table>

Anaconda reserves 20% of the thin pool size within the volume group for future metadata expansion. This is to prevent an out-of-the-box configuration from running out of space under normal usage conditions. Oracle recommend using the default allocations which use more.

For information about x86-based servers that are certified for Oracle Linux with UEK, see the **Hardware Certification List for Oracle Linux and Oracle VM** at https://linux.oracle.com/hardware-certifications.

Do not install any third-party watchdogs on your Oracle Linux KVM compute hosts, as they can interfere with the watchdog daemon provided by VDSM.

Do not install any other applications on the Oracle Linux KVM compute hosts as they may interfere with the operation of the KVM hypervisor.

For more details about system requirements and known issues with installation, see:

Storage Requirements

- The Oracle Linux 7 Installation Guide at https://docs.oracle.com/en/operating-systems/oracle-linux/7/install/.

Storage Requirements

Before you can create virtual machines, you must provision and attach storage to a data center. You can use Network File System (NFS), Internet Small Computer System Interface (iSCSI), or Fibre Channel Protocol (FCP) storage. You can also configure local storage attached directly to hosts.

Storage devices in Oracle Linux Virtualization Manager are referred to as data domains, which are used to store virtual hard disks, snapshots, ISO files, and templates. Every data center must have at least one data domain. Data domains cannot be shared between data centers.

Scalability Limits

The following table shows the limits for the Oracle Linux Virtualization Manager host, Oracle Linux KVM hosts, networks, virtual machines and storage.

Table 2.1 Scalability Limits

<table>
<thead>
<tr>
<th>Component</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of logical CPUs on a Oracle Linux 7 host</td>
<td>384</td>
</tr>
<tr>
<td>Amount of memory on a Oracle Linux 7 host</td>
<td>2 TB</td>
</tr>
<tr>
<td>Number of servers managed by one Oracle Linux Virtualization Manager</td>
<td>64</td>
</tr>
<tr>
<td>Number of VLANs managed by one Oracle Linux Virtualization Manager</td>
<td>1024</td>
</tr>
<tr>
<td>Number of concurrently running VMs</td>
<td>5000</td>
</tr>
<tr>
<td>Number of concurrently running VMs on a single Oracle Linux 7 host</td>
<td>600, depending on the performance of the host</td>
</tr>
<tr>
<td>Number of virtual CPUs in a VM</td>
<td>256</td>
</tr>
<tr>
<td>Amount of virtual RAM in a VM</td>
<td>2 TB</td>
</tr>
<tr>
<td>Number of LUNs attached to same number of VMs</td>
<td>300</td>
</tr>
<tr>
<td>Number of SAN data domains attached to a single data center</td>
<td>100</td>
</tr>
</tbody>
</table>

Guest Operating System Requirements

The following guest operating systems are tested with Oracle Linux Virtualization Manager.

Linux Guest Operating Systems

- Oracle Linux 7 Update 6 64-bit
- Oracle Linux 6 Update 10 32-bit or 64-bit, cloud-init is not available for this OS
- Oracle Linux 5 Update 11 64-bit, cloud-init is not available for this OS
• CentOS 7.1804 64-bit

• CentOS 6.10 32-bit or 64-bit, cloud-init is not available for this operating system

• Red Hat Enterprise Linux 7 Update 6 64-bit

• Red Hat Enterprise Linux 6 Update 10 32-bit or 64-bit, cloud-init is not available for this OS

• Red Hat Enterprise Linux 5 Update 11 32-bit or 64-bit, cloud-init is not available for this OS

You can download Oracle Linux ISO images and disk images from Oracle Software Delivery Cloud: https://edelivery.oracle.com/linux.

Microsoft Windows Guest Operating Systems

• Microsoft Windows Server 2016 64-bit

• Microsoft Windows Server 2012 R2 64-bit

• Microsoft Windows Server 2012 64-bit

• Microsoft Windows Server 2008 R2 SP1 64-bit

• Microsoft Windows Server 2008 SP1 32-bit or 64-bit

• Microsoft Windows 10 32-bit or 64-bit

• Microsoft Windows 8.1 32-bit or 64-bit

• Microsoft Windows 8 32-bit or 64-bit

• Microsoft Windows 7 SP1 32-bit or 64-bit

Oracle recommends that you install the Oracle VirtIO Drivers for Microsoft Windows in Windows guest OSes for improved performance for network and block (disk) devices and to resolve common issues. The drivers are paravirtualized drivers for Microsoft Windows guests running on Oracle Linux KVM hypervisors. For instructions on how to obtain and install the drivers, see Oracle VirtIO Drivers for Microsoft Windows in the Oracle Linux 7 Administration Guide.
Chapter 3 Planning Your Environment

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Before you install Oracle Linux Virtualization Manager, review this section to help you to plan your deployment. For more information about the virtualization management platform, see Chapter 1, Architecture.

Data Centers

A data center is a high-level logical entity for all physical and logical resources in the environment. You can have multiple data centers and all the data centers are controlled from a single Administration Portal. For more information, see Creating a New Data Center.

When you install Oracle Linux Virtualization Manager, a default data center (Default), which you can rename and configure. You can also create and configure additional data centers. To initialize any data center, you must add a cluster, a host, and a storage domain:

• Cluster

  A cluster is an association of physical hosts sharing the same storage domains and having compatible processors. Every cluster belongs to a data center; every host belongs to a cluster. A cluster has to have a minimum of one host, and at least one active host is required to connect the system to a storage pool.

• Host

  Hosts, or hypervisors, are the physical servers that run virtual machines (VMs). You must have at least one host in a cluster.

• Storage Domain

  Data centers must have at least one data storage domain. Set up the data storage domain of the type required for the data center: NFS, iSCSI, FCP or Local.
Logical networks are not required to initialize a data center, but are required for Oracle Linux Virtualization Manager to communicate with all components of a data center. Logical networks are also used for the virtual machines to communicate with hosts and storage, for connecting clients to virtual machine resources, and for migrating virtual machines between the hosts in a cluster.

Figure 3.1 Data Center

Clusters

A cluster consists of one or more logical grouping of Oracle Linux KVM Kernel-based Virtual Machine (KVM) hosts on which a collection of virtual machines can run. The KVM hosts in a cluster must share the same storage domains and have the same type of CPU (either Intel or AMD).

Each cluster in the environment must belong to a data center and each KVM host must belong to a cluster. During installation, a default cluster is created in the Default data center. For more information, see Creating a New Cluster.

Virtual machines are dynamically allocated to any KVM host in the cluster and can be migrated between them, according to policies defined on the cluster and settings on the virtual machines. The cluster is the highest level at which power and load-sharing policies can be defined. Since virtual machines are not bound to any specific host in the cluster, virtual machines always start even if one or more of the hosts are unavailable.
Figure 3.2 Single Cluster

Cluster A

Oracle Linux KVM Hosts

- VDSM
  - Guest Agent
  - Win/Linux VM
  - Local Storage

- VDSM
  - Guest Agent
  - Win/Linux VM
  - Local Storage

- VDSM
  - Guest Agent
  - Win/Linux VM
  - Local Storage

Storage Server

- Storage Domain A
- Storage Domain B
- Storage Domain C
In Oracle Linux Virtualization Manager, you install Oracle Linux 7 Update 6 (or later) on a bare metal (physical) server and leverage the Unbreakable Enterprise Kernel Release 5, which allows the server to be used as a KVM hypervisor. When you are running a hypervisor on a server it is referred to as a **host** meaning it is capable of hosting virtual machines.

The engine host is a separate physical host and provides the administration tools for managing the Oracle Linux Virtualization Manager environment. All hosts in your environment must be Oracle Linux KVM hosts, except for the host running the engine which is an Oracle Linux hosts.

Oracle Linux Virtualization Manager can manage a maximum of 64 Oracle Linux KVM hosts, each of which can run multiple VMs concurrently. Each VM runs as individual Linux processes and threads on the KVM host and can be installed either with a Windows or Linux operating system.

Using the Administration Portal you can install, configure and manage your KVM hosts. You can also use the **Cockpit web interface** to monitor a KVM host's resources and perform administrative tasks. The Cockpit feature must be installed and enabled separately. You can access a host's Cockpit web interface from the Administration Portal or by connecting directly to the host.
Virtual Machines

The Virtual Desktop and Server Manager (VDSM) service is a host agent that runs as a daemon on the KVM compute hosts and communicates with the engine to:

- manage and monitor physical resources, including storage, memory, and networks.
- manage and monitor the virtual machines running on a host.
- gather statistics and collects logs.

For more information, see Host Architecture and Adding a KVM Compute Host to the Manager.

Virtual Machines

Virtual machines can be created for either Linux or Windows operating systems. They can be created to a certain specification or cloned from an existing template in the virtual machine pools. For more information, see Creating a New Virtual Machine and Creating a Template.

- A **virtual machine pool** is a group of on-demand virtual machines that are all clones of the same template. They are available to any user in a given group.

  When accessed from the VM Portal, virtual machines in a pool are stateless, meaning that data is not persistent across reboots. Each virtual machine in a pool uses the same backing read-only image, and uses a temporary copy-on-write image to hold changed and newly generated data. Each time a virtual machine is assigned from a pool, it is allocated in its base state. Users who have been granted permission to access and use virtual machines from a pool receive an available virtual machine based on their position in a queue of requests.

  When accessed from the Administration Portal, virtual machines in a pool are not stateless so that administrators can make changes to the disk if needed.

- **Guest agents and drivers** provide functionality for virtual machines such as the ability to monitor resource usage, shutdown and reboot the virtual machines from the Administration Portal.

- A **snapshot** captures a virtual machine’s operating system and applications on all available disks at a given point in time. Use a snapshot to restore a virtual machine to its previous state.

- A **template** is a copy of a virtual machine that you can use to simplify the subsequent, repeated creation of similar virtual machines. Templates capture the configuration of software, the configuration of hardware, and the software installed on the virtual machine on which the template is based, which is known as the source virtual machine.

  Virtual machines that are created based on a template use the same NIC type and driver as the original virtual machine but are assigned separate, unique MAC addresses.

- **Instance types** are pre-defined hardware configuration for a virtual machine. There are several instance types included by default for you to use when creating or editing a virtual machine which automatically fills in the hardware configuration fields. You can configure new instance types at the data center level or modify the default instance types.

  Whether you are using a default or custom instance type, you can create multiple virtual machines with the same hardware configuration without having to manually fill in every field. However, you always have the option of entering a custom configuration when creating or editing a VM that applies only to that VM.

You access virtual machine consoles using the **Remote Viewer application** (*virt-viewer*) on Enterprise Linux and Microsoft Windows clients. Remote Viewer allows you to interact with a virtual machine in a similar way to a physical machine. For more information, see Consoles.
To download Remote Viewer, click Console Client Resources in the Downloads section on the Oracle Linux Virtualization Manager Welcome page. You must have Administrator privileges to install the Remote Viewer application.

High Availability and Optimization

You can configure Oracle Linux Virtualization Manager so that your cluster is optimized and your hosts and virtual machine are highly available. You can also enable or disable devices (hot plug) while a virtual machine is running.

Clusters
Using the Optimization tab when creating or editing a cluster, you can select the memory page sharing threshold for the cluster, and optionally enable CPU thread handling and memory ballooning on the hosts in the cluster. Some of the benefits are:

• Virtual machines run on hosts up to the specified overcommit threshold. Higher values conserve memory at the expense of great CPU usage.

• Hosts can run virtual machines with a total number of CPU cores greater than the number of cores in the host.

• Memory overcommitment on virtual machines running on the hosts in the cluster.

• Memory Overcommitment Manager (MoM) runs Kernel Same-page Merging (KSM) when it can yield a memory saving benefit.

You can set cluster optimization for the MoM to start ballooning where and when possible, with a limitation of the guaranteed memory size of every virtual machine. To have a ballooning running, a virtual machine needs to have a balloon device with relevant drivers. Each virtual machine includes a balloon device unless specifically removed. Each host in the cluster receives a balloon policy update when its status changes to Up. If necessary, you can manually update the balloon policy on a KVM compute host without having to change the status.

Hosts
Fencing keeps hosts in a cluster highly available and allows a cluster to react to unexpected host failures and enforce power saving, load balancing, and VM availability policies. To make an Oracle Linux KVM compute host highly available, power management and fencing must be configured. This enables the engine to keep the hosts in a cluster up and running by reacting to host failures. If a KVM compute host becomes non-responsive, it is rebooted. If it remains non-responsive manual intervention needs to be taken.

You need at least two KVM compute hosts in a cluster or data center that are in Up or Maintenance status to ensure they are connected to the Manager.

You can select between:

• Any host in the same cluster as the host requiring fencing.

• Any host in the same data center as the host requiring fencing.

A viable fencing proxy host has a status of either Up or Maintenance.

If power management is not enabled, you can restart or stop a KVM compute host from the Administration Portal.

The engine uses a proxy to send power management commands to a host power management device because the engine does not communicate directly with fence agents. The host agent
(VDSM) executes power management device actions and another host in the environment is used as a fencing proxy. This is why you must have at least two hosts for power management operations.

After you configure the fencing parameters for your host’s power management device you should test their correctness occasionally.

Each KVM compute host in a cluster has limited resources. If a KVM compute host becomes overutilized, there is an adverse impact on the virtual machines that are running on the host. To avoid or mitigate overutilization, you use scheduling, load balancing, and migration policies to ensure the performance of virtual machines. If a KVM compute host becomes overutilized, VMs are migrated to another KVM compute host in the cluster.

Important

If a host runs virtual machines that are highly available, power management must be enabled and configured.

Virtual Machines

A highly available virtual machine automatically live migrates to another host in the cluster if the host crashes or becomes non-operational. Only VMs with high availability are restarted on another host. If the VM’s host is manually shut down, the VM does not automatically live migrate to another host.

Note

Live migration is only available if you use shared storage.

Using the Resource Allocation tab when creating or editing a VM, you can:

• set the maximum amount of processing capability a VM can access on its host.
• pin a virtual CPU to a specific physical CPU.
• guarantee an amount of memory for the VM.
• enable the memory balloon device for the VM. (Enable Memory Balloon Optimization must also be selected for the cluster.)
• improve the speed of disks that have a VirtIO interface by pinning them to a thread separate from the VM's other functions.

When a KVM compute host goes into Maintenance mode, all VMs are migrated to other servers in the cluster. This mean there is no downtime for virtual machines during planned maintenance windows.

If a virtual machine is unexpectedly terminated, it is automatically restarted, either on the same KVM compute host or another host in the cluster. This is achieved through monitoring of the hosts and storage to detect any hardware failures. If you configure a virtual machine for high availability and its host fails, the VM automatically restarts on another KVM compute host in the cluster.

Policies

Load balancing, scheduling, and resiliency policies, enable critical VMs to be restarted on another KVM compute host in the event of hardware failure with three levels of priority.

Scheduling policies enable you to specify the usage and distribution of virtual machines between available hosts. You can define the scheduling policy to enable automatic load
balancing across the hosts in a cluster. Regardless of the scheduling policy, a virtual machine does not start on a host with an overloaded CPU. By default, a host’s CPU is considered overloaded if it has a load of more than 80% for 5 minutes, but these values can be changed using scheduling policies. For more information, see .

Migration policies enable you to define the conditions for live migrating virtual machines in the event of KVM compute host failure. These conditions include the downtime of the virtual machine during migration, network bandwidth, and how the virtual machines are prioritized.

Resilience policies enable you to define how the virtual machines are prioritized in migration.

For more information about high availability and optimization, see Deployment Optimization.

Networks

The following are general, high-level networking recommendations.

- Use bond network interfaces, especially on production hosts
- Use VLANs to separate different traffic types
- Use 1 GbE networks for management traffic
- Use 10 GbE, 25 GbE, 40 GbE, or 100 GbE for virtual machines and Ethernet-based storage
- When adding physical interfaces to a host for storage use, uncheck VM network so that the VLAN is assigned directly to the physical interface

The Oracle Linux Virtualization Manager host and all Oracle Linux KVM hosts must have a fully qualified domain name (FQDN) as well as forward and reverse name resolution. Oracle recommend using DNS. Alternatively, you can use the /etc/hosts file for name resolution, however, this requires more work and is error-prone.

All DNS services used for name resolution must be hosted outside of the environment.

Logical Networks

In Oracle Linux Virtualization Manager, you configure logical networks to represent the resources required to ensure the network connectivity of the Oracle Linux KVM compute hosts for a specific purpose, for example to indicate that a network interface controller (NIC) is on a management network.

You define a logical network for a data center, apply the network to one or more clusters, and then configure the hosts by assigning the logical networks to the hosts physical interfaces. Once you implement the network on all the hosts in a cluster, the network becomes operational. You perform all these operations from the Administration Portal.

At the cluster level, you can assign one or more network roles to a logical network to specify its purpose:

- A management network is used for communication between Oracle Linux Virtualization Manager and the hosts.
- A VM network is used for virtual machine communication, a virtual machine's virtual NIC is attached to a VM network. For more information, see Creating a Virtual Machine Network.
- A display network is used to connect clients to virtual machine graphical consoles, using either the VNC or RDP protocols.
• A **migration network** is used to migrate virtual machines between the hosts in a cluster.

By default a single logical network named **ovirtmgmt** is created and this is used for all network communication in a data center. You separate the network traffic according to your needs by defining and applying additional logical networks.

One logical network is configured as the default route for the hosts.

A logical network can be marked as a required network. If a required network ceases to function, any KVM compute hosts associated with the network become non-operational.

For logical networks that are **not** VM networks, you connect the host directly to the network using either a physical network interface, a VLAN interface, or a bond.

For VM networks, a bridge is created on the host for each logical network. Virtual machine VNICs are connected to the bridges as needed. The bridge is connected to the network using either a physical network interface, a VLAN interface, or a bond.
Figure 3.4 Bridge Networks
You can perform most network configuration operations on hosts from the Administration Portal, including:

- Assign a host NIC to logical networks.
- Configure a NIC’s boot protocol, IP settings, and DNS settings.
- Create bonds and VLAN interfaces on KVM compute hosts.

When there are a large number of KVM compute hosts and logical networks, using network labels enables you to simplify administration. Labels can be applied to logical networks and host interfaces. When you set a label on a network, you to deploy the network on host NICs that have the same label. This requires that the host NICs are configured for DHCP.

**VLANs**

A virtual local area network (VLAN) enables hosts and virtual machines to communicate regardless of their actual physical location on a LAN.

VLANs enable you improve security by segregating network traffic. Broadcasts between devices in the same VLAN are not visible to other devices with a different VLAN, even if they exist on the same switch.

VLANs can also help to compensate for the lack of physical NICs on hosts. A host or virtual machine can be connected to different VLANs using a single physical NIC or bond. This is implemented using VLAN interfaces.

A VLAN is identified by an ID. A VLAN interface attached to a host’s NIC or bond is assigned a VLAN ID and handles the traffic for the VLAN. When traffic is routed through the VLAN interface, it is automatically tagged with the VLAN ID configured for that interface, and is then routed through the NIC or bond that the VLAN interface is attached to.

The switch uses the VLAN ID to segregate traffic among the different VLANs operating on the same physical link. In this way, a VLAN functions exactly like a separate physical connection.

You need to configure the VLANs needed to support your logical networks before you can use them. This is usually accomplished using switch trunking. Trunking involves configuring ports on the switch to enable multiple VLAN traffic on these ports, to ensure that packets are correctly transmitted to their final destination. The configuration required depends on the switches you use.

When you create a logical network, you can assign a VLAN ID to the network. When you assign a host NIC or bond to the network, the VLAN interface is automatically created on the host and attached to the selected device.
Figure 3.5 VLANs
Figure 3.6 VLANs over Network Bonds
**Virtual NICs**

A virtual machine uses a virtual network interface controller (VNIC) to connect to a logical network.

VNICS are always attached to a bridge on a KVM compute host. A bridge is a software network device that enables the VNICS to share a physical network connection and to appear as separate physical devices on a logical network.

Oracle Linux Virtualization Manager automatically assigns a MAC address to a VNIC. Each MAC address corresponds to a single VNIC. Because MAC addresses must be unique on a network, the MAC addresses are allocated from a predefined range of addresses, known as a MAC address pool. MAC address pools are defined for a cluster.

Virtual machines are connected to a logical network by their VNICS. The IP address of each VNIC can be set independently, by DHCP or statically, using the tools available in the operating system of the virtual machine. To use DHCP, you need to configure a DHCP server on the logical network.

Virtual machines can communicate with any other machine on the virtual network, and, depending on the configuration of the logical network, with public networks such as the Internet.

For more information, see Customizing vNIC Profiles for Virtual Machines.

**Bonds**

Bonds bind multiple NICs into a single interface. A bonded network interface combines the transmission capability of all the NICs included in the bond and acts as a single network interface, which can provide greater transmission speed. Because all network interface cards in the bond must fail for the bond itself to fail, bonding provides increased fault tolerance.
Figure 3.7 Network Bonds

Oracle Linux KVM Host 1

VM 1

VM 2

Bridge E

Bond

NIC

NIC

Logical Network E

Oracle Linux KVM Host 2

VM 3

VM 4

Bridge E

Bond

NIC

NIC

Bridge F

Bond

NIC

NIC

Logical Network F
MAC Address Pools

MAC address pools define the range (or ranges) of MAC addresses allocated for each cluster. A MAC address pool is specified for each cluster. By using MAC address pools, the Manager can automatically generate and assign MAC addresses to new virtual network devices, which helps to prevent MAC address duplication. MAC address pools are more memory efficient when all MAC addresses related to a cluster are within the range for the assigned MAC address pool.

The same MAC address pool can be shared by multiple clusters, but each cluster has a single MAC address pool assigned. A default MAC address pool is created by the Manager and is used if another MAC address pool is not assigned.

Note
If more than one cluster shares a network, you should not rely solely on the default MAC address pool because the virtual machines in each cluster attempt to use the same range of MAC addresses, which can lead to conflicts. To avoid MAC address conflicts, check the MAC address pool ranges to ensure that each cluster is assigned a unique MAC address range.

The MAC address pool assigns the next available MAC address after the last address that is returned to the pool. If there are no further addresses left in the range, the search starts again from the beginning of the range. If there are multiple MAC address ranges with available MAC addresses defined in a single MAC address pool, the ranges take turns in serving incoming requests in a similar manner as when MAC addresses are selected.

Storage

Oracle Linux Virtualization Manager uses a centralized storage system for virtual machine disk images, ISO files and snapshots. You can use Network File System (NFS), Internet Small Computer System Interface (iSCSI), or Fibre Channel Protocol (FCP) storage. You can also configure local storage attached directly to hosts. For more information, see Adding Storage and Storage.

A data center cannot be initialized unless a storage domain is attached to it and activated.

The storage must be located on the same subnet as the Oracle Linux KVM hosts that will use the storage, in order to avoid issues with routing.

Since you need to create, configure, attach and maintain storage, make sure you are familiar with the storage types and their use. Read your storage array manufacturer guides for more information.

Storage Domains

A storage domain is a collection of images that have a common storage interface. A storage domain contains complete images of templates, VMs, VM snapshots, or ISO files. Oracle Linux Virtualization Manager supports storage domains that are block devices (SAN - iSCSI or FCP) or a file system (NAS - NFS).

On NFS, all virtual disks, templates, and snapshots are files. On SAN (iSCSI/FCP), each virtual disk, template or snapshot is a logical volume.

Virtual machines that share the same storage domain can be migrated between hosts that belong to the same cluster.

Storage, also referred to as a data domain, is used to store the virtual hard disks, snapshots, ISO files, and Open Virtualization Format (OVF) files for virtual machines and templates. Every data center must have at least one data domain. Data domains cannot be shared between data centers.
Storage Pool Manager

Note

The Administration Portal currently offers options for creating storage domains that are export domains or ISO domains. These options are deprecated.

Detaching a storage domain from a data center stops the association, but does not remove the storage domain from the environment. A detached storage domain can be attached to another data center. And, the data, such as VMs and templates, remains attached to the storage domain.

Storage Pool Manager

The Storage Pool Manager (SPM) is a management role assigned to one of the hosts in a data center enabling it to manage the storage domains of the data center. Any host in the data center can run the SPM entity, which is assigned by the engine. SPM controls access to storage by coordinating the metadata across the storage domains. This includes creating,Deleting, and manipulating virtual disks (images), snapshots, and templates, and allocating storage for sparse block devices (on SAN).

The host running as SPM can still host virtual resources. The SPM priority setting for hosts enables you to prioritize which host is assigned the SPM role. Since the SPM role uses some of the host's available resources, it is important to prioritize hosts that can afford the resources.

Because the SPM must always be available, the engine assigns the SPM role to another host if the SPM host becomes unavailable. A host with higher SPM priority is assigned the SPM role before a host with lower SPM priority.

Virtual Machine Storage

The Storage Pool Manager (SPM) is responsible for creating and deleting virtual disks, as well as snapshots, and templates. In addition it allocates storage for sparse block devices.

• If you are using NFS or local storage, the SPM creates a thin provisioned virtual disk by default.

• If you are using iSCSI storage or other block-based devices, Logical Unit Numbers (LUNs) are provided to the SPM. Then, a volume group on top of the LUNs and logical volumes for use as virtual machine disks are created and the SPM preallocates the space by default.

• If a virtual disk is thinly-provisioned, a 1 GB logical volume is created with a QCOW2 format. Use thin provisioning for virtual machines with low I/O requirements.

• The VM's host continuously monitors the logical volume used for its virtual disk. You can set a threshold so that when the disk usage nears the threshold the host notifies the SPM and extends the logical volume by 1 GB.

• If the storage in a pool starts to become exhausted, a new LUN can be added to the volume group. The SPM automatically distributes the additional storage to logical volumes that need it.

• If a virtual disk is preallocated, a logical volume of the specified size in GB and a virtual disk of RAW format is created. Use preallocated disks for virtual machines with high levels of I/O. Preallocated disks cannot be enlarged.

• If an application requires storage to be shared between virtual machines, use Shareable virtual disks which can be attached to multiple virtual machines concurrently.

QCOW2 format virtual disks cannot be shareable. You cannot take a snapshot of a shared disk and virtual disks that have snapshots that cannot be marked shareable. You cannot live migrate a shared disk.

If the VMs are not cluster-aware, mark shareable disks as read-only to avoid data corruption.
Storage Leases

- Use direct LUN to enable virtual machines to directly access RAW block-based storage devices on the host bus adapter (HBA). The mapping of the direct LUN to the host causes the storage to be emulated as file-based storage to virtual machines. This removes a layer of abstraction between virtual machines and their data as the virtual machine is being granted direct access to block-based storage LUNs.

Storage Leases

When you add a storage domain to Oracle Linux Virtualization Manager, a special volume is created called xleases volume. Virtual machines are able to acquire a lease on this special volume, which enables the VM to start on another host even if the original host loses power.

A storage lease is configured automatically for the VM when you select a storage domain to hold the VM lease. (See Configuring a Highly Available Virtual Machine.)

This triggers a "create a new lease" request to the engine which then send the request to the SPM. The SPM creates a lease and a lease id for the VM on the xreleases volume. VDSM creates the sanlock which is used to acquire an exclusive lock on a virtual disk.

The lease id and other information is then sent from the SPM to the ovirt engine. The engine then updates the VM's device list with the lease information.

Local Storage

Local storage is storage that is attached directly to an Oracle Linux KVM compute host, such as a local physical disk or a locally attached SAN.

When a KVM compute host is configured to use local storage, it is automatically added to a cluster where it is the only host. This is because clusters with multiple hosts must have shared storage domains accessible to all hosts.

When you use local storage, features such as live migration, scheduling, and fencing are not available.

For more information, see Configuring a KVM Compute Host to Use Local Storage.

System Backup and Recovery

You use the `engine-backup` tool to take regular backups of the Oracle Linux Virtualization Manager. The tool backs up the `engine` database and configuration files into a single file and can be run without interrupting the `ovirt-engine` service.

You also use the `engine-backup` tool to restore a backup. However, the steps you need to take can be more involved depending on your restoration destination. For example, the `engine-backup` tool can be used to restore backups to fresh installations of Oracle Linux Virtualization Manager, on top of existing installations of Oracle Linux Virtualization Manager, and using local or remote databases.

If you restore a backup to a fresh installation of Oracle Linux Virtualization Manager, you do not run the `engine-setup` command to configure the Manager.

You can also use data center recovery if the data in your master data domain gets corrupted. This enables you to replace the master data domain of a data center with a new master data domain.

Reinitializing a data center enables you to restore all other resources associated with the data center, including clusters, hosts, and storage domains. You can import any backup or exported virtual machines or templates into the new master data domain.

For more information, see Backing Up and Restoring the Manager.
Users, Roles, and Permissions

In Oracle Linux Virtualization Manager, there are two types of user domains: local domain and external domain. During the installation of the Manager, a default local domain called the internal domain is created with a default admin@internal user. This account is intended for use when initially configuring the environment and for troubleshooting.

You can create additional users on the internal domain using ovirt-aaa-jdbc-tool command utility. For more information about creating users, see Administering User and Group Accounts from the Command Line.

User properties consist of the roles and permissions assigned to a user. The security roles for all actions and objects in the platform are granular, inheritable, and provide for multi-level administration.

Roles are sets of permissions defined in the Administration Portal and are used to specify permissions to resources in the environment. There are two types of roles:

- **Administrator Role**
  Conveys management permissions of physical and virtual resources through the Administration Portal. Examples of roles within this group are SuperUser, ClusterAdmin and DataCenterAdmin.

- **User Role**
  Conveys permissions for managing and accessing virtual machines and templates through the VM Portal by filtering what is visible to a user. Roles can be assigned to the users for individual resources, or levels of objects. Examples of roles within this group are UserRole, PowerUserRole and UserVmManager.

It is possible to create new roles with specific permissions applicable to a user's role within the environment. It is also possible to remove specific permissions to a resource from a role assigned to a specific user.

You can also use an external directory server to provide user account and authentication services. You can use Active Directory, OpenLDAP, and 389ds. Use the ovirt-engine-extension-aaa-ldap-setup command to configure the connection to these directories.

**Note**

After you have attached an external directory server, added the directory users, and assigned them with appropriate roles and permissions, the admin@internal user can be disabled if it is not required. For more information, see Disabling User Accounts.

For more information on users, roles, and permissions, see Global Configuration.

System State and History

When you install and configure Oracle Linux Virtualization Manager, you are prompted to install and configure the engine and data warehouse PostgreSQL databases. See Manager Configuration Options.

- The engine database (engine) stores information about the state of the Oracle Linux Virtualization Manager environment and its configuration and performance.

- The data warehouse database is a management history database (ovirt_engine_history) that can be used by any application to retrieve historical configuration information and statistical metrics for data centers, clusters, and hosts.
Event Logging and Notifications

The data warehouse service (ovirt-engine-dwd) extracts data from the engine database and loads it into the ovirt_engine_history database. This is commonly known as ETL (extract, transform, load).

Both the history and engine databases can run on a remote host to reduce the load on the Manager host. Running these databases on a remote hosts are currently technology preview features, see Technology Preview.

For more information, see Data Warehouse and Databases.

Event Logging and Notifications

Oracle Linux Virtualization Manager captures events in the following log files:

- /var/log/ovirt-engine/engine.log contains all Oracle Linux Virtualization Manager UI crashes, Active Directory lookups, database issues, and other events.
- /var/log/vdsm/vdsm.log is the log file for VDSM, the engine’s agent on the virtualization host(s), and contains host-related events.

Within the Administration Portal, you can also view Alerts and Events in the Notification Drawer, which you can access by clicking Bell icon in the upper-right corner.

The ovirt-log-collector tool enables you to collect relevant logs from across the environment. To use the tool, you must log into the Oracle Linux Virtualization Manager host as the root user and log into the Administration Portal with administration credentials.

The tool collects all logs from the Manager host, the Oracle Linux KVM hosts it manages, and the database.

Oracle Linux Virtualization Manager provides event notification services that allow you to configure the Engine to notify designated users by email when certain events occur or to send Simple Network Management Protocol (SNMP) traps to one or more external SNMP manager with system event information to monitor your virtualization environment.

For more information about configuring event notifications, see Event Logging and Notifications.