Introduction to VMware vSphere

Update 1
ESX 4.0
ESXi 4.0
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About This Book

Introduction to VMware vSphere provides information about the features and functionality of VMware® vSphere.

Introduction to VMware vSphere covers ESX, ESXi, and vCenter Server.

Intended Audience

This information is intended for anyone who needs to familiarize themselves with the components and capabilities of VMware vSphere. This information is for experienced Windows or Linux system administrators who are familiar with virtual machine technology and datacenter operations.

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VMware vSphere Documentation

The VMware vSphere documentation consists of the combined VMware vCenter Server and ESX/ESXi documentation set.

Abbreviations Used in Figures

The figures in this manual use the abbreviations listed in Table 1.

Table 1. Abbreviations

Abbreviation	Description
database	vCenter Server database
datastore	Storage for the managed host
dsk#	Storage disk for the managed host
hostn	vCenter Server managed hosts
SAN	Storage area network type datastore shared between managed hosts
tmplt	Template
user#	User with access permissions
VC	vCenter Server
VM#	Virtual machines on a managed host

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VMware vSphere Introduction

VMware vSphere leverages the power of virtualization to transform datacenters into simplified cloud computing infrastructures and enables IT organizations to deliver flexible and reliable IT services. VMware vSphere virtualizes and aggregates the underlying physical hardware resources across multiple systems and provides pools of virtual resources to the datacenter.

As a cloud operating system, VMware vSphere manages large collections of infrastructure (such as CPUs, storage, and networking) as a seamless and dynamic operating environment, and also manages the complexity of a datacenter. The following component layers make up VMware vSphere:

Infrastructure Services Infrastructure Services are the set of services provided to abstract, aggregate, and allocate hardware or infrastructure resources. Infrastructure Services can be categorized into:

- VMware vCompute—the VMware capabilities that abstract away from underlying disparate server resources. vCompute services aggregate these resources across many discrete servers and assign them to applications.

- VMware vStorage—the set of technologies that enables the most efficient use and management of storage in virtual environments.

- VMware vNetwork—the set of technologies that simplify and enhance networking in virtual environments.

Application Services Application Services are the set of services provided to ensure availability, security, and scalability for applications. Examples include HA and Fault Tolerance.

VMware vCenter Server VMware vCenter Server provides a single point of control of the datacenter. It provides essential datacenter services such as access control, performance monitoring, and configuration.

Clients Users can access the VMware vSphere datacenter through clients such as the vSphere Client or Web Access through a Web browser.

Figure 1 shows the relationships between the component layers of VMware vSphere.

Figure 1. VMware vSphere
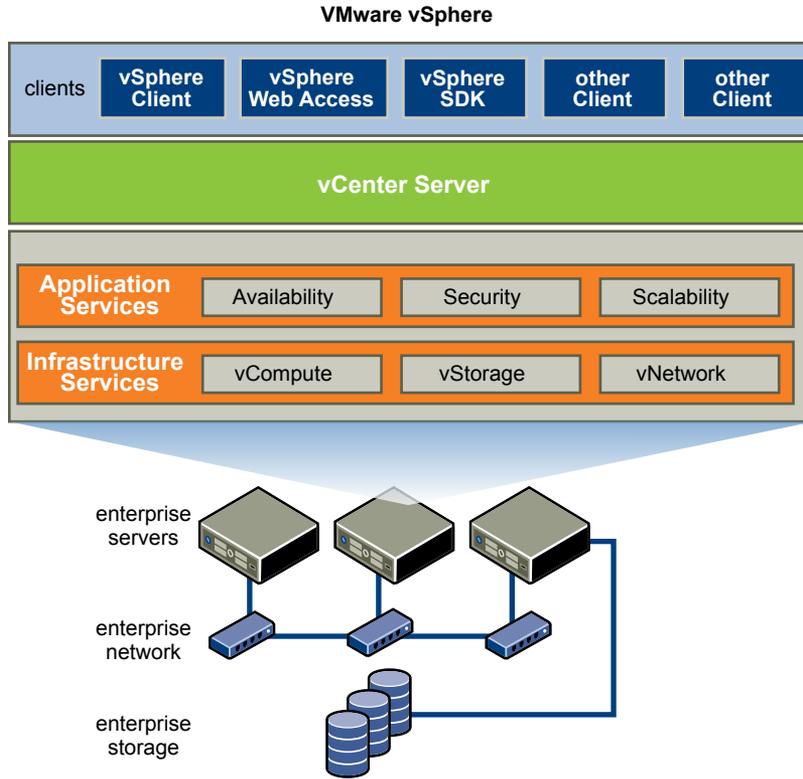
VMware vSphere Components

This topic introduces the components of VMware vSphere.

VMware vSphere includes the following components:

VMware® ESX and VMware® ESXi	A virtualization layer run on physical servers that abstracts processor, memory, storage, and resources into multiple virtual machines.
	Two versions of ESX are available:
	■ VMware ESX 4.0 contains a built-in service console. It is available as an installable CD-ROM boot image.
	■ VMware ESXi 4.0 does not contain a service console. It is available in two forms: VMware ESXi 4.0 Embedded and VMware ESXi 4.0 Installable. ESXi 4.0 Embedded is firmware that is built into a server's physical hardware. ESXi 4.0 Installable is software that is available as an installable CD-ROM boot image. You install the ESXi 4.0 Installable software onto a server's hard drive.
VMware® vCenter Server	The central point for configuring, provisioning, and managing virtualized IT environments.
VMware® vSphere Client	An interface that allows users to connect remotely to vCenter Server or ESX/ESXi from any Windows PC.
VMware® vSphere Web Access	A Web interface that allows virtual machine management and access to remote consoles.

VMware® Virtual Machine File System (VMFS)	A high performance cluster file system for ESX/ESXi virtual machines.
VMware® Virtual SMP	Feature that enables a single virtual machine to use multiple physical processors simultaneously.
VMware® VMotion and Storage VMotion	VMware VMotion enables the live migration of running virtual machines from one physical server to another with zero down time, continuous service availability, and complete transaction integrity. Storage VMotion enables the migration of virtual machine files from one datastore to another without service interruption. You can choose to place the virtual machine and all its disks in a single location, or select separate locations for the virtual machine configuration file and each virtual disk. The virtual machine remains on the same host during Storage VMotion. Migration with VMotion - Moving a powered-on virtual machine to a new host. Migration with VMotion allows you to move a virtual machine to a new host without any interruption in the availability of the virtual machine. Migration with VMotion cannot be used to move virtual machines from one datacenter to another. Migration with Storage VMotion - Moving the virtual disks or configuration file of a powered-on virtual machine to a new datastore. Migration with Storage VMotion allows you to move a virtual machine's storage without any interruption in the availability of the virtual machine.
VMware® High Availability (HA)	Feature that provides high availability for applications running in virtual machines. If a server fails, affected virtual machines are restarted on other production servers that have spare capacity.
VMware® Distributed Resource Scheduler (DRS)	Feature that allocates and balances computing capacity dynamically across collections of hardware resources for virtual machines. This feature includes distributed power management (DPM) capabilities that enable a datacenter to significantly reduce its power consumption.
VMware® Consolidated Backup (Consolidated Backup)	Feature that provides a centralized facility for agent-free backup of virtual machines. It simplifies backup administration and reduces the impact of backups on ESX/ESXi performance.
VMware® vSphere SDK	Feature that provides a standard interface for VMware and third-party solutions to access the VMware vSphere.
VMware® Fault Tolerance	When Fault Tolerance is enabled for a virtual machine, a secondary copy of the original (or primary) virtual machine is created. All actions completed on the primary virtual machine are also applied to the secondary virtual machine. If the primary virtual machine becomes unavailable, the secondary machine becomes active, providing continual availability.
vNetwork Distributed Switch (DVS)	Feature that includes a distributed virtual switch (DVS), which spans many ESX/ESXi hosts enabling significant reduction of on-going network maintenance activities and increasing network capacity. This allows virtual machines to maintain consistent network configuration as they migrate across multiple hosts.

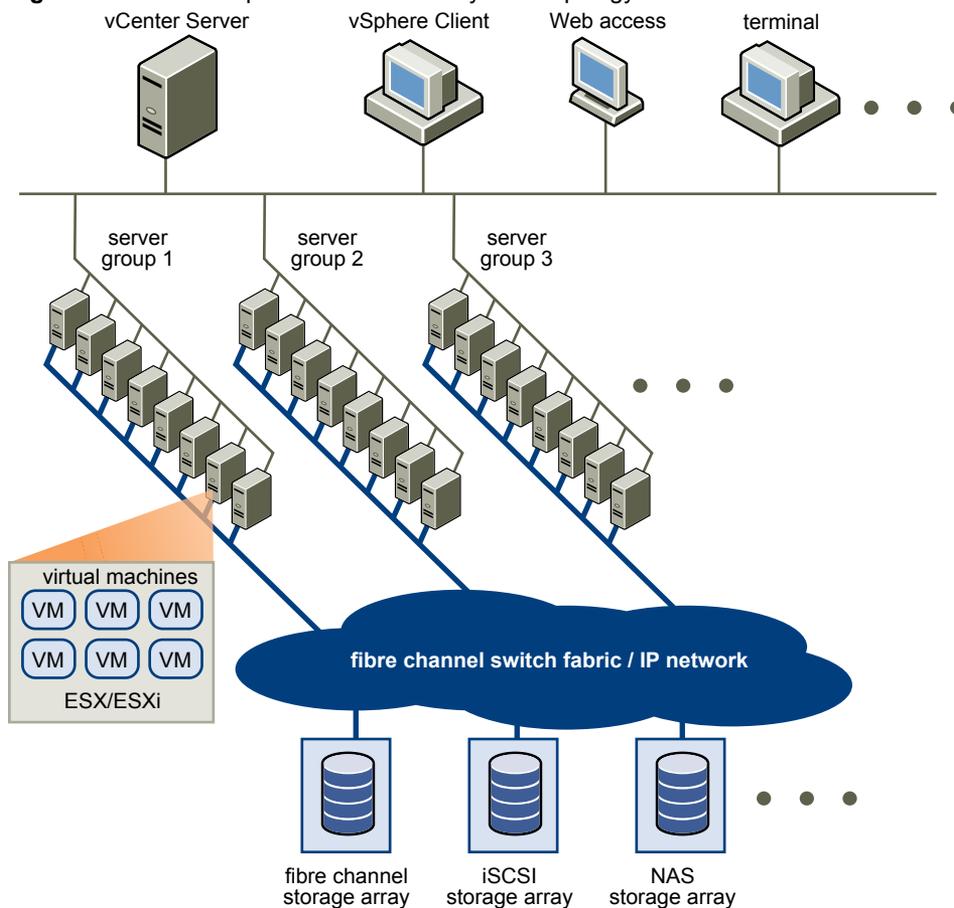|	
Host Profiles	Feature that simplifies host configuration management through user-defined configuration policies. The host profile policies capture the blueprint of a known, validated host configuration and use this to configure networking, storage, security, and other settings across multiple hosts. The host profile policies also monitor compliance to standard host configuration settings across the datacenter. Host profiles reduce manual steps involved in configuring a host and can help maintain consistency and correctness across the datacenter.
Pluggable Storage Array (PSA)	A storage partner plug-in framework that enables greater array certification flexibility and improved array-optimized performance. PSA is a multipath I/O framework allowing storage partners to enable their array asynchronously to ESX release schedules. VMware partners can deliver performance-enhancing multipath load-balancing behaviors that are optimized for each array.

Physical Topology of vSphere Datacenter

A typical VMware vSphere datacenter consists of basic physical building blocks such as x86 virtualization servers, storage networks and arrays, IP networks, a management server, and desktop clients.

This physical topology of the vSphere datacenter is illustrated in Figure 2.

Figure 2. VMware vSphere Datacenter Physical Topology

The components that make up the vSphere datacenter topology are:

Computing servers Industry standard x86 servers that run ESX/ESXi on the bare metal. ESX/ESXi software provides resources for and runs the virtual machines. Each computing server is referred to as a standalone host in the virtual environment. You can group a number of similarly configured x86 servers with connections to the same network and storage subsystems to provide an aggregate set of resources in the virtual environment, called a cluster.

Storage networks and arrays Fibre Channel SAN arrays, iSCSI SAN arrays, and NAS arrays are widely used storage technologies supported by VMware vSphere to meet different datacenter storage needs. The storage arrays are connected to and shared between groups of servers through storage area networks. This arrangement allows aggregation of the storage resources and provides more flexibility in provisioning them to virtual machines.

IP networks Each computing server can have multiple Ethernet network interface cards (NICs) to provide high bandwidth and reliable networking to the entire VMware vSphere datacenter.

vCenter Server vCenter Server provides a single point of control to the datacenter. It provides essential datacenter services such as access control, performance monitoring, and configuration. It unifies the resources from the individual computing servers to be shared among virtual machines in the entire datacenter. It does this by managing the assignment of virtual machines to the computing servers and the assignment of resources to the virtual machines within a given computing server based on the policies that the system administrator sets.

 Computing servers continue to function even in the unlikely event that vCenter Server becomes unreachable (for example, if the network is severed). They can be managed separately and continue to run the virtual machines assigned to them based on the resource assignment that was last set. After connection to vCenter Server is restored, it can manage the datacenter as a whole again.

Management clients VMware vSphere provides several interfaces for datacenter management and virtual machine access. These interfaces include VMware vSphere Client (vSphere Client), web access through a web browser, vSphere Command-Line Interface (vSphere CLI), or vSphere Management Assistant (vMA).

Virtual Datacenter Architecture

VMware vSphere virtualizes the entire IT infrastructure including servers, storage, and networks.

VMware vSphere aggregates these resources and presents a uniform set of elements in the virtual environment. With VMware vSphere, you can manage IT resources like a shared utility and dynamically provision resources to different business units and projects.

Figure 3 shows the key elements in virtual datacenter.

Figure 3. Virtual Datacenter Architecture
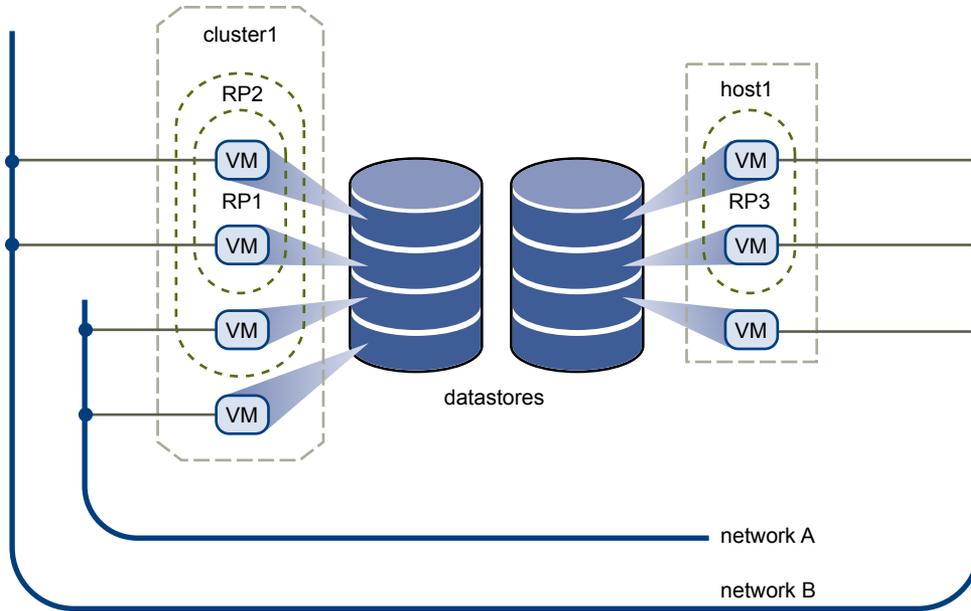
You can use vSphere to view, configure, and manage these key elements. These elements include:

- Computing and memory resources called hosts, clusters, and resource pools
- Storage resources called datastores
- Networking resources called networks
- Virtual machines

A host is the virtual representation of the computing and memory resources of a physical machine running ESX/ESXi. When one or more physical machines are grouped together to work and be managed as a whole, the aggregate computing and memory resources form a cluster. Machines can be dynamically added or removed from a cluster. Computing and memory resources from hosts and clusters can be finely partitioned into a hierarchy of resource pools.

Datastores are virtual representations of combinations of underlying physical storage resources in the datacenter. These physical storage resources can come from the following:

- Local SCSI, SAS, or SATA disks of the server
- Fibre Channel SAN disk arrays
- iSCSI SAN disk arrays
- Network Attached Storage (NAS) arrays

Networks in the virtual environment connect virtual machines to one another and to the physical network outside of the virtual datacenter.

Virtual machines are designated to a particular host, cluster or resource pool, and a datastore when they are created. After they are powered-on, virtual machines consume resources dynamically as the workload increases or give back resources dynamically as the workload decreases.

Provisioning of virtual machines is much faster and easier than physical machines. New virtual machines can be created in seconds. When a virtual machine is provisioned, the appropriate operating system and applications can be installed unaltered on the virtual machine to handle a particular workload just as though they were being installed on a physical machine. A virtual machine can even be provisioned with the operating system and applications already installed and configured.

Resources get provisioned to virtual machines based on the policies set by the system administrator who owns the resources. The policies can reserve a set of resources for a particular virtual machine to guarantee its performance. The policies can also prioritize and set a variable portion of the total resources to each virtual machine. A virtual machine is prevented from being powered-on and consuming resources if doing so violates the resource allocation policies. For more information on resource and power management, see the *Resource Management Guide*.

Hosts, Clusters, and Resource Pools

Hosts, clusters, and resources pools provide flexible and dynamic ways to organize the aggregated computing and memory resources in the virtual environment and link them back to the underlying physical resources.

A host represents the aggregate computing and memory resources of a physical x86 server. For example, if the physical x86 server has four dual-core CPUs running at 4GHz each and 32GB of system memory, the host has 32GHz of computing power and 32GB of memory available for running virtual machines that are assigned to it.

A cluster acts and can be managed as a single entity. It represents the aggregate computing and memory resources of a group of physical x86 servers sharing the same network and storage arrays. For example, if the group contains eight servers with four dual-core CPUs each running at 4GHz and 32GB of memory. The cluster then has and aggregate 256GHz of computing power and 256GB of memory available for running virtual machines.

Resource pools are partitions of computing and memory resources from a single host or a cluster. Resource pools can be hierarchical and nested. You can partition any resource pool into smaller resource pools to further divide and assign resources to different groups or for different purposes.

Figure 4 illustrates the use of resource pools. Three x86 servers with 4GHz computing power and 16GB of memory each are aggregated to form a cluster of 12GHz computing power and 48GB of memory. The Finance Department resource pool reserves 8GHz of computing power and 32GB of memory from the cluster, leaving 4GHz computing power and 16GB of memory reserved for the other virtual machine. From the Finance Department resource pool, the smaller Accounting resource pool reserves 4GHz computing power and 16GB of memory for the virtual machines from the accounting department. That leaves 4GHz of computing power and 16GB of memory for the virtual machine called Payroll.

Figure 4. Hosts, Clusters, and Resource Pools
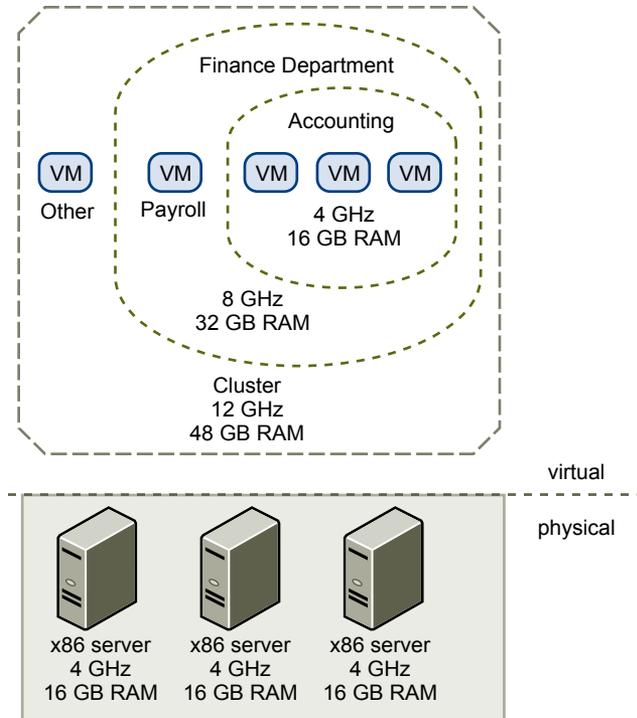
You can dynamically change resource allocation policies. For example, at year end, the workload on Accounting increases, and which requires an increase in the Accounting resource pool reserve of 4GHz of power to 6GHz. You can make the change to the resource pool dynamically without shutting down the associated virtual machines.

When reserved resources are not being used by resource pool or virtual machine, they can be shared. In the example, if the 4GHz of resources reserved for the Accounting department are not being used, the Payroll virtual machine can use those gigahertz during its peak time. When Accounting resource demands increase, Payroll dynamically returns them. Even though resources are reserved for different resource pools, they are not wasted if their owner does not use them. This capability helps to maximize resource utilization while also ensuring that reservations are met and resource policies enforced.

As demonstrated by the example, resource pools can be nested, organized hierarchically, and dynamically reconfigured so that the IT environment matches the company organization. Individual business units can receive dedicated resources while still exploiting from the efficiency of resource pooling.

VMware vSphere Distributed Services

VMware VMotion, VMware Storage VMotion, VMware DRS, VMware HA, and Fault Tolerance are distributed services that enable efficient and automated resource management and high availability for virtual machines.

Virtual machines run on and consume resources from ESX/ESXi. VMotion enables the migration of running virtual machines from one physical server to another without service interruption, as shown in Figure 5. The effect is a more efficient assignment of resources. With VMotion, resources can be dynamically reallocated to virtual machines across physical servers.

Figure 5. Migration with VMotion
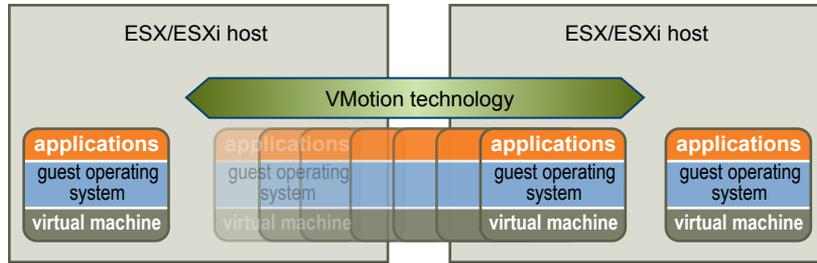
Storage VMotion enables the migration of virtual machines from one datastore to another datastore without service interruption. This allows administrators, for example, to off-load virtual machines from one storage array to another to perform maintenance, reconfigure LUNs, resolve out-of-space issues, and upgrade VMFS volumes. Administrators can also use Storage VMotion to optimize the storage environment for improved performance by seamlessly migrating virtual machine disks.

VMware DRS helps you manage a cluster of physical hosts as a single compute resource. You can assign a virtual machine to a cluster and DRS finds an appropriate host on which to run the virtual machine. DRS places virtual machines in such a way as to ensure that load across the cluster is balanced, and cluster-wide resource allocation policies (for example, reservations, priorities, and limits) are enforced. When a virtual machine is powered on, DRS performs an initial placement of the virtual machine on a host. As cluster conditions change (for example, load and available resources), DRS migrates (using VMotion) virtual machines to other hosts as necessary.

Figure 6. VMware DRS
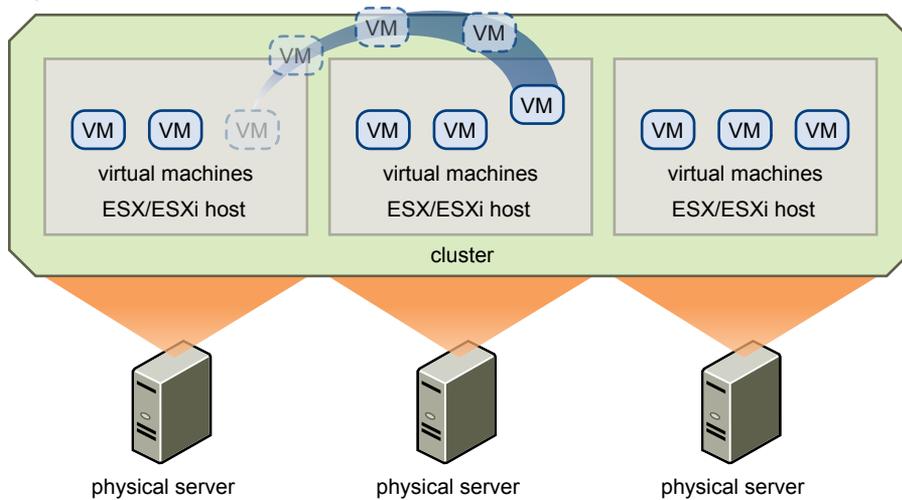
When a new physical server is added to a cluster, DRS enables virtual machines to immediately and automatically take advantage of the new resources because it distributes the running virtual machines.

When DPM is enabled, the system compares cluster-level and host-level capacity to the demands of virtual machines running in the cluster. If the resource demands of the running virtual machines can be met by a subset of hosts in the cluster, DPM migrates the virtual machines to this subset and powers down the hosts that are not needed. Once resource demands increase, DPM powers these hosts back on and migrates the virtual machines to them. This dynamic cluster right-sizing that DPM performs reduces the power consumption of the cluster without sacrificing virtual machine performance or availability.

You can configure DRS to automatically execute virtual machine placement, virtual machine migration, and host power actions, or to provide recommendations which the datacenter administrator can assess and manually act upon.

VMware HA enables quick restart of virtual machines on a different physical server within a cluster automatically if a host fails. All applications within the virtual machines have the high availability benefit, through application clustering.

HA monitors all physical hosts in a cluster and detects host failures. An agent placed on each physical host maintains a heartbeat with the other hosts in the resource pool. Loss of a heartbeat initiates the process of restarting all affected virtual machines on other hosts. See Figure 7 for an example of VMware HA. HA ensures that sufficient resources are available in the cluster at all times to restart virtual machines on different physical hosts in the event of host failure.

Figure 7. VMware HA
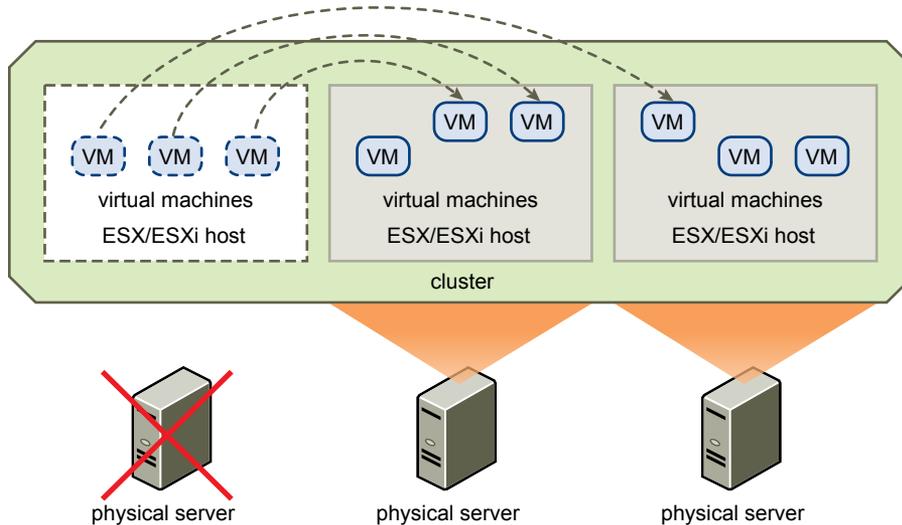
HA also provides a Virtual Machine Monitoring feature that monitors the status of virtual machines in an HA cluster. If a virtual machine does not generate heartbeats within a specified time, Virtual Machine Monitoring identifies it as having failed and automatically restarts it. If restarts occur, policies can control the number of restarts.

With HA, vCenter Server is not a single point of failure. HA is configured centrally via vCenter Server; however, once configured, it operates continuously and in a distributed manner on every ESX host. vCenter Server is no longer involved. Even if vCenter Server fails, HA failovers still occur successfully.

Using VMware vLockstep technology, VMware Fault Tolerance (FT) on the ESX/ESXi host platform provides continuous availability by protecting a virtual machine (the Primary VM) with a shadow copy (Secondary VM) that runs in virtual lockstep on a separate host. Inputs and events performed on the Primary VM are recorded and replayed on the Secondary VM, ensuring that the two remain in an identical state. For example, mouse-clicks and keystrokes are recorded on the Primary VM and replayed on the Secondary VM. Because the VM is in virtual lockstep with the Primary VM, it can take over execution at any point without interruption or loss of data.

Network Architecture

VMware vSphere has a set of virtual networking elements that lets you network the virtual machines in the data center like a physical environment.

Figure 8. Networking with vNetwork Standard Switches
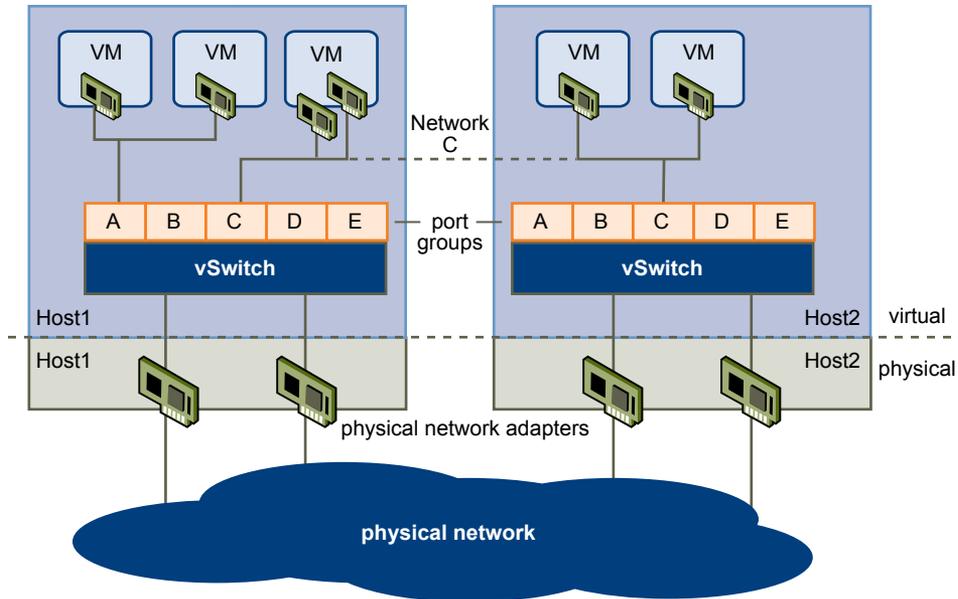

Figure 8 shows the relationship between the networks inside and outside the virtual environment for vSwitches. The virtual environment provides networking elements similar to the physical world. They are virtual network interface cards (vNIC), vNetwork Standard Switches (vSwitch), vNetwork Distributed Switches (dvSwitch), and port groups. dvSwitch networking is shown in Figure 9.

Like a physical machine, each virtual machine has one or more vNICs. The guest operating system and application programs communicate with a vNIC through either a commonly available device driver or a VMware device driver optimized for the virtual environment. In either case, communication in the guest operating system occurs just as it would with a physical device. Outside the virtual machine, the vNIC has its own MAC address and one or more IP addresses, and responds to the standard Ethernet protocol as would a physical NIC. An outside agent does not detect that it is communicating with a virtual machine.

A virtual switch works like a layer 2 physical switch. Each server has its own virtual switches. On one side of the virtual switch are port groups that connect to virtual machines. On the other side are uplink connections to physical Ethernet adapters on the server where the virtual switch resides. Virtual machines connect to the outside world through the physical Ethernet adapters that are connected to the virtual switch uplinks.

A virtual switch can connect its uplinks to more than one physical Ethernet adapter to enable NIC teaming. With NIC teaming, two or more physical adapters can be used to share the traffic load or provide passive failover in the event of a physical adapter hardware failure or a network outage. For information on NIC teaming, see the *ESX Configuration Guide* or *ESXi Configuration Guide*.

A vNetwork Distributed Switch (dvSwitch) functions as a single virtual switch across all associated hosts. This allows virtual machines to maintain consistent network configuration as they migrate across multiple hosts. Like a vSwitch, each dvSwitch is a network hub that virtual machines can use. A vSwitch can route traffic internally between virtual machines or link to an external network by connecting to physical Ethernet adapters. Each vSwitch can also have one or more dvPort groups assigned to it. dvPort groups aggregate multiple ports under a common configuration and provide a stable anchor point for virtual machines connecting to labeled networks.

Figure 9. Networking with vNetwork Distributed Switches
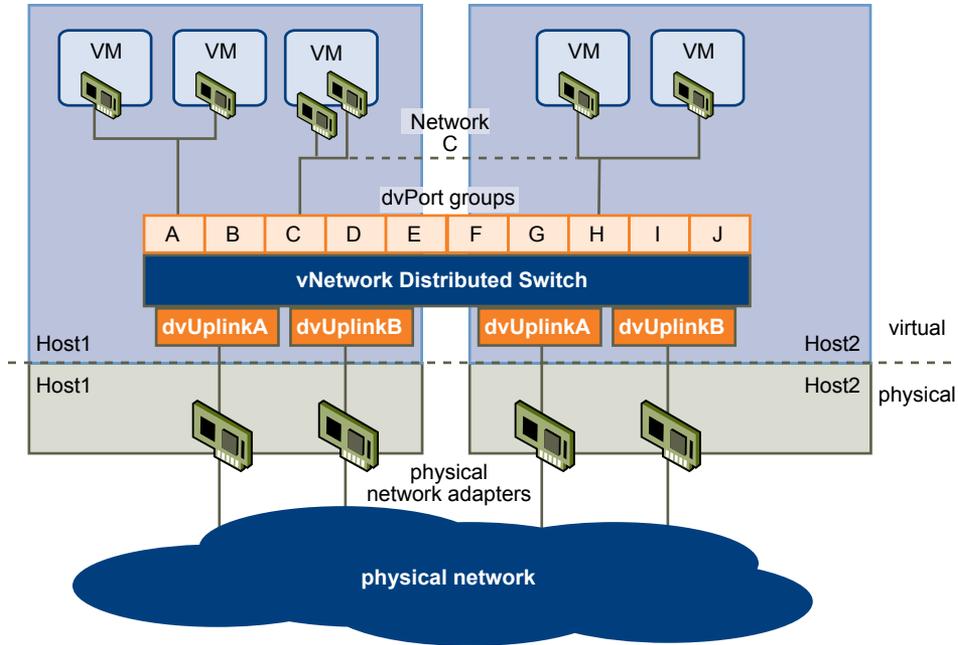
Port group is a unique concept in the virtual environment. A port group is a mechanism for setting policies that govern the network connected to it. A vSwitch can have multiple port groups. Instead of connecting to a particular port on the vSwitch, a virtual machine connects its vNIC to a port group. All virtual machines that connect to the same port group belong to the same network inside the virtual environment even if they are on different physical servers.

You can configure port groups to enforce policies that provide enhanced networking security, network segmentation, better performance, high availability, and traffic management.

Layer 2 security options	Enforces what vNICs attached to a port group in a virtual machine can do by controlling capabilities for a promiscuous mode, MAC address changes, or forged transmissions.
VLAN support	Integrates virtual networks with physical network VLANs.
Private VLAN	Allows use of VLAN IDs within a private network without having to worry about duplicating VLAN IDs across a wider network.
Traffic shaping	Defines QOS policies for average and peak bandwidth, and traffic burst size. You set policies to improve traffic management.
NIC teaming	Sets the NIC teaming policies for an individual port group or network to share traffic load or provide failover in case of hardware failure.

Storage Architecture

The VMware vSphere storage architecture consists of layers of abstraction that hide and manage the complexity and differences among physical storage subsystems.

This storage architecture is shown in Figure 10.

Figure 10. Storage Architecture
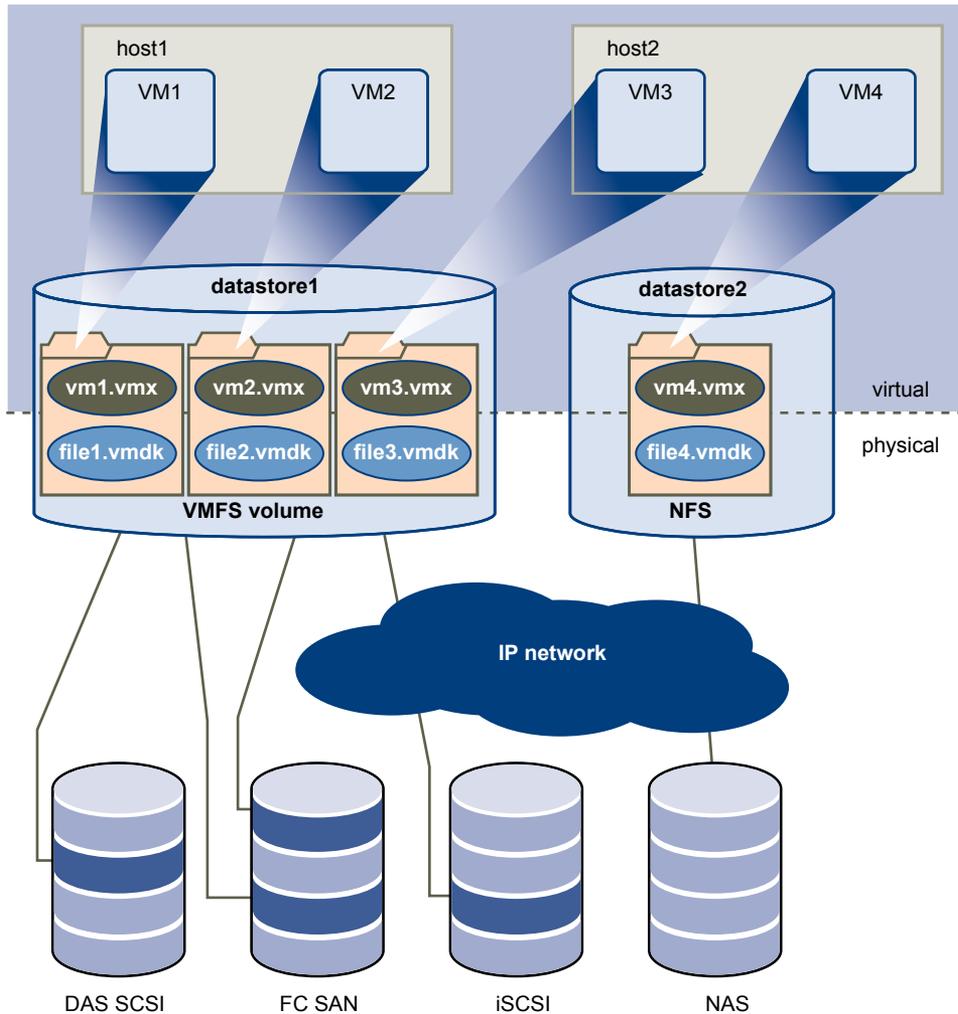
To the applications and guest operating systems inside each virtual machine, the storage subsystem appears as a virtual SCSI controller connected to one or more virtual SCSI disks as shown in Figure 10. These controllers are the only types of SCSI controllers that a virtual machine can see and access, and include BusLogic Parallel, LSI Logic Parallel, LSI Logic SAS, and VMware Paravirtual.

The virtual SCSI disks are provisioned from datastore elements in the datacenter. A datastore is like a storage appliance that delivers storage space for virtual machines across multiple physical hosts.

The datastore abstraction is a model that assigns storage space to virtual machines while insulating the guest from the complexity of the underlying physical storage technology. The guest virtual machine is not exposed to Fibre Channel SAN, iSCSI SAN, direct attached storage, and NAS.

Each virtual machine is stored as a set of files in a directory in the datastore. The disk storage associated with each virtual guest is a set of files within the guest's directory. You can operate on the guest disk storage as an ordinary file. It can be copies, moved, or backed up. New virtual disks can be added to a virtual machine without powering it down. In that case, a virtual disk file (.vmdk) is created in VMFS to provide new storage for the added virtual disk or an existing virtual disk file is associated with a virtual machine.

Each datastore is a physical VMFS volume on a storage device. NAS datastores are an NFS volume with VMFS characteristics. Datastores can span multiple physical storage subsystems. As shown in Figure 10, a single VMFS volume can contain one or more LUNs from a local SCSI disk array on a physical host, a Fibre Channel SAN disk farm, or iSCSI SAN disk farm. New LUNs added to any of the physical storage subsystems are detected and made available to all existing or new datastores. Storage capacity on a previously created

datastore can be extended without powering down physical hosts or storage subsystems. If any of the LUNs within a VMFS volume fails or becomes unavailable, only virtual machines that touch that LUN are affected. An exception is the LUN that has the first extent of the spanned volume. All other virtual machines with virtual disks residing in other LUNs continue to function as normal.

VMFS is a clustered file system that leverages shared storage to allow multiple physical hosts to read and write to the same storage simultaneously. VMFS provides on-disk locking to ensure that the same virtual machine is not powered on by multiple servers at the same time. If a physical host fails, the on-disk lock for each virtual machine is released so that virtual machines can be restarted on other physical hosts.

VMFS also features failure consistency and recovery mechanisms, such as distributed journaling, a failure-consistent virtual machine I/O path, and machine state snapshots. These mechanisms can aid quick identification of the cause and recovery from virtual machine, physical host, and storage subsystem failures.

VMFS also supports raw device mapping (RDM). RDM provides a mechanism for a virtual machine to have direct access to a LUN on the physical storage subsystem (Fibre Channel or iSCSI only). RDM is useful for supporting two typical types of applications:

- SAN snapshot or other layered applications that run in the virtual machines. RDM better enables scalable backup offloading systems using features inherent to the SAN.

- Microsoft Clustering Services (MSCS) spanning physical hosts and using virtual-to-virtual clusters as well as physical-to-virtual clusters. Cluster data and quorum disks must be configured as RDMs rather than files on a shared VMFS.

Figure 11. Raw Device Mapping
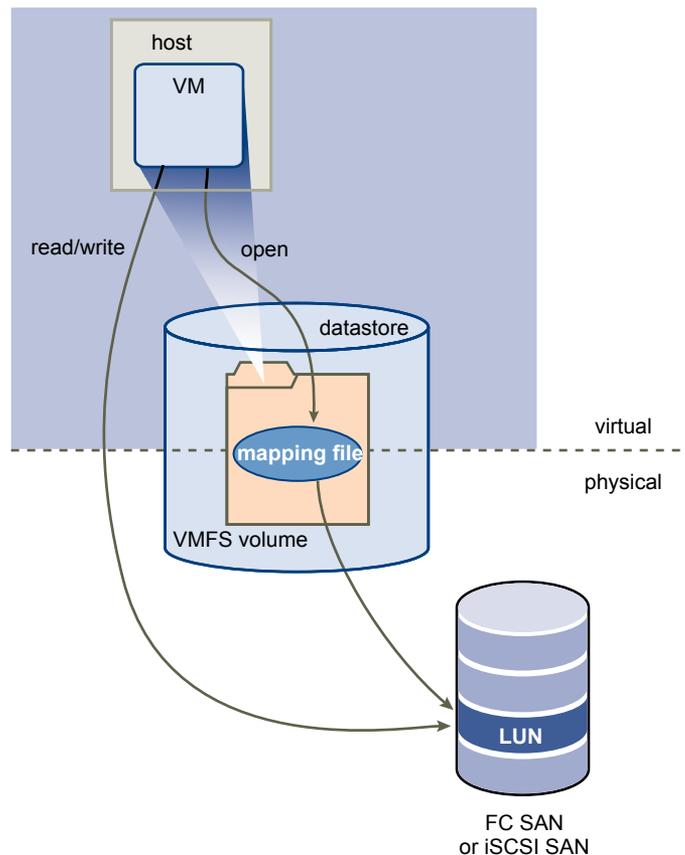
An RDM is a symbolic link from a VMFS volume to a raw LUN. The mapping makes LUNs appear as files in a VMFS volume. The mapping file, not the raw LUN, is referenced in the virtual machine configuration.

When a LUN is opened for access, the mapping file is read to obtain the reference to the raw LUN. Thereafter, reads and writes go directly to the raw LUN rather than going through the mapping file.

VMware Consolidated Backup

The VMware vSphere storage architecture enables VMware Consolidated Backup. Consolidated Backup provides a centralized facility for LAN-free backup of virtual machines.

As shown in Figure 12, Consolidated Backup works in conjunction with a third-party backup agent residing on a separate backup proxy server (not on the server running ESX/ESXi) but does not require an agent inside the virtual machines.

When the third-party backup agent initiates a backup of virtual machine storage, Consolidated Backup runs a set of scripts. The pre-backup scripts quiesce the virtual disks and generate snapshots. Once completed, the post-backup scripts restore the virtual machine back to normal operation. At the same time, it mounts the disk snapshot to the backup proxy server. Finally, the third-party backup agent backs up the files on the mounted snapshot to its backup targets. By taking snapshots of the virtual disks and backing them up through a separate backup proxy server, Consolidated Backup provides a simple and low-overhead backup solution for the virtual environment, and is less intrusive than running backups inside each guest virtual machine.

Figure 12. VMware Consolidated Backup
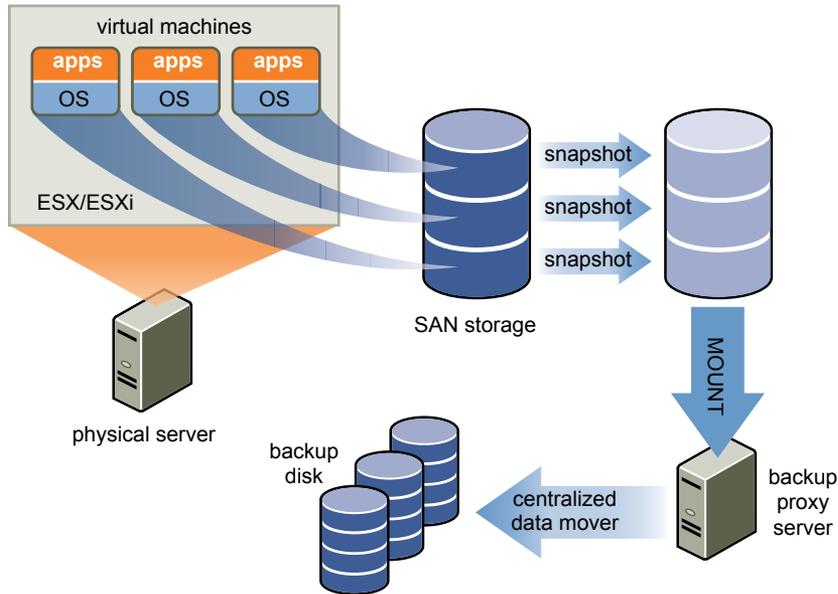
VMware vCenter Server

VMware vCenter Server provides centralized management for datacenters.

vCenter Server aggregates physical resources from multiple ESX/ESXi hosts and presents a central collection of simple and flexible resources for the system administrator to provision to virtual machines in the virtual environment.

vCenter Server components are user access control, core services, distributed services, plug-ins, and various interfaces.

Figure 13 shows the key components of vCenter Server.

Figure 13. vCenter Server Components
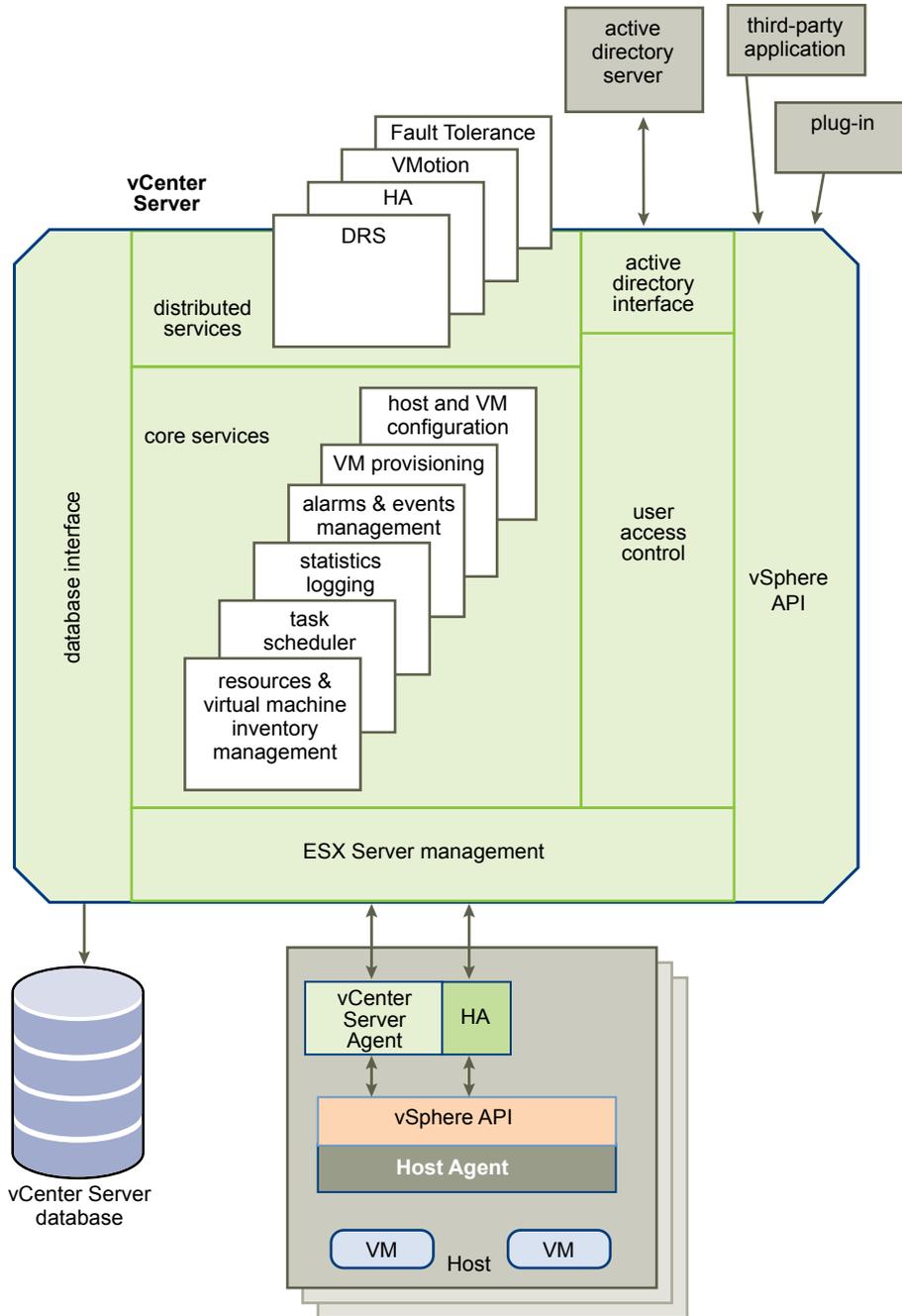
The User Access Control component allows the system administrator to create and manage different levels of access to vCenter Server for different classes of users.

For example, a user class might manage and configure the physical virtualization server hardware in the datacenter. Another user class might only manage virtual resources within a particular resource pool in the virtual machine cluster.

vCenter Server Core Services

Core Services are basic management services for a virtual datacenter.

Core Services include services such as:

Virtual machine provisioning	Guides and automates the provisioning of virtual machines and their resources.
Host and VM configuration	Allows the configuration of hosts and virtual machines.
Resources and virtual machine inventory management	Organizes virtual machines and resources in the virtual environment and facilitates their management.
Statistics and logging	Logs and reports on the performance and resource use statistics of datacenter elements, such as virtual machines, hosts, and clusters.
Alarms and event management	Tracks and warns users on potential resource overuse or event conditions. Alarms can be set to trigger on events and notify when critical error conditions occur. In addition, alarms are triggered only when they satisfy certain time conditions to minimize the number of false triggers.
Task scheduler	Schedules actions such as VMotion to occur at a given time.
Consolidation	Analyzes the capacity and use of a datacenter's physical resources. Provides recommendations for improving use by discovering physical systems that can be converted to virtual machines and consolidated onto ESX/ESXi. Automates the consolidation process, but also provides the user flexibility in adjusting consolidation parameters.
vApp	A vApp has the same basic operation as a virtual machine, but can contain multiple virtual machines or appliances. With vApps, you can perform operations on multi-tier applications as separate entities (for example, clone, power on and off, and monitor). vApps package and manage those applications.

Distributed Services are solutions that extend VMware vSphere capabilities beyond a single physical server. These include: VMware DRS, VMware HA, and VMware VMotion. Distributed Services allow the configuration and management of these solutions centrally from vCenter Server.

Multiple vCenter Server hosts can be joined into a single connected group. When a vCenter Server host is part of a connected group, you can view and manage the inventories of all vCenter Server hosts in that group.

vCenter Server Plug-Ins

Plug-ins are applications that can be installed on top of vCenter Server and that add additional features and functionality.

vCenter Server Plug-ins include:

VMware vCenter Converter	Enables users to convert physical machines, and virtual machines in a variety of formats, to ESX/ESXi virtual machines. Converted systems can be imported into any location in the vCenter Server inventory.
VMware Update Manager	Enables security administrators to enforce security standards across ESX/ESXi hosts and managed virtual machines. This plug-in provides the ability to create user-defined security baselines that represent a set of security standards. Security administrators can compare hosts and virtual machines against these baselines to identify and remediate virtual machines that are not in compliance.

vCenter Server Interfaces

vCenter Server interfaces integrate vCenter Server with third party products and applications.

vCenter Server has four key interfaces:

ESX management	Interfaces with the vCenter Server agent to manage each physical server in the datacenter.
VMware vSphere API	Interfaces with VMware management clients and third-party solutions.
Database interface	Connects to Oracle, Microsoft SQL Server, or IBM DB2 to store information, such as virtual machine configurations, host configurations, resources and virtual machine inventory, performance statistics, events, alarms, user permissions, and roles.
Active Directory interface	Connects to Active Directory to obtain user access control information.

Communication Between vCenter Server and ESX

vCenter Server communicates with the ESX/ESXi host agent through the VMware vSphere API (vSphere API).

When a host is first added to vCenter Server, vCenter Server sends a vCenter Server agent to run on the host. As Figure 14 shows, that agent communicates with the host agent.

Figure 14. Host Agent
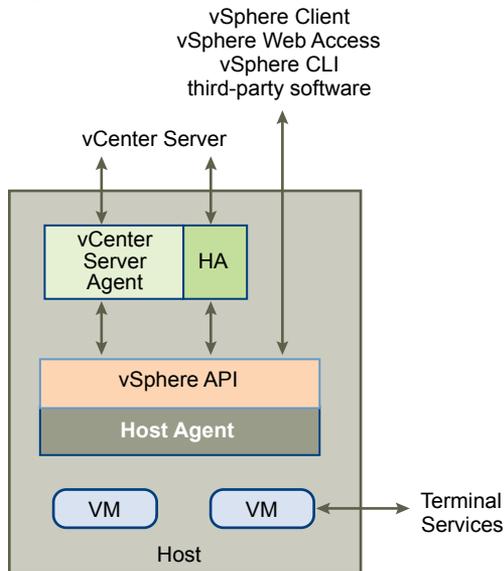
The vCenter Server agent acts as a mini-vCenter Server to perform the following functions:

- Relays and enforces resource allocation decisions made in vCenter Server, including those that the DRS engine sends.

- Passes virtual machine provisioning and configuration change commands to the host agent.

- Passes host configuration change commands to the host agent.

- Collects performance statistics, alarms, and error conditions from the host agent and sends them to the vCenter Server.

- Allows management of ESX/ESXi hosts at different release versions.

Accessing the Virtual Datacenter

Users can access the VMware vSphere datacenter through the vSphere Client, Web Access through a Web browser, or terminal services (such as Windows Terminal Services).

Only physical host administrators in special circumstances should access hosts. All relevant functions that can be done on the host can also be done in vCenter Server.

Figure 15. VMware vSphere Access and Control
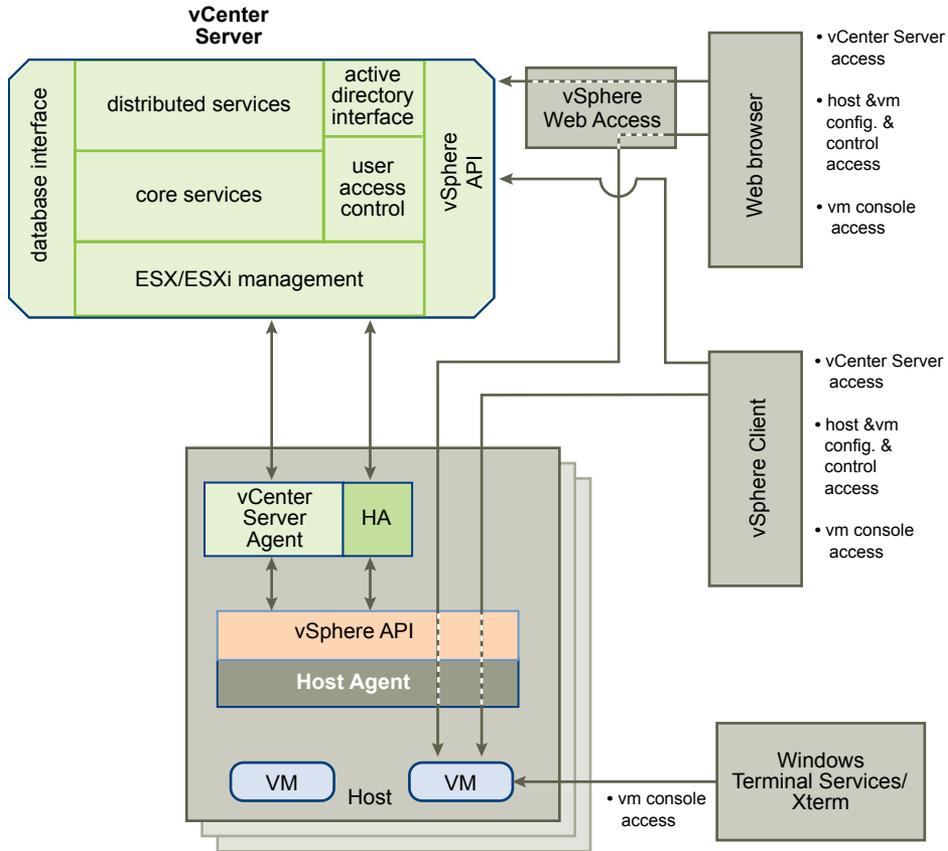
The vSphere Client accesses vCenter Server through the VMware API. After the user is authenticated, a session starts in vCenter Server, and the user sees the resources and virtual machines that are assigned to the user. For virtual machine console access, the vSphere Client first obtains the virtual machine location from vCenter Server through the VMware API. It then connects to the appropriate host and provides access to the virtual machine console.

NOTE   vSphere Web Access cannot be used to access a host running ESXi 4.0.

First Time Use

The vSphere Client includes embedded assistance that guides users who are new to virtualization concepts through the steps to set up their virtual infrastructure. This embedded assistance is in-line content presented in the vSphere Client GUI and an online tutorial. The assistance can be turned off for experienced users, or turned back on when new, inexperienced users are introduced to the system.

Web Access

Users can also access vCenter Server through the Web browser by first pointing the browser to an Apache Tomcat Server set up by vCenter Server. The Apache Tomcat Server mediates the communication between the browser and vCenter Server through the VMware API.

To access the virtual machine consoles through the Web browser, users can use the bookmark that vCenter Server creates. The bookmark first points to the vSphere Web Access.

vSphere Web Access resolves the physical location of the virtual machine and redirects the Web browser to ESX/ESXi where the virtual machine resides.

If the virtual machine is running and the user knows the IP address of the virtual machine, the user can also access the virtual machine console by using standard tools, such as Windows Terminal Services.

NOTE   Web Access is turned off by default for ESX hosts.

Additional Resources

Additional tasks are required to set up a virtual infrastructure. References to the documentation are provided that contains details about those tasks.

Table 2 lists the tasks and references documentation for setting up VMware vSphere. Documentation also exists for the following topics:

- Documentation road map and quick start

- Virtual machine mobility planning

- VMware SDK and API developer resources

- Configuration maximums and release notes

Table 2.   Documentation

Tasks	Documents
Install vCenter Server and the vSphere Client	*ESX and vCenter Server Installation Guide*
	ESXi Installable and vCenter Server Setup Guide
Install ESX 4.0	*ESX and vCenter Server Installation Guide*
Install and Configure ESXi 4.0 Installable	*ESXi Installable and vCenter Server Setup Guide*
Upgrade vCenter Server, vSphere Clients, ESX, or ESXi	*Upgrade Guide*
Obtain and install licenses	*ESX and vCenter Server Installation Guide*
	ESXi Installable and vCenter Server Setup Guide
Configure storage	*iSCSI SAN Configuration Guide*
	Fibre Channel SAN Configuration Guide
	ESX Configuration Guide
	ESXi Configuration Guide
Configure networks	*ESX Configuration Guide*
	ESXi Configuration Guide
Configure security	*ESX Configuration Guide*
■ ESX security	*ESXi Configuration Guide*
■ User management	*Basic System Administration*
■ Virtual machine patch management	*VMware Update Manager Administration Guide*
Deploy virtual machines	*Basic System Administration*
	Guest Operating System Installation Guide
Import physical systems, virtual machines, virtual appliances, or backup images into the virtual infrastructure	*Basic System Administration*
	VMware Converter Enterprise Administration Guide
Configure distributed services	*VMware Availability Guide*
■ VMware HA and Fault Tolerance	*Resource Management Guide*
■ VMware DRS	*Virtual Machine Backup Guide*
■ VMware Consolidated Backup	

Glossary

administrative lockout

A global setting that provides password protection for Windows hosts. Administrative lockout restricts users from creating new virtual machines, editing virtual machine configurations, and changing network settings.

alarm

An entity that monitors one or more properties of a virtual machine, such as CPU load. Alarms send notifications as directed by the configurable alarm definition.

allocated disk

A type of virtual disk in which all disk space for the virtual machine is allocated at the time the disk is created. This is the default type of virtual disk created by vCenter Server.

API (application programming interface)

A specified set of functions that enables you to access a service programmatically.

append mode

In ESX Server 2.x, a disk mode in which software running in the virtual machine appears to write changes to the disk. Changes are stored in a temporary `.REDO` file. If a system administrator deletes the redo-log file, the virtual machine returns to the state it was in the last time it was used in persistent mode. See also disk mode.

authorization role

A set of privileges grouped for convenient identification under names such as Administrator.

child

A managed entity grouped by a folder object or another managed entity. See also folder.

clone

(n.) A duplicate of a virtual machine. (v.) To make a copy of a virtual machine. When a clone is created, vCenter Server provides an option for customizing the guest operating system of that virtual machine. Hosted products distinguish between full clones and linked clones. See also full clone, linked clone.

cluster

A server group in the virtual environment. Clusters enable a high-availability solution.

cluster compute resource

An extended compute resource that represents a cluster of hosts available for backing virtual machines. See also compute resource.

compute resource

A managed object that represents either a single host or a cluster of hosts available for backing virtual machines. See also cluster compute resource.

configuration

See virtual machine configuration.

console

See service console, VMware virtual machine console.

current virtual machine

A virtual machine of the latest version supported by the product in use. See also legacy virtual machine.

customization

The process of applying new characteristic values to a virtual machine as it is being deployed from a template or cloned from another existing virtual machine. Customization options include changing the new virtual machine identification and network information.

custom networking

In hosted products, any type of network connection between virtual machines and the host that does not use the default bridged, host-only, or network address translation (NAT) configurations. For instance, different virtual machines can be connected to the host by separate networks or connected to each other and not to the host. Any network topology is possible.

daemon

A UNIX background program that runs unattended, performing services at a specified time or when some condition occurs. Analogous to a service in Windows.

datacenter

A required structure under which hosts and their associated virtual machines are added to the vCenter Server. vCenter Server supports multiple datacenters. A host can be managed under only one datacenter.

datacenter folder

An optional inventory grouping structure contained within the datacenter structure. A vCenter Server supports multiple datacenter folders. Datacenter folders can contain only datacenters and other datacenter folders.

datastore

Virtual representations of combinations of underlying physical storage resources in the datacenter. A datastore is the storage location (for example, a physical disk, a RAID, or a SAN) for virtual machine files.

DHCP (Dynamic Host Configuration Protocol)

A communications protocol that enables dynamic addressing. The software relieves administrators of the task of assigning an IP address to each device that connects to a network.

disabled

A state in which actions and features are deactivated. The feature is turned off by a choice the user makes.

disk arrays

Groups of multiple disk devices that are the typical SAN disk storage device. These arrays vary in design, capacity, performance, and other features.

disk mode

A property of a virtual disk that defines its external behavior (how the virtualization layer treats its data. It is invisible to the guest operating system. Available modes vary by product. See also persistent mode, nonpersistent mode and append mode.

distributed virtual port group

A dvPort group is a port group associated with a DVS. It specifies port configuration options for each member port. A dvPort group defines how a connection is made through the DVS to the network.

DNS (Domain Name System)

An Internet data query service that translates host names into IP addresses. Also called Domain Name Server or Domain Name Service.

dvPort (distributed virtual port)

A port on a DVS that connects to a host's service console or VMkernel or to a virtual machine's network adapter.

DVS

See vNetwork Distributed Switch (DVS).

enable

A state in which actions and features are active. The feature is turned on by a choice the user makes.

enumeration

The act of discovering resources available in a virtual machine environment. In particular, discovering all resources of a given type or a list of resources discovered by enumeration.

Ethernet switch

A physical switch that manages network traffic between machines. A switch has multiple ports, each of which can be connected to a machine or to another switch on the network. See also virtual switch.

EULA (end user license agreement)

The software license that details any restrictions placed on users.

event

An action that is of interest to vCenter Server. Each event triggers an event message. Event messages are archived in the vCenter Server database. Messages appear in two locations in the user interface: the **Events** option in the navigation bar and the **Events** tab for objects under the **Inventory** button.

event declaration

Type of event (alert, error, info, warning, or user) and its name, arguments, and message format.

existing partition

A partition on a physical disk. See also physical disk.

fabric

A Fibre Channel network topology in which devices pass data to each other through interconnecting switches. A fabric is used in many SANs. Fabrics are typically divided into zones. Also called switched fabric or Fibre Channel fabric. See also FC (Fibre Channel).

FAT (file allocation table)

See file allocation table (FAT).

fault

A data object containing information about an exception condition encountered by an operation.

FC (Fibre Channel)

An ANSI-standard, gigabit-speed network technology used to build storage area networks and transmit data. Fibre Channel components include HBAs, switches, and cabling.

file

A container for raw data, such as text or an image.

file allocation table (FAT)

An area on a disk that stores information about the location of each piece of every file on the disk and about the location of unusable areas of the disk.

file system cache

A storage mechanism that speeds access to files stored on a disk by caching frequently accessed data. The maximum disk cache for 32-bit operating systems is 512MB; for 64-bit operating systems, the maximum is 1TB. All platforms use file system caches for improved performance.

folder

A managed entity used to group other managed entities. Folder types are determined by the types of child entities they contain. See also child.

FQDN (fully qualified domain name)

The name of a host that includes the host name and the domain name. For example, the FQDN of a host named esx1 in the domain vmware.com is esx1.vmware.com.

full clone

A complete copy of the original virtual machine, including all associated virtual disks. See also linked clone.

full screen switch mode

A display mode in which the virtual machine's display fills the entire screen. (The user has no access to the VMware Workstation user interface.) The user cannot create, reconfigure, or start virtual machines. A system administrator performs those functions. See also quick switch mode.

full virtual machine backup

Backs up all files that make up the entire virtual machine. These files include disk images, `.vmx` files, and so on.

Go to snapshot

To restore a snapshot of the active virtual machine. See also revert to snapshot.

GOS (guest operating system)

See guest operating system.

group

A set of users assigned a common set of privileges. A group may contain other groups. See also service console.

growable disk

A type of virtual disk in which the disk space is not preallocated to its full size. The disk files begin small and grow as data is written to the disk.

guest operating system

An operating system that runs inside a virtual machine. See also host operating system.

guest user

An unauthenticated user who can log in to a system with a temporary user name and password. A guest user has restricted access to files and folders and has a set of restricted permissions

handle

A temporary token used by a Web service client to invoke Web service operations that require a reference to an object. Like a file handle, an object handle is a temporary handle that always refers to the same object.

HBA (host bus adapter)

A device that connects one or more peripheral units to a computer and manages data storage and I/O processing (often for Fibre Channel, IDE, or SCSI interfaces). An HBA can be physical (attached to a host) or virtual (part of a virtual machine).

HCL (hardware compatibility list)

The definitive list of hardware that VMware supports.

headless

Describes a program that runs in the background without any interface connected to it. A running virtual machine that has no console connections is running headless.

heartbeat

A signal emitted at regular intervals by software to demonstrate that it is still active. The signal emitted by a Level 2 Ethernet transceiver at the end of every packet to show that the collision-detection circuit is still connected.

host

A computer that uses virtualization software to run virtual machines. Also called the host machine or host computer. The physical computer on which the virtualization (or other) software is installed.

host agent

Software that performs actions on behalf of a remote client when installed on a virtual machine host.

host-based licensing

In ESX server software, one of two modes for licensing VMware software. License files reside on the host. Feature availability is tied strictly to the host in which the file resides. See also server-based licensing.

hosted products

VMware products (including Workstation, VMware Player, VMware Server, VMware ACE, and Lab Manager) that run as applications on physical machines with operating systems such as Microsoft Windows or Linux. See also hypervisor.

host-only networking

In hosted products, a type of network connection between a virtual machine and the host. With host-only networking, a virtual machine is connected to the host on a private network, which normally is not visible outside the host. Multiple virtual machines configured with host-only networking on the same host are on the same network. See also NAT (network address translation).

host operating system

An operating system that runs on the host machine. See also guest operating system.

hot fix

An installable file that resets a user's password, renews an expired virtual machine, or enables a copy-protected virtual machine to run from a new location.

hyperthreading

A technology that allows a single physical processor to behave like two logical processors. The processor can run two independent applications at the same time.

hypervisor

A platform that allows multiple operating systems to run on a host computer at the same time.

image-level (volume-level) backup

A process that backs up an entire storage volume.

inactive

A feature is not currently functioning because of a constraint other than user choice. Can also be used when the feature is turned off by indirect user choice. For example, a feature can be "disabled" by direct user choice or made "inactive" by indirect user choice.

incremental backup

A process that backs up only those files that have changed since the last backup, whether it is a full or incremental backup.

independent disk

A type of virtual disk that is not affected by snapshots. You can configure independent disks in persistent and nonpersistent modes. See also nonpersistent mode, persistent mode.

internal storage configuration

Storage virtualization devices are those that aggregate capacity from multiple heterogeneous arrays and manage a logical representation of this capacity. Models that belong to this group are array-based controllers only and not server-based or switch-based controllers. Most of these devices can also have physical disks installed internally that are presented to hosts as physical SAN LUNs, which are not virtualized. When these devices are supported in the internal storage configuration, this refers to the LUNs presented from disks internal to the array and not those virtualized from other arrays which they aggregate.

inventory

A hierarchical structure used by the vCenter Server or the host agent to organize managed entities. This hierarchy is a list of all the monitored objects in vCenter Server.

inventory mapping

Mapping between resource pools, networks, and virtual machine folders on the protection site and their destination counterparts on the recovery site.

IP storage

Any form of storage that uses TCP/IP network communication as its foundation. Both Network File System (NFS) and iSCSI storage can be used as virtual machine datastores. NFS can also be used for direct mounting of .ISO files for presentation to virtual machines as CD-ROM discs.

ISV (independent software vendor)

A company that develops and sells software for use on other companies' platforms. Includes systems management vendors, imaging and provisioning vendors, storage management vendors, and so on.

LAN segment

A private virtual network that is available only to virtual machines within the same team. See also team, virtual network.

legacy virtual machine

A virtual machine supported by the product in use but not current for that product.

license activation code (LAC)

A unique code associated with one or more VMware products purchased. You receive this code after your order is processed. If you purchase your products from a VMware partner, you receive your license activation code after you register your partner activation code for your VMware account.

license file

A text file determining the license mode and entitlement to licensed features.

license key

An encrypted block of text within a license file, determining entitlement to one specific licensed feature.

license mode

The method used for licensing VMware software. A license file can be located on an ESX server host or on a license server. vCenter Server uses server-based licensing. ESX server licensing can be server-based or host-based at the option of the system administrator. See also host-based licensing, server-based licensing.

link

A hyperlink that contains a path to another object. As on the Web, links can be relative to the current object path, relative to the current server's object root, or on a specific server, as interpreted by the current client's host name resolver.

linked clone

A copy of the original virtual machine. The copy must have access to the parent virtual machine's virtual disks. The linked clone stores changes to the virtual disks in a separate set of files. See also full clone.

LMHOSTS (LAN Manager HOSTS) file

A text file in a Windows network that maps NetBIOS host names to IP addresses.

lockout

See administrative lockout.

LUN (logical unit number)

An identifier for a disk volume in a storage array.

LUN Masking

A process that is used for permission management to make a LUN available to some hosts and not to other hosts. Also referred to as Selective Storage Presentation, Access Control, and Partitioning, depending on the vendor.

managed entity

A managed object that is present in the inventory. See also inventory, managed object.

managed object

An object that resides on a server and is passed between the client and the Web service only by reference. A managed object has operations associated with it but might not have properties. See also.

managed object reference

A data object created to uniquely identify a managed object.

message

A data element that is used by an operation to carry data. It lists the data types exchanged between the Web service and the client.

migration

The process of moving a virtual machine between hosts. Unless VMotion or Storage VMotion is used, the virtual machine must be powered off when you migrate it. See also migration with VMotion.

migration with VMotion

The process of moving a virtual machine that is powered on and meets selected requirements, including the activation of VMotion on both the source and target hosts. When you migrate a virtual machine using VMotion, the operations of the virtual machine can continue without interruption.

MKS (mouse, keyboard, screen)

A set of basic input-output services for user interaction with a virtual machine.

MoRef (managed object reference)

A managed object has a MoRef that is server-specific. The MoRef is a pointer to an object.

MSCS (Microsoft Cluster Service)

Software that distributes data among the nodes of the cluster. If one node fails, other nodes provide failover support for applications such as databases, file servers, and mail servers.

name

A path (such as a URL) that refers to an object or the name of an item of information in the server.

NAS (network-attached storage)

A complete storage system that is designed to be attached to a traditional data network.

NAT (network address translation)

In hosted networking, a type of network connection that enables you to connect your virtual machines to an external network when you have only one IP network address and the host computer uses that address. The VMware NAT device passes network data between one or more virtual machines and the external network. It identifies incoming data packets intended for each virtual machine and sends them to the correct destination. See also host-only networking.

nbtstat command

A diagnostic command that helps determine how a system name or IP address is resolved. Because it can display current connections using NetBIOS over TCP/IP, `nbtstat` is useful for determining whether Windows systems are online from a NetBIOS view. See also NetBIOS (network basic input/output system).

NetBIOS (network basic input/output system)

An API that enables applications on different computers to communicate across a LAN. NetBIOS provides the name service and offers two communication modes: session service for connection-oriented communication and datagram distribution service for connectionless communication.

Network access

Policies that give you detailed and flexible control over the network access you can provide to users of your ACE instances. Using a packet filtering firewall, the network access feature lets you specify exactly which machines or subnets an ACE instance or its host system may access.

network quarantine

A set of controls, governed by policies, that ensure only up-to-date virtual machines have access to specified resources on an organization's network. These controls enable administrators to specify which machines or subnets a virtual machine may access.

NIC (network interface card)

An expansion board that provides a dedicated connection between a computer and a network. Also called a network adapter.

NIC teaming

The association of multiple NIC adapters with a single virtual switch to form a team. Such teams can provide passive failover and share traffic loads between members of physical and virtual networks.

NLB (Network Load Balancing)

A Microsoft clustering technology that load balances incoming IP traffic across a cluster of nodes for applications such as Web servers and terminal services.

nonpersistent mode

A disk mode in which all disk writes issued by software running inside a virtual machine appear to be written to the independent disk. In fact, they are discarded after the virtual machine is powered off. As a result, a virtual disk or physical disk in independent-nonpersistent mode is not modified by activity in the virtual machine. See also disk mode, persistent mode.

not-shared storage

Amount of storage that is used only by a virtual machine and is not shared with other virtual machines. (This terms was formerly called unshared storage.) Also, the amount of guaranteed storage which can be reclaimed if a virtual machine is migrated out of a datastore or is deleted.

NTFS file system

The correct, redundant use of new technology file system.

NTP (Network Time Protocol)

A protocol for distributing the Coordinated Universal Time (UTC) by synchronizing the clocks of computer systems over packet-switched, variable-latency data networks.

open virtual appliance (OVA)

A packaging format for virtual machines that allows virtual machine templates to be distributed, customized, and instantiated on any OVA supporting VMM.

Open Virtualization Format (OVF)

A distribution format for virtual appliances that uses existing packaging tools to combine one or more virtual machines with a standards-based XML wrapper. OVF gives the virtualization platform a portable package containing all required installation and configuration parameters for virtual machines. This format allows any virtualization platform that implements the standard to correctly install and run virtual machines.

OUI (organizationally unique identifier)

An IEEE-assigned manufacturer ID value for MAC addresses, Fibre Channel nodes, and ports.

package

An installable bundle for distribution to end users. The package might include one or more virtual machines and an application used to run virtual machines.

page file

A component of an operating system that provides virtual memory for the system. Recently used pages of memory are swapped out to this area on the disk to make room in physical memory (RAM) for newer memory pages. Also called a "swap file." See also virtual memory.

PAM (pluggable authentication module)

A mechanism (developed at Sun Microsystems) for integrating a variety of existing authentication technologies in a UNIX or Linux environment. A set of modules can be plugged in to customize the authentication of users or programs.

paravirtual device

A device designed with specific awareness that it is running in a virtualized environment.

paravirtual appliance

Free virtual machines that are intended to demonstrate the Virtual Machine Interface (VMI) for virtual machine hypervisors. See also hypervisor.

parent

(1) The source virtual machine from which you take a snapshot or make a clone. If you delete the parent virtual machine, any snapshot becomes permanently disabled. (2) In a VMware vSphere inventory, the managed entity that immediately encloses a given entity (considered the child entity). See also full clone, linked clone, snapshot, template.

Perfmon

A tool that enables user-level applications to collect and access performance statistics. Some form of performance monitoring is available on all Windows, Linux, and UNIX platforms, although the specific information collected and made available varies.

permission

A data object consisting of an authorization role, a user or group name, and a managed entity reference. A permission allows a specified user to access the entity (such as a virtual machine) with any of the privileges pertaining to the role.

persistent mode

A disk mode in which all disk writes issued by software running inside a virtual machine are immediately and permanently written to a virtual disk that is configured as an independent disk. As a result, a virtual disk or physical disk in independent-persistent mode behaves like a conventional disk drive on a physical computer. See also disk mode, nonpersistent mode.

physical CPU

A single physical CPU in a physical machine.

physical disk

In hosted products, a hard disk in a virtual machine that is mapped to a physical disk drive or partition on the host machine. A virtual machine's disk can be stored as a file on the host file system or on a local hard disk. When a virtual machine is configured to use a physical disk, vCenter Server directly accesses the local disk or partition as a raw device (not as a file on a file system). See also virtual disk.

physical Ethernet

Manages network traffic between machines on the physical network. A switch has multiple ports, each of which can be connected to a single other machine or another switch on the network.

physical network

A network of physical machines (plus cabling, switches, routers, and so on) that are connected so that they can send data to and receive data from each other. See also virtual network.

policy

A set of system enforced rules that automatically execute or inhibit actions upon entities such as virtual machines, processes, and users. Policies are set in the policy editor.

port group

A construct for configuring virtual network options such as bandwidth limitations and VLAN tagging policies for each member port. Virtual networks that are connected to the same port group, share network policy configuration. See also virtual network, VLAN (virtual local area network).

privilege

Authorization to perform a specific action or set of actions on a managed object or group of managed objects.

property

An attribute of an object. In the VMware vSphere SDK, a property can be a nested data object, a managed object reference, or other data such as an integer or string.

property collector

A managed object used to control the reporting of managed object properties and the primary means of monitoring status on host machines.

provisioning

The process of creating a functioning virtual machine by assigning resources such as CPU, memory, and virtual hardware and then deploying a system image.

quick switch mode

A display mode in which the virtual machine's display fills most of the screen. In this mode, tabs at the top of the screen enable you to switch quickly from one running virtual machine to another. See also full screen switch mode.

raw disk

See physical disk.

RDM (raw device mapping)

A mechanism that enables a virtual machine to have direct access to a LUN on the physical storage subsystem (Fibre Channel or iSCSI only). At the same time, the virtual machine has access to the disk that is using a mapping file in the VMFS name space.

read-only user

A role in which the user is allowed to view the inventory but not allowed to perform any tasks.

redo-log file

The file that stores changes made to a disk in all modes except the persistent and independent-persistent modes. For a disk in nonpersistent mode, the redo-log file is deleted when you power off or reset the virtual machine without writing any changes to the disk. You can permanently apply the changes saved in the redo-log file to a disk in undoable mode so that they become part of the main disk files. See also disk mode.

remote console

An interface that provides nonexclusive access to a virtual machine from the server on which the virtual machine is running and from workstations connected to that server.

resource pool

A division of computing resources used to manage allocations between virtual machines.

resume

To return a virtual machine to operation from its suspended state. When you resume a suspended virtual machine, all applications are in the same state as when the virtual machine was suspended. See also suspend.

revert to snapshot

To restore the status of the active virtual machine to its immediate parent snapshot. This parent is represented in the Snapshot manager by the snapshot appearing to the left of the **You are here** icon. See also Go to snapshot, Snapshot Manager, You are here icon.

role

A defined set of privileges that can be assigned to users and groups to control access to VMware vSphere objects.

root user

The superuser who has full administrative privileges to log in to an ESX Server host. The root user can manipulate permissions, create users and groups, and work with events.

SAN (storage area network)

A large-capacity network of storage devices that can be shared among multiple VMware ESX server hosts. A SAN is required for VMotion.

SATA (serial advanced technology attachment)

A standard, based on serial signaling technology, for connecting computers and hard drives. Also called Serial ATA.

scheduled task

A vCenter Server activity that is configured to occur at designated times. In VMware Converter, scheduled tasks consist of migrations and configurations of virtual machines.

SDK (software development kit)

A set of tools for programmers who are developing software for a particular platform. A VMware SDK might include an API, an IDL, client stubs, sample code, and documentation.

server

(1) A system capable of managing and running virtual machines. (2) A process capable of accepting and executing instructions from another process.

server-based licensing

A mode of licensing VMware software in which all license keys are administered by a license server, which manages a central license pool. Feature entitlement is checked out and returned on demand. See also host-based licensing.

service console

The command-line interface for an ESX server system that enables administrators to configure the system. The service console is installed as the first component and used to bootstrap the ESX server installation and configuration. The service console also boots the system and initiates execution of the virtualization layer and resource manager. You can open the service console directly on an ESX server system. If the ESX server system's configuration allows Telnet or SSH connections, you can also connect remotely to the service console.

service host

The host on which a Web service executes.

service instance

In the VMware vSphere SDK, the managed entity that provides access to all other managed entities. Clients must access the service instance to begin a session.

shared folder

A folder on a host computer—or on a network drive accessible from the host computer—that can be used by both the host computer and one or more virtual machines. It provides a simple way of sharing files between host and guest or among virtual machines. In a Windows virtual machine, shared folders appear in **My Network Places** (**Network Neighborhood** in a Windows NT virtual machine) under **VMware Shared Folders**. In a Linux virtual machine, shared folders appear under a specified mount point.

shrink

To reclaim unused space in a virtual disk. If a disk has empty space, shrinking reduces the amount of space the virtual disk occupies on the host drive. Shrinking virtual disks is a way to update an older virtual disk to the format supported by the current version of vCenter Server. You cannot shrink preallocated virtual disks or physical disks.

slot

A unit of CPU and memory that can accommodate the CPU and memory reservation requirements of the largest virtual machine in your cluster. Spare capacity for failover is maintained on hosts in the cluster in slot sizes, so that any virtual machine in the cluster can fit in the slot size and be able to be failed over. Represents potential computing capacity on a node. A virtual machine can run in an empty slot in the event of failover.

Technical definition: A unit of CPU and memory that can accommodate the CPU and memory reservation requirements of the largest virtual machine in the cluster. Spare capacity for failover is maintained on hosts in the cluster in slot sizes, so that any virtual machine in the cluster can fit in the slot size and be able to be failed over.

snapshot

A reproduction of the virtual machine just as it was when you took the snapshot, including the state of the data on all the virtual machine's disks and the virtual machine's power state (on, off, or suspended). You can take a snapshot when a virtual machine is powered on, powered off, or suspended. See also independent disk.

Snapshot Manager

A control that enables you to take actions on any of the snapshots associated with the selected virtual machine. See also snapshot.

SSH (Secure Shell)

A program for securely logging on to a remote machine and executing commands. SSH provides encrypted communications between two untrusted hosts over a network. SSH can use several forms of encryption and has been ported to multiple platforms, including Linux, Microsoft Windows, and Macintosh.

storage array

A storage system that contains multiple disk drives.

suspend

A state in which settings are preserved and actions are no longer performed. To turn off a virtual machine while preserving the current state of a running virtual machine. See also resume.

target

The object that corresponds to a request URL.

task

A managed object representing the state of a long-running operation.

TCP (Transmission Control Protocol)

A reliable transfer protocol used between two endpoints on a network. TCP is built on top of the Internet Protocol (IP). See also TCP/IP (Transmission Control Protocol/Internet Protocol).

TCP/IP (Transmission Control Protocol/Internet Protocol)

The set of protocols that is the language of the Internet, designed to enable communication between networks regardless of the computing technologies that they use. TCP connects hosts and provides a reliable exchange of data streams with guaranteed delivery. IP specifies the format of packets and handles addressing. See also UDP (User Datagram Protocol).

team

A group of virtual machines configured to operate as one object. You can power on, power off, and suspend a team with one command. You can configure a team to communicate independently of any other virtual or real network by setting up a LAN segment. See also LAN segment, NIC teaming, virtual network.

template

A master image of a virtual machine. The template typically includes a specified operating system and a configuration that provides virtual counterparts to hardware components. Optionally, a template can include an installed guest operating system and a set of applications. Templates are used by vCenter Server to create new virtual machines. See also linked clone, parent, snapshot.

templates list

A list of virtual machines that provides a means to import and store virtual machines as templates. You can deploy the templates at a later time to create new virtual machines.

UDP (User Datagram Protocol)

One of the core protocols in the Internet protocol suite. UDP enables a program to send packets (datagrams) to other programs on remote machines. UDP does not require a connection and does not guarantee reliable communication. It is a quick and efficient method for broadcasting messages over a network. See also TCP/IP (Transmission Control Protocol/Internet Protocol).

UUID (universally unique identifier)

A number used to uniquely identify some object or entity. The UUID is either assigned by VMware vSphere (in the case of virtual machines) or is hardware-assigned (in the case of SCSI LUNs). vCenter Server attempts to ensure that the UUIDs of all virtual machines being managed are unique, changing the UUIDs of conflicting virtual machines if necessary.

VCS (Veritas Cluster Server)

Symantec clustering software for reducing application downtime. VCS runs on UNIX, Linux, Windows, and VMware systems.

view

(1) An XML document that contains information about objects, particularly virtual machines and hosts. Use a view to access virtual machines and other top-level objects through the Web service. (2) In the Perl Toolkit, an object stored in the client that encapsulates the properties of a managed object with methods to access the properties and act on the managed object.

view definition

An XML document that specifies the elements that appear in a view. View definitions typically specify the items of interest in the view but might include additional elements for presentation or computation related to those items.

virtual appliance

A software solution that is composed of one or more virtual machines. A virtual appliance is packaged as a unit by an appliance vendor and is deployed, managed, and maintained as a unit. Converting virtual appliances allows you to add preconfigured virtual machines to your Virtual Center, ESX Server, Workstation, or Player inventory.

vCenter Server administrator

A role in which the user can set the user+role permissions and control vCenter Server licensing.

vCenter Server agent

Installed on each virtual machine host, this software coordinates actions received from the vCenter Server.

vCenter Server database

A persistent storage area for maintaining the status of each virtual machine and user that is managed in the vCenter Server environment. Located on the same machine as the vCenter Server.

virtual disk

A file or set of files that appears as a physical disk drive to a guest operating system. These files can be on the host machine or on a remote file system. See also growable disk, physical disk.

virtual hardware

The devices that make up a virtual machine. The virtual hardware includes the virtual disk, removable devices such as the DVD-ROM/CD-ROM and floppy drives, and the virtual Ethernet adapter. See also virtual machine settings editor.

virtual machine

A virtual machine is a software computer that, like a physical computer, runs an operating system and applications. Multiple virtual machines can operate on the same host system concurrently.

See the guidelines for using the acronym VM in place of virtual machine.

virtual machine administrator

A role in which the user can perform all the virtual machine management functions.

virtual machine array

A set of virtual machines that can be operated on collectively. Currently called a VM Group or VM Folder in vCenter Server.

virtual machine configuration

The specification of which virtual devices, such as disks and memory, are present in a virtual machine and how they are mapped to host files and devices. In vConverter, VMware virtual machines whose disks have been populated by restoring from a backup or by some other direct means of copying undergo configuration to enable them to boot in VMware products. See also virtual machine.

virtual machine configuration file

A file containing a virtual machine configuration. This `.vmx` file is created when you create the virtual machine. It is used to identify and run a specific virtual machine.

virtual machine group

An optional grouping structure and a subset of a farm. vCenter Server supports multiple virtual machine groups. Virtual machine groups contain virtual machines and other virtual machine groups.

Virtual Machine Properties control panel

In vSphere Client, a point-and-click control panel used to view and modify the resource settings of all the virtual machines on a host.

virtual machine settings editor

A point-and-click control panel used to view and modify the settings of a virtual machine setting.

virtual memory

An extension of a system's physical memory, enabled by the declaration of a page file. See also page file.

virtual network

A network connecting virtual machines that does not depend on physical hardware connections. For example, you can create a virtual network between a virtual machine and a host that has no external network connections. You can also create a LAN segment for communication between virtual machines on a team. See also LAN segment, team.

virtual switch

A virtualized network switch used by ESX server to manage traffic between virtual machines, the service console, and the physical network adapters on the ESX server machine.

VLAN (virtual local area network)

A software-managed logical segmentation of a physical LAN. Network traffic within each segment is isolated from traffic in all other segments.

VM (acronym for virtual machine)

Restricted use. A virtual machine is a software computer that, like a physical computer, runs an operating system and applications. A virtual machine is also referred to as a VM. Use the acronym VM when the screen or controls do not have sufficient space to use the complete term virtual machine.

VMA (VMware virtual machine agent)

The VMware vCenter Server Web service that provides a Web services interface that enables client programs to talk to each other using the SOAP protocol.

VMFS (Virtual Machine File System)

A file system that is optimized for storing virtual machines. One VMFS partition is supported per SCSI storage device or LUN. Each version of ESX server uses a corresponding version of VMFS. For example, VMFS3 was introduced with ESX Server 3.

VMkernel

In ESX server, a high-performance operating system that occupies the virtualization layer and manages most of the physical resources on the hardware, including memory, physical processors, storage, and networking controllers.

VMM (virtual machine monitor)

Software that is responsible for virtualizing the CPUs. One VMM runs in kernel space for each running virtual machine.

VMware guest operating system service

A component installed with VMware Tools that executes commands in the virtual machine, gracefully shuts down and resets the virtual machine, sends a heartbeat to VMware Migration Server, synchronizes the time of the guest operating system with the host operating system, and passes strings from the host operating system to the guest operating system.

VMware virtual machine console

An interface that provides access to one or more virtual machines on the local host or on a remote host running vCenter Server. You can view a virtual machine's display to run programs within it, or you can modify guest operating system settings. You can also change the virtual machine's configuration, install the guest operating system, or run the virtual machine in full screen mode.

vNetwork Distributed Switch (DVS)

An abstraction representation of multiple hosts defining the same vSwitch (same name, same network policy) and portgroup. These representations are needed to explain the concept of a virtual machine being connected to the same network as it migrates among multiple hosts.

VNIC

A virtual network interface card that is configured on top of a system's physical Network adapter. See also NIC (network interface card).

vSwitch

See virtual switch.

WAN (wide area network)

A computer network that connects a wider area than a local area network, typically by use of high-speed, long-distance communications technology.

WWPN (World Wide Port Name)

The identifier for a network port in a Fibre Channel SAN.

You are here icon

An icon in the Snapshot manager that indicates the current status of the active virtual machine. Checking the position of this icon can help you decide whether to revert to a snapshot or go to a snapshot. See also Go to snapshot, revert to snapshot, Snapshot Manager.

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