vSphere Security

ESXi 5.1
vCenter Server 5.1

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About vSphere Security

vSphere Security provides information about securing your vSphere® environment for VMware® vCenter® Server and VMware ESXi.

To help you protect your ESXi™ installation, this documentation describes security features built in to ESXi and the measures that you can take to safeguard it from attack.

Intended Audience

This information is intended for anyone who wants to secure their ESXi configuration. The information is written for experienced Windows or Linux system administrators who are familiar with virtual machine technology and datacenter operations.

Updated Information

This *vSphere Security* documentation is updated with each release of the product or when necessary.

This table provides the update history of the *vSphere Security* documentation.

Revision	Description
EN-000792-02	■ Corrected command syntax in "Import vCenter Single Sign On Multisite Replication Data," on page 108. ■ Added 'Turn off the Virtual Machine' to the prerequisites in "Modify Guest Operating System Variable Memory Limit in the vSphere Web Client," on page 135 and "Prevent the Guest Operating System Processes from Sending Configuration Messages to the Host in the vSphere Web Client," on page 135. ■ Minor edits.
EN- 000792-01	■ Added section on troubleshooting Single Sign-On, at "Troubleshooting vCenter Single Sign-On," on page 108. ■ Updated list of TCP and UDP ports needed for vCenter Virtual Appliance at "TCP and UDP Ports for Management Access," on page 23 ■ Added note indicating that the process for configuring and replacing certificates is different for the vCenter Server Virtual Appliance. ■ Changed Note text, User name description, and Password description in Step 4 of "Add a vCenter Single Sign On Identity Source," on page 89. ■ Minor edits.
EN- 000792-00	Initial release.

Security for ESXi Systems 1

ESXi is developed with a focus on strong security. VMware ensures security in the ESXi environment and addresses system architecture from a security standpoint.

This chapter includes the following topics:

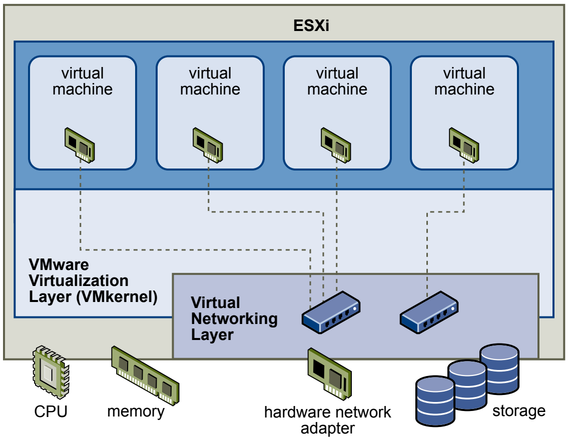
- "ESXi Architecture and Security Features," on page 11
- "Security Resources and Information," on page 18

ESXi Architecture and Security Features

The components and the overall architecture of ESXi are designed to ensure security of the ESXi system as a whole.

From a security perspective, ESXi consists of three major components: the virtualization layer, the virtual machines, and the virtual networking layer.

Figure 1-1. ESXi Architecture



Security and the Virtualization Layer

VMware designed the virtualization layer, or VMkernel, to run virtual machines. It controls the hardware that hosts use and schedules the allocation of hardware resources among the virtual machines. Because the VMkernel is fully dedicated to supporting virtual machines and is not used for other purposes, the interface to the VMkernel is strictly limited to the API required to manage virtual machines.

ESXi provides additional VMkernel protection with the following features:

Memory Hardening

The ESXi kernel, user-mode applications, and executable components such as drivers and libraries are located at random, non-predictable memory addresses. Combined with the non-executable memory protections made available by microprocessors, this provides protection that makes it difficult for malicious code to use memory exploits to take advantage of vulnerabilities.

Kernel Module Integrity

Digital signing ensures the integrity and authenticity of modules, drivers and applications as they are loaded by the VMkernel. Module signing allows ESXi to identify the providers of modules, drivers, or applications and whether they are VMware-certified. VMware software and certain third-party drivers are signed by VMware.

Trusted Platform Module (TPM)

vSphere uses Intel Trusted Platform Module/Trusted Execution Technology (TPM/TXT) to provide remote attestation of the hypervisor image based on hardware root of trust. The hypervisor image comprises the following elements:

- ESXi software (hypervisor) in VIB (package) format
- Third-party VIBs
- Third-party drivers

To leverage this capability, your ESXi system must have TPM and TXT enabled.

When TPM and TXT are enabled, ESXi measures the entire hypervisor stack when the system boots and stores these measurements in the Platform Configuration Registers (PCR) of the TPM. The measurements include the VMkernel, kernel modules, drivers, native management applications that run on ESXi, and any boot-time configuration options. All VIBs that are installed on the system are measured.

Third-party solutions can use this feature to build a verifier that detects tampering of the hypervisor image, by comparing the image with an image of the expected known good values. vSphere does not provide a user interface to view these measurements.

The measurements are exposed in a vSphere API. An event log is provided as part of the API, as specified by the Trusted Computing Group (TCG) standard for TXT.

Security and Virtual Machines

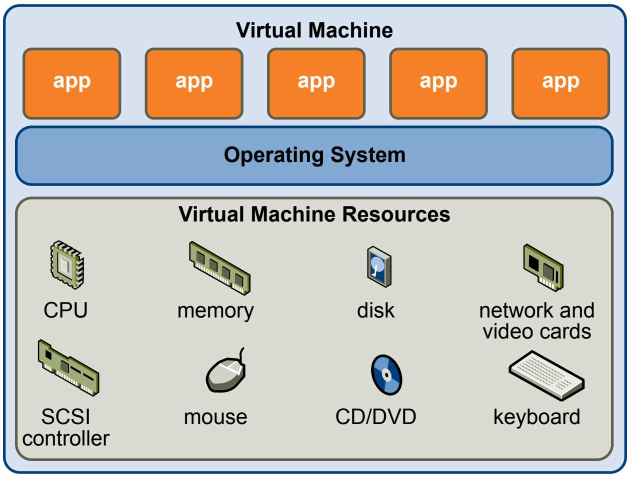
Virtual machines are the containers in which applications and guest operating systems run. By design, all VMware virtual machines are isolated from one another. This isolation enables multiple virtual machines to run securely while sharing hardware and ensures both their ability to access hardware and their uninterrupted performance.

Even a user with system administrator privileges on a virtual machine's guest operating system cannot breach this layer of isolation to access another virtual machine without privileges explicitly granted by the ESXi system administrator. As a result of virtual machine isolation, if a guest operating system running in a virtual machine fails, other virtual machines on the same host continue to run. The guest operating system failure has no effect on:

- The ability of users to access the other virtual machines
- The ability of the operational virtual machines to access the resources they need
- The performance of the other virtual machines

Each virtual machine is isolated from other virtual machines running on the same hardware. Although virtual machines share physical resources such as CPU, memory, and I/O devices, a guest operating system on an individual virtual machine cannot detect any device other than the virtual devices made available to it.

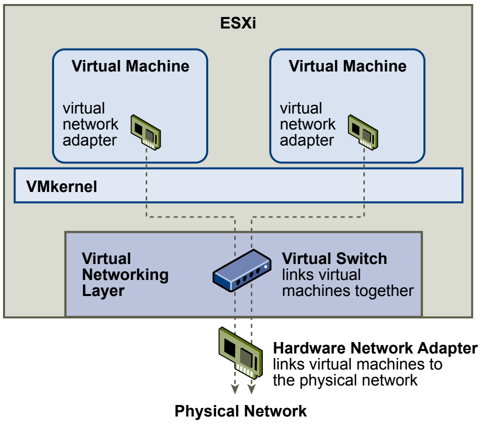
Figure 1-2. Virtual Machine Isolation



Because the VMkernel mediates the physical resources and all physical hardware access takes place through the VMkernel, virtual machines cannot circumvent this level of isolation.

Just as a physical machine communicates with other machines in a network through a network card, a virtual machine communicates with other virtual machines running in the same host through a virtual switch. Further, a virtual machine communicates with the physical network, including virtual machines on other ESXi hosts, through a physical network adapter.

Figure 1-3. Virtual Networking Through Virtual Switches



These characteristics apply to virtual machine isolation in a network context:

- If a virtual machine does not share a virtual switch with any other virtual machine, it is completely isolated from virtual networks within the host.
- If no physical network adapter is configured for a virtual machine, the virtual machine is completely isolated from any physical networks.
- If you use the same safeguards (firewalls, antivirus software, and so forth) to protect a virtual machine from the network as you would for a physical machine, the virtual machine is as secure as the physical machine.

You can further protect virtual machines by setting up resource reservations and limits on the host. For example, through the detailed resource controls available in ESXi, you can configure a virtual machine so that it always receives at least 10 percent of the host's CPU resources, but never more than 20 percent.

Resource reservations and limits protect virtual machines from performance degradation that would result if another virtual machine consumed excessive shared hardware resources. For example, if one of the virtual machines on a host is incapacitated by a denial-of-service (DoS) attack, a resource limit on that machine prevents the attack from taking up so much of the hardware resources that the other virtual machines are also affected. Similarly, a resource reservation on each of the virtual machines ensures that, in the event of high resource demands by the virtual machine targeted by the DoS attack, all the other virtual machines still have enough resources to operate.

By default, ESXi imposes a form of resource reservation by applying a distribution algorithm that divides the available host resources equally among the virtual machines while keeping a certain percentage of resources for use by other system components. This default behavior provides a degree of natural protection from DoS and distributed denial-of-service (DDoS) attacks. You set specific resource reservations and limits on an individual basis to customize the default behavior so that the distribution is not equal across the virtual machine configuration.

Security and the Virtual Networking Layer

The virtual networking layer includes virtual network adapters and virtual switches. ESXi relies on the virtual networking layer to support communications between virtual machines and their users. In addition, hosts use the virtual networking layer to communicate with iSCSI SANs, NAS storage, and so forth.

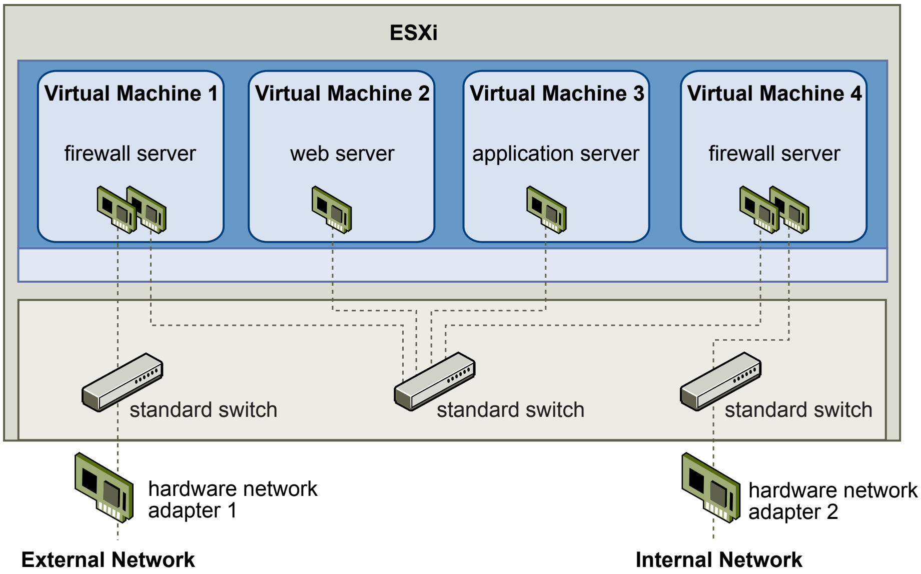
The methods you use to secure a virtual machine network depend on which guest operating system is installed, whether the virtual machines operate in a trusted environment, and a variety of other factors. Virtual switches provide a substantial degree of protection when used with other common security practices, such as installing firewalls.

ESXi also supports IEEE 802.1q VLANs, which you can use to further protect the virtual machine network or storage configuration. VLANs let you segment a physical network so that two machines on the same physical network cannot send packets to or receive packets from each other unless they are on the same VLAN.

Creating a Network DMZ on a Single ESXi Host

One example of how to use ESXi isolation and virtual networking features to configure a secure environment is the creation of a network demilitarized zone (DMZ) on a single host.

Figure 1-4. DMZ Configured on a Single ESXi Host



In this example, four virtual machines are configured to create a virtual DMZ on Standard Switch 2:

- Virtual Machine 1 and Virtual Machine 4 run firewalls and are connected to virtual adapters through standard switches. Both of these virtual machines are multi homed.
- Virtual Machine 2 runs a Web server, and Virtual Machine 3 runs as an application server. Both of these virtual machines are single-homed.

The Web server and application server occupy the DMZ between the two firewalls. The conduit between these elements is Standard Switch 2, which connects the firewalls with the servers. This switch has no direct connection with any elements outside the DMZ and is isolated from external traffic by the two firewalls.

From an operational viewpoint, external traffic from the Internet enters Virtual Machine 1 through Hardware Network Adapter 1 (routed by Standard Switch 1) and is verified by the firewall installed on this machine. If the firewall authorizes the traffic, it is routed to the standard switch in the DMZ, Standard Switch 2. Because the Web server and application server are also connected to this switch, they can serve external requests.

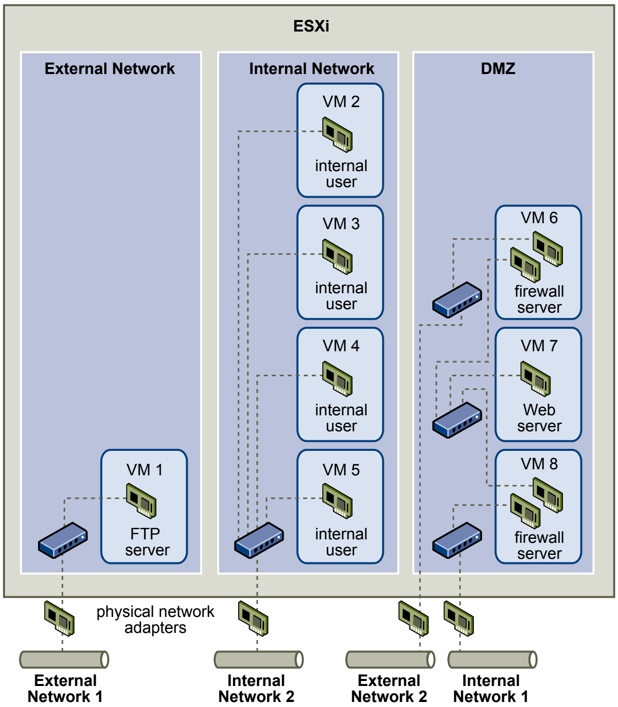
Standard Switch 2 is also connected to Virtual Machine 4. This virtual machine provides a firewall between the DMZ and the internal corporate network. This firewall filters packets from the Web server and application server. If a packet is verified, it is routed to Hardware Network Adapter 2 through Standard Switch 3. Hardware Network Adapter 2 is connected to the internal corporate network.

When creating a DMZ on a single host, you can use fairly lightweight firewalls. Although a virtual machine in this configuration cannot exert direct control over another virtual machine or access its memory, all the virtual machines are still connected through a virtual network. This network could be used for virus propagation or targeted for other types of attacks. The security of the virtual machines in the DMZ is equivalent to separate physical machines connected to the same network.

Creating Multiple Networks Within a Single ESXi Host

The ESXi system is designed so that you can connect some groups of virtual machines to the internal network, others to the external network, and still others to both—all on the same host. This capability is an outgrowth of basic virtual machine isolation coupled with a well-planned use of virtual networking features.

Figure 1-5. External Networks, Internal Networks, and a DMZ Configured on a Single ESXi Host



In the figure, the system administrator configured a host into three distinct virtual machine zones: FTP server, internal virtual machines, and DMZ. Each zone serves a unique function.

FTP server

Virtual Machine 1 is configured with FTP software and acts as a holding area for data sent to and from outside resources such as forms and collateral localized by a vendor.

This virtual machine is associated with an external network only. It has its own virtual switch and physical network adapter that connect it to External Network 1. This network is dedicated to servers that the company uses to receive data from outside sources. For example, the company uses External Network 1 to receive FTP traffic from vendors and allow vendors access to data stored on externally available servers though FTP. In addition to servicing Virtual Machine 1, External Network 1 services FTP servers configured on different ESXi hosts throughout the site.

Because Virtual Machine 1 does not share a virtual switch or physical network adapter with any virtual machines in the host, the other resident virtual machines cannot transmit packets to or receive packets from the Virtual Machine 1 network. This restriction prevents sniffing attacks, which require sending network traffic to the victim. More importantly, an attacker cannot use the natural vulnerability of FTP to access any of the host's other virtual machines.

Internal virtual machines

Virtual Machines 2 through 5 are reserved for internal use. These virtual machines process and store company-private data such as medical records, legal settlements, and fraud investigations. As a result, the system administrators must ensure the highest level of protection for these virtual machines.

These virtual machines connect to Internal Network 2 through their own virtual switch and network adapter. Internal Network 2 is reserved for internal use by personnel such as claims processors, in-house lawyers, or adjustors.

Virtual Machines 2 through 5 can communicate with one another through the virtual switch and with internal virtual machines elsewhere on Internal Network 2 through the physical network adapter. They cannot communicate with externally facing machines. As with the FTP server, these virtual machines cannot send packets to or receive packets from the other virtual machines' networks. Similarly, the host's other virtual machines cannot send packets to or receive packets from Virtual Machines 2 through 5.

DMZ

Virtual Machines 6 through 8 are configured as a DMZ that the marketing group uses to publish the company's external Web site.

This group of virtual machines is associated with External Network 2 and Internal Network 1. The company uses External Network 2 to support the Web servers that use the marketing and financial department to host the corporate Web site and other Web facilities that it hosts to outside users. Internal Network 1 is the conduit that the marketing department uses to publish content to the corporate Web site, post downloads, and maintain services like user forums.

Because these networks are separate from External Network 1 and Internal Network 2, and the virtual machines have no shared points of contact (switches or adapters), there is no risk of attack to or from the FTP server or the internal virtual machine group.

By capitalizing on virtual machine isolation, correctly configuring virtual switches, and maintaining network separation, the system administrator can house all three virtual machine zones in the same ESXi host and be confident that there will be no data or resource breaches.

The company enforces isolation among the virtual machine groups by using multiple internal and external networks and making sure that the virtual switches and physical network adapters for each group are completely separate from those of other groups.

Because none of the virtual switches straddle virtual machine zones, the system administrator succeeds in eliminating the risk of packet leakage from one zone to another. A virtual switch, by design, cannot leak packets directly to another virtual switch. The only way for packets to travel from one virtual switch to another is under the following circumstances:

- The virtual switches are connected to the same physical LAN.
- The virtual switches connect to a common virtual machine, which could be used to transmit packets.

Neither of these conditions occur in the sample configuration. If system administrators want to verify that no common virtual switch paths exist, they can check for possible shared points of contact by reviewing the network switch layout in the vSphere Client.

To safeguard the virtual machines' resources, the system administrator lowers the risk of DoS and DDoS attacks by configuring a resource reservation and a limit for each virtual machine. The system administrator further protects the ESXi host and virtual machines by installing software firewalls at the front and back ends of the DMZ, ensuring that the host is behind a physical firewall, and configuring the networked storage resources so that each has its own virtual switch.

Security Resources and Information

You can find additional information about security on the VMware Web site.

The table lists security topics and the location of additional information about these topics.

Table 1-1. VMware Security Resources on the Web

Topic	Resource
VMware security policy, up-to-date security alerts, security downloads, and focus discussions of security topics	http://www.vmware.com/security/
Corporate security response policy	http://www.vmware.com/support/policies/security_response.html VMware is committed to helping you maintain a secure environment. Security issues are corrected in a timely manner. The VMware Security Response Policy states our commitment to resolve possible vulnerabilities in our products.
Third-party software support policy	http://www.vmware.com/support/policies/ VMware supports a variety of storage systems, software agents such as backup agents, system management agents, and so forth. You can find lists of agents, tools, and other software that supports ESXi by searching http://www.vmware.com/vmtn/resources/ for ESXi compatibility guides. The industry offers more products and configurations than VMware can test. If VMware does not list a product or configuration in a compatibility guide, Technical Support will attempt to help you with any problems, but cannot guarantee that the product or configuration can be used. Always evaluate security risks for unsupported products or configurations carefully.
General information about virtualization and security	VMware Virtual Security Technical Resource Center http://www.vmware.com/go/security/
Compliance and security standards, as well as partner solutions and in-depth content about virtualization and compliance	http://www.vmware.com/go/compliance/
Information about VMsafe technology for protection of virtual machines, including a list of partner solutions	http://www.vmware.com/go/vmsafe/

Securing ESXi Configurations 2

You can take measures to promote a secure environment for your ESXi hosts, virtual machines, and iSCSI SANs. Consider network configuration planning from a security perspective and the steps that you can take to protect the components in your configuration from attack.

This chapter includes the following topics:

Securing the Network with Firewalls

Security administrators use firewalls to safeguard the network or selected components in the network from intrusion.

Firewalls control access to devices within their perimeter by closing all communication pathways, except for those that the administrator explicitly or implicitly designates as authorized. The pathways, or ports, that administrators open in the firewall allow traffic between devices on different sides of the firewall.

IMPORTANT The ESXi firewall in ESXi 5.0 does not allow per-network filtering of vMotion traffic. Therefore, you must install rules on your external firewall to ensure that no incoming connections can be made to the vMotion socket.

In a virtual machine environment, you can plan your layout for firewalls between components.

- Physical machines such as vCenter Server systems and ESXi hosts.
- One virtual machine and another—for example, between a virtual machine acting as an external Web server and a virtual machine connected to your company's internal network.
- A physical machine and a virtual machine, such as when you place a firewall between a physical network adapter card and a virtual machine.

How you use firewalls in your ESXi configuration is based on how you plan to use the network and how secure any given component needs to be. For example, if you create a virtual network where each virtual machine is dedicated to running a different benchmark test suite for the same department, the risk of unwanted access from one virtual machine to the next is minimal. Therefore, a configuration where firewalls are present between the virtual machines is not necessary. However, to prevent interruption of a test run from an outside host, you might set up the configuration so that a firewall is present at the entry point of the virtual network to protect the entire set of virtual machines.

Firewalls for Configurations with vCenter Server

If you access ESXi hosts through vCenter Server, you typically protect vCenter Server using a firewall. This firewall provides basic protection for your network.

A firewall might lie between the clients and vCenter Server. Alternatively, vCenter Server and the clients can be behind the firewall, depending on your deployment. The main point is to ensure that a firewall is present at what you consider to be an entry point for the system.

For a comprehensive list of TCP and UDP ports, including those for vSphere vMotion™ and vSphere Fault Tolerance, see "TCP and UDP Ports for Management Access," on page 23.

Networks configured with vCenter Server can receive communications through the vSphere Client or third-party network management clients that use the SDK to interface with the host. During normal operation, vCenter Server listens for data from its managed hosts and clients on designated ports. vCenter Server also assumes that its managed hosts listen for data from vCenter Server on designated ports. If a firewall is present between any of these elements, you must ensure that the firewall has open ports to support data transfer.

You might also include firewalls at a variety of other access points in the network, depending on how you plan to use the network and the level of security various devices require. Select the locations for your firewalls based on the security risks that you have identified for your network configuration. The following is a list of firewall locations common to ESXi implementations.

- Between the vSphere Client or a third-party network-management client and vCenter Server.
- If your users access virtual machines through a Web browser, between the Web browser and the ESXi host.
- If your users access virtual machines through the vSphere Client, between the vSphere Client and the ESXi host. This connection is in addition to the connection between the vSphere Client and vCenter Server, and it requires a different port.
- Between vCenter Server and the ESXi hosts.
- Between the ESXi hosts in your network. Although traffic between hosts is usually considered trusted, you can add firewalls between them if you are concerned about security breaches from machine to machine.

  If you add firewalls between ESXi hosts and plan to migrate virtual machines between the servers, perform cloning, or use vMotion, you must also open ports in any firewall that divides the source host from the target hosts so that the source and targets can communicate.
- Between the ESXi hosts and network storage such as NFS or iSCSI storage. These ports are not specific to VMware, and you configure them according to the specifications for your network.

Firewalls for Configurations Without vCenter Server

If you connect clients directly to your ESXi network instead of using vCenter Server, your firewall configuration is somewhat simpler.

Networks configured without vCenter Server receive communications through the same types of clients as they do if vCenter Server were present: the vSphere Client or third-party network management clients. For the most part, the firewall needs are the same, but there are several key differences.

- As you would for configurations that include vCenter Server, be sure a firewall is present to protect your ESXi layer or, depending on your configuration, your clients and ESXi layer. This firewall provides basic protection for your network. The firewall ports you use are the same as those you use if vCenter Server is in place.
- Licensing in this type of configuration is part of the ESXi package that you install on each of the hosts. Because licensing is resident to the server, a separate license server is not required. This eliminates the need for a firewall between the license server and the ESXi network.

Connecting to vCenter Server Through a Firewall

The port that vCenter Server uses to listen for data transfer from its clients is 443. If you have a firewall between vCenter Server and its clients, you must configure a connection through which vCenter Server can receive data from the clients.

To enable vCenter Server to receive data from the vSphere Client, open port 443 in the firewall to allow data transfer from the vSphere Client to vCenter Server. Contact the firewall system administrator for additional information on configuring ports in a firewall.

If you are using the vSphere Client and do not want to use port 443 as the port for vSphere Client-to-vCenter Server communication, you can switch to another port by changing the vCenter Server settings in the vSphere Client. To learn how to change these settings, see the *vCenter Server and Host Management* documentation.

Connecting to the Virtual Machine Console Through a Firewall

When you connect your client to ESXi hosts through vCenter Server, certain ports are required for user and administrator communication with virtual machine consoles. These ports support different client functions, interface with different layers on ESXi, and use different authentication protocols.

Port 902

This is the port that vCenter Server assumes is available for receiving data from ESXi. The vSphere Client uses this port to provide a connection for guest operating system mouse, keyboard, screen (MKS) activities on virtual machines. It is through this port that users interact with the virtual machine guest operating systems and applications. Port 902 is the port that the vSphere Client assumes is available when interacting with virtual machines.

Port 902 connects vCenter Server to the host through the VMware Authorization Daemon (`vmware-authd`). This daemon multiplexes port 902 data to the appropriate recipient for processing. VMware does not support configuring a different port for this connection.

Port 443

The vSphere Client and SDK use this port to send data to vCenter Server managed hosts. Also, the vSphere SDK, when connected directly to ESXi, use this port to support any management functions related to the server and its virtual machines. Port 443 is the port that clients assume is available when sending data to ESXi. VMware does not support configuring a different port for these connections.

Port 443 connects clients to ESXi through the Tomcat Web service or the SDK. The host process multiplexes port 443 data to the appropriate recipient for processing.

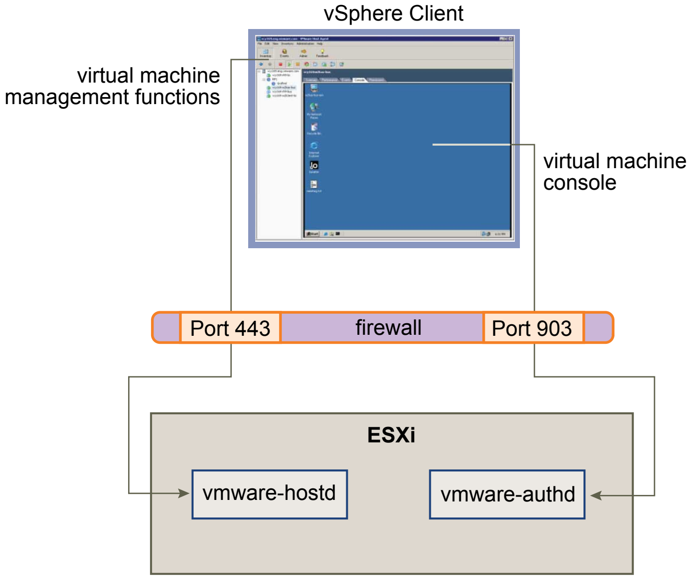
Port 903

The vSphere Client uses this port to provide a connection for guest operating system MKS activities on virtual machines. It is through this port that users interact with the guest operating systems and applications of the virtual machine. Port 903 is the port that the vSphere Client assumes is available when interacting with virtual machines. VMware does not support configuring a different port for this function.

Port 903 connects the vSphere Client to a specified virtual machine configured on ESXi.

The following figure shows the relationships between vSphere Client functions, ports, and processes.

Figure 2-1. Port Use for vSphere Client Communications with ESXi



If you have a firewall between your vCenter Server system and vCenter Server managed host, open ports 443 and 903 in the firewall to allow data transfer to ESXi hosts from vCenter Server .

For additional information on configuring the ports, see the firewall system administrator.

Connecting ESXi Hosts Through Firewalls

If you have a firewall between two ESXi hosts and you want to allow transactions between the hosts or use vCenter Server to perform any source or target activities, such as vSphere High Availability (vSphere HA) traffic, migration, cloning, or vMotion, you must configure a connection through which the managed hosts can receive data.

To configure a connection for receiving data, open ports for traffic from services such as vSphere High Availability, vMotion, and vSphere Fault Tolerance. See "TCP and UDP Ports for Management Access," on page 23 for a list of ports. Refer to the firewall system administrator for additional information on configuring the ports.

TCP and UDP Ports for Management Access

vCenter Server, ESXi hosts, and other network components are accessed using predetermined TCP and UDP ports. If you manage network components from outside a firewall, you might be required to reconfigure the firewall to allow access on the appropriate ports.

The table lists TCP and UDP ports, and the purpose and the type of each. Ports that are open by default at installation time are indicated by (Default).

Table 2-1. TCP and UDP Ports

Port	Purpose	Traffic Type
22	SSH Server	Incoming TCP
53 (Default)	DNS Client	Incoming and outgoing UDP
68 (Default)	DHCP Client	Incoming and outgoing UDP
161 (Default)	SNMP Server	Incoming UDP
80 (Default)	vSphere Fault Tolerance (FT) (outgoing TCP, UDP) HTTP access The default non-secure TCP Web port typically used in conjunction with port 443 as a front end for access to ESXi networks from the Web. Port 80 redirects traffic to an HTTPS landing page (port 443). WS-Management	Incoming TCP Outgoing TCP, UDP
111 (Default)	RPC service used for the NIS register by vCenter Virtual Appliance	Incoming and outgoing TCP
123	NTP Client	Outgoing UDP
135 (Default)	Used to join vCenter Virtual Appliance to sn Active Direcotry domain	Incoming and outgoing TCP
427 (Default)	The CIM client uses the Service Location Protocol, version 2 (SLPv2) to find CIM servers.	Incoming and outgoing UDP
443 (Default)	HTTPS access vCenter Server access to ESXi hosts Default SSL Web port vSphere Client access to vCenter Server vSphere Client access to ESXi hosts WS-Management vSphere Client access to vSphere Update Manager Third-party network management client connections to vCenter Server Third-party network management clients access to hosts	Incoming TCP
513 (Default)	vCenter Virtual Appliance used for logging activity	Incoming UDP

Table 2-1. TCP and UDP Ports (Continued)

Port	Purpose	Traffic Type
902 (Default)	Host access to other hosts for migration and provisioning Authentication traffic for ESXi and remote console traffic (xinetd/vmware-authd) vSphere Client access to virtual machine consoles (UDP) Status update (heartbeat) connection from ESXi to vCenter Server	Incoming and outgoing TCP, outgoing UDP
903	Remote console traffic generated by user access to virtual machines on a specific host. vSphere Client access to virtual machine consoles MKS transactions (xinetd/vmware-authd-mks)	Incoming TCP
1234, 1235 (Default)	vSphere Replication	Outgoing TCP
2049	Transactions from NFS storage devices This port is used on the VMkernel interface.	Incoming and outgoing TCP
3260	Transactions to iSCSI storage devices	Outgoing TCP
5900-5964	RFB protocol, which is used by management tools such as VNC	Incoming and outgoing TCP
5988 (Default)	CIM transactions over HTTP	Incoming TCP
5989 (Default)	CIM XML transactions over HTTPS	Incoming and outgoing TCP
8000 (Default)	Requests from vMotion	Incoming and outgoing TCP
8009	AJP connector port for vCenter Virtual Appliance communication with Tomcat	Outgoing TCP
8100, 8200 (Default)	Traffic between hosts for vSphere Fault Tolerance (FT)	Incoming and outgoing TCP, UDP
8182	Traffic between hosts for vSphere High Availability (HA)	Incoming and outgoing TCP, incoming and outgoing UDP
9009	Used to allow a vCenter Virtual Appliance to communicate with the vSphere Web Client	Incoming and outgoing TCP

In addition to the TCP and UDP ports, you can configure other ports depending on your needs.

Securing Virtual Machines with VLANs

The network can be one of the most vulnerable parts of any system. Your virtual machine network requires as much protection as your physical network. You can add security to your virtual machine network in several ways.

If your virtual machine network is connected to a physical network, it can be subject to breaches to the same degree that a network made up of physical machines is. Even if the virtual machine network is isolated from any physical network, virtual machines in the network can be subject to attacks from other virtual machines in the network. The requirements for securing virtual machines are often the same as those for physical machines.

Virtual machines are isolated from each other. One virtual machine cannot read or write another virtual machine's memory, access its data, use its applications, and so forth. However, within the network, any virtual machine or group of virtual machines can still be the target of unauthorized access from other virtual machines and might require further protection by external means.

You can add this level of security in different ways.

- Adding firewall protection to your virtual network by installing and configuring host-based firewalls on some or all of its virtual machines.

  For efficiency, you can set up private virtual machine Ethernet networks or virtual networks. With virtual networks, you install a host-based firewall on a virtual machine at the head of the virtual network. This serves as a protective buffer between the physical network adapter and the remaining virtual machines in the virtual network.

  Installing a host-based firewall on virtual machines at the head of virtual networks is a good security practice. However, because host-based firewalls can slow performance, balance your security needs against performance before you decide to install host-based firewalls on virtual machines elsewhere in the virtual network.

- Keeping different virtual machine zones within a host on different network segments. If you isolate virtual machine zones on their own network segments, you minimize the risks of data leakage from one virtual machine zone to the next. Segmentation prevents various threats, including Address Resolution Protocol (ARP) spoofing, in which an attacker manipulates the ARP table to remap MAC and IP addresses, thereby gaining access to network traffic to and from a host. Attackers use ARP spoofing to generate Man in the Middle attacks, Denial of Service (DoS) attacks, hijack the target system, and otherwise disrupt the virtual network.

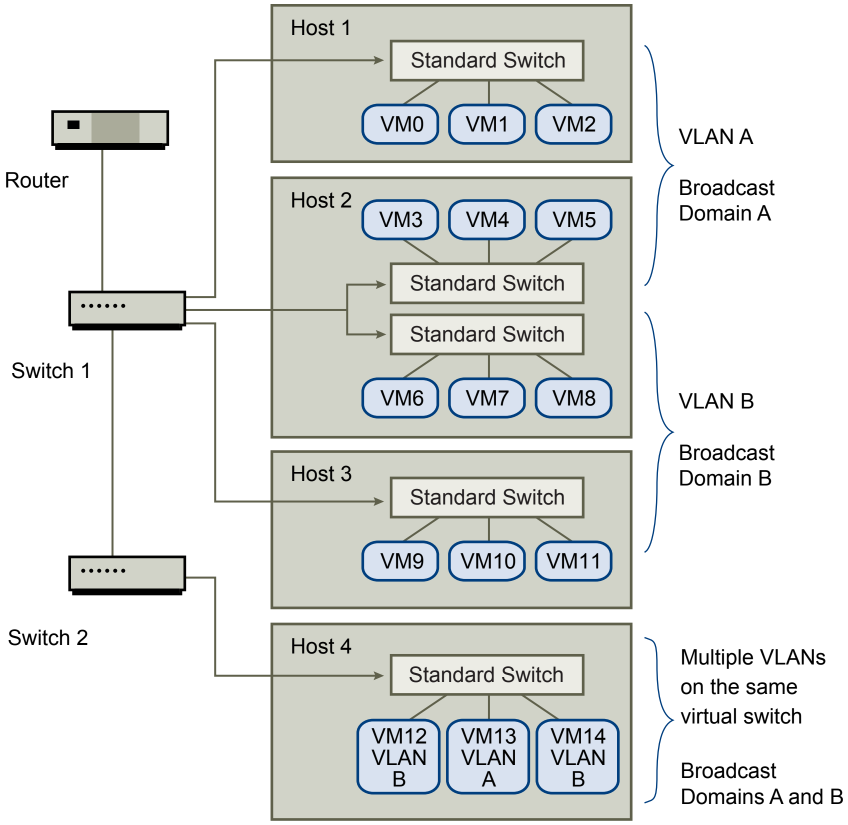
  Planning segmentation carefully lowers the chances of packet transmissions between virtual machine zones, which prevents sniffing attacks that require sending network traffic to the victim. Also, an attacker cannot use an insecure service in one virtual machine zone to access other virtual machine zones in the host. You can implement segmentation by using either of two approaches, each of which has different benefits.

  - Use separate physical network adapters for virtual machine zones to ensure that the zones are isolated. Maintaining separate physical network adapters for virtual machine zones is probably the most secure method and is less prone to misconfiguration after the initial segment creation.
  - Set up virtual local area networks (VLANs) to help safeguard your network. Because VLANs provide almost all of the security benefits inherent in implementing physically separate networks without the hardware overhead, they offer a viable solution that can save you the cost of deploying and maintaining additional devices, cabling, and so forth.

VLANs are an IEEE standard networking scheme with specific tagging methods that allow routing of packets to only those ports that are part of the VLAN. When properly configured, VLANs provide a dependable means for you to protect a set of virtual machines from accidental or malicious intrusions.

VLANs let you segment a physical network so that two machines in the network are unable to transmit packets back and forth unless they are part of the same VLAN. For example, accounting records and transactions are among a company's most sensitive internal information. In a company whose sales, shipping, and accounting employees all use virtual machines in the same physical network, you might protect the virtual machines for the accounting department by setting up VLANs.

Figure 2-2. Sample VLAN Layout



In this configuration, all employees in the accounting department use virtual machines in VLAN A and the employees in sales use virtual machines in VLAN B.

The router forwards packets containing accounting data to the switches. These packets are tagged for distribution to VLAN A only. Therefore, the data is confined to Broadcast Domain A and cannot be routed to Broadcast Domain B unless the router is configured to do so.

This VLAN configuration prevents the sales force from intercepting packets destined for the accounting department. It also prevents the accounting department from receiving packets intended for the sales group. The virtual machines serviced by a single virtual switch can be in different VLANs.

Security Considerations for VLANs

The way you set up VLANs to secure parts of a network depends on factors such as the guest operating system and the way your network equipment is configured.

ESXi features a complete IEEE 802.1q-compliant VLAN implementation. VMware cannot make specific recommendations on how to set up VLANs, but there are factors to consider when using a VLAN deployment as part of your security enforcement policy.

VLANs as Part of a Broader Security Implementation

VLANs are an effective means of controlling where and how widely data is transmitted within the network. If an attacker gains access to the network, the attack is likely to be limited to the VLAN that served as the entry point, lessening the risk to the network as a whole.

VLANs provide protection only in that they control how data is routed and contained after it passes through the switches and enters the network. You can use VLANs to help secure Layer 2 of your network architecture —the data link layer. However, configuring VLANs does not protect the physical layer of your network model or any of the other layers. Even if you create VLANs, provide additional protection by securing your hardware (routers, hubs, and so forth) and encrypting data transmissions.

VLANs are not a substitute for firewalls in your virtual machine configurations. Most network configurations that include VLANs also include firewalls. If you include VLANs in your virtual network, be sure that the firewalls that you install are VLAN-aware.

Properly Configure VLANs

Equipment misconfiguration and network hardware, firmware, or software defects can make a VLAN susceptible to VLAN-hopping attacks.

VLAN hopping occurs when an attacker with authorized access to one VLAN creates packets that trick physical switches into transmitting the packets to another VLAN that the attacker is not authorized to access. Vulnerability to this type of attack usually results from a switch being misconfigured for native VLAN operation, in which the switch can receive and transmit untagged packets.

To help prevent VLAN hopping, keep your equipment up to date by installing hardware and firmware updates as they become available. Also, follow your vendor’s best practice guidelines when you configure your equipment.

VMware standard switches do not support the concept of a native VLAN. All data passed on these switches is appropriately tagged. However, because other switches in the network might be configured for native VLAN operation, VLANs configured with standard switches can still be vulnerable to VLAN hopping.

If you plan to use VLANs to enforce network security, disable the native VLAN feature for all switches unless you have a compelling reason to operate some of your VLANs in native mode. If you must use native VLAN, see your switch vendor’s configuration guidelines for this feature.

Standard Switch Protection and VLANs

VMware standard switches provide safeguards against certain threats to VLAN security. Because of the way that standard switches are designed, they protect VLANs against a variety of attacks, many of which involve VLAN hopping.

Having this protection does not guarantee that your virtual machine configuration is invulnerable to other types of attacks. For example, standard switches do not protect the physical network against these attacks; they protect only the virtual network.

Standard switches and VLANs can protect against the following types of attacks.

MAC flooding

Floods a switch with packets that contain MAC addresses tagged as having come from different sources. Many switches use a content-addressable memory table to learn and store the source address for each packet. When the table is full, the switch can enter a fully open state in which every incoming packet is broadcast on all ports, letting the attacker see all of the switch's traffic. This state might result in packet leakage across VLANs.

Although VMware standard switches store a MAC address table, they do not get the MAC addresses from observable traffic and are not vulnerable to this type of attack.

802.1q and ISL tagging attacks

Force a switch to redirect frames from one VLAN to another by tricking the switch into acting as a trunk and broadcasting the traffic to other VLANs.

VMware standard switches do not perform the dynamic trunking required for this type of attack and, therefore, are not vulnerable.

Double-encapsulation attacks

Occur when an attacker creates a double-encapsulated packet in which the VLAN identifier in the inner tag is different from the VLAN identifier in the outer tag. For backward compatibility, native VLANs strip the outer tag from transmitted packets unless configured to do otherwise. When a native VLAN switch strips the outer tag, only the inner tag is left, and that inner tag routes the packet to a different VLAN than the one identified in the now-missing outer tag.

VMware standard switches drop any double-encapsulated frames that a virtual machine attempts to send on a port configured for a specific VLAN. Therefore, they are not vulnerable to this type of attack.

Multicast brute-force attacks

Involve sending large numbers of multicast frames to a known VLAN almost simultaneously to overload the switch so that it mistakenly allows some of the frames to broadcast to other VLANs.

VMware standard switches do not allow frames to leave their correct broadcast domain (VLAN) and are not vulnerable to this type of attack.

Spanning-tree attacks

Target Spanning-Tree Protocol (STP), which is used to control bridging between parts of the LAN. The attacker sends Bridge Protocol Data Unit (BPDU) packets that attempt to change the network topology, establishing themselves as the root bridge. As the root bridge, the attacker can sniff the contents of transmitted frames.

VMware standard switches do not support STP and are not vulnerable to this type of attack.

Random frame attacks

Involve sending large numbers of packets in which the source and destination addresses stay the same, but in which fields are randomly changed in length, type, or content. The goal of this attack is to force packets to be mistakenly rerouted to a different VLAN.

VMware standard switches are not vulnerable to this type of attack.

Because new security threats develop over time, do not consider this an exhaustive list of attacks. Regularly check VMware security resources on the Web to learn about security, recent security alerts, and VMware security tactics.

Securing Standard Switch Ports

As with physical network adapters, a virtual network adapter can send frames that appear to be from a different machine or impersonate another machine so that it can receive network frames intended for that machine. Also, like physical network adapters, a virtual network adapter can be configured so that it receives frames targeted for other machines.

When you create a standard switch for your network, you add port groups to impose a policy configuration for the virtual machines and storage systems attached to the switch. You create virtual ports through the vSphere Client.

As part of adding a port or standard port group to a standard switch, the vSphere Client configures a security profile for the port. You can use this security profile to ensure that the host prevents the guest operating systems for its virtual machines from impersonating other machines on the network. This security feature is implemented so that the guest operating system responsible for the impersonation does not detect that the impersonation was prevented.

The security profile determines how strongly you enforce protection against impersonation and interception attacks on virtual machines. To correctly use the settings in the security profile, you must understand the basics of how virtual network adapters control transmissions and how attacks are staged at this level.

Each virtual network adapter has its own MAC address assigned when the adapter is created. This address is called the initial MAC address. Although the initial MAC address can be reconfigured from outside the guest operating system, it cannot be changed by the guest operating system. In addition, each adapter has an effective MAC address that filters out incoming network traffic with a destination MAC address different from the effective MAC address. The guest operating system is responsible for setting the effective MAC address and typically matches the effective MAC address to the initial MAC address.

When sending packets, an operating system typically places its own network adapter’s effective MAC address in the source MAC address field of the Ethernet frame. It also places the MAC address for the receiving network adapter in the destination MAC address field. The receiving adapter accepts packets only when the destination MAC address in the packet matches its own effective MAC address.

Upon creation, a network adapter’s effective MAC address and initial MAC address are the same. The virtual machine’s operating system can alter the effective MAC address to another value at any time. If an operating system changes the effective MAC address, its network adapter receives network traffic destined for the new MAC address. The operating system can send frames with an impersonated source MAC address at any time. This means an operating system can stage malicious attacks on the devices in a network by impersonating a network adapter that the receiving network authorizes.

You can use standard switch security profiles on hosts to protect against this type of attack by setting three options. If you change any default settings for a port, you must modify the security profile by editing standard switch settings in the vSphere Client.

MAC Address Changes

The setting for the **MAC Address Changes** option affects traffic that a virtual machine receives.

When the option is set to **Accept**, ESXi accepts requests to change the effective MAC address to other than the initial MAC address.

When the option is set to **Reject**, ESXi does not honor requests to change the effective MAC address to anything other than the initial MAC address, which protects the host against MAC impersonation. The port that the virtual adapter used to send the request is disabled and the virtual adapter does not receive any more frames until it changes the effective MAC address to match the initial MAC address. The guest operating system does not detect that the MAC address change was not honored.

Note The iSCSI initiator relies on being able to get MAC address changes from certain types of storage. If you are using ESXi iSCSI and have iSCSI storage, set the **MAC Address Changes** option to **Accept**.

In some situations, you might have a legitimate need for more than one adapter to have the same MAC address on a network—for example, if you are using Microsoft Network Load Balancing in unicast mode. When Microsoft Network Load Balancing is used in the standard multicast mode, adapters do not share MAC addresses.

MAC address changes settings affect traffic leaving a virtual machine. MAC address changes will occur if the sender is permitted to make them, even if standard switches or a receiving virtual machine does not permit MAC address changes.

Forged Transmissions

The setting for the **Forged Transmits** option affects traffic that is transmitted from a virtual machine.

When the option is set to **Accept**, ESXi does not compare source and effective MAC addresses.

To protect against MAC impersonation, you can set this option to **Reject**. If you do, the host compares the source MAC address being transmitted by the operating system with the effective MAC address for its adapter to see if they match. If the addresses do not match, ESXi drops the packet.

The guest operating system does not detect that its virtual network adapter cannot send packets by using the impersonated MAC address. The ESXi host intercepts any packets with impersonated addresses before they are delivered, and the guest operating system might assume that the packets are dropped.

Promiscuous Mode Operation

Promiscuous mode eliminates any reception filtering that the virtual network adapter would perform so that the guest operating system receives all traffic observed on the wire. By default, the virtual network adapter cannot operate in promiscuous mode.

Although promiscuous mode can be useful for tracking network activity, it is an insecure mode of operation, because any adapter in promiscuous mode has access to the packets regardless of whether some of the packets are received only by a particular network adapter. This means that an administrator or root user within a virtual machine can potentially view traffic destined for other guest or host operating systems.

Note In some situations, you might have a legitimate reason to configure a standard switch to operate in promiscuous mode (for example, if you are running network intrusion detection software or a packet sniffer).

Internet Protocol Security

Internet Protocol Security (IPsec) secures IP communications coming from and arriving at a host. ESXi hosts support IPsec using IPv6.

When you set up IPsec on a host, you enable authentication and encryption of incoming and outgoing packets. When and how IP traffic is encrypted is depends on how you set up the system's security associations and security policies

A security association determines how the system encrypts traffic. When you create a security association, you specify the source and destination, encryption parameters, a name for the security association.

A security policy determines when the system should encrypt traffic. The security policy includes source and destination information, the protocol and direction of traffic to be encrypted, the mode (transport or tunnel) and the security association to use.

Add a Security Association

Add a security association to specify encryption parameters for associated IP traffic.

You can add a security association using the `esxcli` vSphere CLI command.

Procedure

- At the command prompt, enter the command **`esxcli network ip ipsec sa add`** with one or more of the following options.

Option	Description
`--sa-source=` ***source address***	Required. Specify the source address.
`--sa-destination=` ***destination address***	Required. Specify the destination address.
`--sa-mode=` ***mode***	Required. Specify the mode, either `transport` or `tunnel`.
`--sa-spi=` ***security parameter index***	Required. Specify the security parameter index. The security parameter index identifies the security association to the host. It must be a hexadecimal with a 0x prefix. Each security association you create must have a unique combination of protocol and security parameter index.
`--encryption-algorithm=` ***encryption algorithm***	Required. Specify the encryption algorithm using one of the following parameters. ■ `3des-cbc` ■ `aes128-cbc` ■ `null` `null` provides no encryption.
`--encryption-key=` ***encryption key***	Required when you specify an encryption algorithm. Specify the encryption key. You can enter keys as ASCII text or as a hexadecimal with a 0x prefix.
`--integrity-algorithm=` ***authentication algorithm***	Required. Specify the authentication algorithm, either `hmac-sha1` or `hmac-sha2-256`.
`--integrity-key=` ***authentication key***	Required. Specify the authentication key. You can enter keys as ASCII text or as a hexadecimal with a 0x prefix.
`--sa-name=`***name***	Required. Provide a name for the security association.

Example: New Security Association Command

The following example contains extra line breaks for readability.

```
esxcli network ip ipsec sa add
--sa-source 3ffe:501:ffff:0::a
--sa-destination 3ffe:501:ffff:0001:0000:0000:0000:0001
--sa-mode transport
--sa-spi 0x1000
--encryption-algorithm 3des-cbc
--encryption-key 0x6970763672656164796c6f676f336465736362636f757432
--integrity-algorithm hmac-sha1
--integrity-key 0x6970763672656164796c6f67736861316f757432
--sa-name sa1
```

Remove a Security Association

You can remove a security association from the host.

You can remove a security association using the `esxcli` vSphere CLI command.

Prerequisites

Be sure that the security association you want to use is not currently in use. If you try to remove a security association that is in use, the removal operation fails.

Procedure

- At the command prompt, enter the command **`esxcli network ip ipsec sa remove --sa-name`*`security_association_name`***.

List Available Security Associations

ESXi can provide a list of all security associations available for use by security policies. The list includes both user created security associations and any security associations the VMkernel installed using Internet Key Exchange.

You can get a list of available security associations using the `esxcli` vSphere CLI command.

Procedure

- At the command prompt, enter the command **`esxcli network ip ipsec sa list`**.

ESXi displays a list of all available security associations.

Create a Security Policy

Create a security policy to determine when to use the authentication and encryption parameters set in a security association.

You can add a security policy using the `esxcli` vSphere CLI command.

Prerequisites

Before creating a security policy, add a security association with the appropriate authentication and encryption parameters as described in "Add a Security Association," on page 30.

Procedure

- At the command prompt, enter the command **`esxcli network ip ipsec sp add`** with one or more of the following options.

Option	Description
`--sp-source=` ***source address***	Required. Specify the source IP address and prefix length.
`--sp-destination=` ***destination address***	Required. Specify the destination address and prefix length.
`--source-port=` ***port***	Required. Specify the source port. The source port must be a number between 0 and 65535.
`--destination-port=` ***port***	Required. Specify the destination port. The source port must be a number between 0 and 65535.
`--upper-layer-protocol=` ***protocol***	Specify the upper layer protocol using one of the following parameters. ■ `tcp` ■ `udp` ■ `icmp6` ■ `any`
`--flow-direction=` ***direction***	Specify the direction in which you want to monitor traffic using either `in` or `out`.
`--action=` ***action***	Specify the action to take when traffic with the specified parameters is encountered using one of the following parameters. ■ `none`: Take no action ■ `discard`: Do not allow data in or out. ■ `ipsec`: Use the authentication and encryption information supplied in the security association to determine whether the data comes from a trusted source.

Option	Description
--sp-mode= ***mode***	Specify the mode, either `tunnel` or `transport`.
--sa-name=*security association name*	Required. Provide the name of the security association for the security policy to use.
--sp-name=*name*	Required. Provide a name for the security policy.

Example: New Security Policy Command

The following example includes extra line breaks for readability.

```
esxcli network ip ipsec add
--sp-source=2001:db8:1::/64
--sp-destination=2002:db8:1::/64
--source-port=23
--destination-port=25
--upper-layer-protocol=tcp
--flow-direction=out
--action=ipsec
--sp-mode=transport
--sa-name=sa1
--sp-name=sp1
```

Remove a Security Policy

You can remove a security policy from the ESXi host.

You can remove a security policy using the `esxcli` vSphere CLI command.

Prerequisites

Be sure that the security policy you want to use is not currently in use. If you try to remove a security policy that is in use, the removal operation fails.

Procedure

- At the command prompt, enter the command **`esxcli network ip ipsec sp remove --sa-name`** ***`security policy name`***.

  To remove all security policies, enter the command **`esxcli network ip ipsec sp remove --remove-all`**.

List Available Security Policies

ESXi can provide a list of all security policies on the host.

You can get a list of available security policies using the `esxcli` vSphere CLI command.

Procedure

- At the command prompt, enter the command **`esxcli network ip ipsec sp list`**.

The host displays a list of all available security policies.

Securing iSCSI Storage

The storage you configure for a host might include one or more storage area networks (SANs) that use iSCSI. When you configure iSCSI on a host, you can take several measures to minimize security risks.

iSCSI is a means of accessing SCSI devices and exchanging data records by using TCP/IP over a network port rather than through a direct connection to a SCSI device. In iSCSI transactions, blocks of raw SCSI data are encapsulated in iSCSI records and transmitted to the requesting device or user.

iSCSI SANs let you make efficient use of existing Ethernet infrastructures to provide hosts access to storage resources that they can dynamically share. iSCSI SANs provide an economical storage solution for environments that rely on a common storage pool to serve numerous users. As with any networked system, your iSCSI SANs can be subject to security breaches.

NOTE The requirements and procedures for securing an iSCSI SAN are similar for the hardware iSCSI adapters you can use with hosts and for iSCSI configured directly through the host.

Securing iSCSI Devices Through Authentication

One means of securing iSCSI devices from unwanted intrusion is to require that the host, or initiator, be authenticated by the iSCSI device, or target, whenever the host attempts to access data on the target LUN.

The goal of authentication is to prove that the initiator has the right to access a target, a right granted when you configure authentication.

ESXi does not support Kerberos, Secure Remote Protocol (SRP), or public-key authentication methods for iSCSI. Additionally, it does not support IPsec authentication and encryption.

Use the vSphere Client to determine whether authentication is being performed and to configure the authentication method.

Enabling Challenge Handshake Authentication Protocol (CHAP) for iSCSI SANs

You can configure the iSCSI SAN to use CHAP authentication.

In CHAP authentication, when the initiator contacts an iSCSI target, the target sends a predefined ID value and a random value, or key, to the initiator. The initiator creates a one-way hash value that it sends to the target. The hash contains three elements: a predefined ID value, the random value that the target sends, and a private value, or CHAP secret, that the initiator and target share. When the target receives the hash from the initiator, it creates its own hash value by using the same elements and compares it to the initiator's hash. If the results match, the target authenticates the initiator.

ESXi supports unidirectional and bidirectional CHAP authentication for iSCSI. In unidirectional CHAP authentication, the target authenticates the initiator, but the initiator does not authenticate the target. In bidirectional CHAP authentication, an additional level of security enables the initiator to authenticate the target.

ESXi supports CHAP authentication at the adapter level, when only one set of authentication credentials can be sent from the host to all targets. It also supports per-target CHAP authentication, which enables you to configure different credentials for each target to achieve greater target refinement.

See the *vSphere Storage* documentation for information about how to work with CHAP.

Disabling iSCSI SAN Authentication

You can configure the iSCSI SAN to use no authentication. Communications between the initiator and target are still authenticated in a rudimentary way because the iSCSI target devices are typically set up to communicate with specific initiators only.

Choosing not to enforce more stringent authentication can make sense if your iSCSI storage is housed in one location and you create a dedicated network or VLAN to service all your iSCSI devices. The iSCSI configuration is secure because it is isolated from any unwanted access, much as a Fibre Channel SAN is.

As a basic rule, disable authentication only if you are willing to risk an attack to the iSCSI SAN or cope with problems that result from human error.

See the *vSphere Storage* documentation for information about how to work with CHAP.

Protecting an iSCSI SAN

When you plan your iSCSI configuration, take measures to improve the overall security of the iSCSI SAN. Your iSCSI configuration is only as secure as your IP network, so by enforcing good security standards when you set up your network, you help safeguard your iSCSI storage.

The following are some specific suggestions for enforcing good security standards.

Protect Transmitted Data

A primary security risk in iSCSI SANs is that an attacker might sniff transmitted storage data.

Take additional measures to prevent attackers from easily seeing iSCSI data. Neither the hardware iSCSI adapter nor ESXi iSCSI initiator encrypts the data that they transmit to and from the targets, making the data more vulnerable to sniffing attacks.

Allowing your virtual machines to share standard switches and VLANs with your iSCSI configuration potentially exposes iSCSI traffic to misuse by a virtual machine attacker. To help ensure that intruders cannot listen to iSCSI transmissions, make sure that none of your virtual machines can see the iSCSI storage network.

If you use a hardware iSCSI adapter, you can accomplish this by making sure that the iSCSI adapter and ESXi physical network adapter are not inadvertently connected outside the host by virtue of sharing a switch or some other means. If you configure iSCSI directly through the ESXi host, you can accomplish this by configuring iSCSI storage through a different standard switch than the one used by your virtual machines.

In addition to protecting the iSCSI SAN by giving it a dedicated standard switch, you can configure your iSCSI SAN on its own VLAN to improve performance and security. Placing your iSCSI configuration on a separate VLAN ensures that no devices other than the iSCSI adapter have visibility into transmissions within the iSCSI SAN. Also, network congestion from other sources cannot interfere with iSCSI traffic.

Secure iSCSI Ports

When you run iSCSI devices, ESXi does not open any ports that listen for network connections. This measure reduces the chances that an intruder can break into ESXi through spare ports and gain control over the host. Therefore, running iSCSI does not present any additional security risks at the ESXi end of the connection.

Any iSCSI target device that you run must have one or more open TCP ports to listen for iSCSI connections. If any security vulnerabilities exist in the iSCSI device software, your data can be at risk through no fault of ESXi. To lower this risk, install all security patches that your storage equipment manufacturer provides and limit the devices connected to the iSCSI network.

Cipher Strength

Transmitting data over insecure connections presents a security risk because malicious users might be able to scan data as it travels through the network. As a safeguard, network components commonly encrypt the data so that it cannot be easily read.

To encrypt data, the sending component, such as a gateway or redirector, applies cryptographic algorithms, or ciphers, to alter the data before transmitting it. The receiving component uses a key to decrypt the data, returning it to its original form. Several ciphers are in use, and the level of security that each provides is different. One measure of a cipher's ability to protect data is its cipher strength—the number of bits in the encryption key. The larger the number, the more secure the cipher.

To ensure the protection of the data transmitted to and from external network connections, ESXi uses one of the strongest block ciphers available—256-bit AES block encryption. ESXi also uses 1024-bit RSA for key exchange. These encryption algorithms are the default for the following connections.

- vSphere Client connections to vCenter Server and to ESXi through the management interface.
- SDK connections to vCenter Server and to ESXi.
- Management interface connections to virtual machines through the VMkernel.
- SSH connections to ESXi through the management interface.

SSH Security

You can use SSH to remotely log in to the ESXi Shell and perform troubleshooting tasks for the host.

SSH configuration in ESXi is enhanced to provide a high security level.

Version 1 SSH protocol disabled

VMware does not support Version 1 SSH protocol and uses Version 2 protocol exclusively. Version 2 eliminates certain security problems present in Version 1 and provides you with a safe way to communicate with the management interface.

Improved cipher strength

SSH supports only 256-bit and 128-bit AES ciphers for your connections.

These settings are designed to provide solid protection for the data you transmit to the management interface through SSH. If this configuration is too restricted for your needs, you can lower security parameters.

Control CIM-Based Hardware Monitoring Tool Access

The Common Information Model (CIM) system provides an interface that enables hardware-level management from remote applications using a set of standard APIs. To ensure that the CIM interface is secure, provide only the minimum access necessary to these applications. If an application has been provisioned with a root or full administrator account and the application is compromised, the full virtual environment might be compromised.

CIM is an open standard that defines a framework for agent-less, standards-based monitoring of hardware resources for ESXi. This framework consists of a CIM object manager, often called a CIM broker, and a set of CIM providers.

CIM providers are used as the mechanism to provide management access to device drivers and underlying hardware. Hardware vendors, including server manufacturers and specific hardware device vendors, can write providers to provide monitoring and management of their particular devices. VMware also writes providers that implement monitoring of server hardware, ESXi storage infrastructure, and virtualization-specific resources. These providers run inside the ESXi system and therefore are designed to be extremely lightweight and focused on specific management tasks. The CIM broker takes information from all CIM providers, and presents it to the outside world via standard APIs, the most common one being WS-MAN.

Do not provide root credentials to remote applications to access the CIM interface. Instead, create a service account specific to these applications and grant read-only access to CIM information to any local account defined on the ESXi system, as well as any role defined in vCenter Server.

Procedure

1 Create a service account specific to CIM applications.

2 Grant read-only access to CIM information to any local account defined on the ESXi system, as well as any role defined in vCenter Server.

3 (Optional) If the application requires write access to the CIM interface, create a role to apply to the service account with only two privileges:

   - **Host.Config.SystemManagement**
   - **Host.CIM.CIMInteraction**

   This role can be local to the host or centrally defined on vCenter Server, depending on how the monitoring application works.

When a user logs into the host with the service account (for example, using the vSphere Client), the user has only the privileges **SystemManagement** and **CIMInteraction**, or read-only access.

Securing the Management Interface 3

Security of the ESXi management interface is critical to protect against unauthorized intrusion and misuse.

If a host is compromised in certain ways, the virtual machines it interacts with might also be compromised. To minimize the risk of an attack through the management interface, ESXi is protected with a firewall.

This chapter includes the following topics:

General Security Recommendations

To protect the host against unauthorized intrusion and misuse, VMware imposes constraints on several parameters, settings, and activities. You can loosen the constraints to meet your configuration needs, but if you do so, make sure that you are working in a trusted environment and have taken enough other security measures to protect the network as a whole and the devices connected to the host.

Consider the following recommendations when evaluating host security and administration.

- Limit user access.

  To improve security, restrict user access to the management interface and enforce access security policies like setting up password restrictions.

  The ESXi Shell has privileged access to certain parts of the host. Therefore, provide only trusted users with ESXi Shell login access.

  Also, strive to run only the essential processes, services, and agents such as virus checkers, and virtual machine backups.

- Use the vSphere Client to administer your ESXi hosts.

  Whenever possible, use the vSphere Client or a third-party network management tool to administer your ESXi hosts instead of working though the command-line interface as the root user. Using the vSphere Client lets you limit the accounts with access to the ESXi Shell, safely delegate responsibilities, and set up roles that prevent administrators and users from using capabilities they do not need.

- Use only VMware sources to upgrade ESXi components.

  The host runs a variety of third-party packages to support management interfaces or tasks that you must perform. VMware does not support upgrading these packages from anything other than a VMware source. If you use a download or patch from another source, you might compromise management interface security or functions. Regularly check third-party vendor sites and the VMware knowledge base for security alerts.

In addition to implementing the firewall, risks to the hosts are mitigated using other methods.

- ESXi runs only services essential to managing its functions, and the distribution is limited to the features required to run ESXi.
- By default, all ports not specifically required for management access to the host are closed. You must specifically open ports if you need additional services.
- By default, weak ciphers are disabled and all communications from clients are secured by SSL. The exact algorithms used for securing the channel depend on the SSL handshake. Default certificates created on ESXi use SHA-1 with RSA encryption as the signature algorithm.
- The Tomcat Web service, used internally by ESXi to support access by Web clients, has been modified to run only those functions required for administration and monitoring by a Web client. As a result, ESXi is not vulnerable to the Tomcat security issues reported in broader use.
- VMware monitors all security alerts that could affect ESXi security and, if needed, issues a security patch.
- Insecure services such as FTP and Telnet are not installed, and the ports for these services are closed by default. Because more secure services such as SSH and SFTP are easily available, always avoid using these insecure services in favor of their safer alternatives. If you must use insecure services and have implemented sufficient protection for the host, you must explicitly open ports to support them.

NOTE Follow only VMware security advisories, found at http://www.vmware.com/security/.

ESXi Firewall Configuration

ESXi includes a firewall between the management interface and the network. The firewall is enabled by default.

At installation time, the ESXi firewall is configured to block incoming and outgoing traffic, except traffic for the default services listed in "TCP and UDP Ports for Management Access," on page 23.

NOTE The firewall also allows Internet Control Message Protocol (ICMP) pings and communication with DHCP and DNS (UDP only) clients.

Supported services and management agents that are required to operate the host are described in a rule set configuration file in the ESXi firewall directory `/etc/vmware/firewall/`. The file contains firewall rules and lists each rule's relationship with ports and protocols.

You cannot add a rule to the ESXi firewall unless you create and install a VIB that contains the rule set configuration file. The VIB authoring tool is available to VMware partners.

NOTE The behavior of the NFS Client rule set (`nfsClient`) is different from other rule sets. When the NFS Client rule set is enabled, all outbound TCP ports are open for the destination hosts in the list of allowed IP addresses. See "NFS Client Rule Set Behavior," on page 43 for more information.

Rule Set Configuration Files

A rule set configuration file contains firewall rules and describes each rule's relationship with ports and protocols. The rule set configuration file can contain rule sets for multiple services.

Rule set configuration files are located in the `/etc/vmware/firewall/` directory. To add a service to the host security profile, VMware partners can create a VIB that contains the port rules for the service in a configuration file. VIB authoring tools are available to VMware partners.

The ESXi 5.x ruleset.xml format is the same as in ESX and ESXi 4.x, but has two additional tags: enabled and required. The ESXi 5.x firewall continues to support the 4.x ruleset.xml format.

Each set of rules for a service in the rule set configuration file contains the following information.

- A numeric identifier for the service, if the configuration file contains more than one service.

- A unique identifier for the rule set, usually the name of the service.
- For each rule, the file contains one or more port rules, each with a definition for direction, protocol, port type, and port number or range of port numbers.
- A flag indicating whether the service is enabled or disabled when the rule set is applied.
- An indication of whether the rule set is required and cannot be disabled.

Example: Rule Set Configuration File

```
<ConfigRoot>
<service id='0000'>
 <id>serviceName</id>
  <rule id = '0000'>
   <direction>inbound</direction>
   <protocol>tcp</protocol>
   <porttype>dst</porttype>
   <port>80</port>
  </rule>
  <rule id='0001'>
   <direction>inbound</direction>
   <protocol>tcp</protocol>
   <porttype>src</porttype>
   <port>
    <begin>1020</begin>
    <end>1050</end>
   </port>
 </rule>
 <enabled>true</enabled>
    <required>false</required>
</service>
</ConfigRoot>
```

Allow or Deny Access to an ESXi Service or Management Agent

You can configure firewall properties to allow or deny access for a service or management agent.

You add information about allowed services and management agents to the host configuration file. You can enable or disable these services and agents using the vSphere Client or at the command line.

NOTE If different services have overlapping port rules, enabling one service might implicitly enable overlapping services. To minimize the effects of this behavior, you can specify which IP addresses are allowed to access each service on the host.

Procedure

1 Log in to a vCenter Server system using the vSphere Client.

2 Select the host in the inventory panel.

3 Click the **Configuration** tab and click **Security Profile**.

The vSphere Client displays a list of active incoming and outgoing connections with the corresponding firewall ports.

4 In the Firewall section, click **Properties**.

The Firewall Properties dialog box lists all the rule sets that you can configure for the host.

5 Select the rule sets to enable, or deselect the rule sets to disable.

   The Incoming Ports and Outgoing Ports columns indicate the ports that the vSphere Client opens for the service. The Protocol column indicates the protocol that the service uses. The Daemon column indicates the status of daemons associated with the service.

6 Click **OK**.

Allow or Deny Access to an ESXi Service or Management Agent with the vSphere Web Client

You can configure firewall properties to allow or deny access for a service or management agent.

You add information about allowed services and management agents to the host configuration file. You can enable or disable these services and agents using the vSphere Client or at the command line.

NOTE If different services have overlapping port rules, enabling one service might implicitly enable overlapping services. To minimize the effects of this behavior, you can specify which IP addresses are allowed to access each service on the host.

Procedure

1 Browse to the host in the vSphere Web Client inventory.

2 Click the **Manage** tab and click **Settings**.

3 Click **Security Profile**.

   The vSphere Client displays a list of active incoming and outgoing connections with the corresponding firewall ports.

4 In the Firewall section, click **Edit**.

5 Select the rule sets to enable, or deselect the rule sets to disable.

   The Incoming Ports and Outgoing Ports columns indicate the ports that the vSphere Client opens for the service. The Protocol column indicates the protocol that the service uses. The Daemon column indicates the status of daemons associated with the service.

6 Click **OK**.

Add Allowed IP Addresses

You can specify which networks are allowed to connect to each service that is running on the host.

You can use the vSphere Client or the command line to update the Allowed IP list for a service. By default, all IP addresses are allowed.

Procedure

1 Log in to a vCenter Server system using the vSphere Client.

2 Select the host in the inventory panel.

3 Click the **Configuration** tab and click **Security Profile**.

4 In the Firewall section, click **Properties**.

5 Select a service in the list and click **Firewall**.

6 Select **Only allow connections from the following networks** and enter the IP addresses of networks that are allowed to connect to the host.

   You can enter IP addresses in the following formats: 192.168.0.0/24, 192.168.1.2, 2001::1/64, or fd3e: 29a6:0a81:e478::/64.

7 Click **OK**.

Add Allowed IP Addresses in the vSphere Web Client

You can specify which networks are allowed to connect to each service that is running on the host.

You can use the vSphere Client or the command line to update the Allowed IP list for a service. By default, all IP addresses are allowed.

Procedure

1 Browse to the host in the vSphere Web Client inventory.

2 Click the **Manage** tab and click **Settings**.

3 Under System, click **Security Profile**.

4 In the Firewall section, click **Edit** and select a service from the list.

5 In the Allowed IP Addresses section, deselect **Allow connections from any IP address** and enter the IP addresses of networks that are allowed to connect to the host.

You can enter IP addresses in the following formats: 192.168.0.0/24, 192.168.1.2, 2001::1/64, or fd3e: 29a6:0a81:e478::/64.

6 Click **OK**.

NFS Client Rule Set Behavior

The NFS Client rule set behaves differently than other ESXi firewall rule sets. ESXi configures NFS Client settings when you mount or unmount an NFS datastore.

When you add or mount an NFS datastore, ESXi checks the state of the NFS Client (`nfsClient`) firewall rule set.

- If the NFS Client rule set is disabled, ESXi enables the rule set and disables the Allow All IP Addresses policy by setting the `allowedAll` flag to `FALSE`. The IP address of the NFS server is added to the allowed list of outgoing IP addresses.
- If the NFS Client rule set is enabled, the state of the rule set and the allowed IP address policy are not changed. The IP address of the NFS server is added to the allowed list of outgoing IP addresses.

When you remove or unmount an NFS datastore, ESXi performs one of the following actions.

- If ESXi is mounted on any NFS datastore, the IP address of the unmounted NFS server is removed from the list of allowed outgoing IP addresses and the NFS Client rule set remains enabled.
- If ESXi is not mounted on any NFS datastore, the IP address of the unmounted NFS server is removed from the list of allowed outgoing IP addresses and the NFS Client rule set is disabled.

NOTE If you manually enable the NFS Client rule set or manually set the Allow All IP Addresses policy, either before or after you add an NFS datastore to the system, your settings are overridden when the last NFS datastore is unmounted. The NFS Client rule set is disabled when all NFS datastores are unmounted.

Automating Service Behavior Based on Firewall Settings

ESXi can automate whether services start based on the status of firewall ports.

Automation helps ensure that services start if the environment is configured to enable their function. For example, starting a network service only if some ports are open can help avoid the situation where services are started, but are unable to complete the communications required to complete their intended purpose.

In addition, having accurate information about the current time is a requirement for some protocols, such as Kerberos. The NTP service is a way of getting accurate time information, but this service only works when required ports are opened in the firewall. The service cannot achieve its goal if all ports are closed. The NTP services provide an option to configure the conditions when the service starts or stops. This configuration includes options that account for whether firewall ports are opened, and then start or stop the NTP service based on those conditions. Several possible configuration options exist, all of which are also applicable to the SSH server.

NOTE The settings described in this section only apply to service settings configured through the vSphere Client or applications created with the vSphere Web services SDK. Configurations made through other means, such as the ESXi Shell or configuration files in `/etc/init.d/`, are not affected by these settings.

- **Start automatically if any ports are open, and stop when all ports are closed**: The default setting for these services that VMware recommends. If any port is open, the client attempts to contact the network resources pertinent to the service in question. If some ports are open, but the port for a particular service is closed, the attempt fails, but there is little drawback to such a case. If and when the applicable outgoing port is opened, the service begins completing its tasks.
- **Start and stop with host**: The service starts shortly after the host starts and closes shortly before the host shuts down. Much like **Start automatically if any ports are open, and stop when all ports are closed**, this option means that the service regularly attempts to complete its tasks, such as contacting the specified NTP server. If the port was closed but is subsequently opened, the client begins completing its tasks shortly thereafter.
- **Start and stop manually**: The host preserves the user-determined service settings, regardless of whether ports are open or not. When a user starts the NTP service, that service is kept running as long as the host is powered on. If the service is started and the host is powered off, the service is stopped as part of the shutdown process, but as soon as the host is powered on, the service is started again, preserving the user-determined state.

NOTE ESXi firewall automates when rule sets are enabled or disabled based on the service startup policy. When a service starts, its corresponding rule set is enabled. When a service stops, the rule set is disabled.

Set Service or Client Startup Options

By default, daemon processes start when any of their ports are opened and stop when all of their ports are closed. You can change this startup policy for the selected service or client.

Procedure

1. Log in to a vCenter Server system using the vSphere Client.
2. Select the host in the inventory panel.
3. Click the **Configuration** tab and click **Security Profile**.
4. In the Firewall section, click **Properties**.

   The Firewall Properties dialog box lists all the services and management agents you can configure for the host.
5. Select the service or management agent to configure and click **Options**.

   The Startup Policy dialog box determines when the service starts. This dialog box also provides information about the current state of the service and provides an interface for manually starting, stopping, or restarting the service.
6. Select a policy from the **Startup Policy** list.
7. Click **OK**.

Set Service or Client Startup Options in the vSphere Web Client

By default, daemon processes start when any of their ports are opened and stop when all of their ports are closed. You can change this startup policy for the selected service or client.

Procedure

1. Browse to the host in the vSphere Web Client inventory.
2. Click the **Manage** tab and click **Settings**.
3. Click **Security Profile**.
4. In the Services section, click **Edit**.
5. Select the service or management agent to configure.
6. Select a policy from the **Startup Policy** list.
7. Click **OK**.

ESXi Firewall Commands

You can configure the ESXi firewall at the command line.

Firewall Configuration Using the ESXi Shell

The vSphere Client graphical user interface provides the preferred means of performing many configuration tasks. However, you can use the ESXi Shell to configure ESXi at the command line if necessary.

Table 3-1. Firewall Commands

Command	Description
`esxcli network firewall get`	Returns the enabled or disabled status of the firewall and lists default actions.
`esxcli network firewall set --defaultaction`	Update default actions.
`esxcli network firewall set --enabled`	Enable or disable the ESXi firewall.
`esxcli network firewall load`	Load the firewall module and rule set configuration files.
`esxcli network firewall refresh`	Refresh the firewall configuration by reading the rule set files if the firewall module is loaded.
`esxcli network firewall unload`	Destroy filters and unload the firewall module.
`esxcli network firewall ruleset list`	List rule sets information.
`esxcli network firewall ruleset set --allowedall`	Set the `allowedall` flag.
`esxcli network firewall ruleset set --enabled`	Enable or disable the specified rule set.
`esxcli network firewall ruleset allowedip list`	List the allowed IP addresses of the specified rule set.
`esxcli network firewall ruleset allowedip add`	Allow access to the rule set from the specified IP address or range of IP addresses.
`esxcli network firewall ruleset allowedip remove`	Remove access to the rule set from the specified IP address or range of IP addresses.

4 Using the ESXi Shell

The ESXi Shell (formerly Tech Support Mode or TSM) is disabled by default on ESXi. You can enable local and remote access to the shell if necessary.

Enable the ESXi Shell for troubleshooting only. The ESXi Shell can be enabled and disabled whether or not the host is running in lockdown mode.

ESXi Shell Enable this service to access the ESXi Shell locally.

SSH Enable this service to access the ESXi Shell remotely using SSH.

Direct Console UI (DCUI) When you enable this service while running in lockdown mode, you can log in locally to the Direct Console User Interface (DCUI) as a user with the DCUI Access privilege and disable lockdown mode. You can then access the host by enabling the ESXi Shell.

Only users with the Administrator role can access the ESXi Shell. Users who are in the Active Directory group ESX Admins are automatically assigned the Administrator role. Any user with the Administrator role can execute system commands (such as `vmware -v`) using the ESXi Shell.

NOTE Do not enable the ESXi Shell until it is required.

This chapter includes the following topics:

Use the vSphere Client to Enable Access to the ESXi Shell

Use the vSphere Client to enable local and remote access to the ESXi Shell.

Procedure

1 Log in to a vCenter Server system using the vSphere Client.

2 Select the host in the inventory panel.

3 Click the **Configuration** tab and click **Security Profile**.

4 In the Services section, click **Properties**.

5 Select a service from the list.

   - ESXi Shell
   - SSH
   - Direct Console UI

6 Click **Options** and select **Start and stop manually**.

   When you select **Start and stop manually**, the service does not start when you reboot the host. If you want the service to start when you reboot the host, select **Start and stop with host**.

7 Select **Start** to enable the service.

8 Click **OK**.

What to do next

Set the availability and idle timeouts for the ESXi Shell.

Create a Timeout for ESXi Shell Availability

The ESXi Shell is disabled by default. You can set an availability timeout for the ESXi Shell to increase security when you enable the shell.

The availability timeout setting is the amount of time that can elapse before you must log in after the ESXi Shell is enabled. After the timeout period, the service is disabled and users are not allowed to log in.

Procedure

1 Select the host in the inventory and click the **Configuration** tab.

2 Under Software, select **Advanced Settings**.

3 In the left panel, select **UserVars**.

4 In the UserVars.ESXiShellTimeOut field, enter the availability timeout setting.

   You must restart the SSH service and the ESXi Shell service for the timeout to take effect.

5 Click **OK**.

If you are logged in when the timeout period elapses, your session will persist. However, after you log out or your session is terminated, users are not allowed to log in.

Create a Timeout for Idle ESXi Shell Sessions

If a user enables the ESXi Shell on a host, but forgets to log out of the session, the idle session remains connected indefinitely. The open connection can increase the potential for someone to gain privileged access to the host. You can prevent this by setting a timeout for idle sessions.

The idle timeout is the amount of time that can elapse before the user is logged out of an idle interactive sessions. Changes to the idle timeout apply the next time a user logs in to the ESXi Shell and do not affect existing sessions.

Procedure

1 Select the host in the inventory and click the **Configuration** tab.

2 Under Software, select **Advanced Settings**.

3 In the left panel, select **UserVars**.

4 In the UserVars.ESXiShellInteractiveTimeOut field, enter the availability timeout setting.

   You must restart the SSH service and the ESXi Shell service for the timeout to take effect.

5 Click **OK**.

If you are logged in when the timeout period elapses, your session will persist. However, after you log out or your session is terminated, users are not allowed to log in.

Use the vSphere Web Client to Enable Access to the ESXi Shell

Use the vSphere Web Client to enable local and remote access to the ESXi Shell.

Procedure

1 Browse to the host in the vSphere Web Client inventory.

2 Click the **Manage** tab and click **Settings**.

3 Under System, select **Security Profile**.

4 In the Services panel, click **Edit**.

5 Select a service from the list.

- ESXi Shell
- SSH
- Direct Console UI

6 Click **Service Details** and select the startup policy **Start and stop manually**.

When you select **Start and stop manually**, the service does not start when you reboot the host. If you want the service to start when you reboot the host, select **Start and stop with host**.

7 Select **Start** to enable the service.

8 Click **OK**.

What to do next

Set the availability and idle timeouts for the ESXi Shell.

Create a Timeout for ESXi Shell Availability in the vSphere Web Client

The ESXi Shell is disabled by default. You can set an availability timeout for the ESXi Shell to increase security when you enable the shell.

The availability timeout setting is the amount of time that can elapse before you must log in after the ESXi Shell is enabled. After the timeout period, the service is disabled and users are not allowed to log in.

Procedure

1 Browse to the host in the vSphere Web Client inventory.

2 Click the **Manage** tab and click **Settings**.

3 Under System, select **Advanced System Settings**.

4 Select UserVars.ESXiShellTimeOut and click the **Edit** icon.

5 Enter the idle timeout setting.

You must restart the SSH service and the ESXi Shell service for the timeout to take effect.

6 Click **OK**.

If you are logged in when the timeout period elapses, your session will persist. However, after you log out or your session is terminated, users are not allowed to log in.

Create a Timeout for Idle ESXi Shell Sessions in the vSphere Web Client

If a user enables the ESXi Shell on a host, but forgets to log out of the session, the idle session remains connected indefinitely. The open connection can increase the potential for someone to gain privileged access to the host. You can prevent this by setting a timeout for idle sessions.

The idle timeout is the amount of time that can elapse before the user is logged out of an idle interactive sessions. Changes to the idle timeout apply the next time a user logs in to the ESXi Shell and do not affect existing sessions.

Procedure

1. Browse to the host in the vSphere Web Client inventory.
2. Click the **Manage** tab and click **Settings**.
3. Under System, select **Advanced System Settings**.
4. Select UserVars.ESXiShellTimeOut and click the **Edit** icon.
5. Enter the idle timeout setting.

   You must restart the SSH service and the ESXi Shell service for the timeout to take effect.

If you are logged in when the timeout period elapses, your session will persist. However, after you log out or your session is terminated, users are not allowed to log in.

Use the Direct Console User Interface (DCUI) to Enable Access to the ESXi Shell

The Direct Console User Interface (DCUI) allows you to interact with the host locally using text-based menus. You can use the Direct Console User Interface to enable local and remote access to the ESXi Shell.

Note Changes made to the host using the Direct Console User Interface, the vSphere Client, ESXCLI, or other administrative tools are committed to permanent storage every hour or upon graceful shutdown. Changes might be lost if the host fails before they are committed.

Procedure

1. From the Direct Console User Interface, press F2 to access the System Customization menu.
2. Select **Troubleshooting Options** and press Enter.
3. From the Troubleshooting Mode Options menu, select a service to enable.
   - Enable ESXi Shell
   - Enable SSH
4. Press Enter to enable the service.
5. Press Esc until you return to the main menu of the Direct Console User Interface.

What to do next

Set the availability and idle timeouts for the ESXi Shell.

Create a Timeout for Idle ESXi Shell Sessions

If a user enables the ESXi Shell on a host, but forgets to log out of the session, the idle session remains connected indefinitely. The open connection can increase the potential for someone to gain privileged access to the host. You can prevent this by setting a timeout for idle sessions.

The idle timeout is the amount of time that can elapse before the user is logged out of an idle interactive sessions. Changes to the idle timeout apply the next time a user logs in to the ESXi Shell and do not affect existing sessions.

Procedure

1. From the Troubleshooting Mode Options menu, select **Modify ESXi Shell and SSH timeouts** and press Enter.
2. Enter the idle timeout.

   You must restart the SSH service and the ESXi Shell service for the timeout to take effect.
3. Press Enter and press Esc until you return to the main menu of the Direct Console User Interface.

If you are logged in when the timeout period elapses, your session will persist. However, after you log out or your session is terminated, users are not allowed to log in.

Create a Timeout for ESXi Shell Availability in the Direct Console User Interface

The ESXi Shell is disabled by default. You can set an availability timeout for the ESXi Shell to increase security when you enable the shell.

The availability timeout setting is the amount of time that can elapse before you must log in after the ESXi Shell is enabled. After the timeout period, the service is disabled and users are not allowed to log in.

Procedure

1. From the Troubleshooting Mode Options menu, select **Modify ESXi Shell and SSH timeouts** and press Enter.
2. Enter the availability timeout.

   You must restart the SSH service and the ESXi Shell service for the timeout to take effect.
3. Press Enter and press Esc until you return to the main menu of the Direct Console User Interface.
4. Click **OK**.

If you are logged in when the timeout period elapses, your session will persist. However, after you log out or your session is terminated, users are not allowed to log in.

Log in to the ESXi Shell for Troubleshooting

You should perform ESXi configuration tasks through the vSphere Client or using the vSphere CLI. Log in to the ESXi Shell (formerly Tech Support Mode or TSM) for troubleshooting purposes only.

Procedure

1. Log in to the ESXi Shell using one of the following methods.
   - If you have direct access to the host, press Alt+F1 to open the login page on the machine's physical console.
   - If you are connecting to the host remotely, use SSH or another remote console connection to start a session on the host.

2 Enter a user name and password recognized by the host.

Lockdown Mode 5

To increase the security of your ESXi hosts, you can put them in lockdown mode.

When you enable lockdown mode, no users other than `vpxuser` have authentication permissions, nor can they perform operations against the host directly. Lockdown mode forces all operations to be performed through vCenter Server.

When a host is in lockdown mode, you cannot run vSphere CLI commands from an administration server, from a script, or from vMA against the host. External software or management tools might not be able to retrieve or modify information from the ESXi host.

NOTE Users with the DCUI Access privilege are authorized to log in to the Direct Console User Interface (DCUI) when lockdown mode is enabled. When you disable lockdown mode using the DCUI, all users with the DCUI Access privilege are granted the Administrator role on the host. You grant the DCUI Access privilege in Advanced Settings.

Enabling or disabling lockdown mode affects which types of users are authorized to access host services, but it does not affect the availability of those services. In other words, if the ESXi Shell, SSH, or Direct Console User Interface (DCUI) services are enabled, they will continue to run whether or not the host is in lockdown mode.

You can enable lockdown mode using the Add Host wizard to add a host to vCenter Server, using the vSphere Client to manage a host, or using the Direct Console User Interface (DCUI).

NOTE If you enable or disable lockdown mode using the Direct Console User Interface (DCUI), permissions for users and groups on the host are discarded. To preserve these permissions, you must enable and disable lockdown mode using the vSphere Client connected to vCenter Server.

Lockdown mode is only available on ESXi hosts that have been added to vCenter Server.

This chapter includes the following topics:

Lockdown Mode Behavior

Enabling lockdown mode affects which users are authorized to access host services.

Users who were logged in to the ESXi Shell before lockdown mode was enabled remain logged in and can run commands. However, these users cannot disable lockdown mode. No other users, including the root user and users with the Administrator role on the host, can use the ESXi Shell to log in to a host that is in lockdown mode.

Users with administrator privileges on the vCenter Server system can use the vSphere Client to disable lockdown mode for hosts that are managed by the vCenter Server system. Users granted the DCUI Access privilege can always log directly in to the host using the Direct Console User Interface (DCUI) to disable lockdown mode, even if the user does not have the Administrator role on the host. You must use Advanced Settings to grant the DCUI Access privilege.

NOTE When you disable lockdown mode using the DCUI, all users with the DCUI Access privilege are granted the Administrator role on the host.

Root users or users with the Administrator role on the host cannot log directly in to the host with the DCUI if they have not been granted the DCUI Access privilege. If the host is not managed by vCenter Server or if the host is unreachable, only DCUI Access users can log into the DCUI and disable lockdown mode. If the DCUI service is stopped, you must reinstall ESXi.

Different services are available to different types of users when the host is running in lockdown mode, compared to when the host is running in normal mode. Nonroot users cannot run system commands in the ESXi Shell.

Table 5-1. Lockdown Mode Behavior

Service	Normal Mode	Lockdown Mode
vSphere WebServices API	All users, based on ESXi permissions	vCenter only (vpxuser)
CIM Providers	Root users and users with Admin role on the host	vCenter only (ticket)
Direct Console UI (DCUI)	Users with Admin role on the host and users with the DCUI Access privilege	Users with the DCUI Access privilege.
ESXi Shell	Users with Admin role on the host	No users
SSH	Users with Admin role on the host	No users

Lockdown Mode Configurations

You can enable or disable remote and local access to the ESXi Shell to create different lockdown mode configurations.

The following table lists which services are enabled for three typical configurations.

CAUTION If you lose access to vCenter Server while running in Total Lockdown Mode, you must reinstall ESXi to gain access to the host.

Table 5-2. Lockdown Mode Configurations

Service	Default Configuration	Recommended Configuration	Total Lockdown Configuration
Lockdown	Off	On	On
ESXi Shell	Off	Off	Off

Table 5-2. Lockdown Mode Configurations (Continued)

Service	Default Configuration	Recommended Configuration	Total Lockdown Configuration
SSH	Off	Off	Off
Direct Console UI (DCUI)	On	On	Off

Enable Lockdown Mode Using the vSphere Client

Enable lockdown mode to require that all configuration changes go through vCenter Server. You can also enable or disable lockdown mode through the Direct Console User Interface (DCUI).

Procedure

1. Log in to a vCenter Server system using the vSphere Client.
2. Select the host in the inventory panel.
3. Click the **Configuration** tab and click **Security Profile**.
4. Click the **Edit** link next to lockdown mode.

   The Lockdown Mode dialog box appears.
5. Select **Enable Lockdown Mode**.
6. Click **OK**.

Enable Lockdown Mode Using the vSphere Web Client

Enable lockdown mode to require that all configuration changes go through vCenter Server. You can also enable or disable lockdown mode through the Direct Console User Interface (DCUI).

Procedure

1. Browse to the host in the vSphere Web Client inventory.
2. Click the **Manage** tab and click **Settings**.
3. Under System, select **Security Profile**.
4. In the Lockdown Mode panel, click **Edit**.
5. Select **Enable Lockdown Mode**.
6. Click **OK**.

Enable Lockdown Mode from the Direct Console User Interface

You can enable lockdown mode from the Direct Console User Interface (DCUI).

NOTE If you enable or disable lockdown mode using the Direct Console User Interface, permissions for users and groups on the host are discarded. To preserve these permissions, you must enable and disable lockdown mode using the vSphere Client connected to vCenter Server.

Procedure

1. At the Direct Console User Interface of the host, press F2 and log in.
2. Scroll to the **Configure Lockdown Mode** setting and press Enter.
3. Press Esc until you return to the main menu of the Direct Console User Interface.

ESXi Authentication and User Management 6

ESXi handles user authentication and supports user permissions.

ESXi 5.1 is not integrated with vCenter Single Sign On and you cannot create ESXi users with the vSphere Web Client. You must create and manage ESXi users with the vSphere Client. vCenter Server is not aware of users that are local to ESXi, and ESXi is not aware of vCenter Server users. However, you can configure Single Sign On to use an Active Directory domain as an identity source, and configure ESXi to point to the same Active Directory domain to obtain user and group information. This action allows the same set of users to be available to the host and to vCenter Server. For information about vCenter Single Sign On, see "Configuring vCenter Single Sign-On," on page 87.

This chapter includes the following topics:

Managing Users with the vSphere Client

A user is an individual authorized to log in to ESXi or vCenter Server.

In vSphere 5.1, ESXi user management has the following caveats.

- You cannot create ESXi users with the vSphere Web Client. You must log directly into the host with the vSphere Client to create ESXi users.
- ESXi 5.1 does not support local groups. However, Active Directory groups are supported.

To prevent anonymous users such as root from accessing the host with the Direct Console User Interface (DCUI) or ESXi Shell, remove the user's administrator privileges on the root folder of the host. This applies to both local users and Active Directory users and groups.

Add a Local ESXi User

Adding a user to the users table updates the internal user list that the host maintains.

Prerequisites

Review the password requirements described in "Password Requirements," on page 59.

Procedure

1 Log in to ESXi using the vSphere Client.

You cannot create ESXi users with the vSphere Web Client. You must directly log into the host with the vSphere Client to create ESXi users.

2 Click the **Local Users & Groups** tab and click **Users**.

3 Right-click anywhere in the Users table and click **Add**.

4 Enter a login, a user name, and a password.

NOTE Do not create a user named `ALL`. Privileges associated with the name `ALL` might not be available to all users in some situations. For example, if a user named `ALL` has Administrator privileges, a user with **ReadOnly** privileges might be able to log in to the host remotely. This is not the intended behavior.

- Specifying the user name and UID are optional.
- Create a password that meets the length and complexity requirements. The host checks for password compliance using the default authentication plug-in, `pam_passwdqc.so`. If the password is not compliant, the following error appears: `A general system error occurred: passwd: Authentication token manipulation error`.
- ESXi 5.1 does not support local groups.

5 Click **OK**.

Modify the Settings for a User on the Host

You can change the user ID, user name, and password for a user.

Prerequisites

Review the password requirements as described in "Password Requirements," on page 59.

Procedure

1 Log in to ESXi using the vSphere Client.

You cannot create ESXi users with the vSphere Web Client. You must log directly into the host with the vSphere Client to create ESXi users.

2 Click the **Local Users & Groups** tab and click **Users**.

3 Right-click the user and click **Edit** to open the Edit User dialog box.

4 Enter a login, a user name, and a password.

NOTE Do not create a user named `ALL`. Privileges associated with the name `ALL` might not be available to all users in some situations. For example, if a user named `ALL` has Administrator privileges, a user with **ReadOnly** privileges might be able to log in to the host remotely. This is not the intended behavior.

- Specifying the user name and UID are optional.
- Create a password that meets the length and complexity requirements. The host checks for password compliance using the default authentication plug-in, `pam_passwdqc.so`. If the password is not compliant, the following error appears: `A general system error occurred: passwd: Authentication token manipulation error`.
- ESXi 5.1 does not support local groups.

5 Click **OK**.

Remove a Local ESXi User from a Host

You can remove a local ESXi user from the host.

CAUTION Do not remove the root user.

If you remove a user from the host, they lose permissions to all objects on the host and cannot log in again.

NOTE Users who are logged in and are removed from the domain keep their host permissions until you restart the host.

Procedure

1 Log in to ESXi using the vSphere Client.

2 Click the **Local Users & Groups** tab and click **Users**.

3 Right-click the user to remove and select **Remove**.

Do not remove the root user for any reason.

Sort, Export, and View Local ESXi Users

You can view, sort, and export lists of a host's local users to a file that is in HTML, XML, Microsoft Excel, or CSV format.

Procedure

1 Log in to ESXi using the vSphere Client.

2 Click the **Local Users & Groups** tab and click **Users** .

3 Determine how to sort the table, and hide or show columns according to the information you want to see in the exported file.

- To sort the table by any of the columns, click the column heading.
- To show or hide columns, right-click any of the column headings and select or deselect the name of the column to hide.
- To show or hide columns, right-click any of the column headings and select or deselect the name of the column to hide.

4 Right-click anywhere in the table and click **Export List** to open the Save As dialog box.

5 Select a path and enter a filename.

6 Select the file type and click **OK**.

Password Requirements

By default, ESXi enforces requirements for user passwords.

When you create a password, include a mix of characters from four character classes: lowercase letters, uppercase letters, numbers, and special characters such as an underscore or dash.

Your user password must meet the following length requirements.

- Passwords containing characters from one or two character classes must be at least eight characters long.
- Passwords containing characters from three character classes must be at least seven characters long.

- Passwords containing characters from all four character classes must be at least six characters long.

NOTE An uppercase character that begins a password does not count toward the number of character classes used. A number that ends a password does not count toward the number of character classes used.

You can also use a passphrase, which is a phrase consisting of at least three words, each of which is 8 to 40 characters long.

Example: Creating Acceptable Passwords

The following password candidates meet the requirements of ESXi.

- xQaTEhbU: Contains eight characters from two character classes.
- xQaT3pb: Contains seven characters from three character classes.
- xQaT3#: Contains six characters from four character classes.

The following password candidates do not meet the requirements of ESXi.

- Xqat3hb: Begins with an uppercase character, reducing the effective number of character classes to two. Eight characters are required when you use only two character classes.
- xQaTEh2: Ends with a number, reducing the effective number of character classes to two. Eight characters are required when you use only two character classes.

Assigning Permissions for ESXi

For ESXi, permissions are defined as access roles that consist of a user and the user's assigned role for an object such as a virtual machine or ESXi host. Permissions grant users the right to perform the activities specified by the role on the object to which the role is assigned.

For example, to configure memory for the host, a user must be granted a role that includes the **Host.Configuration.Memory Configuration** privilege. By assigning different roles to users for different objects, you can control the tasks that users can perform in your vSphere environment.

When connecting directly to a host with the vSphere Client, the root and vpxuser user accounts have the same access rights as any user assigned the Administrator role on all objects.

All other users initially have no permissions on any objects, which means they cannot view these objects or perform operations on them. A user with Administrator privileges must assign permissions to these users to allow them to perform tasks.

Many tasks require permissions on more than one object. These rules can help you determine where you must assign permissions to allow particular operations:

- Any operation that consumes storage space, such as creating a virtual disk or taking a snapshot, requires the **Datastore.Allocate Space** privilege on the target datastore, as well as the privilege to perform the operation itself.
- Moving an object in the inventory hierarchy requires appropriate privileges on the object itself, the source parent object (such as a folder or cluster), and the destination parent object.
- Each host and cluster has its own implicit resource pool that contains all the resources of that host or cluster. Deploying a virtual machine directly to a host or cluster requires the **Resource.Assign Virtual Machine to Resource Pool** privilege.

The list of privileges is the same for both ESXi and vCenter Server.

You can create roles and set permissions through a direct connection to the ESXi host.

Allow Direct Console User Interface (DCUI) Access to Hosts in Lockdown Mode

You can specify which users can log into a host that is lockdown mode. DCUI Access users do not need to have full administrative privileges on the host. You grant the DCUI Access privilege in Advanced Settings.

In versions of vSphere earlier than vSphere 5.1, the root user can log into the DCUI on a host that is in lockdown mode. In vSphere 5.1, you can specify which local ESXi users are allowed to log into the DCUI when the host is in lockdown mode. These special users do not need to have full administrative privileges on the host. Specifying users other than the anonymous root user allows you to log which users have performed operations on the host while it is in lockdown mode.

IMPORTANT When you disable lockdown mode using the DCUI, all users with the DCUI Access privilege are granted the Administrator role on the host.

Procedure

1 Browse to the host in the vSphere Web Client object navigator.

2 Click the **Manage** tab and select **Settings**.

3 Click **Advanced System Settings** and select the setting **DCUI.Access**.

4 Click **Edit** and enter the user names, separated by commas.

By default, the root user is specified. You can remove root from the list of DCUI access users, as long as you specified at least one other user.

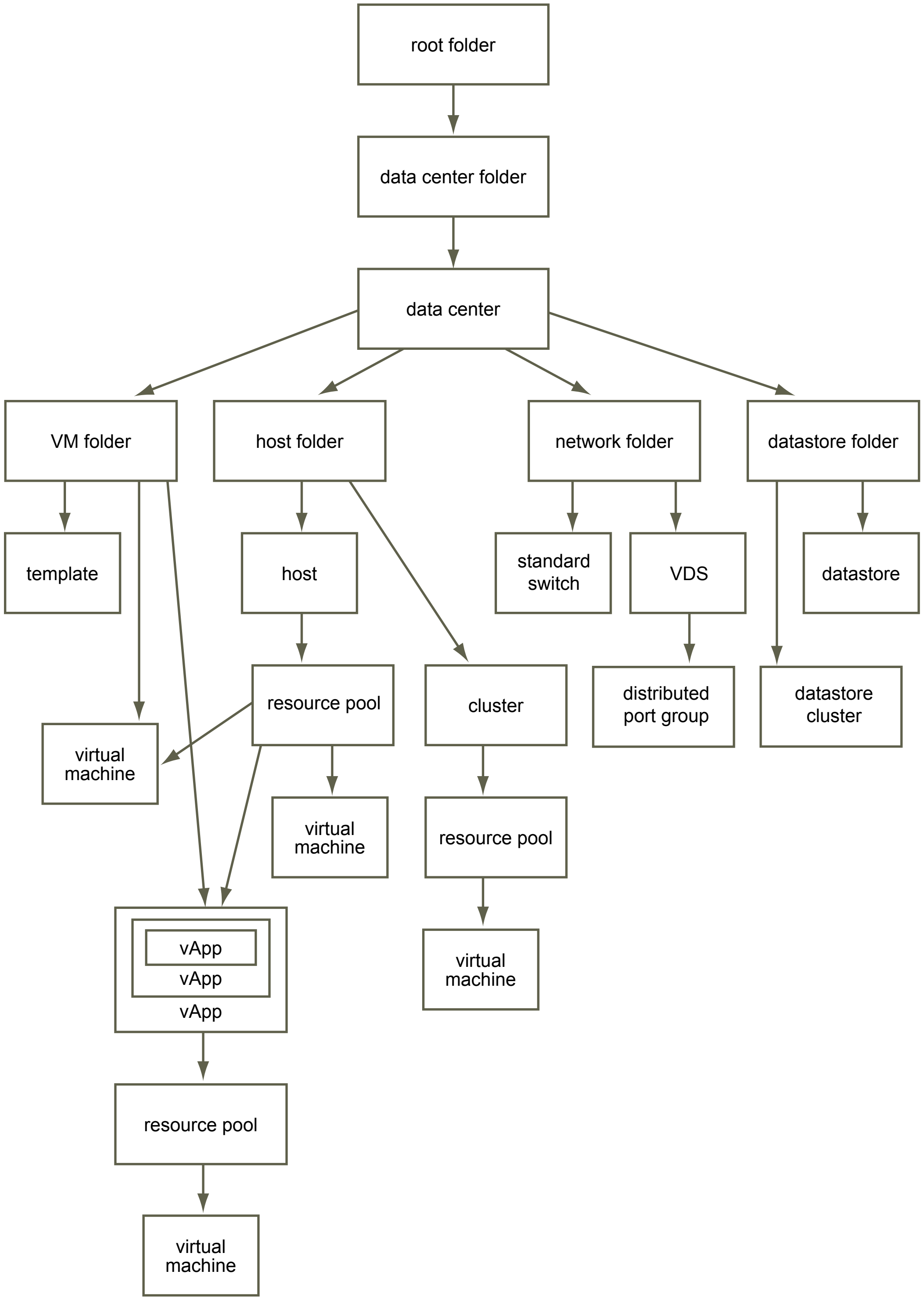
5 Click **OK**.

Hierarchical Inheritance of Permissions

When you assign a permission to an object, you can choose whether the permission propagates down the object hierarchy. You set propagation for each permission. Propagation is not universally applied. Permissions defined for a child object always override the permissions that are propagated from parent objects.

The figure illustrates inventory hierarchy and the paths by which permissions can propagate.

Figure 6-1. vSphere Inventory Hierarchy



Most inventory objects inherit permissions from a single parent object in the hierarchy. For example, a datastore inherits permissions from either its parent datastore folder or parent datacenter. Virtual machines inherit permissions from both the parent virtual machine folder and the parent host, cluster, or resource pool simultaneously. To restrict a user's privileges on a virtual machine, you must set permissions on both the parent folder and the parent host, cluster, or resource pool for that virtual machine.

To set permissions for a distributed switch and its associated distributed port groups, set permissions on a parent object, such a folder or datacenter. You must also select the option to propagate these permissions to child objects.

Permissions take several forms in the hierarchy:

Managed entities

You can define permissions on managed entities.

- Clusters
- Datacenters
- Datastores
- Datastore clusters
- Folders
- Hosts
- Networks (except vSphere Distributed Switches)
- Distributed port groups
- Resource pools
- Templates
- Virtual machines
- vSphere vApps

Global entities

Global entities derive permissions from the root vCenter Server system.

- Custom fields
- Licenses
- Roles
- Statistics intervals
- Sessions

Multiple Permission Settings

Objects might have multiple permissions, but only one permission for each user or group.

Permissions applied on a child object always override permissions that are applied on a parent object. Virtual machine folders and resource pools are equivalent levels in the hierarchy. If you assign propagating permissions to a user or group on a virtual machine's folder and its resource pool, the user has the privileges propagated from the resource pool and from the folder.

If multiple group permissions are defined on the same object and the user belongs to two or more of those groups, two situations are possible:

- If no permission is defined for the user on that object, the user is assigned the set of privileges assigned to the groups for that object.
- If a permission is defined for the user on that object, the user's permission takes precedence over all group permissions.

Example 1: Inheritance of Multiple Permissions

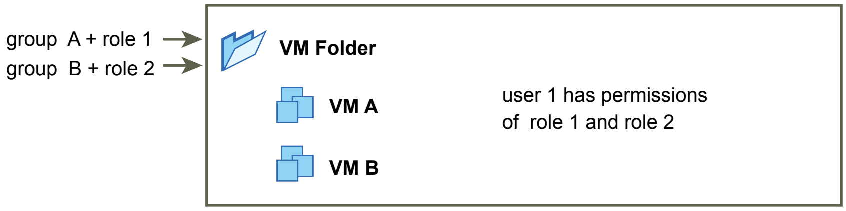
This example illustrates how an object can inherit multiple permissions from groups that are granted permission on a parent object.

In this example, two permissions are assigned on the same object for two different groups.

- Role 1 can power on virtual machines.
- Role 2 can take snapshots of virtual machines.
- Group A is granted Role 1 on VM Folder, with the permission set to propagate to child objects.
- Group B is granted Role 2 on VM Folder, with the permission set to propagate to child objects.
- User 1 is not assigned specific permission.

User 1, who belongs to groups A and B, logs on. User 1 can both power on and take snapshots of VM A and VM B.

Figure 6-2. Example 1: Inheritance of Multiple Permissions



Example 2: Child Permissions Overriding Parent Permissions

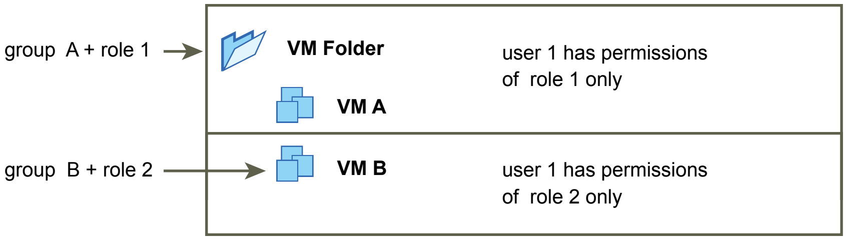
This example illustrates how permissions that are assigned on a child object can override permissions that are assigned on a parent object. You can use this overriding behavior to restrict user access to particular areas of the inventory.

In this example, permissions are assigned to two different groups on two different objects.

- Role 1 can power on virtual machines.
- Role 2 can take snapshots of virtual machines.
- Group A is granted Role 1 on VM Folder, with the permission set to propagate to child objects.
- Group B is granted Role 2 on VM B.

User 1, who belongs to groups A and B, logs on. Because Role 2 is assigned at a lower point in the hierarchy than Role 1, it overrides Role 1 on VM B. User 1 can power on VM A, but not take snapshots. User 1 can take snapshots of VM B, but not power it on.

Figure 6-3. Example 2: Child Permissions Overriding Parent Permissions



Example 3: User Permissions Overriding Group Permissions

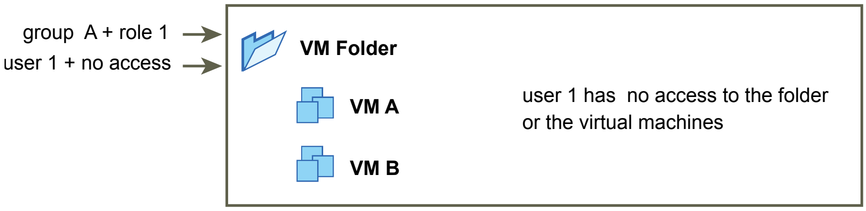
This example illustrates how permissions assigned directly to an individual user override permissions assigned to a group that the user is a member of.

In this example, permissions are assigned to a user and to a group on the same object.

- Role 1 can power on virtual machines.
- Group A is granted Role 1 on VM Folder.
- User 1 is granted No Access role on VM Folder.

User 1, who belongs to group A, logs on. The No Access role granted to User 1 on VM Folder overrides the group permission. User 1 has no access to VM Folder or VMs A and B.

Figure 6-4. Example 3: User Permissions Overriding Group Permissions



root User Permissions

Root users can only perform activities on the specific host that they are logged in to.

For security reasons, you might not want to use the root user in the Administrator role. In this case, you can change permissions after installation so that the root user no longer has administrative privileges. Alternatively, you can remove the access permissions for the root user. (Do not remove the root user itself.)

Important If you remove the access permissions for the root user, you must first create another permission at the root level that has a different user assigned to the Administrator role.

Note In vSphere 5.1, only the root user and no other user with administrator privileges is permitted to add a host to vCenter Server.

Assigning the Administrator role to a different user helps you maintain security through traceability. The vSphere Client logs all actions that the Administrator role user initiates as events, providing you with an audit trail. If all administrators log in as the root user, you cannot tell which administrator performed an action. If you create multiple permissions at the root level—each associated with a different user—you can track the actions of each administrator.

vpxuser Permissions

The vpxuser permission is used for vCenter Server when managing activities for the host. The vpxuser is created when a host is attached to vCenter Server.

vCenter Server has Administrator privileges on the host that it manages. For example, vCenter Server can move virtual machines to and from hosts and perform configuration changes needed to support virtual machines.

The vCenter Server administrator can perform most of the same tasks on the host as the root user and also schedule tasks, work with templates, and so forth. However, the vCenter Server administrator cannot directly create, delete, or edit users and groups for hosts. These tasks can only be performed by a user with Administrator permissions directly on each host.

Note You cannot manage the vpxuser using Active Directory.

Caution Do not change vpxuser in any way. Do not change its password. Do not change its permissions. If you do so, you might experience problems when working with hosts through vCenter Server.

dcui User Permissions

The dcui user runs on hosts and acts with Administrator rights. This user's primary purpose is to configure hosts for lockdown mode from the Direct Console User Interface (DCUI).

This user acts as an agent for the direct console and cannot be modified or used by interactive users.

Permission Validation

vCenter Server and ESXi hosts that use Active Directory regularly validate users and groups against the Windows Active Directory domain. Validation occurs whenever the host system starts and at regular intervals specified in the vCenter Server settings.

For example, if user Smith was assigned permissions and in the domain the user's name was changed to Smith2, the host concludes that Smith no longer exists and removes permissions for that user when the next validation occurs.

Similarly, if user Smith is removed from the domain, all permissions are removed when the next validation occurs. If a new user Smith is added to the domain before the next validation occurs, the new user Smith receives all the permissions the old user Smith was assigned.

Assign Permissions

You have defined a role and created a user. To use the role and user, you must assign permissions to the relevant inventory objects.

To assign persmissions, select a user and a role for an object. Permissions propagate to child objects. In a production environment, you can assign the same permissions at one time on multiple objects by moving the objects to a folder and setting the permissions on the folder.

Procedure

1 Log in to the vSphere Web Client as the vCenter Server administrator.

   a In the **User name** text box, type `administrator`.

   b In the Password text box, type `My_windows_password`.

   You configured vCenter Server to use the administrative account of the host Windows machine in the Getting Started with vCenter Server scenario.

2 Select your vCenter Server system in the object navigator.

3 Click the **Manage** tab and click **Permissions**.

4 Click the **Add Permission** icon (+).

5 In the Add Permission dialog, assign the user and role that you created.

   a Click **Add**.

   b In the **Domain** drop-down menu, select **SYSTEM-DOMAIN**.

c Select the user **user-deploy**, and click **Add**.

d In the **Assigned Role** drop-down menu, select **Deployer of virtual machines from template**.

e Click **OK**.

The roles that are assigned to the object appear in the menu. The privileges contained in the role are listed in the section below the role title.

The new user entry appears in the list of users and groups that have permissions for the vCenter Server system.

What to do next

Deploy a virtual machine from template as the new user.

Change Permission Validation Settings

vCenter Server periodically validates its user and group lists against the users and groups in the Windows Active Directory domain. It then removes users or groups that no longer exist in the domain. You can change the interval between validations.

Procedure

1 From the vSphere Client connected to a vCenter Server system, select **Administration > vCenter Server Settings**.

2 In the navigation pane, select **Active Directory**.

3 (Optional) Deselect the **Enable Validation** check box to disable validation.

Validation is enabled by default. Users and groups are validated when vCenter Server system starts, even if validation is disabled.

4 If validation is enabled, enter a value in the Validation Period text box to specify a time, in minutes, between validations.

Change Permissions

After a user and role pair is set for an inventory object, you can change the role paired with the user or change the setting of the **Propagate** check box. You can also remove the permission setting.

Procedure

1 From the vSphere Client, select an object in the inventory.

2 Click the **Permissions** tab.

3 Right-click the line item to select the user and role pair.

4 Select **Properties**.

5 Select a role for the user or group from the drop-down menu.

6 To propagate the privileges to the children of the assigned inventory object, click the **Propagate** check box and click **OK**.

Remove Permissions

Removing a permission for a user or group does not remove the user or group from the list of those available. It also does not remove the role from the list of available items. It removes the user or group and role pair from the selected inventory object.

Procedure

1 From the vSphere Client, click the **Inventory** button.

2 Expand the inventory as needed and click the appropriate object.

3 Click the **Permissions** tab.

4 Click the appropriate line item to select the user or group and role pair.

5 Select **Inventory > Permissions > Delete**.

Best Practices for Roles and Permissions

Use best practices for roles and permissions to maximize the security and manageability of your vCenter Server environment.

VMware recommends the following best practices when configuring roles and permissions in your vCenter Server environment:

- Where possible, grant permissions to groups rather than individual users.
- Grant permissions only where needed. Using the minimum number of permissions makes it easier to understand and manage your permissions structure.
- If you assign a restrictive role to a group, check that the group does not contain the Administrator user or other users with administrative privileges. Otherwise, you could unintentionally restrict administrators' privileges in parts of the inventory hierarchy where you have assigned that group the restrictive role.
- Use folders to group objects to correspond to the differing permissions you want to grant for them.
- Use caution when granting a permission at the root vCenter Server level. Users with permissions at the root level have access to global data on vCenter Server, such as roles, custom attributes, vCenter Server settings, and licenses. Changes to licenses and roles propagate to all vCenter Server systems in a Linked Mode group, even if the user does not have permissions on all of the vCenter Server systems in the group.
- In most cases, enable propagation on permissions. This ensures that when new objects are inserted in to the inventory hierarchy, they inherit permissions and are accessible to users.
- Use the No Access role to masks specific areas of the hierarchy that you don’t want particular users to have access to.

Required Privileges for Common Tasks

Many tasks require permissions on more than one object in the inventory. You can review the privileges required to perform the tasks and, where applicable, the appropriate sample roles.

The following table lists common tasks that require more than one privilege. You can use the Applicable Roles on the inventory objects to grant permission to perform these tasks, or you can create your own roles with the equivalent required privileges.

Table 6-1. Required Privileges for Common Tasks

Task	Required Privileges	Applicable Role
Create a virtual machine	On the destination folder or datacenter: ■ **Virtual machine.Inventory.Create new** ■ **Virtual Machine.Configuration.Add New Disk** (if creating a new virtual disk) ■ **Virtual Machine .Configuration.Add Existing Disk** (if using an existing virtual disk) ■ **Virtual Machine.Configuration.Raw Device** (if using a RDM or SCSI pass-through device)	Virtual Machine Administrator
	On the destination host, cluster, or resource pool: **Resource.Assign Virtual Machine to Resource Pool**	Virtual Machine Administrator

Table 6-1. Required Privileges for Common Tasks (Continued)

Task	Required Privileges	Applicable Role
	On the destination datastore or folder containing a datastore: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
	On the network that the virtual machine will be assigned to: **Network.Assign Network**	Network Consumer or Virtual Machine Administrator
Deploy a virtual machine from a template	On the destination folder or datacenter: ■ **Virtual machine .Inventory.Create from existing** ■ **Virtual Machine .Configuration.Add Add New Disk**	Virtual Machine Administrator
	On a template or folder of templates: **Virtual Machine.Provisioning.Deploy Template**	Virtual Machine Administrator
	On the destination host, cluster or resource pool: **Resource.Assign Virtual.Machine to Resource Pool**	Virtual Machine Administrator
	On the destination datastore or folder of datastores: **Datastore.Allocate Space**s	Datastore Consumer or Virtual Machine Administrator
	On the network that the virtual machine will be assigned to: **Network.Assign Network**	Network Consumer or Virtual Machine Administrator
Take a virtual machine snapshot	On the virtual machine or a folder of virtual machines: **Virtual Machine.State.Create Snapshot**s	Virtual Machine Power User or Virtual Machine Administrator
	On the destination datastore or folder of datastores: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
Move a virtual machine into a resource pool	On the virtual machine or folder of virtual machines: ■ **Resource.Assign Virtual Machine to Resource Pool** ■ **Virtual machine.Inventory.Move**	Virtual Machine Administrator
	On the destination resource pool: **Resource.Assign Virtual Machine to Resource Pool**s	Virtual Machine Administrator
Install a guest operating system on a virtual machine	On the virtual machine or folder of virtual machines: ■ **Virtual Machine.Interaction.Answer Question** ■ **Virtual Machine.Interaction.Console Interaction** ■ **Virtual Machine.Interaction.Device Connection** ■ **Virtual Machine.Interaction.Power Off**s ■ **Virtual Machine.Interaction.Power On** ■ **Virtual Machine.Interaction.Reset** ■ **Virtual Machine.Interaction.Configure CD Media** (if installing from a CD) ■ **Virtual Machine.Interaction.Configure Floppy Media** (if installing from a floppy disk) ■ **Virtual Machine.Interaction.Tools Install**	Virtual Machine Power User or Virtual Machine Administrator
	On a datastore containing the installation media ISO image: **Datastore.Browse Datastore** (if installing from an ISO image on a datastore)	Virtual Machine Power User or Virtual Machine Administrator

Table 6-1. Required Privileges for Common Tasks (Continued)

Task	Required Privileges	Applicable Role
Migrate a virtual machine with vMotion	On the virtual machine or folder of virtual machines: - **Resource.Migrate** - **Resource.Assign Virtual Machine to Resource Pool** (if destination is a different resource pool from the source)	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination host, cluster, or resource pool (if different from the source): **Resource.Assign Virtual Machine to Resource Pool**	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
Cold migrate (relocate) a virtual machine	On the virtual machine or folder of virtual machines: - **Resource.Relocate** - **Resource.Assign Virtual Machine to Resource Pool** (if destination is a different resource pool from the source)	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination host, cluster, or resource pool (if different from the source): **Resource.Assign Virtual Machine to Resource Pool**	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination datastore (if different from the source): **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
Migrate a Virtual Machine with Storage vMotion	On the virtual machine or folder of virtual machines: **Resource.Migrate**	Datacenter Administrator or Resource Pool Administrator or Virtual Machine Administrator
	On the destination datastore: **Datastore.Allocate Space**	Datastore Consumer or Virtual Machine Administrator
Move a host into a cluster	On the host: **Host.Inventory.Add Host to Cluster**	Datacenter Administrator or Virtual Machine Administrator
	On the destination cluster: **Host.Inventory.Add Host to Cluster**	Datacenter Administrator or Virtual Machine Administrator

Assigning ESXi Roles

ESXi grants access to objects only to users who are assigned permissions for the object. When you assign a user permissions for the object, you do so by pairing the user with a role. A role is a predefined set of privileges.

ESXi hosts provide three default roles, and you cannot change the privileges associated with these roles. Each subsequent default role includes the privileges of the previous role. For example, the Administrator role inherits the privileges of the Read Only role. Roles you create yourself do not inherit privileges from any of the default roles.

You can create custom roles by using the role-editing facilities in the vSphere Client to create privilege sets that match your user needs. If you use the vSphere Client connected to vCenter Server to manage ESXi hosts, you have additional roles to choose from in vCenter Server. Also, the roles you create directly on a host are not accessible within vCenter Server. You can work with these roles only if you log in to the host directly from the vSphere Client.

NOTE When you add a custom role and do not assign any privileges to it, the role is created as a Read Only role with three system-defined privileges: System.Anonymous, System.View, and System.Read.

If you manage ESXi hosts through vCenter Server, maintaining custom roles in the host and vCenter Server can result in confusion and misuse. In this type of configuration, maintain custom roles only in vCenter Server.

You can create host roles and set permissions through a direct connection to the ESXi host with the vSphere Client.

Create a Role

VMware recommends that you create roles to suit the access control needs of your environment.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 Right-click the **Roles** tab information panel and click **Add**.

3 Type a name for the new role.

4 Select privileges for the role and click **OK**.

Clone a Role

You can make a copy of an existing role, rename it, and later edit it. When you make a copy, the new role is not applied to any users or groups and objects. You must assign the role to users or groups and objects.

If you create or modify a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 To select the role to duplicate, click the object in the list of **Roles**.

3 To clone the selected role, select **Administration > Role > Clone**.

A duplicate of the role is added to the list of roles. The name is `Copy of` *`rolename`*.

Edit a Role

When you edit a role, you can change the privileges selected for that role. When completed, these privileges are applied to any user or group assigned the edited role.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. However, assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 Right-click the role to edit and select **Edit Role**.

3 Select privileges for the role and click **OK**.

Rename a Role

When you rename a role, no changes occur to that role's assignments.

If you create or modify a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 Click the object in the list of roles that you want rename.

3 Select **Administration > Role > Rename**.

4 Type the new name.

Remove a Role

When you remove a role that is not assigned to any users or groups, the definition is removed from the list of roles. When you remove a role that is assigned to a user or group, you can remove assignments or replace them with an assignment to another role.

CAUTION You must understand how users will be affected before removing all assignments or replacing them. Users who have no permissions granted to them cannot log in to vCenter Server.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

If you remove a role from a vCenter Server system that is part of a connected group in Linked Mode, check the use of that role on the other vCenter Server systems in the group. Removing a role from one vCenter Server system removes the role from all other vCenter Server systems in the group, even if you reassign permissions to another role on the current vCenter Server system.

Procedure

1 On the vSphere Client Home page, click **Roles**.

2 Click the object you want to remove in the list of roles.

3 Select **Administration > Role > Remove**.

4 Click **OK**.

The role is removed from the list.

If the role is assigned to a user or group, a warning message appears.

5 Select a reassignment option and click **OK**.

Option	Description
Remove Role Assignments	Removes configured user or group and role pairings on the server. If a user or group does not have other permissions assigned, they lose all privileges.
Reassign affected users to	Reassigns any configured user or group and role pairings to the selected new role.

Using Roles to Assign Privileges

A role is a predefined set of privileges. Privileges define individual rights that a user requires to perform actions and read properties.

When you assign a user or group permissions, you pair the user or group with a role and associate that pairing with an inventory object. A single user might have different roles for different objects in the inventory. For example, if you have two resource pools in your inventory, Pool A and Pool B, you might assign a particular user the Virtual Machine User role on Pool A and the Read Only role on Pool B. These assignments would allow that user to turn on virtual machines in Pool A, but not those in Pool B. The user would still be able to view the status of the virtual machines in Pool B.

The roles created on a host are separate from the roles created on a vCenter Server system. When you manage a host using vCenter Server, the roles created through vCenter Server are available. If you connect directly to the host using the vSphere Client, the roles created directly on the host are available.

vCenter Server and ESXi hosts provide default roles:

System roles System roles are permanent. You cannot edit the privileges associated with these roles.

Sample roles VMware provides sample roles for convenience as guidelines and suggestions. You can modify or remove these roles.

You can also create roles.

All roles permit the user to schedule tasks by default. Users can schedule only tasks they have permission to perform at the time the tasks are created.

NOTE Changes to permissions and roles take effect immediately, even if the users involved are logged in. The exception is searches, where permission changes take effect after the user has logged out and logged back in.

Using Active Directory to Manage Users and Groups

You can configure ESXi to use a directory service such as Active Directory to manage users and groups.

When you use Active Directory, users supply their Active Directory credentials and the domain name of the Active Directory server when adding a host to a domain.

Configure a Host to Use Active Directory

You can configure the host to use a directory service such as Active Directory to manage users and groups.

Prerequisites

- Verify that you have an Active Directory domain. See your directory server documentation.
- Verify that the host name of ESXi is fully qualified with the domain name of the Active Directory forest.

  fully qualified domain name = *host_name.domain_name*

Procedure

1 Synchronize the time between ESXi and the directory service system using NTP.

  ESXi supports synchronizing time with an external NTPv3 or NTPv4 server that is compliant with RFC 5905 and RFC 1305. The Microsoft Windows W32Time service does not meet these requirements when running with default settings. See "Configure a Windows NTP Client for Network Clock Synchronization," on page 151 or the VMware Knowledge Base for information about how to synchronize ESXi time with a Microsoft Domain Controller.

2 Ensure that the DNS servers you configured for the host can resolve the host names for the Active Directory controllers.

  a In the vSphere Client, select the host in the inventory.

  b Click the **Configuration** tab and click **DNS and Routing**.

  c Click the **Properties** link at the top right of the panel.

  d In the DNS and Routing Configuration dialog box, verify that the host name and DNS server information for the host are correct.

What to do next

Use the vSphere Client to join a directory service domain.

Configure a Host to Use Active Directory in the vSphere Web Client

You can configure a host to use a directory service such as Active Directory to manage users and groups.

Prerequisites

- Verify that you have an Active Directory domain. See your directory server documentation.
- Verify that the host name of ESXi is fully qualified with the domain name of the Active Directory forest.

  fully qualified domain name = *host_name.domain_name*

Procedure

1 Synchronize the time between ESXi and the directory service system using NTP.

  See "Configure a Windows NTP Client for Network Clock Synchronization," on page 151 or the VMware Knowledge Base for information about how to synchronize ESXi time with a Microsoft Domain Controller.

2 Ensure that the DNS servers you configured for the host can resolve the host names for the Active Directory controllers.

   a Browse to the host in the vSphere Web Client object navigator.

   b Click the **Manage** tab and click **DNS and Routing** under Networking.

   c Click **Edit**.

   d In the DNS and Routing Configuration dialog box, verify that the host name and DNS server information for the host are correct.

What to do next

Use the vSphere Web Client to join a directory service domain.

Add a Host to a Directory Service Domain

To use a directory service, you must join the host to the directory service domain.

You can enter the domain name in one of two ways:

- `name.tld` (for example, `domain.com`): The account is created under the default container.
- `name.tld/container/path` (for example, `domain.com/OU1/OU2`): The account is created under a particular organizational unit (OU).

To use the vSphere Authentication Proxy service (CAM service), see "Use vSphere Authentication Proxy to Add a Host to a Domain," on page 81.

Prerequisites

Verify that the vSphere Client is connected to a vCenter Server system or to the host.

Procedure

1 Select a host in the vSphere Client inventory, and click the **Configuration** tab.

2 Click **Properties**.

3 In the Directory Services Configuration dialog box, select the directory service from the drop-down menu.

4 Enter a domain.

   Use the form `name.tld` or `name.tld/container/path`.

5 Click **Join Domain**.

6 Enter the user name and password of a directory service user who has permissions to join the host to the domain, and click **OK**.

7 Click **OK** to close the Directory Services Configuration dialog box.

Add a Host to a Directory Service Domain in the vSphere Web Client

To use a directory service, you must join the host to the directory service domain.

You can enter the domain name in one of two ways:

- `name.tld` (for example, `domain.com`): The account is created under the default container.
- `name.tld/container/path` (for example, `domain.com/OU1/OU2`): The account is created under a particular organizational unit (OU).

To use the vSphere Authentication Proxy service, see "Use vSphere Authentication Proxy to Add a Host to a Domain," on page 81.

Procedure

1 Browse to the host in the vSphere Web Client inventory.

2 Click the **Manage** tab and click **Settings**.

3 Under System, select **Authentication Services**.

4 Click **Join Domain**.

5 Enter a domain.

  Use the form `name.tld` or `name.tld/container/path`.

6 Enter the user name and password of a directory service user who has permissions to join the host to the domain, and click **OK**.

7 Click **OK** to close the Directory Services Configuration dialog box.

View Directory Service Settings

You can view the type of directory server, if any, the host uses to authenticate users and the directory server settings.

Procedure

1 Select a host in the vSphere Client inventory, and click the **Configuration** tab.

2 Under Software, select **Authentication Services**.

  The Authentication Services Settings page displays the directory service and domain settings.

View Directory Service Settings in the vSphere Web Client

You can view the type of directory server, if any, the host uses to authenticate users and the directory server settings.

Procedure

1 Browse to the host in the vSphere Web Client inventory.

2 Click the **Manage** tab and click **Settings**.

3 Under System, select **Authentication Services**.

  The Authentication Services page displays the directory service and domain settings.

Using vSphere Authentication Proxy

When you use the vSphere Authentication Proxy, you do not need to transmit Active Directory credentials to the host. Users supply the domain name of the Active Directory server and the IP address of the authentication proxy server when they add a host to a domain.

Install the vSphere Authentication Proxy Service

To use the vSphere Authentication Proxy service for authentication, you must install the service on a host machine.

You can install the vSphere Authentication Proxy on the same machine as the associated vCenter Server, or on a different machine that has a network connection to the vCenter Server. The vSphere Authentication Proxy is not supported with vCenter Server versions earlier than version 5.0.

The vSphere Authentication Proxy service binds to an IPv4 address for communication with vCenter Server, and does not support IPv6. vCenter Server can be on an IPv4-only, IPv4/IPv6 mixed-mode, or IPv6-only host machine, but the machine that connects to vCenter Server through the vSphere Client must have an IPv4 address for the vSphere Authentication Proxy service to work.

Prerequisites

- Verify that you have administrator privileges on the host machine where you install the vSphere Authentication Proxy service.
- Verify that the host machine has Windows Installer 3.0 or later.
- Verify that the host machine has a supported processor and operating system. The vSphere Authentication Proxy supports the same processors and operating systems as vCenter Server.
- Verify that the host machine has a valid IPv4 address. You can install vSphere Authentication Proxy on an IPv4-only or IPv4/IPv6 mixed-mode host machine, but you cannot install vSphere Authentication Proxy on an IPv6-only host machine.
- If you are installing vSphere Authentication Proxy on a Windows Server 2008 R2 host machine, download and install the Windows hotfix described in Windows KB Article 981506 on the support.microsoft.com Web site. If this hotfix is not installed, the Authentication Proxy Adapter fails to initialize. This problem is accompanied by error messages in `camadapter.log` similar to `Failed to bind CAM website with CTL` and `Failed to initialize CAMAdapter.`

Gather the following information to complete the installation:

- The location where you will install the vSphere Authentication Proxy, if you are not using the default location.
- The IP address or host name, HTTP port, and credentials for the vCenter Server system that the vSphere Authentication Proxy will connect to.
- The host name or IP address to identify the vSphere Authentication Proxy host machine on the network.

Procedure

1. On the host machine where you will install the vSphere Authentication Proxy service, install the .NET Framework 3.5.
2. Install vSphere Auto Deploy.

   You do not have to install Auto Deploy on the same host machine as the vSphere Authentication Proxy service.
3. Add the host machine where you will install the authentication proxy service to the domain.
4. Use the Domain Administrator account to log in to the host machine.
5. In the software installer directory, double-click the `autorun.exe` file to start the installer.
6. Select **VMware vSphere Authentication Proxy** and click **Install**.
7. Follow the wizard prompts to complete the installation.

   During installation, the authentication service registers with the vCenter Server instance where Auto Deploy is registered.

The authentication proxy service is installed on the host machine.

Note When you install the vSphere Authentication Proxy service, the installer creates a domain account with appropriate privileges to run the authentication proxy service. The account name begins with the prefix `CAM-` and has a 32-character, randomly generated password associated with it. The password is set to never expire. Do not change the account settings.

What to do next

Configure the host to use the authentication proxy service to join the domain.

Configure a Host to Use the vSphere Authentication Proxy for Authentication

After you install the vSphere Authentication Proxy service (CAM service), you must configure the host to use the authentication proxy server to authenticate users.

Prerequisites

Install the vSphere Authentication Proxy service (CAM service) on a host as described in "Install the vSphere Authentication Proxy Service," on page 76.

Procedure

1 Use the IIS manager on the host to set up the DHCP range.

Setting the range allows hosts that are using DHCP in the management network to use the authentication proxy service.

Option	Action
For IIS 6	a Browse to **Computer Account Management Web Site**. b Right-click the virtual directory **CAM ISAPI**. c Select **Properties > Directory Security > Edit IP Address and Domain Name Restrictions > Add Group of Computers**.
For IIS 7	a Browse to **Computer Account Management Web Site**. b Click the **CAM ISAPI** virtual directory in the left pane and open **IPv4 Address and Domain Restrictions**. c Select **Add Allow Entry > IPv4 Address Range**.

2 If a host is not provisioned by Auto Deploy, change the default SSL certificate to a self-signed certificate or to a certificate signed by a commercial certificate authority (CA).

Option	Description
Self-signed certificate	If you replace the default certificate with a self-signed certificate, add the host to vCenter Server so that the authentication proxy server will trust the host.
CA-signed certificate	Add the CA-signed certificate (Windows format only) to the local trust certificate store on the system where the authentication proxy service is installed and restart the vSphere Authentication Proxy Adapter service. ■ For Windows 2003, copy the certificate file to `C:\Documents and Settings\All Users\Application Data\VMware\vSphere Authentication Proxy\trust`. ■ For Windows 2008, copy the certificate file to `C:\Program Data\VMware\vSphere Authentication Proxy\trust`.

Authenticating vSphere Authentication Proxy to ESXi

Before you use the vSphere Authentication Proxy to connect ESXi to a domain, you must authenticate the vSphere Authentication Proxy server to ESXi. If you use Host Profiles to connect a domain with the vSphere Authentication Proxy server, you do not need to authenticate the server. The host profile authenticates the proxy server to ESXi.

To authenticate ESXi to use the vSphere Authentication Proxy, export the server certificate from the vSphere Authentication Proxy system and import it to ESXi. You need only authenticate the server once.

NOTE By default, ESXi must authenticate the vSphere Authentication Proxy server when using it to join a domain. Make sure that this authentication functionality is enabled at all times. If you must disable authentication, you can use the Advanced Settings dialog box to set the `UserVars.ActiveDirectoryVerifyCAMCertifcate` attribute to 0.

Export vSphere Authentication Proxy Certificate

To authenticate the vSphere Authentication Proxy to ESXi, you must provide ESXi with the proxy server certificate.

Prerequisites

Install the vSphere Authentication Proxy service on a host as described in "Install the vSphere Authentication Proxy Service," on page 76.

Procedure

1 On the authentication proxy server system, use the IIS Manager to export the certificate.

Option	Action
For IIS 6	a Right-click **Computer Account Management Web Site**. b Select **Properties > Directory Security > View Certificate**.
For IIS 7	a Click **Computer Account Management Web Site** in the left pane. b Select **Bindings** to open the Site Bindings dialog box. c Select **https** binding. d Select **Edit > View SSL Certificate**.

2 Select **Details > Copy to File**.

3 Select the options **Do Not Export the Private Key** and **Base-64 encoded X.509 (CER)**.

What to do next

Import the certificate to ESXi.

Import a vSphere Authentication Proxy Server Certificate to ESXi

To authenticate the vSphere Authentication Proxy server to ESXi, upload the proxy server certificate to ESXi.

You use the vSphere Client user interface to upload the vSphere Authentication Proxy server certificate to ESXi.

Prerequisites

Install the vSphere Authentication Proxy service on a host as described in "Install the vSphere Authentication Proxy Service," on page 76.

Export the vSphere Authentication Proxy server certificate as described in "Export vSphere Authentication Proxy Certificate," on page 79.

Procedure

1 Select a host in the vSphere Client inventory and click the **Summary** tab.

2 Upload the certificate for the authentication proxy server to a temporary location on ESXi.

   a Under Resources, right-click a datastore and select **Browse Datastore**.

   b Select a location for the certificate and select the **Upload File** button.

   c Browse to the certificate and select **Open**.

3 Select the **Configuration** tab and click **Authentication Services**.

4 Click **Import Certificate**.

5 Enter the full path to the authentication proxy server certificate file on the host and the IP address of the authentication proxy server.

   Use the form [*datastore name*] *file path* to enter the path to the proxy server.

6 Click **Import**.

What to do next

Set up the host to use vSphere Authentication Proxy server to authenticate users.

Import a Proxy Server Certificate to ESXi in the vSphere Web Client

To authenticate the vSphere Authentication Proxy server to ESXi, upload the proxy server certificate to ESXi.

You use the vSphere Client user interface to upload the vSphere Authentication Proxy server certificate to ESXi.

Prerequisites

Install the vSphere Authentication Proxy service on a host as described in "Install the vSphere Authentication Proxy Service," on page 76.

Export the vSphere Authentication Proxy server certificate as described in "Export vSphere Authentication Proxy Certificate," on page 79.

Procedure

1 Upload the certificate for the authentication proxy server to a temporary location accessible to the host.

   a In the vSphere Web Client, browse to a datastore accessible to the host and click the **Manage** tab.

   b Click **Files** and click **Upload File**.

2 Browse to the certificate and select **Open**.

   To upload or download files from a datastore, you must have the Client Integration Plug-in installed on the system where you use the vSphere Web Client.

3 Browse to the host and click the **Manage** tab.

4 Select the **Configuration** tab and click **Authentication Services**.

5 Click **Import Certificate**.

6 Enter the full path to the authentication proxy server certificate file on the host and the IP address of the authentication proxy server.

   Use the form [*datastore name*] *file path* to enter the path to the proxy server.

7 Click **Import**.

What to do next

Set up the host to use vSphere Authentication Proxy server to authenticate users.

Use vSphere Authentication Proxy to Add a Host to a Domain

When you join a host to a directory service domain, you can use the vSphere Authentication Proxy server for authentication instead of transmitting user-supplied Active Directory credentials.

You can enter the domain name in one of two ways:

- `name.tld` (for example, `domain.com`): The account is created under the default container.
- `name.tld/container/path` (for example, `domain.com/OU1/OU2`): The account is created under a particular organizational unit (OU).

Prerequisites

- Verify that the vSphere Client is connected to a vCenter Server system or to the host.
- If ESXi is configured with a DHCP address, set up the DHCP range as described in "Configure a Host to Use the vSphere Authentication Proxy for Authentication," on page 78.
- If ESXi is configured with a static IP address, verify that its associated profile is configured to use the vSphere Authentication Proxy service to join a domain so that the authentication proxy server can trust the ESXi IP address.
- If ESXi is using a self-signed certificate, verify that the host has been added to vCenter Server. This allows the authentication proxy server to trust ESXi.
- If ESXi is using a CA-signed certificate and is not provisioned by Auto Deploy, verify that the CA certificate has been added to the local trust certificate store of the authentication proxy server as described in "Configure a Host to Use the vSphere Authentication Proxy for Authentication," on page 78.
- Authenticate the vSphere Authentication Proxy server to the host as described in "Authenticating vSphere Authentication Proxy to ESXi," on page 79.

Procedure

1. In the vSphere Client inventory, select the host.
2. Select the **Configuration** tab and click **Authentication Services**.
3. Click **Properties**.
4. In the Directory Services Configuration dialog box, select the directory server from the drop-down menu.
5. Enter a domain.

   Use the form `name.tld` or `name.tld/container/path`.
6. Select the **Use vSphere Authentication Proxy** check box.
7. Enter the IP address of the authentication proxy server.
8. Click **Join Domain**.
9. Click **OK**.

Use vSphere Authentication Proxy to Add a Host to a Domain in the vSphere Web Client

When you join a host to a directory service domain, you can use the vSphere Authentication Proxy server for authentication instead of transmitting user-supplied Active Directory credentials.

You can enter the domain name in one of two ways:

- **`name.tld`** (for example, **`domain.com`**): The account is created under the default container.
- **`name.tld/container/path`** (for example, **`domain.com/OU1/OU2`**): The account is created under a particular organizational unit (OU).

Prerequisites

- Verify that the vSphere Client is connected to a vCenter Server system.
- If ESXi is configured with a DHCP address, set up the DHCP range.
- If ESXi is configured with a static IP address, verify that its associated profile is configured to use the vSphere Authentication Proxy service to join a domain so that the authentication proxy server can trust the ESXi IP address.
- If ESXi is using a self-signed certificate, verify that the host has been added to vCenter Server. This allows the authentication proxy server to trust ESXi.
- If ESXi is using a CA-signed certificate and is not provisioned by Auto Deploy, verify that the CA certificate has been added to the local trust certificate store of the authentication proxy server as described in "Configure a Host to Use the vSphere Authentication Proxy for Authentication," on page 78.
- Authenticate the vSphere Authentication Proxy server to the host.

Procedure

1. Browse to the host in the vSphere Web Client and click the **Manage** tab.
2. Click **Settings** and select **Authentication Services**.
3. Click **Join Domain**.
4. Enter a domain.

   Use the form **`name.tld`** or **`name.tld/container/path`**.
5. Select **Using Proxy Server**.
6. Enter the IP address of the authentication proxy server.
7. Click **OK**.

View vSphere Authentication Proxy Settings

You can verify the IP address and the port where the proxy server listens.

After you set up a vSphere Authentication Proxy service on a host machine, you can view the host machine address and port information in the vSphere Client.

Procedure

◆ In the vSphere Client, select **Inventory > Administration > vSphere Authentication Proxy**.

The VMware vSphere Authentication Proxy page is displayed.

vCenter Server Authentication and User Management 7

vCenter Server users and groups are authenticated by the vCenter Single Sign On server.

In product versions earlier than vCenter Server 5.1, when users connect to vCenter Server, they were authenticated when vCenter Server validated their credentials against an Active Directory domain or the list of local operating system users. In vCenter Server 5.1, users authenticate through vCenter Single Sign-On.

The default Single Sign-On administrator is admin@System-Domain with the password you specified at installation. You use these credentials to log in to the Single Sign-On administration tool in the vSphere Web Client. You can then assign Single Sign-On administrator privileges to users who are allowed to manage the Single Sign-On server. These users might be different from the users that administer vCenter Server.

NOTE On the vCenter Server Appliance, local operating system administrators (for example, root) also have vCenter Single Sign-On administrator privileges.

The following information is important for you to manage users and groups.

- Logging in to the vSphere Web Client with Windows session credentials is supported only for Active Directory users of the domain to which the Single Sign-On system belongs.
- ESXi 5.1 is integrated with vCenter Single Sign-On, and you can create ESXi users with the vSphere Web Client.vCenter Server is not aware of users that are local to ESXi. In addition, ESXi is not aware of vCenter Server users. However, you can configure Single Sign-On to use an Active Directory domain as an identity source, and configure ESXi to point to the same Active Directory domain to obtain user and group information. This action allows the same set of users to be available to the host and to vCenter Server.

This chapter includes the following topics:

Using vCenter Single Sign-On with vSphere

You use vCenter Single Sign-On to authenticate and manage vCenter Server users.

In vCenter Server versions earlier than vCenter Server 5.1, when a user connects to vCenter Server, vCenter Server authenticates the user by validating the user against an Active Directory domain or the list of local operating system users. In vCenter Server 5.1, users authenticate through vCenter Single Sign-On.

The Single Sign-On administrative interface is part of the vSphere Web Client. To configure Single Sign-On and manage Single Sign-On users and groups, you log in to the vSphere Web Client as a user with Single Sign-On administrator privileges. This might not be the same user as the vCenter Server administrator. Enter the credentials on the vSphere Web Client login page and upon authentication, you can access the Single Sign-On administration tool to create users and assign administrative permissions to other users.

vSphere 5.1 users have the option of logging in to vCenter Server with the vSphere Client or with the vSphere Web Client.

- Using the vSphere Client, you log in to each vCenter Server system separately. All linked vCenter Server instances are visible on the left pane of the vSphere Client. The vSphere Client does not show vCenter Server systems that are not linked to the vCenter Server that the user logged in to unless the user connects to those vCenter Server systems explicitly. This behavior is unchanged from vCenter Server versions earlier than version 5.1.
- Using the vSphere Web Client, you authenticate to vCenter Single Sign-On by entering your credentials on the vSphere Web Client login page. You can then view all of the vCenter Server instances for which you have permissions. After you connect to vCenter Server, no further authentication is required. The actions that you can perform on objects depend on the user's vCenter Server permissions on those objects.

For versions earlier than vCenter Server 5.1, you must explicitly register each vCenter Server system with the vSphere Web Client. For vCenter Server 5.1, vCenter Server systems are automatically detected and are displayed in the vSphere Web Client inventory.

How vCenter Single Sign-On Deployment Scenarios Affect Log In Behavior

The way that you deploy vCenter Single Sign-On and the type of user who installs vCenter Single Sign-On affects which administrator user accounts have privileges on the Single Sign-On server and on vCenter Server.

During the vCenter Server installation process, certain users are granted privileges to log in to vCenter Server and certain users are granted privileges to manage vCenter Single Sign-On. The vCenter Server administrator might not be the same user as the vCenter Single Sign-On administrator. This means that when you log in to the vSphere Web Client as the default Single Sign-On administrator (admin@System-Domain), you might not see any vCenter Server systems in the inventory. The inventory appears to be empty because you see only the systems upon which you have privileges in the vSphere Web Client.

This also means that when you log in to the vSphere Web Client as the default vCenter Server administrator, you might not see the vCenter Single Sign-On configuration tool. The configuration tool is not present because only the default vCenter Single Sign-On Administrator (admin@System-Domain) is allowed to view and manage vCenter Single Sign-On after installation. The Single Sign-On administrator can create additional administrator users if necessary.

- Login Behavior When You Use vCenter Simple Install on page 85

  The vCenter Simple Install process installs vCenter Single Sign-On, the Inventory Service, and vCenter Server on one system. The account you use when you run the Simple Install process affects which users have privileges on which components.

- Login Behavior When You Deploy vCenter Single Sign-On as a Standalone Server on page 85

  Deploying vCenter Single Sign-On in Basic mode means that a standalone version of vCenter Single Sign-On is installed on a system. Multiple vCenter Server, Inventory Service, and vSphere Web Client instances can point to this standalone version of vCenter Single Sign-On.

- Login Behavior When You Install a Cluster of vCenter Single Sign-On Instances on page 86

  Deploying vCenter Single Sign-On as a cluster means that two or more instances of vCenter Single Sign-On are installed in high availability mode. vCenter Single Sign-On high availability mode is not the same as vSphere HA. All instances of vCenter Single Sign-On use the same database and point to the same identity sources. Single Sign-On administrator users see the primary Single Sign-On instance when they connect to vCenter Server through the vSphere Web Client.

Login Behavior When You Use vCenter Simple Install

The vCenter Simple Install process installs vCenter Single Sign-On, the Inventory Service, and vCenter Server on one system. The account you use when you run the Simple Install process affects which users have privileges on which components.

When you log in as a domain account user or local account user to install vCenter Server using vCenter Simple Install, the following behavior occurs upon installation.

- By default, users in the local operating system Administrators group can log in to the vSphere Web Client and vCenter Server. These users cannot configure Single Sign-On or view the Single Sign-On management interface in the vSphere Web Client.
- By default, the vCenter Single Sign-On administrator user is admin@System-Domain. This user can log in to the vSphere Web Client to configure Single Sign-On and add accounts to manage Single Sign-On if necessary. This user cannot view or configure vCenter Server.
- If you are logged in as a domain account user, the default Active Directory identity sources are discovered automatically during vCenter Single Sign On installation. If you are logged in as a local account user, Active Directory identity sources are not discovered automatically during vCenter Single Sign On installation.
- The local operating system (localos or *hostname*) users are added as an identity source.

Login Behavior When You Deploy vCenter Single Sign-On as a Standalone Server

Deploying vCenter Single Sign-On in Basic mode means that a standalone version of vCenter Single Sign-On is installed on a system. Multiple vCenter Server, Inventory Service, and vSphere Web Client instances can point to this standalone version of vCenter Single Sign-On.

In this deployment scenario, the installation process grants admin@System-Domain vCenter Server privileges by default. In addition, the installation process creates the user admin@System-Domain to manage vCenter Single Sign-On.

NOTE When you install vCenter Server components with separate installers, you can choose which account or group can log in to vCenter Server upon installation. Specify this account or group on the Single Sign-On Information page of the installer, in the following text box: **vCenter Server administrator recognized by vCenter Single Sign-On**. For example, to grant a group of domain administrators permission to log in to vCenter Server, type of name of the domain administrators group, such as Domain Admins@VCADSSO.LOCAL.

In high availablity and multisite Single Sign-On modes, there is no local operating system identity source. Therefore, it will not work if you enter `Administrators` or `Administrator` in the text box **vCenter Server administrator recognized by vCenter Single Sign-On**. `Administrators` is treated as the local operating system group Administrators, and `Administrator` is treated me as local operating system user Administrator.

Installing in Basic Mode as Domain Account User

When you log in as a domain account user to install vCenter Single Sign-On in basic mode, on a separate system from the Inventory Service and vCenter Server, the following behavior occurs upon installation.

- By default, the user admin@System-Domain can log in to the vSphere Web Client and vCenter Server.
- The default Active Directory identity sources are discovered.
- The local operating system (localos or *hostname*) users are added as an identity source.

Installing in Basic Mode as Local Account User

When you log in as a local account user to install vCenter Single Sign-On in basic mode, on a separate system from the Inventory Service and vCenter Server, the following behavior occurs upon installation.

- By default, the user admin@System-Domain can log in to the vSphere Web Client and vCenter Server.
- Active Directory identity sources are not discovered.
- The local operating system (localos or *hostname*) users are added as an identity source.

Login Behavior When You Install a Cluster of vCenter Single Sign-On Instances

Deploying vCenter Single Sign-On as a cluster means that two or more instances of vCenter Single Sign-On are installed in high availability mode. vCenter Single Sign-On high availability mode is not the same as vSphere HA. All instances of vCenter Single Sign-On use the same database and point to the same identity sources. Single Sign-On administrator users see the primary Single Sign-On instance when they connect to vCenter Server through the vSphere Web Client.

In this deployment scenario, the installation process grants admin@System-Domain vCenter Server privileges by default. In addition, the installation process creates the user admin@System-Domain to manage vCenter Single Sign-On.

NOTE When you install vCenter Server components with separate installers, you can choose which account or group can log in to vCenter Server upon installation. Specify this account or group on the Single Sign-On Information page of the installer, in the following text box: **vCenter Server administrator recognized by vCenter Single Sign-On**. For example, to grant a group of domain administrators permission to log in to vCenter Server, type of name of the domain administrators group, such as Domain Admins@VCADSSO.LOCAL.

In high availablity and multisite Single Sign-On modes, there is no local operating system identity source. Therefore, it will not work if you enter `Administrators` or `Administrator` in the text box **vCenter Server administrator recognized by vCenter Single Sign-On**. `Administrators` is treated as the local operating system group Administrators, and `Administrator` is treated me as local operating system user Administrator.

When you log in as a domain account user or local account user to install vCenter Single Sign-On in cluster mode, on a separate system from the Inventory Service and vCenter Server, the following behavior occurs upon installation.

- By default, the user admin@System-Domain can log in to the vSphere Web Client and vCenter Server.
- If you are logged in as a domain account user, the default Active Directory identity sources are discovered. If you are logged in as a local account user, Active Directory identity sources are not discovered.

Configuring vCenter Single Sign-On

vCenter lets you add identity sources, manage default domains, configure a password policy, and edit the lockout policy.

Before you configure vCenter Single Sign-On, understand the following elements.

Identity Source

An identity source is a collection of user and group data. The user and group data is stored in a repository, such as Active Directory, LDAP, or a database that is internal to Single Sign-On or local to an operating system. Upon installation, every instance of Single Sign-On has the identity source System-Domain. This identity source is internal to Single Sign-On. Administrator users can create Single Sign-On users and groups. Single Sign-On users have one of the following roles:

- The password policy defined in the vCenter Single Sign-On configuration tool determines when your password expires. By default, Single Sign-On passwords expire after one year, but your system administrator might change this depending on the policy of your organization.

  IMPORTANT The vSphere Web Clientdoes not remind you when your password is about to expire. If your password expires and you are unable to log in to the vSphere Web Client, a Single Sign-Onuser with administrator privileges can reset it.

- Regular access users are allowed limited self-management capabilities, such as updating an email address or password. Regular users can browse Single Sign-On users and groups. They can view but not edit Single Sign-On configuration options.
- Administrator access allows a user complete super user privileges on the Single Sign-On system, including the ability to create users and groups, assign permissions, add identity sources, and modify policies (lockout and password). Upon installation, only one user (admin@System-Domain) has this role.

  NOTE On the vCenter Server Appliance, local operating system administrators (for example, root) also have vCenter Single Sign-On administrator privileges.

Default Domain

Every identity source is associated with a domain, and you can specify one or more domains as default. When attempting to authenticate a user, Single Sign-On searches default domains in the order specified.

Password Policy

A Single Sign-On password policy is a set of rules and restrictions on the format and age of Single Sign-On user passwords. Password policies apply only to Single Sign-On users. They do not apply to users that are a part of an Active Directory or OpenLDAP domain, nor do they apply to local operating system users.

Lockout Policy

A lockout policy specifies the conditions under which a user's Single Sign-On account will be locked. In vSphere 5.1 and later, you log in to Single Sign-On rather than into individual vCenter Server systems. The lockout policy applies to users who access vCenter Server by logging in to the vSphere Web Client.

An account might be locked when a user exceeds the allowed number of failed attempts to log in. The lockout policy lets you specify the maximum number of failed login attempts and how much time can elapse between failed attempts. The policy also specifies how much time must elapse before the account is automatically unlocked.

To set up vCenter Single Sign-On, you must have Single Sign-On administrator privileges. Having Single Sign-On administrator privileges is different from having the Administrator role on vCenter Server or ESXi.

About Identity Sources

An identity source is a collection of user and group data. The user and group data is stored in a repository, such as Active Directory, LDAP, or a database that is internal to vCenter Single Sign On or local to an operating system.

vCenter Server versions earlier than version 5.1 supported Active Directory and local operating system users as user repositories. vCenter Server 5.1 supports the following types of user repositories as identity sources.

- OpenLDAP versions 2.4 and later.
- Active Directory versions 2003 and later.
- Local operating system users.

  Local operating system users are local to the operating system where the Single Sign On server is running (for example, Windows). Only one local operating system identity source is allowed. The local operating system identity source exists only in basic Single Sign On server deployments.

A fourth type of user repository is Single Sign On system users (System-Domain). Exactly one system identity source is always associated with an installation of Single Sign On. These users are contained in a database that is internal to the Single Sign On server. System users are not the same as local operating system users.

You can attach multiple identity sources from each type to a Single Sign On server.

Manage Default Domains for vCenter Single Sign On

Each identity source known to vCenter Single Sign On is associated with a domain. You can specify one or more default domains. vCenter Single Sign On uses default domains to authenticate users when a user name is provided without a domain name.

If a user name exists in more than one of the specified default domains, Single Sign On attempts to authenticate the user against each domain in the order listed. Authentication succeeds with the first domain that accepts the credentials that the user provided. By default, Single Sign On first validates the user against the local operating system identity source.

Procedure

1. Browse to **Administration > Sign-On and Discovery > Configuration** in the vSphere Web Client.
2. On the **Identity Sources** tab, select a domain and click **Add to Default Domains**.
3. Click the **Save** icon.

   The domain is added to the list of default domains.
4. (Optional) To change the order of the default domains, use the **Move Up** and **Move Down** arrows and click **Save**.
5. To remove a domain from the list, select the domain and click **Remove**.

6 Click the **Save** icon.

The domain is removed from the Default Domains list, but it remains in the list of identity sources.

Create vCenter Single Sign On Administrator Users

You can assign vCenter Single Sign On administrator privileges to users who are allowed to manage the Single Sign On server. These users might be different from the users that administer vCenter Server.

Prerequisites

Ensure that you have vCenter Single Sign On administrator privileges.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Click the **Groups** tab and click the group **Administrators**.

3 Click **Add Principals**.

A principal is the member of a group.

4 Select the identity source that contains the user to add to the Administrators group.

5 (Optional) Enter a search term and click **Search**.

6 Select the user and click **Add**.

You can simultaneously add multiple users to a group.

7 Click **OK**.

The user with Single Sign On administrator privileges appears in the lower panel of the **Groups** tab.

Add a vCenter Single Sign On Identity Source

vSphere users are defined in an identity source. An identity source can be a directory service like Active Directory and Open LDAP; a database that is internal to the system where vCenter Single Sign On is installed; or operating system users that are local to the system where Single Sign On is installed. You can register more than one identity source with the vSphere Web Client.

Prerequisites

A directory service such as Active Directory is set up and configured in your environment.

Ensure that you have vCenter Single Sign On administrator privileges.

Procedure

1 Browse to **Administration > Sign-On and Discovery > Configuration** in the vSphere Web Client.

2 On the **Identity Sources** tab, click the **Add Identity Source** icon.

3 Select the type of identity source.

Option	Description
OpenLDAP	The identity source is an OpenLDAP server. OpenLDAP versions 2.4 and later are supported.
Active Directory	The identity source is a Microsoft Active Directory server. Active Directory versions 2003 and later are supported.
Local Operating System	Users local to the operating system where Single Sign On is installed (for example, Windows). There can be only one local operating system identity source.

4 Enter the identity source settings.

Option	Description
Name	The name of the identity source
Primary server URL	For Open LDAP and Active Directory, use the format ldap://hostname:port or ldaps://hostname:port A certificate that establishes trust for the LDAPS endpoint of the Active Directory server is required when you use ldaps:// in the primary or secondary LDAP URL. For OpenLDAP and Active Directory, the port is typically 389 for ldap: connections and 636 for ldaps: connections. For Active Directory multi-domain controller deployments, the port is typically 3268 for ldap: connections and 3269 for ldaps: connections.
Secondary server URL	(Optional) Address of a secondary LDAP server used for failover.
Base DN for users	(Optional) The base domain name for users.
Domain name	The domain's DNS name.
Domain alias	(Optional) The domain's NetBIOS name.
Base DN for groups	(Optional) The base domain name for groups.
Authentication type	■ Anonymous: The identity source server uses no authentication. ■ Password: The identity source server uses a combination of user name and password for authentication. ■ Reuse Session: The Single Sign On server reuses the process session credentials to authenticate against the external server. This type of authentication is supported only if the identity source is an Active Directory server and the Single Sign On server runs as a user that has been authenticated against the same Windows domain to which the Active Directory server belongs.
User name	The ID of an Active Directory user with a minimum of read-only access to BaseDN for users and groups.
Password	The password of the Active Directory user with a minimum of read-only access to BaseDN for users and groups..

NOTE When you use the authentication type Password for an identity source, you must update the identity source details whenever the password changes for the configured user. You update the password on the Edit Identity Source dialog box.

If the user account is locked or disabled, authentications and group and group and user searches in the Active Directory domain will fail. The user account must have read-only access over the User and Group OU, and must be able to read user and group attributes. This is the default Active Directory domain configuration for user permissions. VMware recommends using a special service user to ensure that the password does not expire and lock out or disable the user account.

5 Click **Test Connection** to ensure that you can connect to the identity source.

6 Click **OK**.

Edit a vCenter Single Sign On Identity Source

vSphere users are defined in an identity source. You can edit the details of an identity source that is associated with vCenter Single Sign On.

Procedure

1 Browse to **Administration > Sign-on and Discovery > Configuration** in the vSphere Web Client.

2 Click the **Identity Sources** tab.

3 Right-click the identity source in the table and select **Edit Identity Source**.

4 Edit the identity source settings.

Option	Description
Name	The name of the identity source
Primary server URL	For Open LDAP and Active Directory, use the format ldap://hostname:port or ldaps://hostname:port A certificate that establishes trust for the LDAPS endpoint of the Active Directory server is required when you use ldaps:// in the primary or secondary LDAP URL. For OpenLDAP and Active Directory, the port is typically 389 for ldap: connections and 636 for ldaps: connections. For Active Directory multi-domain controller deployments, the port is typically 3268 for ldap: connections and 3269 for ldaps: connections.
Secondary server URL	(Optional) Address of a secondary LDAP server used for failover.
Base DN for users	(Optional) The base domain name for users.
Domain name	The domain's DNS name.
Domain alias	(Optional) The domain's NetBIOS name.
Base DN for groups	(Optional) The base domain name for groups.
Authentication type	■ Anonymous: The identity source server uses no authentication. ■ Password: The identity source server uses a combination of user name and password for authentication. ■ Reuse Session: The Single Sign On server reuses the process session credentials to authenticate against the external server. This type of authentication is supported only if the identity source is an Active Directory server and the Single Sign On server runs as a user that has been authenticated against the same Windows domain to which the Active Directory server belongs.
User name	The ID of an Active Directory user with a minimum of read-only access to BaseDN for users and groups.
Password	The password of the Active Directory user with a minimum of read-only access to BaseDN for users and groups..

NOTE When you use the authentication type Password for an identity source, you must update the identity source details whenever the password changes for the configured user. You update the password on the Edit Identity Source dialog box.

5 Click **Test Connection** to ensure that you can connect to the identity source.

6 Click **OK**.

Edit a vCenter Single Sign On Password Policy

A Single Sign On password policy is a set of rules and restrictions on the format and age of Single Sign On user passwords. The password policy applies to Single Sign On (System-Domain) users only.

By default, Single Sign-Onpasswords expire after one year.

IMPORTANT The vSphere Web Client does not remind you when your password is about to expire. If your password expires and you are unable to log in to the vSphere Web Client, a Single Sign-On user with administrator privileges can reset it. If the administrator password expires, any Single Sign-On administrator can reset it for you, or you can reset the password at the command line using your expired password.

Procedure

1 Browse to **Administration > Sign-On and Discovery > Configuration** in the vSphere Web Client.

2 Click the **Policies** tab and select **Password Policies**.

3 Click **Edit**.

4 Edit the Lifetime and Format parameters.

Option	Description
Maximum lifetime	Maximum number of days a password can exist before the user must change it.
Restrict re-use	Number of the user's previous passwords that cannot be selected. For example, if a user cannot reuse any of the last five passwords, type 5.
Maximum length	Maximum number of characters allowed in the password.
Minimum length	Minimum number of characters required in the password. The minimum length must be no less than the combined minimum of alphabetic, numeric, and special character requirements.
Character requirements	Minimum number of different character types required in the password. ■ Special: & # % etc. ■ Alphabetic: A b c D ■ Uppercase: A B C ■ Lowercase: a b c ■ Numeric: 1 2 3 The minimum number of alphabetic characters must be no less than the combined uppercase and lowercase requirements.
Identical adjacent characters	Maximum number of identical adjacent characters allowed in the password. Must be greater than 0. For example, if you enter 1, the following password is not allowed: p@$$word.

5 Click **OK**.

Reset an Expired vCenter Single Sign On Administrator Password on Windows

The default Single Sign On password policy specifies that passwords expire after one year. The vSphere Web Client does not provide a warning when a password is about to expire. If the administrator password for the Single Sign On system expires and you are unable to log in to the vSphere Web Client, a user with Single Sign On administrator privileges must reset it.

Problem

The password for the vCenter Single Sign On administrator user expired and the administrator is unable to log in to the vSphere Web Client to change the password.

Solution

- Change the password in the vSphere Web Client.

  a Log in to the vSphere Web Client as a user with Single Sign On administrator privileges.

  b Navigate to **Administration > Access > SSO Users and Groups** and click the **Users** tab.

  c Right-click the user and select **Edit User**.

  d Enter the new password and confirm it.

  e Click **OK**.

- Change the password at the command line.

  a Open a terminal window and navigate to `C:\Program Files\VMware\Infrastructure\SSOServer\ssolscli`.

  b Run the following command.

  ```
  ssopass username
  ```

  c Enter the current password for the user, even if it has expired.

  d Enter the new password and enter it again for confirmation.

  The administrator password is reset and the user can log in to the vSphere Web Client with the new credentials.

Reset an Expired vCenter Single Sign On Administrator Password on Linux

The default Single Sign On password policy specifies that passwords expire after one year. The vSphere Web Client does not provide a warning when a password is about to expire. If the administrator password for the Single Sign On system expires and you are unable to log in to the vSphere Web Client, a user with Single Sign On administrator privileges must reset it.

Problem

The password for the vCenter Single Sign On administrator user expired and the administrator is unable to log in to the vSphere Web Client to change the password.

Solution

- Change the password in the vSphere Web Client.

  a Log in to the vSphere Web Client as the system root user.

  On Linux systems, the root account is always a Single Sign-On administrator. You can update the password of any Single Sign-On user by logging in to the vSphere Web Client using the credentials of the root user.

  b Navigate to **Administration > Access > SSO Users and Groups** and click the **Users** tab.

  c Right-click the user and select **Edit User**.

  d Enter the new password and confirm it.

  e Click **OK**.

- Change the password at the command line.

  a Open a terminal window and navigate to the `/usr/lib/vmware-sso/bin` directory.

  b Run the following command.

  ```
  ./ssopass username
  ```

  c Enter the current password for the user, even if it has expired.

  d Enter the new password and enter it again for confirmation.

  The administrator password is reset and the user can log in to the vSphere Web Client with the new credentials.

```
ssopass [-d lookup-service] [-t thumbprint] username [password] [new-password]
```

Parameter	Description
`-d`, `--ls-url` *arg*	(Optional) Address of the Lookup Service (typically `https://`*`SSO server URL`*`:7444/lookupservice/sdk`). If you do not specify the address, the server attempts to contact a Single Sign On server running on the local system.
`-t`, `--thumbprint` *arg*	(Optional) Thumbprint used to verify the Lookup Service SSL certificate.
username	User name of the administrator whose password has expired.
password	Current password of the administrator, even if it has expired.
new-password	New password for the administrator.

Edit a vCenter Single Sign On Lockout Policy

A lockout policy specifies the conditions under which a user's vCenter Single Sign On account is locked. In vSphere 5.1, you log in to the Single Sign On server rather than in to individual vCenter Server systems. This means that the lockout policy applies to users who access vCenter Server by logging in to the vSphere Web Client. You can edit the lockout policy.

A vCenter Single Sign On user account might be locked when a user exceeds the allowed number of failed attempts to log in. The lockout policy allows you to specify the maximum number of failed login attempts and how much time can elapse between failures. The policy also specifies how much time must elapse before the account is automatically unlocked.

Procedure

1. Browse to **Administration > Sign-On and Discovery > Configuration**.
2. Click the **Policies** tab and select **Lockout Policy**.
3. Click **Edit**.
4. Edit the Lockout Policy Basics and Configuration parameters.

Option	Description
Description	Description of the lockout policy (for example, Default).
Max number of failed login attempts	Maximum number of failed login attempts allowed before the account is locked.
Time interval between failures (seconds)	Time period in which failed login attempts must occur to trigger a lockout.
Unlock time (seconds)	The amount of time that the account will remain locked. When you enter 0, the administrator must unlock the account explicitly.

5. Click **OK**.

Refresh the Security Token Service (STS) Root Certificate

vCenter Single Sign On provides a Security Token Service (STS). The Security Token Service is a Web service that issues, validates, and renews security tokens. You can manually refresh the existing Security Token Service certificate when it expires or changes.

When you use vCenter Single Sign On with vSphere, consider the following types of certificates.

- SSL certificates, which are used to establish a secure connection with the Single Sign On server. These certificates are not used to validate tokens or authenticate solutions, and they are not the same SSL certificates that vCenter Server uses.
- STS certificates, which are used for Single Sign On token validation.

STS certificates expire or change periodically and you must update or refresh them. In some environments, your system administrator might implement automatic updates of the certificate. Otherwise, you can update the certificate manually using the Single Sign On administration tool.

NOTE You must restart the vSphere Web Client service after you refresh the Security Token Service certificate.

Procedure

1 Browse to **Administration > Sign-On and Discovery > Configuration** in the vSphere Web Client.

2 Select the **STS Certificate** tab and click **Edit**.

3 Click **Browse** to browse to the key store JKS file that contains the new certificate and click **Open**.

If the key store file is valid, the STS certificate table is populated with the certificate information.

4 Click **OK**.

The new certificate information appears on the **STS Certificate** tab.

What to do next

Restart the vSphere Web Client service.

Using vCenter Single Sign On to Manage Users and Groups

vCenter Server uses vCenter Single Sign On to authenticate users.

In product versions earlier than vCenter Server 5.1, when users connect to vCenter Server, they were authenticated when vCenter Server validated their credentials against an Active Directory domain or the list of local operating system users. In vCenter Server 5.1, users authenticate through vCenter Single Sign-On.

The default Single Sign-On administrator is admin@System-Domain with the password you specified at installation. You use these credentials to log in to the Single Sign-On administration tool in the vSphere Web Client. You can then assign Single Sign-On administrator privileges to users who are allowed to manage the Single Sign-On server. These users might be different from the users that administer vCenter Server.

NOTE On the vCenter Server Appliance, local operating system administrators (for example, root) also have vCenter Single Sign-On administrator privileges.

The following information is important for you to manage users and groups.

- Logging in to the vSphere Web Client with Windows session credentials is supported only for Active Directory users of the domain to which the Single Sign-On system belongs.
- ESXi 5.1 is integrated with vCenter Single Sign-On, and you can create ESXi users with the vSphere Web Client.vCenter Server is not aware of users that are local to ESXi. In addition, ESXi is not aware of vCenter Server users. However, you can configure Single Sign-On to use an Active Directory domain as an identity source, and configure ESXi to point to the same Active Directory domain to obtain user and group information. This action allows the same set of users to be available to the host and to vCenter Server.

If more than one user known to vCenter Single Sign-On has the same user name, Single Sign-On authenticates the user against the default domains in the order specified on the **Identity Sources** tab in the Single Sign-On administration tool. For example, a user named VMadmin exists in the domain System-Domain, the identity source internal to Single Sign-On. A second user, also named VMadmin, exists in the domain localos, the identity source local to the operating system (for example, Linux). By default, Single Sign-On validates the user against the local operating system. The user VMadmin is authenticated and logs in as VMadmin@localos. If VMadmin@localos has not been granted Single Sign-On administrator privileges, the user cannot access the Single Sign-Onadministration tool or perform Single Sign-On administrative tasks.

To prevent unintentionally logging in as a user from another domain, specify the domain when you log in to the vSphere Web Client. For example, log in as admin@System-Domain rather than as admin.

Add a vCenter Single Sign On User with the vSphere Web Client

In the vSphere Web Client, users listed on the **Users** tab are internal to vCenter Single Sign On. These users are not the same as local operating system users, which are local to the operating system of the machine where Single Sign On is installed (for example, Windows).

When you add a Single Sign On user with the Single Sign On administration tool, that user is stored in the Single Sign On database, which runs on the system where Single Sign On is installed. These users are part of the domain System-Domain. Exactly one system identity source is associated with an installation of Single Sign On.

Prerequisites

Review and understand the vCenter Single Sign On password requirements defined on the **Policies** tab in the Single Sign On administration tool.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 On the **Users** tab, click the **New User** icon.

3 Type a user name and password for the new user.

You cannot change the user name after you create a user.

The password must meet the password policy requirements for the system.

4 (Optional) Type the first name and last name of the new user.

5 Type the email address for the new user.

6 Select the type of permissions the user is granted.

User roles are incremental. More powerful roles are supersets of weaker roles.

Option	Description
Guest user	(Default) Guest access users are allowed to change their own passwords. Guest users cannot browse Single Sign-On users and groups, nor can they view or edit Single Sign-Onconfiguration options.
Regular user	Regular access users are allowed limited self-management capabilities, such as updating an email address or password. Regular users can browse Single Sign-On users and groups. They can view but not edit Single Sign-On configuration options.
Administrator user	Administrator access allows a user complete super user privileges on the Single Sign-On system, including the ability to create users and groups, assign permissions, add identity sources, and modify policies (lockout and password). Upon installation, only one user (admin@System-Domain) has this role. NOTE On the vCenter Server Appliance, local operating system administrators (for example, root) also have vCenter Single Sign-On administrator privileges.

7 (Optional) Enter a description of the user.

8 Click **OK**.

Edit a vCenter Single Sign On User with the vSphere Web Client

You can change the password or other details of a vCenter Single Sign On user in the vSphere Web Client. You cannot change the user name of a user.

Single Sign On users are stored in the Single Sign On database, which runs on the system where Single Sign On is installed. These users are part of the domain System-Domain.

Prerequisites

Review and understand the Single Sign On password requirements defined on the **Policies** tab in the Single Sign On administration tool.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Click the **Users** tab.

3 Right-click the user and select **Edit User**.

4 Make changes to the user.

   You cannot change the user name of the user.

   The password must meet the password policy requirements for the system.

5 Click **OK**.

Change Your Password in the vSphere Web Client

Depending on your vCenter Single Sign On privileges, you might not be able to view or edit your Single Sign On user profile. However, all users can change their Single Sign On passwords in the vSphere Web Client.

The password policy defined in the vCenter Single Sign-On configuration tool determines when your password expires. By default, Single Sign-On passwords expire after one year, but your system administrator might change this depending on the policy of your organization.

IMPORTANT The vSphere Web Clientdoes not remind you when your password is about to expire. If your password expires and you are unable to log in to the vSphere Web Client, a Single Sign-Onuser with administrator privileges can reset it.

Procedure

1 Log in to the vSphere Web Client using your vCenter Single Sign On credentials.

2 In the upper navigation pane, click your user name to pull down the menu.

3 Select **Change Password** and type your current password.

4 Type a new password and confirm it.

5 Click **OK**.

Add a vCenter Single Sign On Group with the vSphere Web Client

In the vSphere Web Client, groups listed on the **Groups** tab are internal to vCenter Single Sign On. A group lets you create a container for a collection of group members called principals.

When you add a Single Sign On group with the Single Sign On administration tool, the group is stored in the Single Sign On database. The database runs on the system where Single Sign On is installed. These groups are part of the identity source System-Domain.

Group members can be users or other groups, and a group can contain members from across multiple identity sources. After you create a group and add principals, you apply permissions to the group. Members of the group inherit the group permissions.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Select the **Groups** tab and click the **New Group** icon.

3 Enter a name and description for the group.

You cannot change the group name after you create the group.

4 Click **OK**.

What to do next

- Add principals (members) to the group.
- Assign permissions to the group.

Edit a vCenter Single Sign On Group in the vSphere Web Client

You can change the description of a Single Sign On group in the vSphere Web Client. You cannot change the name of the group.

Single Sign On groups are stored in the Single Sign On database, which runs on the system where Single Sign On is installed. These groups are part of the identity source System-Domain.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Click the **Groups** tab.

3 Right-click the group to edit and select **Edit Group**.

4 Edit the description for the group.

You cannot change the group name after you create the group.

5 Click **OK**.

Add Members to a vCenter Single Sign On Group in the vSphere Web Client

Members of a vCenter Single Sign On group can be users or other groups from one or more identity sources. Members of a group are called principals.

Groups listed on the **Groups** tab in the vSphere Web Client are internal to Single Sign On and are part of the identity source System-Domain. You can add group members from other domains to a local group. You can also nest groups.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Click the **Groups** tab and click the group (for example, Administrators).

3 Click **Add Principals**.

4 Select the identity source that contains the principal to add to the group.

5 (Optional) Enter a search term and click **Search**.

6 Select the principal and click **Add**.

  You can simultaneously add multiple principals.

7 Click **OK**.

The principal (user or group) is a member of the group and appears in the lower panel of the Groups tab.

Remove Members from a Local Group with the vSphere Web Client

When you remove a member (user or group) from a local group, you do not delete the member from the system. Members of a group are called principals.

Procedure

1 Browse to **Administration > Access > Users and Groups** in the vSphere Web Client.

2 Select the **Groups** tab and click the group.

3 In the list of group members, select the user or group and click the **Remove Principal** icon.

4 Click **OK**.

The principal (user or group) is removed from the group, but it is still available in the system.

Manage Locked vCenter Single Sign On Users in the vSphere Web Client

A vCenter Single Sign On user account might be locked when a user exceeds the allowed number of failed login attempts. After a user account is locked, the user cannot log in to the Single Sign On system until the account is unlocked, either manually or after a certain amount of time has elapsed.

You specify the conditions under which a user account is locked in the Single Sign On Lockout Policy. Locked user accounts appear on the Users and Groups administration page. Users with appropriate privileges can manually unlock Single Sign On user accounts before the specified amount of time has elapsed.

Prerequisites

You must be a member of the Single Sign On Administrators group to unlock a Single Sign On user.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Click the **Locked Users** tab.

3 Right-click the user and select **Unlock**.

The Single Sign On user account is unlocked, and the user can log in to the Single Sign On server immediately.

Manage Disabled vCenter Single Sign On Users in the vSphere Web Client

When a vCenter Single Sign On user account is disabled, the user cannot log in to the Single Sign On server until the account is enabled by an administrator.

Disabled user accounts remain available in the Single Sign On system, but the user cannot log in or perform operations on the server. Users with appropriate privileges can disable and enable accounts on the Administration page.

Prerequisites

You must be a member of the Single Sign On Administrators group to manage disabled Single Sign On users.

Procedure

1 Browse to **Administration > Access > SSO Users and Groups** in the vSphere Web Client.

2 Click the **Disabled Users** tab.

3 Right-click the user and select **Enable**.

The Single Sign On user account is enabled, and the user can log in and perform operations immediately.

Manage Application Users in the vSphere Web Client

When you install vCenter Single Sign On, vCenter Server instances and extensions are recognized as application (or solution) users and are granted privileges on the system. You can remove application users.

Procedure

1 Browse to **Administration > Access > Users and Groups** in the vSphere Web Client.

2 Click the **Applications Users** tab, and click the application user name.

3 Click the **Delete Application User** icon.

4 Click **Yes**.

The application (or solution) no longer has access to vSphere.

vCenter Server User Directory Settings

You can limit the number of results returned when you search for users and groups and set a user directory timeout for vCenter Server.

vCenter Server systems that use a directory service regularly validate users and groups against the user directory domain. Validation occurs at regular intervals specified in the vCenter Server settings. For example, if user Smith was assigned permissions and in the domain the user's name was changed to Smith2, the host concludes that Smith no longer exists and removes permissions for that user when the next validation occurs.

Similarly, if user Smith is removed from the domain, all permissions are removed when the next validation occurs. If a new user Smith is added to the domain before the next validation occurs, the new user Smith receives all the permissions the old user Smith was assigned.

Adjust the Search List in Large Domains

If you have domains with thousands of users or groups, or if searches take a long time to complete, adjust the search settings in the Select Users or Groups dialog box.

NOTE This procedure applies only to vCenter Server user lists. ESXi host user lists cannot be searched in the same way.

Prerequisites

To configure Active Directory settings, the vSphere Client must be connected to the vCenter Server system.

Procedure

1 From the vSphere Client connected to a vCenter Server system, select **Administration > vCenter Server Settings**.

2 In the navigation pane, select **Active Directory**.

3 Change the values as needed.

Option	Description
Active Directory Timeout	Timeout interval in seconds for connecting to the Active Directory server. This value specifies the maximum amount of time vCenter Server allows a search to run on the selected domain. Searching large domains can take a long time.
Enable Query Limit	Select the check box to limit the number of users and groups that vCenter Server displays in the Add Permissions dialog box for the selected domain.
Users & Groups value	Specifies the maximum number of users and groups vCenter Server displays from the selected domain in the Select Users or Groups dialog box. If you enter 0 (zero), all users and groups appear.

4 Click **OK**.

Adjust the Search List in Large Domains in the vSphere Web Client

If you have domains with thousands of users or groups, or if searches take a long time to complete, adjust the search settings.

NOTE This procedure applies only to vCenter Server user lists. ESXi host user lists cannot be searched in the same way.

Procedure

1 Browse to the vCenter Server system in the vSphere Web Client object navigator.

2 Select the **Manage** tab and click **Settings**.

3 Click **General** and click **Edit**.

4 Select **User directory**.

5 Change the values as needed.

Option	Description
User directory timeout	Timeout interval in seconds for connecting to the Active Directory server. This value specifies the maximum amount of time vCenter Server allows a search to run on the selected domain. Searching large domains can take a long time.
Query limit	Select the checkbox to set a maximum number of users and groups that vCenter Server displays.
Query limit size	Specifies the maximum number of users and groups vCenter Server displays from the selected domain in the Select Users or Groups dialog box. If you enter 0 (zero), all users and groups appear.

6 Click **OK**.

Assigning Permissions for vCenter Server

Permissions are access roles that consist of a user and the user's assigned role for an object such as a virtual machine or ESXi host. Permissions grant users the right to perform the activities specified by the role on the object to which the role is assigned.

For example, to configure memory for the host, you must grant a role to a user that includes the **Host.Configuration.Memory Configuration** privilege. By assigning different roles to users for different objects, you control the tasks that users can perform in your vSphere environment.

Users other than root and vpxuser initially have no permissions on any objects, which means they cannot view these objects or perform operations on them. A user with Administrator privileges must assign permissions to these users to allow them to perform tasks.

Many tasks require permissions on more than one object. These rules can help you determine where you must assign permissions to allow particular operations:

- Any operation that consumes storage space, such as creating a virtual disk or taking a snapshot, requires the **Datastore.Allocate Space** privilege on the target datastore, as well as the privilege to perform the operation itself.
- Moving an object in the inventory hierarchy requires appropriate privileges on the object itself, the source parent object (such as a folder or cluster), and the destination parent object.
- Each host and cluster has its own implicit resource pool that contains all the resources of that host or cluster. Deploying a virtual machine directly to a host or cluster requires the **Resource.Assign Virtual Machine to Resource Pool** privilege.

The list of privileges is the same for both ESXi and vCenter Server.

Assign Permissions in the vSphere Web Client

After you create users and groups and define roles, you must assign the users and groups and their roles to the relevant inventory objects. You can assign the same permissions at one time on multiple objects by moving the objects to a folder and setting the permissions on the folder.

Prerequisites

Permissions.Modify permission on the parent object of the object whose permissions you want to modify.

Procedure

1 Browse to the object in the vSphere Web Client object navigator.

2 Click the **Manage** tab and select **Permissions**.

3 Click **Add Permission**.

4 Click **Add**.

5 Identify the user or group to assign to this role.

   a Select the domain where the user or group is located from the **Domain** drop-down menu.

   b Type a name in the Search box or select a name from the list.

   The system searches user names, group names, and descriptions.

   c Select the user and click **Add**.

   The name is added to either the **Users** or **Groups** list.

   d (Optional) Click **Check Names** to verify that the user or group exists in the database.

   e Click **OK**.

6 Select a role from the **Assigned Role** drop-down menu.

   The roles that are assigned to the object appear in the menu. The privileges contained in the role are listed in the section below the role title.

7 (Optional) Deselect the **Propagate to Child Objects** check box.

   The role is applied only to the selected object and does not propagate to the child objects.

8 Verify that the users and groups are assigned to the appropriate permissions and click **OK**.

The server adds the permission to the list of permissions for the object.

The list of permissions references all users and groups that have roles assigned to the object and indicates where in the vCenter Server hierarchy the role is assigned.

Change Permission Validation Settings in the vSphere Web Client

vCenter Server periodically validates its user and group lists against the users and groups in the user directory. It then removes users or groups that no longer exist in the domain. You can disable validation or change the interval between validations.

Procedure

1 Browse to the vCenter Server system in the vSphere Web Client object navigator.

2 Select the **Manage** tab and click **Settings**.

3 Click **General** and click **Edit**.

4 Select **User directory**.

5 (Optional) Deselect the **Validation** check box to disable validation.

Validation is enabled by default. Users and groups are validated when vCenter Server system starts, even if validation is disabled.

6 (Optional) If validation is enabled, enter a validation period to specify a time, in minutes, between validations.

7 Click **OK**.

Change Permissions in the vSphere Web Client

After a user or group and role pair is set for an inventory object, you can change the role paired with the user or group or change the setting of the **Propagate** check box. You can also remove the permission setting.

Procedure

1 Browse to the object in the vSphere Web Client object navigator.

2 Click the **Manage** tab and select **Permissions**.

3 Click the line item to select the user or group and role pair.

4 Click **Change role on permission**.

5 Select a role for the user or group from the **Assigned Role** drop-down menu.

6 To propagate the privileges to the children of the assigned inventory object, click the **Propagate** check box and click **OK**.

Remove Permissions in the vSphere Web Client

Removing a permission for a user or group does not remove the user or group from the list of those available. It also does not remove the role from the list of available items. It removes the user or group and role pair from the selected inventory object.

Procedure

1 Browse to the object in the vSphere Web Client object navigator.

2 Click the **Manage** tab and select **Permissions**.

3 Click the appropriate line item to select the user or group and role pair.

4 Click **Remove permission**.

vCenter Server removes the permission setting.

Assigning Roles in the vSphere Web Client

vCenter Server grants access to objects only to users who are assigned permissions for the object. When you assign a user permissions for the object, you pair the user with a role. A role is a predefined set of privileges.

vCenter Server provides three default roles, and you cannot change the privileges associated with these roles. Each subsequent default role includes the privileges of the previous role. For example, the Administrator role inherits the privileges of the Read Only role. Roles that you create do not inherit privileges from any of the default roles.

You can create custom roles by using the role-editing facilities in the vSphere Web Client to create privilege sets that match your user needs. The roles that you create directly on a host are not accessible within vCenter Server. You can work with these roles only if you log in to the host directly from the vSphere Client.

NOTE When you add a custom role and do not assign any privileges to it, the role is created as a Read Only role with three system-defined privileges: System.Anonymous, System.View, and System.Read.

If you manage ESXi hosts through vCenter Server, maintaining custom roles in the host and vCenter Server can result in confusion and misuse. In this type of configuration, maintain custom roles only in vCenter Server.

Create a Role in the vSphere Web Client

VMware recommends that you create roles to suit the access control needs of your environment.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes that you make are propagated to all other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 Browse to **Administration > Role Manager** in the vSphere Web Client.

2 Select a vCenter Server system from the drop-down menu.

3 Click **Create role action**.

4 Type a name for the new role.

5 Select privileges for the role and click **OK**.

Edit a Role in the vSphere Web Client

When you edit a role, you can change the privileges selected for that role. When completed, these privileges are applied to any user or group that is assigned the edited role.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 Browse to **Administration > Role Manager** in the vSphere Web Client.

2 Select a vCenter Server system from the drop-down menu.

3 Select a role and click **Edit role action**.

4 Select privileges for the role and click **OK**.

Clone a Role in the vSphere Web Client

You can make a copy of an existing role, rename it, and edit it. When you make a copy, the new role is not applied to any users or groups and objects. You must assign the role to users or groups and objects.

If you create or edit a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to all other vCenter Server systems in the group. Assignments of roles to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 Browse to **Administration > Role Manager** in the vSphere Web Client.

2 Select a vCenter Server system from the drop-down menu.

3 Click **Clone role action**.

4 Type a name for the cloned role.

5 Select privileges for the role and click **OK**.

Rename a Role in the vSphere Web Client

You might rename a role when you change the role's purpose. When you rename a role, no changes occur to that role’s assignments.

If you create or modify a role on a vCenter Server system that is part of a connected group in Linked Mode, the changes you make are propagated to other vCenter Server systems in the group. Roles that are assigned to specific users and objects are not shared across linked vCenter Server systems.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

Procedure

1 Browse to **Administration > Role Manager** in the vSphere Web Client.

2 Select a vCenter Server system from the drop-down menu.

3 Select the role and click **Edit role action**.

4 Type a new name for the role.

5 Click **OK**.

Remove a Role in the vSphere Web Client

When you remove a role that is not assigned to any users or groups, the definition of the role is removed from the list of roles. When you remove a role that is assigned to a user or group, you can remove assignments or replace them with an assignment to another role.

CAUTION You must understand how users will be affected before removing all assignments or replacing them. Users who have no permissions granted to them cannot log in to vCenter Server.

Prerequisites

Verify that you are logged in as a user with Administrator privileges.

If you remove a role from a vCenter Server system that is part of a connected group in Linked Mode, check the use of that role on the other vCenter Server systems in the group. If you remove a role from one vCenter Server system, you remove the role from all other vCenter Server systems in the group, even if you reassign permissions to another role on the current vCenter Server system.

Procedure

1. Browse to **Administration > Role Manager** in the vSphere Web Client.
2. Select a vCenter Server system from the drop-down menu.
3. Select a role and click **Delete role**.
4. Click **Yes**.

   The role is removed from the list.

   If the role is assigned to a user or group, a warning message appears.
5. Select a reassignment option and click **OK**.

Option	Description
Remove Role Assignments	Removes configured user or group and role pairings on the server. If a user or group does not have other permissions assigned, the user or group loses all privileges.
Reassign affected users to	Reassigns any configured user or group and role pairings to the selected new role.

Manually Replicate Data in a Multisite vCenter Single Sign-On Deployment

When you make a change to a node in a multisite vCenter Single Sign-On deployment, you can replicate the change to other nodes. To transport replication data among the vCenter Single Sign-On nodes in a multisite deployment, you install each node in multisite mode. You do this procedure manually.

Data that is replicated includes information that determines service behavior and information that is managed through the vCenter Single Sign-On management interface. The following list includes examples of information:

- Identity source configuration
- Password policy
- Lockout policy
- STS policy (token lifetimes, clock tolerance, delegation, and renewal count)
- Users from the system identity source, including solution user certificates

- Groups from the system identity source
- Password expiration configuration
- Certificate trust stores
- User lockout status for users from the system identity source

Changes (set or update) to any of these elements trigger the replication state. In addition, when a user unsuccessfully attempts to log in and invokes the lockout policy, a replication state is triggered. Only users that are defined in the system identity source can invoke the lockout policy.

IMPORTANT To ensure that data remains in sync during the manual replication process, do not make any changes to the data to be replicated, for example adding or deleting identity sources or local users.

Manual transport of replication data must be performed sequentially. This process means that changes on a node are propagated to all other nodes in the deployment before changes occur on other nodes. This model requires one export and (N-1) imports for each updated node.

Export vCenter Single Sign On Multisite Replication Data

When you make a change on a vCenter Single Sign On system and the system is part of multisite vCenter Single Sign On deployment, you can manually broadcast the change to the other systems in the deployment. To broadcast a change, export the replication state from the system where the change occurred.

You must perform manual transport of replication data sequentially. The changes on a node are propagated to all other nodes in the deployment before changes occur on other nodes.

Prerequisites

Verify that you have vCenter Single Sign On administrator privileges on the vCenter Single Sign On system where you export the replication data.

Procedure

1. Log in to the vCenter Single Sign On system where the change originates.
2. Navigate to the following directory: `SSO install directorysso-replication-cli`
3. Run the `repl_tool.cmd` with the following parameters to export the replication state file.

   ```
   export -f file -u admin_user_name [-p password]
   ```

   Enter the following command-line parameters in the order listed.

Parameter	Value
mode	Export
file	Relative or absolute path to a file where the data is exported.
admin_user_name	Name of a valid vCenter Single Sign On administrator user.
password	Optional. If you do not supply the password, you are prompted for a password when you run the command.

   The file is exported to the directory you specified.
4. Copy the exported file to the target vCenter Single Sign On systems or to a location that is accessible by the other systems in the deployment.

What to do next

Import the replication data to the target systems.

Import vCenter Single Sign On Multisite Replication Data

After you make a change to a vCenter Single Sign On system in a multisite deployment, you can broadcast the change to other vCenter Single Sign On systems in the deployment. To broadcast a change, import the replication state of the system where the change originated to the other nodes in the multisite deployment.

IMPORTANT This procedure completely overrides the state of the target node. You must perform manual transport of replication data sequentially. This means that changes on a node are propagated to all other nodes in the deployment before changes occur on any other nodes.

Prerequisites

Export the replication data from the system where the change originates.

Verify that you have vCenter Single Sign On administrator privileges on the target vCenter Single Sign On system where you import the replication data.

Procedure

1 Log in to the vCenter Single Sign On system where you will apply the change.

2 Navigate to the directory `*SSO install directory*sso-replication-cli`

3 Run `repl_tool.cmd` with the following parameters to import the replication state file.

   ```
   import -f file -u admin_user_name [-p password]
   ```

   Enter the following command-line parameters in the order listed.

Parameter	Value
mode	Import.
file	Relative or absolute path to a file from which the data is imported.
admin_user_name	Name of a valid vCenter Single Sign On administrator user.
password	Optional. If you do not enter the password, you are prompted for a password when you run the command.

The replication data is imported and overrides the state of the target node.

Troubleshooting vCenter Single Sign-On

Determining the Cause of a Lookup Service Error

vCenter Single Sign-On installation displays an error referring to the vCenter Server or the vSphere Web Client.

Problem

vCenter Server and Web Client installers show the error `Could not contact Lookup Service. Please check VM_ssoreg.log....`

Cause

This problem has several causes, including unsynchronized clocks on the host machines, firewall blocking, and services that must be started.

Solution

1 Verify that the clocks on the host machines running vCenter Single Sign-On, vCenter Server, and the Web Client are synchronized.

2 View the specific log file found in the error message.

In the message, system temporary folder refers to `%TEMP%`.

3 Within the log file, search for the following messages.

The log file contains output from all installation attempts. Locate the last message that shows `Initializing registration provider...`

Message	Cause and solution
java.net.ConnectException: Connection timed out: connect	The IP address is incorrect, a firewall is blocking access to vCenter Single Sign-On, or vCenter Single Sign-On is overloaded. Ensure that a firewall is not blocking the vCenter Single Sign-On port (by default 7444) and that the machine on which vCenter Single Sign-On is installed has adequate free CPU, I/O. and RAM capacity.
java.net.ConnectException: Connection refused: connect	IThe IP address or FQDN is incorrect and the vCenter Single Sign-On has not started or has started within the past minute. Verify that vCenter Single Sign-On is working by checking the status of vCenter Single Sign-On service (Windows) and vmware-sso daemon (Linux). Restart the service. If this does not correct the problem, see the recovery section of the vSphere troubleshooting guide.
Unexpected status code: 404. SSO Server failed during initialization	Restart vCenter Single Sign-On. If this does not correct the problem, see the Recovery section of the *vSphere Troubleshooting Guide*.
The error shown in the UI begins with `Could not connect to vCenter Single Sign-on`.	You also see the return code `SslHandshakeFailed`. This is an uncommon error. It indicates that the provided IP address or FQDN that resolves to vCenter Single Sign-On host was not the one used when you installed vCenter Single Sign-On. In `%TEMP%\VM_ssoreg.log`, find the line that contains the following message. `host name in certificate did not match: <install-configured FQDN or IP> != <A> or <B> or <C>` where A was the FQDN you entered during the vCenter Single Sign-On installation, and B and C are system-generated allowable alternatives. Correct the configuration to use the FQDN on the right of the != sign in the log file. In most cases, use the FQDN that you specified during vCenter Single Sign-On installation. If none of the alternatives are possible in your network configuration, recover your vCenter Single Sign-On SSL configuration.

Unable to Log In Using Active Directory Domain Authentication with the vCenter Server Appliance

If vCenter Single Sign-On does not autodiscover the Active Domain directory, you cannot log in to vCenter.

Problem

After enabling Active Directory domain authentication from the **Authentication** tab on the Web Console, you cannot log in to vCenter by using an Active Directory domain user.

Cause

The Active Directory domain was not autodiscovered by vCenter Single Sign-On. If Single Sign-On autodiscovered the Active Directory domain, the Active Directory domain appears in the Identity Sources list.

If the domain is present in the Identity sources list, log in using the qualified name. For example, log in with user@domain or DOMAIN\user. If your organization requires you to authenticate with an unqualified name, add the domain to the list of default domains.

Solution

1 Open `/var/log/vmware/vpx/sso_cfg.log`.

2 Verify that you see lines that include the Active Directory domain, DNS Name, NetBIOS name, the primary controller and, if one exists, the secondary controller.

   You need to know the names of the controllers for a later step.

3 Synchronize the clocks between the vCenter Server Appliance and the Active Directory domain controllers.

4 Enter the following code at a command line to verify that each domain controller has a pointer record (PTR) in the Active Directory domain DNS service and that the PTR record information matches the DNS name of the controller.

```
# dig my-controller.my-ad.com
...
;; ANSWER SECTION:
my-controller.my-ad.com (...) IN A controller IP address
...
# dig -x <controller IP address>
...
;; ANSWER SECTION:
IP-in-reverse.in-addr.arpa. (...) IN PTR
my-controller.my-ad.com
...
```

5 If the controller LDAP services are SSL-enabled, verify that the SSL certificate is valid.

6 (Optional) If steps 1 through 5 did not resolve the problem, remove the vCenter Server Appliance from the Active Directory domain and then rejoin the domain.

7 Restart vCenter Single Sign-On.

vSphere Web Client Fails to Recognize vCenter Single Sign-On Login

When you use vCenter Single Sign-On, logging in to the vSphere Web Client fails to validate the log in credentials.

Problem

When you log in to the vSphere Web Client with vCenter Single Sign-On, the credentials fail to validate.

Cause

The most common causes of the failure are an error when entering the credentials or an expired password.

Solution

- Verify that you entered the correct user name and password and that the case is correct.
- Provide a fully qualified domain name in the format *user-name@domain-name* or *NETBIOS-Domain-Name/user-name*.
- Verify that your password is valid. An expired password results in the same error for invalid credentials.

- If you are certain that the user name and password are valid, perform the applicable solution.
  - If you log in with a user from the System-Domain, request the Single Sign-On administrator to reset your password through the vSphere Web Client. By default the password for all users in the System-Domain expire in one year.
  - If you are the Single Sign-On administrator, reset your password from the Single Sign-On server console.
  - If you log in with a user from an Active Directory or LDAP domain, follow your corporate policy to reset the expired password.
  - If none of these steps fix the problem, view the logs to determine the cause, then take the correct action.

    You can find the logs for the vSphere Web Client service at the location shown for your Operating System.
    - Windows: `C:\Program Files\VMware\Infrastructure\vSphere Web Client\DMServer\serviceability\`
    - Linux: `/usr/lib/vmware-vsphere-client/server/serviceability/`

vSphere Web Client with vCenter Single Sign-On Login Fails Because the User Account is Locked

When you use vCenter Single Sign-On and log in to the vSphere Web Client, you cannot log in if the user account is locked.

Problem

After several failed attempts, you cannot log in to the vSphere Web Client using vCenter Single Sign-On. You see the message that your account is locked.

Cause

You exceeded the maximum number of failed login attempts (three by default). For security, vCenter Single Sign-On locks your account.

Solution

- If you log in with a user name from the System-Domain, ask your vCenter Single Sign-On administrator to unlock your account.
- If you log in with a user from an Active Directory or LDAP domain, ask your Active Directory or LDAP administrator to unlock your account.
- Wait until your account is unlocked. By default, the account is unlocked for users in the System-Domain after 15 minutes.

vCenter Single Sign-On Server Fails to Respond to a vSphere Web Client Log In

If vCenter Single Sign-On fails to respond when logging in to the vSphere Web Client, there might be a problem with connectivity.

Problem

The vCenter Single Sign-On server shows the error `Failed to communicate with the vCenter Single Sign On server <server-address>. The server might have failed to respond or responded in an unexpected way.`

Cause

Connectivity to your vCenter Single Sign-On server is lost. The most common causes are that there is no connectivity to the Single Sign On server or that Single Sign On is not running.

1. The vCenter Single Sign-On server is working correctly, but there is no network connectivity to it.
2. The vCenter Single Sign-On server is not running.

Solution

1. Verify that the vCenter Single Sign-On server is working by checking the status of the vCenter Single Sign-On (Windows) and vmware-sso (Linux) services.
2. Restart vCenter Single Sign-On.

vCenter Server Appliance Fails to Authenticate Admin User From an External vCenter Single Sign-On Server

When you are configuring a vCenter Server Appliance to work with an external vCenter Single Sign-On server, problems can occur if you set up users incorrectly.

Problem

You receive the `Failed to authenticate the Single Sign On Administrator user` error.

Cause

This error occurs for several reasons.

Solution

1. Re-enter the user name using email-style qualification, for example, user@domain.

   If you log in as root, enter the user name as root@localos.

2. Verify that the user account is not locked or disabled.

   Log in to the Web Client with the same user name as the one that generated the error message. If the user account is locked or disabled, any other vCenter Single Sign-On administrator can unlock or re-enable the user account. If necessary, create additional vCenter Single Sign-On administrator accounts.

3. Review `/var/log/vmware/sso/utils/sso_servicecfg.log` to locate the initial error message.

   This log can provide details about the cause of the error and the corrective action to take.

Encryption and Security Certificates 8

ESXi and vCenter Server support standard X.509 version 3 (X.509v3) certificates to encrypt session information sent over Secure Socket Layer (SSL) protocol connections between components. If SSL is enabled, data is private, protected, and cannot be modified in transit without detection.

All network traffic is encrypted as long as the following conditions are true:

- You did not change the Web proxy service to allow unencrypted traffic for the port.
- Your firewall is configured for medium or high security.

Certificate checking is enabled by default and SSL certificates are used to encrypt network traffic. However, ESXi and vCenter Server use automatically generated certificates that are created as part of the installation process and stored on the server system. These certificates are unique and make it possible to begin using the server, but they are not verifiable and are not signed by a trusted, well-known certificate authority (CA). These default certificates are vulnerable to possible man-in-the-middle attacks.

To receive the full benefit of certificate checking, particularly if you intend to use encrypted remote connections externally, install new certificates that are signed by a valid internal certificate authority or purchase a certificate from a trusted security authority. For more information, see *Replacing Default vCenter and ESXi Certificates*.

This chapter includes the following topics:

Generate New Certificates for ESXi

You typically generate new certificates only if you change the host name or accidentally delete the certificate. Under certain circumstances, you must force the host to generate new certificates.

Procedure

1 Log in to the ESXi Shell as a user with administrator privileges.

2 In the directory `/etc/vmware/ssl`, back up any existing certificates by renaming them using the following commands.

```
mv rui.crt orig.rui.crt
mv rui.key orig.rui.key
```

NOTE If you are regenerating certificates because you have deleted them, this step is unnecessary.

3 Run the command `/sbin/generate-certificates` to generate new certificates.

4 Restart the host after you install the new certificate.

Alternatively, you can put the host into maintenance mode, install the new certificate, and then use the Direct Console User Interface (DCUI) to restart the management agents.

5 Confirm that the host successfully generated new certificates by using the following command and comparing the time stamps of the new certificate files with `orig.rui.crt` and `orig.rui.key`.

```
ls -la
```

Enable SSL Certificate Validation Over NFC

Network File Copy (NFC) provides a file-type-aware FTP service for vSphere components. ESXi uses NFC for operations such as copying and moving data between datastores. You can enable SSL certificate validation for NFC operations.

The initial authentication for an NFC transfer occurs using SSL, but by default, the actual data transfer occurs in plain text for performance reasons. Because this file transfer occurs over the management network, the risk of data being leaked is related to the isolation of the management network.

When you enable SSL over NFC, connections between vSphere components over NFC are secure. This connection can help prevent man-in-the-middle attacks within a datacenter.

NOTE Enabling SSL over NFC causes some performance degradation.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

  a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

  b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options**.

4 Click **Advanced** and click **Edit Configuration**.

5 Add or edit the parameter `nfc.useSSL` and set the value to **`true`**.

6 Click **OK**.

Upload an SSL Certificate and Key Using HTTPS PUT

You can use third-party applications to upload certificates. Applications that support HTTPS PUT operations work with the HTTPS interface that is included with ESXi.

Procedure

1 In your upload application, open the file.

2 Publish the file to one of these locations.

Option	Description
Certificates	`https://hostname/host/ssl_crt`
Keys	`https://hostname/host/ssl_key`

3 In the Direct Console User Interface (DCUI), use the Restart Management Agents operation to initiate the settings.

Replace a Default ESXi Certificate with a CA-Signed Certificate

ESXi uses automatically generated certificates that are created as part of the installation process. These certificates are unique and make it possible to begin using the server, but they are not verifiable and they are not signed by a trusted, well-known certificate authority (CA).

Using default certificates might not comply with the security policy of your organization. If you require a certificate from a trusted certificate authority, you can replace the default certificate.

Note If the host has Verify Certificates enabled, replacing the default certificate might cause vCenter Server to stop managing the host. If the new certificate is not verifiable by vCenter Server, you must reconnect the host using the vSphere Client.

ESXi supports only X.509 certificates to encrypt session information sent over SSL connections between server and client components.

Prerequisites

All file transfers and other communications occur over a secure HTTPS session. The user used to authenticate the session must have the privilege **Host.Config.AdvancedConfig** on the host. For more information on ESXi privileges, see Chapter 6, "ESXi Authentication and User Management," on page 57.

Procedure

1 Log in to the ESXi Shell as a user with administrator privileges.

2 In the directory `/etc/vmware/ssl`, rename the existing certificates using the following commands.

```
mv rui.crt orig.rui.crt
mv rui.key orig.rui.key
```

3 Copy the new certificate and key to `/etc/vmware/ssl`.

4 Rename the new certificate and key to `rui.crt` and `rui.key`.

5 Restart the host after you install the new certificate.

Alternatively, you can put the host into maintenance mode, install the new certificate, and then use the Direct Console User Interface (DCUI) to restart the management agents.

Replace a Default ESXi Certificate with a CA-Signed Certificate Using the vifs Command

ESXi uses automatically generated certificates that are created as part of the installation process. These certificates are unique and make it possible to begin using the server, but they are not verifiable and they are not signed by a trusted, well-known certificate authority (CA).

Using default certificates might not comply with the security policy of your organization. If you require a certificate from a trusted certificate authority, you can replace the default certificate.

NOTE If the host has Verify Certificates enabled, replacing the default certificate might cause vCenter Server to stop managing the host. If the new certificate is not verifiable by vCenter Server, you must reconnect the host using the vSphere Client.

ESXi supports only X.509 certificates to encrypt session information sent over SSL connections between server and client components.

Prerequisites

All file transfers and other communications occur over a secure HTTPS session. The user used to authenticate the session must have the privilege **Host.Config.AdvancedConfig** on the host. For more information on ESXi privileges, see Chapter 6, "ESXi Authentication and User Management," on page 57.

Procedure

1. Back up the existing certificates.
2. At the command line, use the `vifs` command to upload the certificate to the appropriate location on the host.

   ```
   vifs --server hostname --username username --put rui.crt /host/ssl_cert
   ```

   ```
   vifs --server hostname --username username --put rui.key /host/ssl_key
   ```
3. Restart the host.

   Alternatively, you can put the host into maintenance mode, install the new certificate, and then use the Direct Console User Interface (DCUI) to restart the management agents.

Upload an SSH Key Using HTTPS PUT

You can use authorized keys to log in to a host with SSH. You can upload authorized keys with HTTPS PUT.

Authorized keys allow you to authenticate remote access to a host. When users or scripts try to access a host with SSH, the key provides authentication without a password. With authorized keys you can automate authentication, which is useful when you write scripts to perform routine tasks.

You can upload the following types of SSH keys to a host using HTTPS PUT:

- Authorized keys file for root user
- DSA key
- DSA public key
- RSA key
- RSA public key

IMPORTANT Do not modify the `/etc/ssh/sshd_config` file.

Procedure

1 In your upload application, open the key file.

2 Publish the file to one of these locations.

Type of key	Location
Authorized key files for the root user	`https://`*`hostname or IP address`*`/host/ssh_root_authorized keys` You must have full administrator privileges on the host to upload this file.
DSA keys	`https://`*`hostname or IP address`*`/host/ssh_host_dsa_key`
DSA public keys	`https://`*`hostname or ip`*`/host/ssh_host_dsa_key_pub`
RSA keys	`https://`*`hostname or ip`*`/host/ssh_host_rsa_key`
RSA public keys	`https://`*`hostname or ip`*`/host/ssh_host_rsa_key_pub`

Upload an SSH Key Using a vifs Command

You can use authorized keys to log in to a host with SSH. You can upload authorized keys with a `vifs` command.

Authorized keys allow you to authenticate remote access to a host. When users or scripts try to access a host with SSH, the key provides authentication without a password. With authorized keys you can automate authentication, which is useful when you write scripts to perform routine tasks.

You can upload the following types of SSH keys to a host:

- Authorized keys file for root user
- DSA key
- DSA public key
- RSA key
- RSA public key

IMPORTANT Do not modify the `/etc/ssh/sshd_config` file.

Procedure

◆ At the command line, use the `vifs` command to upload the SSH key to appropriate location.

```
vifs --server hostname --username username --put filename /host/ssh_host_dsa_key_pub
```

Type of key	Location
Authorized key files for the root user	`/host/ssh_root_authorized keys` You must have full administrator privileges to upload this file.
DSA keys	`/host/ssh_host_dsa_key`
DSA public keys	`/host/ssh_host_dsa_key_pub`
RSA keys	`/host/ssh_host_rsa_key`
RSA public keys	`/host/ssh_host_rsa_key_pub`

Configure SSL Timeouts

You can configure SSL timeouts for ESXi.

Timeout periods can be set for two types of idle connections:

- The Read Timeout setting applies to connections that have completed the SSL handshake process with port 443 of ESXi.

- The Handshake Timeout setting applies to connections that have not completed the SSL handshake process with port 443 of ESXi.

Both connection timeouts are set in milliseconds.

Idle connections are disconnected after the timeout period. By default, fully established SSL connections have a timeout of infinity.

Procedure

1 Log in to the ESXi Shell as a user with administrator privileges.

2 Change to the directory `/etc/vmware/rhttpproxy/`.

3 Use a text editor to open the `config.xml` file.

4 Enter the `<readTimeoutMs>` value in milliseconds.

For example, to set the Read Timeout to 20 seconds, enter the following command.

```
<readTimeoutMs>20000</readTimeoutMs>
```

5 Enter the `<handshakeTimeoutMs>` value in milliseconds.

For example, to set the Handshake Timeout to 20 seconds, enter the following command.

```
<handshakeTimeoutMs>20000</handshakeTimeoutMs>
```

6 Save your changes and close the file.

7 Restart the `rhttpproxy` process:

```
/etc/init.d/rhttpproxy restart
```

Example: Configuration File

The following section from the file `/etc/vmware/rhttpproxy/config.xml` shows where to enter the SSL timeout settings.

```
<vmacore>
 ...
 <http>
    ...
  <readTimeoutMs>20000</readTimeoutMs>
    ...
 </http>
 ...
 <ssl>
  ...
  <handshakeTimeoutMs>20000</handshakeTimeoutMs>
  ...
    </ssl>
</vmacore>
```

Modifying ESXi Web Proxy Settings

When you modify Web proxy settings, you have several encryption and user security guidelines to consider.

Note Restart the host process after making any changes to host directories or authentication mechanisms.

- Do not set up certificates using pass phrases. ESXi does not support pass phrases, also known as encrypted keys. If you set up a pass phrase, ESXi processes cannot start correctly.

- You can configure the Web proxy so that it searches for certificates in a location other than the default location. This capability proves useful for companies that prefer to centralize their certificates on a single machine so that multiple hosts can use the certificates.

Caution If certificates are not stored locally on the host—for example, if they are stored on an NFS share—the host cannot access those certificates if ESXi loses network connectivity. As a result, a client connecting to the host cannot successfully participate in a secure SSL handshake with the host.

- To support encryption for user names, passwords, and packets, SSL is enabled by default for vSphere Web services SDK connections. If you want to configure the these connections so that they do not encrypt transmissions, disable SSL for your vSphere Web Services SDK connection by switching the connection from HTTPS to HTTP.

  Consider disabling SSL only if you created a fully trusted environment for these clients, where firewalls are in place and transmissions to and from the host are fully isolated. Disabling SSL can improve performance, because you avoid the overhead required to perform encryption.

- To protect against misuse of ESXi services, most internal ESXi services are accessible only through port 443, the port used for HTTPS transmission. Port 443 acts as a reverse proxy for ESXi. You can see a list of services on ESXi through an HTTP welcome page, but you cannot directly access the Storage Adapters services without proper authorization.

  You can change this configuration so that individual services are directly accessible through HTTP connections. Do not make this change unless you are using ESXi in a fully trusted environment.

- When you upgrade vCenter Server, the certificate remains in place.

Configure the Web Proxy to Search for Certificates in Nondefault Locations

You can configure the Web proxy so that it searches for certificates in a location other than the default location. This is useful for companies that centralize their certificates on a single machine so that multiple hosts can use the certificates.

Procedure

1 Log in to the ESXi Shell as a user with administrator privileges.

2 Change to the `/etc/vmware/rhttpproxy/` directory.

3 Use a text editor to open the `config.xml` file and find the following XML segment.

```
<ssl>
<!-- The server private key file -->
<privateKey>/etc/vmware/ssl/rui.key</privateKey>
<!-- The server side certificate file -->
<certificate>/etc/vmware/ssl/rui.crt</certificate>
</ssl>
```

4 Replace `/etc/vmware/ssl/rui.key` with the absolute path to the private key file that you received from your trusted certificate authority.

  This path can be on the host or on a centralized machine on which you store certificates and keys for your company.

  Note Leave the `<privateKey>` and `</privateKey>` XML tags in place.

5 Replace `/etc/vmware/ssl/rui.crt` with the absolute path to the certificate file that you received from your trusted certificate authority.

⚠ **CAUTION** Do not delete the original `rui.key` and `rui.crt` files. The host uses these files.

6 Save your changes and close the file.

7 Restart the rhttpproxy process:

```
/etc/init.d/rhttpproxy restart
```

Change Security Settings for a Web Proxy Service

You can change the security configuration so that individual services are directly accessible through HTTP connections.

Procedure

1 Log in to the ESXi Shell as a user with administrator privileges.

2 Change to the `/etc/vmware/hostd/`directory.

3 Use a text editor to open the `proxy.xml` file.

The contents of the file typically appears as follows.

```
<ConfigRoot>
<EndpointList>
<_length>10</_length>
<_type>vim.ProxyService.EndpointSpec[]</_type>
<e id="0">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpsWithRedirect</accessMode>
<port>8309</port>
<serverNamespace>/</serverNamespace>
</e>
<e id="1">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpAndHttps</accessMode>
<port>8309</port>
<serverNamespace>/client/clients.xml</serverNamespace>
</e>
<e id="2">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpAndHttps</accessMode>
<port>12001</port>
<serverNamespace>/ha-nfc</serverNamespace>
</e>
<e id="3">
<_type>vim.ProxyService.NamedPipeServiceSpec</_type>
<accessMode>httpsWithRedirect</accessMode>
<pipeName>/var/run/vmware/proxy-mob</pipeName>
<serverNamespace>/mob</serverNamespace>
</e>
<e id="4">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpAndHttps</accessMode>
<port>12000</port>
```

```
<serverNamespace>/nfc</serverNamespace>
</e>
<e id="5">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpsWithRedirect</accessMode>
<port>8307</port>
<serverNamespace>/sdk</serverNamespace>
</e>
<e id="6">
<_type>vim.ProxyService.NamedPipeTunnelSpec</_type>
<accessMode>httpOnly</accessMode>
<pipeName>/var/run/vmware/proxy-sdk-tunnel</pipeName>
<serverNamespace>/sdkTunnel</serverNamespace>
</e>
<e id="7">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpsWithRedirect</accessMode>
<port>8308</port>
<serverNamespace>/ui</serverNamespace>
</e>
<e id="8">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpsOnly</accessMode>
<port>8089</port>
<serverNamespace>/vpxa</serverNamespace>
</e>
<e id="9">
<_type>vim.ProxyService.LocalServiceSpec</_type>
<accessMode>httpsWithRedirect</accessMode>
<port>8889</port>
<serverNamespace>/wsman</serverNamespace>
</e>
</EndpointList>
</ConfigRoot>
```

4 Change the security settings as required.

For example, you might want to modify entries for services that use HTTPS to add the option of HTTP access.

Option	Description
e id	ID number for the server ID XML tag. ID numbers must be unique within the HTTP area.
_type	Name of the service you are moving.
accessmode	Forms of communication the service permits. Acceptable values include: ■ httpOnly – The service is accessible only over plain-text HTTP connections. ■ httpsOnly – The service is accessible only over HTTPS connections. ■ httpsWithRedirect – The service is accessible only over HTTPS connections. Requests over HTTP are redirected to the appropriate HTTPS URL. ■ httpAndHttps – The service is accessible both over HTTP and HTTPS connections.

Option	Description
port	Port number assigned to the service. You can assign a different port number to the service.
serverNamespace	Namespace for the server that provides this service, for example `/sdk` or `/mob`.

5 Save your changes and close the file.

6 Restart the `hostd` process:

```
/etc/init.d/hostd restart
```

Enable Certificate Checking and Verify Host Thumbprints

To prevent man-in-the-middle attacks and to fully use the security that certificates provide, certificate checking is enabled by default. You can verify that certificate checking is enabled in the vSphere Client.

NOTE vCenter Server certificates are preserved across upgrades.

Procedure

1 Log in to the vCenter Server system using the vSphere Client.

2 Select **Administration > vCenter Server Settings**.

3 Click **SSL Settings** in the left pane and verify that **Check host certificates** is selected.

4 If there are hosts that require manual validation, compare the thumbprints listed for the hosts to the thumbprints in the host console.

To obtain the host thumbprint, use the Direct Console User Interface (DCUI).

a Log in to the direct console and press F2 to access the System Customization menu.

b Select **View Support Information**.

The host thumbprint appears in the column on the right.

5 If the thumbprint matches, select the **Verify** check box next to the host.

Hosts that are not selected will be disconnected after you click **OK**.

6 Click **OK**.

Enable Certificate Checking and Verify Host Thumbprints in the vSphere Web Client

To prevent man-in-the-middle attacks and to fully use the security that certificates provide, certificate checking is enabled by default. You can verify that certificate checking is enabled in the vSphere Web Client.

NOTE vCenter Server certificates are preserved across upgrades.

Procedure

1 Browse to the vCenter Server system in the vSphere Web Client object navigator.

2 Select the **Manage** tab, click **Settings**, and click **General**.

3 Click **Edit**.

4 Click **SSL Settings** and verify that **vCenter requires verified host SSL certificates** is selected.

5. If there are hosts that require manual validation, compare the thumbprints listed for the hosts to the thumbprints in the host console.

   To obtain the host thumbprint, use the Direct Console User Interface (DCUI).

   a. Log in to the direct console and press F2 to access the System Customization menu.

   b. Select **View Support Information**.

      The host thumbprint appears in the column on the right.

6. If the thumbprint matches, select the **Verify** check box next to the host.

   Hosts that are not selected will be disconnected after you click **OK**.

7. Click **OK**.

Securing Virtual Machines 9

The guest operating system that runs in the virtual machine is subject to the same security risks as a physical system. Secure virtual machines as you would secure physical machines.

This chapter includes the following topics:

General Virtual Machine Protection

A virtual machine is, in most respects, the equivalent of a physical server. Employ the same security measures in virtual machines that you do for physical systems.

For example, ensure that antivirus, anti-spy ware, intrusion detection, and other protection are enabled for every virtual machine in your virtual infrastructure. Keep all security measures up-to-date, including applying appropriate patches. It is especially important to keep track of updates for dormant virtual machines that are powered off, because it can be easy to overlook them.

Disable Unnecessary Functions Inside Virtual Machines

Any service running in a virtual machine provides the potential for attack. By disabling unnecessary system components that are not necessary to support the application or service running on the system, you reduce the number of components that can be attacked.

Virtual machines do not usually require as many services or functions as physical servers. When you virtualize a system, evaluate whether a particular service or function is necessary.

Procedure

- Disable unused services in the operating system.

  For example, if the system runs a file server, turn off any Web services.

- Disconnect unused physical devices, such as CD/DVD drives, floppy drives, and USB adaptors.

  See "Removing Unnecessary Hardware Devices," on page 136.
- Turn off screen savers.
- Do not run the X Window system on Linux, BSD, or Solaris guest operating systems unless it is necessary.

Use Templates to Deploy Virtual Machines

When you manually install guest operating systems and applications on a virtual machine, you introduce a risk of misconfiguration. By using a template to capture a hardened base operating system image with no applications installed, you can ensure that all virtual machines are created with a known baseline level of security.

You can use these templates to create other, application-specific templates, or you can use the application template to deploy virtual machines.

Procedure

- Provide templates for virtual machine creation that contain hardened, patched, and properly configured operating system deployments.

  If possible, deploy applications in templates as well. Ensure that the applications do not depend on information specific to the virtual machine to be deployed.

What to do next

You can convert a template to a virtual machine and back to a template in the vSphere Client, which makes updating templates easy. For more information about templates, see the *vSphere Virtual Machine Administration* documentation.

Prevent Virtual Machines from Taking Over Resources

When one virtual machine consumes so much of the host resources that other virtual machines on the host cannot perform their intended functions, a Denial of Service (DoS) might occur. To prevent a virtual machine from causing a DoS, use host resource management features such as setting shares and limits to control the server resources that a virtual machine consumes.

By default, all virtual machines on a host share resources equally.

Procedure

- Use shares or reservations to guarantee resources to critical virtual machines.

  Limits constrain resource consumption by virtual machines that have a greater risk of being exploited or attacked, or that run applications that are known to have the potential to greatly consume resources.

What to do next

See the *vSphere Resource Management* documentation for information about shares and limits.

Restrict Unauthorized Users from Running Commands within a Virtual Machine

By default, the vCenter Server Administrator role allows users to interact with files and programs within a virtual machine's guest operating system. To reduce the risk of breaching guest confidentiality, availability, or integrity, create a non-guest access role without the Guest Operations privilege.

Apply the role to users who require administrator privileges, but who are not authorized to interact with files and programs within a guest operating system.

Prerequisites

Verify that you have vCenter Server Administrator privileges on the vCenter Server system where you create the role.

Procedure

1 Log in to the vSphere Web Client as a user who has vCenter Server Administrator privileges on the system where you will create the role.

2 Click **Administration** and click **Access > Role Manager**.

3 Click the **Create role** icon and enter a name for the role.

  For example, enter Administrator No Guest Access.

4 Select **All Privileges**.

5 Remove the Guest Operations set of privileges by deselecting **All Privileges.Virtual machine.Guest Operations**.

6 Click **OK**.

What to do next

Assign users who require Administrator privileges without guest access privileges to the newly created role, ensuring that these users are removed from the default Administrator role.

Limit Informational Messages from Virtual Machines to VMX Files

Limit informational messages from the virtual machine to the VMX file to avoid filling the datastore and causing a Denial of Service (DoS). A Denial of Service can occur when you do not control the size of a virtual machine's VMX file and the amount of information exceeds the datastore's capacity.

The configuration file containing these name-value pairs is limited to a size of 1MB. This capacity is sufficient in most cases, but you can change this value if necessary. For example, you might increase the limit if large amounts of custom information are being stored in the configuration file.

The default limit of 1MB is applied even when the sizeLimit parameter is not listed in the VMX file.

Procedure

1 On the ESXi system that hosts the virtual machine, browse to the VMX file.

  Virtual machine configuration files are located in the `/vmfs/volumes/`*`datastore`* directory, where *datastore* is the name of the storage device on which the virtual machine files reside. For example, `/vmfs/volumes/vol1/vm-finance/`.

2 Use a text editor to add or edit the following line in the .vmx file:

```
tools.setInfo.sizeLimit=104857
```

3 Save and close the file.

Prevent Virtual Disk Shrinking

Nonadministrative users in the guest operating system are able to shrink virtual disks. Shrinking a virtual disk reclaims the disk's unused space. However, if you shrink a disk repeatedly, the disk can become unavailable or cause a Denial of Service (DoS). To prevent this, disable the ability to shrink virtual disks.

Prerequisites

Turn off the virtual machine.

Procedure

1 Log in to the vCenter Server system using the vSphere Client.

2 Select the virtual machine in the inventory.

3 On the **Summary** tab, click **Edit Settings**.

4 Select **Options > Advanced > General** and click **Configuration Parameters**.

5 Add or edit the following parameters.

Name	Value
isolation.tools.diskWiper.disable	TRUE
isolation.tools.diskShrink.disable	TRUE

6 Click **OK** to close the Configuration Parameters dialog box, and click **OK** again to close the Virtual Machine Properties dialog box.

When you disable this feature, you cannot shrink virtual machine disks when a datastore runs out of space.

Prevent Virtual Disk Shrinking in the vSphere Web Client

Nonadministrative users in the guest operating system are able to shrink virtual disks. Shrinking a virtual disk reclaims the disk's unused space. However, if you shrink a virtual disk repeatedly, the disk can become unavailable and cause a denial of service. To prevent this, disable the ability to shrink virtual disks.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

   a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

   b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options**.

4 Click **Advanced** and click **Edit Configuration**.

5 Add or edit the following parameters.

Name	Value
isolation.tools.diskWiper.disable	TRUE
isolation.tools.diskShrink.disable	TRUE

6 Click **OK**.

When you disable this feature, you cannot shrink virtual machine disks when a datastore runs out of space.

Prevent Users from Spying on Remote Console Sessions

To prevent spying on remote console sessions, limit the number of remote console connections that are allowed.

By default, more than one user can connect to a virtual machine remote console session at a time. If more than one user connects to a remote console, the users can observe the operations performed by other remote console users. For example, if a virtual machine administrator logs in to the virtual machine using the remote console, a user without administrator privileges can simultaneously connect to the virtual machine console and observe the administrator's actions.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

   a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

   b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options**.

4 Click **Advanced** and click **Edit Configuration**.

5 Add or edit the parameter `RemoteDisplay.maxConnections` and set the value to **1**.

6 Click **OK**.

Only one remote console connection to the virtual machine is permitted. Other attempts to start a remote console are rejected until the first session disconnects.

Configuring Logging Levels for the Guest Operating System

Virtual machines can write troubleshooting information into a virtual machine log file stored on the VMFS volume. Virtual machine users and processes can abuse logging either on purpose or inadvertently so that large amounts of data flood the log file. Over time, the log file can consume enough file system space to cause a denial of service.

To prevent this problem, consider modifying logging settings for virtual machine guest operating systems. These settings can limit the total size and number of log files. Normally, a new log file is created each time you reboot a host, so the file can grow to be quite large. You can ensure new log file creation happens more frequently by limiting the maximum size of the log files. VMware recommends saving 10 log files, each one limited to 100KB. These values are large enough to capture sufficient information to debug most problems that might occur.

Each time an entry is written to the log, the size of the log is checked. If it is over the limit, the next entry is written to a new log. If the maximum number of log files exists, the oldest log file is deleted. A DoS attack that avoids these limits could be attempted by writing an enormous log entry, but each log entry is limited in size to 4KB, so no log files are ever more than 4KB larger than the configured limit.

Limit Log File Numbers and Sizes

To prevent virtual machine users and processes from flooding the log file, which can lead to denial of service, you can limit the number and size of the log files ESXi generates.

ESXi creates a new log file only when you reboot the host. Therefore, the size of log files on the host can become unmanageable if you do not reboot the host frequently. To ensure that ESXi creates new log files frequently, you can limit the maximum size of the log files. To restrict the total size of logging data, save 10 log files and limit each file to 1,000KB.

Procedure

1 Log in to a vCenter Server system using the vSphere Client.

2 On the **Summary** tab, click **Edit Settings**.

3 Select **Options > General Options** and make a record of the path displayed in the **Virtual Machine Configuration File** text box.

4 Log into the ESXi Shell as a user with administrator privileges.

5 Change directories to access the virtual machine configuration file whose path you recorded in Step 3.

   Virtual machine configuration files are located in the `/vmfs/volumes/`*`datastore`* directory, where *datastore* is the name of the storage device on which the virtual machine files reside. For example, if the virtual machine configuration file you obtained from the Virtual Machine Properties dialog box is `[vol1]vm-finance/vm-finance.vmx`, you would change to the following directory.

```
/vmfs/volumes/vol1/vm-finance/
```

6 To limit the log size, use a text editor to add or edit the following line to the `.vmx` file, where *maximum_size* is the maximum file size in bytes.

```
log.rotateSize=maximum_size
```

   For example, to limit the size to around 100KB, enter **`100000`**.

7 To keep a limited number of log files, use a text editor to add or edit the following line to the `.vmx` file, where *number_of_files_to_keep* is the number of files the server keeps.

```
log.keepOld=number_of_files_to_keep
```

   For example, to keep 10 log files and begin deleting the oldest ones as new ones are created, enter **`10`**.

8 Save your changes and close the file.

Virtual machine logs are unavailable for troubleshooting and support.

Limit Log File Numbers and Sizes in the vSphere Web Client

To prevent virtual machine users and processes from flooding the log file, which can lead to denial of service, you can limit the number and size of the log files ESXi generates.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

   a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

   b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options**.

4 Click **Advanced** and click **Edit Configuration**.

5 Add or edit the following parameters.

Name	Value
log.rotateSize	Maximum size of log file in bytes. For example, to limit the size to 100KB, enter **100000**.
log.keepOld	Number of files to keep. For example, to keep 10 log files and begin deleting the oldest files as new ones are created, enter **10**.

6 Click **OK**.

Disable Logging for the Guest Operating System

If you choose not to write troubleshooting information into a virtual machine log file stored on the VMFS volume, you can stop logging altogether.

If you disable logging for the guest operating system, be aware that you might not be able to gather adequate logs to allow troubleshooting. Further, VMware does not offer technical support for virtual machine problems if logging has been disabled.

Procedure

1 Log in to a vCenter Server system using the vSphere Client and select the virtual machine in the inventory.

2 On the **Summary** tab, click **Edit Settings**.

3 Click the **Options** tab and in the options list under Advanced, select **General**.

4 In Settings, deselect **Enable logging**.

5 Click **OK** to close the Virtual Machine Properties dialog box.

Disable Logging for the Guest Operating System in the vSphere Web Client

If you choose not to write troubleshooting information into a virtual machine log file stored on the VMFS volume, you can stop logging altogether.

If you disable logging for the guest operating system, be aware that you might not be able to gather adequate logs to allow troubleshooting. Further, VMware does not offer technical support for virtual machine problems if logging has been disabled.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

  a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

  b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options > Advanced**.

4 In Settings, deselect **Enable logging**.

5 Click **OK**.

Limiting Exposure of Sensitive Data Copied to the Clipboard

Copy and paste operations are disabled by default for hosts to prevent exposing sensitive data that has been copied to the clipboard.

When copy and paste is enabled on a virtual machine running VMware Tools, you can copy and paste between the guest operating system and remote console. As soon as the console window gains focus, non-privileged users and processes running in the virtual machine can access the clipboard for the virtual machine console. If a user copies sensitive information to the clipboard before using the console, the user—perhaps unknowingly —exposes sensitive data to the virtual machine. To prevent this problem, copy and paste operations for the guest operating system are disabled by default.

It is possible to enable copy and paste operations for virtual machines if necessary.

Ensure that Copy and Paste Operations are Disabled Between the Guest Operating System and Remote Console

Copy and paste operations between the guest operating system and remote console are disabled by default. For a secure environment, retain the default setting. If you require copy and paste operations, you must enable them using the vSphere Client.

Prerequisites

Turn off the virtual machine.

Procedure

1 Log into a vCenter Server system using the vSphere Client and select the virtual machine.

2 On the **Summary** tab, click **Edit Settings**.

3 Select **Options > Advanced > General** and click **Configuration Parameters**.

4 Ensure that the following values are in the Name and Value columns, or click **Add Row** to add them.

Name	Value
isolation.tools.copy.disable	true
isolation.tools.paste.disable	true

These options override any settings made in the guest operating system's VMware Tools control panel.

5 Click **OK** to close the Configuration Parameters dialog box, and click **OK** again to close the Virtual Machine Properties dialog box.

6 (Optional) If you made changes to the configuration parameters, restart the virtual machine.

Ensure that Copy and Paste Operations are Disabled Between the Guest Operating System and Remote Console in the vSphere Web Client

Copy and paste operations between the guest operating system and remote console are disabled by default. For a secure environment, retain the default setting. If you require copy and paste operations, you must enable them using the vSphere Web Client.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

   a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

   b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options**.

4 Click **Advanced** and click **Edit Configuration**.

5 Add or edit the following parameters.

Name	Value
isolation.tools.copy.disable	TRUE
isolation.tools.paste.disable	TRUE

These options override any settings made in the guest operating system's VMware Tools control panel.

6 Click **OK**.

Disable Unexposed Features

VMware virtual machines are designed to work on both vSphere systems and hosted virtualization platforms such as Workstation and Fusion. Certain VMX parameters do not need to be enabled when you run a virtual machine on a vSphere system. Disable these parameters to reduce the potential for vulnerabilities.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

   a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

   b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options**.

4 Click **Advanced** and click **Edit Configuration**.

5 Add or edit the following parameters.

Name	Value
isolation.tools.unity.push.update.disable	TRUE
isolation.tools.ghi.launchmenu.change	TRUE
isolation.tools.memSchedFakeSampleStats.disable	TRUE
isolation.tools.getCreds.disable	TRUE
isolation.tools.ghi.autologon.disable	TRUE

Name	Value
isolation.bios.bbs.disable	TRUE
isolation.tools.hgfsServerSet.disable	TRUE

6 Click **OK**.

Setting `isolation.tools.hgfsServerSet.disable` to true disables registration of the guest's HGFS server with the host. APIs that use HGFS to transfer files to and from the guest operating system, such as some VIX commands or the VMware Tools auto-upgrade utility, will not function.

Limiting Guest Operating System Writes to Host Memory

The guest operating system processes send informational messages to the host through VMware Tools. If the amount of data the host stored as a result of these messages was unlimited, an unrestricted data flow would provide an opportunity for an attacker to stage a denial-of-service (DoS) attack.

The informational messages sent by guest operating processes are known as `setinfo` messages and typically contain name-value pairs that define virtual machine characteristics or identifiers that the host stores (for example, `ipaddress=10.17.87.224`). The configuration file containing these name-value pairs is limited to a size of 1MB, which prevents attackers from staging a DoS attack by writing software that mimics VMware Tools and filling the host's memory with arbitrary configuration data, which consumes space needed by the virtual machines.

If you require more than 1MB of storage for name-value pairs, you can change the value as required. You can also prevent the guest operating system processes from writing any name-value pairs to the configuration file.

Modify Guest Operating System Variable Memory Limit

You can increase the guest operating system variable memory limit if large amounts of custom information are being stored in the configuration file.

Prerequisites

Turn off the virtual machine.

Procedure

1 Log in to a vCenter Server system using the vSphere Client.

2 Select the virtual machine in the inventory panel.

3 On the **Summary** tab, click **Edit Settings**.

4 Select **Options > Advanced > General** and click **Configuration Parameters**.

5 If the size limit attribute is not present, you must add it.

  a Click **Add Row**.

  b In the Name column, type **`tools.setInfo.sizeLimit`**.

  c In the Value column, type **`Number of Bytes`**.

  If the size limit attribute exists, modify it to reflect the appropriate limits.

6 Click **OK** to close the Configuration Parameters dialog box, and click **OK** again to close the Virtual Machine Properties dialog box.

Modify Guest Operating System Variable Memory Limit in the vSphere Web Client

You can increase the guest operating system variable memory limit if large amounts of custom information are being stored in the configuration file.

Prerequisites

Turn off the virtual machine.

Procedure

1 Find the virtual machine in the vSphere Web Client inventory.

  a To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.

  b Click the **Related Objects** tab and click **Virtual Machines**.

2 Right-click the virtual machine and click **Edit Settings**.

3 Select **VM Options > Advanced** and click **Edit Configuration**.

4 Add or edit the parameter `tools.setInfo.sizeLimit` and set the value to the number of bytes.

5 Click **OK**.

Prevent the Guest Operating System Processes from Sending Configuration Messages to the Host

You can prevent guests from writing any name-value pairs to the configuration file. This is appropriate when guest operating systems must be prevented from modifying configuration settings.

Prerequisites

Turn off the virtual machine.

Procedure

1 Log in to a vCenter Server system using the vSphere Client.

2 Select the virtual machine in the inventory panel.

3 On the **Summary** tab, click **Edit Settings**.

4 Select **Options > Advanced > General** and click **Configuration Parameters**.

5 Click **Add Row** and type the following values in the Name and Value columns.

  - In the Name column: **`isolation.tools.setinfo.disable`**
  - In the Value column: **`true`**

6 Click **OK** to close the Configuration Parameters dialog box, and click **OK** again to close the Virtual Machine Properties dialog box.

Prevent the Guest Operating System Processes from Sending Configuration Messages to the Host in the vSphere Web Client

You can prevent guests from writing any name-value pairs to the configuration file. This is appropriate when guest operating systems must be prevented from modifying configuration settings.

Prerequisites

Turn off the virtual machine.

Procedure

1. Find the virtual machine in the vSphere Web Client inventory.
   1. To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.
   2. Click the **Related Objects** tab and click **Virtual Machines**.
2. Right-click the virtual machine and click **Edit Settings**.
3. Select **VM Options**.
4. Click **Advanced** and click **Edit Configuration**.
5. Add or edit the parameter `isolation.tools.setinfo.disable` and set the value to **`TRUE`**.
6. Click **OK**.

Removing Unnecessary Hardware Devices

Any enabled or connected device represents a potential attack channel. Users and processes without privileges on a virtual machine can connect or disconnect hardware devices, such as network adapters and CD-ROM drives. Attackers can use this capability to breach virtual machine security. Removing unnecessary hardware devices can help prevent attacks.

Use the following guidelines to increase virtual machine security.

- Ensure that unauthorized devices are not connected and remove any unneeded or unused hardware devices.
- Disable unnecessary virtual devices from within a virtual machine. An attacker with access to a virtual machine can connect a disconnected CD-ROM drive and access sensitive information on the media left in the drive, or disconnect a network adapter to isolate the virtual machine from its network, resulting in a denial of service.
- Ensure that no device is connected to a virtual machine if it is not required. Serial and parallel ports are rarely used for virtual machines in a datacenter environment, and CD/DVD drives are usually connected only temporarily during software installation.
- For less commonly used devices that are not required, either the parameter should not be present or its value must be false. Ensure that the following parameters are either not present or set to false unless the device is required.

Parameter	Value	Device
floppyX.present	false	floppy drives
serialX.present	false	serial ports
parallelX.present	false	parallel ports
usb.present	false	USB controller
ideX:Y.present	false	CD-ROM

Prevent a Virtual Machine User or Process from Disconnecting Devices

Users and processes without root or administrator privileges within virtual machines have the capability to connect or disconnect devices, such as network adaptors and CD-ROM drives, as well as the ability to modify device settings. To increase virtual machine security, remove these devices. If you do not want to permanently remove a device, you can prevent a virtual machine user or process from connecting or disconnecting the device from within the guest operating system.

Prerequisites

Turn off the virtual machine.

Procedure

1. Log in to a vCenter Server system using the vSphere Client and select the virtual machine.
2. On the **Summary** tab, click **Edit Settings**.
3. Select **Options > Advanced > General** and click **Configuration Parameters**.
4. Add or edit the following parameters.

Name	Value
isolation.device.connectable.disable	true
isolation.device.edit.disable	true

   These options override any settings made in the guest operating system's VMware Tools control panel.
5. Click **OK** to close the Configuration Parameters dialog box, and click **OK** again to close the Virtual Machine Properties dialog box.
6. (Optional) If you made changes to the configuration parameters, restart the virtual machine.

Prevent a Virtual Machine User or Process from Disconnecting Devices in the vSphere Web Client

Users and processes without root or administrator privileges within virtual machines have the capability to connect or disconnect devices, such as network adaptors and CD-ROM drives, as well as the ability to modify device settings. To increase virtual machine security, remove these devices. If you do not want to permanently remove a device, you can prevent a virtual machine user or process from connecting or disconnecting the device from within the guest operating system.

Prerequisites

Turn off the virtual machine.

Procedure

1. Find the virtual machine in the vSphere Web Client inventory.
   a. To find a virtual machine, select a datacenter, folder, cluster, resource pool, or host.
   b. Click the **Related Objects** tab and click **Virtual Machines**.
2. Right-click the virtual machine and click **Edit Settings**.
3. Select **VM Options > Advanced** and click **Edit Configuration**.
4. Verify that the following values are in the Name and Value columns, or click **Add Row** to add them.

Name	Value
isolation.device.connectable.disable	true
isolation.device.edit.disable	true

   These options override any settings made in the guest operating system's VMware Tools control panel.
5. Click **OK** to close the Configuration Parameters dialog box, and click **OK** again to close the Virtual Machine Properties dialog box.

Securing vCenter Server Systems 10

Securing vCenter Server includes ensuring security of the host where vCenter Server is running, following best practices for assigning privileges and roles, and verifying the integrity of the clients that connect to vCenter Server.

This chapter includes the following topics:

Hardening the vCenter Server Host Operating System

Protect the host where vCenter Server is running against vulnerabilities and attacks by ensuring that the operating system of the host (Windows or Linux) is as secure as possible.

- Maintain a supported operating system, database, and hardware for the vCenter Server system. If vCenter Server is not running on a support operating system, it might not run properly, making vCenter Server vulnerable to attacks.
- Keep the vCenter Server system properly patched. By staying up-to-date with operating system patches, the server is less vulnerable to attack.
- Provide operating system protection on the vCenter Server host. Protection includes antivirus and antimalware software.

For operating system and database compatibility information, see the *vSphere Compatibility Matrixes*.

Best Practices for vCenter Server Privileges

Strictly control vCenter Server administrator privileges to increase security for the system.

- Full administrative rights to vCenter Server should be removed from the local Windows administrator account and granted to a special-purpose local vCenter Server administrator account. Grant full vSphere administrative rights only to those administrators who are required to have it. Do not grant this privilege to any group whose membership is not strictly controlled.

- Avoid allowing users to log in directly to the vCenter Server system. Allow only those users who have legitimate tasks to perform to log into the system and ensure that these events are audited.
- Install vCenter Server using a service account instead of a Windows account. You can use a service account or a Windows account to run vCenter Server. Using a service account allows you to enable Windows authentication for SQL Server, which provides more security. The service account must be an administrator on the local machine.
- Check for privilege reassignment when you restart vCenter Server. If the user or user group that is assigned the Administrator role on the root folder of the server cannot be verified as a valid user or group, the Administrator privileges are removed and assigned to the local Windows Administrators group.
- Grant minimal privileges to the vCenter Server database user. The database user requires only certain privileges specific to database access. In addition, some privileges are required only for installation and upgrade. These can be removed after the product is installed or upgraded.

Restrict Use of the Administrator Privilege

By default, vCenter Server grants full administrator privileges to the administrator of the local system, which can be accessed by domain administrators. To minimize risk of this privilege being abused, remove administrative rights from the local operating system's administrator account and assign these rights to a special-purpose local vSphere administrator account. Use the local vSphere account to create individual user accounts.

Grant the Administrator privilege only to administrators who are required to have it. Do not grant the privilege to any group whose membership is not strictly controlled.

Procedure

1 Create a user account that you will use to manage vCenter Server (for example, vi-admin).

   Ensure that the user does not belong to any local groups, such as the Administrators group.

2 Log into the vCenter Server system as the local operating system administrator and grant the role of global vCenter Server administrator to the user account you created (for example, vi-admin).

3 Log out of vCenter Server and log in with the user account you created (vi-admin).

4 Verify that the user can perform all tasks available to a vCenter Server administrator.

5 Remove the administrator privileges that are assigned to the local operating system administrator user or group.

Restrict Use of the Administrator Role

Secure the vCenter Server Administrator role and assign it only to certain users.

Protect the vCenter Server administrator user from regular use by relying on user accounts associated with specific individuals.

Prerequisites

- Create a user account to manage vCenter Server and assign full vCenter Server administrator privileges to the user. See "Assigning Permissions for vCenter Server," on page 101.
- Remove vCenter Server administrator privileges from the local operating system administrator.

Procedure

1 Log in to the vCenter Server system as the vCenter Server administrator you created (for example, vi-admin).

2 Grant full administrator privileges to the minimum number of individuals required.

3 Log out as the vCenter Server administrator.

What to do next

Protect the vCenter Server administrator account password. For example, create a password with two halves, each half of which is known to only one person, or lock a printout of the password in a safe.

Limiting vCenter Server Network Connectivity

Avoid putting vCenter Server on any network other than the management network. By limiting network connectivity, you limit certain types of attack.

vCenter Server requires access to the management network only. Avoid putting the vCenter Server system on networks such as your production network or storage network, or on any network with access to the public Internet. vCenter Server does not need access to the network where vMotion operates.

vCenter Server needs network connectivity to the following systems.

- All ESXi hosts
- The vCenter Server database
- Other vCenter Server systems (linked mode only)
- Systems that are authorized to run management clients. For example, the vSphere Client, a Windows system where you use the PowerCLI, or any other SDK-based client.
- Systems that run add-on components such as VMware vSphere Update Manager
- Infrastructure services such as DNS, Active Directory, and NTP
- Other systems that run components that are essential to functionality of the vCenter Server system

Use a local firewall on the Windows system where vCenter Server is running or use a network firewall. Include IP-based access restrictions so that only necessary components can communicate with the vCenter Server system.

Block access to ports that are not being used by vCenter Server using the local firewall on the Windows system where vCenter Server is installed or a network firewall.

Restricting Use of Linux-Based Clients

Communication between client components and vCenter Server or ESXi are protected by SSL-based encryption. Linux versions of these components do not perform certificate validation, so you should restrict the use of these clients.

Even when the management interfaces of vCenter Server and ESXi are available on trusted networks only, encryption and certificate validation add extra layers of defense against an attack. The following components are vulnerable when they run on the Linux operating system.

- vCLI commands
- vSphere SDK for Perl scripts
- Programs written using the vSphere SDK

You can relax the restriction against using Linux-based clients if you enforce proper controls.

- Restrict management network access to authorized systems only.
- Use firewalls to ensure that only authorized hosts are allowed to access vCenter Server.
- Use jump-box systems to ensure that Linux clients are behind the jump.

Verifying the Integrity of the vSphere Client

vSphere Client extensions run at the same privilege level as the user that is logged in. A malicious extension can masquerade as a useful plug-in and perform harmful operations such as stealing credentials or changing the system configuration. To increase security, use a vSphere Client installation that includes only authorized extensions from trusted sources.

vCenter Server includes a vSphere Client extensibility framework, which provides the ability to extend the vSphere Client with menu selections or toolbar icons that provide access to vCenter add-on components or external, Web-based functionality. With this flexibility, there is a risk of introducing unintended capabilities. For example, an administrator might install a plug-in in an instance of the vSphere Client. The plug-in can then execute arbitrary commands with the privilege level of that administrator.

To protect against potential compromise, do not install any vSphere Client plug-ins that do not come from a trusted source. Verify which plug-ins are installed in the vSphere Client using the **Plug-ins > Manage Plug-ins** menu and clicking the **Installed Plug-ins** tab.

Set an Inactivity Timeout for the vSphere Client

You can set a timeout for idle vSphere Client sessions. This allows you to close sessions automatically, which reduces the potential for unauthorized users to access vCenter Server.

Procedure

◆ On each Windows system where the vSphere Client is installed, verify that an idle timeout is set.

  - You can specify the idle timeout as a parameter in the vpxClient.exe.config file (typically, `C:\Program Files\VMware\Infrastructure\Virtual Infrastructure Client\Launcher\VpxClient.exe.config`).
  - Alternatively, advise users to run the vSphere Client executable with a flag set for the timeout value (for example, `vpxClient.exe –inactivityTimeout 5`, where 5 is five minutes).

What to do next

This client-side setting can be changed by the user. After you set the default timeout value, periodically audit the configuration file.

Disable Sending Host Performance Data to Guests

vSphere includes virtual machine performance counters on Windows operating systems where VMware Tools is installed. Performance counters allow virtual machine owners to do accurate performance analysis within the guest operating system. By default, vSphere does not expose host information to the guest virtual machine. An adversary might use the information to perform further attacks on the host.

The ability to send host performance data to a guest virtual machine is disabled by default. This default setting prevents a virtual machine from obtaining detailed information about the physical host.

Procedure

1 On the ESXi system that hosts the virtual machine, browse to the VMX file.

  Virtual machine configuration files are located in the `/vmfs/volumes/`*`datastore`* directory, where *datastore* is the name of the storage device where the virtual machine files are stored.

2 In the VMX file, verify that the following parameter is set.

```
tools.guestlib.enableHostInfo=FALSE
```

3 Save and close the file.

You cannot retrieve performance information about the host from inside the guest virtual machine, where it might be useful for troubleshooting.

Best Practices for Virtual Machine and Host Security 11

Consider basic security recommendations when creating and configuring hosts and virtual machines.

This chapter includes the following topics:

Installing Antivirus Software

Because each virtual machine hosts a standard operating system, consider protecting it from viruses by installing antivirus software. Depending on how you are using the virtual machine, you might also want to install a software firewall.

Stagger the schedule for virus scans, particularly in deployments with a large number of virtual machines. Performance of systems in your environment will degrade significantly if you scan all virtual machines simultaneously.

Because software firewalls and antivirus software can be virtualization-intensive, you can balance the need for these two security measures against virtual machine performance, especially if you are confident that your virtual machines are in a fully trusted environment.

Managing ESXi Log Files

Log files are an important component of troubleshooting attacks and obtaining information about breaches of host security Logging to a secure, centralized log server can help prevent log tampering. Remote logging also provides a long-term audit record.

Take the following measures to increase the security of the host.

- Configure persistent logging to a datastore. By default, the logs on ESXi hosts are stored in the in-memory file system. Therefore, they are lost when you reboot the host, and only 24 hours of log data is stored. When you enable persistent logging, you have a dedicated record of server activity available for the host.
- Remote logging to a central host allows you to gather log files onto a central host, where you can monitor all hosts with a single tool. You can also do aggregate analysis and searching of log data, which might reveal information about things like coordinated attacks on multiple hosts.
- Configure remote secure syslog on ESXi hosts using a remote command line such as vCLI or PowerCLI, or using an API client.
- Query the syslog configuration to make sure that a valid syslog server has been configured, including the correct port.

Configure Syslog on ESXi Hosts

All ESXi hosts run a syslog service (`vmsyslogd`), which logs messages from the VMkernel and other system components to log files.

You can use the vSphere Client or the `esxcli system syslog` vCLI command to configure the syslog service.

For more information about using vCLI commands, see *Getting Started with vSphere Command-Line Interfaces*.

Procedure

1. In the vSphere Client inventory, select the host.
2. Click the **Configuration** tab.
3. In the Software panel, click **Advanced Settings**.
4. Select **Syslog** in the tree control.
5. To set up logging globally, click **global** and make changes to the fields on the right.

Option	Description
Syslog.global.defaultRotate	Sets the maximum number of archives to keep. You can set this number globally and for individual subloggers.
Syslog.global.defaultSize	Sets the default size of the log, in KB, before the system rotates logs. You can set this number globally and for individual subloggers.
Syslog.global.LogDir	Directory where logs are stored. The directory can be located on mounted NFS or VMFS volumes. Only the `/scratch` directory on the local file system is persistent across reboots. The directory should be specified as [*datastorename*] *path_to_file* where the path is relative to the root of the volume backing the datastore. For example, the path `[storage1] /systemlogs` maps to the path `/vmfs/volumes/storage1/systemlogs`.

Option	Description
Syslog.global.logDirUnique	Selecting this option creates a subdirectory with the name of the ESXi host under the directory specified by **Syslog.global.LogDir**. A unique directory is useful if the same NFS directory is used by multiple ESXi hosts.
Syslog.global.LogHost	Remote host to which syslog messages are forwarded and port on which the remote host receives syslog messages. You can include the protocol and the port, for example, `ssl://hostName1:514`. UDP (default), TCP, and SSL are supported. The remote host must have syslog installed and correctly configured to receive the forwarded syslog messages. See the documentation for the syslog service installed on the remote host for information on configuration.

6 (Optional) To overwrite the default log size and log rotation for any of the logs.

   a Click **loggers**.

   b Click the name of the log you that want to customize and enter the number of rotations and log size you want.

7 Click **OK**.

Changes to the syslog options take effect immediately.

ESXi Log File Locations

ESXi records host activity in log files, using a syslog facility.

Component	Location	Purpose
VMkernel	`/var/log/vmkernel.log`	Records activities related to virtual machines and ESXi.
VMkernel warnings	`/var/log/vmkwarning.log`	Records activities related to virtual machines.
VMkernel summary	`/var/log/vmksummary.log`	Used to determine uptime and availability statistics for ESXi (comma separated).
ESXi host agent log	`/var/log/hostd.log`	Contains information about the agent that manages and configures the ESXi host and its virtual machines.
vCenter agent log	`/var/log/vpxa.log`	Contains information about the agent that communicates with vCenter Server (if the host is managed by vCenter Server).
Shell log	`/var/log/vpxa.log`	Contains a record of all commands typed into the ESXi Shell as well as shell events (for example, when the shell was enabled).
Authentication	`/var/log/auth.log`	Contains all events related to authentication for the local system.

Component	Location	Purpose
System messages	`/var/log/syslog.log`	Contains all general log messages and can be used for troubleshooting. This information was formerly located in the messages log file.
Virtual machines	The same directory as the affected virtual machine's configuration files, named vmware.log and vmware*.log. For example, `/vmfs/volumes/`*`datastore`*`/`*`virtual machine`*`/vwmare.log`	Contains virtual machine power events, system failure information, tools status and activity, time sync, virtual hardware changes, vMotion migrations, machine clones, and so on.

Securing Fault Tolerance Logging Traffic

When you enable Fault Tolerance (FT), VMware vLockstep captures inputs and events that occur on a Primary VM and sends them to the Secondary VM, which is running on another host.

This logging traffic between the Primary and Secondary VMs is unencrypted and contains guest network and storage I/O data, as well as the memory contents of the guest operating system. This traffic can include sensitive data such as passwords in plaintext. To avoid such data being divulged, ensure that this network is secured, especially to avoid "man-in-the-middle" attacks. For example, use a private network for FT logging traffic.

Auto Deploy Security Considerations

To best protect your environment, be aware of security risks that might exist when you use Auto Deploy with host profiles.

In most cases, administrators set up Auto Deploy to provision target hosts not only with an image, but also with a host profile. The host profile includes configuration information such as authentication or network settings. Host profiles can be set up to prompt the user for input on first boot. The user input is stored in an answer file. The host profile and answer file (if applicable) are included in the boot image that Auto Deploy downloads to a machine.

- The administrator password and user passwords that are included with the host profile and answer file are MD5-encrypted. Any other passwords associated with host profiles are in the clear.
- Use the vSphere Authentication Service to set up Active Directory to avoid exposing the Active Directory password. If you set up Active Directory using host profiles, the passwords are not protected.

For more information about Auto Deploy, see the Auto Deploy information that is part of the *vSphere Installation and Setup* documentation. For more information about host profiles and answer files, see the *vSphere Host Profiles* documentation.

Image Builder Security Considerations

To protect the integrity of the ESXi host, do not allow users to install unsigned (community-supported) VIBs. An unsigned VIB contains untested code that is not certified by, accepted by, or supported by VMware or its partners. Community-supported VIBs do not have a digital signature.

The ESXi Image Profile lets you set an acceptance level for the type of VIBs that are allowed on the host. The acceptance levels include the following.

- VMware Certified. VIBs that are VMware Certified are created, tested, and signed by VMware.
- VMware Accepted. VIBs that are created by a VMware partner, but tested and signed by VMware.
- Partner Supported. VIBs that are created, tested, and signed by a certified VMware partner.

- Community Supported. VIBs that have not been tested by VMware or a VMware partner.

For more information about Image Builder, see the *vSphere Installation and Setup* documentation.

Host Password Strength and Complexity

By default, ESXi uses the `pam_passwdqc.so` plug-in to set the rules that users must observe when creating passwords and to check password strength.

The `pam_passwdqc.so` plug-in lets you determine the basic standards that all passwords must meet. By default, ESXi imposes no restrictions on the root password. However, when nonroot users attempt to change their passwords, the passwords they choose must meet the basic standards that `pam_passwdqc.so` sets.

A valid password should contain a combination of as many character classes as possible. Character classes include lowercase letters, uppercase letters, numbers, and special characters such as an underscore or dash.

NOTE When the number of character classes is counted, the plug-in does not count uppercase letters used as the first character in the password and numbers used as the last character of a password.

To configure password complexity, you can change the default value of the following parameters.

- *retry* is the number of times a user is prompted for a new password if the password candidate is not sufficiently strong.
- *N0* is the number of characters required for a password that uses characters from only one character class. For example, the password contains only lowercase letters.
- *N1* is the number of characters required for a password that uses characters from two character classes.
- *N2* is used for passphrases. ESXi requires three words for a passphrase. Each word in the passphrase must be 8-40 characters long.
- *N3* is the number of characters required for a password that uses characters from three character classes.
- *N4* is the number of characters required for a password that uses characters from all four character classes.
- *match* is the number of characters allowed in a string that is reused from the old password. If the `pam_passwdqc.so` plug-in finds a reused string of this length or longer, it disqualifies the string from the strength test and uses only the remaining characters.

Setting any of these options to `-1` directs the `pam_passwdqc.so` plug-in to ignore the requirement.

Setting any of these options to `disabled` directs the `pam_passwdqc.so` plug-in to disqualify passwords with the associated characteristic. The values used must be in descending order except for `-1` and `disabled`.

NOTE The `pam_passwdqc.so` plug-in used in Linux provides more parameters than the parameters supported for ESXi.

For more information on the `pam_passwdqc.so` plug-in, see your Linux documentation.

Change Default Password Complexity for the pam_passwdqc.so Plug-In

Configure the `pam_passwdqc.so` plug-in to determine the basic standards all passwords must meet.

Procedure

1. Log in to the ESXi Shell as a user with administrator privileges.
2. Open the `passwd` file with a text editor.

   For example, `vi /etc/pam.d/passwd`

3 Edit the following line.

```
password requisite /lib/security/$ISA/pam_passwdqc.so retry=N min=N0,N1,N2,N3,N4
```

4 Save the file.

Example: Editing /etc/pam.d/passwd

```
password requisite /lib/security/$ISA/pam_passwdqc.so retry=3 min=12,9,8,7,6
```

With this setting in effect, the password requirements are:

- retry=3: A user is allowed 3 attempts to enter a sufficient password.
- *N0*=12: Passwords containing characters from one character class must be at least 12 characters long.
- *N1*=9: Passwords containing characters from two character classes must be at least nine characters long.
- *N2*=8: Passphrases must contain words that are each at least eight characters long.
- *N3*=7: Passwords containing characters from three character classes must be at least seven characters long.
- *N4*=6: Passwords containing characters from all four character classes must be at least six characters long.

Ensure that vpxuser Password Meets Policy

When you add a host to the vCenter Server inventory, vCenter Server creates a special user account called vpxuser on the host. vpxuser is a privileged account that acts as a proxy for all actions initiated through vCenter Server. Ensure that the default settings for the vpxuser password meet the requirements of your organization's password policy.

By default, vCenter Server generates a new vpxuser password every 30 days using OpenSSL crypto libraries as a source of randomness. The password is 32 characters long and is guaranteed to contain at least one symbol from four character classes: symbols (-./:=@[\ \]^_{}~), digits (1-9), uppercase letters, and lowercase letters. Ensuring that the password expires periodically limits the amount of time an attacker can use the vpxuser password if it is compromised.

You can change the default value for password expiration and for password length to meet your password policy.

IMPORTANT To preclude the possibility that vCenter Server is locked out of the ESXi host, the password aging policy must not be shorter than the interval that is set to automatically change the vpxuser password.

Procedure

1 To change the password length policy, edit the `vpxd.hostPasswordLength` parameter in the vCenter Server configuration file on the system where vCenter Server is running.

Operating System	Default Location
Windows	`C:\Documents and Settings\All Users\Application Data\VMware VirtualCenter\vpxd.cfg`
Linux	`/etc/vmware-vpx/vpxd.cfg`

2 To change the password aging requirement, use the Advanced Settings dialog box in the vSphere Web Client.

a Browse to the vCenter Server system in the vSphere Web Client inventory.

b Click the **Manage** tab and click **Settings**.

c Select **Advanced Settings** and locate the `VirtualCenter.VimPasswordExpirationInDays` parameter.

3 Restart vCenter Server.

Synchronizing Clocks on the vSphere Network

Before you install vCenter Single Sign On, install the vSphere Web Client, or deploy the vCenter Server appliance, make sure all machines on the vSphere network have their clocks synchronized.

If the clocks on vCenter Server network machines are not synchronized, SSL certificates, which are time-sensitive, might not be recognized as valid in communications between network machines. Unsynchronized clocks can result in authentication problems, which can cause the vSphere Web Client installation to fail or prevent the vCenter Server Appliance vpxd service from starting.

Synchronize ESX and ESXi Clocks with a Network Time Server

Before you install vCenter Single Sign On, the vSphere Web Client, or the vCenter Server appliance, make sure all machines on the vSphere network have their clocks synchronized.

Procedure

1 From the vSphere Web Client, connect to the vCenter Server.

2 Select the host in the inventory.

3 Select the **Manage** tab.

4 Select **Settings**.

5 Select **Time Configuration**.

6 Click **Edit**.

7 Select **Use Network Time Protocol (Enable NTP Client)**.

8 Set the NTP Service Status and NTP Service Startup Policy.

9 Enter the IP addresses of the NTP servers to synchronize with.

The host synchronizes with the NTP servers as specified in your settings.

Configure a Windows NTP Client for Network Clock Synchronization

The clocks of all servers on the vSphere network must be synchronized. You can configure a Windows NTP client as a source for clock synchronization on Windows servers.

Use the registry editor on the Windows server to make the configuration changes.

Procedure

1 Enable NTP mode.

a Go to the registry setting
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Parameters

b Set the Type value to `NTP`.

2 Enable the NTP client.

a Go to the registry setting
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Config

b Set the AnnounceFlags value to `5`.

3 Enter the upstream NTP servers to synchronize from.

   a Go to the registry setting HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders.

   b Set the NtpServer value to a list of at least three NTP servers.

   For example, you might set the value to 0x1 1.pool.ntp.org,0x1 2.pool.ntp.org,0x1 3.pool.ntp.org.

4 Specify a 150-minute update interval.

   a Go to the registry setting HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\TimeProviders\NtpClient,

   b Set the SpecialPollInterval value to **`900`**.

5 Restart the W32time service for the changes to take effect.

Disable Shell Access for Anonymous Users

To prevent anonymous users such as root from accessing the host with the Direct Console User Interface (DCUI) or ESXi Shell, remove the user's administrator privileges on the root folder of the host. This applies to both local users and Active Directory users and groups.

Procedure

1 Log in to ESXi using the vSphere Client.

2 Click the **Local Users & Groups** tab and click **Users**.

3 Right-click the anonymous user (for example, root) in the Users table and click **Properties**.

4 Select an access role from the drop-down list.

5 Click **OK**.

What to do next

By default, available roles are No access, Administrator, and Read-only. You can create new roles to apply to the user, as described in "Assigning ESXi Roles," on page 71.

Limit DCUI Access in Lockdown Mode

In versions of vSphere earlier than vSphere 5.1, the root user can log into the Direct Console User Interface (DCUI) on a host that is in lockdown mode. In vSphere 5.1, you can specify which local ESXi users are allowed to log into the DCUI when the host is in lockdown mode. Specifying users other than the anonymous root user allows you to log which users have performed operations on the host while it is in lockdown mode.

Procedure

1 Browse to the host in the vSphere Web Client object navigator.

2 Click the **Manage** tab and select **Settings**.

3 Click **Advanced System Settings**, and select the setting **DCUI.Access**.

4 Click **Edit** and enter the user names, separated by commas.

   By default, the root user is specified. You can remove root from the list of DCUI access users, as long as you specified at least one other user.

5 Click **OK**.

Disable the Managed Object Browser (MOB)

The managed object browser provides a way to explore the VMkernel object model. However, attackers can use this interface to perform malicious configuration changes or actions. The managed object browser lets you change the host configuration. This interface is used primarily for debugging the vSphere SDK.

Procedure

1 Connect directly to the host using the ESXi Shell.

2 (Optional) Determine if the managed object browser (MOB) is enabled by running the following command.

```
vim-cmd proxysvc/service_list
```

If the service is running, the following text appears in the list of services:

```
...
serverNamespace = '/mob',
accessMode = "httpsWithRedirect",
pipeName = "/var/run/vmware/proxy-mod",
...
```

3 Disable the service by running the following command.

```
vim-cmd proxysvc/remove_service "/mob" "httpsWithRedirect"
```

Changes are effective immediately and persist across reboots.

The managed object browser is no longer available for diagnostics. Some third-party tools use this interface to gather information.

What to do next

After you disable the managed object browser, perform tests to verify that third-party applications still function as expected.

To reenable the service, run the following command.

```
vim-cmd proxysvc/add_np_service "/mob" httpsWithRedirect /var/run/vmware/proxy-mob
```

Disable Authorized (SSH) Keys

Authorized keys allow you to enable access to an ESXi host through SSH without requiring user authentication. To increase host security, do not allow users to access a host using authorized keys.

A user is considered trusted if their public key is in the `/etc/ssh/keys-root/authorized_keys` file on a host. Trusted remote users are allowed to access the host without providing a password.

Procedure

- For day-to-day operations, disable SSH on ESXi hosts.
- If SSH is enabled, even temporarily, monitor the contents of the `/etc/ssh/keys-root/authorized_keys` file to ensure that no users are allowed to access the host without proper authentication.
- Monitor the `/etc/ssh/keys-root/authorized_keys` file to verify that it is empty and no SSH keys have been added to the file.
- If you find that the `/etc/ssh/keys-root/authorized_keys` file is not empty, remove any keys.

Disabling remote access with authorized keys might limit your ability to run commands remotely on a host without providing a valid login. For example, this can prevent you from running an unattended remote script.

Establish and Maintain Configuration File Integrity

Although most configurations on ESXi are controlled via an API, there are a limited set of configuration files that are used directly to govern host behavior. These specific files are exposed with the vSphere HTTPS-based file transfer API. Tampering with these files has the potential to enable unauthorized access to the host configuration and virtual machines.

Any changes to these files should be correlated with an approved administrative action, such as an authorized configuration change.

IMPORTANT Attempting to monitor files that are not exposed by the file-transfer API can destabilize the system.

View or retrieve configuration files using the managed object browser (MOB) or an API client such as vCLI or PowerCLI. These methods allow you to keep track of the files and their contents, which helps ensure that they are not improperly modified. Do not monitor log files and other files whose content is expected to change regularly. You should also account for configuration file changes that are due to deliberate administrative activity.

NOTE Not all of the files that are listed are modifiable.

Procedure

◆ Browse to https://<hostname>/host to view accessible configuration files.

  You cannot browse to this URL if the managed object browser (MOB) is disabled. In that case, view or retrieve files with an API client such as vCLI or PowerCLI.

Monitoring and Restricting Access to SSL Certificates

Attackers can use SSL certificates to impersonate vCenter Server and decrypt the vCenter Server database password. You must monitor and strictly control access to the certificate.

Only the service account user requires regular access to the directory that contains vCenter Server SSL certificates. Infrequently, the vCenter Server system administrator might need to access the directory as well. Because the SSL certificate can be used to impersonate vCenter Server and decrypt the database password, monitor the event log and set an alert to trigger when an account other than the service account accesses the directory.

To prevent a user other than the service account user from accessing the directory, change the permissions on the directory so that only the vCenter Server service account is allowed to access it. This restriction prevents you from collecting a complete support log when you issue a vc-support script. The restriction also prevents the administrator from changing the vCenter Server database password.

Delete VMDK Files Securely

To help prevent sensitive data in VMDK files from being read off the physical disk after it is deleted, write zeros to the entire contents of a VMDK file ("zero out") before you delete it, overwriting the sensitive data. When you zero out a file, it is more difficult for someone to reconstruct the contents.

Procedure

1 Shut down or stop the virtual machine.

2 On the VMDK file to delete, run the command `vmkfstools –writezeroes`

3 Delete the file from the datastore.

What to do next

For more information about initializing a virtual disk using vmkfstools, see the *vSphere Storage* documentation.

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