Virtual Machine Guide

VMware Server 1.0

vmware®

VMware Server Virtual Machine Guide
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CHAPTER 1 Introduction and System Requirements

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VMware Server Overview

VMware Server is a free virtualization product for Microsoft Windows and Linux servers. It enables users to quickly provision new server capacity by partitioning a physical server into multiple virtual machines. You can use VMware Server to provision a wide variety of plug-and-play virtual appliances for commonly used infrastructure.

VMware Server supports:

- Any standard x86 hardware.
- A wide variety of Linux, NetWare, Solaris, and Windows operating systems, including 64-bit operating systems. For information about specific hardware requirements, see **VMware Knowledge Base article 1901** or "Hardware Requirements for 64-bit Guest Operating Systems" on page 15.
- Two-way Virtual SMP (experimental support).
- Intel Virtualization Technology (experimental support).

With VMware Server, you can:

- Provision a new server without investing in more hardware by locating multiple virtual machines on the same host.

- Run Windows and Linux operating systems and applications without software conflicts because virtual machines are completely isolated from one another and from the physical host.
- Move virtual machines from one physical host to another without having to reconfigure.
- Shorten the time for provisioning a new server by creating and deploying custom virtual machines with the VMware Server Virtual Machine Wizard.
- Move virtual machines to different physical hosts as conditions change.

For more information, see "Features of VMware Server" on page 2.

Features of VMware Server

This section provides information about key features of VMware Server.

Support for 32-bit and 64-bit Guest Operating Systems

VMware Server provides full and experimental support for virtual machines running 32-bit and 64-bit guest operating systems. For more information, see "Supported Guest Operating Systems" on page 15. The host machine—the server on which you install VMware Server—must have one of the processors that VMware Server supports. You can use a remote console running on a 32-bit machine to connect to a 64-bit host machine running 64-bit guest operating systems. For more information, see "Hardware Requirements for 64-bit Guest Operating Systems" on page 15.

Two-Way Virtual SMP (Experimental Support)

Experimental support for two-way Virtual Symmetric Multiprocessing (Virtual SMP) lets you assign two virtual processors to a virtual machine on any host machine that has at least two logical processors. VMware Server does not support guests with more than two virtual processors. You can, however, power on and run multiple dual-processor virtual machines. For more information, see "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 244.

Connect to VMware GSX Virtual Machines and Hosts

You can connect to hosts running VMware GSX Server 3 from the VMware Server Console and run virtual machines in VMware Server created under VMware GSX Server 3 as legacy machines. For information, see "Connecting to VMware GSX Server and Older Virtual Machines" on page 86.

Upgrade and Use GSX Virtual Machines

You can upgrade the virtual hardware of virtual machines created under both VMware GSX Server 2 and 3. You must upgrade hardware of virtual machines created under GSX 2 to run them under VMware Server. For more information, see "Upgrading the Virtual Hardware on a Legacy Virtual Machine" in the VMware Server Administration Guide.

Move Existing Virtual Machines

You can move virtual machines from one VMware Server host to another and from a VMware GSX Server or VMware Workstation host to a host running VMware Server. For more information, see "Moving and Sharing Virtual Machines" in the VMware Server Administration Guide.

Compatible with VMware Workstation 5.x Virtual Machines

You can run virtual machines created using VMware Workstation 5.x. However, you cannot connect from a host running VMware Server to a host running VMware Workstation.

Configure Virtual Hardware Devices to be Automatically Detected

You can configure a number of virtual devices, including serial and parallel ports, DVD/CD-ROM drives, floppy drives, and sound drivers (Linux only) to be automatically detected. The benefit of auto-detect devices is that you can move them between virtual machines running different guest operating systems, such as Windows and Linux, without having to reconfigure the devices. For more information, see"Using Devices in a Virtual Machine" on page 102.

Take and Revert to Snapshots in the Background

You can configure any virtual machine to take and revert to snapshots in the background. When you take a snapshot, you preserve the state of the virtual machine, including the state of the data on all the virtual machine disks and whether the virtual machine was powered on, powered off, or suspended. For more information, see "Snapshot Actions as Background Activity" on page 116.

Support for VMware Virtual Machine Importer

VMware Server includes support for the VMware Virtual Machine Importer version 1.5, which lets you import virtual machines from Microsoft Virtual Server and Virtual PC as well as Symantec LiveState Recovery system images.

To access the VMware Virtual Machine Importer from the VMware Server Console, choose **File** > **Import** or **File** > **Open**. The Wizard to import a virtual machine or system image opens. You can access the VMware Virtual Machine Importer only from a Windows host machine.

For more detailed information about how to use the VMware Virtual Machine Importer, see the **VMware Virtual Machine Importer User's Manual**.

Support for VirtualCenter

VMware Server includes support for using VirtualCenter version 1.4 to manage virtual machines running on VMware Server.

APIs Included with VMware Server

VMware Server supports the VMware scripting APIs, which include the VmPerl API and the VmCOM API, and the Programming API. All of the APIs are installed on a Windows host when you perform a complete installation using the VMware Server Windows Installer. The Programming API and VmPerl API are installed when you install the VMware Server software. You can also install any of the APIs on a client machine.

Host System Requirements

You can install the VMware Server software on a Microsoft Windows or Linux server. You can store virtual machines on the server host or locate them on a network share.

Server Host Hardware

VMware Server supports up to 16-way multiprocessor servers. The number of virtual machines you can run concurrently depends on the resources they require, but VMware recommends you run no more than four virtual machines concurrently per processor. You can run a maximum of 64 virtual machines concurrently on one host.

The server host hardware includes:

- (Standard x86-based server with up to 16 processors hosts with 32-bit IA-32 processors, and IA-32 processors with 64-bit extensions supported
- 733MHz or faster compatible x86 processor that supports the Pentium instruction set

Compatible processors include:

  - Intel: Pentium II, Pentium III, Pentium 4, Pentium M Xeon, and EM64T.

    - AMD: Athlon, Athlon MP, Athlon XP, AMD Opteron, AMD Athlon 64, Turion 64.
    - Experimental support for AMD Sempron.
    - Multiprocessor systems are supported.
    - Dual-core processors are supported and counted as one processor for licensing.

Processor Requirements for 64-bit Guests

Your server must be running one of the following 64-bit processors to be able to configure a virtual machine running a 64-bit guest.

- AMD Athlon 64, revision D or later
- AMD Opteron, revision E or later
- AMD Turion 64, revision E or later
- AMD Sempron, 64-bit-capable revision D or later
- Intel EM64T VT-capable processors

Memory

You need enough memory to run the Microsoft Windows or Linux host operating system, plus memory required for each guest operating system and applications on the host and each guest. See your guest operating system and application documentation for their memory requirements.

Memory requirements include:

- Minimum: 512MB
- Maximum:
    - 64GB for Windows hosts and Linux hosts that support large memory or are PAE-enabled
    - 4GB for non-PAE-enabled Windows hosts or 2GB for Linux hosts with kernels in the 2.2.x series

Display

- 16-bit display adapter or higher

Host Hard Disk

- 250MB free disk space on Windows hosts required for VMware Server, VMware Management Interface, the VmPerl API, the VmCOM API, the Programming API, and VMware Server Console installation.
- 200MB free disk space on Linux hosts required for VMware Server, VMware Management Interface, VmPerl API, Programming API, and VMware Server Console installation.
  - Disk space in `/tmp` on Linux hosts should be equivalent to 1.5 times the amount of memory on the host. For information on the `/tmp` directory, read VMware knowledge base article 844 at **http://www.vmware.com/support/kb/enduser/std_adp.php?p_faqid=844**.
- Sufficient free disk space for each guest operating system and the application software used with it. Using a default setup, the actual disk space needs are approximately the same as those for installing and running the guest operating system and applications on a physical computer.
- IDE or SCSI hard drives and DVD/CD-ROM drives supported.
- Guest operating systems can reside in virtual disk files or on physical (raw) disk partitions.

Local Area Networking

- Any Ethernet controller that the host operating system supports.
- Non-Ethernet networks are supported using built-in network address translation (NAT) or using a combination of host-only networking plus routing software on the host operating system.
- Static IP address for your host machine (recommended).

Windows Host Operating System Requirements

You must use a Microsoft Windows server operating system. To use the VMware Management Interface, Internet Information Server (IIS) 5.0 or 6.0 must be installed.

NOTE Operating systems and service packs that are not listed are not supported for use as a host operating system for VMware Server.

64-bit host computers can run the following operating systems for 64-bit extended systems:

- Microsoft Windows Server 2003 Enterprise, Standard, and Web Editions, R2

- Microsoft Windows Server 2003 Enterprise, Standard, and Web Editions, Service Pack 1

32-bit host computers can run the following operating systems:

- Microsoft Windows Server 2003 Enterprise, Standard, Web, and Small Business Editions, including Service Pack 1
- Microsoft Windows 2000 Advanced Server, Service Pack 3 and Service Pack 4
- Microsoft Windows 2000 Server, Service Pack 3 and Service Pack 4

VmPerl API requires Perl 5.005x or higher.

VMware Management Interface requires one of these browsers:

- Internet Explorer 5.5 or 6.0 (6.0 highly recommended)
- Firefox 1.x
- Mozilla 1.x
- Netscape Navigator 7.0

NOTE VMware tests the VMware Management Interface for stability and reliability with new browser versions. VMware makes every effort to add support for new browser versions in a timely manner, but until a browser is added to the above list, its use with the product is not supported.

Linux Host Operating System Requirements

Supported distributions and kernels are listed in this section. VMware Server might not run on systems that do not meet these requirements. Platforms that are not listed are not supported.

64-bit host computers can run the following operating systems for 64-bit extended systems:

- Red Hat Enterprise Linux 3.0 AS, ES, and WS, stock 2.4.21, update 2.4.21-15, and updates 6 and 7
- Red Hat Enterprise Linux 3.0 AS, ES, and WS, update 8 (experimental support)
- Red Hat Enterprise Linux 4.0 AS, ES, and WS, including update 3
- Red Hat Enterprise Linux 4.0 update 4 (experimental support)
- SUSE Linux Enterprise Server 10 (experimental support)
- SUSE Linux Enterprise Server 9, including SP1, SP2, and SP3
- SUSE Linux 10

- SUSE Linux 10.1
- SUSE Linux 9.3
- SUSE Linux 9.2, including SP1
- SUSE Linux 9.1 stock 2.6.4-52
- Mandriva Linux 2006
- Ubuntu Linux 5.04 and 5.10
- Ubuntu Linux 6.06 (experimental support)

32-bit host computers can run the following operating systems:

- Mandriva Linux 2006
- Mandrake Linux 10.1
- Mandrake Linux 9.0 stock 2.4.19
- Red Hat Enterprise Linux 4.0 AS, ES, and WS, including updates 1,2, and 3
- Red Hat Enterprise Linux 4.0 update 4 (experimental support)
- Red Hat Enterprise Linux 3.0, updates 1, 2, 3, 4, 5, 6, and 7
- Red Hat Enterprise Linux 3.0 update 8 (experimental support)
- Red Hat Enterprise Linux 2.1stock 2.4.9-e3
- Red Hat Linux 9.0, stock 2.4.20-8 and upgrade 2.4.20-20.9
- Red Hat Linux 8.0 stock 2.4.18
- Red Hat Linux 7.3 stock 2.4.18
- Red Hat Linux 7.2, stock 2.4.7-10 and upgrades 2.4.9-7, 2.4.9-13, 2.4.9-21, and 2.4.9-31
- SUSE Linux Enterprise Server 10 (experimental support)
- SUSE LINUX Enterprise Server 9, including SP1, SP2, and SP3
- SUSE Linux Enterprise Server 8 stock 2.4.19
- SUSE LINUX 9.3
- SUSE LINUX 9.2
- SUSE Linux 10
- SUSE Linux 10.1

- SUSE LINUX 9.1 stock 2.6.4-52
- SUSE LINUX 9.0 stock 2.4.21-99
- SUSE Linux 8.2 stock 2.4.20
- SUSE Linux 7.3
- Ubuntu Linux 5.04 and 5.10
- Ubuntu 6.06

NOTE As new Linux kernels and distributions are released, VMware modifies and tests its products for stability and reliability on those host platforms. VMware makes every effort to add support for new kernels and distributions in a timely manner, but until a kernel or distribution is added to the list, its use is not supported. Look for newer prebuilt modules in the Download section of VMware Web site. Go to **http://www.vmware.com/download**.

Other Linux host operating system requirements include:

- Linux kernel 2.2.14-5.0 is not supported.
- Standard Linux server installation is required with `glibc` version 2.1 or higher and `libXpm.so.`
- The `inetd` process must be configured and active for VMware Server Console and VMware Management Interface connections.
- Version 2.1.36 of the SCSI Generic (`sg.o`) driver is required to use generic SCSI devices in virtual machines.
- Perl 5.005x or higher is required to use VmPerl API.
- X server is required to run the VMware Server Console.

The VMware Management Interface requires one of these browsers:

- Firefox 1.x
- Mozilla 1.x
- Netscape Navigator 7.0

NOTE As new browser versions are released, VMware tests the VMware Management Interface for stability and reliability with these versions. VMware makes every effort to add support for new browser versions in a timely manner, but until a browser is added to the above list, its use with the product is not supported.

Running VMware Server on Some SUSE Linux Hosts

Keep in mind the following when you run VMware Server on these SUSE Linux hosts.

- **SLES 8** — Install `gcc` on your SLES 8 host before installing VMware Server.
- **SLES 7** —To upgrade the kernel, deselect any Samba components when you apply the update patch because the patch incorrectly updates Samba on your host. Running the update with the Samba packages selected can result in serious issues on your host such as system hangs or segmentation faults.

VmPerl and VmCOM APIs

The VmPerl API includes the `vmware-cmd` utility. The VmCOM API works only on Windows Server 2003, Windows XP, Windows 2000, and Windows NT clients. For more information, go to the VMware Web site at **http://www.vmware.com/support/developer**.

Programming API

VMware Server includes support for the Programming API (previously called C API). For more information, go to the VMware Web Site at **http://www.vmware.com/support/pubs/server_pubs**

Remote Client Requirements

The remote client is a Microsoft Windows or Linux system from which you launch the VMware Server Console or use VMware Scripting APIs to remotely manage virtual machines on the VMware Server host. You access the VMware Management Interface to manage virtual machines on the host using a Web browser.

Hardware Requirements

- Standard x86-based computer.
- 266MHz or faster processor.
- 64MB RAM minimum.
- 30MB (for Windows hosts) or 60MB (for Linux hosts) of free disk space is required for installation of the VMware Server Console.
- 17MB free disk space is required for VMware Scripting APIs (VmCOM and VmPerl APIs) installation on Windows remote clients. 14MB is required for VmPerl API on Linux remote clients.

Software Requirements – Windows Remote Client

- Windows Server 2003 x64 Edition, Windows Server 2003 Standard Edition, Windows Server 2003 Enterprise Edition, and Windows Server 2003 Web Edition
- Windows XP Professional and Windows XP Home Edition
  Service Pack 1 and Service Pack 2
- Windows 2000 Professional, Server and Advanced Server, Service Pack 1, Service Pack 2, Service Pack 3 and Service Pack 4
- Windows NT 4.0 Workstation and Server, Service Pack 6a, with Internet Explorer 6.0 installed
- The VMware Management Interface requires one of these browsers:
  - Internet Explorer 5.5 or 6.0 (6.0 highly recommended)
  - Firefox 1.x
  - Mozilla 1.x
  - Netscape Navigator 7.0

NOTE As new browser versions are released, VMware tests the VMware Management Interface for stability and reliability with these versions. VMware makes every effort to add support for new browser versions in a timely manner, but until a browser is added to the above list, its use with the product is not supported.

Software Requirements – Linux Remote Client

- Standard Linux installation is required with `glibc` version 2.1 or higher and one of the following kernels:
  - For single-processor systems: kernel 2.0.32 or higher in the 2.0.x series, or kernel in the 2.2.x, 2.4.x or 2.6.x series.
  - For SMP systems: kernel in the 2.2.x, 2.4.x or 2.6.x series

NOTE Linux kernel 2.2.14-5.0 is not supported.

- Perl 5.005x or higher is required to use VmPerl API.
- X server is required to run the VMware Server Console on the client.
- The VMware Management Interface requires one of these browsers:
  - Firefox 1.x
  - Mozilla 1.x

- Netscape Navigator 7.0

NOTE As new browser versions are released, VMware tests the VMware Management Interface for stability and reliability with these versions. VMware makes every effort to add support for new browser versions in a timely manner, but until a browser is added to the above list, its use with the product is not supported.

VmPerl and VmCOM APIs

The VmPerl API includes the `vmware-cmd` utility. The VmCOM API works on Windows Server 2003, Windows XP, Windows 2000, and Windows NT clients only. For more information, go to the VMware Web site at **http://www.vmware.com/support/developer**.

Programming API

VMware Server includes support for the Programming API. For more information, go to the **VMware Web site at http://www.vmware.com/support/pubs/server_pubs**.

Virtual Machine Specifications

Each virtual machine created with VMware Server provides a platform that includes the following devices that your guest operating system can see.

Virtual Processor

- Intel Pentium II or later, or AMD Athlon or later, depending on host processor; Intel EMT64VT (experimental support).
- Single and multiprocessor per virtual machine on symmetric multiprocessor (SMP) systems.

Virtual Chipset

- Intel 440BX-based motherboard with NS338 SIO chip and 82093AA IOAPIC

Virtual BIOS

- PhoenixBIOS 4.0 Release 6 with VESA BIOS
- DMI/SMBIOS-compliant for system management agent support

Virtual Memory

- Up to 3600MB of memory per virtual machine, depending upon the host system's configuration, the types of applications running on the host, and the amount of memory on the host.

Virtual Graphics

- VGA and SVGA support

Virtual IDE Drives

- Up to four devices: disks, CD-ROM or DVD (DVD drives can be used to read data DVD discs). DVD video is not supported.
- Hard disks can be virtual disks or physical disks.
- IDE virtual disks up to 950GB.
- CD-ROM can be a physical device or an ISO image file.

Virtual SCSI Devices

- Up to 60 devices on up to four virtual SCSI controllers.
- SCSI virtual disks up to 950GB.
- Hard disks can be virtual disks or physical disks.
- Generic SCSI support allows scanners, CD-ROM, DVD-ROM, tape drives, and other SCSI devices to be used without requiring drivers in the host operating system.
- Mylex (BusLogic) BT-958 compatible host bus adapter.
- LSI Logic Ultra160 LSI53C10xx SCSI controller.

Virtual PCI Slots

- Six virtual PCI slots, to be divided among the virtual SCSI controllers, virtual Ethernet cards, virtual display adapter, and virtual sound adapter.

Virtual Floppy Drives

- Up to two 1.44MB floppy devices.
- Physical drives or floppy image files.

Virtual Serial (COM) Ports

- Up to four serial (COM) ports.

- Output to serial ports, Windows files, Linux files, or named pipes.

Virtual Parallel (LPT) Ports

- Up to three bidirectional parallel (LPT) ports.
- Output to parallel ports or host operating system files.

Virtual USB ports

- Two-port USB 1.1 UHCI controller.
- Supported devices include USB printers, scanners, PDAs, hard disk drives, memory card readers, and still digital cameras.

Virtual Keyboard

- 104-key Windows 95/98 enhanced

Virtual Mouse and Drawing Tablets

- PS/2 mouse
- Serial tablet support

Virtual Ethernet Card

- Up to four virtual Ethernet cards
- AMD PCnet-PCI II compatible
- Wireless networking support with bridged and NAT networking
- PXE ROM version 2.0

Virtual Networking

- Nine virtual Ethernet switches (three configured by default for bridged, host-only and NAT networking).
- Virtual networking supports most Ethernet-based protocols, including TCP/IP, NetBEUI, Microsoft Networking, Samba, Novell NetWare, and Network File System.
- Built-in NAT supports client software using TCP/IP, FTP, DNS, HTTP, and Telnet.

Virtual Sound Adapter

- Sound output and input.

- Creative Labs Sound Blaster AudioPCI emulation. MIDI input, game controllers, and joysticks are not supported.

Supported Guest Operating Systems

The operating systems listed here have been tested in VMware Server virtual machines and are officially supported. For notes on installing guest operating systems, see the *VMware Guest Operating System Installation Guide* which is available from the VMware Web site.

VMware Server supports all guest operating systems supported by VMware Workstation 5.5. Operating systems that are not listed are not supported for use in a VMware Server virtual machine.

Hardware Requirements for 64-bit Guest Operating Systems

VMware Server supports virtual machines with 64-bit guest operating systems only on host machines that have one of the following 64-bit processors.

- AMD Athlon 64, revision D or later
- AMD Opteron, revision E or later
- AMD Turion 64, revision E or later
- AMD Sempron, 64-bit-capable revision D or later (experimental support)
- Intel EM64T VT-capable processors (experimental support)

VMware Server performs an internal check. If the host CPU is not a supported 64-bit processor, VMware Server displays an error message that indicates the hardware on your host machine is incompatible with 64-bit guest operating systems. You can, however, continue to power on the virtual machine.

VMware Server provides a standalone utility that performs the same check and determines whether your CPU is supported for VMware Server virtual machines with 64-bit guest operating systems. You can download the 64-bit processor check utility from the VMware Web site at **http://www.vmware.com/download**.

Microsoft Windows 64-bit Guest Operating Systems

- Microsoft Windows Vista (experimental support)
- Microsoft Windows Server 2003 Enterprise, Standard, and Web Editions, R2
- Microsoft Windows Server Enterprise 2003 Enterprise, Standard, and Web Editions, SP1
- Microsoft Windows XP Professional

Linux 64-bit Guest Operating Systems

- Mandriva Linux 2006
- Red Hat Enterprise Linux 3.0, including stock 2.4.21, update 2.4.21-15, and updates 6, and 7
- Red Hat Enterprise Linux 3.0, update 8 (experimental support)
- Red Hat Enterprise Linux 4.0, including update 3
- Red Hat Enterprise Linux 4.0, update 4 (experimenetal support)
- SUSE Linux 9.1 stock 2.6.4-52
- SUSE Linux 9.2, including SP1
- SUSE Linux 9.3
- SUSE Linux 10
- SUSE Linux 10.1
- SUSE Linux Enterprise Server 9, including SP1, SP2, and SP3
- SUSE Linux Enterprise Server 10 (experimental support)

FreeBSD

- FreeBSD 5.3 and 5.4
- FreeBSD 6.0

Sun Solaris

- Solaris 10, including update 1 and update 2 (experimental support)

Ubuntu

- Ubuntu Linux 5.04 and 5.10
- Ubuntu Linux 6.06 (experimental support)

Hardware Requirements for 32-bit Guest Operating Systems

VMware Server supports virtual machines with the following 32-bit guest operating systems.

Microsoft Windows 32-bit Guest Operating Systems

- Microsoft Windows Server 2003, including Small Business, Standard, and Web Editions

- Microsoft Windows Server 2003 Enterprise Edition, including R2
- Microsoft Windows XP Professional and Home Editions, including SP1 and SP2
- Microsoft Windows Vista (experimental support)
- Microsoft Windows 2000 Professional, including SP1, SP2, SP3, and SP4
- Microsoft Windows 2000 Server, including SP1, SP2, SP3, and SP4
- Microsoft Windows 2000 Advanced Server, SP3 and SP4 only
- Microsoft Windows NT 4.0 Server Service Pack 6a, Windows NT Workstation 4.0, including Service Pack 6a, and Windows NT 4.0 Terminal Server Edition Service Pack 6a
- Microsoft Windows Me
- Microsoft Windows 98, including all service packs
- Microsoft Windows 98 SE
- Microsoft Windows 95, including SP 1 and all OSR releases
- Microsoft Windows for Workgroups 3.11
- Microsoft Windows 3.1

Microsoft MS-DOS

- MS-DOS 6.x

Linux 32-bit Guest Operating Systems

- Mandriva Linux 2006
- Mandrake Linux 10.1
- Mandrake Linux 9.2
- Mandrake Linux 9 stock 2.4.19
- Mandrake Linux 3.2 stock 2.4.18-6mdk
- Red Hat Enterprise Linux 3.0 AS, ES, and WS, including updates 1, 2, 3, 4, 5, 6, and 7)
- Red Hat Enterprise Linux 3.0 update 8 (experimental support)
- Red Hat Enterprise Linux 4.0 AS, ES, and WS, including updates 1, 2, and 3
- Red Hat Enterprise Linux 4.0 update 4 (experimental support)
- Red Hat Enterprise Linux 2.1 AS, ES, and WS, including stock 2.4.9-e3

- Red Hat Linux 9.0, stock 2.4.20-8 and upgrade 2.4.20-20.9
- Red Hat Linux 8.0 stock 2.4.18
- Red Hat Linux 7.3 stock 2.4.18
- Red Hat Linux 7.2, stock 2.4.7-10 and upgrades 2.4.9-7, 2.4.9-13, 2.4.9-21, and 2.4.9-31
- Red Hat Linux 7.1 stock 2.4.2-2 and upgrade 2.2.3-12
- Red Hat Linux 7.0 stock 2.2.16-22 and upgrade 2.2.17-14
- SUSE Linux Enterprise Server 10 (experimental support)
- SUSE Linux Enterprise Server 9, including SP1, SP2, and SP3
- SUSE Linux Enterprise Server 8 stock 2.4.19
- SUSE Linux Enterprise Server 7 stock 2.4.7 and patch 2
- SUSE Linux 10
- SUSE Linux 10.1
- SUSE Linux 9.0 stock 2.4.21-99
- SUSE Linux 9.1 stock 2.6.4-52
- SUSE Linux 9.2, including SP1
- SUSE Linux 9.3
- SUSE Linux 8.2 stock 2.4.20
- SUSE Linux 8.1 stock 2.4.19
- SUSE Linux 8.0 stock 2.4.18
- SUSE Linux 7.3 stock 2.4.10
- Novell Linux Desktop 9, including SP2
- Novell Open Enterprise Server, including SP1
- Turbolinux Enterprise Server 8.0
- Turbolinux Server 7.0
- Turbolinux Workstation 8.0
- Turbolinux Desktop 10

Novell NetWare

- NetWare 4.2
- NetWare 5.1, SP8 only
- NetWare 6, SP 5 only
- Netware 6.5, SP3 only

FreeBSD

- FreeBSD 4.0–4.6.2
- FreeBSD 4.8
- FreeBSD 5
- Free BSD 5.1-5.3
- Free BSD 5.4
- FreeBSD 6.0

Sun Solaris

- Solaris 9 (experimental support)
- Solaris 10, including update 1 and update 2

Ubuntu

- Ubuntu Linux 5.04 and 5.10
- Ubuntu Linux 6.06

Technical Support Resources

The following sections describe various technical support resources available to you.

- "Self-Service Support"
- "Online and Telephone Support"
- "Support Offerings"
- "Reporting Problems"
- "Log Files"

Self-Service Support

Use the VMware Technology Network for self help tools and technical information:

- Product Information — **http://www.vmware.com/products/product_index.html**
- Technology Information — **http://www.vmware.com/vcommunity/technology**
- Documentation — **http://www.vmware.com/support/pubs**
- Knowledge Base — **http://www.vmware.com/support/kb**
- Discussion Forums — **http://www.vmware.com/community**
- User Groups — **http://www.vmware.com/vcommunity/usergroups.html**

For more information about the VMware Technology Network, go to **http://www.vmtn.net**.

Online and Telephone Support

Use online support to submit technical support requests, view your product and contract information, and register your products. Go to **http://www.vmware.com/support**.

Use phone support for the fastest response on priority 1 issues for customers with appropriate support contracts. Go to **http://www.vmware.com/support/phone_support.html**.

Support Offerings

Find out how VMware's support offerings can help you meet your business needs. Go to **http://www.vmware.com/support/services**.

Reporting Problems

If you have problems while running VMware Server, report them to the VMware support team. You must register your serial number and then you can report your problems by submitting a support request at **http://www.vmware.com/requestsupport**.

This section describes the information needed to diagnose and report problems. This information largely comes from log files. The required log files depend upon the problem you encounter.

You can simplify the process of collecting the needed information by running the support script to collect the appropriate log files and system information. Follow the steps that apply to your host computer.

NOTE The support script runs only on the VMware Server host. If you encounter problems on a remote client, you must supply the log files manually. The required log files depend on the problem encountered on the client. You should include the VMware Server Console log file and the installation log files.

To run the support script on a Windows host

1 Open a command prompt.

2 Change to the VMware Server program directory.

```
C:
cd \Program Files\VMware\VMware Server
```

If you did not install the program in the default directory, use the appropriate drive letter and substitute the appropriate path in the `cd` command above.

3 Run the support script.

```
cscript vm-support.vbs
```

After the script runs, it displays the name of the directory where it has stored its output.

4 Use a file compression utility such as WinZip or PKZIP to zip that directory, and include the zip file with your support request.

To run the support script on a Linux host

1 Open a terminal.

2 Run the support script as the user who is running the virtual machine or as root.

```
vm-support
```

If you do not run the script as root, the script displays messages indicating that it cannot collect some information. This is normal. If the VMware support team needs that information, a support representative may ask you to run the script again as root.

The script creates a compressed `.tgz` file in the current directory.

3 Include the output file with your support request.

Log Files

The following log files are generated by VMware Server and are collected by the support script as needed. Because the VMware Server Console does not include a support script, you need to submit a support request at

http://www.vmware.com/requestsupport for any issues you encounter on a client and include the VMware Server Console's log file or its installation log files.

Virtual Machine Log File

If a virtual machine exits abnormally or crashes, run the support script or save the log file before you launch that virtual machine again.

On a Windows host, the `vmware.log` file is in the same directory as the configuration file (`.vmx`) of the virtual machine. The path to the log file of the active virtual machine is located under **Virtual Machine** > **Settings** > **Options** > **Advanced**.

On a Linux host, the `<vmname>.log` file is in the same directory as the configuration file (`.vmx`) of the virtual machine.

Also save any core files (`core` or `vmware-core`).

Virtual Machine Event Log File

The virtual machine's event log, some of which can be viewed in the VMware Management Interface, is stored as a file on the host. This file can also be useful in the event a virtual machine crashes.

Each virtual machine on the host includes an event log file called `event-<path_to_configuration_file>.vmx.log`.

On a Windows host, the log is stored in `C:\Program Files\VMware\VMware Server\vmserverdRoot\eventlog`.

On a Linux host, the log is stored in `/var/log/vmware`.

VMware Server Console Log File

The VMware Server Console keeps a log. If you encounter problems with the VMware Server Console on a remote client, submit a support request and this log file.

On a Windows host, the log is called `vmware-<username>-<PID>.log` and is stored in the user's TEMP directory; by default, this directory is `C:\Documents and Settings\<username>\Local Settings\Temp`. The path to this file appears in the About dialog box. In the VMware Server Console, choose **Help** > **About VMware Server**, and look under **Additional information**.

On a Linux host, the log is called `ui-<PID>.log` and is stored in the user's TEMP directory; by default, this directory is `/tmp/vmware-<username>`. The path to this file appears in the terminal when you start the VMware Server Console.

VMware Management Interface Log File

The VMware Management Interface keeps a log.

On a Windows host, the log is called `mui.log` and is stored by default in `C:\Program Files\VMware\VMware Management Interface`.

On a Linux host, the log is called `error_log` and is stored by default in `/var/log/vmware-mui`.

VMware Authorization Service Log File

You can manually enable logging for the VMware Authorization Service, known as `vmware-authd` on Linux hosts.

To enable logging for VMware Authorization Service

1. In a text editor, open the following file:

   - On a Windows host – `edit config.ini` located in `C:\Documents and Settings\All Users\Application Data\VMware\VMware Server`

   - On a Linux host – edit `/etc/vmware/config`

2. Add the following lines to the file:

   ```
   vmauthd.logEnabled = TRUE
   log.vmauthdFileName = "vmauthd.log"
   ```

   A file is created called `vmauthd.log`. On a Windows host, this file appears by default in `C:\Windows\system32` or `C:\WINNT\system32`; on a Linux host, this file appears by default in `/var/log/vmware`.

3. Save and close the configuration file.

   The log is enabled on a Linux host.

4. On a Windows host, choose **Start** > **Administrative Tools** > **Services**.

5. Right-click **VMware Authorization Service** and choose **Restart**.

   The log is enabled on a Windows host.

VMware Registration Service Log File

The VMware Registration Service keeps a log.

On a Windows host, the log is called `vmware-serverd.log` and is stored in `C:\Windows\Temp`.

On a Linux host, the log is called `vmware-serverd.log` and is stored in `/var/log/vmware`.

VMware Server and VMware Server Console Installation Log Files

VMware Server keeps installation log files on the server host.

On a remote client, the VMware Server Console keeps two installation log files. If you encounter problems installing the VMware Server Console, submit a support request including the names of these log files.

On a Windows host, the files are `vminst.log and vmmsi.log which are` saved in your TEMP directory; the default location is `C:\Documents and Settings\<username>\Local Settings\Temp`. The `Local Settings` folder is hidden by default. To see its contents, open **My Computer**, choose **Tools** > **Folder Options**, click the **View** tab and select **Show Hidden Files and Folders**.

On a Linux host, the log is called `locations` and is stored in `/etc/vmware`.

CHAPTER 2 Creating a New Virtual Machine

This chapter describes how to create a new virtual machine and covers the following topics:

- "Setting Up a New Virtual Machine" on page 25
- "Installing a Guest Operating System" on page 37

Setting Up a New Virtual Machine

The New Virtual Machine Wizard guides you through the key steps for setting up a new virtual machine, helping you set various options and parameters. You can then use the virtual machine settings editor (**VM** > **Settings**) to make any changes to your virtual machine's setup.

- To create a new virtual machine from a console, see "Creating a New Virtual Machine with the Virtual Machine Wizard" on page 27.

NOTE You must use the VMware Server Console to create a virtual machine.

What's in a Virtual Machine?

The virtual machine typically is stored on the host computer in a set of files, all of which are in a directory set aside for that particular virtual machine. In these examples, `<vmname>` is the name of your virtual machine. The key files are:

- `<vmname>.vmx` — The configuration file, which stores settings chosen in the New Virtual Machine Wizard or virtual machine settings editor.
- `nvram` — The file that stores the state of the virtual machine's BIOS.
- `<vmname>.vmdk` — The virtual disk file, which stores the contents of the virtual machine's hard disk drive.
- `<vmname>.log` or `vmware.log` — The file that keeps a log of key virtual machine activity. This file can be useful in troubleshooting if you encounter problems. This file is stored in the directory that holds the configuration file (`.vmx`) of the virtual machine.

- `<vmname>.vmdk.REDO_xxxxxx` — A redo-log file created automatically when a virtual machine is in independent-nonpersistent mode. This file stores changes made to a virtual disk while the virtual machine is running. More than one such file might exist. The xxxxxx indicates a unique suffix added automatically by VMware Server to avoid duplicate filenames.
- `<vmname>.vmss` — The suspended state file, which stores the state of a suspended virtual machine.

  NOTE Some earlier VMware products used the extension `.std` for suspended state files.

- `<vmname>.vmsn` — The snapshot state file, which stores the running state of a virtual machine at the time you take a snapshot of it.

There might also be other files, some of which are present only while a virtual machine is running.

Virtual Disks

A virtual disk is made up of one or more `.vmdk` files. If you specify to split the virtual disk into 2GB files, the number of `.vmdk` files depends on the size of the virtual disk.

By default, all virtual disk space is preallocated when you create the virtual disk. Make sure you have enough disk space on the host before you create a preallocated disk.

If you do not allocate all disk space when you create the virtual disk, the `.vmdk` files grow in size as data is added to the virtual disk. Almost all of a `.vmdk` file's content is the virtual machine's data, with a small portion allotted to virtual machine overhead.

If the virtual machine is connected directly to a physical disk, rather than to a virtual disk, the `.vmdk` file stores information about the partitions the virtual machine is allowed to access.

NOTE Earlier VMware products used the extension `.dsk` for virtual disk files.

Permissions and Running Virtual Machines

When you create a virtual machine, by default the virtual machine is private, which means you are the only user who can access it. If you choose the custom path when creating the virtual machine, you can specify that all users can access the virtual machine.

When a virtual machine is private, it appears only in the inventory of the console of the user who created it. The virtual machine does not appear in the inventory of consoles for other users connected to the host. The virtual machine appears in the VMware Management Interface only when you are logged on as the user who created the virtual machine.

When the virtual machine is running, the actions you can take depend on your permissions. For more information about permissions, see "Understanding Permissions and Virtual Machines".

Creating a New Virtual Machine with the Virtual Machine Wizard

When you create a new virtual machine, the result is a set of files that represent a new computer, complete with a blank, unformatted hard disk—the virtual disk—onto which you install the guest operating system. The virtual disk by default has all its disk space preallocated at the time it is created.

The virtual machines you create are located on the host to which you are currently logged on, even if the console you are using is running on a remote client.

NOTE Before you create the virtual machine, check the installation notes for the guest operating system you intend to install. You can find this information in the *VMware Guest Operating System Installation Guide* available from the VMware Web site at **www.vmware.com/support/guestnotes/doc/index.html**.

To create a new virtual machine

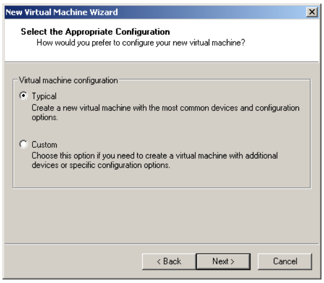
1 Launch the VMware Server Console.

Windows hosts: See "Connecting to a Virtual Machine from a Windows Host or Client" on page 82.

Linux hosts: See "Connecting to a Virtual Machine from a Linux Host or Client" on page 84.

2 Start the New Virtual Machine Wizard. Choose **File** > **New > Virtual Machine** or click the New Virtual Machine icon on the console **Home** tab.

3 Select the method to use for configuring your virtual machine.



Select the Appropriate Configuration
How would you prefer to configure your new virtual machine?

Virtual machine configuration

● Typical
Create a new virtual machine with the most common devices and configuration options.

○ Custom
Choose this option if you need to create a virtual machine with additional devices or specific configuration options.

If you select **Typical**, you can specify or accept defaults only for:

- The guest operating system.
- The virtual machine name and the location of the virtual machine's files.
- The network connection type.
- The size of the virtual disk.
- Allocating all the disk space for the virtual disk at the time you create it.
- Splitting the virtual disk into 2GB files.

Select **Custom** to:

- Set the number of processors, which is required to enable two-way Virtual SMP (experimental support).
- Allocate an amount of memory different from the default.
- Choose between the LSI Logic and BusLogic types of SCSI adapters. (An ATAPI IDE adapter is always installed.)
- Let other users access this virtual machine.
- Have the virtual machine automatically power on or off when the VMware Server Windows host starts up or shuts down.
- Specify the user account the virtual machine uses when running.
- Use an existing virtual disk or use a physical disk rather than a virtual disk (for advanced users).
- Use an IDE virtual disk for a guest operating system that would otherwise have a SCSI virtual disk created by default and vice versa.

- Create a virtual disk as a single disk file. If the virtual disk is larger than 8GB, the host file system must support files larger than 8GB.
- Store your virtual disk files in a particular location.
- Specify a particular virtual device node for the virtual disk.
- Use independent disk mode (if you don't plan to use snapshots with this virtual machine; see "Independent Disks" on page 121).

NOTE If you follow the custom path, you still specify the options under the typical path.

4 Under **Guest operating system**, select the operating system family. Select the specific operating system from the **Version** list.

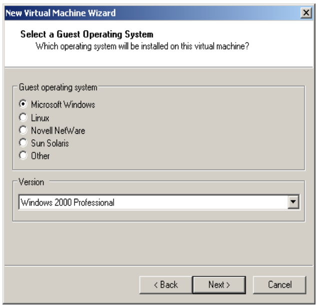
NOTE VMware Server supports 64-bit guests. The Wizard includes options for installing 64-bit versions of certain operating systems.

VMware Server performs an internal check. If the host CPU is not a supported 64-bit processor, VMware Server displays an error message that indicates the hardware on your host machine is incompatible with 64-bit guest operating systems. You can, however, continue to power on the virtual machine.

VMware Server provides a standalone utility to use without VMware Server that performs the same check and determines whether your CPU is supported for VMware Server virtual machines with 64-bit guest operating systems. You can download the 64-bit processor check utility from the VMware Web site at **www.vmware.com/download**.

In this example, the remaining steps assume you plan to install a Windows Server 2003 Enterprise guest operating system. You can find detailed installation notes for this and other guest operating systems in the *VMware Guest Operating System Installation Guide*, available from the VMware Web site at **www.vmware.com/support/guestnotes/doc/index.html**.

If the operating system you are using is not listed, select **Other as both the guest operating system and version**.



New Virtual Machine Wizard

Select a Guest Operating System

Which operating system will be installed on this virtual machine?

Guest operating system

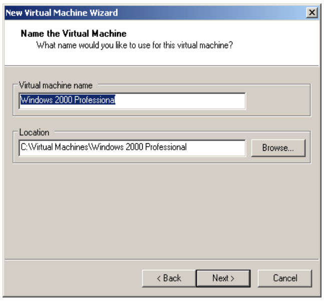
● Microsoft Windows
○ Linux
○ Novell NetWare
○ Sun Solaris
○ Other

Version: Windows 2000 Professional

The New Virtual Machine Wizard uses this information to select appropriate default values, such as the amount of memory needed. The Wizard also uses this information when naming associated virtual machine files.

NOTE VMware Server supports 64-bit guests. The Wizard includes options for installing 64-bit versions of certain operating systems.

5 Select a name and directory for the virtual machine.



New Virtual Machine Wizard

Name the Virtual Machine

What name would you like to use for this virtual machine?

Virtual machine name: Windows 2000 Professional

Location: C:\Virtual Machines\Windows 2000 Professional

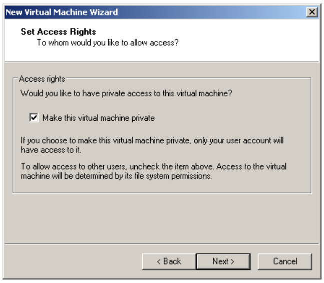
Windows hosts: The virtual machine directory and its files are stored in the default location `<installdrive>:\Virtual Machines`.

Linux hosts: The virtual machine directory and its files are stored in the default location `/var/lib/vmware/Virtual Machines`.

If you selected **Typical** as your configuration path, go to step 10.

If you selected **Custom** as your configuration path, continue with the steps for customizing your virtual machine configuration.

6 Specify whether this virtual machine should be private.



Set Access Rights
To whom would you like to allow access?

Access rights
Would you like to have private access to this virtual machine?

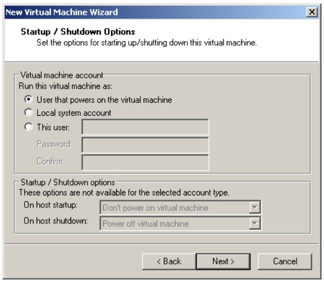
☑ Make this virtual machine private

If you choose to make this virtual machine private, only your user account will have access to it.

To allow access to other users, uncheck the item above. Access to the virtual machine will be determined by its file system permissions.

By default, a virtual machine is private, so only you have access to it.

7 Choose the user account for running the virtual machine (for virtual machines on Windows hosts only) and the host startup and shutdown options.



Startup / Shutdown Options
Set the options for starting up/shutting down this virtual machine.

Virtual machine account
Run this virtual machine as:
● User that powers on the virtual machine
○ Local system account
○ This user:
Password:
Confirm:

Startup / Shutdown options
These options are not available for the selected account type.
On host startup: Don't power on virtual machine
On host shutdown: Power off virtual machine

Windows hosts: Under **Virtual machine account**, choose which user account the virtual machine uses when it runs. This account is used for actions like network access from within the virtual machine and access to virtual machine resources that are on the network.

- **User that powers on the virtual machine** — The virtual machine runs as the account of the user who powered on the virtual machine until the virtual machine is powered off. Other users can connect to the virtual machine but it still runs as the user who powered on the virtual machine.
- **Local system account** —The virtual machine runs as the local system account (administrator). You can enable this option only if you are logged on to the host operating system as an administrator.

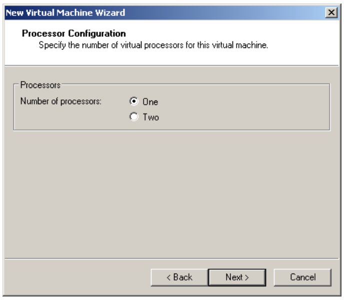
  NOTE This user can run virtual machines that are in local storage only.

- **This user** — The virtual machine runs as the user account specified here. The password is not validated until you power on the virtual machine. You can specify a local user account, a local system administrator account or a fully-qualified domain user account for this user.

All hosts: Under **Startup/Shutdown Options**, choose whether this virtual machine powers on automatically when the VMware Server host starts up and powers off when the host shuts down.

To enable the startup and shutdown options, you must configure the virtual machine to run as an administrator user. You can change these options whether the virtual machine is powered on or off.

8 Specify the number of processors for the virtual machine.



New Virtual Machine Wizard

Processor Configuration

Specify the number of virtual processors for this virtual machine.

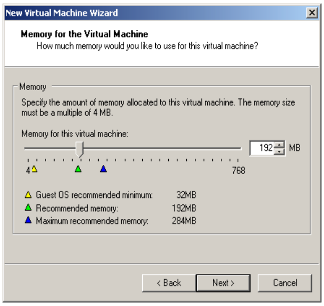
Processors

Number of processors: ● One ○ Two

The following are considered to have two logical processors:

- A single-processor host with hyperthreading enabled.
- A single-processor host with a dual-core CPU
- A multiprocessor host with two CPUs, neither of which are dual-core or have hyperthreading enabled.

9 Use the default or change the amount of memory allocated to the virtual machine. To change the amount of memory, move the slider to the appropriate location, use the spin controller next to the field, or type a new value in the field.



New Virtual Machine Wizard

Memory for the Virtual Machine

How much memory would you like to use for this virtual machine?

Memory

Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4 MB.

Memory for this virtual machine: 192 MB

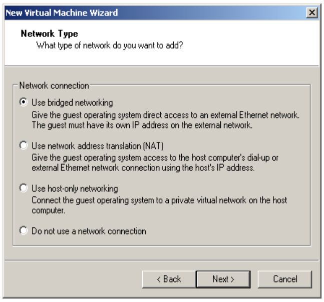
△ Guest OS recommended minimum:	32MB
△ Recommended memory:	192MB
▲ Maximum recommended memory:	284MB

The New Virtual Machine Wizard provides a default value based on your guest operating system selection, as well as the recommended range and the total amount of memory all running virtual machines can use.

The Wizard also indicates the minimum amount of memory recommended by the manufacturer and the VMware Server recommended maximum value for best performance of your virtual machine on this server host.

CAUTION You cannot allocate more than 2000MB of memory to a virtual machine if it is stored on a file system that cannot support files larger than 2GB, such as FAT16. You will not be able to power on such a virtual machine. Further, you cannot allocate more than 2000MB of memory to a virtual machine if it is stored on a FAT32 file system, even though it does support files up to 4GB in size.

10 Configure the networking capabilities of the virtual machine.



Network Type
What type of network do you want to add?

Network connection

- ● Use bridged networking
  Give the guest operating system direct access to an external Ethernet network. The guest must have its own IP address on the external network.
- ○ Use network address translation (NAT)
  Give the guest operating system access to the host computer's dial-up or external Ethernet network connection using the host's IP address.
- ○ Use host-only networking
  Connect the guest operating system to a private virtual network on the host computer.
- ○ Do not use a network connection

If your host computer is on a network and you have a separate IP address for your virtual machine (or can get one automatically from a DHCP server), select **Use bridged networking**.

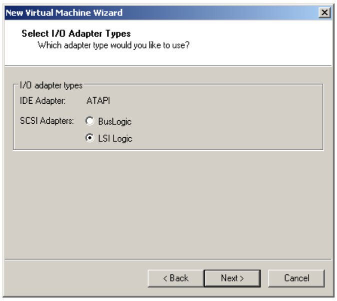
If you do not have a separate IP address for your virtual machine but you want to be able to connect to the Internet, select **Use network address translation (NAT)**. NAT is useful if you have a wireless network adapter on a Linux host (as bridged networking on wireless network adapters is supported only on Windows hosts). It also allows for the sharing of files between the virtual machine and the host operating system.

To enable your virtual machine to use a virtual network limited to the host and the virtual machines on the host using only the host-only network adapter, select **Use host-only networking**.

If you selected **Typical** as your configuration path, go to step 14.

If you selected **Custom** as your configuration path, continue with the steps for customizing your virtual machine configuration.

11 Choose the type of SCSI adapter to use with the virtual machine.

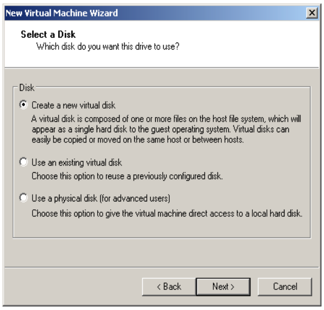


Select I/O Adapter Types
Which adapter type would you like to use?

I/O adapter types
IDE Adapter: ATAPI
SCSI Adapters: ○ BusLogic
● LSI Logic

You cannot change the SCSI adapter type after you create the virtual machine.

12 Select the disk to use with the virtual machine.



Select a Disk
Which disk do you want this drive to use?

Disk
● Create a new virtual disk
A virtual disk is composed of one or more files on the host file system, which will appear as a single hard disk to the guest operating system. Virtual disks can easily be copied or moved on the same host or between hosts.
○ Use an existing virtual disk
Choose this option to reuse a previously configured disk.
○ Use a physical disk (for advanced users)
Choose this option to give the virtual machine direct access to a local hard disk.

To use a new, unformatted virtual disk, select **Create a new virtual disk**.

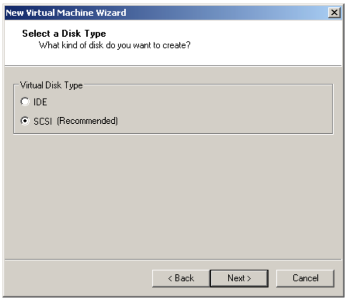
To use an existing virtual disk with this virtual machine, select **Use an existing virtual disk**. Browse to select the disk.

To install the guest operating system on a physical (also called raw) IDE disk, select **Use a physical disk**. To use a physical SCSI disk, add it to the virtual machine later with the virtual machine settings editor (**VM** > **Settings**). Booting from a physical SCSI disk is not supported.

To install your guest operating system directly on an existing IDE disk partition, read the reference note "Installing an Operating System onto a Physical Partition" on page 146.

CAUTION VMware recommends that only advanced users use physical disks with virtual machines.

13 Select whether you want the virtual disk to be an IDE disk or a SCSI disk.



New Virtual Machine Wizard

Select a Disk Type

What kind of disk do you want to create?

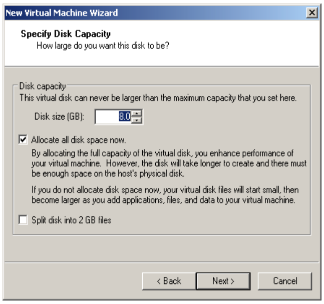
Virtual Disk Type

○ IDE

● SCSI (Recommended)

The Wizard recommends the best choice based on the guest operating system you selected.

14 Enter the size of the virtual disk that you want to create.



New Virtual Machine Wizard

Specify Disk Capacity

How large do you want this disk to be?

Disk capacity

This virtual disk can never be larger than the maximum capacity that you set here.

Disk size (GB): 8.0

☑ Allocate all disk space now.

By allocating the full capacity of the virtual disk, you enhance performance of your virtual machine. However, the disk will take longer to create and there must be enough space on the host's physical disk.

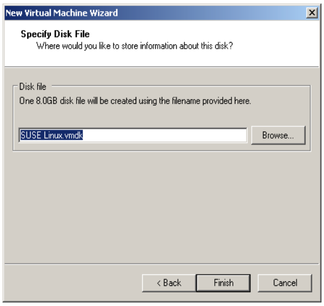
If you do not allocate disk space now, your virtual disk files will start small, then become larger as you add applications, files, and data to your virtual machine.

☐ Split disk into 2 GB files

If this setting is larger than the space available on the host machine's hard disk, a warning message appears, and specifies how much space you have on the host. If the disk will exceed the available space on the host, you must make the virtual disk smaller or clear the **Allocate all disk space now** check box.

Your virtual disk can be as small as 0.1GB (100MB).

15 Specify the name and location of the virtual disk's files.



New Virtual Machine Wizard

Specify Disk File

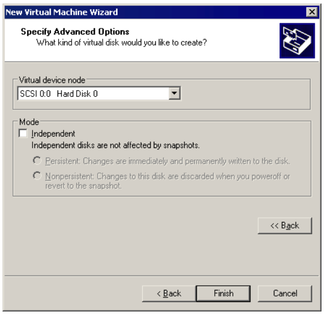
Where would you like to store information about this disk?

Disk file

One 8.0GB disk file will be created using the filename provided here.

SUSE Linux.vmdk

To specify which virtual device node should be used by your virtual disk or to use independent disk mode, click **Advanced**.



New Virtual Machine Wizard

Specify Advanced Options

What kind of virtual disk would you like to create?

Virtual device node

SCSI 0:0 Hard Disk 0

Mode

□ Independent

Independent disks are not affected by snapshots.

○ Persistent: Changes are immediately and permanently written to the disk.

○ Nonpersistent: Changes to this disk are discarded when you poweroff or revert to the snapshot.

CAUTION The independent disk option should be used only by advanced users who need it for special-purpose configurations.

You have the following options for an independent disk:

- **Persistent** — changes are immediately and permanently written to the disk.
- **Nonpersistent** — changes to the disk are discarded when you power off or reset the virtual machine.

16 Click **Finish**. VMware Server creates the virtual machine.

Your new virtual machine is like a physical computer with a blank hard disk. Before you can use it, you need to partition and format the virtual disk and install an operating system. The operating system's installation program might handle the partitioning and formatting steps for you.

Installing a Guest Operating System

A new virtual machine is like a physical computer with a blank hard disk. Before you can use it, you need to partition and format the virtual disk and install an operating system. The operating system's installation program can handle the partitioning and formatting steps for you.

Installing a guest operating system inside your VMware Server virtual machine is essentially the same as installing it on a physical computer. The basic steps for a typical operating system are:

1 Launch the VMware Server Console.

2 Insert the installation CD-ROM or floppy disk for your guest operating system.

> **NOTE** If you plan to use a PXE server to install the guest operating system over a network connection, you don't need the operating system installation media. When you power on the virtual machine in the next step, the virtual machine detects the PXE server, if one is available on the network. For more information, see "Using PXE with Virtual Machines" on page 100.

In some host configurations, the virtual machine is not able to boot from the installation CD-ROM. You can work around that problem by creating an ISO image file from the installation CD-ROM. Use the virtual machine settings editor (**VM** > **Settings**) to connect the virtual machine's CD-ROM drive to the ISO image file, then power on the virtual machine.

3 Power on your virtual machine by clicking the **Power On** button.

4 Follow the instructions provided by the operating system vendor.

For a brief illustration of installing a Windows Server 2003 guest operating system, see "Example: Installing Windows Server 2003 as a Guest OS" on page 37. The example describes the process on a Windows host. The steps are the same on a Linux host.

For information on installing other guest operating systems, see the *VMware Guest Operating System Installation Guide*, available from the VMware Web site at **www.vmware.com/support/guestnotes/doc/index.html**.

Example: Installing Windows Server 2003 as a Guest OS

You can install Windows Server 2003 Standard Edition, Enterprise Edition, or Web Edition in a virtual machine using the corresponding Windows Server 2003 distribution CD.

To install Windows Server 2003 as a guest OS

1. Insert the Windows Server 2003 CD in the CD-ROM drive.
2. Power on the virtual machine to start installing Windows Server 2003.
3. If you enabled the virtual machine's Ethernet adapter, an AMD PCNET Family Ethernet Adapter is detected and set up automatically.
4. Follow the installation steps as you would for a physical computer.

After installing your guest operating system, you are ready to install VMware Tools as described in "Installing VMware Tools" on page 41.

For more information about using Windows Server 2003 guest operating systems, such as enabling networking in the virtual machine, see the *VMware Guest Operating System Installation Guide*, available from the VMware Web site.

CHAPTER 3 Using VMware Tools

This chapter describes how to install and run VMware Tools and covers the following topics:

About VMware Tools

VMware Tools is a suite of utilities that enhances the performance of the virtual machine's guest operating system and improves management of the virtual machine by VMware Server. It is very important that you install VMware Tools in the guest operating system. Although VMware Server can run a guest operating system without VMware Tools, you lose important functionality and convenience.

When you install VMware Tools, you install:

- The VMware Tools service (or `vmware-guestd` on Linux guests).
- A set of VMware device drivers, including an SVGA display driver, the `vmxnet` networking driver for some guest operating systems, the BusLogic SCSI driver for some guest operating systems, and the VMware mouse driver.
- The VMware Tools control panel that lets you modify settings, shrink virtual disks, and connect and disconnect virtual devices.
- A set of scripts that help automate guest operating system operations. The scripts run when the virtual machine's power state changes.
- A component that supports copying and pasting text between the guest and host operating systems.

VMware Tools performs various duties within the guest operating system, such as passing messages from the host operating system to the guest operating system, sending a heartbeat to VMware Server, grabbing and releasing the mouse cursor, and synchronizing the time in the guest operating system with the time in the host operating system. The service starts automatically when the guest operating system boots. For more information, see "About the VMware Tools Service" on page 68.

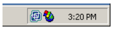
With the VMware SVGA driver installed, VMware Server supports up to 32-bit displays and high display resolution, with significantly faster overall graphics performance. If you run a guest operating system without VMware Tools, the graphics environment within the virtual machine is limited to VGA mode graphics (640x480, 16 color) and display performance might be unsatisfactory.

The VMware virtual SCSI driver is a BusLogic driver. Some recent guest operating systems contain LSI Logic drivers and can take advantage of the virtual LSI Logic adapter for better device performance.

The `vmxnet` networking driver improves network performance. This driver is automatically installed when you install VMware Tools.

The VMware mouse driver improves mouse performance in some guest operating systems. You must use the VMware mouse driver with third-party tools like Microsoft's Terminal Services.

In a Windows guest, you can access the VMware Tools control panel through the Windows Control Panel (choose **Start** > **Settings** > **Control Panel** > **VMware Tools**) or through the VMware Tools icon, which appears by default in the system tray.



In a Linux or FreeBSD guest operating system, the VMware Tools control panel is called `vmware-toolbox`. You can launch it manually as a background process from a by typing:

```
vmware-toolbox &
```

NOTE Always run `vmware-toolbox` in the guest operating system to ensure you have access to all VMware Tools features, such as copy and paste and mouse ungrab for operating systems for which X display driver is not available.

In a NetWare 5.1 or higher guest operating system, access the VMware Tools control panel by choosing **Novell** > **Settings** > **VMware Tools for NetWare**.

In a NetWare 4.2 guest operating system, use VMware Tools commands in the system console. The VMware Tools program is called `vmwtool`. For information about using this command, see "Configuring VMware Tools for NetWare Guests in the System Console" on page 66.

With some window managers, you can place the command to start VMware Tools in a startup configuration so VMware Tools starts automatically when you start your graphical environment. Consult your window manager's documentation for details.

Installation files for VMware Tools for all supported Windows, Linux, NetWare, and FreeBSD guest operating systems are built into VMware Server.

NOTE VMware Server provides experimental VMware Tools support for both the 32-bit and 64-bit versions of Sun Solaris 10 as guest operating systems. The 32-bit version of VMware Tools runs in compatibility mode on virtual machines running 64-bit Solaris 10. In addition, the version of VMware Tools included in this release does not include X drivers for 64-bit versions of Solaris 10.

Installing VMware Tools

The following sections describe how to install VMware Tools:

- "Installing VMware Tools in a Windows Virtual Machine" on page 41
- "Automating the Installation of VMware Tools in a Windows Guest" on page 48
- "Additional Steps When Migrating from Old Versions of Windows" on page 45
- "Installing VMware Tools in a Linux Virtual Machine" on page 50
- "Installing VMware Tools in a NetWare Virtual Machine" on page 53

The installers for VMware Tools for Windows, Linux, FreeBSD, Solaris, and NetWare guest operating systems are built into VMware Server as ISO image files. (An ISO image file looks like a CD-ROM to your guest operating system and even appears as a CD-ROM in Windows Explorer. You do not use an actual CD-ROM to install VMware Tools, and you do not need to download the CD-ROM image or burn a physical CD-ROM of this image file.)

When you install VMware Tools, VMware Server temporarily connects the virtual machine's first virtual CD-ROM drive to the ISO image file that contains the VMware Tools installer for your guest operating system, and begins the installation process. (To cancel the installer, choose **VM** > **Cancel VMware Tools Install** to return your virtual machine's CD-ROM drive to its original configuration.)

Installing VMware Tools in a Windows Virtual Machine

VMware Tools for Windows guest operating systems supports all Windows guest operating systems.

The detailed steps for installing VMware Tools depend on the version of Windows you are running. The steps that follow show how to install VMware Tools in a Windows Server 2003 guest. Some steps that are automated in current versions of Windows must be performed manually in Windows 9x and Windows NT.

NOTE If you are running VMware Server on a Windows host and your virtual machine has only one CD-ROM drive, the CD-ROM drive must be configured as an IDE or SCSI CD-ROM drive. It cannot be configured as a generic SCSI device.

To add an IDE or SCSI CD-ROM drive, see "Adding, Configuring, and Removing Devices in a Virtual Machine" on page 103. For information about generic SCSI, see "Connecting to a Generic SCSI Device" on page 237.

You can automate the installation of VMware Tools in a Windows guest operating system. For information, see "Automating the Installation of VMware Tools in a Windows Guest" on page 48.

To install VMware Tools in a Windows Guest Operating System

1 Power on the virtual machine.

2 Log on to the virtual machine as an administrator.

NOTE You must be an administrator to install VMware Tools in a Windows guest operating system, unless the guest operating system is Windows Me, Windows 98, or other early versions of Windows.

3 When the guest operating system starts, choose **VM > Install VMware Tools**.

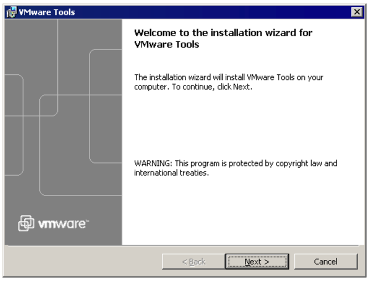
The remaining steps take place inside the virtual machine. If you have autorun enabled in your guest operating system (the default setting for Windows operating systems), a splash screen that says VMware Tools appears, followed by a dialog box that asks whether you want to install VMware Tools.

4 Click **Yes** to launch the InstallShield wizard.

If autorun is not enabled, the dialog box does not appear. If it doesn't appear, run the VMware Tools installer. Click **Start** > **Run** and enter `D:\setup.exe`

NOTE You do not use an actual CD-ROM to install VMware Tools. The VMware Server software contains an ISO image that looks like a CD-ROM to your guest operating system and even appears as a CD-ROM in Windows Explorer. This image contains all the files needed to install VMware Tools in your guest operating system. When you finish installing VMware Tools, this image file no longer appears in your CD-ROM drive.

The VMware Tools installation wizard starts.

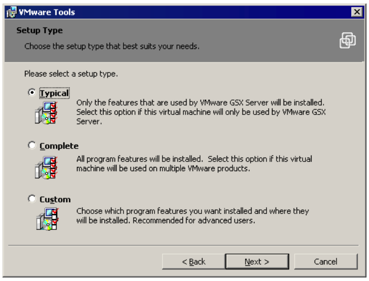


Welcome to the installation wizard for VMware Tools

The installation wizard will install VMware Tools on your computer. To continue, click Next.

WARNING: This program is protected by copyright law and international treaties.

5 Click **Next** to continue with the VMware Tools installation wizard. The Setup Type dialog box appears.



Setup Type

Choose the setup type that best suits your needs.

Please select a setup type.

● **Typical**

Only the features that are used by VMware GSX Server will be installed. Select this option if this virtual machine will only be used by VMware GSX Server.

○ **Complete**

All program features will be installed. Select this option if this virtual machine will be used on multiple VMware products.

○ **Custom**

Choose which program features you want installed and where they will be installed. Recommended for advanced users.

6 Choose a typical, complete, or custom installation. The installer uses this selection each time you upgrade VMware Tools.

Typical Installation

A typical installation installs the utilities to enhance the performance of the guest operating system, and a set of drivers specific to VMware Server virtual machines — the VMware SVGA driver, the VMware Mouse driver, the VMware SCSI driver, and the VMware `vmxnet` networking driver (the `vlance` driver is installed when you create the virtual machine). You do not need to configure your virtual machine to use the `vmxnet` networking driver. The `vmxnet` driver is activated when reboot your virtual machine after you install VMware Tools.

If you do not plan to use this virtual machine with other VMware products, such as VMware Workstation, use the typical installation. To choose the typical installation, select **Typical**, click **Next**, and go to step 7.

Complete Installation

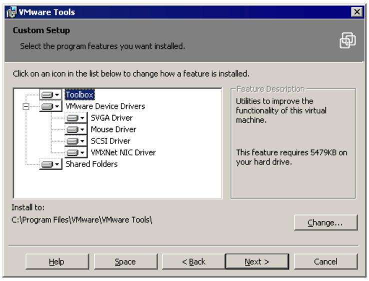
A complete installation installs the utilities to enhance the performance of the guest operating system, and all the drivers — the VMware SVGA driver, the

VMware Mouse driver, the VMware SCSI driver, the VMware `vmxnet` networking driver (the `vlance` driver is installed automatically when you created the virtual machine) and the shared folders driver (for use by virtual machines with VMware Workstation).

If you plan on using this virtual machine with other VMware products, use the complete installation. To choose the complete installation, select **Complete**, click **Next**, then go to step 7.

Custom Installation

A custom installation lets you pick and choose which components to install. You can always run the installer again at a later date to install components you did not install the first time, or remove components you no longer want. Select **Custom** and click **Next**. The Custom Setup screen appears.



VMware Tools

Custom Setup

Select the program features you want installed.

Click on an icon in the list below to change how a feature is installed.

Feature Description

Utilities to improve the functionality of this virtual machine.

This feature requires 5479KB on your hard drive.

Install to:
C:\Program Files\VMware\VMware Tools\

In the Custom Setup screen, pick and choose the components to install. Click the arrow to the left of the component you do not want to install and select the appropriate option from the menu.

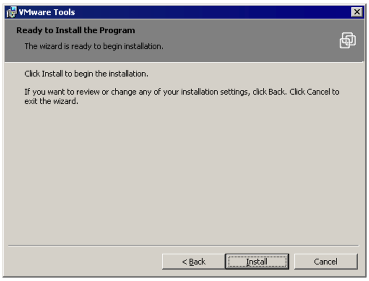
If you need to determine how much free space is on the guest, click **Space**. This is useful if you are choosing a custom installation due to limited disk space on your guest.

If you want to install all the VMware Tools components in a directory other than the default, click **Browse** and select the directory. If the directory does not exist, the installer creates it for you.

When you are ready to continue, click **Next**.

7 To change any settings or information you provided, click **Back** until you reach the dialog box containing the information you want to change.

Click **Install** once you are ready to begin the installation. The installer begins copying files to your host.



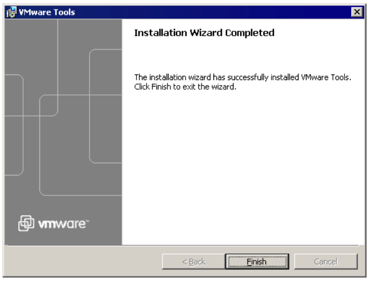
Ready to Install the Program

The wizard is ready to begin installation.

Click Install to begin the installation.

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

You might see one or more Digital Signature Not Found dialog boxes when the installer begins to install the virtual drivers. You can safely ignore these warnings and click **Yes** or **Continue** to approve installation of the drivers.



Installation Wizard Completed

The installation wizard has successfully installed VMware Tools. Click Finish to exit the wizard.

8 After the installer finishes installing the files, click **Finish**.

If you installed the VMware SVGA driver, most Windows guest operating systems can use it only after you reboot the guest. With Windows XP guests, you do not have to reboot to use the new driver.

With some older Windows guest operating systems, extra steps are needed.

Additional Steps When Migrating from Old Versions of Windows

If you are migrating from VMware GSX Server to VMware Server and your guest operating system is Windows NT, Windows Me, Windows 98, or Windows 95, you might need to configure the video driver by hand. Instructions are displayed in Notepad at the end of the installation process. If the Notepad window is hidden, bring it to the front by clicking the **Notepad** button on the Windows taskbar.

For details, see the following steps that correspond to your guest operating system.

To migrate from Windows NT guest operating systems

1 After installing VMware Tools, click **Finish**. The Display Properties dialog box appears.

2 Click the **Display Type** button. The Display Type dialog box appears.

3 Click the **Change** button. The Change Display dialog box appears.

4 Select **VMware, Inc.** from the **Manufacturer** list.

5 Select **VMware SVGA** as the display adapter and click **OK**.

6 Click **Yes** in response to the on-screen question about third-party drivers to install the driver. Click **OK** to confirm the drivers were installed.

7 Click **Close** from the Display Type dialog box, and click **Close** from the Display Properties dialog box.

8 Click **Yes** to restart Windows NT and start using the new video driver.

9 The VMware Tools background application is launched when you reboot your virtual machine.

To migrate from Windows Me guest operating systems

1 After installing VMware Tools, click **Finish**. The Display Settings dialog box appears.

2 Click the **Advanced** button.

3 Click the **Adapter** tab.

4 Click the **Change** button. The Update Device Driver wizard starts. Click **Next**.

The wizard displays two options.

5 Choose the second option to **Specify the location of the driver**. Click **Next**.

6 Check the **Specify a location** check box. Enter the following path:

```
D:\video\win9x
```

`D:` is the drive letter for the first virtual CD-ROM drive in your virtual machine. Click **OK**.

Windows Me automatically locates your driver.

7 Select the **VMware SVGA II** display adapter and click **Next**.

8 Click **Next** to install the driver.

If you are upgrading a virtual machine created under VMware GSX Server 2, you might see a dialog box that warns, “The driver you are installing is not specifically designed for the hardware you have.… Do you wish to continue?” Click **Yes**.

9 After the driver is installed, click **Finish**.

10 Click **Yes** to restart Windows Me and start using the new video driver.

11 The VMware Tools background application starts automatically when you reboot your virtual machine.

To migrate from Windows 98 guest operating systems

1 After installing VMware Tools, click **Finish**. The Display Settings dialog box appears.

2 Click the **Advanced** button. The Standard Display Adapter (VGA) Properties dialog box appears. If you are upgrading from a previous version of the VMware drivers, this dialog box is titled VMware SVGA Properties.

3 Click the **Adapter** tab.

4 Click the **Change** button. The Update Device Driver wizard starts. Click **Next**.

The wizard displays two options.

5 Choose the option to **Display a list of all drivers in a specific location**. Click **Next**.

6 Select **Have Disk**. The Install From Disk dialog box appears.

7 Enter the following path:

```
D:\video\win9x
```

`D:` is the drive letter for the first virtual CD-ROM drive in your virtual machine.

Click **OK**.

8 Select **VMware SVGA** display adapter and click **OK**.

9 Answer **Yes** to the on-screen question, and click **Next** to install the driver.

10 After the driver is installed, click **Finish**.

11 Click **Close** in the SVGA Properties dialog box, and click **Close** in the Display Settings dialog box.

12 Click **Yes** to restart Windows 98 and start using the new video driver.

The VMware Tools background application starts automatically when you reboot your virtual machine.

To migrate from Windows 95 guest operating systems

1. After installing VMware Tools, click **Finish**. The Display Settings dialog box appears.
2. Click the **Advanced Properties** button. The Advanced Display Properties dialog box appears.
3. Click the **Change** button. The Select Device dialog box appears.
4. Select **Have Disk**.
5. Enter the following path:

   `D:\video\win9x`

   `D:` is the drive letter for the first virtual CD-ROM drive in your virtual machine.

   Click **OK**.
6. Click **OK** again to install the driver.
7. Click **Close** from the Advanced Display Properties dialog box, and click **Close** from the Display Setting dialog box.
8. Click **Yes** to restart Windows 95 and start using the new video driver.
9. The VMware Tools background application starts automatically when you reboot your virtual machine.

Automating the Installation of VMware Tools in a Windows Guest

To automate the installation of VMware Tools in a Windows guest operating system, use the Microsoft Windows Installer runtime engine to install the software silently (in quiet mode). If you are installing VMware Tools in a number of Windows virtual machines, you might want to use the silent install features.

The guest operating system in which you are installing VMware Tools must have Microsoft Windows Installer runtime engine version 2.0 or higher installed. This version is included with Windows Server 2003 and Windows XP. If you are installing VMware Tools in other Windows guest operating systems, check the version of this file:

```
%WINDIR%\system32\msiexec.exe
```

If you need to upgrade the engine, run `instmsiw.exe` (`instmsia.exe` for Windows 95 or Windows 98 guests), which is included with the VMware Tools installer.

For more information on using the Microsoft Windows Installer, go to the Microsoft Web site — **msdn.microsoft.com/library/default.asp?url=/library/en-us/msi/setup/about_windows_installer.asp**.

To install VMware Tools silently in a Windows guest, make sure the virtual machine's CD-ROM drive is connected to the VMware Tools ISO image (`windows.iso`, located in the directory where you installed VMware Server) and configured to connect when you power on the virtual machine. Run the silent installation on the extracted installation packages. At the command prompt, on one line, type:

```
msiexec -i "D:\VMware Tools.msi" ADDLOCAL=ALL /qn
```

The installation command can be customized using standard Microsoft Windows Installer installation options.

The `ADDLOCAL` option defaults to install all VMware Tools components. You can customize the installation using a combination of the `ADDLOCAL` and `REMOVE` options. For information about the features of VMware Tools, see "About VMware Tools" on page 39. You can include or exclude the following features:

- `Toolbox` — the VMware Tools control panel and its utilities. Excluding this feature prevents you from using VMware Tools in the guest operating system, and is not recommended.
- `Drivers` — this includes the SVGA, Mouse, BusLogic, and `vmxnet` drivers.
    - `SVGA` — the VMware SVGA driver. Excluding this feature limits the display capabilities of your virtual machine.
    - `Mouse` — the VMware mouse driver. Excluding this feature decreases mouse performance in your virtual machine.
    - `Buslogic` — the VMware BusLogic driver. Excluding this feature prevents you from using this driver in your virtual machine. If your virtual machine is configured to use the LSI Logic driver, then you may want to remove this feature.
    - `VMXNet` — the VMware `vmxnet` networking driver. Excluding this feature prevents you from using this driver in your virtual machine.
    - `MemCtl` — the VMware memory control driver. This feature is recommended if you plan on using this virtual machine with VMware ESX Server. Excluding this feature hinders the memory management capabilities of the virtual machine running on an VMware ESX Server system.

To include a feature, use it with the `ADDLOCAL` option.

To exclude a feature, use it with the `REMOVE` option.

For example, to install everything but the shared folders driver, type the following on the command line:

```
msiexec -i "D:\VMware Tools.msi" ADDLOCAL=ALL REMOVE=Hgfs /qn
```

The SVGA, Mouse, BusLogic, vmxnet and MemCtl features are children of the Drivers feature. Thus, on the command line, if you type:

```
msiexec -i "D:\VMware Tools.msi" ADDLOCAL=ALL REMOVE=Drivers /qn
```

you also skip installation of the SVGA, Mouse, BusLogic, vmxnet and MemCtl drivers.

The drivers installed by VMware Tools are not signed by Microsoft. When you install VMware Tools, you are asked to confirm the installation of these drivers. You can prevent these messages from appearing in the guest operating system during installation by completing the following steps.

To prevent driver installation messages:

1 On the virtual machine's desktop, right-click **My Computer**, and choose **Properties**.

2 Click the **Hardware** tab, and click **Driver Signing**. The Driver Signing dialog box appears.

3 Click **Ignore**, and click **OK** twice.

Installing VMware Tools in a Linux Virtual Machine

This section explains how to install VMware Tools in a Linux, FreeBSD, or Solaris virtual machine.

To install VMware Tools in a Linux, FreeBSD, or Solaris Virtual Machine

1 Power on the virtual machine.

2 After the guest operating system has started, prepare your virtual machine to install VMware Tools.

Choose **VM > Install VMware Tools**.

The remaining steps take place inside the virtual machine.

NOTE You can install VMware Tools either from a terminal in an X window session or in text mode.

3 As root (`su -`), mount the VMware Tools virtual CD-ROM image, change to a working directory (for example, `/tmp`), uncompress the installer, and unmount the CD-ROM image.

NOTE You do not use an actual CD-ROM to install VMware Tools, and you do not need to download the CD-ROM image or burn a physical CD-ROM of this image file. The VMware Server software contains an ISO image that looks like a CD-ROM to your guest operating system. This image contains all the files needed to install VMware Tools in your guest operating system.

Using the Tar Installer on Linux Guests: Some Linux distributions use different device names or organize the /dev directory differently. If your CD-ROM drive is not /dev/cdrom or if the mount point for a CD-ROM is not /mnt/cdrom, modify the following commands to reflect the conventions used by your distribution.

Also, some Linux distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the mount and umount commands below. You still must untar the VMware Tools installer to /tmp.

```
mount /dev/cdrom /mnt/cdrom
cd /tmp
tar zxf /mnt/cdrom/vmware-linux-tools.tar.gz
umount /mnt/cdrom
```

Go to step 4.

Using the RPM Installer on Linux Guests: Some Linux distributions use different device names or organize the /dev directory differently. If your CD-ROM drive is not /dev/cdrom or if the mount point for a CD-ROM is not /mnt/cdrom, modify the following commands to reflect the conventions used by your distribution.

Also, some Linux distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the mount and umount commands below.

```
mount /dev/cdrom /mnt/cdrom
cp /mnt/cdrom/vmware-linux-tools-<xxxxx>.i386.rpm
/tmp rpm -Uhv /tmp/vmware-linux-tools-<xxxxx>.i386.rpm
umount /mnt/cdrom
```

where <xxxxx> is the build number of the VMware Server release.

Go to step 6.

Solaris Guests: The Solaris volume manager—vold—mounts the CD-ROM under /cdrom/vmwaretools. If the CD-ROM is not mounted, restart the volume manager using the following commands:

```
/etc/init.d/volmgt stop
/etc/init.d/volmgt start
```

After the CD-ROM is mounted, use the following commands to extract VMware Tools.

```
cd /tmp
gunzip -c /cdrom/vmwaretools/vmware-solaris-tools.tar.gz | tar xf -
```

Go to step 4.

FreeBSD Guests: Some FreeBSD distributions automatically mount CD-ROMs. If your distribution uses automounting, do not use the `mount` and `umount` commands below. You still must untar the VMware Tools installer to `/tmp`.

```
mount /cdrom
cd /tmp
tar zxf /cdrom/vmware-freebsd-tools.tar.gz
umount /cdrom
```

4 Run the VMware Tools installer.

```
cd vmware-tools-distrib
./vmware-install.pl
```

5 Answer the questions about default directories.

6 Run the configuration program.
`vmware-config-tools.pl`

7 To change your virtual machine's display resolution, answer yes, and enter the number that corresponds to the desired resolution.

8 Log off of the root account.

```
exit
```

9 Start X and your graphical environment. If you installed VMware Tools in an X windows session, restart X windows.

10 In an X terminal, launch the VMware Tools background application.

```
vmware-toolbox &
```

You can run VMware Tools as root or as a normal user. To shrink virtual disks or to change any VMware Tools scripts, you must run VMware Tools as root (`su -`).

NOTE Always run `vmware-toolbox` in the guest operating system to ensure you have access to all VMware Tools features, such as copy and paste and mouse ungrab for operating systems for which X display driver is not available.

Starting VMware Tools Automatically

You might find it helpful to configure your guest operating system so VMware Tools starts when you start your X server. The steps for doing so vary depending on your Linux distribution and your desktop environment. Check your operating system documentation for the appropriate steps to take.

For example, in a Red Hat Linux 7.1 guest using GNOME, follow these steps.

1. Open the Startup Programs screen in the GNOME Control Center.

   Main Menu (click the foot icon in the lower left corner of the screen) > **Programs** > **Settings** > **Session** > **Startup Programs**

2. Click **Add**.
3. In the **Startup Command** field, enter `vmware-toolbox`.
4. Click **OK**, click **OK** again, and close the GNOME Control Center.

The next time you start X, VMware Tools also starts.

Starting VMware Tools in a FreeBSD 4.5 Guest Operating System

In a FreeBSD 4.5 guest operating system, sometimes VMware Tools does not start after you install VMware Tools, reboot the guest operating system, or start VMware Tools on the command line in the guest. An error message appears:

```
Shared object 'libc.so.3' not found.
```

The required library was not installed. This does not happen with full installations of FreeBSD 4.5, but does occur for minimal installations. To fix the problem of the missing library, take the following steps:

1. Insert and mount the FreeBSD 4.5 installation CD or access the ISO image file.
2. Change directories and run the installation script.

   ```
   cd /cdrom/compat3x
   ./install.sh
   ```

Uninstalling VMware Tools

To remove VMware Tools from your Linux guest operating system, log on as root (`su -`) and run the following command:

```
vmware-uninstall-tools.pl
```

Installing VMware Tools in a NetWare Virtual Machine

VMware Tools is available for NetWare 4.2, 5.1, 6.0, and 6.5 guest operating systems.

When you install VMware Tools in a NetWare guest operating system, the CPU idler program is installed and loaded. The idler can be disabled from the system console. For information on configuring VMware Tools from the system console, see "Configuring VMware Tools for NetWare Guests in the System Console" on page 66.

Follow the appropriate steps for your NetWare guest operating system.

Installing VMware Tools in a NetWare 5.1, 6.0, or 6.5 Virtual Machine

1. Power on the virtual machine.

2. Prepare your virtual machine to install VMware Tools.

   Choose **VM > Install VMware Tools**.

   The remaining steps take place inside the virtual machine.

3. Load the CD-ROM driver so the CD-ROM device mounts the ISO image as a volume. Do one of the following.

   - In the system console for a NetWare 6.5 virtual machine, type
     `LOAD CDDVD`

   - In the system console for a NetWare 6.0 or NetWare 5.1 virtual machine, type
     `LOAD CD9660.NSS`

4. When the driver finishes loading, you can begin installing VMware Tools. In the system console, type
   `vmwtools:\setup.ncf`

   When the installation finishes, the message `VMware Tools for NetWare are now running` appears in the Logger Screen (NetWare 6.5 and NetWare 6.0 guests) or the Console Screen (NetWare 5.1 guests).

5. Restart the guest operating system. In the system console, type
   `restart server`

After you install VMware Tools, make sure the VMware Tools virtual CD-ROM image (`netware.iso`) is not attached to the virtual machine. If it is, disconnect it. Right-click the CD-ROM icon in the status bar of the console window and select **Disconnect**.

Installing VMware Tools in a NetWare 4.2 Virtual Machine

1. Power on the virtual machine.

2. Prepare your virtual machine to install VMware Tools. Choose **VM > Install VMware Tools**. The remaining steps take place inside the virtual machine.

3. Load the `cdrom.nlm` module. In the system console, type
   `load cdrom`

4. Mount the VMware Tools CD-ROM image. In the system console, type
   `cd mount vmwtools`

5. Start installing VMware Tools. In the system console, type
   `vmwtools:\setup`

   When the installation finishes, the message `VMware Tools for NetWare are now running` appears in the Console Screen.

6. Bring the guest operating system down. In the system console, type
   `down`

7. Restart the guest operating system. In the system console, type
   `restart server`

After you install VMware Tools, make sure the VMware Tools virtual CD-ROM image (`netware.iso`) is not attached to the virtual machine. If it is, disconnect it. Right-click the CD-ROM icon in the status bar of the console window and select **Disconnect**.

Executing Scripts When the Virtual Machine's Power State Changes

You can run scripts in the guest operating system when you power on, power off, suspend, or resume the virtual machine.

Scripts can help automate guest operating system operations when you change the virtual machine's power state.

You perform these power operations from the toolbar buttons and menus in the VMware Server Console and the VMware Management Interface.

On Microsoft Windows hosts only, you can configure scripts to run when you use the power buttons on the toolbar by choosing **VM** > **Settings** > **Options** > **Power** and checking the appropriate options under **Run VMware Tools scripts**.

NOTE The commands on the **Power** menu take precedence over how the toolbar power buttons are configured.

Scripts can be executed only when the VMware Tools service is running. The service is a part of VMware Tools, so VMware Tools must be running in the guest for scripts to run. The service starts by default when you start the guest operating system. For more information about the VMware Tools service, see "About the VMware Tools Service" on page 68.

Default scripts are included in VMware Tools. On a Microsoft Windows host, the default script executed when you suspend a virtual machine releases the IP address of the virtual machine, while the default script executed when you resume a virtual machine renews the IP address of the virtual machine (this affects only virtual machines configured to use DHCP). On a Linux host, the default script executed when you suspend a virtual machine stops networking for the virtual machine, while the default script executed when you resume a virtual machine starts networking for the virtual machine.

In addition, you can create your own scripts. The scripts you can run must be batch files for Windows hosts, but can be any executable format (such as shell or Perl scripts) for Linux hosts. You should have a thorough familiarity with these types of scripts before you modify the default scripts or create your own.

If you create your own scripts, you must associate each script with its particular power operation. For more information, see "Choosing Scripts for VMware Tools to Run During Power State Changes" on page 58 for Windows guests and "Choosing Scripts for VMware Tools to Run During Power State Changes" on page 61 for Linux guests.

For scripts and their associated power operations to work, the following conditions must be met:

- The VMware Tools service must be running in the virtual machine.
- The version of VMware Tools must be updated to the current version. If you are using a virtual machine created with another VMware product, such as VMware GSX Server 3, update VMware Tools to the version included in this release.
- Depending on the operation the script performs, the virtual machine must have a virtual network adapter connected, or the power operation fails.

CAUTION When you reinstall VMware Tools after you upgrade the VMware Server software, any changes you made to the default scripts are overwritten. Any scripts you created on your own remain untouched, but do not benefit from any underlying changes that enhance the default scripts.

Configuring VMware Tools

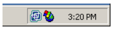
The following sections describe how to configure VMware Tools in a virtual machine:

- "Configuring VMware Tools in a Windows Virtual Machine" on page 57
- "Configuring VMware Tools in a Linux, FreeBSD, or Solaris Virtual Machine" on page 60
- "Configuring VMware Tools in a NetWare Virtual Machine" on page 64

Configuring VMware Tools in a Windows Virtual Machine

This section shows the options available in a Windows 2000 guest operating system. Similar configuration options are available in VMware Tools for other Windows guests.

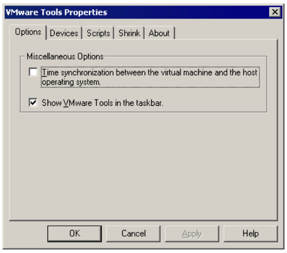
To open the VMware Tools control panel, double-click the VMware Tools icon in the system tray.



If the VMware Tools icon does not appear in the system tray, go to **Start** > **Control Panel** > **VMware Tools**.

Setting Options with VMware Tools

The Options tab shows miscellaneous options.



Miscellaneous Options

□ Time synchronization between the virtual machine and the host operating system.

☑ Show VMware Tools in the taskbar.

- **Time synchronization between the virtual machine and the host operating system** — this option lets you synchronize the time in the guest operating system with the time in the host operating system.

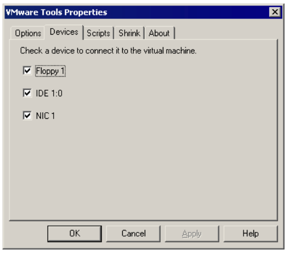
  NOTE You can synchronize the time in the guest operating system with the time on the host operating system only when you set the clock in the guest operating system to a time earlier than the time set in the host.

  To completely disable time synchronization, see "Disabling Time Synchronization" on page 70.

- **Show VMware Tools in the taskbar** — this option displays the VMware Tools icon in the Windows taskbar.

Connecting Devices with VMware Tools

The Devices tab allows you to enable or disable removable devices. Removable devices include the floppy and CD-ROM drives and the virtual network adapter.



Check a device to connect it to the virtual machine.

☑ Floppy 1
☑ IDE 1:0
☑ NIC 1

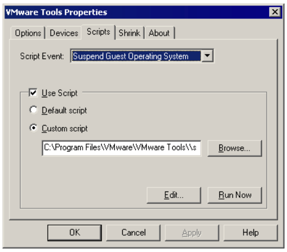
To connect a device select the check box next to the device. To disconnect the device, deselect the check box next to the device.

NOTE You can also set these options from the **VM** > **Removable Devices** menu in the virtual machine window.

Choosing Scripts for VMware Tools to Run During Power State Changes

Through VMware Tools, you can run scripts that execute when you power on, power off, suspend, or resume the virtual machine. For more information, see "Executing Scripts When the Virtual Machine's Power State Changes" on page 55.

NOTE Scripts cannot be run in Windows 95 guest operating systems. Scripts in Windows NT and Windows Me guest operating systems do not release and renew the IP address.



Script Event: Suspend Guest Operating System

☑ Use Script
○ Default script
● Custom script
C:\Program Files\VMware\VMware Tools\\s

The Scripts tab lets you enable, disable, and run scripts that are associated with the Suspend, Resume, Power On, and Power Off buttons.

A default script for each power state is included in VMware Tools. These scripts are located in the guest operating system in `C:\Program Files\VMware`.

Table 3-1.

When You …	This Default Script Runs
Suspend the guest operating system	`suspend-vm-default.bat`
Resume the guest operating system	`resume-vm-default.bat`
Power off the guest operating system	`poweroff-vm-default.bat`
Power on the guest operating system	`poweron-vm-default.bat`

Windows hosts: If the virtual machine is configured to use DHCP, the script executed when you suspend a virtual machine releases the IP address of the virtual machine. The script executed when you resume a virtual machine renews the IP address of the virtual machine.

Linux, FreeBSD, and Solaris hosts: The script executed when you suspend a virtual machine stops networking for the virtual machine. The script executed when you resume a virtual machine starts networking for the virtual machine.

For each power state, you can use the default script or you can substitute a script you created. In addition, you can test a script or disable the running of a script. Complete the following steps.

1. In the **Script Event** list, select the power operation with which to associate the script.

2. Do one of the following:

   - To select a different script, click **Custom Script**, click **Browse,** and select the new script.

   - To edit a script, click **Edit**. The script opens in your default editor. Make your changes there.

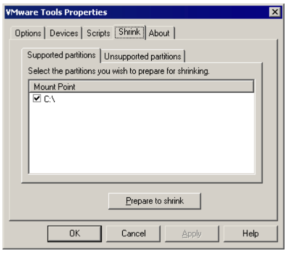
   - To test the script, click **Run Now**.

   - To disable the running of a script, click to deselect the **Use Script** check box.

3. Click **Apply** to save your settings.

Shrinking Virtual Disks with VMware Tools

The Shrink tab gives you access to the controls you need to reclaim unused space in a virtual disk.



Select the partitions you wish to prepare for shrinking.

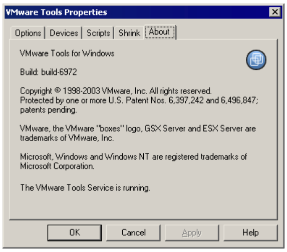
Mount Point
☑ C:\

In some configurations, it is not possible to shrink virtual disks. If your virtual machine uses such a configuration, the Shrink tab displays information explaining why you cannot shrink your virtual disks.

For more information about shrinking virtual disks, see "Defragmenting and Shrinking Virtual Disks" on page 125.

Viewing Information About VMware Tools

For general information about VMware Tools, click the **About** tab.



VMware Tools for Windows

Build: build-6972

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The VMware Tools Service is running.

In addition to copyright information, this tab contains the following information:

- The VMware Tools build number, which lets you verify that your VMware Tools version matches the VMware Server version you are running. The build number is also useful when you request support.
- An indication as to whether the VMware Tools service is running.

Configuring VMware Tools in a Linux, FreeBSD, or Solaris Virtual Machine

This section shows the options available in a Linux or FreeBSD guest operating system.

To open the VMware Tools control panel, at a command prompt, type:

```
vmware-toolbox &
```

You can run VMware Tools as root or as a normal user. To shrink virtual disks, you should run VMware Tools as root (`su -`).

NOTE Always run `vmware-toolbox` in the guest operating system to ensure you have access to all VMware Tools features, such as copy and paste and mouse ungrab for operating systems for which X display driver is not available.

Connecting Devices with VMware Tools

The Devices tab allows you to enable or disable removable devices. Removable devices include the floppy and CD-ROM drives and the virtual network adapter.

To connect a device, select the check box next to the device. To disconnect the device, click to deselect the check box next to the device.

NOTE You can also set these options from the **VM** > **Removable Devices** menu in the virtual machine window.

Choosing Scripts for VMware Tools to Run During Power State Changes

Through VMware Tools, you can run scripts that execute when you power on, power off, suspend, or resume the virtual machine. For more information, see "Executing Scripts When the Virtual Machine's Power State Changes" on page 55.

A default script for each power operation is included in VMware Tools. These scripts are located in the guest operating system in `/etc/vmware-tools`.

Table 3-2.

When You …	This Default Script Runs
Suspend the guest operating system	`suspend-vm-default`
Resume the guest operating system	`resume-vm-default`
Power off the guest operating system	`poweroff-vm-default`
Power on the guest operating system	`poweron-vm-default`

For each power state, you can use the default script or you can substitute a script you created. In addition, if you are logged on as root, you can edit a script, test a script, or disable the running of a script. Complete the following steps.

1 To edit the appropriate power operation, select:

   - **Use default script to suspend guest operating system**
   - **Use default script to resume guest operating system**
   - **Use default script to shut down guest operating system**
   - **Use default script to power on guest operating system**

2 Do one of the following:

   - To select a different script, click **Browse** and select the new script.
   - To edit a script, click **Edit**. The script opens in `vi`. Make your changes there.

     NOTE To edit scripts from the Scripts tab, `xterm` and `vi` must be installed in the guest operating system. You must be a root user to edit the script and have `vi` and `xterm` in your PATH when using the Scripts tab. You can also edit scripts manually using any text editor.

   - To test a script, click **Test**.

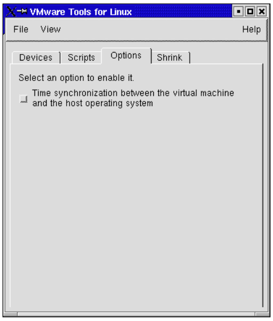
     NOTE If you plan to test scripts in a Turbolinux 7.0 guest operating system, you need to update the Turbolinux guest operating system. This is a known issue with Turbolinux.

   - To disable a script, select the path to the script and delete it.

3 Click **Apply** to save your settings.

Setting Options with VMware Tools

The Options tab gives you the option to synchronize the time in the guest operating system with the time in the host operating system.



Select an option to enable it.

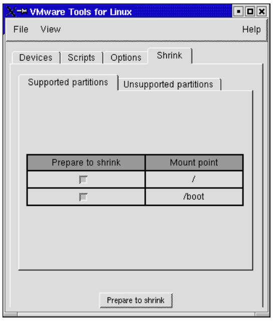
□ Time synchronization between the virtual machine and the host operating system

NOTE You can synchronize the time in the guest operating system with the time in the host operating system only when the time in the guest is earlier than the time in the host.

To completely disable time synchronization, see "Disabling Time Synchronization" on page 70.

Shrinking Virtual Disks with VMware Tools

The Shrink tab gives you access to the controls you need to reclaim unused space in a virtual disk.



Prepare to shrink	Mount point
□	/
□	/boot

To shrink virtual disks, you should run VMware Tools as the root user (`su -`). If you shrink the virtual disk as a non-root user, you cannot prepare to shrink the parts of the virtual disk that require root-level permissions.

NOTE The shrink process affects all disks—not only the disks that you prepare to shrink.

For more information about shrinking virtual disks, see "Defragmenting and Shrinking Virtual Disks" on page 125.

Configuring VMware Tools in a NetWare Virtual Machine

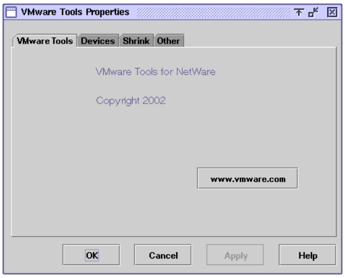
This section discusses the options available in a NetWare 6.5, 6.0, or 5.1 guest. VMware Tools does not include a control panel for NetWare 4.2 because that version of Netware does not include a graphical user interface. You can configure certain virtual machine options such as time synchronization, CPU idling, and device configuration with VMware Tools in a NetWare 4.2 guest in the system console. For more information, see "Configuring VMware Tools for NetWare Guests in the System Console" on page 66.

Configuring VMware Tools in a NetWare 6.5, 6.0, or NetWare 5.1 Guest

To open the VMware Tools control panel, choose **Novell** > **Settings** > **VMware Tools for NetWare**.

Viewing Information About VMware Tools

For general information about VMware Tools, click the **VMware Tools** tab.



VMware Tools for NetWare

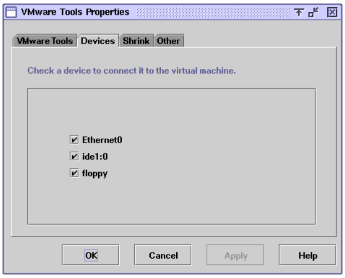
Copyright 2002

This tab contains:

- Copyright information.
- A button you click to visit the VMware Web site.

Connecting Devices with VMware Tools

The Devices tab allows you to enable or disable removable devices. Removable devices include the floppy and CD-ROM drives and the virtual network adapter.



Check a device to connect it to the virtual machine.

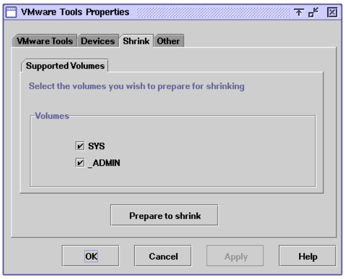
☑ Ethernet0
☑ ide1:0
☑ floppy

To connect a device, select the check box next to the device. To disconnect the device, deselect the check box next to the device.

NOTE You can also set these options from the **VM** > **Removable Devices** menu in the virtual machine window.

Shrinking Virtual Disks with VMware Tools

The Shrink tab gives you access to the controls you need to reclaim unused space in a virtual disk.



Supported Volumes

Select the volumes you wish to prepare for shrinking

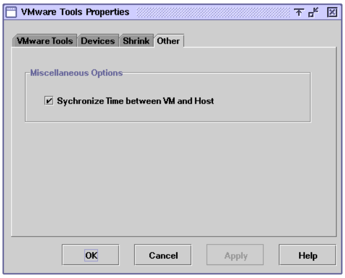
Volumes

☑ SYS
☑ _ADMIN

For more information about shrinking virtual disks, see "Defragmenting and Shrinking Virtual Disks" on page 125.

Setting Options with VMware Tools

The Other tab gives you the option to synchronize the time in the guest operating system with the time in the host operating system.



☑ Sychronize Time between VM and Host

NOTE You can synchronize the time in the guest operating system with the time in the host operating system only when the time in the guest is earlier than the time in the host.

To completely disable time synchronization, see "Disabling Time Synchronization" on page 70.

Configuring VMware Tools for NetWare Guests in the System Console

You can configure certain virtual machine options such as time synchronization, CPU idling, and device configuration with VMware Tools in a NetWare virtual machine using the system console. The VMware Tools command line program is called `vmwtool`.

To see the options associated with this command, type `vmwtool help` at the system console.

When VMware Tools is installed in a NetWare guest, a heartbeat is always sent from the virtual machine to VMware Server. You can verify the virtual machine's heartbeat by viewing information about this virtual machine in the VMware Management Interface. For more information, see "Monitoring the Virtual Machine's Heartbeat".

In addition, you can gracefully power the virtual machine on or off in the VMware Management Interface. To power a virtual machine on or off with the VMware Management Interface, see "Changing a Virtual Machine's Power State from the Management Interface" on page 90. Because scripts are not available for NetWare virtual machines, no scripts are run.

Summary of VMware Tools Commands for a NetWare Guest

Each command in the following table must be entered into the system console after the VMware Tools command `vmwtool`. Use the following format:
`vmwtool <command>`to enter commands.

Table 3-3.

`vmwtool` Command	Definition
`help`	Displays a summary of VMware Tools commands and options in a NetWare guest.
`partitonlist`	Displays a list of all disk partitions in the virtual disk and whether or not a partition can be shrunk.
`shrink <partition>`	Shrinks the listed partitions. If no partitions are specified, all partitions in the virtual disk are shrunk. The status of the shrink process appears at the bottom of the system console. For more information, see "Defragmenting and Shrinking Virtual Disks" on page 125.
`devicelist`	Lists each removable device in the virtual machine, its device ID and whether the device is enabled or disabled. Removable devices include the virtual network adapter, CD-ROM and floppy drives.
`disabledevice <device name>`	Disables the specified device or devices in the virtual machine. If no device is specified, all removable devices in the virtual machine are disabled. **Note:** You can also disable devices from the **VM** > **Removable Devices** menu in the VMware Server console window.
`enabledevice <device name>`	Enables the specified device or devices in the virtual machine. If no device is specified, all removable devices in the virtual machine are enabled. **Note:** You can also enable devices from the **VM** > **Removable Devices** menu in the VMware Server console window.

Table 3-3.

`vmwtool` Command	Definition
`synctime [on|off]`	Lets you enable or disable time synchronization between the guest operating system and the host operating system. By default, time synchronization is disabled. Use this command without any options to view the current time synchronization status. You can synchronize the time in the guest operating system with time on the host operating system only when the time in the guest operating system is earlier than the time set in the host.
`idle [on|off]`	Lets you enable or disable the CPU idler. By default, the idler is turned on. The CPU idler program is included in VMware Tools for NetWare guests. The idler program is needed because NetWare servers do not idle the processor when the operating system is idle. As a result, a virtual machine takes processor time from the host regardless of whether the NetWare server software is idle or busy.

About the VMware Tools Service

When you install VMware Tools in a virtual machine, the VMware Tools service is one of the primary components installed. The service does the following:

- Synchronizes the time of the guest operating system with the time in the host operating system.
- Runs scripts in a virtual machine when the power state changes. See "Executing Scripts When the Virtual Machine's Power State Changes" on page 55.
- Executes commands in the virtual machine when you shut down or restart a Linux or Solaris guest operating system.
- Sends a heartbeat to VMware Server so that it knows the guest operating system is running. A gauge for this heartbeat appears in the VMware Management Interface. For more information, see "Using the Status Monitor".
- Passes messages from the host operating system to the guest operating system.
- Passes information between the guest operating system and a VMware Scripting API script.

The service starts when you boot the guest operating system.

In a Windows guest, the VMware Tools service program file is called `VMwareService.exe`. Help is available by right-clicking the VMware Tools icon in the system tray and choosing **Help**.

In a Linux or Solaris guest, the VMware Tools service is called `vmware-guestd`. To display help about the service, including a list of all options, use the following command:

```
/usr/sbin/vmware-guestd --help
```

This section covers the following topics:

- "Synchronizing the Time in the Guest OS with the Host OS" on page 69
- "Executing Commands After You Power Off or Reset a Virtual Machine" on page 70
- "Passing a String from the Host OS to the Guest OS" on page 70
- "Passing Information Between the Guest OS and a VMware API Script" on page 73

Synchronizing the Time in the Guest OS with the Host OS

The VMware Tools service can synchronize the date and time in the guest operating system with the time in the host operating system once every minute. To enable time synchronization for a Windows guest, see "Setting Options with VMware Tools" on page 57. To enable time synchronization for a Linux, FreeBSD, or Solaris guest, see "Setting Options with VMware Tools" on page 63. To enable time synchronization for a NetWare guest, see "Setting Options with VMware Tools" on page 66.

Synchronizing Guest Time in Response to System Events

The service synchronizes the date and time in the guest with the time in the host in response to various system events. These events include:

- Taking a snapshot. In the virtual machine's configuration file (`.vmx`), this setting is represented by the `time.synchronize.continue` option.
- Reverting to a snapshot. In the virtual machine's configuration file (`.vmx`), this setting is represented by the `time.synchronize.restore` option.
- Resuming a suspended virtual machine. In the virtual machine's configuration file (`.vmx`), this setting is represented by the `time.synchronize.resume.disk` option.
- Shrinking the virtual disk. In the virtual machine's configuration file (`.vmx`), this setting is represented by the `time.synchronize.shrink` option.

Disabling Time Synchronization

To disable time synchronization in the guest, open the virtual machine’s configuration file (`.vmx`) in a text editor and set the following options to `FALSE`.

```
tools.syncTime
tools.synchronize.restore
time.synchronize.resume.disk
time.synchronize.continue
time.synchronize.shrink
```

Executing Commands After You Power Off or Reset a Virtual Machine

In a Linux guest, you can have the VMware Tools service execute specific commands when you shut down or restart the guest operating system. This is in addition to any script that you might have specified to run when you shut down the guest operating system.

To execute these commands, you need to modify `/etc/vmware-tools/tools.conf`. The commands are:

```
halt-command = <command>
```

(where `<command>` is the command to execute when you shut down the guest operating system)

```
reboot-command = <command>
```

(where `<command>` is the command to execute when you restart the guest operating system)

Passing a String from the Host OS to the Guest OS

With VMware Server and knowledge of a scripting language like Perl or NetShell (in a Windows 2000 guest operating system), you can pass a string from your virtual machine's configuration file in the host operating system to the guest operating system when you use the configuration file to launch a virtual machine.

What you pass to the guest operating system is up to you. You should pass a string only if you have a good understanding of a scripting language and know how to modify system startup scripts.

There are two ways of passing strings to a virtual machine's guest operating system:

1. You can place a string in the virtual machine's configuration file by setting the string to the `machine.id` parameter.

   For example, you can set this string:
   `machine.id = "Hello World."`

2. You pass the string to the guest operating system from the command line when you launch the virtual machine. See example 1 below.

You can pass items like the Windows system ID (SID), a machine name or an IP address. Inside the guest operating system startup script, you have the service retrieve this string, which can then be used in another script you write and include in the startup script to set your virtual machine's system ID, machine name, or IP address.

This way, you can make copies of the same configuration file, add a different string to each (either in the configuration file itself or at the command line), then use these variations of the same configuration file to launch the same virtual disk in nonpersistent mode multiple times in a training or testing environment, for example.

This is what portions of two configuration files that point to the same virtual disk might look like. Each configuration file contains its own unique string set for the `machine.id` parameter.

`<config_file_1>.vmx` contains:

```
ide0:0.present = TRUE
ide0:0.fileName = "my_common_virtual_hard_drive.vmdk"
machine.id = "the_string_for_my_first_vm"
```

`<config_file_2>.vmx` contains:

```
ide0:0.present = TRUE
ide0:0.fileName = "my_common_virtual_hard_drive.vmdk"
machine.id = "the_string_for_my_second_vm"
```

Passing a string is also useful in situations where you want to deploy virtual machines on a network using a common configuration file, while providing each machine with its own unique identity. In this case, you specify the string at the command line (you need to launch each virtual machine with the `vmware -s` command) when you launch each virtual machine using this configuration file. See example 1 below.

Each virtual machine disk file must be copied into its own directory if it shares its filename with another virtual machine disk file.

The following example uses a Windows host and guest to illustrate how you can use the service to retrieve a string containing what will become the virtual machine's machine name and IP address. In this example, W2K-VM is the machine name and 148.30.16.24 is the IP address.

1 Define a string. Do this by either:

   - Adding the following line to your virtual machine's configuration file:
     `machine.id = "W2K-VM 148.30.16.24"`
     then launching a virtual machine using this configuration file.

   - Launching a virtual machine from the command line. At the command line, type:
     ```
     “C:\Program Files\VMware\VMware Server\vmware -s 'machine.id=W2K-VM
     148.30.16.24' C:\Virtual Machines\win2000\win2000.vmx”
     ```

NOTE Write the above command on one line.

NOTE On a Linux host, the machine ID passed on the command line takes precedence and is passed to the guest operating system if the following conditions are met:

   - A virtual machine ID is specified in a configuration file.
   - You use that file to launch a virtual machine.
   - You also specify a machine ID on the command line.

2 Retrieve the string in the virtual machine. In a Windows guest, the command to retrieve the string is
   ```
   VMwareService --cmd machine.id.get
   ```

NOTE In your Linux guest operating system’s startup script, add the following command before the network startup section:
```
/etc/vmware/vmware-guestd --cmd 'machine.id.get'
```

You need to further customize this startup script so it uses the string the service retrieved during startup to set the virtual machine's network name to W2K-VM and its IP address to 148.30.16.24. This string should be located in the script before the network services are started. If you're using a Windows 2000 guest operating system, for example, you can call the NetShell utility (`netsh`) and pass it the contents of the string, which then uses the string accordingly (that is, it can set a new IP address for the virtual machine, if that is what was passed in the string originally).

From your host operating system, you can prevent a string from being passed to the guest operating system via the service. To do this, set the following line in your virtual machine's configuration file:

```
isolation.tools.getMachineID.disable = TRUE
```

Passing Information Between the Guest OS and a VMware API Script

When the guest operating system is running inside a virtual machine, the VMware Tools service allows you to pass information from a VMware Scripting API script you created (that is running in another host machine) to the guest operating system and from the guest operating system to a script.

For more information, go to the VMware Web site at **www.vmware.com/support/developer**.

CHAPTER 4 Running Virtual Machines

After you have installed VMware Server, a guest operating system, and VMware Tools, you are ready to run your virtual machine. This chapter describes the most common tasks to run virtual machines and covers the following topics:

- "Overview of the VMware Server Console Window" on page 75
- "Connecting to Virtual Machines and VMware Server Hosts" on page 82
- "Changing the Power State of a Virtual Machine" on page 88
- "Controlling the Virtual Machine Display" on page 95
- "Running Virtual Machines from DVDs or CD-ROM Discs" on page 98
- "Running Virtual Machines from DVDs or CD-ROM Discs" on page 98
- "Using PXE with Virtual Machines" on page 100
- "Installing Software in a Virtual Machine" on page 101
- "Cutting, Copying, and Pasting Text" on page 102
- "Using Devices in a Virtual Machine" on page 102
- "Command Reference" on page 104

For purposes of illustration, the examples in these sections use a Windows Server 2003 guest operating system. Some commands used in the illustrations are different from those used in other guest operating systems.

Overview of the VMware Server Console Window

The following sections provide an overview of the VMware Server Console:

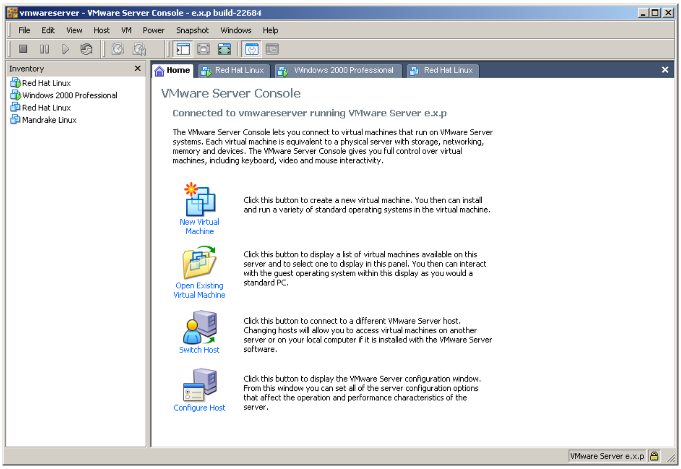
- "Using the Home Tab" on page 77
- "Using Tabs" on page 78
- "Configuring a Virtual Machine" on page 79
- "Using the Virtual Machine Inventory" on page 79
- "Displaying Hints" on page 80

- "Checking the Status of VMware Tools" on page 80
- "Creating a Screen Shot of a Virtual Machine" on page 81

Think of a VMware Server virtual machine as a separate computer that runs in a window on your physical computer's desktop. The VMware Server Console lets you connect to multiple virtual machines and switch easily from one to another.

When you first connect the VMware Server Console to a VMware Server host, the Home tab appears in the virtual machine display. The Home tab indicates whether you are connecting to GSX 3 Server or VMware Server and the version of the server software. The status bar of the VMware Server Console window also displays this information.

NOTE VMware supports connecting to VMware GSX Server 3 hosts and using virtual machines created with VMware GSX Server 3 as legacy machines. You can also upgrade the virtual hardware of those virtual machines. You must upgrade the hardware of virtual machines created under VMware GSX Server 2. You cannot connect to VMware ESX Server from VMware Server. For more information see, "Migrating from GSX Server to VMware Server" in the *VMware Server Administration Guide*.



VMware Server Console

Connected to vmwareserver running VMware Server e.x.p

The VMware Server Console lets you connect to virtual machines that run on VMware Server systems. Each virtual machine is equivalent to a physical server with storage, networking, memory and devices. The VMware Server Console gives you full control over virtual machines, including keyboard, video and mouse interactivity.

Click this button to create a new virtual machine. You then can install and run a variety of standard operating systems in the virtual machine.

Click this button to display a list of virtual machines available on this server and to select one to display in this panel. You then can interact with the guest operating system within this display as you would a standard PC.

Click this button to connect to a different VMware Server host. Changing hosts will allow you to access virtual machines on another server or on your local computer if it is installed with the VMware Server software.

Click this button to display the VMware Server configuration window. From this window you can set all of the server configuration options that affect the operation and performance characteristics of the server.

If you are connecting to a GSX 3 Server some of the controls and functionality of the interface change to accommodate the differences between the features available to that product. To see a list of what is different, see "Connecting to VMware GSX Server and Older Virtual Machines" on page 86.

Menu Layouts

The following table lists the locations for the most commonly used menu items.:

Table 4-1.

Menu Items
File > New > Virtual Machine
File > New > Window
File > Exit
VM > Removable Devices
Host > Settings (for global host settings) and Edit > Preferences (for user settings)
VM > Settings
Host > Virtual Network Settings
VM > Install VMware Tools
VM > Upgrade Virtual Hardware
VM > Send Ctrl+Alt+Del
VM > Grab Input

Using the Home Tab

You can use the Home tab to quickly create new virtual machines, open existing virtual machines, connect to other VMware Server hosts, and set global preferences for the current VMware Server host.

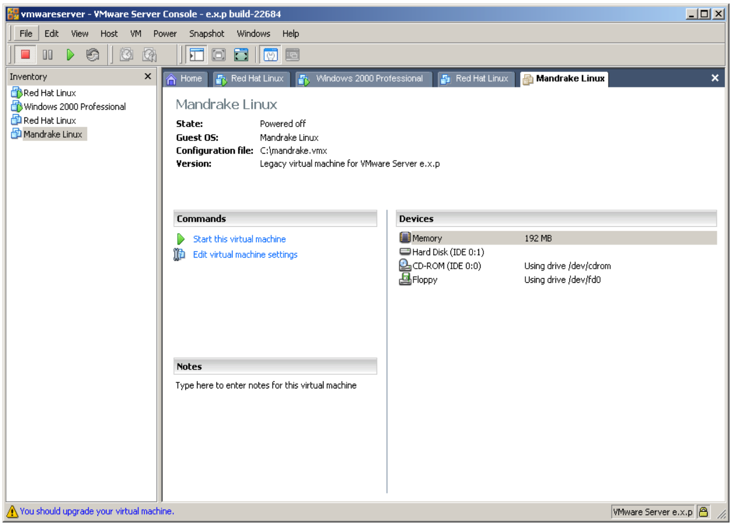
- For information on creating virtual machines, see "Creating a New Virtual Machine with the Virtual Machine Wizard" on page 27.
- For information on opening an existing virtual machine, see "Connecting to Virtual Machines and VMware Server Hosts" on page 82.
- For information on changing hosts, see "Connecting to a Different VMware Server Host" on page 85.
- For information on configuring the VMware Server host, see "Setting Global Preferences for VMware Server".

Opening Virtual Machines from the Inventory list

In VMware Server, you can open multiple virtual machines located on the same server host in the same VMware Server Console window. You can run multiple consoles and have each connect to virtual machines on different servers. Be sure you have enough memory and processor power to handle the number of virtual machines you want to run.

Selecting virtual machines in the **Inventory** list opens them in new tabs. If the virtual machine is already running, its desktop appears in the virtual machine display.

If the virtual machine is suspended or powered off, the virtual machine display lists information about the virtual machine, including its power state, the guest operating system, the location of the configuration file, and whether the virtual machine is configured for VMware Server or VMware GSX Server 3.



Mandrake Linux

State: Powered off
Guest OS: Mandrake Linux
Configuration file: C:\mandrake.vmx
Version: Legacy virtual machine for VMware Server e.x.p

Commands

Start this virtual machine
Edit virtual machine settings

Devices

Memory	192 MB
Hard Disk (IDE 0:1)	
CD-ROM (IDE 0:0)	Using drive /dev/cdrom
Floppy	Using drive /dev/fd0

Notes

Type here to enter notes for this virtual machine

You should upgrade your virtual machine.

VMware Server e.x.p

Figure 4-1. With the virtual machine powered off or suspended, you can enter notes about it, edit its settings or start it. Double-click on a device to configure it.

For information about the inventory, see "Using the Virtual Machine Inventory" on page 79.

Instead of using physical buttons to turn this computer on and off, you use buttons on the toolbar at the top of the VMware Server Console window.

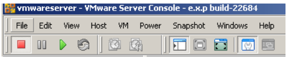


Figure 4-2. Toolbar when a virtual machine is powered off (as seen on a Windows host)

There are separate Power Off and Power On buttons. When you suspend a virtual machine, the Power On button becomes a Resume button.

Using Tabs

When a virtual machine is active, its virtual machine name appears on a tab at the top of the virtual machine display. To switch from one virtual machine display to another, click the tab of the virtual machine you want to see. It’s like a soft KVM switch. You can use this feature in the windowed view and also in the quick switch view.

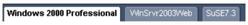


Figure 4-3. Tabs make it easy to switch among active virtual machines (as seen on a Windows host)

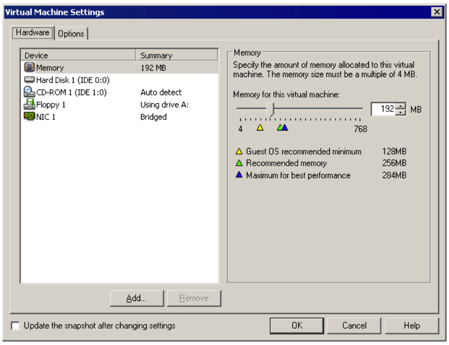
You can close a virtual machine’s tab without interrupting the operation of the virtual machine. If the virtual machine is running when you close the tab, the virtual machine keeps running in the background and will be running when you open it in a tab again.

To view the virtual machine in the virtual machine display again, click the virtual machine in the inventory. If you close the Home tab, you can open it again by choosing **View** > **Go to Home Tab**.

If you want to view more than one virtual machine at the same time, you can open multiple console windows and launch one or more virtual machines in each. To view virtual machines on different servers, connect a new console to each server.

Configuring a Virtual Machine

To change settings for a virtual device, use the virtual machine settings editor. Choose **VM** > **Settings**, click the device name in the list on the left, then make changes on the right.



Device	Summary
Memory	192 MB
Hard Disk 1 (IDE 0:0)	
CD-ROM 1 (IDE 1:0)	Auto detect
Floppy 1	Using drive A:
NIC 1	Bridged

Memory

Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4 MB.

Memory for this virtual machine: 192 MB

Guest OS recommended minimum	128MB
Recommended memory	256MB
Maximum for best performance	284MB

□ Update the snapshot after changing settings

Figure 4-4. Use the virtual machine settings editor to add, remove and modify virtual machine components

For more information, see “Using Devices in a Virtual Machine” on page 102.

Using the Virtual Machine Inventory

When you create a virtual machine with VMware Server it is added to the inventory automatically. This allows the virtual machine to be accessed by a VMware Server Console and the VMware Management Interface.

The inventory gives you a convenient way to open virtual machines. To add a virtual machine to the inventory (for example, if you copied the virtual machine from another host, you need to add it to the inventory manually), choose **File** > **Open**, click **Browse,** and browse to the virtual machine's configuration (`.vmx`) file.

Indicators on the icons for virtual machines in the list show whether a virtual machine is powered off, powered on or suspended.

To toggle the display of the inventory on or off, press `F9` on both Windows and Linux hosts. On Windows hosts only, you can also click the inventory button (▤) on the toolbar.

Removing a Virtual Machine from the Inventory

If you do not currently need to use a virtual machine, but do not want to delete it, you can remove it from the inventory instead. The virtual machine no longer appears in the VMware Server Console or the VMware Management Interface.

Removing the virtual machine from the list does not affect the virtual machine's files.

To remove a name from the Inventoy

1 Select a virtual machine name in the list.

2 Choose **File** > **Remove from Inventory**.

Displaying Hints

VMware Server can display hints that appear in response to various actions you take when you run a virtual machine. The hints provide more information about these actions. By default, hints are turned off. VMware recommends that users new to VMware Server display hints. To display hints, choose **Help** > **Hints** > **Show Enabled Hints** in the VMware Server Console. To enable hints that were disabled, choose **Help** > **Hints** > **Enable All Hints**.

You can hide each hint on a case by case basis. To hide a hint, check **Never show this hint again** before dismissing the hint dialog box. To enable hints that were disabled, choose **Help** > **Hints** > **Enable All Hints**.

Checking the Status of VMware Tools

For best performance, you should install VMware Tools and run in your virtual machine. For more information about VMware Tools, see "Using VMware Tools" on page 39.

After you install VMware Tools in a Windows virtual machine, the VMware Tools services start automatically when you start the guest operating system.

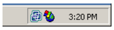


Figure 4-5. When VMware Tools is running in a Windows virtual machine, the VMware Tools icon appears in the system tray unless you disable the icon.

If the VMware Tools icon is not displayed in the system tray, use the VMware Tools control panel in the guest operating system (**Start** > **Settings** > **Control Panel** > **VMware Tools**) to change settings for VMware Tools. You can also reactivate the system tray icon. On the Options tab, check **Show VMware Tools in the taskbar**.

In a Linux or FreeBSD virtual machine, boot the guest operating system, start X, and launch your graphical environment. Launch the VMware Tools background application with this command:

```
vmware-toolbox &
```

You can run VMware Tools as root or as a normal user. To shrink virtual disks, you must run VMware Tools as root (`su -`). To test and edit scripts, you must run VMware Tools as the root user.

In a NetWare 5.1 or higher guest operating system, you access the VMware Tools control panel by choosing **Novell** > **Settings** > **VMware Tools for NetWare**.

With some window managers, you can place the command to start VMware Tools automatically when you start your graphical environment. Consult your window manager's documentation for details. For more information, see "Starting VMware Tools Automatically" on page 53.

A Reminder About Installing VMware Tools

An alert appears in the status bar — at the lower left corner of the VMware Server window — when your virtual machine is not running the version of VMware Tools that matches your version of VMware Server.

You do not have VMware Tools installed.

To launch the VMware Tools installer, choose **VM** > **Install VMware Tools**.

NOTE Your guest operating system must be completely installed and running when you install VMware Tools.

For details, see "Installing VMware Tools" on page 41.

Creating a Screen Shot of a Virtual Machine

You can capture a screen shot of a virtual machine using **VM** > **Capture Screen**. You can save this image as a bitmap (`.bmp`) file on a Windows host or as a portable network graphics (`.png`) file on a Linux host.

Connecting to Virtual Machines and VMware Server Hosts

This section covers the following topics:

- "Connecting to a Virtual Machine from a Windows Host or Client" on page 82
- "Connecting to a Virtual Machine from a Linux Host or Client" on page 84
- "Connecting to a Virtual Machine from the VMware Management Interface" on page 85
- "Connecting to a Different VMware Server Host" on page 85
- "Connecting to VMware GSX Server and Older Virtual Machines" on page 86

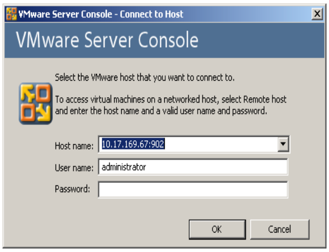
Connecting to a Virtual Machine from a Windows Host or Client

To view a particular virtual machine's desktop, either from a remote client or the local client, attach the VMware Server Console and connect to the virtual machine.

To connect to a virtual machine from a Windows host:

1 Start the VMware Server Console, either by clicking on the VMware Server Console icon or by going to **Start** > **Programs** > **VMware** > **VMware Server** > **VMware Server Console**.

The VMware Virtual Machine Console - Connect to Host dialog box appears.



Select the VMware host that you want to connect to.

To access virtual machines on a networked host, select Remote host and enter the host name and a valid user name and password.

Host name: 10.17.169.67:902

User name: administrator

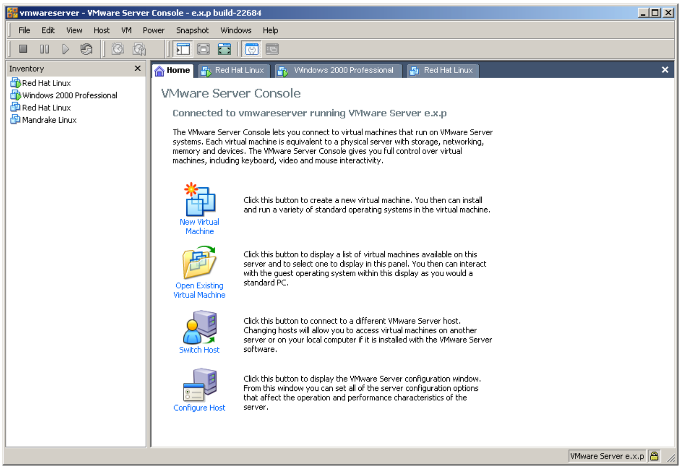
Password:

If you are connecting from the local host, select local host.
To connect to a remote host, specify the host name, user name, and password to connect to that host, and click **OK**.

NOTE If this is the first time you have launched VMware Server and you did not enter the serial number when you installed the product (an option available on a Windows host), you are prompted to enter it. The serial number is in the email message that came with your electronic distribution. Enter your serial number and click **OK**.

The serial number you enter is saved and VMware Server does not ask you for it again. For your convenience, VMware Server automatically sends the serial number to the VMware Web site when you use certain Web links built into the product (for example, **Help** > **VMware on the Web** > **Register Now!** and **Help** > **VMware on the Web** > **Request Support**). This allows us to direct you to the correct Web page to register and get support for your product.

The VMware Server Console window opens.



Connected to vmwareserver running VMware Server e.x.p

The VMware Server Console lets you connect to virtual machines that run on VMware Server systems. Each virtual machine is equivalent to a physical server with storage, networking, memory and devices. The VMware Server Console gives you full control over virtual machines, including keyboard, video and mouse interactivity.

Click this button to create a new virtual machine. You then can install and run a variety of standard operating systems in the virtual machine.

Click this button to display a list of virtual machines available on this server and to select one to display in this panel. You then can interact with the guest operating system within this display as you would a standard PC.

Click this button to connect to a different VMware Server host. Changing hosts will allow you to access virtual machines on another server or on your local computer if it is installed with the VMware Server software.

Click this button to display the VMware Server configuration window. From this window you can set all of the server configuration options that affect the operation and performance characteristics of the server.

2 Select the name of the virtual machine in the **Inventory** list at the left of the VMware Server Console window.

If the virtual machine does not appear in the inventory, choose **File** > **Open**, click **Browse** and browse to the configuration (`.vmx`) file for the virtual machine to use.

NOTE By default, VMware Server stores virtual machines in `<installdrive>:\Virtual Machines\<guestOS>`.

3 To start a virtual machine, click the **Power On** button.

4 If VMware Tools is not running in the virtual machine, click anywhere inside the virtual machine window to give the virtual machine control of your mouse and keyboard.

5 To log on, use Ctrl-Alt-Ins—not Ctrl-Alt-Del—and type your name and password just as you do on a physical computer. If you use Ctrl-Alt-Del, the Windows host detects the command.

Connecting to a Virtual Machine from a Linux Host or Client

To view a particular virtual machine's desktop from a local Linux host, a remote Linux host running VMware Server or a client, attach the VMware Server Console and connect to the virtual machine.

You need an X server to run the VMware Server Console. If an X server is not installed, you must install `libxpm.so.4`, located on your Linux distribution disk.

1 Start the VMware Server Console. Open a terminal window.

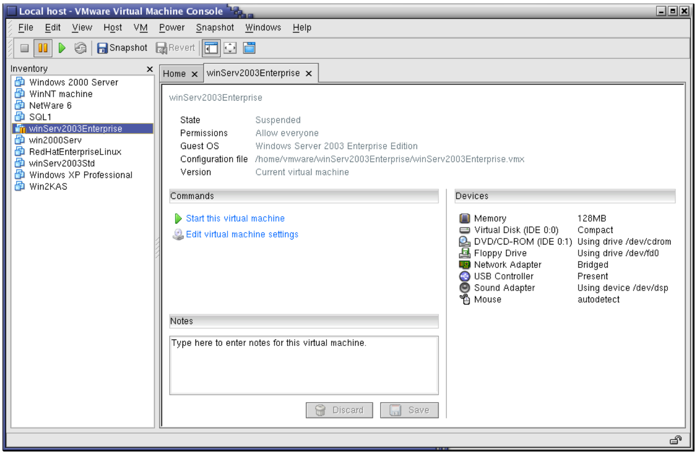
2 To connect the VMware Server Console to a virtual machine, type:

`vmware & for either a local or remote host`Press Enter.
The Connect to Host dialog box appears.

3 If you are connecting from a local host, select Local host, and click Connect.

To connect to a remote host, select Remote host, and specify the host name, user name, and password. Click Connect.

The VMware Server Console window opens.



winServ2003Enterprise

State	Suspended
Permissions	Allow everyone
Guest OS	Windows Server 2003 Enterprise Edition
Configuration file	/home/vmware/winServ2003Enterprise/winServ2003Enterprise.vmx
Version	Current virtual machine

Type here to enter notes for this virtual machine.

Memory	128MB
Virtual Disk (IDE 0:0)	Compact
DVD/CD-ROM (IDE 0:1)	Using drive /dev/cdrom
Floppy Drive	Using drive /dev/fd0
Network Adapter	Bridged
USB Controller	Present
Sound Adapter	Using device /dev/dsp
Mouse	autodetect

4 Select the name of the virtual machine you want to use in the **Inventory** list at the left of the VMware Server Console window.

If the virtual machine does not appear in the Inventory, choose **File** > **Open** and click **Browse** to locate the configuration file (`.vmx` or `.cfg` file) for the virtual machine you want to use.

NOTE By default, VMware Server stores virtual machines in `/var/lib/vmware/Virtual Machines/<guestOS>`.

5 To start the virtual machine, click the **Power On** button.

6 If VMware Tools is not running in the virtual machine, click anywhere inside the virtual machine display to give the virtual machine control of your mouse and keyboard.

7 To log on, type in your name and password just as you do on a physical computer.

Connecting to a Virtual Machine from the VMware Management Interface

To view a particular virtual machine's desktop, you can attach the VMware Server Console and connect to the virtual machine.

From the VMware Management Interface, click the terminal icon (🖥) in the row for the virtual machine to which you want to connect with the VMware Server Console. For more information, see "Connecting to a Virtual Machine from a Windows Host or Client" on page 82 and "Connecting to a Virtual Machine from a Linux Host or Client" on page 84.

Connecting to a Different VMware Server Host

Each VMware Server Console can connect to one VMware Server host at a time. To switch hosts from the VMware Server Console, complete the following steps.

1 From a VMware Server Console, choose **Host** > **Switch Host**. The Switch Host dialog box appears.

2 Choose whether to connect to the local host or another VMware Server host.

- To connect to a virtual machine on another VMware Server host, specify the host name, user name, and password to connect to that host, then click **OK**.

If you were already connected to a different VMware Server host, you lose that connection.

Connecting to VMware GSX Server and Older Virtual Machines

When you connect a VMware Server Console from VMware Server to VMware GSX Server 3, the VMware Server Console controls adapt to VMware GSX Server. Features introduced in VMware Server, such as Virtual SMP, are not available on virtual machines running VMware GSX Server 3.

As discussed in "Overview of the VMware Server Console Window" on page 75, the Home tab and the status bar in the VMware Server Console window display the type—VMware GSX Server 3 or VMware Server—and version of the server to which you are connecting.

If you are running VMware Server with a virtual machine created under VMware GSX Server 3, the virtual machine's summary information indicates that it is a **legacy** virtual machine. If the virtual machine was created using VMware Server or Workstation 5.x, the virtual machine is considered to be a **current** virtual machine when run under VMware Server. Look for the **Version** information in the virtual machine display when the virtual machine is not running.

In addition, the virtual machine settings editor identifies a virtual machine as a legacy virtual machine.

NOTE To determine which version of another VMware product is older than VMware Server, see the *VMware Virtual Machine Mobility Planning Guide* on the VMware Web site. This guide also discusses moving virtual machines between VMware products.

If you are running an older virtual machine on a VMware Server host, the virtual machine is considered a legacy virtual machine until you upgrade the virtual hardware. Some legacy virtual machine settings are disabled. For example, you cannot add physical disks to a legacy virtual machine on a current VMware Server host.

The abilities and limitations of connecting the VMware Server Console to older servers and older virtual machines are outlined below.

Configuring the Host

You can configure a host running VMware Server or VMware GSX Server 3 only. You cannot configure a host running any other version of VMware GSX Server or any other VMware product.

Creating and Deleting Virtual Machines

You can create new virtual machines on the VMware GSX Server 3 host from the VMware Server Console. You can also delete virtual machines running on a VMware GSX Server 3 host from the VMware Server Console.

Upgrading Virtual Hardware

Using the VMware Server Console, you can upgrade the virtual hardware of legacy virtual machines only to the virtual hardware level supported by the VMware GSX Server 3 or VMware Server host that it resides on. To upgrade the virtual hardware of a legacy virtual machine created using VMware GSX Server 2, you must uninstall VMware GSX Server on the host and install VMware Server.

After you upgrade the virtual hardware, the virtual machine is no longer considered to be a legacy virtual machine. For more information on how to upgrade the virtual hardware of a legacy virtual machine, see "Upgrading Virtual Hardware" in the *VMware Server Administration Guide*.

Virtual Disk Modes

You can specify a disk mode for persistent or nonpersistent virtual disks. For a discussion of disk modes, see "Adding Virtual Disks to a Virtual Machine" on page 132.

If you are running a legacy virtual machine on a VMware Server host, the virtual machine's disk modes are honored but cannot be modified. Independent disk modes do not apply (see "Independent Disks" on page 121). For information on how snapshots work with disk modes, see "Snapshots and Legacy Disk Modes" on page 117.

Using Snapshots

You can take snapshots of virtual machines running on VMware GSX Server 3 when connected to the VMware GSX Server host from a VMware Server host. You cannot take snapshots of legacy virtual machines running on a VMware Server host. For more information, see "Snapshots and Legacy Disk Modes" on page 117.

Virtual CD-ROM Drive Differences

You can enable raw access for the virtual machine. This is known as legacy emulation in VMware Server.

Virtual Network Interface Card (NIC)

If you are running a VMware GSX Server 3 virtual machine, you can choose the `vmxnet` adapter only if the guest operating system is Windows 2000, Windows XP or Windows Server 2003.

Product Messages

Messages that the VMware Server Console displays are based on the version of the server to which you are connecting. References to menu items, interface elements and product terminology are relevant to that server type and version, not necessarily to the current version of VMware Server.

Viewing the Tip of the Day

You can view the tip of the day when you are connected to a VMware GSX Server 3 host.

Changing the Power State of a Virtual Machine

The following topics discuss ways you change a virtual machine's power state:

- "Using Power Options for Virtual Machines" on page 88
- "Suspending and Resuming Virtual Machines" on page 91
- "Shutting Down a Virtual Machine" on page 92
- "Powering Virtual Machines On and Off" on page 92

Using Power Options for Virtual Machines

The basic power operations for a virtual machine include powering on, powering off, suspending, resuming, and resetting. These options are analogous to the power operations on a physical computer.

If VMware Tools is running, you can run scripts when you change the power state of a virtual machine. For more information, see "Executing Scripts When the Virtual Machine's Power State Changes" on page 55.

When you reset a virtual machine, you can choose either to restart the guest operating system, which gracefully closes applications and restarts the guest operating system, or to reset the virtual machine, which is the same as pressing the reset button on a physical computer.

Similarly, when you power off the virtual machine, you can choose either to shut down the guest operating system, which gracefully closes applications and shuts the guest operating system down, or to turn off the virtual machine, which is the same as pressing the power button on a physical computer.

All the power options are available on the **Power** menu. The menu items might not be available, depending upon the current power state of the virtual machine. For example, if the virtual machine is powered off, you cannot select any power off, suspend, resume, or reset options.

For the purpose of running scripts in the guest operating system, the commands on the **Power** menu take precedence over how the toolbar power buttons are configured.

For example, if the Suspend toolbar button is configured to run a script when you suspend the virtual machine, and you do not want to run the script, choose **Power** > **Suspend**. Similarly, if the Suspend toolbar button is not configured to run a script, and you want to run the script at the time you suspend the virtual machine, choose **Power** > **Suspend after running script**.

Options for Powering On a Virtual Machine

Choose from the following options when powering on a virtual machine:

- **Power On** — powers on the virtual machine. This is the same as clicking the **Power On** button on the toolbar. When the virtual machine is suspended, this menu item appears as **Resume**.
- **Power On and Run Script** — powers on the virtual machine, then executes the associated script.

Options for Powering Off a Virtual Machine

Choose from the following options when powering off a virtual machine:

- **Power Off** — powers off the virtual machine. This is similar to turning off a physical computer by pressing its power button, so any programs running in the virtual machine could be adversely affected.
- **Shut Down Guest** — runs the associated script, then gracefully shuts the guest operating system down and, if the guest operating system supports Advanced Power Management, powers off the virtual machine. This is the same as choosing **Start** > **Shut Down** > **Shut Down** in a Windows operating system or issuing a `shutdown` command in a Linux operating system.

You can configure the stop button (🟥) on the toolbar to power off the virtual machine or shut down the guest operating system. Choose **VM** > **Settings**, then click **Options** > **Power**, and choose the desired action in the list under **Power Controls**.

Options for Suspending a Virtual Machine

Choose from the following options when suspending a virtual machine:

- **Suspend** — suspends the virtual machine.
- **Suspend after Running Script** — executes the associated script, then suspends the virtual machine.

Options for Resuming a Virtual Machine

Choose from the following options when resuming a virtual machine:

- **Resume** — resumes the suspended virtual machine. When the virtual machine is powered off, this menu item appears as **Power On**.
- **Resume and Run Script** — resumes the suspended virtual machine, then executes the associated script.

Options for Resetting a Virtual Machine

Choose from the following options when resetting a virtual machine:

- **Reset** — resets the virtual machine. This is similar to resetting a physical computer by pressing its reset button, so any programs running in the virtual machine could be adversely affected.
- **Restart Guest** — gracefully restarts the virtual machine. This is the same as choosing **Start** > **Shut Down** > **Restart** in a Windows operating system or issuing a `reboot` command in a Linux operating system.

You can configure the reset button (🔄) on the toolbar to reset the virtual machine or restart the guest operating system. Choose **VM** > **Settings**, then click **Options** > **Power**, and choose the desired action in the list under **Power Controls**.

Changing a Virtual Machine's Power State from the Management Interface

Depending upon your permissions, you can change the power state of the virtual machine in the VMware Management Interface. Your permissions are listed in the **Users and Events** tab for the virtual machine. For more information, see "Viewing a List of Connected Users".

To change the virtual machine's power state, click the button that corresponds to the virtual machine's current power state. A pop-up menu appears, displaying the following buttons:

Table 4-2.

Button	Description
🟥	Shuts down the guest operating system and powers off the virtual machine. Any open applications close, the guest operating system shuts down, then VMware Server powers off the virtual machine. VMware Tools executes any script associated with this power state change. When this icon is red, the virtual machine is powered off.
⏸	Suspends a running virtual machine. VMware Tools executes any script associated with this power state change. When this icon is amber, the virtual machine is suspended.
▶	Powers on a stopped virtual machine or resumes a suspended virtual machine. VMware Tools executes any script associated with this power state change. When this icon is green, the virtual machine is running.
🔄	Restarts a guest operating system. Any open applications close, the guest operating system shuts down, then VMware Server restarts the guest. VMware Tools executes any script associated with this power state change.

Changing the power state executes any script associated with the power state change. For more information about running scripts, see "Executing Scripts When the Virtual Machine's Power State Changes" on page 55.

Suspending and Resuming Virtual Machines

You can save the current state of your virtual machine by suspending it. Later, you can resume the virtual machine to pick up work quickly, right where you stopped — with all documents you were working on open and all applications in the state they were at the time you suspended the virtual machine.

To suspend a virtual machine:

1 If your virtual machine is running in full screen mode, return to window mode by pressing the Ctrl-Alt key combination.

2 Click **Suspend** on the VMware Server Console toolbar.

To resume a suspended virtual machine:

1 Start the VMware Server Console and choose a suspended virtual machine. The process is the same as that described in "Connecting to Virtual Machines and VMware Server Hosts" on page 82.

2 Click **Resume** on the VMware Server Console toolbar.

Note that any applications you were running at the time you suspended the virtual machine are running and the content is the same as it was when you suspended the virtual machine.

For more information, see "Suspending and Resuming Virtual Machines" on page 109.

To suspend and resume a virtual machine from the VMware Management Interface, see "Changing a Virtual Machine's Power State from the Management Interface" on page 90.

Shutting Down a Virtual Machine

As with physical computers, you need to shut down your guest operating system before you power off your virtual machine. Follow the standard steps you also follow in the host operating system.

For example, in a Windows guest operating system, take these steps.

1. Select **Shut Down** from the **Start** menu of the guest operating system (inside the virtual machine).
2. Select **Shut Down**, then click **OK**.
3. After the guest operating system shuts down, you can turn off the virtual machine. Click **Power Off**.

Powering Virtual Machines On and Off

You can configure a virtual machine to power on automatically when the VMware Server host starts. When the host shuts down, you can specify whether to power off the virtual machine or shut down the guest operating system.

You can enable these settings as long as the startup and shutdown options are not disabled for the server. See "Configuring Startup and Shutdown Options for Virtual Machines".

To specify these options, the virtual machine must be configured to run as either the local system account or as a specific user. The virtual machine cannot be configured to run as the user that powers it on.

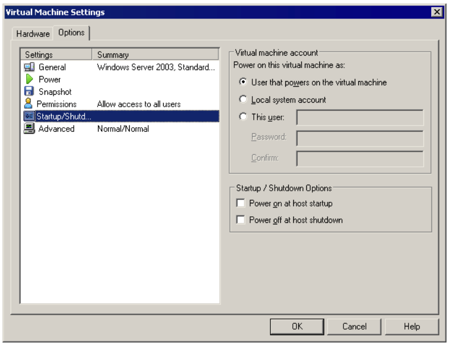
You can change the startup and shutdown options whether the virtual machine is powered on or powered off.

Setting Startup and Shutdown Options from the VMware Server Console

To configure a virtual machine's startup and shutdown options from the VMware Server Console, complete the following steps.

1 In the VMware Server Console, select the virtual machine, and choose **VM** > **Settings**. The virtual machine settings editor opens.

2 Click the **Options** tab, and click **Startup/Shutdown**.



Settings	Summary
General	Windows Server 2003, Standard...
Power	
Snapshot	
Permissions	Allow access to all users
Startup/Shutd...	
Advanced	Normal/Normal

Virtual machine account

Power on this virtual machine as:

● User that powers on the virtual machine

○ Local system account

○ This user:

Password:

Confirm:

Startup / Shutdown Options

□ Power on at host startup

□ Power off at host shutdown

3 Under **Startup/Shutdown Options**, choose whether you want this virtual machine to power on automatically when the VMware Server host starts up, and whether you want to power off the virtual machine or shut down the guest operating system when the host shuts down.

To power on the virtual machine when the host starts, select **Power on the virtual machine** in the **On host startup** list.

To power off the virtual machine — or shut down the guest — when the host shuts down, select the appropriate option in the **On host shutdown** list.

4 Click **OK** to save your changes and close the virtual machine settings editor.

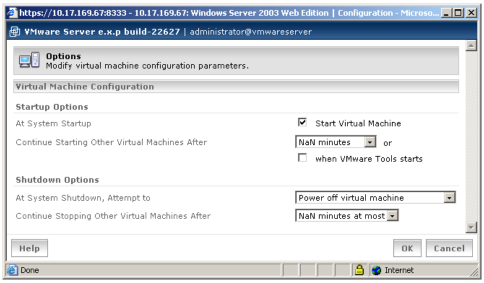
You cannot configure a virtual machine to start up or shut down automatically when the host starts or shuts down until the host is configured accordingly. To configure the host, see "Configuring Startup and Shutdown Options for Virtual Machines". You must log on to the VMware Management Interface as an administrator to configure the VMware Server host.

Setting Startup and Shutdown Options from the Management Interface

To configure a virtual machine's startup and shutdown options from the VMware Management Interface, complete the following steps.

1 On the Status Monitor page of the VMware Management Interface, click the virtual machine menu icon (▾), then choose **Configure Options**. The Options tab for the virtual machine appears.

2 Click **Edit** under **System Startup Options** or **System Shutdown Options**. The Options page appears.



https://10.17.169.67:8333 - 10.17.169.67: Windows Server 2003 Web Edition | Configuration - Microso...

VMware Server e.x.p build-22627 | administrator@vmwareserver

Options
Modify virtual machine configuration parameters.

Virtual Machine Configuration

Startup Options

At System Startup ☑ Start Virtual Machine

Continue Starting Other Virtual Machines After NaN minutes ▾ or
□ when VMware Tools starts

Shutdown Options

At System Shutdown, Attempt to Power off virtual machine ▾

Continue Stopping Other Virtual Machines After NaN minutes at most ▾

3 To allow the virtual machine to start up when the system starts up, check the **Start Virtual Machine** check box.

Specify the period of time before the next virtual machine starts in the **Continue Starting Virtual Machines After** list. Choose the number of minutes or whether VMware Server should not wait before starting the next virtual machine. If you select **Other**, a prompt appears; specify in the prompt the number of minutes to wait. The **System Default** is specified in "Configuring Startup and Shutdown Options for Virtual Machines".

To specify that VMware Tools should start in a virtual machine before the next virtual machine starts, check the **when VMware Tools starts** check box. If VMware Tools does not start in the virtual machine before the specified time elapses, VMware Server starts the next virtual machine.

4 Specify what happens to the virtual machine when the system shuts down. In the **At System Shutdown, Attempt to** list, select whether you want to power off the virtual machine, shut down the guest operating system, or suspend the virtual machine.

Configure when VMware Server should stop the next virtual machine after this virtual machine stops in the **Continue Stopping Other Virtual Machines After** list. Choose the number of minutes, if any, that VMware Server should wait before stopping the next virtual machine. If you select **Other**, a prompt appears; specify in the prompt the number of minutes to wait. The **System Default** is specified in "Configuring Startup and Shutdown Options for Virtual Machines".

5 Click **OK** to save your settings.

6 Click **Close Window** to return to the virtual machine's Options page.

Controlling the Virtual Machine Display

There are a variety of ways for you to control how your virtual machines display in the VMware Server Console window. They include:

- "Using Full Screen Mode" on page 95
- "Using Quick Switch Mode" on page 95
- "Taking Advantage of Multiple Monitors" on page 96
- "Fitting the VMware Server Console Window to the Virtual Machine" on page 97
- "Fitting a Windows Guest OS Display to the Console Window" on page 97
- "Simplifying the Screen Display" on page 98

Using Full Screen Mode

To have the virtual machine's display fill the screen — so you no longer see the borders of the VMware Server Console window — click the **Full Screen** button on the toolbar. You can also use a keyboard shortcut — press the Ctrl-Alt-Enter keys at the same time.

To exit full screen mode — to show your virtual machine inside a VMware Server Console window again — press the Ctrl-Alt key combination.

You can configure the virtual machine to enter full screen mode when you power it on. In the VMware Server Console, choose **VM** > **Settings**, then click **Options** > **Power**. Select the **Enter full screen mode after powering on** check box, and click **OK**.

NOTE VMware Server does not support running virtual machines in full screen mode on dual-monitor systems.

Using Quick Switch Mode

Quick switch mode is similar to full screen mode, except it adds tabs at the top of the screen for switching from one active virtual machine to another. The virtual machine's display resizes to fill the screen completely, except for the space occupied by the tabs.

To enter quick switch mode, choose **View** > **Quick Switch**.

To view the VMware Server menus and toolbar while you are using quick switch mode, move the mouse pointer to the top of the screen.

To resize a Windows guest operating system's display so it fills as much of the screen as possible in quick switch mode, choose **View** > **Fit Guest Now**. The Fit Guest Now option works only if you have the current version of VMware Tools installed in the guest operating system and you disabled Autofit.

NOTE When you choose **Fit Guest Now**, VMware Server adjusts the display settings of your Windows guest operating system as needed. If you subsequently run the virtual machine in window mode, you might want to change the display settings back to their previous values.

To get out of quick switch mode, move the mouse pointer to the top of the screen to activate the menu, then choose **View** > **Quick Switch**.

Taking Advantage of Multiple Monitors

If your host has a standard multiple monitor display, you can run separate sets of virtual machines on each of the monitors. To use two monitors, launch two instances of the VMware Server Console. Start one or more virtual machines in each console window and drag each console window to the monitor on which you want to use it. For the largest possible screen display, use quick switch mode (**View** > **Quick Switch**).

To switch mouse and keyboard input from the virtual machine on the first screen to the virtual machine on the second screen, move the mouse pointer from one to the other. You do not need to take any special steps if VMware Tools is running in both guest operating systems and if you are using the default settings for grabbing input. If you have changed the defaults, you might need to press Ctrl-Alt to release the mouse pointer from the first virtual machine Move the mouse pointer to the second virtual machine and click it so it grabs control of mouse and keyboard input.

NOTE Multiple monitor support is experimental in this release of VMware Server. It does not work properly with some third-party desktop management software or display drivers.

If you switch to full screen mode, VMware Server always uses the primary display. To use multiple monitors, you must use either the normal (windowed) mode or quick switch mode.

Fitting the VMware Server Console Window to the Virtual Machine

The **View** menu gives you two ways to adjust the size of the VMware Server Console window so it exactly fits the virtual machine's display.

Autofit is toggled on or off each time you click it. When **Autofit** is on, the VMware Server Console window adjusts automatically to fit the virtual machine's display. When it is off, you can adjust the VMware Server Console window to a size of your choice. If you make the VMware Server Console window smaller than the virtual machine's display, scroll bars appear so you can move to the part of the virtual machine's display that you want to see.

If **Autofit** is off, you can choose **View** > **Fit Window Now** to adjust the window so it fits the virtual machine's display.

Fitting a Windows Guest OS Display to the Console Window

If your Windows guest operating system is set to a display resolution larger or smaller than the size of the virtual machine window, you can make it fit exactly by choosing **View** > **Fit Guest Now**.

When you choose **Fit Guest Now**, VMware Server adjusts the display settings of your Windows guest operating system as needed. If you subsequently run the virtual machine in window mode, you might want to change the display settings back to their previous values.

NOTE When you use the **Fit Guest Now** option and the window is small, your guest operating system's screen resolution might be set to something smaller than VGA (640 x 480). Some installers and other programs do not run at resolutions smaller than 640 x 480. If either the width or height is smaller than the corresponding dimension required for VGA, the programs refuse to run. Error messages can include such phrases as "VGA Required To Install" or "You must have VGA to install."

There are two ways to work around this problem.

- If your host computer's screen resolution is high enough, you can enlarge the window, and choose **Fit Guest Now**.
- If your host computer's screen resolution does not allow you to enlarge the window enough, do not use **Fit Guest Now**. Instead, set the guest operating system's screen resolution to 640 x 480 or larger.

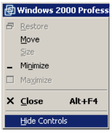
Simplifying the Screen Display

You can hide many of the controls visible in the VMware Server Console window.

Use the **View** menu to toggle the following controls on or off:

- Inventory
- Toolbar
- Status bar
- Virtual machine tabs

On a Windows host, you can also hide the menu bar. Click the title bar icon, then choose **Hide Controls**.



Choosing **Hide Controls** hides the menu bar, the toolbar, the status bar, and the inventory.

For the simplest possible VMware Server Console window on a Windows host, first choose **View** > **Tabs** to turn off the tabs. Then, from the title bar icon shortcut menu, choose **Hide Controls**.

Running Virtual Machines from DVDs or CD-ROM Discs

You can store a virtual disk on DVD/CD-ROM, and run the virtual machine from your VMware Server host's DVD/CD-ROM drive. You do not have to copy the virtual disk files from the DVD/CD-ROM to the VMware Server host.

One suggested use for this method is to install VMware Server on a host you want to use for product demonstrations, which could be a laptop. Instead of taking up limited hard disk space with virtual disks, you can have any number of virtual machines with virtual disks burned onto DVD or CD-ROM and point each virtual machine's configuration file to the virtual disk on the DVD or CD-ROM.

Other uses include sales or proof-of-concept demonstrations where you want to keep virtual disk files off a customer's system but want to illustrate a multiple machine demonstration in the customer's environment. Or you can have multiple physical servers in a datacenter run virtual machines without copying the virtual disk files to the servers themselves. Yet another use is, if you need a "master" virtual machine for some purpose, you can create a write-protected copy of your original virtual machine.

The virtual disk must be an independent disk in nonpersistent mode, since any changes you make in the virtual machine cannot be written to the DVD or CD-ROM. The redo log for the virtual machine must be on the VMware Server host. For more information about independent disks, see "Independent Disks" on page 121.

NOTE If you take a snapshot of the virtual machine and you want to save the changes made to the virtual disk after the snapshot was taken, you must copy the virtual disk to the VMware Server host's hard drive, then update the snapshot. In addition, if you copy the disk file to a Windows host, you need to make the disk file writable.

Before you run a virtual machine with a virtual disk stored on DVD or CD-ROM, you should consider whether you may need to modify the virtual machine's BIOS at some point. In this case, the virtual machine's BIOS, which is stored in a file called `nvram`, must be located on the VMware Server host. Or, you can add a setting to the virtual machine's configuration file that allows for the `nvram` file to be on the DVD/CD-ROM, where it cannot be modified.

NOTE The performance of the virtual machine accessing a virtual disk stored on a DVD or CD-ROM depends on the speed of the DVD/CD-ROM drive. Keep in mind that a virtual machine on a DVD/CD-ROM drive runs slower than it would if it were running on your host's hard disk.

To run a virtual machine with a virtual disk stored on DVD or CD-ROM, complete the following steps.

1. Create a virtual machine and install the guest operating system and any applications you need within it.
2. Make sure the virtual machine is powered off. Burn the virtual disk (`.vmdk`) files onto a DVD or CD-ROM. Place the DVD or CD-ROM into the VMware Server host's DVD/CD-ROM drive.
3. Choose **VM** > **Settings** to open the virtual machine settings editor for this virtual machine. On the **Hardware** tab, select **Virtual Disk** and browse to the virtual disk file on the DVD/CD-ROM.
4. Click **Advanced**. Under **Mode**, check **Independent** and set the disk mode to **Nonpersistent**. Click **OK** to save these settings.
5. On the Options tab, select **General**. Under **Working directory**, browse to and select a location for the redo log on the VMware Server host.
6. Click **OK** to save your changes. The virtual machine settings editor closes.

7 In a text editor, open the virtual machine's configuration file (`.vmx`) and add two of the following lines to the file:

   ```
   disk.locking = FALSE
   ```

   `nvram = <path on VMware Server host>\nvram` (if you think you need to modify the virtual machine's BIOS)
   or
   `nvram.mode = "nonpersistent"` (if you do not need to modify the virtual machine's BIOS)

8 Save your changes and close the configuration file.

The virtual machine is now ready to be run with the virtual disk on the VMware Server host's DVD/CD-ROM drive.

NOTE Another method you can use is to burn all virtual machine files (the configuration file, `nvram,` and virtual disk files) onto DVD or CD-ROM. First make sure the redo log directory points to a drive on your VMware Server host and that the configuration file has all the desired settings before you burn the files onto the DVD/CD-ROM.

Using PXE with Virtual Machines

You can use a preboot execution environment (commonly known as PXE) to boot a virtual machine over a network. When you use PXE with a virtual machine, you can:

- Remotely install a guest operating system over a network without needing the operating system installation media.
- Deploy an image of a virtual disk to the virtual machine.
- Boot a Linux virtual machine over the network and run it diskless.

You use PXE with your virtual machine in conjunction with remote installation tools such as Windows 2000 Remote Installation Services or the Red Hat Linux 9.0 installer's PXE package. You can use Ghost or Altiris to stream an image of an already configured virtual disk to a new virtual machine.

Make sure the virtual machine has a virtual network adapter; one is installed by default. VMware supports PXE when the virtual machine is configured to use either the `vmxnet` or `vlance` virtual network adapter.

The virtual machine must have a virtual disk without a guest operating system installed.

When a virtual machine boots and there is no guest operating system installed, it proceeds to boot from devices (hard disk, CD-ROM drive, floppy drive, and network adapter) in the order in which they occur in the boot sequence specified in the virtual machine's BIOS. If you plan to use PXE with a virtual machine, it is a good idea to put the network adapter at the top of the boot order. When the virtual machine first boots, press F2 to enter the virtual machine's BIOS and change the boot order there.

As the virtual machine boots from the network adapter, it tries to connect to a DHCP server. The DHCP server provides the virtual machine with an IP address and a list of any PXE servers available on the network. After the virtual machine connects to a PXE server, it can connect to a bootable disk image (such as an operating system image or a Ghost or Altiris disk image) and start installing a guest operating system.

VMware has tested and supports the following PXE configurations with VMware Server:

- Remote installation of a Windows Server 2003 guest operating system from a server running Windows Server 2003 Automated Deployment Services
- Remote installation of a Windows 2000 guest operating system from a server running Windows 2000 Server/Advanced Server Remote Installation Services
- Remote installation of a Linux guest operating system from a Red Hat Enterprise Linux 3.0 AS PXE boot server
- Remote installation of a supported guest operating system from a Ghost image using Windows 2000 and Ghost RIS Boot package
- Remote installation of a supported guest operating system from an Altiris image using a Windows 2000 Altiris server
- Network booting a Linux virtual machine by connecting with the Linux Diskless option to a Red Hat Enterprise Linux 3.0 AS server

Installing Software in a Virtual Machine

Installing software in a virtual machine is just like installing it on a physical computer. For example, to install software in a Windows virtual machine, complete the following steps:

1. Be sure you have started the virtual machine and, if necessary, logged on. In the VMware Server Console window, check **VM** > **Removable Devices** to be sure the virtual machine has access to the CD-ROM drive and, if needed, the floppy drive.
2. Insert the installation CD-ROM or floppy disk into the proper drive on the VMware Server host. If you are installing from a CD-ROM, the installation program might start automatically.

3 If the installation program does not start automatically, click the Windows **Start** button, go to **Settings** > **Control Panel**, then double-click **Add/Remove Programs** and click the **Install** button. Follow the instructions on screen and in the user manual for your new software.

NOTE Some applications use a product activation feature that creates a key, based on the virtual hardware in the virtual machine where it is installed. Changes in the configuration of the virtual machine might require you to reactivate the software. To minimize the number of significant changes, set the final memory size for your virtual machine and install VMware Tools before you activate the software.

When you try to run a few programs, including the installer for the Japanese-language version of Trend Micro Virus Buster, the VMware Server might appear to hang. To work around this problem, try disabling acceleration in the guest. For more information, see "Issues Installing or Running Applications in a Guest Operating System".

Cutting, Copying, and Pasting Text

When VMware Tools is running, you can cut (or copy) and paste text between applications in the virtual machine and the host computer or between two virtual machines. Use the normal hot keys or menu choices to cut, copy, and paste.

NOTE If you are copying text from a Windows host into a Linux guest operating system, you can paste only by using the middle mouse button. If you are using a two-button mouse, click both mouse buttons at the same time to paste.

To turn off this feature — to prevent accidental copying and pasting from one environment to another — change your preferences.

Choose **Edit** > **Preferences**. On the Input tab, clear the **Enable copy and paste to and from virtual machine** check box.

Using Devices in a Virtual Machine

The following sections provide an overview on the devices in your virtual machine.

- "Adding, Configuring, and Removing Devices in a Virtual Machine" on page 103
- "Connecting and Disconnecting Removable Devices" on page 104

Adding, Configuring, and Removing Devices in a Virtual Machine

The virtual machine settings editor (**VM** > **Settings**) is the control center where you can add devices to a virtual machine, change the settings for those devices, and remove them. In addition, you can add, change, and remove devices in the VMware Management Interface.

For more information about Virtual SMP and how to configure a virtual machine to use two virtual processors on a host machine that has at least two logical processors, see "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 244.

For more information about adding and configuring devices such as parallel ports, serial ports, USB controllers, and generic SCSI devices, see "Configuring Devices" on page 211.

For information on adding and configuring virtual disks, physical disks, DVD/CD-ROM drives and floppy drives, see "Using Disks in a Virtual Machine" on page 119.

NOTE You can configure parallel ports, serial ports, DVD/CD-ROM drives, floppy drives, and sound drivers (Linux only) as auto-detect devices. The benefit of auto- detect devices is that they can be moved between virtual machines running different operating systems, such as Linux and Windows, without having to be reconfigured.

For information on adding and configuring virtual network adapters, see "Adding and Modifying Virtual Network Adapters" on page 162.

For information on configuring virtual machine memory, see "Allocating Memory to a Virtual Machine" on page 251.

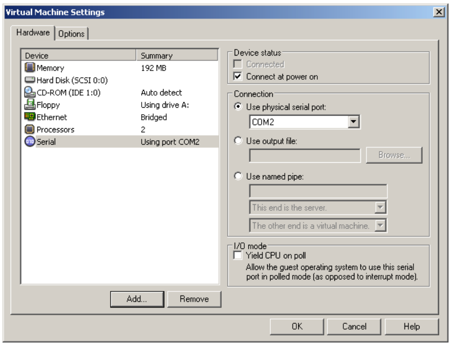
To remove a device or other hardware from a virtual machine, make sure it is powered off. You can remove hardware using the VMware Server Console or the VMware Management Interface.

NOTE You cannot add or remove some items from a virtual machine, such as the processor, SCSI controllers, or the virtual display adapter. VMware Server creates SCSI controllers as needed when you add SCSI devices. However, the number of virtual SCSI controllers is included in the six virtual PCI slot limit for a virtual machine. For information on which devices use PCI slots, see "Virtual Machine Specifications" on page 12.

Removing Hardware Using the VMware Server Console

To remove hardware from a virtual machine, make sure the virtual machine is powered off, then complete the following steps.

1 In the VMware Server Console, select the virtual machine, then click **Edit virtual machine settings**. The virtual machine settings editor appears.



Device	Summary
Memory	192 MB
Hard Disk (SCSI 0:0)	
CD-ROM (IDE 1:0)	Auto detect
Floppy	Using drive A:
Ethernet	Bridged
Processors	2
Serial	Using port COM2

Device status
☐ Connected
☑ Connect at power on

Connection
● Use physical serial port: COM2
○ Use output file:
○ Use named pipe:
This end is the server.
The other end is a virtual machine.

I/O mode
☐ Yield CPU on poll
Allow the guest operating system to use this serial port in polled mode (as opposed to interrupt mode).

2 Select the item you want to remove, then click **Remove**.

3 Click **OK** to save the change and close the virtual machine settings editor.

Connecting and Disconnecting Removable Devices

Choose **VM** > **Removable Devices** to connect and disconnect removable devices that you have configured for a virtual machine — including floppy drives, DVD/CD-ROM drives, USB devices and Ethernet adapters — while the virtual machine is running.

When you choose **VM** > **Removable Devices**, a submenu appears. Choose a device from that menu to connect or disconnect it, and to edit device settings. If you choose **Edit**, a dialog box appears. Make all the changes you want to make, then click **OK**.

Command Reference

The following sections describe command line options that are available when you launch the VMware Server Console and keyboard shortcuts that you can use while a virtual machine is running.

- "Startup Options on a Linux Host" on page 105
- "Startup Options on a Windows Host" on page 106
- "Using Keyboard Shortcuts" on page 106

Startup Options on a Linux Host

The following list describes various options available when you run VMware Server from the command line on a Linux host operating system. You can also set the power options when you change a virtual machine's power options. See "Using Power Options for Virtual Machines" on page 88.

```
vmware [-x] [-X] [-q] [-v] [-s] [-l]
[/<path_to_config>/<config>.vmx]
[X toolkit options]
```

`-x` automatically powers on the virtual machine when the VMware Server Console is launched. This is equivalent to clicking the **Power On** button in the toolbar.

`-X` automatically powers on the virtual machine, then switches the VMware Server Console window to full screen mode.

NOTE This option does not work when you connect with the VMware Server Console from a remote client to the VMware Server host.

`-q` closes the virtual machine's tab when the virtual machine powers off. If no other virtual machine is open, it also closes the VMware Server Console. This is particularly useful when the guest operating system is capable of powering off the virtual machine.

`-l` launches the VMware Server Console, connecting it directly to the local host.

`-v` displays the product name, version and build number.

`-s NAME=VALUE` sets a configuration variable called `name` to `value`. This configuration setting applies until the virtual machine is powered off. These settings are found in the virtual machine's configuration (`.vmx`) file. You should use this option only if you know the exact variable and value to use; typically you use this when you are troubleshooting issues, and VMware support suggests you use a particular configuration setting.

`-m` automatically starts the virtual machine in quick switch mode. This option works for virtual machines running on Linux hosts only. For information on quick switch mode, see "Using Quick Switch Mode" on page 95.

`/<path_to_config>/<config>.vmx` (or `.cfg`) launches a virtual machine using the specified configuration file.

X toolkit options can be passed as arguments, although some of them (most notably the size and title of the VMware Server Console window) cannot be overridden.

Options to Use when Connecting Remotely

If you are connecting to a virtual machine from a remote client, you can use the following options:

`-h <host>` to connect to a specific host.

`-P <portNumber>` to connect to the host over the specified port. Port 902 is the default port the VMware Server Console uses with remote connections. For information about the port number, see "Changing the Port Number for VMware Server Console Connections".

`-u <username>` specifies the user name to use when you log on to a remote host.

`-w <password>` specifies the password to use when you log on to a remote host.

Startup Options on a Windows Host

You can also use the Linux switches described on a Windows host. The most convenient way to use the switches is to incorporate them into the command generated by a Windows shortcut.

Create the shortcut, right-click the shortcut, then click **Properties**. In the **Target** field, add any switches you want to use after the `vmware.exe` filename. For example,

```
"C:\Program Files\VMware\VMware Server\vmware.exe" -X "C:\Virtual
                 Machines\Windows Server 2003\Windows Server 2003.vmx"
```

launches the specified Windows Server 2003 virtual machine, powers it on automatically and switches to full screen mode.

Be sure to enclose paths in quotation marks if they contain spaces.

NOTE The configuration file has a `.vmx` extension by default. Pathnames on Windows use the backslash character (\). X toolkit options are not relevant on a Windows host.

Using Keyboard Shortcuts

To work from the keyboard, use the keyboard shortcuts provided in this section. If you have changed the Preferences setting for the hot-key combination, substitute your new setting for Ctrl-Alt as needed in the shortcuts listed in Table 4-3.

Table 4-3.

Shortcut	Action
Ctrl-B	Power on.
Ctrl-E	Power off.
Ctrl-R	Reset the power.
Ctrl-Z	Suspend.
Ctrl-N	Create a new virtual machine.
Ctrl-O	Open a virtual machine.
Ctrl-F4	Close the current virtual machine.
Ctrl-D	Edit the virtual machine's configuration.
Ctrl-G	Grab input from the keyboard and mouse.
Ctrl-P	Edit preferences. See "Setting User Preferences for the VMware Server Host".
Ctrl-Alt-Enter	Go to full screen mode.
Ctrl-Alt	Return to normal (windowed) mode.
Ctrl-Alt-Tab	Switch among open virtual machines while the mouse and keyboard input are grabbed.
Ctrl-Tab	Switch among open virtual machines while the mouse and keyboard input are not grabbed. VMware Server must be the active application.
Ctrl-Shift-Tab	Switch among open virtual machines while the mouse and keyboard input are not grabbed. VMware Server must be the active application.
Ctrl-Alt-Fx	Switch among open virtual machines while using full screen mode. Fx is a function key corresponding to the virtual machine you want to use. The key combination to use for a virtual machine is shown in the VMware Server title bar when that virtual machine is active and in normal (windowed) mode.

CHAPTER 5 Preserving the State of a Virtual Machine

VMware Server provides two ways to preserve the state of a virtual machine. You can either suspend and resume virtual machines or take snapshots of virtual machines. This chapter describes these features and covers the following topics:

- "Suspending and Resuming Virtual Machines" on page 109
- "Taking Snapshots" on page 112

Suspending and Resuming Virtual Machines

The suspend and resume feature is most useful when you want to save the current state of your virtual machine and pick up work later with the virtual machine in the same state as when you stopped.

After you resume the virtual machine and do additional work, you can return to the state the virtual machine was in at the time you suspended only if you took a snapshot at the time.

NOTE To preserve the state of the virtual machine so you can return to the same state repeatedly, take a snapshot. For details, see "Taking Snapshots" on page 112.

The speed of the suspend and resume operations depends on how much data has changed while the virtual machine has been running. In general, the first suspend operation takes longer than subsequent suspend operations do.

When you suspend a virtual machine, a file with a `.vmss` extension is created. This file contains the entire state of the virtual machine. When you resume the virtual machine, its state is restored from the `.vmss` file. The `.vmss` file cannot be used to resume a virtual machine again from the original suspended state.

NOTE You should not change a configuration file after you suspend a virtual machine The virtual machine does not resume properly if the configuration file is inconsistent with the suspended virtual machine. Also, you should not move any physical (raw) disks that the virtual machine uses. If you do, the virtual machine cannot access its virtual disks when it resumes.

To suspend a virtual machine

1. If your virtual machine is running in full-screen mode, return to window mode by pressing the Ctrl-Alt key combination.
2. Click **Suspend** on the VMware Server Console toolbar.
3. When VMware Server has completed suspending the virtual machine, choose **File** > **Exit**

To resume a virtual machine that you have suspended

1. Launch the VMware Server Console and choose a suspended virtual machine.
2. Click **Resume** on the console toolbar.

   Any applications you were running at the time you suspended the virtual machine are running, and the content is the same as when you suspended the virtual machine.

You use also use the VMware Management Interface to suspend and resume a virtual machine. See "Changing a Virtual Machine's Power State from the Management Interface" on page 90.

You can also set the configuration of each virtual machine so the file that stores information on the suspended state is saved in a location of your choice.

Setting the Suspended State File Directory

When a virtual machine is suspended, its state is written to a file with a `.vmss` extension. By default, the `.vmss` file is stored in the directory in which the virtual machine's configuration file (`.vmx`) resides. Similarly, when a virtual machine is being resumed, VMware Server looks for the `.vmss` file in the same directory.

To change the directory where the suspended state file for a virtual machine is stored, you must power off the virtual machine. You can specify this directory from the console's virtual machine settings editor or the VMware Management Interface.

NOTE Changing the working directory also changes where you store the virtual machine's snapshot and redo-log files.

Setting the Suspended State File Directory from the Console

1 Connect to the virtual machine with a console. Make sure the virtual machine is powered off.

2 Choose **Edit virtual machine settings**.

3 On the **Options** tab, click **General**.

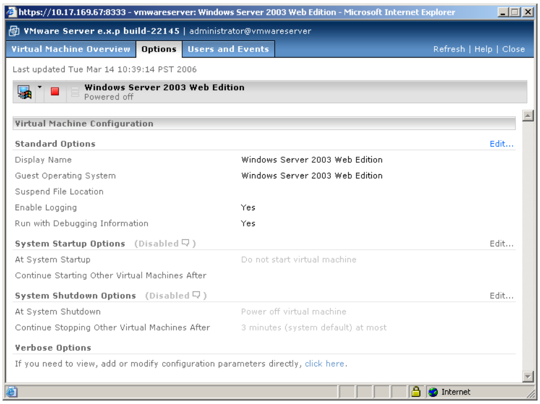
4 Under **Working Directory**, enter the name of a directory to use, or click **Browse** to select a directory.

5 Click **OK**.

Setting the Suspended State File Directory from the VMware Management Interface

1 Log on to the VMware Management Interface. Click the virtual machine menu icon (▾) for the virtual machine you want to change and choose **Configure Options**.

The Options page for this virtual machine appears in a new browser window.


https://10.17.169.67:8333 - vmwareserver: Windows Server 2003 Web Edition - Microsoft Internet Explorer
VMware Server e.x.p build-22145 | administrator@vmwareserver
Virtual Machine Overview
Options
Users and Events
Refresh | Help | Close
Internet

Last updated Tue Mar 14 10:39:14 PST 2006

Windows Server 2003 Web Edition
Powered off

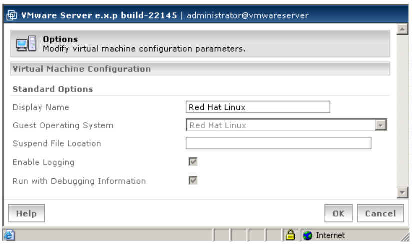
Virtual Machine Configuration

Standard Options	Edit...
Display Name	Windows Server 2003 Web Edition
Guest Operating System	Windows Server 2003 Web Edition
Suspend File Location	
Enable Logging	Yes
Run with Debugging Information	Yes
System Startup Options (Disabled)	Edit...
At System Startup	Do not start virtual machine
Continue Starting Other Virtual Machines After	
System Shutdown Options (Disabled)	Edit...
At System Shutdown	Power off virtual machine
Continue Stopping Other Virtual Machines After	3 minutes (system default) at most

Verbose Options

If you need to view, add or modify configuration parameters directly, click here.

2 Click **Edit**. The Options page appears.


VMware Server e.x.p build-22145 | administrator@vmwareserver
Help
OK
Cancel
Internet

Options
Modify virtual machine configuration parameters.

Virtual Machine Configuration

Standard Options	
Display Name	Red Hat Linux
Guest Operating System	Red Hat Linux
Suspend File Location	
Enable Logging	☑
Run with Debugging Information	☑

For fastest suspend and restore operations, type the path to the appropriate directory in the **Suspend File Location** field. VMware Server adds a suffix to the name of the suspended state file to ensure that one virtual machine does not overwrite the suspended state file of another.

3 Click **OK** to save your changes.

Taking Snapshots

The snapshot feature is most useful when you want to preserve the state of the virtual machine so you can return to the same state repeatedly.

To save the current state of your virtual machine and pick up work later with the virtual machine in the same state, suspend the virtual machine. For details, see "Suspending and Resuming Virtual Machines" on page 109.

You can take a snapshot of a virtual machine at any time and revert to that snapshot at any time. If the virtual machine is located on a Linux host, you should not take a snapshot while you are suspending the virtual machine. Wait until the snapshot is completely saved before taking the snapshot.

You can take a snapshot while a virtual machine is powered on, powered off, or suspended. A snapshot preserves the virtual machine just as it was when you took the snapshot — the state of the data on all the virtual machine's disks and whether the virtual machine was powered on, powered off, or suspended.

When you revert to a snapshot, you discard all changes made to the virtual machine since you took the snapshot. This includes any data written to the virtual disk and any changes to the virtual machine's configuration.

Similarly, if you take a snapshot of a virtual machine and later modify the virtual machine's configuration, any changes you make to the configuration are not reflected in the snapshot. You need to take a new snapshot.

Use the **Snapshot** and **Revert** buttons on the console toolbar to take a snapshot and revert to it later.

You can take a new snapshot at any time. When you do so, you replace the previous snapshot. You can have only one active snapshot at a time.

NOTE Taking a new snapshot when a snapshot already exists can take a long time, as the original snapshot needs to be removed. While you are taking a new snapshot, other consoles might not be able to connect to the server host and the users trying to connect might see an error that the VMware Registration Service (`vmware-serverd`) is not running. You cannot take snapshots if using an Independent disk while the virtual machine is powered on or suspended.

The following sections describe snapshots in greater detail.

What Is Captured by a Snapshot?

A snapshot captures the entire state of the virtual machine at the time you take the snapshot. This includes:

- The state of all the virtual machine's disks.
- The contents of the virtual machine's memory.
- The virtual machine settings.

When you revert to the snapshot, you return all these items to the state at the time you took the snapshot.

NOTE In certain special purpose configurations, you might want to exclude one or more of the virtual machine's disks from the snapshot. To exclude a disk from the snapshot, choose **VM** > **Settings**, select the drive you want to exclude, and click **Advanced**. On the advanced settings screen, select **Independent**. You have the following options for an independent disk:

- **Persistent** — changes are immediately and permanently written to the disk. All changes to an independent disk in persistent mode remain, even when you revert to the snapshot.
- **Nonpersistent** — changes to the disk are discarded when you power off or revert to the snapshot.

Ways of Using Snapshots

The following examples illustrate the most common ways to use a snapshot.

Always Saving Changes (No Snapshot)

If you do not take a snapshot, your virtual machine runs the same way a physical computer does. All changes you make while you are working with a virtual machine are saved and you cannot return to an earlier state.

Running your virtual machine without a snapshot provides the best performance. To ensure a virtual machine does not have a snapshot, choose **Snapshot** > **Remove Snapshot**.

To configure the virtual machine not to use snapshots, choose **VM** > **Settings** > **Options** > **Snapshots**, and check **Disable snapshots**.

You can also configure the virtual disk in independent mode to make sure the virtual machine doesn’t use snapshots. For more information, see “Independent Disks” on page 121.

Making Risky Changes

If you plan to make risky changes in a virtual machine (for example, testing new software or examining a virus), take a snapshot before you begin to make those changes. If you encounter a problem, click **Revert** on the console toolbar to return the virtual machine to its state at the time you took the snapshot.

If the first action you take causes no problems and you want to protect the virtual machine in its new state, you can take a new snapshot. You can have only one snapshot at a given time. When you take the new snapshot, you replace your previous snapshot, and the contents of the previous snapshot are written to the virtual disk. You do not lose any data.

Snapshots and a Virtual Machine’s Hard Disks

When a snapshot is created and the virtual machine writes data to disk, that data is written to a new virtual disk file. Virtual disk files have a .vmdk extension and are stored in the virtual machine's working directory. These files can grow quite large as newly saved data continues to accumulate in them until you take an action that affects the snapshot. Be aware of how much disk space these files consume.

- Remove the snapshot — When you remove the snapshot, the changes accumulated in the new virtual disk file is written permanently to the base disks (either the virtual disk files or the physical disks, depending on your virtual machine's hard disk configuration).
- Revert to the snapshot — When you revert to the snapshot, the contents of the newly created virtual disk file is discarded. Any additional changes are, once again, accumulated in a new virtual disk file.
- Take a snapshot — If you take a snapshot when the virtual machine already has a snapshot, changes stored in the new virtual disk file are written permanently to the base disk. Any subsequent changes again accumulate in a new virtual disk file. Depending on how large the virtual disk file is, taking a new snapshot can take some time

Snapshots and Other Activity in the Virtual Machine

When you take a snapshot, be aware of other activity occurring in the virtual machine and the likely impact of reverting to the snapshot. In general, it is best to take the snapshot when no applications in the virtual machine are communicating with other computers. The potential for problems is greatest if the virtual machine is communicating with another computer, especially in a production environment.

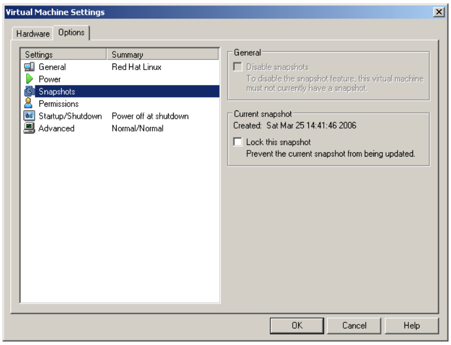
Consider a case in which you take a snapshot while the virtual machine is downloading a file from a server on the network. After you take the snapshot, the virtual machine continues downloading the file, communicating its progress to the server. If you revert to the snapshot, communications between the virtual machine and the server are confused and the file transfer fails.

Or consider a case in which you take a snapshot while an application in the virtual machine is sending a transaction to a database on a separate machine. If you revert to the snapshot — especially if you revert after the transaction starts but before it has been committed — the database is likely to be confused.

Settings for Snapshots

You can specify what VMware Server does with the snapshot whether the machine is powered on or powered off.

Go to **VM** > **Settings** > **Options** > **Snapshots**.



Settings	Summary
General	Red Hat Linux
Power	
Snapshots	
Permissions	
Startup/Shutdown	Power off at shutdown
Advanced	Normal/Normal

General

□ Disable snapshots
To disable the snapshot feature, this virtual machine must not currently have a snapshot.

Current snapshot

Created: Sat Mar 25 14:41:46 2006

□ Lock this snapshot
Prevent the current snapshot from being updated.

If the virtual machine has no snapshot, you can disable the snapshot feature by selecting **Disable snapshots**. If you have a snapshot and want to disable the snapshot feature, first go to the console window and choose **Snapshot** > **Remove Snapshot**. Return to the virtual machine settings editor and select **Disable snapshots**.

To lock the snapshot so no new snapshot can be taken, select **Lock this snapshot**.

Snapshot Actions as Background Activity

Taking a snapshot is not instantaneous. When you take a snapshot, you can continue working while VMware Server preserves the snapshot in the background. You can enable background snapshots in the Priority tab of the Settings window on both Windows and Linux hosts.

Choose **Host** > **Settings** > **Priority**.

Check the **Take and Restore Snapshots in the Background** box. You must reboot your virtual machine for this option to take effect.

Enabling background snapshots for a host with slow hard disks might affect performance. If you experience significant performance problems when taking or restoring snapshots, disable this option.

Removing the Snapshot

You can remove the snapshot any time the virtual machine is powered off. Removing the snapshot writes the contents of the snapshot to the virtual disk. This action does not destroy any data in the virtual machine. Moving forward, any changes you make as you run the virtual machine are written to the virtual disk. You cannot revert to a previous state because the snapshot no longer exists.

To remove the snapshot, shut down and power off the virtual machine. Choose **Snapshot** > **Remove Snapshot**.

NOTE Removing a snapshot when the virtual machine is powered off can take a long time, depending on the size of the snapshot file. While you are removing the snapshot, other consoles might not be able to connect to the server host, and the users trying to connect might see an error that the VMware Registration Service (`vmware-serverd`) is not running.

Snapshots and Legacy Disk Modes

If you are familiar with the disk modes used in VMware GSX Server 2 and earlier, you can use the snapshot to achieve equivalent results. If you want the equivalent of:

- Persistent mode — Do not take a snapshot.
- Nonpersistent mode — Be sure the virtual machine is in the state you want it. Power off the virtual machine. Take a snapshot. On the console toolbar, go to **Snapshot** and choose **Revert to snapshot**.

NOTE VMware Server does not support undoable disks.

Snapshots and Legacy Virtual Machines

VMware Server does not support snapshots with legacy virtual machines.

CHAPTER 6 Using Disks in a Virtual Machine

This chapter describes how to configure your virtual machine's hard disk storage and covers the following topics:

- "Configuring Hard Disk Storage in a Virtual Machine" on page 119
- "Configuring Optical and Floppy Drives" on page 128
- "Adding Drives to a Virtual Machine" on page 131
- "Using VMware Virtual Disk Manager" on page 139
- "Installing an Operating System onto a Physical Partition" on page 146
- "Disk Performance in Windows NT Guests on Multiprocessor Hosts" on page 150

Configuring Hard Disk Storage in a Virtual Machine

Like a physical computer, a VMware Server virtual machine stores its operating system, programs, and data files on one or more hard disks. Unlike a physical computer, VMware Server gives you options for undoing changes to the virtual machine's hard disk.

The New Virtual Machine Wizard creates a virtual machine with one disk drive. Use the virtual machine settings editor (**VM** > **Settings**) to add more disk drives to your virtual machine, to remove disk drives from your virtual machine, or to change certain settings for the existing disk drives.

The following sections describe the choices you can make in setting up hard disk storage for your virtual machine.

- "Disk Types: Virtual and Physical" on page 120
- "Additional Information about Disk, Redo-Log, Snapshot, and Lock Files" on page 122
- "Defragmenting and Shrinking Virtual Disks" on page 125

Disk Types: Virtual and Physical

In the most common configurations, VMware Server creates virtual hard disks, which are made up of files that are typically stored on your host computer's hard disk. In some circumstances, you might need to give your virtual machine direct access to a physical hard drive on your host computer — using the disk type referred to as a physical disk.

Virtual Disk

A virtual disk is a file or set of files that appears as a physical disk drive to a guest operating system. The files can be on the host machine or on a remote computer. When you configure a virtual machine with a virtual disk, you can install a new operating system onto the virtual disk without repartitioning a physical disk or rebooting the host.

IDE virtual disks can be as large as 950GB. SCSI virtual disks can be as large as 950GB. Depending on the size of the virtual disk and the host operating system, VMware Server creates one or more files to hold each virtual disk.

By default, the virtual disk is configured so all the disk space is allocated at the time the virtual disk is created. This type of virtual disk is known as a **preallocated disk**. A preallocated disk provides enhanced performance and is useful if you are running performance-sensitive applications in the virtual machine. A virtual disk that is not preallocated is known as a **growable disk**. A growable virtual disk's files start out small and grow to their maximum size as needed. The main advantage of this approach is the smaller file size. Smaller files require less storage space and are easier to move if you want to move the virtual machine to a new location. You can shrink this type of virtual disk. However, it takes longer to write data to a disk configured in this way.

Virtual disks can be set up as IDE disks for any guest operating system. They can be set up as SCSI disks for any guest operating system that has a driver for the BusLogic SCSI adapter used in a VMware Server virtual machine.

NOTE To use SCSI disks in a Windows XP or Windows Server 2003 virtual machine, you need a special SCSI driver available from the download section of the VMware Web site at **www.vmware.com/download**. Follow the instructions on the Web site to use the driver with a fresh installation of Windows XP or Windows Server 2003.

A virtual disk of either type can be stored on either type of physical hard disk. That is, the files that make up an IDE virtual disk can be stored on either an IDE hard disk or a SCSI hard disk. So can the files that make up a SCSI virtual disk. They can also be stored on other types of fast-access storage media, such as DVDs or CD-ROM discs. For information about running virtual machines from DVD-ROM or CD-ROM, see "Running Virtual Machines from DVDs or CD-ROM Discs" on page 98.

A key advantage of virtual disks is their portability. Because the virtual disks are stored as files on the host machine or a remote computer, you can move them easily to a new location on the same computer or to a different computer. You can also use VMware Server on a Windows host to create virtual disks and move them to a Linux computer and use them under VMware Server for Linux — or vice versa. For information about moving virtual disks, see "Moving and Sharing Virtual Machines" in *VMware Server Administration Guide*.

Physical (Raw) Disk

A physical disk directly accesses an existing local disk or partition Use physical disks for VMware Server to run one or more guest operating systems from existing disk partitions. You can set up physical disks on both IDE and SCSI devices. However, booting from an operating system already set up on an existing SCSI disk or partition is not supported.

The most common use of a physical disk is to convert a dual-boot or multiple-boot machine so one or more of the existing operating systems can be run inside a virtual machine.

CAUTION You can set up physical disks on both IDE and SCSI devices.You cannot use a physical disk that is stored on a SAN. You must use a disk or a partition on the VMware Server host.

If you run an operating system natively on the host computer, and switch to running it inside a virtual machine, the change is like pulling the hard drive out of one computer and installing it in a second computer with a different motherboard and other hardware. You need to prepare carefully for such a switch. The specific steps you need to take depend on the operating system you want to use inside the virtual machine.

You can create a new virtual machine that uses a physical disk instead of a virtual disk. For details, see "Installing an Operating System onto a Physical Partition" on page 146. In most cases, however, it is better to use a virtual disk.

Only advanced users should attempt physical disk configurations.

Independent Disks

Independent disks add a layer of control and complexity to your virtual disks. You configure virtual disks in independent mode for certain special purpose configurations.

For example, you might want to run a virtual machine that uses a virtual disk stored on DVD or CD-ROM. For more information, see "Running Virtual Machines from DVDs or CD-ROM Discs" on page 98.

Or, you might want to exclude one or more virtual disks from a virtual machine's snapshot. For more information about snapshots, see "Taking Snapshots" on page 112.

To configure a disk as an independent disk, choose **VM** > **Settings**, select the virtual disk, and click **Advanced**. On the advanced settings screen, select **Independent**, then the mode for the disk. You have the following options for an independent disk:

- **Persistent** — changes are immediately and permanently written to the disk. All changes to an independent disk in persistent mode remain, even when you revert to the snapshot.
- **Nonpersistent** — changes to the disk are discarded when you power off or revert to the snapshot. Choose this option to run a virtual machine where the virtual disk is stored on a DVD or CD-ROM, or to lose any changes made to the virtual disk since the snapshot was taken when you revert to the snapshot.

Additional Information about Disk, Redo-Log, Snapshot, and Lock Files

This section provides information about virtual machine files.

Disk Files

The virtual machine settings editor (**VM** > **Settings**) lets you choose the disk files for a virtual machine.

Choose a file other than the one created by the New Virtual Machine Wizard if you are using a virtual disk that you created in a different location or if you are moving the created disk files to a new location.

The disk files for a virtual disk store the information that you write to a virtual machine's hard disk — the operating system, the program files, and the data files. The virtual disk files have a `.vmdk` extension.

A virtual disk is made up of one or more `.vmdk` files.

On Microsoft Windows hosts, each virtual disk is contained in one file by default. You can optionally configure the virtual disk to use a set of files limited to 2GB per file. Use this option if you plan to move the virtual disk to a file system that does not support files larger than 2GB.

You must set this option at the time you create the virtual disk.

If you are setting up a new virtual machine, follow the custom path in the New Virtual Machine Wizard. In the screen that lets you specify the virtual disk's capacity, select **Split disk into 2GB files**.

If you are adding a virtual disk to an existing virtual machine, follow the steps in the Add Hardware Wizard. In the screen that lets you specify the virtual disk's capacity, select **Split disk into 2GB files**.

When a disk is split into multiple files, larger virtual disks have more `.vmdk` files.

The first `.vmdk` file for each disk is small and contains pointers to the other files that make up the virtual disk. The other `.vmdk` files contain data stored by your virtual machine and use a small amount of space for virtual machine overhead.

By default, all disk space is allocated when you create the virtual disk. A preallocated virtual disk has fixed file sizes, and most of the files are 2GB. As mentioned above, the first file is small. The last file in the series might also be smaller than 2GB.

If you chose not to allocate the space in advance, the `.vmdk` files grow as data is added, to a maximum of 2GB each — except for the first file in the set, which remains small.

The virtual machine settings editor shows the name of the first file in the set — the one that contains pointers to the other files in the set. The other files used for that disk are assigned names based on the name of the first file.

For example, a Windows 2000 Server virtual machine using the default configuration, with files that grow as needed, stores the disk in files named `Windows 2000 Server.vmdk`, `Windows 2000 Server-s001.vmdk`, `Windows 2000 Server-s002.vmdk` and so on.

If the disk space is allocated in advance and the virtual disk is split into 2GB files, the names are similar, except that they include an `f` instead of an `s` — for example, `Windows 2000 Server-f001.vmdk`. If the disk is not split into 2GB files, the virtual machine stores the disk in two files, named `Windows 2000 Server.vmdk` and `Windows 2000 Server-flat.vmdk`.

If you are using a physical disk, the `.vmdk` file stores information about the physical disk or partition used by the virtual machine.

Redo-Log Files

Redo-log files are stored in the virtual machine's working directory`,` and are for saving changes to independent-nonpersistent disks. Redo-log files save blocks that the virtual machine modifies while it is running. The redo-log file for a disk in independent-nonpersistent mode is not saved when the virtual machine is powered off or reset.

The redo-log file for a virtual disk `vm` is named `vm.vmdk.REDO`. If the virtual disk is split into 2GB files, the disk files are named `vm.vmdk`, `vm-02.vmdk`, `vm-03.vmdk` and so on; its redo-log files are named `vm.vmdk.REDO`, `vm-02.vmdk.REDO`, `vm-03.vmdk.REDO` and so on.

You can choose the location where the redo-log files are stored. By default, the files are stored in the same directory as the virtual disk (`.vmdk`) file. By default, redo-log files for physical disks are located in the same directory as the virtual machine configuration file (`.vmx`). You can change the location of the redo-log files in the virtual machine settings editor. With the virtual machine powered off, choose **VM** > **Settings**. Click the **Options** tab, select **General**. Under **Working directory**, enter the name or browse to the folder in which the redo-log file should be stored.

You can store these files in a different directory to increase available space or improve performance. For best performance, the log files for a virtual machine should be on a local hard drive on the host computer.

Snapshot Files

When you take a snapshot of a virtual machine named `vm`, VMware Server stores the snapshot in a file named `vm.vmsn`. VMware Server stores snapshot information in files named vm-SnapshotX.vmsn and in vm-xxxxxx.vmdk. For more information about snapshots, see "Taking Snapshots" on page 112.

You can choose the location where the snapshot files are stored. By default, the files are stored in the same directory as the virtual disk (`.vmdk`) file. You can change the location of the snapshot files in the virtual machine settings editor. With the virtual machine powered off, choose **VM** > **Settings**. Click the **Options** tab, select **General**. Under **Working directory**, enter the name or browse to the folder in which the snapshot file should be stored.

You can store these files in a different directory to increase available space or improve performance. For best performance, the log files for a virtual machine should be on a local hard drive on the host computer.

Lock Files

A running virtual machine creates lock files to prevent consistency problems on virtual disks. If the virtual machine did not use locks, multiple virtual machines might read and write to the disk, causing data corruption.

Lock files are always created in the same directory as the `.vmdk` file.

The locking methods used by VMware Server on Microsoft Windows and Linux hosts are different, so files shared between them are not fully protected. If you use a common file repository that provides files to users on both Windows and Linux hosts, be sure that each virtual machine is run by only one user at a time.

You can use SCSI reservation to work around the lock file so that multiple virtual machines can access it. This is typically done in conjunction with a high-availability configuration, such as clustering. For more information about this, see "Using High-Availability Configurations" in the *VMware Server Administration Guide*.

When a virtual machine is powered off, it removes the lock files it created. If it cannot remove the lock, a stale lock file is left protecting the `.vmdk` file. For example, if the host machine crashes before the virtual machine has a chance to remove its lock file, a stale lock remains.

If a stale lock file remains when the virtual machine is started again, the virtual machine tries to remove the stale lock. To make sure that no virtual machine could be using the lock file, the virtual machine checks the lock file to see whether

1 The lock was created on the same host where the virtual machine is running.

2 The process that created the lock is not running.

If those two conditions are true, the virtual machine can safely remove the stale lock. If either of those conditions is not true, a dialog box appears, warning you that the virtual machine cannot be powered on. If you are sure it is safe to do so, you can delete the lock files manually. On Windows hosts, the filenames of the lock files end in `.lck`. On Linux hosts, the filenames of the lock files end in `.WRITELOCK`.

Physical disk partitions are also protected by locks. However, the host operating system is not aware of this locking convention and does not respect it. For this reason, VMware strongly recommends that the physical disk for a virtual machine not be installed on the same physical disk as the host operating system.

Defragmenting and Shrinking Virtual Disks

If you have a virtual disk that grows as data is added, you can defragment and shrink it as described in this section. If you allocated all the space for your virtual disk at the time you created it, you cannot defragment and shrink it.

Defragmenting Virtual Disks

Defragmenting disks rearranges files, programs, and unused space on the virtual disk so that programs run faster and files open more quickly. Defragmenting does not reclaim unused space on a virtual disk. To reclaim unused space, shrink the disk.

For best disk performance, you can take the following three actions, in the order listed:

1. Run a disk defragmentation utility inside the virtual machine.
2. Power off the virtual machine and defragment its virtual disks from the virtual machine settings editor (**VM** > **Settings**). Select the virtual disk you want to defragment, and click **Defragment**.
3. Run a disk defragmentation utility on the host computer.

Defragmenting disks can take considerable time.

NOTE The defragmentation process requires free working space on the host computer's disk. If your virtual disk is contained in a single file, for example, you need free space equal to the size of the virtual disk file. Other virtual disk configurations require less free space.

Shrinking Virtual Disks

Shrinking a virtual disk reclaims unused space in the virtual disk. This process reduces the amount of space the virtual disk occupies on the host drive. VMware recommends you shrink virtual disks when the amount of used space on the virtual hard drive is much lower than the size of the actual .vmdk files associated with the virtual hard drive. VMware recommends that you not shrink a virtual disk when the space used on the virtual hard drive is nearly the same as the size of the actual .vmdk files associated with the virtual hard drive.

You cannot shrink preallocated virtual disks or physical disks. Shrinking requires free disk space on the host equal to the size of the virtual disk being shrunk.

NOTE The shrink process applies to all virtual disks even if you do not prepare all the virtual disks in a virtual machine for shrinking.

Shrinking virtual disks is a convenient way to convert a virtual disk to the format supported by VMware Server. Virtual disks created in the new format cannot be recognized by VMware GSX Server 3 or any other VMware product, except Workstation 5.x.

The virtual disks to be shrunk must not be booted as independent disks. You can change the mode of a virtual disk before the virtual machine is powered on. See "Independent Disks" on page 121.

Shrinking a disk is a two-step process. In the first step, called wiping, VMware Tools reclaims all unused portions of disk partitions (such as deleted files) and prepares them for shrinking. This allows for the maximum shrink possible. Wiping takes place in the guest operating system.

The shrink process itself is the second step, and it takes place outside the virtual machine. VMware Server reduces the size of the disk based on the disk space reclaimed by the wipe process. This step occurs after the wipe finishes preparing the disk for shrinking.

When a virtual machine is powered on, you shrink its virtual disks from the VMware Tools control panel. You cannot shrink virtual disks if a snapshot exists. To remove an existing snapshot, choose **Snapshot** > **Remove Snapshot**.

In a Linux or FreeBSD guest operating system, to prepare virtual disks for shrinking, you should run VMware Tools as the root user. This way, you ensure the whole virtual disk is shrunk. If you shrink disks as a non-root user, you cannot wipe the parts of the virtual disk that require root-level permissions.

1. To launch the control panel in a Windows guest, double-click the VMware Tools icon in the system tray or choose **Start** > **Settings** > **Control Panel**, and double-click **VMware Tools**.

   To launch the control panel in a Linux or FreeBSD guest, become root (`su -`), and run `vmware-toolbox`.

2. Click the **Shrink** tab.

3. Select the virtual disks you want to shrink, then click **Prepare to Shrink**.

   NOTE If you deselect some of the partitions to prepare to shrink, the entire disk is still shrunk. However, those partitions are not prepared for shrinking, and the shrink process does not reduce the size of the virtual disk as much as it could otherwise.

4. When VMware Tools finishes preparing the selected disk partitions, you are prompted to begin shrinking the disks.

Shrinking disks can take considerable time.

In some configurations, it is not possible to shrink virtual disks. The **Shrink** tab displays information explaining why you cannot shrink your virtual disks. For example, you cannot shrink a virtual disk if:

- You preallocated disk space when you created the disk, which is the default option for both typical and custom virtual machine creation paths.

- The virtual machine has a snapshot.

- The virtual machine contains physical (raw) disks.

- The virtual disk is not an independent disk in persistent mode. For more information, see "Independent Disks" on page 121.
- The virtual disk is stored on a CD-ROM.

Configuring Optical and Floppy Drives

The following sections describe how to configure your virtual machine's optical (DVD/CD-ROM) and floppy drives. You can use the physical device or point the virtual machine to an ISO or floppy image file.

- "Configuring Virtual DVD/CD-ROM Drives" on page 128
- "Configuring Virtual Floppy Drives" on page 130

Configuring Virtual DVD/CD-ROM Drives

Each virtual machine can access a physical DVD/CD-ROM drive on the VMware Server host or an ISO image file.

Multiple virtual machines can connect to the DVD/CD-ROM drive on the VMware Server host at the same time, unless a virtual machine is configured to use the drive exclusively. For information about exclusive use of the optical drive, see "Exclusively Using the DVD/CD-ROM Drive" on page 130.

You configure virtual DVD/CD-ROM drives from the virtual machine settings editor (**VM** > **Settings**).

Options you can configure include choosing the device node for the guest, using legacy emulation mode, using the optical drive on a client instead of the VMware Server host, and exclusively using the DVD/CD-ROM drive.

Configuring a Virtual Machine's DVD/CD-ROM Drive from the Console

To configure a virtual machine's DVD/CD-ROM drive, complete the following steps.

1. Connect to the virtual machine with the VMware Server Console.
2. Open the virtual machine settings editor. Choose **VM** > **Settings**.
3. On the Hardware tab, select the CD-ROM drive. You can make any of the following changes.
   - "Choosing a Device Node for the DVD/CD-ROM Drive" on page 129
   - "Using Legacy Emulation for DVD/CD-ROM Drives" on page 129
   - "Exclusively Using the DVD/CD-ROM Drive" on page 130

- "Using the DVD/CD-ROM Drive on a Client" on page 130

4 Click **OK** to save your changes and close the virtual machine settings editor.

Choosing a Device Node for the DVD/CD-ROM Drive

Like a virtual disk, the virtual machine's DVD/CD-ROM drive can be associated with a specific SCSI or IDE device node.

The type of device does not have to match the type of device on the host, so if your VMware Server host has an IDE CD-ROM drive, you can still configure your virtual machine with a SCSI CD-ROM drive.

If you want to do more than read data from the drive — for example, burn CD-ROMs — you should match the bus types. So if your host has an IDE CD-ROM drive, configure the virtual CD-ROM drive on an IDE device node.

However, if you want to boot from a virtual CD-ROM drive, you must configure the drive as an IDE device.

Using Legacy Emulation for DVD/CD-ROM Drives

The virtual machine settings editor provides a **Legacy emulation** option for DVD/CD-ROM drives attached to the virtual machine.

On Windows hosts, this option is deselected by default.

On Linux hosts with IDE drives, the default setting for this option depends on whether the `ide-scsi` module is loaded in your kernel. The `ide-scsi` module must be loaded — or you must be using a physical SCSI drive —to connect to the DVD/CD-ROM drive in raw mode.

If you encounter problems using your DVD/CD-ROM drive, try selecting **Legacy emulation**.

In legacy emulation mode, you can read from data discs in the DVD/CD-ROM drive, but some other functions are not available. For example, you cannot read from multisession discs if your DVD/CD-ROM drive is configured for legacy mode. You cannot burn CD-ROMs either.

When **Legacy emulation** is deselected, the guest operating system communicates directly with the drive. This direct communication enables capabilities that are not possible in legacy emulation mode, such as using CD and DVD writers to burn discs, reading multisession CDs, performing digital audio extraction, and viewing video.

However, in some cases, the DVD/CD-ROM drive might not work correctly when the guest operating system is communicating directly with the drive. In addition, certain drives and their drivers do not work correctly in raw mode. Select **Legacy emulation** to work around these problems.

Exclusively Using the DVD/CD-ROM Drive

You can prevent other virtual machines and the host from using the DVD/CD-ROM drive until either you disconnect it from this virtual machine or you power off or suspend the virtual machine. In the virtual machine settings editor, check **Connect exclusively to this virtual machine**.

Using the DVD/CD-ROM Drive on a Client

When you use the VMware Server Console on a remote client to connect to a virtual machine, you have the option of using the optical drive on the client machine instead of the drive on the VMware Server host. This is a convenient way of installing software remotely if you do not have access to the host.

To use a client machine's DVD/CD-ROM drive, make sure you are using the physical drive. Next to **Location**, select **Client**.

All virtual machine settings — like using legacy emulation and exclusive connections — apply, except that a CD-ROM drive on a client cannot start connected.

If you want to boot the virtual machine from the DVD/CD-ROM drive in a client system, complete the following steps.

1. When you first begin booting the guest operating system, press the Esc key. A boot menu appears.
2. In the console, open the virtual machine settings editor (**VM** > **Settings**) and select the CD-ROM drive. Select **Use physical drive** and next to **Location**, select **Client**.
3. Select the CD-ROM drive, Press Enter to boot the virtual machine from the CD-ROM drive of the client on which you are running the VMware Server Console.

Configuring Virtual Floppy Drives

Each virtual machine can access a physical floppy drive on the VMware Server host or a floppy image file.

Only one virtual machine can connect to the floppy drive on the server at a time.

You configure virtual floppy drives from the virtual machine settings editor.

Configuring a Virtual Machine's Floppy Drive from the Console

To configure a virtual machine's floppy drive, complete the following steps.

1. Connect to the virtual machine with the VMware Server Console.
2. Open the virtual machine settings editor. Choose **VM** > **Settings**.
3. On the Hardware tab, select the floppy drive.
4. To connect this virtual machine to the floppy drive when the virtual machine is powered on, check **Connect at Power On**.
5. Specify whether to connect to the host's floppy drive or to a floppy image.
   If you select **Use physical drive**, choose the drive from the list or select **Auto detect** to let VMware Server choose the drive.
   f you select **Use floppy Image**, create a new or browse to an existing floppy image.

NOTE The benefit of auto-detect devices is that you can move them between virtual machines running different guest operating systems, such as Windows and Linux, without having to reconfigure them.

6. Click **OK** to save your changes and close the virtual machine settings editor.

Adding Drives to a Virtual Machine

A VMware Server virtual machine can use up to four IDE devices and up to seven SCSI devices. Any of these devices can be a virtual hard disk or DVD/CD-ROM drive. A virtual machine can read data from a DVD-ROM disc. VMware Server does not support playing DVD movies in a virtual machine.

Many other SCSI devices can be connected to a virtual machine using the host operating system's generic SCSI driver. For details on connecting these devices, see "Connecting to a Generic SCSI Device" on page 237.

The following sections describe how to add virtual disks, physical disks, DVD/CD-ROM drives, and floppy drives to virtual machines. In addition, you can connect CD-ROM and floppy drives to disk image files.

- "Adding Virtual Disks to a Virtual Machine" on page 132
- "Adding Physical Disks to a Virtual Machine" on page 134
- "Adding DVD/CD-ROM Drives to a Virtual Machine" on page 137
- "Adding Floppy Drives to a Virtual Machine" on page 138

Adding Virtual Disks to a Virtual Machine

Virtual disks are stored as files on the host computer or on a network file server. It does not matter whether the disk that holds the files is IDE or SCSI. A virtual IDE drive can be stored on an IDE drive or on a SCSI drive. So can a virtual SCSI drive.

Use the virtual machine settings editor to add a new virtual disk to your virtual machine. The virtual machine should be powered off before you begin. If it is not, shut down the guest operating system normally, and click **Power Off** on the VMware Server Console toolbar.

NOTE If you have a Windows NT 4.0 guest with a SCSI virtual disk, you cannot add both an additional SCSI disk and an IDE disk to the configuration.

To add a new virtual disk from the VMware Server Console

1 Open the virtual machine settings editor (**VM** > **Settings**) and click **Add**. The Add Hardware Wizard guides you through the steps to create your virtual disk. Click **Next** to start configuring the virtual disk.

2 Click **Hard Disk**, and click **Next**.

3 Select **Create a new virtual disk**, and click **Next**.

4 Choose the type of virtual disk. The Wizard recommends whether to use SCSI or IDE, based on the guest operating system installed in the virtual machine.

5 Set the capacity for the new virtual disk.

You can set a size between 0.1GB (100MB) and 950GB for a SCSI virtual disk or 950GB for an IDE virtual disk. The default is 8GB.

By default, **Allocate all disk space now** is checked.

Allocating all the space at the time you create the virtual disk gives somewhat better performance, but it requires as much disk space as the size you specify for the virtual disk.

A preallocated virtual disk is useful for clustering virtual machines. For more information about clustering, see “Using High-Availability Configurations” in the *VMware Server Administration Guide*.

If you deselect this option, the virtual disk’s files start small and grow as needed, but they can never grow larger than the size you set here.

You can also specify whether the virtual disk is created as one large file or split into a set of 2GB files. To split the disk, select **Split disk into 2GB files**. You should split the virtual disk if it is stored on a FAT32 file system or on a file system that cannot support files larger than 2GB, such as FAT16.

6 Accept the default filename and location for the virtual disk file, or change it if you want to use a different name or location. To find a different folder, click **Browse**.

If you want to specify a device node for your virtual disk, click **Advanced**.

On the advanced settings screen, you can also specify a disk mode. This is useful in certain special-purpose configurations in which you want to exclude disks from the snapshot. For more information on snapshots, see "Taking Snapshots" on page 112. You can choose between a normal disk and an independent disk.

Normal disks are included in snapshots. This is the default setting for a new disk.

Independent disks are not included in snapshots. If you select **Independent**, you must further select one of the following modes:

- **Persistent** — changes are immediately and permanently written to the disk.
- **Nonpersistent** — changes to the disk are discarded when you power off or revert to the snapshot.

When you have set the filename and location and have made any selections on the advanced settings screen, click **Finish**.

7 The Wizard creates the new virtual disk. It appears to your guest operating system as a new, blank hard disk. Use the guest operating system's tools to partition and format the new drive.

To add an existing virtual disk from the VMware Server Console

1 Open the virtual machine settings editor (**VM** > **Settings**) and click **Add**. The Add Hardware Wizard guides you through the steps to create your virtual disk. Click **Next** to start configuring the virtual disk.

2 Click **Hard Disk**, and then click **Next**.

3 Select **Use an existing virtual disk**, and then click **Next**.

4 Click **Browse**, and then browse to the virtual disk (`.vmdk`) you want to use.

5 To associate the virtual disk with a specific device node, click **Advanced** and select the device node in the **Virtual device node** list.

On the advanced settings screen, you can also specify a disk mode. This is useful in certain special-purpose configurations in which you want to exclude disks from the snapshot. For more information on the snapshot feature, see "Taking

Snapshots" on page 112. You can choose between a normal disk and an independent disk.

Normal disks are included in snapshots. This is the default setting for a new disk.

Independent disks are not included in snapshots. If you select **Independent**, you must further select one of the following modes:

- **Persistent** — changes are immediately and permanently written to the disk.
- **Nonpersistent** — changes to the disk are discarded when you power off or revert to the snapshot.

When you have set the filename and location to use and have made any selections on the advanced settings screen, click **Finish**. The Wizard adds the virtual disk to the virtual machine.

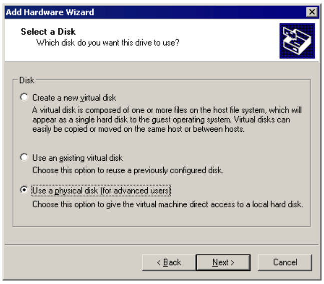
Adding Physical Disks to a Virtual Machine

Use the virtual machine settings editor (**VM** > **Settings**) to add a physical disk to your virtual machine. The virtual machine should be powered off before you begin. If it is not, shut down the guest operating system normally, and click **Power Off** on the VMware Server Console toolbar.

CAUTION Physical disks are an advanced feature and should be configured only by advanced users.

1 Open the virtual machine settings editor (**VM** > **Settings**) and click **Add**. The Add Hardware Wizard guides you through the steps to create your virtual disk.

2 Click **Hard Disk**, and click **Next**. The Select a Disk screen appears.



Add Hardware Wizard

Select a Disk
Which disk do you want this drive to use?

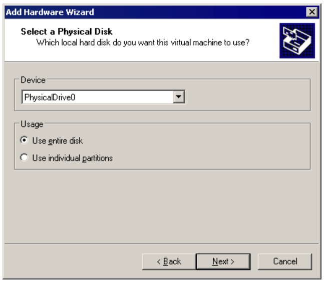
Disk

○ Create a new virtual disk
A virtual disk is composed of one or more files on the host file system, which will appear as a single hard disk to the guest operating system. Virtual disks can easily be copied or moved on the same host or between hosts.

○ Use an existing virtual disk
Choose this option to reuse a previously configured disk.

● Use a physical disk (for advanced users)
Choose this option to give the virtual machine direct access to a local hard disk.

3 Select **Use a physical disk**, and click **Next**. The Select a Physical Disk screen appears.



Select a Physical Disk

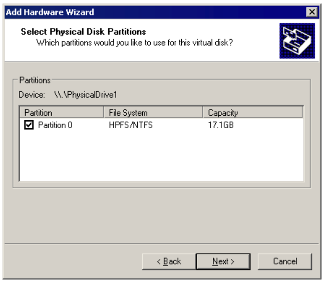
Which local hard disk do you want this virtual machine to use?

Device: PhysicalDrive0

Usage:
- ● Use entire disk
- ○ Use individual partitions

4 Choose the physical hard disk to use from the drop-down list. Then select whether use the entire disk or use only individual partitions on the disk.

- To use the entire disk, select **Use entire disk**, then click **Next**.
- To use specific partitions on the disk, select **Use individual partitions**, and then click **Next**. The Select Partition screen appears.



Select Physical Disk Partitions

Which partitions would you like to use for this virtual disk?

Partitions

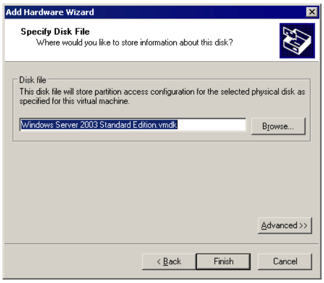
Device: \\.\PhysicalDrive1

Partition	File System	Capacity
☑ Partition 0	HPFS/NTFS	17.1GB

Select which partitions to use in the virtual machine. Only the partitions you select in this step are visible to the virtual machine. All other partitions are hidden from it.

Click **Next**.

5 The Specify Disk File screen appears.


Add Hardware Wizard

Specify Disk File

Where would you like to store information about this disk?

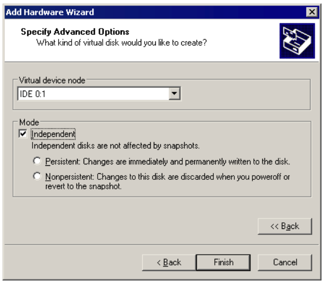
Disk file

This disk file will store partition access configuration for the selected physical disk as specified for this virtual machine.

Windows Server 2003 Standard Edition.vmdk

To change the default filename and location for the file that stores access information for this physical disk, click Browse.

Click **Advanced** to specify the virtual machine SCSI or IDE device node to which this disk is connected.


Add Hardware Wizard

Specify Advanced Options

What kind of virtual disk would you like to create?

Virtual device node

IDE 0:1

Mode

☑ Independent

Independent disks are not affected by snapshots.

○ Persistent: Changes are immediately and permanently written to the disk.

○ Nonpersistent: Changes to this disk are discarded when you poweroff or revert to the snapshot.

On the advanced settings screen, you can also specify a disk mode. This is useful in certain special-purpose configurations in which you want to exclude disks from the snapshot. For more information on the snapshot feature, see “Taking Snapshots” on page 112. You can choose between a normal disk and an independent disk.

Normal disks are included in snapshots. This is the default setting for a new disk.

Independent disks are not included in snapshots. If you select **Independent**, you must also select a mode:

- **Persistent** — changes are immediately and permanently written to the disk.
- **Nonpersistent** — changes to the disk are discarded when you power off or revert to the snapshot.

When you have set the filename and location to use and have made any selections on the advanced settings screen, click **Finish**.

6 The Wizard configures the new physical disk. If the partitions used on the physical disk are not formatted for your guest operating system, use the guest operating system's tools to format them.

NOTE After you create a physical disk using one or more partitions on a physical disk, you should never modify the partition tables by running `fdisk` or a similar utility in the guest operating system. If you use `fdisk` or a similar utility on the host operating system to modify the partition table of the physical disk, you must recreate the virtual machine's physical disk.

Adding DVD/CD-ROM Drives to a Virtual Machine

You can add one or more DVD/CD-ROM drives to your virtual machine. You can connect the virtual machine's drive to a physical drive on the host machine or to an ISO image file.

You can configure the virtual DVD/CD-ROM drive as either IDE or SCSI, no matter what kind of physical drive you connect it to. In other words, if your host computer has an IDE CD-ROM drive, you can set up the virtual machine's drive as either SCSI or IDE and connect it to the host's drive. The same is true if the host's physical drive is a SCSI drive.

To add a new virtual DVD/CD-ROM drive to a virtual machine, make sure the virtual machine is powered off, and complete the following steps. You must use the console to can add the device.

To add a DVD/CD-ROM drive from the VMware Server Console

1 Open the virtual machine settings editor (**VM** > **Settings**) and click **Add** to start the Add Hardware Wizard.

2 Click **DVD/CD-ROM Drive**, and then click **Next**.

3 Select **Use physical drive** to connect the virtual machine's drive to a physical drive on the host computer. Select **Use ISO Image** to connect the virtual machine's drive to an ISO image file.

4 Do one of the following:

- If you selected **Use physical drive**, choose the drive to use from the drop-down list or choose **Auto detect,** which lets VMware Server select the drive.
  The default is Auto detect.

NOTE The benefit of using Auto detect devices is that they can be moved between virtual machines running different operating systems, such as Windows and Linux, without having to be reconfigured.

If you do not want the CD-ROM drive connected when the virtual machine starts, uncheck **Connect at power on**.

Click **Advanced** to specify the device node the drive should use in the virtual machine.

On the advanced settings screen you can also select **Legacy emulation**. This is necessary only if you have had problems using normal mode. The legacy emulation mode does not support all the capabilities of normal mode. For example, if you are using legacy emulation mode, you cannot record CDs, you cannot read multisession CDs, you cannot extract digital audio from a CD, and you cannot read or write DVDs. For details, see "Using Legacy Emulation for DVD/CD-ROM Drives" on page 129.

After you have made any desired changes in these settings, click **Finish**.

- If you selected **Use ISO Image**, enter the path and filename for the image file or click **Browse** to navigate to the file.

  If you do not want the CD-ROM drive connected when the virtual machine starts, uncheck **Connect at power on**.

  Click **Advanced** to specify the device node the drive should use in the virtual machine.

  After you have made any desired changes in these settings, click **Finish**.

5 The drive is set up initially so it appears to the guest operating system as an IDE drive. If you want it to appear to the guest operating system as a SCSI drive, click the drive's entry in the virtual machine settings editor and make the change.

Adding Floppy Drives to a Virtual Machine

You can add up to two floppy drives to your virtual machine. A virtual floppy drive can connect to a physical floppy drive on the host computer, to an existing floppy image file, or to a blank floppy image file.

To add a floppy drive from the VMware Server Console

1. Open the virtual machine settings editor (**VM** > **Settings**) and click **Add** to start the Add Hardware Wizard.

2. Click **Floppy Drive**, and click **Next**.

3 Select what you want to connect to — a physical floppy drive on the host computer, an existing floppy image file, or a new floppy image file. Click **Next**.

4 If you selected **Use a physical floppy drive**, choose the drive's letter (on a Windows host) or device name (on a Linux host) from the drop-down list or choose **Auto detect** to let VMware Server select the drive to use. Click **Finish**.
The benefit of auto-detect devices is that you can move them between virtual machines that use different operating systems, such as Windows and Linux, without having to reconfigure them.

If you selected **Use a floppy image**, type the path and filename for the floppy image file you want to use, or click **Browse** to navigate to the file. Click **Finish**.

If you selected **Create a blank floppy image**, use the default path and filename or type in a new one. To navigate to a location, click **Browse**. When the field contains the path and filename you want to use for the new floppy image file, click **Finish**.

NOTE By default, only one floppy drive is enabled in the virtual machine's BIOS. If you are adding a second floppy drive to the virtual machine, click inside the virtual machine window and press F2 as the virtual machine boots to enter the BIOS setup utility. On the main screen, choose **Legacy Diskette B:** and use the plus (+) and minus (-) keys on the numerical keypad to select the type of floppy drive you want to use. Press F10 to save your changes and close the BIOS setup utility.

Using VMware Virtual Disk Manager

VMware Virtual Disk Manager is a utility in VMware Server that lets you create, manage, and modify virtual disk files from the command line or within scripts.

One key feature is the ability to enlarge a virtual disk so its maximum capacity is larger than it was when you created it. This way, if you find you need more disk space on a given virtual disk, but do not want to add another virtual disk or use ghosting software to transfer the data on a virtual disk to a larger virtual disk, you can simply change the maximum size of the disk. This is something you cannot do with physical hard drives.

Another feature allows you to change whether or not all virtual disk space is preallocated or growable, and whether or not the virtual disk is stored in a single file or split into 2GB files. For example, you might find that you preallocated all the disk space for a virtual disk, but need to reclaim some hard disk space on the host. You can convert the preallocated virtual disk into a growable disk and remove the original virtual disk file. The new virtual disk is large enough to contain all the data on the original virtual disk. The virtual disk grows in size as you add data to it, as if you never preallocated the disk space when you created the virtual disk.

You can use the virtual disk manager to:

- Automate the management of virtual disks with scripts.
- Create virtual disks that are not associated with a particular virtual machine, to be used for templates, for example.
- Switch the virtual disk type from preallocated to growable, or vice versa. When changing the disk type to growable, some space on the virtual disk is reclaimed. You can shrink the virtual disk to reclaim even more disk space.
- Expand the size of a virtual disk so it is larger than the size specified when you created it.
- Defragment virtual disks.
- Prepare and shrink virtual disks without powering on the virtual machine (Windows hosts only).
- Rename and move virtual disks.

You cannot use the virtual disk manager to create physical (raw) disks. You cannot shrink physical disks at all.

The following sections provide more information about the virtual disk manager:

- "Running the VMware Virtual Disk Manager Utility" on page 140
- "Shrinking Virtual Disks with VMware Virtual Disk Manager" on page 143
- "Examples Using the VMware Virtual Disk Manager" on page 144

Running the VMware Virtual Disk Manager Utility

To run the VMware Virtual Disk Manager utility, open a command prompt or terminal on the VMware Server host. For Windows hosts, change to the directory where you installed your VMware Server software. By default, this directory is `C:\Program Files\VMware\VMware Server`.

The command syntax is:

```
vmware-vdiskmanager [options]
```

The options you can or must use are outlined in Table 6-1.

Table 6-1.

Options/Parameters	Description
`<diskname>`	Is the name of the virtual disk file. The virtual disk file must have a `.vmdk` extension. You can specify a path to where you want to locate the disk. If you mapped network shares on your host, you can create the virtual disk there by providing the correct path information with the disk filename.
`-c`	Creates the virtual disk. You must use the `-a`, `-s` and `-t` options, and you must specify the name of the virtual disk (`<diskname>`).

`-r <sourcediskname>`
`<targetdiskname>`
	Converts the virtual disk specified by`<sourcediskname>`, creating a new virtual disk as a result. You must use the `-t` option to specify the disk type to which the virtual disk is converted and you must specify the name of the target virtual disk (`<targetdiskname>`).
	After the conversion is completed and you have tested the converted virtual disk to make sure it works as expected, you can delete the original virtual disk file.
	To have the virtual machine recognize the converted virtual disk, use the virtual machine settings editor to remove the existing virtual disk from the virtual machine. Add the converted disk to the virtual machine. For information on adding virtual disks to a virtual machine, see "Adding Virtual Disks to a Virtual Machine" on page 132.

`-x <n>[GB|MB]`
`<diskname>`
	Expands the virtual disk to the specified capacity. You must specify the new, larger size of the virtual disk in Gigabytes or Megabytes. You cannot change the size of a physical (raw) disk.
	Caution: Before running the virtual disk manager utility, you should back up your virtual disk files.
	Note: If the virtual disk is partitioned, you must use a third-party utility in the virtual machine to expand the size of the partitions. For more information, see VMware knowledge base article 1647 at **www.vmware.com/support/kb/enduser/std_adp.php?p_faqid=1647**.
	If you have a virtual machine with a snapshot or a redo-log file stored in a different directory, do not use the virtual disk manager to expand the virtual disk until you remove the snapshot or commit the redo-log file. Otherwise, you might not be able to power on the virtual machine.

Table 6-1.

Options/Parameters	Description
`-n <sourcediskname> <targetdiskname>`	Renames the virtual disk specified by `<sourcediskname>`. You must specify the name of the target virtual disk (`<targetdiskname>`). By providing directory paths, you can rename the disk and place it in a different directory or place the disk with the same name in a different directory. Before you rename the virtual disk or change the directory in which it is located, you should remove the virtual disk from any virtual machine that contains the disk. Choose **VM** > **Settings** > **<virtualdisk>**, then click **Remove**. If this virtual machine has a snapshot or a redo log stored in a different directory, remove the snapshot or commit the redo log. Otherwise, you may not be able to power on the virtual machine. After you rename or relocate the virtual disk, add it back to any virtual machines that use it. Choose **VM** > **Settings**, click **Add**, then follow the Wizard to add this existing virtual disk.
`-d <diskname>`	Defragments the specified virtual disk. You can defragment only growable virtual disks. You cannot defragment preallocated virtual disks.
`-p <mountpoint>`	Prepares a virtual disk for shrinking. If the virtual disk is partitioned into volumes, each volume must be prepared separately. The volume must be mounted by VMware DiskMount at `<mountpoint>`. After you prepare the volume, unmount it with VMware DiskMount. Continue mounting each volume of the virtual disk and preparing it for shrinking until you complete this process for all the volumes of the virtual disk. You can mount only one volume of a virtual disk at a time with VMware DiskMount. You can prepare volumes of virtual disks for shrinking on only on Windows hosts.
`-k <diskname>`	Shrinks the specified virtual disk. You can shrink only growable virtual disks. You can shrink virtual disks only on Windows hosts. You cannot shrink a virtual disk if the virtual machine has a snapshot. To keep the virtual disk in its current state, remove the snapshot. To discard changes made since you took the snapshot, revert to the snapshot.
`-a [ide|buslogic|lsilogic]`	Specifies the disk adapter type. You must specify an adapter type when creating a new virtual disk. Choose one of the following types: ■ `ide` — for an IDE adapter. ■ `buslogic` — for a BusLogic SCSI adapter. ■ `lsilogic` — for an LSI Logic SCSI adapter.

Table 6-1.

Options/Parameters	Description
`-s <n>[GB|MB]`	Specifies the size of the virtual disk. Specify whether the size `<n>` is in gigabytes or megabytes. You must specify the size of a virtual disk when you create it. Even though you must specify the size of a virtual disk when you expand it, you do not use the `-s` option at that time.
`-t [0|1|2|3]`	You must specify the type of virtual disk when you create a new one or reconfigure an existing one. Specify one of the following disk types: `0` — to create a single, growable virtual disk. `1` — to create a growable virtual disk split into 2GB files. `2` — to create a preallocated virtual disk contained in a single virtual disk file. `3` — to create a preallocated virtual disk split into 2GB files.
`-q`	Disables virtual disk manager logging. If you keep logging enabled, messages generated by the virtual disk manager are stored in a log file. The name and location of the log file appear in the terminal after the virtual disk manager command is run.

Shrinking Virtual Disks with VMware Virtual Disk Manager

You can use the virtual disk manager to prepare and shrink virtual disks only on a Microsoft Windows host. The VMware virtual disk manager is not supported on Linux hosts. You cannot use the virtual disk manager to shrink physical disks. Shrinking a virtual disk does not reduce the maximum capacity of the virtual disk. For more information about shrinking, see "Defragmenting and Shrinking Virtual Disks" on page 125.

CAUTION You cannot shrink a virtual disk if the virtual machine has a snapshot. To keep the virtual disk in its current state, remove the snapshot. To discard changes made after you took the snapshot, revert to the snapshot.

You must prepare each volume of the virtual disk for shrinking before you can shrink the disk. To prepare a volume for shrinking, you must first mount it. To mount the volume, use the VMware DiskMount Utility, available with VMware Server. For more information, see "Appendix: Mounting Virtual Disks" in the *VMware Server Administration Guide*.

VMware DiskMount mounts individual volumes of a virtual disk. For optimal shrinking of a virtual disk, you should mount all the volumes and prepare them for shrinking.

After you mount a virtual disk volume, use the virtual disk manager to prepare the volume for shrinking. After you prepare a volume, unmount it, and repeat the process for each volume of the virtual disk. After you prepare all the volumes of the virtual disk, you can shrink the virtual disk. For examples, see "Preparing a Virtual Disk for Shrinking" on page 145 and "Shrinking a Virtual Disk" on page 146.

Examples Using the VMware Virtual Disk Manager

The following examples illustrate how to use the virtual disk manager. You run the virtual disk manager from a command prompt.

Creating a new Virtual Disk

To create a new virtual disk, `use the following:`

```
vmware-vdiskmanager -c -t 0 -s 40GB -a ide myDisk.vmdk
```

This creates a 40GB IDE virtual disk named `myDisk.vmdk`. The virtual disk is contained in a single `.vmdk` file. The disk space is not preallocated.

Converting a Virtual Disk from

To convert a virtual disk from preallocated to a growable disk, `use the following:`

```
vmware-vdiskmanager -r sourceDisk.vmdk -t 0 targetDisk.vmdk
```

This converts the disk from its original preallocated type to a growable virtual disk consisting of a single virtual disk file. All of the virtual disk space is no longer preallocated, and the virtual disk manager reclaims some disk space in the virtual disk so it is only as large as the data contained within it.

Expanding the Size of an Existing Virtual Disk

To expand the size of a virtual disk, use the following:

```
vmware-vdiskmanager -x 40GB myDisk.vmdk
```

This increases the maximum capacity of the virtual disk to 40GB.

Renaming a Virtual Disk

To rename a virtual disk, first remove it from any virtual machine that contains the disk (choose **VM** > **Settings** > **<virtualdisk>**, click **Remove**).

Use the following:

```
vmware-vdiskmanager -n myDisk.vmdk myNewDisk.vmdk
```

To rename the disk and locate it in a different directory, use:

```
vmware-vdiskmanager -n myDisk.vmdk ..\<new>\<path>\myNewDisk.vmdk
```

NOTE The paths used in these examples assume a Microsoft Windows host.

To locate the disk in a different directory but keep the same name, use:

```
vmware-vdiskmanager -n myDisk.vmdk ..\<new>\<path>\myDisk.vmdk
```

After you rename or relocate the virtual disk, add it back to any virtual machines that use it. Choose **VM** > **Settings**, click **Add**. Follow the Wizard to add this existing virtual disk.

Defragmenting a Virtual Disk

To defragment a virtual disk, use the following:

```
vmware-vdiskmanager -d myDisk.vmdk
```

You cannot defragment a virtual disk if you preallocated all the disk space when you created the virtual disk. You cannot defragment a physical disk.

Preparing a Virtual Disk for Shrinking

Before you can shrink a virtual disk, you must prepare each volume on the disk for shrinking. The disk must be located on a Windows host. First you must mount the volume. To mount the volume, use the VMware DiskMount Utility, available with VMware Server. For information about how to use VMware DiskMount, see "Shrinking Virtual Disks with VMware Virtual Disk Manager" on page 143.

VMware DiskMount mounts individual volumes of a virtual disk. For optimal shrinking of a virtual disk, you should mount all the volumes and shrink them.

After you mount a virtual disk volume, use the virtual disk manager to prepare the disk for shrinking. To prepare the volume mounted at the M drive for shrinking, use the following:

```
vmware-vdiskmanager -p M:
```

Once the preparations are complete, unmount the volume. Repeat this process for each volume of the virtual disk. After you prepare all the volumes for shrinking, you can shrink the virtual disk.

Shrinking a Virtual Disk

To shrink a virtual disk, it must be located on a Microsoft Windows host. Before you can shrink the virtual disk, make sure you prepare all the volumes of the virtual disk for shrinking. Then use the following:

```
vmware-vdiskmanager -k myDisk.vmdk
```

Remember, you cannot shrink a virtual disk if you preallocated all the disk space when you created the virtual disk. You cannot shrink a physical (raw) disk.

You cannot shrink a virtual disk if the virtual machine has a snapshot. To keep the virtual disk in its current state, remove the snapshot. To discard changes made since you took the snapshot, revert to the snapshot.

Installing an Operating System onto a Physical Partition

In some situations, you might want to install a guest operating system directly on a physical disk or partition—also known as a raw disk—even if you do not need to boot that disk on the host, outside of the virtual machine.

You can use either an unused partition or a completely unused disk on the host as a disk in the virtual machine. However, it is important to be aware that an operating system installed in this setting probably cannot boot outside of the virtual machine, even though the data is available to the host.

CAUTION You cannot use a physical disk that is stored on a SAN. You must use a disk or a partition on the VMware Server host. Physical disks are an advanced feature and should be configured only by advanced users.

VMware Server uses description files to control access to each physical disk on the system. These description files contain access privilege information that controls a virtual machine’s access to certain partitions on the disks. This mechanism prevents users from accidentally running the host operating system again as a guest or running a guest operating system that the virtual machine is not configured to use. The description file also prevents accidental writes to physical disk partitions from badly behaved operating systems or applications.

Use the New Virtual Machine Wizard to configure a virtual machine to use existing physical disk partitions. The Wizard guides you though creating a new virtual machine, including configuring the physical disk description files. Rerun the Wizard to create a separate configuration for each guest operating system installed on a raw partition.

NOTE While installing the guest operating system on a physical disk, if your virtual machine does not boot from the CD-ROM, try changing the boot order in the virtual machine's BIOS. Restart the virtual machine, and press F2 while the virtual machine is booting to enter the BIOS. Change the boot order there.

Read the section appropriate to your VMware Server host operating system.

- "Configuring a Windows Host" on page 147
- "Configuring a Linux Host" on page 149

Configuring a Windows Host

The following sections describe how to configure physical disks on a Windows host.

Use the following steps to run a guest operating system from a physical disk.

NOTE If you use a Windows host's IDE disk in a physical disk configuration, it cannot be configured as the slave on the secondary IDE channel if the master on that channel is a CD-ROM drive.

To configure the virtual machine to use a physical disk

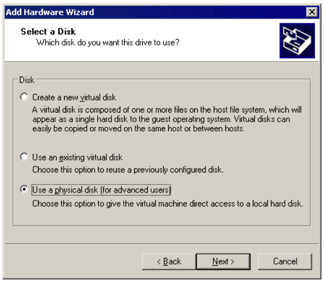
1. Identify the raw partition on which you plan to install the guest operating system.

   Check the guest operating system documentation regarding the type of partition on which the operating system can be installed. For example, operating systems like DOS, Windows 95, and Windows 98 must be installed on the first primary partition while others, like Linux, can be installed on a primary or extended partition on any part of the drive.

   Identify an appropriate raw partition or disk for the guest operating system to use. Be sure that the raw partition is not mounted by the Windows host and not in use by others. Also, be sure the raw partition or disk does not have data you will need in the future; if it does, back up that data now.

2. Start the New Virtual Machine Wizard (**File** > **New** > **Virtual Machine**) and select **Custom**.

3 When you reach the Select a Disk step, select **Use a physical disk**.



Select a Disk
Which disk do you want this drive to use?

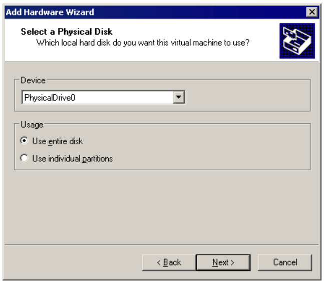
Disk

○ Create a new virtual disk
A virtual disk is composed of one or more files on the host file system, which will appear as a single hard disk to the guest operating system. Virtual disks can easily be copied or moved on the same host or between hosts.

○ Use an existing virtual disk
Choose this option to reuse a previously configured disk.

● Use a physical disk (for advanced users)
Choose this option to give the virtual machine direct access to a local hard disk.

4 Choose the physical hard disk to use from the drop-down list. Select whether to use the entire disk or use only individual partitions on the disk. Click **Next**.

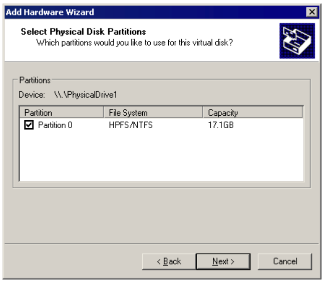


Select a Physical Disk
Which local hard disk do you want this virtual machine to use?

Device
PhysicalDrive0

Usage
● Use entire disk
○ Use individual partitions

5 If you selected **Use individual partitions** in the previous step, select which partitions you want to use in the virtual machine. If you selected **Use entire disk**, this step does not appear.



Select Physical Disk Partitions
Which partitions would you like to use for this virtual disk?

Partitions
Device: \\.\PhysicalDrive1

Partition	File System	Capacity
☑ Partition 0	HPFS/NTFS	17.1GB

Click **Next**.

6 The partition on which you are installing the guest operating system should be unmapped in the host.

CAUTION Corruption is possible if you allow the virtual machine to modify a partition that is simultaneously mounted under Windows. Since the virtual machine and guest operating system access a physical disk partition while the host continues to run Windows, it is critical that you not allow the virtual machine to modify any partition mounted by the host or in use by another virtual machine. To safeguard against this problem, be sure the physical disk partition you use for the virtual machine is not in use by the host.

Use Disk Management (**Start** > **Settings** > **Control Panel** > **Administrative Tools** > **Computer Management** > **Storage** > **Disk Management**). Select the partition you want to unmap. Choose **Action** > **All Tasks** > **Change Drive Letter and Path**. Click **Remove**.

7 Use the virtual machine settings editor (**VM** > **Settings**) to change any configuration options from the Wizard defaults — for example, to change the amount of memory allocated to the virtual machine.

8 At this point you are ready to begin installing the guest operating system onto the physical disk you configured for the virtual machine. For more details, read the installation notes for various guest operating systems in the *VMware Guest Operating System Installation Guide*, available from the VMware Web site.

Configuring a Linux Host

1 Identify the raw partition on which to install the guest operating system.

Check the guest operating system documentation regarding the type of partition on which the operating system can be installed. For example, operating systems like DOS, Windows 95, and Windows 98 must be installed on the first primary partition while others, like Linux, can be installed on a primary or extended partition on any part of the drive.

Identify an appropriate raw partition or disk for the guest operating system to use. Check that the raw partition is not mounted by the Linux host and not in use by others. Also, be sure the raw partition or disk does not have data you will need in the future; if it does, back up that data now.

2 Check the operating system partition mounts. Be sure the existing disk partitions that you plan to use in the virtual machine are not mounted by Linux.

3 Set the device group membership or device ownership.

The master physical disk device or devices need to be readable and writable by the user who runs VMware Server. On most distributions, the raw devices, such as

/dev/hda (IDE physical disk) and /dev/sdb (SCSI physical disk) belong to group ID disk. If this is the case, you can add VMware Server users to the disk group. Another option is to change the owner of the device. Think carefully about security issues when you explore different options here.

VMware recommends granting VMware Server users access to all /dev/hd[abcd] raw devices that contain operating systems or boot managers rather than to rely on VMware Server's physical disk configuration files to guard access. This provides boot managers access to configuration and other files they might need to boot the operating systems. For example, LILO needs to read /boot on a Linux partition to boot a non-Linux operating system that might be on another drive.

4 Start the New Virtual Machine Wizard (**File** > **New** > **Virtual Machine**) and select **Custom**.

5 When you reach the Select a Disk step, select **Use a physical disk**.

6 If the physical disk you plan to use already has multiple partitions, certain operating systems (DOS, Windows 95, Windows 98) must be installed on the first primary partition.

CAUTION	Corruption is possible if you allow the virtual machine to modify a partition that is simultaneously mounted under the Linux host operating system. Because the virtual machine and guest operating system access an existing partition while the host continues to run Linux, it is critical that the virtual machine not be allowed to modify any partition mounted by the host or in use by another virtual machine.

To safeguard against this problem, be sure the partition you use for the virtual machine is not mounted under the Linux host.

7 At this point you are ready to begin installing the guest operating system on the physical disk you configured for the virtual machine. For more details, read the installation notes for various guest operating systems in the *VMware Guest Operating System Installation Guide*, available from the VMware Web site.

Disk Performance in Windows NT Guests on Multiprocessor Hosts

Some users have experienced slower than expected disk input and output performance when running Windows NT guest operating systems. Users might experience the problem in VMware Server virtual machines using IDE virtual disks on multiprocessor host computers. The I/O issue is especially noticeable when the virtual machine is booting.

NOTE Performance in Windows NT guest operating systems might also be affected by disk fragmentation on the host computer. For details, see "Configuring and Maintaining the Host Computer".

Improving Performance

You can increase performance by enabling DMA (direct memory access) on the virtual hard disk's IDE channel in the virtual machine.

If you have a virtual disk and a DVD/CD-ROM attached as master and slave to the primary IDE controller (channel 0) and you want to enable DMA, power off the virtual machine and use the virtual machine settings editor (**VM** > **Settings**) to move the DVD/CD-ROM drive to the secondary IDE controller (channel 1) at IDE 1:0.

You can enable the DMA feature after you finish installing Windows NT. You must install Service Pack 3 or higher in the virtual machine to enable this option.

After the virtual machine is running Windows NT, insert an SP3 or SP4 CD in the drive and run `DMACHECK.EXE` from the `\SUPPORT\UTILS\I386` folder on the CD. Or download `DMACHECK.EXE` from the Microsoft Web site (**support.microsoft.com/support/kb/articles/Q191/7/74.ASP**).

Click the **Enabled** option for the IDE controller and channel configured for the virtual disk. Typically, this is channel 0 only, unless you have the virtual machine configured with multiple virtual disks and no virtual DVD/CD-ROM drive.

As noted above, you should not enable DMA on an IDE channel with a virtual DVD/CD-ROM drive attached.

CHAPTER 7 Networking

This chapter describes how to use virtual networking components to create a wide range of configurations and covers the following topics:

When you create a virtual machine with the New Virtual Machine Wizard, you can choose any of the common configurations — bridged networking, network address translation (NAT), and host-only networking. The Wizard connects the virtual machine to the appropriate virtual network.

You can set up more specialized configurations by choosing the appropriate settings in the virtual machine settings editor, in the Virtual Network Editor (on Microsoft Windows hosts) and on your host computer.

On a Windows host, the software needed for all networking configurations is installed when you install VMware Server. On a Linux host, all components are available if you choose to have both bridged and host-only networking available to your virtual machines at the time you install VMware Server.

Components of the Virtual Network

The following items are components of a virtual network:

Virtual switch – Like a physical switch, a virtual switch lets you connect other networking components together. The VMware Server software creates virtual switches as needed. Windows hosts support as many as 10 switches, while Linux hosts support as many as 100 switches. You can connect one or more virtual machines to a switch.

Several of the switches and the networks associated with them are, by default, used for special named configurations. The bridged network normally uses VMnet0. The host-only network uses VMnet1 by default. The NAT network uses VMnet8 by default. The other available networks are named VMnet2, VMnet3, VMnet4, and so on.

You connect a virtual machine to a switch by selecting the virtual network adapter to connect in the virtual machine settings editor, and configuring it to use the virtual network.

Bridge – The bridge lets you connect your virtual machine to the LAN used by your host computer. It connects the virtual network adapter in your virtual machine to the physical Ethernet adapter in your host computer.

The bridge is installed during VMware Server installation (on a Linux host, you must choose to make bridged networking available to your virtual machines). It is set up when you create a new virtual machine using bridged networking.

You can set up additional virtual bridges to use in custom configurations that require connections to more than one physical Ethernet adapter on the host computer.

Host virtual adapter – The host virtual adapter is a virtual Ethernet adapter that appears to your host operating system as a VMware virtual Ethernet adapter on a Windows host and as a host-only interface on a Linux host. It allows you to communicate between your host computer and the virtual machines on that host computer. The host virtual adapter is used in host-only and NAT configurations.

The host virtual adapter is not connected to any external network unless you set up special software on the host computer — a proxy server, for example — to connect the host-only adapter to the physical network adapter.

The software that creates the host virtual adapter is installed when you install VMware Server (on a Linux host, you must choose to make host-only networking available to your virtual machines). A host virtual adapter is created when you boot the host computer.

You can set up additional host virtual adapters as needed.

NAT device – The NAT (network address translation) device allows you to connect your virtual machines to an external network when you have only one IP network address on the physical network, and that address is used by the host computer. You can, for example, use NAT to connect your virtual machines to the Internet through a dial-up connection on the host computer or through the host computer’s Ethernet adapter or wireless Ethernet adapter. NAT is also useful when you need to connect to a non-Ethernet network, such as Token Ring or ATM.

The NAT device is set up automatically when you install VMware Server. (On a Linux host, you must choose to make NAT available to your virtual machines.)

DHCP server – The DHCP (dynamic host configuration protocol) server provides IP network addresses to virtual machines in configurations that are not bridged to an external network — for example, host-only and NAT configurations.

Network adapter – One virtual network adapter is set up for your virtual machine when you create it with the New Virtual Machine Wizard using any type of networking (a virtual network adapter is always added to a virtual machine created with the VMware Management Interface). It appears to the guest operating system as an AMD PCNET PCI adapter.

You can create and configure up to four virtual network adapters in each virtual machine using the virtual machine settings editor.

The adapter can use one of two drivers: the `vlance` driver and the `vmxnet` driver. VMware Server supports NIC morphing, which dynamically selects the driver. The vlance driver installs when a virtual machine is started or rebooted. If the virtual machine has VMware Tools installed, the vmxnet driver is automatically installed. Otherwise, the vlance driver remains as the default.

Common Networking Configurations

The following sections illustrate the networking configurations that are set up when you choose the standard networking options in the New Virtual Machine Wizard or virtual machine settings editor.

- "Bridged Networking" on page 156
- "Network Address Translation (NAT)" on page 157
- "Host-Only Networking" on page 158

Only one virtual machine is shown in each example, but multiple virtual machines can be connected to the same virtual Ethernet switch. On a Windows host, you can connect an unlimited number of virtual network devices to a virtual switch. On a Linux host, you can connect up to 32 devices.

Bridged Networking

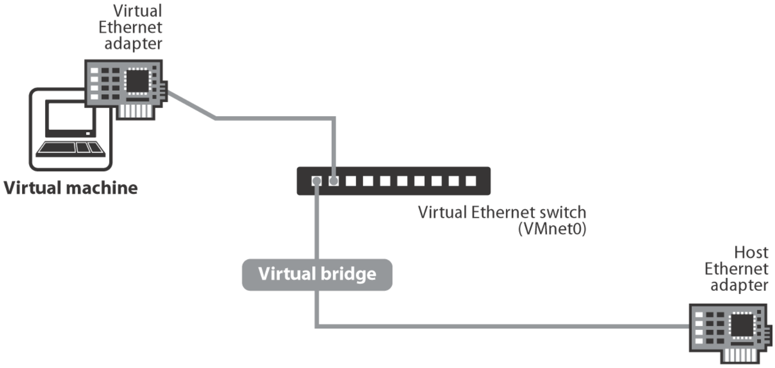


Figure 7-1. Bridged networking connects a virtual machine to a network using the host computer's Ethernet adapter.

Bridged networking is set up automatically if you select **Use bridged networking** in the New Virtual Machine Wizard or if you select the **Typical** setup path. This selection is available on a Linux host only if you enable the bridged networking option when you install VMware Server.

Bridged networking is often the easiest way to give your virtual machine access to the network when your host computer is on an Ethernet network. On a Windows host, you can use bridged networking to connect to either a wired or a wireless network. On a Linux host, you can use bridged networking to connect to a wired network.

If you use bridged networking, your virtual machine needs to have its own identity on the network. For example, on a TCP/IP network, the virtual machine needs its own IP address. Your network administrator can tell you whether IP addresses are available for your virtual machine and what networking settings you should use in the guest operating system. Generally, your guest operating system can acquire an IP address and other network details automatically from a DHCP server. You might need to set the IP address and other details manually in the guest operating system.

Using bridged networking enables the virtual machine to be a full participant in the network. It has access to other machines on the network and can be contacted by other machines on the network as if it were a physical computer on the network.

If the host computer is set up to boot multiple operating systems and you run one or more of them in virtual machines, you need to configure each operating system with a unique network address. People who boot multiple operating systems often assign all systems the same address, since they assume only one operating system will run at a time. If you use one or more of the operating systems in a virtual machine, this assumption is no longer true.

You can set or change the option to use bridged networking in the virtual machine settings editor (**VM** > **Settings**). For details, see "Changing the Networking Configuration" on page 162.

Network Address Translation (NAT)

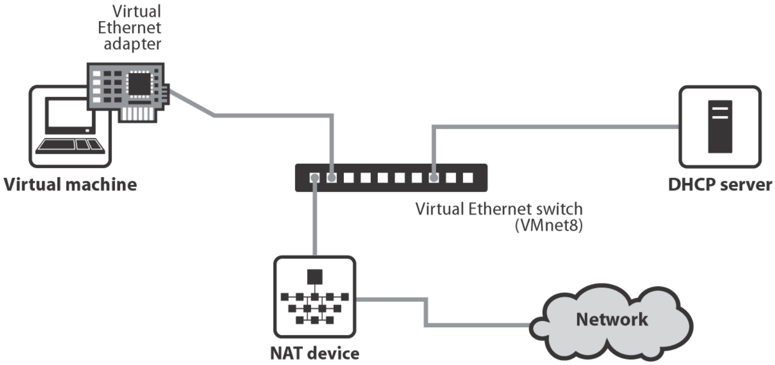


Figure 7-2. NAT gives a virtual machine access to network resources using the host computer's IP address.

A network address translation connection is set up automatically if you follow the **Custom** path in the New Virtual Machine Wizard and select **Use network address translation**.

If you want to connect to the Internet or other TCP/IP network using the host computer's dial-up networking or broadband connection and you are not able to give your virtual machine an IP address on the external network, NAT is often the easiest way to give your virtual machine access to that network.

NAT also allows you to connect to a TCP/IP network using a Token Ring adapter on the host computer. However r your virtual machine does not have its own IP address on the external network if you use NAT. Instead, a separate private network is set up on the host computer. Your virtual machine gets an address on that network from the VMware virtual DHCP server. The VMware NAT device passes network data between one or more virtual machines and the external network. It identifies incoming data packets intended for each virtual machine and sends them to the correct destination.

If you select NAT, the virtual machine can use many standard TCP/IP protocols to connect to other machines on the external network. For example, you can use HTTP to browse Web sites, FTP to transfer files, and Telnet to log on to other computers. In the default configuration, computers on the external network cannot initiate connections to the virtual machine. That means, for example, that the default configuration does not let you use the virtual machine as a Web server to send Web pages to computers on the external network.

If you make some other selection in the New Virtual Machine Wizard and later decide to use NAT, you can make that change in the virtual machine settings editor (**VM** > **Settings**). For details, see "Changing the Networking Configuration" on page 162.

For a more thorough discussion of NAT, see "Understanding NAT" on page 190.

Host-Only Networking

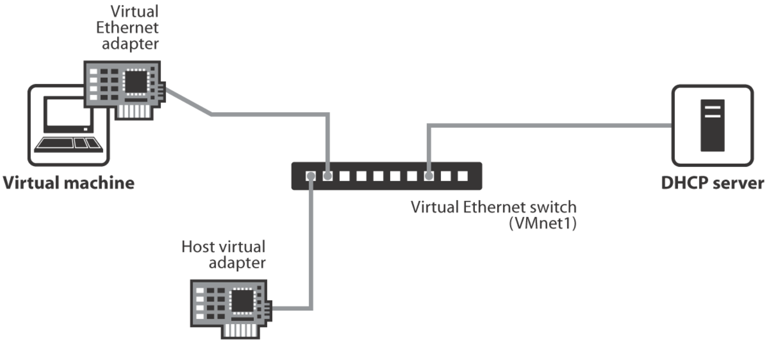


Figure 7-3.
Host-only networking creates a network that is completely contained within the host computer.

A host-only network is set up automatically if you select **Use Host-Only Networking** in the New Virtual Machine Wizard. On Linux hosts, this selection is available only if you enabled the host-only networking option when you installed VMware Server.

Host-only networking provides a network connection between the virtual machine and the host computer, using a virtual Ethernet adapter that is visible to the host operating system. This approach can be useful if you need to set up an isolated virtual network.

If you use host-only networking, your virtual machine and the host virtual adapter are connected to a private TCP/IP network. Addresses on this network are provided by the VMware DHCP server.

If you make some other selection in the New Virtual Machine Wizard and later decide you want to use host-only networking, you can make that change in the virtual machine settings editor (**VM** > **Settings**). For details, see "Changing the Networking Configuration" on page 162.

Routing and Connection Sharing

If you install the proper routing or proxy software on your host computer, you can establish a connection between the host virtual Ethernet adapter and a physical network adapter on the host computer. This allows you, for example, to connect the virtual machine to a Token Ring or other non-Ethernet network.

On a Windows 2000 or Windows Server 2003 host computer, you can use host-only networking in combination with the Internet connection sharing feature in Windows to allow a virtual machine to use the host's dial-up networking adapter or other connection to the Internet. See your Windows documentation for details on configuring Internet connection sharing.

Custom Networking Configurations

The virtual networking components provided by VMware Server make it possible for you to create sophisticated virtual networks. The virtual networks can be connected to one or more external networks, or they can run entirely on the host computer.

Setting up networking components for your custom virtual network is a straightforward process. Before attempting to set up complex virtual networks, you should have a good understanding of how to configure network devices in your host and guest operating systems.

The sample configuration described in this section illustrates one of the many ways you can combine devices on a virtual network. Other custom configurations are described in "Advanced Networking Topics" on page 171 and "Understanding NAT" on page 190.

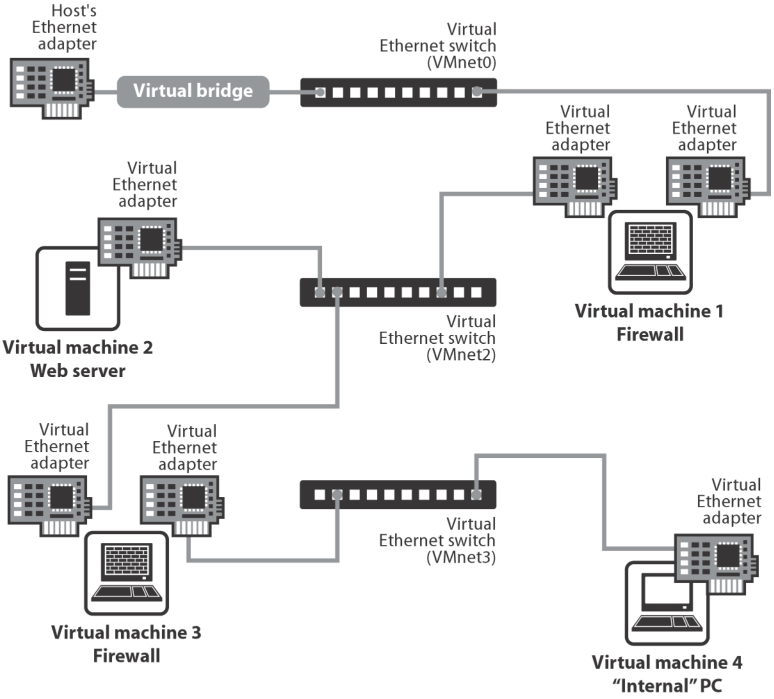

Host's Ethernet adapter
Virtual bridge
Virtual Ethernet switch (VMnet0)
Virtual Ethernet adapter
Virtual Ethernet adapter
Virtual Ethernet adapter
Virtual machine 1 Firewall
Virtual machine 2 Web server
Virtual Ethernet switch (VMnet2)
Virtual Ethernet adapter
Virtual Ethernet adapter
Virtual Ethernet switch (VMnet3)
Virtual Ethernet adapter
Virtual machine 3 Firewall
Virtual machine 4 "Internal" PC

Figure 7-4. In this custom configuration, a Web server connects through a firewall to an external network. An administrator's computer can connect to the Web server through a second firewall.

To set up this configuration, you must create four virtual machines and use the virtual machine settings editor to adjust the settings for their virtual Ethernet adapters. You also need to install the appropriate guest operating systems and application software in each virtual machine and make the appropriate networking settings in each virtual machine.

1 Set up four virtual machines using the New Virtual Machine Wizard.

   Create the first virtual machine with bridged networking so it can connect to an external network using the host computer's Ethernet adapter.

   Create the other three virtual machines without networking. You will set up their virtual Ethernet adapters in later steps.

2 Launch a VMware Server Console and open virtual machine 1. Do not power on the virtual machine.

Use the virtual machine settings editor (**VM** > **Settings**) to add a second virtual network adapter, as described in "Changing the Networking Configuration" on page 162. Connect the second adapter to **Custom (VMnet2)**.

Click **OK** to save the configuration and close the virtual machine settings editor.

3 If a console is not running, launch one. Open virtual machine 2. Do not power on the virtual machine.

Use the virtual machine settings editor (**VM** > **Settings**) to add a virtual network adapter. Connect the adapter to **Custom (VMnet2)**.

Click **OK** to save the configuration and close the virtual machine settings editor.

4 If a console is not running, launch one. Open virtual machine 3. Do not power on the virtual machine.

Use the virtual machine settings editor to add a virtual network adapter. Connect the adapter to **Custom (VMnet2)**.

Use the virtual machine settings editor to add a second virtual network adapter. Connect the adapter to **Custom (VMnet3)**.

Click **OK** to save the configuration and close the virtual machine settings editor.

5 If a console is not running, launch one. Open virtual machine 4. Do not power on the virtual machine.

Use the virtual machine settings editor to add a virtual network adapter. Connect the adapter to **Custom (VMnet3)**.

Click **OK** to save the configuration and close the virtual machine settings editor.

6 Determine the network addresses used for VMnet2 and VMnet3.

NOTE On a Windows host, you can skip the steps for configuring network addresses manually and, instead, use VMware Server's DHCP server. Choose **Host** > **Virtual Network Settings** > **DHCP** and add VMnet2 and VMnet3 to the list of virtual networks served by the virtual DHCP server. Then skip to step 9.

On a Windows host, open a command prompt on the host computer and run `ipconfig /all`. Note the network addresses used by each virtual adapter.

On a Linux host, run `ifconfig` at the console or in a terminal window on the host computer. Note the network addresses used by each virtual switch.

7 Launch a console, open each virtual machine in turn and install the appropriate guest operating system.

8. Configure the networking in each guest operating system.

   For the bridged Ethernet adapter in virtual machine 1, use the networking settings needed for a connection to the external network. If the virtual machine gets its IP address from a DHCP server on the external network, the default settings should work.

   For the second Ethernet adapter in virtual machine 1, manually assign an IP address in the range you are using with VMnet2.

   In virtual machine 2, assign an IP address in the range you are using with VMnet2.

   In virtual machine 3, network adapters are connected to VMnet2 and VMnet3. Assign each adapter an IP address in the range you are using with the virtual network to which it is connected.

   In virtual machine 4, assign an IP address in the range you are using with VMnet3.

9. Install the necessary application software in each virtual machine.

Changing the Networking Configuration

Using the virtual machine settings editor (**VM** > **Settings**), you can change the configuration of your virtual networks by

- "Adding and Modifying Virtual Network Adapters" on page 162
- "Configuring Bridged Networking Options on a Windows Host" on page 164
- "Enabling, Disabling, Adding, and Removing Host Virtual Adapters" on page 168

Adding and Modifying Virtual Network Adapters

You can add new or configure existing virtual network adapters from the VMware Server Console and from the VMware Management Interface. The settings you can configure include the virtual network device to which the virtual machine is bound and the network driver it uses.

VMware Server supports two network drivers for a virtual network adapter, the `vlance` driver and the `vmxnet` driver. VMware Server automatically selects the network driver based on the configuration on your virtual machine. The vlance driver installs when a virtual machine is started or rebooted. If the virtual machine has VMware Tools installed, the vmxnet driver is automatically installed. Otherwise, the vlance driver remains as the default.

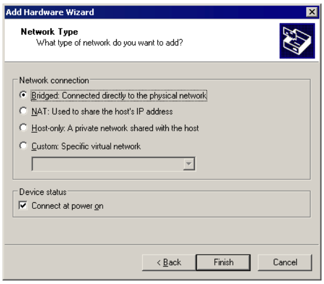
To add and configure a virtual network adapter from the Console

1 Power off the virtual machine.

1 Open the virtual machine settings editor. Choose **VM** > **Settings**.

2 Click **Add**.

3 The Add Hardware Wizard starts. Select **Ethernet Adapter**. Click **Next**. The Network Type screen appears.



Add Hardware Wizard

Network Type
What type of network do you want to add?

Network connection
● Bridged: Connected directly to the physical network
○ NAT: Used to share the host's IP address
○ Host-only: A private network shared with the host
○ Custom: Specific virtual network

Device status
☑ Connect at power on

4 Specify the type of networking this virtual NIC uses. Select **Bridged**, **NAT**, **Host-only**, **Custom** or **Named**.

If you select **Custom**, choose the VMnet virtual network you want to use for the network from the drop-down list.

NOTE Although VMnet0, VMnet1, and VMnet8 are available in this list, they are normally used for bridged, host-only, and NAT configurations, respectively. Special steps are required to make them available for use in custom configurations. You should choose one of the other switches.

---

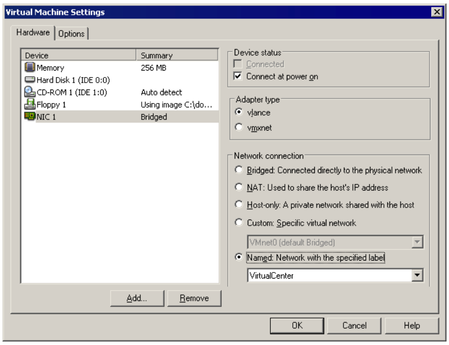
5 Click **Finish**. The new adapter is added.

6 Click **OK** to save your configuration and close the virtual machine settings editor.

To change the configuration of an existing virtual network adapter

1 Open the virtual machine settings editor. Choose **VM** > **Settings**.

2 Select the adapter you want to modify.



Device	Summary
Memory	256 MB
Hard Disk 1 (IDE 0:0)	
CD-ROM 1 (IDE 1:0)	Auto detect
Floppy 1	Using image C:\do...
NIC 1	Bridged

Device status
□ Connected
☑ Connect at power on

Adapter type
● vlance
○ vmxnet

Network connection
○ Bridged: Connected directly to the physical network
○ NAT: Used to share the host's IP address
○ Host-only: A private network shared with the host
○ Custom: Specific virtual network
VMnet0 (default Bridged)
● Named: Network with the specified label
VirtualCenter

3 Specify the type of networking this virtual NIC uses. Select **Bridged**, **NAT**, **Host-only**, **Custom** or **Named**.

If you select **Custom**, choose the VMnet virtual network you want to use for the network from the drop-down list.

4 Click **OK** to save your changes and close the virtual machine settings editor.

5 Be sure the guest operating system is configured to use an appropriate IP address on the new network. If the guest is using DHCP, release and renew the lease. If the IP address is set statically, be sure the guest has an address on the correct virtual network.

If you selected a custom network, select the specific virtual network from the list.

Configuring Bridged Networking Options on a Windows Host

You can view and change the settings for bridged networking on your host. These changes affect all virtual machines using bridged networking on the host.

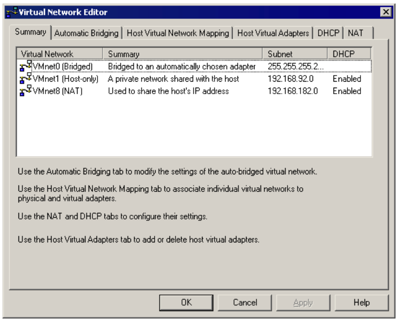
You can decide which network adapters on your host to use for bridged networking. You can map specific network adapters to specific virtual networks (VMnets).

To configure bridged networking options on a Windows host

1 Launch a VMware Server Console.

2 Choose **Host** > **Virtual Network Settings**.

The Virtual Network Editor appears, with the Summary tab active.



Virtual Network	Summary	Subnet	DHCP
VMnet0 (Bridged)	Bridged to an automatically chosen adapter	255.255.255.2...	
VMnet1 (Host-only)	A private network shared with the host	192.168.92.0	Enabled
VMnet8 (NAT)	Used to share the host's IP address	192.168.182.0	Enabled

Use the Automatic Bridging tab to modify the settings of the auto-bridged virtual network.

Use the Host Virtual Network Mapping tab to associate individual virtual networks to physical and virtual adapters.

Use the NAT and DHCP tabs to configure their settings.

Use the Host Virtual Adapters tab to add or delete host virtual adapters.

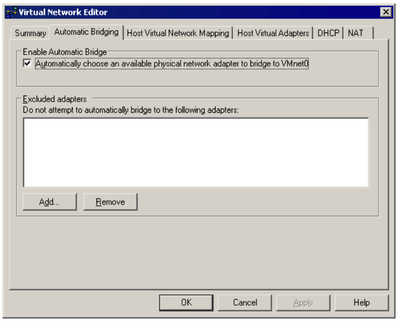
3 By default, the VMnet0 virtual network is set up in bridged mode and bridges to one of the active Ethernet adapters on the host computer.

The choice of which adapter it uses is arbitrary. VMware recommends that you let VMware Server choose an available physical network adapter for bridging, as it provides fault tolerance. If a network adapter becomes unavailable (for example, if it is unplugged or removed from the host), the network bridge automatically switches to another network adapter on the host.

You can restrict the range of choices by using options on the Automatic Bridging tab.

(Also shown are VMnet1, the default virtual network for host-only networking, and VMnet8, the default virtual network for NAT, if they are enabled in VMware Server.)

4 To exclude one or more physical Ethernet adapters from the list to which VMnet0 can be bridged, click the **Automatic Bridging** tab.



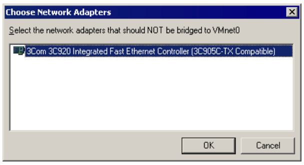
Enable Automatic Bridge

☑ Automatically choose an available physical network adapter to bridge to VMnet0

Excluded adapters

Do not attempt to automatically bridge to the following adapters:

To exclude an Ethernet adapter, click **Add** to add it to the list of excluded devices.

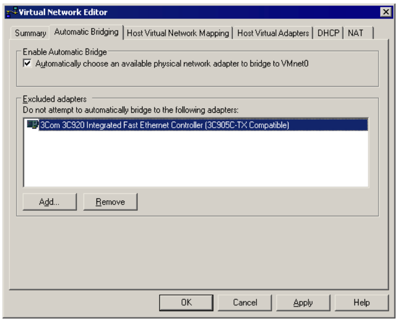


Select the network adapters that should NOT be bridged to VMnet0

3Com 3C920 Integrated Fast Ethernet Controller (3C905C-TX Compatible)

In the Choose Network Adapters dialog box, select the listing for the adapter you want to exclude, then click **OK**.

To remove an adapter from the list of excluded adapters, select its name in the list, and click **Remove**.



Enable Automatic Bridge

☑ Automatically choose an available physical network adapter to bridge to VMnet0

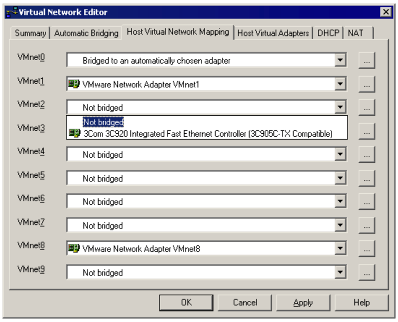
Excluded adapters

Do not attempt to automatically bridge to the following adapters:

3Com 3C920 Integrated Fast Ethernet Controller (3C905C-TX Compatible)

If you are using teamed network adapters on your host, you can exclude the physical network adapters from bridged networking. For information about teamed network adapters, see "Configuring Bridged Networking When Using Teamed Network Interface Cards" on page 180.

5 To designate a physical Ethernet adapter to be used for bridged networking on virtual switches named VMnet2–VMnet7, click the **Host Virtual Network Mapping** tab.



VMnet0 Bridged to an automatically chosen adapter

VMnet1 VMware Network Adapter VMnet1

VMnet2 Not bridged

Not bridged

3Com 3C920 Integrated Fast Ethernet Controller (3C905C-TX Compatible)

VMnet3

VMnet4 Not bridged

VMnet5 Not bridged

VMnet6 Not bridged

VMnet7 Not bridged

VMnet8 VMware Network Adapter VMnet8

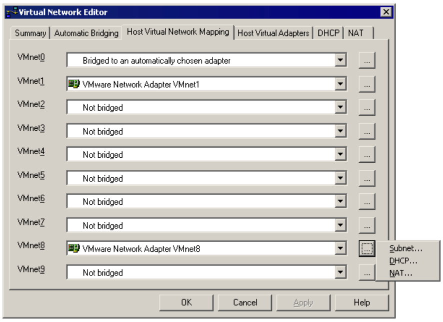
VMnet9 Not bridged

Choose an adapter from the drop-down list beside the name of the virtual switch you want to use.

If you are using teamed network adapters on your host, you can choose the teamed NIC for VMnet0.

CAUTION Be careful when you change the bridged adapter mappings. If you re-assign a physical Ethernet adapter to a different virtual network, any virtual machine using the original network loses its network connectivity through that network. You must then change the setting for each affected virtual machine's network adapter individually. This can be especially troublesome if your host has only one physical Ethernet adapter and you reassign it to a VMnet other than VMnet0. Even though the VMnet still appears to be bridged to an automatically chosen adapter, the only adapter it can use has been assigned to another VMnet.

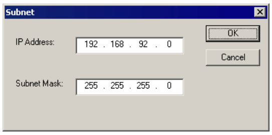
6 To make changes to the subnet or the DHCP settings for a virtual network, click the button on the right that corresponds to the virtual network you want to configure, then choose **Subnet** or **DHCP**.



VMnet0 Bridged to an automatically chosen adapter
VMnet1 VMware Network Adapter VMnet1
VMnet2 Not bridged
VMnet3 Not bridged
VMnet4 Not bridged
VMnet5 Not bridged
VMnet6 Not bridged
VMnet7 Not bridged
VMnet8 VMware Network Adapter VMnet8
VMnet9 Not bridged

Changing the Subnet

In the Subnet dialog box, you can change the subnet's IP address and the subnet mask.



IP Address: 192 . 168 . 92 . 0
Subnet Mask: 255 . 255 . 255 . 0

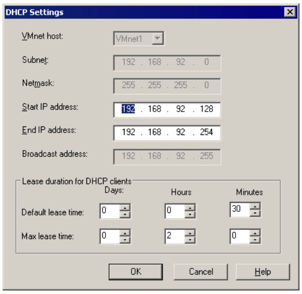
The address should specify a valid network address that is suitable for use with the subnet mask.

The default subnet mask is 255.255.255.0 (a class-C network). Typically, this means you should modify only the third number in the IP address — for example, x in 192.168.x.0 or 172.16.x.0. In general, you should not change the subnet mask. Certain virtual network services may not work as well with a customized subnet mask.

When you modify the network address or subnet mask, VMware Server automatically updates the IP address settings for other components — such as DHCP, NAT and host virtual adapter — on that virtual network to reflect the new settings. The specific settings that are automatically updated include DHCP lease range, DHCP server address, NAT gateway address and host virtual adapter IP address. However, if you have changed any of these settings from its default value — even if you have later changed the setting back to the default — VMware Server does not update that setting automatically. It presumes that custom settings are not to be modified.

Changing DHCP Settings

In the DHCP settings dialog box, you can change the range of IP addresses provided by the DHCP server on a particular virtual network. You can also set the duration of leases provided to clients on the virtual network.



DHCP Settings

VMnet host: VMnet1

Subnet: 192 . 168 . 92 . 0

Netmask: 255 . 255 . 255 . 0

Start IP address: 192 . 168 . 92 . 128

End IP address: 192 . 168 . 92 . 254

Broadcast address: 192 . 168 . 92 . 255

Lease duration for DHCP clients

	Days:	Hours	Minutes
Default lease time:	0	0	30
Max lease time:	0	2	0

7 When you have made all the changes you want to make on all tabs of the VMware Network Editor, click **OK**.

Enabling, Disabling, Adding, and Removing Host Virtual Adapters

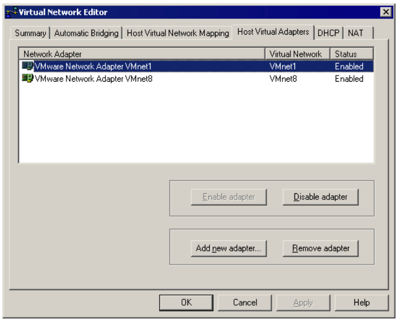
When you install VMware Server, two network adapters are added to the configuration of your host operating system — one that allows the host to connect to the host-only network and one that allows the host to connect to the NAT network.

If you are not using these adapters, you can remove them (users on Windows hosts can disable the adapters instead of removing them). The presence of these adapters has a slight performance cost, because broadcast packets must go to the extra adapters. On Windows networks, browsing your network can be slower than usual. And in some cases, these adapters interact with the host computer's networking configuration in undesirable ways.

To disable a host virtual adapter on a Windows host

1 Use the Virtual Network Editor to disable any unwanted adapters.

2 Choose **Host** > **Virtual Network Settings** > **Host Virtual Adapters**.



Network Adapter	Virtual Network	Status
VMware Network Adapter VMnet1	VMnet1	Enabled
VMware Network Adapter VMnet8	VMnet8	Enabled

3 Select the adapter you want to disable.

4 Click **Disable adapter**.

5 Click **OK**.

To enable a disabled host virtual adapter on a Windows host

1 Choose **Host** > **Virtual Network Settings** > **Host Virtual Adapters**.

2 Select the disabled adapter you want to enable.

3 Click **Enable adapter**.

4 Click **OK**.

To add a host virtual adapter on a Windows host

1 Choose **Host** > **Virtual Network Settings** > **Host Virtual Adapters**.

2 Click **Add new adapter**.

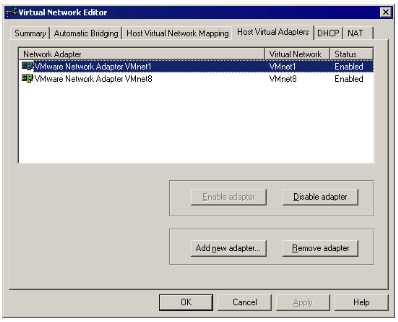
3 Choose the virtual network on which you want to use the adapter and click **OK**.

4 Click **Apply**.

5 Click **OK** to close the Virtual Network Editor.

To remove a host virtual adapter on a Windows host

1 Choose **Host** > **Virtual Network Settings** > **Host Virtual Adapters**.



Network Adapter	Virtual Network	Status
VMware Network Adapter VMnet1	VMnet1	Enabled
VMware Network Adapter VMnet8	VMnet8	Enabled

2 Select the adapter you want to remove, then click **Remove adapter**.

3 Click **OK**.

Removing a Host Virtual Adapter from a Linux Host

Follow these steps to remove a host virtual adapter from a Linux host.

1 Become root and run the VMware Server configuration program.

```
su -
vmware-config.pl
```

CAUTION In order to configure VMware Server correctly, the `vmware-config.pl` configuration program requires all virtual machines to be shut down. The program shuts down any running virtual machines automatically.

2 Watch for the following question:

```
Do you want networking for your Virtual Machines? (yes/no/help) [yes]
```

Answer `yes` if you still want to use any networking in your virtual machines, then continue to the next question.

Otherwise, answer `no` to remove all networking.

3 If you answer `yes`, the script prompts you to select the Wizard or editor to edit your network configuration. Select `editor`. This is the only way to delete virtual network adapters without removing all of them.

```
Would you prefer to modify your existing networking configuration using
                  the wizard or the editor? (wizard/editor/help)
                  [wizard] editor
```

4 You see a list of virtual networks that have been configured. Select the network corresponding to the adapter you wish to disable.

```
The following virtual networks have been defined:
. vmnet0 is bridged to eth0
. vmnet1 is a host-only network on subnet 172.16.155.0.
. vmnet8 is NAT network on a private subnet 172.16.107.0.
Which virtual network do you wish to configure? (0-99) 1
```

5 You might be prompted to keep this virtual network. If you are sure you want to remove it, answer yes to the question.

```
The network vmnet1 has been reserved for a host-only network. You may
                  change it, but it is highly recommended that you use it
                  as a host-only network. Are you sure you want to modify
                  it? (yes/no) [no] yes
```

6 When prompted about the type of virtual network, select none to remove the virtual network.

```
What type of virtual network do you wish to set vmnet1?
                  (bridged,hostonly,nat,none) [hostonly] none
```

Advanced Networking Topics

The following sections describe advanced networking topics:

- "Selecting IP Addresses on a Host-Only Network or NAT Configuration" on page 172
- "Avoiding IP Packet Leakage in a Host-Only Network" on page 174
- "Maintaining and Changing the MAC Address of a Virtual Machine" on page 176
- "Controlling Routing for a Host-Only Network on a Linux Host" on page 177
- "Issues with Host-Only Networking on a Linux Host" on page 178
- "Setting Up a Second Bridged Network Interface on a Linux Host" on page 179
- "Configuring Bridged Networking When Using Teamed Network Interface Cards" on page 180
- "Setting Up Two Separate Host-Only Networks" on page 182

- "Routing Between Two Host-Only Networks" on page 185
- "Using Virtual Ethernet Adapters in Promiscuous Mode on a Linux Host"

Selecting IP Addresses on a Host-Only Network or NAT Configuration

A host-only network uses a private virtual network. The host and all virtual machines configured for host-only networking are connected to the network through a virtual switch. Typically all the parties on this private network use the TCP/IP protocol suite, although other communication protocols can be used.

A network address translation (NAT) configuration also sets up a private network, which must be a TCP/IP network. The virtual machines configured for NAT are connected to that network through a virtual switch. The host computer is also connected to the private network used for NAT through a host virtual adapter.

Each virtual machine and the host must be assigned addresses on the private network. This is typically done using the DHCP server that comes with VMware Server. Note that this server does not service virtual (or physical) machines residing on bridged networks.

Addresses can also be assigned statically from a pool of addresses that are not assigned by the DHCP server.

If host-only networking is enabled when VMware Server is installed, the network number to use for the virtual network is automatically selected as an unused private IP network number. To find out which network is used on a Windows host, choose **Host** > **Virtual Network Settings** and check the subnet number associated with the virtual network. On a Linux host, run `ifconfig` in a terminal.

A NAT configuration also uses an unused private network automatically selected when you install VMware Server. To find out which network is used on a Windows host, choose **Host** > **Virtual Network Settings** and check the subnet number associated with the virtual network. On a Linux host, run `ifconfig` in a terminal.

Using DHCP to assign IP addresses is simpler than statically assigning them. Most Windows operating systems, for example, come preconfigured to use DHCP at boot time, so Windows virtual machines can connect to the network the first time they are booted, without additional configuration. If you want your virtual machines to communicate with each other using names instead of IP addresses, however, you must set up a naming convention, a name server on the private network, or both. In that case it might be simpler to use static IP addresses.

In general, if you have virtual machines you intend to use frequently or for extended periods of time, it is probably most convenient to assign them static IP addresses or to configure the VMware DHCP server to always assign the same IP address to each of these virtual machines.

To configure the DHCP server on a Linux host

1 On a Linux host, configure the host-only DHCP server by editing the DHCP configuration file for VMnet1 (`/etc/vmware/vmnet1/dhcp/dhcp.conf`).

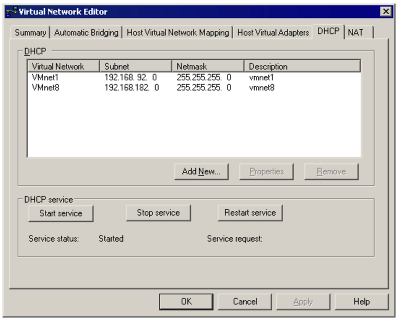
2 To configure the DHCP server for the NAT network, edit the configuration file for VMnet8 (`/etc/vmware/vmnet8/dhcp/dhcp.conf`).

Editing the DHCP server configuration file requires information that is best obtained directly from the DHCP server documentation.

3 Consult the manual pages `dhcpd(8)` and `dhcpd.conf(8)`.

To configure the DHCP server on a Windows host

1 On a Windows host, you configure the DHCP server using the Virtual Network Editor (**Host** > **Virtual Network Settings** > **DHCP**).



DHCP

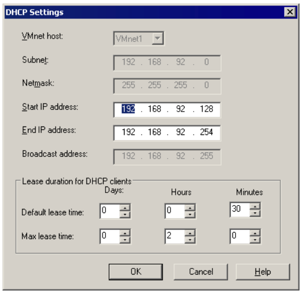
Virtual Network	Subnet	Netmask	Description
VMnet1	192.168. 92. 0	255.255.255. 0	vmnet1
VMnet8	192.168.182. 0	255.255.255. 0	vmnet8

DHCP service

Service status: Started

Service request:

2 Select the virtual network for which you want to change settings and click **Properties**.



VMnet host: VMnet1

Subnet: 192 . 168 . 92 . 0

Netmask: 255 . 255 . 255 . 0

Start IP address: 192 . 168 . 92 . 128

End IP address: 192 . 168 . 92 . 254

Broadcast address: 192 . 168 . 92 . 255

Lease duration for DHCP clients

	Days:	Hours	Minutes
Default lease time:	0	0	30
Max lease time:	0	2	0

3 Make the desired changes, then click **OK**.

Choosing the Method for Assigning IP Addresses

For virtual machines that you do not expect to keep for long, use DHCP and let it allocate an IP address.

For each host-only or NAT network, the available IP addresses are split up using the conventions shown in the tables below, where <net> is the network number assigned to your host-only or NAT network. VMware Server always uses a Class C address for host-only and NAT networks.

Table 7-1. Address Use on a Host-Only Network

Range	Address use	Example
<net>.1	Host machine	192.168.0.1
<net>.2–<net>.127	Static addresses	192.168.0.2–192.168.0.127
<net>.128–<net>.253	DHCP-assigned	192.168.0.128–192.168.0.253
<net>.254	DHCP server	192.168.0.254
<net>.255	Broadcasting	192.168.0.255

Table 7-2. Address Use on a NAT Network

Range	Address use	Example
<net>.1	Host machine	192.168.0.1
<net>.2	NAT device	192.168.0.2
<net>.3–<net>.127	Static addresses	192.168.0.3–192.168.0.127
<net>.128–<net>.253	DHCP-assigned	192.168.0.128–192.168.0.253
<net>.254	DHCP server	192.168.0.254
<net>.255	Broadcasting	192.168.0.255

Avoiding IP Packet Leakage in a Host-Only Network

By design, each host-only network should be confined to the host machine on which it is set up. That is, no packets sent by virtual machines on this network should leak out to a physical network attached to the host. Packet leakage can occur only if a machine actively forwards packets. It is possible for the host machine or any virtual machine running on the host-only network to be configured in a way that permits packet leakage.

Windows Hosts

Systems using server versions of Windows 2000 are capable of forwarding IP packets that are not addressed to them. By default, however, these systems come with IP packet forwarding disabled.

If you find packets leaking out of a host-only network on a Windows 2000 host computer, check to see whether forwarding has been enabled on the host machine. If it is enabled, disable it.

Choose **Start** > **Programs** > **Administrative Tools** > **Routing and Remote Access**. An icon on the left is labeled with the host name. If a green dot appears over the icon, IP forwarding is turned on. To turn it off, right-click the icon and disable **Routing and Remote Access**. A red dot appears, indicating that IP forwarding is disabled.

Linux Hosts

If you find packets leaking out of a host-only network on a Linux host computer, check to see whether forwarding has mistakenly been enabled on the host machine. If it is enabled, disable it.

For many Linux systems, disable forwarding by writing a 0 (zero) to the special file `/proc/sys/net/ipv4/ip_forward`. As root, enter this command:

```
echo 0 > /proc/sys/net/ipv4/ip_forward
```

Other Linux systems have a system configuration option that you can set. The method depends on your Linux distribution. You can use a control panel, specify a setting at the time you compile your kernel, or possibly enter a specification when you boot your system. Consult your operating system documentation for details on the method to use with your particular distribution.

Using Filtering

If the host computer has multiple network adapters, it might be intentionally configured to do IP forwarding. In this case, you do not want to disable forwarding. To avoid packet leakage, you must enable a packet filtering facility and specify that packets from the host-only network should not be sent outside the host computer. Consult your operating system documentation for details on how to configure packet filtering.

Leaks from a Virtual Machine

Virtual machines might leak packets, as well. For example, if you use dial-up networking support in a virtual machine and packet forwarding is enabled, host-only network traffic might leak out through the dial-up connection.

To prevent the leakage, be sure packet forwarding is disabled in your guest operating system.

Maintaining and Changing the MAC Address of a Virtual Machine

When a virtual machine is powered on, VMware Server automatically assigns each of its virtual network adapters an Ethernet MAC address. MAC stands for media access control. A MAC address is the unique address assigned to each Ethernet device.

The software guarantees that virtual machines are assigned unique MAC addresses within a given host system. In most cases, the virtual machine is assigned the same MAC address every time it is powered on, so long as the virtual machine is not moved (the path and filename for the virtual machine's configuration file must remain the same) and no changes are made to certain settings in that file.

In addition, VMware Server does its best, but cannot guarantee, to automatically assign unique MAC addresses for virtual machines running on multiple host systems.

Avoiding MAC Address Changes

To avoid changes in the MAC address automatically assigned to a virtual machine, you must not move the virtual machine's configuration file. Moving it to a different host computer or even moving it to a different location on the same host computer changes the MAC address.

You also need to be sure not to change certain settings in the virtual machine's configuration files. If you do not edit the configuration file by hand and do not remove the virtual Ethernet adapter, these settings remain untouched. If you do edit the configuration file by hand, be sure not to remove or change the following options:

```
ethernet[n].generatedAddress
ethernet[n].addressType
ethernet[n].generatedAddressOffset
uuid.location
uuid.bios
ethernet[n].present
```

In these options, `[n]` is the number of the virtual Ethernet adapter, for example `ethernet0`.

NOTE To preserve a virtual Ethernet adapter's MAC address, you also must be careful not to remove it. If you remove the adapter, then recreate it, it might be assigned a different MAC address.

Manually Assigning a MAC Address

If you want to guarantee that the same MAC address is assigned to a given virtual machine every time, even if the virtual machine is moved, or if you want to guarantee a unique MAC address for each virtual machine within a networked environment, you can assign the address manually instead of letting VMware Server assign it automatically.

To assign the same, unique MAC address to any virtual machine manually, use a text editor to remove three lines from the configuration file and add one line. The configuration file has a`.vmx` extension at the end of the filename. On a Linux host, a virtual machine created with an earlier VMware product might have a configuration file with a `.cfg` extension.

Remove the three lines that begin with the following:

```
ethernet[n].generatedAddress
ethernet[n].addressType
ethernet[n].generatedAddressOffset
```

In these options, `[n]` is the number of the virtual Ethernet adapter — for example `ethernet0`.

Add the following line to the configuration file :

```
ethernet0.address = 00:50:56:XX:YY:ZZ
```

In this line, `XX` must be a valid hexadecimal number between `00h` and `3Fh`, and `YY` and `ZZ` must be valid hexadecimal numbers between `00h` and `FFh`. Because VMware Server virtual machines do not support arbitrary MAC addresses, you must use the above format.

So long as you choose a value for `XX:YY:ZZ` that is unique among your hard-coded addresses (where `XX` is a valid hexadecimal number between `00h` and `3Fh`, and `YY` and `ZZ` are valid hexadecimal numbers between `00h` and `FFh`), conflicts between the automatically assigned MAC addresses and the manually assigned ones should never occur.

Controlling Routing for a Host-Only Network on a Linux Host

A host-only network is a full-fledged network. It has a network interface associated with it (VMnet1) that is marked “up” at the time the host operating system is booted. Consequently, routing server processes that operate on the host operating system, such as `routed` and `gated`, automatically discover the network and propagate information on how to reach it unless you explicitly configure them not to do so.

If either of these processes is being run only to receive routing information, the easiest solution is to run the process with a -q option so that it does not supply routing information, only receives it.

If, however, the processes are running because they supply routing information, you need to configure them so they do not advertise routes to the host-only network.

The version of routed that comes with many distributions of Linux has no support for specifying that an interface should not be advertised. Consult the routed(8) manual page for your system in case you have a more contemporary version of the software.

The gated process requires some configuration. You need to explicitly exclude the VMnet1 interface from any protocol activity. If you need to run virtual machines on a host-only network on a multihomed system where gated is used and have problems doing so, please contact VMware technical support by submitting a support request at **www.vmware.com/requestsupport**.

Issues with Host-Only Networking on a Linux Host

The following are common issues you might encounter when you are configuring a host-only network.

DHCPD on the Linux Host Does Not Work After VMware Server Installation

If you were running the DHCP server program dhcpd on your machine before installing VMware Server, it probably was configured to respond to DHCP requests from clients on any network interface present on the machine. When host-only networking is configured, an additional network interface, VMnet1, is marked “up” and available for use, and dhcpd might notice this.

In such cases, some dhcpd implementations abort if their configuration files do not include a subnet specification for the interface — even if dhcpd is not supposed to respond to messages that arrive through the interface.

The best solution to this problem is to add a line in the following format to the dhcpd configuration file:

```
subnet <net>.0 netmask 255.255.255.0 {}
```

<net> is the network number assigned to your host-only network — for example, 192.168.0. This configuration file entry informs dhcpd about the host-only network and tells it explicitly not to respond to any DHCP requests it sees coming from it.

An alternative solution is to explicitly state the set of network interfaces that you want dhcpd to listen to each time you start the program. For example, if your machine has one Ethernet interface, eth0, then each time you start dhcpd, list it on the command line:

```
dhcpd eth0
```

This keeps dhcpd from probing for all available network interfaces.

If the above solutions do not work for your DHCP server program, then it likely is old. You can try upgrading to a more current version such as the DHCP software available from the ISC Web site at **www.isc.org**.

DHCP and Dynamic Domain Name Service (DDNS)

DHCP can be used to hand out IP addresses as well as other information, such as the identity of a host running a name server and the nearest router or gateway. The DHCP server in VMware Server does not provide a means to dynamically establish a relationship between the IP address it assigns and a client's name (that is, to update a DNS server using DDNS).

If you want to use names to communicate with other virtual machines, you must either edit the DHCP configuration file for VMnet1 (/etc/vmware/vmnet1.conf) or use IP addresses that are statically bound to a host name. Editing the DHCP server configuration file requires information that is best obtained directly from the DHCP server documentation. Consult the manual pages dhcpd(8) and dhcpd.conf(8).

Setting Up a Second Bridged Network Interface on a Linux Host

If your host computer has two Ethernet adapters connected to two different networks, you can configure your virtual machines on that host computer to bridge to both Ethernet adapters. That way, the virtual machines can access either or both physical networks.

When you install VMware Server on a host computer with multiple Ethernet adapters, you have the option of configuring more than one bridged network. You can also configure additional bridged networks at any time by rerunning vmware-config.pl.

1 On the host computer, become root (su -) and run the VMware Server configuration program.

```
vmware-config.pl
```

CAUTION To configure VMware Server correctly, the vmware-config.pl configuration program requires all virtual machines to be shut down. The program shuts down any running virtual machines automatically.

2. If you have more than one physical Ethernet adapter, one of the prompts you see is similar to this:

   ```
   The following bridged networks have been defined:
   . vmnet0 is bridged to eth0
   Do you wish to configure another bridged network? (yes/no) [no]
   ```

   Answer yes.

3. If you have additional physical Ethernet adapters not yet connected to a bridged network, the prompt is repeated, showing information about all currently configured bridged networks.

4. When you have set up all the bridged networks you want, type `no`.

Configuring Bridged Networking When Using Teamed Network Interface Cards

Network adapter teaming (where two or more network interface cards work as one and appear as a single, separate device) provides a VMware Server host and the virtual machines running on it with a level of network hardware fault tolerance. If one physical network adapter fails, then network traffic for the host and virtual machines can continue using the remaining network adapters in the team.

Another method for providing fault tolerance is by making sure that automatic bridging is enabled. This feature is available on Windows hosts only and is enabled by default. For more information, see "Configuring Bridged Networking Options on a Windows Host" on page 164. This method is more limited than using NIC teaming, as it does not allow for load balancing, switch fault tolerance, fault tolerance to any necessary services running on the host, or the ability to specify an adapter as the primary or secondary adapter.

Certain NIC teaming modes provide load balancing and are discussed below.

If your VMware Server host is configured to use teamed network interface cards, and you use bridged networking with your virtual machines, you need to adjust your network settings. You do this by binding the VMware Bridge Protocol to the teamed NIC and unbinding it from each individual, physical NIC on the host. See "Setting Up the Windows Host" on page 181.

Before you start using teamed NICs to network your virtual machines, you should have a good understanding of how network teaming works in your host environment.

Support for Network Adapter Teaming

VMware supports teamed NICs on Windows hosts with enterprise class network adapters that can be configured for NIC teaming. If there is a specific teamed networking mode (such as 802.3ad Dynamic or 802.3ad-Draft Static mode) you want to use, you should use adapters that support that mode.

VMware has not tested and does not support network adapter teams with VMware Server on Linux hosts.

VMware Server supports teamed Broadcom-based network adapters when used with Broadcom teaming software in the following modes:

- Generic Trunking (FEC/GEC/802.3ad-Draft Static)
- Link Aggregation (802.3ad)
- Smart Load Balance and Fail Over

VMware Server supports teamed Intel-based network adapters when used with Intel PROSet version 6.4 or higher (32-bit hosts) or PROSet version 10.0 or higher (64-bit hosts) in the following modes:

- Adapter Fault Tolerance
- Adaptive Load Balancing
- Static Link Aggregation (64-bit hosts)
- FEC/802.3ad Static Link Aggregation (32-bit hosts)
- GEC/802.3ad Static Link Aggregation (32-bit hosts)
- IEEE 802.3ad Dynamic Link Aggregation

NOTE Express Teaming mode is not supported when you are teaming Intel-based network adapters.

Setting Up the Windows Host

When using VMware Server on a Windows host with teamed network adapters and bridged networking, the VMware Bridge Protocol must be bound to the teamed network adapter and unbound from the individual physical network adapters.

To set up bridged networking on a Windows host

1. Open the Windows Control Panel, and open Network Connections (on a Windows Server 2003 host) or open Network and Dial-up Connections (on a Windows 2000 host).
2. Right-click the teamed NIC device, and choose **Properties** to bind the VMware Bridge Protocol to the teamed NIC.
3. Check **VMware Bridge Protocol**.

4. Click **OK** to close the property sheet.
5. Right-click the NIC device, and choose **Properties** to unbind the VMware Bridge Protocol from each physical NIC that is being used for bridged networking.
6. Clear the **VMware Bridge Protocol** check box.
7. Click **OK** to close the property sheet.

Alternately, you can use the Virtual Network Editor to either map the teamed NIC to VMnet0 or exclude the physical adapters from any automatic bridging by VMware Server. For information, see "Configuring Bridged Networking Options on a Windows Host" on page 164.

Changing the Teamed Networking Mode

If you change the teamed networking mode, you must delete the original NIC team on the host and create a new team. Do not modify a virtual machine's NIC teaming settings.

CAUTION Before you delete the original team, power off or suspend all virtual machines on the host to prevent the teaming software from locking up.

Setting Up Two Separate Host-Only Networks

For some configurations, you might need to set up more than one host-only network on the same host computer.

You might, for example, want to have two virtual machines connected to one host-only network, and at the same time have other virtual machines connected to another host-only network. This setup isolates network traffic on each network.

Or you might want to test routing between two virtual networks. Or test a virtual machine with multiple network interface cards — without using any physical Ethernet adapters.

On Windows hosts, the first host-only network is set up automatically when you install VMware Server.

On Linux hosts, the first host-only network is set up when you run the `vmware-config.pl` program after you install VMware Server (provided you agree to install host-only networking). If you did not agree to use host-only networking, you need to run the script again to set up host-only networking.

To set up the second host-only network, follow the steps outlined below for your host operating system.

To set up the second host-only interface on a Windows host

1. Choose **Host** > **Virtual Network Settings** > **Host Virtual Adapters**.
2. Click **Add new adapter**.
3. Choose the virtual network on which to use the adapter and click **OK**.
4. Click **Apply**.
5. Click **OK** to close the Virtual Network Editor.

To set up the second host-only interface on a Linux host

1. As root (`su -`), run the VMware Server configuration program.
   `vmware-config.pl`

   CAUTION To configure VMware Server correctly, the `vmware-config.pl` configuration program requires all virtual machines to be shut down. The program shuts down any running virtual machines automatically.

   After asking about a NAT network, the program asks:

   ```
   Do you want to be able to use host-only networking in your virtual
                   machines?
   ```

2. Select `yes`.

   The Wizard reports on host-only networks that you have already set up on the host or, if no host-only network is present, configures the first one.

   The Wizard asks:

   ```
   Do you wish to configure another host-only network?
   ```

3. Select `yes`.

   Repeat this step until you have as many host-only networks as you want. Then answer `no`.

4. Complete the remaining steps in the Wizard.

   When the Wizard is finished, it restarts all services used by VMware Server.

5. Run `ifconfig`.

   You should see at least four network interfaces — `eth0`, `lo`, `vmnet1`, and `vmnet2`. If the VMnet interfaces do not display immediately, wait for a minute, and run the command again. These four interfaces should have different IP address on separate subnets.

Configuring the Virtual Machines

Now you have two host-only interfaces (VMnet1 and VMnet2). You are ready to set up your virtual machines for one of the following configurations:

- The virtual machine is configured with one virtual Ethernet adapter, and that virtual adapter is connected to the default host-only interface (VMnet 1).
- The virtual machine is configured with one virtual Ethernet adapter, and that virtual adapter is connected to the newly created host-only interface (VMnet2).
- The virtual machine is configured with two virtual Ethernet adapters. One virtual adapter is connected to the default host-only interface (VMnet1) and the other virtual adapter is connected to the newly created host-only interface (VMnet2).

Configuration 1 — Connect to the Default Host-Only Interface

1. Create the virtual machine or use an existing virtual machine.
2. Launch a VMware Server Console and open the virtual machine.
3. Select **VM** > **Settings** to edit the configuration using the virtual machine settings editor.
4. Select **NIC**, select **Custom**, and choose **VMnet1 (Host-only)** (on a Windows host) or **/dev/vmnet1** (on a Linux host) from the drop-down list on the right.

   If no network adapter is shown in the list of devices, click **Add**, and use the Add Hardware Wizard to add an adapter.

Configuration 2 — Connect to the Newly Created Host-Only Interface

1. Create the virtual machine or use an existing virtual machine.
2. Launch a VMware Server Console and open the virtual machine.
3. Edit the configuration using the virtual machine settings editor (**VM** > **Settings**).

   Select **NIC**, select **Custom**, and choose **VMnet 2 (Host-only)** (on a Windows host) or **/dev/vmnet2** (on a Linux host) from the drop-down list on the right.

   If no network adapter is shown in the list of devices, click **Add**, and use the Add Hardware Wizard to add an adapter.

Configuration 3 — Connect to Two Host-Only Interfaces

1 Create the virtual machine or use an existing virtual machine.

2 Launch VMware Server and open the virtual machine.

3 Edit the configuration using the virtual machine settings editor (**VM** > **Settings**).

Select the first network adapter in the list of devices, select **Custom**, and choose **VMnet1 (Host-only)** (on a Windows host) or **/dev/vmnet1** (on a Linux host) from the drop-down list on the right. Select the second network adapter in the list of devices, select **Custom**, then choose **VMnet 2 (Host-only)** (on a Windows host) or **/dev/vmnet2** (on a Linux host) from the drop-down list on the right.

If you need to add one or more network adapters, click **Add**, and use the Add Hardware Wizard to add an adapter.

At this point you can power on the virtual machine and install your guest operating system. In configurations 1 and 2 you see one AMD PCNet Family Adapter. In configuration 3 you see two AMD PCNet Family Adapters within the guest. Configure the Ethernet adapters as you would physical adapters on a physical computer, giving each adapter an IP address on the appropriate VMnet subnet.

On Windows hosts, you can open a command prompt and run `ipconfig /all` to see what IP addresses each host-only network is using.

On Linux hosts, you can open a terminal and run `ifconfig` to see what IP addresses each host-only network is using.

Routing Between Two Host-Only Networks

If you are setting up a complex test network using virtual machines, you might want to have two independent host-only networks with a router between them.

There are two basic approaches. In one, the router software runs on the host computer. In the other, the router software runs in its own virtual machine. In both cases, you need two host-only interfaces.

The examples described here outline the simplest case, with one virtual machine on each of the host-only networks. For more complex configurations, you can add more virtual machines and host-only networks as appropriate.

Setting Up the First Host-Only Interface

On Windows hosts, the first host-only network is set up when you install VMware Server.

On Linux hosts, the first host-only network is set up when you run the `vmware-config.pl` program after you install VMware Server, provided you agree to install host-only networking. If you did not agree to use host-only networking, you need to run the script again to set up host-only networking.

To set up the second host-only interface on a Windows host

1. Go to **Host** > **Virtual Network Settings** > **Host Virtual Adapters**.
2. Click **Add new adapter**.
3. Choose the virtual network on which you want to use the adapter and click **OK**.
4. Click **Apply**.
5. Click **OK** to close the Virtual Network Editor.

To set up the second host-only interface on a Linux host

1. As root (`su -`), run the VMware Server configuration program.

   ```
   vmware-config.pl
   ```

   CAUTION In order to configure VMware Server correctly, the `vmware-config.pl` configuration program requires all virtual machines to be shut down. The program shuts down any running virtual machines automatically.

2. Use the Wizard to modify your configuration. After asking about a NAT network, the program asks:

   ```
   Do you want to be able to use host-only networking in your virtual
                     machines?
   ```

   Answer yes.

   The Wizard reports on host-only networks that you have already set up on the host or, if none is present, configures the first host-only network.

3. The Wizard asks:

   ```
   Do you wish to configure another host-only network?
   ```

   Answer yes.

   Repeat this step until you have as many host-only networks as you want. Then answer `no`.

4 Complete the Wizard. When it is finished, it restarts all services used by VMware Server.

5 Run `ifconfig`. You should see at least four network interfaces — `eth0`, `lo`, `vmnet1,` and `vmnet2`. If the VMnet interfaces do not show up immediately, wait for a minute, then run the command again. These four interfaces should have different IP address on separate subnets.

Setting Up the Virtual Machines

Now you have two host-only network adapters on the host computer. Each is connected to its own virtual switch (VMnet1 and VMnet2). You are ready to create and configure your virtual machines and connect them to the appropriate virtual switches.

Virtual Machine 1 — Connected to the Default Host-Only Interface

1 Create the virtual machine or use an existing virtual machine.

2 Launch a VMware Server Console and open the virtual machine.

3 Edit the configuration using the virtual machine settings editor (**VM** > **Settings**).

Select **NIC**, select **Custom**, and choose **VMnet1 (Host-only)** (on a Windows host) or **/dev/vmnet1** (on a Linux host) from the drop-down list on the right.

If no network adapter is shown in the list of devices, click **Add**, and use the Add Hardware Wizard to add an adapter.

Virtual Machine 2 — Connected to the Newly Created Host-Only Interface

1 Create the virtual machine or use an existing virtual machine.

2 Launch a VMware Server Console and open the virtual machine.

3 Edit the configuration using the virtual machine settings editor (**VM** > **Settings**).

Select **NIC**, select **Custom**, and choose **VMnet2 (Host-only)** (on a Windows host) or **/dev/vmnet2** (on a Linux host) from the drop-down list on the right.

If no network adapter is shown in the list of devices, click **Add**, and use the Add Hardware Wizard to add an adapter.

If you plan to run the router software on your host computer, you can skip the next section.

Virtual Machine 3 — Connected to Both Host-Only Interfaces

If you plan to run the router software on a virtual machine, set up a third virtual machine for that purpose.

1 Create the virtual machine or use an existing virtual machine.

2 Launch a VMware Server Console and open the virtual machine.

3 Edit the configuration using the virtual machine settings editor (**VM** > **Settings**).

   Select the first network adapter in the list of devices, select **Custom**, and choose **VMnet1 (Host-only)** (on a Windows host) or **/dev/vmnet1** (on a Linux host) from the drop-down list on the right. Select the second network adapter in the list of devices, then select **Custom**, choose **VMnet 2 (Host-only)** (on a Windows host) or **/dev/vmnet2** (on a Linux host) from the drop-down list on the right.

   If you need to add one or more network adapters, click **Add**, and use the Add Hardware Wizard to add an adapter.

Now you need to configure the networking components on the host and in the virtual machines. The recommended approach uses static IP addresses for all the virtual machines.

1 Stop the VMnet DHCP server service.

   Windows host: Choose **Host** > **Virtual Network Settings** > **DHCP** and click **Stop service**.

   Linux host: Stop the `vmnet-dhcpd` service.

```
killall -TERM vmnet-dhcpd
```

2 Install guest operating systems in each of the virtual machines.

3 Install the router software — on the host computer or in the third virtual machine, depending on the approach you are using.

4 Configure networking in the first two virtual machines to use addresses on the appropriate host-only network.

   On Windows hosts, you can open a command prompt and run `ipconfig /all` to see what IP addresses each host-only network is using.

   On Linux hosts, you can open a terminal and run `ifconfig` to see what IP addresses each host-only network is using.

5 If you are running the router on the host computer, assign default router addresses based on the addresses of the host-only adapters on the host computer. In the first virtual machine's networking configuration, the default router address should be

the IP address for the host-only adapter connected to VMnet1. In the second virtual machine’s networking configuration, the default router address should be the IP address for the host-only adapter connected to VMnet2.

If you are running the router software on the third virtual machine, set the default router addresses in the first two virtual machines based on those used by the third virtual machine. In the first virtual machine’s networking configuration, the default router address should be the IP address for the third virtual machine’s Ethernet adapter connected to VMnet1. In the second virtual machine’s networking configuration, the default router address should be the IP address for the third virtual machine’s Ethernet adapter connected to VMnet2.

At this point you should be able to ping the router machine from virtual machines one and two. And if the router software is set up correctly, you should be able to communicate between the first and second virtual machines.

Using Virtual Ethernet Adapters in Promiscuous Mode on a Linux Host

VMware Server does not allow the virtual Ethernet adapter to go into promiscuous mode unless the user running VMware Server has permission to make that setting. This follows the standard Linux practice that only root can put a network interface into promiscuous mode.

When you install and configure VMware Server, you must run the installation as root. VMware Server creates the VMnet devices with root ownership and root group ownership, which means that only root has read and write permissions to the devices.

To set the virtual machine’s Ethernet adapter to promiscuous mode, you must launch VMware Server as root because you must have read and write access to the VMnet device. For example, if you are using bridged networking, you must have access to `/dev/vmnet0`.

To grant selected other users read and write access to the VMnet device, you can create a new group, add the appropriate users to the group and grant that group read and write access to the appropriate device. You must make these changes on the host operating system as root (`su -`). For example, you can enter the following commands:

```
chgrp <newgroup> /dev/vmnet0
chmod g+rw /dev/vmnet0
```

`<newgroup>` is the group that should have the ability to set `vmnet0` to promiscuous mode.

If you want all users to be able to set the virtual Ethernet Adapter (`/dev/vmnet0` in our example) to promiscuous mode, you can simply run the following command on the host operating system as root:

```
chmod a+rw /dev/vmnet0
```

Understanding NAT

Network address translation, or NAT, provides a simple way for virtual machines to use most client applications over almost any type of network connection available to the host. The only requirement for NAT is that the network connection must support TCP/IP.

NAT is useful when you have a limited supply of IP addresses or are connected to the network through a non-Ethernet network adapter. NAT works by translating addresses of virtual machines in a private VMnet network to that of the host machine. When a virtual machine sends a request to access a network resource, it appears to the network resource as if the request came from the host machine.

NAT uses the host's own network resources to connect to the external network. Thus, any TCP/IP network resource to which the host has access should be available through the NAT connection.

The chief advantage of NAT is that it provides a transparent, easy to configure way for virtual machines to gain access to network resources.

The following sections provide more information about NAT:

- "Using NAT" on page 191
- "The Host Computer and the NAT Network" on page 191
- "DHCP on the NAT Network" on page 191
- "DNS on the NAT Network" on page 191
- "External Access from the NAT Network" on page 192
- "Advanced NAT Configuration" on page 193
- "Custom NAT and DHCP Configuration on a Windows Host" on page 196
- "Considerations for Using NAT" on page 198
- "Using NAT with NetLogon" on page 198
- "Sample Linux vmnetnat.conf File" on page 200

Using NAT

The NAT device is connected to the VMnet8 virtual switch. Virtual machines connected to the NAT network also use the VMnet8 virtual switch.

The NAT device waits for packets coming from virtual machines on the VMnet8 virtual network. When a packet arrives, the NAT device translates the address of the virtual machine to that of the host before forwarding the packet to the external network. When data arrives from the external network for the virtual machine on the private network, the NAT device receives the data, replaces the network address with that of the virtual machine and forwards the data to the virtual machine on the virtual network. This translation occurs automatically and requires minimal configuration on the guest and the host.

The Host Computer and the NAT Network

The host computer has a host virtual adapter on the NAT network (identical to the host virtual adapter on the host-only network). This adapter allows the host and the virtual machines to communicate with each other for such purposes as file sharing. The NAT never forwards traffic from the host virtual adapter.

DHCP on the NAT Network

In order to make networking configuration easy, a DHCP server is automatically installed when you install VMware Server. Virtual machines running on the network with the NAT device can dynamically obtain their IP addresses by sending out DHCP requests. The DHCP server on the NAT network, which is also used in host-only networking configurations, dynamically allocates IP addresses in the range of <net>.128 through <net>.254, where <net> is the network number assigned to your NAT network. VMware Server always uses a Class C address for NAT networks. IP addresses <net>.3 through <net>.127 can be used for static IP addresses. IP address <net>.1 is reserved for the host adapter; <net>.2 is reserved for the NAT device.

In addition to the IP address, the DHCP server on the NAT network also sends out additional configuration information that enables the virtual machine to operate automatically. This information includes the default gateway and the DNS server. In the DHCP response, the NAT device instructs the virtual machine to use the IP address <net>.2 as the default gateway and DNS server. This causes all IP packets destined for the external network and DNS requests to be forwarded to the NAT device.

DNS on the NAT Network

The NAT device acts as a DNS server for the virtual machines on the NAT network. Actually, the NAT device is a DNS proxy and merely forwards DNS requests from the virtual machines to a DNS server that is known by the host. Responses come back to the NAT device, which then forwards them to the virtual machines.

If they get their configuration information from DHCP, the virtual machines on the NAT network automatically use the NAT device as the DNS server. However, the virtual machines can be statically configured to use another DNS server.

The virtual machines in the private NAT network are not, themselves, accessible via DNS. If you want the virtual machines running on the NAT network to access each other by DNS names, you must set up a private DNS server connected to the NAT network.

External Access from the NAT Network

In general, any protocol using TCP or UDP can be used automatically by a virtual machine on the NAT network so long as the virtual machine initiates the network connection. This is true for most client applications such as Web browsing, Telnet, passive-mode FTP, and downloading streaming video. Additional protocol support has been built into the NAT device to allow FTP and ICMP echo (ping) to work completely transparently through the NAT.

On the external network to which the host is connected, any virtual machine on the NAT network appears to be the host itself, because its network traffic uses the host's IP address. It is able to send and receive data using TCP/IP to any machine that is accessible from the host.

Before any such communication can occur, the NAT device must set up a mapping between the virtual machine's address on the private NAT network and the host's network address on the external network.

When a virtual machine initiates a network connection with another network resource, this mapping is created automatically. The operation is perfectly transparent to the user of the virtual machine on the NAT network. No additional work needs to be done to let the virtual machine access the external network.

The same cannot be said for network connections that are initiated from the external network to a virtual machine on the NAT network.

When a machine on the external network attempts to initiate a connection with a virtual machine on the NAT network, it cannot reach the virtual machine because the NAT device does not forward the request. Network connections that are initiated from outside the NAT network are not transparent.

However, it is possible to configure port forwarding manually on the NAT device so network traffic destined for a certain port can still be forwarded automatically to a virtual machine on the NAT network. For details, see “Advanced NAT Configuration” on page 193.

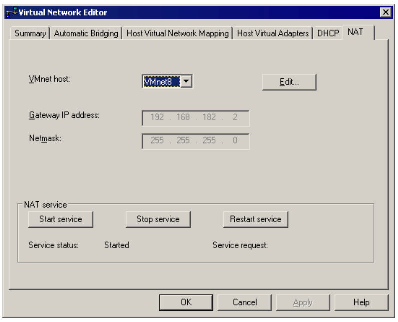
File sharing of the type used by Windows operating systems and Samba is possible among computers on the NAT network — including virtual machines and the host computer. If you are using WINS servers on your network, a virtual machine using NAT networking can access shared files and folders on the host that are known by the WINS server so long as those shared files and folders are in the same workgroup or domain.

Advanced NAT Configuration

Read the section that corresponds to your host operating system for information on configuring NAT for your virtual machines.

Windows Hosts

Configure the NAT device using the Virtual Network Editor (**Host** > **Virtual Network Settings** > **NAT**).



VMnet host: VMnet8

Gateway IP address: 192 . 168 . 182 . 2

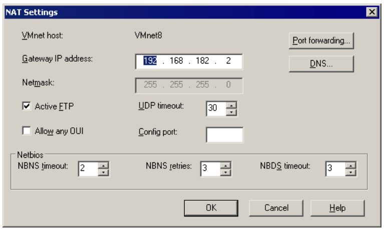
Netmask: 255 . 255 . 255 . 0

Service status: Started

Service request:

You can stop, restart, and start the virtual NAT device by clicking the appropriate button. The **VMnet host** setting lets you choose which virtual network uses the NAT device. You can select **Disable** if you do not want to use NAT on any virtual network.

To edit NAT settings for a virtual network, choose it from the drop-down menu, then click **Edit**. The NAT Settings dialog box appears.



VMnet host: VMnet8

Gateway IP address: 192 . 168 . 182 . 2

Netmask: 255 . 255 . 255 . 0

☑ Active FTP

UDP timeout: 30

□ Allow any OUI

Config port:

Netbios

NBNS timeout: 2

NBNS retries: 3

NBDS timeout: 3

You can change any of the following NAT settings:

- **Port forwarding** lets you send incoming TCP or UDP requests to a specific virtual machine on the virtual network served by the NAT device. To set up and configure forwarded ports, click **Port forwarding**. A dialog box appears.

  To add a new port for either TCP or UDP, click **Add**. If a port is already listed, you can change its settings. Select its name in the list, and click **Properties**. Or click **Remove** to remove the selected port.

  When you click **Add**, another dialog box appears. In the **Host port** field, type the number of the incoming TCP or UDP port. For example, incoming HTTP requests are usually on port 80. In the first **Forwarding IP address** field, type the IP address of the virtual machine to which you want to forward the incoming requests. In the second field on that line, type the port number you want to use for those requests on that virtual machine. You can enter the standard port, such as 80 for HTTP, or a nonstandard port if software running in the virtual machine is configured to accept requests on a nonstandard port. The **Description** field is optional. You might use it to identify the service being forwarded (for example, HTTP). When you have made these settings, click **OK**.

- You can specify DNS servers to be used by the virtual NAT device. To do so, click **DNS**. A dialog box appears. You can change the **Policy** for using multiple DNS servers if you prefer to use **Rotate** or **Burst** instead of the default setting of **Order**. To add a DNS server to the list, click **Add**. Another dialog box appears. Enter the DNS server's IP address in the **IP address** field. The **Description** field is optional. When you have made the desired settings, click **OK**.To change the settings for a server already in the list, select its entry in the DNS dialog box, and click **Properties**. To delete an entry, select the entry, and click **Remove**. When you have made the desired changes, click **OK**.

- You can change the IP address for the NAT device in the **Gateway IP address** field. To change the Netmask, click the **…** button on the **Host Virtual Network Mapping** tab of the Virtual Network Editor and choose **Subnet**.

- To allow only passive mode FTP over the NAT device, deselect **the Active FTP** check box.
- You can change the number of minutes to keep the UDP mapping for the NAT in the **UDP timeout** field.
- If you change the OUI (Organizationally Unique Identifier) portion of the MAC address for the virtual machine and subsequently cannot use NAT with the virtual machine, you should check the **Allow Any OUI** check box.
- In the **Config port** field, you can specify a port that can be used to access status information about the NAT. This option is used for troubleshooting purposes with VMware technical support only.
- You can change NetBIOS timeout and retry settings.

When you have made all the networking changes you want, click **OK**.

Linux Hosts

Use the NAT configuration file on the host to configure the NAT device. This file is `/etc/vmware/vmnet8/nat/nat.conf`.

The configuration file is divided into sections. Each section configures a part of the NAT device. Text surrounded by square brackets — such as `[host]` — marks the beginning of a section. In each section is a configuration parameter that can be set. The configuration parameters take the form `ip = 192.168.27.1/24`.

For an example of a NAT configuration file, see "Sample Linux vmnetnat.conf File" on page 200. The configuration file variables are described below.

The [host] Section

`ip`
The IP address that the NAT device should use. It can optionally be followed by a slash and the number of bits in the subnet.

`netmask`
The subnet mask to use for the NAT. DHCP addresses are allocated from this range of addresses.

`configport`
A port that can be used to access status information about the NAT.

`device`
The VMnet device to use. Linux devices are of the format `/dev/vmnet<x>`. VMnet8 is the default NAT device.

`activeFTP`
A flag that indicates if active FTP is to be allowed. Active FTP allows incoming connections to be opened by the remote FTP server. Turning this off means that only passive mode FTP works. Set the flag to `0` to turn active FTP off.

The [udp] Section

`timeout`
The number of minutes to keep the UDP mapping for the NAT.

The [incomingtcp] Section

Use this section to configure TCP port forwarding for NAT. You can assign a port number to an IP address and port number on a virtual machine.

The following line shows the format used in this section.

```
8887 = 192.168.27.128:21
```

This example creates a mapping from port 8887 on the host to the IP address 192.168.27.128 and port 21. When this mapping is set and an external machine connects to the host at port 8887, the network packets are automatically forwarded to port 21 (the standard port for FTP) on the virtual machine with IP address 192.168.27.128.

The [incomingudp] Section

Use this section to configure UDP port forwarding for NAT. You can assign a port number to an IP address and port number on a virtual machine.

The following line shows the format used in this section. It illustrates a way to forward X server traffic from the host port 6000 to the virtual machine’s port 6001.

```
6000 = 192.168.27.128:6001
```

This example creates a mapping from port 6000 on the host to the IP address 192.168.27.128 and port 6001. When this mapping is set and an external machine connects to the host at port 6000, the network packets are automatically forwarded to port 6001 on the virtual machine with IP address 192.168.27.128.

Custom NAT and DHCP Configuration on a Windows Host

If you are an advanced user on a Windows host computer, you can make custom configuration settings by editing the NAT and DHCP configuration files. If your host operating system is installed on the C drive, the configuration files for NAT and DHCP are in the following locations:

- **NAT:** `C:\Documents and Settings\All Users\Application Data\VMware\vmnetnat.conf`

- **DHCP:** `C:\Documents and Settings\All Users\Application Data\VMware\vmnetdhcp.conf`

NOTE You can change many key NAT and DCHP settings using the Virtual Network Editor (**Host** > **Virtual Network Settings**). However, if you have made manual changes to the configuration files, some or all of those changes might be lost when you use the Virtual Network Editor. If you have made manual changes, you should make backup copies of the files before changing any settings in the Virtual Network Editor. After making changes in the Virtual Network Editor, you can copy your manual changes back into the appropriate configuration files.

Specifying Connections from Ports Below 1024

When a client machine makes a TCP or UDP connection to a server, the connection comes from a particular port on the client (the source port) and connects to a particular port on the server (the destination port). For security reasons, some servers accept connections only from source ports below 1024.

If a virtual machine using NAT attempts to connect to a server that requires the client to use a source port below 1024, it is important that the NAT device forward the request from a port below 1024. You can specify this behavior in the `vmnetnat.conf` file.

This behavior is controlled by entries in sections headed `[privilegedUDP]` and `[privilegedTCP]`. You might have to add settings to or modify settings in either or both of these sections, depending on the kind of connection you need to make.

You can set two parameters, each of which appears on a separate line.

`autodetect = <n>`
The autodetect setting determines whether the VMware NAT device automatically attempts to map virtual machine source ports below 1024 to NAT source ports below 1024. A setting of `1` means true. A setting of `0` means false. On a Windows host, the default is `1` (true). On a Linux host, the default is `0` (false).

`port = <n>`
The port setting specifies a destination port (`<n>` is the port on the server that accepts the connection from the client). Whenever a virtual machine connects to the specified port on any server, the NAT device attempts to make the connection from a source port below 1024. You can include one or more port settings in the `[privilegedUDP]` or `[privilegedTCP]` section or in both sections, as required for the connections you need to make. Each port setting must be entered on a separate line.

Considerations for Using NAT

Because NAT requires that every packet sent and received from virtual machines be in the NAT network, there is an unavoidable performance penalty. Our testing shows that the penalty is minor for dial-up and DSL connections, and performance is adequate for most VMware Server uses.

NAT is not perfectly transparent. It does not normally allow connections to be initiated from outside the network, although you can set up server connections by manually configuring the NAT device. The practical result is that some TCP and UDP protocols that require a connection be initiated from the server machine — some peer to peer applications, for example — do not work automatically, and some might not work at all.

A standard NAT configuration provides basic-level firewall protection because the NAT device can initiate connections from the private NAT network, but devices on the external network cannot normally initiate connections to the private NAT network.

Using NAT with NetLogon

When using NAT networking in a virtual machine with a Windows guest operating system running on a Windows host, you can use NetLogon to log on to a Windows domain from the virtual machine. You can then access file shares known by the WINS server in the domain.

To use NetLogon, you need to know how WINS servers and Windows domain controllers work. This section explains how to set up the virtual machine to use NetLogon. The setup process is similar to the way you set up a physical computer on one LAN that is using a domain controller on another LAN.

In order to log on to a Windows domain outside the virtual NAT network, the virtual machine needs access to a WINS server for that domain. There are two ways you can connect the virtual machine to a WINS server. You can connect to the WINS server provided by the DHCP server used on the NAT network, provided that the WINS server is already set up on the host. If you want to connect from the virtual machine to a WINS server not set up on the host, you can manually enter the IP address of the WINS server.

Using NAT to Connect to an Existing WINS Server Already Set Up on the Host

In order to use this method, a WINS server in the same workgroup or domain must be set up on the host. These steps use Windows 2000, Windows XP, or

Windows Server 2003 as a guide. The process is similar for Windows NT, Windows Me, and Windows 9x guests.

1 In the virtual machine, right-click on **My Network Places** and select **Properties**.

2 In the Network Connections window, right-click the virtual network adapter and select **Properties**.

3 In the Properties dialog box, select **Internet Protocol (TCP/IP)**, and click **Properties**.

4 In the TCP/IP Properties dialog box, click **Advanced**.

5 Click the **WINS** tab, then under **NetBIOS setting**, select **Use NetBIOS setting from DHCP Server**.

6 Click **OK** twice, and click **Close**.

Manually Entering the IP Address of a WINS Server

Use this method to connect to a WINS server in the same workgroup or domain that is not already set up on the host.

1 In the virtual machine, right-click on **My Network Places** and select **Properties**.

2 In the Network Connections window, right-click the virtual network adapter and select **Properties**.

3 In the Properties dialog box, select **Internet Protocol (TCP/IP)**, and click **Properties**.

4 In the TCP/IP Properties dialog box, click **Advanced**.

5 Click the **WINS** tab, and click **Add**.

6 In the TCP/IP WINS Server dialog box, enter the IP address for the WINS server in the **WINS server** field, and click **OK**. The IP address of the WINS server appears in the **WINS addresses** list on the WINS tab.

Repeat steps 5 and 6 for each WINS server to which you want to connect from this virtual machine.

7 Click **OK** twice, and click **Close**.

Now that the virtual machine has an IP address for a WINS server, you use NetLogon in the virtual machine to log on to a domain and access shares in that domain.

For example, if the WINS server covers a domain with a domain controller, it is possible to access that domain controller from the virtual machine and add the virtual machine to the domain. You need to know the user ID and password of the Administrator on the domain controller.

NOTE Your access is limited to shares of virtual machines that are on the same NAT network or are bridged on the same domain.

Sample Linux vmnetnat.conf File

The following is a sample Linux `vmnetnat.conf` file.

```
# Linux NAT configuration file

[host]
# NAT gateway address
ip = 192.168.237.2/24
hostMAC = 00:50:56:C0:00:08

# enable configuration; disabled by default for security reasons
#configport = 33445

# VMnet device if not specified on command line
device = VMnet8

# Allow PORT/EPRT FTP commands (they need incoming TCP stream...)
activeFTP = 1

# Allows the source to have any OUI. Enable this if you change the OUI
# in the MAC address of your virtual machines.
#allowAnyOUI = 1

[udp]
# Timeout in seconds, 0 = no timeout, default = 60; real value might
# be up to 100% longer
timeout = 30

[incomingtcp]
# Use these with care - anyone can enter into your virtual machine through
# these...

# FTP (both active and passive FTP is always enabled)
#   ftp localhost 8887
#8887 = 192.168.27.128:21
```

```
# WEB (make sure that if you are using named webhosting, names point to
#   your host, not to guest... And if you are forwarding port other
#   than 80 make sure that your server copes with mismatched port
#   number in Host: header)
#   lynx http://localhost:8888
#8888 = 192.168.27.128:80

# SSH
#   ssh -p 8889 root@localhost
#8889 = 192.168.27.128:22

[incomingudp]
# UDP port forwarding example
#6000 = 192.168.27.128:6001
```

Using Samba for File Sharing on a Linux Host

On a Linux host computer, VMware Server can automatically install and configure a Samba server to act as a file server for Microsoft Windows guest operating systems.

You can then use Windows Explorer in the virtual machine to move and copy files between virtual machine and host — or between virtual machines on the same network — just as you would with files on physical computers that share a network connection.

The lightly modified Samba server installed by VMware Server runs over the VMware Server virtual Ethernet, and the Samba traffic between different operating systems is isolated from actual local area networks.

The source code differences for the changes (in diff format and based on Samba 2.0.6) are available from VMware. For more information, see **www.vmware.com/download/open_sources.html**.

If you already have Samba configured on your Linux host, the recommended approach is to modify that configuration so it includes the IP subnet used by the VMware Server virtual Ethernet adapter, VMnet1.

You can configure your existing Samba server to work with a host-only network. Note that all the shares you set up in Samba and in the guest operating system normally appear on the bridged network as well.

If you need to be sure the shares set up in the guest operating system are seen only on the host-only network, you might find it easiest to install and use the Samba server provided with VMware Server.

If you do not need any shares to appear on your bridged network, you can use your existing Samba server and set up the configuration file so it works only on the host-only network.

Samba configurations can be quite complex. This section provides several sample configuration files. If you need to go beyond the issues covered here, see the man page for the `smb.conf` file. To view this man page, type one of the following commands in a terminal window:

```
man smb.conf
```

or

```
man 5 smb.conf
```

Pay particular attention to the section on encrypted passwords. If you have enabled clear-text passwords in the guest operating system, be sure that `smb.conf` is set up to use clear-text passwords. Similarly, if you are using encrypted passwords, you must have the same setting in the guest operating system and in `smb.conf`.

NOTE Using Samba printer sharing with virtual machines is not supported. Consult the man pages for guidance on configuring Samba for printing.

Sample smb.conf for Host-Only Networking

The following sample Samba configuration file is for use with host-only networking. This configuration is for the 2.0.6 version of Samba installed by VMware Server. The configuration files are placed in `/etc/vmware/vmnet1/smb` by default.

```
# This is the VMware(TM) Samba configuration file. You should read the
# smb.conf(5) manual page in order to understand the options listed
# here. Samba has a huge number of configurable options
# most of which are not shown in this example
#
# Any line that starts with a ; (semicolon) or a # (hash)
# is a comment and is ignored. In this example we will use a #
# for commentary and a ; for parts of the config file that you
# may wish to enable
#
#
# Configuration file for Samba 2.0.6 vmware-[sn]mbd operating on
# vmnet1.
#
# This file was generated by the VMware configuration
# program and modified for this document.
```

```
#
# If you modify it, it will be backed up the next time you run the
# configuration program.

# Global settings
[global]

# This should be polled at install time from the private subnet created by
# vmware-config.pl
socket address = 192.168.183.1
interfaces = vmnet1
bind interfaces only = yes

workgroup = WORKGROUP
netbios name = HOSTNAME
server string = VMware host-only

security = user
encrypt passwords = yes

# Note: Printers not loaded in this example. Resource definitions commented
# below.
; load printers = yes

socket options = TCP_NODELAY SO_RCVBUF=8192 SO_SNDBUF=8192

# VMware extension to use a different shared memory access key on each
# Samba server running on this host
sysv shm key = /dev/vmnet1

; log file = /etc/vmware/vmnet1/smb/var/log.smb
; log level = 1
; max log size in KB
; max log size = 50

lock directory = /etc/vmware/vmnet1/smb/var/locks

smb passwd file = /etc/vmware/vmnet1/smb/private/smbpasswd

codepage dir = /usr/lib/vmware/smb/codepages

dns proxy = no
```

```
# Shared resources

# Home directories
[homes]
comment = Home directories
browseable = no
writable = yes

# Printers
;[printers]
; comment = All printers
; path = /var/lpd
; browseable = no
; guest ok = no
; writable = no
; printable = yes

;[HostFS]
; comment = VMware host filesystem
; path = /
; public = no
; writeable = yes
; printable = no
```

Sample smb.conf for Bridged Networking

The following sample Samba configuration file is for use with bridged networking. This configuration file is based on the 2.0.7 version of Samba and assumes that you are using your existing Samba server, as provided with your host computer's Linux distribution. The configuration file is placed in /etc by default.

```
# This is the main Samba configuration file. You should read the
# smb.conf(5) manual page in order to understand the options listed
# here. Samba has a huge number of configurable options
# most of which are not shown in this example
#
# Any line that starts with a ; (semicolon) or a # (hash)
# is a comment and is ignored. In this example we will use a #
# for commentary and a ; for parts of the config file that you
# may wish to enable
#
# NOTE: Whenever you modify this file you should run the command
# "testparm" to check that you have not many any basic syntactic
# errors.

# Global Settings

[global]

interfaces = eth0

workgroup = WORKGROUP
netbios name = HOSTNAME
server string = Samba Host Box

# Note: Printers not loaded in this example. Resource definitions commented
# below.
; printcap name = lpstat
; load printers = yes
; printing = cups

socket options = TCP_NODELAY SO_RCVBUF=8192 SO_SNDBUF=8192

log file = /var/log/samba/log.%m
max log size = 50

security = user
encrypt passwords = yes
smb passwd file = /etc/smbpasswd

dns proxy = no

preserve case = yes
short preserve case = yes
default case = lower
; case sensitive = no

# Shared Resources

[homes]
comment = Home Directories
browseable = yes
writable = yes
```

```
;[printers]
; comment = All Printers
; path = /var/spool/samba
; browseable = yes
; guest ok = yes
; writable = no
; printable = yes
; create mode = 0700
; print command = lpr-cups -P %p -o raw %s -r # using client side
; printer drivers.
; print command = lpr-cups -P %p %s # using cups own drivers (use
; generic PostScript on clients).
; lpq command = lpstat -o %p
; lprm command = cancel %p-%j

;[system]
; comment = System share
; path = /
; valid users = username
; public = no
; browsable = yes
; writable = yes
; printable = no
```

Adding User Names and Passwords to the VMware Server Samba Password File

You must be sure the Samba password file includes entries for all users of the virtual machine who will access the host's file system. The user names and passwords in the Samba password file must be the same as those used for logging on to the guest operating system.

You can add user names and passwords to the VMware Server Samba password file at any time from a terminal window on your Linux host computer.

1. Log on to the root account.

   ```
   su -
   ```

2. Run the VMware Server Samba password command.

   ```
   vmware-smbpasswd vmnet1 -a <username>
   ```

   `<username>` is the user name you want to add. Follow the instructions on the screen.

NOTE vmware-smbpasswd is based on the standard Samba password program. If you are familiar with the options used in smbpasswd, you can use any of them in vmware-smbpasswd.

3 Log off of the root account.

```
exit
```

You might receive an error message that says

```
Unknown virtual interface "vmnet1"
```

This indicates your machine is not using the VMware Server Samba server.

If your installation of VMware Server does not include the VMware Server Samba server and you want to set it up, log on to the root account on your host computer (su -), then run vmware-config.pl from a terminal on the host. The configuration program asks

```
Do you want this script to automatically configure your system to allow your
virtual machines to access the host file system?
```

Answer yes.

CAUTION In order to configure VMware Server correctly, the vmware-config.pl configuration program requires all virtual machines to be shut down. The program shuts down any running virtual machines automatically.

If You Are Already Running Samba

If you already have Samba running on your Linux host, you should not install the VMware Server Samba server when you are installing VMware Server on your host.

The configuration program prompts you

```
Do you want this script to automatically configure your system to allow your
virtual machines to access the host file system?
```

Answer no.

Be sure to modify your Samba configuration so it includes the IP subnet used by the VMware Server virtual Ethernet adapter, VMnet1.

To determine what subnet is being used by VMnet1, run

```
/sbin/ifconfig vmnet1
```

You must be sure the Samba password file includes entries for all users of the virtual machine who will access the host's file system. The user names and passwords in the Samba password file must be the same as those used for logging on to the guest operating system.

You can add user names and passwords to the Samba password file at any time from a terminal window on your Linux host computer.

1. Log on to the root account.
   ```
   su -
   ```
2. Run the Samba password command.
   ```
   smbpasswd -a <username>
   ```
   `<username>` is the user name you want to add. Follow the instructions on the screen.
3. Log off of the root account.
   ```
   exit
   ```

Using a Samba Server for Both Bridged and Host-Only Networks

You can use the Samba server of your choice — either the existing Samba server from your host operating system's distribution or the one provided with VMware Server — for both host-only and bridged networking. To do so, you must modify one parameter in the `smb.conf` file. You can define the `interface` parameter so your Samba server serves multiple interfaces. An example of this is:

```
interface = eth0 vmnet1
```

This example tells the Samba server that it is to listen to and use both the `eth0` and `vmnet1` interfaces — the interfaces used by bridged and host-only networking, respectively.

Using VMware Server's Samba with an Existing Installation

You can also run both your existing Samba server and the VMware Server Samba server at the same time.To do this, your current Samba server must be version 2.0.6 or higher and must be configured correctly. However, this approach is not recommended.

To determine the version of your Samba server, run

```
smbd -V
```

If you want to try running both Samba servers at the same time, use this sample `smb.conf` file as a basis for configuring the regular Samba server on your host computer.

Sample smb.conf for Running Two Samba Servers at the Same Time

```
; This file is the recommended smb.conf file for your
; normal Samba server if you want to run it concurrently
; (which we don't advise) with the VMware Samba server.
;
; Your normal samba server should be at least v 2.0.6
```

```
;
; Note that you will need to insert specific information
; for your system at several points indicated in the file
; by <text in angle brackets>.
;
; --------------
;
; Larmor samba server configuration
;
; Global settings
[global]
;
; Identity
;
; Allow several Samba servers on the same machine
interfaces = <your real subnet>/<your real netmask>
bind interfaces only = yes
; Workgroup the host belongs to
workgroup = VMware
; SMB name of the host (the hostname by default)
netbios name = <your Windows name>
; Description of the host
server string = Linux running Samba 2.0.6
;
; Access
;
; Allow connections from
; hosts allow = <your real subnet>/<your real netmask>
; Authentication scheme
security = user
encrypt passwords = yes
;
; Options
;
; Automatically load the printer list (from /etc/printcap
; by default)
load printers = yes
; Gives better performance
socket options = TCP_NODELAY SO_RCVBUF=8192 SO_SNDBUF=8192
;
; Files and directories
;
```

```
; Max log size in KB
max log size = 1024
; Locks
lock directory = /var/samba
; SMB passwords
smb passwd file = /etc/samba/smbpasswd
;
; Name browsing
;
; Allow the host to participate in master browser
; elections
local master = yes
; Force a local browser election upon startup
; We need that otherwise it takes a long time before the
; windows network is browsable
preferred master = yes
; Do not try to resolve SMB names via DNS
dns proxy = no

; Shared resources
;
; Home directories
[homes]
comment = Home directories
browseable = no
writable = yes
; Printers
;[printers]
; comment = All printers
; path = /var/lpd
; browseable = no
; guest ok = no
; writable = no
; printable = yes
[Slash]
comment = Whole filesystem
path = /
public = no
writeable = yes
printable = no
```

CHAPTER 8 Configuring Devices

This chapter describes how to use various devices with a virtual machine and covers the following topics:

- "Using Parallel Ports" on page 211
- "Using Serial Ports" on page 216
- "Keyboard Mapping on a Linux Host" on page 226
- "Using USB Devices in a Virtual Machine" on page 232
- "Connecting to a Generic SCSI Device" on page 237
- "Using Two-Way Virtual Symmetric Multiprocessing (Experimental)" on page 244

Using Parallel Ports

VMware Server supports a partial emulation of bidirectional PS/2-style ports.

On Linux hosts, VMware Server requires that the parallel port "PC-style hardware" option (`CONFIG_PARPORT_PC`) be built and loaded as a kernel module (that is, it must be set to "`m`"). VMware Server is unable to use parallel port devices if `CONFIG_PARPORT_PC` is built directly (compiled) into the kernel. This limitation exists because `CONFIG_PARPORT_PC` does not correctly export its symbols.

The following sections describe how to use parallel ports with VMware Server:

- "About Parallel Ports" on page 211
- "Adding a Parallel Port in a Virtual Machine" on page 212
- "Configuring a Parallel Port on a Linux Host" on page 213
- "Special Notes for the Iomega Zip Drive" on page 216

About Parallel Ports

Parallel ports are used by a variety of devices, including printers, scanners, dongles, and disk drives.

Currently, VMware Server provides only partial emulation of PS/2 hardware. Specifically, interrupts requested by a device connected to the physical port are not passed to the virtual machine. Also, the guest operating system cannot use DMA (direct memory access) to move data to or from the port. For this reason, not all devices that attach to the parallel port are guaranteed to work correctly.

You can attach up to three parallel ports to a virtual machine. The virtual parallel port can connect to a parallel port or a file on the host operating system.

Adding a Parallel Port in a Virtual Machine

If the virtual machine is configured with a parallel port, most guest operating systems detect it at installation time and install the required drivers. Some operating systems, including Linux, Windows NT, and Windows 2000, detect the ports at boot time. Others, like Windows 95 and Windows 98, do not.

To add a parallel port to the virtual machine's configuration, complete the following steps with the virtual machine powered off. You can add the device from the console or from the VMware Management Interface.

NOTE In a Windows 95 or Windows 98 guest, run the guest operating system's Add New Hardware Wizard (**Start** > **Settings** > **Control Panel** > **Add New Hardware**) after you add the port and let Windows detect the new device.

Adding a Parallel Port from the Console

1 Open the virtual machine settings editor. Choose **VM** > **Settings**.

2 Click **Add** to start the New Hardware Wizard.

3 Select **Parallel Port**, and click **Next**.

4 Make the appropriate selection to use a physical parallel port or connect the virtual parallel port to a file, and click **Next**.

5 If you selected **Use physical parallel port on the host**, either choose the port from the **Physical parallel port** list or choose **Auto detect** to let VMware Server select the port to use.

NOTE The benefit of auto detect devices is that you can move them between virtual machines running different operating systems, such as Linux and Microsoft Windows, without having to reconfigure the devices.

If you selected **Output file**, enter the path and filename in the **Output file** field, or browse to the location of the file.

Under **Device status**, the default setting is **Connect at power on**. Deselect the check box if you do not want the parallel port device to be connected when the virtual machine powers on.

6 Click **Finish** to install the virtual parallel port, and click **OK** to save the configuration and close the virtual machine settings editor.

Configuring a Parallel Port on a Linux Host

For the parallel port to work properly in a guest, it must first be configured properly on the host. Most issues involving parallel port functionality are a result of the host configuration. Check these areas: the version of your Linux kernel, your device access permissions, and the required modules.

Parallel Ports and Linux 2.6.x Kernels

Be sure that PC Style Hardware (CONFIG_PARPORT_PC) is loaded as a module as mentioned at the beginning of "Using Parallel Ports" on page 211. If you are using a 2.6.x kernel, the modules that provide parallel port functionality are `parport_pc` and `ppdev`.

To verify these modules are installed and running on your system, run the `lsmod` command as the root user. You can also look at the `/proc/modules` file for the same list.

With a 2.6.x kernel, loading `parport_pc` does not load both modules. If neither of the listed parallel port modules is running, use this command:

```
modprobe parport_pc && modprobe ppdev
```

This command inserts both modules needed for a parallel port.

If you continue to experience problems, it is possible that the `lp` module is running. If it is, the virtual machine cannot use the parallel port correctly. To remove the `lp` module, run this command as the root user:

```
rmmod lp
```

You should also ensure that the line referring to the `lp` module in the `/etc/modules.conf` or `/etc/conf.modules` file is removed or commented out by inserting a hash character (#) at the beginning of the line. The name of the configuration file depends on the Linux distribution you are using. When you reboot the host after removing this line, the configuration file no longer starts the `lp` module.

To ensure that the proper modules for the parallel port are loaded at boot time, add this line to the `/etc/modules.conf` or `/etc/conf.modules` file:

```
alias parport_lowlevel parport_pc
```

Linux kernels in the 2.6.x series also use a special arbitrator that allows access to the parallel port hardware. If the parallel port is in use by the host, the guest cannot use it. If a virtual machine is using the parallel port, the host and any users accessing the host are not given access to the device. VMware Server puts a lock on the device, and this lock restricts access so only the virtual machine can use the port.

Choose **VM** > **Removable Devices** to disconnect the parallel port from the virtual machine and reconnect it.

Parallel Ports and Linux 2.4.x Kernels

Be sure that PC Style Hardware (`CONFIG_PARPORT_PC`) is loaded as a module, as mentioned at the beginning of "Using Parallel Ports" on page 211. If you are using a 2.4.x kernel, the modules that provide parallel port functionality are `parport`, `parport_pc` and `ppdev`.

To verify these modules are installed and running on your system, run the `lsmod` command as the root user. These three modules should be included in the listing of running modules. You can also look at the `/proc/modules` file for the same list.

To load the proper modules, run this command:

```
insmod -k <modulename>
```

If none of the listed parallel port modules is running, use this command:

```
insmod -k parport_pc
```

This command inserts the three modules needed for a parallel port.

If you continue to experience problems, it is possible that the `lp` module is running. If it is, the virtual machine cannot use the parallel port correctly. To remove the `lp` module, run this command as the root user:

```
rmmod lp
```

You should also ensure that the line referring to the `lp` module in the `/etc/modules.conf` or `/etc/conf.modules` file is removed or commented out by inserting a hash character (#) at the beginning of the line. The name of the configuration file depends on the Linux distribution you are using. When you reboot the host after removing this line, the configuration file no longer starts the `lp` module.

To ensure that the proper modules for the parallel port are loaded at boot time, add this line to the `/etc/modules.conf` or `/etc/conf.modules` file:

```
alias parport_lowlevel parport_pc
```

Linux kernels in the 2.4.x series also use a special arbitrator that allows access to the parallel port hardware. If the parallel port is in use by the host, the guest cannot use it.

If a virtual machine is using the parallel port, the host and any users accessing the host are not given access to the device. VMware Server puts a lock on the device, and this lock restricts access so only the virtual machine can use the port.

You can choose **VM** > **Removable Devices** to disconnect the parallel port from the virtual machine and reconnect it.

Parallel Ports and Linux 2.2.x Kernels

The 2.2.x kernels that support parallel ports use the parport, parport_pc and vmppuser modules. Be sure that PC Style Hardware (CONFIG_PARPORT_PC) is loaded as a module, as mentioned at the beginning of "Using Parallel Ports" on page 211. The vmppuser module is supplied by VMware Server to give virtual machines user-level access to the parallel port.

To verify these modules are installed and running on your system, run the lsmod command as the root user. These three modules should be included in the listing of running modules. You can also look at the /proc/modules file for the same list.

To load the proper modules, run this command:

```
insmod -k <modulename>
```

If none of the listed parallel port modules is running, use this command:

```
insmod -k parport_pc
```

This command inserts the three modules needed for a parallel port.

If you continue to experience problems, it is possible that the lp module is running. If it is, the virtual machine cannot use the parallel port correctly. To remove the lp module, run this command as the root user:

```
rmmod lp
```

You should also ensure that the line referring to the lp module in the /etc/modules.conf or /etc/conf.modules file is removed or commented out by inserting a hash character (#) at the beginning of the line. The name of the configuration file depends on your Linux distribution. When you reboot the host after removing this line, the configuration file no longer starts the lp module.

To ensure that the proper modules for the parallel port are loaded at boot time, add this line to the /etc/modules.conf or /etc/conf.modules file:

```
alias parport_lowlevel parport_pc
```

Device Permissions

Some Linux distributions by default do not grant the virtual machine access to the lp and parport devices. In most of these cases, the owner of the device is root and the associated group is lp. To allow the VMware Server user to access the device, add the user to the associated group. To view the owner and group of the device, run this command:

```
ls -la /dev/parport0
```

The third and fourth columns of the output show the owner and group, respectively.

To add the user to the device group, edit the /etc/group file. On the line starting with lp, which defines the lp group, add the VMware Server user's user name. You must make this change as the root user. The following line provides an example for a user whose user name is userj.

```
lp::7:daemon,lp,userj
```

The next time the user logs on to the host, the changes take effect.

Special Notes for the Iomega Zip Drive

On Windows 95 or Windows 98, use of older drivers for the Iomega Zip drive might cause the guest operating system to lock up intermittently at boot time or during installation of the guest operating system. The newest Iomega drivers work reliably in our tests. They are available at **www.iomega.com/software/index.html**.

Using Serial Ports

The following sections describe how to use serial ports with VMware Server:

- "Using a Serial Port on the Host Computer" on page 217
- "Using a File on the Host Computer" on page 218
- "Connecting an Application on the Host to a Virtual Machine" on page 220
- "Connecting Two Virtual Machines" on page 221
- "Special Configuration Options for Advanced Users" on page 223
- "Examples: Debugging over a Virtual Serial Port" on page 224

A VMware Server virtual machine can use up to four virtual serial ports. The virtual serial ports can be configured in several ways.

- You can connect a virtual serial port to a physical serial port on the host computer.
- You can connect a virtual serial port to a file on the host computer.

- You can make a direct connection between two virtual machines or between a virtual machine and an application running on the host computer.

You can also select whether to connect the virtual serial port when you power on the virtual machine.

Using a Serial Port on the Host Computer

You can set up the virtual serial port in a virtual machine to use a physical serial port on the host computer. This is useful, for example, if you want to use an external modem or a hand-held device in your virtual machine.

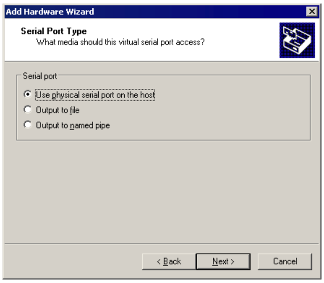
To install a virtual serial port that connects to a physical serial port on the host computer, take the following steps with the virtual machine powered off. Use the VMware Server Console to add the device.

To add a serial port from the Console

1 Open the virtual machine settings editor (choose **VM** > **Settings**).

2 Click **Add** to start the Add Hardware Wizard.

3 Select **Serial Port**, then click **Next**. The Serial Port Type screen appears.



Add Hardware Wizard

Serial Port Type

What media should this virtual serial port access?

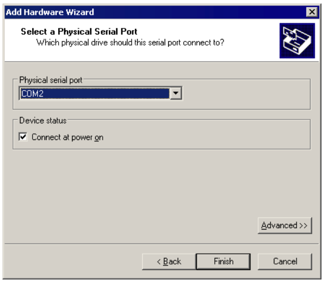
Serial port

● Use physical serial port on the host

○ Output to file

○ Output to named pipe

4 Select **Use physical serial port on the host**, then click **Next**. The Select a Physical Serial Port screen appears.



Add Hardware Wizard

Select a Physical Serial Port

Which physical drive should this serial port connect to?

Physical serial port: COM2

Device status

☑ Connect at power on

5 You can choose the port on the host computer to use for this serial connection or choose **Auto detect** to let VMware Server select the port.

NOTE The benefit of auto-detect devices is that they can be moved between virtual machines running different operating systems, such as Linux and Windows, without having to be reconfigured.

6 By default, the device status setting is **Connect at power on**. Uncheck the box for the port not to be automatically connected when you power on the virtual machine.

NOTE If you are connecting with a Windows console to add a physical serial port to a virtual machine on a remote Linux host, be sure to specify a Linux device name here, such as `/dev/ttyS0`. If you are connecting with a Linux console to add a physical serial port to a virtual machine on a remote Windows host, be sure to specify a Windows device name here, such as COM1.

Click **Advanced** to configure this serial port to use polled mode. This option is of interest primarily to developers who are using debugging tools that communicate over a serial connection. For more information, see "Special Configuration Options for Advanced Users" on page 223.

7 Click **Finish**, and click **OK** to close the virtual machine settings editor.

8 Check **Yield CPU on Poll** to configure this serial port to use polled mode. This option is of interest primarily to developers who are using debugging tools that communicate over a serial connection. For more information, see "Special Configuration Options for Advanced Users" on page 223.

9 Click **OK** to add the serial port.

Using a File on the Host Computer

You can set up the virtual serial port in a virtual machine to send its output to a file on the host computer. This is useful, for example, if you want to capture the data that a program running in the virtual machine sends to the virtual serial port, or if you need a quick way to transfer a file from the guest to the host.

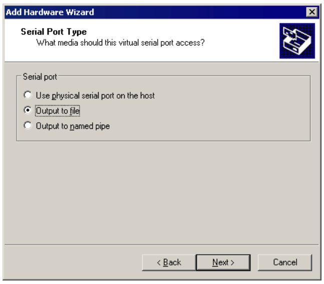
To install a virtual serial port that connects to a file on the host computer, take the following steps with the virtual machine powered off. Use the VMware Server Console to add the device.

Connecting to an Output File from the Console

1 Open the virtual machine settings editor (**VM** > **Settings**).

2 Click **Add** to start the Add Hardware Wizard.

3 Select **Serial Port**, then click **Next**. The Serial Port Type screen appears.



Add Hardware Wizard

Serial Port Type

What media should this virtual serial port access?

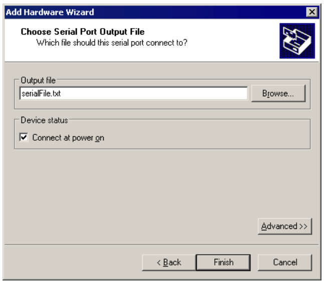
Serial port

○ Use physical serial port on the host

● Output to file

○ Output to named pipe

4 Select **Output to file**, then click **Next**. The Choose Serial Port Output File screen appears.



Add Hardware Wizard

Choose Serial Port Output File

Which file should this serial port connect to?

Output file: serialFile.txt

Device status

☑ Connect at power on

5 Browse to the file on the host computer that you want to use to store the output of the virtual serial port. By default, the device status setting is **Connect at power on**. You may deselect this setting if you wish.

Click **Advanced** if you want to configure this serial port to use polled mode. This option is of interest primarily to developers who are using debugging tools that communicate over a serial connection. For more information, see "Special Configuration Options for Advanced Users" on page 223.

6 Click **Finish**, and click **OK** to close the virtual machine settings editor.

Connecting an Application on the Host to a Virtual Machine

You can set up the virtual serial port in a virtual machine to connect to an application on the host computer. This is useful, for example, if you want to use an application on the host to capture debugging information sent from the virtual machine's serial port.

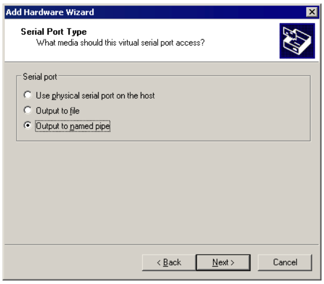
To install a direct serial connection between an application on the host and a virtual machine, complete the following steps with the virtual machine powered off. Use the VMware Server Console to add the device.

Connecting to an Application from the Console

1 Open the virtual machine settings editor (**VM** > **Settings**).

2 Click **Add** to start the Add Hardware Wizard.

3 Select **Serial Port**, then click **Next**. The Serial Port Type screen appears.



Add Hardware Wizard

Serial Port Type

What media should this virtual serial port access?

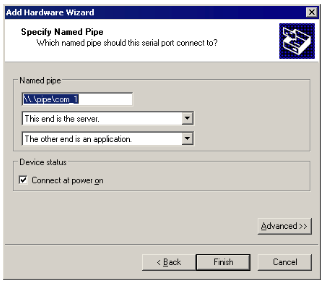
Serial port

○ Use physical serial port on the host

○ Output to file

● Output to named pipe

4 Select **Output to named pipe**, then click **Next**. The Specify Named Pipe screen appears.



Add Hardware Wizard

Specify Named Pipe

Which named pipe should this serial port connect to?

Named pipe

\\.\pipe\com_1

This end is the server.

The other end is an application.

Device status

☑ Connect at power on

5 Use the default pipe name, or enter another pipe name of your choice.

For a serial pipe on a Windows host, the pipe name must follow the form `\\.\pipe\<namedpipe>` — that is, it must begin with `\\.\pipe\`.

For a serial pipe on a Linux host, enter `/tmp/<socket>` or another Unix socket name of your choice.

NOTE If you are using a Windows console to connect to a virtual machine on a remote Linux host, be sure to specify a Linux pipe name here, such as `/tmp/<pipe>`. If you are using a Linux console to connect to a virtual machine on a remote Windows host, be sure to specify a Windows pipe name here, such as `\\.\pipe\<namedpipe>`.

---

6 Select **This end is the server** or **This end is the client**. In general, select **This end is the server** if you plan to start this end of the connection first.

7 Select **The other end is an application**.

8 The default device status setting is **Connect at power on**. Deselect the check box for the device not to be connected when you power on the virtual machine.

Click **Advanced** to configure this serial port to use polled mode. This option is of interest primarily to developers who are using debugging tools that communicate over a serial connection. For more information, see "Special Configuration Options for Advanced Users" on page 223.

9 Click **Finish**, and click **OK** to save your configuration and close the virtual machine settings editor.

10 On your host computer, configure the application that communicates with the virtual machine to use the same pipe or Unix socket name.

Connecting Two Virtual Machines

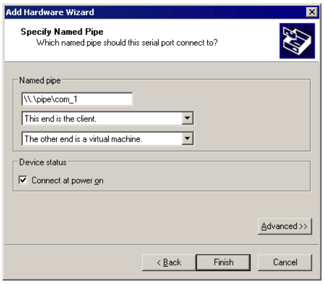
You can set up the virtual serial ports in two virtual machines to connect to each other. This is useful, for example, if you want to use an application in one virtual machine to capture debugging information sent from the other virtual machine's serial port.

To install a direct serial connection between two virtual machines (a server and a client), complete the following steps with the virtual machine powered off. You can add the device from the console or from the VMware Management Interface.

NOTE Make sure you performs these steps **twice**: once for the **server** virtual machine and once for the **client** virtual machine.

Connecting Two Virtual Machines from the Console

1. Connect to the **server** virtual machine with a console.
2. Open the virtual machine settings editor (**VM** > **Settings**).
3. Click **Add** to start the Add Hardware Wizard.
4. Select **Serial Port**, and click **Next**.
5. Select **Output to named pipe**, and click **Next**. The Specify Named Pipe screen appears.



Add Hardware Wizard

Specify Named Pipe

Which named pipe should this serial port connect to?

Named pipe

\\.\pipe\com_1

This end is the client.

The other end is a virtual machine.

Device status

☑ Connect at power on

6. Use the default pipe name, or enter another pipe name of your choice.

   For a serial pipe on a VMware Server for Windows host, the pipe name must follow the form `\\.\pipe\<namedpipe>` — that is, it must begin with `\\.\pipe\`.

   For a serial pipe on a VMware Server for Linux host, enter `/tmp/<socket>` or another Unix socket name of your choice.

   NOTE If you are using a Windows console to connect to a virtual machine on a remote Linux host, be sure to specify a Linux pipe name here, such as `/tmp/<pipe>`. If you are using a Linux console to connect to a virtual machine on a remote Windows host, be sure to specify a Windows pipe name here, such as `\\.\pipe\<namedpipe>`.

7. For the **server** virtual machine, select **This end is the server**.

   For the **client** virtual machine, select **This end is the client**.

8. Select **The other end is a virtual machine**.
9. By default, the device status setting is **Connect at power on**. Deselect the check box for the device not to connect when the virtual machine is powered on.

   Click **Advanced** if you want to configure this serial port to use polled mode. This option is of interest primarily to developers who are using debugging tools that communicate over a serial connection. For more information, see "Special Configuration Options for Advanced Users" on page 223.

10 Click **Finish**, and click **OK** to save your configuration and close the virtual machine settings editor.

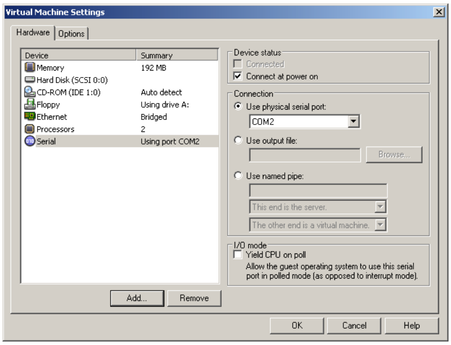
11 Repeat these steps for the **client** virtual machine.

Special Configuration Options for Advanced Users

Two special configuration options are available for serial connections between a virtual machine and the host or between two virtual machines. These options are of interest primarily to developers who are using debugging tools that communicate over a serial connection.

Improving Processor Performance When Debugging

The first option must be set in the virtual machine settings editor (**VM** > **Settings** > **Serial Port**). This option is useful when the serial port is being used by the guest operating system in polled mode as opposed to interrupt mode. Polled mode causes the virtual machine to consume a disproportionate share of processor time. This makes the host and other guests run sluggishly.



Device	Summary
Memory	192 MB
Hard Disk (SCSI 0:0)	
CD-ROM (IDE 1:0)	Auto detect
Floppy	Using drive A:
Ethernet	Bridged
Processors	2
Serial	Using port COM2

Device status
☐ Connected
☑ Connect at power on

Connection
● Use physical serial port:
COM2
○ Use output file:
○ Use named pipe:
This end is the server.
The other end is a virtual machine.

I/O mode
☐ Yield CPU on poll
Allow the guest operating system to use this serial port in polled mode (as opposed to interrupt mode).

To restore performance for applications on the host, check the **Yield CPU on poll** check box. This configuration option forces the affected virtual machine to yield processor time if the only task it is trying to do is poll the virtual serial port.

Changing the Input Speed of the Serial Connection

To use the second option, power off the virtual machine and close the console window. Use a text editor to add the following line to your virtual machine's configuration file (`.vmx`):

```
serial<n>.pipe.charTimePercent = <x>
```

This option is useful if you want to squeeze every possible bit of speed from your serial connection over a pipe to the virtual machine. In principle, there is no limit on the output speed — the speed at which the virtual machine sends data through the virtual serial port. In practice, the output speed depends on how fast the application at the other end of the pipe reads data inbound to it.

`<n>` is the number of the serial port, starting from `0`. So the first serial port is `serial0`.

`<x>` is any positive integer. It specifies the time taken to transmit a character, expressed as a percentage of the default speed set for the serial port in the guest operating system. For example, a setting of `200` forces the port to take twice as long per character, or send data at half the default speed. A setting of `50` forces the port to take only half as long per character, or send data at twice the default speed.

You should first use the guest operating system to configure the serial port for the highest setting supported by the application you are running in the virtual machine.

After the serial port speed is set appropriately in the guest operating system, experiment with this setting. Start with a value of `100` and gradually decrease it until you find the highest speed at which your connection works reliably.

Examples: Debugging over a Virtual Serial Port

You can use Debugging Tools for Windows (`WinDbg`) or Kernel Debugger (`KD`) to debug kernel code in a virtual machine over a virtual serial port. You can download Debugging Tools for Windows from the Windows DDK Web site at **www.microsoft.com/whdc/devtools/debugging/default.mspx**.

The following two examples illustrate how to use a virtual serial port to debug kernel code in a virtual machine:

- With the debugging application on the VMware Server host (Windows hosts only)
- With the debugging application in another virtual machine on the same VMware Server host (useful on a Linux host and can also be done on a Windows host)

Either of these methods lets you debug kernel code on one system, without requiring two physical computers, a modem or serial cable.

Debugging an Application in a Virtual Machine from the Windows or Linux Host

In this example, you have kernel code to debug in a virtual machine (called the target virtual machine) and are running `WinDbg` or `KD` on your Windows host.

To prepare the target virtual machine, follow the steps in "Connecting an Application on the Host to a Virtual Machine" on page 220. Make sure you configure the virtual machine's virtual serial port as follows:

- Select **This end is the server**
- Click **Advanced**, then under **I/O Mode**, select the **Yield CPU on poll** check box, as the kernel in the target virtual machine uses the virtual serial port in polled mode, not interrupt mode

To prepare the host, make sure you have a recent version of Debugging Tools for Windows — one that supports debugging over a pipe. You need version 4.0.18.0 or higher.

When you are ready to begin, complete the following steps:

1. Power on the virtual machine.
2. Check to make sure the serial port is connected. Choose **VM** > **Removable Devices**. On that menu, **serial<n>** should be reported as **\\.\pipe\<namedpipe>** (on Windows hosts) or **/tmp/<socket>** (on Linux hosts). If the serial port is not connected, choose the virtual serial port, then **Connect**.
3. On the host, open a Command Prompt window and do one of the following:

   - If you are using `WinDbg`, type the following:

     ```
     windbg -k com:port=\\.\pipe\<namedpipe>,pipe
     ```

   - If you are using `KD`, type the following:

     ```
     kd -k com:port=\\.\pipe\<namedpipe>,pipe
     ```

   Then press Enter to start debugging.

Debugging an Application in a Virtual Machine from another Virtual Machine

In this situation, you have kernel code to debug in a virtual machine (called the target virtual machine) and are running Debugging Tools for Windows (`WinDbg`) or Kernel Debugger (`KD`) in another virtual machine (called the debugger virtual machine) on the same host.

This setup is useful if you are running VMware Server on a Linux host. The debugger virtual machine must be running Debugging Tools for Windows (`WinDbg`) or Kernel Debugger (`KD`) in a Windows guest operating system.

To prepare the target virtual machine, follow the steps for the **server** virtual machine in "Connecting Two Virtual Machines" on page 221. Make sure when you configure the target virtual machine's virtual serial port that you select the **Yield CPU on poll** check box. The kernel in the target virtual machine uses the virtual serial port in polled mode, not interrupt mode.

To prepare the debugger virtual machine, make sure you have downloaded Debugging Tools for Windows. Follow the steps for the **client** virtual machine in "Connecting Two Virtual Machines" on page 221.

When you are ready to continue, complete the following steps:

1. Power on both virtual machines.
2. Check to make sure the serial port is connected. Choose **VM** > **Removable Devices**. If the serial port is not connected, choose the virtual serial port, and **Connect**.
3. In the debugger virtual machine, start debugging with `WinDbg` or `KD` normally.

Keyboard Mapping on a Linux Host

This section addresses the following issues and provides additional details on keyboard mapping in Linux:

- My (language-specific) keyboard is not supported by VMware Server.
- Some of the keys on my keyboard don't work right in the virtual machine.
- My keyboard works fine when I run a virtual machine locally, but not when I run the same virtual machine with a remote X server.

The following sections describe keyboard mapping on a Linux host:

- "Keyboard Mapping for a Remote Server" on page 226
- "Keyboard Mapping Support for the PC" on page 227
- "V-Scan Code Table" on page 229

Keyboard Mapping for a Remote Server

If your keyboard works correctly with a local X server, and you want the same behavior with a remote X server (which is also an XFree86 server running on a PC), power off the virtual machine and close the console.

Add the following line:

```
xkeymap.usekeycodeMapIfXFree86 = true
```

to the virtual machine configuration file or to `~/.vmware/config`.

Make this change on the host machine, where you run the virtual machine, not on the machine with the remote X server.

If you are using an XFree86-based server that VMware Server does not recognize as an XFree86 server, enter the following line instead:

```
xkeymap.usekeycodeMap = true
```

If you are using an XFree86 server running locally, and the keyboard does not work correctly, report the problem by submitting a support request at **www.vmware.com/requestsupport**.

Keyboard Mapping Support for the PC

Key code mapping is simple, automatic, and foolproof. (Keysym mapping is more complex and described later.) However, because the program cannot tell whether a remote server is running on a PC or on some other kind of computer, it errs on the safe side and uses key code mapping only with local X servers. This is often too conservative and has undesirable effects. This and other behavior related to key code-mapping can be controlled by using a text editor to add configuration settings to the virtual machine's configuration file.

NOTE Powering off the virtual machine and close the console before you edit a configuration file.

- `xkeymap.usekeycodeMapIfXFree86 = true`
  Use key code mapping if you are using an XFree86 server, even if it is remote.
- `xkeymap.usekeycodeMap = true`
  Always use key code mapping regardless of server type.
- `xkeymap.nokeycodeMap = true`
  Never use key code mapping.
- `xkeymap.keycode.<code> = <v-scan code>`
  If using key code mapping, map key code `<code>` to `<v-scan code>`. In this example, `<code>` must be a decimal number and `<v-scan code>` should be a C-syntax hexadecimal number (for example, `0x001`).

The easiest way to find the X key code for a key is to run `xev` or `xmodmap -pk`. Most of the v-scan codes are covered in the "V-Scan Code Table" on page 229. The keysym mapping tables described in this section are also helpful.

Use this feature to make small modifications to the mapping. For example, to swap left Ctrl and Caps Lock, use the following lines:

```
xkeymap.keycode.64 = 0x01d # X Caps_Lock -> VM left ctrl
xkeymap.keycode.37 = 0x03a # X Control_L -> VM caps lock
```

These configuration lines can be added to the individual virtual machine configuration, to your personal VMware Server configuration (`~/.vmware/config`), or even to the host-wide (`/etc/vmware/config`) or installation-wide (usually `/usr/local/lib/vmware/config`) configuration.

When key code mapping cannot be used (or is disabled), VMware Server maps keysyms to v-scan codes. It does this using one of the tables in the `xkeymap` directory in the VMware Server installation (usually `/usr/local/lib/vmware`).

Which table you should use depends on the keyboard layout. The normal distribution includes tables for PC keyboards for the United States and a number of European countries and languages. And for most of these, there are both the 101-key (or 102-key) and the 104-key (or 105-key) variants.

VMware Server automatically determines which table to use by examining the current X keymap. However, its decision-making process can sometimes fail. In addition, each mapping is fixed and might not be completely right for any given keyboard and X key code-to-keysym mapping. For example, a user might have swapped Ctrl and Caps Lock using `xmodmap`. This means the keys are swapped in the virtual machine when using a remote server (keysym mapping) but unswapped when using a local server (key code mapping).

Therefore, keysym mapping is necessarily imperfect. To make up for this defect, you can change most of the behavior using configuration settings:

- `xkeymap.language = <keyboard-type>`
  Use this if VMware Server has a table in `xkeymap` for your keyboard but can't detect it. `<keyboard-type>` must be one of the tables in the `xkeymap` directory. (See above for location.) However, the failure to detect the keyboard probably means the table isn't completely correct for you.

- `xkeymap.keysym.<sym> = <v-scan code>`
  If you use keysym mapping, map keysym `<sym>` to `<v-scan code>`. When you do, `<sym>` must be an X keysym name and `<v-scan code>` should be a C-syntax hexadecimal number (for example, `0x001`).

  The easiest way to find the keysym name for a key is to run `xev` or `xmodmap -pk`.

  The X header file `/usr/X11R6/include/X11/keysymdef.h` has a complete list of keysyms. (The name of a keysym is the same as its C constant without the `XK_` prefix.) Most v-scan codes are in the "V-Scan Code Table" on page 229.

  The `xkeymap` tables themselves are also helpful. Use them to fix small errors in an existing mapping.

- `xkeymap.fileName = <file-path>`
  Use the keysym mapping table in `<file-path>`. A table is a sequence of

configuration lines of the form

```
<sym> = <v-scan code>
```

where `<sym>` is an X keysym name, and `<v-scan code>` is a C-syntax hexadecimal number (for example, `0x001`). (See the explanation of `xkeymap.keysym` above for tips on finding the keysyms and v-scan codes for your keyboard.)

Compiling a complete keysym mapping is difficult. It is best to start with an existing table and make small changes.

V-Scan Code Table

These are the v-scan codes for the 104-key U.S. keyboard:

Table 8-1.

Symbol	Shifted symbol	Location	V-scan code
Esc			0x001
1	!		0x002
2	@		0x003
3	#		0x004
4	$		0x005
5	%		0x006
6	^		0x007
7	&		0x008
8	*		0x009
9	(		0x00a
0	)		0x00b
-	_		0x00c
=	+		0x00d
Backspace			0x00e
Tab			0x00f
Q			0x010
W			0x011
E			0x012
R			0x013
T			0x014
Y			0x015
U			0x016
I			0x017

Table 8-1.

Symbol	Shifted symbol	Location	V-scan code
O			0x018
P			0x019
[	{		0x01a
]	}		0x01b
Enter			0x01c
Ctrl		left	0x01d
A			0x01e
S			0x01f
D			0x020
F			0x021
G			0x022
H			0x023
J			0x024
K			0x025
L			0x026
;			0x027
'			0x028
`			0x029
Shift		left	0x02a
\	|		0x02b
Z			0x02c
X			0x02d
C			0x02e
V			0x02f
B			0x030
N			0x031
M			0x032
,	<		0x033
.	>		0x034
/	?		0x035
Shift		right	0x036
*		numeric pad	0x037
Alt		left	0x038

Table 8-1.

Symbol	Shifted symbol	Location	V-scan code
Space bar			0x039
Caps Lock			0x03a
F1			0x03b
F2			0x03c
F3			0x03d
F4			0x03e
F5			0x03f
F6			0x040
F7			0x041
F8			0x042
F9			0x043
F10			0x044
Num Lock		numeric pad	0x045
Scroll Lock			0x046
Home	7	numeric pad	0x047
Up arrow	8	numeric pad	0x048
PgUp	9	numeric pad	0x049
-		numeric pad	0x04a
Left arrow	4	numeric pad	0x04b
5		numeric pad	0x04c
Right arrow	6	numeric pad	0x04d
+		numeric pad	0x04e
End	1	numeric pad	0x04f
Down arrow	2	numeric pad	0x050
PgDn	3	numeric pad	0x051
Ins	0	numeric pad	0x052
Del		numeric pad	0x053
F11			0x057
F12			0x058
Break	Pause		0x100
Enter		numeric pad	0x11c
Ctrl		right	0x11d
/		numeric pad	0x135

Table 8-1.

Symbol	Shifted symbol	Location	V-scan code
SysRq	Print Scrn		0x137
Alt		right	0x138
Home		function pad	0x147
Up arrow		function pad	0x148
Page Up		function pad	0x149
Left arrow		function pad	0x14b
Right arrow		function pad	0x14d
End		function pad	0x14f
Down arrow		function pad	0x150
Page Down		function pad	0x151
Insert		function pad	0x152
Delete		function pad	0x153
Windows		left	0x15b
Windows		right	0x15c
Menu			0x15d

The 84-key keyboard has a Sys Req key on the numeric pad:

Symbol	Shifted symbol	Location	V-scan code
Sys Req		numeric pad	0x054

Keyboards outside the U.S. usually have an extra key (often < > or < > |) next to the left shift key:

Symbol	Shifted symbol	Location	V-scan code
<	>		0x056

Using USB Devices in a Virtual Machine

The following sections describe how to use USB devices in a virtual machine:

- "Notes on USB Support" on page 233
- "Adding a USB Controller" on page 233
- "Connecting USB Devices" on page 234

- "Using USB with a Windows Host" on page 235
- "Replacing USB 2.0 Drivers on a Windows 2000 Host" on page 235
- "Using USB with a Linux Host" on page 235
- "USB Device Control" on page 236
- "Disconnecting USB Devices from a Virtual Machine" on page 237
- "This is particularly important with data storage devices (a Zip drive, for example). If you move a data storage device too soon after saving a file and the operating system has not actually written the data to the disk, you can lose data." on page 237

VMware Server provides a two-port USB 1.1 controller. You can use up to two USB devices in your virtual machine if both your host operating system and your guest operating system support USB. If your host computer supports USB 2.0 devices, you can use those devices in the virtual machine.

NOTE Linux kernels older than 2.2.17 do not support USB.

Although your host operating system must support USB, you do not need to install device-specific drivers for your USB devices in the host operating system to use those devices only in the virtual machine.

On a Windows 2000 host computer with USB 2.0 support, be sure you are using the Microsoft USB 2.0 driver for the USB controller. Third-party USB 2.0 drivers, such as those provided by some motherboard manufacturers, are not supported. For notes on replacing the third-party drivers, see "Replacing USB 2.0 Drivers on a Windows 2000 Host" on page 235.

Notes on USB Support

We have tested a variety of USB devices with this release. In general, if the guest operating system has appropriate drivers, you should be able to use PDAs, printers, storage (disk) devices, scanners, MP3 players, PC radios, digital cameras, and memory card readers.

Modems and certain streaming data devices, such as speakers and Web cams, do not work properly.

Adding a USB Controller

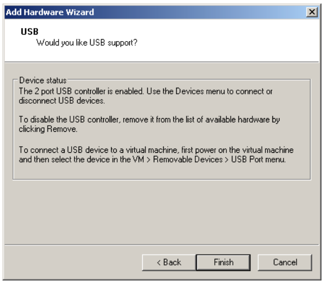
The USB controller is disabled by default in all virtual machines created with VMware Server.To add a USB controller to the virtual machine's configuration, complete the following steps with the virtual machine powered off. Use the VMware Server Console to add the device.

Adding a USB Controller from the Console

1 Open the virtual machine settings editor. Choose **VM** > **Settings**.

2 Click **Add** to start the New Hardware Wizard. Click **Next**. The Hardware Type screen appears.

3 Select **USB Controller**, and click **Next**. The USB screen appears.



USB

Would you like USB support?

Device status

The 2 port USB controller is enabled. Use the Devices menu to connect or disconnect USB devices.

To disable the USB controller, remove it from the list of available hardware by clicking Remove.

To connect a USB device to a virtual machine, first power on the virtual machine and then select the device in the VM > Removable Devices > USB Port menu.

4 Click **Finish** to install the virtual USB controller, and click **OK** to save the configuration and close the virtual machine settings editor.

Connecting USB Devices

Choose **VM** > **Removable Devices** to connect specific USB devices to your virtual machine. You can connect up to two USB devices at a time. If the physical USB devices are connected to the host computer through a hub, the virtual machine sees only the USB devices, not the hub.

Each USB port has a menu item. Move the mouse over one of these items to see a cascading menu of devices that are plugged into your host computer and available for use. To connect a device to the virtual machine, click its name.

If a device is already connected to that port, click the name of a new device to release the first device and connect the new one.

To release a connected device, click **None** on the cascading menu for the port to which it is connected.

If you physically plug a new device into the host computer, the device is initially connected to the host. Its name is also added to the **Removable Devices** submenu so you can connect it to the virtual machine manually.

Using USB with a Windows Host

When a particular USB device is connected to a virtual machine for the first time, the host detects it as a new device named VMware USB Device and installs the appropriate VMware driver.

On a Windows Server 2003 host, User confirmation is required in the Found New Hardware Wizard. Select the default action — **Install the software automatically**. Once the software is installed, the guest operating system detects the USB device and searches for a suitable driver.

When you are synchronizing a PDA, such as a Palm handheld or Handspring Visor, to a virtual machine for the first time, the total time required to load the VMware USB device driver in the host and the PDA driver in the guest might exceed the device's connection timeout value. This causes the device to disconnect itself from the computer before the guest can synchronize with it. If this occurs, let the guest finish installing the PDA driver, dismiss any connection error warnings, then try synchronizing the PDA again. The second attempt should succeed.

Replacing USB 2.0 Drivers on a Windows 2000 Host

To use VMware Server on a Windows 2000 host that has USB 2.0 ports, you must use the Microsoft USB 2.0 drivers for the USB controller in the host operating system. If your host operating system is using a third-party driver — a driver supplied by your motherboard vendor, for example — you must replace it.

Take the following steps to check the provider of your driver:

1. Go to the Device Manager. Right-click **My Computer**, choose **Properties**, click the **Hardware** tab, then click **Device Manager**.
2. Expand the listing for Universal Serial Bus controllers.
3. Right-click the listing for the controller and choose **Properties**.
4. Click the **Driver** tab. If the driver provider shown on that page is Microsoft, you have the correct driver already.

If the driver provider is not Microsoft, download the latest USB driver for your host operating system from the Microsoft Web site and follow the Microsoft instructions to install it. Details are available in Microsoft knowledge base article 319973.

Using USB with a Linux Host

On Linux hosts, VMware Server uses the USB device file system to connect to USB devices. In most Linux systems that support USB, the USB device file system is at `/proc/bus/usb`. If your host operating system uses a different path to the USB device file system, you can change it in the virtual machine settings editor (**VM** > **Settings** > **USB**). Enter the correct path in the **Path to usbdevfs** field.

USB Device Control

Only one computer, host or guest, can have control of a USB device at any one time.

Device Control on a Windows Host

When you connect a device to a virtual machine, it is "unplugged" from the host or from the virtual machine that previously had control of the device. When you disconnect a device from a virtual machine, it is "plugged in" to the host.

CAUTION You need to take a special step to disconnect USB network and storage devices from the host. There is a system tray icon called Eject Hardware on Windows 2000 and Safely Remove Hardware on Windows Server 2003. Use this icon to disconnect the device from the host before connecting it to a virtual machine.

When you connect a USB network or storage device in a virtual machine, you might see a message on your host that says the device can be removed safely. This is normal behavior, and you can simply dismiss the dialog box. However, do **not** remove the device from your physical computer. VMware Server automatically transfers control of the device to the virtual machine.

Under some circumstances, if a USB storage device is in use on the host (for example, one or more files stored on the device are open on the host), an error appears in the virtual machine when you try to connect to the device. You must let the host complete its operation or close any application connected to the device on the host. Reconnect the device in the virtual machine.

Device Control on a Linux Host

On Linux hosts, guest operating systems can use devices that are not already in use by the host — that is, devices that are not claimed by a host operating system driver.

If your device is in use by the host and you try to connect it to the guest using the **VM** > **Removable Devices** menu, a dialog box appears, informing you that there is a problem connecting to the device.

To disconnect the device from the host, you must unload the device driver. You can unload the driver manually as root (`su -`) using the `rmmod` command. If the driver was automatically loaded by `hotplug`, you can disable it in the `hotplug` configuration files in the `/etc/hotplug` directory. See your Linux distribution's documentation for details on editing these configuration files.

A related issue sometimes affects devices that rely on automatic connection (as PDAs often do).

If you have successfully used autoconnection to connect the device to your virtual machine, and later experience problems with the connection to the device, complete the following steps:

1 Disconnect and reconnect the device. You can either unplug it physically, and plug it back in, or use the **VM** > **Removable Devices** menu to disconnect it and reconnect it.

2 If you see a dialog box warning that the device is in use, disable it in the `hotplug` configuration files in the `/etc/hotplug` directory.

USB Devices

USB devices, such as the keyboard and mouse, are not handled through the virtual machine's USB controller. Instead, they appear in the virtual machine as a standard PS/2 keyboard and mouse, even though they are plugged into USB ports on the host.

Disconnecting USB Devices from a Virtual Machine

Before unplugging a USB device or using the **Removable Devices** submenu to disconnect it from a virtual machine, be sure it is in a safe state.

You should follow the procedures the device manufacturer specifies for unplugging the device from a physical computer. This is true whether you are physically unplugging it, moving it from host to virtual machine, moving it between virtual machines, or moving it from virtual machine to host.

This is particularly important with data storage devices (a Zip drive, for example). If you move a data storage device too soon after saving a file and the operating system has not actually written the data to the disk, you can lose data.

Connecting to a Generic SCSI Device

The following sections describe how to use generic SCSI devices in a virtual machine:

- "Device Support in Guest Operating Systems" on page 238
- "Adding a Generic SCSI Device to a Virtual Machine" on page 239
- "Generic SCSI on a Windows Host Operating System" on page 240
- "Generic SCSI on a Linux Host Operating System" on page 243

Generic SCSI lets a virtual machine run any SCSI device that is supported by the guest operating system in the virtual machine. Generic SCSI gives the guest operating system direct access to SCSI devices connected to the host, such as scanners, tape drives, and tape changers.

Device Support in Guest Operating Systems

In theory, generic SCSI is completely device independent, but VMware has discovered it is sensitive to the guest operating system, device class, and specific SCSI hardware. We encourage you to try any SCSI hardware you want to use and report problems to VMware technical support.

Preparing a Windows XP Guest Operating System to Use SCSI Devices

To use SCSI devices in a Windows XP virtual machine, you need a special SCSI driver available from the download section of the VMware Web site at **www.vmware.com/download**. Follow the instructions on the Web site to install the driver.

Preparing a Windows NT 4.0 Guest Operating System to Use SCSI Devices

Generic SCSI devices use the virtual Mylex® (BusLogic) BT/KT-958 compatible host bus adapter provided by the virtual machine. Some guest operating systems guide you through installing the drivers after you install the first SCSI device in the virtual machine. On Windows NT 4.0, however, you might need to install the driver manually, if it is not already installed for a virtual SCSI disk. You should do so before you add a generic SCSI device.

To install the BusLogic driver in a Windows NT 4.0 guest

1. Have your Windows NT installation CD available. Open the SCSI Adapters control panel.

   Start > **Settings** > **Control Panel** > **SCSI Adapters**

2. Click the **Drivers** tab.
3. Click **Add**.
4. In the list of vendors on the left, select **BusLogic**.
5. In the list of drivers on the right, select **BusLogic MultiMaster PCI SCSI Host Adapters**.
6. Click **OK**.
7. Insert the Windows NT CD when you are prompted. Click **OK**.
8. Reboot the guest operating system when you are prompted.

Preparing a Windows Me, Windows 98, or Windows 95 Guest OS to Use SCSI Devices

If you are using generic SCSI devices in a Windows 95, Windows 98, or Windows Me guest operating system and are experiencing problems with the devices, download the latest Mylex (BusLogic) BT/KT-958 compatible host bus adapter from www.lsilogic.com. This driver overrides what Windows chooses as the best driver, but it corrects known problems.

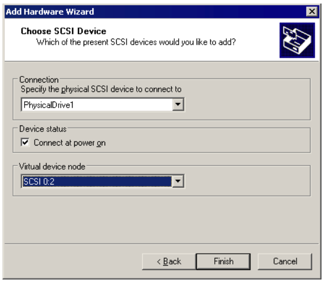
Adding a Generic SCSI Device to a Virtual Machine

You can add generic SCSI devices to your virtual machine in the virtual machine settings editor. The virtual machine settings editor lets you map virtual SCSI devices to physical generic SCSI devices on the host.

To add a new generic SCSI device to a virtual machine, make sure the virtual machine is powered off, and complete the appropriate steps below.

Adding a Generic SCSI Device to a Virtual Machine from the Console

1. Launch a VMware Server Console and select the virtual machine.
2. Choose **VM** > **Settings**. The virtual machine settings editor opens.
3. Click **Add** to start the Add Hardware Wizard. Select **Generic SCSI Device**, then click **Next**.



Add Hardware Wizard

Choose SCSI Device

Which of the present SCSI devices would you like to add?

Connection

Specify the physical SCSI device to connect to: PhysicalDrive1

Device status

☑ Connect at power on

Virtual device node: SCSI 0:2

4. Choose the name of the physical device you want to use.
5. Choose the virtual device node where you want this device to appear in the virtual machine.

   A check box under **Device status** lets you specify whether or not the device should be connected each time the virtual machine is powered on.

NOTE On a Windows host, the device should appear in the form CdRom0, Scanner0, Tape0 or Changer0. If you do not see a listing for the device, you might need to add the device to the virtual machine manually. See "Generic SCSI on a Windows Host Operating System" on page 240.

6 Click **Finish** to install the new device.

7 Click **OK** to save the configuration and close the virtual machine settings editor.

Generic SCSI on a Windows Host Operating System

Using the SCSI Generic driver in Windows, VMware Server allows your guest operating system to operate generic SCSI devices — including scanners, tape drives, and other data storage devices — in a virtual machine.

Adding a Generic SCSI Device Not Detected by VMware Server

When adding a generic SCSI device to a virtual machine, if VMware Server does not display the device you want to add (for example, scanners on a Windows 2000 host or some tape backup devices), you need to add the device manually to the virtual machine's configuration file (`.vmx`).

Reasons VMware Server cannot detect a device include:

- A driver for that device is not installed on the host.
- A driver on the host prevents the device from being detected.
- The virtual machine uses a device for which no drivers are available to the host operating system.

Before you attempt the steps below, verify that the device driver is installed on the host. If the driver is not installed, install it and verify that the device appears correctly to VMware Server. If it does not appear correctly, or if you cannot or do not want to install the driver on the host, add the device manually to the virtual machine.

When adding a device manually to the virtual machine, use `scsiX:Y` notation to refer to the device on the host instead of a device name such as `CdRom0, that` VMware Server uses. For this type of notation, `X` is the SCSI bus on which the device is located on the host and `Y` is the target ID the device uses on the host.

CAUTION Adding a device in this manner is recommended for advanced users only.

CAUTION Before you add the device, you must disable the original SCSI device driver on the host. Some Windows operating systems do not process the send command from the adapter if the device driver is owning the device.

There are a few circumstances that require you to add the device manually. Follow the steps that match your circumstance. In each case, power off the virtual machine and open the virtual machine's configuration file (`.vmx`) in a text editor and make the changes as described below.

1 The virtual machine does not contain any SCSI adapters or devices, or you want to add a generic SCSI device to a new virtual SCSI adapter in the virtual machine.

To add the device to the virtual machine, you need to add the following lines to the virtual machine's configuration file:

```
scsiZ:Y.present = "true"
scsiZ:Y.deviceType = "scsi-passthru"
scsiZ:Y.fileName = "scsiX:Y"
```

Define `X`, `Y` and `Z` as follows:

- `X` is the SCSI bus the device uses on the host system.
- `Y` is the target ID the device uses in the virtual machine **and** on the host. Use the same target ID in the virtual machine that the host already uses for the device to allow the device to work correctly.
- `Z` is the SCSI bus the device uses in the virtual machine.

2 The virtual machine has a SCSI adapter and a SCSI device and you want to use the same device as a generic SCSI device.

To configure the device as a generic SCSI device, you need to add the following lines to the virtual machine's configuration file:

```
scsiZ:Y.deviceType = "scsi-passthru"scsiZ:Y.fileName = "scsiX:Y"
```

Define `X`, `Y` and `Z` as follows:

- `X` is the SCSI bus the device uses on the host system.
- `Y` is the target ID the device uses in the virtual machine **and** on the host. Use the same target ID in the virtual machine that the host already uses for the device to allow the device to work correctly.
- `Z` is the SCSI bus the device uses in the virtual machine.

3 The virtual machine has a SCSI adapter and generic SCSI device, but VMware Server does not recognize the device in the Add Hardware Wizard.

You need to locate a line in the configuration file that looks like:

```
scsiZ:Y.fileName = "<deviceName>"
```

Change the line to:

```
scsiZ:Y.fileName = "scsiX:Y"
```

Define X, Y and Z as follows:

- X is the SCSI bus the device uses on the host system.
- Y is the target ID the device uses in the virtual machine **and** on the host. Use the same target ID in the virtual machine that the host already uses for the device to allow the device to work correctly.
- Z is the SCSI bus the device uses in the virtual machine.

For example, if the problematic device is a CD-ROM drive, the entry in the configuration file might be:

```
scsi0:4.fileName = "CdRom0"
```

If the device on the host is located on bus 2 with target ID 4, you should change this line to:

```
scsi0:4.fileName = "scsi2:4"
```

The target ID the device uses in the virtual machine must be the same as the target ID the device uses on the host system.

4 You added a generic SCSI device to the virtual machine's configuration file (.vmx) as instructed in step 3, but VMware Server does not recognize the device in the Add Hardware Wizard. You might experience this issue with tape drives and tape changers.

In this case, look for the line in the configuration file that looks like:

```
scsiZ:Y.fileName = "scsiX:Y"
```

Change the line to:

```
scsiZ:Y.fileName = "<deviceName>"
```

Example device names include Tape0 and Changer0.

Another alternative you can try is to uninstall or disable the device driver on the host and use the "scsiX:Y" notation in the configuration file.

NOTE The SCSI bus is assigned a number by the host operating system after all IDE buses have been assigned numbers. For example, if you have 2 IDE buses, they are numbered 0 and 1. The first SCSI bus is assigned bus number 2. In the example above, you use `2` for `X`.

If you cannot determine the SCSI bus number on your own, you can try using a third-party tool like `winobj` (which you can download for free from **www.sysinternals.com**) to determine this information.

The device target ID is usually set by some jumpers or switches on the device. Refer to the owner's manual for the device for information on how to determine the target ID.

Generic SCSI on a Linux Host Operating System

Using the SCSI Generic driver in Linux, VMware Server allows your guest operating system to operate generic SCSI devices within a virtual machine. The SCSI Generic driver sets up a mapping for each SCSI device in `/dev`. Each entry starts with `sg` (for the SCSI Generic driver) followed by a letter. For example, `/dev/sga` is the first generic SCSI device.

Each entry corresponds to a SCSI device, in the order specified in `/proc/scsi/scsi`, from the lowest device ID on the lowest adapter to the highest device ID on the lowest adapter, and so on to the highest device ID on the highest adapter. Do not enter `/dev/st0` or `/dev/scd0`.

NOTE When setting up a generic SCSI device in the virtual machine settings editor, as described later in this section, you specify the device you wish to install in the virtual machine by typing its `/dev/sg` entry in the **Connection** field.

Requirements

Generic SCSI requires version 2.1.36 of the SCSI Generic (`sg.o`) driver, which comes with kernel 2.2.14 and higher.

Avoiding Concurrent Access to a Generic SCSI Device

Under Linux, some devices — specifically tape drives, disk drives, and CD-ROM drives — already have a designated `/dev` entry (traditionally, `st`, `sd` and `scd`, respectively). When the SCSI Generic driver is installed, Linux also identifies these devices with corresponding `sg` entries in `/dev` — in addition to their traditional entries. VMware Server ensures that multiple programs are not using the same `/dev/sg` entry at the same time but cannot always ensure that multiple programs are not using the `/dev/sg` and the traditional `/dev` entry at the same time. It is important that you do not attempt to use the same device in both host and guest. This can cause unexpected behavior and may cause loss or corruption of data.

Permissions on a Generic SCSI Device

You must have read and write permissions on a given generic SCSI device to use the device within a virtual machine, even if the device is a read-only device such as a CD-ROM drive. These devices typically default to root-only permissions. Your administrator should create a group with access to read and write to these devices, and add the appropriate users to that group.

Using Two-Way Virtual Symmetric Multiprocessing (Experimental)

For all supported configurations of 32-bit and 64-bit host and guest operating systems running on multiprocessor host machines, VMware Server provides experimental support for two-way virtual Symmetric Multiprocessing (Virtual SMP). Virtual SMP lets you assign two virtual processors to a virtual machine on any host machine that has at least two logical processors.

The following host configurations are all considered to have two logical processors:

- A single-processor host with hyperthreading enabled
- A single-processor host with a dual-core CPU
- A multiprocessor host with two CPUs, neither of which are dual-core or have hyperthreading enabled.

NOTE On hyperthreaded uniprocessor hosts, performance of virtual machines with Virtual SMP might be subpar.

VMware Server does not support guests with more than two virtual processors. You can, however, power on and run multiple dual-processor virtual machines concurrently.

You can set the number of processors for the virtual machine from the VMware Server Console in the virtual machine settings editor.

1 Go to VM > Settings.

2 From the Hardware tab, click the entry for Virtual Processors.

3 Click one or two to set the number of virtual processors, and click OK.

NOTE The summary view also displays the number of virtual processors currently configured for the virtual machine.

You can also set the number of virtual processors when you create a virtual machine using the New Virtual Machine Wizard. You must choose a custom configuration. The option to set the number of virtual processors is not available in a typical configuration. For more information, see "Setting Up a New Virtual Machine" on page 25.

VMware Server does not support or recommend assigning two processors to a host with a single processor that does not have hyperthreading enabled. A warning message appears if you do so. You can disregard this message and assign two processors to the virtual machine, but after you have created the virtual machine, you will not be able to power it on unless you move it to a host machine with at least two logical processors.

Virtual Machines with Virtual SMP enabled are compatible with Workstation 5.x virtual machines. You can also move virtual machines with Virtual SMP enabled between VMware Server and VMware ESX Server.

Virtual Machines with Virtual SMP enabled are not compatible with VMware GSX Server 3 or with versions of Workstation prior to 5.x.

CHAPTER 9 Video and Sound

This chapter provides information on configuring the video display and sound for VMware Server and covers the following topics:

- "Setting Screen Color Depth in a Virtual Machine" on page 247
- "Using Full Screen Mode on a Linux Host" on page 248
- "Configuring Sound" on page 249

Setting Screen Color Depth in a Virtual Machine

The number of screen colors available in the guest operating system depends on the screen color setting of the host operating system.

Virtual machines support

- 16-color (VGA) mode
- 8-bit pseudocolor
- 16 bits per pixel (16 significant bits per pixel)
- 32 bits per pixel (24 significant bits per pixel)

If the host is in 15-bit color mode, the guest operating system's color setting controls offer 15-bit mode in place of 16-bit mode.

If the host is in 24-bit color mode, the guest operating system's color setting controls offer 24-bit mode in place of 32-bit mode.

If you run a guest operating system set for a greater number of colors than your host operating system is using, you can encounter various problems. In some cases, the colors in the guest are not correct. In others, the guest operating system is not able to use a graphical interface.

To fix these problems, you can either increase the number of colors available on the host or decrease the number of colors used in the guest.

For best performance, use the same number of colors in the guest and on the host.

The following sections describe changing the color depth on the host and in a virtual machine:

- "Changing Screen Color Depth on the Host" on page 248
- "Changing Screen Color Depth in the Virtual Machine" on page 248

Changing Screen Color Depth on the Host

To change the color settings on your host operating system, first shut down all guest operating systems, power off the virtual machines, and close the console.

Follow standard procedures for changing the color settings on your host operating system, and restart the console and the virtual machines.

Changing Screen Color Depth in the Virtual Machine

If you choose to change the color settings in the guest operating system, the approach you use depends on the combination of host and guest you are using.

Follow the normal process for changing screen colors in your guest operating system. In a Windows guest, the Display Properties control panel offers only those settings that are supported.

In a Linux or FreeBSD guest, you must either change the color depth before you start the X server or restart the X server after you make the changes.

Using Full Screen Mode on a Linux Host

When you switch a virtual machine into full screen mode, VMware Server changes the full screen display resolution to better match the resolution set in the guest operating system. On a Linux host, VMware Server uses the XF86VidMode to match the host resolution to the one requested by the guest running in the virtual machine.

In a few cases, VMware Server may not find the best resolution.

When VMware Server switches into full screen mode, it can choose only those resolutions that are already configured on your host.

If a virtual machine runs at a resolution that does not match a mode listed in the X server configuration, then for full screen mode VMware Server chooses the closest larger mode (and uses black borders) or else simply does not offer full screen mode at all.

It is possible to have bad modes configured in the `XF86Config` file on your host. If your host's X server configuration was automatically generated, or if you never tested all modes with your current monitor and video card, it is possible that some enabled modes do not work with your monitor. However, the mode-switching code in VMware Server has no way of knowing this and a virtual machine that tries to use a resolution with a bad mode line can cause your monitor to fail to display correctly.

If this happens, immediately leave full screen mode by pressing Ctrl-Alt, then fix your X server configuration and restart the X server. However, if the only problem is that the image is off center or is not quite the right size on the monitor, you can usually correct it using the controls on your monitor. Note that most modern monitors are capable of storing separate settings for each resolution, so changing the settings for a new mode should not impair the settings for the host resolution.

Configuring Sound

VMware Server provides a sound device compatible with the Creative Technology Sound Blaster Audio API adapter and supports sound in Windows 95, Windows 98, Windows Me, Windows NT, Windows 2000, Windows XP, Windows Server 2003, and Linux guest operating systems. The VMware Server sound device is disabled by default and must be installed using the virtual machine settings editor (**VM** > **Settings**).

Sound support includes PCM (pulse code modulation) output, and input. For example, you can play `.wav` files, MP3 audio, and Real Media audio. MIDI output from Windows guests is supported through the Windows software synthesizer. MIDI input is not supported, and no MIDI support is available for Linux guests.

Windows 2000, Windows XP, and most recent Linux distributions automatically detect the sound device and install appropriate drivers for it.

The following sections describe installing sound drivers in some Windows guest operating systems.

Installing Sound Drivers in a Windows Server 2003 Guest OS

Windows Server 2003 does not ship with the drivers for the Sound Blaster AudioPCI adapter. For the 32-bit version of Windows Server 2003, you can install the drivers from a Windows 2000 installation CD-ROM. For information on installing these drivers, see the VMware knowledge base article at **www.vmware.com/support/kb/enduser/std_adp.php?p_faqid=1115**. For the 64-bit version of Windows Server 2003, a sound driver is installed when you install VMware Tools. For more information about VMware Tools, see "Using VMware Tools" on page 39.

Installing Sound Drivers in Windows 9x and NT Guest OS

Windows 95, Windows 98, Windows 98SE, and Windows NT 4.0 do not have drivers for the Sound Blaster AudioPCI adapter. To use sound in these guest operating systems, you must download the driver from the Creative Labs Web site (**www.creative.com**) and install it in the guest operating system.

Creative Labs has a number of Web sites serving various regions of the world. The adapter name varies, depending on the region, but usually includes PCI 128.

CHAPTER 10 Performance Tuning for Virtual Machines

This chapter describes options for getting the best performance from VMware Server and your virtual machines and covers the following topics:

- "Allocating Memory to a Virtual Machine" on page 251
- "Improving Performance for Guest Operating Systems" on page 253

Allocating Memory to a Virtual Machine

VMware Server allows you to allocate a portion of the VMware Server host memory to each virtual machine. By adjusting this setting, you can affect the virtual machine's performance.

You set the size of an individual virtual machine's memory in the virtual machine settings editor or the VMware Management Interface. The minimum size of the memory for the virtual machine should be set based on the recommendations of the operating system provider.

When you create a new virtual machine, the wizard sets what VMware believes are reasonable defaults for the memory size of a virtual machine, based on the type of the guest operating system and the amount of memory in the host computer.

The following section describes how you can allocate memory to a virtual machine:

"Configuring Virtual Machine Memory from a Console" on page 252.

The actual size that should be given to a virtual machine depends on a few practical considerations:

- What kinds of applications will run in the virtual machine.
- What other virtual machines will contend with this virtual machine for memory resources.
- What applications will run on the host at the same time as the virtual machine.

- The total amount of host memory that all running virtual machines can use; for more information, see "Specifying How Much RAM is Used by All Running Virtual Machines".
- The file system where the virtual machine is stored. You cannot allocate more than 2000MB of memory to a virtual machine if it is stored on a file system that cannot support files larger than 2GB, such as FAT16. You will not be able to power on such a virtual machine. Further, you cannot allocate more than 2000MB of memory to a virtual machine if it is stored on a FAT32 file system, even though it does support files up to 4GB in size.

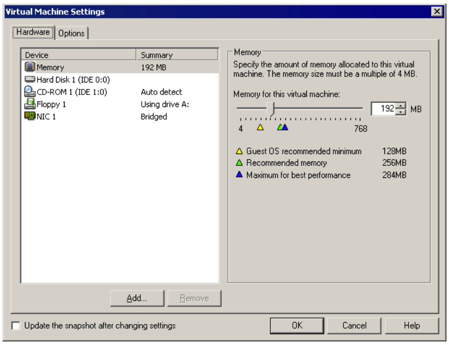
For more information on host memory use, see "Understanding Memory Usage".

Configuring Virtual Machine Memory from a Console

To set the size of an individual virtual machine's memory from the VMware Virtual Machine Console, complete the following steps.

1 Connect to the virtual machine with a console.

2 Open the virtual machine settings editor (**VM** > **Settings**). The virtual machine settings editor opens with the Memory tab selected.



Device	Summary
Memory	192 MB
Hard Disk 1 (IDE 0:0)	
CD-ROM 1 (IDE 1:0)	Auto detect
Floppy 1	Using drive A:
NIC 1	Bridged

Memory

Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4 MB.

Memory for this virtual machine: 192 MB

△ Guest OS recommended minimum	128MB
△ Recommended memory	256MB
▲ Maximum for best performance	284MB

□ Update the snapshot after changing settings

3 Allocate memory to the virtual machine. Use the slider or spin controller, or type the amount of memory to allocate in the **MB** field. The value must be a multiple of four.

NOTE The minimum size of the memory for the virtual machine should be set based on the recommendations of the operating system provider.

Improving Performance for Guest Operating Systems

The tips in this section help you make adjustments to improve performance for particular guest operating systems running inside a virtual machine.

The following sections describe tips to improve performance for various guest operating systems:

- "Windows 2000, Windows XP and Windows Server 2003 Guest OS Performance Tips" on page 253
- "Windows 95 and Windows 98 Guest Operating System Performance Tips" on page 254
- "Linux Guest Operating System Performance Tips" on page 256

Windows 2000, Windows XP and Windows Server 2003 Guest OS Performance Tips

This section offers advice for configuring a Windows 2000, Windows XP, or Windows Server 2003 guest operating system for better performance inside a virtual machine.

NOTE This section pertains to the guest operating system that is running inside a VMware Server virtual machine. It does not describe actions that should be taken on Windows 2000 or Windows Server 2003 running on the host computer.

Guest Operating System Selection

Make certain you have selected the correct guest operating system in the virtual machine settings editor. Choose **VM** > **Settings** > **Options**.

VMware Tools

Make certain VMware Tools is installed. VMware Tools provides an optimized SVGA driver and sets up the VMware Tools service to run automatically when the system starts. Among other things, VMware Tools allows you to synchronize the virtual machine's clock with the host computer's clock, which can improve performance for some functions. Install VMware Tools by choosing **VM > Install VMware Tools**.

Disconnect the Virtual CD-ROM Drive

Using the **Removable Devices** submenu, disconnect the virtual CD-ROM drive if you do not need to use it. Disconnecting the CD-ROM drive reduces processor usage.

Visual Effects

The fade effects that Windows 2000, Windows XP, and Windows Server 2003 use when displaying menus can be somewhat slow and make the virtual machine seem less responsive.

To disable the fade effects, right-click the guest operating system desktop, then choose **Properties** > **Appearance** > **Effects** (on Windows XP or Windows Server 2003) or **Properties** > **Effects** (on Windows 2000) and deselect the **Use transition effects for menus and tool tips** check box.

Full Screen Mode

Run your virtual machine in full screen mode. Click the **Full Screen** button on the VMware Virtual Machine Console toolbar.

Enabling Hardware Acceleration (Windows Server 2003 Guests)

Windows Server 2003 disables hardware acceleration by default. This slows down graphics performance and mouse responsiveness in the guest operating system.

When you install VMware Tools in a Windows Server 2003 guest, you are prompted to enable the hardware acceleration setting. VMware recommends you enable hardware acceleration fully.

To enable hardware acceleration in a Windows Server 2003 guest at a later time, open the Windows Control Panel, then open the Display Properties control panel. On the Settings tab, click **Advanced**. On the Troubleshoot tab, drag the **Hardware acceleration** slider all the way to **Full**.

Windows 95 and Windows 98 Guest Operating System Performance Tips

This section offers advice for configuring a Windows 95 or Windows 98 guest operating system for better performance inside a VMware Server virtual machine.

Guest Operating System Selection

Make certain you have selected the correct guest operating system in the virtual machine settings editor. Choose **VM** > **Settings** > **Options**.

VMware Tools

Make certain VMware Tools is installed. VMware Tools provides an optimized SVGA driver and sets up the VMware Tools service to run automatically when the system starts. Among other things, the VMware Tools service allows you to synchronize the virtual machine’s clock with the host computer’s clock, which can improve performance for some functions. Install VMware Tools by choosing **VM > Install VMware Tools**.

DMA Mode for IDE Disks

Windows 95 OSR2 and higher (including Windows 98) can use direct memory access (DMA) for faster IDE hard disk access. However, DMA might not be enabled by default.

You can turn on DMA access using the guest operating system's Device Manager.

1. Right-click **My Computer** and choose **Properties** from the pop-up menu.
2. Click the **+** sign beside **Disk Drives** to show your virtual machine's individual drives.
3. Right-click the entry for each IDE drive to open its Properties dialog box.
4. Under **Settings**, check the box labeled **DMA** and accept any warning Windows displays.
5. Restart the Windows guest for the new settings to take effect.

Full Screen Mode

Run your virtual machine in full screen mode. Click the **Full Screen** button on the VMware Virtual Machine Console toolbar.

Swap File Usage

In your `system.ini` file, in the `[386enh]` section, add the following line:

```
ConservativeSwapFileUsage=1
```

Disconnect CD-ROM

Using the **Removable Devices** submenu, disconnect your CD-ROM drive if you do not need to use it. Disconnecting the CD-ROM drive reduces processor usage.

Visual Effects

Windows 98 has a number of visual effects, designed to be attractive, that place unnecessary demands on the graphics emulation in VMware Server. Some users have seen performance improvements when they turn off these special effects.

To modify these settings, right-click on the desktop of your virtual machine, then select **Properties** from the pop-up menu. Click the **Effects** tab and deselect the **Animate windows, menus, and lists** check box.

Also, if **Show window contents while dragging** is checked, try deselecting that check box.

Linux Guest Operating System Performance Tips

This section offers advice for configuring a Linux guest operating system for better performance inside a VMware Server virtual machine.

NOTE This document pertains to the guest operating system that is running inside a VMware Server virtual machine. It does not describe actions that should be taken on Linux running on the host computer.

Guest Operating System Selection

Make certain you have selected the correct guest operating system in the virtual machine settings editor. Choose **VM** > **Settings** > **Options**.

VMware Tools

Make certain VMware Tools is installed. VMware Tools provides an optimized SVGA driver and sets up the VMware Tools service to run automatically when the system starts. Among other things, the VMware Tools service allows you to synchronize the virtual machine's clock with the host computer's clock, which can improve performance for some functions. Install VMware Tools by choosing **VM > Install VMware Tools**.

Disconnect CD-ROM

Using the **Removable Devices** submenu, disconnect your CD-ROM drive if you do not need to use it. Disconnecting the CD-ROM drive reduces processor usage.

Install in Text Mode

When you are installing your Linux guest operating system, use the text-mode installer instead of the graphical installer if you have a choice. This makes the installation process faster.

If you do use a graphical installer and if you are using a Linux host computer, try to run the virtual machine in full screen mode during the installation.

Full Screen Mode

Run your virtual machine in full screen mode. Click the **Full Screen** button on the VMware Virtual Machine Console toolbar.

Glossary

Add Hardware Wizard

A point-and-click interface for adding virtual hardware to a virtual machine. To launch the Wizard, power off the virtual machine, open the virtual machine settings editor, then click **Add**. It prompts you for information for configuring the hardware, suggesting default values in most cases.
See also Virtual machine settings editor.

Bridged networking

A type of network connection between a virtual machine and the rest of the world. Under bridged networking, a virtual machine appears as an additional computer on the same physical Ethernet network as the host.
See also Host-only networking.

Configuration

See Virtual machine configuration file.

Console

See VMware Server Console.

Current virtual machine

A virtual machine created under the current VMware Server version and Workstation Server 5.x.
See also Legacy virtual machine.

Custom networking

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

EULA

The end user license agreement.

Existing partition

A partition on a physical disk in the host machine.
See also Physical disk.

Full screen mode

A display mode in which the virtual machine's display fills the entire screen.
See also Quick switch mode.

Growable disk

A type of virtual disk where the disk space is not preallocated to its full size. Its files start out small in size and grow as data is written to it.

Guest operating system

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

Headless

A description for a program or application that runs in the background without any graphical user interface connected to it. A virtual machine running with no consoles connected to it is considered to be running headless.

Host-only networking

A type of network connection between a virtual machine and the host. Under host-only networking, a virtual machine is connected to the host on a private network, which normally is not visible outside the host. Multiple virtual machines configured with host-only networking on the same host are on the same network.
See also Bridged networking, Custom networking and Network address translation.

Host computer

The physical computer on which the VMware Server software is installed. It hosts the VMware Server virtual machines.

Host operating system

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

Independent disk

An independent disk is a type of virtual disk that is not affected by snapshots. Independent disks can be configured in persistent and nonpersistent modes.
See also Nonpersistent mode, Persistent mode.

Inventory

A list in the left panel of the console window that shows the names of virtual machines that a user has added to the list. The inventory makes it easy to launch a virtual machine or to connect to the virtual machine’s configuration file in order to make changes in the virtual machine settings.

Legacy virtual machine

A virtual machine created under VMware GSX Server or VMware Workstation 3 or 4. See also Current virtual machine.

Network address translation (NAT)

A type of network connection that allows you to connect your virtual machines to an external network when you have only one IP network address, and that address is used by the host computer. If you use NAT, your virtual machine does not have its own IP address on the external network. Instead, a separate private network is set up on the host computer. Your virtual machine gets an address on that network from the VMware virtual DHCP server. The VMware NAT device passes network data between one or more virtual machines and the external network. It identifies incoming data packets intended for each virtual machine and sends them to the correct destination.
See also Bridged networking, Custom networking and Host-only networking.

New Virtual Machine Wizard

A point-and-click interface for convenient, easy creation of a virtual machine configuration. To launch the Wizard, choose **File** > **New Virtual Machine**. It prompts you for information, suggesting default values in most cases. It creates files that define the virtual machine, including a virtual machine configuration file and (optionally) a virtual disk or physical disk file.
See also Virtual machine settings editor.

Nonpersistent mode

A mode in which all disk writes issued by software running inside a virtual machine with a disk in nonpersistent mode appear to be written to disk but are in fact discarded after the virtual machine is powered off. If you configure a virtual disk or physical disk as an independent disk in nonpersistent mode, the disk is not modified by VMware Server.
See also Independent disk, Persistent mode

Persistent mode

A mode in which all disk writes issued by software running inside a virtual machine are immediately and permanently written to the virtual disk. If you configure a virtual disk or physical disk as an independent disk in persistent mode, the disk behaves like a conventional disk drive on a physical computer.
See also Independent disk, Nonpersistent mode

Physical disk

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

Preallocated disk

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

Quick switch mode

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

Raw disk

See physical disk.

Redo log

The file that stores the changes made to a disk in independent-nonpersistent mode. The redo-log file is deleted when you power off or reset the virtual machine without writing any changes to the disk.

Resume

Return a virtual machine to operation from its suspended state. When you resume a suspended virtual machine, all applications are in the same state they were when the virtual machine was suspended.
See also Suspend.

Shrink

Reduce the amount of file system space a virtual disk occupies in order to reclaim unused space in a virtual disk. If there is empty space in the disk, shrinking reduces the amount of space the virtual disk occupies on the host drive. You cannot shrink preallocated virtual disks or physical disks.

Snapshot

A way to preserve the state of a virtual machine — the state of the data on all the virtual machine’s disks and the virtual machine’s power state (whether the virtual machine was powered on, powered off or suspended). You can take a snapshot of a virtual machine at any time and revert to that snapshot at any time. The virtual machine can be powered on, powered off or suspended.

Supported partition

A virtual disk partition that VMware Tools can prepare for shrinking, such as one of the drives that comprise the virtual hard disk. You can choose to not prepare certain partitions for shrinking.
See also Shrink.

Suspend

Save the current state of a running virtual machine. To return a suspended virtual machine to operation, use the resume feature.
See also Resume.

Unsupported partition

A virtual disk partition that VMware Tools cannot prepare for shrinking. Unsupported partitions include read-only drive partitions, partitions on remote devices and partitions on removable devices such as floppy drives or CD-ROM

drives.
See also Shrink.

Virtual disk

A virtual disk is a file or set of files that appears as a physical disk drive to a guest operating system. These files can be on the host machine or on a remote file system. When you configure a virtual machine with a virtual disk, you can install a new operating system into the disk file without needing to repartition a physical disk or reboot the host. Virtual disks can be preallocated or growable. A preallocated virtual disk has all the disk space allocated at the time the virtual disk is created. A growable disk is not preallocated; its files start out small in size and grow as data is written to it.
See also Physical disk.

Virtual hardware

The devices that comprise a virtual machine. The virtual hardware includes the virtual disk, the removable devices such as the DVD-ROM/CD-ROM and floppy drives, and the virtual Ethernet adapter. You configure these devices with the virtual machine settings editor.

Virtual machine

A virtualized x86 PC environment in which a guest operating system and associated application software can run. Multiple virtual machines can operate on the same host machine concurrently.

Virtual machine configuration

The specification of what virtual devices (disks, memory size, and so forth) are present in a virtual machine and how they are mapped to host files and devices.

Virtual machine configuration file

A file containing a virtual machine configuration. It is created when you create the virtual machine. It is used by VMware Server to identify and run a specific virtual machine.

Virtual machine settings editor

A point-and-click control panel used to view and modify a virtual machine's settings. You launch it by choosing **VM** > **Settings**.
See also New Virtual Machine Wizard.

Virtual Network Editor

A point-and-click editor used to view and modify the networking settings for the virtual networks created by VMware Server. You launch by choosing **Host** > **Virtual Network Settings**.

Virtual SMP

Symmetric multiprocessing enables you to assign two virtual processors to a virtual machine on any host machine that has at least two logical processors.

VMware Authorization Service

The service VMware Server employs to authenticate users. For both Microsoft Windows and Linux hosts, this process is called `vmware-authd`.

VMware Management Interface

A browser-based tool that allows you to control (start, suspend, resume, reset and stop), configure and monitor virtual machines and the server on which they run.

VMware Registration Service

The service VMware Server employs for managing connections to virtual machines and the VMware Management Interface. This process is known as `vmware-serverd` on Linux hosts and `vmware-serverdwin32` on Microsoft Windows hosts.

VMware Tools

A suite of utilities and drivers that enhances the performance and functionality of your guest operating system. Key features of VMware Tools include some or all of the following, depending on your guest operating system: an SVGA driver, a mouse driver, the VMware Tools service, the VMware Tools control panel, and support for such features as the ability to shrink virtual disks, time synchronization with the host, VMware Tools scripts and the ability to connect and disconnect devices while the virtual machine is running.

VMware Tools service

One of the components installed with VMware Tools that performs various duties in the guest operating system, like executing commands in the virtual machine, gracefully shutting down and resetting a virtual machine, sending a heartbeat to VMware Server, synchronizing the time of the guest operating system with the host operating system and passing strings from the host operating system to the guest operating system.

VMware Server Console

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

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