

Solution Deployment Guide: Improved Performance with Intel® Virtualization Technology (Intel® VT)

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Intel® Virtualization Technology (Intel® VT) with Dual-Core Intel® Xeon® processor-based servers

Target Audience: The target audience for this guide are system integrators and resellers interested in building and deploying solutions built on Dual-Core Intel® Xeon® processor based systems.

Preface

Intel has created unique Solution Deployment Guides to enable its channel partners to provide complete solutions to their customers, backed up by top-quality technology and support. This Deployment Guide examines the need for a more secure, robust, and efficient virtualization experience, which can be addressed using hardware-enhanced virtualization technology available with Dual-Core Intel® Xeon® processor-based servers.

Intel® Virtualization Technology (Intel® VT): Permits one hardware platform to function as multiple virtual platforms. This technology offers improved manageability, which helps limit downtime and maintain worker productivity.

Solution Overview

This document describes how Intel® VT in the Dual-Core Intel® Xeon® processor-based servers and Intel VT-enabled software such as VMware* Server can be deployed to address real world problems that small to medium sized businesses (SMB) must contend with on a daily basis.

Solution Architecture

The following diagram depicts multiple virtual machines running on a hardware assisted virtualized environment.

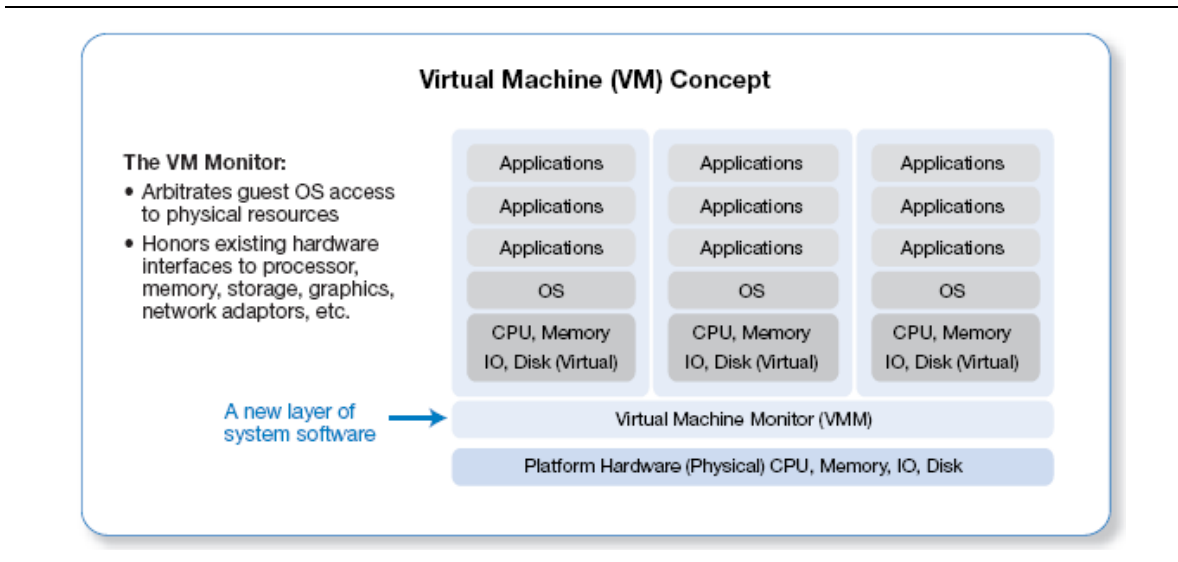


Figure 1: Virtual Machine (VM) Concept

Software Architecture

VMware* Server virtualization software makes the operating system and applications run in a virtual machine environment. This makes these components hardware-independent (i.e. hardware platform support is not required by these software components any more).

The VMware Server virtual machine can be provisioned to any physical server and it can manage multiple OSes and applications as a single unit by encapsulating them into virtual machines.

The licensing requirements for this solution include a license for the host OS, the VMware server and the each of the guest OSes.

NOTE:

VMWare Server is now offered free of charge by VMWare with limited support.

System Architecture

The Dual-Core Intel® Xeon® processor-based servers coupled with VMware Server software makes it an ideal platform for small and medium size businesses to consolidate multiple servers into one high performance server at a low cost. An added

benefit is that VMware Server software is free of charge from VMware. It is easy to setup the software and the built in hooks for Intel® Virtualization Technology (Intel VT) makes its run efficiently on Dual-Core Intel Xeon processor-based server platforms.

Common Notation and Terms

RAS: Industry acronym for reliability, availability, and serviceability.

Virtual Machine Monitor (VMM): The host software that delivers virtualization capability.

Virtualization: The process by which a number of different execution environments can coexist on a single server.

Host Operating System: The operating system that runs directly on the hardware. This is the OS you build the server with.

Guest Operating System: The operating system that runs within a virtual machine environment. This is the OS you install once you start a virtual machine.

Components to Build Virtual Server Solution

- Dual-Core Intel Xeon® processor-based server which includes Intel VT support
- Microsoft* Windows* Server 2003 Enterprise x64 Edition R2
- Intel® PRO/1000 Network driver – download and install it if it is not installed by default (detail in the next section)
- VMware Server for Windows 1.0 Beta 3
- VMware Server Console for client package (optional)
- Guest operating system (OS) – Windows NT 4.0 Server, Red Hat* Desktop 4 update 2, Ubuntu* 5.10



NOTE:

These guest operating systems (OS) listed above are only for example, customer could use but not limited with these OS, please contact Intel field representative for more information.

Where To Get the Solution Components

- You can download the new VMware Server software by following the link <http://www.vmware.com/download/server>. For “Existing Users” simply register using the same serial numbers from prior VMware Server Beta releases. Alternatively, you can request for new serial numbers by following the link for “First Time Users”.
- You can download the Intel PRO1000 network driver by following the link: http://downloadfinder.intel.com/scripts-df-external/Detail_Desc.aspx?DwnldID=6759
- For guest operating systems, please consult with respective OS vendor documentation.

For Windows operating systems, please go to

<http://www.microsoft.com>

For Red Hat Linux, please go to

<http://www.redhat.com>

For Ubuntu Linux, please go to

<http://www.ubuntu.com>

Introductions and Links to Other Documents

For more details on how VMware Server works please consult the following documents.

- http://www.vmware.com/pdf/server_vm_manual.pdf
- http://www.vmware.com/pdf/server_admin_manual.pdf

White Papers on VMware Products

- <http://www.vmware.com/vmtn/resources/>

For Intel hardware setup information, please refer to the following links:

- <http://support.intel.com/support/motherboards/server/<product>/manual.htm>

Bill of Materials

Hardware Configuration and Recommendation

Virtualization can be a very resource intensive application. It requires high performance machines with lots of memory. It is highly recommended that a Dual-Core Intel Xeon® processor-based platform which includes hardware assisted virtualization support be used as a minimum configuration.

In order to run VMware Server software and several virtual machines in a responsive way, here is a recommended hardware configuration. See Intel's support website for a list of tested parts to ensure compatibility.

Qty	Item	Manf	Model
1	Mother Board	Intel	S5000VSA
4	Memory - 512MB (total 2GB minimum)		
1	Hard Drive		Any SATA 160GB HDD
1	CD/DVD-ROM		Standard
2	CPU	Intel	Dual-Core Intel® Xeon® processor, 3.2GHZ
1	NIC (on board)	Intel	Intel PRO/1000

Hard Disk

1GB free disk space on Windows hosts is required for VMware Server and VMware Server Console installation.

NOTE:

At least 4GB free disk space recommended for each guest operating system and the application software used with it; using default setup, the actual disk space needs are approximately the same as those for installing and running the guest operating system and application on a physical computer.

Memory

Our tests show that running a virtual machine with less than 256MB RAM may induce instability issues or degradation of performance. Therefore, we recommend for each virtual machine, you configure at least 256MB RAM. With a total system memory of 2GB you can run 4-6 virtual machines without running out of memory.

Software Configuration and Recommendation

Below is a list of software Intel used to setup its lab environment.

Qty	Item	Manf	Model
1	VMware Server	VMware	1.0 beta
1	Window Server 2003 Enterprise X64 Edition R2/SP1	Microsoft	Host OS
1	Windows XP Pro	Microsoft	Guest OS
1	Browser – Internet Explorer*/Firefox*	Microsoft/Mozilla*	IE 6.0 or higher/Firefox 1.0 or higher
1	Perl (Optional)		5.005x or higher

It is recommended that a Windows server operating system be used as the host operating system. You need a Windows server operating system for the host. If you intend to use the VMware Management Interface, Internet Information Server* (IIS) 5.0 or 6.0 must be installed.

Guest Operating System

The following guest operating systems were tested and validated on the configuration described in the section above and has been installed as virtual machines.

- Windows NT 4.0 Server SP6a
- Ubuntu Linux 5.10
- Red Hat Desktop 4 Update 2

Remote Client

The remote client is a Windows host from which you launch the VMware Server Console or use VMware scripting APIs to remotely manage virtual machines on VMware Server host.

The Remote Client can be installed on one of the following operating systems:

- Windows Server 2003 Enterprise x64 Edition
- Windows XP Professional
- Windows XP Home Edition

The VMware Management Interface requires one of the following browsers:

- Internet Explorer 6.0 (6.0 highly recommended)
- Mozilla Firefox 1.0 or higher

Installing Software

The following sections describe how to install VMware Server on Windows host system:

- Installing VMware Server on a Windows Host
- Installing VMware Server Console
- Uninstalling VMware Server

Installing VMware Server on a Windows Host

Before You Begin

To install the VMware Server, you need

- A network adapter that is installed and configured properly.
- A server and host operating system that meet the system requirements for running VMware Server. See Hardware Configuration and Recommendation, and Software Configuration and Recommendation sections under Bill of Materials.
- (Optional) A remote management client and operating system that meet the system requirements for running the VMware Server remote management software. See Remote Client Requirements section.
- The VMware Server installation software.
- Your VMware Server serial number. The serial number is included in the email message you received from VMware.
- The installation media for your guest operating system.
- If you plan to use the VMware Management Interface, you must make sure Internet Information Services (IIS) 5.0 or 6.0 is installed and configured properly.

Performing the Installation Using the Interactive Method

1. Log on to your Windows host as the Administrator user.
2. Start the VMware Server master installer by double clicking on the downloaded VMware Server installer file(the name is similar to VMware-server-installer-e.x.p-<xxxxx>.exe, where <xxxxx> is a series of numbers representing the version and build numbers).

The master installer starts.



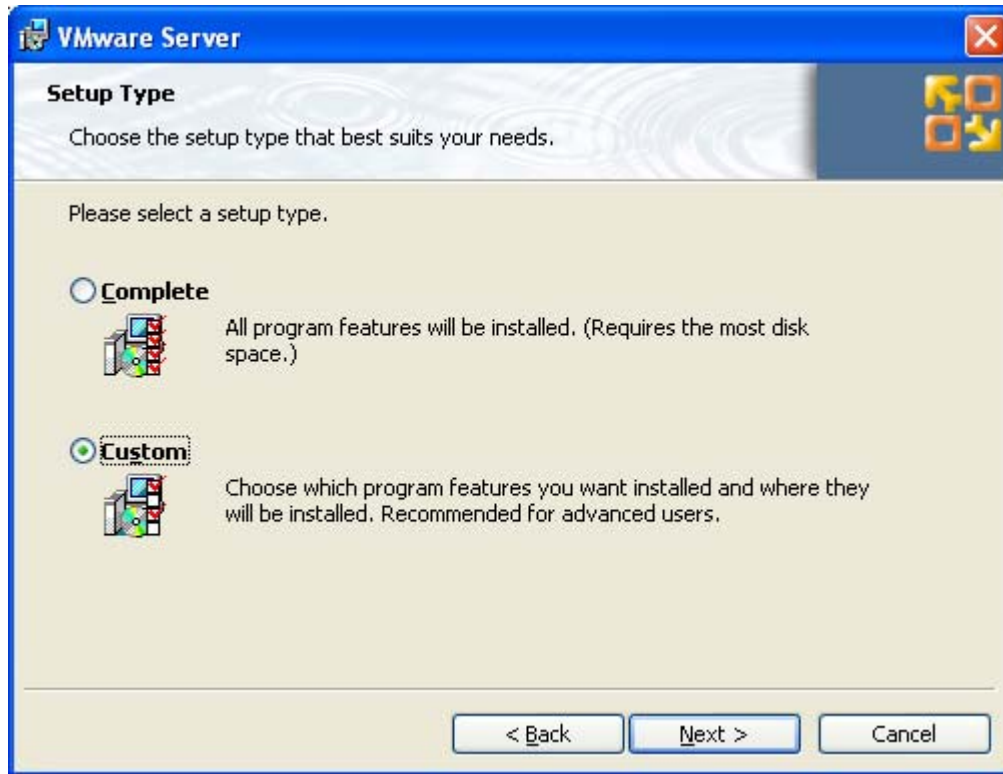
Click **Next**.

3. Accept the end user license agreement (EULA).



Select **I accept the terms in the license agreement** option, then click **Next**.

4. Choose whether you want to perform a complete or a custom installation.

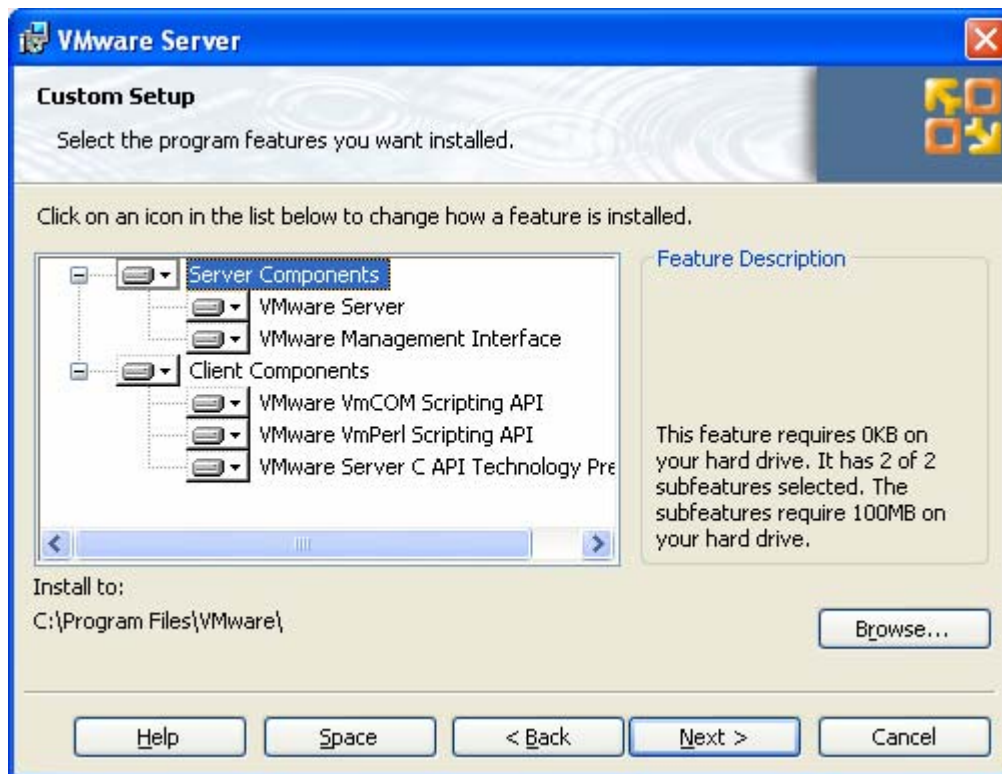


Complete Installation

A complete installation installs the server software, the VMware Management Interface, the VMware Server Console, the VmCOM API, the VmPerl API, and the Server C Preview API on the VMware Server host. To choose the complete installation, select Complete, then click **Next**.

Custom Installation

A custom installation lets you pick and choose which components to install. Select Custom and click **Next**. The Custom Setup screen appears, as is illustrated below.



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

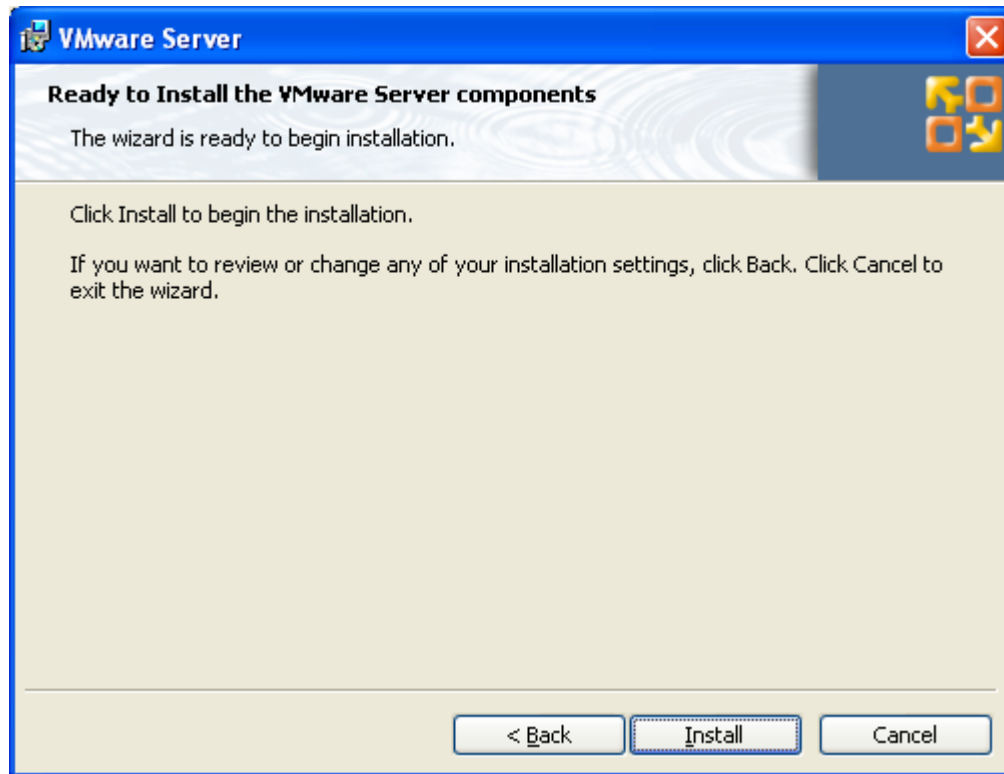
If you want to install all the VMware Server components in a different directory other than the default, click **Browse** and select the directory.

CAUTION:

VMware Server must be installed on a local drive, not a network drive.

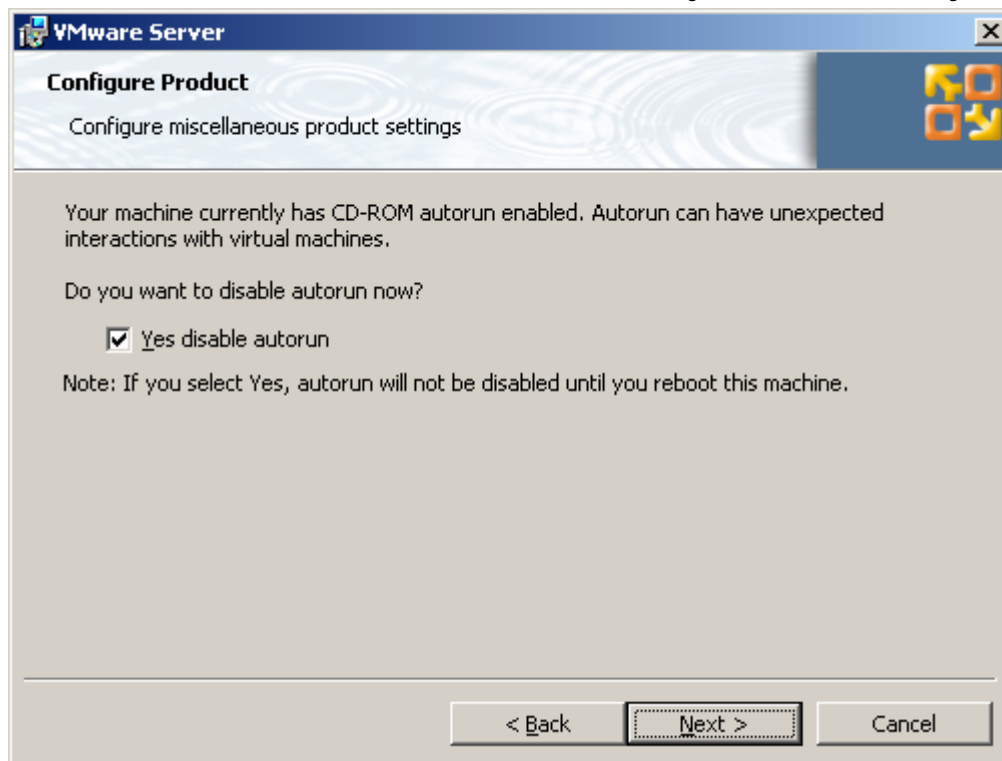
When you are ready to continue, click **Next**.

5. If you want to change any settings or information you provided, click **Back** until you reach the screen containing the information you want to change.



Otherwise, click **Install** to continue.

6. If the installer detects the CD-ROM autorun is enabled, you will see a message that gives you the option to disable this feature. Disabling it (recommended) prevents undesirable interactions with the virtual machines you install on this system.

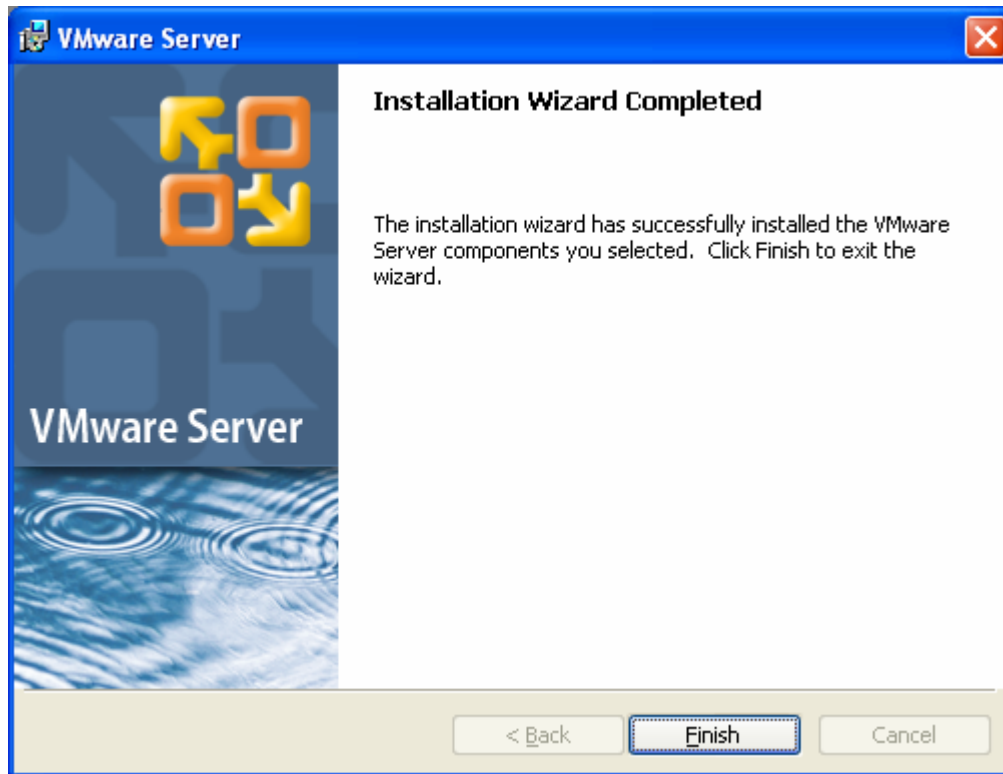


Click **Next** to continue.

If you do not have Microsoft Internet Information Server (IIS) installed, you will see a message telling you that VMware Management Interface requires IIS. Ignore the message if you do not plan to use the Management Interface; otherwise cancel the installation, install the Internet Information Server first, then restart the VMware Server installation.

7. Two shortcuts are created on your Windows Desktop automatically.

8. Click **Finish** to complete the installation. Now the VMware Server software is installed on your Windows host.



Installing the VMware Server Console on a Remote Windows Client

1. After you download the console installation package, go to the directory where you downloaded the installer and extract VMware-console-e.x.p-<xxxxx>.exe from VMware-server-win32-client-e.x.p-<xxxxx>.zip, where <xxxxx> is a series of numbers representing the version and build numbers. The installer window appears. Click **Next**.
2. Accept the end user license agreement (EULA).
Select **I accept the terms in the license agreement**, then click **Next**.
3. Choose the directory in which to install the console. Click **Next**.
4. Click **Install**. The installer begins to copy files to your computer.
5. When setup completes, click **Finish**.

Successful Installation Indicator

There are several things that indicate that VMware software is installed successfully.

- When the VMware install is completed, there is a Finish page to indicate successful installation.
- There is a VMware directory under Program Files (x86) if the user accepted default directory; otherwise it is in the directory the user specified.
- Two Desktop icons created after the installation is completed successfully, one is for VMware Server Console, the other one is for VMware Virtual Machine Console.
- Click on **Start -> All Programs->VMware->VMware Server** and you should be able to launch VMware Server Console.
- You should be able to double click on the VMware Server Console icon (shown below) on the desktop to launch VMware Server to create a virtual machine.



- Click on **Start-> Control Panel->Administrative Tools->Services**. Confirm that the following services are running on Windows Server 2003:
 - VMware Authorization Service
 - VMware DHCP Service
 - VMware NAT Service
 - VMware Registration Service

Configuration

Enable Virtualization in BIOS

1. Reboot the system
2. Press **F2** to enter the BIOS.
3. Select **Advanced** then highlight **Processor** and press **Enter**.
4. Highlight **Virtualization Technology** option and press **Enter**.
5. Select **Enabled** from the menu option and press **Enter**.
6. Press **F10** and select **Yes** when prompted to save the changes and exit.

Creating a New Virtual Machine

There are two steps involved in creating a new virtual machine:

1. Setting up a new virtual machine environment.
2. Installing a guest operating system.

NOTE:

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

Creating a New Virtual Machine with the New Virtual Machine Wizard

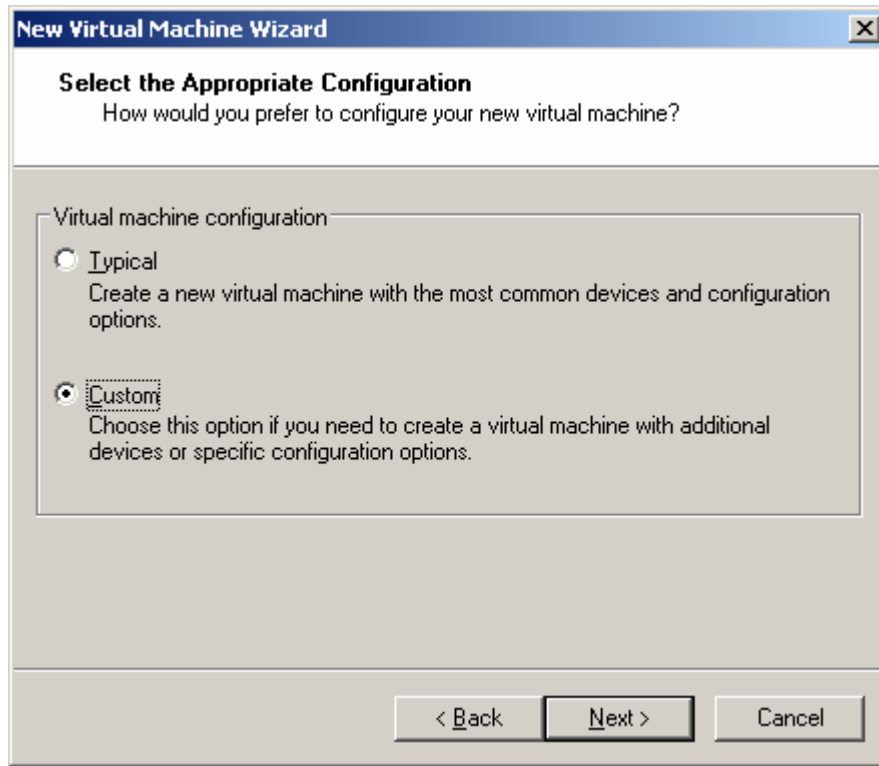
Follow the steps below to create a new virtual machine.

1. Launch the VMware Server Console by clicking on the Desktop shortcut.
2. Start the New Virtual Machine Wizard. Choose **File-> New Virtual Machine** or click the New Virtual Machine icon on the console Home tab.



Click **Next** to continue.

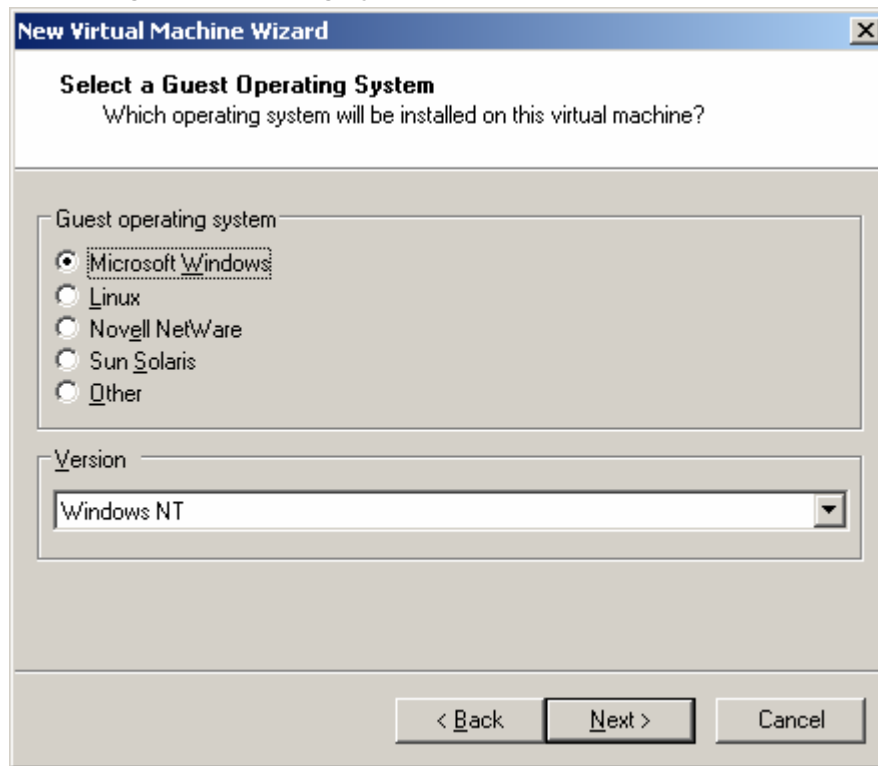
3. Select the method to use for configuring your virtual machine.



Select **Custom** to:

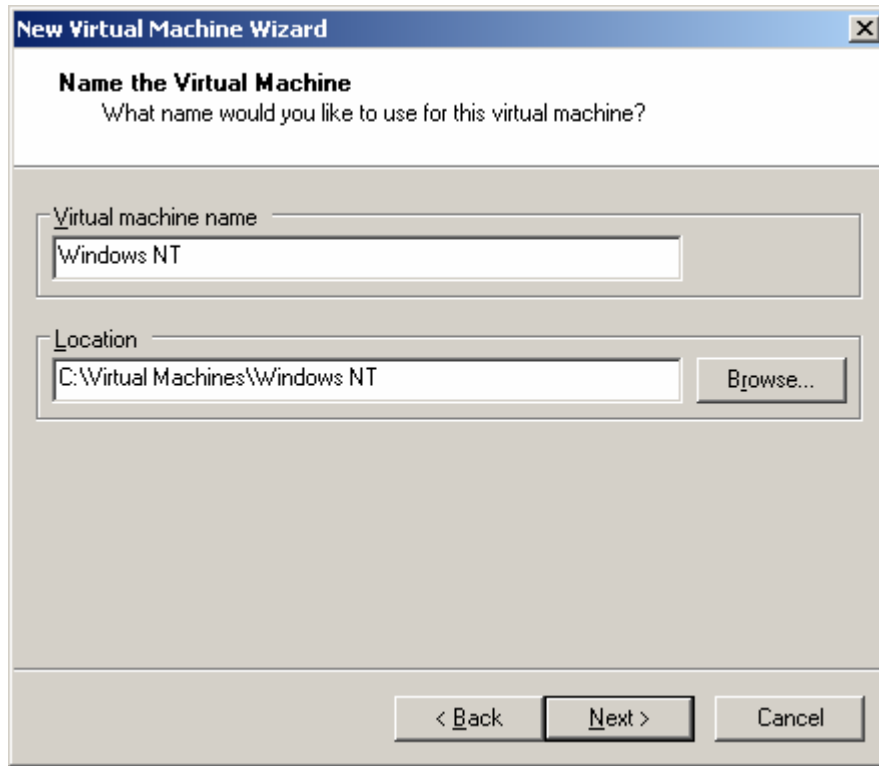
- Set the number of processors, which is required to enable two-way virtual SMP.
- Allocate an amount of memory different from the default
- Choose between the LSI Logic and BusLogic types of SCSI adapters
- Let other users access the virtual machine
- And additional actions

4. Select a guest operating system.



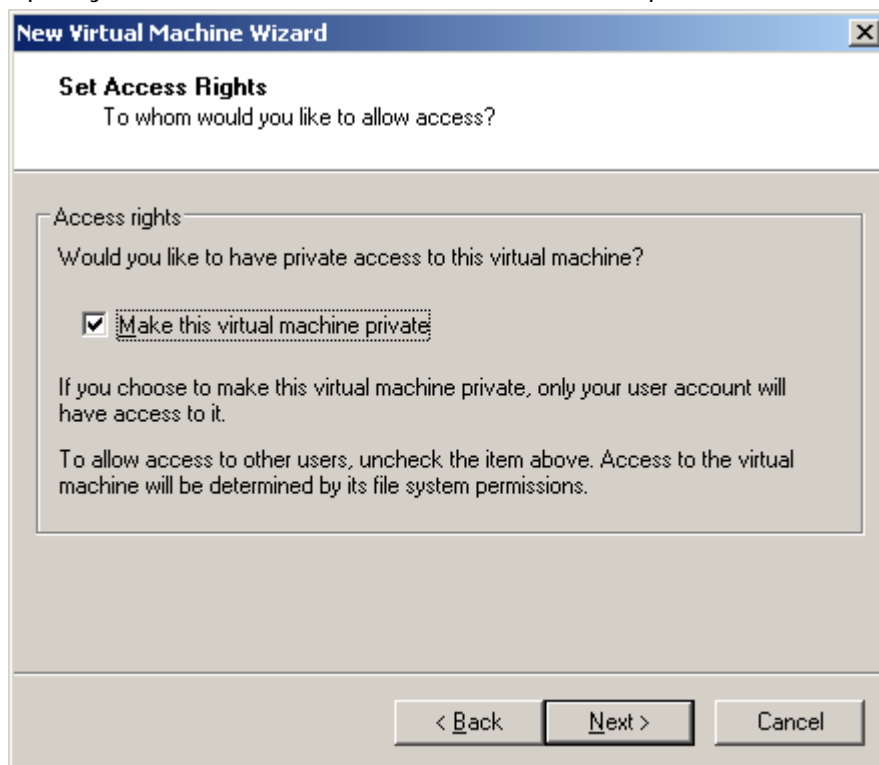
This screen asks which operating system you plan to install in the virtual machine. If the operating system you are using is not listed, select **Other**. Then select **Other** again in the Version list.

5. Select a name and directory for the virtual machine.



The virtual machine directory and its files are stored in a default location
<installdrive>:\Virtual Machines

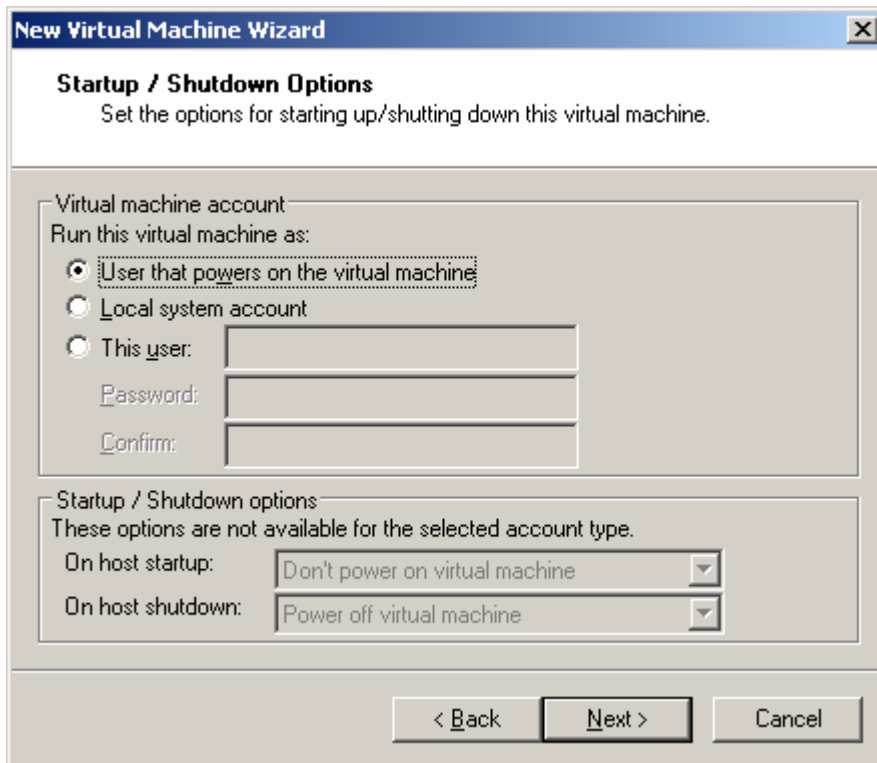
6. Specify whether this virtual machine should be private.



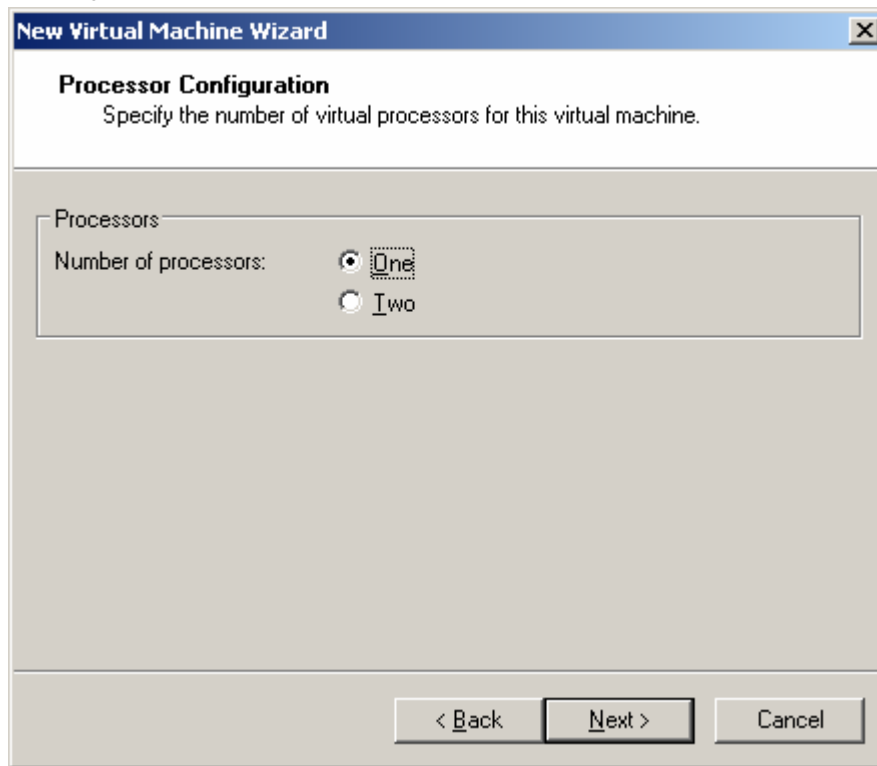
By default, the virtual machine is private. It facilitates the virtual machine provisioning on the host.

You can change access to this virtual machine in the virtual machine settings editor (choose **VM->Settings->Options->Permissions**).

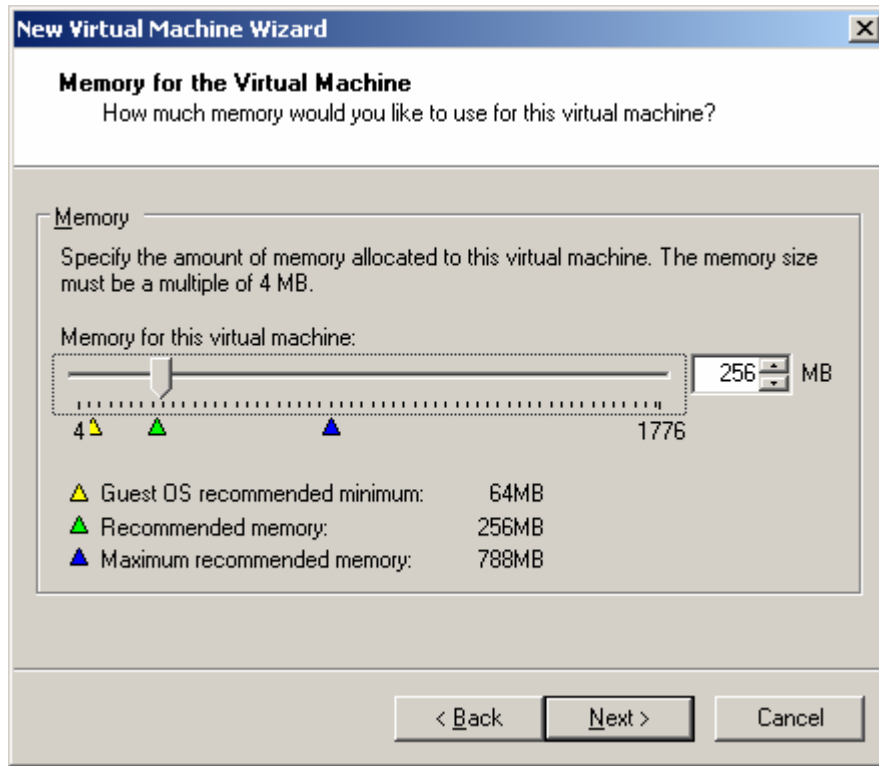
7. Choose the user account for running the virtual machine and the host startup and shutdown options



- Specify the number of processors for the virtual machine.



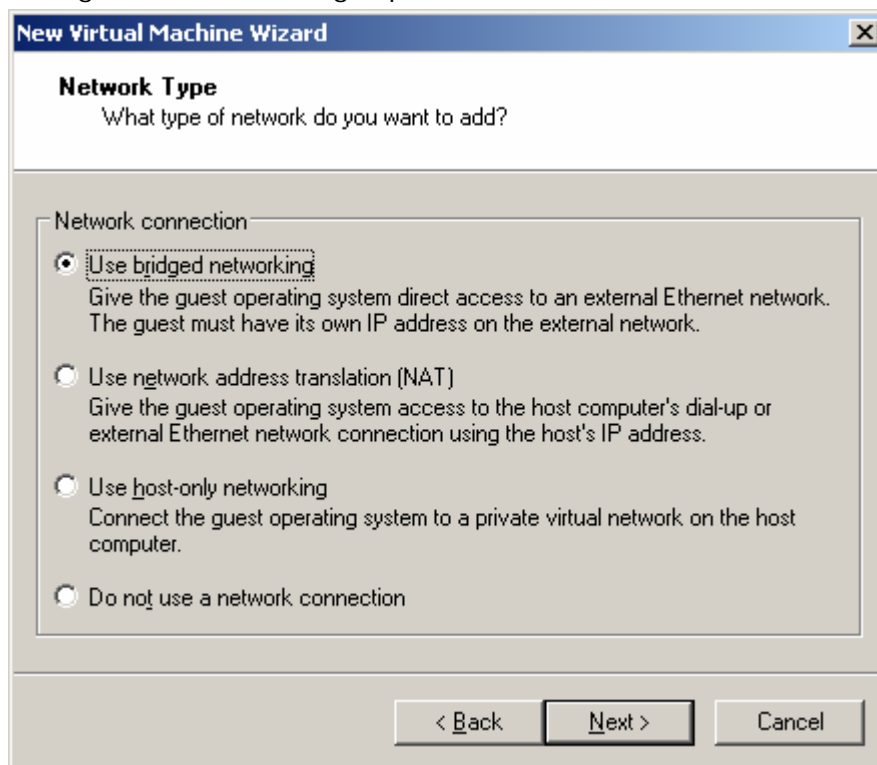
9. Allocate an amount of memory to the virtual machine



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.

10. Configure the networking capabilities of the virtual machine

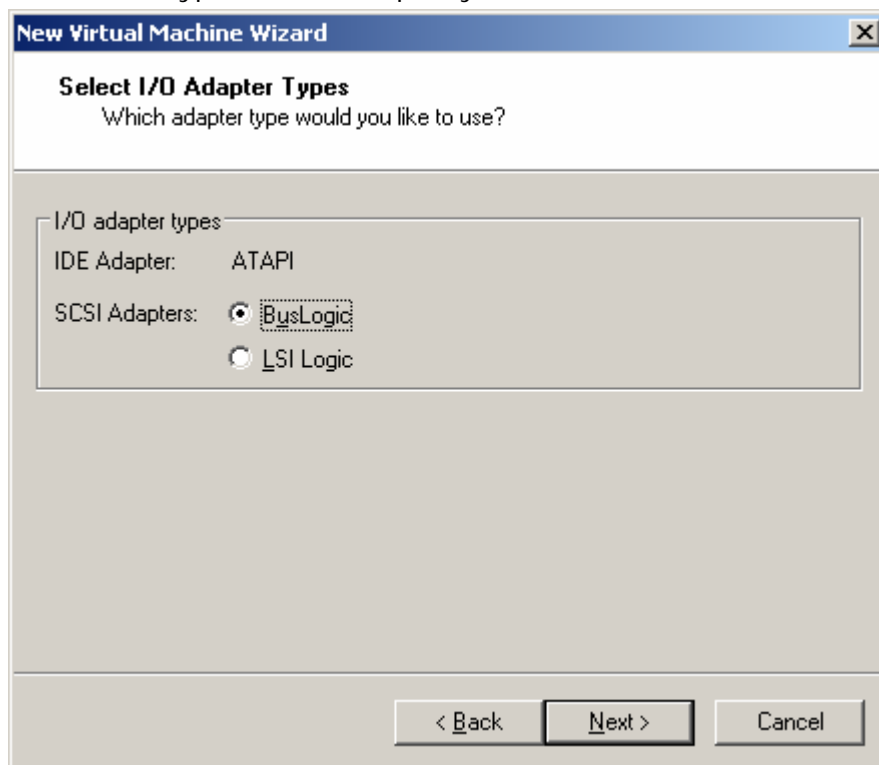


Bridged Networking – If your host is on a network and you have a separate IP address for your virtual machine (or get an IP address through DHCP), use Bridged Networking. You gain direct access to an external network.

NAT – If you do not have a separate IP address for your virtual machine, use the NAT option. The guest operating system accesses the host computer's external network connection using the host's IP address.

Host-only networking – Connect the guest operating system to a private virtual network on the host machine. The host acts like a firewall for the guest operating system.

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

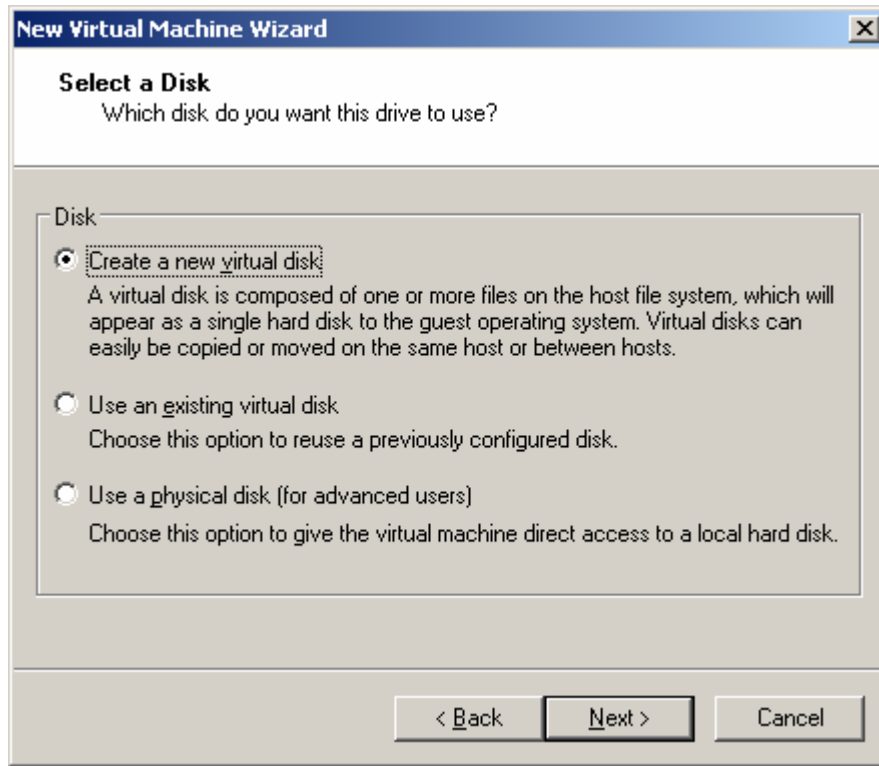


Since most guest operating systems do not include a driver for LSI Logic adapter, you must download the driver from LSI Logic web site.

Most guest operating systems default to BusLogic.

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

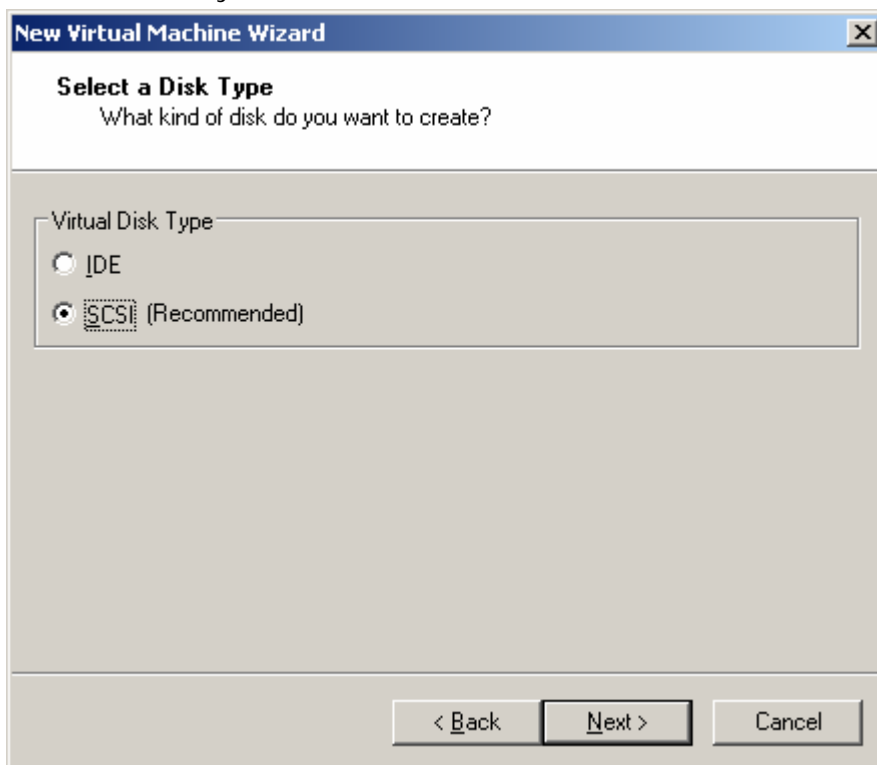
12. Select the disk to use with the virtual machine.



CAUTION:

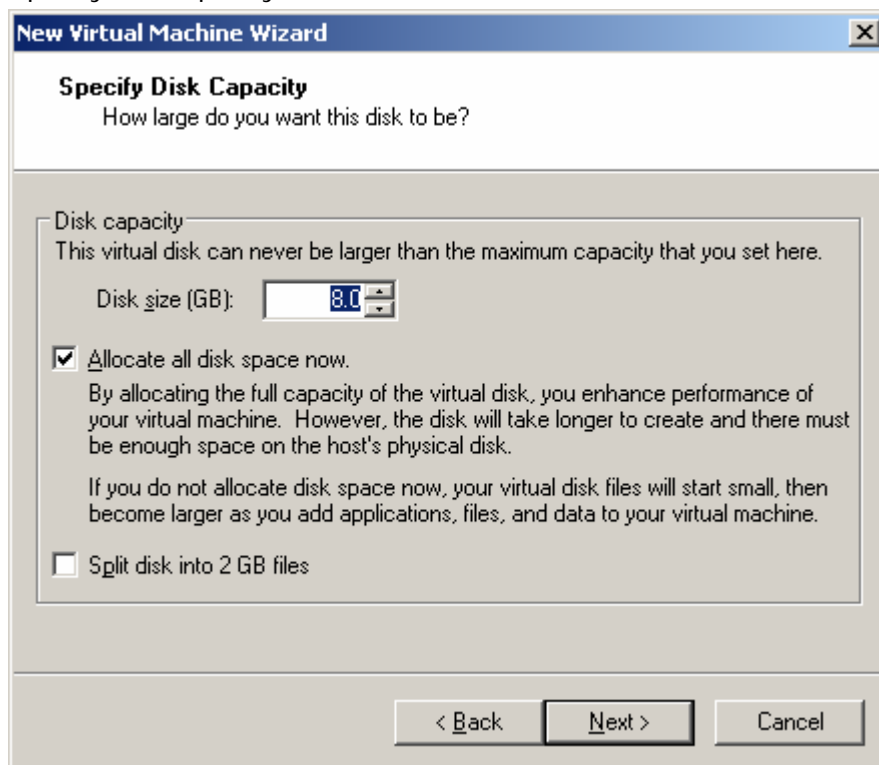
VMware recommends that only advanced users use physical disks with virtual machines.

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



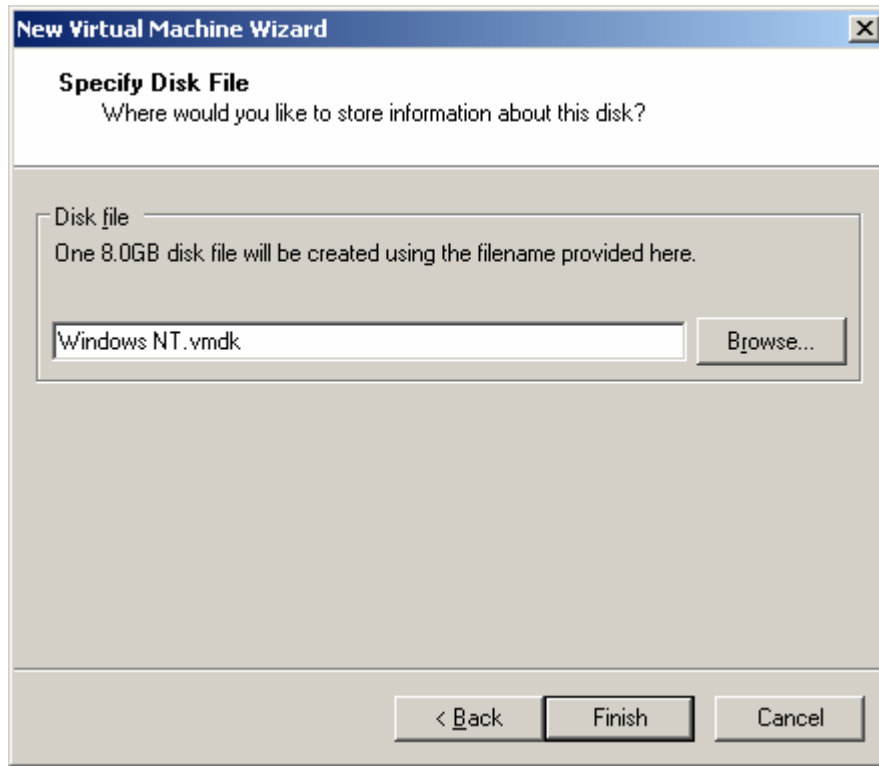
The installation wizard recommends the better virtual disk type based on the guest operating system you selected.

14. Specify the capacity of the virtual disk.



If you selected Typical as your configuration path as it is shown in Step 3 and you have set the disk options you want to use, click Finish. VMware Server creates the virtual machine. If you selected Custom as your configuration path, continue to the next step.

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



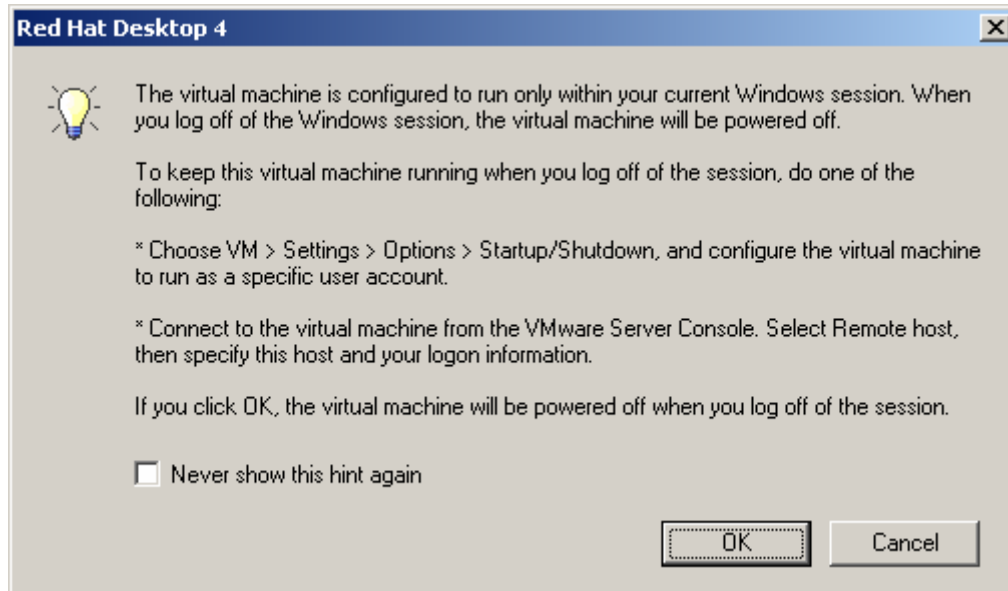
Click **Finish**. VMware Server creates the virtual machine.

Installing a Guest Operating System

Installing a guest operating system inside the 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 from the Desktop.
2. Insert the installation media for the guest operating system.
3. Power on the virtual machine by clicking on the Power On button or Start Virtual Machine.

4. If you chose “**User that powers on the virtual machine**” in step 7 above of Creating a New Virtual Machine, a dialog pops up when you start a new virtual machine.



Click **OK** to continue.

5. Follow the instructions provided by the operating system vendor to complete the guest operating system installation. Intel has tested the following guest operating systems on Windows Server 2003:
 - Microsoft Windows NT 4.0 Server
 - Ubuntu 5.10 Linux
 - Red Hat Desktop 4 update 2

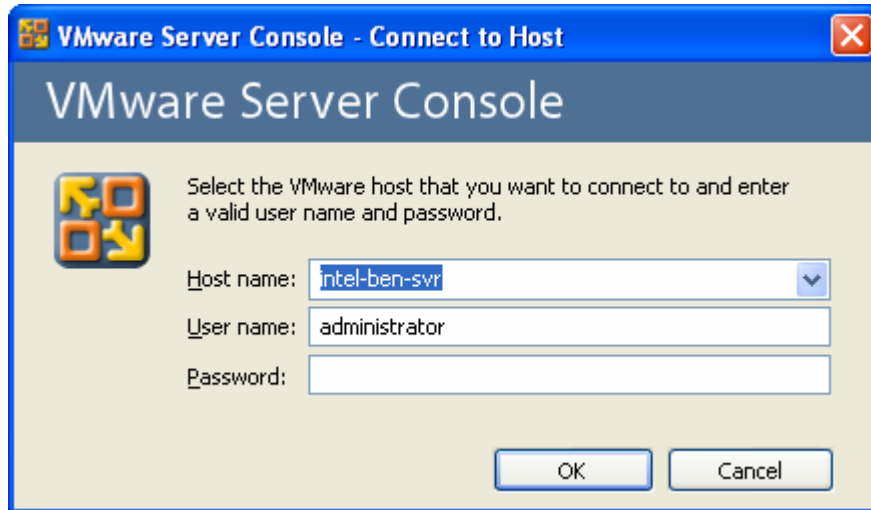
Launch of VMware Server Console Remotely

Steps to launch VMware Server Console from a Windows client machine:

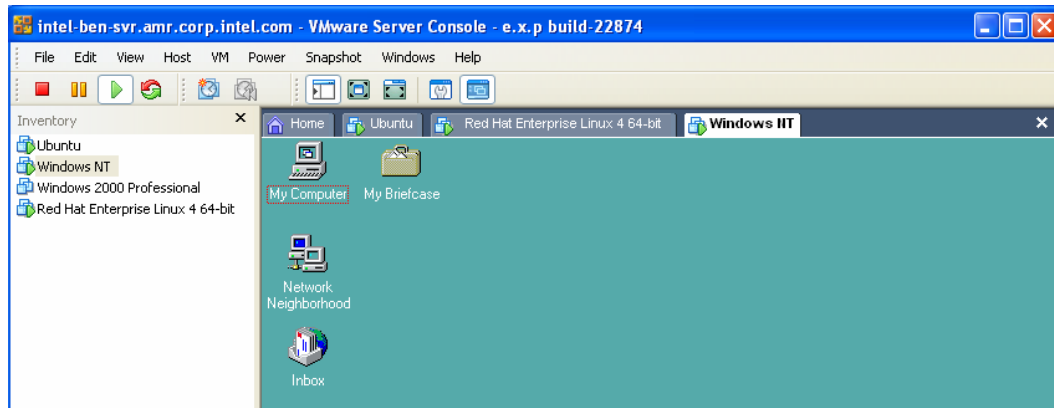
1. Double click the VMware Server Console icon on Windows Desktop.



2. In the login windows, enter the VMware Server host name and administrator's user name and password, then click **OK** to continue.



3. You should see the VMware Server Console just like you see it on the Windows Server 2003.



Troubleshooting and Known Issues

This section provides some troubleshooting and known issues from VMware release notes. For more information, please refer to:

<http://www.vmware.com/products/vmtm/faqs.html>

Opening a .vmx file from VMware Management Interface might fail to launch the VMware Server Console for the virtual machine.

In this release, the VMware Management Interface sometimes fails to launch the VMware Server Console when you attempt to open an .vmx file. To work around this issue, download and open the .vmx file in a text editor and add the -c option to the file. For example, add -c to a file as follows: -h 196.168.25 -P 904 -u root -c

You should now be able to launch the VMware Server Console for the virtual machine from the VMware Management Interface.

Do not edit legacy virtual machine on a network drive using VMware Server Console on a remote client.

In this release, you cannot edit a legacy virtual machine located on a network drive using the VMware Server Console from a remote client. To work around this issue, use a remote desktop (RDP) client to connect to the host and use the VMware Server Console on the local host to edit the legacy virtual machines.

VMware Server Console does not display *.flp or *.img files when editing virtual machine floppy disk.

In this release, the VMware Server Console does not display *.flp files when you go to VM > Settings > Hardware > Floppy, and then select Use Floppy Image and click Browse. If you select Floppy Images (*.flp, *.img) for Files of Type, *.flp and *.img files are not displayed even if such file types are available. To work around this issue, select All Files (*.*) for Files of Type to display *.flp and *.img files.

Do not enable auto-connect option on virtual machine USB device.

In this release, if you enable the Automatically connect new USB device to the virtual machine when it focus option, the USB device fails to connect to the guest operating system. To work around this issue, in the VMware Server Console, go to VM > Settings > Hardware > and click the link for USB Controller. Uncheck the Automatically connect new USB device to the virtual machine when it has focus check box.

VMware Management Interface might display message repeatedly.

In this release, when you go to Options > Virtual Machine Startup and Shutdown, you might immediately see a message notifying you that the virtual machine startup sequence has changed. The message might reappear each time the management

interface updates that page. The message does not indicate a problem with your configuration.

Do not mix components of VMware Server and VMware ESX Server.

You cannot use the VMware Virtual Machine Console from VMware ESX Server to connect to a VMware Server host, or the VMware Server Console to connect to an ESX Server host.

Sound driver needed for 64-bit Windows guest operating systems.

With this release, if you want to use sound in a 64-bit Windows guest operating system, you must use the driver available on the VMware Web site at www.vmware.com/download/ws/#drivers under VMAudio Driver (experimental).

VMware Management Interface log on might fail on some 64-bit Windows Server 2003 hosts.

If you are running VMware Server on a 64-bit Windows Server 2003 host, you might not be able to log on to the VMware Management Interface. This appears to be a rare problem. If you encounter it, please file a support request and include the output from the vm-support script.

Installing standalone GSX Virtual Machine Console on Windows host or client causes the VMware Server Console icon to disappear.

In this release, if you install a GSX Virtual Machine Console on a Windows host or client desktop that has VMware Server Console installed, the icon for VMware Server Console disappears. Only the icon for the GSX Virtual Machine Console appears on the desktop. To work around this issue, go to Start > Programs > VMware > VMware Server to start the VMware Server Console.

Creation of a new folder on a remote host might fail without warning.

In this release, if you attempt to create a new folder on a remote Linux host from the VMware Server Console using File > Open virtual machine > Browse > New Folder, the new folder might not be created. To work around the problem, create the new folder directly on the host computer.

Some command line switches do not work correctly.

Some command line switches do not work correctly in this release. You should not use the -q or -X switch with this release.

Full-screen mode not available; use quick-switch mode instead.

In this release, the full-screen mode feature in the VMware Server Console is not functioning properly. Use quick switch to have the virtual machine's screen fill the screen completely. The only difference from full-mode is that quick-switch mode includes tabs at the top of the screen for switching from one active virtual machine to another. To activate quick switch, go to View > Quick Switch.

Two steps needed to switch between host and client DVD/CD-ROM drives.

In this release, to switch the virtual machine's DVD/CD-ROM drive from using the host's drive to using a client's drive, or vice versa, you must edit the settings twice. First, make the change from host to client or client to host and save the settings. Then return to the virtual machine settings editor to select the specific drive to use.

Mouse cursor got stuck inside of the boundaries of virtual machine

When mouse cursor is inside the virtual machine boundary, if you click the mouse button or press a key, that activates the mouse within that virtual machine. To get out of that state, press Ctrl-Alt then move the mouse out.

When my cursor is "out" (so pressing Enter, there is message, something like "VMware Tools are not installed". What's that message?

This is due to that there are some VMware tools if installed can facilitate keyboard or mouse movement. After the VMware tools is installed, this message will disappear.

Usage Models

Server Consolidation

- Partitioning of the physical machine for flexible server consolidation and hardware cost savings.
- Multiple applications and operating system can be supported in a single physical machine.
- Server can be consolidation into single machine, Windows, Linux, legacy OSs can co-exist on one machine.

Here are some examples of server consolidation:

- We first installed a Microsoft* Windows* Exchange server and configured and made it running on a Windows Server 2003 system, and
- Then we created a virtual machine and use Red Hat* Desktop 4 Update 2 as the guest operating system. We then installed an Apache web server and made it run on the virtual machine.

Improved Performance with Intel® Virtualization Technology

Both applications are running on the same server. You don't need two machines with virtualization as you normally do.

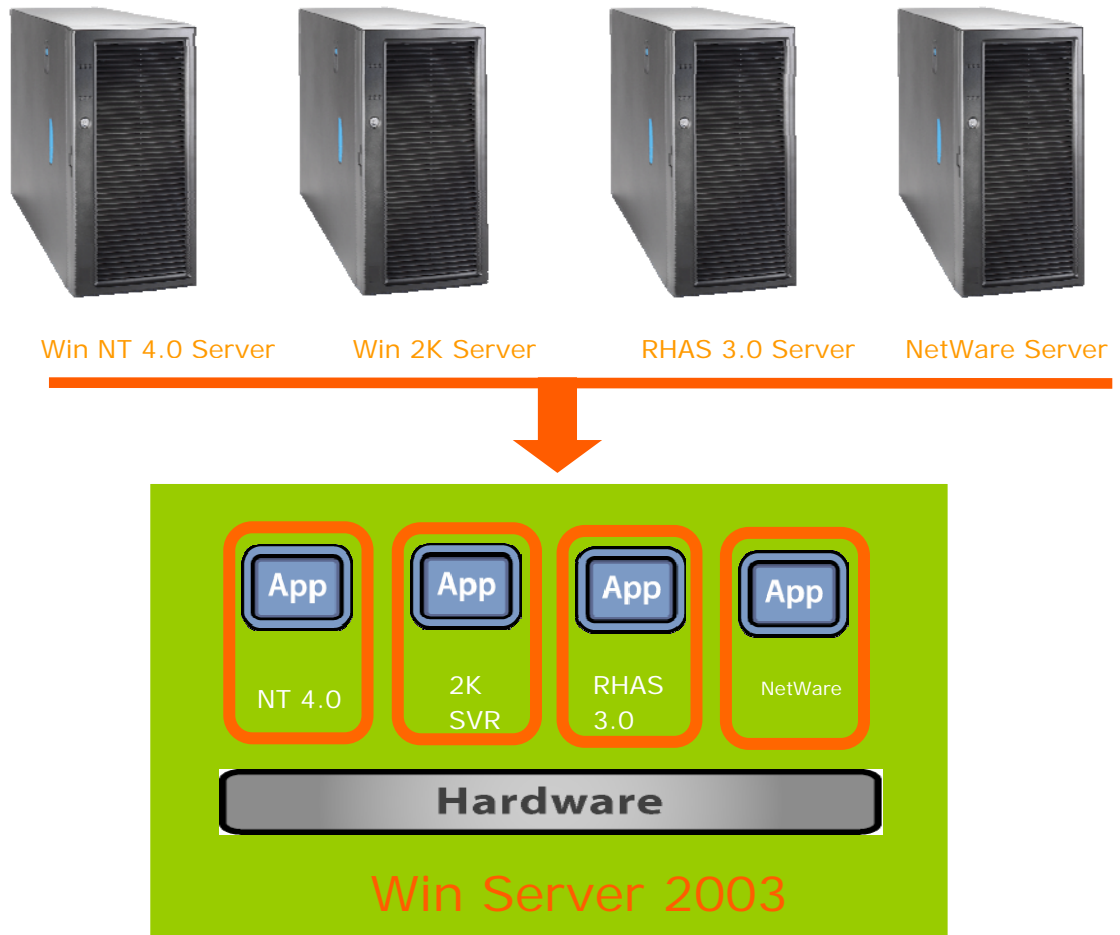
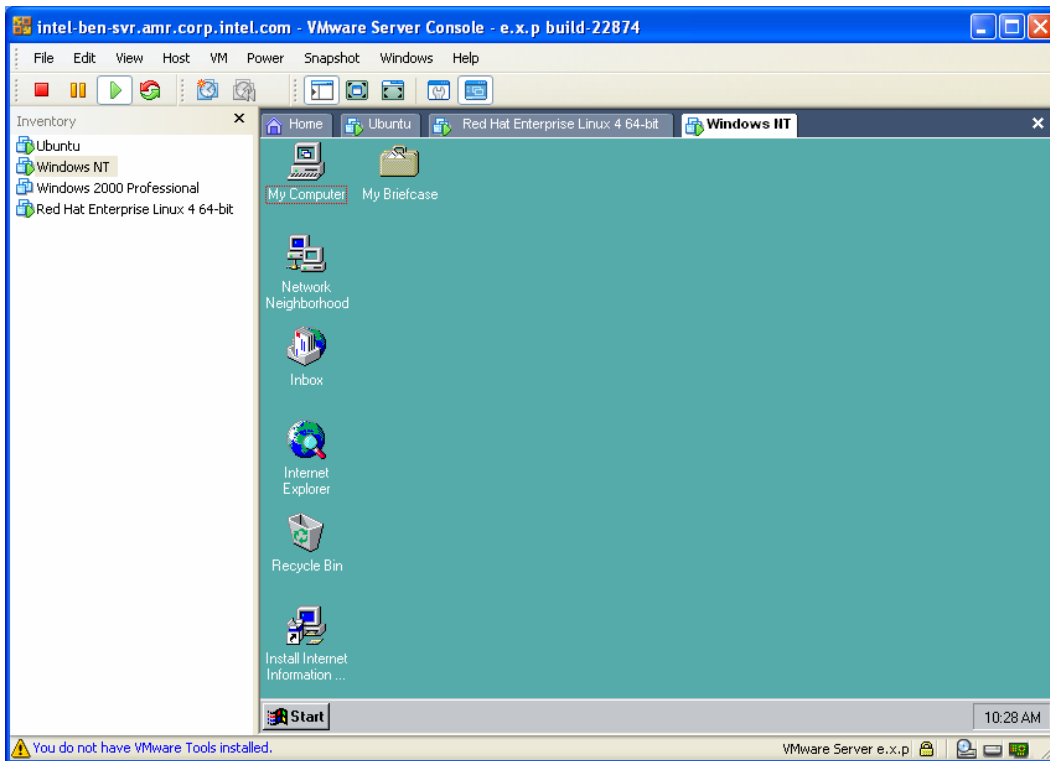
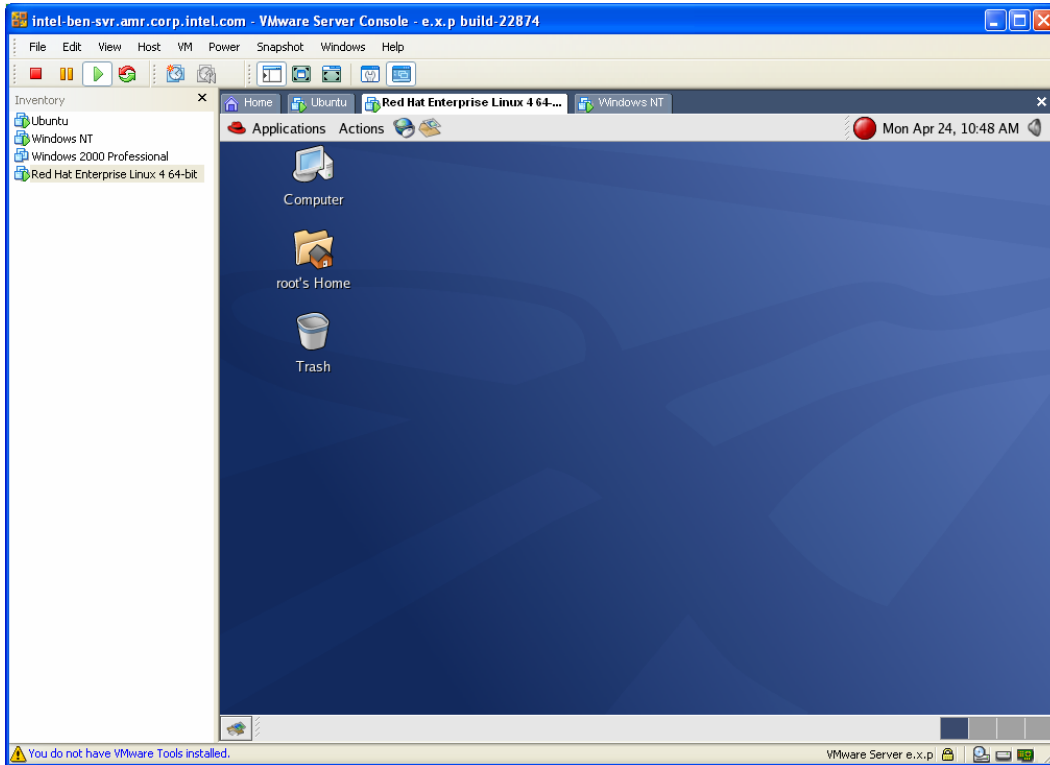


Figure 2: Example of Server Consolidation

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The following are some screenshots of virtual machines running different guest operating systems.



Legacy Application Support

Below is an example we used in our lab to demonstrate how legacy application can be support by virtualization.

We have a legacy Windows application which requires link with a 16 bit library on Windows NT 4.0.

We first created a virtual machine and installed Windows NT 4.0 as the guest OS. We then installed Visual Studio 1.52 which supports building of Windows application in 16 bit environment.

After we installed Visual Studio 1.52 IDE, we could rebuild the legacy Windows application.

Safe Testing Environment

Here is another usage model that demonstrate how you can use virtualization to speed up your development and testing.

- System Isolation provides enhanced availability and security
- Virtual machines are completely isolated from the host system and other virtual machines. If one virtual machine crashes or gets infected by virus, the user can simply remove that virtual machine and create a new one. It won't affect the host system or other virtual machines.
- Security between host machine and virtual machine, and among virtual machines are high. Data won't leak between each other. They communicate through established network channel.

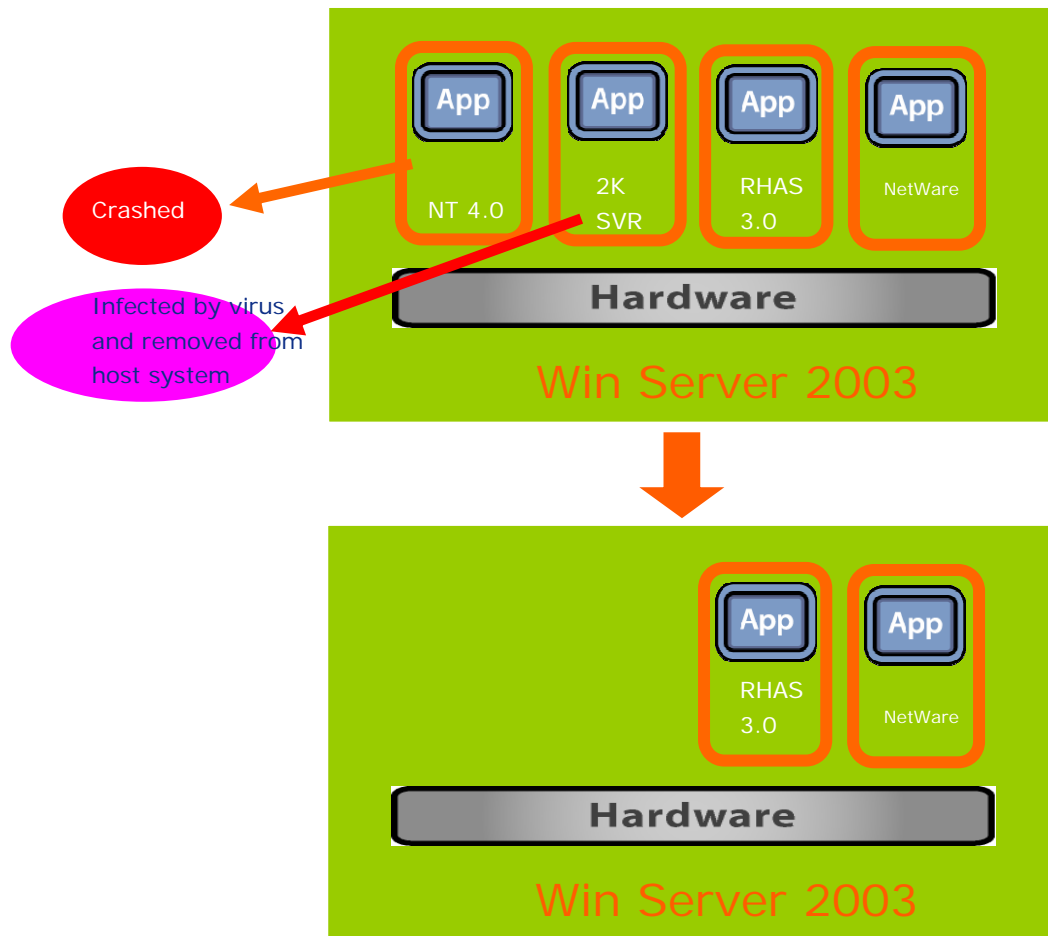


Figure 3: Example of one VM crashed, another infected with virus and removed from the host system

Solution Support

Intel has thoroughly tested and verified the components in this deployment guide. Please continue to use your existing [Intel® Support Services](http://www.intel.com/go/Channel/Support) (<http://www.intel.com/go/Channel/Support>) for information on Intel®-based hardware, including Intel® Processors, Intel® Desktop and Server Boards, and associated drivers.

For your convenience, Intel has worked with the following independent software vendors, open source vendors, and application vendors to streamline technical support for this solution. For more information on the third-party software products, please visit the following links.

Company	Link
VMware	www.vmware.com/support