chapter 30

Virtualization

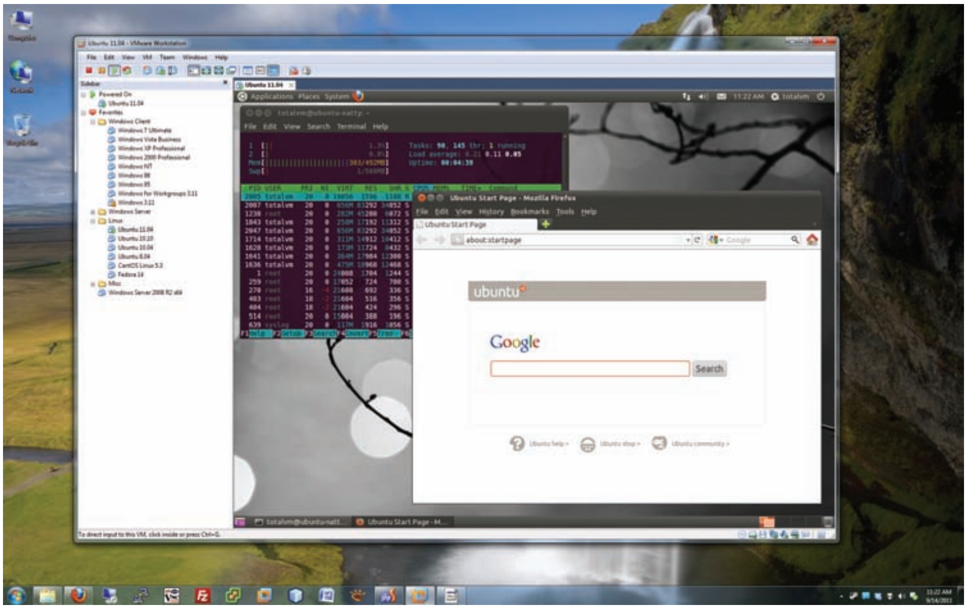
On virtualization: "Once the world figures this stuff out, this is going to be a huge change to the corporate landscape."

—Jeff Birnbaum, Merrill Lynch

In this chapter, you will learn how to

- **Describe the concepts of virtualization**
- **Explain why PC and network administrators have widely adopted virtualization**
- **Describe how virtualization manifests in modern networks**

Virtualization takes your everyday notion of computing and turns it on its head. Left becomes right. Red becomes blue. Physical computers become virtual computers. It might sound complicated—properly configuring a real computer is hard enough—but once you see it in action, it makes perfect sense. In the simplest terms, *virtualization* is the process of using special software—a class of programs called *hypervisors* or *virtual machine managers*—to create a complete environment in which a guest operating system can function as though it were installed on its own computer. That guest environment is called a **virtual machine (VM)**. You learned about one very important virtual machine back in Chapter 19 called Windows XP Mode, which uses a program called Windows Virtual PC to run a virtual Windows XP operating system in Windows 7. Figure 30.1 shows another example: a system running Windows 7 using a program called VMware Workstation to host a virtual machine running Ubuntu Linux.


Ubuntu 11.04 - VMware Workstation
File Edit View VM Team Windows Help
Applications Places System
File Edit View Search Terminal Help
Ubuntu Start Page - Mozilla Firefox
File Edit View History Bookmarks Tools Help
about:startpage
ubuntu
Google
Search

• **Figure 30.1** VMware running Linux

This chapter begins by explaining the ideas behind virtualization. The chapter then explores the motivating factors behind the widespread adoption of virtualization throughout the IT industry. The chapter concludes with an in-depth look at how modern networks implement virtualization. Some of the details presented here go beyond the CompTIA A+ 220-802 exam, but I include them to help you understand the scope and power of virtualization.

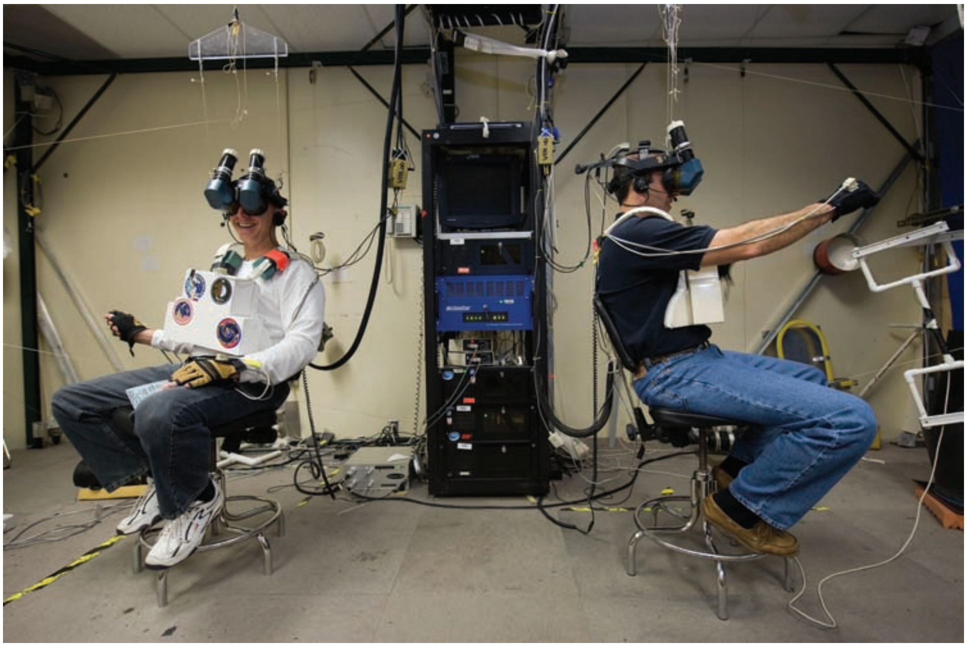
Historical/Conceptual

What Is Virtualization?

Ask 100 people what the term *virtual* means and you'll get a lot of different answers. Most people define *virtual* with words like "fake" or "pretend," but these terms only begin to describe it. Let's try to zero in on virtualization using a term that you've likely heard: *virtual reality*. For most of us, the idea of virtual reality starts with someone wearing headgear and gloves, as shown in Figure 30.2.

The headgear and the gloves work together to create a simulation of a world or environment that appears to be real, even though the person wearing them is located in a room that doesn't resemble the simulated space. Inside this virtual reality, you can see the world by turning your head, just as you do in the real world. Software works with the headset's inputs to emulate a physical world. At the same time, the gloves enable you to touch and move objects in the virtual world.

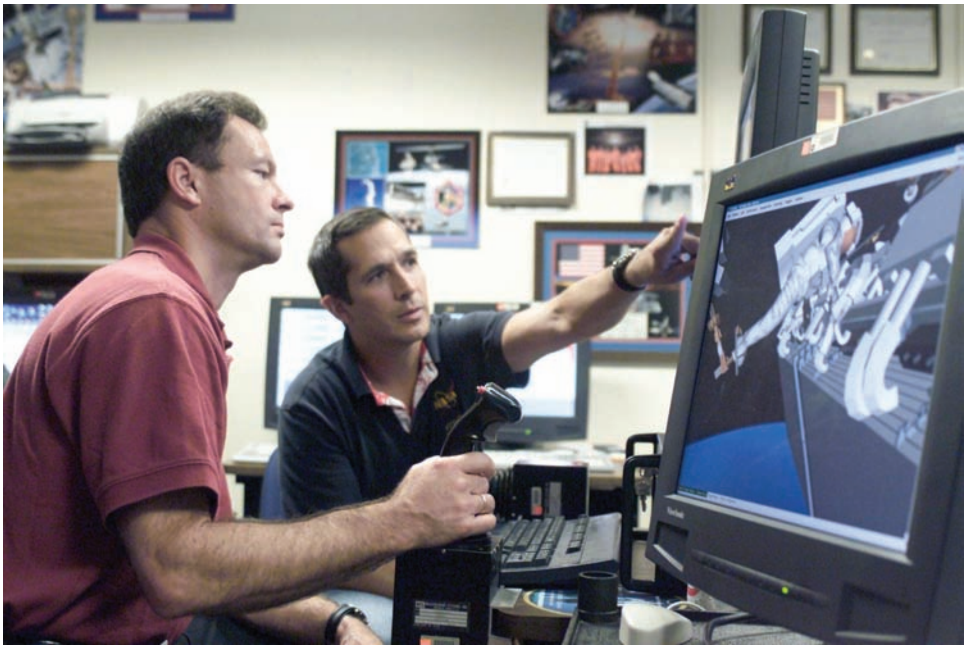
To make virtual reality effective, the hardware and software need to work together to create an environment convincing enough for a human



• **Figure 30.2** Virtual reality training (photo courtesy of NASA)

to work within it. Virtual reality doesn't have to be perfect—it has limitations—but it's pretty cool for teaching someone how to fly a plane or do a spacewalk, for example, without having to start with the real thing (see Figure 30.3).

Virtualization on a computer is virtually (sorry, can't pass up the pun) the same as virtual reality for humans. Just as virtual reality creates an environment that convinces humans they're in a real environment, virtualization convinces an operating system it's running on its own hardware.



• **Figure 30.3** Using virtual reality to practice spacewalking (photo courtesy of NASA)

802

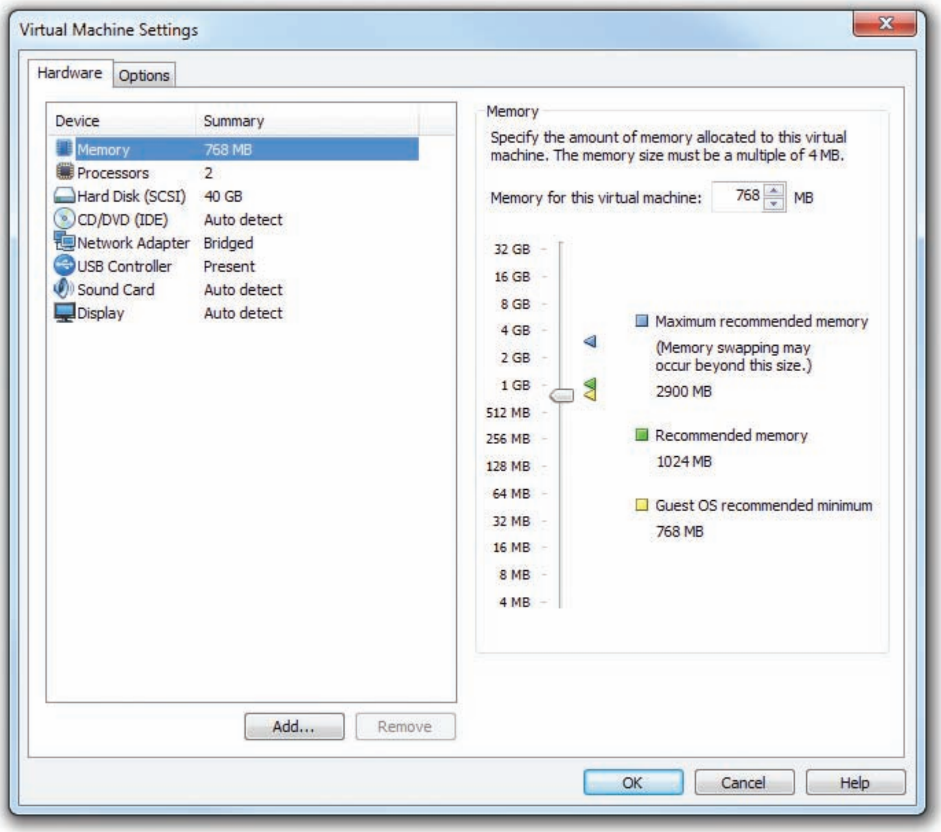
Meet the Hypervisor

A normal operating system uses programming called a *supervisor* to handle very low-level interaction among hardware and software, such as task scheduling, allotment of time and resources, and so on.

Because virtualization enables one machine—called the **host**—to run multiple operating systems simultaneously, full virtualization requires an extra layer of sophisticated programming to manage the vastly more complex interactions. One common method calls this extra programming a **hypervisor** or **virtual machine manager (VMM)**.

A hypervisor has to handle every input and output that the operating system would request of normal hardware. With a good hypervisor like VMware Workstation, you can easily add and remove virtual hard drives, virtual network cards, virtual RAM, and so on. Figure 30.4 shows the Hardware tab of the Virtual Machine Settings dialog box in VMware Workstation.

Virtualization even goes so far as to provide a virtualized BIOS and system setup utility for every virtual machine. Figure 30.5 shows VMware Workstation displaying the system setup utility, just like you'd see it on a regular computer.



Virtual Machine Settings

Hardware | Options

Device	Summary
Memory	768 MB
Processors	2
Hard Disk (SCSI)	40 GB
CD/DVD (IDE)	Auto detect
Network Adapter	Bridged
USB Controller	Present
Sound Card	Auto detect
Display	Auto detect

Memory

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

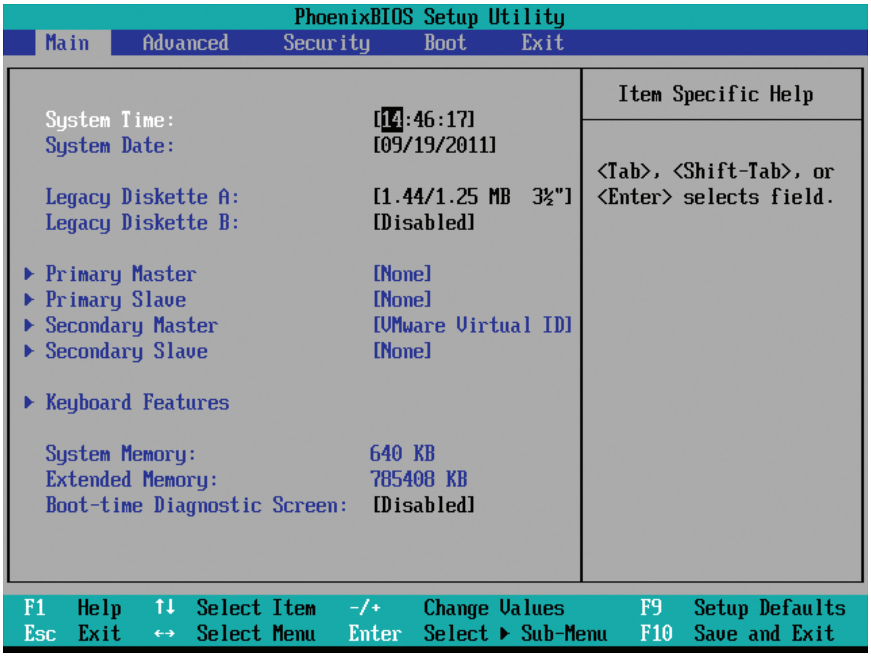
Memory for this virtual machine: 768 MB

🟦 Maximum recommended memory
(Memory swapping may occur beyond this size.)
2900 MB

🟩 Recommended memory
1024 MB

🟨 Guest OS recommended minimum
768 MB

• Figure 30.4 Configuring virtual hardware in VMware Workstation



```
                      PhoenixBIOS Setup Utility
   Main      Advanced      Security      Boot      Exit

   System Time:                [14:46:17]              Item Specific Help
   System Date:                [09/19/2011]
                                                  <Tab>, <Shift-Tab>, or
   Legacy Diskette A:          [1.44/1.25 MB  3½"]  <Enter> selects field.
   Legacy Diskette B:          [Disabled]

 ▶ Primary Master              [None]
 ▶ Primary Slave               [None]
 ▶ Secondary Master            [VMware Virtual ID]
 ▶ Secondary Slave             [None]

 ▶ Keyboard Features

   System Memory:              640 KB
   Extended Memory:            785408 KB
   Boot-time Diagnostic Screen: [Disabled]

 F1   Help  ↑↓  Select Item   -/+    Change Values      F9   Setup Defaults
 Esc  Exit  ↔   Select Menu   Enter  Select ▶ Sub-Menu  F10  Save and Exit
```

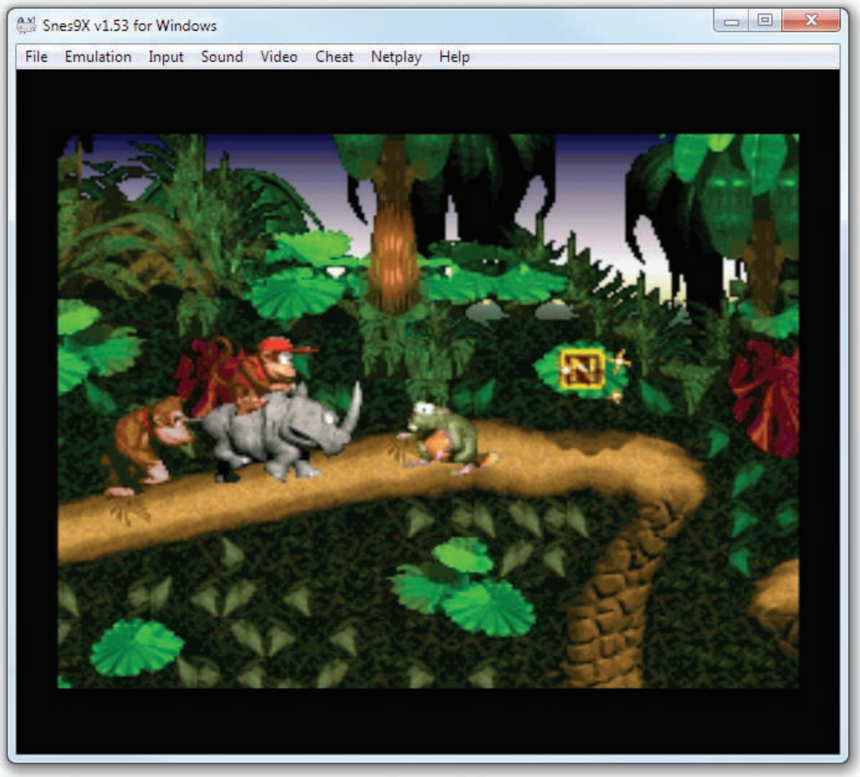
• **Figure 30.5** System setup utility in VMware Workstation

Emulation Versus Virtualization

Virtualization takes the hardware of the host system and segments it into individual virtual machines. If you have an Intel system, a hypervisor creates a virtual machine that acts exactly like the host Intel system. It cannot act like any other type of computer. For example, you cannot create on an Intel system a virtual machine that acts like a Sony PlayStation 3. Hypervisors simply pass the code from the virtual machine to the actual CPU.

Emulation is very different from virtualization. An **emulator** is software or hardware that converts the commands to and from the host machine into an entirely different platform. Figure 30.6 shows a Super Nintendo Entertainment System emulator, Snes9X, running a game called *Donkey Kong Country* on a Windows system.

While the CompTIA A+ 220-802 exam objectives include emulation as a part of virtualization, the concepts are not the same. For the sake of completeness, however, know that emulating another platform (using a PC to run Sony PlayStation 2 games, for example) requires hardware several times more powerful than the platform being emulated.



• **Figure 30.6** Super Nintendo emulator running on Windows

Sample Virtualization

You can perform virtualization in a number of ways; this chapter will show you several of them. Before I go any further, though, let's take the basic pieces you've learned about virtualization and put them together in one of its simpler forms. In this example, I'll use the popular VMware Workstation on a Windows 7 system and create a virtual machine running Ubuntu Linux.

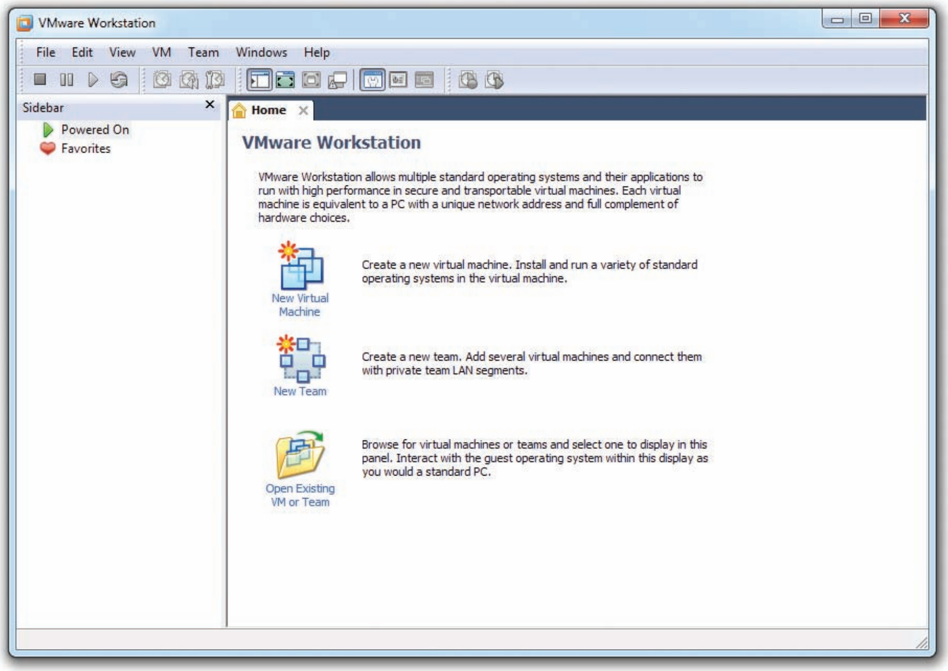
Microsoft's Virtual PC is a free competitor to VMware Workstation. Virtual PC works well, but it lacks some of the more interesting features included in VMware Workstation.

Begin by obtaining a copy of VMware Workstation. This program isn't free, but VMware will give you a 30-day trial. Go to www.vmware.com to get a trial copy. A freshly installed copy of VMware Workstation looks like Figure 30.7.

Clicking New Virtual Machine prompts you for a Typical or Custom setup (see Figure 30.8). These settings are only for backward-compatibility with earlier versions of VMware, so just click Next.

The next dialog box is where the fun starts. Here, VMware Workstation asks for an operating system installation disc. Just because you're creating a virtual machine, don't think the operating system and applications aren't real. You need to install an operating system on that virtual machine. You do this just as you would on a machine without virtualization, using some form of optical media. Would you like to use Microsoft Windows in your virtual machine? No problem, but know that every virtual machine you create on which you install Windows requires a separate, legal copy of Windows.

Because virtual machines are so flexible on hardware, VMware Workstation enables you to use either the host machine's optical drive or an ISO file. I'm installing Ubuntu, so I downloaded the latest ISO image from the Ubuntu Web site (www.ubuntu.com), and as Figure 30.9 shows, I've pointed the dialog box to that image.



VMware Workstation

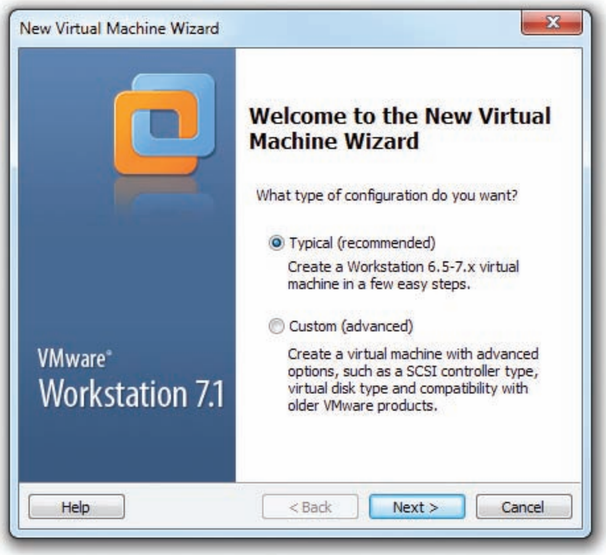
VMware Workstation allows multiple standard operating systems and their applications to run with high performance in secure and transportable virtual machines. Each virtual machine is equivalent to a PC with a unique network address and full complement of hardware choices.

Create a new virtual machine. Install and run a variety of standard operating systems in the virtual machine.

Create a new team. Add several virtual machines and connect them with private team LAN segments.

Browse for virtual machines or teams and select one to display in this panel. Interact with the guest operating system within this display as you would a standard PC.

• Figure 30.7 VMware Workstation



Welcome to the New Virtual Machine Wizard

What type of configuration do you want?

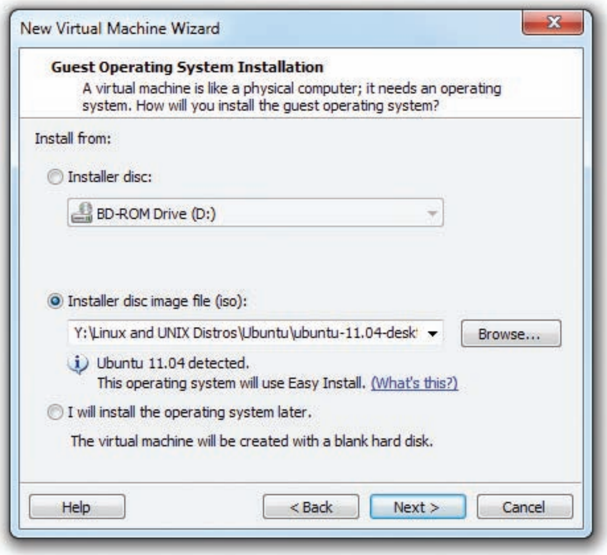
● Typical (recommended)

Create a Workstation 6.5-7.x virtual machine in a few easy steps.

○ Custom (advanced)

Create a virtual machine with advanced options, such as a SCSI controller type, virtual disk type and compatibility with older VMware products.

• **Figure 30.8** Selecting a Typical or Custom setup



Guest Operating System Installation

A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?

Install from:

○ Installer disc:

BD-ROM Drive (D:)

● Installer disc image file (iso):

Y:\Linux and UNIX Distros\Ubuntu\ubuntu-11.04-desk

Ubuntu 11.04 detected.
This operating system will use Easy Install. (What's this?)

○ I will install the operating system later.

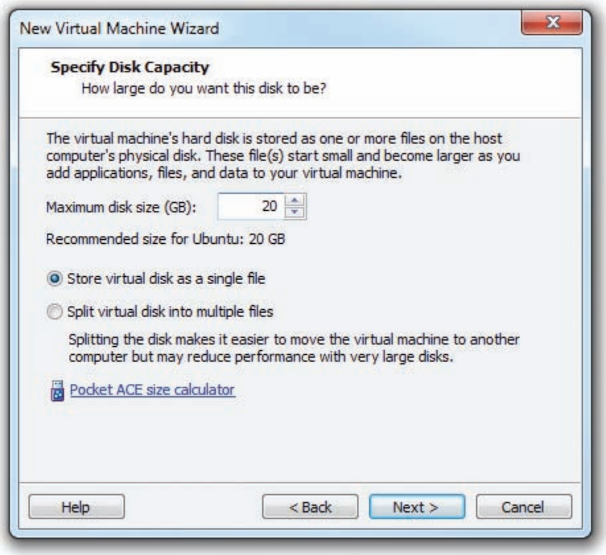
The virtual machine will be created with a blank hard disk.

• **Figure 30.9** Selecting the installation media

Use descriptive names for virtual machines. This will save you a lot of confusion when you have multiple VMs on a single hypervisor.

Compared to some other virtualization programs, VMware Workstation is a powerful, easy-to-use program. If you look closely at Figure 30.9, you'll see that VMware reads the installation media (note the "Ubuntu 11.04 Detected"). Because VMware knows this operating system, it configures all of the virtual hardware settings automatically: amount of RAM, virtual hard drive size, and so on. You can change any of these settings, either before or after the virtual machine is created. Refer to Figure 30.4 to see these settings. Next, you need to accept the size of the virtual drive, as shown in Figure 30.10.

You also need to give the virtual machine a name (see Figure 30.11). By default, VMware Workstation uses a simple name. For this overview, accept



Specify Disk Capacity

How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB): 20

Recommended size for Ubuntu: 20 GB

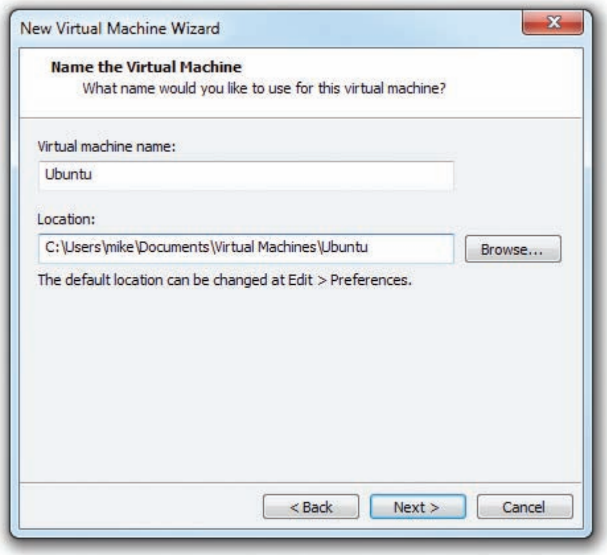
● Store virtual disk as a single file

○ Split virtual disk into multiple files

Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.

Pocket ACE size calculator

• **Figure 30.10** Setting the virtual drive size



Name the Virtual Machine

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

Virtual machine name:
Ubuntu

Location:
C:\Users\mike\Documents\Virtual Machines\Ubuntu

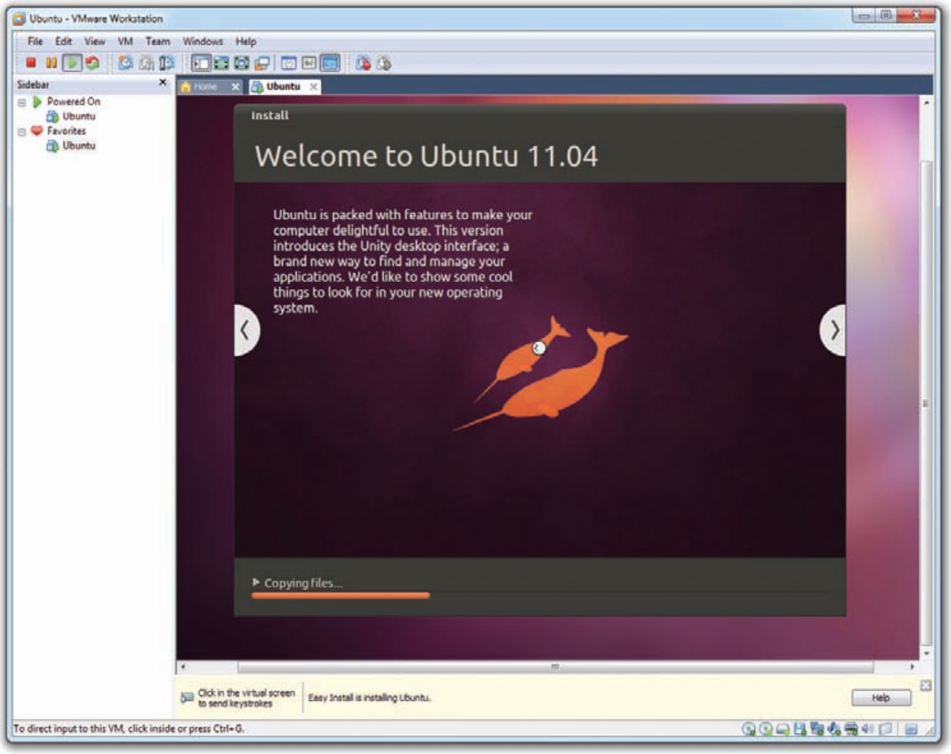
The default location can be changed at Edit > Preferences.

• **Figure 30.11** Entering a VM name and location the default name: Ubuntu. This dialog box also lets you decide where you want to store the files that comprise the virtual machine. Note that VMware uses a folder in the user's Documents folder called Virtual Machines.

After you've gone through all the configuration screens, you can start using your virtual machine. You can start, stop, pause, add, or remove virtual hardware.

VMware is very convenient; it even configures the boot order in the virtual system setup to boot first from the installation media, making the Ubuntu installation automatic (see Figure 30.12).

After the virtual machine installs, you then treat the VM exactly as though it were a real machine. The only big difference is that VMware replaces CTRL-ALT-DELETE with CTRL-ALT-INSERT. Figure 30.13 shows VMware Workstation with the single VM installed but not running. A VM goes through a POST process just like any computer, as shown in Figure 30.14.


Ubuntu - VMware Workstation
File Edit View VM Team Windows Help
Sidebar
Powered On
Ubuntu
Favorites
Ubuntu
Home
Ubuntu
Install

Welcome to Ubuntu 11.04

Ubuntu is packed with features to make your computer delightful to use. This version introduces the Unity desktop interface; a brand new way to find and manage your applications. We'd like to show some cool things to look for in your new operating system.

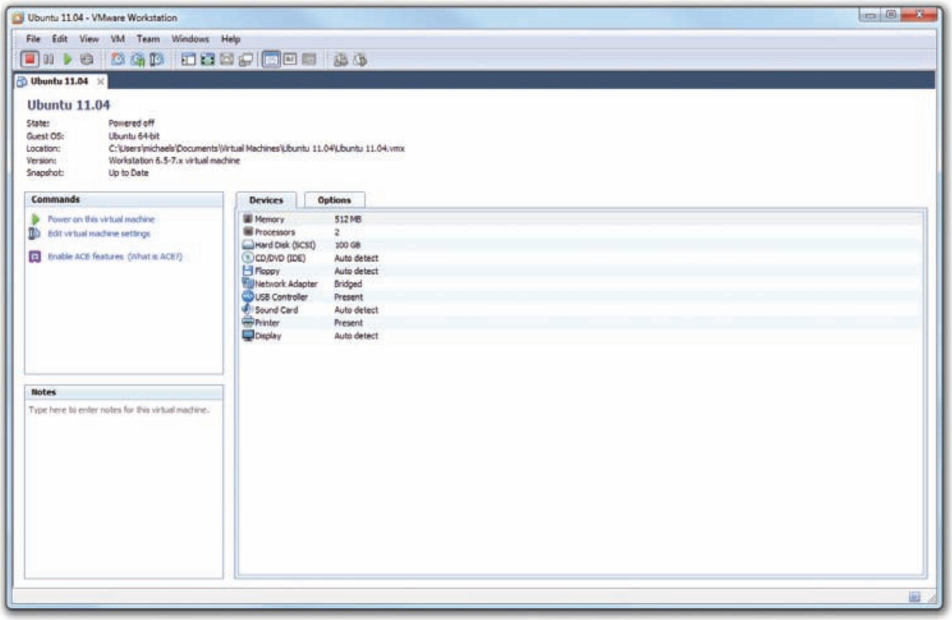
Copying files...

Click in the virtual screen to send keystrokes

Easy Install is installing Ubuntu.

To direct input to this VM, click inside or press Ctrl+G.

• **Figure 30.12** Ubuntu installing into the new virtual machine


Ubuntu 11.04 - VMware Workstation
File Edit View VM Team Windows Help
Ubuntu 11.04

Ubuntu 11.04

State: Powered off
Guest OS: Ubuntu 64-bit
Location: C:\Users\michaels\Documents\Virtual Machines\Ubuntu 11.04\Ubuntu 11.04.vmx
Version: Workstation 6.5-7.x virtual machine
Snapshot: Up to Date

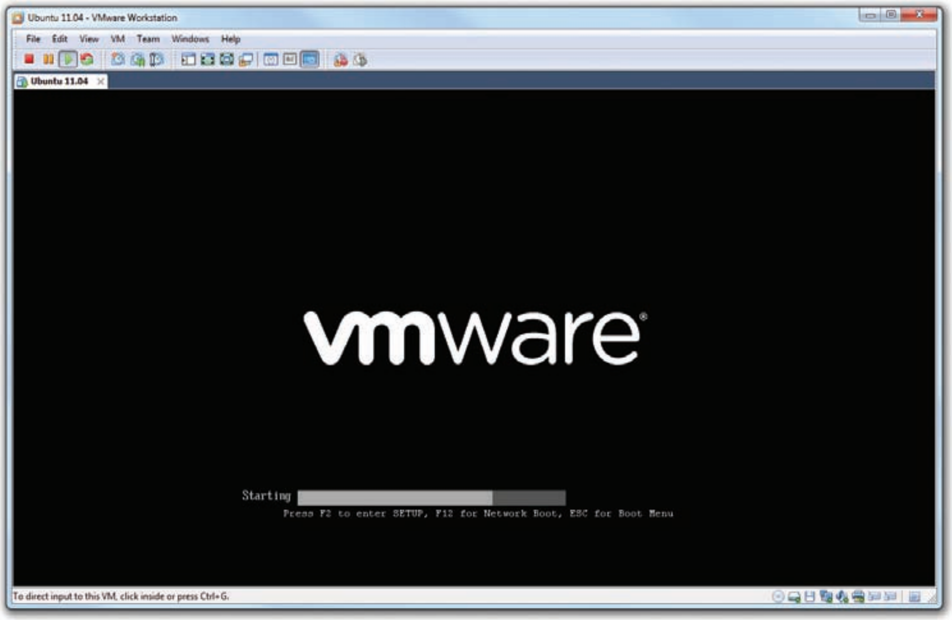
Commands
- Power on this virtual machine
- Edit virtual machine settings
- Enable ACE features (What is ACE?)

Notes

Type here to enter notes for this virtual machine.

Memory	512 MB
Processors	2
Hard Disk (SCSI)	100 GB
CD/DVD (IDE)	Auto detect
Floppy	Auto detect
Network Adapter	Bridged
USB Controller	Present
Sound Card	Auto detect
Printer	Present
Display	Auto detect

• **Figure 30.13** VMware Workstation with a single VM



```
Starting
     Press F2 to enter SETUP, F12 for Network Boot, ESC for Boot Menu
```

To direct input to this VM, click inside or press Ctrl+G.

• **Figure 30.14** POST in a virtual machine

If you wish, you can even access a complete virtual system setup utility by pressing the DELETE key just like on a real system.

Congratulations! You've just installed a *virtual desktop*. Virtual desktops were the first type of popular virtual machines seen in the PC world, championed by VMware and quickly copied by other virtualization programs.

There's a lot more to virtualization than just virtual desktops, however, but before I dive in too far, let's step back a moment and understand a very important question: Why do we virtualize?

Why Do We Virtualize?

Virtualization has taken the computing world by storm, but for those who have never seen virtualization, the big question has got to be: Why? Let's talk about the benefits of virtualization. While you read this section, keep in mind two important things:

- A single hypervisor on a single system will happily run as many virtual machines as its RAM, CPU, and drive space allow.
- A virtual machine that's shut down is little more than a file (or two) sitting on a hard drive.

While you're reading about the benefits of virtualization, don't forget about the costs. To run one or more virtual machines, you'll need a powerful machine—fast processor, loads of RAM (this is usually the limiting factor in how many virtual machines you can run at the same time), and a good amount of hard drive space. If you want the virtual PC to connect to a network, your physical PC needs a NIC.

Virtualized operating systems use the same security features as real operating systems. For each virtual machine user account, you'll need to keep track of user names, passwords, permissions, and so on, just like on a normal PC.

Power Saving

Before virtualization, each installed OS needed to be on a unique physical system. With virtualization, you can place multiple virtual PCs on a single physical system, reducing electrical power use substantially. Rather than one machine running Windows Server 2008 (or Server 2008 R2) and acting as a file server and DNS server, and a second machine running Linux for a DHCP server, for example, the same computer can handle both operating systems simultaneously. Expand this electricity savings over an enterprise network or on a data server farm and the savings—both in terms of dollars spent and electricity used—are tremendous.

Hardware Consolidation

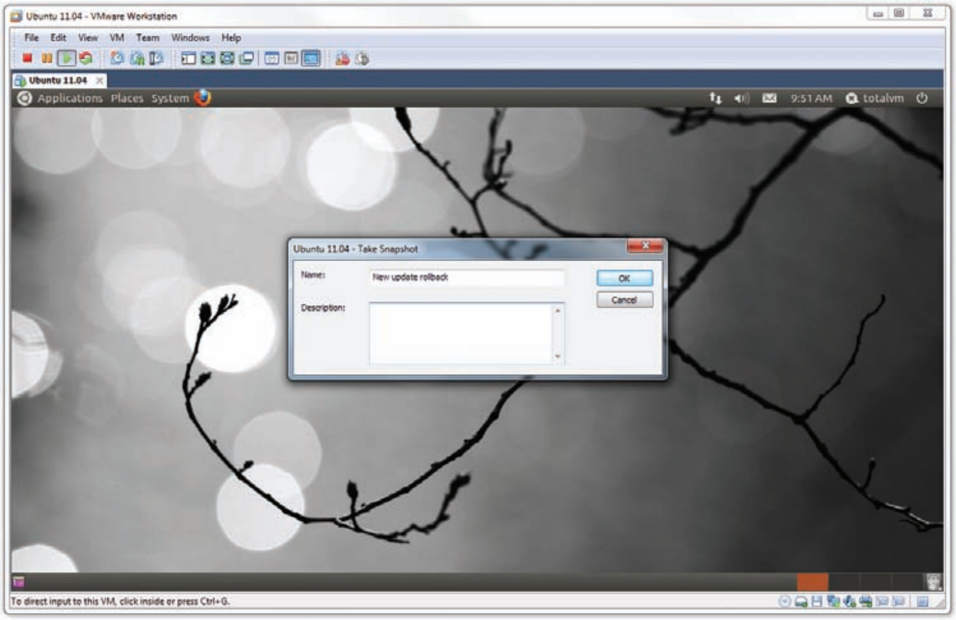
Similar to power saving, why buy a high-end server, complete with multiple processors, RAID arrays, redundant power supplies, and so on, and only run a single server? With virtualization, you can easily beef up the RAM and run a number of servers on a single box.

Rebooting virtual machines is easy, but keep an eye on your physical machine. If your PC goes down, it brings all your virtual machines down with it! Be sure to back up mission-critical virtual machines to an external hard drive—remember that a virtual machine is just a file on your hard drive. You can always install the backed-up virtual machines on another physical machine if necessary.

System Recovery

Possibly the most popular reason for virtualizing is to keep uptime percentage as high as possible. Let's say you have a Web server installed on a single system. If that system goes down—due to hacking, malware, or so on—you need to restore the system from a backup, which may or may not be easily at hand. With virtualization, you merely need to shut down the virtual machine and reload an alternative copy of it.

Think of virtual machines like you would a word processing document. Virtual machines don't have a "File | Save" equivalent, but they do have something called a **snapshot** that enables you to save an extra copy of the virtual machine as it is exactly at the moment the snapshot is taken. Figure 30.15 shows VMware Workstation saving a snapshot.


Ubuntu 11.04 - VMware Workstation
File Edit View VM Team Windows Help
Ubuntu 11.04
Applications Places System
9:51 AM totalvm
Ubuntu 11.04 - Take Snapshot
OK
Cancel

Name: New update rollback

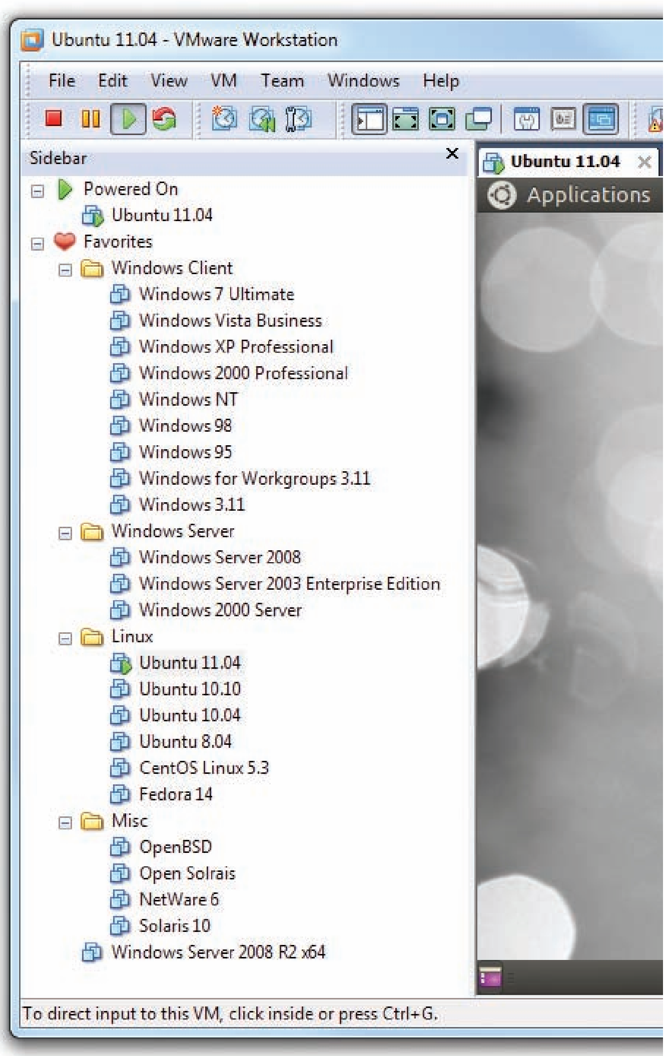
Description:

To direct input to this VM, click inside or press Ctrl+G.

• **Figure 30.15** Saving a snapshot

System Duplication

Closely tied to system recovery, system duplication takes advantage of the fact that VMs are simply files, and like any file, they can be copied. Let's say you want to teach 20 students about Ubuntu Linux. Depending on the hypervisor you choose (VMware does this extremely well), you can simply install a hypervisor on 20 machines and copy a single virtual machine to all the computers. Equally, if you have a virtualized Web server and need to add another Web server (assuming your physical box has the hardware to support it), why not just make a copy of the server and fire it up as well?



To direct input to this VM, click inside or press Ctrl+G.

• **Figure 30.16** Lots of VMs used for research

Research

Here's a great example that happens in my own company. I sell my popular Total Tester test banks: practice questions for you to test your skills on a broad number of certification topics. As with any distributed program, I tend to get a few support calls. Running a problem through the same OS, even down to the service pack, helps me solve the problem. In the days before virtualization, I commonly had seven to ten PCs, using dual-boot, each keeping copies of a particular Windows version. Today, a single hypervisor enables me to support a huge number of Windows versions on a single machine (see Figure 30.16).

Clearly there are a number of good reasons to virtualize some of the computers in a network. Let's look at implementation now.

■ Virtualization in Modern Networks

You've already seen virtualization in action with the example shown using VMware Workstation earlier in this chapter. Many networks use a few virtual machines to augment and refine a traditional network closet. VMware Workstation is how I first performed virtualization on PCs, but the technology and power have grown dramatically over the past few years.

VMware Workstation requires an underlying operating system (such as Windows), so it functions essentially like a very powerful desktop application. What if you could remove the OS altogether and create a bare-metal implementation of virtualization?

VMware introduced ESX in 2001 to accomplish this goal. ESX is a hypervisor that's powerful enough to replace the host operating system on a physical box, turning the physical machine into a machine that does nothing but support virtual machines; no Windows, no Ubuntu—just ESX.

ESX by itself isn't much to look at; it's a tiny operating system/hypervisor that's usually installed on something other than a hard drive. Figure 30.17 shows how I loaded my copy of ESX: via a small USB thumb drive. Power up the server; the server loads ESX off the thumb drive; and in short order, a very rudimentary interface appears where I can input

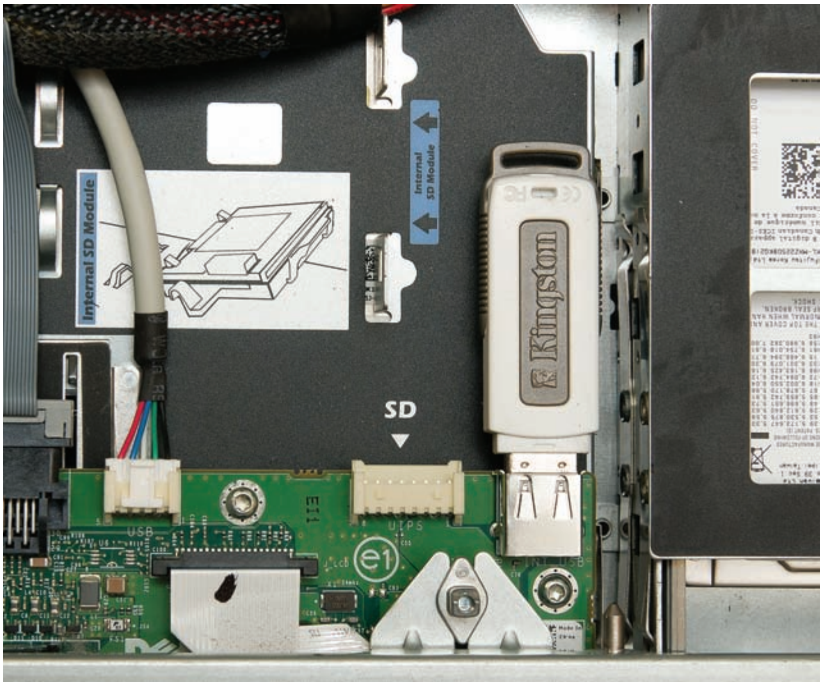
The system shown in Figure 30.16 could obviously never run all those VMs at the same time.

For all you abbreviation lovers, I have some good news and some bad news about "ESX." Officially, it means nothing. Unofficially, it stands for "Elastic Sky," which is probably why it officially means nothing.

essential information, such as a master password and a static IP address.

Don't let ESX's small size fool you. It's small because it only has one job: to host virtual machines. ESX is an extremely powerful operating system/hypervisor.

Notice the built-in USB port shown in Figure 30.17. The popularity of hypervisors on dedicated servers makes these ports extremely common in a serious server box like the Dell system shown.



• **Figure 30.17** USB drive on server system

Powerful hypervisors like ESX are rarely administered directly at the box. Instead you use tools such as VMware's vSphere Client, so you can create, configure, and maintain virtual machines on the hypervisor server from the comfort of a client computer running this program. Once the VM is up and running, you can close the vSphere client, but the VM will continue to run happily on the server. For example, let's say you create a VM and install a Web server on that VM. As long as everything is running well on the Web server, you will find yourself using the vSphere client only to check on the Web server for occasional maintenance and administration.

A free version of ESX is available. Called ESXi, it lacks a number of ESX's features but is still quite powerful.

So you now really have two different ways to virtualize: using virtual machine managers like VMware's Workstation to manage virtual desktops, and using powerful hypervisors like ESX to manage virtual servers. Granted, you could run a server like a Web browser in VMware Workstation, and you also could run a copy of Windows 7 Ultimate from an ESX system. Nothing is wrong with doing either of these.

Thus far, this chapter sounds like an advertisement for VMware. VMware really brought virtualization to the PC world and still holds a strong presence, but there are a number of alternatives to VMware products. Let's see what else is available.

Tech Tip

VMM Versus Hypervisor

Some writers will use the term virtual machine manager *to describe virtual machine software that runs on top of a host operating system. They'll use the term* hypervisor *to describe only software that does not need a host operating system. Using this terminology, VMware Workstation is a virtual machine manager and ESX is a hypervisor.*

Other writers call both the hosted and bare-metal—or native*—virtualization software products* hypervisors, *but make a distinction in other descriptive words (*such as* hosted *or* native*).*

Virtual Machine Managers

When it comes to the more basic virtual machine managers, you have a huge number of choices. The one you use is going to be determined by features and prices.

VMware Workstation

The granddaddy and front leader for virtualization, VMware Workstation, comes in both Windows and Linux versions. VMware Workstation runs virtually (pun!) on any operating system you'll ever need and is incredibly stable and proven. Too bad it's not free.

One of the more interesting features of VMware Workstation is VMTools. VMTools adds useful features such as copy/cut and paste between the virtual desktop and the real desktop.

Try This!

Creating a Virtual Machine

It's difficult to understand how virtual machines work (and how amazing they are) until you've made one yourself. VMware sells many different virtualization products, most of which are too powerful and too expensive for our experimentation purposes. Fortunately, they also offer VMware Player, a basic virtual machine manager that's easy enough for anyone to use, so Try This!

Go to VMware's Web site (www.vmware.com) and search for VMware Player. Follow the Download link and choose the version of VMware Player that matches your OS. (You'll need to sign up for an account before you can download the application.)

While that's downloading, go to the Ubuntu Linux Web site (www.ubuntu.com) and follow the links to download the latest version of Ubuntu. Don't use the Windows installer listed on the Ubuntu Download Web page. Instead, download the installation image using the Start download button.

When the downloads have finished, run the VMware Player executable file. Follow the instructions as you would with any other application. When finished, open VMware Player. Accept the End User License Agreement (EULA), then click on Create a New Virtual Machine.

Use the Easy Install method. VMware Player will build the virtual machine and install the Ubuntu operating system at the same time. You'll need to find where you saved the Ubuntu installation image. Use the default settings provided by the wizard, and create a user name and password when prompted.

After the virtual machine has been installed, you can launch it from the main VMware Player screen by selecting it from the list of machines and clicking *Play Virtual Machine*. Congratulations! You've just created a virtual machine on your PC.

Virtual PC

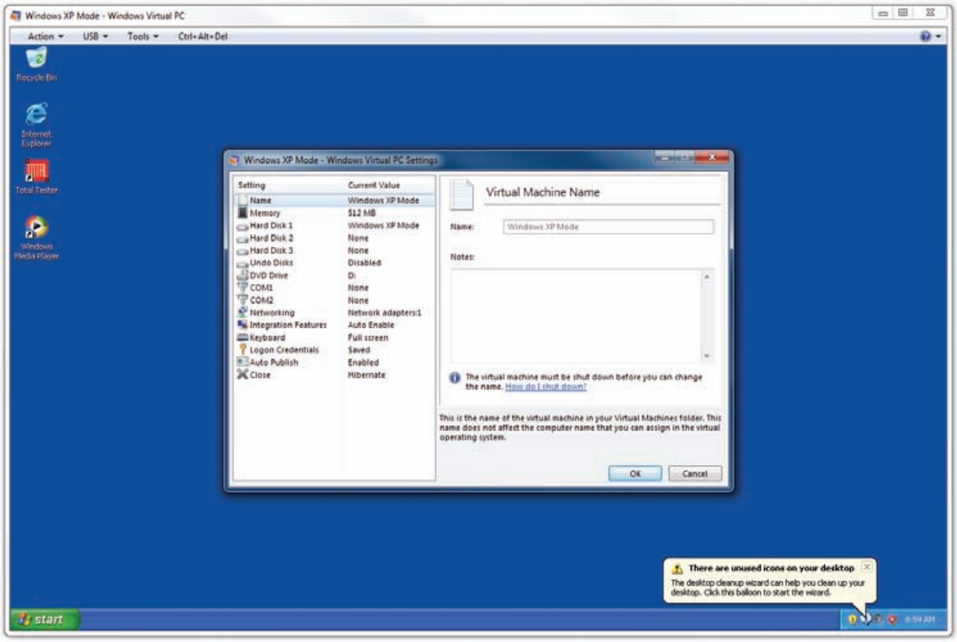
Microsoft has offered a few different virtual machine managers over the years, with the current mainstream product being Windows Virtual PC (see Figure 30.18). Windows Virtual PC is free, but has some serious limitations. First, it only works on Windows 7 Professional, Ultimate, and Enterprise. Second, it only officially supports Windows VMs, although a few intrepid souls have managed to get Linux working.

Remember Windows XP Mode from Chapter 19? It uses Virtual PC and a copy of Windows XP to create a virtual machine on your PC!

Cross Check

Compatibility

You learned about Windows XP Mode and other compatibility modes back in Chapter 19. Remember that Windows XP Mode is really just a virtual OS running inside Microsoft's Virtual PC. What other compatibility features does Windows 7 include? Which editions of Windows 7 include Windows XP Mode? Does Windows Vista include Windows XP Mode?



Windows XP Mode - Windows Virtual PC Settings

Setting	Current Value
Name	Windows XP Mode
Memory	512 MB
Hard Disk 1	Windows XP Mode
Hard Disk 2	None
Hard Disk 3	None
Undo Disks	Disabled
DVD Drive	D:
COM1	None
COM2	None
Networking	Network adapters:1
Integration Features	Auto Enable
Keyboard	Full screen
Logon Credentials	Saved
Auto Publish	Enabled
Close	Hibernate

Virtual Machine Name

Name: Windows XP Mode

Notes:

The virtual machine must be shut down before you can change the name. How do I shut down?

This is the name of the virtual machine in your Virtual Machines folder. This name does not affect the computer name that you can assign in the virtual operating system.

OK Cancel

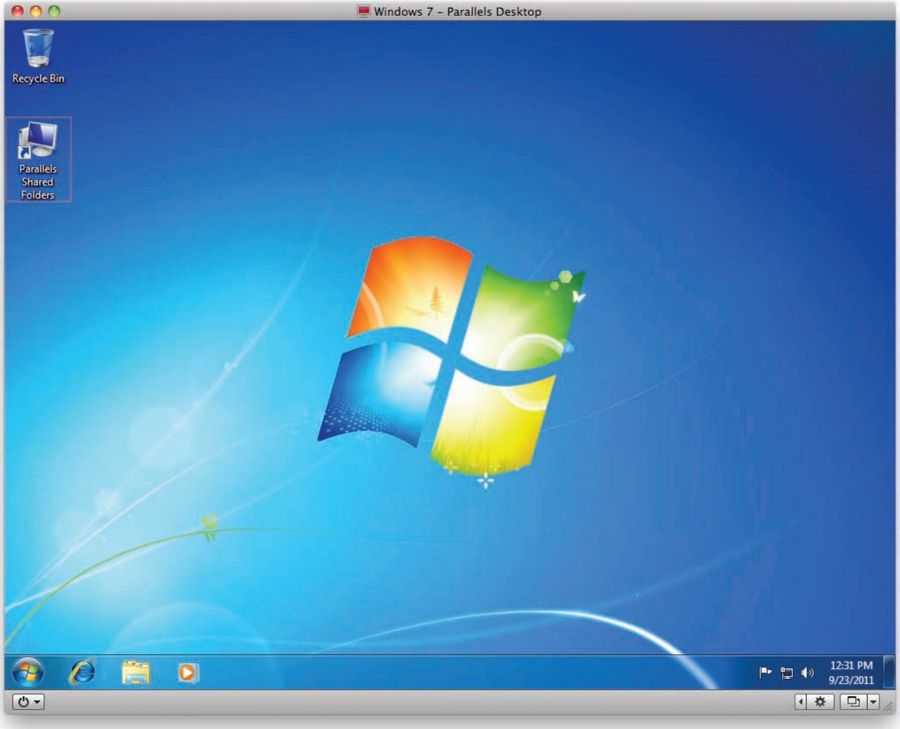
There are unused icons on your desktop

The desktop cleanup wizard can help you clean up your desktop. Click this balloon to start the wizard.

• Figure 30.18 Windows Virtual PC

Parallels

Parallels is the most popular virtualization manager for Mac OS X (see Figure 30.19), although VMware Fusion is a close second. Parallels supports all popular operating systems, and even has a fair degree of 3-D graphics support; more so than even the mighty VMware. Parallels also offers Windows and Linux versions.



• Figure 30.19 Parallels for Mac

KVM

Of course, the open source world has its players too. While picking a single product to represent the Linux/Unix world is hard, no one who knows virtualization would disagree that KVM from Red Hat is a dominant player. Unlike the other virtual machine managers discussed, KVM also supports a few non-x86 processors.

Don't think for a moment that this list is complete! There are lots of other virtual machine options for your desktop, especially if your host machine runs Linux. The most fun you'll have learning about virtualization is the playtime involved experimenting with the many options available.

Hypervisors

While you have lots of choices when it comes to virtual machine managers, your choices for real embedded hypervisors are limited to the two biggies: VMware's ESX and Microsoft's HyperV. There are others, such as Oracle's VM Server, but nothing has the market share of ESX or HyperV.

ESX

I've already discussed a few aspects of ESX, so instead I'll delve into the features that make ESX so popular. When it comes to real server virtualization, VMware truly leads the pack with a host of innovations (some of which are add-on products) that make ESX almost unstoppable. Here are a few examples:

- **Interface with large storage** ESX virtual machines easily integrate with network attached storage (NAS) and storage area networks (SANs) to handle massive data storage.
- **Transparent fault tolerance** ESX can monitor and automatically recover failed VMs with little or no input.
- **Transparent server transfer** You can move a *running* VM from one machine to another. How cool is that?
- **High virtual CPUs** Most hypervisors support a limited number of virtual CPUs, usually two at most. ESX can support up to 32 CPUs, depending on the vSphere product version you purchase to support it.

HyperV

Although HyperV can't stand toe-to-toe with ESX, it has a few aces up its sleeve that give it some intrigue. First, it's free. This is important in that ESX, with only a few extra add-ons, can cost thousands of dollars. Second, it comes as a stand-alone product or as part of Windows Server 2008 and even on some versions of Windows 7, making it easy for those who like to play to access it. Third, its simplicity makes it easier to learn for those new to using hypervisors. Watch HyperV. If Microsoft does one thing well, it's taking market share away from arguably better, more powerful competitors, while slowly making its product better.

Chapter 30 Review

Chapter Summary

After reading this chapter and completing the exercises, you should understand the following about virtualization.

Describe the concepts of virtualization

- Virtual reality creates a simulation of a world or environment that appears to be real, even though the person wearing the headgear and gloves is located in a room that doesn't resemble the simulated space. Virtual computing follows a similar concept.
- In virtual computing, software called a hypervisor or virtual machine manager creates one or more environments, called virtual machines (VMs), on a single machine. You can install an OS into each VM and thus run several OSs simultaneously on a single machine.
- The hypervisor handles the communication between the OSs installed and the hardware. The hypervisor can easily add and remove hard drives, memory space, networking capabilities, and more.
- Emulation differs from virtualization: emulation software translates commands from an application into machine language the host computer can understand, whereas virtualization creates an environment that is native to the application—an operating system, in this case—requiring no translation.

Explain why PC and network administrators have widely adopted virtualization

- Going virtual enables companies to combine multiple servers onto fewer machines than in traditional computing. This offers tremendous savings in hardware purchases, electricity use, and the space used for computing.
- Because a VM is only a single file or two, a hacked or corrupted server can rapidly be replaced with a snapshot (a backup) taken of the properly working server. This provides better uptime than in a traditional server setup. Likewise, the minimal file numbers make it easy to duplicate a VM.
- The capability to run many operating systems on a single physical machine makes multiplatform testing and research much easier and less costly than with traditional setups.

Describe how virtualization manifests in modern networks

- The simplest way virtualization manifests in networks is through one or more VMs performing chores that would have taken multiple physical boxes previously. VMware Workstation is the most common VM implementation tool in these sorts of networks.
- More aggressive network needs can use bare-metal virtualization software that removes the need for an operating system on the VM-supporting machine. These hypervisors, such as VMware ESX, take up minuscule space. You manage them remotely through client software, rather than at the server box.
- The more popular virtual machine managers include the aforementioned VMware Workstation, plus Microsoft Virtual PC, Parallels for OS X, and KVM on the Linux side. The more popular native hypervisors include ESX and HyperV.

Key Terms

emulator *(1156)*
host *(1155)*
hypervisor *(1155)*
snapshot *(1161)*
virtual machine (VM) *(1152)*
virtual machine manager (VMM) *(1155)*

Key Term Quiz

Use the Key Terms list to complete the sentences that follow. Not all the terms will be used.

1. A(n) ________________ is a complete environment for a guest operating system to function as though that operating system were installed on its own computer.
2. A machine that runs multiple operating systems simultaneously is called a(n) ________________.
3. A bare-metal machine that supports virtualization software without needing a host operating system is commonly called a(n) ________________.
4. A(n) ________________ can convert the commands to and from a host machine to an entirely different platform.
5. You can create a(n) ________________ as a backup for a virtual machine.

Multiple-Choice Quiz

1. Tom is installing a Windows 7 Ultimate virtual machine onto a copy of VMware Workstation. Which of the following does he need?
   - **A.** A valid copy of Windows 7 Ultimate installation media
   - **B.** The IP address for the virtual machine host
   - **C.** A disk image of another computer's installed Windows 7 Ultimate
   - **D.** A valid ESX key
2. The number of running virtual machines on a single host is limited by what factor?
   - **A.** Physical RAM
   - **B.** Virtual RAM
   - **C.** Physical NICs
   - **D.** Virtual NICs
3. When a virtual machine is not running, how is it stored?
   - **A.** Firmware
   - **B.** RAM drive
   - **C.** Optical disc
   - **D.** Files
4. VMware Workstation replaces CTRL-ALT-DELETE with which of the following?
   - **A.** A mouse click
   - **B.** CTRL-ALT-INSERT
   - **C.** CTRL-ALT-TAB
   - **D.** CTRL-ALT-SHIFT
5. Which of the following would *not* run on VMware Workstation for Windows?
   - **A.** Windows XP
   - **B.** Sony PlayStation 2
   - **C.** Ubuntu Linux
   - **D.** Windows Vista
6. Which of the following virtualization programs works well with Mac OS X? (Select the best answer.)
   - **A.** ESX
   - **B.** KVM
   - **C.** Parallels
   - **D.** Virtual PC
7. The boss flies into your office yelling that the virtualized Web server has been hacked and now displays only purple dinosaurs. Which of the following would be the fastest way to fix the problem?
   - **A.** Restore from backup
   - **B.** Run System Restore
   - **C.** Reinstall Windows
   - **D.** Load an earlier snapshot
8. Which of the following is *not* a good reason for virtualization?
   - **A.** Power saving
   - **B.** Hardware consolidation
   - **C.** System recovery
   - **D.** Reduced hardware costs

9. Powerful hypervisors like ESX are often booted from __________________.

   A. Floppy diskettes

   B. USB thumb drives

   C. Firmware

   D. Windows

10. Which players dominate the entire hypervisor market? (Select two.)

    A. ESX

    B. HyperV

    C. Parallels

    D. KVM

Essay Quiz

1. A company has three discrete servers: a file server running Linux, a contact and e-mail server running Windows Server, and a DNS and DHCP server running an earlier version of Windows Server. Make a case for or against going virtual with this setup.

2. Write a comparative essay on VMware Workstation and ESX. What are the strengths of each type of virtualization setup? When would you use ESX over VMware Workstation?

Lab Projects

• Lab Project 30.1

Acquire a copy of VMware Workstation or another virtualization program and create some virtual machines. If you can add the VM host to a working network, then attempt to access the different VMs running and access other computers from any of the VMs. This should be a fun lab. Here are links to VM software:

www.vmware.com/products/workstation/overview.html

www.virtualbox.org/wiki/Downloads

www.microsoft.com/windows/virtual-pc/

• Lab Project 30.2

Analyze the current server setup at your school or office. Does it use virtualization? If so, which programs does it use for which purposes? If not, discuss how virtualization could be implemented to make the network more efficient.