Implementing and Managing Hardware

CERTIFICATION OBJECTIVES

2.01 Install and configure server hardware
2.02 Configure, manage, and monitor server hardware
2.03 Troubleshoot server hardware

✓ Two-Minute Drill
Q&A Self Test
Chapter 2: Implementing and Managing Hardware

In many ways, a server is only as good as its components. The hardware resources that you have installed in your machine form the foundation for the capabilities, performance, and reliability of the machine itself. If you get everything right, your servers will be running reliably and efficiently. If not, however, you could be faced with troubleshooting some difficult intermittent issues (or, worse, with a sudden need to update your resume!).

Modern computer hardware involves a lot of complexity. There are many subsystems that must communicate with each other, and there are resources that must be properly managed to prevent conflicts. One of the fundamental purposes of any operating system is to abstract this underlying complexity and to make it all look simple. Windows Server 2003 is no exception. From the time of installation of the operating system through to the time of upgrades and other changes, much of the installation and configuration of hardware happens behind the scenes.

That’s not an excuse for failing to understand Windows Server 2003’s hardware architecture, however! Through the many tools included with Microsoft’s server platform, you can view and manage device drivers and hardware settings. On the exam, Microsoft wants to be sure that you understand how to work with hardware. You need to know how to install and configure new hardware, how to monitor the hardware configuration of your server, and how to troubleshoot hardware-related problems.

In this chapter, you’ll look at many different topics that are related to installing and configuring hardware devices on Windows Server 2003. Specifically, you’ll look at how device drivers work, and what you, the systems administrator, can do to resolve problems when they occur. Drawing on this knowledge, you’ll be well prepared to deal with the wide array of hardware that’s available for modern servers. And, you’ll be well prepared for hardware-related questions on the exam!

Understanding Server Hardware Architecture

I already mentioned that one of the fundamental functions of an operating system is to serve as a bridge between software and the underlying hardware. Often, when it comes to server management, systems administrators focus on applications and features such as the Active Directory. However, in order for those types of services to operate properly, you must be sure that the hardware platform is properly configured.

Like most modern operating systems, Windows Server 2003 supports a vast array of different types of devices. Many of these devices are pieces of hardware that are critical to the proper operation of your server. For example, storage and networking
functionality is vital to the proper operation of almost any server. Other types of hardware devices (such as a scanner or a digital camera), might be less likely to be found on the server side.

Here's a listing of some of the types of hardware that are supported on Windows Server 2003:

- **FireWire (IEEE 1394) Bus** This high-speed external bus is used to connect various types of devices that range from digital video cameras to external storage.

- **Hard disk controllers** The two most common specifications for hard disk controllers are IDE and SCSI. Windows Server 2003 supports both types of disk controllers.

- **Hard disks** Fixed storage devices of many different types are supported in Windows Server 2003. For more information on configuring storage resources, see Chapter 5.

- **Input devices** Input devices are the main ways in which users and systems administrators interact with their computers. Many different types of input devices are available, but the most common are the keyboard and the mouse.

- **Modems** These devices are used to allow computers to communicate over analog phone lines. On the server side, remote access servers might be connected to one or more modems to allow users to create a “dial-up” connection to their networks.

- **Monitors** Monitors provide graphical output of information for users and systems administrators. On the server side, systems administrators can use a keyboard-video-mouse (KVM) switch to connect one monitor, one keyboard, and one mouse to many different servers. Some environments have switched to a “headless” server configuration (also referred to as “lights out” server management). This configuration involves only remote management of servers over the network or through other devices (such as a serial port).

- **Motherboard components** Modern system motherboards include a great deal of functionality, including disk controllers and I/O connectors (such as serial, parallel and USB ports). The motherboard provides support for expansion cards through PCI and AGP slots. Additionally, lower-level features, such as power-saving modes, are also provided by components of the server’s motherboard.
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- **Network adapters** One of the fundamental uses of a server is to provide access to resources over a network. Network adapters allow communications over Ethernet networks (at speeds of 10, 100, or 1000 megabits per second), or through wireless networks.

- **Printers** These devices are used to generate paper-based output, and they can be shared with users over the network. Printers may be physically connected to a server, or they may be located on the network. More information on configuring and managing printing is presented in Chapter 4.

- **Removable storage devices** This broad category includes all types of removable media, including floppy disks, CDs, and DVDs. Generally, these storage devices are used to install new software or to transfer data between machines that are not connected by a network.

- **Universal Serial Bus (USB)** An external connection mechanism that allows the connection of many different types of devices to a machine. Generally, modern servers will have several USB connectors.

- **Video adapters** The basic purpose of a video adapter is to provide server output to a monitor. Modern video adapters provide 3-D acceleration support (primarily for entertainment software), as well as many options for optimizing output.

All of these types of devices are supported on Windows Server 2003. Now, let's look at how the operating system communicates with hardware.

**Understanding Device Drivers**

Windows Server 2003 uses device drivers to form a bridge between the operating system and the hardware that it's running on. Device drivers are pieces of software that specify how the operating system can communicate with hardware, and which features the hardware supports. For example, a device driver for a network adapter would specify the features of the network card (maximum speed, duplexing modes, power-saving options, etc.). Figure 2-1 provides a high-level view of the purpose of device drivers.

When device drivers are properly implemented, users, systems administrators, and software can all depend on the ability to use hardware with minimal effort and management. For example, once a device driver for a network adapter is loaded, administrators can focus on tasks such as setting network addresses and configuring routing options.

Since Microsoft has designed Windows Server 2003 to support the vast majority of devices that are available on its supported hardware platforms, drivers for literally thousands of hardware devices are provided as part of the operating system. For
example, if you decide to add a new IDE hard disk to your computer, Windows Server 2003 will generally detect it automatically and load the appropriate drivers without any user interaction. However, because new hardware devices are constantly being introduced into the market, built-in operating system drivers may not always be available for the hardware that you're trying to install. It's also important to keep in mind that, like any other type of software, device drivers are often upgraded to fix problems and to introduce new features.

Although device drivers are provided with the Windows Server 2003 operating system platform, it is ultimately the responsibility of hardware manufacturers to provide these drivers for their products. Often, device drivers are included on removable media (such as floppy disks or CDs) and are shipped with new hardware. A good method for getting the latest drivers for your system is to download them from your hardware manufacturer's web site. Generally, manufacturers will make the latest drivers for their devices (including any patches or fixes that might have been made) on their web sites.

With many different types of modern hardware, overall performance and features are often dependent on the quality of device drivers. For example, well-optimized video drivers can provide large performance increases, without any hardware changes. On the other hand, poorly designed drivers can lead to compatibility problems and system reliability issues. When choosing hardware for your server, be sure to select devices from companies that have a reputation for providing solid device drivers and support for their devices.

Later in this chapter, you'll look at how you can install various types of hardware and related device drivers.

**Understanding Plug and Play**

The plug and play (sometimes abbreviated “PnP”) specification was developed by Intel Corporation as a method for enabling the automatic detection, installation and
configuration of hardware devices on the PC platform. Windows Server 2003 can automatically detect and install devices that conform to the PnP standard. In the modern hardware world, virtually all devices support PnP, and your servers will automatically detect the installation of new hardware (either immediately or after a reboot).

Non-PnP devices (also referred to as “legacy” hardware) might require special manual configuration. In some cases, this configuration can be performed only in hardware. For example, you may need to manually move jumpers on an old sound card to specify which resources the card should use. Fortunately, the PnP specification allows for interoperability with non-PnP hardware.

**If your servers are still supporting non-PnP hardware, it’s probably time to replace these devices. The cost of replacing older hardware devices with newer ones will likely be offset by a reduction in administrative effort, and increased reliability of your servers. If alternatives are available, it’s probably not worth the effort to support legacy hardware on modern computing platforms.**

### Understanding Hardware Resources

Devices that function within a modern computer require access to several types of resources in order to communicate. For example, certain operations that a network adapter can perform might require the attention of the CPU, or access to specific memory addresses. In order to prevent conflicts between the many components of modern server hardware, it’s important that resources are properly managed.

There are four main types of resources that hardware devices may require in order to function properly. There are:

- **Direct memory access (DMA) channels** In older PC-based architectures, system components were required to communicate with the CPU in order to access memory. This often caused a significant performance bottleneck. Through the use of DMA, system devices can directly access system memory, thereby improving performance. As with other resources, in general, each device should use its own DMA channel.

- **Input/output (I/O) ports** I/O ports are logical addresses through which the computer’s CPU can communicate with hardware devices. Hardware devices must use nonoverlapping I/O port addresses.

- **Interrupt request (IRQ) line numbers** Interrupt requests are generated by hardware when they need the attention of the system’s CPU. In general, each hardware device must have its own IRQ (and some devices might require multiple IRQs). However, the PCI specification for hardware devices allows for the sharing of IRQs.
Memory address ranges

Hardware devices often require access to areas of system memory in order to function properly. These memory address ranges are assigned to specific hardware devices, and their ranges should not overlap.

If two devices are assigned the same resources, a device conflict may occur. When this happens, you may find that the hardware devices that are conflicting don’t function properly. For example, if two different network adapters are assigned the same I/O ports, it’s possible that neither card will function. Or, you may see intermittent errors when using these network adapters.

If this sounds like a lot of minor details to manage, you can relax: For the most part, Windows Server 2003 (as well as all current Microsoft operating system platforms) handles the allocation and management of these resources behind the scenes. In fact, it’s generally recommended that users and systems administrators not try to second-guess the operating system by manually changing and reassigning settings.

Fortunately, thanks to PnP and other hardware-related standards, resource conflicts are rarely encountered on modern computing platforms. We’ll see how resources are managed, should the need arise, later in this chapter.

If you’re like me, you might be tempted to build your own servers for your environment. Though there may be some potential benefits to taking that approach, you’d be hard-pressed to out-engineer modern hardware manufacturers. There are several important reasons for this. First, reputable hardware manufacturers spend considerable time and money in making sure that what they ship will work as expected. That means that they iron out the potential compatibility kinks before the server ships. Second, when you run into problems, you’ll be able to turn to a single vendor for support. These benefits are significant in most environments, and they generally far outweigh any potential benefits of assembling your own servers.

Determining Hardware Compatibility

If you run into problems during the installation of Windows Server 2003, it’s very likely that the cause of the problem is related to hardware (for more information on installing Windows Server 2003, see Chapter 1). Poorly written drivers can cause all kinds of problems, ranging from intermittent system lockups to extended periods of server downtime. Therefore, it’s definitely worth the time and effort to ensure that your hardware platform supports Windows Server 2003 before you migrate to this platform.

Before you install Windows Server 2003, you can perform a preinstallation hardware check from the main screen that is automatically displayed when the installation media is inserted into a computer. All you need to do is select Check System Compatibility from the main page. Note that this option is available only
if you're already running a supported version of Windows. You'll be presented with two different options (see Figure 2-2).

The first option, Check My System Automatically, will launch the Microsoft Windows Upgrade Advisor. After searching through your hardware configuration, the wizard will return the results of the system check. You'll be presented with a report that includes any errors or warnings that might affect the installation of Windows Server 2003. 
For more information about any of the items that appears in the list, click Details. Or, you can save this information to a file by using the Save As command. It’s important to take all of the reported issues seriously: Microsoft has gone to significant lengths to test many different system configurations and to identify potential issues. Often, a little time spent up-front can save hours of troubleshooting effort during and after the installation process.

You can also run the compatibility test by executing the following command from within the I386 folder of the Windows Server 2003 installation media:

```
winnt32 /checkupgradeonly
```

The second option that’s available when you select Check System Compatibility from the Windows Server 2003 installation menu is entitled Visit The Compatibility Web Site. This option will launch your default web browser and take you to the online “Windows Server Catalog” site. The URL for this site is http://www.microsoft.com/windows/catalog/server/, and you can access it from any system that has a current web browser. The Windows Server Catalog includes a wealth of information about which hardware devices have been tested for use with Windows Server 2003 (see Figure 2-3). It includes details about hardware devices that are supported on Microsoft’s Server platforms, and about any known issues with specific hardware. You can search
the entire catalog for a specific hardware device, or else you can browse through the various categories of hardware devices. If you have questions about your critical hardware, or if you’re planning to purchase new hardware, it’s a good idea to consult the Catalog before you make a decision.

Overall, it’s very important to do whatever you can to ensure that your hardware and software will properly support Windows Server 2003, before you begin the installation process. With all of this in mind, let’s move on to looking at how you can configure and manage server hardware.
CERTIFICATION OBJECTIVE 2.01

Installing and Configuring Server Hardware

Before hardware devices can be used in Windows Server 2003, they must be properly installed and configured by the operating system. The first time that hardware detection and configuration is performed is during the installation of the operating system. The Setup process will automatically take an inventory of all of the hardware devices that are present on the system, and if possible, it will install and configure these devices. The entire process requires little user interaction.

However, there are many cases in which you will want to install and configure hardware after the operating system has been installed. The most obvious scenario is one in which you are introducing a new hardware device into your server system. Let's look at how this is done.

Installing a New Hardware Device

When you purchase new hardware for your computers, you'll likely receive instructions within the product packaging. If Windows Server 2003 already includes the necessary device drivers for the hardware, you'll probably be instructed to install the hardware first. How you do this will depend on the type of hardware you're adding. For example, if you're adding a new network adapter to the computer, you will likely have to shut down the server, open the case and add the hardware to an available expansion slot, and then boot the computer. After you log on to the server, you'll be presented with information that either specifies that the hardware was installed or else informs you that you'll need to provide additional information.

For other types of devices, you may be able to just plug them into the system while it is running. For example, you can connect new USB devices without first shutting down the computer. Generally, these will automatically be detected by the operating system. Certain types of devices might be installed automatically, and without any user interaction. With this in mind, let's look at various ways in which you can install new hardware on your servers.

Using the Add Hardware Wizard

For most plug and play–compatible devices, Windows Server 2003 automatically launches the Add Hardware Wizard whenever a new hardware device is connected to the system and additional interaction is required. However, your new hardware
may come with instructions that specify that you should use the Add Hardware Wizard to install the device. Or, you may be installing legacy hardware that is not automatically detected by Windows Server 2003. In these cases, you'll need to manually install the hardware device.

You can launch the Add Hardware Wizard manually by clicking the Add Hardware icon in Control Panel. The introduction screen of the Wizard looks like this:

![Add Hardware Wizard](image)

When you click Next, the Wizard will automatically start searching for any new hardware that you have installed in the system. The process can take up to several minutes, depending on the server hardware. During the process, Windows Server 2003 searches for any hardware that is connected to the computer, but for which no device drivers have been loaded.

If new hardware has been found, you will be prompted to provide additional information about how it should be installed (you'll learn the details later in this chapter). Otherwise, you'll be asked whether the hardware that you selected has already been installed in or connected to the computer. If you select the No option, the Wizard will kindly inform you that you should shut down the computer and add the new hardware.

If you select Yes and click Next, you'll be prompted to provide information about the category of the new hardware device that you wish to install. The list of device types will include all of the hardware that has already been configured on the computer. If you select an existing hardware item, Windows Server 2003 will perform a quick
check to determine whether or not the device is properly installed. If the device is properly installed, the Wizard will inform you of that fact and will not perform any further configuration.

If the device is not properly installed, or if you select Add A New Hardware Device (the last option in the list), you’ll be prompted to provide information about how the drivers should be installed.

Add Hardware Wizard

The wizard can help you install other hardware

What do you want the wizard to do?
- Search for and install the hardware automatically (Recommended)
- Install the hardware that I manually select from a list (Advanced)
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The first (and recommended) option is to automatically search for and install the hardware. When you choose this option, Windows Server 2003 will perform a thorough search for any unconfigured hardware that may be present on the system.

If a hardware device was found, you'll be prompted to walk through the process of configuring it. If one was not found, or if you chose the Install The Hardware That I Manually Select From A List (Advanced) option, you'll be presented with a list of hardware device types. The options include the many different categories of common hardware types that are supported by the Windows Server 2003 operating system.
This list includes

- Display adapters
- IDE ATA/ATAPI controllers
- IEEE 1394 bus host controllers
- Imaging devices
- Modems
- Multiport serial adapters
- Network adapters
- PCMCIA adapters
- PCMCIA and flash memory devices
- Ports (COM and LPT)
- Printers
- SCSI and RAID controllers
- Sound, video, and game controllers
- System devices
- Tape drives

Generally, you'll have a good idea of what type of hardware you're planning to install. If not, however, you can choose the first option, Show All Devices. Once you make a selection and click Next, the Add Hardware Wizard will provide you with a list of all of the available drivers that are installed on the system. As shown next, the list of available drivers is grouped by manufacturer, and then by the model of the hardware. Notice that this step of the wizard will also tell you whether or not a particular driver is digitally signed (you'll read the details of digital signing later in this chapter).

If the manufacturer and model of the hardware that you want to install are shown in the list, you should select the appropriate items and click Next.
In some cases, you will not be able to find the hardware that you want to install in the list. To install hardware in this situation, you must have access to Windows Server 2003 drivers that support the hardware. To provide your own drivers, click Have Disk. As shown next, you'll be prompted to provide the location of the drivers. This location can be a location in the file system (such as “C:\Drivers”), a location on removable storage media (such as floppy disks or CD-ROMs), or it can be a network location (assuming your network is properly functioning). Specifically, the Add Hardware Wizard will search for *.inf files in the location that you specify. These files provide details about the driver and how it should be installed.

As shown next, you'll be provided with a list of the driver or drivers that are described in the *.inf file. You should select the appropriate driver for the hardware that you are planning to install and then click Next.

Whether you choose to install a driver from the list of available manufacturers and models or if you choose to supply the driver manually, you'll see a confirmation that tells you which driver is about to be installed and configured.
When you click Next, the Add Hardware Wizard will start to load the specified drivers. During the installation process, you may receive a warning if the driver has not been digitally signed (you’ll read the details later in this chapter). Finally, once the Wizard has completed, you will see information that the device is ready for use. If, for some reason, the driver was not properly installed, you will need to perform additional hardware troubleshooting (a topic treated later in this chapter).

Now that you’ve walked through the process of installing new server hardware, let’s look at how you can monitor what’s installed on your system.

CERTIFICATION OBJECTIVE 2.02

Configuring, Managing, and Monitoring Server Hardware

Once you have performed the initial installation of your hardware devices, you may occasionally want to check on the status of your hardware and the device drivers that are installed in the system. Windows Server 2003 provides several different ways in which you can monitor your server hardware. Let’s start by looking at the most familiar and powerful tool: the Device Manager.
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Monitoring Hardware Using the Device Manager

If you’ve had experience with configuring hardware on any Microsoft operating system starting with Windows 95, you’re probably familiar with the Device Manager. The Device Manager is designed to provide a graphical method for viewing and configuring the hardware (and associated device drivers) that are installed in your system. There are several ways to access the Device Manager, including these:

- Launch the Computer Management item from the Administrative Tools program group. Click Device Manager.
- Right-click the My Computer desktop icon and choose Manage. Click Device Manager.
- Launch the System Control Panel applet and select the Hardware tab. Click the Device Manager button.

Figure 2-4 shows an example of the default screen of the Device Manager’s user interface. The default interface displays information about all of the hardware that is connected to the system, grouped by the type of the device. To view a list of devices in any category, simply expand the appropriate branch.

The Device Manager has several different view options. You can view a list of these by right-clicking the top node of the Device Manager and selecting the View menu, or by choosing the appropriate option from the View menu of the MMC console. The options include:

- Devices by type  This is the default view that most users and systems administrators are used to seeing in the Device Manager. All of the hardware in the computer is grouped by type. For example, all fixed storage devices are listed under the “disk drives” grouping, and all standard network adapters are listed under the “network adapters” grouping. This view is best...
for getting an overall snapshot of hardware installed in your system, if you know which device(s) you want to configure.

- **Device by connection** This option allows you to view all of the devices that are attached to the computer, grouped by their type of connection (see Figure 2-5). For example, you may be able to navigate the following branch: Standard PC | PCI Bus. This will provide you with information about all of the PCI devices that are currently connected to the computer. Similarly, you could drill down to view the device or devices that are attached to specified USB ports.

- **Resources by type** When you’re troubleshooting issues related to resource access, you can choose this option to view resources grouped by type. As shown in Figure 2-6, the groups include DMA, IRQ, I/O, and Memory (all of which you read about earlier in this chapter). By expanding a branch, you can view all of the devices that are using that type of resource. For example, to view details about IRQ usage, simply expand the IRQ branch. All of the IRQs will be listed in order, along with the device(s) that are using each resource. This view provides a quick and easy way to isolate any resource conflicts or to simply get a quick snapshot of resource usage.

![FIGURE 2-4 The default view of the Device Manager](image-url)
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FIGURE 2-5  Viewing device information, grouped by connection

FIGURE 2-6  Viewing resource information, grouped by type
Resources by connection  This view is similar to the “resources by type” option, but it allows you to view device information grouped by connections. Again, the top-level groupings will include the various resource types that are in use. By expanding a branch, you can drill down into the various connections that are using resources (see Figure 2-7).

Show hidden devices  When hardware has been removed from the system, or if certain types of legacy hardware are present, the default display of the Device Manager might hide these items. By checking the Show Hidden Devices option, you can be sure that you’re viewing information for all of the hardware that has been connected to the machine.

Many times in the past (when consulting or working with other IT staff), I’ve run into systems administrators that claim that the Windows platform is unstable or that they have to regularly reboot their servers in order for the servers to work properly. Microsoft Windows Server 2003 is the evolution of many versions of the Windows platform, and regular system crashes should not occur. If they are occurring, you should look into your hardware configuration to find possible compatibility issues. A poorly written driver can cause problems with overall system stability. Of course, there could be other causes of instability, including application memory leaks. However, you should always start by...

FIGURE 2-7  Viewing resource information, grouped by connection
assuming that the problem is not Windows itself, but instead your configuration!

Generally, the Device Manager will include a list of all of the hardware that is currently installed and configured on your computer. If all is well, the default view will have all of the device types collapsed. However, if there is a problem (such as an incorrectly installed driver or a disabled driver), the Device Manager will automatically expand the appropriate device type node. You will see either a yellow exclamation mark (which specifies that a device driver is not properly installed for this hardware device), or a red X if a device driver is disabled. Figure 2-8 provides an example. Later in this chapter, you’ll see how you can troubleshoot these types of problems.

If you have recently added new hardware to the system, it may not automatically show up in the Device Manager view. To force a refresh of the information shown in the display, you can click the Scan For Hardware Changes button, or you can select Action | Scan for Hardware Changes. This operation will scan for new hardware devices that are connected to the computer. If new hardware is detected, the Add New Hardware Wizard may be automatically launched.

One additional useful feature is that you can also use the Device Manager to view resource information about remote computers. To do this, simply right-click
the Computer Management (Local) icon (from within the Computer Management administrative tool), and select Connect to another computer. You’ll see a dialog box (shown next) that allows you to specify to which computer you want to connect. As long as you have the necessary permissions on the remote computer, you’ll be able to view the Device Manager’s information for that machine. There is one limit to this feature, however: The information that you see is read-only. That is, you can’t make driver or resource configuration changes on remote computers.

Now that you have a good overview of the Device Manager, let’s look at some other ways in which you can monitor server hardware.

**Using the System Information Tool**

Often, when you’re working with an installation of Windows Server 2003, you want to get a quick snapshot of the server’s configuration. Although you could open the Device Manager and expand various branches to find details about particular devices, this may not provide the information you’re looking for. Fortunately, there’s a better way to get a system summary.

The System Information tool is somewhat buried within the Start menu. To launch it, choose Start | Programs | Accessories | System Tools | System Information. After a few seconds, you’ll see a quick, high-level summary of the status of your system (see Figure 2-9).

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**In the real world, you’ll often want to get a quick snapshot of the hardware installed on a server. This can most easily be done by choosing Start | Run and typing msinfo32. This will launch the System Information tool. This will also work on Windows 2000 and Windows XP computers.**
There are several very useful features in the System Information tool. Related to monitoring server hardware, the “Hardware Resources” section can provide a great deal of information. Within this branch you can view details grouped by resource usage (see Figure 2-10). If you suspect that your computer is experiencing a hardware resource conflict, this is a good place to get details.

The System Information tool provides several useful features for tracking information. The first is the ability to save (and later open) *.nfo files. Both of these options are available from the File menu. When you choose to save the current information to a file, the System Information tool will collect all of the data that it needs and then create a new file with the name that you provide. This is a simple (and almost effortless) way to create basic server documentation! It’s also a good way to keep track of configuration changes over time. By comparing system information from various points in time, you can see when changes have occurred. Note that, on most
systems, it can take up to several minutes for the System Information tool to collect all of the data that it needs.

The *.nfo file that’s created with the Save command is generated in a special format that can be viewed only using the System Information tool. In some cases, you might want to dump all of the data to a single text file. The Export command (available on the File menu) does exactly that. Note that, unlike the Save command, the Export command will save only the information that is contained within the selected portion of the System Information display. So, for example, if you want to save only IRQ-related hardware resource information, you can click the appropriate branch in the tree and then use the Export command. You can view the resulting text in any text editor (such as Notepad), or you can create scripts or applications that can parse the output for useful data. Figure 2-11 shows an excerpt of the data collected from my desktop computer.
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**FIGURE 2-11** Viewing exported IRQ resource usage information

```
Local Server IRQ Usage.txt - Notepad

System Information report written at: 05/30/03 11:58:48
System Name: win2003server

Resource Device Status
IRQ 14 Primary IDE Channel OK
IRQ 15 Secondary IDE Channel OK
IRQ 16 BusLogic MultiMaster PCI SCSI Host Adapter OK
IRQ 10 AMD PCnet Family PCI Ethernet Adapter #3 OK
IRQ 0 System Timer OK
IRQ 1 PC/AT Enhanced PS/2 keyboard (101/102-Key) OK
IRQ 4 Communications Port (COM3) OK
IRQ 8 Communications Port (COM2) OK
IRQ 6 Standard floppy disk controller OK
IRQ 8 System CMOS/Real time clock OK
IRQ 13 Numeric data processor OK
IRQ 12 VMware Pointing Device OK
```

**FIGURE 2-12** Viewing the Conflicts/Sharing node in the System Information tool
In terms of monitoring hardware, there's one particularly useful section of the Hardware Resources node: Conflicts/Sharing. This node, shown in Figure 2-12, can provide information about any hardware devices that are sharing the same resources. This is a good first place to look when you suspect that your server might be experiencing problems related to resource assignments. However, note that just the presence of items in this display does not necessarily mean that something is wrong with your configuration. For example, in modern systems, multiple devices may be sharing the same IRQs, and this may not cause any problems.

Another useful feature is the Search option at the bottom of the System Information tool. If you know the name of a device or driver that you want further details about, you can enter the name of the item and have the tool search through the configuration information for it.

Finally, the System Information tool isn't limited to just viewing information about the local machine: You can also view information about another computer on the network using the View | Remote Computer option. As you can see, the System Information tool can provide a great deal of useful information about a system in a single place!

Now that you have a good idea of how you can view information about server hardware resources, let's look at how resources can be managed.

### SCENARIO & SOLUTION

<table>
<thead>
<tr>
<th>You want to get a quick inventory of the complete hardware configuration of the local machine. You also want to save this information to a text file.</th>
<th>Use the System Information tool to view the information. The Export command will allow you to save the content to a text file (or to a *.nfo file).</th>
</tr>
</thead>
<tbody>
<tr>
<td>You suspect that some hardware in your system is experiencing a resource conflict. You want to determine which device(s) might have conflicts.</td>
<td>Use the Device Manager or the System Information tool. In the Device Manager, you can change the display to view information based on resource usage. And in the System Information tool, you can access the Hardware Resources</td>
</tr>
<tr>
<td>You want to view hardware-related information for a remote computer.</td>
<td>Both the Device Manager and System Information tools enable you to view information from a remote computer.</td>
</tr>
</tbody>
</table>
Configuring and Managing Server Hardware

After your server has been set up and is running properly, you might want to make some changes to the hardware configuration. Common tasks include updating device drivers (to fix bugs, add features, or improve performance) and changing device settings (perhaps due to changing requirements for the server). As you might have expected, Windows Server 2003 provides many different tools that allow you to configure your hardware. In this section, you'll look at the features that can help you optimize and better manage your server’s hardware platform.

Although this isn’t always easy for technical people, it’s important to resist the urge to make hardware-related changes just to see what will happen. In general, if your server is functioning properly, you should avoid making changes, unless you have a clear reason to do so. For more details on taking an organized approach to improving system performance, see Chapter 8.

Configuring Device Properties and Settings Using the Device Manager

Many types of hardware devices can have settings. For example, you might be able to specify the transfer rate data transfer mode that should be used on an IDE disk controller, or a network adapter may allow you to set various transmission options. The Device Manager is the main tool that you’ll use to configure your hardware settings. To access detailed settings for a device, simply right-click a device in the Device Manager and select Properties. Depending on the type of hardware that you choose (and the specific device driver that is installed), you may see some or all of the following configuration tabs:

- **General** The General tab (shown in the following illustration) is available for all types of device drivers, and as its name suggests, it provides you with a high-level overview of the status of the device driver. The information presented includes the device type and the name of the manufacturer of the device. The Device Status box describes the current status of the hardware, in text form. There are two functions that you can perform from the General tab. The first is to click Troubleshoot to launch a Hardware Troubleshooter from the Windows Server 2003 Support and Help Center. The troubleshooter that is launched may be a generic one, or it may be specific to the type of hardware...
you are viewing. The other option is to specify whether the device is enabled or disabled.

**Driver** This tab is also available for all device drivers that are installed on the system. Important information includes the provider of the driver (generally either “Microsoft” or the name of the manufacturer of the hardware device), the date of the driver, and the version of the driver. This information is extremely useful when you want to check which driver you’re using. For more information about the specific files that are included in the device driver (along with their versions), you can click the Driver Details tab. You’ll learn about the other three options later in this section.
Resources  On the Resources tab, shown next, you’ll see which resources are being used by the specified hardware device. This tab will be available only if the hardware that you select is actually using resources. For example, hard disk controllers will use resources (such as memory addresses and IRQs), but hard disk devices will not (since they use the same resources as the controller to which they’re attached). For many types of devices, you will be unable to configure hardware resource settings manually. This is because the settings are managed by the computer’s BIOS and/or the Windows Server 2003 operating system. For legacy devices, however, you may be able to change resource settings, if necessary.
In the not-so-distant past, having to manually manage resource settings for hardware was a common task. However, on current hardware platforms, this is rarely necessary. You should generally think of the manual management of hardware resources as a last resort to troubleshooting hardware-related issues.

In addition to these properties tabs, there are several others that can provide device-specific configuration information. For example, a mouse device might include an Advanced Settings tab that allows you to fine-tune the performance of the mouse.
Storage devices, in particular, have several other options. For example, you can configure write caching for hard disks on the Policies tab. Also, you can view additional details about the logical volumes that are contained on a physical hard disk by selecting the Volumes tab and clicking Populate. For more information on configuring storage resources, see Chapter 5.
Exercise 2-1 walks you through the process of viewing configuration options for various types of devices.

**EXERCISE 2-1**

**Configuring Hardware Using the Device Manager**

Note that in this exercise, you will walk through configuration options for several different types of hardware. You will not be making any configuration changes, to prevent any hardware-related problems. In some cases, your server may not have all of these devices installed, so you may have to skip a step. You should also be able to perform all of these steps on a client computer that is running Windows 2000 or Windows XP.

1. Log on to the computer as an Administrator and open the Device Manager by selecting the Computer Management administrative tool and clicking Device Manager.
2. Your first step will be to view configuration options for an IDE disk controller. Expand the branch for IDE ATA/ATAPI Controllers. You will likely see a hardware device listed as the controller, as well as two IDE channels. Right-click the primary IDE channel device and click Properties. Then, select the Advanced tab. As shown in the illustration, you will see information about the transfer mode for the devices that are attached to this IDE channel. When finished, click Cancel.

3. Next, let’s look at the properties for a hard disk drive device. In the Device Manager, expand the Disk Drives node, right-click a hard disk, and select Properties. Select the Policies tab to view write caching options for this hard disk. Depending on your specific system configuration, some of the options may be disabled (see illustration). For example, if the hard disk is not removable, the option to Optimize For Performance will be selected, by default. Note that you can choose whether you want to enable write caching and, if so,
if you want to use the Advanced Performance option. This latter option
could lead to the loss or corruption of data in the case of a power failure
or improper server hardware, but it can improve disk write performance
through the use of caching. When finished, click Cancel.

4. Now, take a look at some configuration options for common external hardware
connections. In the Device Manager, expand the Ports (COM & LPT) node.
Right-click any Communications Port device and select Properties. Select
the Port Settings tab. Note that you can specify various options related to the
data transfer rate and method for the serial port. These options are useful for
troubleshooting issues that might occur when you try to use devices that are
connected to the serial port. When finished, click Cancel.
5. Your final stop on this tour of device properties is the Advanced properties for a network adapter. To access these properties, in the Device Manager, expand the Network Adapters node. Right-click a network adapter and select Properties. Click the Advanced tab. If your network adapter driver provides configuration options, you will see a list similar to that shown in the illustration. These settings can be used to optimize network performance, or to troubleshoot specific network-related issues. For example, you may be able to specify whether the network adapter is operating in half- or full-duplex mode. When finished viewing the properties, click Cancel. Close the Device Manager.
We left a couple of loose ends in covering the operations that you can perform using the Device Manager. Let's look at those, next.

**Updating Drivers Using the Device Manager**

After a server is up and running properly, one of the most commonly performed tasks for systems administrators is to update device drivers. There are several reasons to stay up-to-date with the latest device drivers. First and foremost, newer device drivers can fix bugs that resolve potential issues. Since the failure of critical device drivers can lead to downtime, this reason alone is probably enough to warrant the updates! There are other reasons to update drivers, however. The overall performance and feature set of many types of modern hardware are often based largely on the quality of their drivers. For example, in the area of video performance, updated drivers can provide significant performance enhancements in demanding applications (especially games). The same can be true for network adapters drivers, disk storage controllers, and practically any other device that you can install on your server.
In some cases, if you want to live on the cutting edge of technology, you might get cut! On critical systems, you might want to hold off on being the first in line to install the latest drivers or system patches. By letting others test the software first, you might avoid some potential problems or issues that were not known at release time.

Fortunately, the process of updating drivers is a fairly simple one. If you want to update a driver for a device that is already configured on your system, start by opening the Device Manager, right-clicking the appropriate device, and selecting Update Driver. Alternatively, you can click the Update Driver button on the Driver tab in the properties of the hardware device. This will launch the Hardware Update Wizard, which will walk you through the steps that are required to update a device driver.

Much of the process of updating a driver is similar to the process of adding new hardware to the system (a topic covered earlier in this chapter). The first decision you’ll have to make is whether you want the wizard to automatically search your system for an updated driver. This option is useful if you have recently installed new driver versions on your system and you want those drivers to be automatically chosen.
The other option that you have with the Hardware Update Wizard is to manually choose the driver that you want to install (the option reads, Install From A List Or Specific Location (Advanced)). As shown next, you have several options. The default is to have Windows Server 2003 automatically search removable media devices. This is useful if you have a CD-ROM or floppy disk that contains updated drivers. Just insert the media into the appropriate device, and the Wizard will search it for updated drivers. You can also choose to specify a location in which the Wizard should search for new drivers (for example “C:\Download\Drivers”). Click Next to begin the search process. If the Wizard finds appropriate updated drivers, they will be installed automatically. If not, you’ll be informed that no changes were made.

The other advanced option in the Hardware Update Wizard is labeled, “Don’t search. I will choose the driver to install.” When you select this option, you will be presented with a list of compatible hardware device drivers that Windows Server 2003 is aware of. The list will include the currently installed driver, along with any newer and older versions of the driver that are available.
If you don’t see the driver that you want to install in the list, you have two options: The first is to uncheck the Show Compatible Hardware box. This will present you with a list of hardware manufacturers and models from which you can choose the driver to install. The other option is to click Have Disk and to specify the file system or network location that contains the driver files that you want to install.

Once you have completed selecting drivers in the Hardware Update Wizard, the Wizard will attempt to install the drivers. If the installation is successful, you’ll see the message shown next (you’ll read about troubleshooting later in this chapter). Note that the installation of some types of drivers might require you to reboot the computer before they go into effect.
Uninstalling a Hardware Device

Most internal components of modern PCs can be removed only when the server hardware is powered off. For such devices, it’s often possible to remove the device without informing the Windows Server 2003 operating system. For example, if you want to remove a network adapter, you must first power off the server. Then, you can open the server and physically remove the adapter card (assuming, of course, that it is a removable expansion card). Then, when you reboot the computer, Windows Server 2003 will automatically detect that the device has been removed.

In some cases, you might want to remove or uninstall an item using the Device Manager before you physically remove the hardware. To do this, you can simply find the appropriate hardware device in the Device Manager. Right-click the device that you want to remove and click Uninstall to remove that device from the system’s configuration.

On servers that support the hot-swapping of hard disks, there are some special considerations that you should take into account to ensure that there is no data loss. Details on disconnecting hard disks and importing “foreign disks” is covered in Chapter 5.
Disabling Hardware Devices

Windows Server 2003 allows you to disable devices that may otherwise be properly installed and running on the system. Although it’s not common to want to disable a hardware device, you can do this to troubleshoot potential conflicts between hardware components, or to prevent the use of some functionality on the server. For example, you may have multiple physical network adapters installed and configured on a server. If you move the server to another network, you may not want all of these network adapters to be functional (perhaps for security purposes). Although you could physically remove the network adapter from the computer (assuming that it is a removable card), it’s easier to just tell Windows Server 2003 to disable it.

The process is simple and can be performed in one of two ways. To disable a device, you can right-click it in the Device Manager and select Disable. Or, you can select the General tab of the properties for the device and use the drop-down list for Device Status to specify whether the device should be enabled or disabled.

Once a device has been disabled, it will still appear in the Device Manager, but the item itself will have a red X on it. When you view the properties of this device, the General tab will show further details (see the following illustration). Generally, the device will be unavailable for use by the system. For example, if you disable a specific hard disk, it may appear as “offline” or may not be available in the Disk Management utility.
To reenable the device, you can simply click the Enable Device button, or you can choose Use This Device (Enable) from the Device Usage drop-down menu.

**Configuring Hardware Using the Control Panel**

The Device Manager can be used to view and modify various details about hardware devices that are installed on your system. For some types of hardware, however, the Device Manager is limited. Certain types of hardware have additional settings that you may want to configure. A common operation is to adjust the display resolution, color depth, and refresh rate for your monitor and display adapter. To handle these kinds of details, you can use various applets that are located within the Control Panel.

In relation to hardware configuration and monitoring, here are some useful Control Panel items:

- **Add Hardware**  This icon launches the Add Hardware Wizard, covered earlier in this chapter.

- **Display**  You can configure various display settings by accessing the Display Properties. These properties allow you to set various options that control how Windows Server 2003 looks. For example, you can change desktop settings on the Themes, Desktop, and Appearance tabs, and you can change the screen saver settings on the Screen Saver tab. Specifically, related to hardware, the Settings tab includes options related to the resolution and color depth of the display.
The two buttons on this page provide even more options. If you are experiencing problems with the display, you can click Troubleshoot to launch the Video Display Troubleshooter (see Figure 2-13). The Troubleshooter will walk you through a series of questions and will make recommendations to fix the most common problems. By clicking Advanced, you can access more properties of the display settings, including any device driver–specific options.

Note that you can also access the Display properties by right-clicking on the desktop and choosing Properties.
Game Controllers Although you’re probably not going to use this option often on your production servers, you can configure game controllers (such as game pads, joysticks, and steering wheels) using this applet.

Keyboard This tab provides options for fine-tuning keyboard performance. You can specify the key repeat rate and delay, as well as the cursor blink rate. Many third-party keyboard drivers provide various extensions that allow the configuration of additional buttons, the mouse wheel, and other hardware-specific options.

Mouse This applet allows you to configure settings for the mouse that is attached to the computer. Options include setting mouse cursor types and mouse performance. Often, third-party input drivers provide additional tabs and functionality via this applet.
Network Connections These settings are primarily intended to allow systems administrators to configure network options (such as TCP/IP addresses), but they can also be used to view and modify network adapter device configuration.

Phone and Modem Options These settings enable you to specify settings for analog communications, including any dialing prefix that may be required to access an outside line.

Power Options In an effort to decrease power that is wasted by idle computers, modern machines provide the ability to automatically enter various power savings modes. On most production server systems, the Always On option is the most appropriate. For details regarding other options, see the Windows Server 2003 Help and Support Center.
Printers and Faxes  As its name implies, this applet allows you to configure print devices and fax devices. For more information, see Chapter 4.

Scanners and Cameras  Digital cameras and scanner devices are common on desktop computers. Using this Control Panel applet, you can add, remove, and configure scanners and cameras.

Sounds and Audio Devices  In addition to the basic hardware settings that are available for audio hardware, these settings allow you to further fine-tune sound output. For example, on the Volume tab, you can indicate what types of speakers are connected to the computer.

System  Through the use of this Control Panel applet, you can monitor and manage various areas of the system configuration. In relation to hardware resources, you can access the Device Manager (covered in detail throughout this chapter), the Performance Logs and Alerts functionality (see Chapter 8), and the Disk Management utility (see Chapter 5).

All of these Control Panel applets provide additional configuration methods for managing and troubleshooting all of the many hardware devices that might be present on computers that you support. Although not all of them will be used frequently on
Chapter 2: Implementing and Managing Hardware

CERTIFICATION OBJECTIVE 2.03
Troubleshooting Server Hardware

When managing the servers in your environment, it may become necessary to troubleshoot hardware problems. Issues can arise from improper driver installation, from poorly written drivers, or from a variety of other types of problems. You should always treat hardware-related issues seriously, since they can result in unscheduled downtime or intermittent errors. Remember, just about everything your server does is dependent on the hardware it’s running on! In this section, you’ll look at many different ways in which you can troubleshoot hardware problems using the tools provided with Windows Server 2003.

General Hardware Device Troubleshooting

Throughout this chapter, you’ve looked at various features in Windows Server 2003 that can be used for managing hardware. Some of these tools and techniques can also

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>You want to change resource settings for a legacy sound card.</td>
<td>Access the Resources tab of the properties of the sound card in the Device Manager.</td>
</tr>
<tr>
<td>Recently, you have moved your multihomed computer to a different subnet. You want to disable one of the network adapters on the machine without physically removing it.</td>
<td>In the Device Manager, right-click the appropriate network adapter item and disable it. This will prevent the hardware from being usable in Windows Server 2003.</td>
</tr>
<tr>
<td>A vendor has recommended that you update drivers for a SCSI controller to improve performance and fix some minor bugs.</td>
<td>Use the Update Driver feature in the Device Manager. You can either right-click the SCSI device and choose Update Driver or click the Update Driver button on the Driver tab of the properties of the device.</td>
</tr>
<tr>
<td>You want to configure some advanced driver-related settings for a network adapter that you recently installed in a server.</td>
<td>Use the Device Manager and access the Advanced tab for the properties of the device.</td>
</tr>
</tbody>
</table>

your server machines, be sure that you know where to go to configure details for a specific type of hardware device.
be used for troubleshooting. Here are some general hardware troubleshooting guidelines that can be used to isolate and resolve common issues:

- **Keep your systems up-to-date**  I’ve already mentioned several times in this chapter that the proper functioning of hardware devices often depends on the quality of their drivers. As you perform routine maintenance on your servers, be sure to remember to check for updated device drivers. One quick and easy way to find the latest drivers is to use the Windows Update functionality (see Figure 2-14, and Chapter 8 for more information).

  *Keeping up-to-date with the latest drivers can sometimes offer benefits to system performance and reliability. However, in some cases, the latest drivers may not be the “greatest.” If your systems are working properly, you might want to consider leaving them running with their current drivers. Of course, be sure to keep your eyes open for updates that resolve potential problems and look for significant enhancements.*

**FIGURE 2-14** Updating device drivers in Windows XP using Windows Update
Chapter 2: Implementing and Managing Hardware

- **Create a test environment** If you are considering updating drivers on a critical production server, it is very helpful to verify the proper functioning of the drivers in a test environment. In the real world, this can be particularly difficult, since test hardware may not be identical to high-performance production machines. However, if you can detect problems before you modify your most important systems, the potential time and cost savings can be great!

- **Maintain a log of hardware changes** Troubleshooting hardware issues can be difficult, especially when problems are intermittent. Particularly in environments in which multiple systems administrators might be able to modify server hardware configurations, it’s important to keep track of all changes. This might be done simply through the use of a text file or a Word document in which the date and time of a change, along with the purpose and details of the change, are documented. Then, whenever issues arise, you can look through the change log to find a potential correlation between a change and the problems that you’re experiencing. As with many other areas of systems administration, there aren’t any good alternatives to using good management techniques.

- **Use Hardware Troubleshooters** Many systems administrators totally ignore online help and troubleshooting tools because these often focus on only the simplest of issues. For example, I personally don’t feel like I need a help file to tell me to verify whether a network cable is plugged in. In some cases, help files may be annoying, at best. However, the Troubleshooters that are available within the Windows Server 2003 Help and Support Center can be very helpful. Generally, it takes only a few minutes to walk through one of the troubleshooters, and the information can remind you to check the obvious. You can access Hardware Troubleshooters by clicking the Troubleshoot button on the General properties of a device.

Now that you have a good idea of basic troubleshooting techniques, let’s look at some specific features in Windows Server 2003.

**Configuring Driver Signing Options**

A disappointing aspect of working with many modern computers and hardware devices is that vendors and manufacturers often cut corners when developing device drivers. Unfortunately, these drivers can cause serious system problems, many of which are
difficult to troubleshoot. Microsoft has found that a significant portion of server reliability issues are caused by poorly written device drivers. In an attempt to alleviate these problems, the company has created a program for testing and verifying device drivers to ensure that they meet the guidelines and requirements for properly running on various versions of the Windows platform.

In order to meet these standards, hardware manufacturers must submit their device drivers to Microsoft for testing. Drivers that have passed Microsoft's review process are granted the use of a “Designed for Microsoft Windows Server 2003” certification, which assures systems administrators that the device drivers have been reviewed by Microsoft. Note, however, that this cannot provide a 100 percent guarantee that you won't have problems; it just provides some added reassurance. In order to prove that drivers have been properly tested, Microsoft provides digital signing features in Windows Server 2003.

By default, whenever you attempt to install a driver that has not been digitally signed, you will receive a warning message. You can still choose to continue the installation of the driver, or you can choose to abort it.

To configure driver signing, you should launch the System Control Panel applet. Click the Hardware tab and then select Driver Signing. As shown next, there are three options for driver signing configuration.
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**Ignore**  This setting effectively disables any warnings associated with the lack of a digital signature. Drivers, whether they are signed or unsigned, will be automatically installed without any warning. This is the least restrictive (and most dangerous) option.

**Warn**  This setting, which is the default for new installations of Windows Server 2003, provides a warning whenever an unsigned driver is being installed. Users will be able to specify whether or not they want to continue the installation.

**Block**  This setting specifies that the system will not allow installation of unsigned device drivers. This is the most restrictive (and safest) option available. The rules are simple: If the driver is not signed, it cannot be installed into the operating system. Here is the error message that you'll receive when you attempt to install an unsigned driver:
There is also an option to make these settings the defaults for all users on the system. Ideally, you would install only drivers that are certified by Microsoft (particularly on important production systems). However, some hardware vendors do not want to go through the time and cost of getting their drivers certified. A good general rule of thumb is to be especially wary of drivers that have not been digitally signed.

**Using File Signature Verification**

Software installation routines can make many different types of changes to your system configuration. Sometimes, products may automatically install updated drivers or replace critical system files with other versions. The end result can be numerous problems, especially if other applications and operating system features are depending on the replaced files.

To help get around these potential problems, Microsoft has digitally signed all of the files that are included with the operating system. By checking for a digital signature for critical system file and drivers, systems administrators can ensure that they are using safe versions. If a file is lacking a digital signature, it is likely that it was replaced through the installation of another product or device driver. This is a good way to track down issues that might have been caused by the installation of unsigned drivers.
The File Signature Verification tool can be used to perform an automated search of all of the files located within the Windows Server 2003 system root directory. It can then return a report of any files that are not digitally signed. To launch this tool, click Start | Run and type `sigverif`.

When you click Advanced, you can specify which files will be scanned. Also, the default option is to store the signature verification results in a text file called `SigVerif.txt`. You can change the logging options to specify if and how the log file should be written. To begin the signature verification process, click Start. The verification process may take several minutes, because several thousands of files must be scanned.

When the process is complete, you’ll see an on-screen report of any files that are not digitally signed. You can use this information to identify driver files or system files that have been overwritten or that have not passed Microsoft’s verification testing.
Exercise 2-2 walks you through the process of configuring driver signing options, and of using the File Signature Verification tool.

**EXERCISE 2-2**

**Configuring Driver Signing Options**

1. Log on to the computer as an Administrator and open the System Control Panel applet. Click the Hardware tab.

   ![System Control Panel Hardware Tab]

2. First, you are going to examine the driver signing options for the local Windows Server 2003 machine. Click the Driver Signing button to access the driver signing device settings. There are three main options for the device driver configuration settings (see the earlier section “Configuring Driver Signing Options”): Ignore, Warn, and Block. The default option, Warn, allows the installation of unsigned drivers after a warning is displayed.
If you want to ensure that only signed drivers are installed, you can select the Block option. For the sake of this Exercise, make no changes. Then, click OK twice to exit the driver signing properties.

3. Next, open the File Signature Verification tool by choosing Start | Run and typing sigverif.

4. Before you start the file signature verification process, make some configuration changes that affect how the utility will be run. Click Advanced to access these options. On the Search tab, leave the settings at their defaults. Note that, in addition to searching system files, you can choose to search any local file system directory. You can also restrict the search to examining only certain file types (*.dll files, for example).

5. Click the Logging tab. The default options are to save the file signature verification log to a file. By default, this information will be stored to a text file called SigVerif.txt, and it will be located within the user’s \Windows folder (for example, “C:\Documents and Settings\User1 \Windows”). Ensure that the first option is checked, and that you have chosen to overwrite the log file. Change the name of the log file to SigVerif-Test.txt. Note that you can also provide a fully qualified local path, such as “C:\Data\SigVerif-Test.txt.” Then, click OK.
6. To begin the file signature verification process, click Start. Since you have chosen the default option of analyzing all system files, the process could take up to several minutes to complete.

7. When the tool is finished scanning your system files, you'll see a new window that lists any files that were not digitally signed. You'll also see statistics related to how many files were scanned. When finished, click Close twice to exit the File Signature Verification Tool.

8. Optionally, load the file that you specified in step 5 in a text editor (such as Notepad) and view the details about which files were scanned.
Using Device Driver Rollback

Sometimes, the installation of a new device driver might introduce problems in Windows Server 2003. For example, you might start experiencing intermittent network connectivity issues after you update the device drivers for a network adapter. Or, a device such as a mouse or keyboard may stop working when updated. To resolve these types of issues, you can use the device driver rollback functionality from within the Device Manager.

You can access the device driver rollback feature by opening the Device Manager and viewing the Driver tab of the properties of a hardware device. To begin the process, click Roll Back Driver (see the following illustration). You will be prompted to confirm this action. If you select Yes, the driver will be reverted to its earlier version. Note that you may be required to reboot the computer for some driver changes. Overall, this is a handy way to go back to a known good configuration if an updated driver is causing problems.
Using the “Last Known Good” Configuration

Windows Server 2003 depends on the successful functioning of many different types of hardware devices and device drivers in order to boot properly. If an incorrect or poorly written device driver is loaded for a critical system component (such as hard disk controller), the operating system may fail to start. Fortunately, there’s a quick and easy way to try to solve this problem.

One of the boot options that’s available on the Windows Server 2003 startup menu is to choose the “Last Known Good” configuration. You can access this menu by pressing the F8 key just before Windows Server 2003 begins booting, or by selecting special options from the boot menu. This feature relies on the fact that, after every successful system interactive logon, the operating system saves its configuration information. This information includes driver versions, hardware settings, and other details. When you choose the Last Known Good option from the boot menu, Windows Server 2003 will start up with older configuration information. Generally, this will allow you to access the operating system and to make any necessary configuration changes to restore the server to working order.

Note, however, that there is a major limitation to using the Last Known Good boot option. Since the configuration information does not include copies of actual driver files, if your new driver installation overwrote or deleted some of the older files, this process may not work. In that case, your best bet would be to try to use the device drive rollback functionality (assuming, of course, that your server boots properly).

If you have just rebooted your server after making configuration problems and it appears to be acting erratically, don’t log onto the computer. Just power it off and try to reboot using the Last Known Good Configuration. This will prevent Windows Server 2003 from thinking that the boot process was successful and overwriting the previous Last Known Good configuration data.

There are several other options for troubleshooting boot issues. See Chapter 6 for more information on other boot options and details about using the Recovery Console.
Command-Line Hardware Troubleshooting Utilities

In addition to all of the hardware troubleshooting tools and features that you have considered thus far, Windows Server 2003 includes some additional utilities that can be used for diagnosing and resolving hardware issues.

One such utility is the DriverQuery command. As its name implies, the purpose of this tool is to build a list of information about all of the drivers that are installed on a computer. The DriverQuery command can be used to return information about the local computer, or to get information from a remote computer. Output can be provided in several formats, including table (the default), list, and comma-separated values. This makes it easy to use the DriverQuery command to document your server configuration from a basic script file. Figure 2-15 shows an example of running this command on a Windows Server 2003 machine.

Another useful command-line utility is the Device Console Utility. This utility can be run from a command line using the command DevCon. Though you might think that it would join your server to a Top Secret Military project, its purpose is...
to provide command-line access to the types of functionality that are available from
the graphical Device Manager tool. For example, you can use DevCon to view a list
of devices that are installed on the system, to scan for new hardware, to reconfigure
driver settings and options, and to disable device drivers. Figure 2-16 provides an
example of running the following command:

    DevCon Status *

For further details about these command-line utilities, see the Windows Server 2003
Help and Support Center.

Later in this book, you'll see
details related to performance monitoring
and optimization (covered in Chapter 8),
how to plan for and recover from various
types of server failures (covered in
Chapter 6), and the management
of storage resources (covered in
Chapter 5). All of these topics include
further information about techniques
for monitoring and resolving hardware
problems.

SCENARIO & SOLUTION

After updating a device driver for a SCSI controller,
the vendor notifies you that the driver might cause
stability problems in certain configurations. You want
to revert to using the older driver for the controller.

You want to obtain hardware driver–related
information from the command line.

You recently installed a new device driver on your
computer. However, when you reboot the system, the
to troubleshoot this issue with the least effort.

You suspect that another systems administrator has
installed nonsigned drivers on a Windows Server 2003
machine. You want to search for any nonsigned files.

Use the Rollback command within the properties
of the SCSI controller. This will load the previous
driver that was installed for that device.

The DriverQuery command-line utility can be
used to obtain a list of device drivers, or to return
details about specific drivers.

A good first step in trying to resolve this problem
is to try to boot the computer using the "Last
Known Good" configuration. This doesn’t require
significant effort, and it could immediately solve
the problem.

Use the File Signature Verification tool to search
for nonsigned files.
Chapter 2: Implementing and Managing Hardware

CERTIFICATION SUMMARY

The importance of proper hardware configuration on production servers cannot be overstated: Simply put, the hardware platform forms the basis for everything your server does. Throughout this chapter, you looked at many different server hardware-related tools and techniques. You began by taking a look at Windows Server 2003's hardware architecture, including the concepts of device drivers and plug and play.

Then, you looked at how you can install new hardware on your servers. The process is actually very simple, but it requires a basic understanding of hardware types. Next, you looked at ways in which you can monitor your server hardware, after it has been installed and configured. Windows Server 2003 also provides several different ways in which you can configure your hardware device, ranging from the Device Manager to device-specific Control Panel applets.

Finally, you looked at methods to perform the important task of troubleshooting server hardware problems. Fortunately, there are many methods for resolving these potentially serious issues. Drawing on the information presented on this chapter, you should be well prepared to tackle hardware-related issues—both on the exam and in the real world!
TWO-MINUTE DRILL

Install and Configure Server Hardware

- Most types of hardware devices require the use of one or more resources, including IRQs, DMA addresses, memory addresses, and I/O ports.
- Windows Server 2003 relies on the use of device drivers to interact with hardware devices.
- During the setup process, Windows Server 2003 automatically detects and installs as much hardware as possible.
- The Add Hardware Wizard can be used to install new device drivers.

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- The Device Manager provides several views through which you can monitor your hardware devices.
- If a device appears in the Device Manager with a yellow icon, this means that the driver for this device is not properly installed, or the hardware is not working properly.
- The System Information tool can provide a great deal of information relating to hardware resource usage and hardware-related conflicts.

Troubleshoot Server Hardware

- Driver signing is designed to allow only fully tested device drivers to be installed on a Windows Server 2003 computer. Systems administrators can configure options that specify whether device drivers must be signed.
- You can use the device driver Rollback functionality in the Device Manager to revert to the previous driver for a piece of hardware.
- The DriverQuery and DevCon command-line utilities can be used for obtaining hardware-related information from a command prompt.
- The Last Known Good boot option can resolve common driver-related issues that may prevent Windows Server 2003 from booting properly.
SELF TEST

The following questions will help you measure your understanding of the material presented in this chapter. Read all the choices carefully because there might be more than one correct answer. Choose all correct answers for each question.

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1. Rajesh is planning to install an old legacy hardware device into a computer that is running Windows Server 2003. He shuts down the server, installs the hardware, and then boots the operating system. After logging in to the server, he does not receive any messages. However, the device does not appear in the Device Manager. Which of the following tools should he run to most easily install the hardware?
   A. The System Control Panel applet
   B. Hardware Troubleshooter
   C. The Update Driver Wizard
   D. The Add Hardware Control Panel applet
   E. System Information

2. You are planning to install Windows Server 2003 on a two-year-old server that is currently running Windows 2000 Server. Before you begin the installation process, you want to make sure that the hardware platform is supported for this operating system. Which of the following methods can you use to verify compatibility before installing Windows Server 2003? (Choose all that apply.)
   A. The Windows Server Catalog web site
   B. The Add Hardware Wizard
   C. The Device Manager
   D. The Check System Compatibility feature of the Windows Server 2003 setup media
   E. The System Control Panel applet
   F. The File Signature Verification Wizard

3. Luis is installing a new plug and play network adapter into a server that does not currently have any network adapters. He physically installs the hardware and then boots into Windows Server 2003. After he logs on, he sees the Add Hardware Wizard. He follows the prompts to attempt to automatically find drivers for the new device, but the Wizard informs him that a suitable driver cannot be found. In which of the following ways can Luis directly provide the driver to the Wizard? (Choose all that apply.)
A. From a local directory
B. From a network share
C. From a floppy disk
D. From a CD-ROM
E. From the vendor's web site

4. In general, which of the following types of resources should not be shared between multiple physical hardware devices (choose all that apply)?
   A. Virtual memory
   B. Physical memory
   C. Storage resources
   D. Direct memory access (DMA) addresses

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5. You are hired as a consultant to assist in managing a server farm that includes 53 web servers. The servers were purchased at different times and therefore have different hardware configurations. In order to track server configurations, you decide that you want to take an inventory of all of the hardware and software installed on these machines. You want this information to be stored to a file that can later be used to view server configuration information. Which of the following tools/methods will allow you to most easily do this (choose all that apply)?
   A. System Information | Export
   B. Device Manager | Print
   C. The System Control Panel applet | Export
   D. System Information | Save As
   E. The Add Hardware Wizard

6. You want to change hardware device settings for this device, which is installed on ten different Windows Server 2003 machines in your environment. Which of the following can you use to change hardware resources? (Choose one.)
   A. A single instance of the Device Manager, running on one of the Windows Server 2003 machines
   B. An instance of the Device Manager running locally on each of the servers
   C. An instance of the System Information tool, running locally on each of the servers
   D. Both A and B
   E. Both B and C
   F. None of the above
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7. You suspect that more than one hardware device in your computer is using a specific IRQ, and that this is the reason a serial port device is not working. Which of the following views in the Device Manager will provide you with a sorted list of IRQs, along with the devices that are using them (choose all that apply)?
   A. Devices by type
   B. Devices by connection
   C. Resources by type
   D. Resources by connection

8. Rekha is experiencing problems using a mouse connected to a computer that is running Windows Server 2003. The problem seems to be that the mouse pointer is moving erratically across the screen, making it difficult to administer the computer. Which of the following can she use to view and/or change mouse-related options and settings. (Choose all that apply.)
   A. The Resources tab of the properties of the mouse in the Device Manager.
   B. The Driver tab of the properties of the mouse in the Device Manager.
   C. The Mouse Control Panel Applet
   D. The Advanced Settings tab of the properties of the mouse in the Device Manager

9. Following the installation of a second network adapter in your Windows Server 2003 machine, the server has automatically rebooted three times. Previously, you never had any problems with this server, so you suspect that the addition of the new hardware has caused the problems. Specifically, you believe that there may be a hardware resource conflict between two or more devices in the server. Which of the following tools will help you isolate or rule out any hardware resource conflicts most quickly?
   A. The File Signature Verification Wizard
   B. The System Information Tool | Hardware | Conflicts / Sharing
   C. The Add Hardware Wizard
   D. The Networking Control Panel applet

Troubleshoot Server Hardware.

10. Following the installation of an updated SCSI controller device driver, your Windows Server 2003 computer fails to reboot. Before the logon screen is displayed, the server spontaneously restarts the boot process. Which of the following methods can you use to troubleshoot the issue with the least amount of effort?
    A. Use the Device Manager to disable the SCSI controller.
    B. Use the Rollback function in the Driver tab of the properties of the SCSI controller.
C. Use the Windows Server Recovery Console.
D. Use the Safe Mode boot option.
E. Use the Last Known Good Configuration boot option

11. Which of the following command-line utilities will allow you to change the configuration of a device driver?
   A. DeviceManager.exe
   B. DriverQuery.exe
   C. DevMgr.exe
   D. DevCon.exe
   E. HWConfig.exe
   F. None of the above

12. In order to troubleshoot a network routing issue, Paul has decided that he wants to prevent Windows Server 2003 from using two of the three network adapters that are installed in a Windows Server 2003 computer. As a first troubleshooting step, he wants this option to be easily reversible. Which of the following methods will allow Paul to most easily accomplish these goals?
   A. Delete the driver files for the device.
   B. Disable the hardware device using the Device Manager.
   C. Reconfigure the network connection and assign it a static IP address.
   D. Use the Update Driver Wizard to install “loopback” drivers for the device.
   E. Use the Device Manager to uninstall the drivers for the network devices.

13. You are attempting to install a vendor-provided driver update for a display adapter that is installed on your computer. However, when you attempt to install the driver, you receive an error message stating that it cannot be installed. Based on this information, which of the following Driver Signing options is the server currently using?
   A. Prevent
   B. Warn
   C. Deny
   D. Ignore
   E. None of the above

14. Previously, another systems administrator was responsible for managing a specific Windows Server 2003 computer that seems to be experiencing intermittent lockups. You have been asked to troubleshoot the problem. You find that the Driver Signing option is set to Ignore,
and you suspect that unsigned drivers have been installed. Which of the following methods can you use to most quickly find out which unsigned drivers have been installed on the computer?

A. Access the Drivers tab in the properties sheet for all of the drivers that have been installed on the computer.

B. Access the General tab in the properties sheet for all of the drivers that have been installed on the computer.

C. Use the File Signature Verification Wizard.

D. Use the System Information tool.

LAB QUESTION

You are a systems administrator for an environment that supports 25 production servers. Recently, you upgraded all of the machines to run Windows Server 2003. These computers were purchased at different times, and with differing configurations. Many of the servers were originally implemented over two years ago, and they are beginning to show their age. Your organization has grown by 30 percent, and new applications and a greater reliance on network resources are putting significant strain on your servers.

You have been tasked with evaluating each server to determine whether hardware should be upgraded or entirely replaced. To make things more challenging, you have a limited budget. Since all of these servers are currently in production, your primary goal is to minimize the disruption of service when the hardware or software is upgraded.

Based on performance monitoring results for all of your servers, you make the determination to upgrade some servers and to completely replace others. Following the upgrades, you find that overall server performance is significantly improved (especially for the computers that were completely replaced).

However, you now find that four of the servers are experiencing intermittent issues, ranging from spontaneous system reboots to periodic application errors. None of these problems were experienced before, and other than the hardware upgrades or replacements, no other changes have been made. What are some steps you can take to monitor and troubleshoot these issues?
SELF TEST ANSWERS

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1. ✓ D. Through the use of the Add Hardware Wizard, Rajesh can force Windows Server 2003 to search for the legacy hardware device. He will then have the option of either installing or providing the appropriate drivers for the device.
   ✗ A, B, and E are incorrect because they do not allow for the installation of new drivers. C is incorrect because a hardware device must be visible in the Device Manager before the Update Driver Wizard can be used.

2. ✓ A and D. Both of these methods will allow you to verify the current hardware platform before you perform the installation.
   ✗ B, C, E, and F are incorrect because, although they may provide hardware-related information, they cannot provide you with details about whether the devices in your computer have passed Microsoft’s compatibility tests.

3. ✓ A, C, and D. Luis can specify that the driver files should be loaded from a removable media device (such as a CD-ROM or floppy disk), or from a folder that is located on the local file system.
   ✗ B is incorrect because, although a network path could normally be specified, the question clearly states that the server does not have any other network adapters. Therefore, until this device is configured, the drivers cannot be loaded from a network share. E is incorrect because Luis must first download the appropriate drivers from the vendor’s web site before they can be used by the Add Hardware Wizard.

4. ✓ D. Hardware devices require their own unique DMA addresses in order to function properly. Generally, this is handled automatically by the operating system. However, if you’re using older hardware, you should keep this in mind when troubleshooting hardware-related problems. Also, since modern hardware allows for the sharing of IRQs between multiple devices, just the fact that multiple devices are sharing the same resource does not necessarily indicate a problem.
   ✗ A and B are incorrect because physical and virtual memory resources do not apply directly to hardware devices.

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5. ✓ A and D. The System Information tool allows you to export data to a text file (option A), and to save information to a binary *.nfo file (option D). Both methods can be used to later view server configuration information for each of the machines.
B, C, and E are incorrect because they are not functions that allow you to save configuration information to a file.

6. B. Although you can use the Device Manager to view information on remote computers, you can modify hardware resource settings only from a locally running copy of this utility. A is incorrect because the Device Manager cannot be used to modify hardware resources on a remote machine. C is incorrect because the System Information tool does not allow for modifying hardware resources.

7. C and D. Both of these Device Manager views will return a list of IRQs and the hardware devices that are using each. A and B are incorrect because they do not provide information in the required format.

8. A, B, C, and D. All of these methods can be used to either view or change settings for the mouse. The Driver, Resources, and Advanced Settings tabs all provide methods for viewing details about the device driver that is installed. And through the use of the Mouse Control Panel applet, Rekha can modify settings that might affect mouse movement.

9. B. The quickest and easiest way to return a list of any hardware resources that are in conflict is to use the Conflicts / Sharing view in the System Information tool. Although you could obtain the same information via other tools and troubleshooting steps, this view will provide the information that you need in one place. Also, note that if resources are listed as “shared,” this does not necessarily mean that there is a problem, since modern computers allow multiple devices to share IRQs. A and C are incorrect because these methods will not provide information about hardware resource usage and conflicts. D is incorrect because there is no such Control Panel applet.

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10. E. The purpose of the Last Known Good option is to revert the system configuration to its state following the last successful logon. Since the problem is likely due to the installation of the updated driver, this is the quickest and easiest way to boot the server so that further troubleshooting can be performed. However, keep in mind that, if the installation of the new driver deleted the older driver, the Last Known Good boot option will not fix the problem, since the older driver is no longer accessible. A and B are incorrect because, since the server is not booting at all, these methods cannot be used to configure or troubleshoot the driver. C and D are possible methods by which this problem could be resolved, but both require more effort than option E.

11. D. The purpose of the DevCon.exe command-line is to provide the functions that are possible through the Device Manager in a command-line format.
A, C, and E are incorrect because these are not Windows Server 2003 command-line utilities. B is incorrect because the main purpose of the DriverQuery command is to return information about the drivers that are installed in the system.

12. B. The easiest and safest method of preventing the use of these network adapters is to disable them using the Device Manager. This function will leave the device drivers in place but will not allow the operating system to access the hardware. Paul can easily reenable the devices, if necessary, using the Device Manager utility.

A is incorrect because this is not a valid method for disabling a device. C is incorrect because this would not prevent the use of the network adapter. D is not supported in Windows Server 2003. Finally, E is a possibility, but it not the easiest method for prevent the use of the device.

13. E. It is likely that you are trying to install unsigned device drivers. The only option that would automatically prevent the installation of unsigned device drivers is the Block setting.

A and C are incorrect because these are not options for the Driver Signing configuration. B and D are incorrect because these options would not prevent the installation of an unsigned driver.

14. C. By running the File Signature Wizard, you will be able to quickly find the names of any unsigned driver files that have been installed on the computer.

A is incorrect because it is not the quickest method for finding driver signing information. B and D are incorrect because they do not provide driver signing information, at all.

LAB ANSWER

It’s fairly obvious that the problems that you are seeing are due to hardware changes. Since the only changes to the environment involved hardware modifications (either complete server replacements or component upgrades), this is the first area that you should suspect. In many environments, this issue can be very common. Unfortunately, you’ve experienced pretty poor results based on your hardware upgrades—since four out of the 25 servers are experiencing problems. Fortunately, there are ways to either avoid these problems or to troubleshoot them once they occur.

The first step that you should take when deciding to perform upgrades is to verify compatibility with Microsoft’s Hardware Compatibility web site. On that site, you can easily find out if the server computers that you plan to purchase fully support Windows Server 2003. If the computers that you are purchasing are listed on the site, this means that they have been certified by Microsoft to support this server operating system. Additionally, should you encounter problems with using the server, the vendor should be able to provide you with support.
The case is a little more complicated for performing upgrades of servers. You should still begin by ensuring that the device(s) that you plan to purchase have been tested for compatibility. Next, you should verify with the original hardware manufacturer that the upgrade is supported. Many hardware platforms place limitations on memory type, supported CPUs, and other hardware components. Finally, you should be sure that you select and install only digitally signed drivers. As you saw from the results of the upgrades, hardware device driver issues can cause significant problems.

In this scenario, most of this is in hindsight. So, what can you do to isolate the issues that you’re experiencing now? First, you can start by using the Device Manager and System Information tools to identify any resource conflicts or device driver problems. Either of these can point you toward the device(s) that might be causing the problem. When you isolate a problem area, you should try to update the current driver with a digitally signed one (if one exists). You may be able to use Windows Server 2003’s Hardware Troubleshooting Wizards to resolve common issues. Or, you can choose to either disable or uninstall the device. Unfortunately, you might find that the quality of some hardware (and the accompanying drivers) is so low that you’ll have to simply replace the product with something more reliable.

Finally, you can use the File Signature Verification tool to identify any drivers or other system files that have not been digitally signed. This can help you quickly identify which components might be causing problems.

By using all of these methods together, you can avoid many common hardware-related issues, and you can resolve the ones that do come up!