Chapter 10

Network Adapter Cards

A *network adapter card* is a hardware device that installs in a PC and provides an interface from a PC to the transmission medium. Most PC networks, including Ethernet and Token Ring networks, use network adapter cards. The network adapter card is thus an essential part of networking, and an understanding of network adapter cards is crucial for any networking professional. This chapter examines the role of the network adapter card and describes the processes of installing and configuring network adapter cards. In addition, this chapter discusses how to resolve hardware conflicts related to network adapter cards.

Chapter 10 targets the following objective in the Implementation section of the Networking Essentials exam:

Test Objectives

- Given the manufacturer's documentation for the network adapter, to install, configure, and resolve hardware conflicts for multiple adapters in a Token Ring or Ethernet network

Stop! Before reading this chapter, test yourself to determine how much study time you will need to devote to this section.

1. Three duties of the network adapter card are as follows:

   A. Preparing data

   B. Sending data

   C. Identifying problems with the cabling medium

   D. Controlling the flow of data

2. On Ethernet networks, data flows from the network adapter card to the transmission medium in _____ form.

   A. parallel

   B. serial

   C. either A or B

   D. none of the above

3. A recommended IRQ setting for network adapter cards is _____.

   A. IRQ15

   B. IRQ2

   C. IRQ1

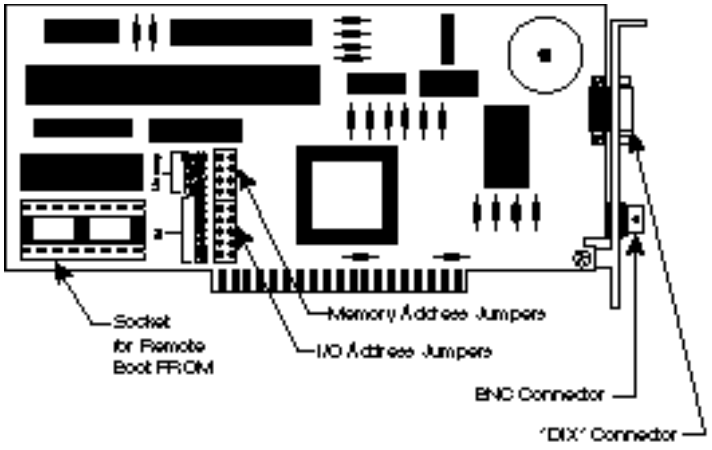
   D. IRQ5

Defining a Network Adapter Card

A network adapter card links a PC with the network cabling system (see fig. 10.1). The network adapter card fits into one of the PC's expansion slots. The card has one or more user-accessible ports to which the network cabling medium is connected.

Figure 10.1

An Ethernet network adapter card.



Like other hardware devices, a network adapter card has a *driver*, a software component that manages the device. The network adapter card driver serves a crucial role in the networking architecture. Adapter card drivers inhabit the Data Link layer of the OSI model (see Chapter 2, "Networking Standards," for more information), or, more specifically, the Media Access Control (MAC) sublayer of the Data Link layer. A network adapter card driver sometimes is also called a MAC driver. As Chapter 2 mentions, the NDIS and ODI standards provide a uniform interface for the adapter card driver, enabling one adapter to support multiple protocols and making one protocol accessible to multiple adapters.

The network adapter card's built-in ROM (read only memory) performs the functions of the Logical Link Control sublayer of the OSI Data Link layer.

The network adapter card and its accompanying software and firmware perform several roles. Microsoft identifies the following roles for the network adapter card:

- Preparing data for the transmission medium
- Sending data
- Controlling the flow of data from the PC to the transmission medium

Of course, the network adapter must also play these roles in reverse, receiving data from the network and converting that data to the form necessary for the local system.

Preparing Data

Data travels on the network in serial form (one bit at a time). Inside the PC, however, data moves along the bus in parallel form (8, 16, or 32 bits at a time). The network adapter card, therefore, must convert the parallel data from the bus into the serial form required for network transmission. If the card receives data from the local system, it can transmit that data to the network. The data then is stored in a memory buffer on the adapter card until the card can catch up.

Because the network adapter card's software and firmware participate in the Data Link layer of the protocol stack, they are responsible for contributing data-link header information, such as the network adapter card's physical address (see Chapter 2).

The *data bus* is a pathway inside your computer that carries data between the hardware components. Four data-bus architectures are used in Intel-based PCs: Industry Standard Architecture (ISA), Extended Industry Standard Architecture (EISA), Micro Channel, and Peripheral Component Interconnect (PCI). In recent models, *PCI* and *EISA* are the most common data-bus architectures. *ISA* is a (more limited) predecessor of EISA. *Micro Channel* is a data bus developed by IBM for the PS/2 series that never caught on—it is, however, still used for some high-end models.

Sending Data

The network adapter card places data on the network and receives data from the network. These tasks require a certain amount of flow control (see the following section). The MAC-layer software also must know *when* to put data on the network.

Chapter 4, "Network Topologies and Architectures," discusses various media-access methods (such as CSMA/CD or token passing) used by the card, as well as how and when each of these methods provides access to the transmission medium.

As Chapter 4 describes, the network adapter card receives packets from the network, checking the destination address of all packets and interrupting the CPU only if the packet is addressed to the local system.

Controlling the Flow of Data

For two computers to exchange data, the computers' network adapter cards must be in agreement on certain transmission parameters. A newer card with a higher maximum transmission rate, for instance, might have the capability to use a lower rate in order to communicate with a slower card. Before sending data, the cards exchange messages and agree on such parameters as a transmission speed and a time interval between packets.

Installing Network Adapter Cards

The details of how to install a network adapter card might depend on the card, the operating system, or the hardware platform, but the steps are basically the same. To install a network adapter card, you must follow these steps:

1. Physically plug the card into the expansion slot, configuring jumpers and DIP switches as required.
2. Install the network adapter card driver.
3. Configure the operating system so that the network adapter card won't conflict with other devices (see the next section).
4. Bind the network adapter to the required protocols (see Chapter 5, "Transport Protocols," for more information).
5. Attach the network cable to the card.

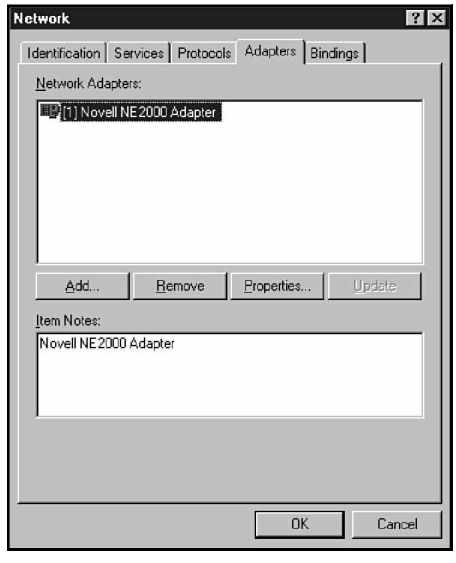
Depending on the hardware operating system, some of these steps might happen automatically when you plug a card into the slot and start your system. Windows NT is not really plug-and-play capable, so when you install a network adapter card after the operating system is in place, you might have to spend some time with steps 2–4.

To install a network adapter card driver in Windows NT, follow these steps:

1. Click the Start button and choose Settings/Control Panel. Double-click the Control Panel Network application. In the Control Panel Network application, choose the Adapters tab (see fig. 10.2).

Figure 10.2

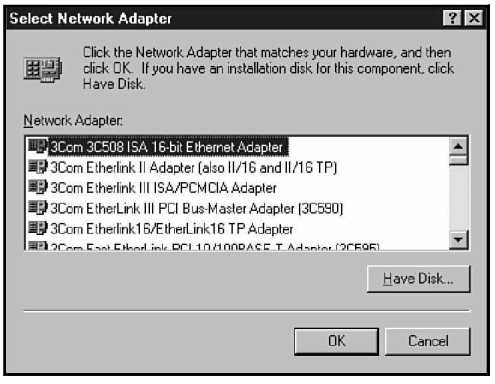
The Control Panel Network application's Adapters tab.



2. In the Adapters tab (refer to fig. 10.2), click the Add button to invoke the Select Network Adapter dialog box (see fig. 10.3). Choose the adapter model from the list or click the Have Disk button to install a driver that isn't listed. Windows NT asks for the location of the Windows NT installation CD-ROM.

Figure 10.3

The Select Network Adapter dialog box.



Make sure the adapter is compatible with your version of Windows NT. To do so, check the Windows NT Hardware Compatibility list or consult the manufacturer.

3. Windows NT will attempt to detect the adapter and then might prompt you for additional information (see the section titled "Configuring Network Adapter Cards" later in this chapter).

4. When the installation is complete, shut down Windows NT and Restart.

5. Use the Network application's Bindings tab to check and set protocol bindings for the new adapter (see Chapter 5).

Before you buy a network adapter card, you must make sure it has the correct data-bus architecture for your PC and the correct connector type for your transmission medium.

Almost all PCs use one of four basic data-bus architectures: ISA, EISA, PCI, and Micro Channel. (Refer to the note on data-bus architectures earlier in this chapter.) These architectures are not necessarily compatible—for example, a Micro Channel card won't work on an EISA system and, in fact, won't even fit in the slot—so when you buy a card for an expansion slot, be ready to tell the vendor what type of data-bus architecture you have on your system.

The data-bus architecture is generally independent of the processor type. Two Pentium machines from different vendors might have different (and incompatible) data-bus architectures.

Chapter 3, "Transmission Media," discussed some basic LAN network cabling types. The network adapter is responsible for transmitting in accordance with the specifications of the transmission medium. The adapter card also must supply a connector that is compatible with the cabling system. (See Chapter 3 for more information on Ethernet and token-ring cabling and connectors.) Some boards offer connectors for more than one cabling type, in which case you must configure jumpers or DIP switches to set the active type.

Jumpers are small connectors that bridge across predetermined terminal points on the card itself to hardwire the card for certain user-defined settings, such as the IRQ setting. *DIP (dual inline package) switches* are small switches (usually in groups) that, like jumpers, can configure the card for user-defined settings.

Configuring Network Adapter Cards

You must configure your operating system so that it can communicate with the network adapter card. In many cases, you must manually configure the adapter card (through jumper or DIP switch settings) so that it can communicate with the operating system.

To communicate, the operating system and the network adapter must agree on certain important parameters, called *resource settings*. Some common resource settings for a network adapter are as follows:

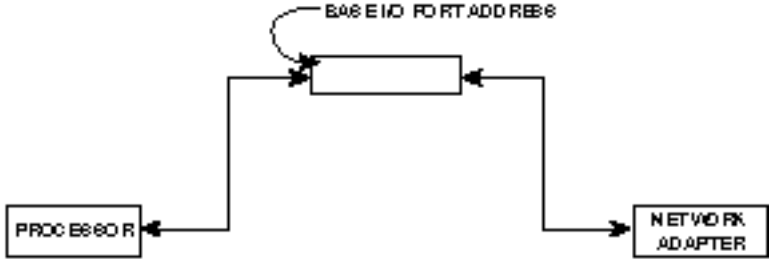
- IRQ
- Base I/O port address
- Base memory address

The *IRQ (Interrupt Request Line)* setting reserves an interrupt request line for the adapter to use when contacting the CPU. Devices make requests to the CPU using a signal called an *interrupt*. Each device must send interrupts on a different interrupt request line. Interrupt request lines are part of the system hardware. The IRQ setting (such as IRQ3, IRQ5, or IRQ15) defines which interrupt request line the device will use. By convention, certain IRQ settings are reserved for specific devices. IRQ3 and IRQ5, for instance, typically are used for network adapter cards. Microsoft recommends IRQ5 if it is available; IRQ5 is often the default.

The *base I/O port address* defines a memory address through which data will flow to and from the adapter. The base I/O port address functions more like a port, defining a channel to the adapter (see fig. 10.4).

Figure 10.4

The base I/O port address defines a memory address through which data flows to the adapter.



The *base memory address* is a place in the computer's memory that marks the beginning of a buffer area reserved for the network adapter. Not all network adapter cards use the computer's RAM, and therefore not all adapters require a base memory address setting.

Any effort to configure a network adapter card should begin with the card's vendor documentation. The documentation tells you which resources setting you must set, and it might recommend values for some or all of the settings. The documentation also recommends any jumper or DIP switch settings for the card.

The actual process of configuring the operating system to interact with a network adapter card depends on the operating system. A plug-and-play operating system such as Windows 95, when used with a plug-and-play compatible adapter card, may perform much of the configuring automatically. In Windows NT, you can configure adapter card resource settings through the Control Panel

Network application's Adapters tab. The Windows NT Diagnostics application in the Administrative Tools group (see exercise 10.2 at the end of the chapter) indicates the resource settings that are currently available.

Resolving Hardware Conflicts

Hardware conflicts are caused when the devices on the system compete for the same system resources, such as interrupt request lines, base I/O port addresses, and base memory addresses. An improperly configured device can cause a hardware conflict with other devices, so you must make sure that each device has exclusive access to the required system resources.

It is important to note that plug-and-play (sometimes called plug-and-pray) is still relatively new technology for Microsoft-based systems. Ideally, Windows 95 will configure a plug-and-play compatible card without much user intervention, but in some cases, you might still face configuration problems.

In Windows NT, a hardware conflict might invoke a warning message from the system or an entry in the Event Log (see Chapter 13, "Troubleshooting"). If you experience a hardware conflict, use Windows NT Diagnostics (see exercise 10.2) to check resource settings for system devices. Then change the resource settings of any conflicting devices.

In Windows 95, use Device Manager (see the following note) to spot hardware conflicts and track resource settings.

Windows 95 includes a utility called Device Manager that displays system devices by type, looks for resource conflicts, and provides an interface for checking and changing resource settings.

To access Device Manager, follow these steps:

1. Click the Start button and choose Settings/Control Panel.

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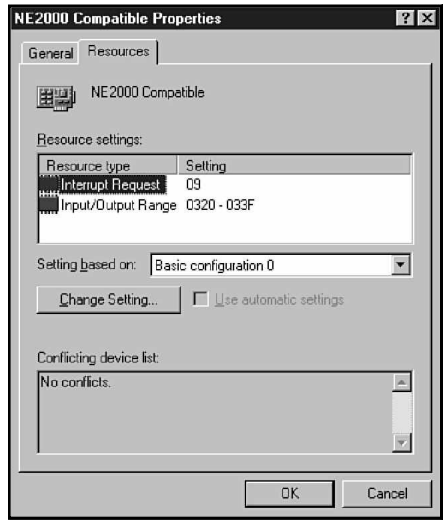
2. In the Windows 95 Control Panel, double-click the System application.
3. Choose the Device Manager tab in the System Properties dialog box.
4. Device Manager displays system devices in a tree format. Click on the plus sign next to a device type to view the installed devices. Double-click on an installed device (or choose the device and click the Properties button) for a Properties dialog box, such as the one shown in figure 10.5.

Figure 10.5

An adapter card's Properties dialog box in Device Manager.



If you can't pinpoint a resource conflict by using Windows NT Diagnostics, Windows 95's Device Manager, or some other diagnostic program, try removing all the cards except the network adapter and then replacing the cards one by one. Check the network with each addition to determine which device is causing the conflict.

Summary

This chapter examined the network adapter card—an essential component in Ethernet and Token Ring networks. The network adapter card performs several functions, including preparing, sending, and controlling the flow of data to the network transmission medium. This chapter also discussed how to install and configure network adapters. Configuration tasks for a network adapter card include setting jumpers and/or DIP switches on the card itself, as well as configuring resource settings (such as IRQ, Base I/O port address, and base memory address) that the operating system must use to communicate with the card.

Exercises

Exercise 10.1: Network Adapter Resource Settings

Objective: Become familiar with the process of configuring network adapter resource settings in Windows NT

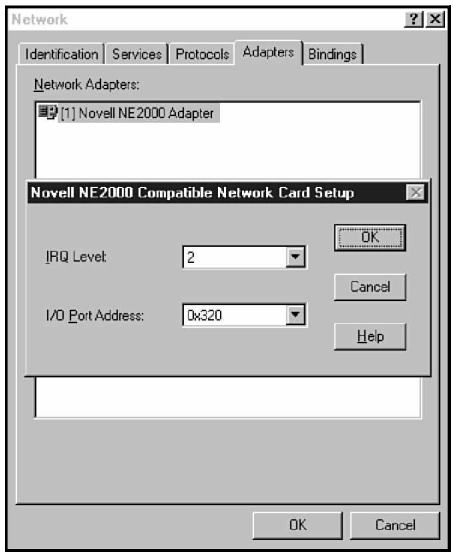
Estimated time: 10 minutes

Earlier in this chapter, you learned how to install a network adapter card driver by using the Windows NT Network application. You also can use the Network application to check or change the resource settings for an adapter that is already installed.

1. Click the Start button and choose Settings/Control Panel. Double-click the Windows NT Control Panel Network application.
2. In the Network application, click the Adapters tab (refer to figure 10.2).
3. Select the network adapter that is currently installed on your system and click the Properties button.
4. The Network Card Setup dialog box then appears on your screen (see fig. 10.6).

Figure 10.6

A Network Card Setup dialog box.



5. In the Network Card Setup dialog box, you can change the resource settings as required. You might want to use the Windows NT Diagnostics application to look for available settings (see exercise 10.2). Don't change the settings unless you're experiencing problems, though, because you could introduce a hardware conflict with another device.

6. Click Cancel to leave the Network Card Setup dialog box and click Cancel again to leave the Network application.

Exercise 10.2: Windows NT Diagnostics

Objective: Learn to check resource settings through Windows NT Diagnostics

Estimated time: 10 minutes

Windows NT Diagnostics tabulates a number of important system parameters. You can use Windows NT Diagnostics to help resolve resource conflicts for network adapters.

1. Click the Start button and choose Programs/Administrative Tools. Choose Windows NT Diagnostics from the Administrative Tools menu.

2. Windows NT Diagnostics provides several tabs with information on different aspects of the system. Choose the Resources tab (see fig. 10.7).

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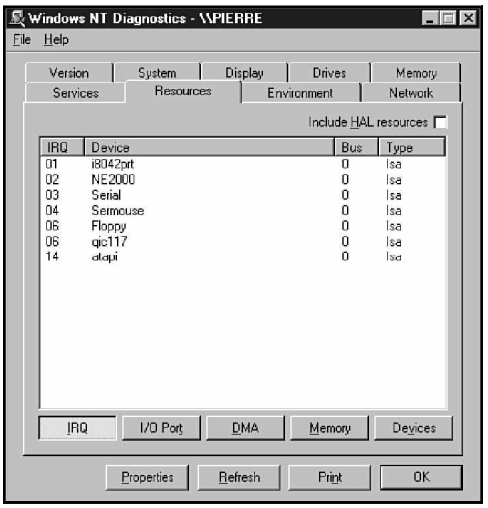
Exercise 10.2: Continued

Figure 10.7

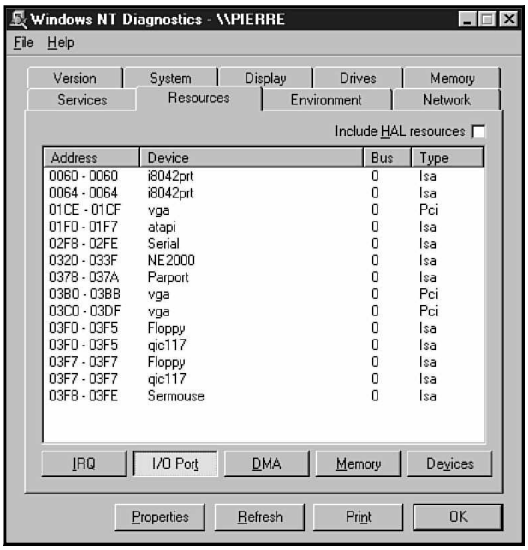
The Windows NT Diagnostics Resources tab.



3. Figure 10.7 displays the IRQ settings for system devices. (Note that the network adapter card for which the resource settings were displayed in figure 10.6 is listed here beside IRQ2.) The buttons at the bottom of the screen invoke views of other resource settings. Click on a button to see the associated list. Figure 10.8 shows the I/O Port list.

Figure 10.8

The Windows NT Diagnostics Resources tab—I/O Port settings.



You can't change any values in Windows NT Diagnostics. You can only view services, devices, statistics, and settings.

Review Questions

1. In Windows NT, you can use _____ to install network adapter card drivers.

   A. Windows NT Diagnostics

   B. the System application

   C. Device Manager

   D. none of the above

2. The user sometimes must hardwire resource settings on a network adapter card using _____.

   A. jumpers

   B. resource switches

   C. needle connectors

   D. none of the above

3. Which two of the following are common data-bus architectures?

   A. EISA

   B. Pentium

   C. Plug-and-Play

   D. PCI

4. Which resource setting gives the device a channel for contacting the CPU?

   A. IRQ

   B. Base I/O port address

   C. Base memory address

   D. None of the above

5. Which resource setting defines a means for passing data to the adapter?

   A. IRQ
   B. Base I/O port address
   C. Base memory address
   D. None of the above

6. Which resource setting specifies a serial communications port for the network adapter?

   A. IRQ
   B. Base I/O port address
   C. Base memory address
   D. None of the above

7. Which resource setting locates a buffer for the adapter in the computer's RAM?

   A. IRQ
   B. Base I/O port address
   C. Base memory address
   D. None of the above

8. A maximum of _____ devices can use the same IRQ simultaneously.

   A. 1
   B. 2
   C. 4
   D. 8

9. Which two of the following enable you to check the resource settings for a network adapter card in Windows NT?

   A. Device Manager

   B. The Network application

   C. Windows NT Diagnostics

   D. The System application

10. Which of the following enables you to change the resource settings for a network adapter card in Windows NT?

   A. Device Manager

   B. The Network application

   C. Windows NT Diagnostics

   D. The System application