



# 4

## Preparing Network Connections

### CHAPTER OBJECTIVES

- 4.01 Cisco's Networking Products
- 4.02 Chassis Information
- 4.03 Connections

- 4.04 Cabling
- ✓ Two-Minute Drill
- Q&A Self Test

The first three chapters of this book dealt with an introduction to networking, networking concepts, and IP addressing—basically theory and concept information. In this chapter, I'll begin discussing the applied side of networking. This chapter focuses on installing your networking devices (switches and routers), cabling up your LAN and WAN connections, and establishing a console connection so that you can put a configuration on these devices. Once you have established a console connection in this chapter, Chapter 5 will begin the basics of using the router's or switch's command-line interface (CLI) to put a basic configuration on these devices.

## CERTIFICATION OBJECTIVE 4.01

### Cisco's Networking Products

The last part of Chapter 2 discussed Cisco's three-layer hierarchical model for network design: core, distribution, and access. Once you have designed your network and have decided on the types of devices you'll be using at each of the three layers, you must then pick a specific product for each of these devices. When choosing a networking product, consider the following:

- Is the product easy to install and support?
- Does the product provide the necessary features/functions to meet your networking requirements?
- Does the product support enough ports and offer enough backplane capacity to meet your network's growth and bandwidth requirements?
- Is the product reliable, and can it provide redundancy?
- If it is a layer-3 device, does the product provide support for both mobile users and branch office connections?
- Can the product be easily upgraded, protecting your investment in the product?

When you have answered these questions, you are ready to pick the appropriate products for your networking design. The products discussed later in this chapter do not represent all of Cisco's products, nor do they include all of the products for a specific category. When choosing a product, you'll need to log on to Cisco's web site

(<http://www.cisco.com>) and look up the specifications of the products that you are interested in before making a choice.

If you are implementing a WAN solution, you should consider the following when making a choice:

- Make sure the solution is cost-effective.
- Make sure the service you want to use is available in the location where you will be installing it. Some services, such as ATM, DSL, and ISDN, are not available in all areas.
- Make sure the solution you choose provides the necessary amount of bandwidth for your users' needs.

Remember that modem connections support up to only 53 Kbps and therefore are best for telnet, e-mail, small file transfers, and limited web browsing traffic. ISDN and Frame Relay connections up to speeds of 128 Kbps are more suitable for file transfers, Internet access, and voice traffic. Leased lines, DSL, ATM, and Frame Relay are best suited for multimedia applications, including voice and video, as well as for high-bandwidth needs (greater than 128 Kbps).

## Hubs

As was mentioned in Chapter 2, hubs function at the physical layer and provide a logical bus structure for Ethernet; devices connected to the hub have the illusion that they are all connected to the same physical piece of wire. Devices connected to a hub are in the same collision domain, since hubs are repeaters and they repeat any physical layer signal that they receive. Cisco has many hub products, including the following: 1500 Micro Hub; 1528 10/100 Micro Hub; 100, 200, 300, and 400 Fast Hubs.

### exam

#### Watch

**Hubs and repeaters are used to connect devices together in the same collision domain. These devices repeat any signal sent to them,**

**including collisions. All devices connected via layer-1 are in the same collision domain, sometimes referred to as a bandwidth domain.**

### Switches

As discussed in Chapter 2, switches function at the data link layer. They are normally used to solve bandwidth and collision problems. If you experience a heavy amount of collisions or a lot of contention for bandwidth, in today's world, you would use a switch to solve your problem. Cisco supports different switching products, including the following: 1548 Micro Switch 10/100, Catalyst 1900 and 2800, Catalyst 2950, Catalyst 3550, Catalyst 4000, Catalyst 6x00, and Catalyst 8500 switches. Most of these switches support only a layer-2 functionality, like the Catalyst 1900, while others, such as the Catalyst 3550 switch, support both layer-2 and layer-3.

One of the things to keep in the back of your mind when choosing switches is that many of Cisco's switches use different command-line interfaces (CLIs). As you will see starting in Chapter 5, even the 1900 and 2950 use, for the most part, different commands to configure their settings. This can become confusing for someone new to switching and Cisco's products in general.

#### exam

##### Watch

**Switches and bridges are used to solve collision and bandwidth problems. Each port connected to a bridge or switch is a separate collision**

**or bandwidth domain. Microsegmentation is a term used with switches when each networking device has its own dedicated port on a switch.**

### Routers

As I mentioned in Chapter 2, routers are used to solve many problems, including the containment of broadcasts. Cisco has a wide range of routing products, including layer-3 switches that they support. Cisco groups these routing products into different categories, including home office, small office, branch office, and central site solutions, to better help you choose the appropriate product for your network.

#### exam

##### Watch

**Routers are used to connect broadcast domains together. In this sense, routers contain broadcast problems: routers, by default, do not propagate broadcast traffic.**

For home office solutions, Cisco recommends the following products: 800, 900, 1600, and 1700 series routers. For small office solutions, Cisco recommends the 1600, 1700, and 2500 series of routers. For branch office solutions, Cisco recommends the 2600, 3600, and 3700 series routers. For central site solutions, Cisco recommends the 3600, 3700, 7x00, and 12000

GSR routers, as well as the 5x00 access server products. Of all of the router products that I mentioned, only the 700 series does not use the same CLI when performing configuration tasks. Therefore, if you know how to configure a 2500 router, configuring the 3600 router (or any other router, for that matter) is basically the same.

## CERTIFICATION OBJECTIVE 4.02

### Chassis Information

Before you begin connecting any cables to your Cisco products, you should first become familiar with their chassis and interfaces. First, you should understand how to turn on your Cisco device, what interfaces it has, and the meanings of the various LEDs (light-emitting diodes) on the chassis. The next few sections will cover this in more depth.

#### Catalyst 1900 Switch

The Catalyst 1900 and 2820 switches are basically the same product. Both switches support an optional external redundant power supply (RPS). The main difference is that the 1900 comes in a fixed chassis format, whereas the 2820 supports two modular slots. Otherwise, they both run the same software and have the same internal hardware infrastructure. There are two basic chassis formats for the 1900: the 1912 and the 1924. Table 4-1 shows the differences. The 1912 has a total of 15 ports, while the 1924 has 27 ports. As you can see from this table, the 1912 has 12 fixed 10BaseT ports, while the 1924 has 24.

The 2820 Catalyst switch comes in two varieties: 2822 and 2828. Both support 1 fixed AUI 10BaseT port on the rear of the chassis, 24 10BaseT ports on the front of

**TABLE 4-1** 1900 Ports

Port	Location	Number—1912	Number—1924
AUI 10Base5 port	Rear	1	1
100BaseTX/FX uplink ports	Front right	2	2
10BaseT ports	Front Middle	12	24

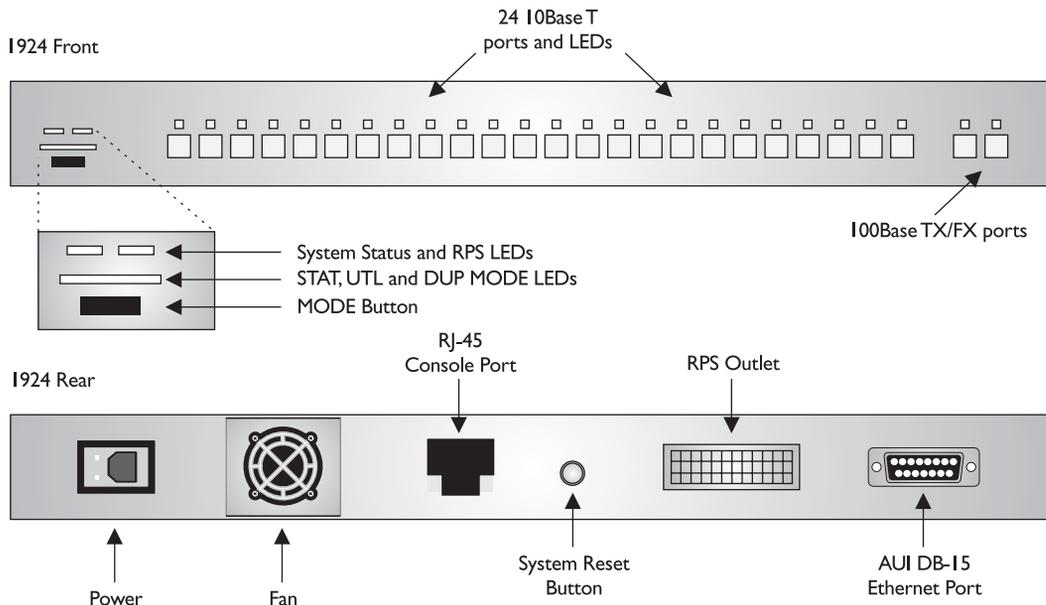
the chassis, and two modular slots on the front of the chassis. The cards that fit into these slots support Ethernet, Fast Ethernet, ATM, and FDDI interfaces. The main difference between these two switches is the number of MAC addresses that they can put in their port address tables. The 2822 supports up to 2,048 MAC addresses while the 2828 supports up to 8,192 addresses (the 1900 supports 1,024 MAC addresses). Other than this difference, the two 2800 series switches are identical. One important item to point out is that you cannot upgrade a 2822 to a 2828—the number of MAC addresses is physically tied to the switch you bought.

### 1900 Chassis

Figure 4-1 shows a picture of the front and rear of a 1924 switch. The top part shows the front while the bottom part shows the rear. For the top part of the picture, there is a cut-out of the LEDs on the left-hand side of the switch. The front of the chassis contains the MODE button as well as the LEDs and all but one of the Ethernet ports.

The rear of the chassis has the management connections. You'll notice that there is no toggle switch to turn the switch on or off. To turn the switch on, plug one end of the power cable into the back of the switch and the other into a power outlet. To turn the switch off, unplug the power cable from either end. Also notice the 10Base5 Ethernet port, which uses a DB-15 AUI interface.

**FIGURE 4-1** A 1924 switch



Depending on how old your switch is, you'll have either an RJ-45 (newer) or DB-9 (older) console interface. The DB-9 interface uses a null modem cable for connectivity to a terminal or terminal emulation device for console access. The RJ-45 interface uses a rollover cable, discussed later in this chapter. You can also see a very, very small reset button on the rear of the chassis. You need to use the tip of a pencil or paper clip in order to press this button. Pressing this button causes the switch to reboot, which is basically the same as pulling the power cord out of the chassis and putting it back in.

## LEDs

The 1900 has four sets of LEDs on the front of its chassis: SYSTEM, RPS (redundant power supply), port, and mode LEDs. Table 4-2 shows the status of the system and rps LEDs. Note that for LEDs that say amber, this is a light orange color. The next section will cover the rest of the LEDs.

## MODE Button

There is an LED above each port on the front of the 1900's chassis. The meaning of this LED is dependent upon what mode the LED is set to. You can change the mode by pressing the MODE button on the bottom left-hand side of the front of the chassis, below the SYSTEM and RPS LEDs. Right above the MODE button are three port-mode LEDs: STAT, UTL, and FDUP. By default, the STAT LED is lit: this indicates that the LEDs above the Ethernet ports refer to the status of the port. Table 4-3 shows the possible LED colors and descriptions for the various port statuses.

If you push the MODE button once, the mode LED will change from STAT to UTIL. The UTIL LED, when lit, indicates that the LEDs above the Ethernet ports are

**TABLE 4-2** 1900 SYSTEM and RPS LEDs

LED	Color	Description
SYSTEM	Green	The system is up and operational.
	Amber	The system experienced a malfunction.
	Off	The system is powered down.
RPS	Green	The RPS is attached and operational.
	Amber	The RPS is installed, but is not operational. Check the RPS to make sure that it hasn't failed.
	Flashing amber	Both the internal power supply and the external RPS are installed, but the RPS is providing power.
	Off	The RPS is not installed.

**TABLE 4-3**Status Mode  
and Port LEDs

LED Color	LED Meaning
Green	There is a powered-up physical layer connection to the device attached to the port.
Flashing green	There is traffic entering and/or leaving the port.
Flashing green and amber	There is an operational problem with the port—perhaps excessive errors or a connection problem.
Amber	The port has been disabled manually (shut down) or because of a security issue.
Off	There is no powered-up physical layer connection on the port.

functioning as a utilization meter bar. This meter bar reflects the amount of bandwidth that the switch is currently using on its backplane. The meter readings are different for a 24-port switch than for a 12-port switch, as is shown in Table 4-4 and Table 4-5.

If you push the MODE button again, the LED will change from UTL to FDUP. When in FDUP mode, the LEDs about the ports represent the duplexing of the ports. If the LED is green, the port is set to full-duplex. If the port LED is off, the port is set to half-duplex. If you hit the MODE button again, the mode LED will change back to STAT. As you can see, the MODE button allows you to cycle through the different mode settings. If the mode LED is either UTL or FDUP, it will automatically change back to STAT after one minute.

### Boot-Up Process and LEDs

Whenever you boot up any of Cisco's networking products, they will run through hardware diagnostics called the power-on self test (POST). This is also true with the 1900 switches. When you power up your 1900, initially, all of the port LEDs will be green. As each self-test in POST is running, a specific LED above an Ethernet port will turn off (while the others remain green). As the test completes, the LED turns back to green

**TABLE 4-4**Utilization Mode  
and Port LEDs  
for a 1924

Port LEDs Lit Up	Backplane Bandwidth
1–8	< 6 Mbps
9–16	< 120 Mbps
17–24	< 280 Mbps

**TABLE 4-5**

Utilization Mode  
and Port LEDs  
for a 1912

Port LEDs Lit Up	Backplane Bandwidth
1–4	< 1.5 Mbps
5–8	< 20 Mbps
9–12	< 120 Mbps

and another, lower-numbered port LED will go off, signifying that the next POST test is being performed. Table 4-6 shows the various POST tests that are performed on the 1900.

If a particular self-test fails, then the LED above the port will turn from off to amber and remain in this state. Normally, if a self-test fails, this is fatal to the switch and the switch will not boot. If all of the self-tests have been successful, all of the LEDs should flash green and then turn off. In this state, the MODE LED will default to STAT.

**TABLE 4-6**

POST Tests  
Performed

Port LED	Test Performed	If the Test Fails
16	ECU DRAM	Switch will not boot
15	No self-tests performed	
14	No self-tests performed	
13	No self-tests performed	
12	Forwarding Engine ASIC	Switch will not boot
11	Forwarding Engine memory	Switch will not boot
10	RAM	Switch will not boot
09	ISL ASIC	Switch will not boot
08	Port control and status	Switch will not boot
07	System timer interrupt	Switch will not boot
06	Port address table RAM	Switch will not boot
05	Real-time clock	Switch will boot
04	Console port	Switch will boot
03	Port address table	Switch will not boot
02	Switch's MAC address	Switch will not boot
01	Port loopback test	A port might not function correctly

## Catalyst 2950 Switch

The 2950 series of switches are Cisco’s current desktop and workgroup switching solution, replacing the 1900 and 2820 switches. The 2950 series of switches come with two different versions of software: standard and enhanced. This book focuses on the standard version of software. The enhanced version handles advanced Quality of Service, telephony, and other features. The other major difference between the different types of 2950 switch models is the number and types of ports. Table 4-7 compares the 2950 switches and their port types and capacities. The 2950, like the 1900 series, supports an optional external RPS.

### 2950 Chassis

Figure 4-2 shows a picture of the front and rear of a 2950-24 switch. The top part shows the front, while the bottom part shows the rear. For the top part of the picture, there is a cut-out of the LEDs on the left-hand side of the switch. The front of the chassis contains the MODE button as well as the LEDs and all of the Ethernet ports.

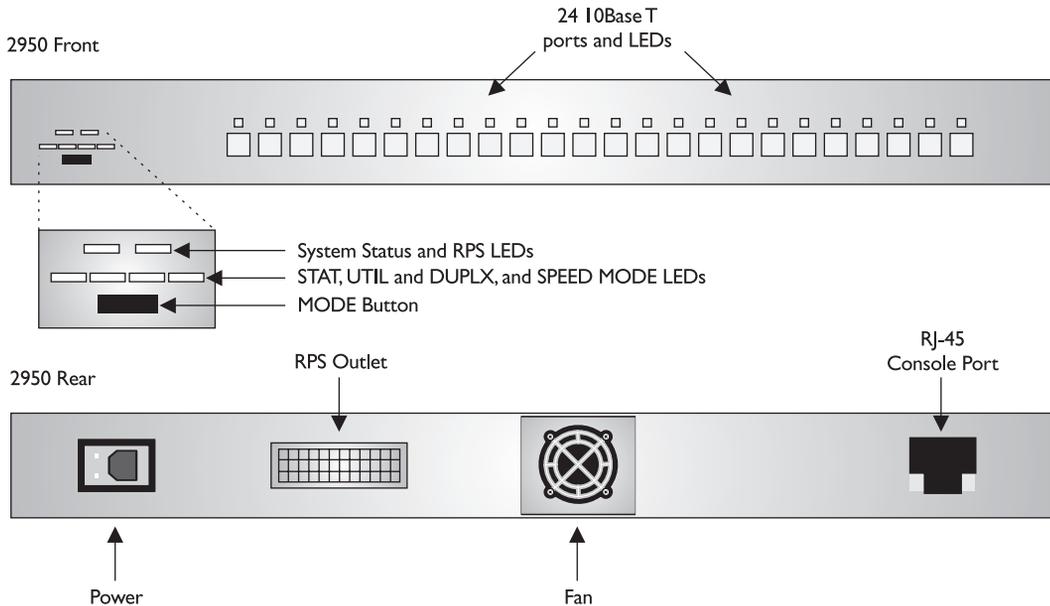
The rear of the chassis has the management connections. You’ll notice that there is no toggle switch to turn the switch on or off. To turn the switch on, plug one end of the power cable into the back of the switch and the other into a power outlet. To turn the switch off, unplug the power cable from either end.

Unlike the 1900 series, the 2950 doesn’t have a 10Base5 Ethernet port. Also, the 2950 supports only an RJ-45 console interface, which uses a rollover cable for connectivity to a terminal or terminal emulation device for console access. The 2950 also doesn’t have a reset button—if you want to reboot the switch, you need to either

**TABLE 4-7**

2950 Models

Switch	10/100BaseTX	100BaseFX	Gigabit
2950-12	12	0	0
2950-24	24	0	0
2950C-24	24	2	0
2950G-12-EI	12	0	2
2950G-24-EI	24	0	2
2950G-48-EI	48	0	2
2950SX-24	24	0	2
2950T-24	24	0	2

**FIGURE 4-2** A 2950 switch

execute the **reload** command from the CLI or unplug the power connector from the switch and then reinsert it.

### 2950 LEDs and MODE Button

Like the 1900, the 2950 has many LEDs on the front of the chassis that you can use to monitor the switch's activity and performance. In the top left-hand corner of the front of the 2950's chassis are the SYSTEM and RPS LEDs. The colors of these LEDs and their meanings are the same as those for the 1900, which were shown in Table 2-2.

Below these two LEDs are four LEDs: STAT, UTIL, DUPLX, and SPEED. These LEDs function similar to the corresponding LEDs on the 1900—they are controlled by the MODE button below them. The default mode is STAT, which causes the LEDs above each port to reflect the status of the port. These were explained in Table 2-3.

Pressing the MODE button once changes the mode LED from STAT to UTIL. The LEDs above each of the ports in this mode reflect the bandwidth utilization of the backplane of the switch. The LEDs will turn green, acting like a meter bar. If an LED is amber, this indicates the maximum amount of bandwidth the switch has used since the switch was booted. This means that the port LEDs to the right of this will be off

and the ones to the left will be green or off, indicating the current utilization. When you are reading the meter bar to measure the actual bandwidth used on the backplane of the switch, note each switch has a slightly different process for reading the LEDs, since each has a different number of ports. In general, if only the leftmost LED is green, less than one-twentieth of one percent of the backplane capacity is used. If all of the LEDs are green with the exception of the far right-hand port, then the switch is using less than 50 percent of its backplane capacity.

Pressing the MODE button again changes the mode LED from UTIL to DUPLX. When this is enabled, the LEDs above the ports reflect the duplexing of the port. If the LED above the port is off, the port is set to half-duplex; if the LED is green, the port is set to full-duplex. By pressing the mode button again, the MODE LED will change from DUPLX to SPEED. This LED isn't contained on the 1900 series switches, since their ports operate only at 10 Mbps or 100 Mbps. The 2950 supports 10/100 ports, and even 10/100/1000 ports. When the mode LED is set to SPEED, the LEDs above the port refer to the speed the port is operating at. Table 4-8 lists the LED colors of the ports by port type and configured speed.

If you hit the MODE button again, the mode LED will change back to STAT. As you can see, the use of the MODE button allows you to cycle through the different mode settings. If the mode LED is either UTL, FDUP, or SPEED, it will automatically change back to STAT after one minute.

### Boot-Up Process and LEDs

When power is applied to the 2950, the switch will begin its POST process. POST is used to verify that the different components of the switch are operational. When POST begins, the SYSTEM LED is off. Once POST completes all testing, and all tests have passed, the SYSTEM LED should turn green. If it is amber, then at least one test has failed during POST, which is usually catastrophic for the switch: in other words, the switch won't boot up.

**TABLE 4-8** Port LED Colors for Speed Indication

Port Type	Off	Green	Flashing Green
10/100	10 Mbps		Not used
10/100/1000	10 Mbps	100 Mbps	1 Gbps
1000Base-X	Port disabled	1 Gbps	Not used

## Routers

Each Cisco router has its own unique chassis and, depending on the model, unique components. Cisco has attempted to modularize many of the components so that they can be used in related models. For instance, many of the cards for the 2600 and 3600 series routers are interchangeable. However, this is not the case for all of Cisco's routers. Therefore, there is typically no standardization as to what the router looks like and what LEDs it contains. This is also true of management ports. Most routers Cisco sells today have an RJ-45 console port. But many of Cisco's older routers, the 4000 and 7500 series, for example, use a DB-25 console port. The larger routers have both a console and an auxiliary port, while the smaller routers, like the 800, have only a console port.

Since each router is different from an external viewpoint, as well as its internal architecture, this book will not cover any of the chassis of the router models. If you are tested on any LEDs on the CCNA exam, it will be on the 1900 and 2950 switches. You might be tested on console connections, but I will cover this in more depth in the next section.

## Connections

Cisco's networking products support two types of external connections: ports (referred to as lines) and interfaces. Physical ports are used for management purposes and provide

**e x a m**

**W a t c h**

**Out-of-band management does not affect the bandwidth flowing through your network, while in-band management does.**

an out-of-band method for managing your Cisco product. Out-of-band means that your management tasks do not affect traffic that is flowing through your Cisco product. Interfaces are used to connect different networking devices together, such as a switch to router or a hub to a PC. Interfaces are connected to the backplane of the switch. You can also use interfaces for management purposes, but doing so can affect the performance of your

network device. These types of connections are called in-band connections. The following sections will cover the console port as well as interfaces on your Cisco devices.

## Console Port

Almost every Cisco product has a console port. This port is used to establish an out-of-band connection in order to access the CLI to manage your Cisco device. Once

you have placed a basic configuration on your Cisco device, assigning it IP addressing information, for instance, you can then come in via one of its interfaces in order to manage your product in-band. Some methods of in-band management include telnet, a web browser, SNMP, and CiscoWorks 2000.

Assuming that your Cisco device has an RJ-45 console port, you will need two components in order to manage your Cisco device from your PC:

- An RJ-45 rollover cable
- An RJ-45-to-DB-9 or RJ-45-to-DB-25 terminal adapter: determined by the number of pins that your COM port has on your PC

If your router has a DB-25 console port, you'll also need a DB-25-to-RJ-45 modem adapter, which is plugged into the console port of the router.

### exam

#### Watch

**Most console connections to Cisco devices require an RJ-45 rollover cable and an RJ-45-to-DB9 terminal adapter. The rollover cable pins are reversed on the two sides.**

on the other side; pin 2 is mapped to pin 7, pin 3 is mapped to pin 6, pin 4 is mapped to pin 5, pin 5 is mapped to pin 4, pin 6 is mapped to pin 3, pin 7 is mapped to pin 2, and pin 8 is mapped to pin 1.

### exam

#### Watch

**Remember the terminal parameters in Table 4-9 to establish a console connection to a Cisco device.**

The rollover cable used for the console connection looks like an Ethernet CAT-5 cable; however, this cable is proprietary to Cisco and will not work for other types of connections, such as Ethernet connections. The rollover cable has eight wires inside its plastic shielding and two RJ-45 connectors at each end. Each side of the rollover cable reverses the pins compared to the other side: pin 1 on one side is mapped to pin 8

Once you have connected one end of the rollover cable to the console port of your Cisco product and the other end into the terminal adapter and into the COM port of your PC (or terminal), you are ready to configure your PC to access your Cisco product. You will need a terminal emulation package to do this. There are many available products that you can use,

including HyperTerminal, which comes standard with Microsoft Windows operating systems. However, one of my personal favorites is TeraTerm. Within your terminal emulation software, you will need to set the parameters in Table 4-9 to the specified values. Once you have configured these settings, you should be able to press the ENTER key a few times to gain access to the CLI. At this point, you are accessing the Cisco product out-of-band.

TABLE 4-9

COM Port  
Settings

COM Component	Setting
Speed	9,600 bps
Data bits	8
Stop bits	1
Parity	None
Flow control	None

## Hardware Interfaces

This section will cover the nomenclature that Cisco uses for both their switch and router interfaces. This is important when it comes to configuring the components of a specific interface, such as its duplexing, or connecting a cable to it. As you will see under the following two headings, there are some minor differences between these two types of products.

### Switch Interface Nomenclature

The Catalyst 1900 and 2950 switches support only fixed interfaces, while the 2800 supports fixed and modular interfaces. Like their modular router counterparts, the nomenclature of an interface is: *type slot\_#/port\_#*. The type of interface is the media type, like *ethernet*, *fastethernet*, or *gigabit*. Following this is the slot number. For all fixed interfaces on the 1900 and 2950 switches, the slot number is always 0. For the 2820 switches, the fixed interfaces are referred to be in slot 0, while the two modular slots are 1 and 2.

The port number is the number of the port in the specified slot. Unlike in Cisco routers, port numbers start at 1 and work their way up. For instance, on a 1900, the very first port is *ethernet 0/1*, the second port is *ethernet 0/2*, and so on. For either the 1912 or 1924 switches, the AUI port on the back of the switch is

## exam

### Watch

**The nomenclature of a switch interface is:** *type slot\_#/port\_#*. **The type of interface is the media type, like** *ethernet*, *fastethernet*, **or** *gigabit*.

**Following this is the slot number. For all fixed interfaces on the 1900 and 2950 switches, the slot number is always 0. All port numbers start at 1 and work their way up.**

ethernet 0/25 and the two Fast Ethernet uplink ports are fastethernet 0/26 and fastethernet 0/27. Another difference between Cisco routers and switches is that with Cisco routers, each port type's numbering begins with 0: ethernet 0, ethernet 1, . . . , and fastethernet 0, fastethernet 1, . . . , but the Catalyst switches use a different scheme: the numbers start with 1 with the first port and work their way up, even if the port type changes.

### Router Interface Nomenclature

Depending on the Cisco router product, the interfaces are either fixed, modular, or a combination of the two. When referring to fixed interfaces on a Cisco product, the interface numbers *always* begin with 0 (not 1, like the switches) and work their way up within a particular interface type. Unlike switches, routers support many different data link layer media types, depending on their model. These types can include the following: atm, asynch, bri, ethernet, fddi, serial, tokenring, as well as many others.

For routers that have only fixed interfaces, the interface nomenclature is *type port\_#*. For example, if a router has two fixed Ethernet interfaces and two fixed serial interfaces, they would be called ethernet 0 and ethernet 1 and serial 0 and serial 1. As you can see in this example, the port numbers begin at 0 within *each* interface type. Through use of an interface type and a number, each of the interfaces can be uniquely identified.

However, if a router has modular slots, where you can insert interface cards into these slots, the interface nomenclature is like the Catalyst switches: *type slot\_#/port\_#*. Each slot has a unique slot number beginning with 0, and within each slot, the ports begin at 0 and work their way up. For example, if you had a modular router with two slots, the first slot would be 0 and the second 1. If the first

## exam

### Watch

**The nomenclature of a router interface is either *type slot\_#/port\_#* or *type port\_#*. The type of interface is the media type, like atm, asynch, bri, ethernet, fddi, serial, tokenring, as well as many**

**others. Following this is the slot number for modular routers. The slot numbers start at 0 and work their way up. All port numbers within a slot and type start at 0 and work their way up, which differs from the Catalyst switches.**

slot had four Ethernet interfaces, the interface numbers would be 0–3 and if the second slot had two Ethernet interfaces, the interface numbers would be 0 and 1.

Here's an example of a four-port serial module in the third slot of a 3640 router: `serial 2/0`, `serial 2/1`, `serial 2/2`, and `serial 2/3`. Here are some examples of routers with modular interfaces: 2600, 3600, 3700, 7000, 7200, and 7500. The exception to this is the 1600 and 1700 routers; even though they are modular, you don't configure any slot number when specifying a particular interface.

## CERTIFICATION OBJECTIVE 4.03

### Cabling

The last section of this chapter will deal with cabling. The CCNA focuses on Ethernet as a LAN technology and multiple types of WAN technologies. Therefore, this part of the chapter will focus on cables used for Ethernet and various WAN connections.

#### Ethernet Cabling

Ethernet has become the de facto standard for LAN implementations. At one time, there were three competing technologies: Ethernet, Token Ring, and FDDI. Because of the cost of FDDI, it was never really implemented on a wide scale but used only for backbone connections. Token Ring, however, was designed and heavily promoted by IBM. When Cisco purchased IBM's networking division, this stopped any further development on Token Ring technology. Therefore, most companies that used other LAN media types have converted to Ethernet. This section will provide a review from Chapter 2 on Ethernet, as well as the types of connections and cables you'll use to attach Ethernet devices together.

#### Cabling Specifications

IEEE 802.3 specifies the following standards for 10 Mbps Ethernet: 10Base2, 10Base5, 10BaseT, and 10BaseFL. IEEE 802.3r specifies the following standards for 100 Mbps Ethernet, called Fast Ethernet: 100BaseFX and 100BaseTX. At one time, there was another competing Fast Ethernet standard, 100BaseT4, but it has been supplanted by the two previous standards. When you look at Cisco's three-layer hierarchical model (core, distribution, and access), Cisco recommends that you use Ethernet only at the access layer, but you can use Fast Ethernet at any of the three layers.

## Cabling Devices

With today's implementation of Ethernet over copper, two components make up the connection: an RJ-45 connector and a Category-5 UTP cable. The cable has eight wires in it (4-pair of wires). There are two types of implementations for the pinouts of the two sides of the cable: straight-through and crossover.

A straight-through cable has pin 1 on one side connected to pin 1 on the other side, pin 2 to pin 2, and so on. A straight-through cable is used for DTE-to-DCE connections. The terms DTE and DCE are typically used in WAN connections, where the DCE provides clocking. These terms will be discussed in more depth in Chapter 15. However, in LAN terms, a DTE is a router, PC, or file server and a DCE is a hub or a switch. Here is when you should use a straight-through cable:

- A hub to a router, PC, or file server
- A switch to a router, PC, or file server

A crossover cable crosses over two sets of wires: pin 1 on one side is connected to pin 3 on the other and pin 2 is connected to pin 6. Crossover cables should be used when you connect a DTE to another DTE or a DCE to another DCE. Use a crossover cable for the following:

- A hub to another hub
- A switch to another switch
- A hub to a switch
- A PC, router, or file server to another PC, router, or file server

Sometimes the Ethernet interface will give you a clue as to the type of cable to use. If there is an X on the port and the other port doesn't have an X labeled on it, then use a straight-through cable. If neither device has an X or both do have an X, then use a crossover cable. In some instances, this setting can be changed in software with

## exam

### Watch

**For Ethernet, use a crossover cable for DTE-to-DTE and DCE-to-DCE devices and a straight cable for DTE-to-DCE connections.**

**A DTE device is a PC, file server, or router. A DCE device is a hub or a switch. An Ethernet crossover cable crosses over pins 1 ↔ 3 and 2 ↔ 6.**

a command or in hardware through the use of a DIP switch, which allows you to use the cable type that you currently have available.

## WAN Cabling

In WAN connections, your router is the DTE and the equipment it attaches to, such as a modem, CSU/DSU, or an NT1, is a DCE. The DCE is responsible for providing the clocking and synchronization of the physical layer connection. The cabling discussed in this section applies only to DTE-to-DCE connections. The cabling used for WAN connection is dependent on the technology and speed of access that you are using. Table 4-10 lists the cables and when they are used.

### exam

#### Watch

**Most Cisco synchronous serial interfaces have either a DB-60 or DB-21 connector.**

Each cable has two ends: one connects to the DCE and the other to the DTE. The DCE end-point is defined in the Cable Standards column in Table 4-10. However, the DTE end is proprietary to Cisco. With the exception of RJ-45, most of the WAN DTE end points either use a Cisco proprietary DB-60 connector or the smaller Cisco proprietary DB-21 connector, which looks like a flat USB connector. An ISDN BRI connection uses an RJ-45 connector.

### on the job

**It is extremely important that you plug your ISDN BRI connection from the router into the appropriate ISDN outlet. The ISDN connection has a voltage that runs through it, and if you connect the cable from the ISDN outlet to another router port, such as the console port or an Ethernet interface, you will probably damage your non-ISDN interface.**

**TABLE 4-10** WAN Cable Types

Cable Standards	ISDN BRI	HDLC	PPP	Frame Relay	HSSI
EIA/TIA-232	No	Yes	Yes	Yes	No
EIA/TIA-449	No	Yes	Yes	Yes	No
EIA/TIA-612/613	No	No	No	No	Yes
X.21	No	Yes	Yes	Yes	No
V.24	No	Yes	Yes	Yes	No
V.35	No	Yes	Yes	Yes	No
RJ-45	Yes	No	No	No	No

## CERTIFICATION SUMMARY

When choosing a networking product, you should consider ease-of-use, features and functions, capacity, reliability, and management. When choosing a WAN solution, consider cost, availability, and bandwidth requirements.

Hubs and repeaters are used to connect devices in the same bandwidth or collision domain. Switches are used to break up collision and bandwidth domains into smaller, more manageable segments through a process called microsegmentation. Routers are used to route between different broadcast domains.

The 1912 has 12 10BaseT interfaces and the 1924 has 24 10BaseT interfaces. Both have one 10Base5 AUI port and two 100BaseTX or FX uplink ports. The 2950 switches come in many varieties (hardware and software). Most interfaces support multiple auto-sensing speeds. The switch also supports two versions of software: standard and enhanced. On both switches, the RJ-45 console port is on the rear of the switch. When either switch boots up, it runs POST, which performs internal hardware diagnostics. Most test failures will cause the switch not to boot. To turn the switch off or on, remove or insert the power cord into the switch.

If the SYSTEM LED is amber, the switch experienced a malfunction. The MODE button is used to change the meanings of the LEDs for the Ethernet ports. mode LEDs include STAT, UTIL, FDUP/DUPLX, and SPEED (only the 2950). In STAT MODE, if the port LED is flashing green, the interface is passing traffic; if it is flashing green and amber, there is an operational problem with the port, like excessive collisions; if it is amber, the port has been disabled by a security violation or manually by an administrator. The UTIL MODE displays the current bandwidth usage of the backplane of the switch.

The console port requires an RJ-45 rollover cable and an RJ-45 to DB-9 terminal adapter. The rollover cable pins are reversed on the two sides. Your terminal emulator on your PC will need to be configured for 9,600 bps, 8 data bits, 1 stop bit, no parity, and no flow control for a console connection.

The nomenclature of a switch interface is: *type slot\_#/port\_#*. The type of interface is the media type, like *ethernet*, *fastethernet*, or *gigabit*. Following this is the slot number. For all fixed interfaces on the 1900 and 2950 switches, the slot number is always 0. All port numbers start at 1 and work their way up. The nomenclature of a router interface is either *type slot\_#/port\_#* or *type port\_#*. The type of interface is the media type, like *atm*, *asynch*, *bri*, *ethernet*, *fddi*, *serial*, *tokenring*, as well as many others. Following this is the slot number for modular routers. The slot numbers start at 0 and work their way

up. All port numbers within a slot and type start at 0 and work their way up, which is different from the Catalyst switches.

For Ethernet, use a crossover cable for DTE-to-DTE and DCE-to-DCE devices and a straight cable for DTE-to-DCE connections. A DTE device is a PC, file server, or router. A DCE device is a hub or a switch. Most Cisco synchronous serial interfaces use either a DB-60 or DB-21 connector.



## TWO-MINUTE DRILL

### Cisco's Networking Products

- When choosing a network product, consider: is it easy to install/support, does it support your requirements, does it have enough capacity, does it support redundancy, does it support mobile users, is it easily upgraded?
- For WAN solutions, ensure the following: that it is cost-effective, that the service is available, that you choose a solution with enough bandwidth.

### Chassis Information

- The 1900 supports 1024 MAC addresses. The 2800 supports two modular slots. All these switches have an AUI port on the rear and two 100Base uplink ports. The 1900 supports 10BaseT and 100Base fixed ports.
- The 1900 has a system LED: green is operational and amber is a malfunction. The MODE button is used to switch between the three mode LEDs: STAT (status of the port), UTL (backplane utilization), and FDUP (port duplexing). For port status, here are the LED colors: green, physical layer signal; flashing green, traffic entering the port; flashing green/amber, connection problem; amber, disabled. The default mode is port status.
- The 2950 supports fixed 10/100, 10/100/1000, and Gigabit ports. The 2950 has four port modes: STAT, UTIL, DUPLX, and SPEED. The colors of these LEDs are the same as on the 1900.
- Most failures during POST will cause the 1900 and 2950 switches to fail.

### Connections

- Out-of-band management is done through the console or auxiliary ports; in-band is done through an interface.
- Console port connections require an RJ-45 rollover cable and an RJ-45-to-DB-9 terminal adapter. In your terminal emulation package, set the following: speed to 9600 bps, data bits to 8, stop bits to 1, parity to none, and flow control to none.
- The slot number of the 1900 and 2950 is 0; port numbers start at 1. Router slot numbers begin with 0; port numbers start at 0 and restart with each type within each slot.

**Cabling**

- ❑ Ethernet straight-through cables are used to connect a DTE to a DCE: hub or switch to a router, PC, or file server.
- ❑ Ethernet crossover cables cross over pins 1 ↔ 3 and pins 2 ↔ 6. These connections are used for DTE-to-DTE and DCE-to-DCE connections, such as a hub or switch to another hub or switch; or a router, PC, or file server to another router, PC, or file server. If a networking device has an X over it, its port is set to DCE.

## SELF TEST

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

### Cisco's Networking Products

1. When choosing a networking product, you should consider all of the following except \_\_\_\_\_.
  - A. Ease of installation and support
  - B. Product features and functions
  - C. Backplane capacity
  - D. Amount of memory
2. When choosing a WAN solution, consider all of the following except \_\_\_\_\_.
  - A. Number of devices
  - B. Cost-effectiveness
  - C. Availability
  - D. Amount of bandwidth

### Chassis Information

3. A 1924 has \_\_\_\_\_ Ethernet interfaces.
  - A. 24
  - B. 26
  - C. 27
  - D. 28
4. The function of the MODE button is to \_\_\_\_\_.
  - A. Change the status of the ports
  - B. Affect what the SYSTEM and RPS LEDs represent
  - C. Affect what the port LEDs represent
  - D. Change the status of all the LEDs

5. If the 1900 SYSTEM LED is \_\_\_\_\_, a system POST test has failed.
  - A. Green
  - B. Amber
  - C. Flashing amber
  - D. Flashing green and amber
6. If the port status LED on a 2950 is \_\_\_\_\_, there is a physical layer connection problem.
  - A. Flashing green and amber
  - B. Flashing green
  - C. Amber
  - D. Flashing amber
7. If the 1900's mode is FDUP, and the LED is \_\_\_\_\_, the port speed is set to autodetect.
  - A. Green
  - B. Off
  - C. Amber
  - D. None of these
8. If the 2950's RPS is \_\_\_\_\_, the external power supply is supplying power.
  - A. Off
  - B. Amber
  - C. Flashing amber
  - D. Green

### **Connections**

9. When setting up an RJ-45 console connection, you need a RJ-45-to-DB-9 \_\_\_\_\_ adapter to attach to the COM port of your PC.
  - A. Auxiliary
  - B. Console
  - C. Connection
  - D. Terminal
10. With a rollover cable, pin 7 on one end is mapped to pin \_\_\_\_\_ on the other end.

11. The slot number of a 1900's Fast Ethernet uplink ports is \_\_\_\_\_.
- A. 0
  - B. 1
  - C. 2
  - D. No slot number is used
12. When configuring your terminal emulation software for a console connection, set the flow control to \_\_\_\_\_.
- A. Hardware
  - B. Software
  - C. None

### **Cabling**

13. When connecting a router to a PC, use a \_\_\_\_\_ cable.
- A. Crossover
  - B. Straight-through
  - C. Rollover
14. When connecting a switch to a router, use a \_\_\_\_\_ cable.
- A. Crossover
  - B. Straight-through
  - C. Rollover
15. With a crossover cable, which pins are crossed over?
- A. 1 and 2, 3 and 6
  - B. 1 and 3, 2 and 6
  - C. 1 and 4, 2 and 6
  - D. 1 and 3, 4 and 6

# SELF TEST ANSWERS

## Cisco's Networking Products

- D.** The amount of memory is not, typically, an important item when choosing between different networking products.  
 **A, B, and C** should be considered when choosing between network products.
- A.** The number of devices is typically not as important as the cost-effectiveness, availability of the service, and amount of needed bandwidth when choosing a WAN solution.  
 **B, C, and D** should all be considered when choosing a WAN solution.

## Chassis Information

- C.** A 1924 has 27 Ethernet interfaces: 24 10BaseT, 1 AUI, and 2 100Base uplink interfaces.  
 **A** is the number of 10BaseT interfaces. **B** is the number of interfaces on the front of the chassis. **D** specifies too many interfaces.
- C.** The function of the MODE button is to affect what the port LEDs represent.  
 **A** is true of a physical problem or software configuration. **B** has nothing to do with these two LEDs. And **D** is partially true: it affects the port LEDs, but not the SYSTEM and RPS LEDs.
- B.** If the 1900 system LED is amber, a SYSTEM POST test has failed.  
 **A** indicates that all POST tests passed. **C** and **D** aren't supported with this LED.
- A.** If the port status LED on a 2950 is flashing green and amber, there is a physical layer problem.  
 **B** indicates traffic passing through the port. **C** indicates the interface is disabled. **D** is not an LED status.
- D.** The 1900 doesn't support different speeds on the same interface: they're 10BaseT, 10Base5, or 100BaseTX/FX. The 2950, however, supports this function.  
 **A, B, and C** are thus incorrect.
- C.** If the 2950's RPS is flashing amber, the external power supply is supplying power.  
 **A** indicates that the external RPS is not installed. **B** indicates that the external RPS has failed or has a problem. **D** indicates that the RPS is installed but the internal power supply is supplying power.

## Connections

- 9.  **D**. When setting up an RJ-45 console connection, you need a RJ-45-to-DB-9 terminal adapter to attach to the COM port of your PC.  
 **A**, **B**, and **C** are incorrect adapters.
- 10.  With a rollover cable, pin 7 on one end is mapped to pin 2 on the other end.
- 11.  **A**. The slot number of a 1900's Fast Ethernet uplink ports is 0 .  
 **B** is the first slot in a 2800. **C** is the second slot in a 2800. The 1900 has at least one, logical, slot, making **D** incorrect.
- 12.  **C**. When configuring your terminal emulation software for a console connection, set the flow control to *none*.  
 **A** and **B** are incorrect.

## Cabling

- 13.  **A**. When connecting a router to a PC, use a crossover cable.  
 **B** is used for DTE-to-DCE connections. **C** is used for console connections.
- 14.  **B**. When connecting a switch to a router, use a straight-through cable.  
 **A** is true for DTE-to-DTE and DCE-to-DCE connections. **C** is for console connections.
- 15.  **B**. For a crossover cable, pins 1 and 3 and 2 and 6 are crossed over.  
 **A**, **C**, and **D** have the wrong pinouts crossed.