

4. Explain what a router is and what it does.

Answers should include some variation of the following points:

- A router is a specialized computer with a _____, _____, and an _____.
- A router is an _____ device that connects _____, especially _____ and _____.
- A router makes a decision about the _____ to use to _____ individual packets to the _____.

Routers

Routers are specialized computers for networking services using hardware and software. The hardware includes a processor, memory, specialized chips, and a selection of interfaces or ports. The software provides an operating environment for the hardware. This section of the Study Guide focuses on the terminology and concepts relating to routers. You reinforce your understanding of the internal components of a router by working through some exercises. Other exercises ask you to identify external interfaces and choose the right cable to use to connect devices.

Vocabulary Exercise: Completion

Complete the paragraphs that follow by filling in the appropriate words and phrases.

The main purpose of a router is to _____ packets. A router, like a typical PC, has a CPU and memory components. It also has specialized software, which in Cisco routers is called the _____. The _____ provides the basic routing logic. The router also has _____, just like PCs, which holds basic diagnostic software that runs when the router is first booted. All of these basic components (aaa, aaaa, aaaa, and an aaa) are found in PCs.

In addition, just like PCs have an interface to connect to networks (usually called a _____, or _____), routers also have interfaces. Instead of using a hard drive, routers use two types of memory to permanently store data: _____ and _____.

The main internal router components are as follows:

- _____, which stores _____ tables and the _____ file while the router is powered. It loses content when a router is powered down or restarted.
- _____, which provides storage for the startup _____ file and retains content when a router is powered down or restarted.
- _____, which is a type of EEPROM. It holds the _____ image and retains content when a router is powered down or restarted.
- _____, which maintains instructions for _____ diagnostics and stores bootstrap program and basic operating system software.
- _____, which connect routers to a network for packet entry and exit.

Flash memory is used for storage of the _____ software image. The router normally acquires the default IOS from flash. These images can be upgraded by loading a new image into flash. The IOS can be in uncompressed or compressed form. In most routers, an executable copy of the IOS is transferred to **RAM** during the boot process.

The three basic types of connections on a router are _____ interfaces, _____ interfaces, and _____ ports. The term _____ specifically refers to physical connectors that forward packets. In contrast, the term _____ refers to a physical connector that manages and controls a router.

The LAN and WAN connections provide network connections through which frame packets are passed. To connect to LAN interfaces, routers use a "_____" cable to connect to a switch, just like a "_____" cable should be used to connect a PC NIC to a switch. If you connect a router directly to a PC NIC without an intermediate device, like a hub or a switch, you must use a "_____" cable. This type of connection is common in many of the labs you will configure. To connect to WAN interfaces, the router uses a "_____" or "_____" cable to attach to a CSU/DSU or when directly connecting two WAN interfaces in a lab environment.

The function of management ports is different from that of the other connections. The management port provides a text-based connection for the configuration and troubleshooting of the router. The common management "interfaces" are the "_____" and "_____" ports. The console port and the auxiliary (AUX) port are EIA-232 "_____" serial ports and are not designed as networking ports.

Internal Components of a Router

Knowing the function of the main internal components of a router is more important than knowing the locations of the physical components inside a particular model. Therefore, in the following table, provide a sufficiently detailed description of each component.

Instructor note: The answers shown in the following table are directly from the text. However, encourage the student to paraphrase this material.

Component	Description
	The _____ executes the instructions of the operating system. Among these functions are system initialization, routing functions, and network interface control.
	_____ stores the IOS and contains the working memory needed by the IOS. This includes the routing table, running configurations, and packet queues, which hold packets until the interface can be used to forward the packet. The contents of RAM are lost when the router loses power.
	_____ memory stores a full Cisco IOS software image. In most routers, a copy of the IOS is transferred to RAM from flash during the boot process. Physically, flash memory consists of SIMMs or Personal Computer Memory Card International Association (PCMCIA) cards, which can be upgraded to increase the amount of flash. Flash memory does not lose its contents when the router loses power.
	_____ stores the startup configuration. As described in Chapter 2, "Introduction to Routers," a router copies the startup configuration from _____ into _____ when the router is initialized, and uses the running configuration in RAM for normal router operation. _____ retains its contents when the router loses power.
	_____ provide a physical means for the router to move bits among the different components of the router. Most routers contain a system bus and a CPU bus. The system bus communicates between the CPU and the interfaces; for example, this bus transfers the packets to and from the interfaces. The CPU bus is used by the CPU for accessing router storage devices, like NVRAM and flash memory.

Component	Description
ROM	" " " " " "
Power supply	" " " " "

Another way to learn the internal components of a router is to list each component's function. For each of the following functions, indicate which of the following components performs the function:

- A. RAM
- B. NVRAM
- C. Flash
- D. ROM
- E. Interfaces

Answer	Function
"	Provides temporary memory for the configuration file of the router while the router is powered on
"	Allows software to be updated without removing and replacing chips on the processor
"	Stores routing tables
"	Maintains instructions for POST diagnostics
"	Connect the router to the network for frame entry and exit
"	Can be on the motherboard or on a separate module
"	Is a type of EEPROM
"	Retains content when router is powered down or restarted
"	Stores bootstrap program and basic operating system software
"	Holds Address Resolution Protocol (ARP) cache
"	Loses content when router is powered down or restarted
"	Retains content when router is powered down or restarted
"	Holds the operating system image (IOS)
"	Provides storage for the startup configuration file
"	Can store multiple versions of IOS software

Label the External Components of a Router

Choose the correct label description for each number shown in Figure 1-1. Some labels can be used more than once.

Figure 1-1 Rear View of a 1721 Cisco Router

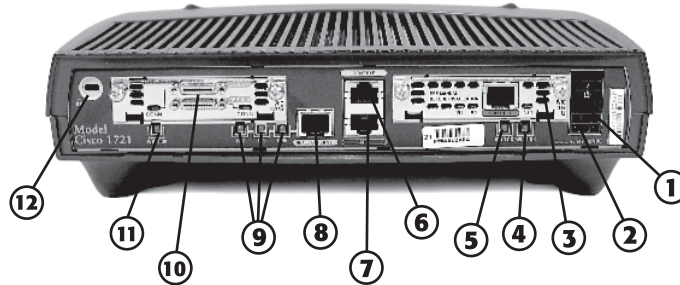


Figure 1-1 Label Description:

- ___ MOD OK LED, which is on when the Virtual Private Network (VPN) hardware encryption module is installed and recognized by the IOS.
- ___ Full duplex, 100 Mbps, and Link LEDs. The Link LED illuminates when a good physical connection exists on the Fast Ethernet port.
- ___ Illuminates when the WAN interface card (WIC) is okay and in use.
- ___ Power socket that connects to either a 120- or 220-volt AC outlet.
- ___ WAN interface card that provides access to a specific type of WAN technology."
- ___ A Kensington-compatible locking socket that allows this device to be padlocked to a secure object, like a rack mount.
- ___ Allows local configuration of the device.
- ___ Power switch.
- ___ Allows remote out-of-bandwidth configuration of the device.
- ___ LAN interface, which allows connections to hubs or switches through a patch or straight-through cable.

Choose the correct label description for each number shown in Figure 1-2. Some labels can be used more than once.

Figure 1-2 Rear View of a 2621 Cisco Router

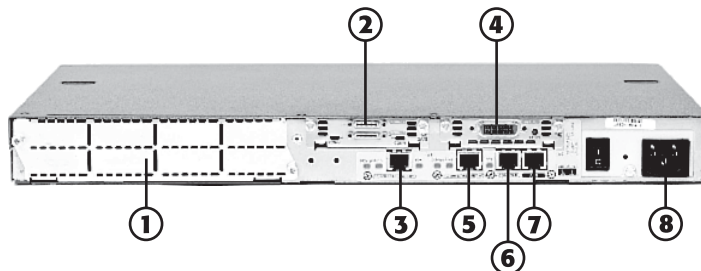







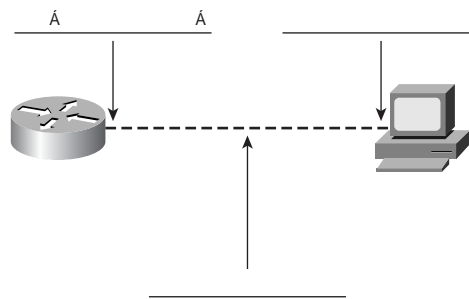


Figure 1-2 Label Description:

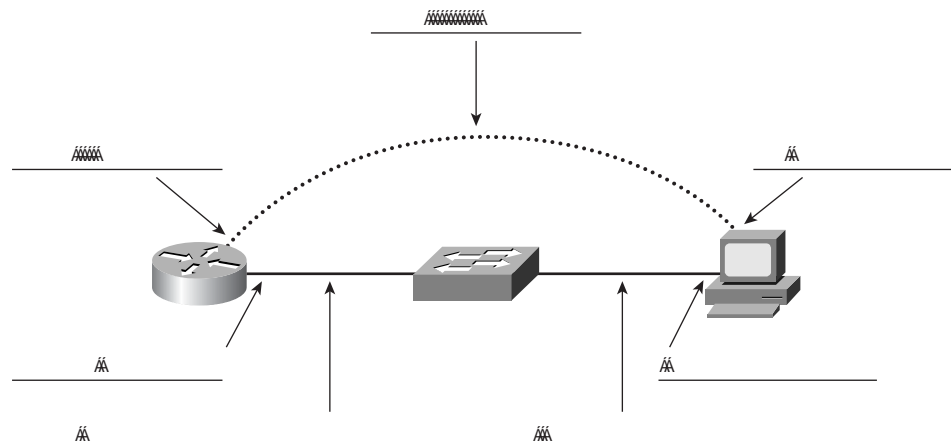
-  LAN interface, which allows connections to hubs or switches through a patch or straight-through cable.
-  WIC with two smart serial interfaces.
-  Power cord connection.
-  Allows remote configuration of the device.
-  Expansion slot.
-  Allows local configuration of the device.
-  WIC with one DB-60 serial interface.

Label the Topology Components Exercise

In Figure 1-3, the PC is attached to the router, which is providing a packet-routing service to the PC. In other words, the PC is part of the in-band network of the router. Label the interfaces and cable type used.

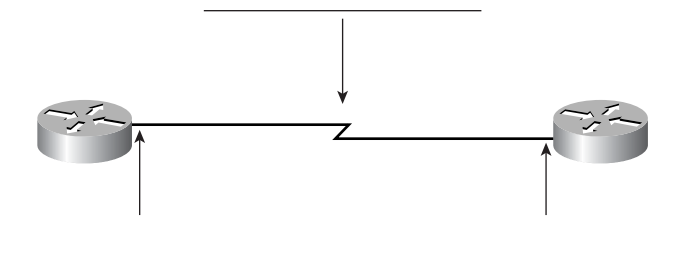
Figure 1-3 Label the Topology Components 1

In Figure 1-4, the PC is part of an in-band network and can also manage the router. Label the interfaces and cable types used.

Figure 1-4 Label the Topology Components 2

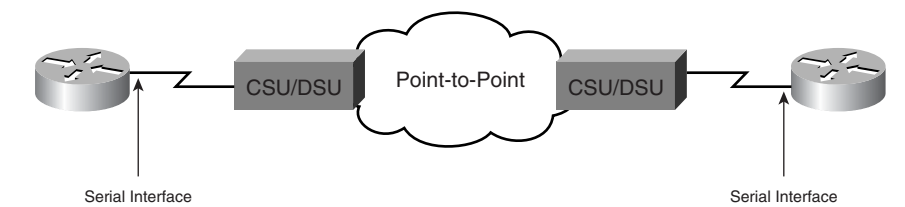
In Figure 1-5, the two routers are directly connected in a lab environment. Label the interfaces and cable types used. Also, choose a side that can provide the clocking, and label it.

Figure 1-5 Label the Topology Components 3



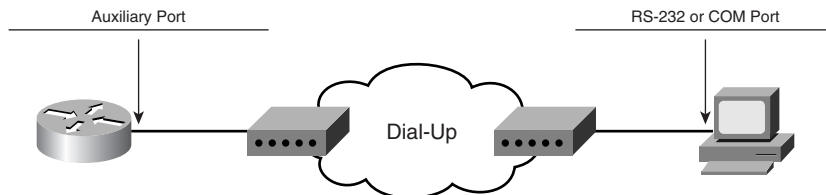
In Figure 1-6, the two routers are connected through a WAN service provider across a dedicated link. Label the interfaces.

Figure 1-6 Label the Topology Components 4



In Figure 1-7, the router and the PC are using an out-of-band network for device management purposes. Label the interfaces.

Figure 1-7 Label the Topology Components 5



Concept Questions

1. What three components of a router retain their memory when power is not present?

2. In what three ways can you configure a router?

3. Of the two management ports, which one is preferred, and why?
The Console port is preferred because you receive log messages from the router, including error messages and boot messages. In addition, you can perform password recovery through the Console port.
4. Besides the PC and the router, what three components (software and hardware) are required to connect a PC to a router's management port?

