



# CISCO ROUTER BASICS

ENTERPRISE NETWORK ENGINEERING

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# Lets Understand these set of QUESTIONS Today ...

## Operation of IP Data Networks

1. Recognize the purpose and functions of various network devices such as Routers, Switches, Bridges, and Hubs.
2. Identify the appropriate media, cables, ports, and connectors to connect Cisco network devices to other network devices and hosts in a LAN

## IP Routing Technologies

1. Configure and verify utilizing the CLI to set basic Router configuration

## Installing Cisco Routers

Routers collectively provide the main feature of the **network layer**—the capability to **forward packets end to end** through a network.

Routers forward packets by connecting to various physical network links, like Ethernet, serial links, and Frame Relay, and then using Layer 3 routing logic to choose where to forward each packet.

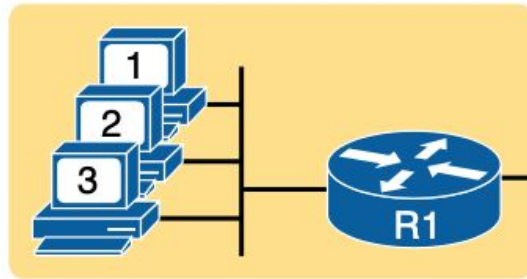
# Installing Enterprise Routers

A typical **enterprise network** has a few centralized sites as well as lots of smaller remote sites. To support devices at each site (the computers, IP phones, printers, and other devices).

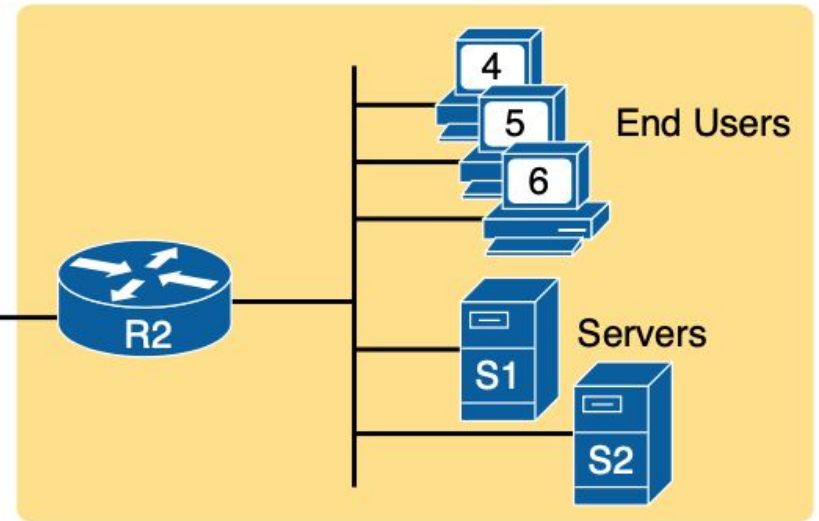
The net- work includes at least **one LAN switch at each site**. Additionally, **each site has a router, which connects to the LAN switch** and to some WAN link.

The **WAN link** provides connectivity from each remote site, back to the central site, and to other sites through the connection to the central site.

## Branch Office

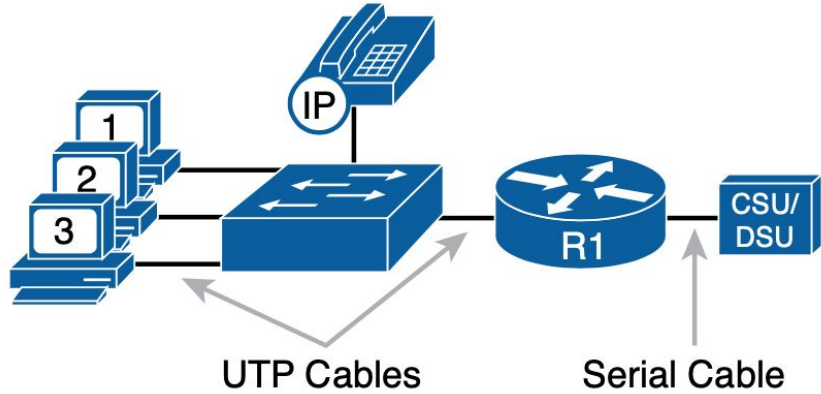


## Central Site

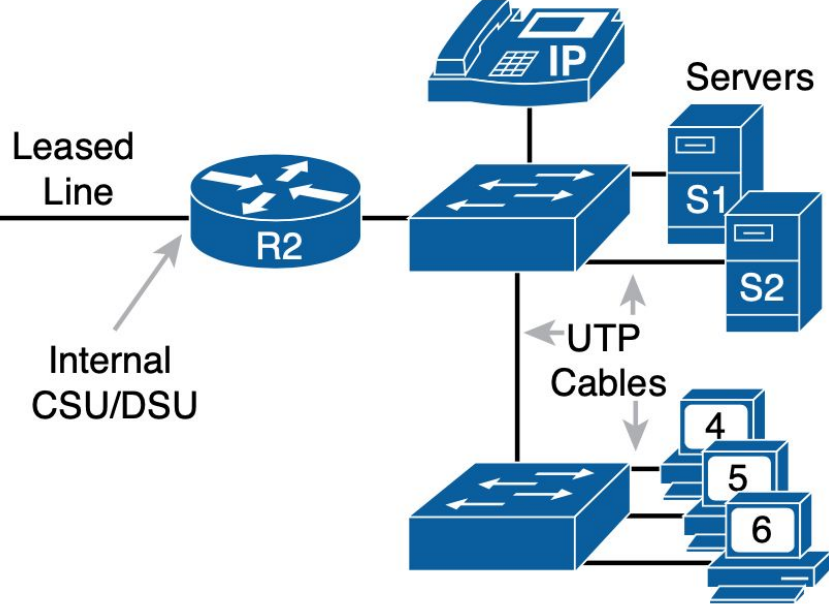


**Figure 15-1** *Generic Enterprise Network Diagram*

## Branch Office



## Central Site



Cabling Diagram for Enterprise Network

**In particular, routers** Ethernet cabling pinouts as PCs, **so each router uses a UTP cable with a straight-through pinout.**

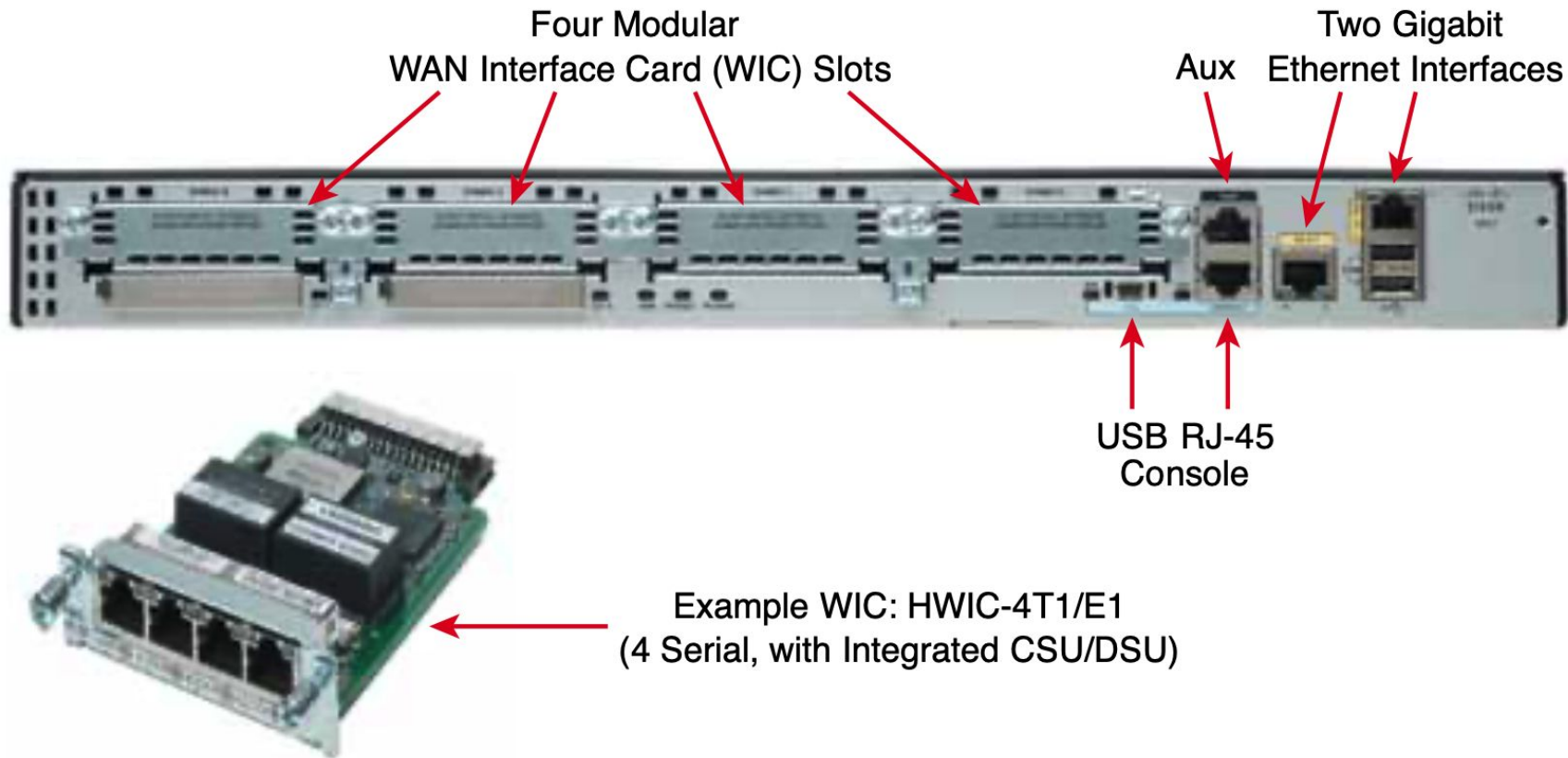
Next, consider the hardware on the ends of the **serial link**, in particular **where the channel service unit/data service unit (CSU/DSU) hardware resides on each end of the serial link.**

It sits either outside the router as a separate device (as shown on the left) or integrated into the router's serial interface hardware (as shown on the right).

Finally, the serial link requires some cabling inside the same wiring closet or other space between where the telco serial line terminates and where the router sits on a shelf or in a rack. The WAN cable installed by the telco typically has an RJ-48 connector, which is the same size and shape as an RJ-45 connector. The telco cable with the RJ-48 connector inserts into the CSU/DSU.

Router (Model - 2901)





**Figure 15-3** *Photos of a Model 2901 Cisco Integrated Services Router (ISR)*

## Physical Installation

Armed with the cabling details in figures like Figure 15-2, and the router hardware details in figures like Figure 15-3, you can physically install a router. To install a router, follow these steps:

- Step 1.** Connect any LAN cables to the LAN ports.
- Step 2.** If using an external CSU/DSU, connect the router's serial interface to the CSU/DSU and the CSU/DSU to the line from the telco.
- Step 3.** If using an internal CSU/DSU, connect the router's serial interface to the line from the telco.
- Step 4.** Connect the router's console port to a PC (using a rollover cable), as needed, to configure the router.
- Step 5.** Connect a power cable from a power outlet to the power port on the router.
- Step 6.** Power on the router.

Note that the steps for router installation match those for a switch, except that Cisco enterprise routers typically have an on/off switch, while switches do not.

# Switch CLI / Router CLI (Command Line Interface)

The configuration commands used for the following features are the same on both routers and switches:

- User and Enable (privileged) mode
- Entering and exiting configuration mode, using the **configure terminal**, **end**, and **exit** commands and the Ctrl+Z key sequence
- Configuration of console, Telnet, and enable secret passwords
- Configuration of SSH encryption keys and username/password login credentials
- Configuration of the hostname and interface description
- Configuration of Ethernet interfaces that can negotiate speed, using the **speed** and **duplex** commands
- Configuring an interface to be administratively disabled (**shutdown**) and administratively enabled (**no shutdown**)
- Navigation through different configuration mode contexts using commands like **line console 0** and **interface**
- CLI help, command editing, and command recall features
- The use of the **debug** command's many options to create log messages about certain events, so that any user can monitor those messages using the **terminal monitor EXEC** command
- Setup mode, used to guide the user through a set of questions to create a simple initial configuration
- The meaning and use of the startup config (in NVRAM), running config (in RAM), and external servers (like TFTP), along with how to use the **copy** command to copy the configuration files and IOS images

# Router Interfaces

One minor difference between Cisco switches and routers is that **routers support a much wider variety of interfaces.**

Routers support a variety of other types of interfaces, including **serial interfaces, cable TV, DSL.**

# Router Interface Brief

Most Cisco routers have at least one Ethernet interface of some type. the router IOS refers to these interfaces based on the fastest speed.

For example,

**10-Mbps-only** Ethernet interface would be configured with the **interface ethernet** number configuration command,

10/100 interface with the **interface fastethernet** number command,

10/100/1000 interface with the **interface gigabitethernet** number command.

# Commands for Listing the Interface

Routers refer to interfaces in many commands, first by the type of interface (**Ethernet, Fast Ethernet, Serial, and so on**) and then with a unique number of that router. On routers, the interface numbers might be a single number, two numbers separated by a slash, or three numbers separated by slashes.

For example, all three of the following configuration commands are correct on at least one model of Cisco router:

**interface ethernet 0**

**interface fastEthernet 0/1**

**interface gigabitethernet 0/0**

**interface serial 1/0/1**

Two of the most common commands to display the interfaces, and their status, are the **show ip interface brief** and **show interfaces** commands. The **first of these commands displays a list with one line per interface**, with some basic information, including the interface IP address and interface status. The **second command lists the interfaces, but with a large amount of information per interface**.



# Note:

Commands that refer to router interfaces can be significantly shortened by truncating the words.

For example,

**sh int fa0/0** can be used instead of **show interfaces fastethernet 0/0**.

## Interface Status Codes

Each interface has two *interface status codes*. To be usable, the two interface status codes must be in an “up” state. The first status code refers essentially to whether Layer 1 is working, and the second status code mainly (but not always) refers to whether the data link layer protocol is working. Table 15-1 summarizes these two status codes.

**Table 15-1** Interface Status Codes and Their Meanings

Name	Location	General Meaning
Line status	First status code	Refers to the Layer 1 status—for example, is the cable installed, is it the right/wrong cable, is the device on the other end powered on?
Protocol status	Second status code	Refers generally to the Layer 2 status. It is always down if the line status is down. If the line status is up, a protocol status of down is usually caused by a mismatched data link layer configuration.

Several combinations of interface status codes exist, as summarized in Table 15-2. The table lists the status codes in order, from being disabled on purpose by the configuration to a fully working state.

**Table 15-2** Typical Combinations of Interface Status Codes

Line Status	Protocol Status	Typical Reasons
Administratively down	Down	The interface has a <b>shutdown</b> command configured on it.
Down	Down	The interface is not <b>shutdown</b> , but the physical layer has a problem. For example, no cable has been attached to the interface, or with Ethernet, the switch interface on the other end of the cable is shut down or the switch is powered off.

Line Status	Protocol Status	Typical Reasons
Up	Down	Almost always refers to data link layer problems, most often configuration problems. For example, serial links have this combination when one router was configured to use PPP and the other defaults to use HDLC.
Up	Up	Layer 1 and Layer 2 of this interface are functioning.

For some examples, look back at Example 15-1's **show ip interface brief** command, to the three interfaces in the following list. The interfaces in this list each have a different combination of interface status codes; the list details the specific reasons for this status code in the lab used to create this example for the book.

**G0/0:** The interface is down/down, in this case because no cable was connected to the interface.

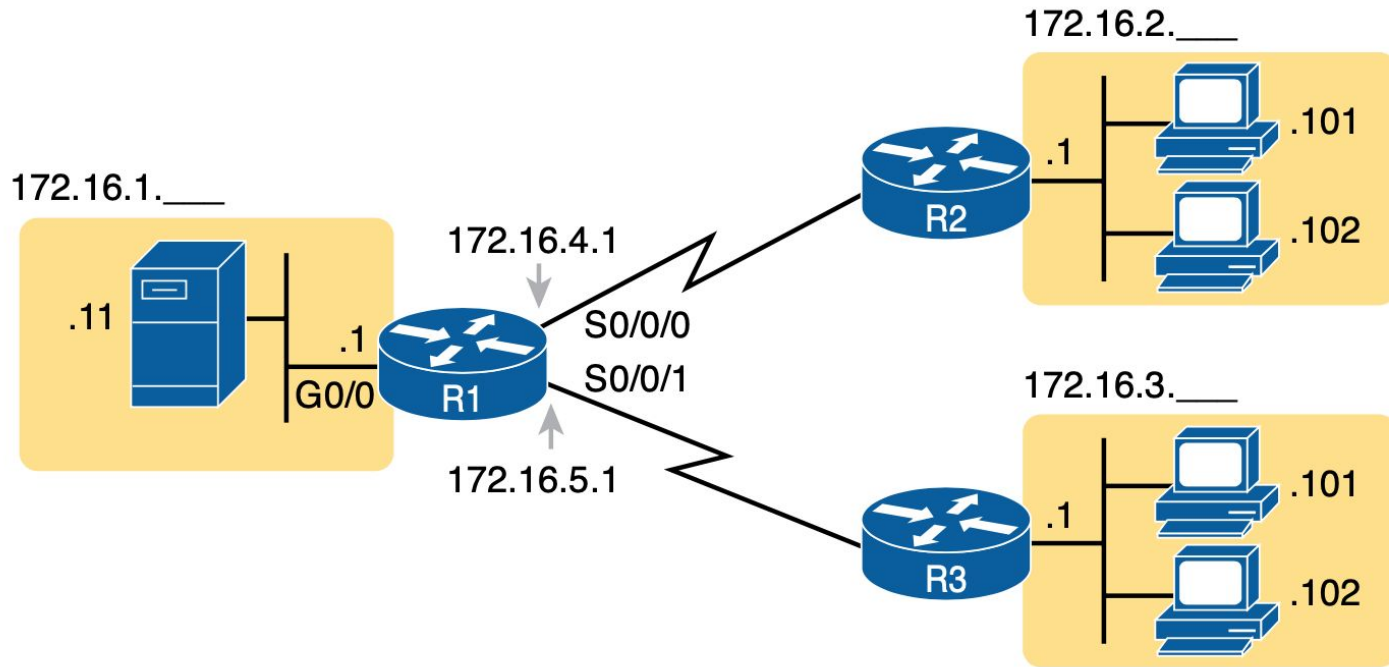
**G0/1:** The interface is administratively down/down, because the configuration includes the **shutdown** command under the G0/1 interface.

**S0/0/0:** The interface is up/up because a serial cable is installed, connected to another router in a lab, and is working.

## Router Interface IP Addresses

Cisco enterprise routers require at least some configuration beyond the default configuration before they will do their primary job: routing IP packets. The following facts tell us that to make a router ready to route IPv4 packets on an interface, you need to enable the interface and assign it an IPv4 address:

- Most Cisco router interfaces default to a disabled (**shutdown**) state and should be enabled with the **no shutdown** interface subcommand.
- Cisco routers do not route IP packets in or out an interface until an IP address and mask have been configured; by default, no interfaces have an IP address and mask.
- Cisco routers attempt to route IP packets for any interfaces that are in an up/up state and that have an IP address/mask assigned. (Routers enable IPv4 routing by default due to a default **ip routing** global configuration command.)



### Example 15-2 *Configuring IP Addresses on Cisco Routers*

```
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# interface G0/0
R1(config-if)# ip address 172.16.1.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# interface S0/0/0
R1(config-if)# ip address 172.16.4.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# interface S0/0/1
R1(config-if)# ip address 172.16.5.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# ^Z
R1#
```

Example 15-3 shows the output of the **show protocols** command. This command confirms the state of each of the three R1 interfaces in Figure 15-6 and the IP address and mask configured on those same interfaces.

### Example 15-3 *Verifying IP Addresses on Cisco Routers*

```
R1# show protocols
Global values:
  Internet Protocol routing is enabled
Embedded-Service-Engine0/0 is administratively down, line protocol is down
GigabitEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.1/24
GigabitEthernet0/1 is administratively down, line protocol is down
  Serial0/0/0 is up, line protocol is up
    Internet address is 172.16.4.1/24
  Serial0/0/1 is up, line protocol is up
    Internet address is 172.16.5.1/24
Serial0/1/0 is administratively down, line protocol is down
Serial0/1/1 is administratively down, line protocol is down
```

Summarize the Command..

**Table 15-5** Chapter 15 Configuration Command Reference

Command	Description
<b>interface</b> <i>type number</i>	Global command that moves the user into configuration mode of the named interface.
<b>ip address</b> <i>address mask</i>	Interface subcommand that sets the router's IPv4 address and mask.
<b>[no] shutdown</b>	Interface subcommand that enables ( <b>no shutdown</b> ) or disables ( <b>shutdown</b> ) the interface.
<b>duplex</b> { full   half   auto }	Interface command that sets the duplex, or sets the use of IEEE autonegotiation, for router LAN interfaces that support multiple speeds.
<b>speed</b> { 10   100   1000 }	Interface command for router Gigabit (10/100/1000) interfaces that sets the speed at which the router interface sends and receives data.
<b>clock rate</b> <i>rate</i>	Interface command that sets the speed at which the router supplies a clocking signal, applicable only when the router has a DCE cable installed. The unit is bits/second.
<b>description</b> <i>text</i>	An interface subcommand with which you can type a string of text to document information about that particular interface.

**Table 15-6** Chapter 15 EXEC Command Reference

Command	Purpose
<b>show interfaces</b> [ <i>type number</i> ]	Lists a large set of informational messages about each interface, or about the one specifically listed interface.
<b>show ip interface brief</b>	Lists a single line of information about each interface, including the IP address, line and protocol status, and the method with which the address was configured (manual or DHCP).
<b>show protocols</b> <i>type number</i>	Lists information about the listed interface, including the IP address, mask, and line/protocol status.
<b>show controllers</b> [ <i>type number</i> ]	Lists many lines of information per interface, or for one interface, for the hardware controller of the interface. On serial interfaces, this command identifies the cable as either a DCE or DTE cable.
<b>show version</b>	Lists the version of IOS currently running in the router, plus a variety of other facts about the currently installed hardware and software in the router.



# Assessment Questions :

# Question - 1

Q. Comparative analysis of following Networking Devices **Switch and Router** in Brief. [ at least 10 Points each]

## Question 2 ( Implement the network topology on **CISCO PACKET TRACER TOOL** - Along with neat labelling )

