Lecture 2

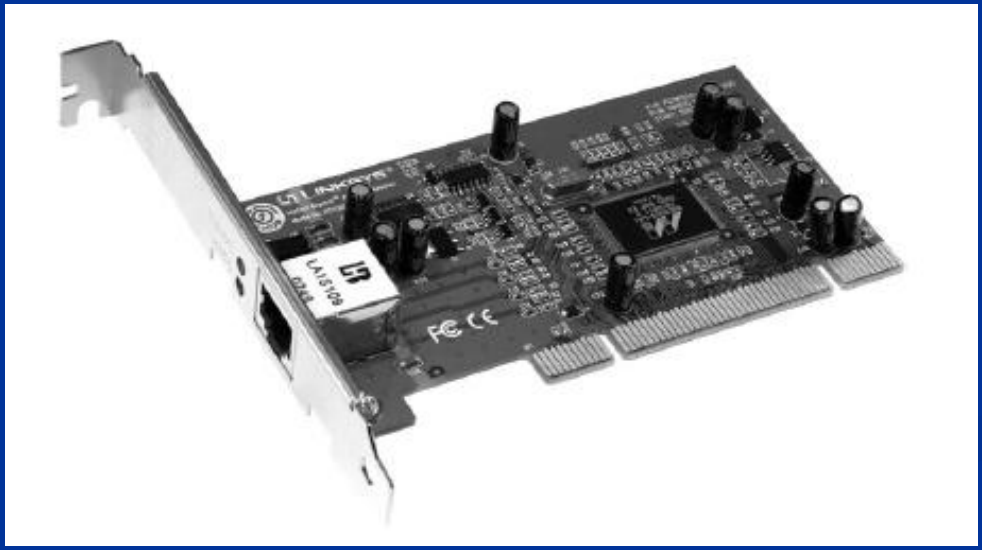
Router Configuration

Network Hardware

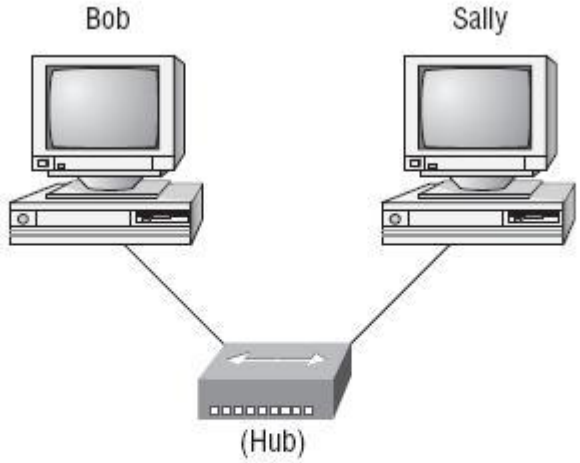
- Network Adapter
- Hub
- Switch
- Router

Network Adapter

- Wired and wireless network adapters are available.
- The type of network adapter used in desktop computers is called the Network Interface Card (NIC).



Hub

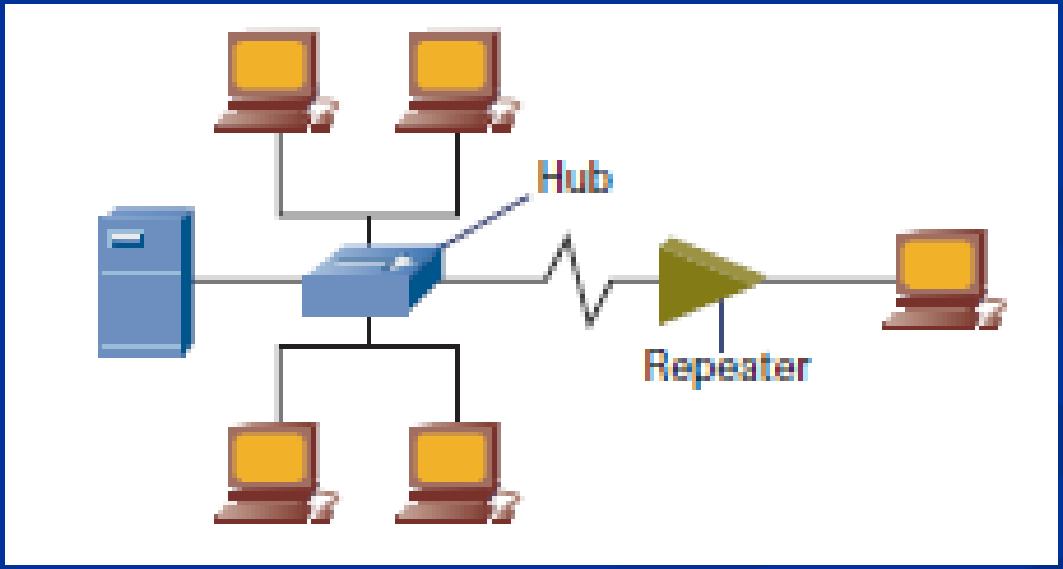


The basic network allows devices to share information.
The term computer language refers to binary code (0s or 1s).
The two hosts above communicate using hardware or MAC addresses.

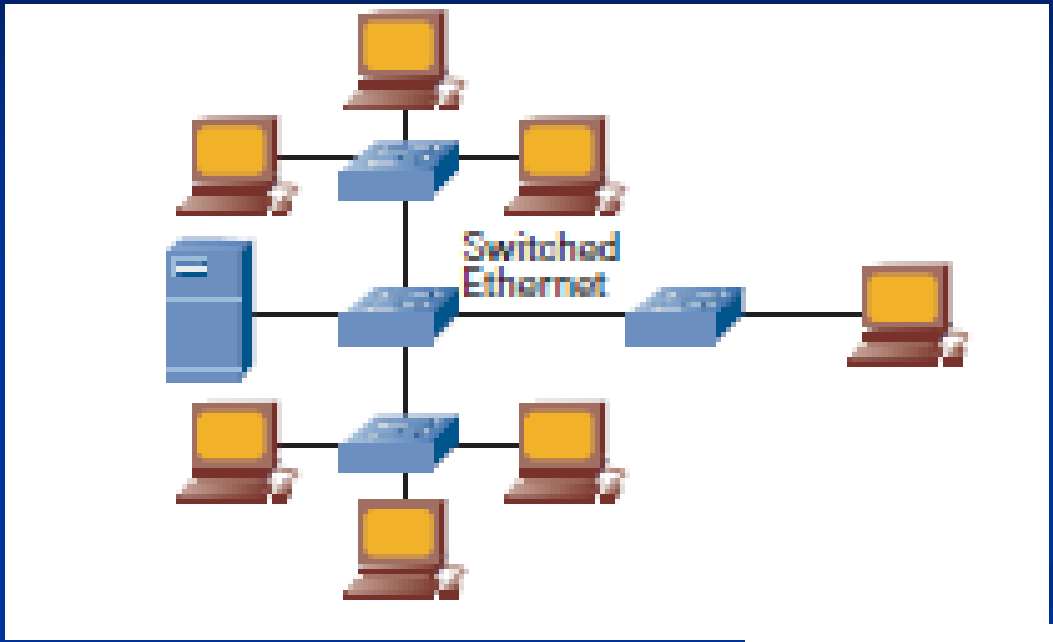
Basic Connnection using hub

Problem of Hub Connection

- Collision
- Reduce Thoughtput



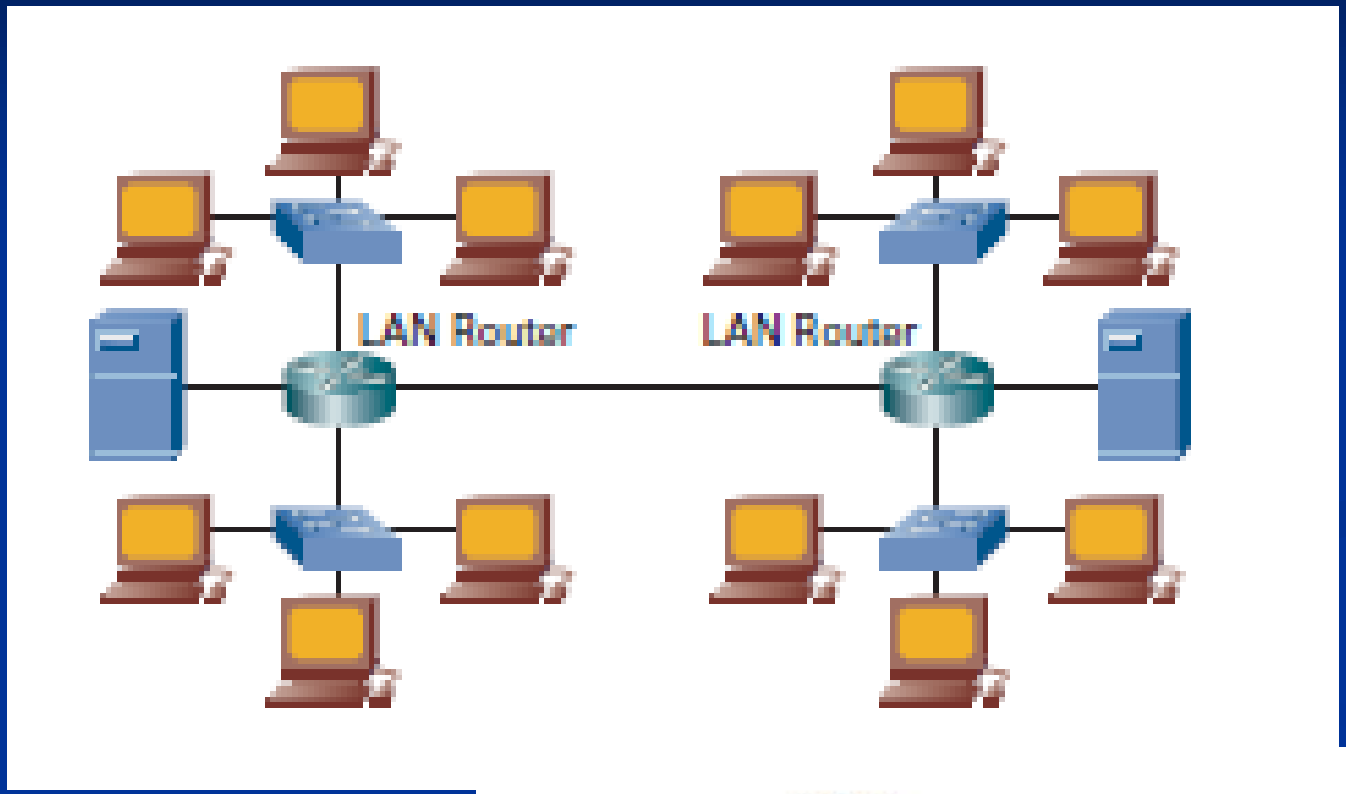
Switch Connection

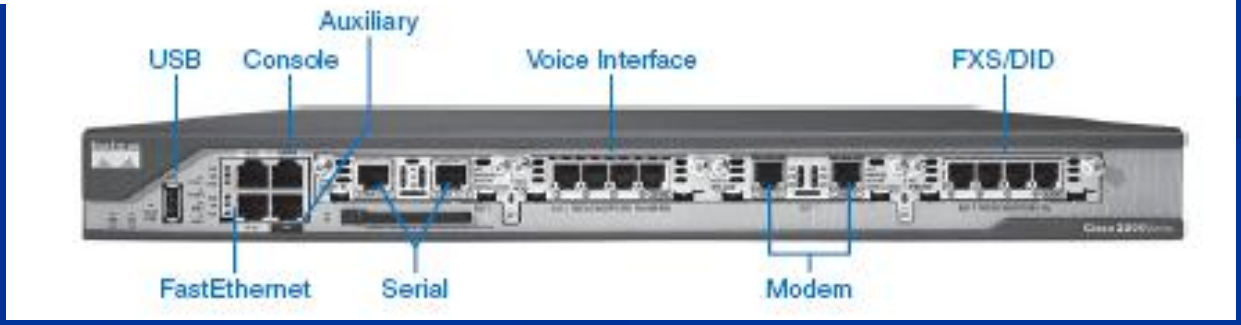


Switch Connection Problem

- A list of some of the things that commonly cause LAN traffic congestion
  - Too many hosts in a broadcast domain
  - Broadcast storms
  - Multicasting
  - Low bandwidth
  - Adding hubs for connectivity to the network
  - A bunch of ARP or IPX traffic (IPX is a Novellrouting protocol that is like IP, but really, really chatty.)

Router


LAN Router
LAN Router


Auxiliary
USB
Console
Voice Interface
FXS/DID
FastEthernet
Serial
Modem

Advantages of Using Routers

- There are two advantages of using routers in your network:
  - They don't forward broadcasts by default.
  - They can filter the network based on layer 3 (Network layer) information (e.g., IP address).

Router Functions

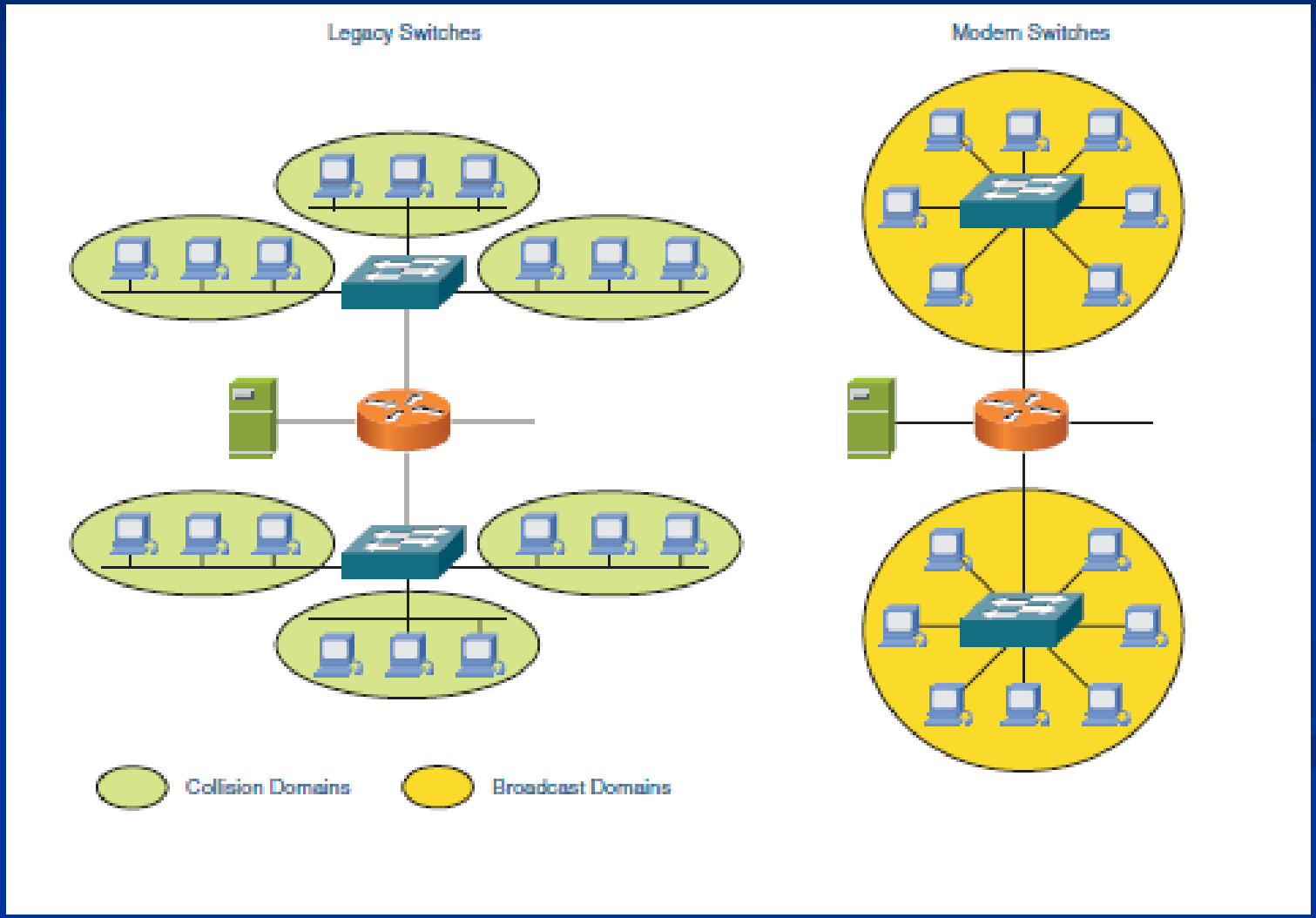
- Four router functions in your network can be listed as follows:
  - Packet switching
  - Packet filtering
  - Internetwork communication
  - Path selection

So..

- Routers are used to connect networks together and route packets of data from one network to another
- Switches aren't used to create internetworks The main purpose of a switch is to make a LAN work better—to optimize its performance—providing more bandwidth

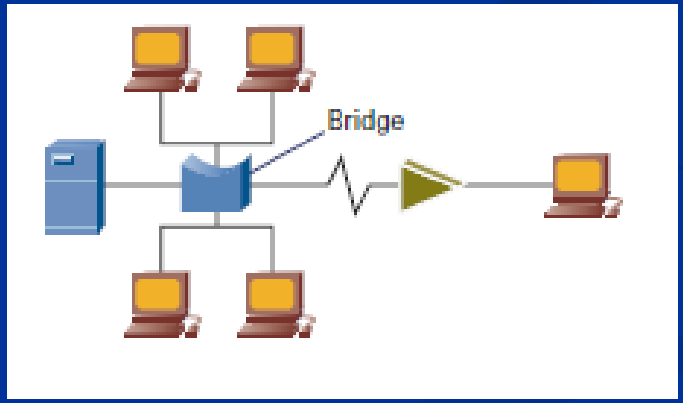
  for the LAN's users.
- By default, switches break up *collision domains*
  - **Collision Domains**: Ethernet term used to describe a network scenario wherein one particular device sends a packet on a network segment, forcing every other devices on that same segment to pay attention to it

Collision & Broadcast Domain

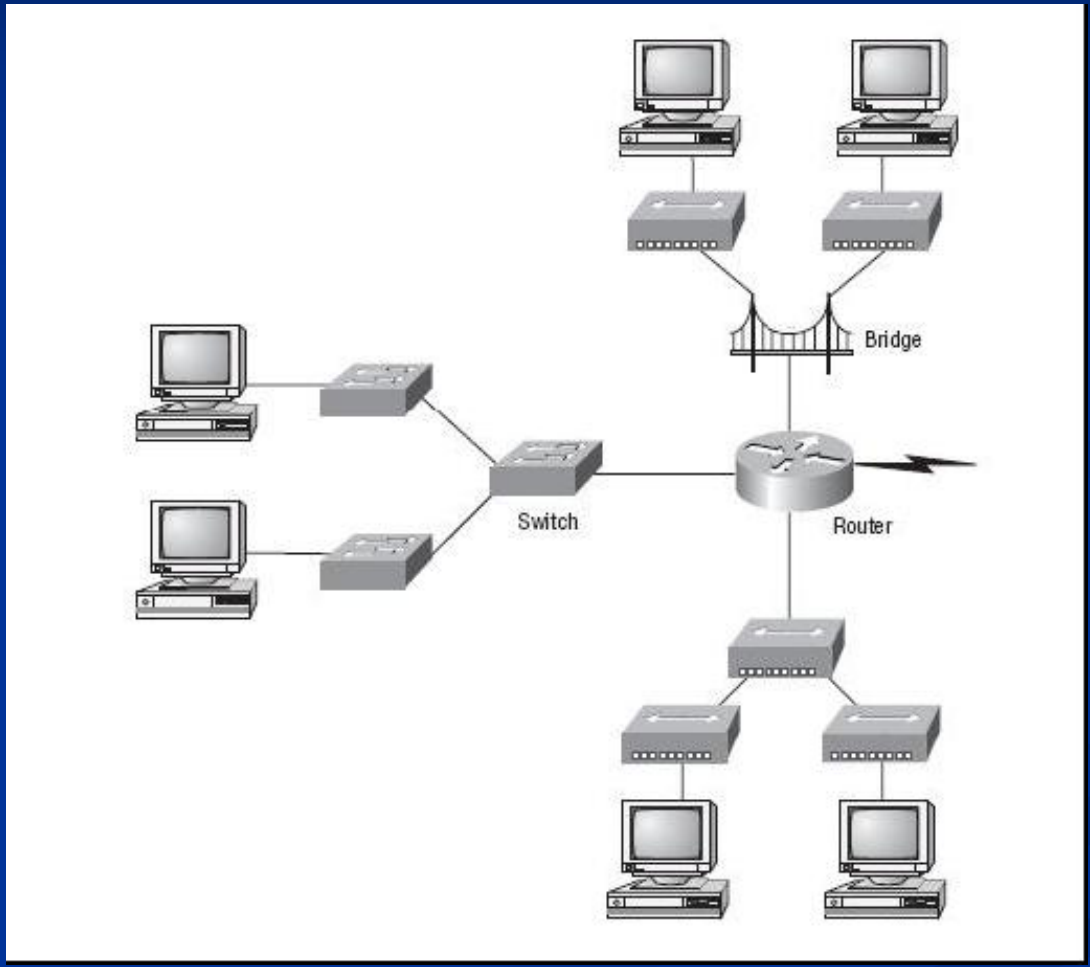


Bridge and Switch

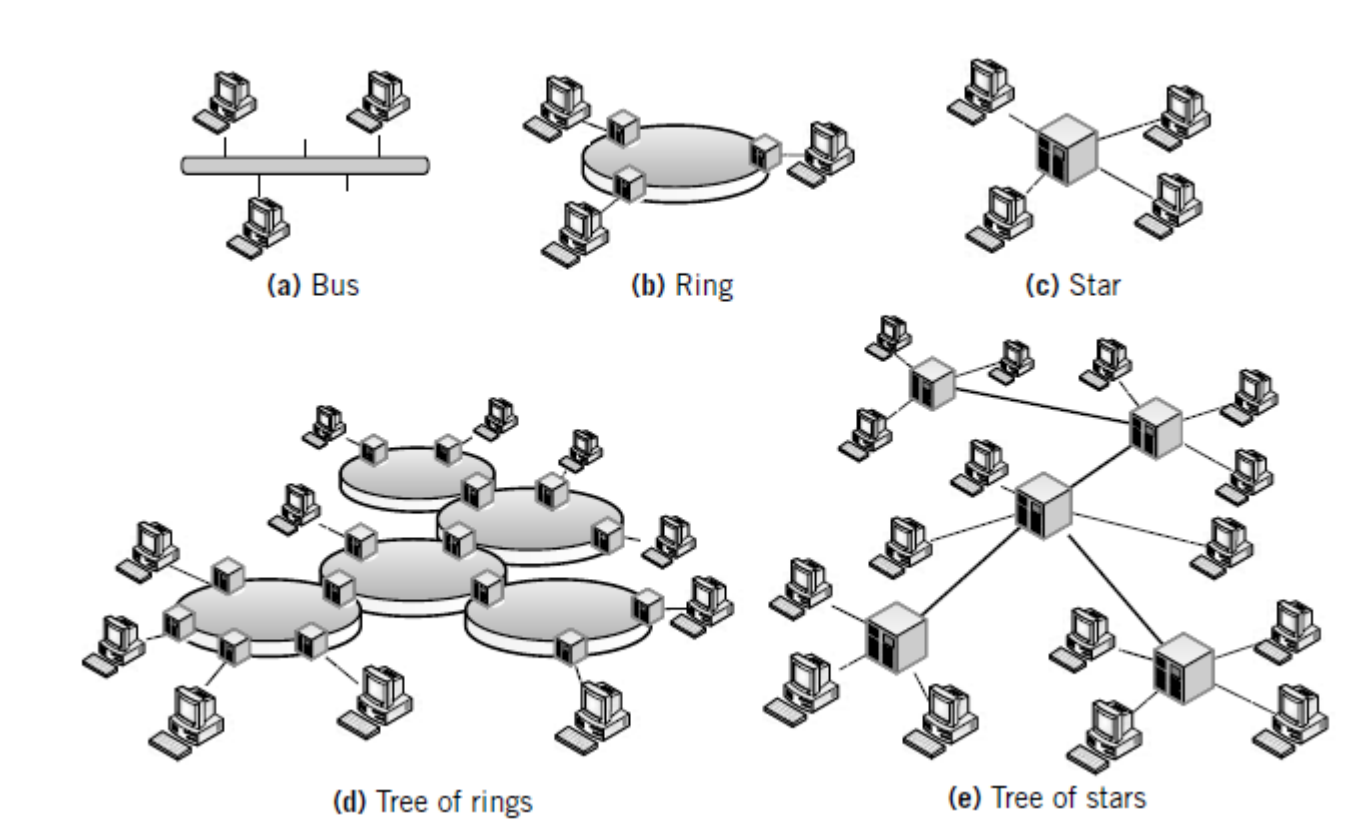
- Bridges and switches basically do the same thing
- In reality, you cannot buy a physical bridge these days, only LAN switches, but they use bridging technologies, so Cisco still calls them *multiport bridges*.



Internetworking devices

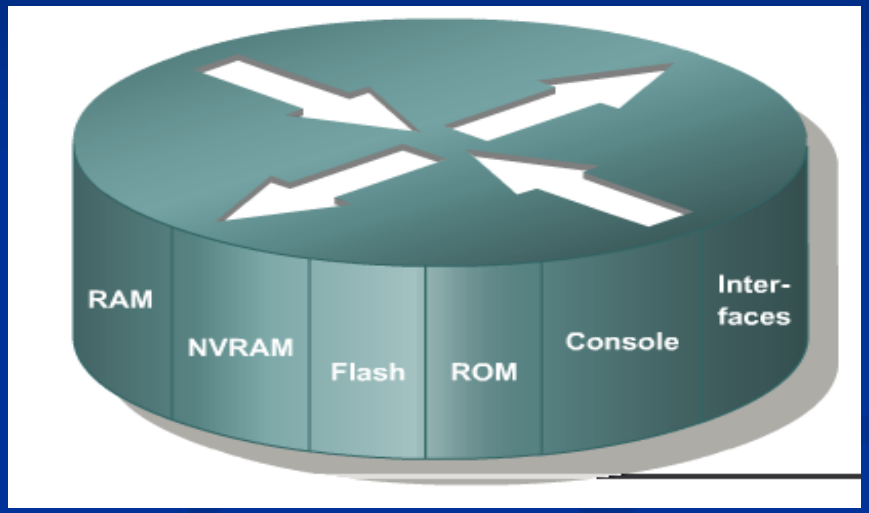


Network Topologies



Introduction to Routers in a WAN

- Routers connect and allow communication between two networks and determine the best path for data to travel through the connected networks.
- Routers need the Internetwork Operating System software (IOS) to run configuration files.



- The main internal components of the router are **random access memory** (RAM), **nonvolatile random-access memory** (NVRAM), **flash memory**, **read-only memory** (ROM), and **interfaces**.

RAM

- Stores routing tables
- Holds ARP cache and fast-switching cache
- Performs packet buffering (shared RAM)
- Maintains packet-hold queues
- Provides temporary memory for the configuration file of the router while the router is powered on
- Loses content when router is powered down or restarted

NVRAM

- Provides storage for the startup configuration file
- Retains content when router is powered down or restarted

Flash Memory

- Holds the operating system image (IOS)
- Allows software to be updated without removing and replacing chips on the processor
- Retains content when router is powered down or restarted
- Can store multiple versions of IOS software
- Is a type of electronically erasable, programmable ROM (EEPROM)

ROM

- Maintains instruction for power-on self test (POST) diagnostics
- Stores bootstrap program and basic operating system software
- Requires replacing pluggable chips on the motherboard for software upgrades

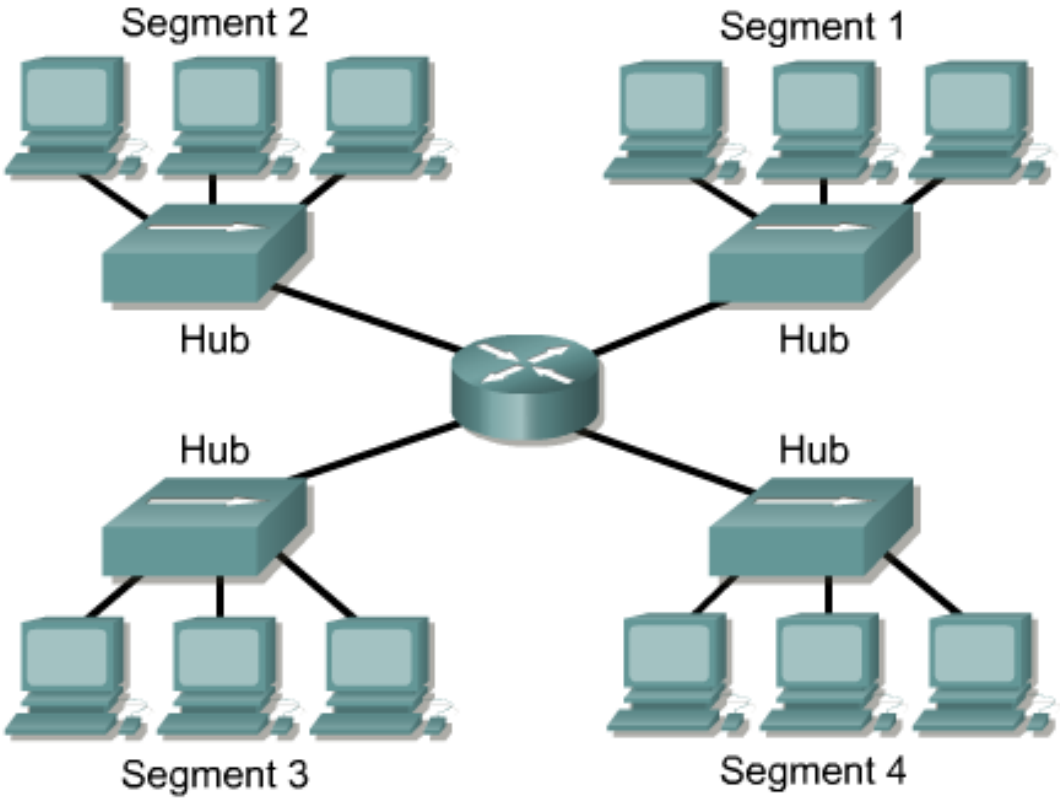
Interfaces

- Connect router to network for frame entry and exit
- Can be on the motherboard or on a separate module

Router LANs and WANs

- While a router can be used to segment LANs, its major use is as a WAN device.
- Routers have both LAN and WAN interfaces
- WAN technologies are frequently used to connect routers and these routers communicate with each other by WAN connections.

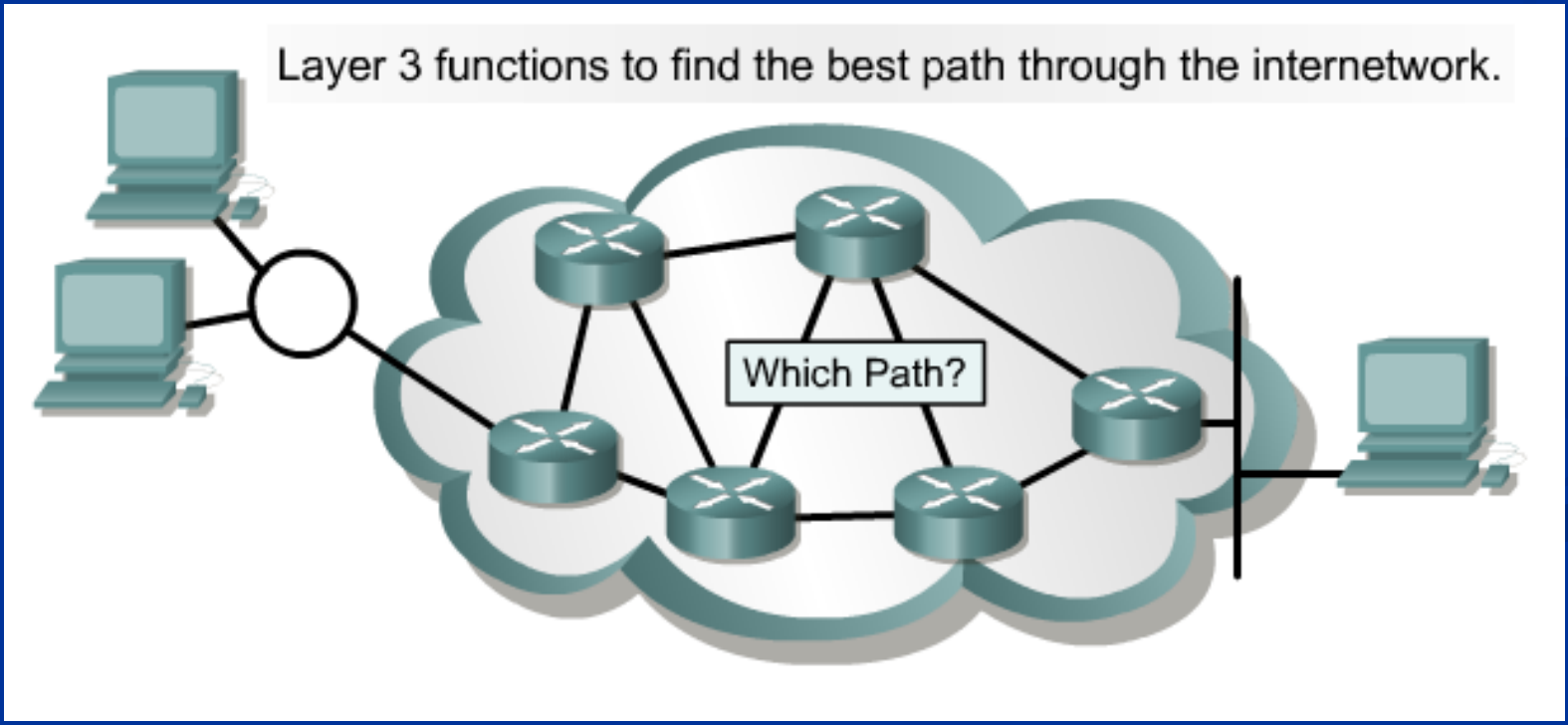
Router LANs and WANs



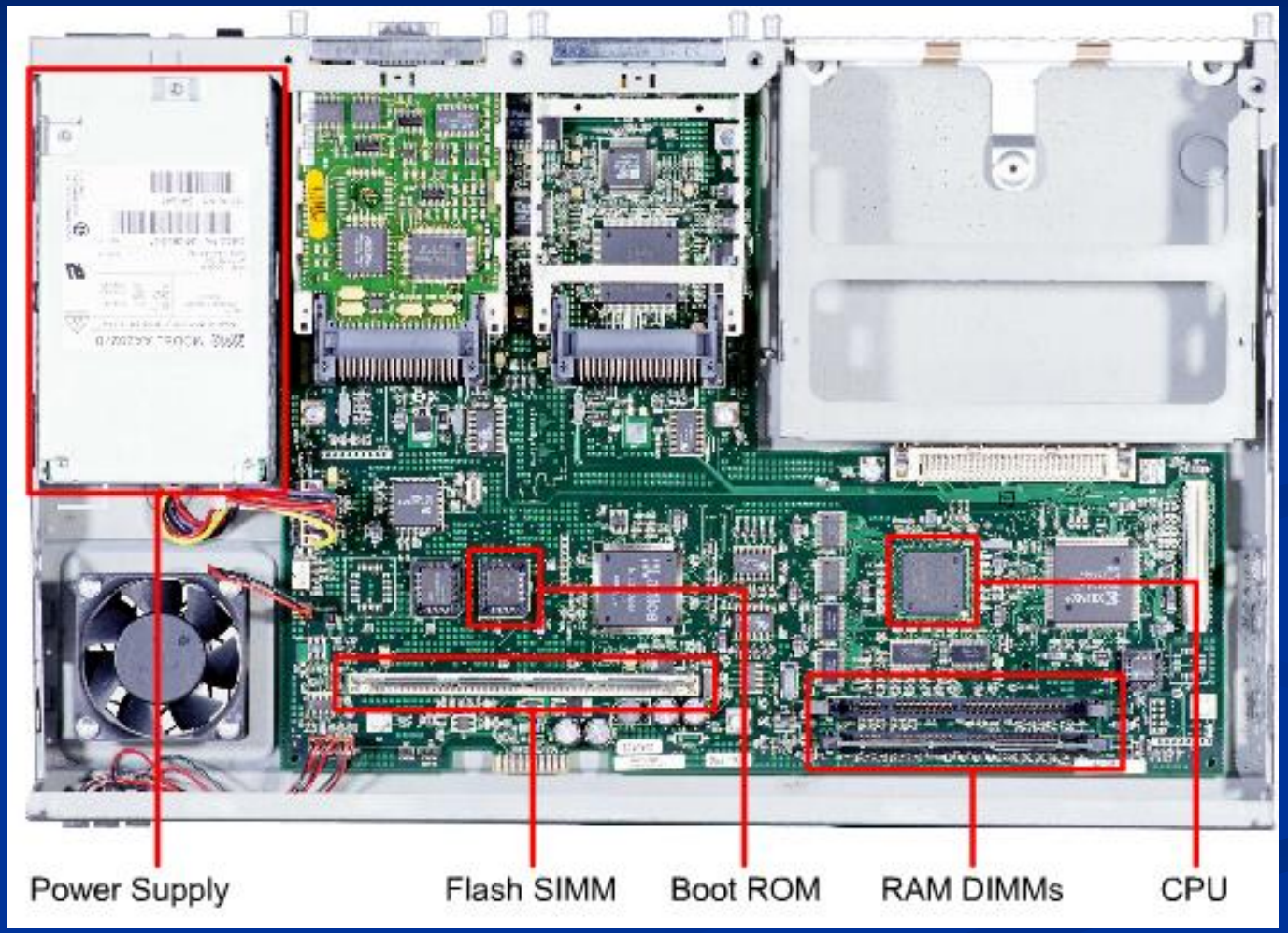
- More manageable, greater functionality, multiple activite paths
- Smaller broadcast domains
- Operates at Layer 3

Router LANs and WANs

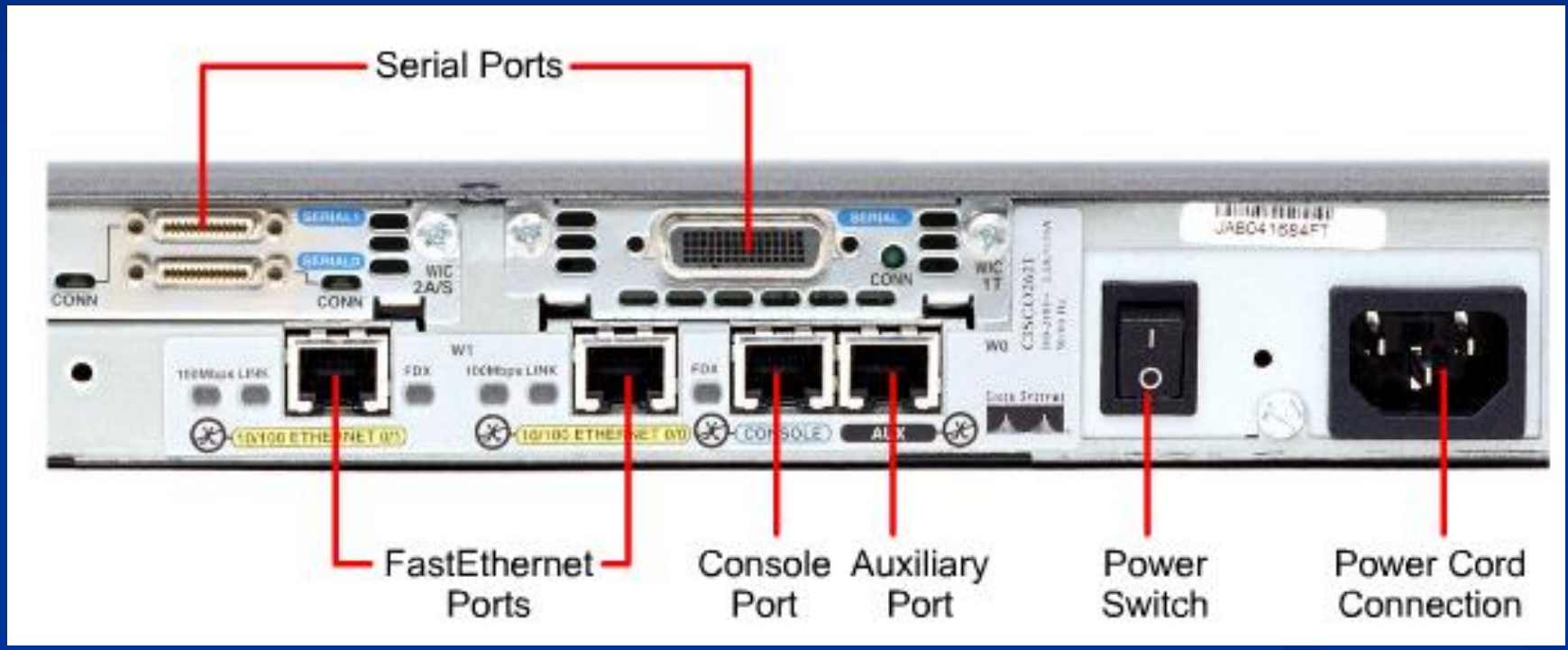
- Two main functions of a router are the ***selection of best path*** and the ***switching of frames*** *to the proper interface*.
- Routers accomplish this by building routing tables and exchanging network information with other routers.



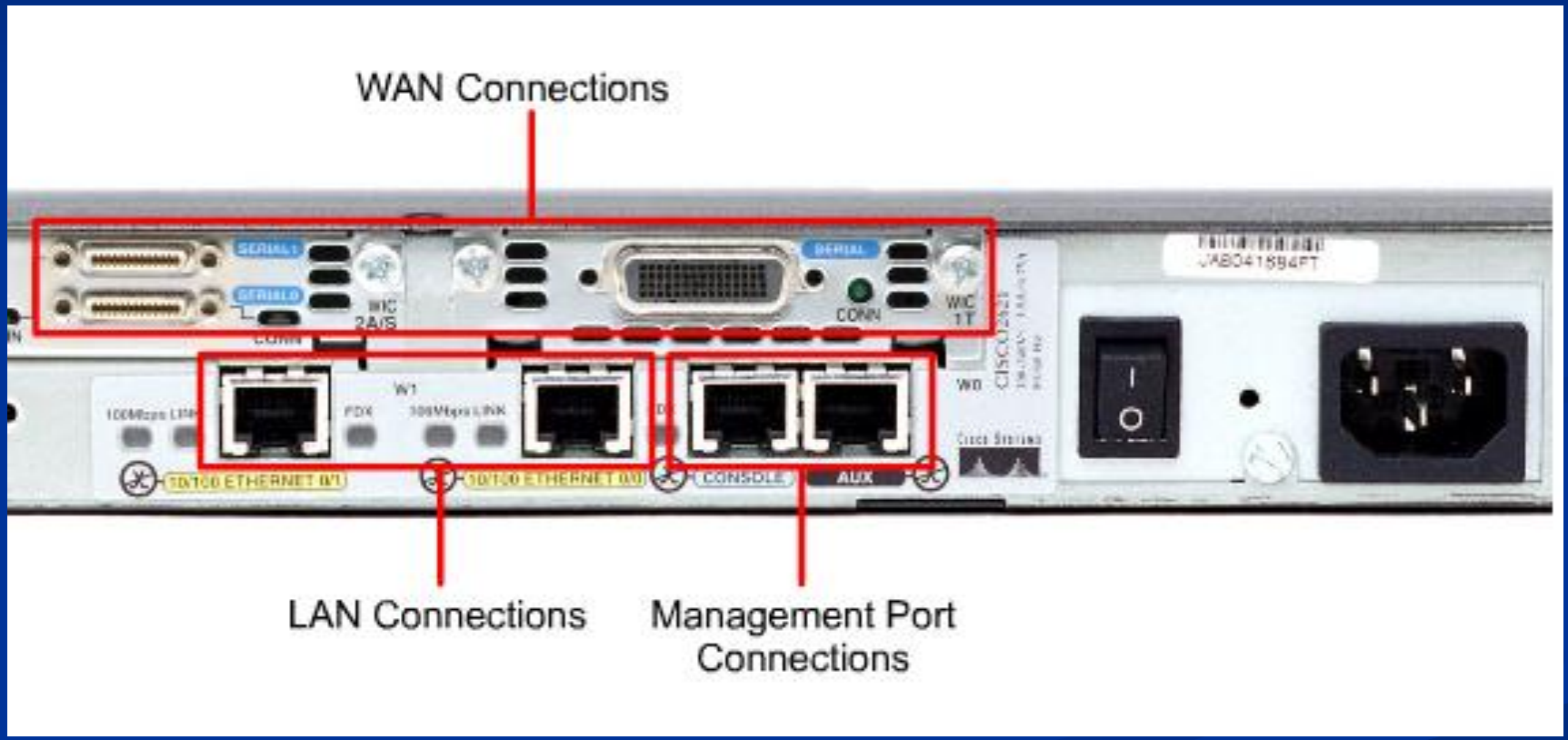
Internal Components of a 2600 Router



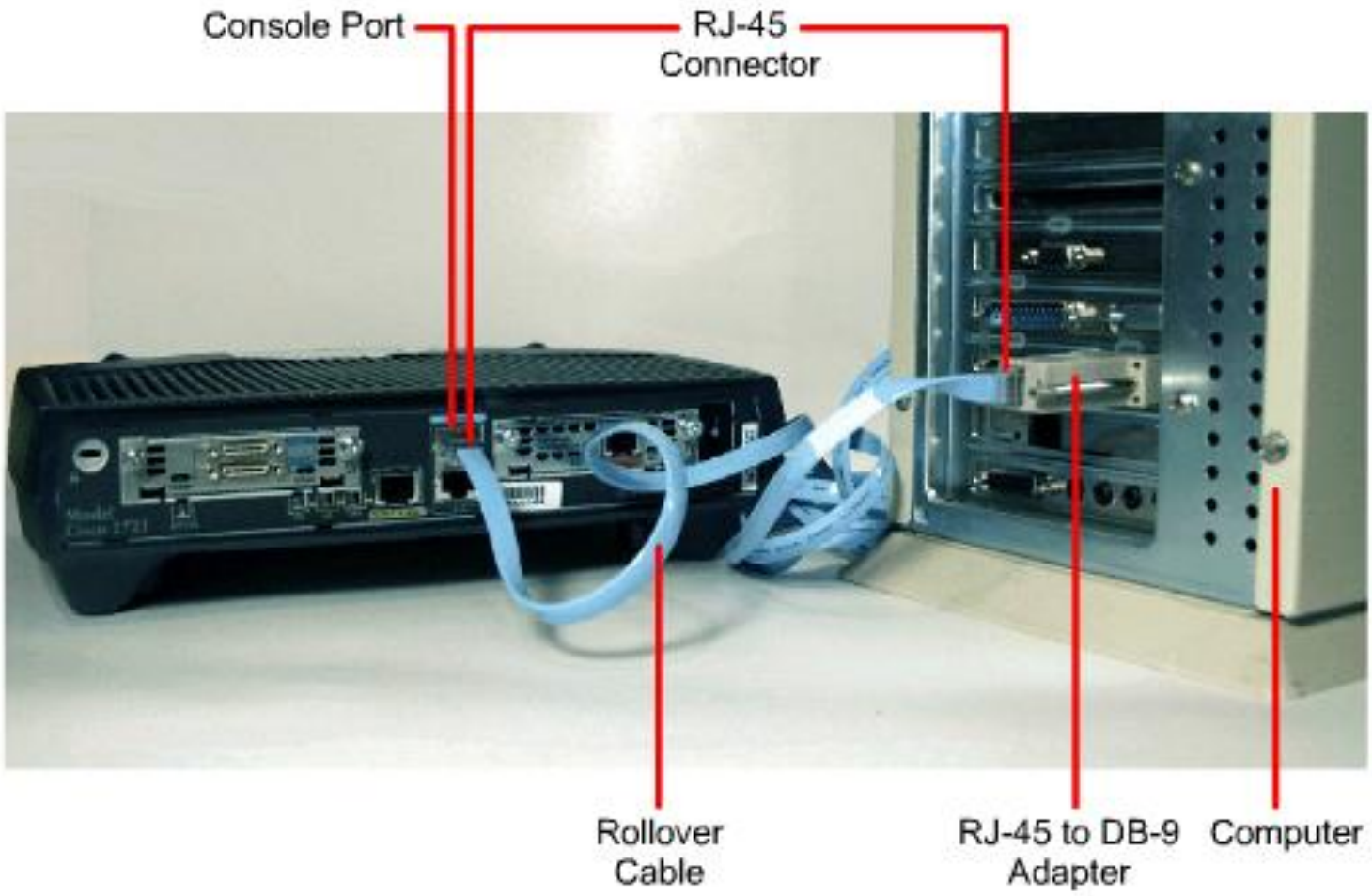
External Connections on a 2600 Router



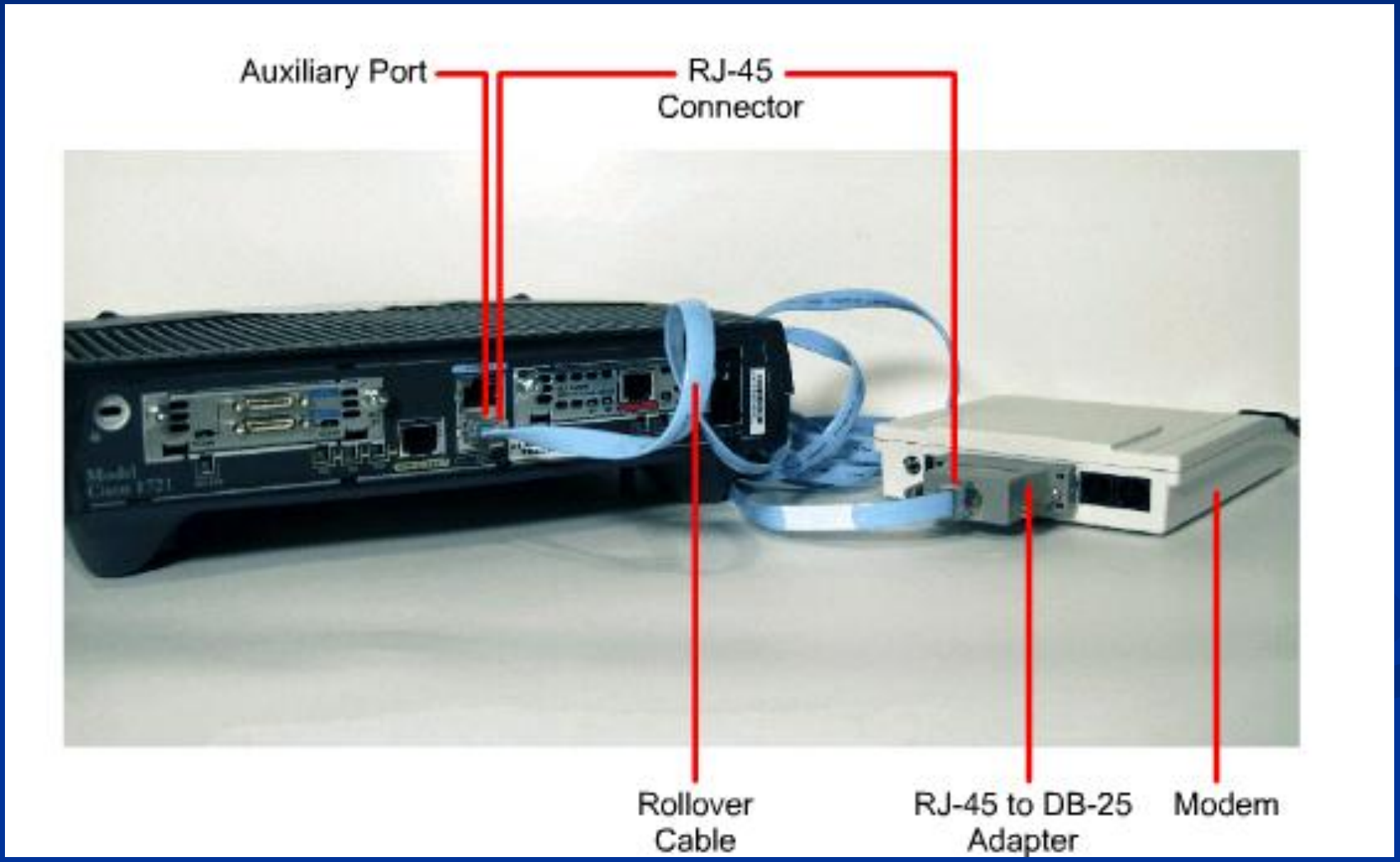
Router External Connections



Computer or Terminal Console Connection



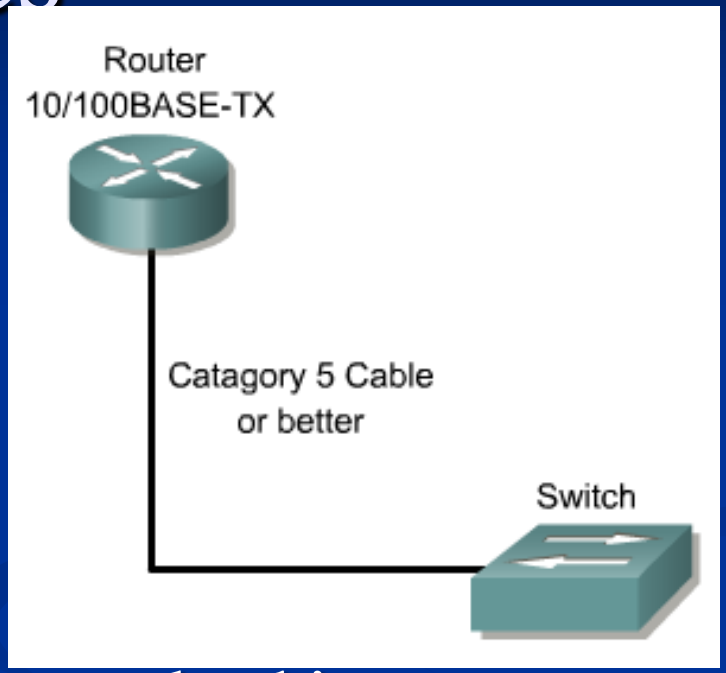
Modem Connection to Console or Auxiliary Port



Connecting Console Interfaces

1. Configure terminal emulation software on the PC for the following:
   - The appropriate com port
   - 9600 baud
   - 8 data bits
   - 1 stop bit
   - No parity
   - No flow control
2. Connect a rollover cable to the router console port (RJ-45 connector).
3. Connect the other end of the rollover cable to the RJ-45 to DB-9 adapter
4. Attach the female DB-9 adapter to a PC.

Connecting Router LAN Interfaces

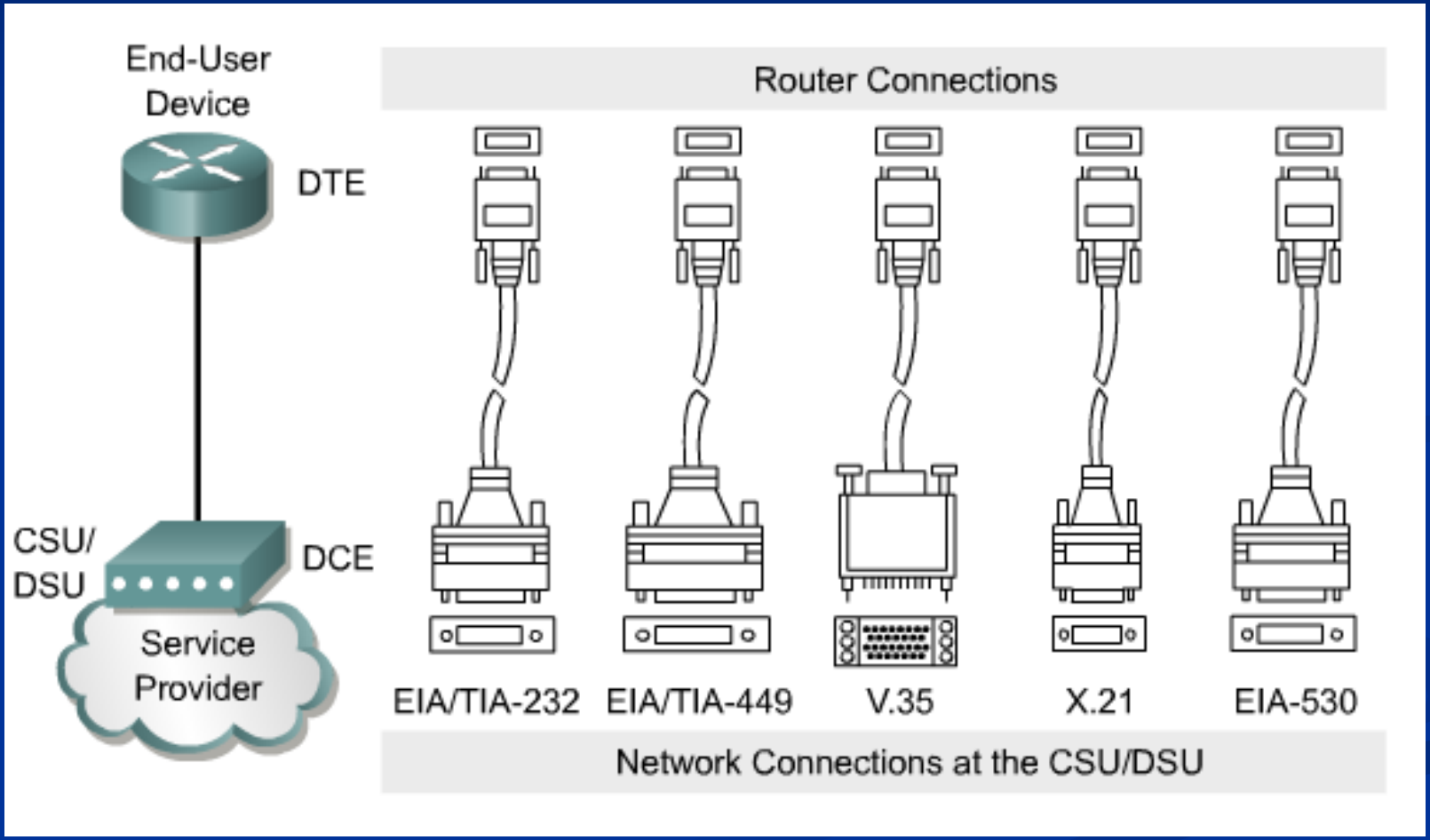


- A router is usually connected to a LAN through an Ethernet or Fast Ethernet interface.
- The router is a host that communicates with the LAN through a hub or a switch.
- A straight-through cable is used to make this connection. A 10BASE-TX or 100BASE-TX router interface requires
- Category 5, or better, unshielded twisted-pair (UTP) cable, regardless of the router type

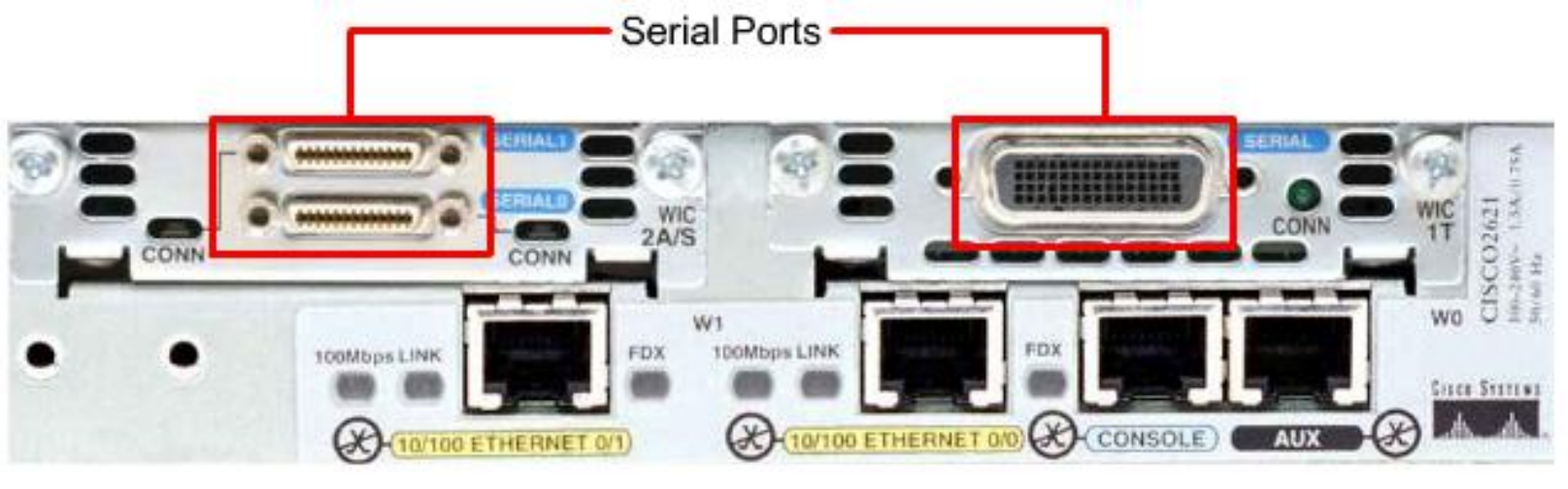
Connecting Router Interfaces

Port or Connection	Port Type	Color	Connected To	Cable
Ethernet	RJ-45	yellow	Ethernet hub or Ethernet switch	Straight-through
T1/E1 WAN	RJ-48C/ CA81A	light green	T1 or E1 network	RJ-48 T1
Console	8 pin	light blue	Computer com port	Roll over
AUX	8 pin	black	Modem	Roll over
BRI S/T	RJ-48C/ CA81A	orange	NT1 device or private integrated network exchange (PINX)	RJ-48
BRI U WAN	RJ-49C/ CA11A	orange	ISDN network	RJ-49
Token	UTP, STP	purple	Token Ring device	RJ-45 Token Ring cable

Router Serial WAN Connectors



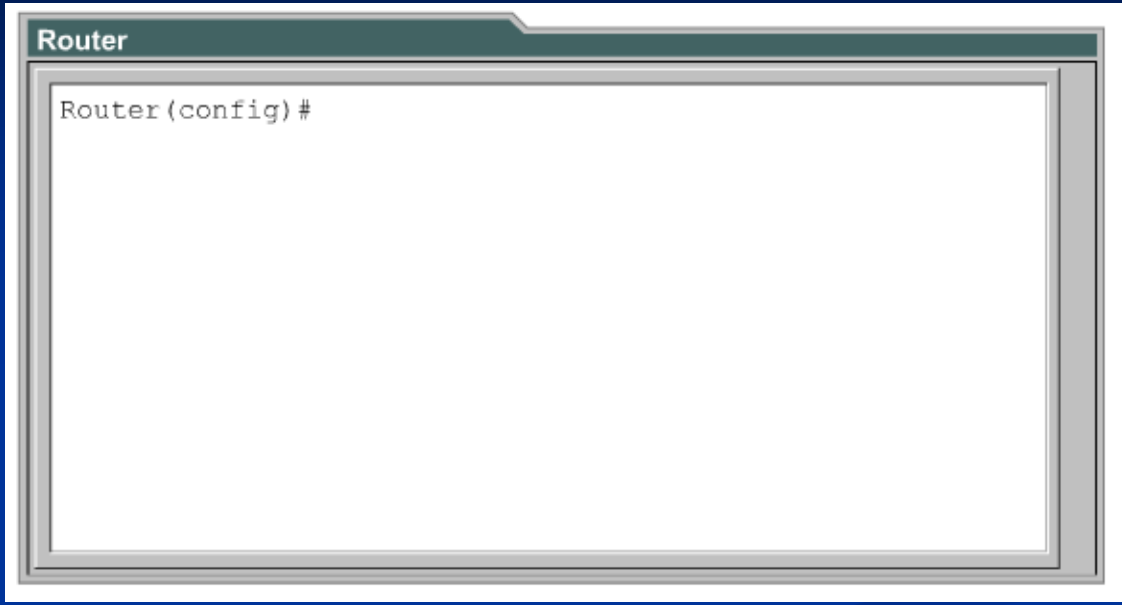
Router Serial WAN Connectors



Cisco IOS Software

- A router or switch cannot function without an operating system.
- Cisco calls its operating system the Cisco Internetwork Operating System or Cisco IOS.
- It is the embedded software architecture in all of the Cisco routers and is also the operating system of the Catalyst switches.
- The Cisco IOS provides the following network services:
  - Basic routing and switching functions
  - Reliable and secure access to networked resources
  - Network scalability

Router User Interface



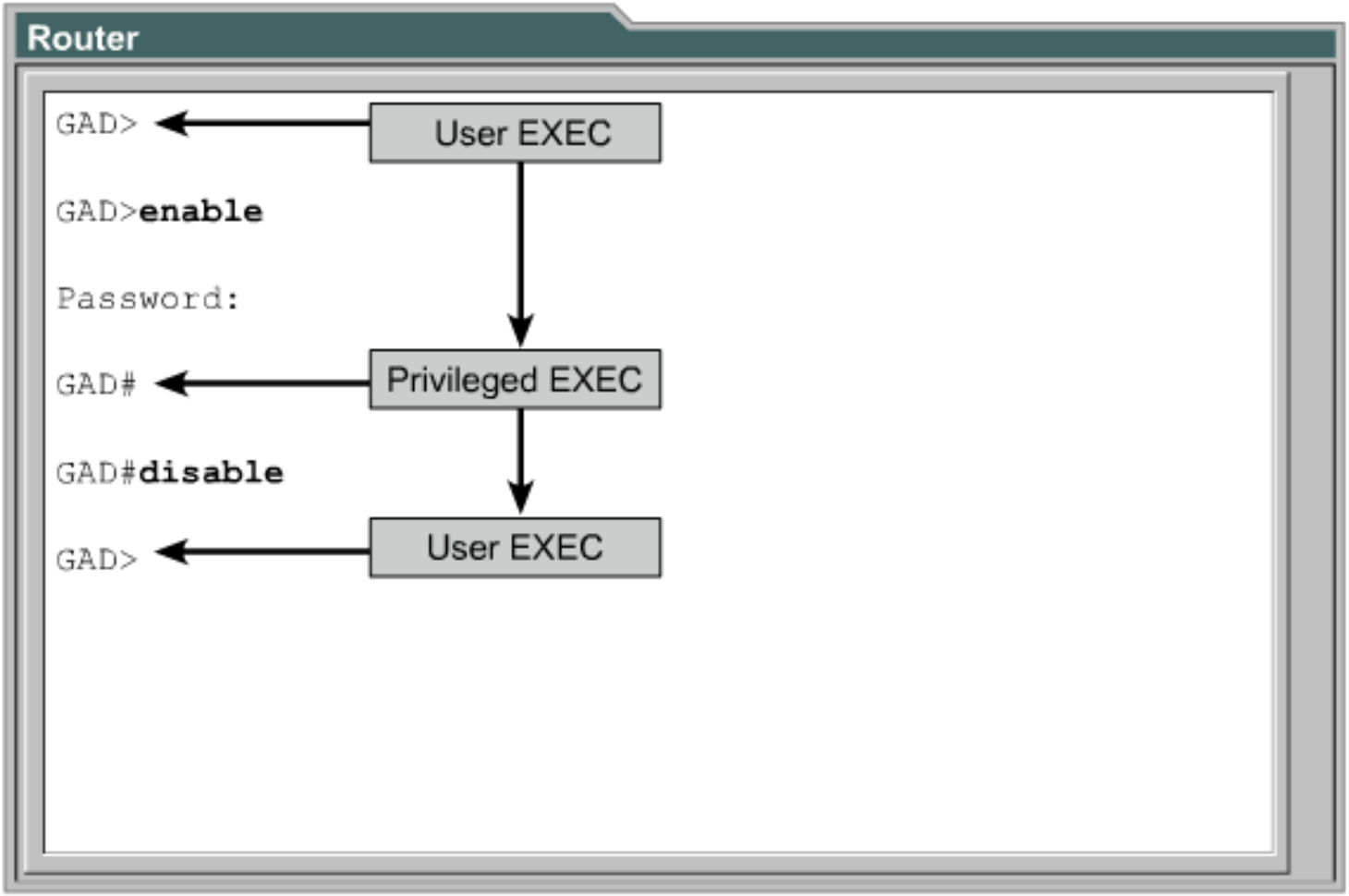
- A user interface to a router or switch utilizes an ASCII terminal program. The most commonly used version is the Windows HyperTerminal program.
- The Cisco IOS software uses a command-line interface (CLI)
- One way to access the CLI is through a **console session**.
- Another way to access a CLI session is by use of a dialup connection using a modem or null modem connected to the router **AUX port**.
- Another method of accessing a CLI session is to **Telnet** to the router

Router User Interface Modes

- The Cisco command-line interface (CLI) uses a **hierarchical structure**.
- This structure requires entry into different modes to accomplish particular tasks.
- The IOS provides a command interpreter service known as the command executive (EXEC).
- As a security feature the Cisco IOS software separates the EXEC sessions into two access levels.

EXEC Mode	Prompt	Typical Use
User	GAD>	check the router status
Privileged	GAD#	accessing the router configuration modes

Router User Interface Modes Continued



Cisco IOS Naming Conventions

The name has three parts, separated by dashes: e.g. xxxx-yyyy-ww:

- xxxx = Platform
- yyyy = Features
- ww = Format - where it executes from if compressed

Name Codes

Platform (Hardware) (Partial list)	
c1005	1005
c1600	1600
c1700	1700, 1720, 1750
c2500	25xx, 3xxx, 5100, AO (11.2 and later only)
c2600	2600
c2800	Catalyst 2800
c2900	2910, 2950
c3620	3620
c3640	3640

Operation of Cisco IOS Software

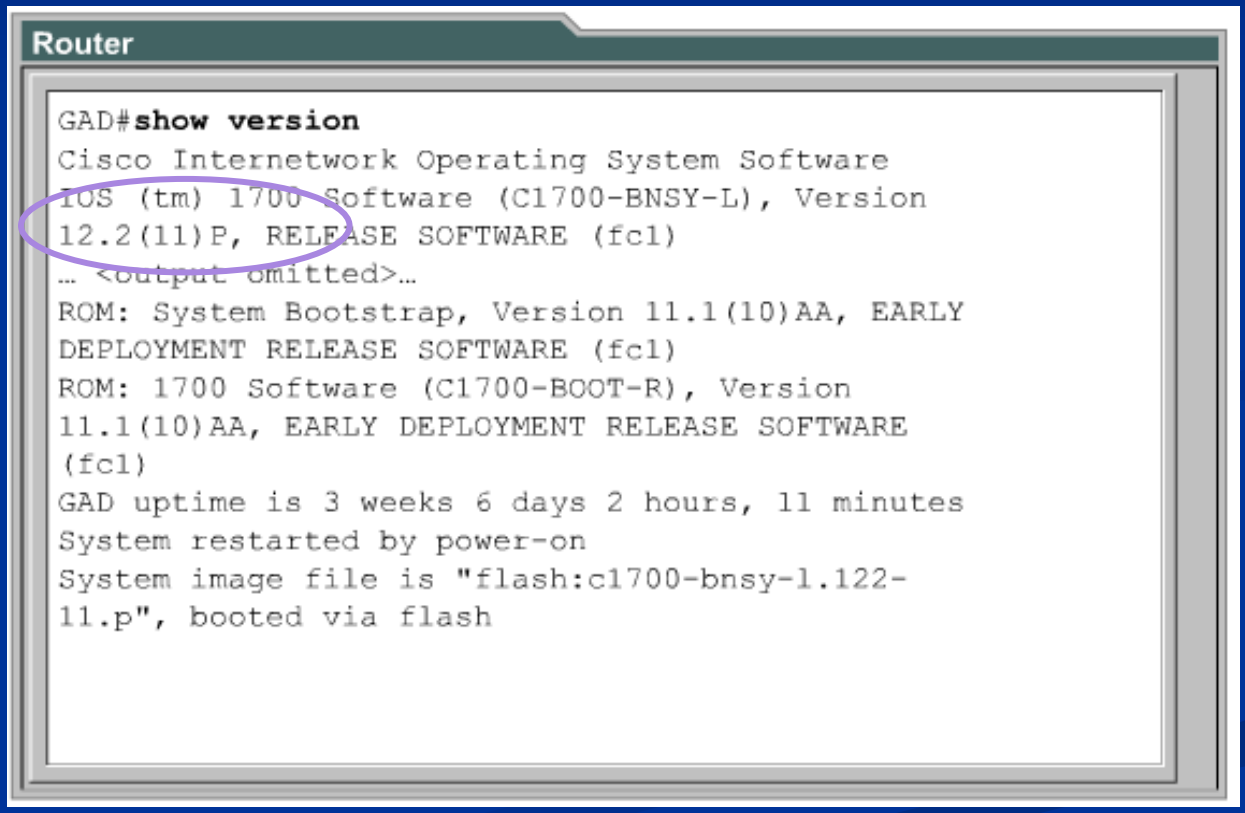
- The Cisco IOS devices have three distinct operating environments or modes:
  - ROM monitor
  - Boot ROM
  - Cisco IOS
- The configuration register setting can be used by the system administrator to control the default start up mode for the router.

Operating Environment	Prompt	Usage
ROM monitor	> or ROMMON>	Failure or password recovery
Boot ROM	Router(boot)>	Flash image upgrade
Cisco IOS	Router>	Normal operation

Note: To upgrade IOS image, have to verify if the memory is sufficient by using “show flash” and “show version”

The show version Command

- IOS version and descriptive information
- Bootstrap ROM version
- Boot ROM version
- Router up time
- Last restart method
- System image file and location
- Router platform
- Configuration register setting

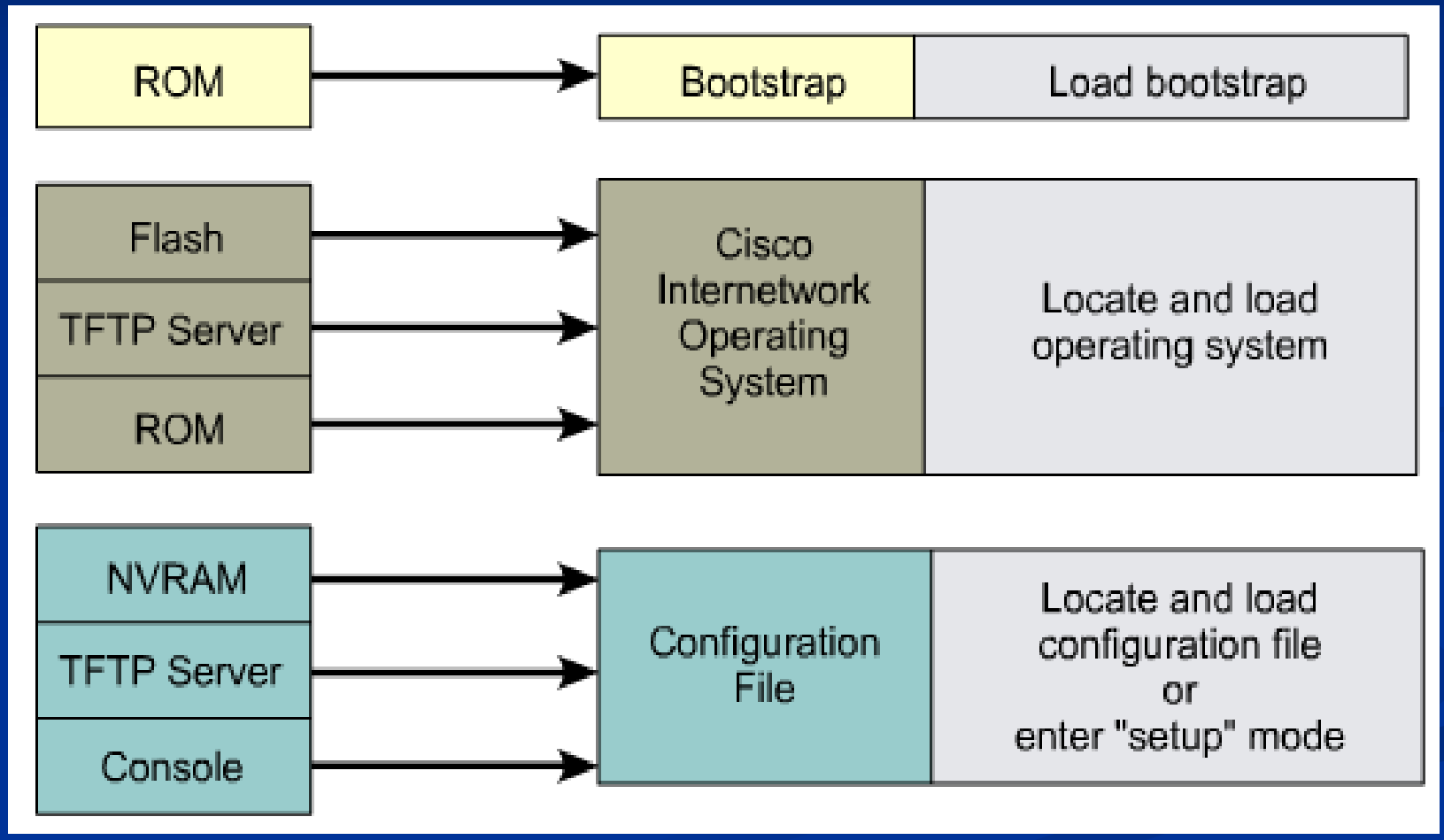


show flash Command

Router

```
BHM#show flash
PCMCIA flash directory:
File  Length    Name/status
  1   6007232   c1700-bnsy-1.212-11.p
[6007296 bytes used, 284160 available, 6291456
total]
6144K bytes of processor board PCMCIA flash (Read
ONLY)
BHM#
```

Steps in Router Initialization

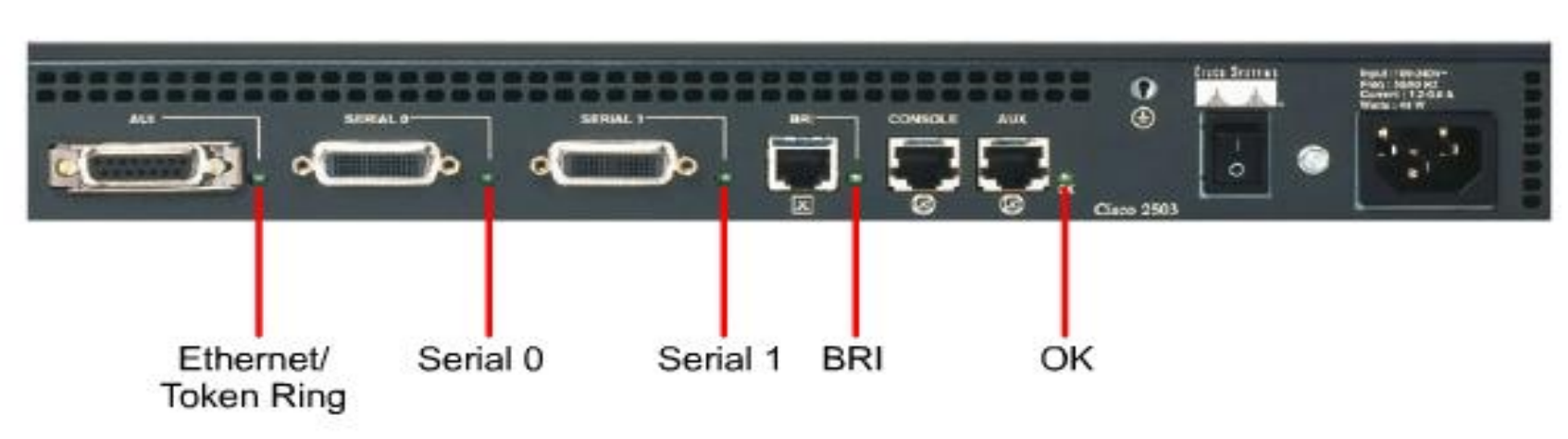


Using the `setup` Command

Router

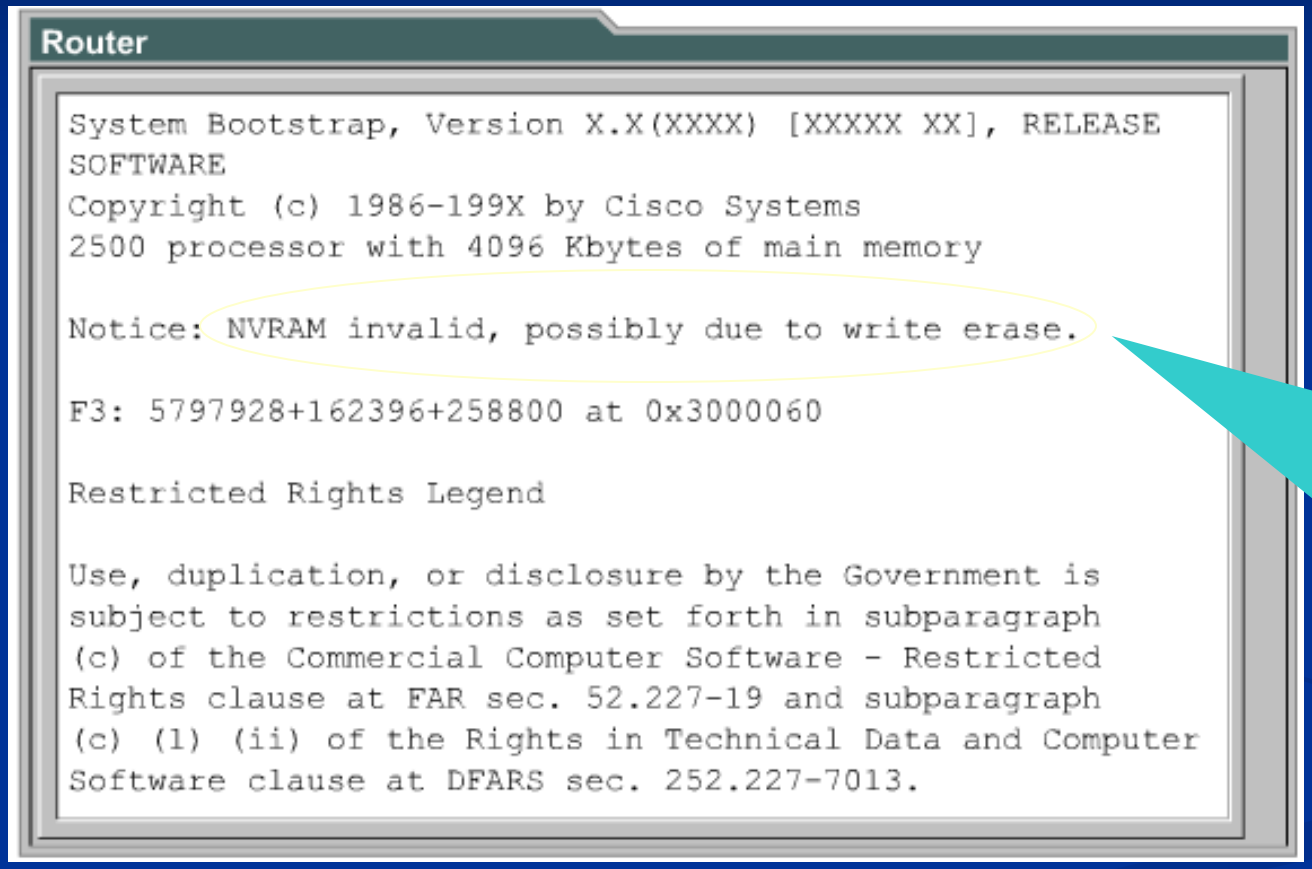
```
#setup

--System Configuration Dialog--
At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.

Continue with configuration dialog? [yes].

First, would you like to see the current interface summary?
[yes]

Interface    IP-Address    OK?   Method    Status   Protocol
TokenRing0   unassigned    NO    not set     down     down
Ethernet0    unassigned    NO    not set     down     down
Serial0      unassigned    NO    not set     down     down
Fddi0        unassigned    NO    not set     down     down
```

Router LED Indicators

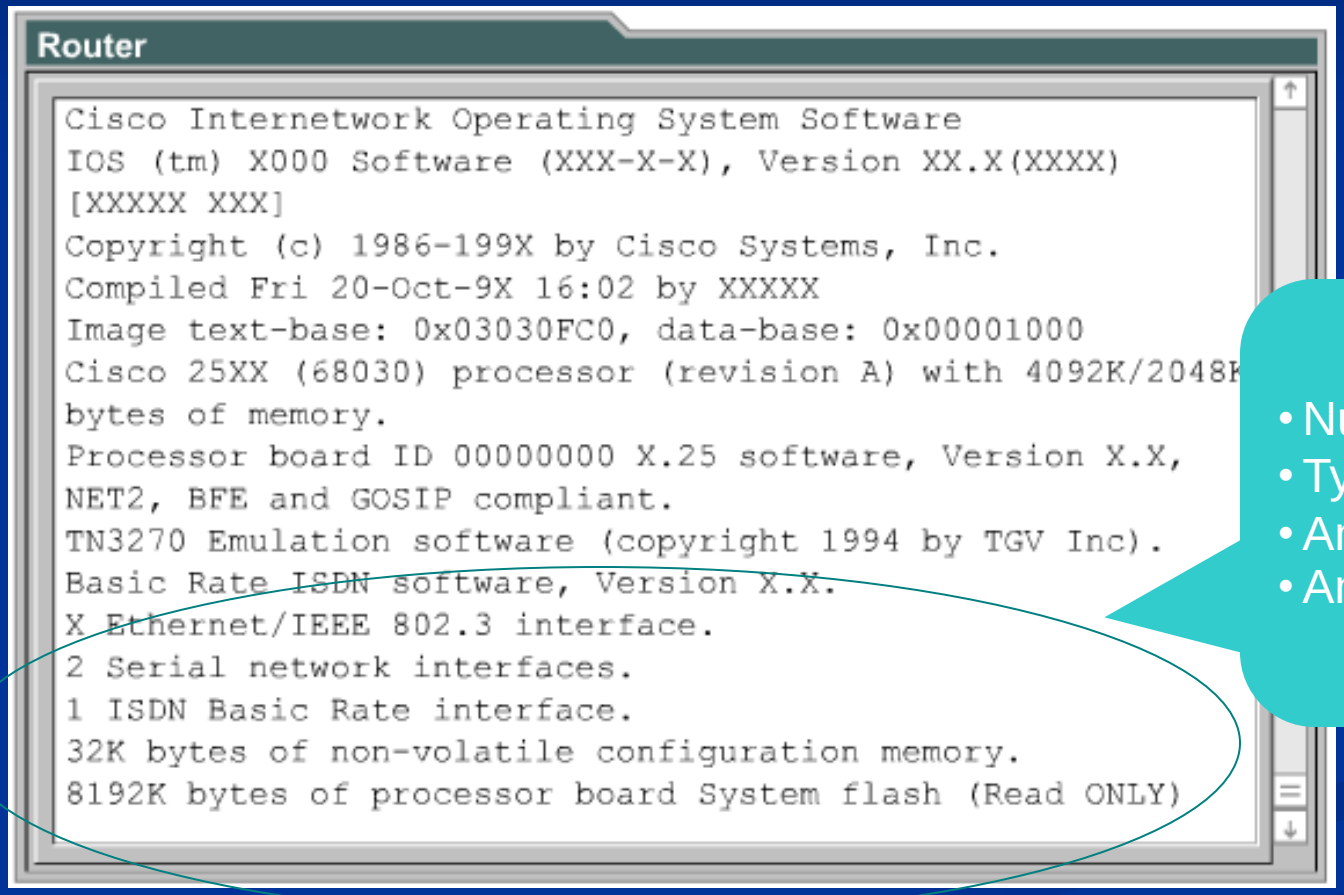


Cisco routers use LED indicators to provide status information. Depending on the Cisco router model, the LED indicators vary.

Examining Initial Bootup Output



Examining Initial Bootup Output Continued



- Number of Interfaces
- Types of Interfaces
- Amount of NVRAM
- Amount of flash memory

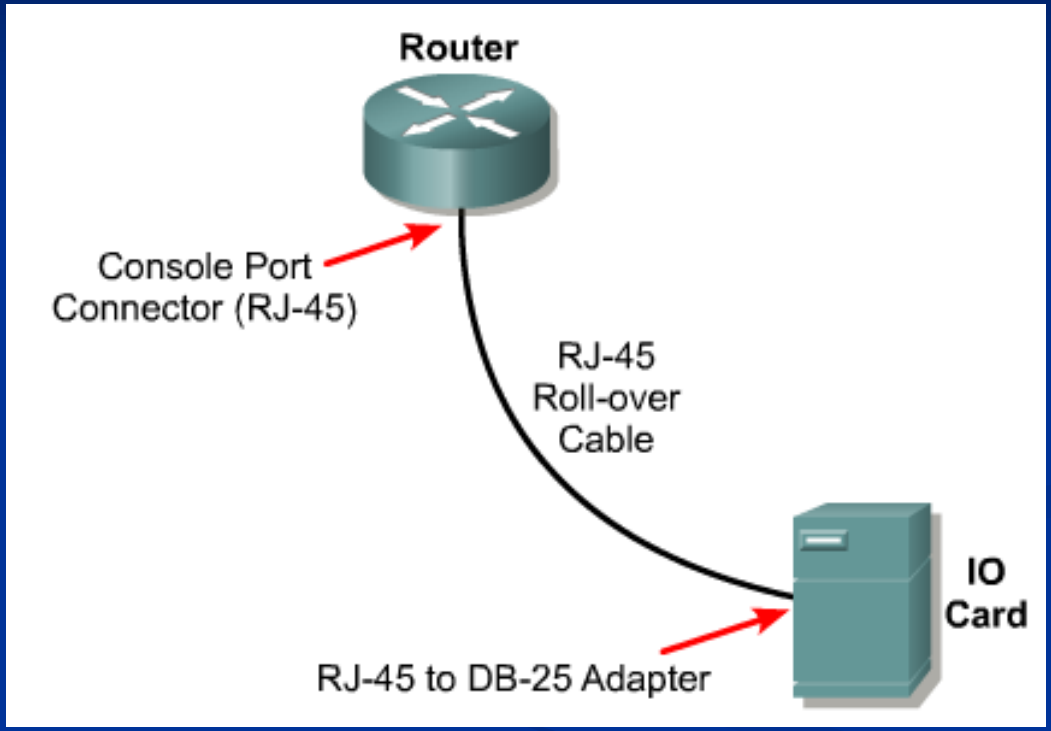
Examining Initial Bootup Output Continued

Router

```
Notice: NVRAM invalid, possibly due to write erase.
--- System Configuration Dialog ---

At any point you may enter a question mark '?' for help.
Refer to the 'Getting Started' Guide for additional help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.
Would you like to enter the initial configuration dialog?
[yes]:
```

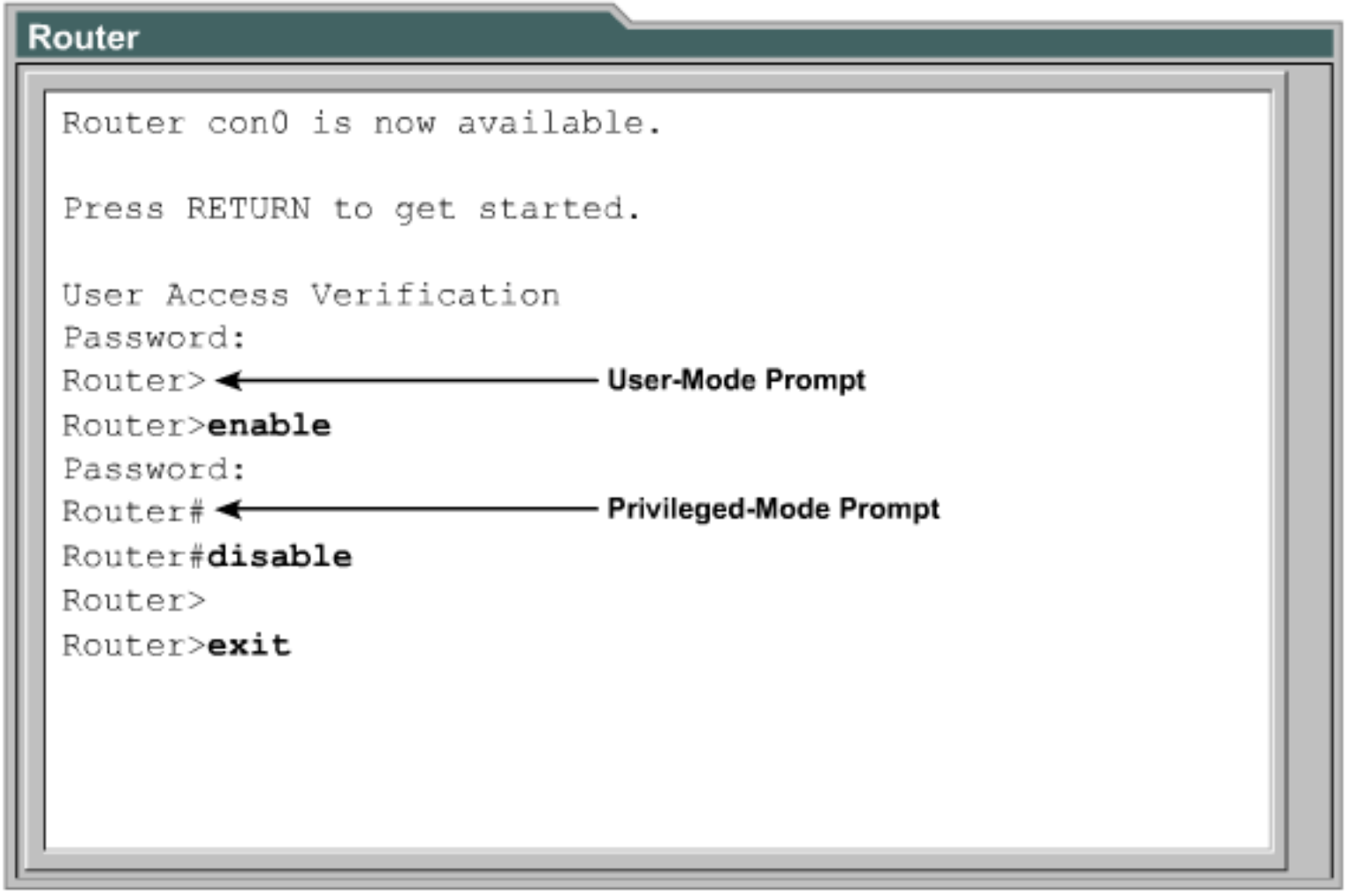
Establishing a Hyperterminal Session

- All Cisco routers include an EIA/TIA-232 asynchronous serial console port (RJ-45).
- Cables and adapters are needed to connect a console terminal (an ASCII terminal or PC running terminal emulation software) to the console port.

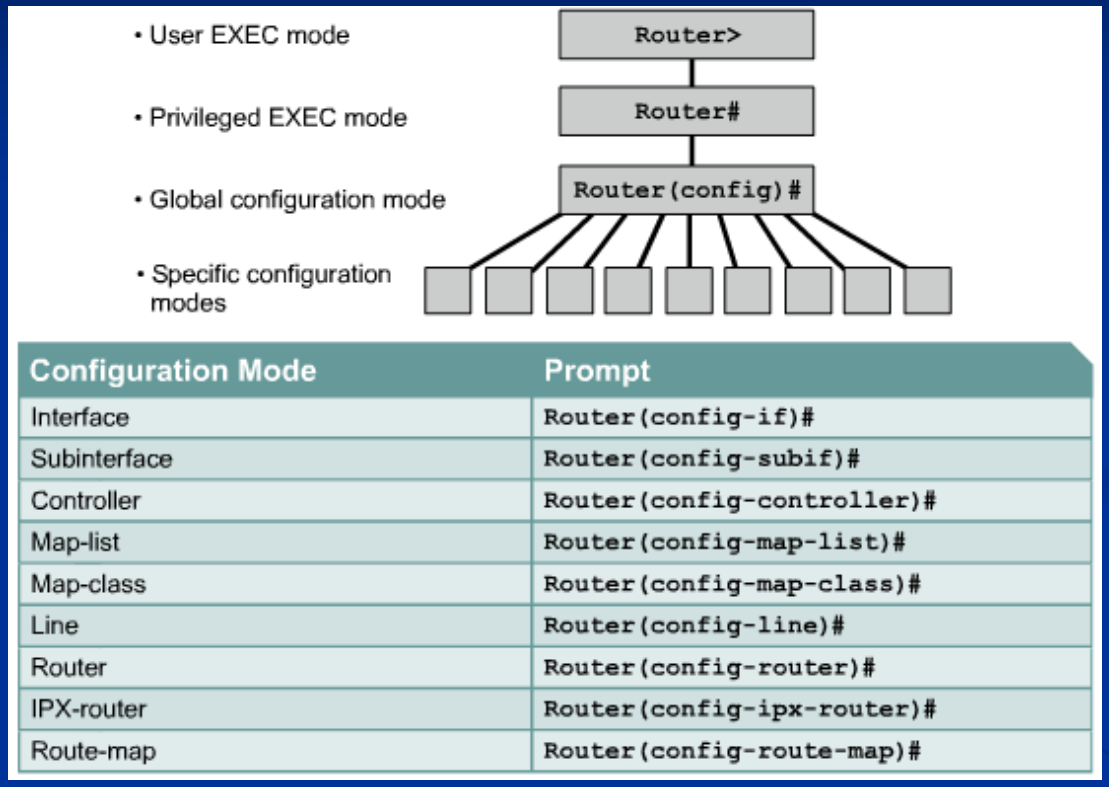


PC Operating System	Software
Windows 95, Windows 98, Windows NT, Windows 2000	HyperTerminal (included with Windows software), ProComm Plus
Windows 3.1	Terminal (included with Windows software)
Macintosh	ProComm, VersaTerm, ZTerm (supplied separately)
Unix/Linux	Minicom

Router Modes



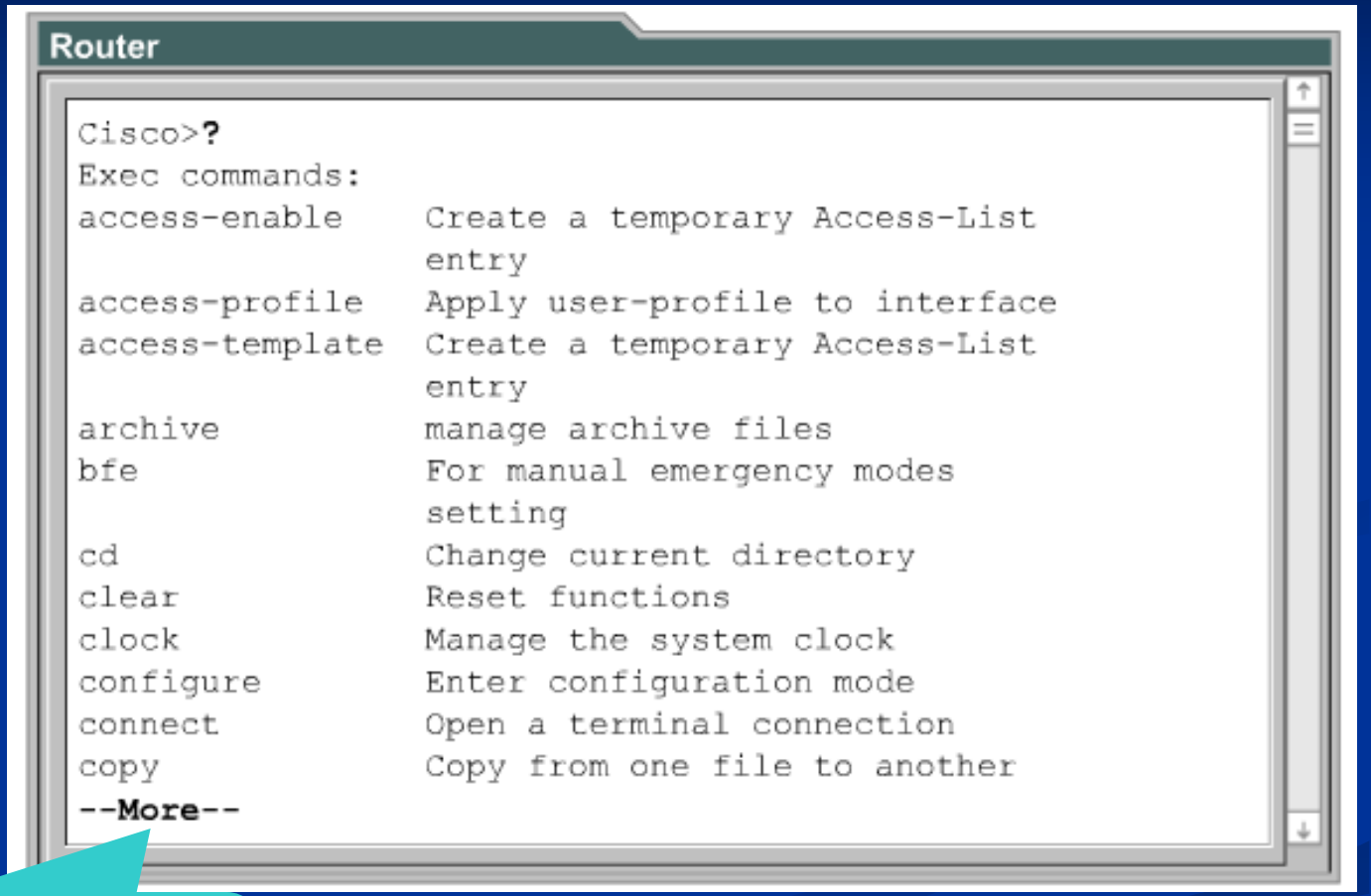
Router Modes (Con't)



Configuration Mode	Prompt
Interface	`Router(config-if)#`
Subinterface	`Router(config-subif)#`
Controller	`Router(config-controller)#`
Map-list	`Router(config-map-list)#`
Map-class	`Router(config-map-class)#`
Line	`Router(config-line)#`
Router	`Router(config-router)#`
IPX-router	`Router(config-ipx-router)#`
Route-map	`Router(config-route-map)#`

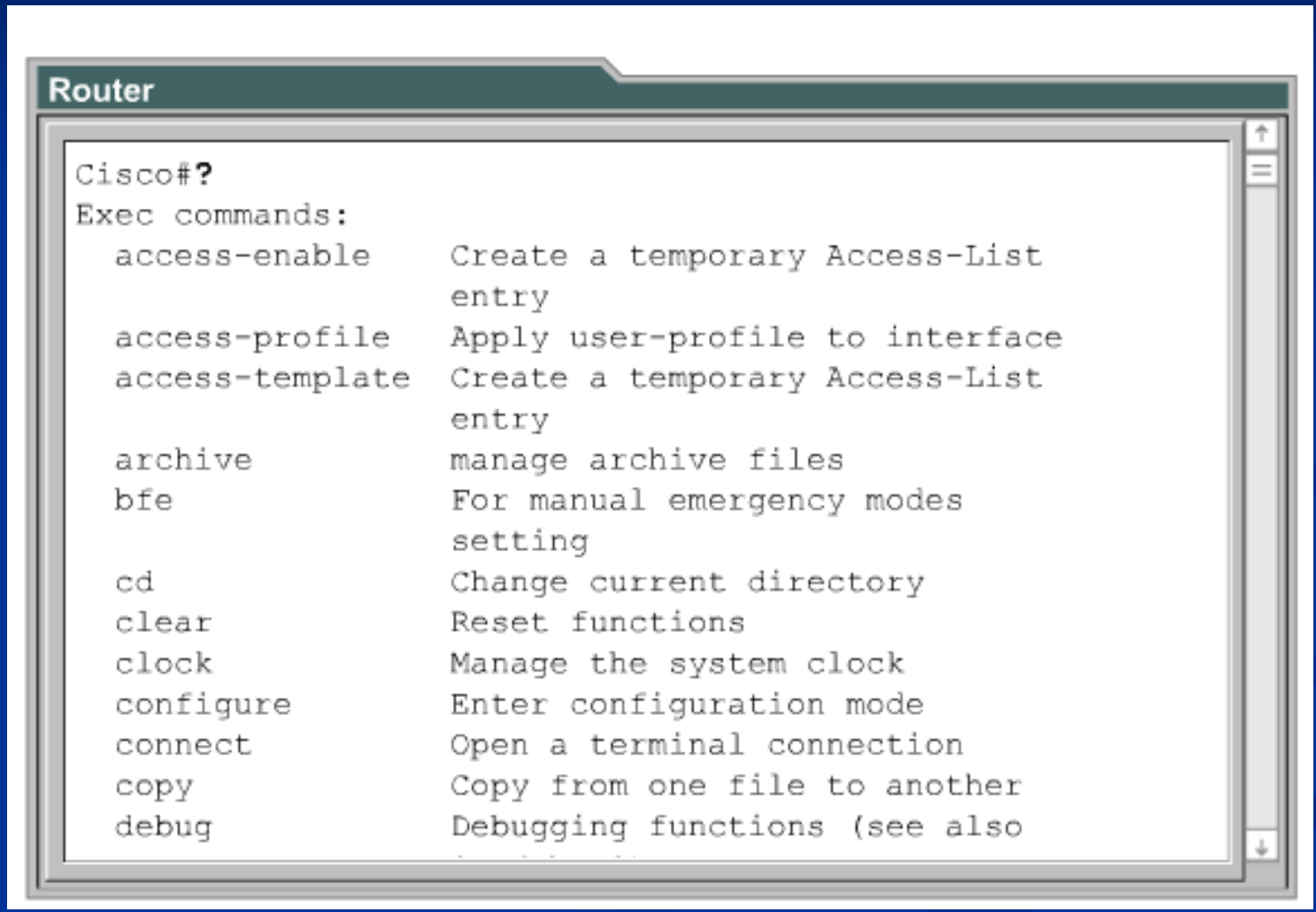
- **Global configuration** mode commands are used in a router to apply configuration statements that affect the system as a whole.
- When these **specific modes** are entered, the router prompt changes to indicate the current configuration mode.

User Mode Commands



--More-- indicates multiple screens are available as output.

Privileged Mode Commands



clock set Command

Router

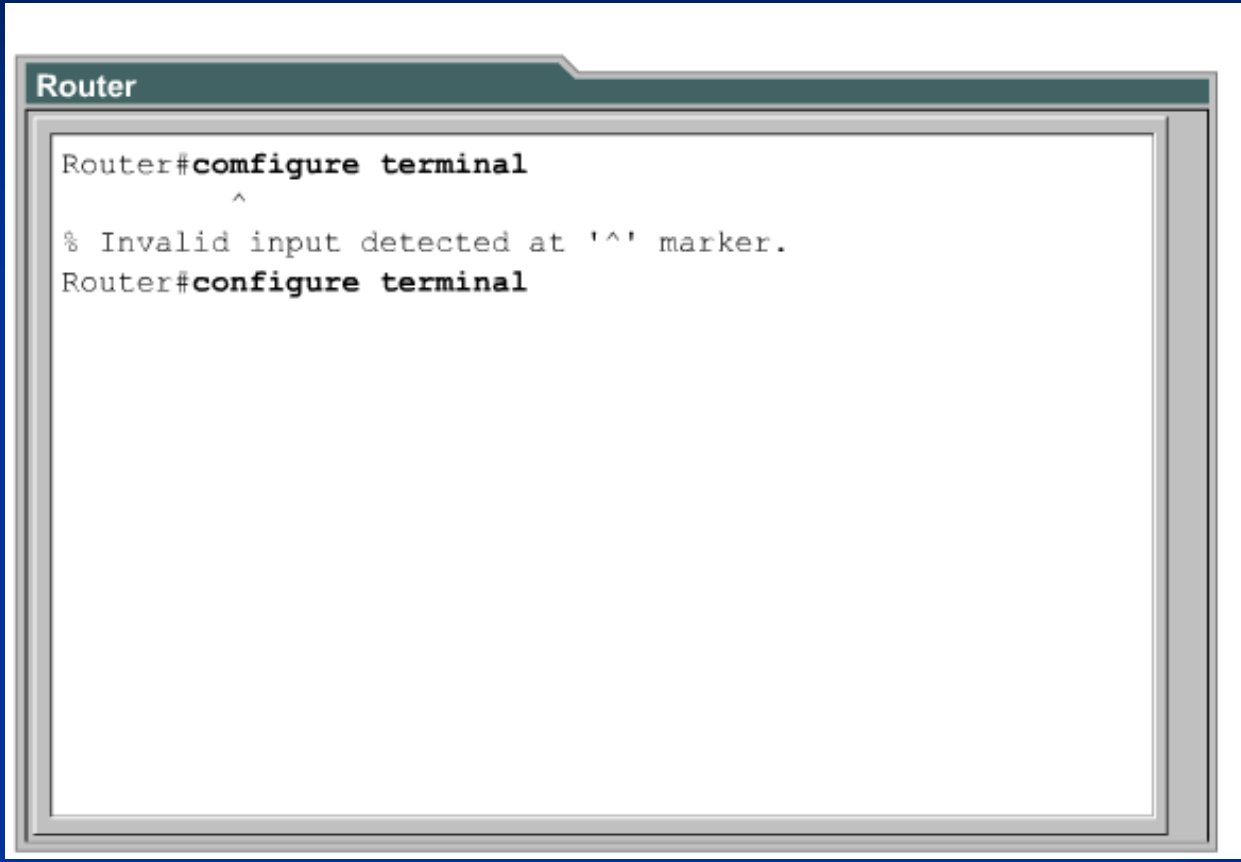
```
Cisco#cl?
clear  clock
Cisco#clock
% Incomplete command.
Cisco#clock ?
  set  Set the time and date
Cisco#clock set
% Incomplete command.
Cisco#clock set ?
  hh:mm:ss  Current Time
```

Using IOS Command `history`

Command	Description
Ctrl-P or up arrow key	Recalls last (previous) command
Ctrl-N or down arrow key	Recalls most recent command
Router>**show history**	Shows command buffer
Router>**terminal history size number-of-lines**	Sets the command history buffer size*
Router>**terminal no editing**	Disables advanced editing features
Router>**terminal editing**	Re-enables advanced editing
<Tab>	Completes the entry

- The command history is enabled by default and the system records **10** command lines in its history buffer.
- The maximum number of commands is **256**.

The User Interface Error Indicator



- The "**^**" (called caret) symbol appears at the point in the command string where an incorrect command, keyword, or argument was entered.