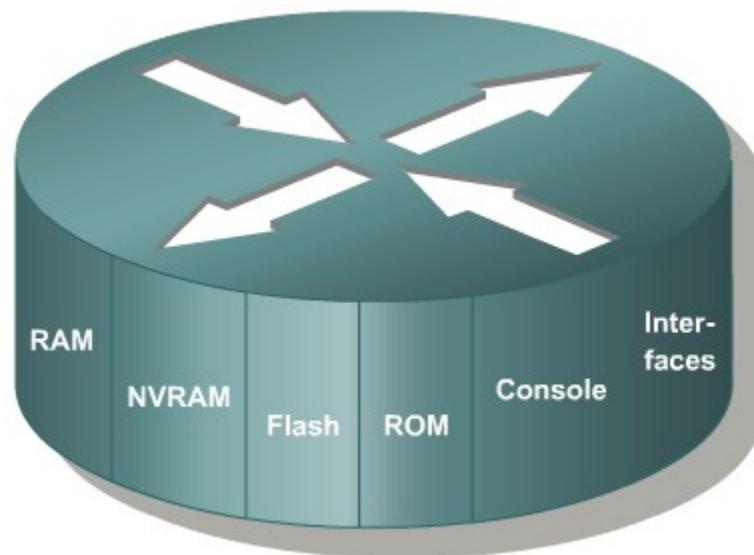


Routers And Cisco IOS



Introduction to Routers

A router is a special type of computer. It has the same basic components as a standard desktop PC. However, routers are designed to perform some very specific functions. Just as computers need operating systems to run software applications, routers need the Internetwork Operating System software (IOS) to run configuration files. These configuration files contain the instructions and parameters that control the flow of traffic in and out of the routers. The many parts of a router are shown below:



RAM

Random Access Memory, also called dynamic RAM (DRAM)

RAM has the following characteristics and functions:

- Stores routing tables
- Holds ARP cache
- Holds 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

Non-Volatile RAM

NVRAM has the following characteristics and functions:

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

Flash

Flash memory has the following characteristics and functions:

- 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

Read-Only Memory

ROM has the following characteristics and functions:

- Maintains instructions 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

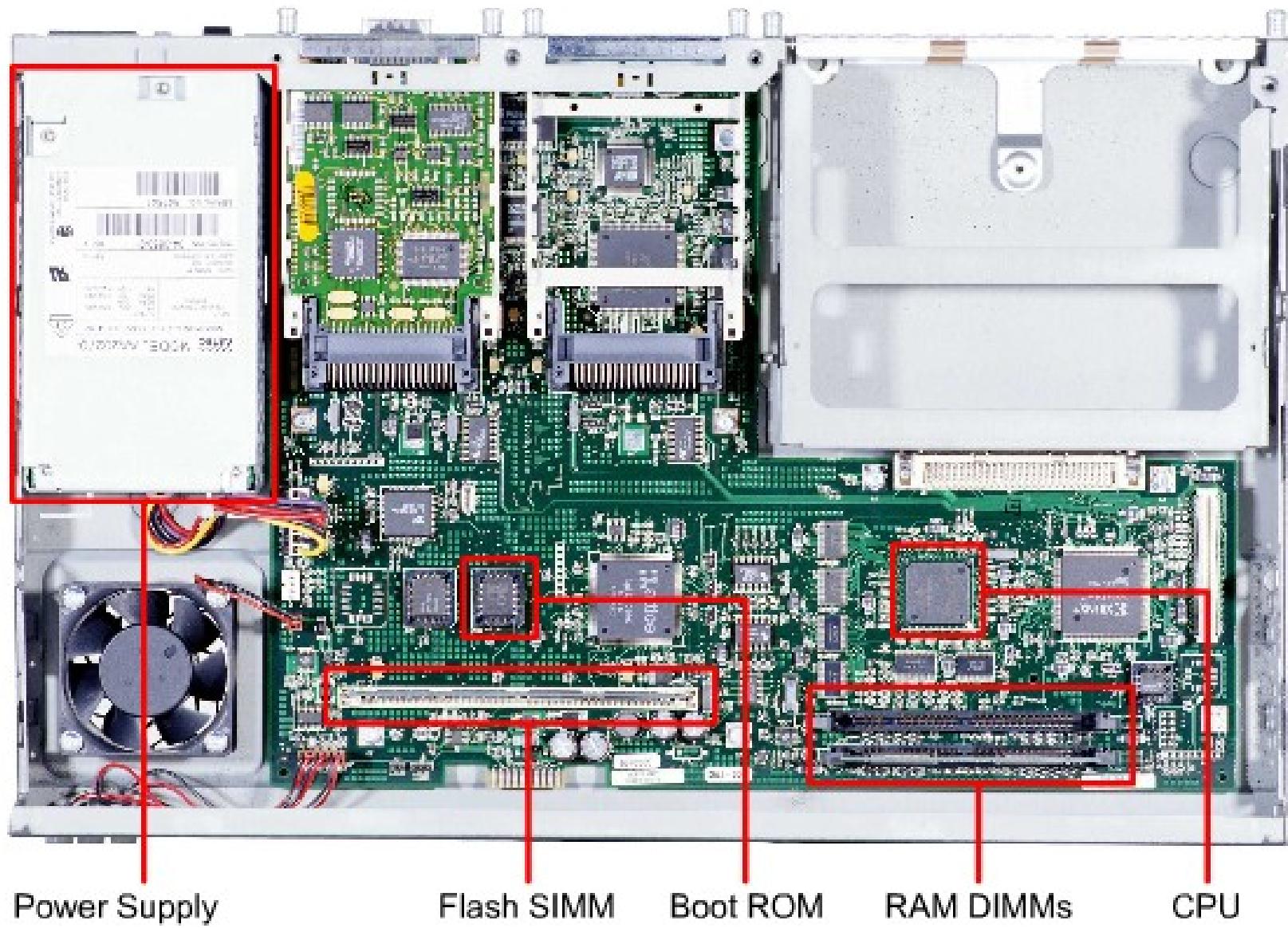
Interfaces have the following characteristics and functions:

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

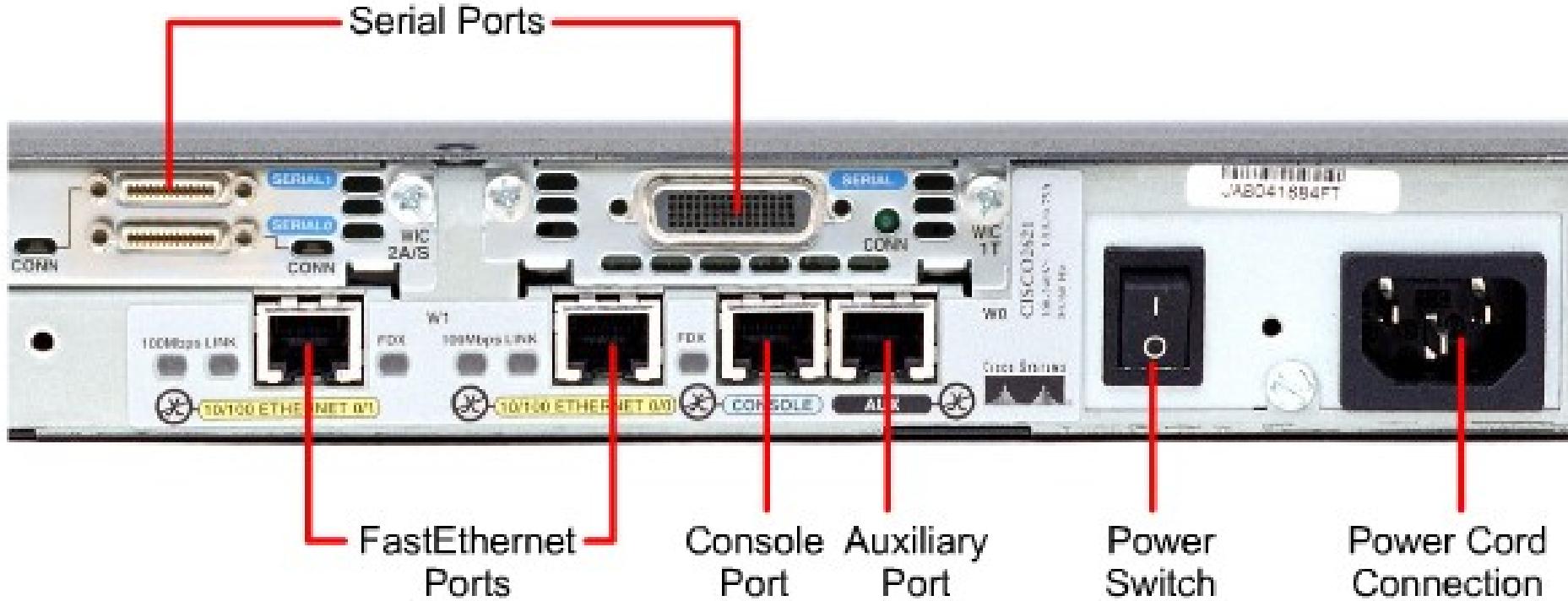
Types of interfaces:

- Ethernet
- Fast Ethernet
- Serial
- Token ring
- ISDN BRI
- Loopback
- Console

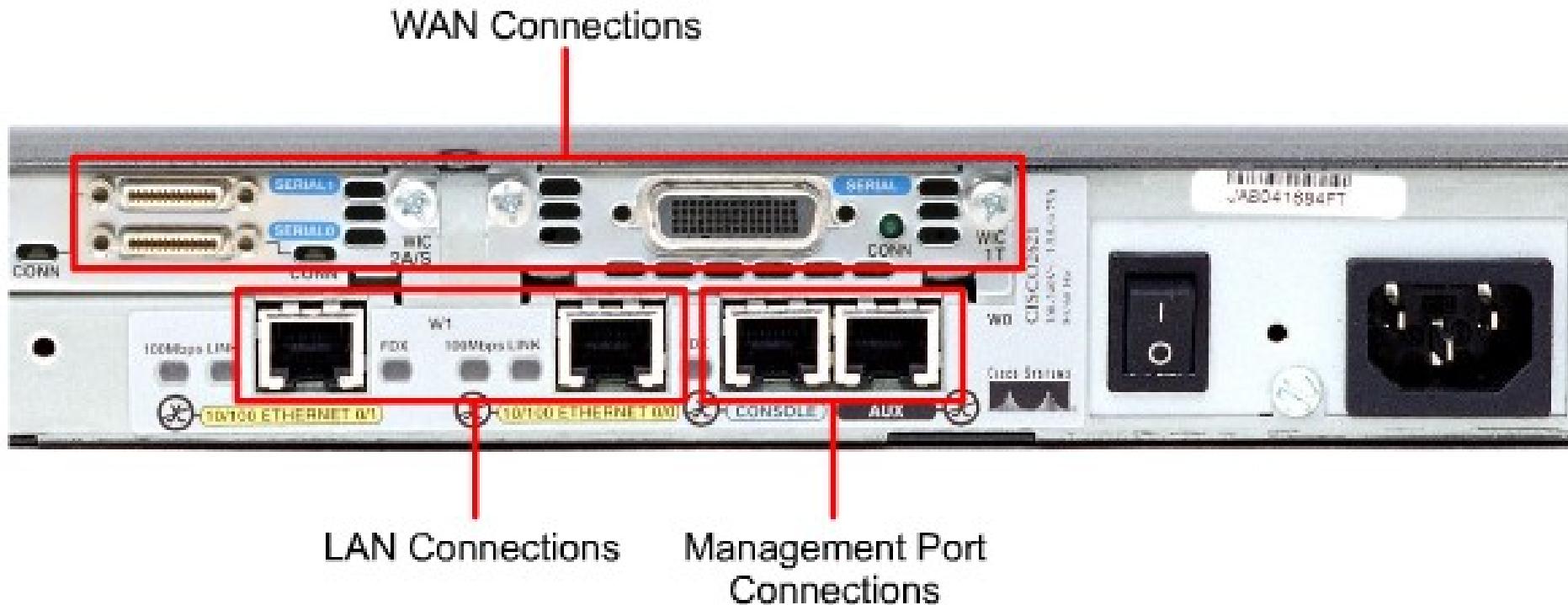
Internal Components of a 2600 Router



External Components of a 2600 Router

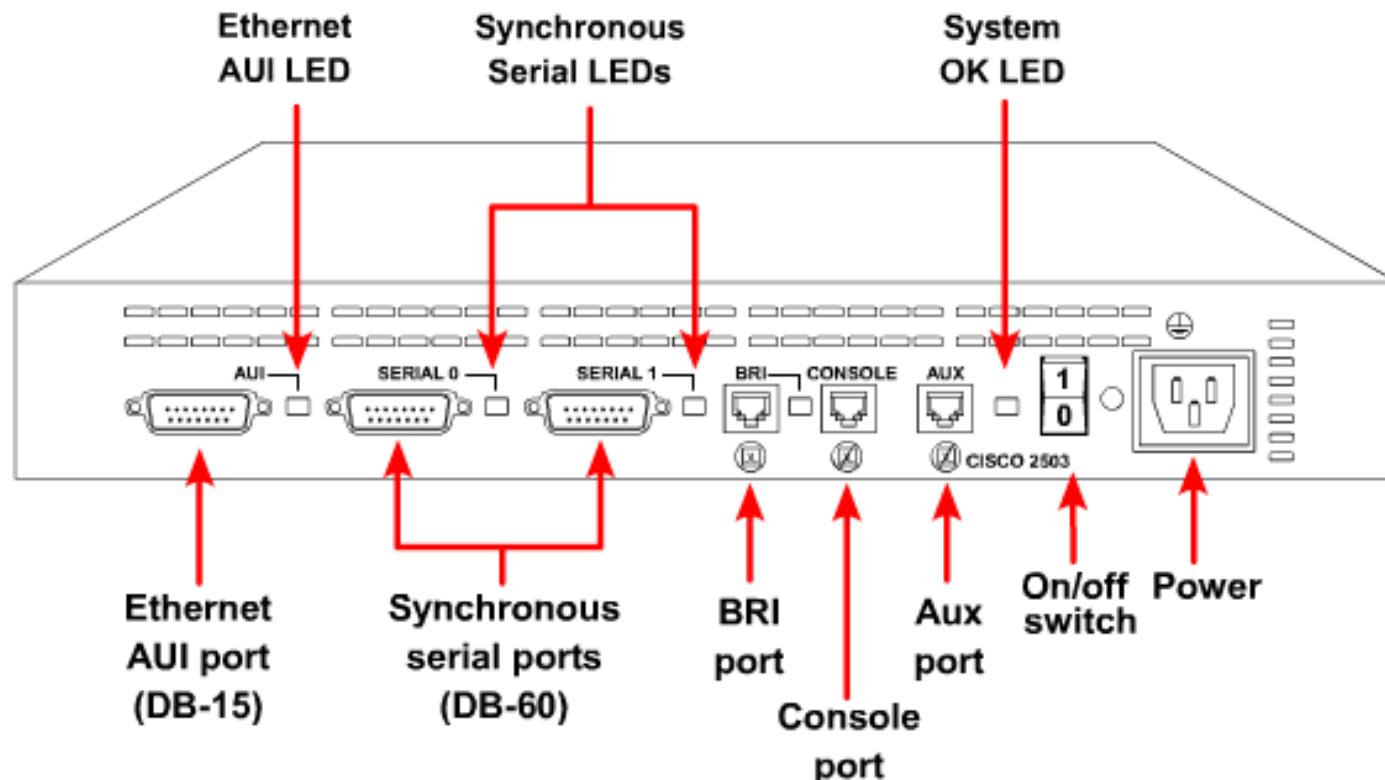


External Connections



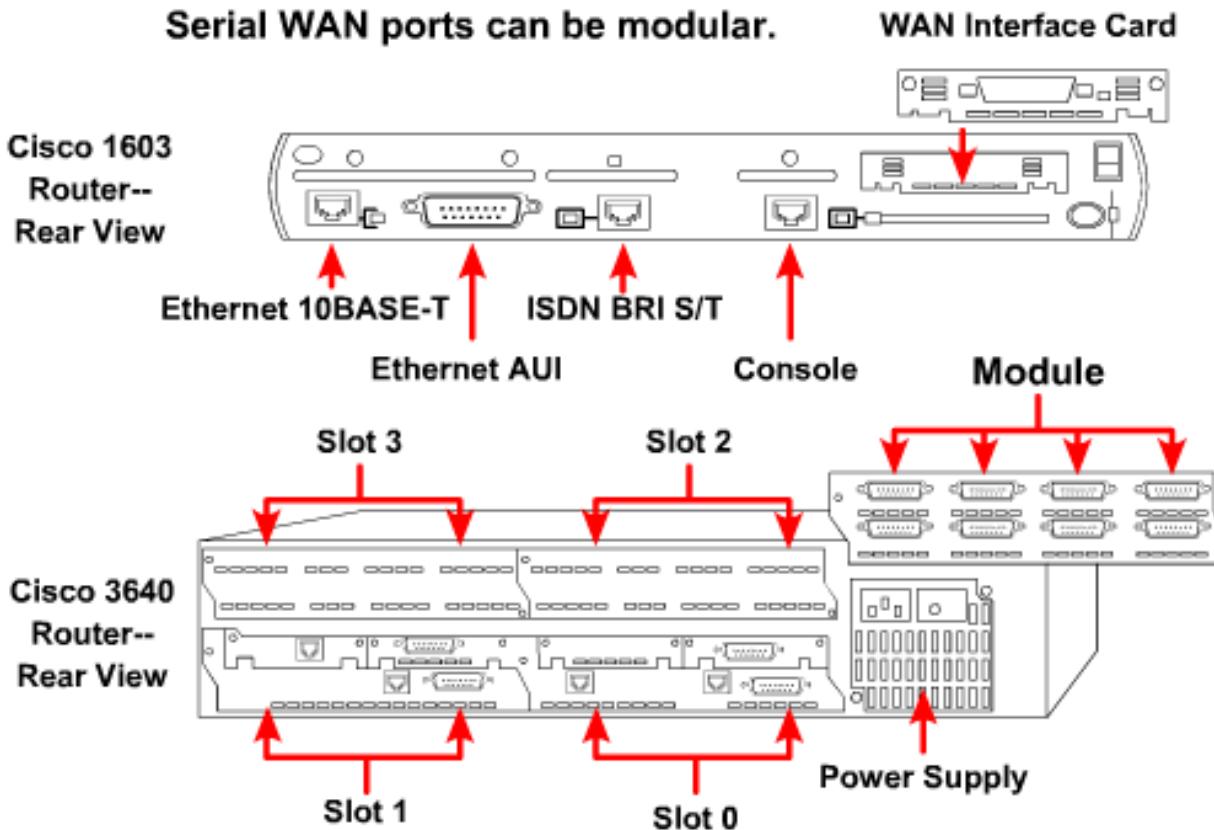
Fixed Interfaces

When cabling routers for serial connectivity, the routers will either have fixed or modular ports. The type of port being used will affect the syntax used later to configure each interface. Interfaces on routers with fixed serial ports are labeled for port type and port number.



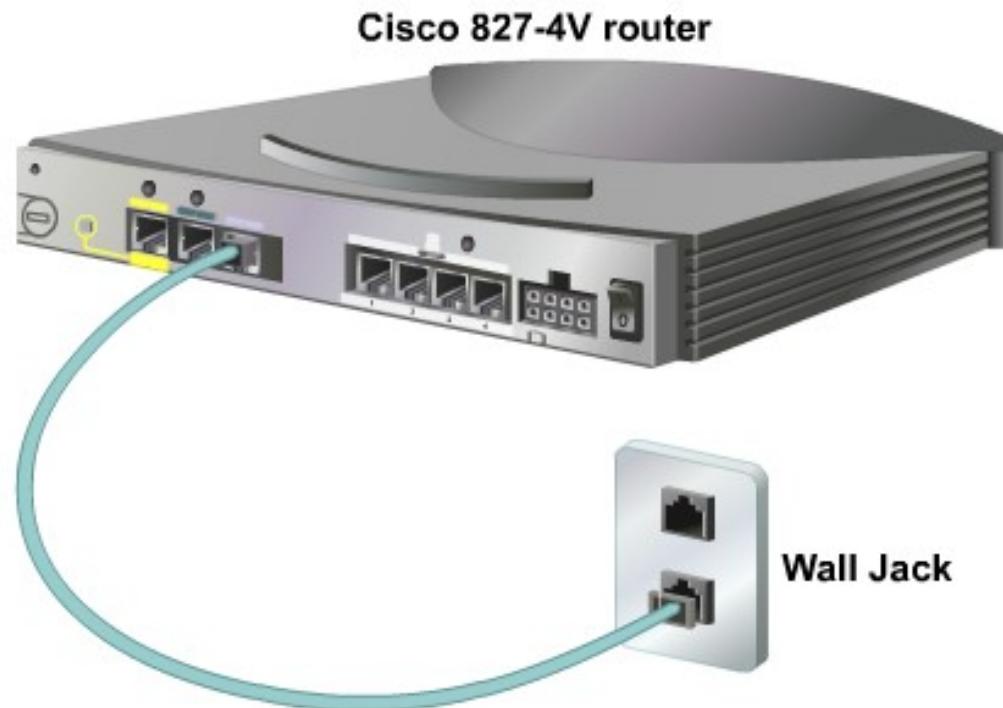
Modular Serial Port Interfaces

Interfaces on routers with modular serial ports are labeled for port type, slot, and port number. The slot is the location of the module. To configure a port on a modular card, it is necessary to specify the interface using the syntax “port type slot number/port number.” Use the label “serial 0/1,” when the interface is serial, the slot number where the module is installed is slot 0, and the port that is being referenced is port 1.

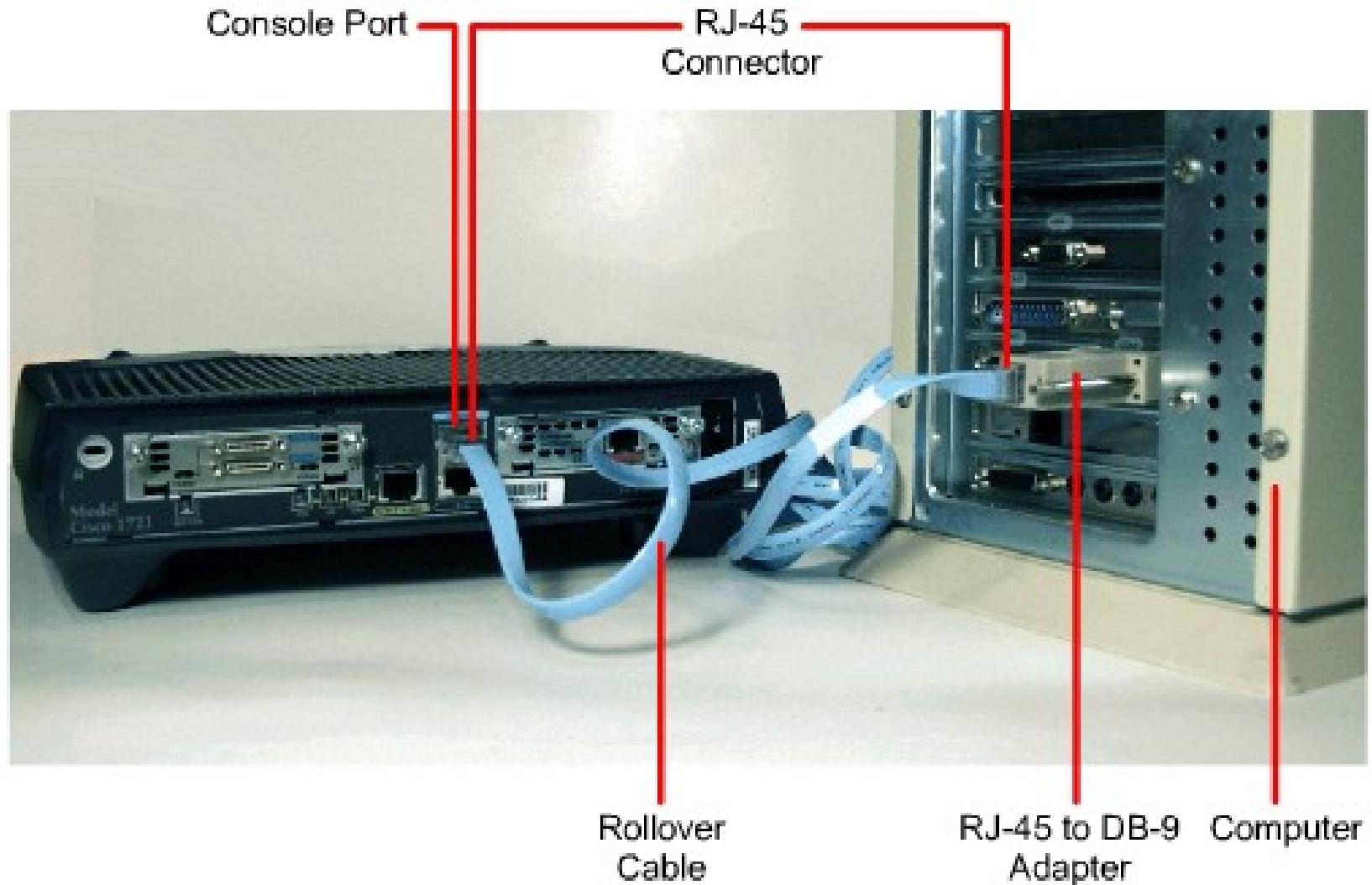


Routers & DSL Connections

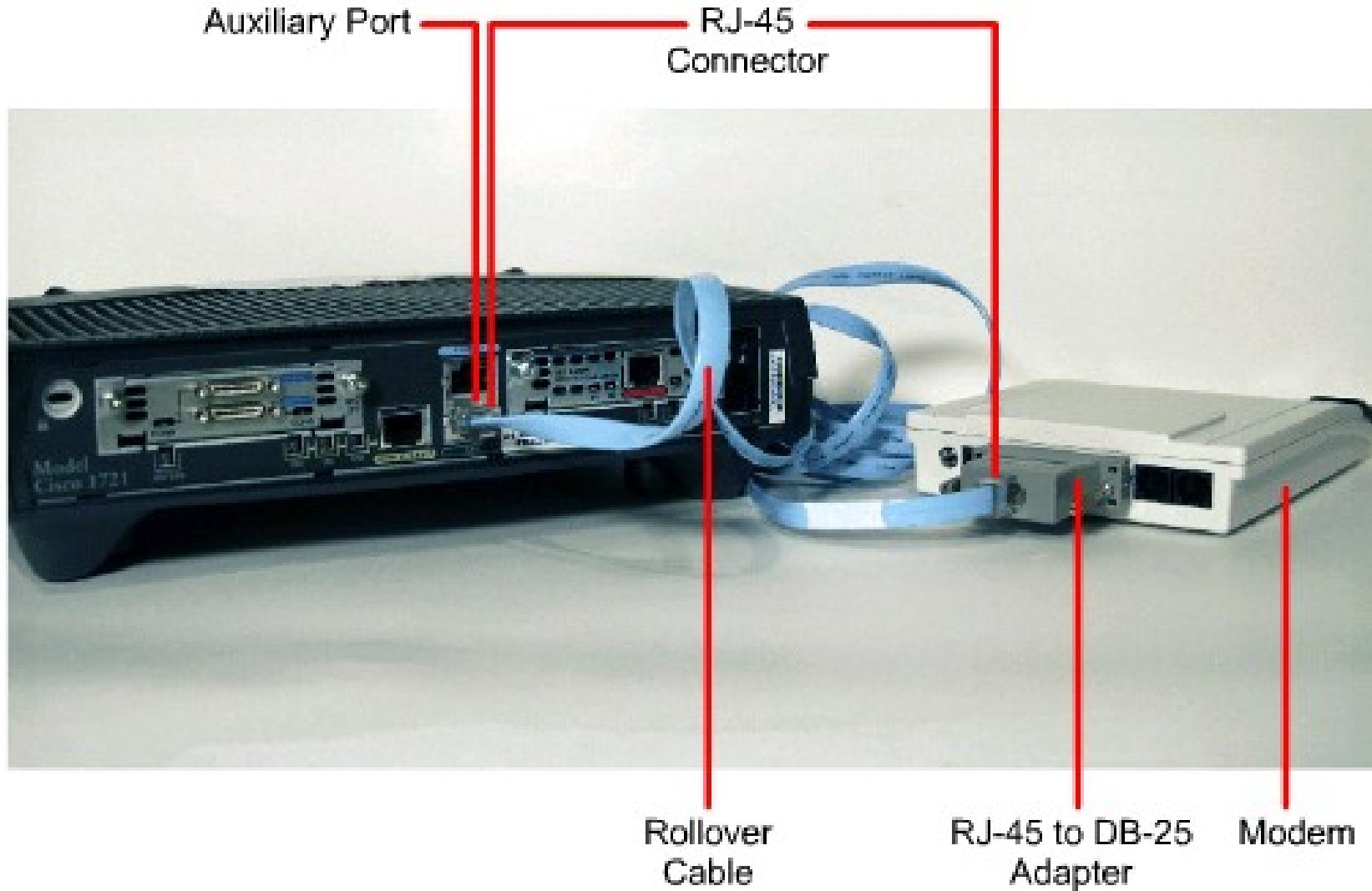
The Cisco 827 ADSL router has one asymmetric digital subscriber line (ADSL) interface. To connect a router for DSL service, use a phone cable with RJ-11 connectors. DSL works over standard telephone lines using pins 3 and 4 on a standard RJ-11 connector.



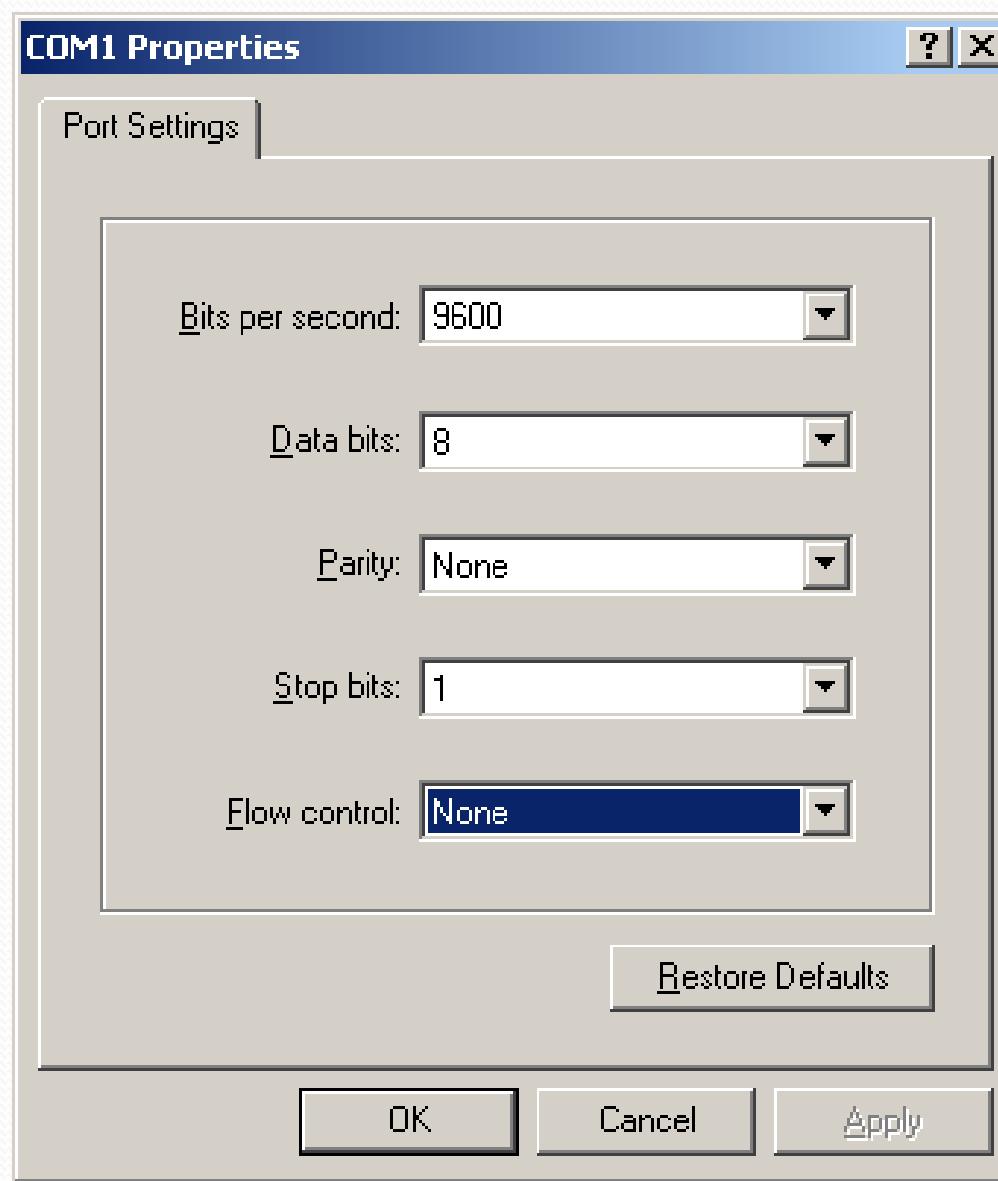
Computer/Terminal Console Connection



Modem Connection to Console/Aux Port



HyperTerminal Session Properties

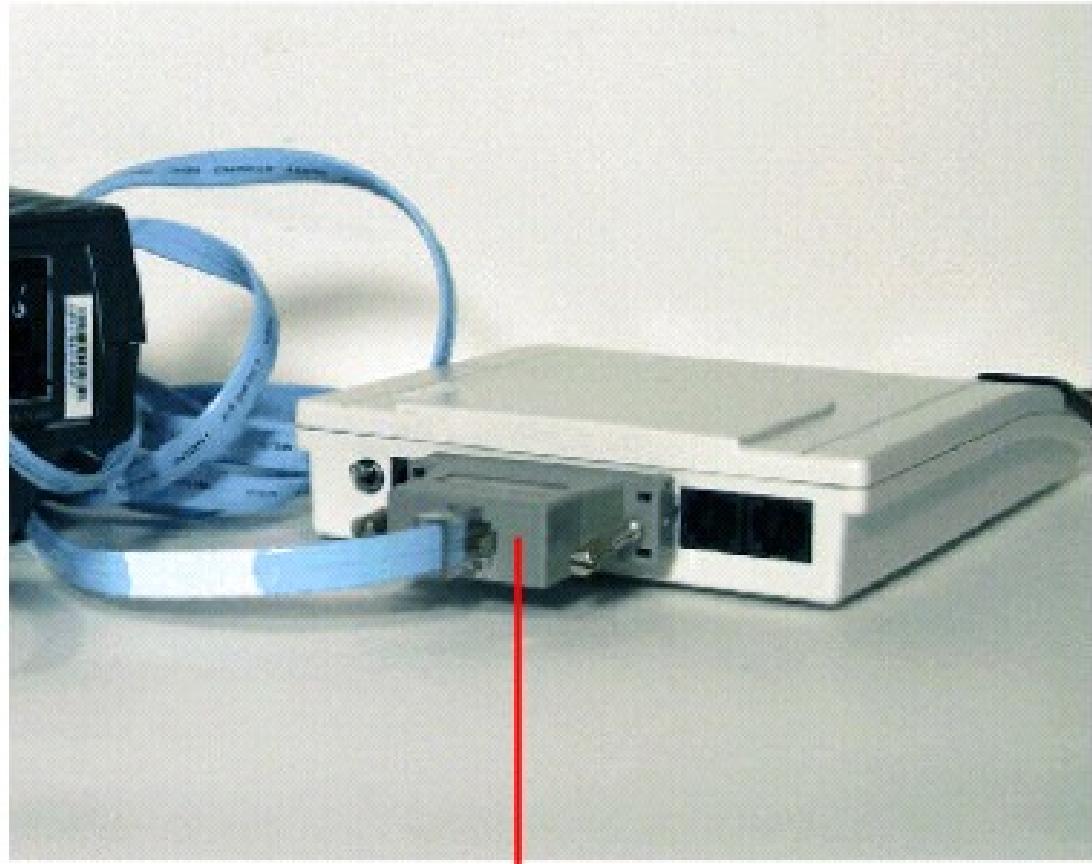


Establishing a HyperTerminal Session

Take the following steps to connect a terminal to the console port on the router:

First, connect the terminal using the RJ-45 to RJ-45 rollover cable and an RJ-45 to DB-9 or RJ-45 to DB-25 adapter.

Then, configure the terminal or PC terminal emulation software for 9600 baud, 8 data bits, no parity, 1 stop bit, and no flow control.



RJ-45 to DB-25 Adapter

Cisco IOS

Cisco technology is built around the Cisco Internetwork Operating System (IOS), which is the software that controls the routing and switching functions of internetworking devices.

A solid understanding of the IOS is essential for a network administrator.

The Purpose of Cisco IOS

As with a computer, 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.

Without an operating system, the hardware does not have any capabilities.

The Cisco IOS provides the following network services:

- Basic routing and switching functions
- Reliable and secure access to networked resources
- Network scalability

Router Command Line Interface

Router

```
Router(config) #
```

Setup Mode

Setup is not intended as the mode for entering complex protocol features in the router. The purpose of the setup mode is to permit the administrator to install a minimal configuration for a router, unable to locate a configuration from another source.

In the setup mode, default answers appear in square brackets [] following the question. Press the **Enter** key to use these defaults.

During the setup process, **Ctrl-C** can be pressed at any time to terminate the process. When setup is terminated using **Ctrl-C**, all interfaces will be administratively shutdown.

When the configuration process is completed in setup mode, the following options will be displayed:

- [0] Go to the IOS command prompt without saving this config.
- [1] Return back to the setup without saving this config.
- [2] Save this configuration to nvram and exit.

Enter your selection [2] :

Operation of Cisco IOS Software

The Cisco IOS devices have three distinct operating environments or modes:

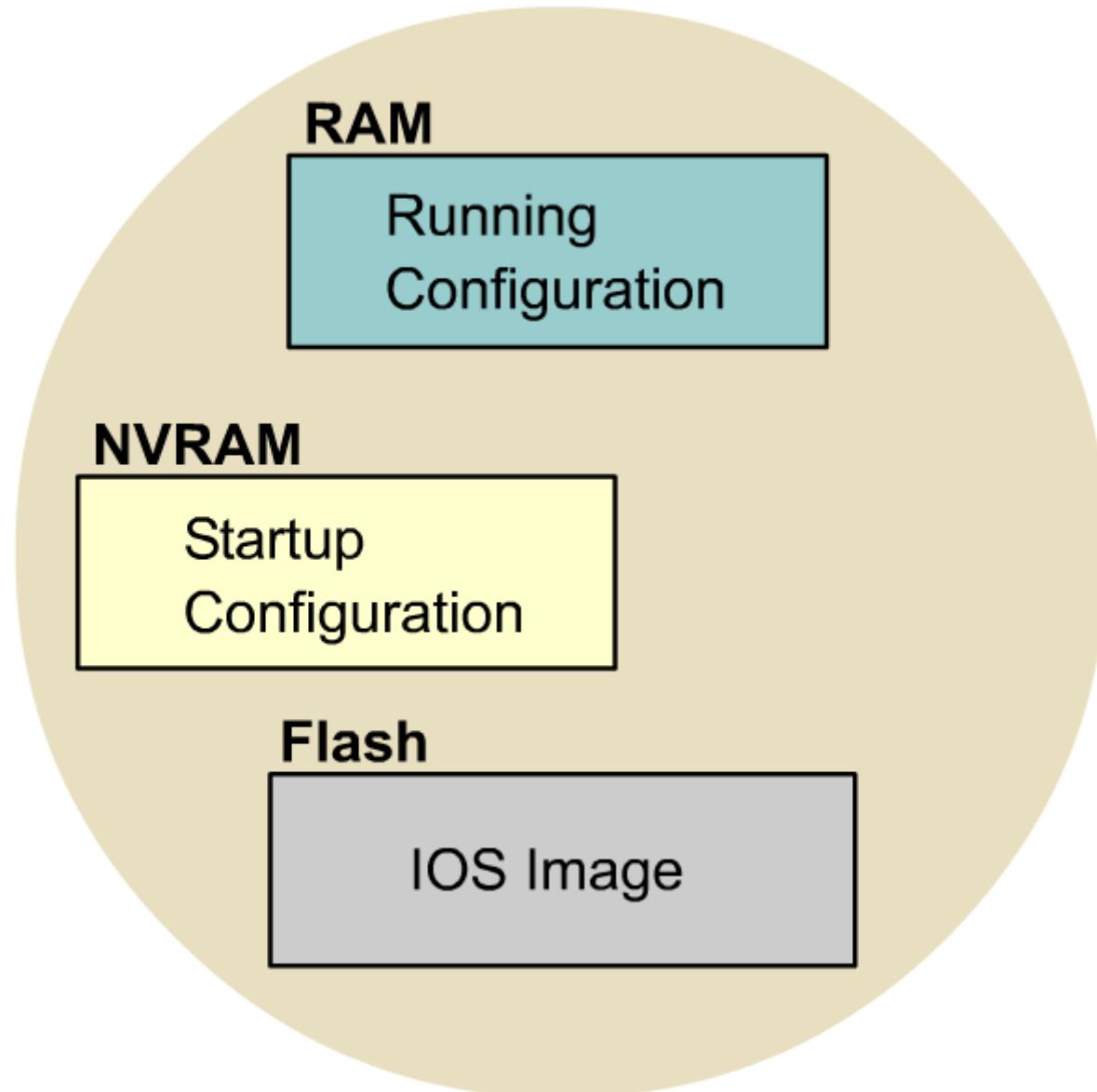
- ROM monitor
- Boot ROM
- Cisco IOS

The startup process of the router normally loads into RAM and executes one of these operating environments. The configuration register setting can be used by the system administrator to control the default start up mode for the router.

To see the IOS image and version that is running, use the **show version** command, which also indicates the configuration register setting.

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

IOS File System Overview



Initial Startup of Cisco Routers

A router initializes by loading the bootstrap, the operating system, and a configuration file.

If the router cannot find a configuration file, it enters setup mode.

Upon completion of the setup mode a backup copy of the configuration file may be saved to nonvolatile RAM (NVRAM).

The goal of the startup routines for Cisco IOS software is to start the router operations. To do this, the startup routines must accomplish the following:

- Make sure that the router hardware is tested and functional.
- Find and load the Cisco IOS software.
- Find and apply the startup configuration file or enter the setup mode.

When a Cisco router powers up, it performs a power-on self test (POST). During this self test, the router executes diagnostics from ROM on all hardware modules.

After the Post...

After the POST, the following events occur as the router initializes:

Step 1

The generic bootstrap loader in ROM executes. A bootstrap is a simple set of instructions that tests hardware and initializes the IOS for operation.

Step 2

The IOS can be found in several places. The boot field of the configuration register determines the location to be used in loading the IOS. If the boot field indicates a flash or network load, boot system commands in the configuration file indicate the exact name and location of the image.

Step 3

The operating system image is loaded.

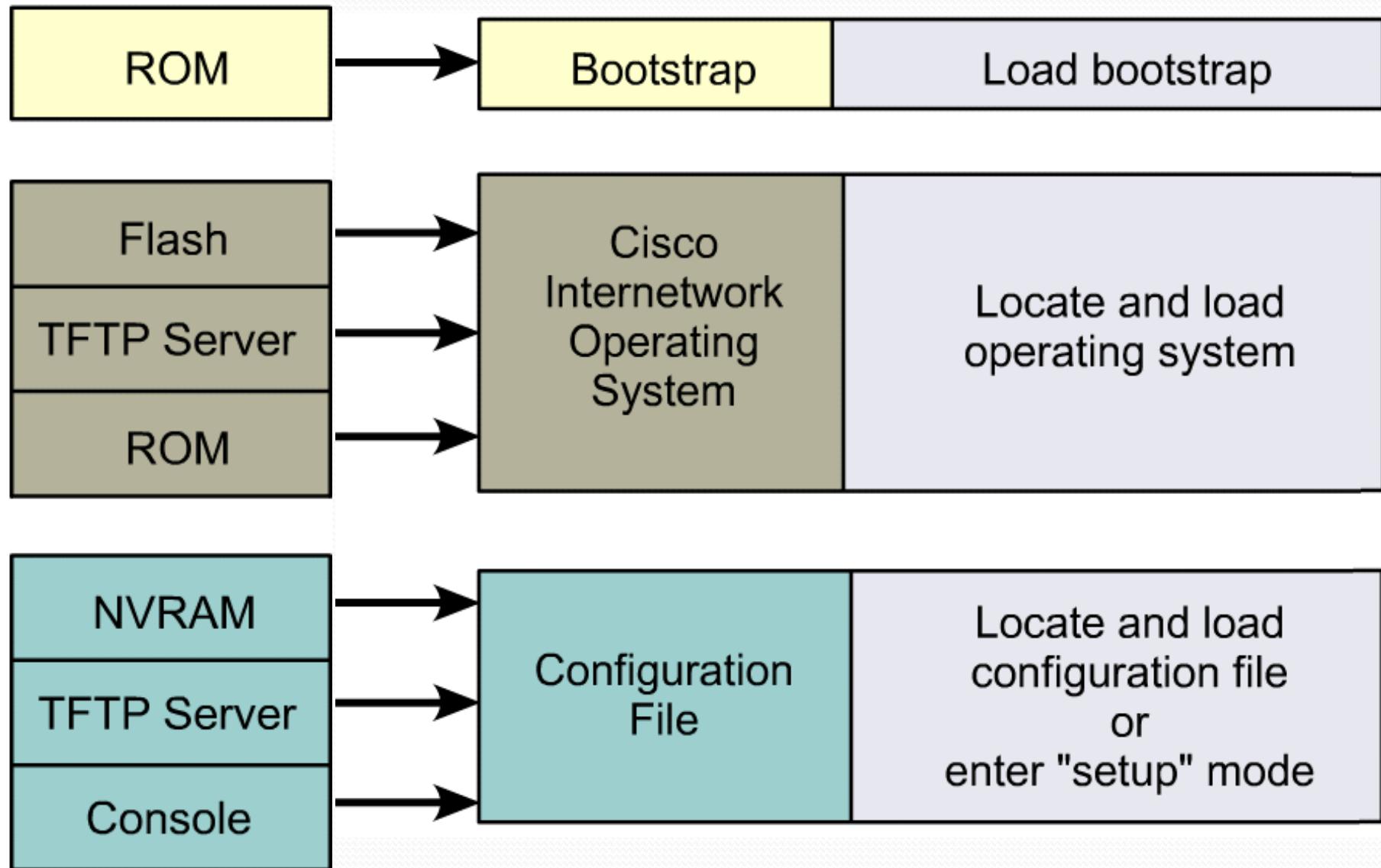
Step 4

The configuration file saved in NVRAM is loaded into main memory and executed one line at a time. The configuration commands start routing processes, supply addresses for interfaces, and define other operating characteristics of the router.

Step 5

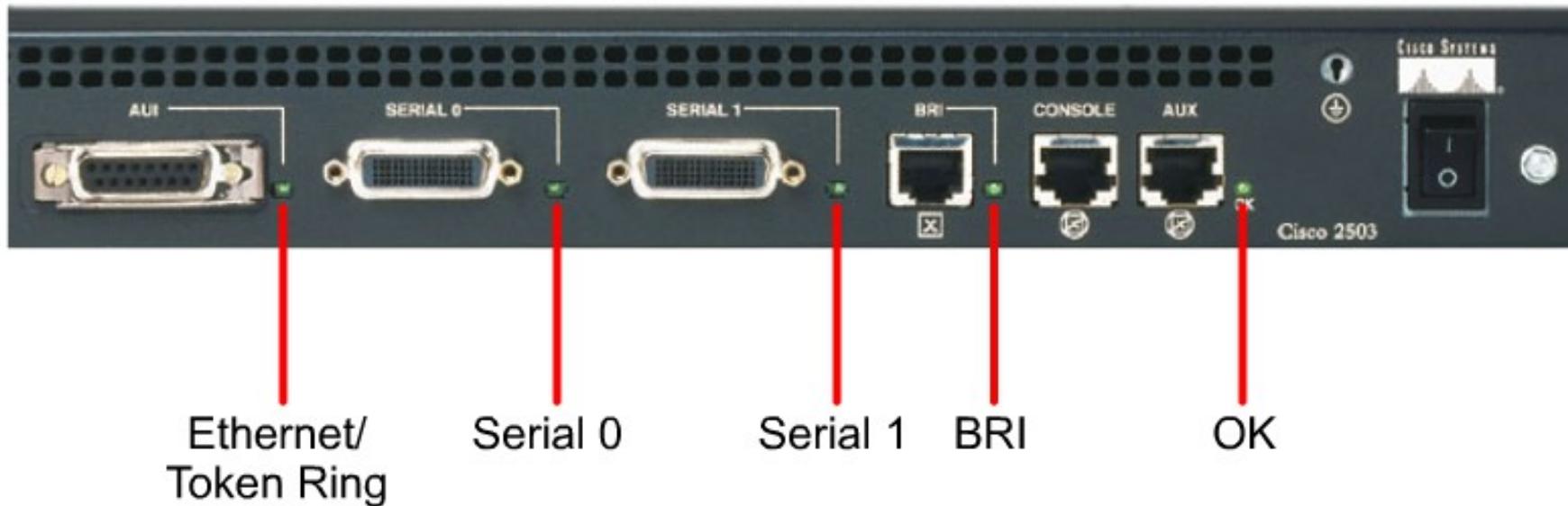
If no valid configuration file exists in NVRAM, the operating system searches for an available TFTP server. If no TFTP server is found, the setup dialog is

Step in Router Initialization



Router LED Indicators

Cisco routers use LED indicators to provide status information. Depending upon the Cisco router model, the LED indicators will vary. An interface LED indicates the activity of the corresponding interface. If an LED is off when the interface is active and the interface is correctly connected, a problem may be indicated. If an interface is extremely busy, its LED will always be on. The green OK LED to the right of the AUX port will be on after the system initializes correctly.



Enhanced Cisco IOS Commands

Command	Description
Ctrl-A	Moves to the beginning of the command line
Esc-B	Moves back one word
Ctrl-B (or right arrow)	Moves back one character
Ctrl-E	Moves to the end of the command line
Ctrl-F(or left arrow)	Moves forward one character
Esc-F	Moves forward one word

The **show version** Command

The **show version** command displays information about the Cisco IOS software version that is currently running on the router. This includes the configuration register and the boot field settings.

The following information is available from 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

Use the **show version** command to identify router IOS image and boot source. To find out the amount of flash memory, issue the **show flash** command.

Checking File System Information with show version command

```
Router#show version
Cisco Internetwork Operating System Software  IOS
(tm) 2500 Software (C2500-JS-L), Version 12.1(5),
RELEASE SOFTWARE (fcl) Copyright (c) 1986-2000 by
cisco Systems, Inc. Compiled Wed 25-Oct-00 05:18
by cmong Image text-base: 0x03071DB0, data-base:
0x00001000
ROM: System Bootstrap, Version 5.2(8a), RELEASE
SOFTWARE BOOTFLASH: 3000 Bootstrap Software (IGS-
RXBOOT), Version 10.2(8a), RELEASE SOFTWARE (fcl)
Router uptime is 7 minutes System returned to ROM
by reload System image file is "flash:c2500-js-
1_121-5.bin".
CISCO 700 (60020) processor (revision D) with
16384K/2048K bytes of memory. Processor board ID
02867477 with hardware revision 00000000 Bridging
software. X.25 software, Version 3.0.0. SuperLAT
software (copyright 1990 by Meridian Technology
Corp). TN3270 Emulation software. 1 Token
Ring/IEEE 802.5 interface(s) 2 Serial network
interface(s) 32K bytes of non-volatile
configuration memory. 16384K bytes of processor
board System flash (Read ONLY)
Configuration register is 0x2142
```