

# **Ch.2 – Introduction to Routers**

CCNA 2 version 3.0

# Overview

Upon completion of this module, the student will be able to perform tasks related to the following:

- |     |                              |
|-----|------------------------------|
| 2.1 | Operating Cisco IOS Software |
| 2.2 | Starting a Router            |

Students completing this module should be able to:

- Describe the purpose of the IOS
- Describe the basic operation of the IOS
- Identify various IOS features
- Identify the methods to establish a command-line interface (CLI) session with the router
- Move between the user command executive (EXEC) and privileged EXEC modes
- Establish a HyperTerminal session on a router
- Log into a router
- Use the help feature in the command line interface
- Troubleshoot command errors

# Cisco IOS Software

# The purpose of Cisco IOS Software

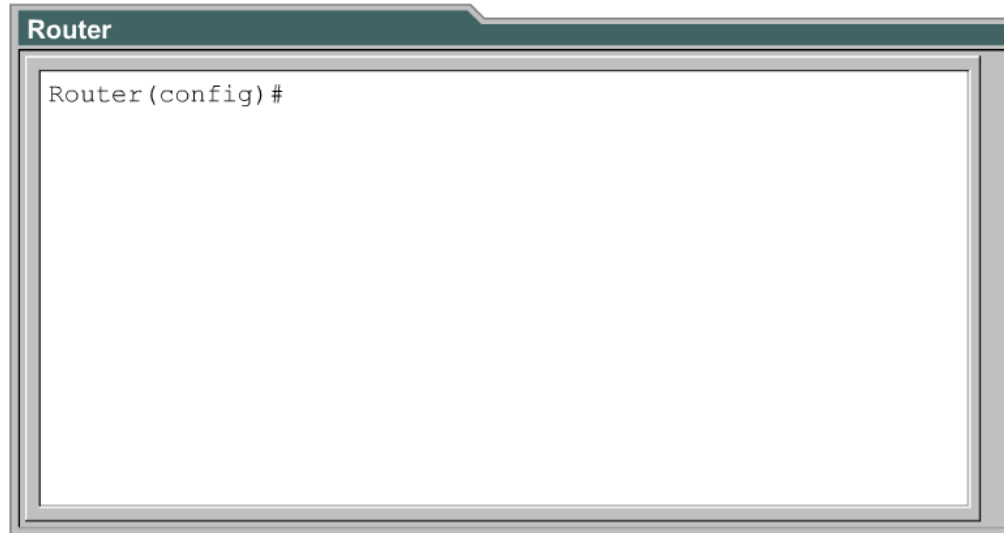


- As with a computer, a router or switch cannot function without an operating system.
- Cisco calls its operating system the **Cisco Internetwork Operating System** or **Cisco IOS**.

The Cisco IOS provides the following network services:

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

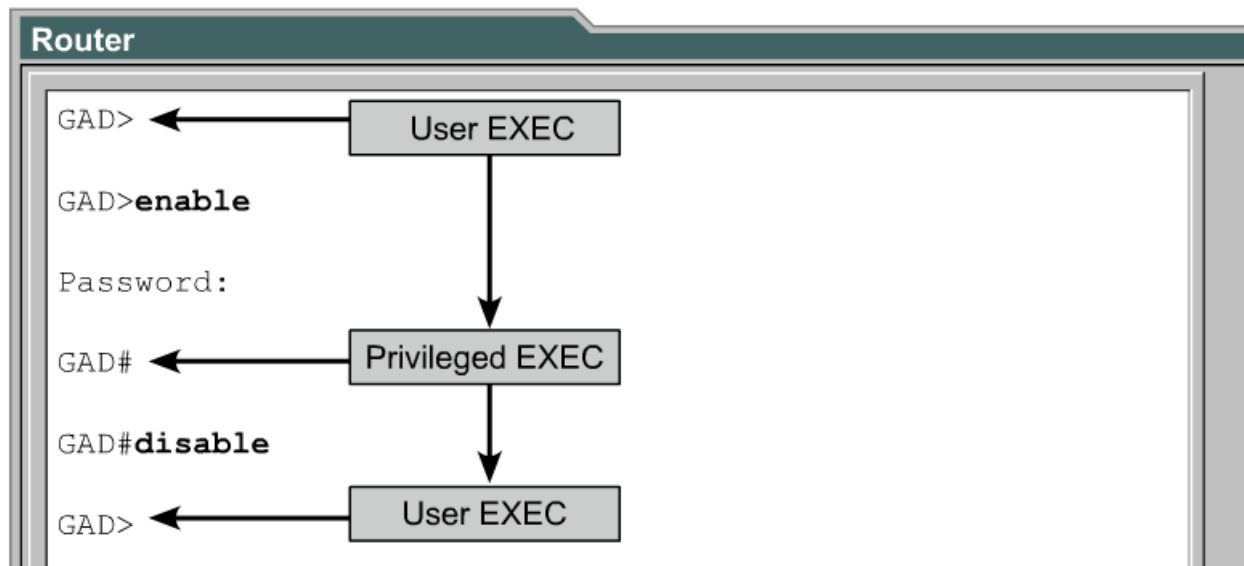
# Router user interface



- The Cisco IOS software uses a command-line interface (CLI) as the traditional console environment.
- This environment is accessible through several methods:
  - Console
  - AUX port (modem)
  - Telnet

# Router user interface modes

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



- The IOS provides a command interpreter service known as the command executive (**EXEC**).
- After each command is entered, the EXEC validates and executes the command.
- The levels are **user EXEC mode** and **privileged EXEC mode**.

# Cisco IOS software features

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

- xxxx = Platform
- yyyy = Features
- zz = 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
c3750	3750 (4400, 4401, 4402)

- Although there are numerous IOS images for different Cisco device models and feature sets, the basic configuration command structure is the same.
- The naming convention for the different Cisco IOS releases contains three parts:
- The platform on which the image runs
  - The special features supported in the image
  - Where the image runs and whether it has been zipped or compressed

# Cisco IOS software features

```
Router
BHM#show version
Cisco Internetwork Operating System Software
IOS (tm) 1700 Software (C1700-BNSY-L), Version
12.2(11)P, RELEASE SOFTWARE (fc1)
... <output omitted>...
System image file is "flash:c1700-y7-mz", booted via
flash
cisco 1721 (68380) processor (revision C) with
3584K/512K bytes of memory.
Processor board ID 12014633, with hardware revision
00000000
Bridging software.
X.25 software, Version 2.0, NET2, BFE and GOSIP
compliant.
1 Ethernet/IEEE 802.3 interface(s)
2 serial(sync/async) network interface(s)
System/IO memory with parity disabled
2048K bytes of DRAM onboard 2048K bytes of DRAM on SIMM
System running from FLASH
8K bytes of non-volatile configuration memory.
6144K bytes of processor board PCMCIA flash (Read ONLY)
Configuration register is 0x2102
BHM#
```

- Use the **show version** command on the Cisco device to check the current image and available flash, which also indicates the configuration register setting.

# Operation of Cisco IOS Software

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

```
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#
```

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

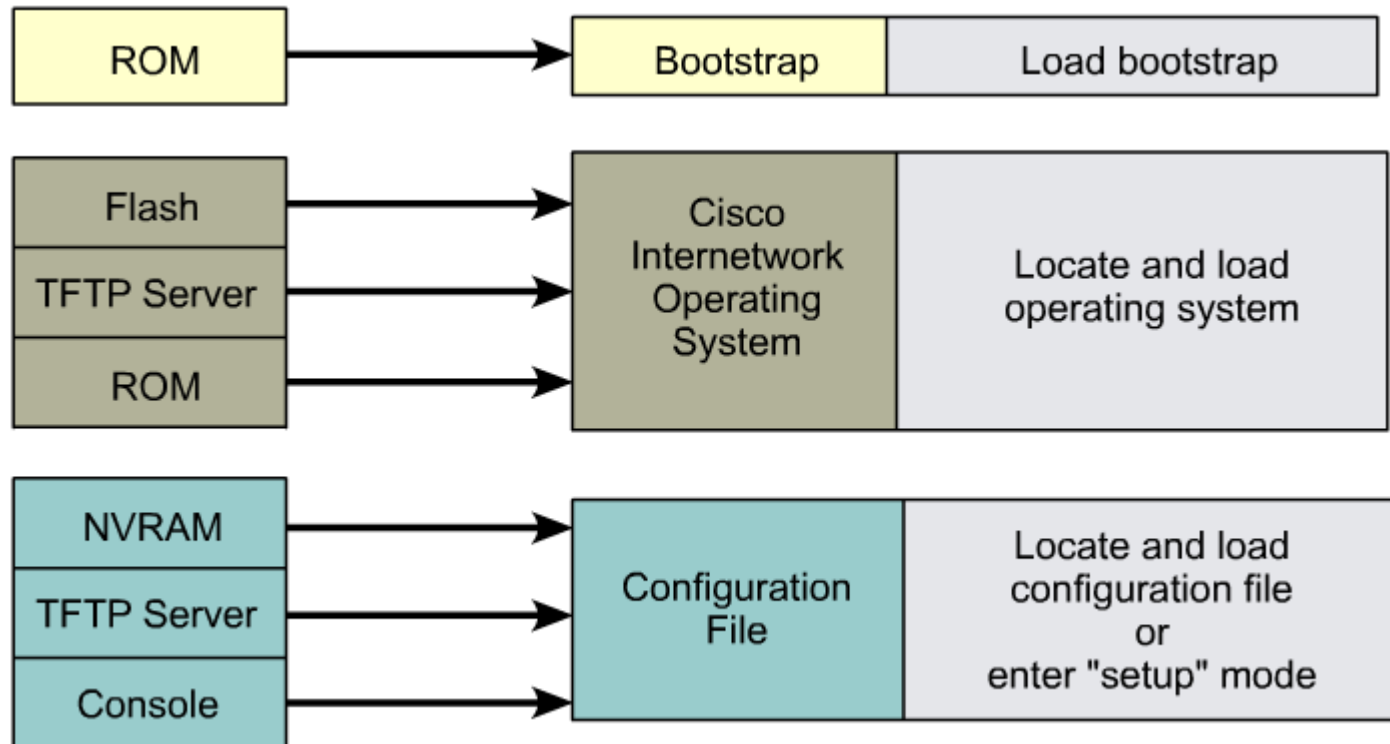
- ROM monitor
- Boot ROM
- Cisco IOS

The **show flash** command is used to verify that the system has sufficient memory to load a new Cisco IOS image.

# Starting a Router

# Initial startup of Cisco routers

- 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, the following events occur as the router initializes:



# Initial startup of Cisco routers

```
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 '[]'.

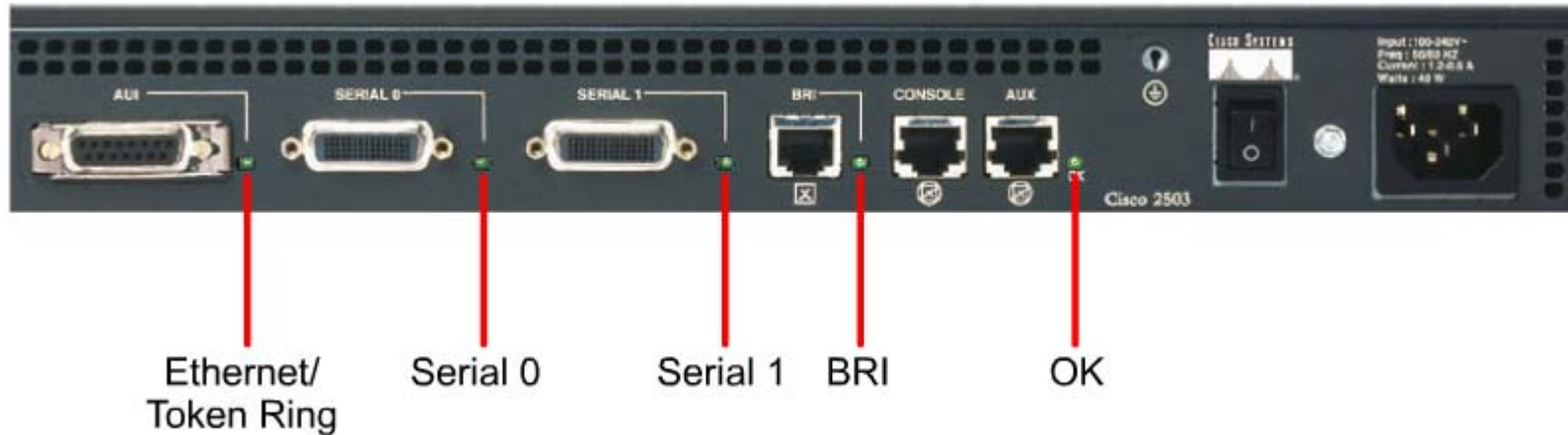
Continue with configuration dialog? [yes]. no

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
```

- During the setup process, **Ctrl-C** can be pressed at any time to terminate the process.

# Router LED indicators



- ON: An interface LED indicates the activity of the corresponding interface.
- OFF: If an LED is off when the interface is active and the interface is correctly connected, a problem may be indicated.
- ALWAYS ON: 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

# Examining the initial router bootup

## Router

```
System Bootstrap, Version X.X(XXXX) [XXXXX XX], RELEASE  
SOFTWARE
```

```
Copyright (c) 1986-199X by Cisco Systems  
2500 processor with 4096 Kbytes of main memory
```

```
Notice: NVRAM invalid, possibly due to write erase.
```

```
F3: 5797928+162396+258800 at 0x3000060
```

```
Restricted Rights Legend
```

```
Use, duplication, or disclosure by the Government is  
subject to restrictions as set forth in subparagraph  
(c) of the Commercial Computer Software - Restricted  
Rights clause at FAR sec. 52.227-19 and subparagraph  
(c) (1) (ii) of the Rights in Technical Data and Computer  
Software clause at DFARS sec. 252.227-7013.
```

## Router

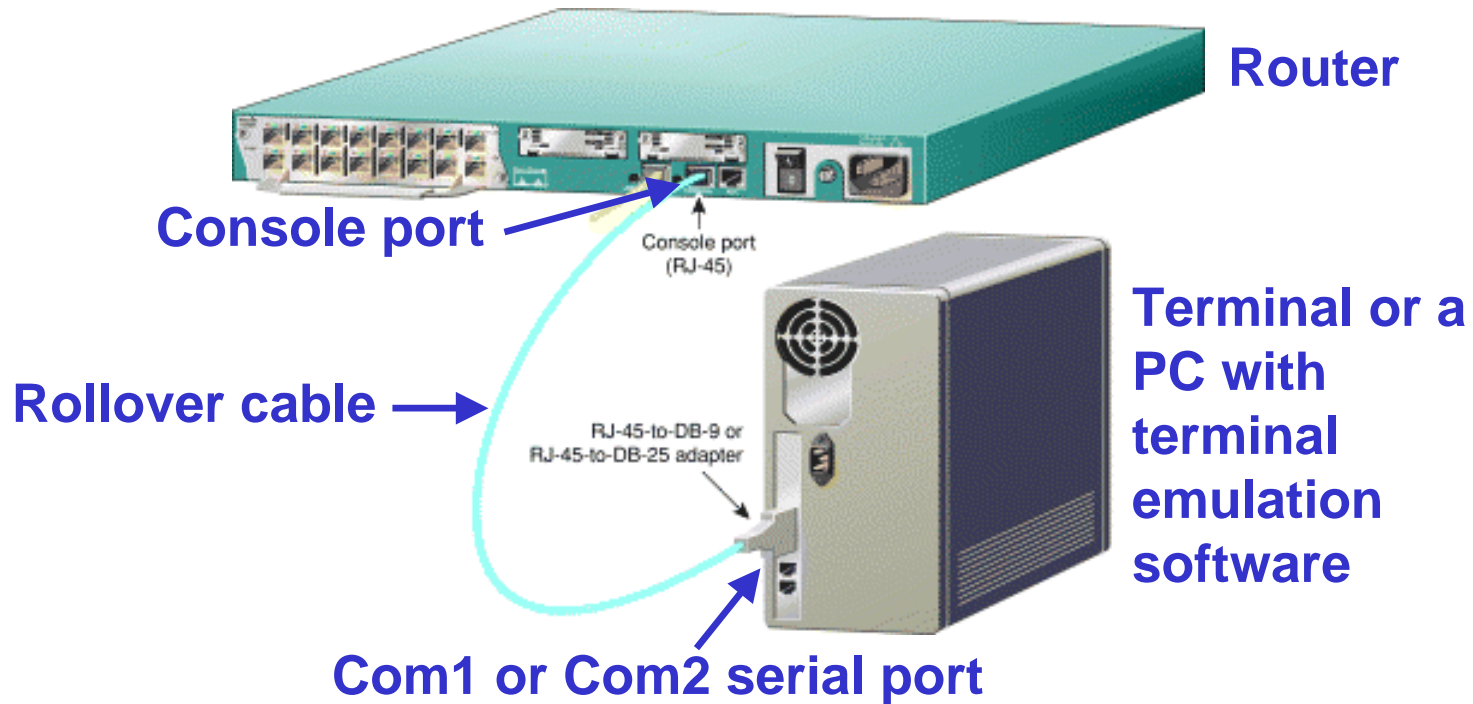
```
Cisco Internetwork Operating System Software  
IOS (tm) X000 Software (XXX-X-X), Version XX.X(XXXX)  
[XXXXX XXX]  
Copyright (c) 1986-199X by Cisco Systems, Inc.  
Compiled Fri 20-Oct-9X 16:02 by XXXXX  
Image text-base: 0x03030FC0, data-base: 0x00001000  
Cisco 25XX (68030) processor (revision A) with 4092K/2048K  
bytes of memory.  
Processor board ID 00000000 X.25 software, Version X.X,  
NET2, BFE and GOSIP compliant.  
TN3270 Emulation software (copyright 1994 by TGV Inc).  
Basic Rate ISDN software, Version X.X.  
X Ethernet/IEEE 802.3 interface.  
2 Serial network interfaces.  
1 ISDN Basic Rate interface.  
32K bytes of non-volatile configuration memory.  
8192K bytes of processor board System flash (Read ONLY)
```

## 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]: no
```

# Establishing a HyperTerminal session

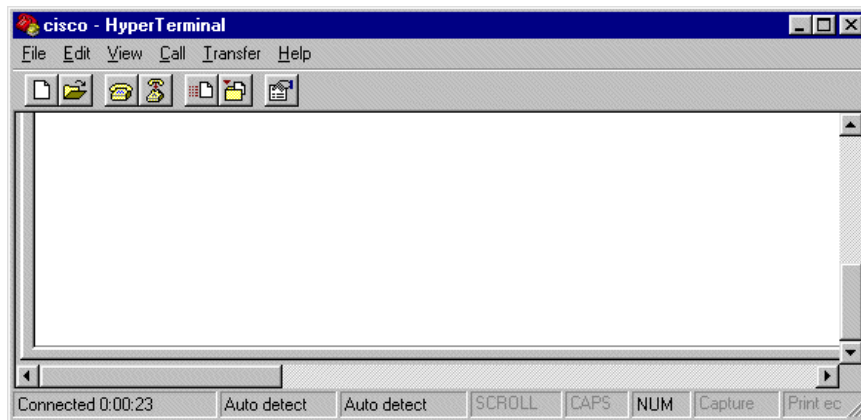


Take the following steps to connect a terminal to the console port on the router:

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

# Establishing a HyperTerminal session

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



=



- Important: A console connection is not the same as a network connection!

# Logging into the router

```
Router
Router con0 is now available.
Press RETURN to get started.
User Access Verification
Password:
Router> ← User-Mode Prompt
Router>enable
Password:
Router# ← Privileged-Mode Prompt
Router#disable
Router>
Router>exit
```

- Two commands can be used to set a password used to access privileged EXEC mode: **enable password** and **enable secret**
- The following are specific modes that can also be accessed from the global configuration mode:
  - Interface
  - Subinterface
  - Line
  - Router
  - Route-map

# Keyboard help in the router CLI

```
Router
Cisco>?
Exec commands:
access-enable      Create a temporary Access-List
                   entry
access-profile     Apply user-profile to interface
access-template    Create a temporary Access-List
                   entry
archive            manage archive files
bfe                For manual emergency modes
                   setting
cd                 Change current directory
clear              Reset functions
clock              Manage the system clock
configure          Enter configuration mode
connect            Open a terminal connection
copy               Copy from one file to another
--More--
```

```
Router
Cisco#?
Exec commands:
access-enable      Create a temporary Access-List
                   entry
access-profile     Apply user-profile to interface
access-template    Create a temporary Access-List
                   entry
archive            manage archive files
bfe                For manual emergency modes
                   setting
cd                 Change current directory
clear              Reset functions
clock              Manage the system clock
configure          Enter configuration mode
connect            Open a terminal connection
copy               Copy from one file to another
debug              Debugging functions (see also
```

# Keyboard help in the router CLI

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
```

Router

```
Cisco#clock set 19:50:00  
% Incomplete command.  
Cisco#clock set 19:50:00 ?  
  <1-31> Day of the month  
  MONTH Month of the year  
Cisco#clock set 19:50:00 14 7  
                                     ^  
% Invalid input detected at '^' marker.  
Cisco#clock set 19:50:00 14 July  
% Incomplete command.  
Cisco#clock set 19:50:00 14 July ?  
  <1993-2035> Year  
Cisco#clock set 19:50:00 14 July 2003  
Cisco#
```

# Enhanced editing 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

```
Router
Router>$ value for our customers and employees
```

- **Ctrl-Z** is a command used to back out of configuration mode. This will return the user to the privileged EXEC mode prompt.

# Router command history

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

\*The number will vary depending on what is displayed on the user's screen

- **terminal history size:** maximum number of commands is 256

# Troubleshooting command line errors

Router

```
Router#comfigure terminal
```

```
      ^
```

```
% Invalid input detected at '^' marker.
```

```
Router#configure terminal
```

# The show version command

```
Router
GAD#show version
Cisco Internetwork Operating System Software
IOS (tm) 1700 Software (C1700-BNSY-L), Version
12.2(11)P, RELEASE SOFTWARE (fc1)
... <output omitted>...
ROM: System Bootstrap, Version 11.1(10)AA, EARLY
DEPLOYMENT RELEASE SOFTWARE (fc1)
ROM: 1700 Software (C1700-BOOT-R), Version
11.1(10)AA, EARLY DEPLOYMENT RELEASE SOFTWARE
```

- 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
- IOS image and boot source.

# The show version command

```
Router>show version
```

```
Cisco Internetwork Operating System Software
```

```
IOS (tm) 2500 Software (C2500-D-L), Version 12.0(5), RELEASE SOFTWARE (fc1)
```

IOS Version

```
Copyright (c) 1986-1999 by cisco Systems, Inc.
```

```
Compiled Tue 15-Jun-99 20:08 by phanguye
```

```
Image text-base: 0x030380DC, data-base: 0x00001000
```

```
ROM: System Bootstrap, Version 11.0(10c)XB2, PLATFORM SPECIFIC RELEASE SOFTWARE (fc1)
```

ROM Version – not usually an issue

```
BOOTFLASH: 3000 Bootstrap Software (IGS-BOOT-R), Version 11.0(10c)XB2, PLATFORM SPECIFIC RELEASE SOFTWARE (fc1)
```

```
Router uptime is 49 minutes
```

Router boot information

```
System restarted by reload
```

```
System image file is "flash:c2500-d-l_120-5.bin"
```

Booted this IOS file from flash

```
cisco 2516 (68030) processor (revision J) with 6144K/2048K bytes of memory.
```

Amount of RAM memory

```
Processor board ID 10375144, with hardware revision 00000001
```

```
Bridging software.
```

Model & CPU

```
X.25 software, Version 3.0.0.
```

```
Basic Rate ISDN software, Version 1.1.
```

```
1 Ethernet/IEEE 802.3 interface(s)
```

```
14 Ethernet/IEEE 802.3 repeater port(s)
```

Router interfaces

```
2 Serial network interface(s)
```

```
1 ISDN Basic Rate interface(s)
```

```
32K bytes of non-volatile configuration memory.
```

Amount of NVRAM

```
8192K bytes of processor board System flash (Read ONLY)
```

Amount of Flash

```
Configuration register is 0x2102
```

Configuration Register, important for password recovery. Must press space or return to get this last line!

```
Router>
```

# Summary

## Summary

- Cisco IOS Software is the software that controls the routing and switching functions of internetworking devices
- Cisco IOS Software uses a command-line interface (CLI) as its traditional console environment
- Cisco IOS Software has two access levels: user EXEC mode and privileged EXEC mode
- A router initializes by loading the bootstrap, the operating system, and a configuration file
- Cisco routers use LED indicators to provide status information