

Module 2

Introduction and Configuration Routers

Starting a Router

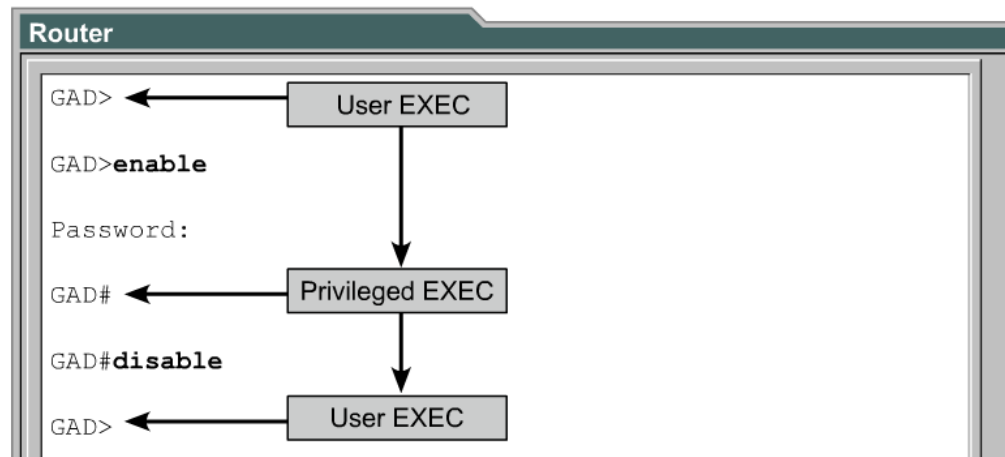
Cisco IOS Software



- Cisco IOS - Cisco **I**nternetwork **O**perating **S**ystem.
- As with a computer, a router or switch cannot function without an operating system.
- Cisco IOS provides the following network services:
 - Basic routing and switching functions
 - Reliable and secure access to networked resources
 - Network scalability

Router User Interface Modes

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



- The Cisco command-line interface (CLI) uses a hierarchical structure.
- Cisco IOS software separates the EXEC sessions into two access levels:
 - The user EXEC mode
 - The privileged EXEC mode

Router User Interface Modes

- The **User EXEC mode**:
 - Allows only a limited number of basic monitoring commands.
 - Does not allow any commands that might change the configuration of the router.
 - Identified by the ">" prompt.
- The **Privileged EXEC mode**:
 - Accesses all router commands.
 - Can be configured to require a password from the user before accessing it.
 - Allows only authorized users to access the router.
 - Configuration and management commands require that the network administrator be at the privileged EXEC level
 - Identified by the "#" prompt.

Cisco IOS

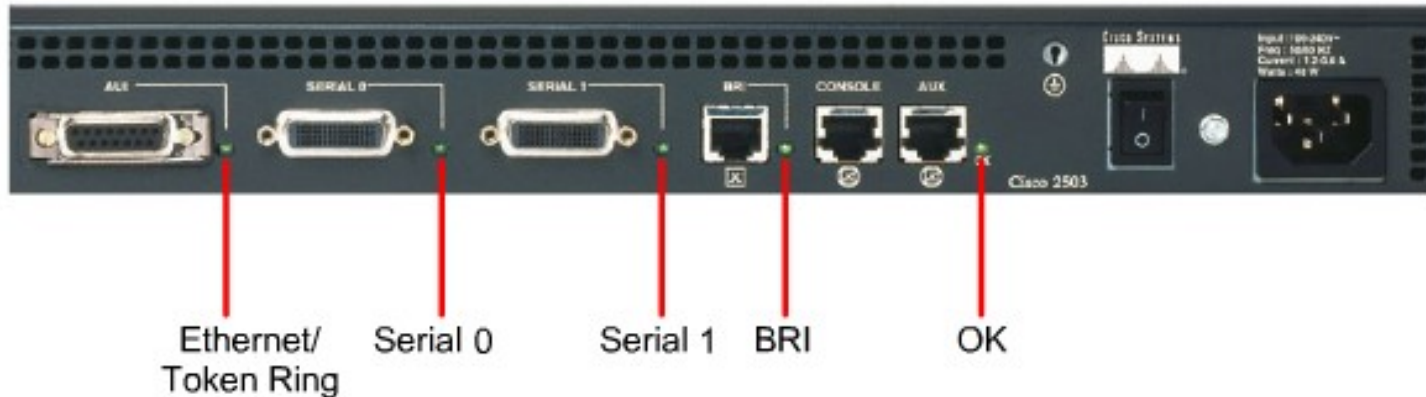
```
Router
BHM#show flash
PCMCIA flash directory:
File   Length   Name/status
  1    6007232   c1700-bnsy-1.212-11.p
[6007296 bytes used, 284160 available, 6291456
total]
6144K bytes of processor board PCMCIA flash (Read
ONLY)
BHM#
```

- The normal operation of a router requires use of the full Cisco IOS image as stored in flash.
- Most Cisco routers require a copy of the IOS to be loaded into RAM and also executed from RAM.
- Some IOS images are stored in flash in a compressed format and have to be expanded when copied to RAM.

See the IOS image and version

- **show version** command displays information about the Cisco IOS Software version current is running on the router
- **show flash** command is used to verify that the system has sufficient memory to load a new Cisco IOS image

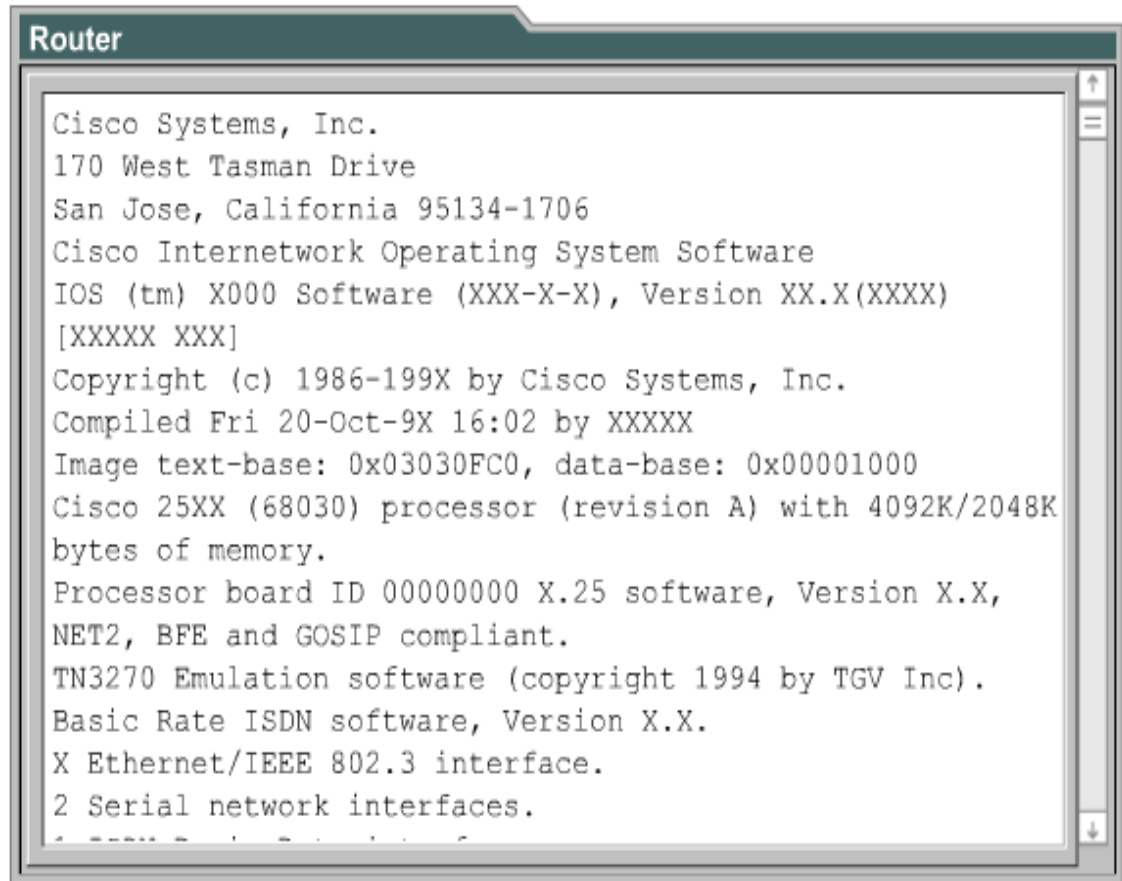
Router LED indicators



- **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

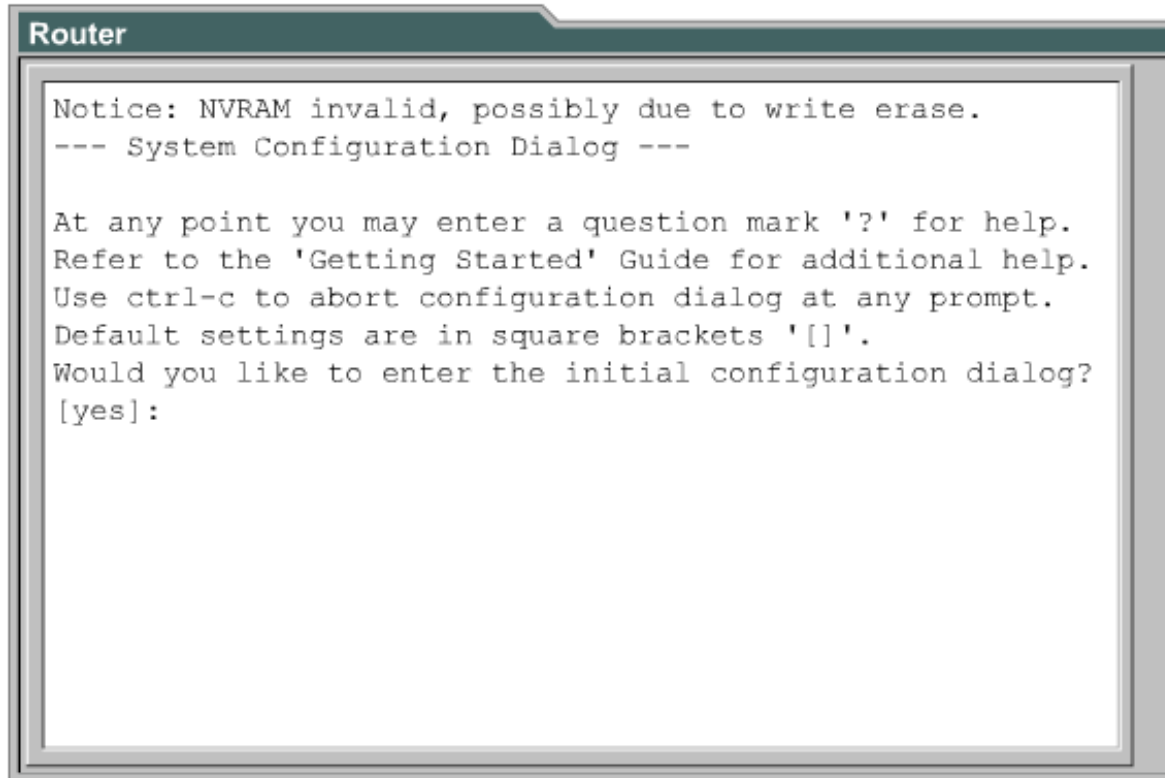
- User can determine the bootstrap version and the IOS version
- Router model, processor, the information listed in this graphic includes:
 - The number of interfaces
 - The types of interfaces
 - The amount of NVRAM
 - The amount of flash memory



```
Router

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134-1706
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.
```

Examining the initial router bootup

A screenshot of a terminal window titled "Router" showing the initial bootup configuration dialog. The text displayed is as follows:

```
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]:
```

- The user has the option to enter setup mode.
- Purpose of the setup mode is to permit to install a minimal configuration for a router, unable to locate a configuration from another source.

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 '[]'.

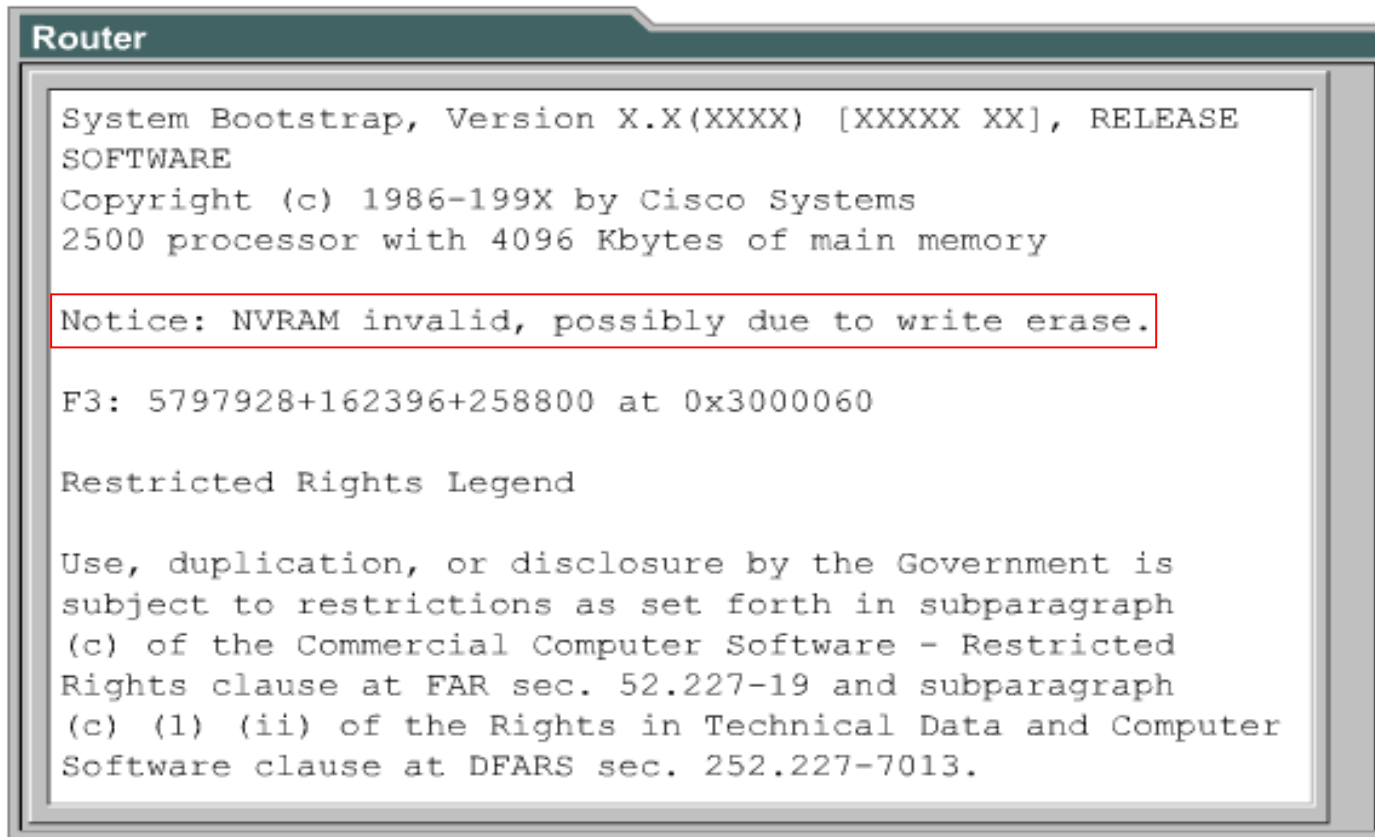
Continue with configuration dialog? [yes] no

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.

Examining the initial router bootup



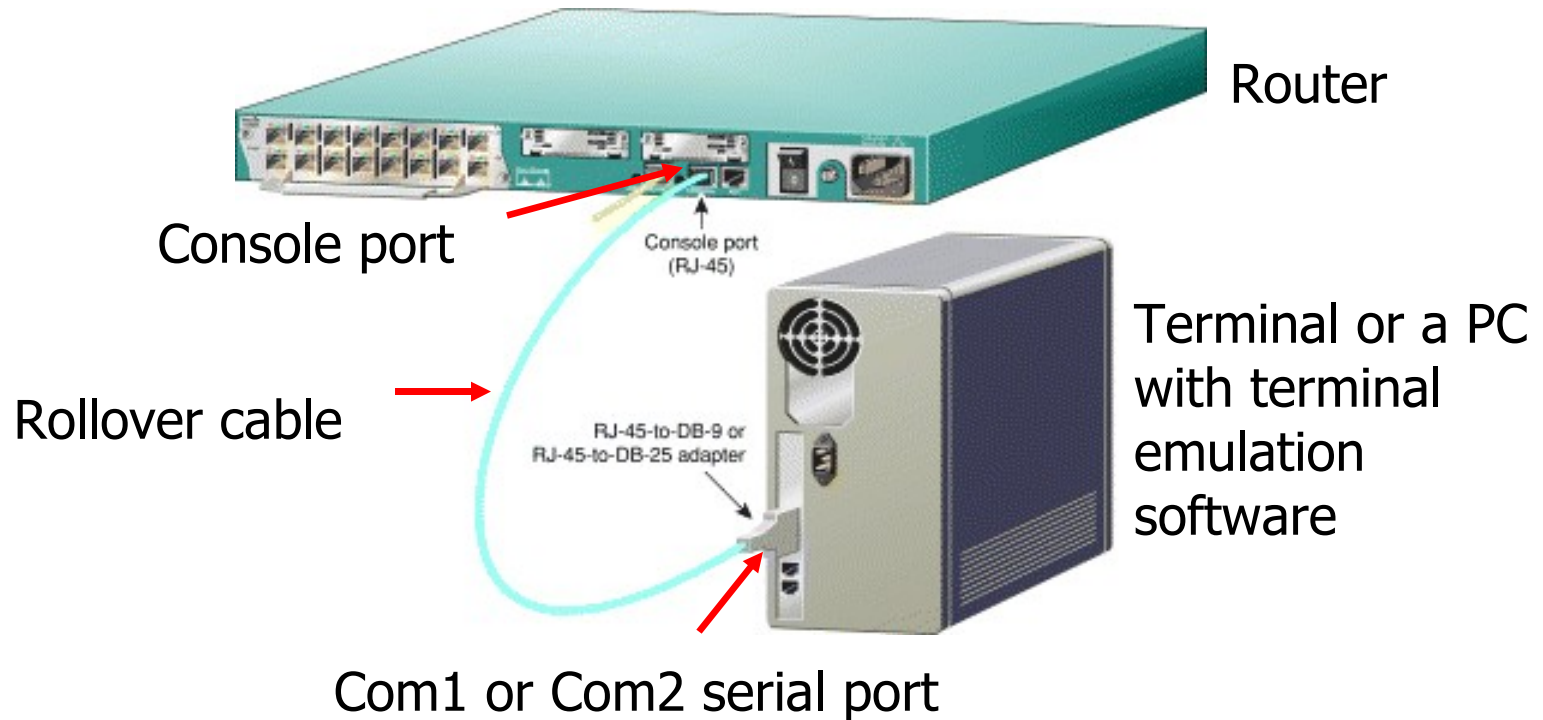
The screenshot shows a terminal window titled "Router" with the following text:

```
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.
```

The line "Notice: NVRAM invalid, possibly due to write erase." is highlighted with a red rectangular border.

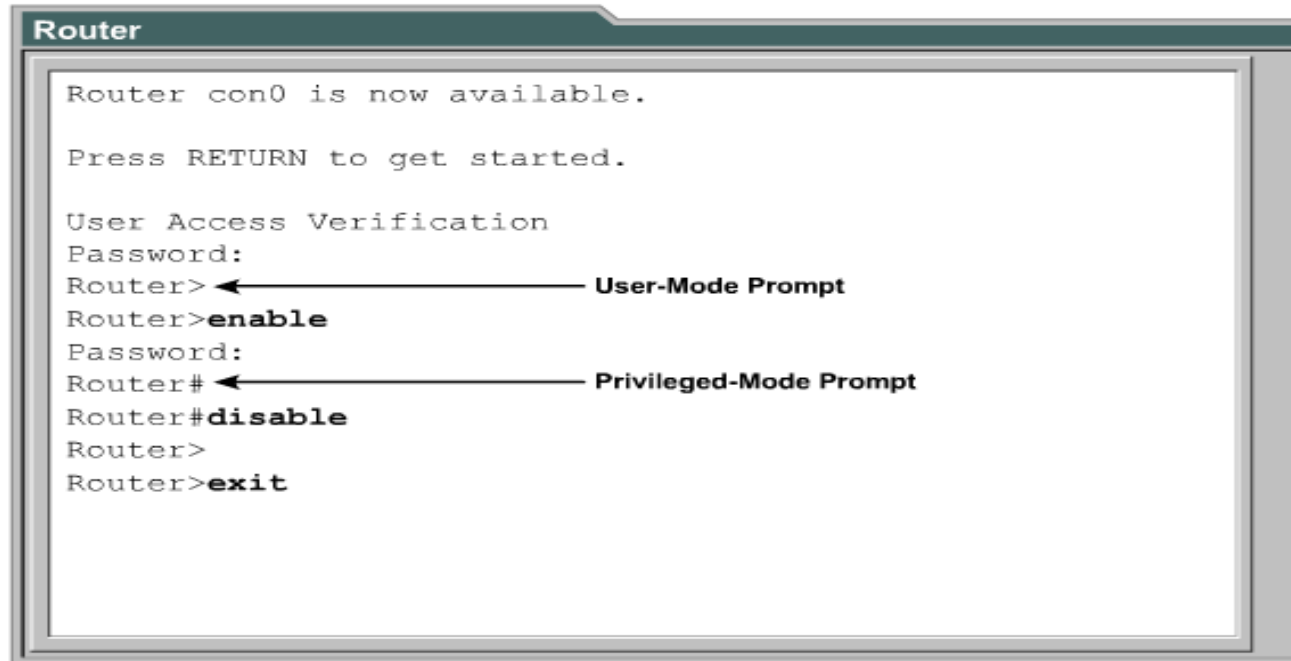
- “NVRAM invalid, possibly due to write erase”, tells the user that this router has not been configured yet or that the NVRAM has been erased.

Establishing a HyperTerminal Session



- 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.

Logging into the router

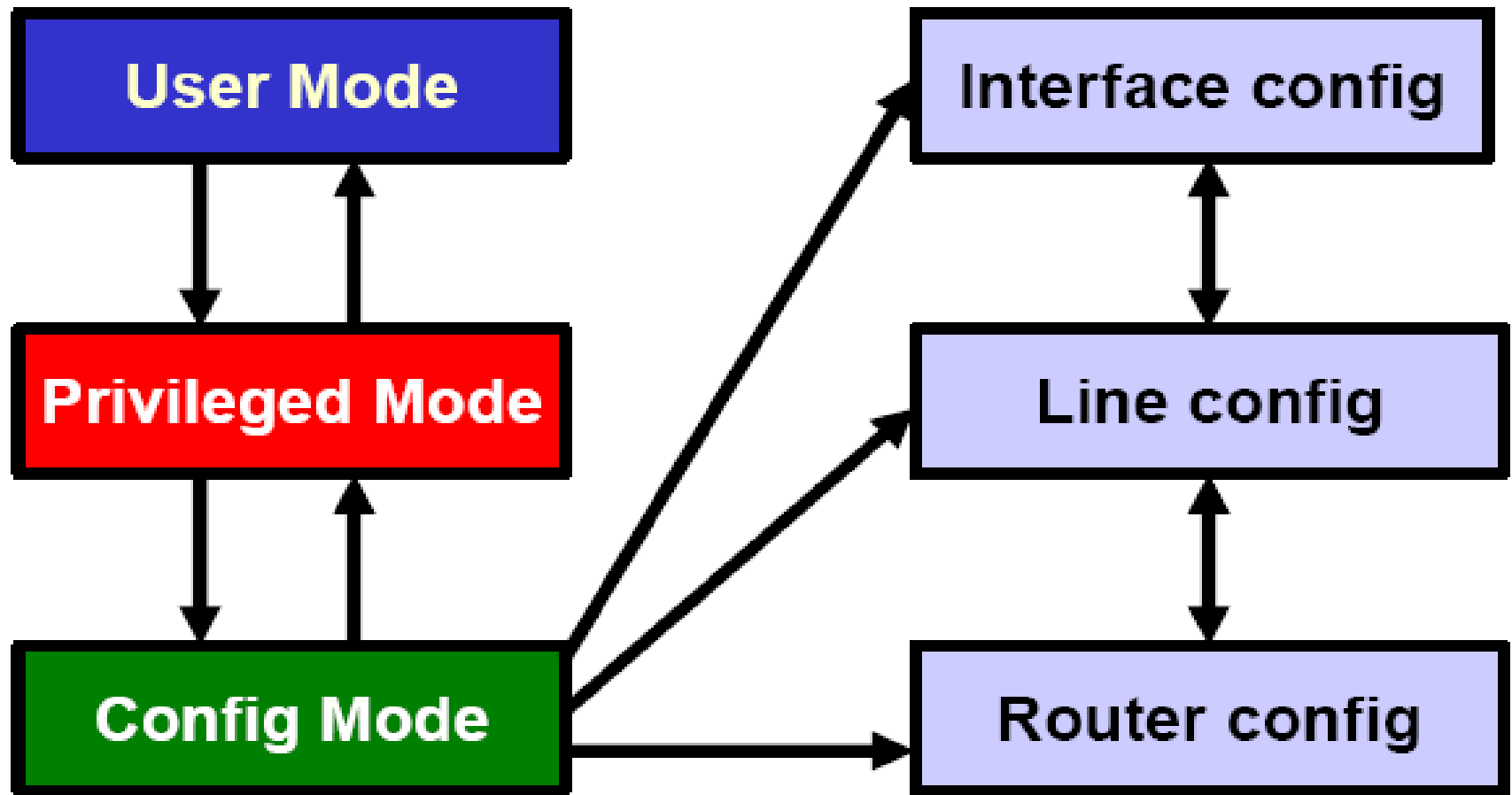


The screenshot shows a terminal window titled "Router". The text inside the window is as follows:

```
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
```

- User EXEC mode
 - Typical tasks include those that check the router status.
 - In this mode, router configuration changes are not allowed.
- Privileged EXEC mode
 - Typical tasks include those that change the router configuration.

Router Modes



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
```


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
```

Help in the router CLI

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#
```

Editing and History Functions

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

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

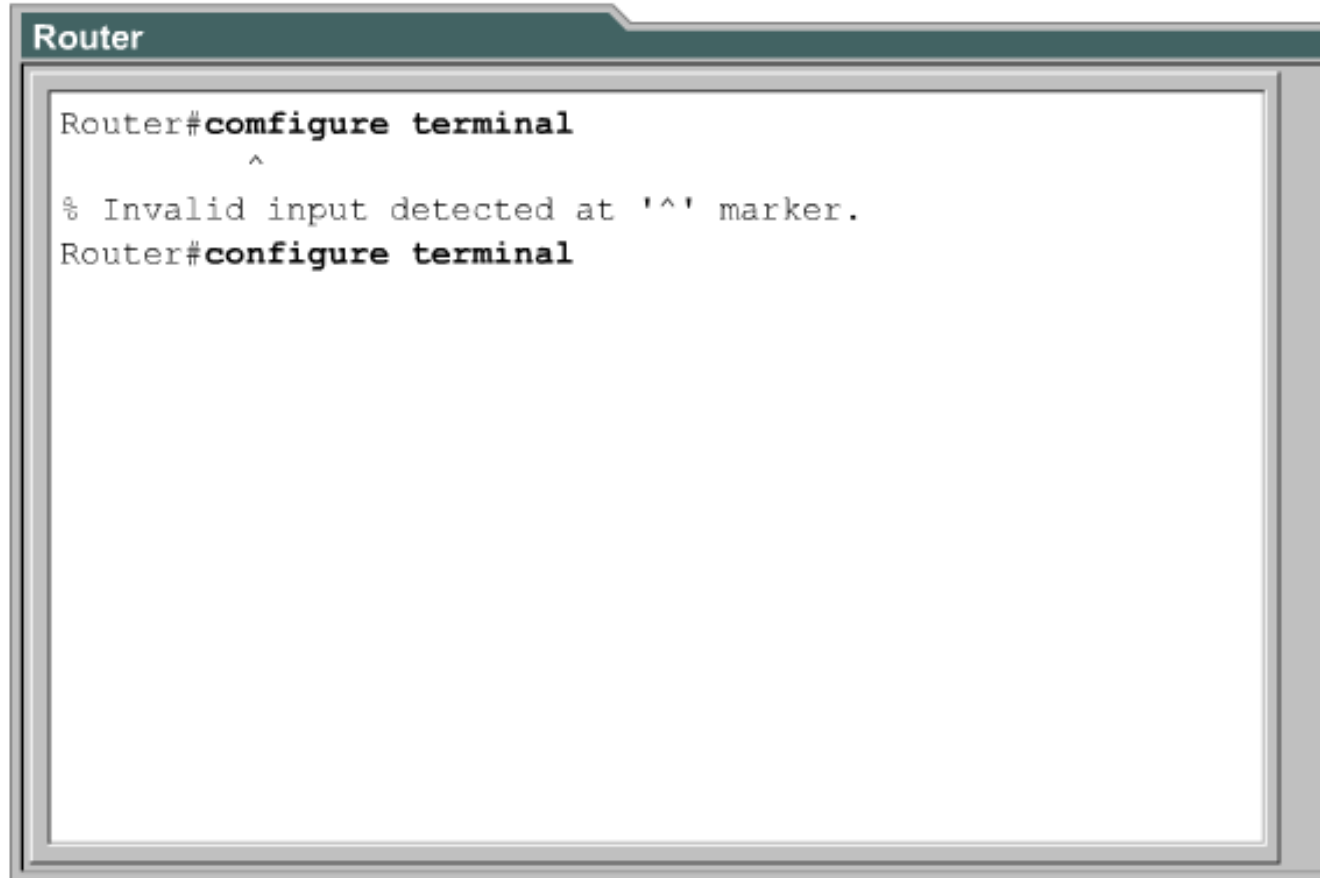
Router Command History

Command	Description
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

terminal history size: maximum number of commands is 256

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

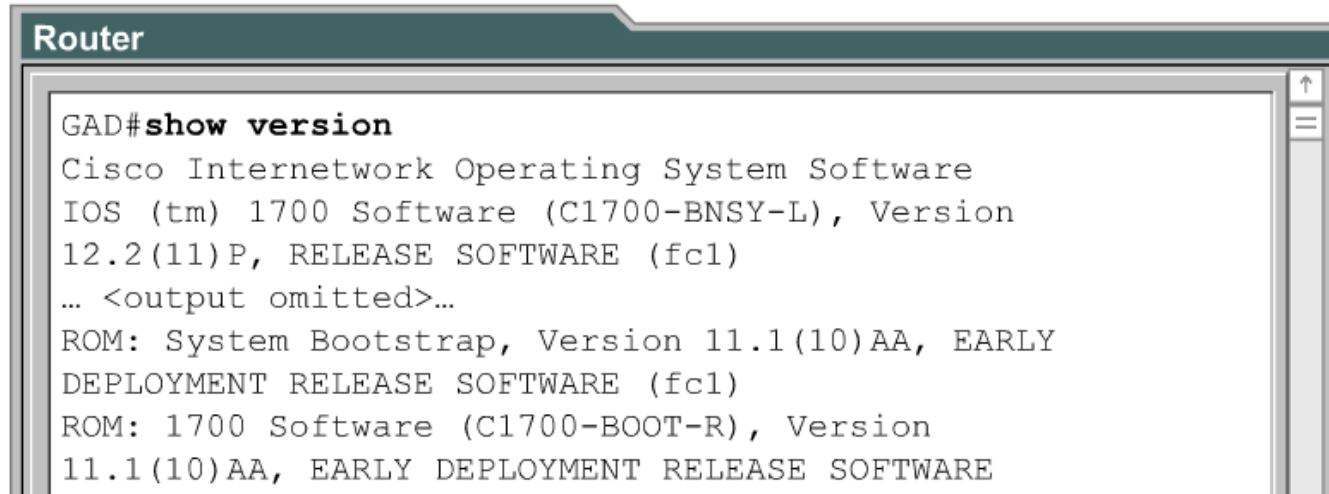
Troubleshooting Command Line Errors



```
Router#configure terminal
      ^
% Invalid input detected at '^' marker.
Router#configure terminal
```

- If a command keyword is incorrectly typed the user interface provides error isolation in the form of an error indicator (^).

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

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
```

```
BOOTLASH: 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.
```

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

```
Bridging software.
```

```
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)
```

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

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

Router interfaces

```
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
```

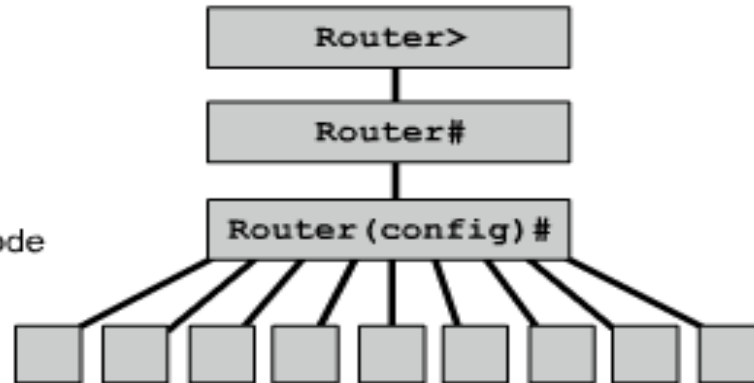
Configuration Register, important for password recovery. Must press space or return to get this last line!

```
Router>
```

Configuring a Router

CLI Command Modes

- User EXEC mode
- Privileged EXEC mode
- Global configuration mode
- Specific configuration modes



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)#

- Router#configure terminal
- Router (config) #

Configuring a router name

Mistake...

A terminal window with a dark header bar labeled "Router". The command prompt is "Router#", and the user has entered "hostname Tokyo". The prompt has changed to "Tokyo(config)#".

```
Router#hostname Tokyo
Tokyo(config)#
```

Should be...

```
Router#config t
Router(config)#hostname Tokyo
Tokyo(config)#
```

- A router should be given a unique name as one of the first configuration tasks.
- This task is accomplished in [Global Configuration Mode](#).

Configuring Router Passwords

Console Password

```
Router(config)#line console 0
Router(config-line)#login
Router(config-line)#password cisco
```



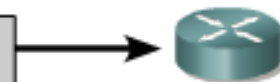
Virtual Terminal Password

```
Router(config)#line vty 0 4
Router(config-line)#login
Router(config-line)#password cisco
```



Enable Password *Not recommended, clear text*

```
Router(config)#enable password san-fran
```



Perform Password Encryption

```
Router(config)#service password-encryption
(set passwords here)
Router(config)#no service password-encryption
```

Encrypts the passwords above, but...

Use this command instead, password is encrypted

```
Router(config)#enable secret <password>
```

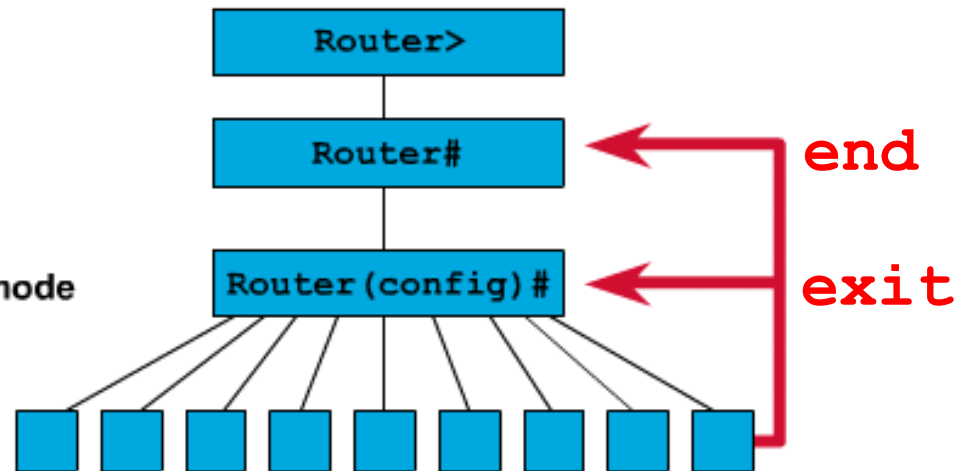
Using **exit**, **end** and Control-Z

◆ User Exec mode

◆ Privileged Exec mode

◆ Global configuration mode

◆ Specific Configuration modes



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) #

Using *exit*, *end* and Control-Z

```
Router# conf t  (abbreviated)
```

```
Router(config)# router protocol
```

```
Router(config-router)# (commands)
```

```
Router(config-router)# exit
```

```
Router(config)# exit
```

```
Router#
```

```
Router(config)# interface type port
```

```
Router(config-if)# (commands)
```

```
Router(config-if)# end    (or Control-Z)
```

```
Router#
```

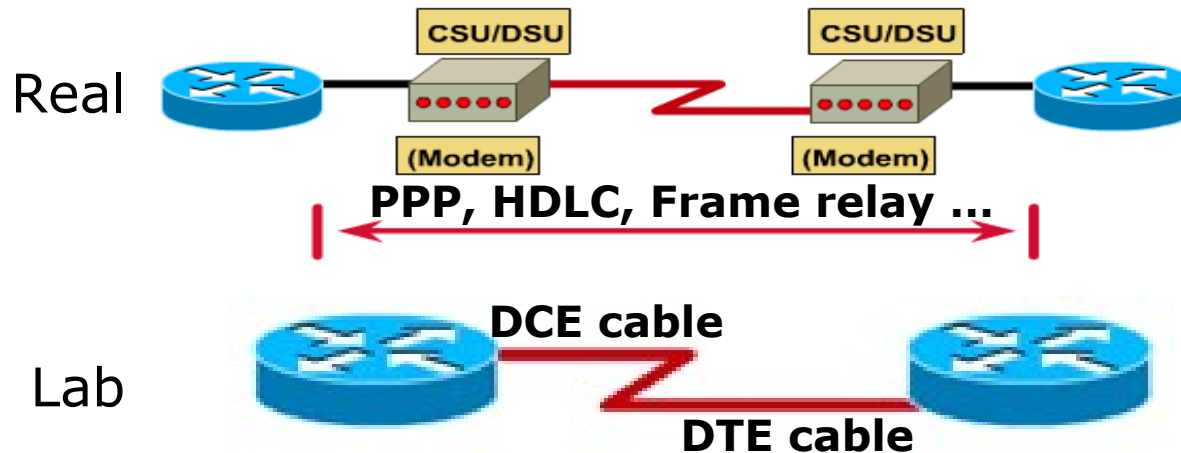
The **show** commands

- There are many **show** commands that can be used to examine the contents of files in the router and for troubleshooting.
- The command **show ?** provides a list of available **show** commands

Configuring a Serial Interface

- Enter global configuration mode.
- Enter interface mode.
- Specify the interface address and subnet mask.
- Set clock rate if a DCE cable is connected. Skip this step if a DTE cable is connected.
- Turn on the interface.

Configuring a Serial Interface



- On serial links that are directly interconnected, as in a lab environment, one side must be considered a **DCE** and **provide a clocking signal**.
- The clock is enabled and speed is specified with the `clock rate` command.

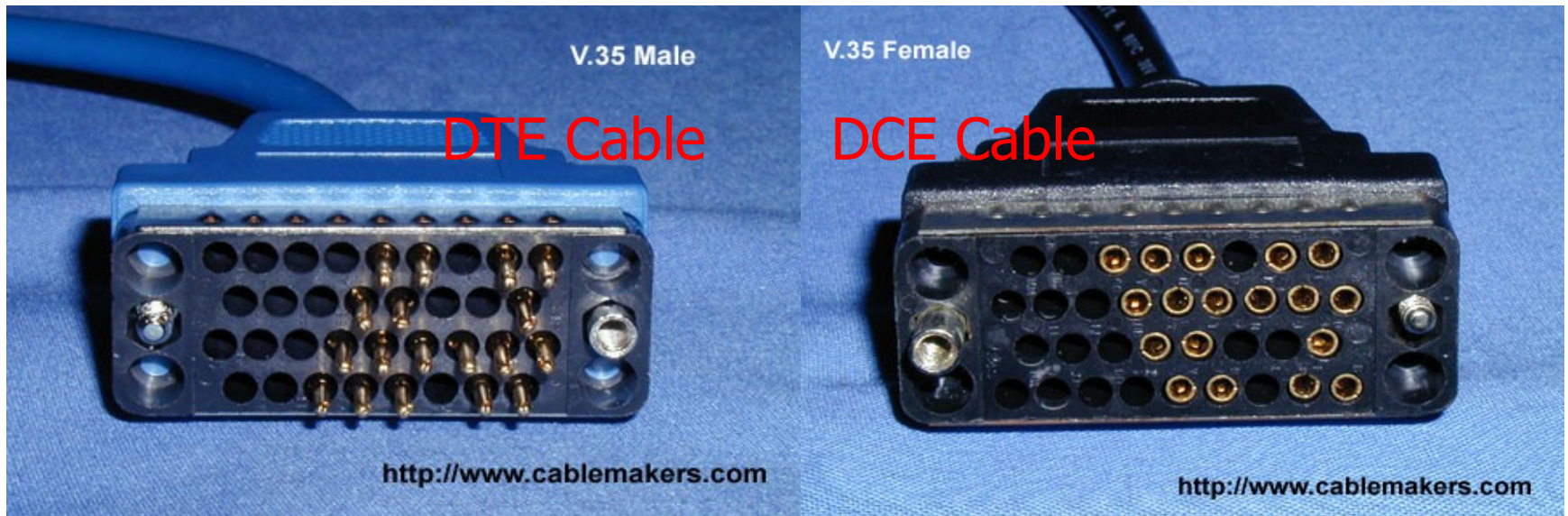
```
Router(config)#interface serial 0/0
```

```
Router(config-if)#ip address 203.162.10.2 255.255.255.0
```

```
Router(config-if)#clock rate 56000
```

```
Router(config-if)#no shutdown
```


Configuring a Serial Interface



How can you tell which end is the DTE and which end is the DCE?

- Look at the label on the cable.
- Look at the connector between the two cables - The DTE cable will always be male and the DCE cable will always be female.
- Use the **show controllers** command!

Configuring a Serial Interface

In the following commands, the *type* argument includes serial, ethernet, fastethernet, token ring, and others:

```
Router(config)#interface type port  
Router(config)#interface type slot/port
```

The following command is used to administratively turn off the interface:

```
Router(config-if)#shutdown
```

The following command is used to turn on an interface that has been shut down:

```
Router(config-if)#no shutdown
```

The following command is used to quit the current interface configuration mode:

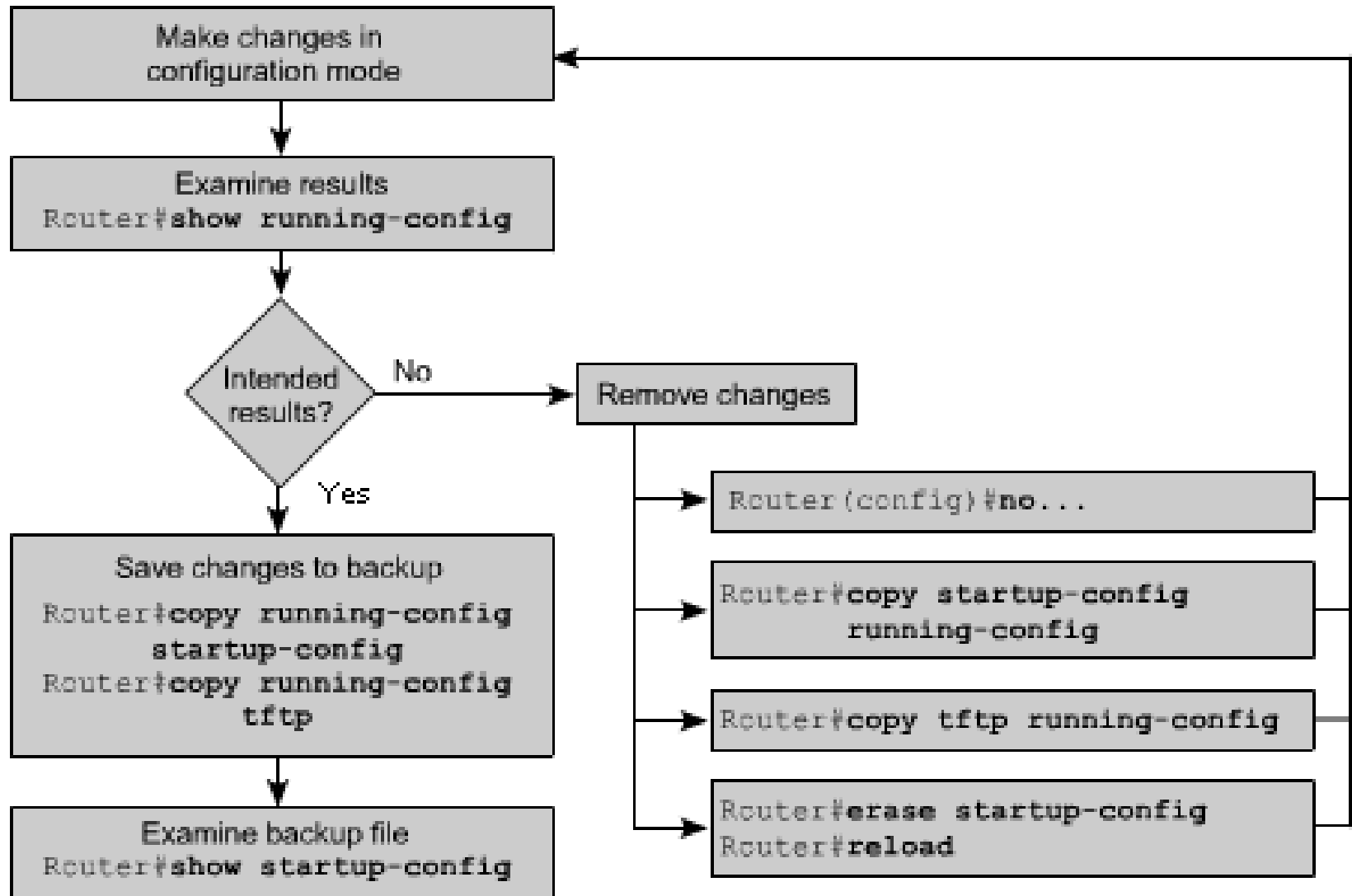
```
Router(config-if)#exit
```

Configuring an Ethernet interface

Router

```
Router(config)#interface e0  
Router(config-if)#ip address 183.8.126.2 255.255.255.128  
Router(config-if)#no shutdown
```

Executing adds, moves, and changes



Finishing the Configuration

Interface Descriptions

- Can help a network user remember specific information about the interface
- Does not affect the operation of the router
- Include the purpose and location of the interface, other devices or locations connected to the interface, and circuit identifiers



```
Tokyo(config)#interface e 0  
  
Tokyo(config-if)#description Engineering LAN, Bldg. 18
```

Configuring Interface Description

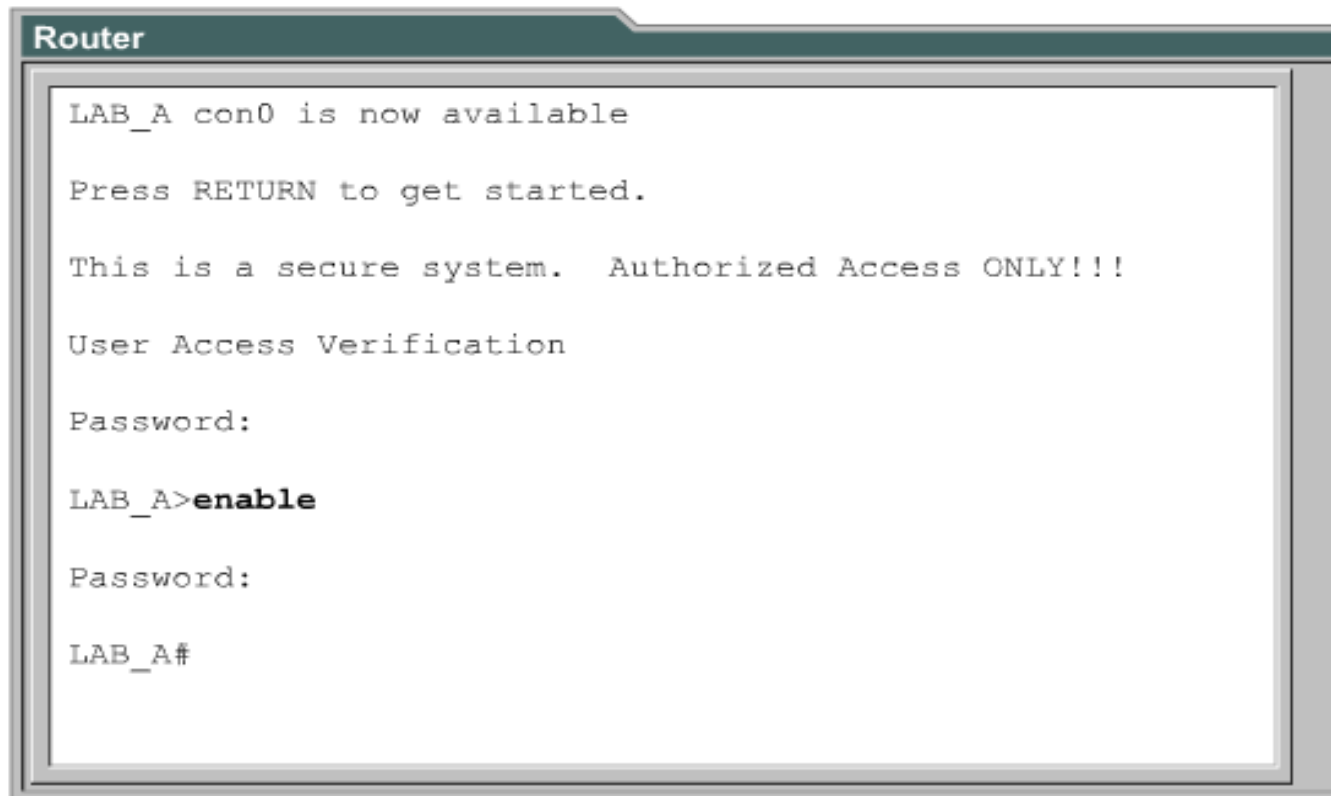
Procedure:

```
LAB_A>enable
Password:
LAB_A#configure terminal
Enter configuration commands, one per line.  End with
CNTL-Z.
LAB_A(config)#interface ethernet 0
```

Result:

```
interface Ethernet0
  description LAN Engineering, Bldg. 2
  ip address 192.5.5.1 255.255.255.0
  no ip directed-broadcast!
```

Login Banners



```
Router
LAB_A con0 is now available

Press RETURN to get started.

This is a secure system.  Authorized Access ONLY!!!

User Access Verification

Password:

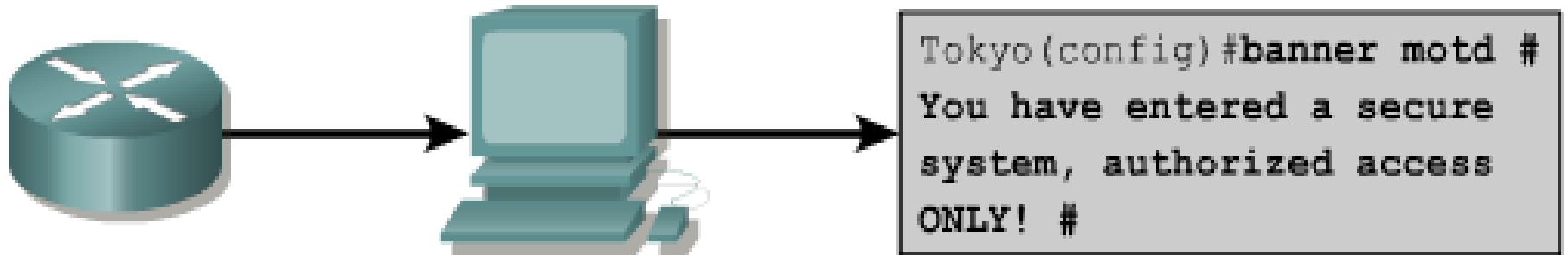
LAB_A>enable

Password:

LAB_A#
```

- A login banner is a message that is displayed at login and is useful for conveying messages that affect all network users.
- A login banner should be a warning not to attempt login unless authorized.

Configuring Message-Of-The-Day (MOTD)



Host Name Resolution

The following is an example of the configuration of a host table on a router:

```
Router(config)#ip host Auckland 172.16.32.1
Router(config)#ip host Beirut 192.168.53.1
Router(config)#ip host Capetown 192.168.89.1
Router(config)#ip host Denver 10.202.8.1
```

```
Router# ping 172.16.32.1
Router# ping Auckland

Router# telnet 192.168.53.1
Router# telnet Beirut

Router# traceroute 192.168.89.1
Router# traceroute Capetown
```

- Host name resolution is the process that a computer system uses to associate a host name with an IP address
- Host names, unlike DNS names, are significant only on the router on which they are configured.

Host Name Resolution

The Name System

Command

```
Router(config)# ip domain-lookup
```

◆ DNS enabled by default

Command

```
Router(config)# no ip domain-lookup
```

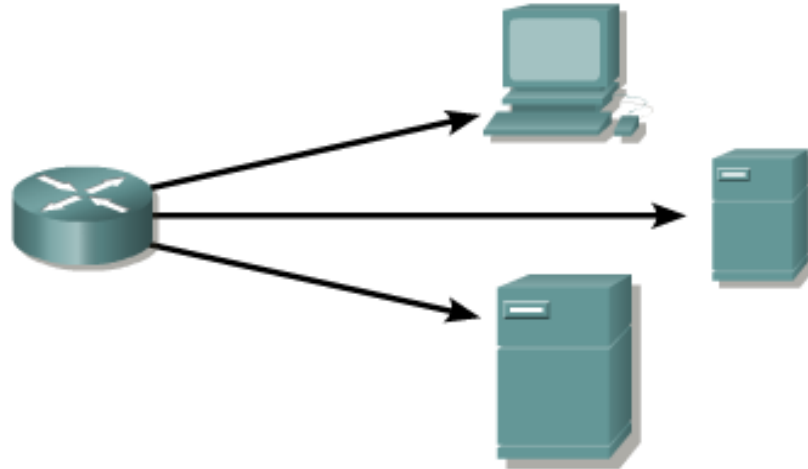
◆ Turns off the name service

```
Router(config)# ip domain-lookup
Router#vdc3
Translating "vdc3"...domain server (255.255.255.255) (Takes a few
seconds)
Translating "vdc3"...domain server (255.255.255.255) (Takes a few
seconds)
Router(config)# no ip domain-lookup
Router#wreh
Translating "wreh"
% Unknown command or computer name, or unable to find computer address
```

Configuration Backup and Documentation

- Management of device configuration includes the following tasks:
 - Listing and comparing configuration files on running devices
 - Storage of configuration files on network servers
 - Performing software installations and upgrades

Configuration Backup and Documentation

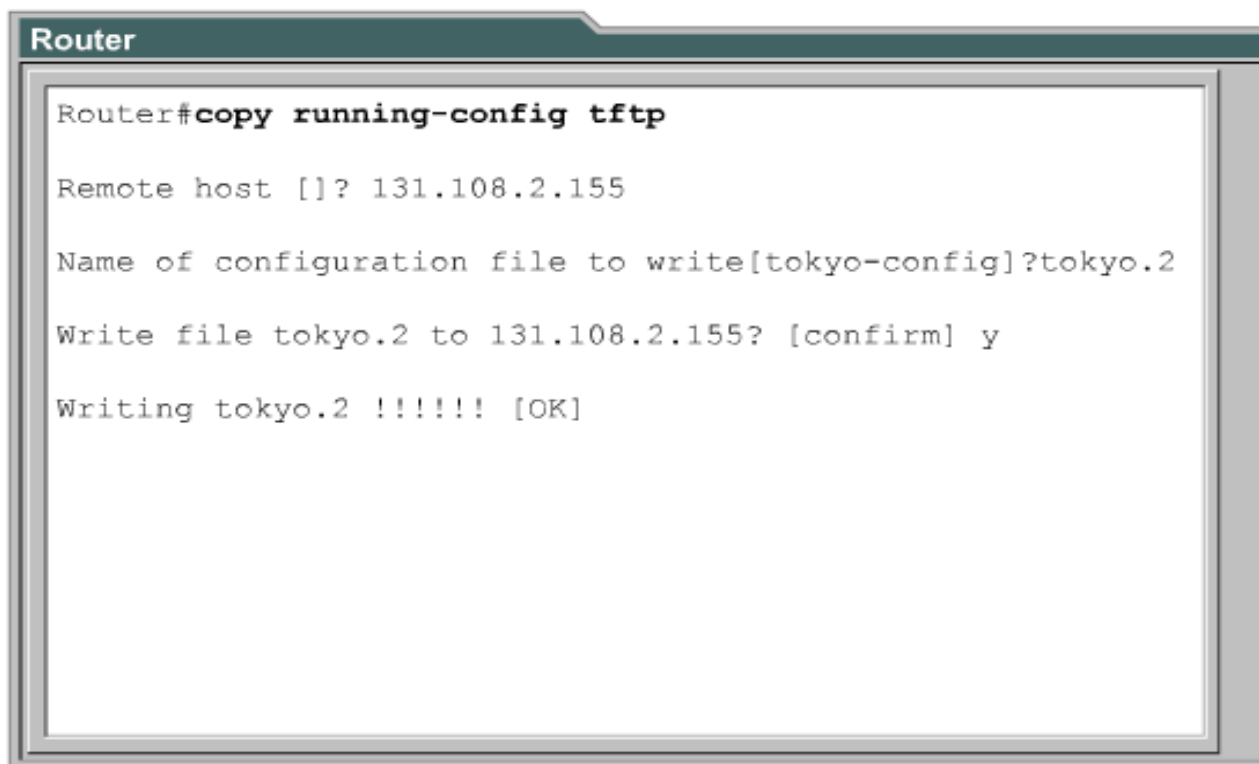


Save configuration files to a:

- TFTP Server
- Network Server
- Disk in a safe place

- Configuration files should be stored as backup files in the event of a problem.
- Configuration files can be stored on a network server, on a TFTP server, or on a disk stored in a safe place.

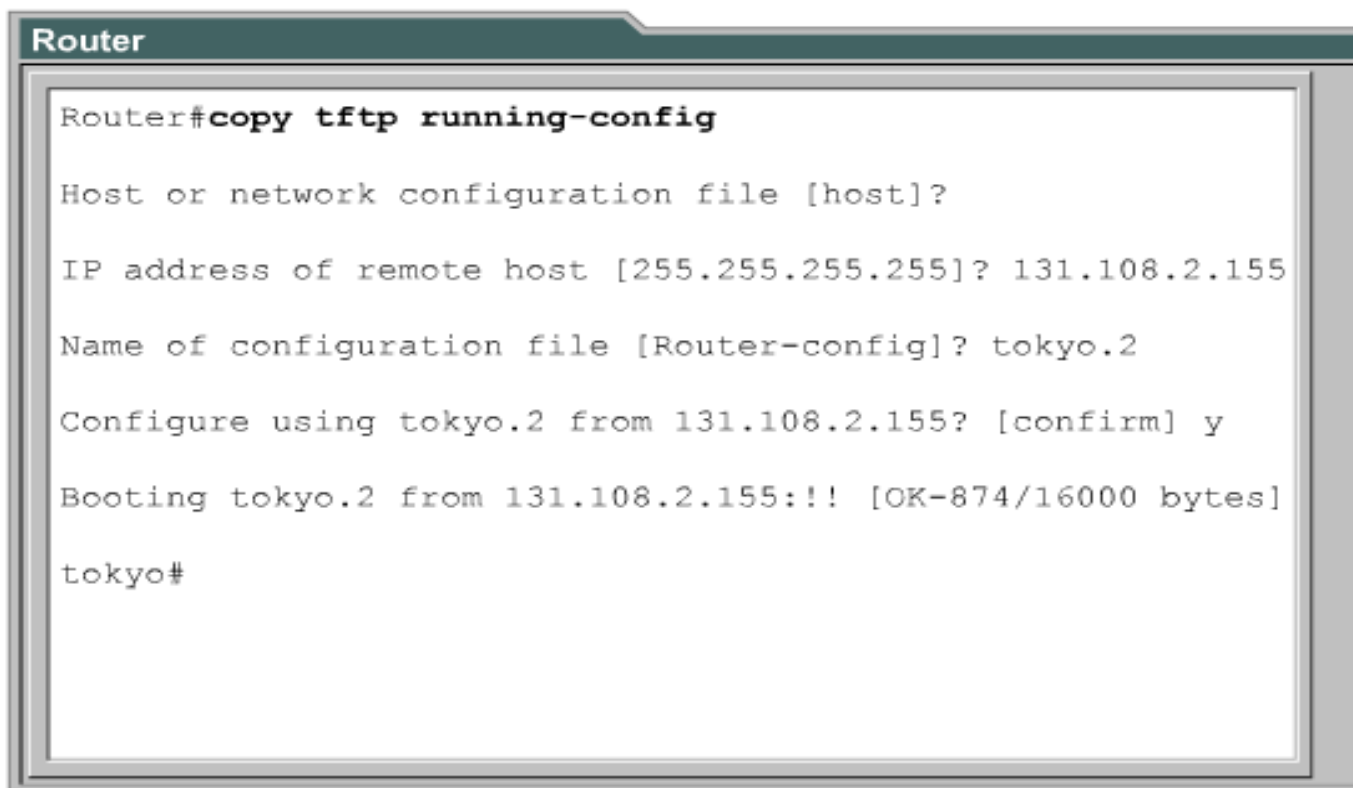
Copying, Editing, and Pasting Configurations



```
Router
Router#copy running-config tftp
Remote host []? 131.108.2.155
Name of configuration file to write[tokyo-config]?tokyo.2
Write file tokyo.2 to 131.108.2.155? [confirm] y
Writing tokyo.2 !!!!! [OK]
```

- A TFTP server will allow image and configuration uploads and downloads over the network.
- The TFTP server can be another router, or it can be a host system.

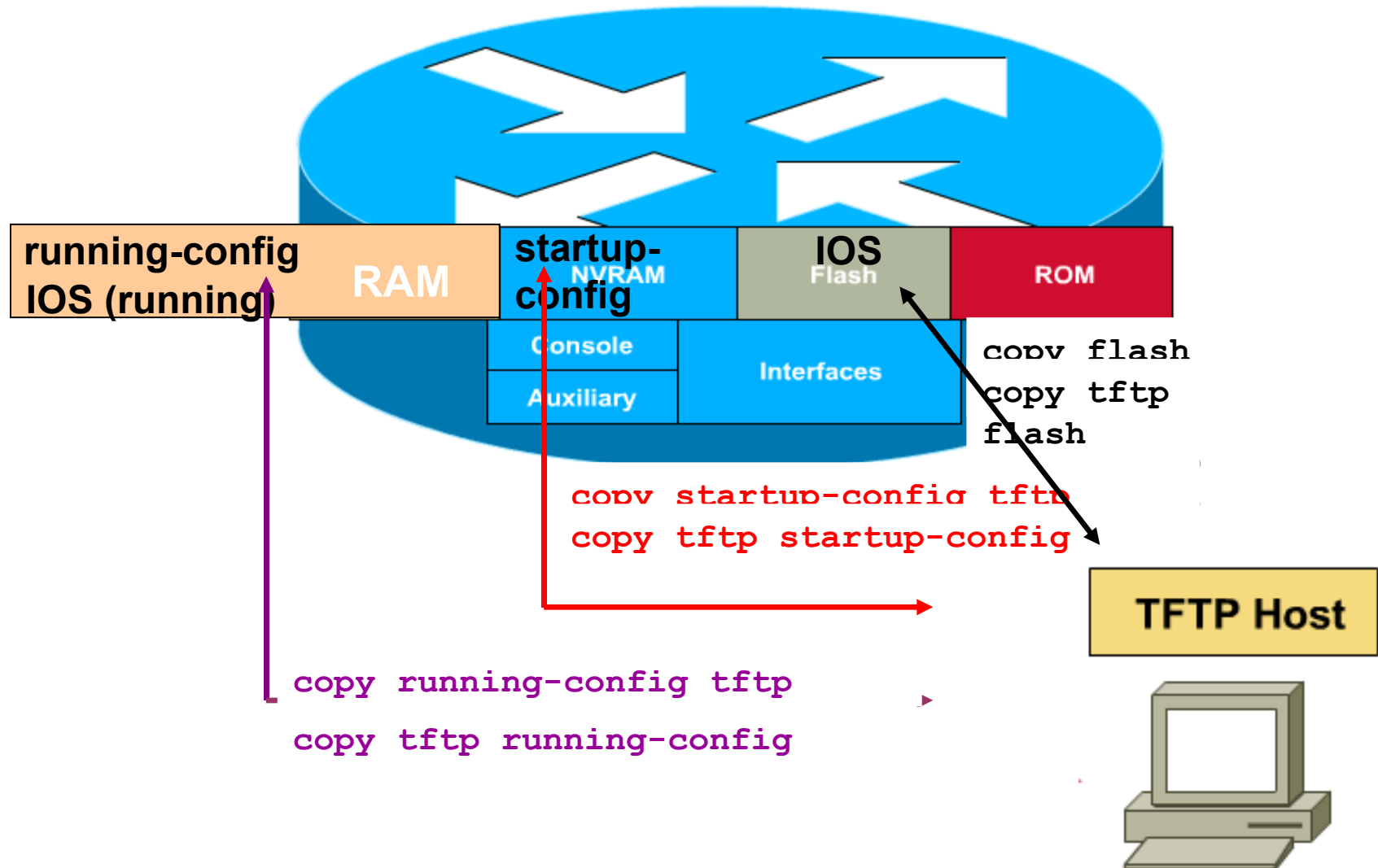
Copying, Editing, and Pasting Configurations



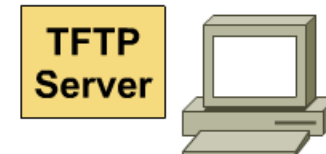
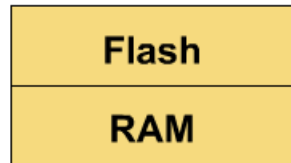
```
Router
Router#copy tftp running-config
Host or network configuration file [host]?
IP address of remote host [255.255.255.255]? 131.108.2.155
Name of configuration file [Router-config]? tokyo.2
Configure using tokyo.2 from 131.108.2.155? [confirm] y
Booting tokyo.2 from 131.108.2.155:!! [OK-874/16000 bytes]
tokyo#
```

- The TFTP host can be any system that has TFTP software loaded and operating and able to receive files from the TCP/IP network.

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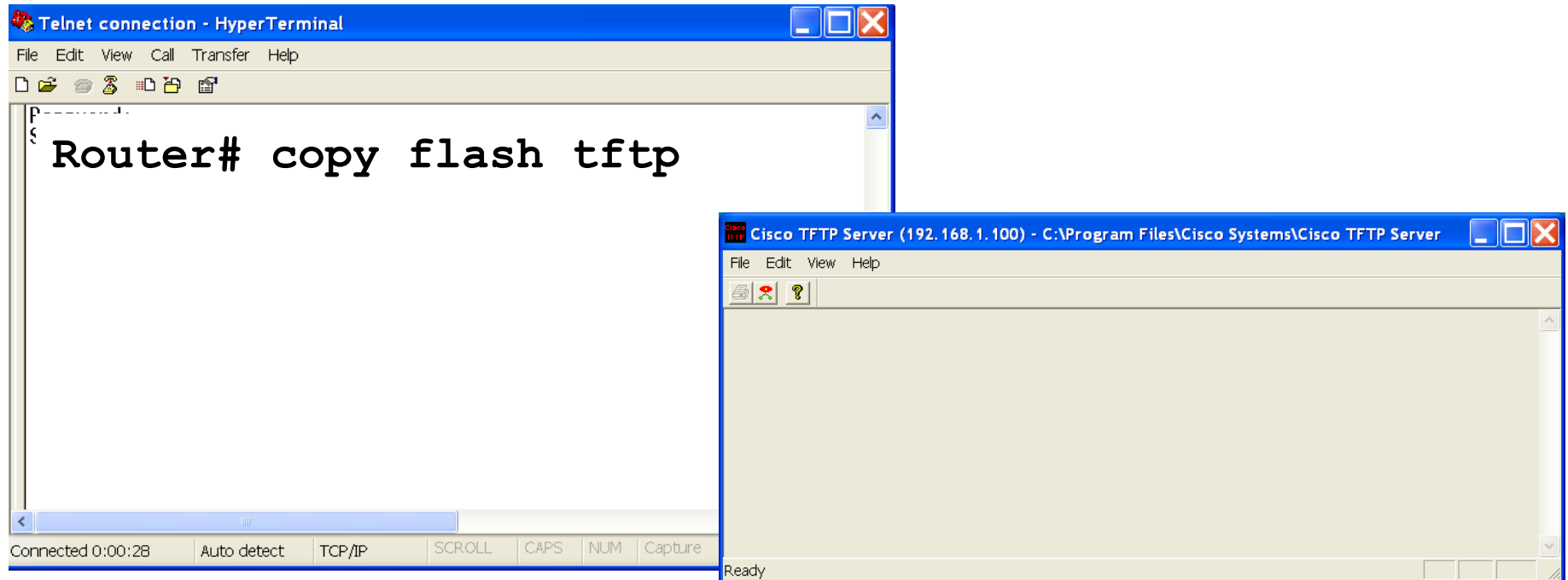


Command

```
Router#ping tftp - address
Type escape sequence to abort
Sending 5, 100-byte ICMP Echoes to 210.93.105.1
timeout is 2 seconds:
!!!!.!
Success rate is 80 percent (4/5)
round trip min/avg/max = 68/68/168 ms
```

- Troubleshooting: Be sure you can ping the TFTP server.

TFTP Software and Servers

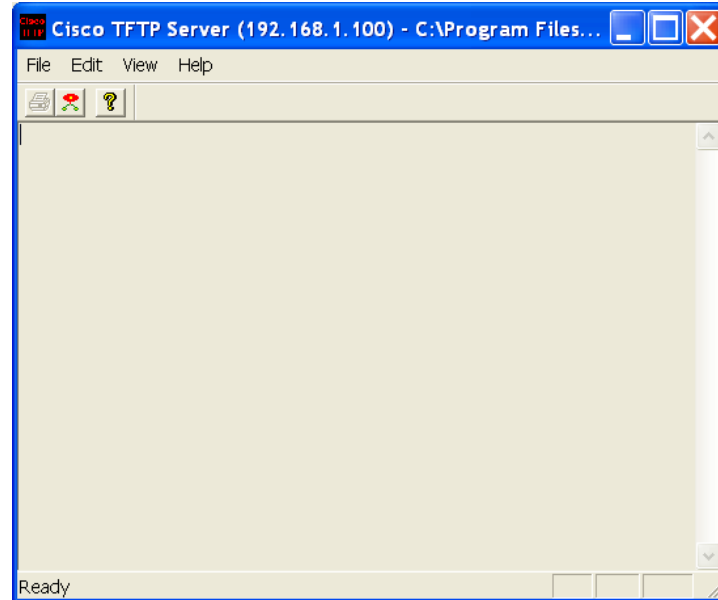


- When using Windows, the TFTP server software must be running.
- The copy can be performed from the console port or from a telnet session.
- The telnet session can be performed on the same computer where the TFTP server is running (or to a different computer).

TFTP Software and Servers



Cisco TFTP Server.Ink



- Just double click on the shortcut...
- Remember, TFTP is “Trivial” FTP:
 - No authentication
 - No login
 - No choice for directory
 - Uses UDP and verified via a TFTP checksum (not TCP ACKs)

Good luck with this module !
