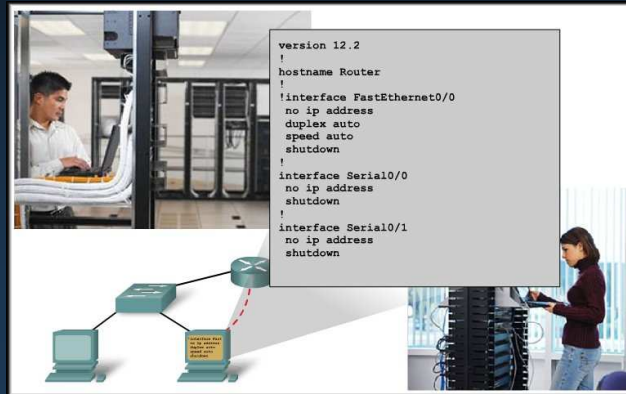# Chapter 11

Configuring and Testing Your Network

Note for Instructors

- These presentations are the result of a collaboration among the instructors at St. Clair College in Windsor, Ontario.
- Thanks must go out to Rick Graziani of Cabrillo College. His material and additional information was used as a reference in their creation.
- If anyone finds any errors or omissions, please let me know at:
  - tdame@stclaircollege.ca.

Configuring and Testing Your Network

Configuring Cisco Devices: IOS Basics

```
version 12.2
!
hostname Router
!
!interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial0/0
 no ip address
 shutdown
!
interface Serial0/1
 no ip address
 shutdown
```

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.**
- The Cisco IOS provides the following network services:
  - Basic routing and switching functions
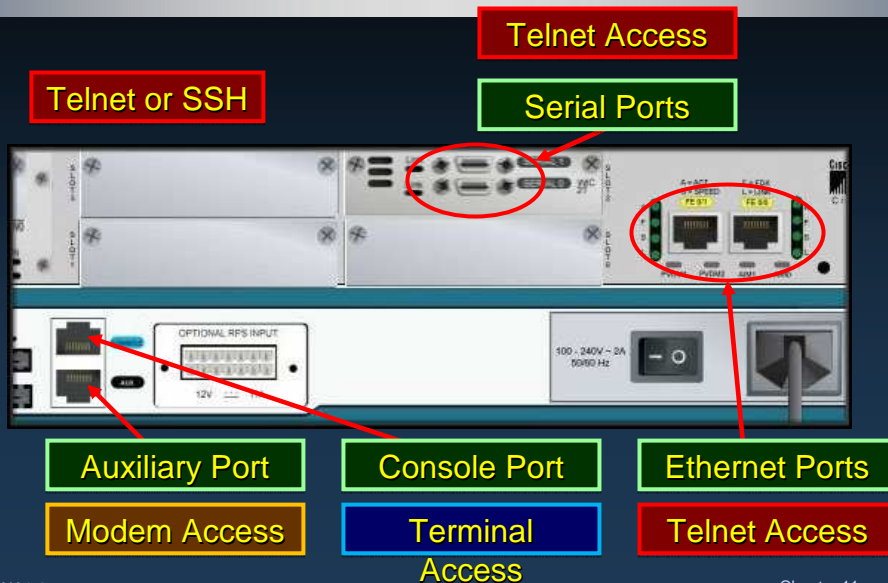 - Reliable and secure access to networked resources
  - Network scalability

Cisco IOS

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

- The Cisco IOS is accessed using the Command Line Interface (CLI).
- Features will vary based on the version of the IOS and the type of device.

Access Methods

Telnet Access

Telnet or SSH

Serial Ports

Auxiliary Port

Console Port

Ethernet Ports

Modem Access

Terminal Access

Telnet Access

Router Components

- The main internal components of a router are:
  - Random Access Memory (RAM)
  - Nonvolatile Random Access Memory (NVRAM)
  - Flash Memory (Flash)
  - Read Only Memory (ROM)
  - Console
  - Interfaces
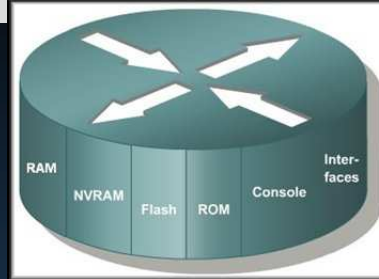
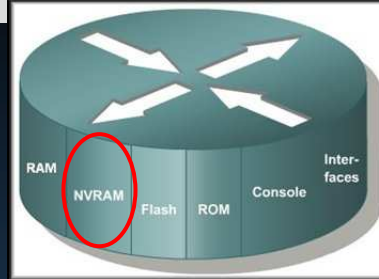# Router Components

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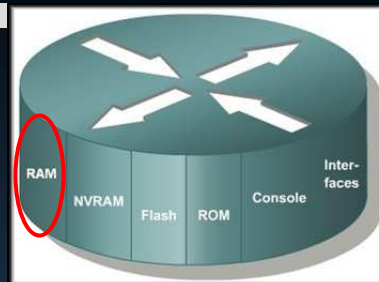
Router Components

- Nonvolatile Random Access Memory **(NVRAM)**:
  - Provides storage for the startup configuration file
  - Retains content when a router is powered down or restarted
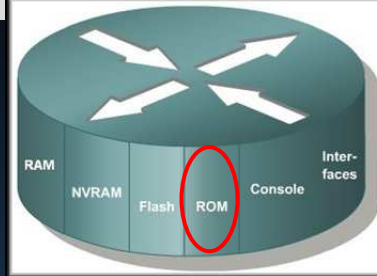

Router Components

- Flash Memory **(Flash)**:
  - Holds the IOS image
  - Allows software to be updated without removing and replacing chips on the processor
  - Retains content when a router is powered down or restarted
  - Can store multiple versions of IOS software
  - Is a type of electrically erasable programmable read-only memory (EEPROM)
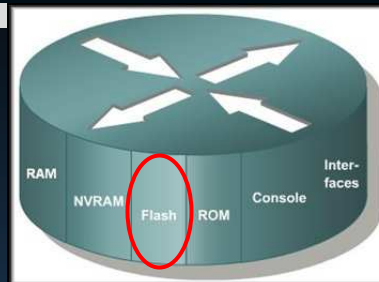
Router Components

- Read Only Memory **(ROM)**:
  - Maintains instructions for power-on self test (POST) diagnostics
  - Stores the bootstrap program and the basic operating system software
  - Requires replacing pluggable chips on the motherboard for software upgrades

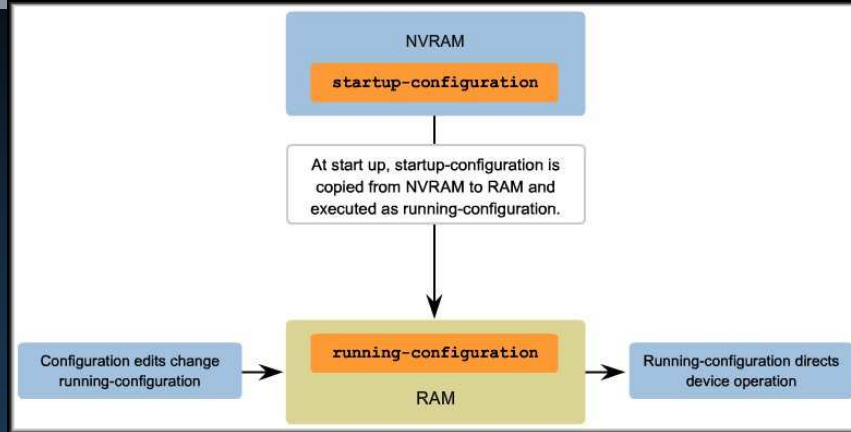# Router Components

- Console:
  - The console port provides physical access for the initial configuration of the router or configuration changes.

- Interfaces:
  - Connect routers to a network for packet entry and exit
  - They can be on the motherboard or on a separate module
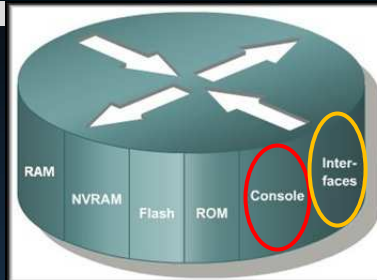
Configuration Files

- Network devices depend upon two types of software:
  - Operating system (IOS)
  - Configuration file

Cisco IOS Modes

Hierarchical Structure

Each mode used to accomplish particular tasks.

Each mode has a specific set of commands.

Cisco IOS Modes - Routers and Switches

Mode	Description	Prompts
User EXEC	Limited commands "View Only" Mode	Router>
Privileged EXEC	Configuration commands Debugging and testing File manipulation	Router#
Global Configuration	Commands for the router Entry to other modes	Router(config)#
Interface Configuration	Commands to configure an interface	Router(config-if)#
Line Configuration	Commands to configure console and telnet/ssh access	Router(config-line)#
Other modes	Specific service configuration (NAT / DHCP)	Router(config-mode)#

Cisco IOS Modes

```
Router>ping 192.168.10.5        User  EXEC

Router#show running-config      Privileged  EXEC

Router(config)#Interface FastEthernet 0/0    Global Configuration

Router(config-if)#ip address 192.168.10.1 255.255.255.0
                                Interface Configuration
```

The prompt changes to denote the current CLI mode.

```
Switch>ping 192.168.10.9

Switch#show running-config

Switch(config)#Interface FastEthernet 0/1

Switch(config-if)#Description connection to WEST LAN4
```

Moving Between User and Privileged EXEC
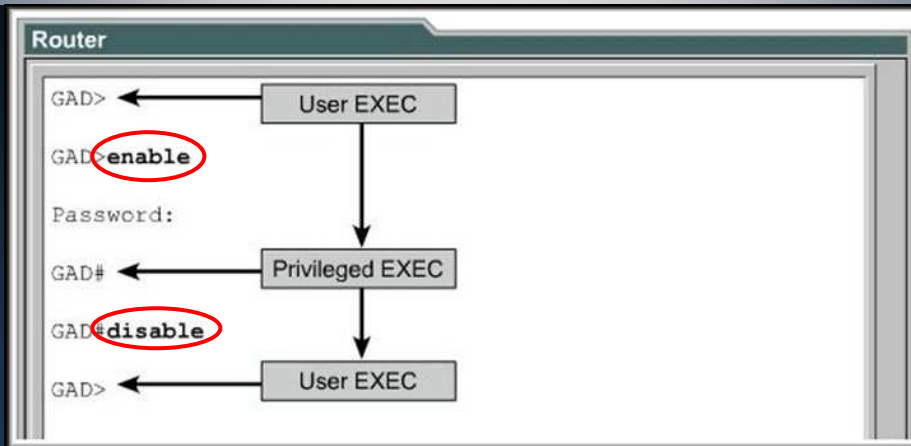
- Use *enable* to move from User to Privileged EXEC.
- Use *disable* or *end* to move back.

Basic IOS Command Structure
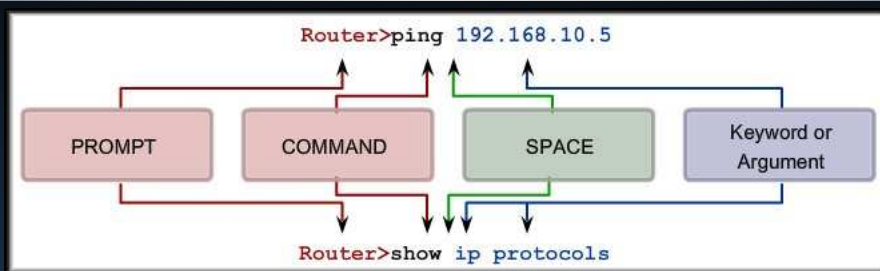
Router(config)#hostname MyRouter
MyRouter(config)#

Router(config)#interface fastethernet 0/0
Router(config-if)#

Router(config-if)# ip address 192.168.100.1 255.255.255.0
Router(config-if)#

Using CLI Help

Context Sensitive Help

Example of a sequence of commands using the CLI context sensitive help

```
Cisco#cl?
clear   clock
Cisco#clock ?
  set  Set the time and date
Cisco#clock set
% Incomplete command.
Cisco#clock set ?
  hh:mm:ss  Current Time
Cisco#clock set 19:50:00
% Incomplete command.
```

Command explanations
Incomplete command messages
Invalid input messages
Variable formats

```
Cisco#clock set 19:50:00 ?
  <1-31>  Day of the month
  MONTH   Month of the year
Cisco#clock set 19:50:00 25 6
                                ^
Invalid input detected at '^' marker.
Cisco#clock set 19:50:00 25 June
% Incomplete command.
Cisco#clock set 19:50:00 25 June ?
  <1993-2035>  Year
Cisco#clock set 19:50:00 25 June 2007
Cisco#
```

Using CLI Help

Command Syntax Check Help

The IOS returns a help message indicating that required keywords or arguments were left off the end of the command:

```
Switch#>clock set
% Incomplete command.
Switch#clock set 19:50:00
% Incomplete command.
```

The IOS returns a help message to indicate that there were not enough characters entered for the command interpreter to recognize the command.

```
Switch#c
% Ambiguous command:'c'
```

The IOS returns a "^" to indicate where the command interpreter can not decipher the command:

```
Switch#clock set 19:50:00 25 6
                           ^
% Invalid input detected at '^' marker.
```

Using CLI Help

- **Hot Keys and Shortcuts:**
    - **CLI Line Editing:**
        - Several outlined in the text.
        - **Backspace** most often used.
            - Note that the **Delete** key is **NOT** recognized to delete invalid characters.

Using CLI Help

- **Hot Keys and Shortcuts:**
    - At the **----More----** Prompt:
   - If the screen fills up with a display, the **More** prompt will be displayed.

At the "-----More-----" prompt	
The Enter Key	Displays the next line.
Space Bar	Displays the next screen.
Any other alphanumeric key	Returns to the EXEC prompt.

Using CLI Help

- **Break Keys:**
  - If you wish to abort a process or command…..

Break Keys	
Ctrl-C	When in any configuration mode, ends the configuration mode and returns to privileged EXEC mode. When in setup mode, aborts back to the command prompt.
Ctrl-Z	When in any configuration mode, ends the configuration mode and returns to privileged EXEC mode.
Ctrl-Shift-6	All-purpose break sequence. Use to abort DNS lookups, traceroutes, pings.

IOS Examination Commands
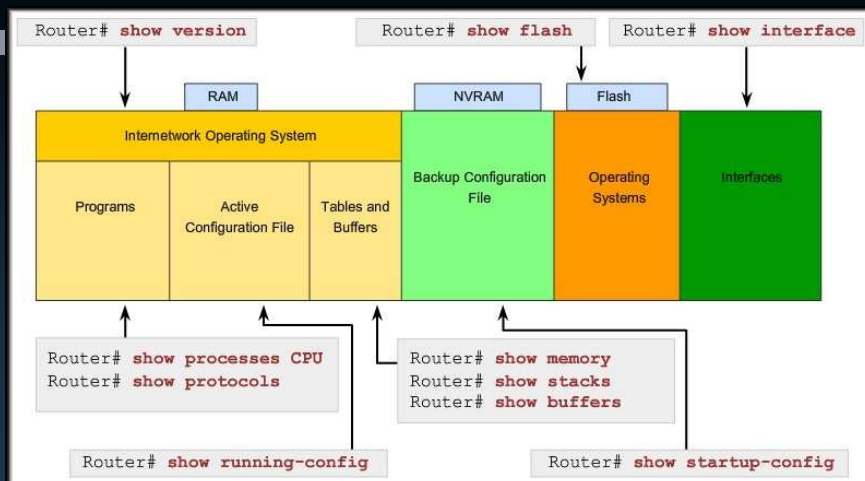
- In order to verify and troubleshoot network operation, we must examine the operation of the devices.
- The basic examination command is the *show* command.

IOS Examination Commands – show version

```
Router

Cisco#show version

Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-JK8S-M), Version
12.2(12c), RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2003 by cisco Systems, Inc.
Compiled Wed 05-Feb-03 16:36 by kellythw
Image text-base: 0x8000808C, data-base: 0x8156F2AC

ROM: System Bootstrap, Version 11.3(2)XA4, RELEASE
SOFTWARE (fc1)
R2 uptime is 4 weeks, 2 days, 17 hours, 9 minutes
System returned to ROM by reload
System image file is "flash:c2600-jk8s-mz.122-12c.bin"

cisco 2620 (MPC860) processor (revision 0x102) with
59392K/6144K bytes of memory

     ------- output omitted -------

Basic Rate ISDN software, Version 1.1.
1 FastEthernet/IEEE 802.3 interface(s)
2 Low-speed serial(sync/async) network interface(s)
1 ISDN Basic Rate interface(s)
32K bytes of non-volatile configuration memory.

16384K bytes of processor board System flash
(Read/Write)

Configuration register is 0x2102
```

- IOS Version, Name
- RAM
- INTERFACES
- FLASH
- Configuration Register

IOS Examination Commands – show flash
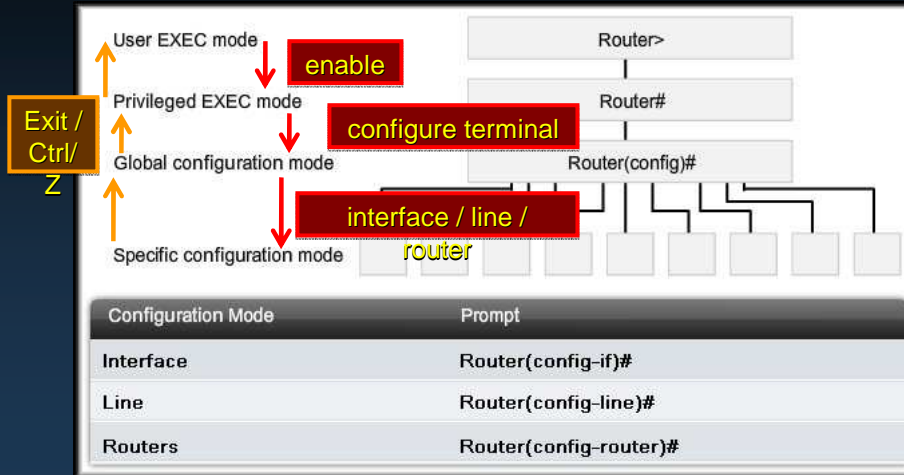
```
Router

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#
```

- Use the *show flash* command to verify that the router has sufficient memory to load a new Cisco IOS software image.
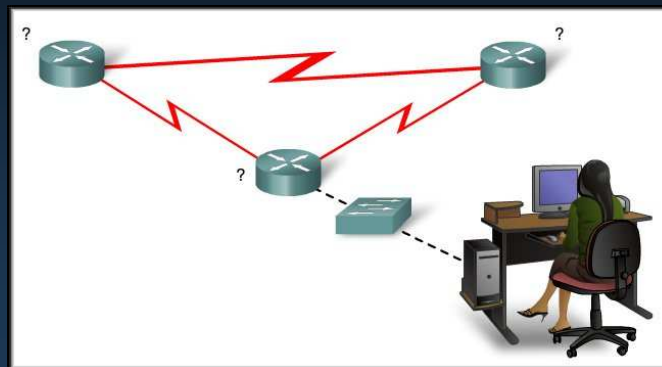
IOS Configuration Modes

User EXEC mode → **enable** — Router>

Privileged EXEC mode — Router#

Exit / Ctrl/ Z ↑↑↑

configure terminal

Global configuration mode — Router(config)#

interface / line / router

Specific configuration mode

Configuration Mode	Prompt
Interface	Router(config-if)#
Line	Router(config-line)#
Routers	Router(config-router)#

# Configuring and Testing Your Network

Applying a Basic Configuration
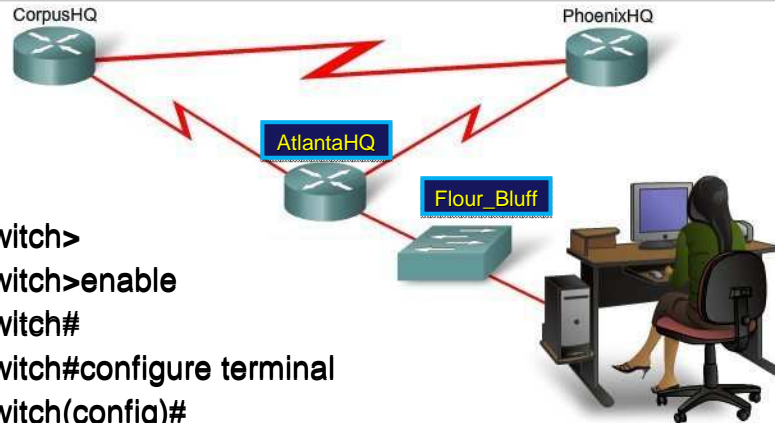
Naming Devices

- **Importance of a Device Name:**
  - Default "**Router**" or "**Switch**"
  - Host Name appears as the CLI prompt.
  - Confirmation that the correct device has been accessed.
  - Naming convention makes maintenance easier.
    - Start with a letter
    - No spaces
    - End with letter or digit
    - Only letters, digits and dashes
    - Maximum of 63 characters

Naming Devices

CorpusHQ   PhoenixHQ
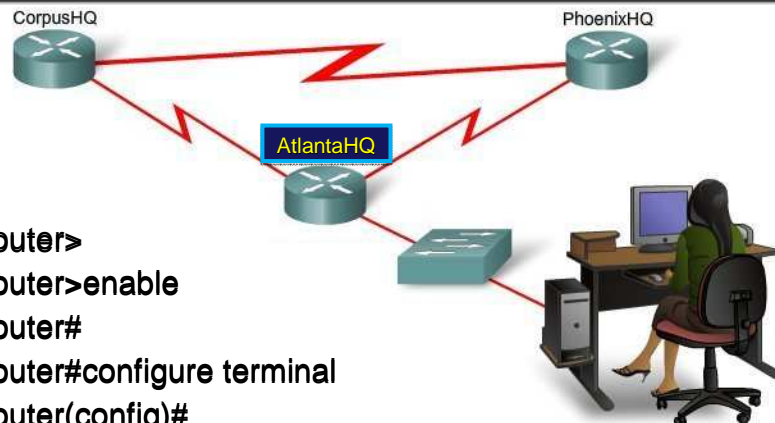
AtlantaHQ

```
Router>
Router>enable
Router#
Router#configure terminal
Router(config)#
Router(config)#hostname AtlantaHQ
AtlantaHQ(config)#
```

Naming Devices

       PhoenixHQ

AtlantaHQ

Flour_Bluff

```
Switch>
Switch>enable
Switch#
Switch#configure terminal
Switch(config)#
Switch(config)#hostname Flour_Bluff
Flour_Bluff(config)#
```

Limiting Device Access

- **Configuring Passwords:**
  - Passwords are the primary defense against unauthorized access to network devices.
    - *Every device should have locally configured passwords to limit access.*
  - **Console password:**
    - Limits device access using the console connection
  - **Enable password:**
    - Limits access to the privileged EXEC mode
  - **Enable secret password:**
    - Encrypted, limits access to the privileged EXEC mode
  - **VTY password:** Limits device access using Telnet / SSH

Limiting Device Access

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

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

Enable Password

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

Limiting Device Access

- **Encrypting Password Display:**
  - The *service password-encryption* command prevents ALL passwords from showing up as plain text when viewing the configuration files.

Perform Password Encryption

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

service password-encryption uses a Cisco Level 7 encryption which is very easy to decrypt.
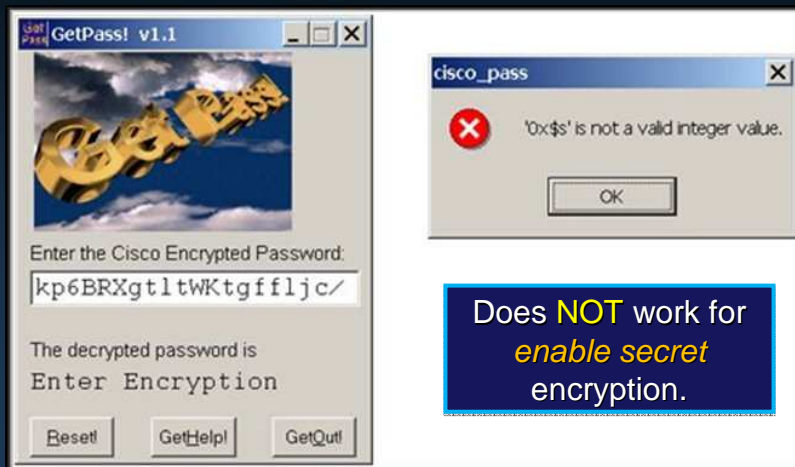
Limiting Device Access

- www.boson.com

Limiting Device Access

- www.boson.com

Does NOT work for *enable secret* encryption.

Limiting Device Access

- Login Banner:

```
LAB_A(config)#banner motd # This is a secure system. Authorized Access ONLY!!! #
```

Delimiting characters not included in message

This configuration results in this message of the day banner

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#
```
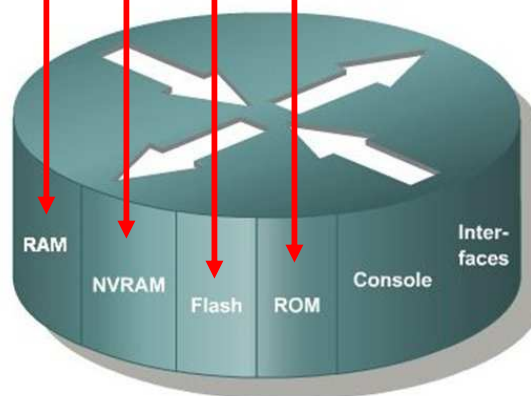

Managing Configuration Files

running-config
(IOS running)

startup-config

IOS   **Boot Program**

RAM   NVRAM   Flash   ROM   Console   Inter-faces

Managing Configuration Files

```
Router#show startup-config
%% Non-volatile configuration memory is not present

Router#show running-config
Building configuration...

Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
ip subnet-zero
!
!
interface Ethernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
interface Serial0
 no ip address
 no ip directed-broadcast
 shutdown
```
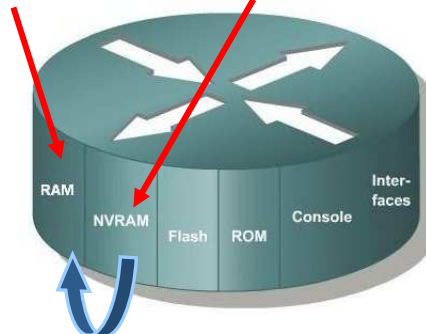
No startup-config file in NVRAM

Default running-config file, created in RAM

Managing Configuration Files

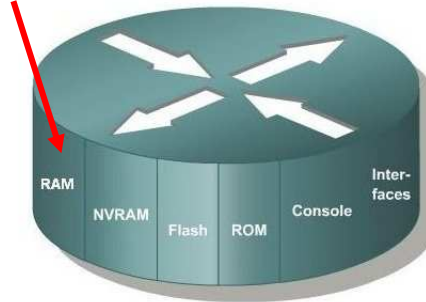**running-config resides here**   **startup-config resides here**

RAM   NVRAM   Flash   ROM   Console   Inter-faces

At boot up, running-config is *replaced* by startup-config….

Managing Configuration Files

If the router loses power or reboots, everything in RAM is lost *including the running-config file*.

running-config resides here

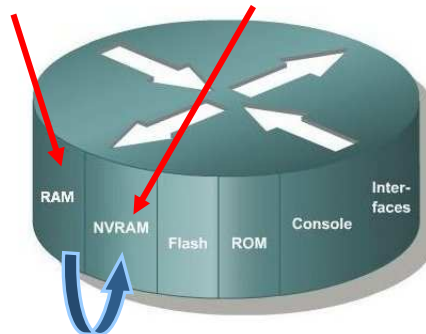**Changes to the router are automatically put in the running-config file.**

Managing Configuration Files

running-config resides here

startup-config resides here

To make sure that router changes are saved… *copy running-config startup-config*

Managing Configuration Files

```
Router#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...

Router#show startup-config
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router
!
!
ip subnet-zero
!
interface Ethernet0
 no ip address
 no ip directed-broadcast
 shutdown
!
```

The startup-config file is now identical to running-config and the router will have these changes if the router reboots.

Managing Configuration Files

Router# `copy running-config startup-config`

OR

Router# `copy running startup`

OR

Router# `copy run start`

Any usage of the command or parameters,
so that they are
still uniquely recognizable.

Managing Configuration Files - WARNING

- Using an *incorrect configuration file name* could overwrite a file in flash, as the router believes you are trying to copy a blank file into flash.

```
Router#copy running-config start-up          ← Incorrect destination
                                                file name
                   ****  NOTICE  ****
Flash load helper v1.0
This process will accept the copy options and then terminate
the current system image to use the ROM based image for the copy.
Routing functionality will not be available during that time.
If you are logged in via telnet, this connection will terminate.
Users with console access can see the results of the copy operation.
                   ---- ******** ----
Proceed? [confirm]^C
%Copy cancelled by user request.            Cancel it with Ctrl-C!
Router#
```

Managing Configuration Files

- Returning the Device to its Original Configuration:
  - reload command
    - Works ONLY IF the running configuration has NOT been copied to the startup configuration.

```
Router# reload
System configuration has been modified. Save?
  [yes/no]: n
Proceed with reload? [confirm] Press Enter
*Apr 13 01:34:15.758: %SYS-5-RELOAD: Reload
  requested by console.
Reload Reason:  Reload Command.
```

Managing Configuration Files

- **Backing Up Configurations Offline:**
  - TFTP server
  - CD
  - USB Memory Stick
    - Text Files using the Clipboard.
    - Text files using HyperTerminal capture.

- **Restoring Configurations:**
  - TFTP Server
  - **Paste to Host** from a text file.

Managing Configuration Files

(We will be using this TFTP server in the lab on each PC.)
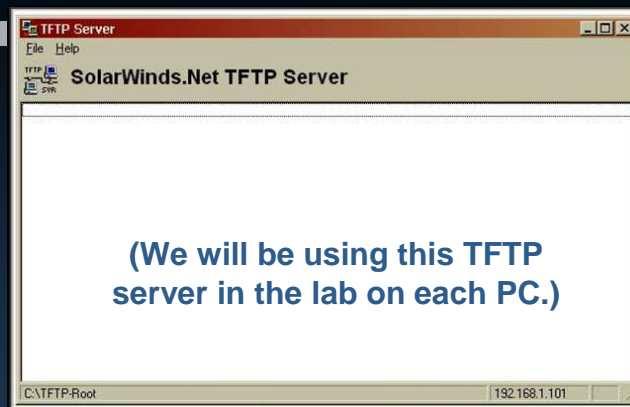
- A TFTP server will allow image and configuration uploads and downloads over the network.
- The TFTP server can be another router, or it can be a host system.
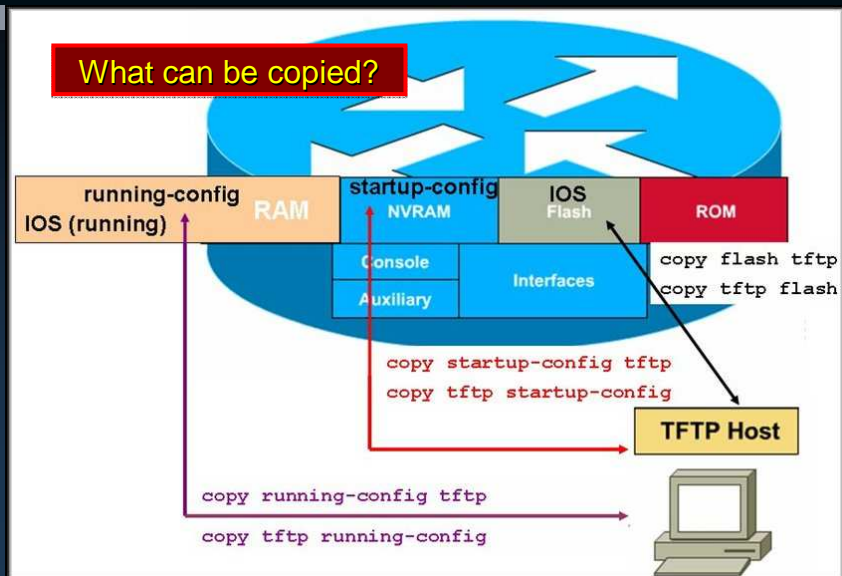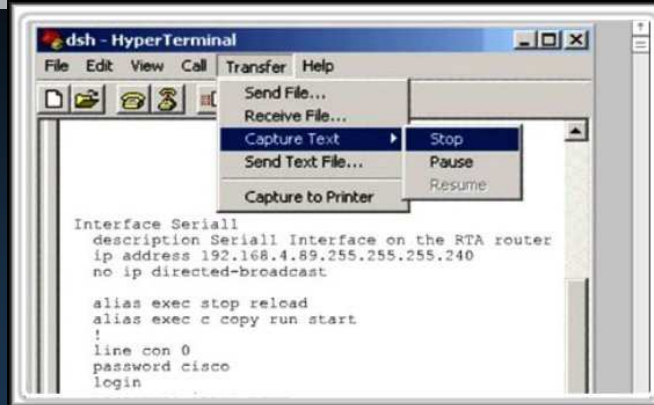
Managing Configuration Files

- Once it is installed or before you attempt to use it, ALWAYS make sure that the connectivity is there….

Managing Configuration Files

Managing Configuration Files

- Configuration files can be captured and saved in text format using the text capture function of HyperTerminal (or any other emulator that has the function).

Configuring Interfaces

All interfaces are accessed by issuing the `interface` command at the global configuration prompt.

In the following commands, the `type` argument includes serial, ethernet, fastethernet, and others:

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

Router
Interfaces

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 shutdown:

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

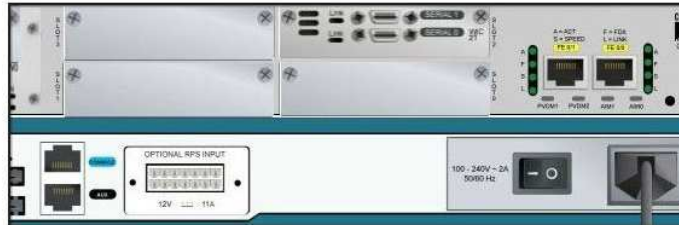The following command is used to quit the current interface configuration mode:

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

When the configuration is complete, the interface is enabled and interface configuration mode is exited.
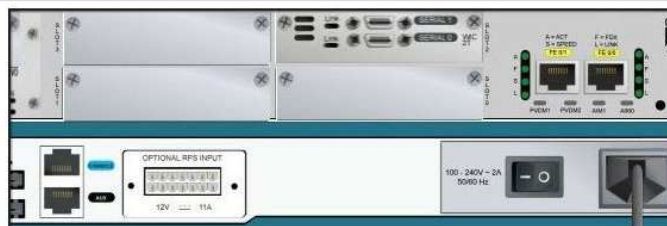
Configuring Interfaces

- Configuring a Router Ethernet Interface:


```
Router#configure terminal
Router(config)#
Router(config)#interface FastEthernet 0/0
Router(config-if)#ip address 192.168.10.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#
```
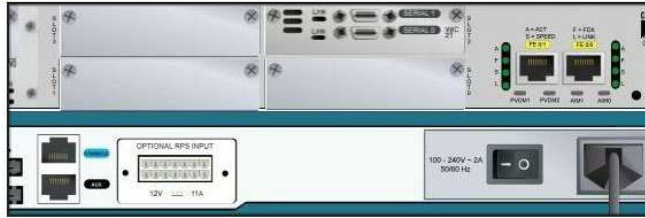
Configuring Interfaces

- Configuring a Router Serial Interface:


```
Router#configure terminal
Router(config)#
Router(config)#interface Serial 0/2/0
Router(config-if)#ip address 192.168.11.1 255.255.255.0
Router(config-if)#clock rate 56000
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#
```

Describing Router Interfaces


```
Router(config)#interface FastEthernet 0/0
Router(config-if)#description   Building B Sales LAN
Router(config-if)#exit
```

Description is all text after this space

Interface description used for internal network documentation

```
Router(config)#interface Serial 0/0/0
Router(config-if)#description   To Perth CKT-PT27834365-01
Router(config-if)#exit
```

Description is all text after this space

Configuring Interfaces

- Configuring a Switch:

```
Switch#configure terminal
Switch(config)#
Switch(config)#hostname Flour_Bluff
Flour_Bluff(config)#
Flour_Bluff(config)#interface FastEthernet 0/1
Flour_Bluff(config-if)#description To TAM switch
Flour_Bluff(config-if)#interface vlan 1
Flour_Bluff(config-if)#ip address 192.168.1.2 255.255.255.0
Flour_Bluff(config-if)#no shutdown
Flour_Bluff(config-if)#exit
Flour_Bluff(config)#ip default-gateway 192.168.1.1
Flour_Bluff(config)#exit
Flour Bluff#
```

Configuring and Testing Your Network

Verifying Connectivity

```
PING
    TRACEROUTE
            SHOW IP INTERFACE BRIEF
```
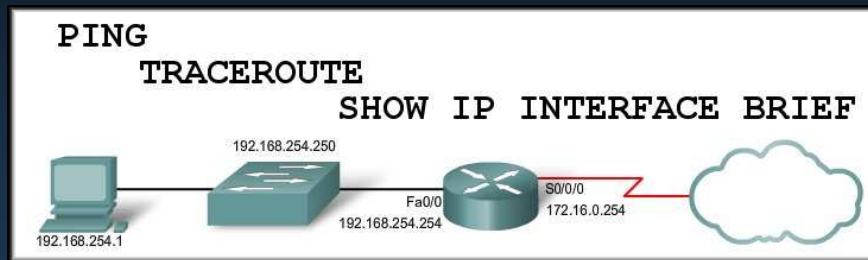
Test the Stack

- PING:
    - From the command window on a PC.

```
C:\>ping 192.168.100.1

Pinging 192.168.100.1 with 32 bytes of data:

Reply from 192.168.100.1: bytes=32 time=1ms TTL=63
Reply from 192.168.100.1: bytes=32 time=1ms TTL=63
Reply from 192.168.100.1: bytes=32 time=1ms TTL=63
Reply from 192.168.100.1: bytes=32 time=1ms TTL=63

Ping statistics for 192.168.100.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\>
```
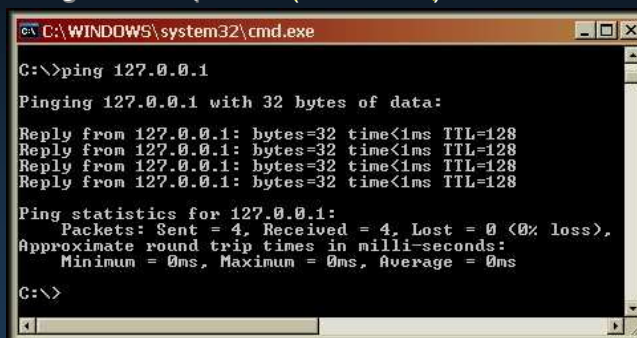
Test the Stack

- PING:
  - From the router IOS.

```
R2-Central>ping 172.16.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
!!!!!
```

```
R2-Central>ping 172.16.1.20

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.20, timeout is 2 seconds:
.....
```

```
R2-Central>ping 202.163.24.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 202.163.24.5, timeout is 2 seconds:
U.U.U
Success rate is 0 percent (0/5)
```

Test the Stack

- PING:
 - Testing the Loopback (127.0.0.1).

```
C:\WINDOWS\system32\cmd.exe                              _ □ X

C:\>ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:

Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

If successful, it means that the protocol stack on the PC is functioning properly from the Network through the Physical Layers.

Testing the Local NIC Assignment

```
IP Address. . . . . . . : 10.0.0.5

Subnet Mask . . . . . . : 255.255.255.0

Default Gateway. . . . : 10.0.0.254
```

C:\>ping 10.0.0.5
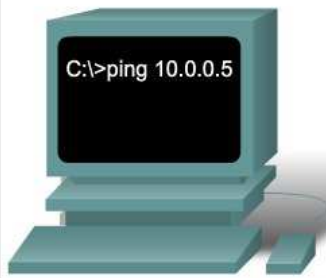
Verify the host NIC address is bound and ready for transmitting signals across the media by pinging its own IP address.

Testing the Router Interfaces

192.168.254.250

Fa0/0
S0/0/0
172.16.0.254

192.168.254.1
192.168.254.254

```
Router1#show ip interface brief
Interface          IP-Address      OK? Method Status                Protocol
FastEthernet0/0    192.168.254.254 YES NVRAM up                     up
FastEthernet0/1    unassigned      YES unset down                   down
Serial0/0/0        172.16.0.254    YES NVRAM up                     up
Serial0/0/1        unassigned      YES unset administratively down  down
Router1#
```

```
Router1#ping 192.168.254.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.254.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5) round-trip min/avg/max = 1/2/4 ms
Router1#
```

```
Router1#traceroute 192.168.0.1
Type escape sequence to abort.
Tracing the route to 192.168.0.1
  1   172.16.0.253   8 msec    4msec    8 msec
  2   10.0.0.254     16 msec  16 msec   8 msec
  3   192.168.0.1    16 msec     *     20 msec
```

Testing the Switch Interfaces
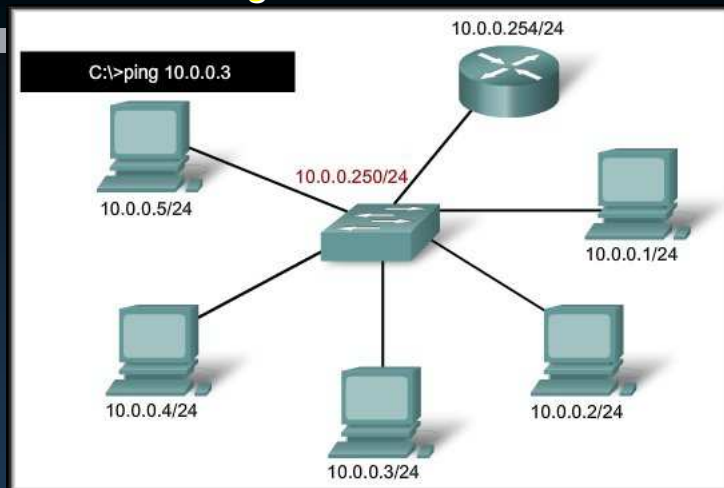


```
Switch1#show ip interface brief
Interface          IP-Address      OK? Method Status     Protocol
FastEthernet0/1    unassigned      YES manual up         up
    .
    .
FastEthernet0/24   unassigned      YES manual down       down
Vlan1              192.168.254.250 YES manual up         up
Switch1#
```

```
Switch1#ping 192.168.254.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.254.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5) round-trip min/avg/max = 1/2/4 ms
Switch1#
```

```
Switch1#traceroute 192.168.0.1
Type escape sequence to abort
Tracing the route to 192.168.0.1
  1  192.168.254.254   4 msec   2 msec   3 msec
  2  172.16.0.253      8 msec   4 msec   8 msec
  3  10.0.0.254       16 msec  16 msec   8 msec
  4  192.168.0.1      16 msec     *     20 msec
```

Testing the Local Network

C:\>ping 10.0.0.3

10.0.0.254/24

10.0.0.250/24

10.0.0.5/24
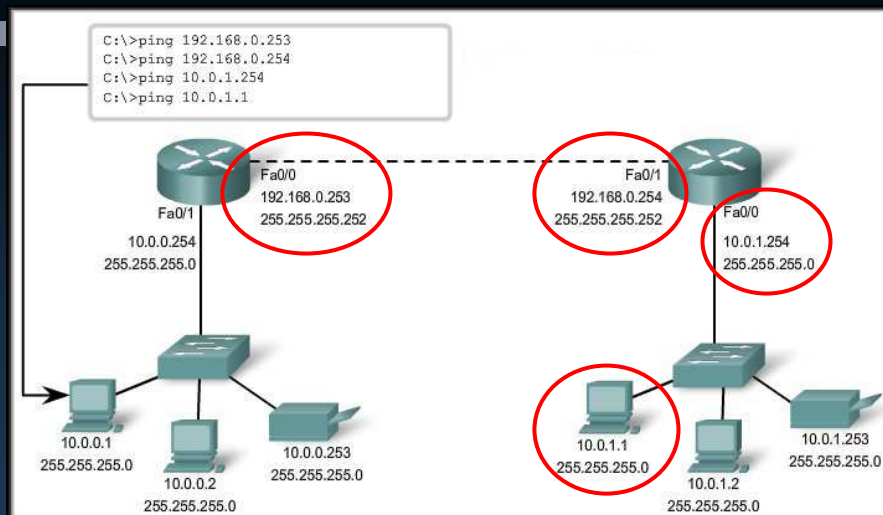
10.0.0.1/24

10.0.0.4/24

10.0.0.2/24

10.0.0.3/24

Successfully pinging another host on the
same subnet verifies that both the local host
and the other host are configured correctly.

Testing Gateway Connectivity
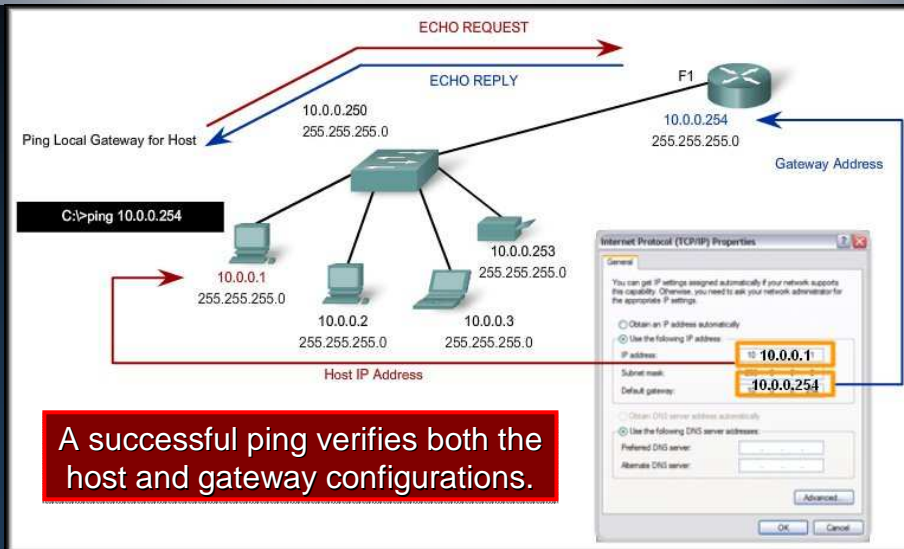
A successful ping verifies both the host and gateway configurations.

Testing Remote Connectivity

Ping each hop between the local and remote host.

Tracing and Interpreting Trace Results

C:\ping 10.1.0.2
Pinging 10.1.0.2 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 10.1.0.2:
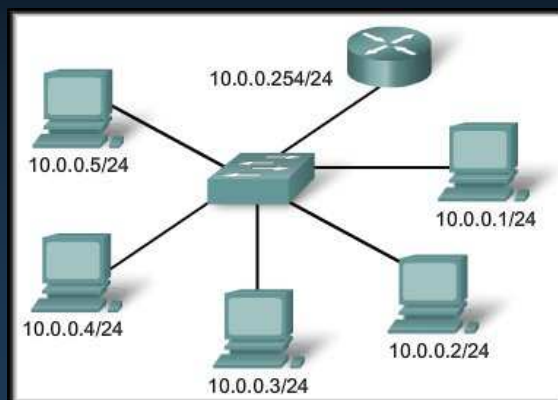Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
The ping test failed.

RouterD

t this point.

10.1.0.254/24

0 hops

```
1   2 ms   2 ms   2 ms   10.0.0.254
2   *      *      *      Request timed out.
3   *      *      *      Request timed out.
4   ^C
```

10.0.0.1/24   10.0.0.2/24   Host 1

Configuring and Testing Your Network

Monitoring and Documenting Networks

Basic Network Baselines

- **Network Baseline:**
  - Process for studying the network at regular intervals.
  - Ensure that the network is working as designed.
  - More than a single report.
  - Health of the network at a certain point in time.
  - Accomplished over a period of time.
  - Varying times and loads will assist in creating a better picture of overall network performance.
    - Copy and paste the results from an executed ping, trace, or other relevant command into a text file.
    - Compare the results over time.

Basic Network Baselines

Run the same test.

At different times.

Compare the results.

```
FEB 2, 2007  08:14:43

C:\>ping 10.66.254.159

Pinging 10.66.254.159 with 32 bytes of data:

Reply from 10.66.254.159: bytes=32 time<1ms TTL=128
Reply from 10.66.254.159: bytes=32 time<1ms TTL=128
Reply from 10.66.254.159: bytes=32 time<1ms TTL=128
Reply from 10.66.254.159: bytes=32 time<1ms TTL=128
```

```
MAR 17, 2007  14:41:06

C:\>ping 10.66.254.159

Pinging 10.66.254.159 with 32 bytes of data:

Reply from 10.66.254.159: bytes=32 time<6ms TTL=128
Reply from 10.66.254.159: bytes=32 time<6ms TTL=128
Reply from 10.66.254.159: bytes=32 time<6ms TTL=128
Reply from 10.66.254.159: bytes=32 time<6ms TTL=128
```
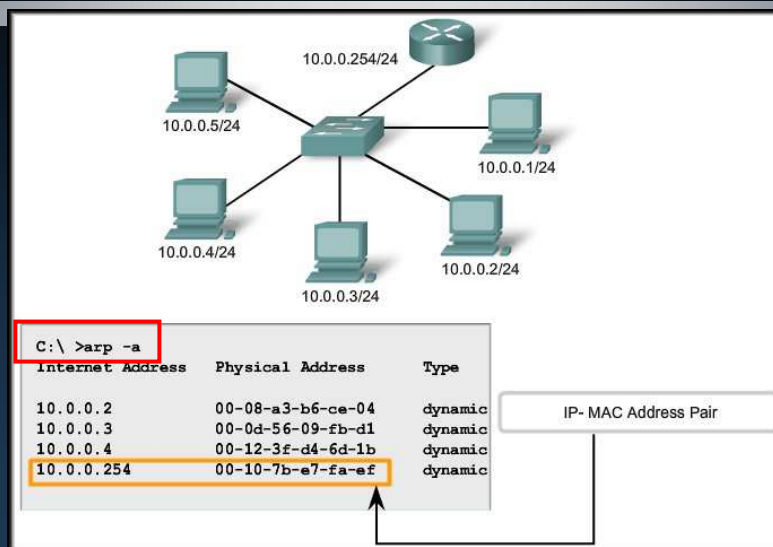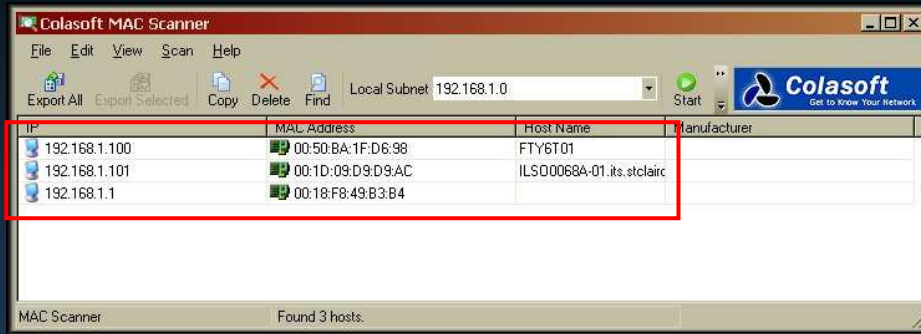
Basic Network Baselines

- **Network Baseline:**
  - Results from a command can be captured and saved as a text file for future study.
    - PING
    - TRACEROUTE
    - CISCO IOS

Learning About the Nodes on the Network

Ping Sweep / MAC Scanner Tools

Switch Connections
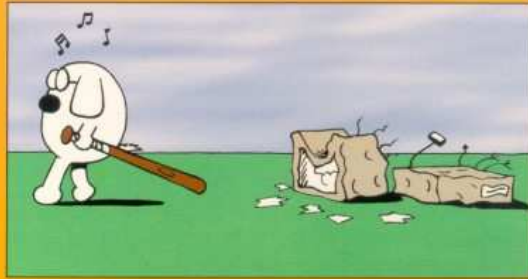
```
Sw1-2950#show mac-address-table

Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
All     0014.a8a8.8780    STATIC      CPU
All     0100.0ccc.cccc    STATIC      CPU
All     0100.0ccc.cccd    STATIC      CPU
All     0100.0cdd.dddd    STATIC      CPU
   1    0001.e640.3b4b    DYNAMIC     Fa0/23
   1    0002.fde1.6acb    DYNAMIC     Fa0/14
   1    0006.5b88.dfc4    DYNAMIC     Gi0/2
   1    0006.5bdd.6fee    DYNAMIC     Fa0/23
   1    0006.5bdd.7035    DYNAMIC     Fa0/23
   1    0006.5bdd.72fd    DYNAMIC     Fa0/23
   1    0006.5bdd.73b0    DYNAMIC     Fa0/23
   1    000e.0cb6.2b51    DYNAMIC     Fa0/2
   1    000f.8f28.b7b5    DYNAMIC     Fa0/18
   1    0011.1165.8acf    DYNAMIC     Fa0/1
   1    0013.720b.40c3    DYNAMIC     Fa0/19
   1    0080.9120.1766    DYNAMIC     Fa0/8
   1    00a0.c949.702a    DYNAMIC     Fa0/15
   1    00c0.b770.6c19    DYNAMIC     Fa0/22
   1    00c0.b770.6c8e    DYNAMIC     Fa0/21
   1    00c0.b770.6c8f    DYNAMIC     Fa0/20
   1    00e0.1e68.0987    DYNAMIC     Fa0/17
```

Multiple devices connected to Fa0/23

THE END!