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Chapter 8

by

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ROUTER & ROUTING PROTOCOL

(W10)
- ROUTER
- ROUTER CONFIGURATION

(W11)
- ROUTING TABLE
- STATIC ROUTE

Router

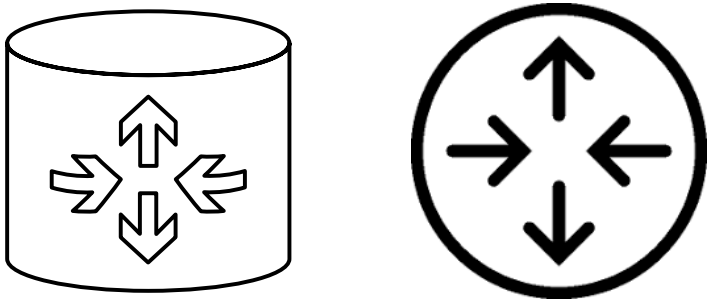
Week 10

Objectives

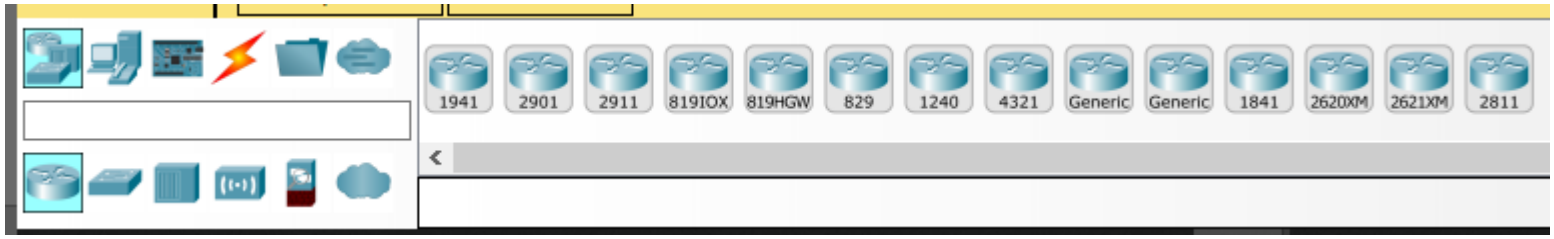
- Identify a router as a computer with an OS and hardware designed for the routing process.
- Demonstrate the ability to configure devices and apply addresses.
- Describe the structure of a routing table.

Router

Router - Symbol



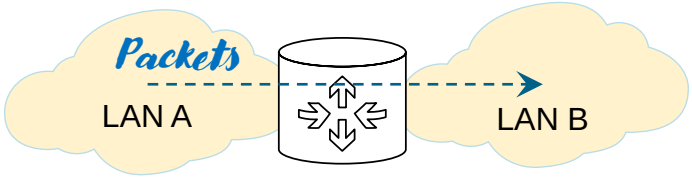
- Simulator –Packet Tracer



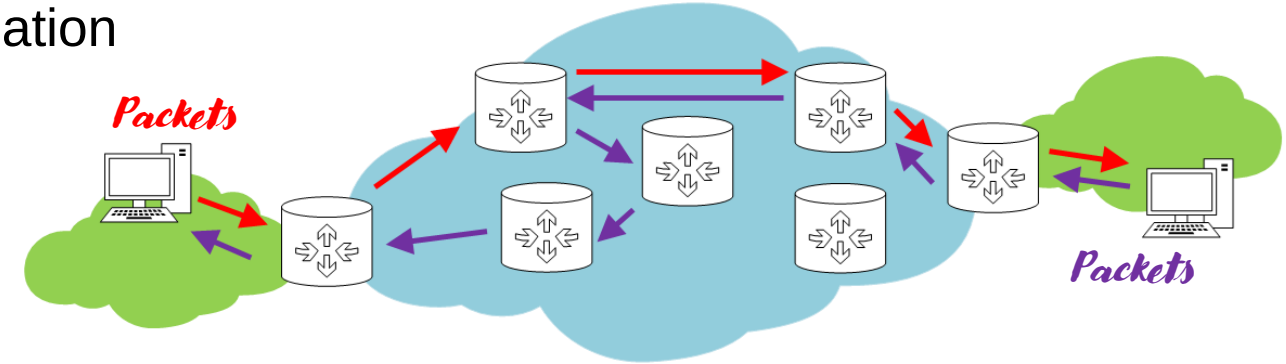
Introduction

The basic purpose of a router.

- A device that specialize in sending data over the network.
- Data is sent in form of packets between 2 end routers



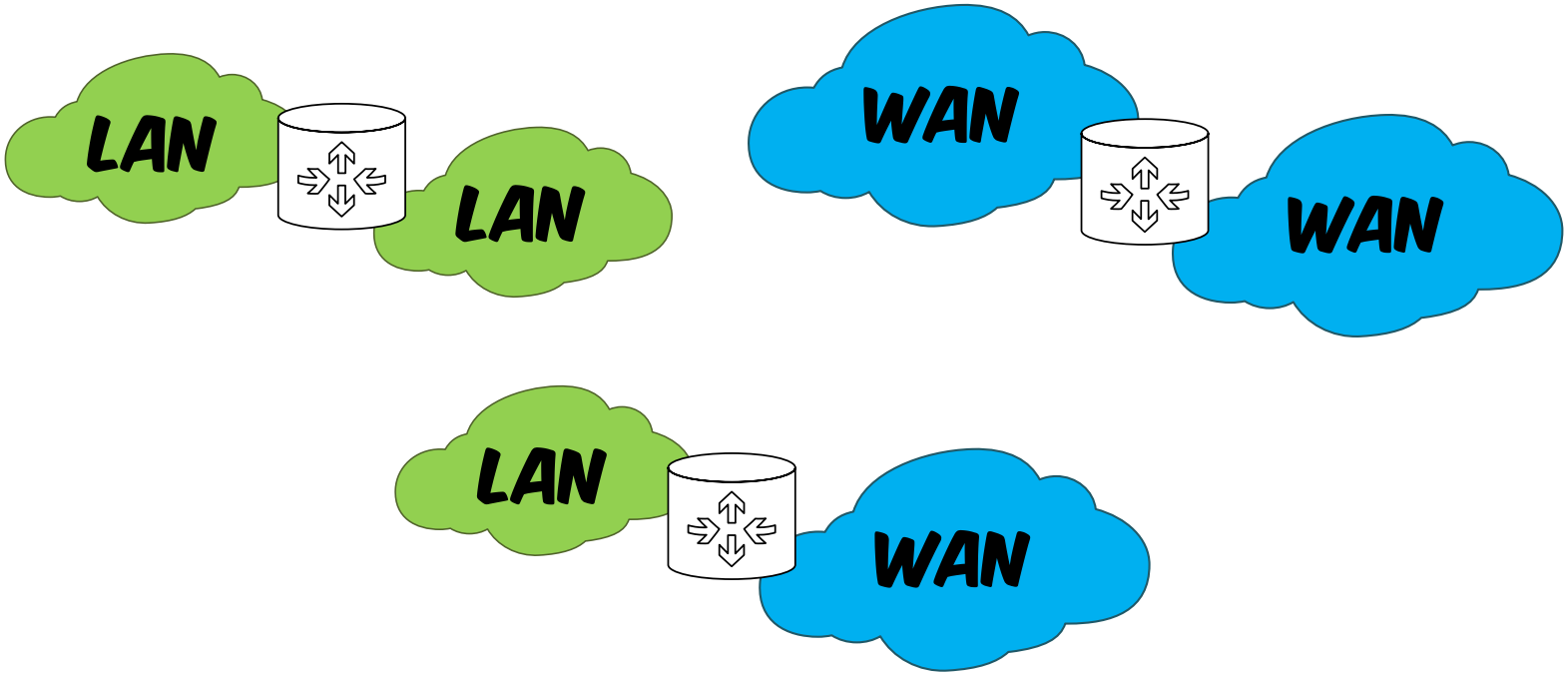
- They are responsible for interconnecting networks by selecting the best path for a packet to travel and forwarding packets to their destination



*Request packets and receive packets may use different path

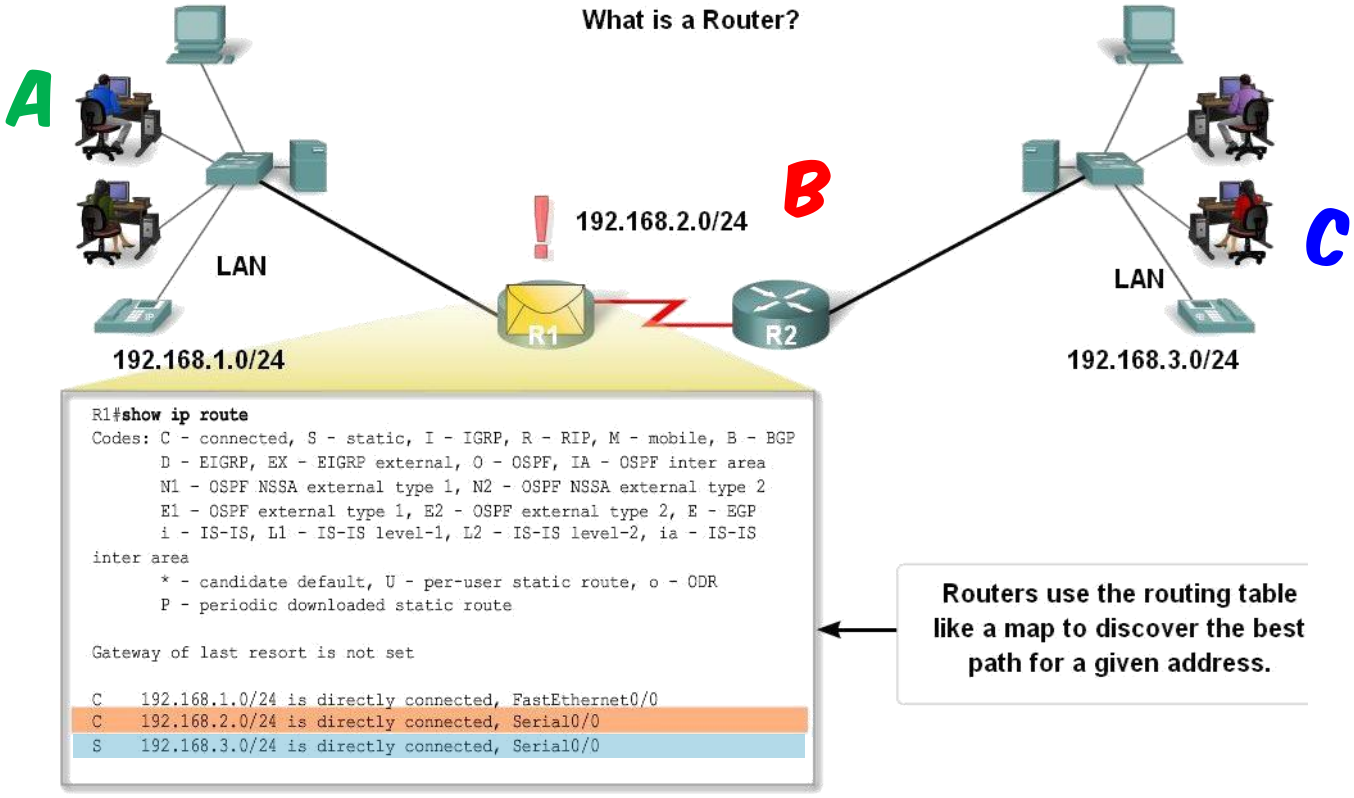
Introduction

- Routers are the network center
  - Routers generally have 2 connections for data communication:
    - WAN connection
    - LAN connection



Introduction

- Routers examine a packet's destination IP address and determine the best path by enlisting the aid of a routing table to forward it.



ROUTING TABLE FOR R1

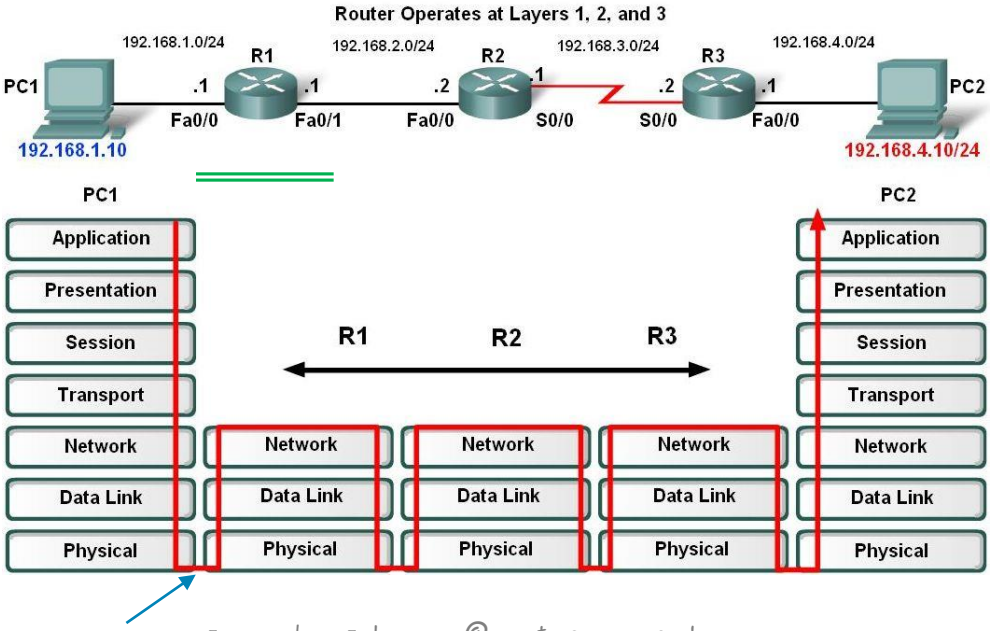
Routers operate at Layers 1, 2 & 3

OSI LAYER

Ex. R1

- Router receives a stream of encoded bits from PC1
- Bits are decoded (frames) and passed to layer 2
- Router de-encapsulates the frames to packets
- Remaining packet passed up to layer 3
  - Routing decision made at this layer by examining destination IP address from Routing Table
- Packet is then re-encapsulated (frames) and pass to layer 2
- Frames are coded to bits and pass to layer 1
- Bits sent out by outbound interface to R2

* PC OPERATES AT ALL LAYER (L1→L7)

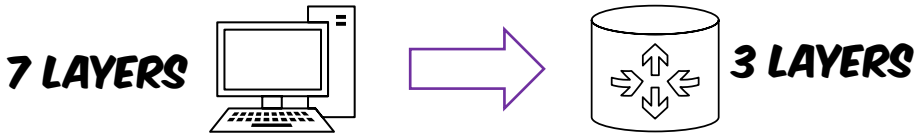


Router as a Computer

* LIKE PC WITHOUT I/O PERIPHERALS - NO MOUSE, NO KEYBOARD, NO MONITOR

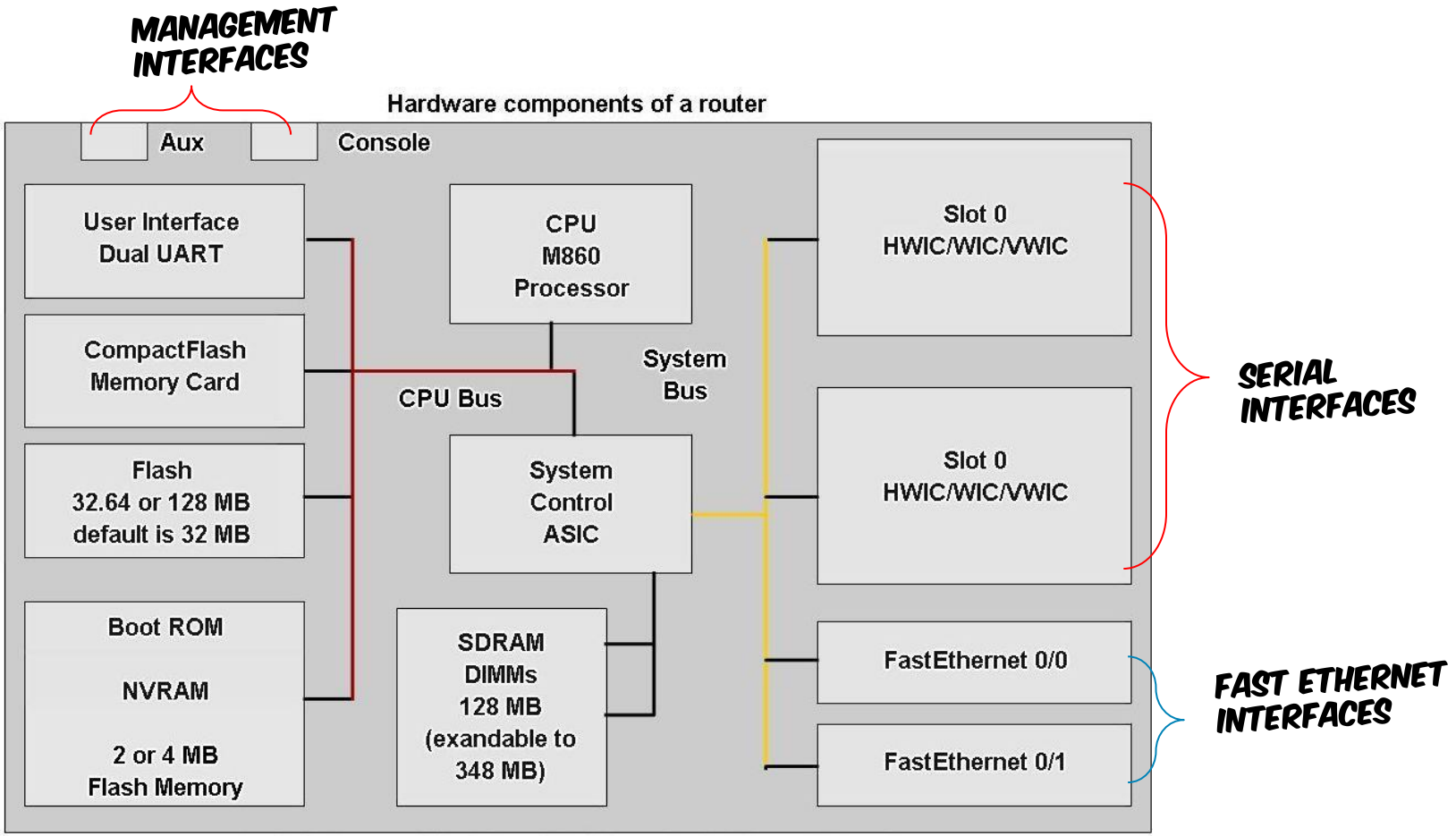
Router components and their functions

- **CPU** - Executes operating system instructions
- **Random access memory (RAM)** - Contains the running copy of configuration file. Stores routing table. RAM contents lost when power is off
- **Read-only memory (ROM)** - Holds diagnostic software used when router is powered up. Stores the router's bootstrap program.
- **Non-volatile RAM (NVRAM)** - Stores startup configuration. This may include IP addresses (Routing protocol, Hostname of router)
- **Flash memory** - Contains the operating system (Cisco IOS)
- **Interfaces** - There exist multiple physical interfaces that are used to connect network. Examples of interface types:
  - Ethernet / fast Ethernet interfaces
  - Serial interfaces
  - Management interfaces



Router as a Computer

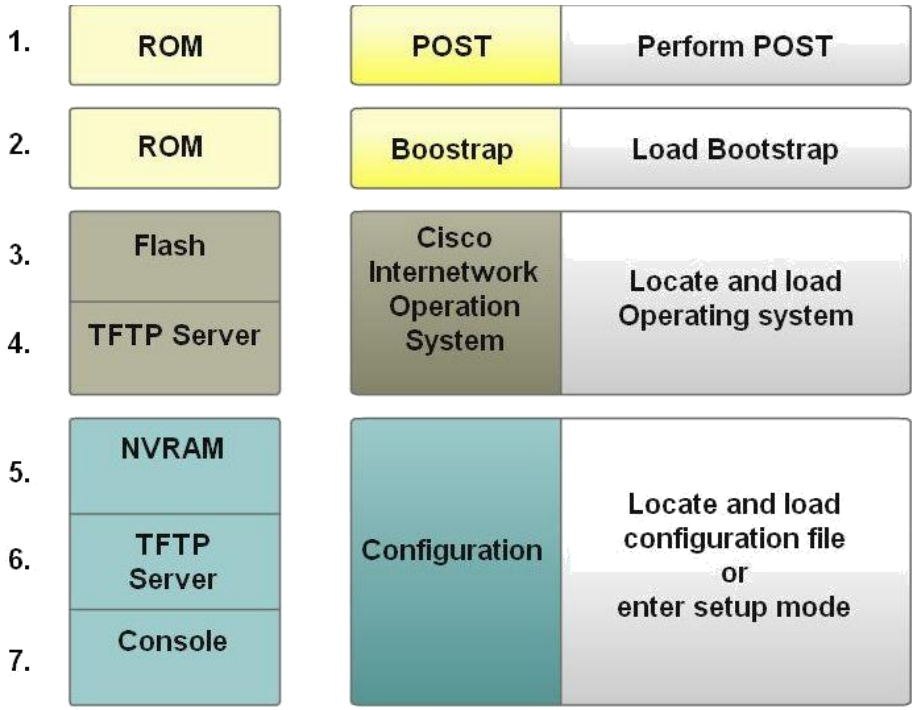
Router components



Router as a Computer

Major phases to the router boot-up process

- Test router hardware
  - Power-On Self Test (POST)
  - Execute bootstrap loader
- Locate & load Cisco IOS software
  - Locate IOS
  - Load IOS
- Locate & load startup configuration file or enter setup mode
  - Bootstrap program looks for configuration file



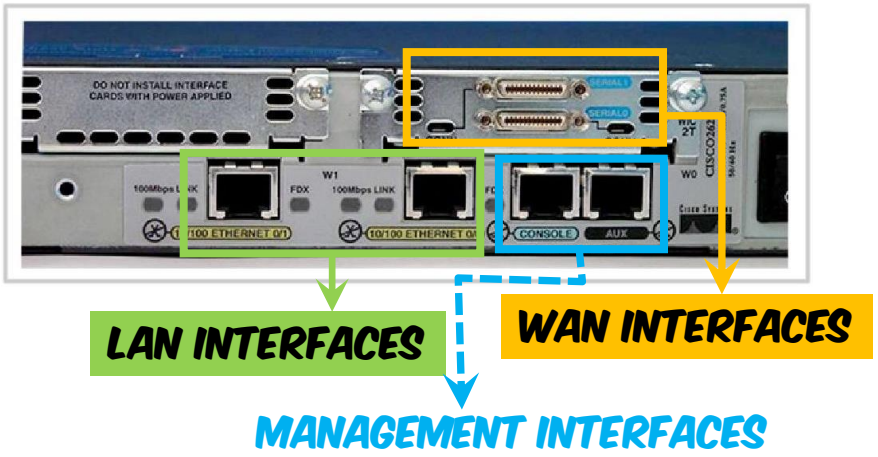
Router as a Computer

Router Interface

- A physical connector that enables a router to send or receive packets
- Each interface connects to a separate network
- Consist of socket or jack found on the outside of a router
- Types of router interfaces:
  - Ethernet
  - FastEthernet
  - Serial
  - DSL
  - ISDN
  - Console
  - Aux

Each individual interface connects to a different network. Thus each interface has an IP address/mask from that network.

Router as a Computer



Two major groups of Router Interfaces

- **LAN Interfaces**
  - Are used to connect router to LAN network
  - Has a layer 2 MAC address
  - Can be assigned a Layer 3 IP address
  - Usually consist of an RJ-45 jack
- **WAN Interfaces**
  - Are used to connect routers to external networks that interconnect LANs.
  - Depending on the WAN technology, a layer 2 address may be used.
  - Uses a layer 3 IP address

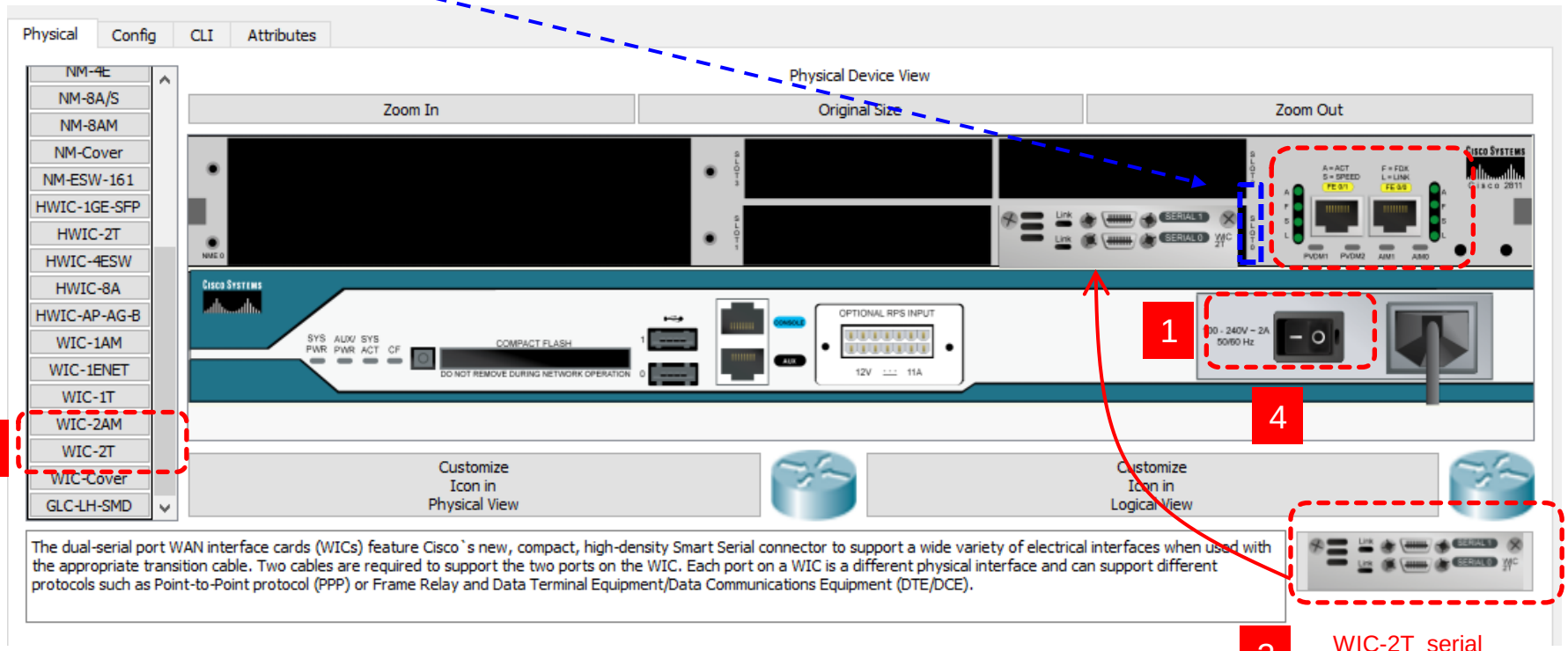
Router as a Computer

- Simulator – Packet Tracer

Most of router doesn't have a WAN interface (Serial interface)
– Need to plug-in it as serial interface module into the available slot.
- example: choose module "WIC-2T".

1. Switch OFF the router
2. Select Serial module > WIC-2T
3. Drag it into any available slot >Slot 0
4. Switch ON back the router

- How to choose slot? Depend on scenario given. In this case, slot 0 is used.> S0/0/0 & S0/0/1

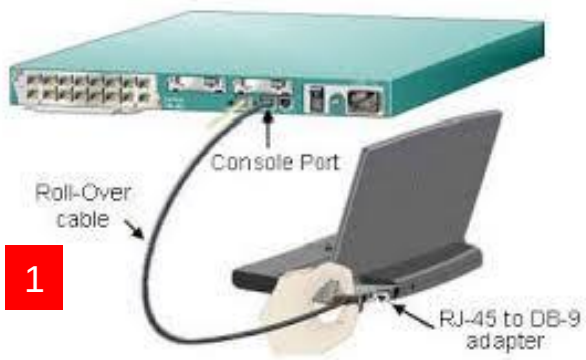


WIC-2T serial interface module has 2 port
- Serial 0
- Serial 1

Configure Devices

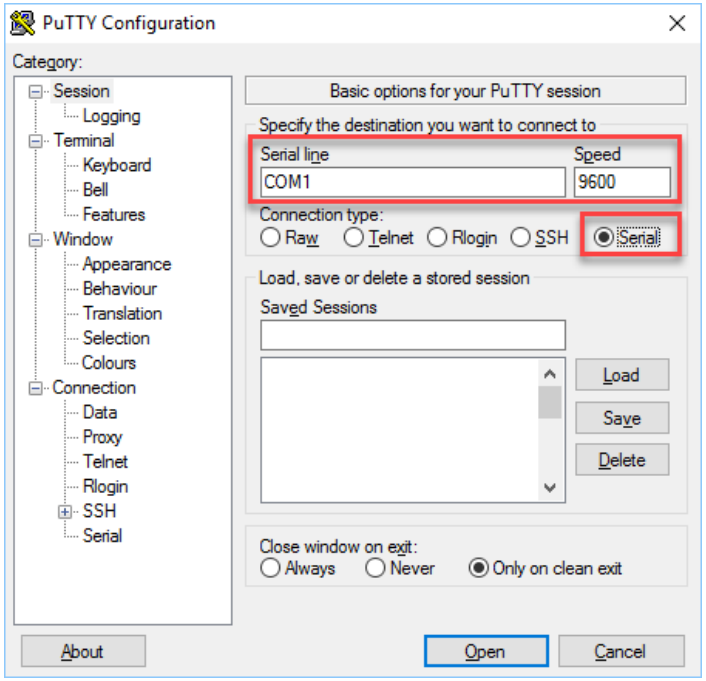
1. Select console/rollover cable > plug to RJ-45 to DB9 adapter (Laptop) and Console port (Router)
2. Open application “Putty”
3. Fill up the Configuration > “Open”

- Physical device - real environment



1

2

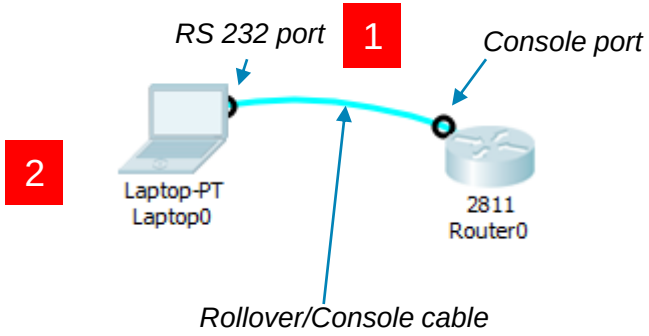


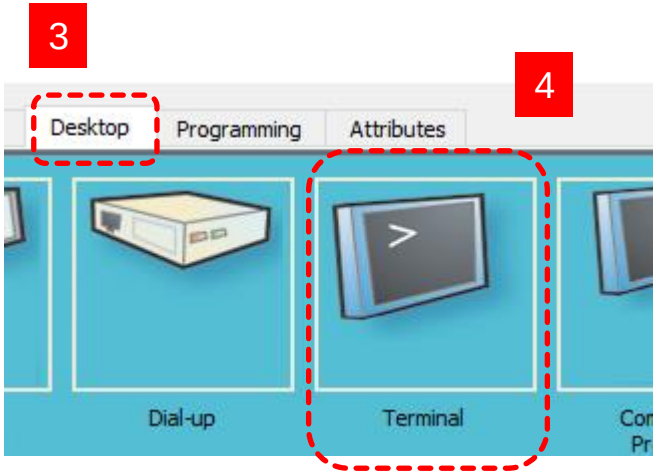
3

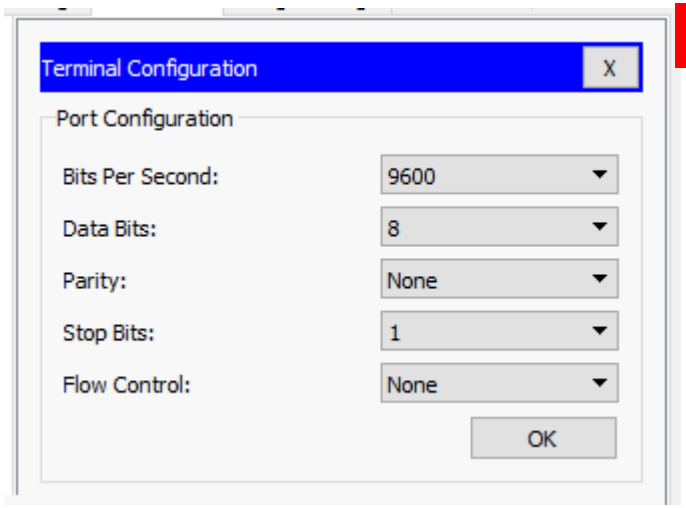
Configure Devices

- Simulator – Packet Tracer

* Since a router doesn't have I/O peripherals, so we use Notebooks' or PCs' for configuration task.







1. Select console cable> plug to RS 232 port (Laptop) and Console port (Router)
2. Click on Laptop-PT
3. Click on "Desktop" tab
4. Click on "Terminal"
5. Fill in "Terminal Configuration" > "OK"

Configure Devices

- After boot process complete, the system will ask as below
- Type “no”

```
This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.
cisco 2811 (MPC860) processor (revision 0x200) with 60416K/5120K bytes of memory
Processor board ID JAD05190MTZ (4292891495)
M860 processor: part number 0, mask 49
2 FastEthernet/IEEE 802.3 interface(s)
239K bytes of non-volatile configuration memory.
62720K bytes of  ATA CompactFlash (Read/Write)
Cisco IOS Software, 2800 Software (C2800NM-ADVIPSERVICESK9-M), Version 12.4(15)T1, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2007 by Cisco Systems, Inc.
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         --- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]: no
```
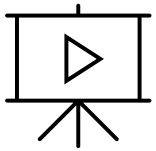
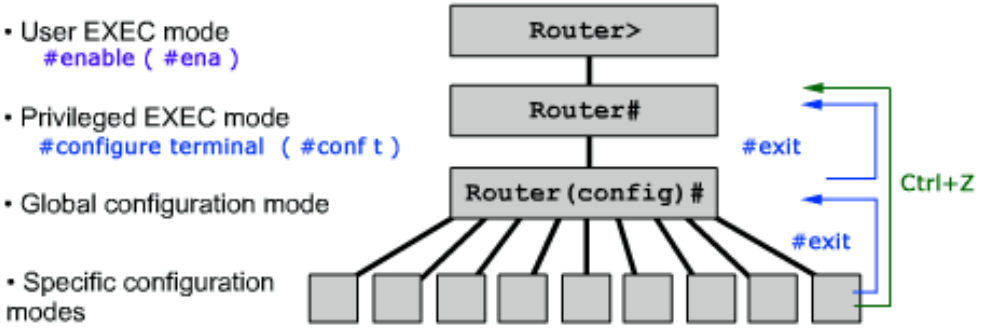



https://youtu.be/FfLWhB5ovSM

Configure Devices

```
Router>
Router>enable
Router#
```



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 www.ic.ims.hr	`Router(config-line)#`
Router	`Router(config-router)#`
IPX-router	`Router(config-ipx-router)#`
Route-map	`Router(config-route-map)#`

Configure Devices

Table 1-1 Command Modes Summary

Command Mode	Access Method	Prompt	Exit or Access Next Mode
User EXEC	This is the first level of access. (For the switch) Change terminal settings, perform basic tasks, and list system information.	`Router>`	Enter the **logout** command. To enter privileged EXEC mode, enter the **enable** command.
Privileged EXEC	From user EXEC mode, enter the **enable** command.	`Router#`	To exit to user EXEC mode, enter the **disable** command. To enter global configuration mode, enter the **configure** command.
Global configuration	From privileged EXEC mode, enter the **configure** command.	`Router(config)#`	To exit to privileged EXEC mode, enter the **exit** or **end** command, or press **Ctrl-Z**. To enter interface configuration mode, enter the **interface** configuration command.
Interface configuration	From global configuration mode, specify an interface by entering the **interface** command followed by an interface identification.	`Router(config-if)#`	To exit to privileged EXEC mode, enter the **end** command, or press **Ctrl-Z**. To exit to global configuration mode, enter the **exit** command.

Configure Devices

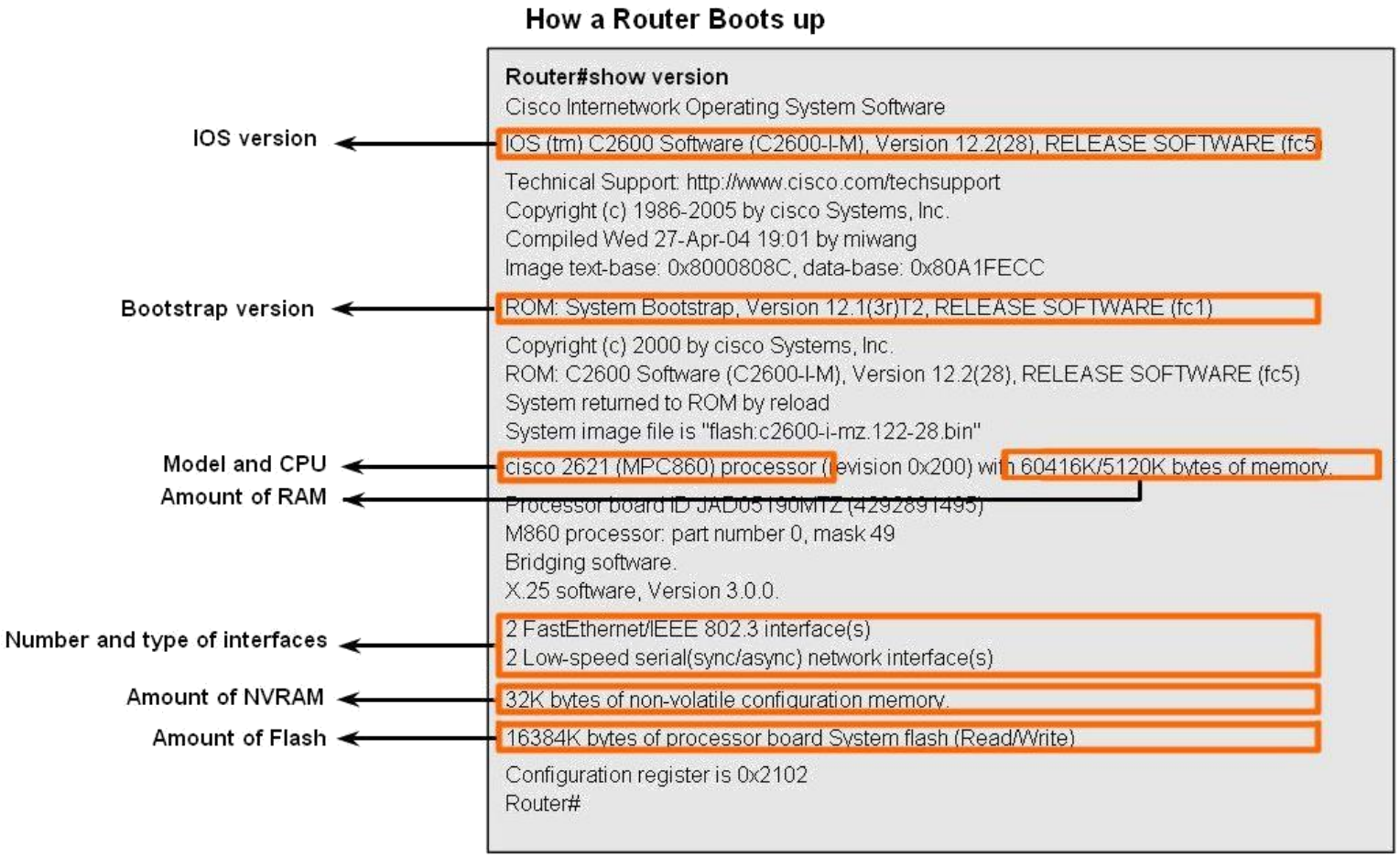
- **User EXEC** - 1st level of user – Basic
  - Router >
- **Privilege EXEC** – save configuration, show activities,
  - Router> enable <enter>
  - Router#
- **Global Privilege EXEC** Configuration – Configuration tasks
  - Router# Configure Terminal <enter>
  - Router (config)#
- **Interface Configuration** - Interface Configuration tasks
  - Router(config)# Interface FastInternet 0/0 <enter>
  - Router(config-if)

Configure Devices

Verify the router boot-up process:

- The **`show version`** command is used to view information about the router during the bootup process.
- Information includes:
  - Platform model number
  - Image name & IOS version
  - Bootstrap version stored in ROM
  - Image file name & where it was loaded from
  - Number & type of interfaces
  - Amount of NVRAM
  - Amount of flash
  - Configuration register

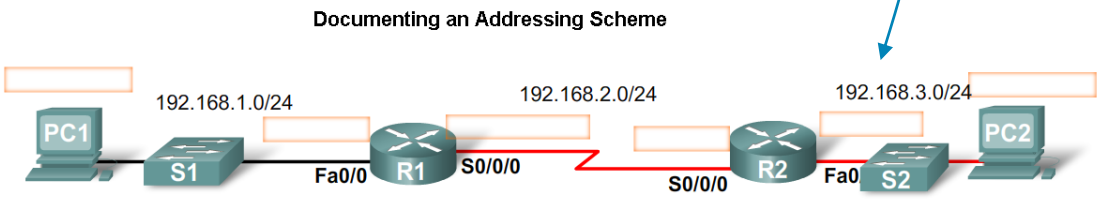
Configure Devices



Configure Devices

Implementing Basic Addressing Schemes

- When designing a new network or mapping an existing network you must provide the following information in the form of a document:
  - Topology drawing that Illustrates physical connectivity
  - Address table that provides the following information:
    - Device name
    - Interfaces used
    - IP addresses
    - Subnet mask
    - Default gateway



Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	192.168.1.1	255.255.255.0	N/A
	S0/0/0	192.168.2.1	255.255.255.0	N/A
R2	Fa0/0		255.255.255.0	N/A
	S0/0/0		255.255.255.0	N/A
PC1	N/A	192.168.1.10	255.255.255.0	192.168.1.1
PC2	N/A		255.255.255.0	

Configure Devices and Apply Addresses

Basic Router Configuration

- A basic router configuration should contain the following:
  - Router name - Host name should be unique
  - Banner - At a minimum, banner should warn against unauthorized use
  - Passwords - Use strong passwords
  - Interface configurations - Specify interface type, IP address and subnet mask. Describe purpose of interface. Issue no shutdown command. If DCE serial interface issue clock rate command.
- After entering in the basic configuration the following tasks should be completed
  - Verify basic configuration and router operations.
  - Save the changes on a router

Configure Devices and Apply Addresses

Basic router configuration command syntax	
Naming the router	Router(config)# hostname name
Setting Passwords	Router(config)# enable secret password
	Router(config)# line console 0
	Router(config-line)# password password
	Router(config-line)# login
	Router(config)# line vty 0 4
	Router(config-line)# password password
	Router(config-line)# login
Configuring an interface	Router(config)# interface type number
	Router(config-if)# ip address address mask
	Router(config-if)# description description
	Router(config-if)# no shutdown
Configuring a message-of-the-day banner	Router(config)# banner motd # message #
Saving changes on a router	Router# copy running-config startup-config
Examining the output of show commands	Router# show running-config
	Router# show ip route
	Router# ip interface brief
	Router# interfaces

Configure Devices and Apply Addresses

Configuring an Ethernet interface

- Enter interface configuration mode
- Enter in the ip address and subnet mask
- Enable the interface
  - × By default all Ethernet interfaces are down

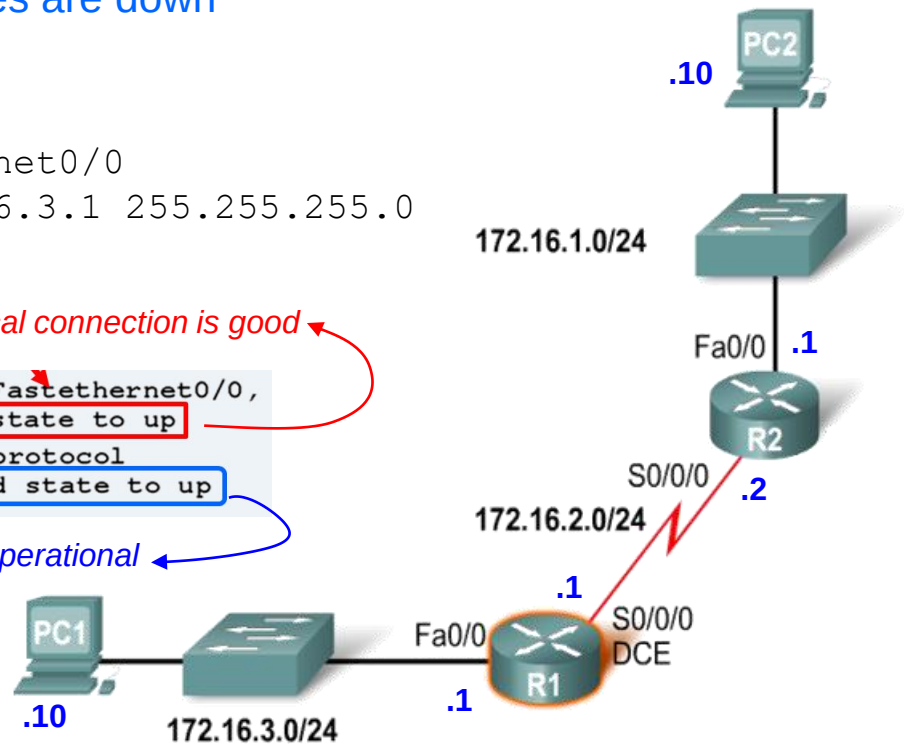
- Example:

```
R1#configure terminal
R1(config)#interface fastethernet0/0
R1(config-if)#ip address 172.16.3.1 255.255.255.0
R1(config-if)#no shutdown
```

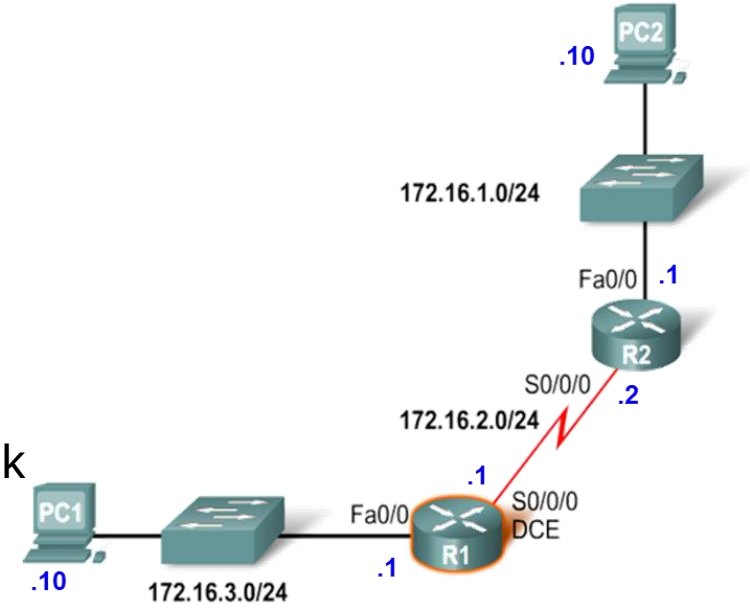
Indicate that the physical connection is good

```
*Mar  1 01:16:08.212: %LINK-3-UPDOWN: Interface Fastethernet0/0,
                                      changed state to up
*Mar  1 01:16:08.212: %LINEPROTO-5-UPDOWN: Line protocol
          on interface Fastethernet0/0, changed state to up
```

Indicate that the Data link layer is operational



Configure Devices



Configuring a Serial interface

- Enter interface configuration mode
- Enter in the ip address and subnet mask
- Enter in the no shutdown command

- Example:

```
R1(config)#interface serial 0/0
R1(config-if)#ip address 172.16.2.1 255.255.255.0
R1(config-if)#no shutdown
```

- The Serial interface is down even though it has an IP address and was enable it.

```
R1#show interfaces serial 0/0/0
Serial0/0/0 is administratively down, line protocol is down
  Hardware is PowerQUICC Serial
  Internet address is 172.16.2.1/24
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
<output omitted>
```

  - The serial interface will be in the ‘up’ state only after the other end of the serial link has also been properly configured and activated.

Configure Devices

Configuring a Serial interface

- A WAN Physical Layer connection has sides:
  - Data Circuit-terminating Equipment (DCE) – This is the service provider. CSU/DSU Modem is a DCE device.
  - Data Terminal Equipment (DTE) – Typically the router is the DTE device.

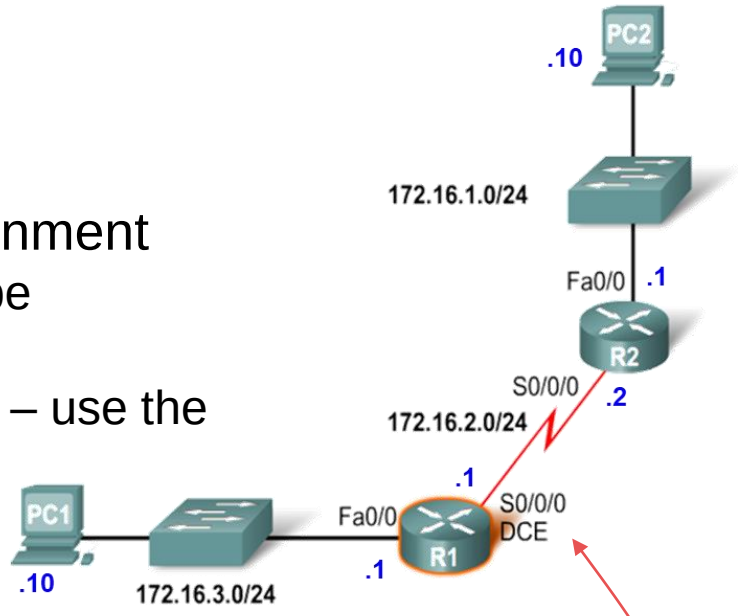
REAL

LAB

Configure Devices

Configuring a Serial interface

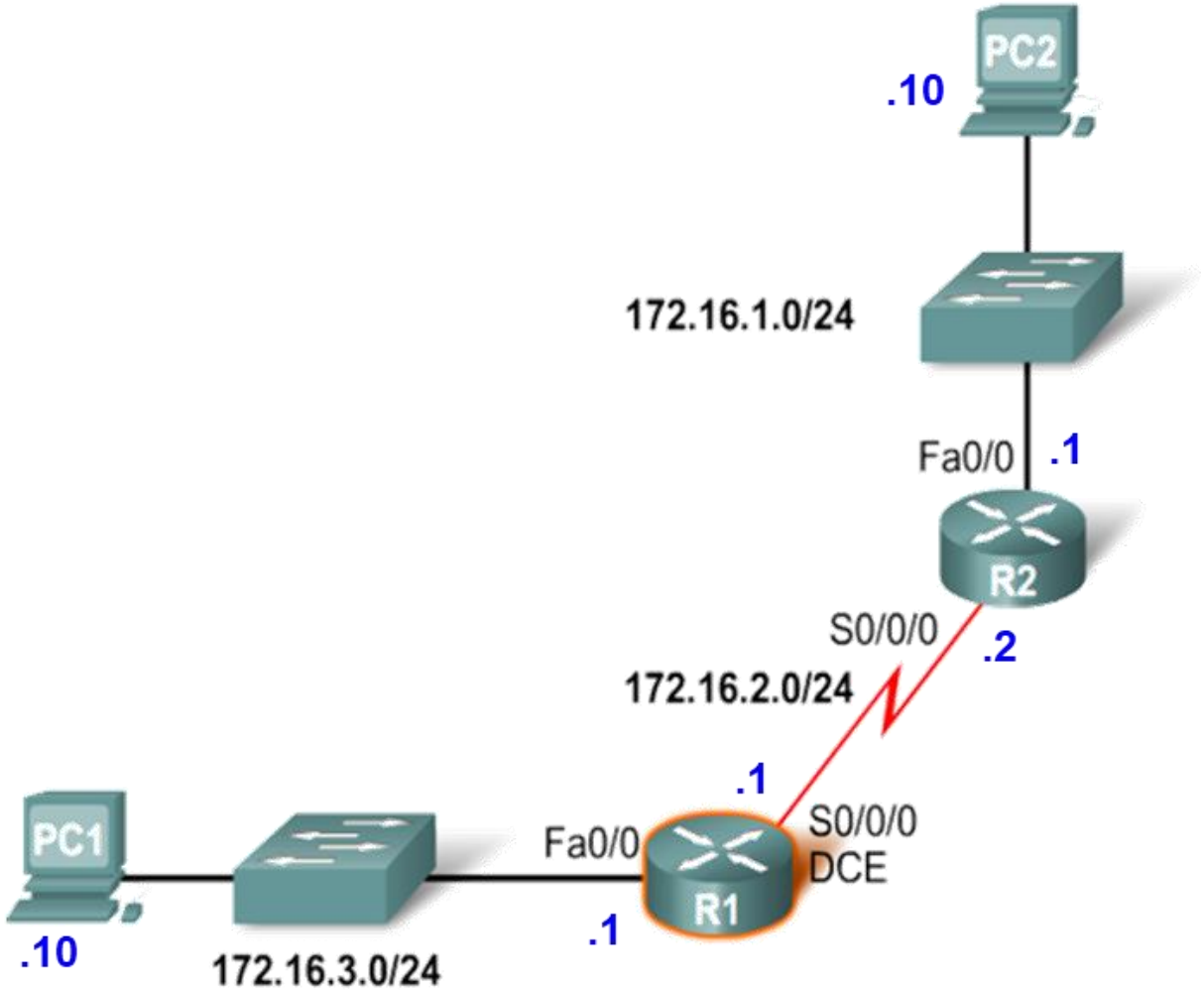
- Configuring serial links in a lab environment
  - One side of a serial connection must be considered a DCE
  - This requires placing a clocking signal – use the clock rate command.
- Example:




```
R1(config)#interface serial 0/0
R1(config-if)#clock rate 64000
```

  - Serial Interfaces require a clock signal to control the timing of the communications.

LAB


PC2
.10
172.16.1.0/24
Fa0/0
.1
R2
S0/0/0
.2
172.16.2.0/24
.1
S0/0/0
DCE
Fa0/0
R1
.1
PC1
.10
172.16.3.0/24

Configure Devices

Verify Basic Router Configuration

- Issue the **`show running-config`** command
  - Displays configuration currently in RAM
- Additional commands that will enable you to further verify router configuration are:
  - **`Show startup-config`** - Displays configuration file NVRAM
  - **`Show IP route`** - Displays routing table
  - **`Show interfaces`** - Displays all interface configurations
  - **`Show IP interfaces brief`** - Displays abbreviated interface configuration information

Save the Configuration

- Save the router configuration by Issuing
  - **`copy running-config startup-config`** command

Configure Devices

R1#show running-config

- Display current configuration in RAM

```
R1#show running-config
Building configuration...

Current configuration : 732 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
!
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
```

Configure Devices

R1#show ip route

- Router has no route

```
R1#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.2.0 is directly connected, Serial0/0/0
C       172.16.3.0 is directly connected, FastEthernet0/0
```

Configure Devices

R1#show ip interface brief

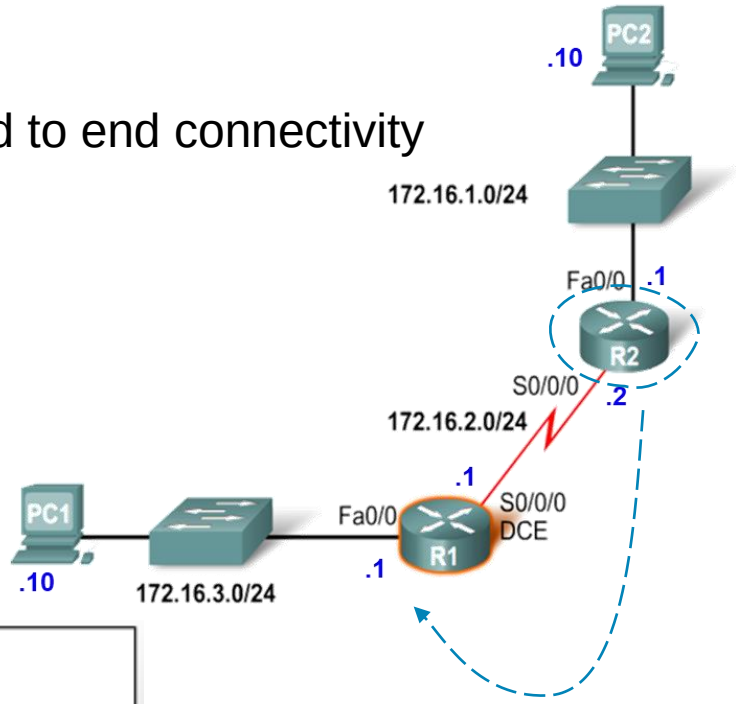
- Summary of interface status

```
R1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        172.16.3.1      YES manual up                    up
FastEthernet0/1        unassigned      YES unset  administratively down down
Serial0/0/0            172.16.2.1      YES manual up                    up
Serial0/0/1            unassigned      YES unset  administratively down down
Vlan1                  unassigned      YES unset  administratively down down
```

Configure Devices

- Checking each route in turn
  - The ping command is used to check end to end connectivity

```
R2#ping 172.16.3.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.3.1,
  timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R2#
```



- Verify by display the Routing Table

```
R2#show ip route
<output omitted>
     172.16.0.0/24 is subnetted, 2 subnets
C    172.16.1.0 is directly connected, FastEthernet0/0
C    172.16.2.0 is directly connected, Serial0/0
R2#
```

- No target Network Address (172.16.3.0) in the routing table

Routing Protocol

Week 11

Objectives

- Describe the structure of a routing table.
- Describe how a router determines a path and switches packets
- Describe static routes with next hop address or exit interfaces
- Describe summary and default route
- Examine how packets get forwarded when using static routes

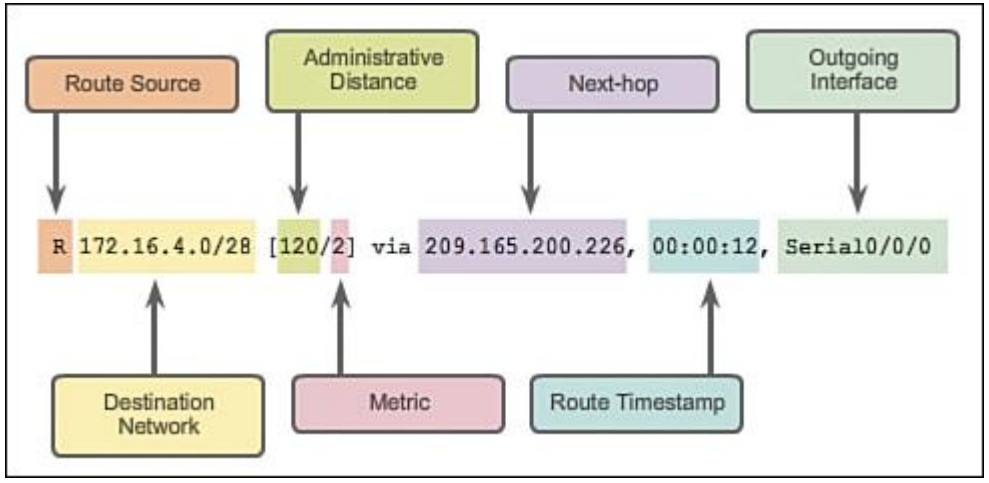
Routing Table Structure

`show ip route` command is used to view a routing table

```
R1#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 3 subnets
S       172.16.1.0 [1/0] via 172.16.2.2
C       172.16.2.0 is directly connected, Serial0/0/0
C       172.16.3.0 is directly connected, FastEthernet0/0
R    192.168.4.0/24 [120/1] via 172.16.2.2, 00:00:20, Serial0/0/0
R    192.168.5.0/24 [120/2] via 172.16.2.2, 00:00:20, Serial0/0/0
```

Routing Table Structure

- Routing Table is stored in RAM and contains information about:
  - Directly connected networks
    - this occurs when a router is connected to another device interface.
  - Remotely connected networks
    - this is a network that is not directly connected to a particular router
    - Static route or Dynamic routing
  - Detailed information about the networks connected
    - include source of information, network address & subnet mask, and IP address of next-hop router



Routing Table Structure

Directly Connected

- Routing tables must contain at least ONE (1) directly connected network, used to connect remote networks before static or dynamic routing can be used
- Includes: network address and exit interface
- Denoted with the code **C** in the routing table

```
R1#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
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C       172.16.2.0 is directly connected, Serial0/0/0
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R    192.168.5.0/24 [120/2] via 172.16.2.2, 00:00:20, Serial0/0/0
```

Routing Table Structure

Static Route

- **Static routes** in the routing table
  - Includes: network address and subnet mask and IP address of next hop router or exit interface
  - Denoted with the code **S** in the routing table
- When to use static routes
  - When network only consists of a few routers
  - Network is connected to internet only through one ISP

```
R1#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
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R    192.168.5.0/24 [120/2] via 172.16.2.2, 00:00:20, Serial0/0/0
```

Routing Table Structure

Dynamic Routing

- Used to add remote networks to a routing table
- Are used to discover networks
  - Automatic network discovery
  - Routers are able discover new networks by sharing routing table information
- Are used to update and maintain routing tables
  - Dynamic routing protocols are used to share routing information with other router & to maintain and up date their own routing table.

Routing Table Structure

- Example of Dynamic routing protocols include:
  - RIP
  - IGRP
  - EIGRP
  - OSPF

```
R1#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
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R    192.168.5.0/24 [120/2] via 172.16.2.2, 00:00:20, Serial0/0/0
```
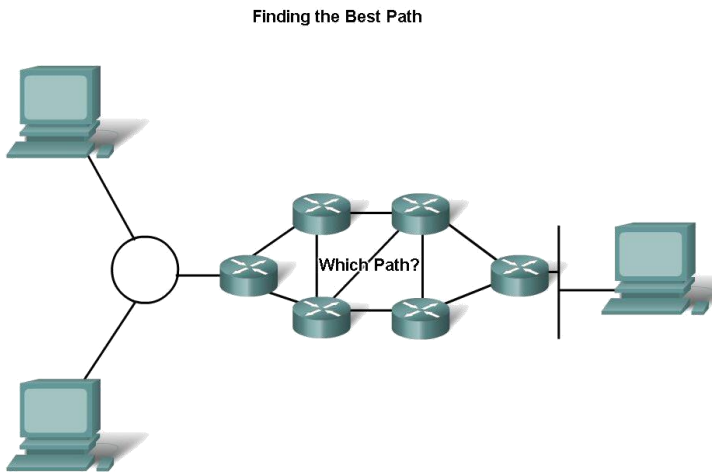

Routing Table Structure

Routing Table Principles

- 3 principles regarding routing tables:
  - Every router makes its decisions alone, based on the information it has in its routing table.
  - Different routing table may contain different information
  - A routing table can tell how to get to a destination but not how to get back

- Effects of the 3 Routing Table Principles
  - Packets are forwarded through the network from one router to another, on a hop by hop basis.
  - Packets can take path “X” to a destination but return via path “Y” (Asymmetric routing).



Router Paths and Packet Switching

- Internet Protocol (IP) packet format contains fields that provide information about the packet and the sending and receiving hosts
- Fields that are importance for students:
  - Destination IP address
  - Source IP address
  - Version & TTL
  - IP header length
  - Precedence & type of service
  - Packet length

Router Paths and Packet Switching

- MAC Layer Frame Format
- MAC Frames are also divided into fields. They include:
  - Preamble
  - Start of frame delimiter
  - Destination MAC address
  - Source MAC address
  - Type/length
  - Data and pad
  - Frame check sequence

Ethernet Frame Fields

Ethernet

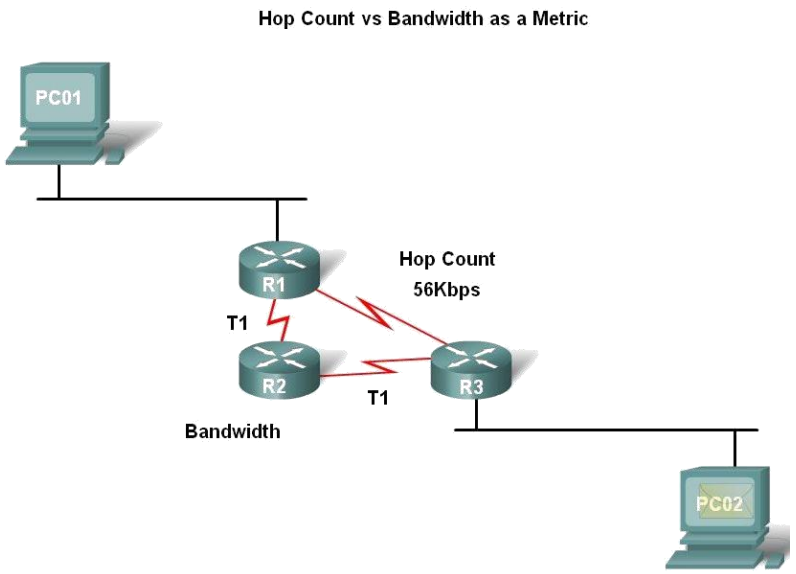
Field Length in Bytes	8	6	6	2	46-1500	4
	Preamble	Destination Address	Source Address	Type	Data	FCS

IEEE 802.3

Field Length in Bytes	7	1	6	6	2	46-1500	4
	Preamble	SOF	Destination Address	Source Address	Length	802.2 Header and Data	FCS

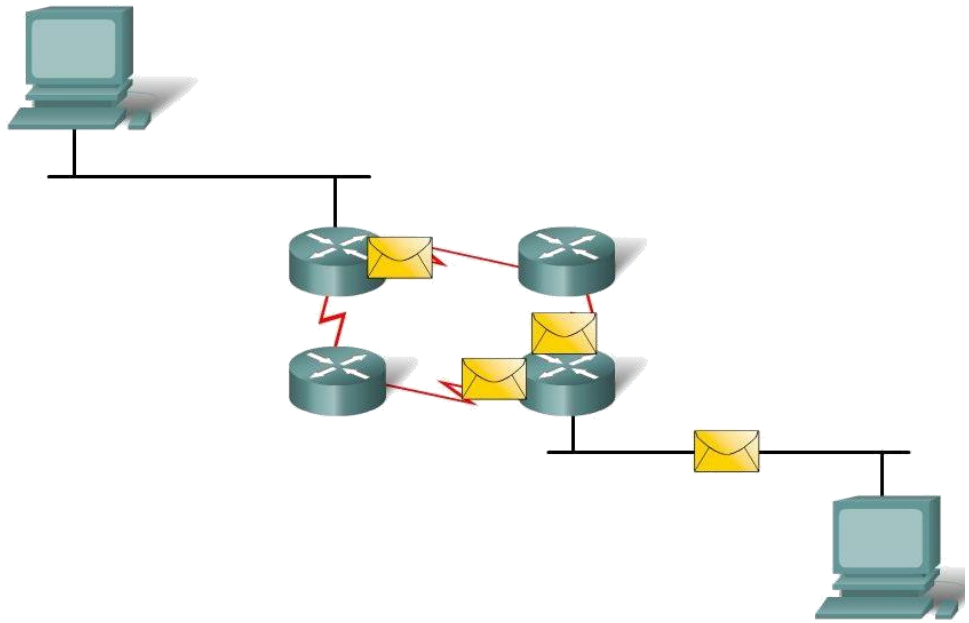
Router Paths and Packet Switching

- A Metric is a numerical value used by routing protocols help determine the best path to a destination
  - The smaller the metric value the better the path
- Among types of metrics used by routing protocols are:
  - **Hop count** - this is the number of routers a packet must travel through to get to its destination
  - **Bandwidth** - this is the “speed” of a link also known as the data capacity of a link



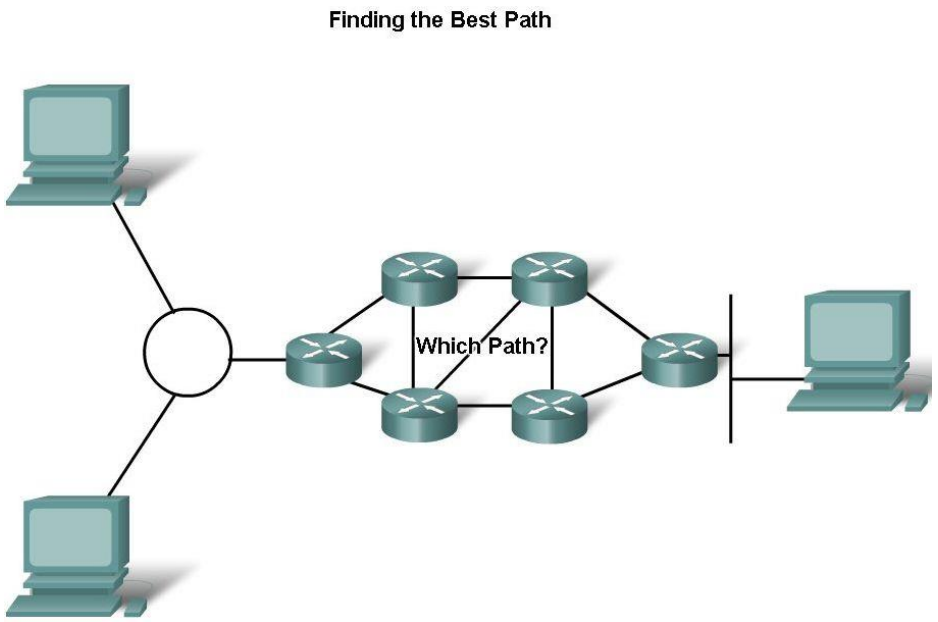
Router Paths and Packet Switching

- **Equal cost metric** is a condition where a router has multiple paths to the same destination that all have the same metric
- To solve this dilemma, a router will use Equal Cost Load Balancing. This means the router sends packets over the multiple exit interfaces listed in the routing table.



Router Paths and Packet Switching

- **Path determination** is a process used by a router to pick the best path to a destination
- One of 3 path determinations results from searching for the best path
  - Directly connected network
  - Remote network
  - No route determined



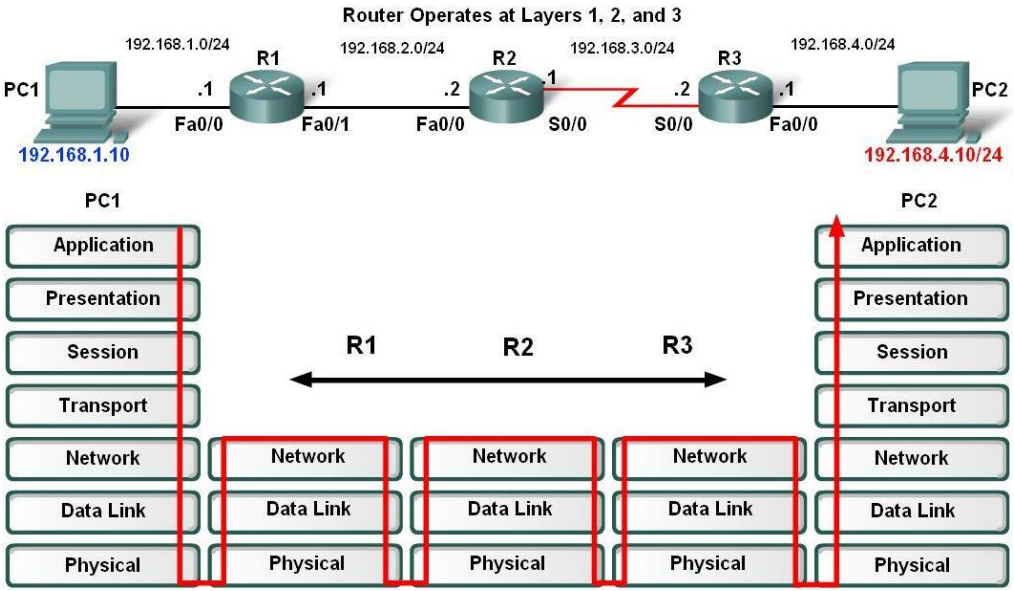
Routers determine the best path to the destination

Router Paths and Packet Switching

- Switching Function of Router is the process used by a router to switch a packet from an incoming interface to an outgoing interface on the same router.
  - A packet received by a router will do the following:
    - Strips off layer 2 headers.
    - Examines destination IP address located in Layer 3 header to find best route to destination.
    - Re-encapsulates layer 3 packet into layer 2 frame.
    - Forwards frame out exit interface.

Router Paths and Packet Switching

- As a packet travels from one networking device to another
  - The Source and Destination IP addresses NEVER change
  - The Source & Destination MAC addresses CHANGE as packet is forwarded from one router to the next.
  - TTL field decrement by one until a value of zero is reached at which point router discards packet (prevents packets from endlessly traversing the network)



Static Route

Static Routes with Exit Interfaces

IP route command

- To configure a static route use the following command: ip route
- Example:

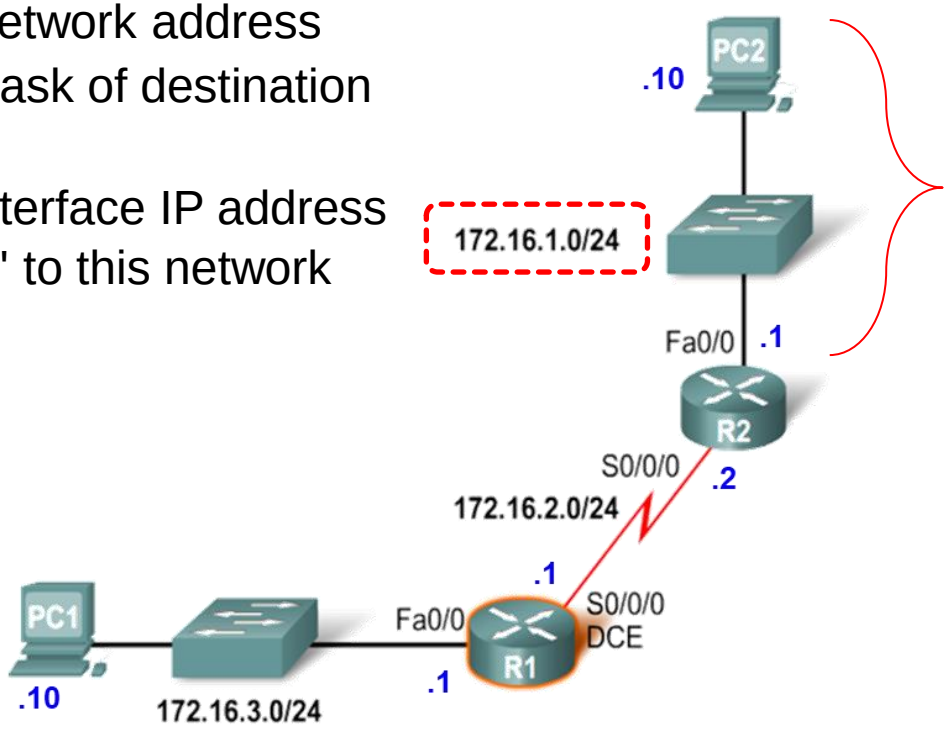
```
Router(config)# ip route network-address subnet-mask
{ip-address | exit-interface }
```

Parameter	Description
network-address	Destination network address of the remote network to be added to the routing table.
subnet-mask	Subnet mask of the remote network to be added to the routing table. The subnet mask can be modified to summarize a group of networks.
ip-address	Commonly referred to as the next-hop router's IP address.
exit-interface	Outgoing interface that is used to forward packets to the destination network.

Static Routes with Exit Interfaces

Insert network 172.16.1.0/24 on R1

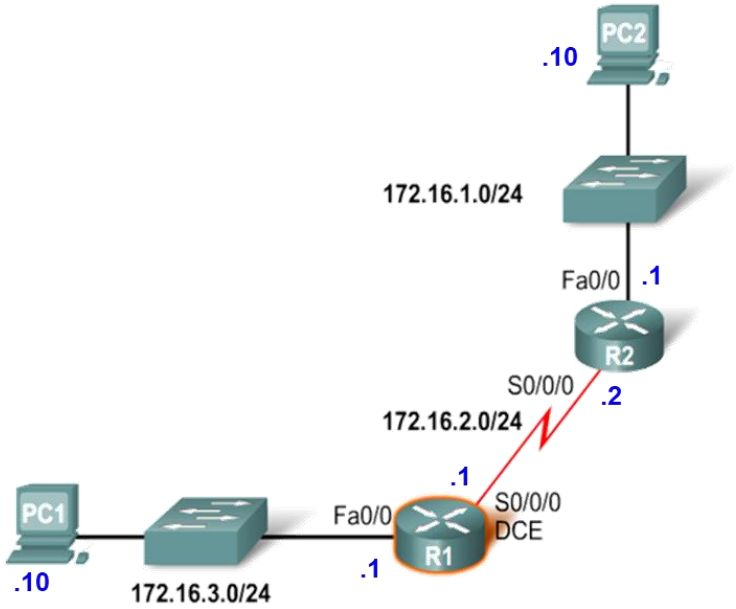
- Dissecting static route syntax
  - **`ip route`** - Static route command
  - **`172.16.1.0`** – Destination network address
  - **`255.255.255.0`** - Subnet mask of destination network
  - **`172.16.2.2`** - Serial 0/0/0 interface IP address on R2, which is the "next-hop" to this network



Static Routes with Exit Interfaces

- **Configuring routes to remote networks**
  - Use the following commands for R1

```
R1(config)#ip route 172.16.1.0 255.255.255.0 172.16.2.2
```



Static Routes with Exit Interfaces

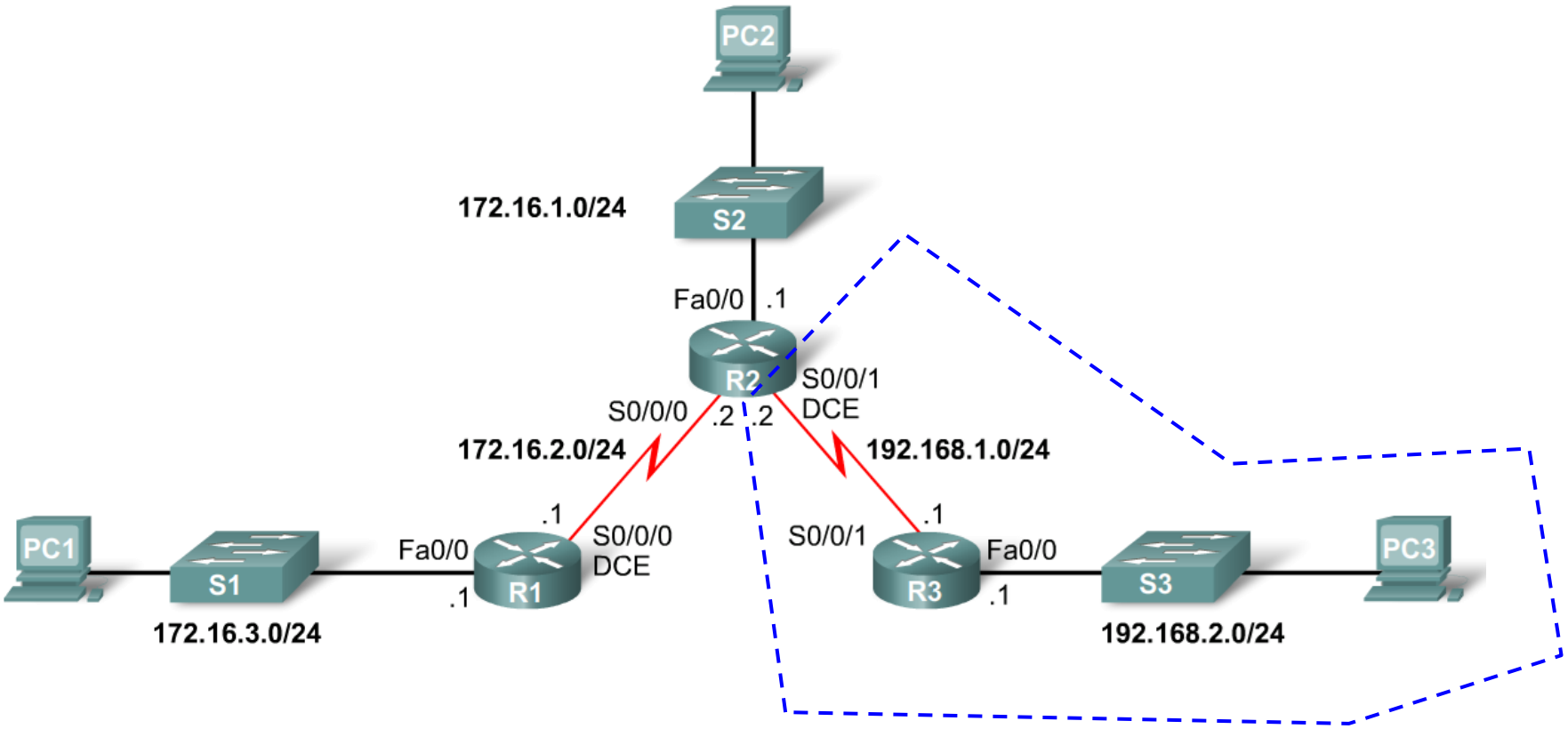
- Modifying Static routes
  - Existing static routes cannot be modified. The old static route must be deleted by placing no in front of the ip route
  - Example:
    - no ip route 192.168.2.0 255.255.255.0 172.16.2.2
  - A new static route must be rewritten in the configuration

```
R1(config)#no ip route 172.16.1.0 255.255.255.0 172.16.2.2
R1(config)#ip route 172.16.1.0 255.255.255.0 serial 0/0/0
```

Static Routes with Exit Interfaces

- Verifying the Static Route Configuration
  - Use the following commands
    - Step 1 **`show running-config`**
    - Step 2 verify static route has been entered correctly
    - Step 3 **`show ip route`**
    - Step 4 verify route was configured in routing table
    - Step 5 issue **`ping`** command to verify packets can reach destination and that Return path is working

Extra – Add R3 and New LAN



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