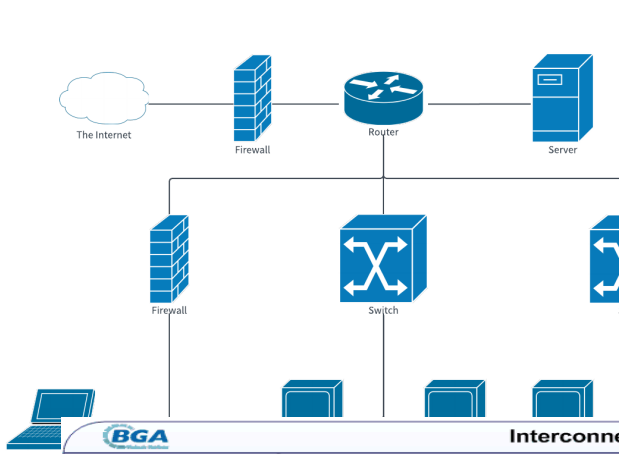
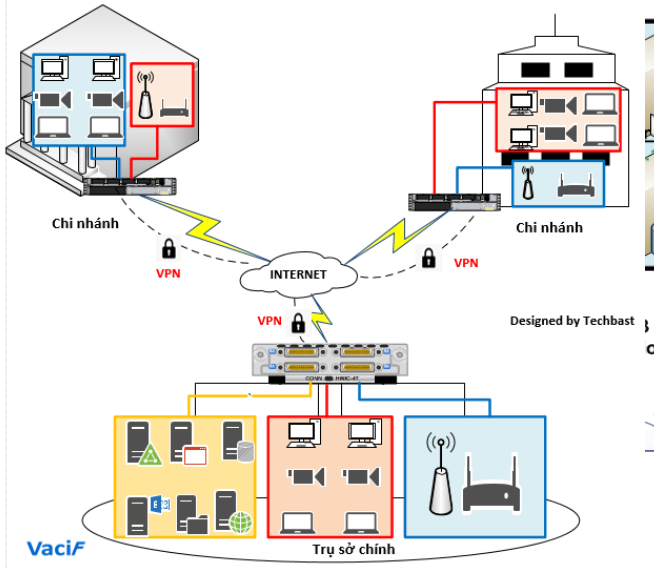
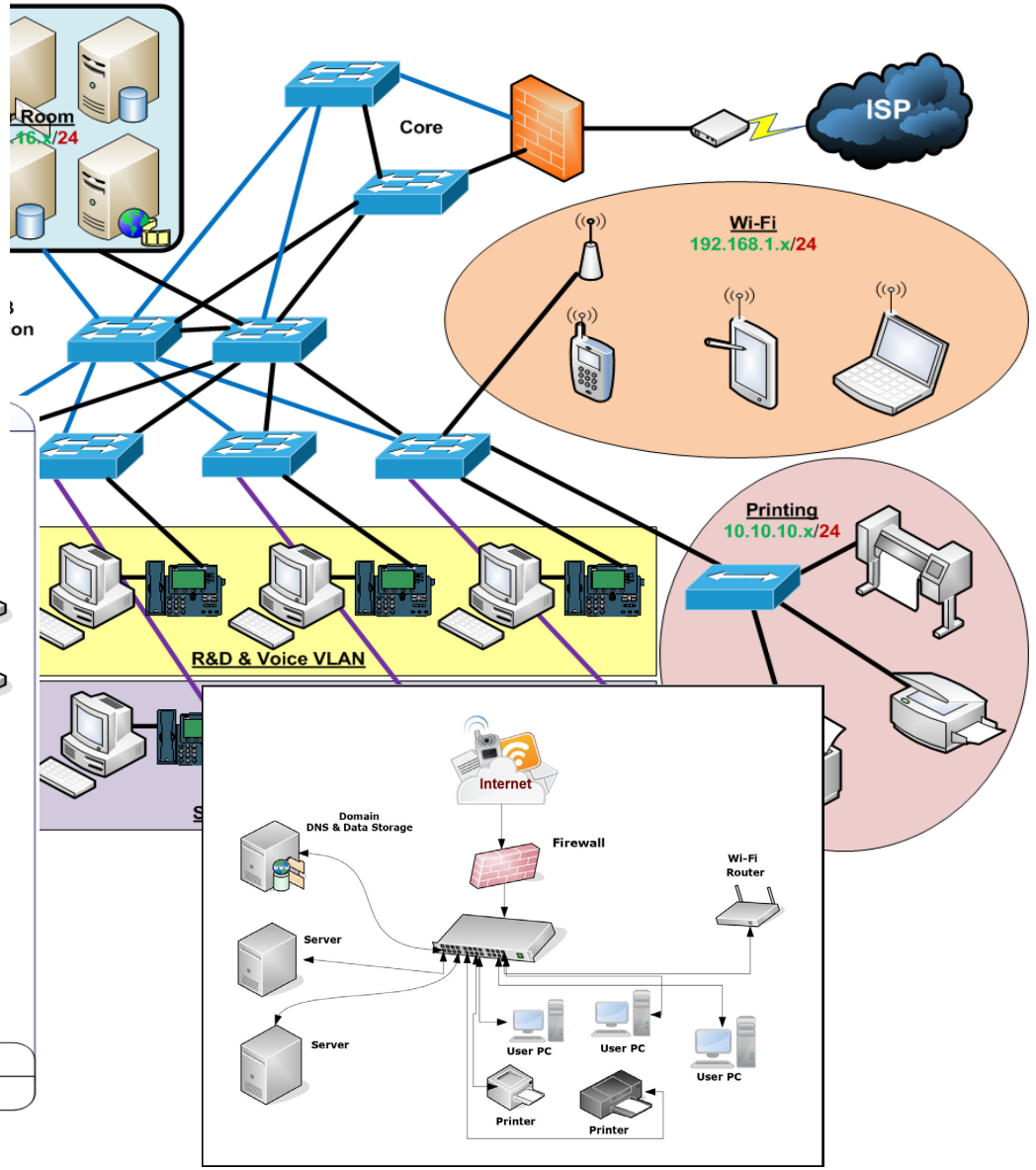
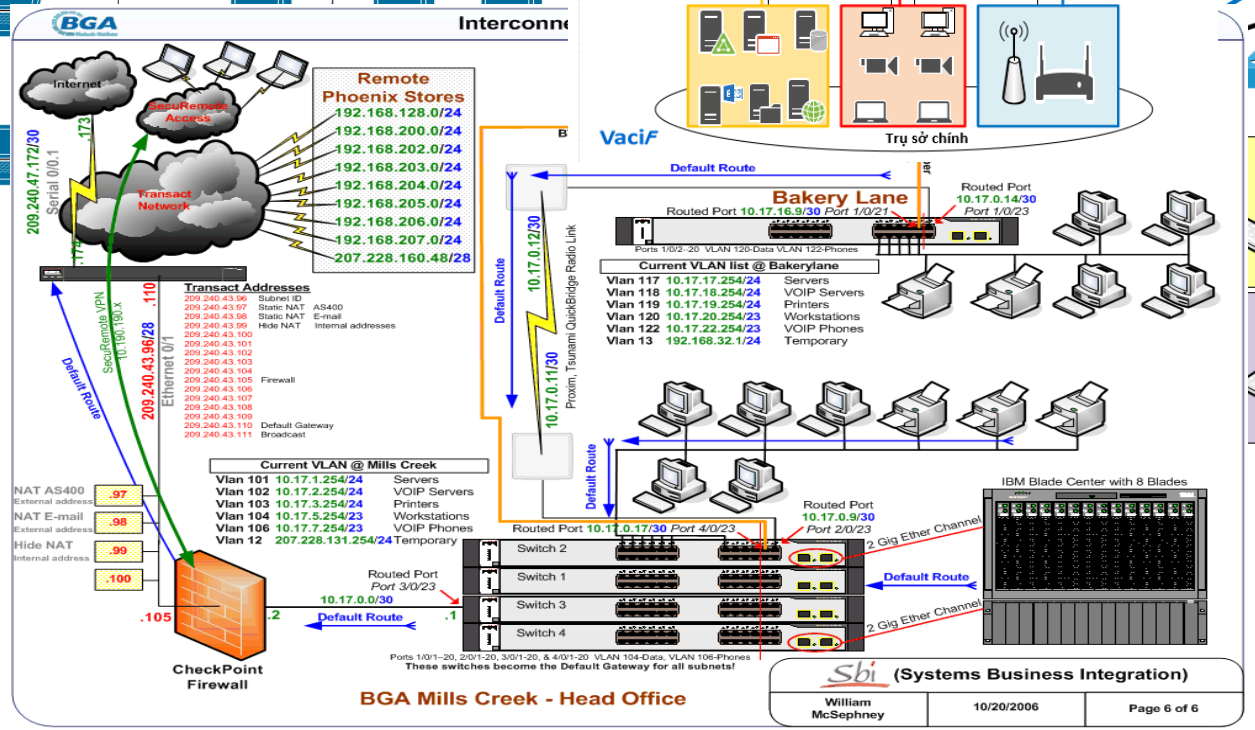
Basics of Switching









House Keeping

INFO-6047 Switching and Routing

ISM1 - Information Security Management (ISM1-ITY-20189) Detailed Weekly Content

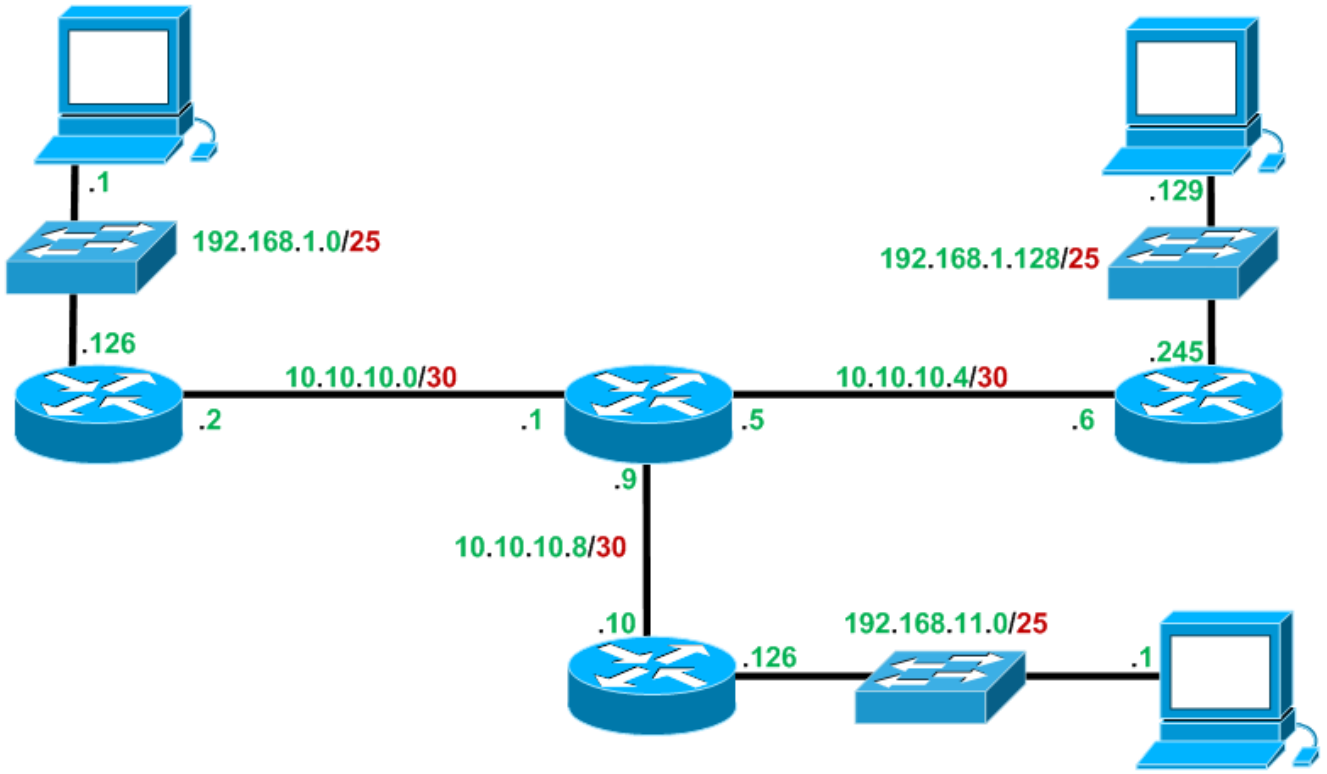
Week	Date of Lecture or Tests, 7:00 – 9:00 PM EST	Lecture/Test	Reading	Lab Time INFO-6047-01 Wednesday 5:00 – 8:00 PM EST INFO-6047-02 Tuesday 5:00 – 8:00 PM EST	Grade
Week 01	Monday, January 02, 2023	College-Wide Orientation			
Week 02	Monday, January 09, 2023	Introduction	N/A	Lab 01 - Basics of PT	3.0%
Week 03	Monday, January 16, 2023	Basics of Routing	**Chapter 01 & 02** *(Introduction to Networking, Network Media Copper)*	Lab 02 - Intro to Routing	3.0%
Week 04	Monday, January 23, 2023	Basics of Switching	**Chapter 03 & 04** *(Network Media Fiber Network Media Wireless)*	Lab 03 - Intro to Switching	3.0%
Week 05	Monday, January 30, 2023	VLANs	**Chapter 05** *(Data Encoding & Transmistion)*	Lab 04 - VLANs	3.0%
Week 06	Monday, February 06, 2023	Routing	**Chapter 06** *(Network OS & Comunications)*	Lab 05 - Routing	3.0%
Week 07	Monday, February 13, 2023	Mid-Term Test		Mid-Term (Test 1)	32.0%
Study Break	Monday, February 20, 2023	Study Break - No Class This Week			
Week 08	Monday, February 27, 2023	Inter-VLAN Routing	**Chapter 10** *(TCP/IP Fundamentals)*	Lab 06 - Inter VLAN Routing	3.0%
Week 09	Monday, March 06, 2023	Static Routing	**Chapter 11** *(Subnetting)*	Lab 07 - Static & Default Routs	3.0%
Week 10	Monday, March 13, 2023	Dynamic Routing - RIP	**Chapter 12** *(Additional Transmission Modalities)*	Lab 08 - RIP Protocol	3.0%
Week 11	Monday, March 20, 2023	Dynamic Routing - OSPF	**Chapter 14** *(RA & LD Communications)*	Lab 09 - OSPF Protocol	3.0%
Week 12	Monday, March 27, 2023	Access Control Lists	**Chapter 15** *(Network Security)*	Lab 10 - ACLs	3.0%
Week 13	Monday, April 03, 2023	DHCP	**Chapter 16** *Maintaining the Network)*	Lab 11 - DHCP	3.0%
Week 14	Monday, April 10, 2023	NAT	**Chapter 17** *(Troubleshooting Fundamentals of a Network)*	Lab 12 - NAT	3.0%
Week 15	Monday, April 17, 2023	Final Test		Final Test (Test 2)	32%

Labs and quizzes will open Monday at 00:01 AM EST and the quiz will close Sunday at 23:59 PM EST.
Tuesday Section-02 from 5:00 – 8:00 PM EST and Wednesday Section-01 from 5:00 – 8:00 PM EST

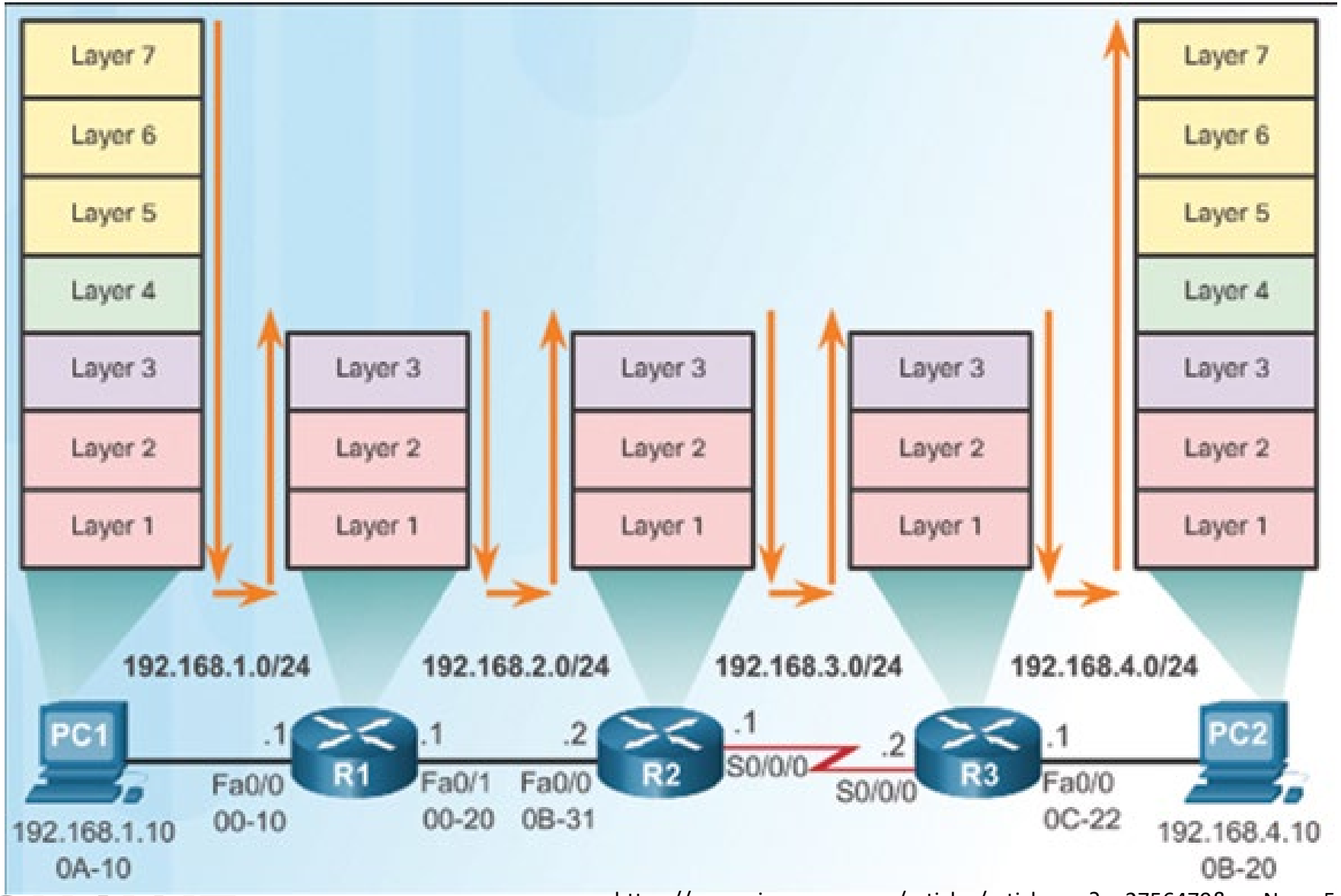
FANSHAWE

Review - Lecture 02 – Basics of Routing

- OSI Model, L3/Routing
- IPv4 Address space (32 bit)
- IPv6 Address space (128 bit)
- Layer 2 vs Layer 3
- Switches as Routers ?
- The word “no”
- Network Topologies
- Physical Layer
- Routers



Encapsulating and De-Encapsulating Packets



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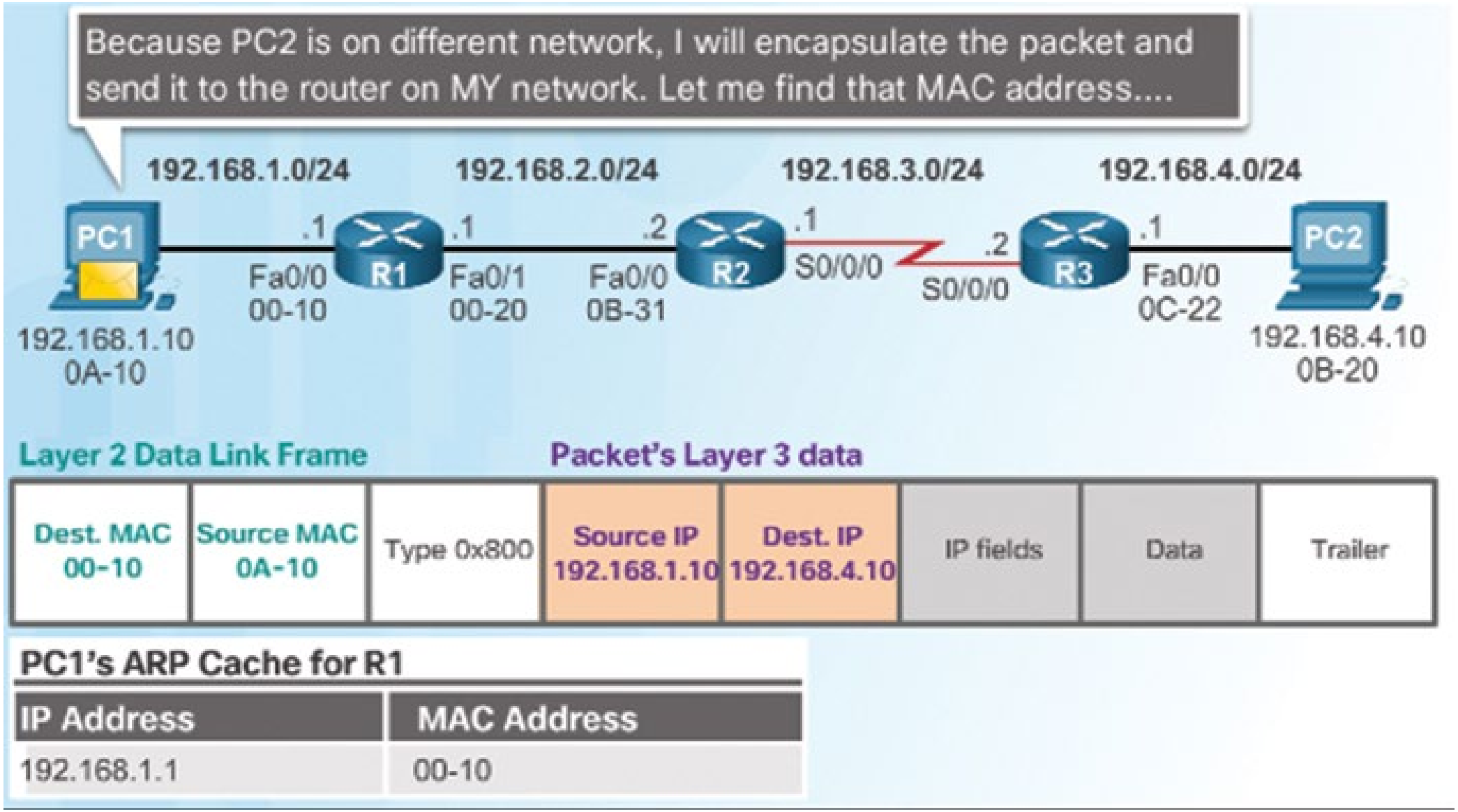
PC1 Sends a Packet to PC2



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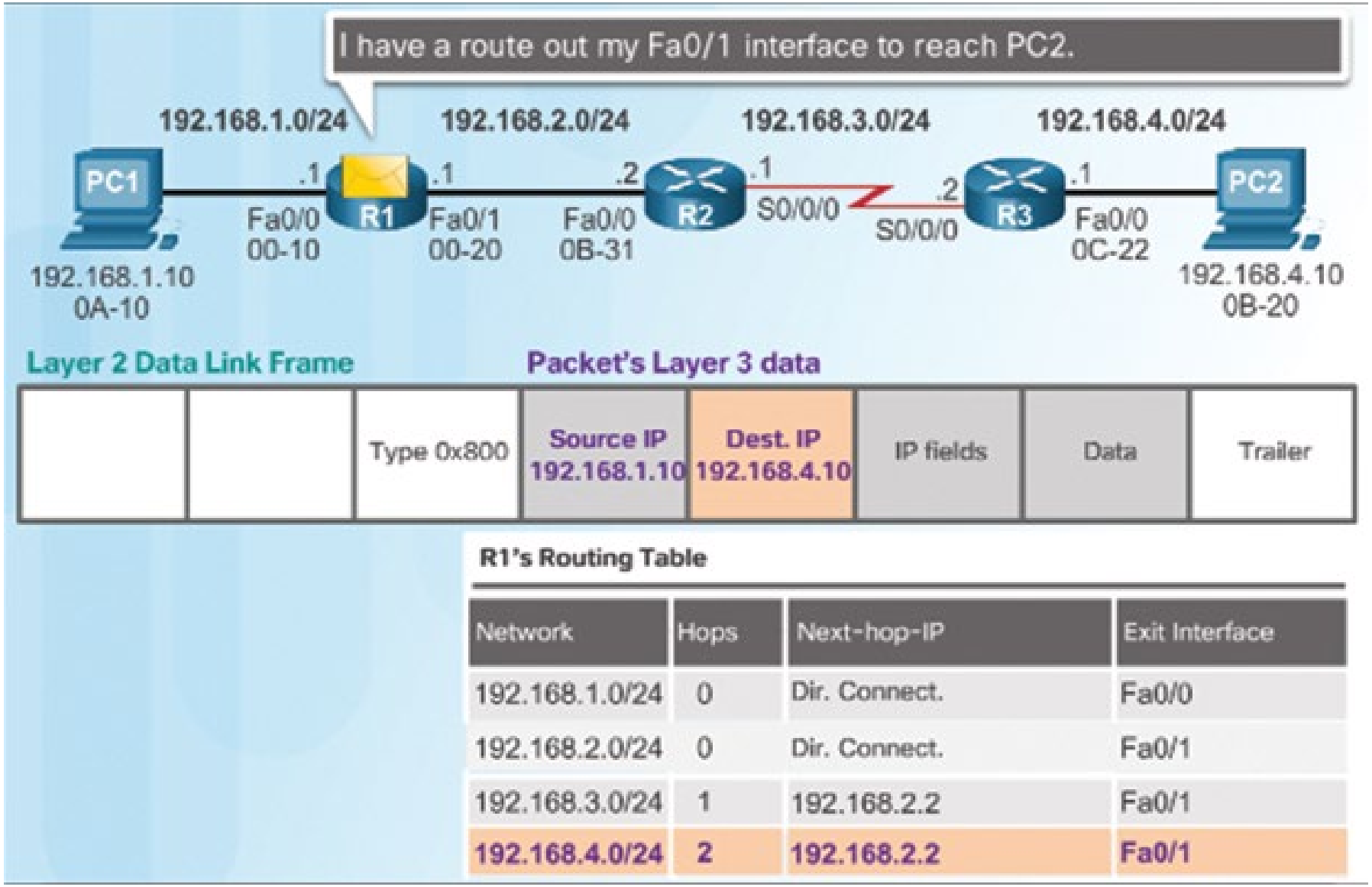
R1 Looks Up Route to Destination



R1's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24	0	Dir. Connect.	Fa0/0
192.168.2.0/24	0	Dir. Connect.	Fa0/1
192.168.3.0/24	1	192.168.2.2	Fa0/1
192.168.4.0/24	**2**	**192.168.2.2**	**Fa0/1**

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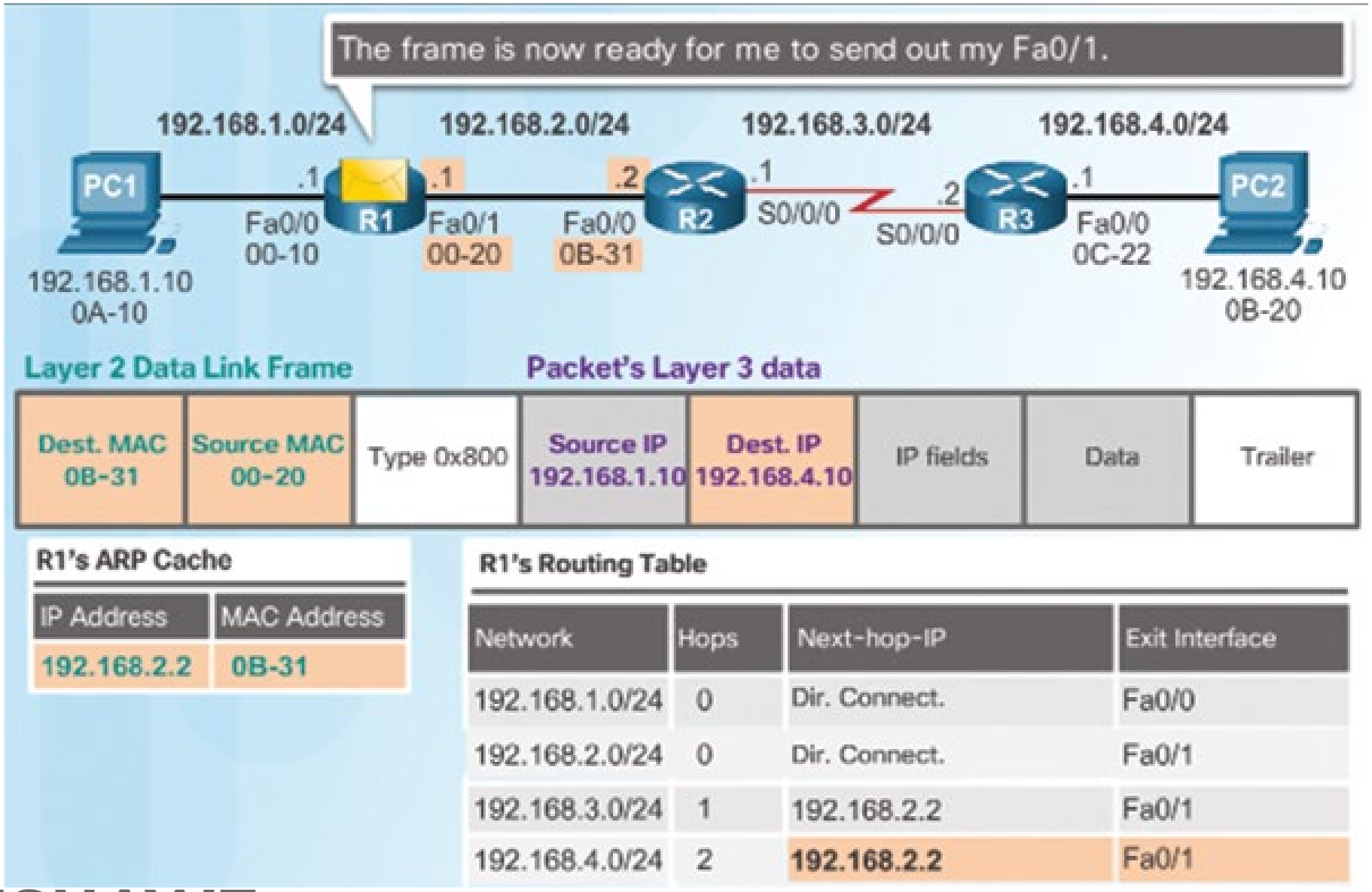
R1 Forwards Packet to R2



R1's ARP Cache

IP Address	MAC Address
192.168.2.2	0B-31

R1's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24	0	Dir. Connect.	Fa0/0
192.168.2.0/24	0	Dir. Connect.	Fa0/1
192.168.3.0/24	1	192.168.2.2	Fa0/1
192.168.4.0/24	2	192.168.2.2	Fa0/1

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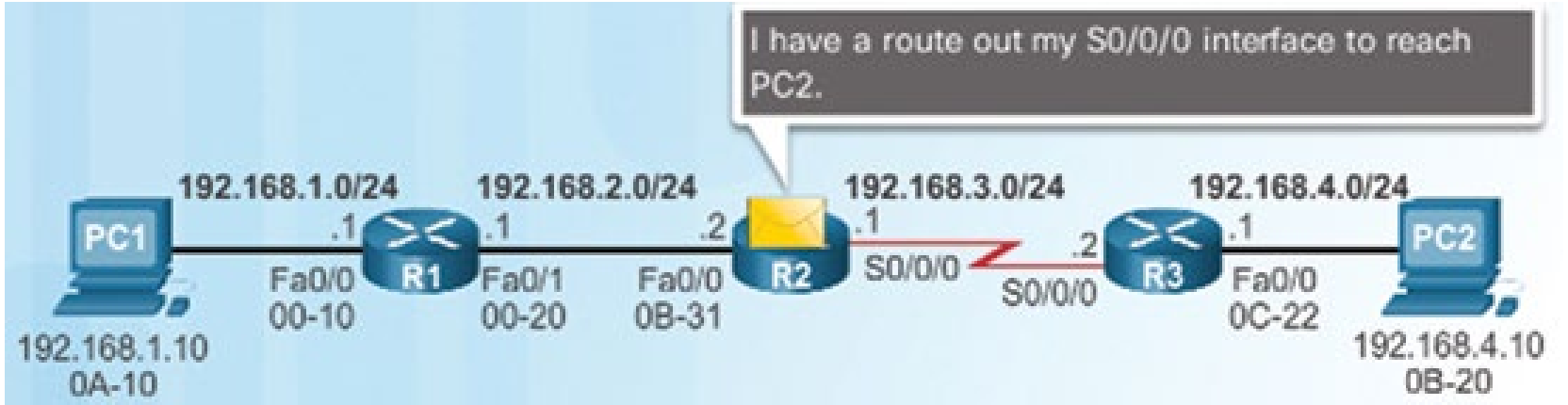
R2 Looks Up Route to Destination



Layer 2 Data Link Frame **Packet's Layer 3 data**

			Source IP 192.168.1.10	Dest. IP 192.168.4.10	IP fields	Data	Trailer

R2's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24	1	192.168.3.1	Fa/0/0
192.168.2.0/24	0	Dir. Connect.	Fa/0/0
192.168.3.0/24	0	Dir. Connect.	S0/0/0
192.168.4.0/24	1	192.162.3.2	S0/0/0

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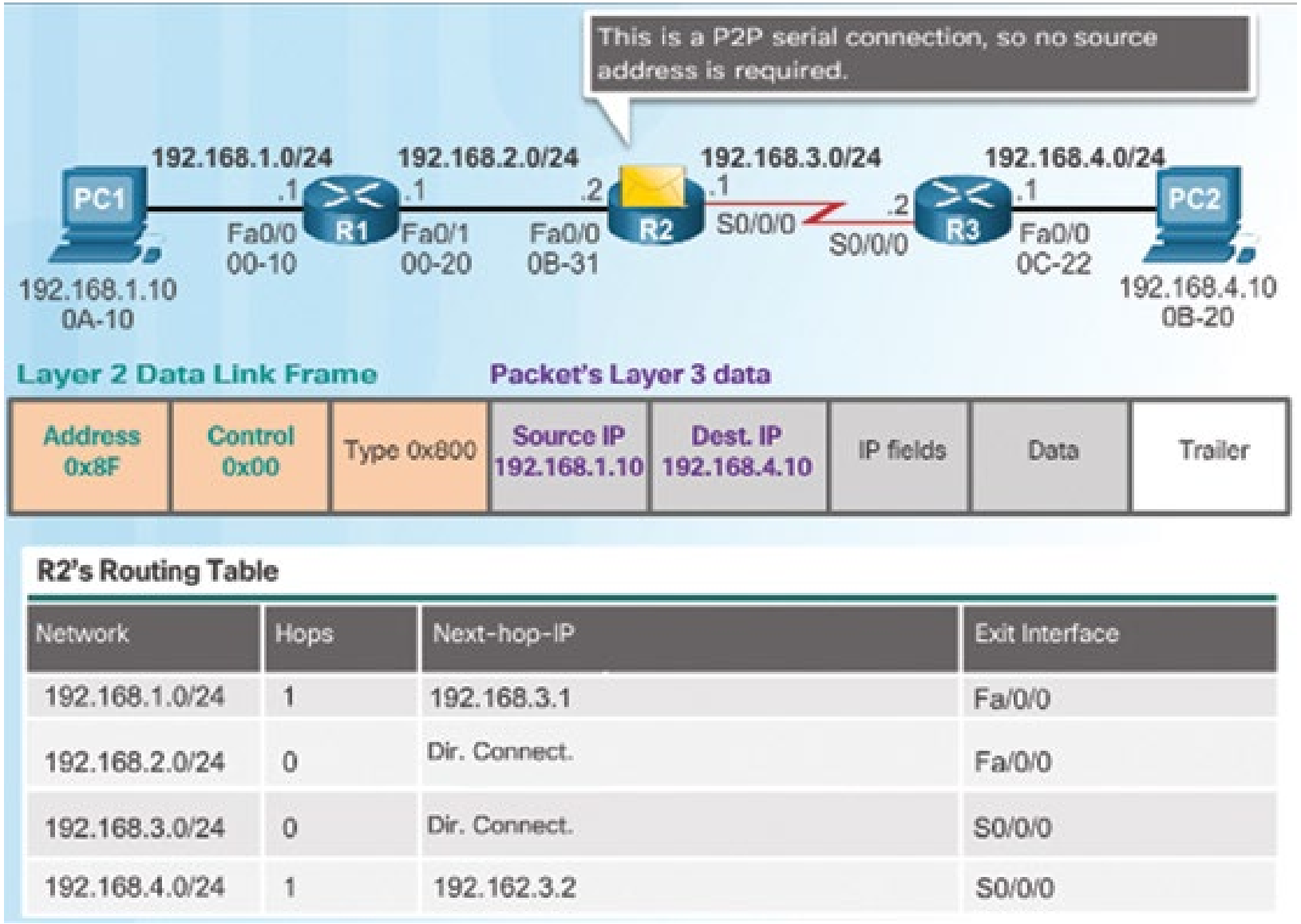
R2 Forwards Packet to R3



R2's Routing Table

Network	Hops	Next-hop-IP	Exit Interface
192.168.1.0/24	1	192.168.3.1	Fa/0/0
192.168.2.0/24	0	Dir. Connect.	Fa/0/0
192.168.3.0/24	0	Dir. Connect.	S0/0/0
192.168.4.0/24	1	192.162.3.2	S0/0/0

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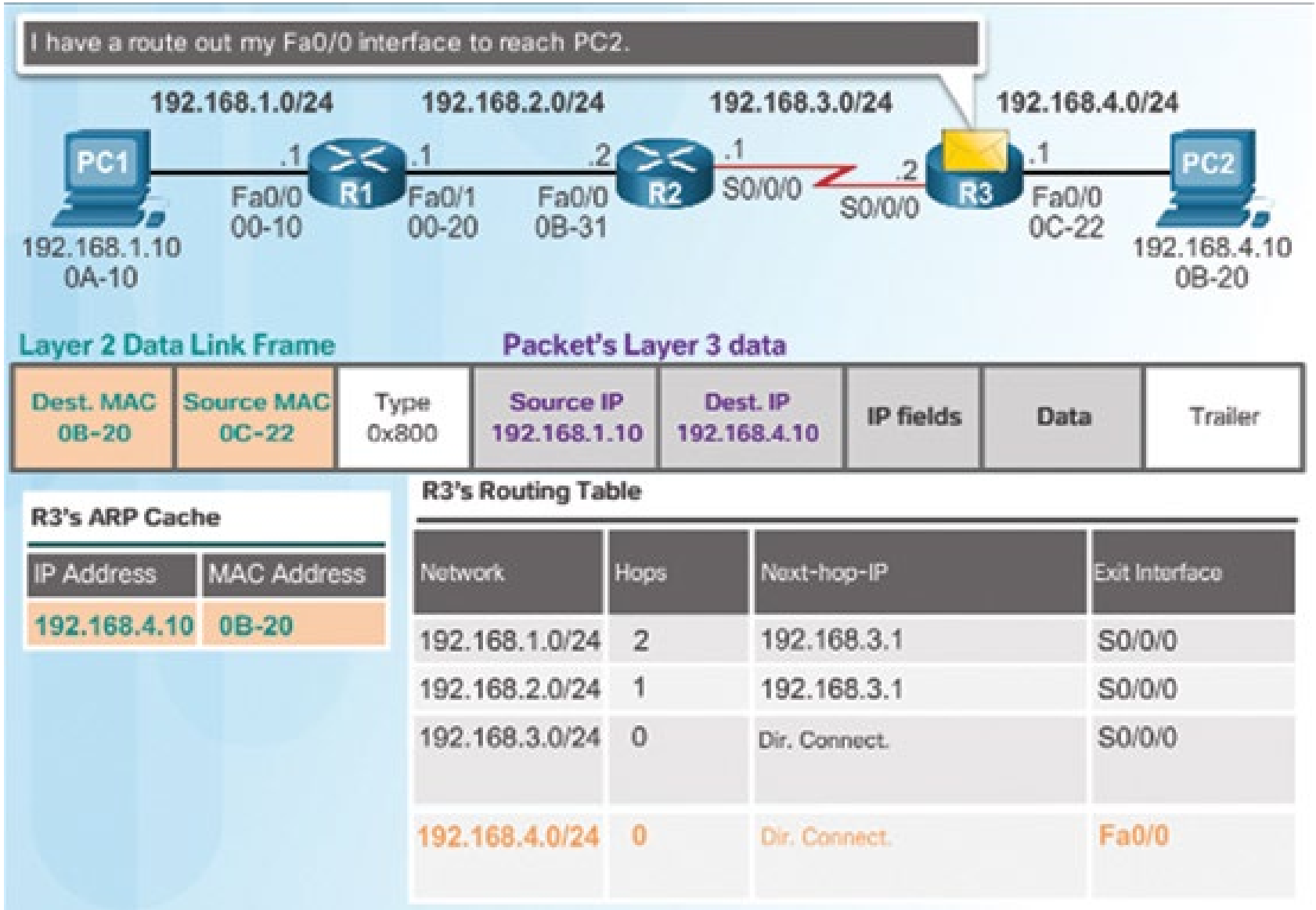
R3 Forwards Packet to PC2



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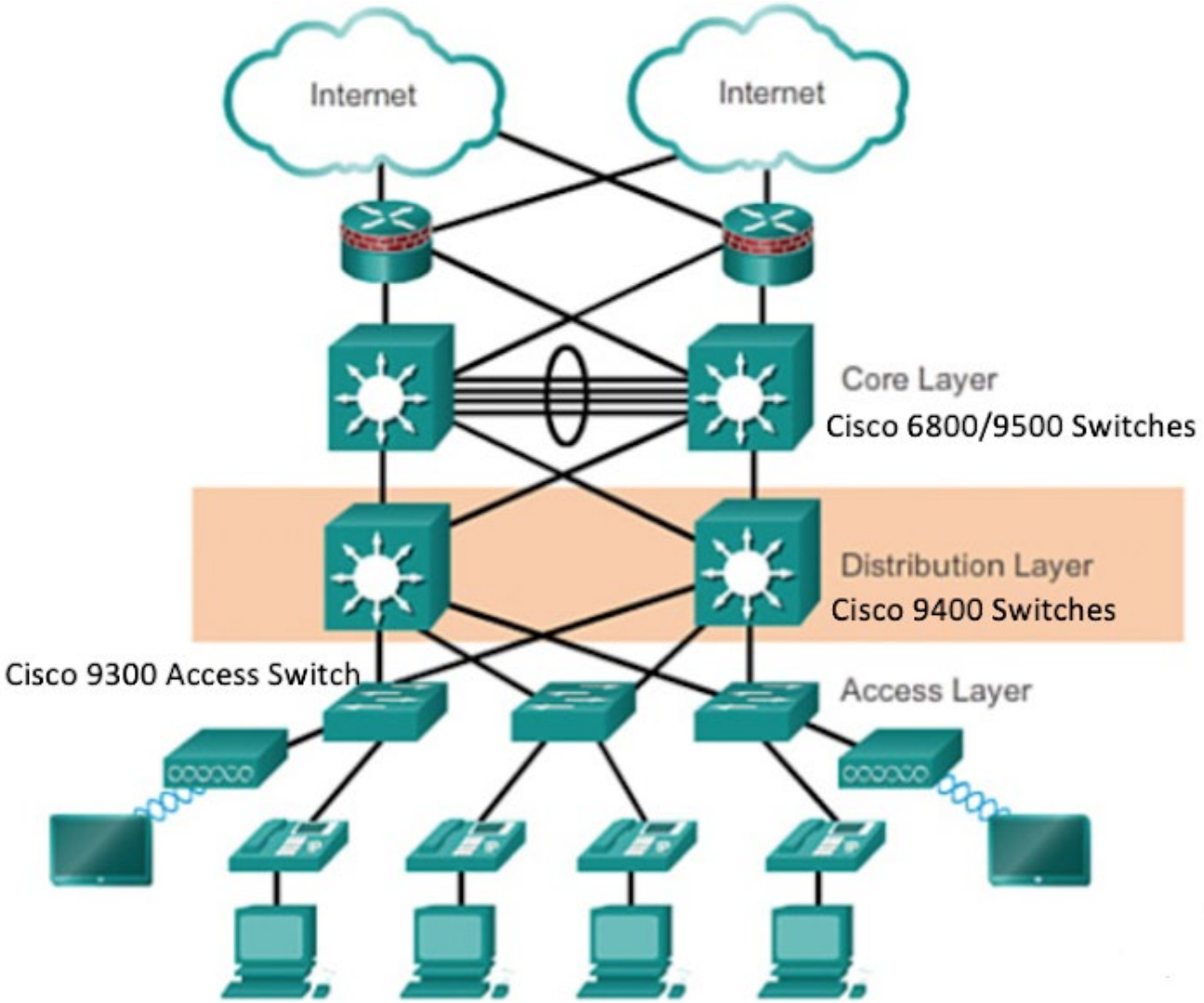
Summary - Basics of switching

- Form Factor
- Ethernet Switches
  - Data Link Layer
  - Broadcast / Unicast
  - MAC Address Table
  - Switch Forwarding Methods
    - Cut-Through
    - Store & Forward
- Network Latency
  - Network Congestion
  - Alleviating Network Congestion
- Switching - Layer 2 / 3
- Switch Database Management (SDM)
- Basic commands
- This week's Lab
- This week's quiz



Form Factor (Cisco)

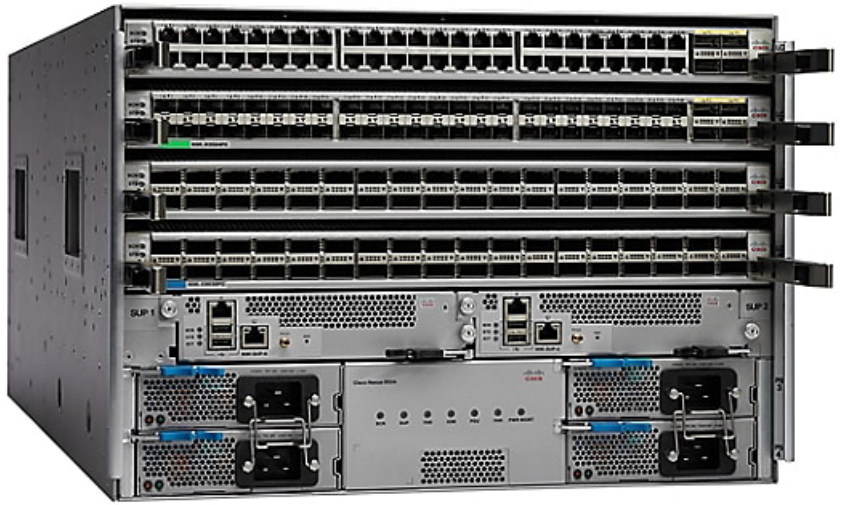
- Fixed Platforms

Common Business Considerations When Selecting Switch Equipment

- **Cost** - The cost of a switch will depend on the number and speed of the interfaces supported features and expansion capability
- **Port Density** - Network Switches must support the appropriate number of devices on the network
- **Power** - it is now common to power access points, IP phones, and even compact switches using Power over Ethernet (PoE). in addition to PoE considerations , some chassis-based switches support redundant power supplies.
- **Reliability** - The switch should provide continuous access to the network
- **Port Speed** - The speed of the network is of primary concern to the end user
- **Frame Buffers** - The ability of the switch to store frames is important in a network where there may be congested port to server or other areas of the network
- **Scalability** - the number of users on a network typically grows over time: therefor, the switch should provide the opportunity for growth.

Form Factor (Cisco) (continued)

- Modular Platform
  - Enterprise chassis
  - The chassis contain one or more management cards
  - The chassis contain one or more Power supplies
  - The chassis accept line cards that contain the port



Form Factor (Cisco) (continued)

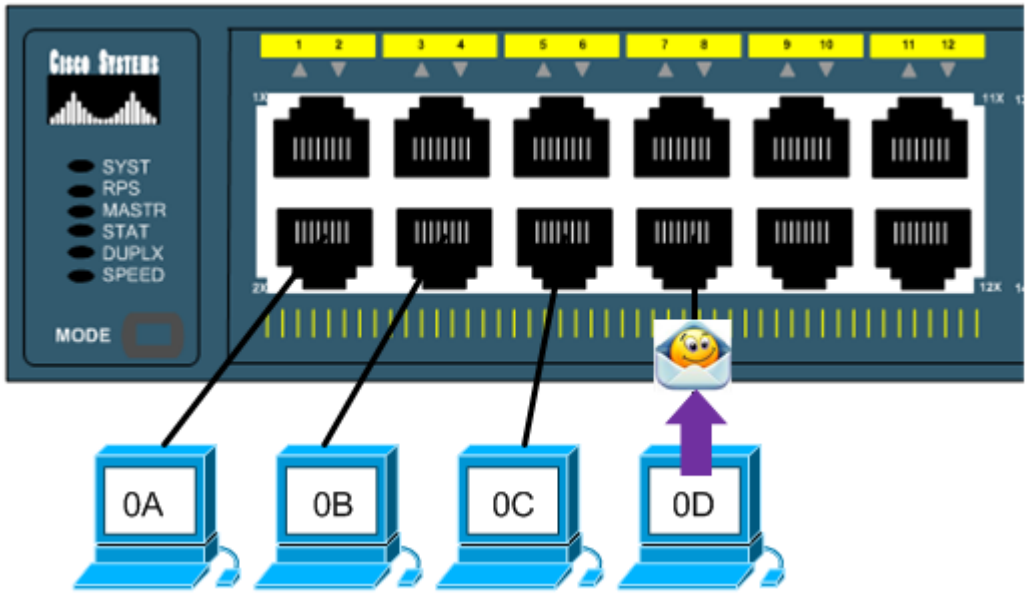
- Stackable Platform
  - Enterprise switches
  - Stackable switches, connected by a special cable, effectively operate as one larger switch
  - Newer versions of the switches, include the possibility of stacking the power supplies

Ethernet Switches (Continued)

- Data Link Layer
  - The basic purposes of data link layer protocols are:
    - Encapsulation, framing
    - access Layer 2
    - to the data channel
    - addressing – MAC addresses
    - bridges, switches
    - many IEEE specifications written at this layer (802.3, 802.5..)
    - moving frame data from device to device
  - Forward Ethernet frames based on the destination MAC address of the frames
  - Builds a table that is used to determine how to forward traffic through the switch
  - Table called a MAC address, forwarding or **C**ontent **A**ddressable **M**emory (CAM) table
  - The port and associated MAC address is stored in the forwarding table
  - The information in the MAC address table is used to send frames

Ethernet Switches (Continued)

- Broadcast



Frame

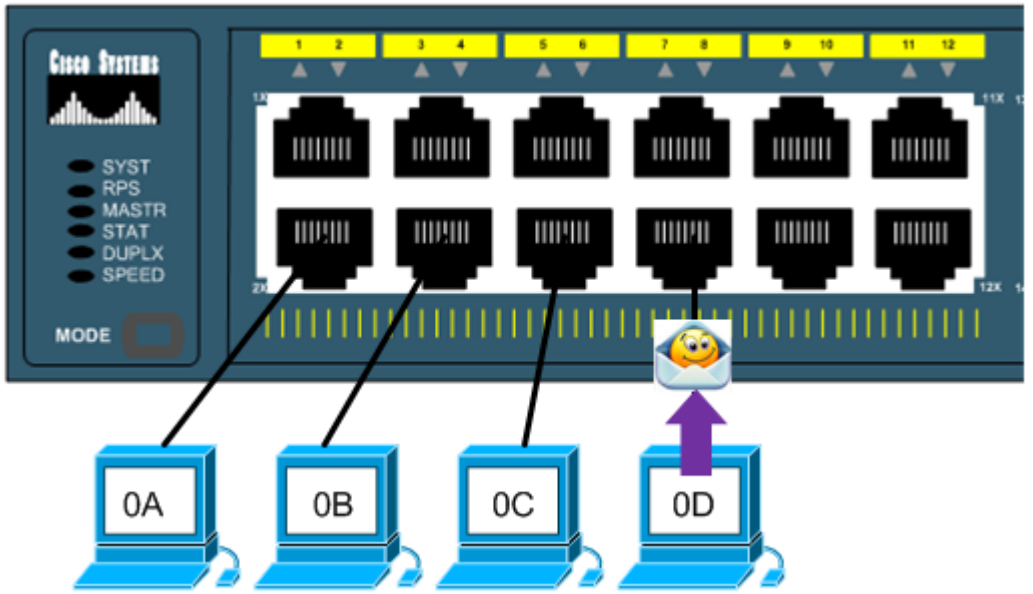
Preamble	Destination MAC	Source MAC	Length	Encapsulated Data	End of Frame
	FF	**0D**			

MAC Table

F0/1	F0/2	F0/3	F0/4	F0/5	F0/6	F0/7	F0/8	F0/9	F0/10	F0/11	F0/12
							0D				

Ethernet Switches (Continued)

- Unicast step 1



Frame

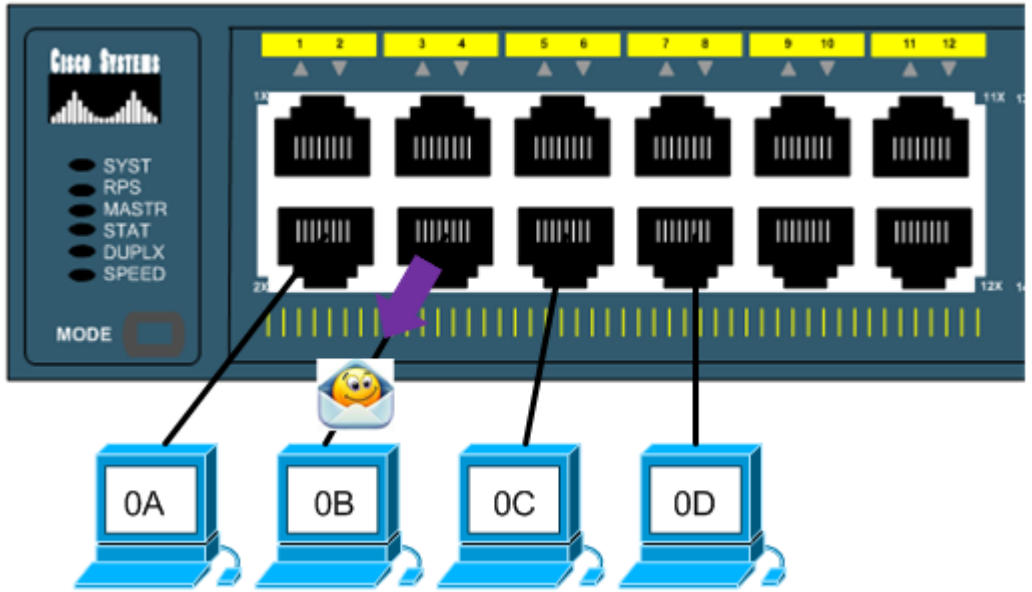
Preamble	Destination MAC	Source MAC	Length	Encapsulated Data	End of Frame
	0B	**0D**			

MAC Table

F0/1	F0/2	F0/3	F0/4	F0/5	F0/6	F0/7	F0/8	F0/9	F0/10	F0/11	F0/12
	0A		**0B**		**0C**		**0D**				

Ethernet Switches (Continued)

- Unicast step 2



Frame

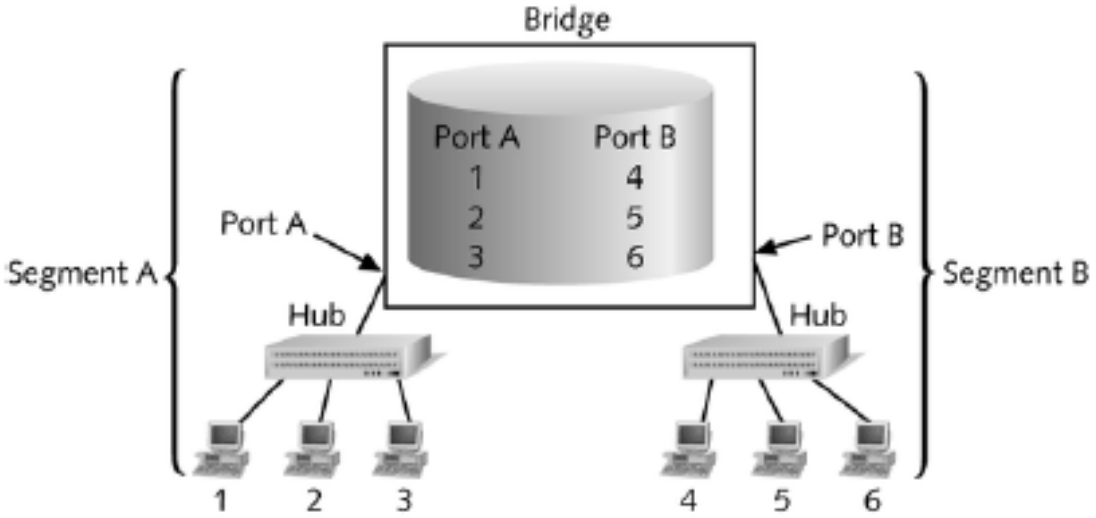
Preamble	Destination MAC	Source MAC	Length	Encapsulated Data	End of Frame
	0B	**0D**			

MAC Table

F0/1	F0/2	F0/3	F0/4	F0/5	F0/6	F0/7	F0/8	F0/9	F0/10	F0/11	F0/12
	0A		**0B**		**0C**		**0D**				

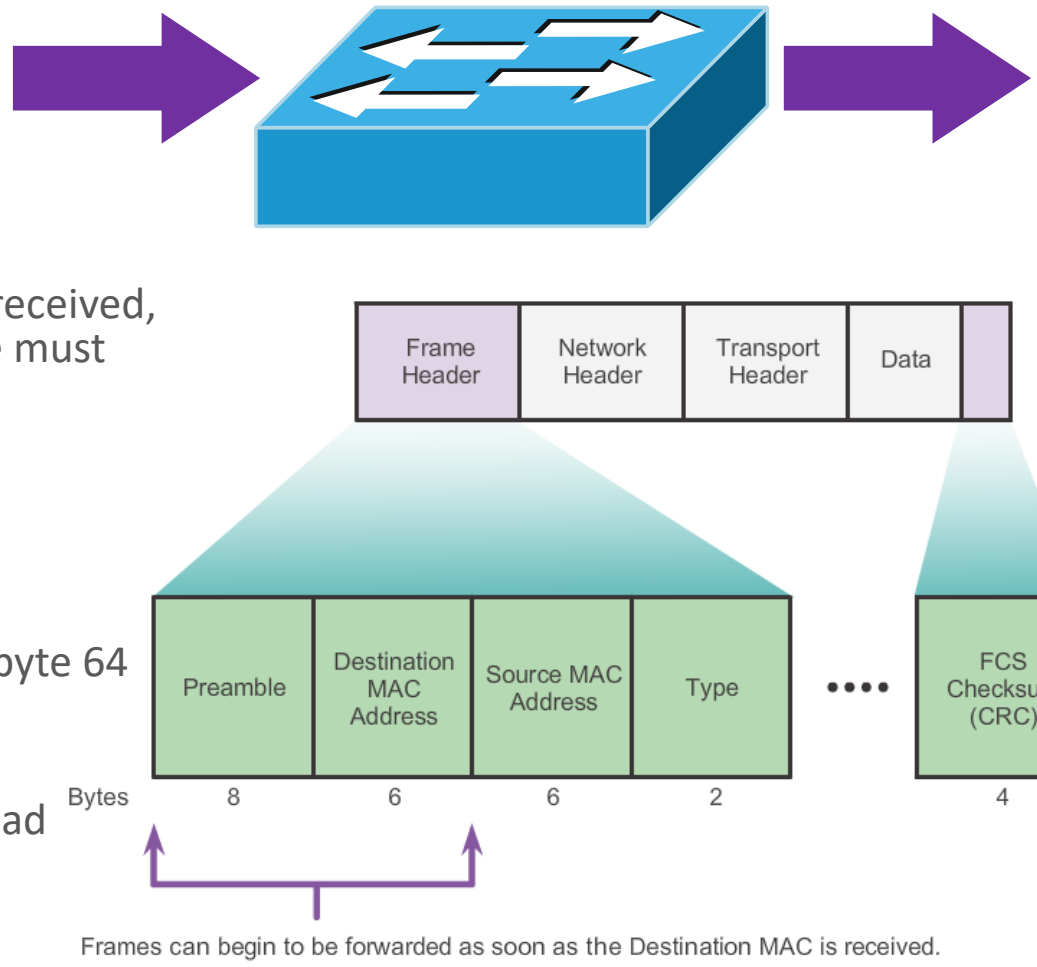
Ethernet Switches (Continued)

- MAC Address Table/Filtering database
  - database of MAC addresses and ports
  - forwarding table
  - Cisco calls CAM
  - Back in the Thick Net, Thin Net and Hub days also known as a **Bridge** or a **Repeater**



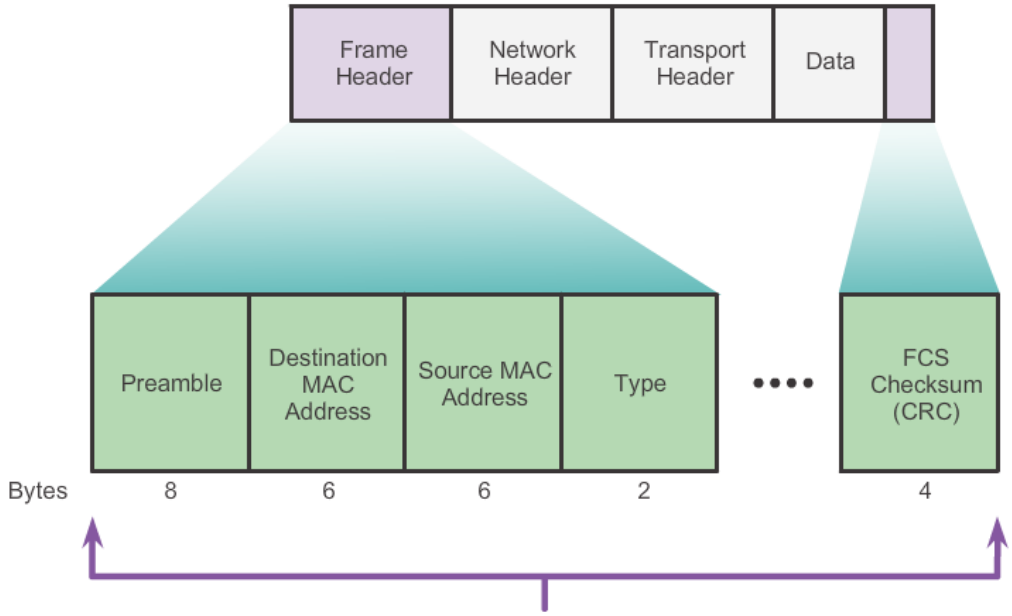
Ethernet Switches (Continued)

- Switch Forwarding Methods
  - Cut-Through
    - First switches were cut-through
    - Used on older switches
    - Two variants:
      - Fast Forward
      - Fragment Free
    - A cut-through switch forwards before it is entirely received, at a minimum the destination address of the frame must be read before the frame can be forwarded
    - Cut Through allows the switch to start forwarding in about 10 microseconds (very Fast)
    - No FCS check
    - No Automatic Buffering
    - Read start of frame as it comes in, as far as end of byte 64
    - Look up port and start forwarding while remainder of frame is still coming in
    - Discards collision fragments (too short) but other bad frames are forwarded
    - Entry and exit must be same bandwidth
    - Lowest latency



Ethernet Switches (Continued)

- Switch Forwarding Methods (Continued)
  - Store & Forward
    - Used when switch has interfaces which support different speeds
    - Cisco switches are now all store and forward
    - Required for support of combination of 10/100/1000 interfaces
    - A store-and-forward switch receives the entire fran switch looks up the destination address which dete forwarded out the correct port
    - Store and Forwarding allows the switch to:
      - Check for errors (via FCS check)
      - Perform Automatic Buffering
    - ~Slower forwarding
    - Used today by most every switch as a default



Store-and-forward switching entails receipt of the entire frame (up to about 9,200 bytes for jumbo frames) before a forwarding decision is made.

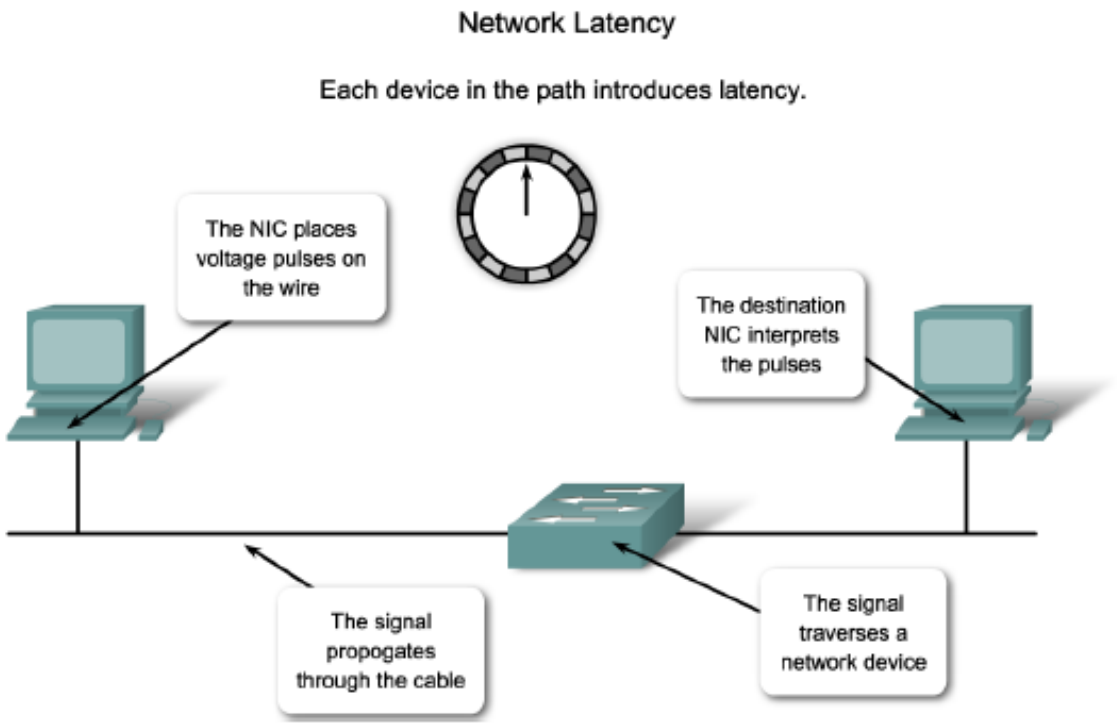
Ethernet Switches (Continued)

- Switch Forwarding Methods (Continued)

	Store-and-Forward	Cut-Through
1. Buffers frames until the full frame has been received by the switch.	✓	
2. Checks the frame for errors before releasing it out of its switch ports if the full frame was not received, the switch discards it.	✓	
3. No error checking on frames is performed by the switch before releasing the frame out of its ports.		✓
4. A great method to use to conserve bandwidth on your network.	✓	
5. The destination Network Interface Card (NIC) discards any incomplete frames using this frame forwarding method.		✓
6. The faster switching method, but may produce more errors in data integrity therefore, more bandwidth may be consumed.		✓

Network Latency

- The time a frame or packet takes to travel from the source to the destination
  - A typist will stop using the network tools somewhere around 250ms of latency



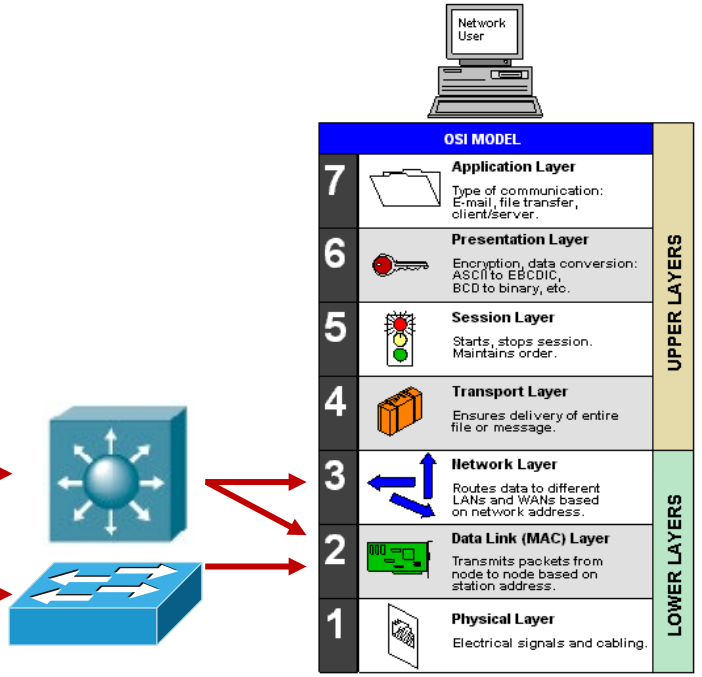
Network Latency (continued)

- Network Congestion
  - PCs more powerful -send and process more data at higher rates
  - Increasing use of remote resources
  - More broadcasts, more congestion
  - Applications make more use of advanced graphics, video etc.
  - Splitting collision and broadcast domains helps
- Alleviating Network Congestion
  - Switches help alleviating network congestion by:
    - facilitating the segmentation of a LAN into separate collision domains
    - providing full-duplex communication between devices
    - taking advantage of their high port density
    - buffering large frames
    - employing high speed ports
    - taking advantage of their fast-internal switching process
    - having a low per-port cost

Switching - Layer 2 / 3

- Traditional Ethernet switches
  - work at layer 2
  - use MAC addresses
- Layer 3 switches
  - can carry out the same functions as layer 2 switches
  - can also use layer 3 IP addresses to route between networks

- Layer 3 switch
- Layer 2 switch



Switch Database Management (SDM)

- Many switches do NOT know what IPv6 is out of the box
- They will pass IPv6 packet with out hinderance
- **BUT** to add an IPv6 address to a VLAN or a route entry we need to use the SDM command to enable IPv6
- To start using IPv6 on a Cisco Layer 3 Switch, you need to start by reconfiguring the switches memory with the SDM command
- The **reload** command is needed to restart the operating system and redistribute the memory
- There are many argument for the SDM command BUT for us this is what we need to do "**sdm prefer dual-ipv4-and-ipv6 default**" to get IPv4 and IPv6 to work on a switch.
- Of course, this **will not work on a L2 device**

In "**enable**" mode use the show command to see the state of the "SDM"

SW-1# show sdm prefer

Now we need to actually tell the switch that we will be using IPv4 and IPv6 addressing

SW-1# conf t

SW-1(config)# sdm prefer ?

This will give you a list of possible SDM configurations, the one you want is:

dual-ipv4-and-ipv6 default

once you see the list of possible options the prompt at the bottom of the screen should be

SW-1(config)# sdm prefer dual-ipv4-and-ipv6 default"

Press enter and follow the prompts which should have you doing:

SW-1(config)# exit

SW-1# reload

Basic Commands

The prompt should look like the following:

switch>

To enter **Privileged** (enable) mode type

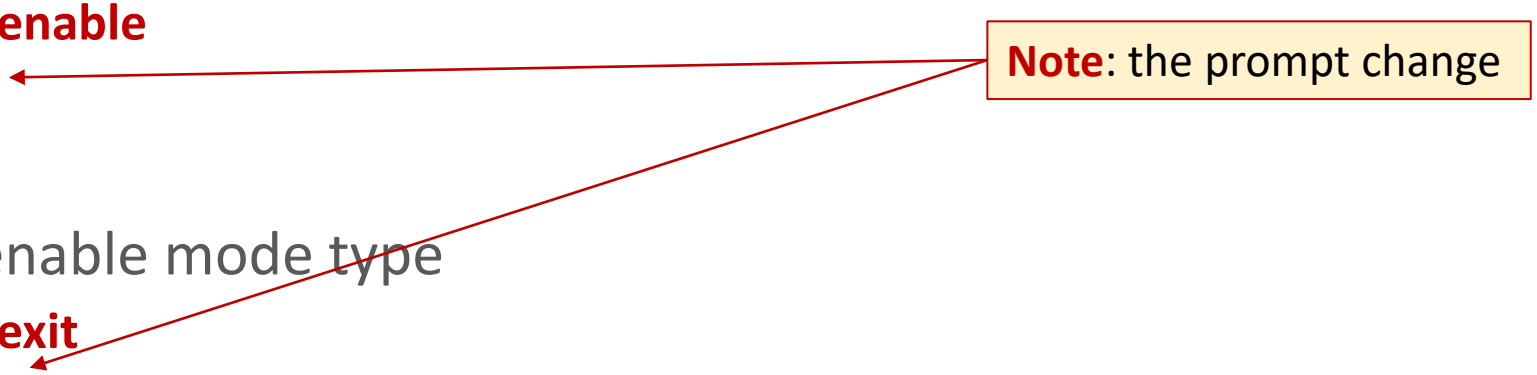
switch> enable

switch#

To leave enable mode type

switch# exit

switch>



Basic Commands (continued)

- Hostname
  - Must be set from Global Configuration Mode

    You must first be in **Privileged** (enable) mode

    To enter **Global Config** mode type

    switch# **conf t** (config terminal)

    switch(config)# hostname <*name*>

```
Press RETURN to get started!


Switch> enable
Switch# config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# hostname G2010
G2010(config)#
```

Note: the prompt change

Basic Commands (continued)

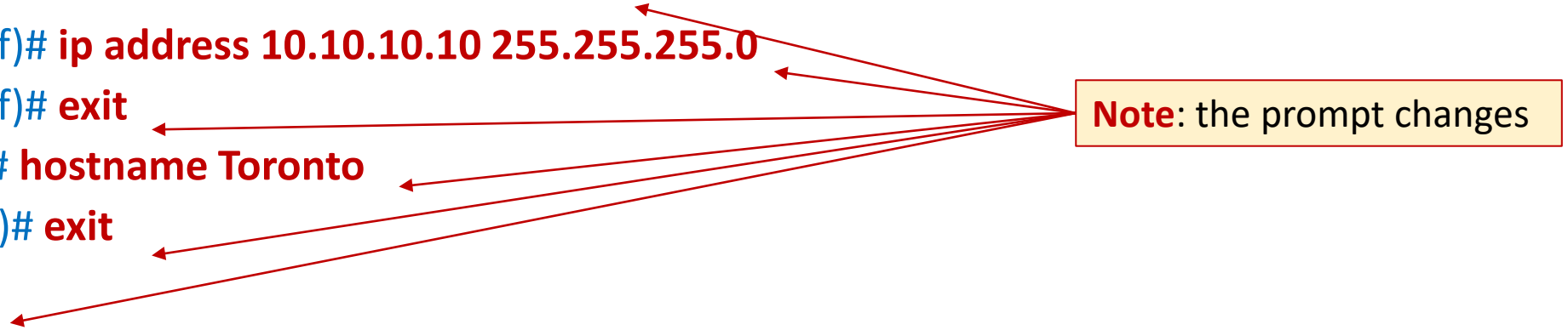
- Login Passwords
  - Cisco stores console enable and telnet passwords in plain text in configuration file
  - **service password-encryption** command used to encrypt all stored passwords
  - Code 7 indicates service password encryption is being used
  - It's not great encryption, BUT it keeps the noisy looky-loos from looking over your shoulder and seeing the passwords
  - There are may sites on the internet where you can feed in a code 7 password, and it will decode it for you.

```
Switch(config)#show running
----------------------deleted output-----------
line con 0
password cisco
login
!
line vty 0 4
password cisco
login
line vty 5 15
password cisco
login

Switch(config)#service password-encryption

Switch(config)#show running
----------------------deleted output-----------
line con 0
password 7 0822455D0A16
login
!
line vty 0 4
password 7 0822455D0A16
login
line vty 5 15
password 7 0822455D0A16
login
```

Basic Commands (continued)

- Working from the privileged mode (**enable**)
  - To configure the switch you must be in configuration mode

switch# **config t** (**t** for terminal) full command is **configure terminal**
switch(config)# **interface vlan 1**
switch(config-if)# **ip address 10.10.10.10 255.255.255.0**
switch(config-if)# **exit**
switch(config)# **hostname Toronto**
Toronto(config)# **exit**
Toronto# **exit**
Toronto>



Basic Commands (continued)

- Commands to verify your configuration
  - Show commands
    - show running-config
    - show ip interface brief ← interfaces used should be “up” and “up”
    - show interface (fa 0/1)
    - show vlan
    - show cdp neighbors ← one of my favorite command to see if cable are plugged in correctly
    - show version
    - show post ← Not available in Packet Tracer
    - show interface status

Basic Commands (continued)

- Interface Range

```
Switch(config)# interface range fa0/1 - 20
Switch(config-if-range)#
```

- A useful command if you want to put the same configuration on several interfaces
  - Place in VLAN
  - Set port security
  - Trunking

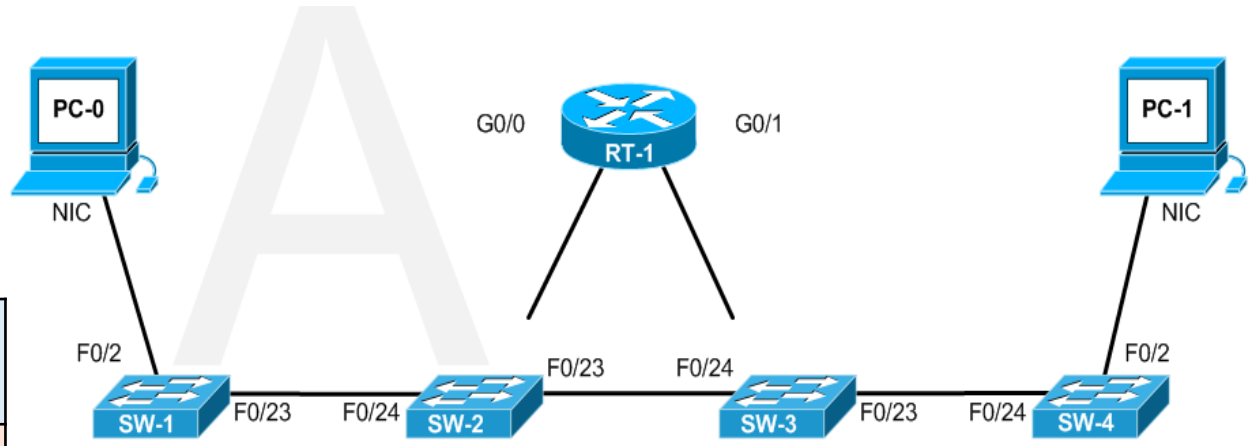
Basic Commands (continued)

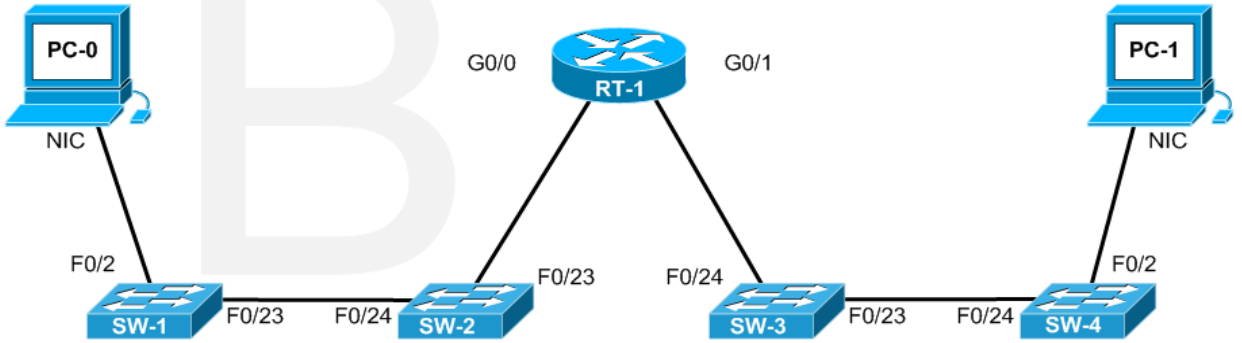
- Save your Configuration
  - Your configuration should be saved to NVRam
    - **copy running-config startup-config**

    or
    - **write** for short or shorter yet **wr**
  - This will save your configuration to a text file called **config.text** in **NVRAM** (**N**one **V**olatile **RAM** (**R**andom **A**ccess **M**emory))
  - Can be copied from the CLI and saved as a text file
  - From the command line you can save a text file to a TFTP or FTP server

LAB

Device	Port	IPaddress	Subnet /CIDR	Default Gatway
RT-1	G0/0	192.268.1.245	/24	
RT-1	G0/1	192.168.11.254	/24	
PC-0	NIC	192.168.1.1	/24	
PC-1	NIC	192.168.1.2	/24	





This weeks quiz

- Reminder
  - This week's quiz questions are from this week's lecture, lab, and chapters 1 through 4 of the reading material!

QUESTIONS