Computer Networks

Lecture 5: **Network Design and Access Layer**

Department of Information and Communication Technology

Outline of the syllabus
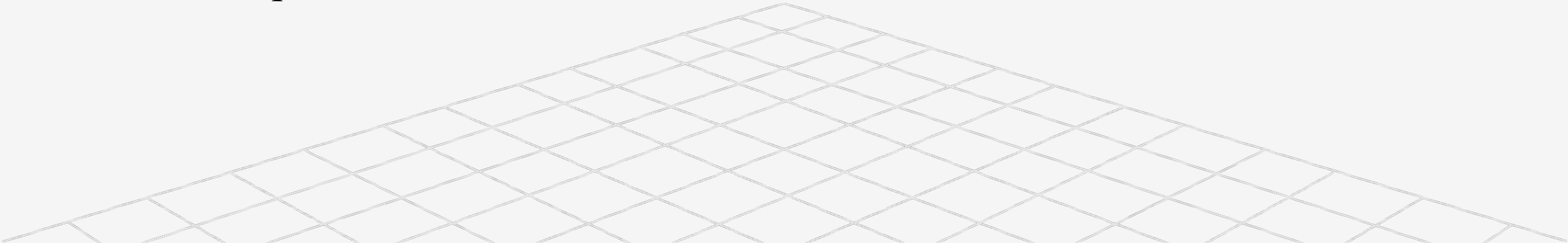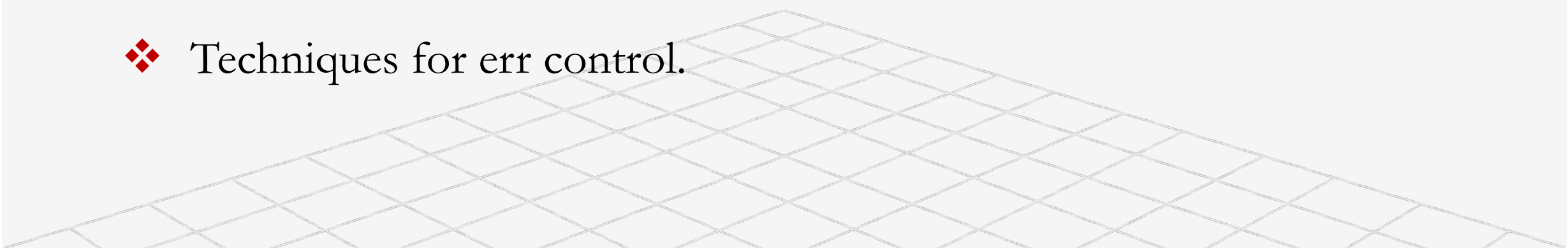
Outline of the syllabus

❖ Week 8 – Transport Layer

❖ Week 9 – Network Layer

❖ Week 10 – Data Link layer

❖ Week 11 – Physical layer.

❖ Week 12 - Routing techniques

❖ Week 13– how to setup local area networrk

❖ Week 14 – Revision

Learning Objectives

After completing this module, you will be able to:

❖ Understand how communication occurs on Ethernet networks.

❖ Understand the what are MAC and LLC and Multiple Access Protocols

❖ Understand the packet and Farm relationship

❖ Services that provides by the DLL

❖ Techniques for err control

Lecture -5 Outline

❖ Revisit the OSI Model

❖ Data Link layer and its characteristics

❖ Discuss the sublayers of the DDL

❖ Explain the protocols – ALOHA and CSMA

❖ Devices that use in DDL

❖ Techniques for err control.

Network Design and Access Layer

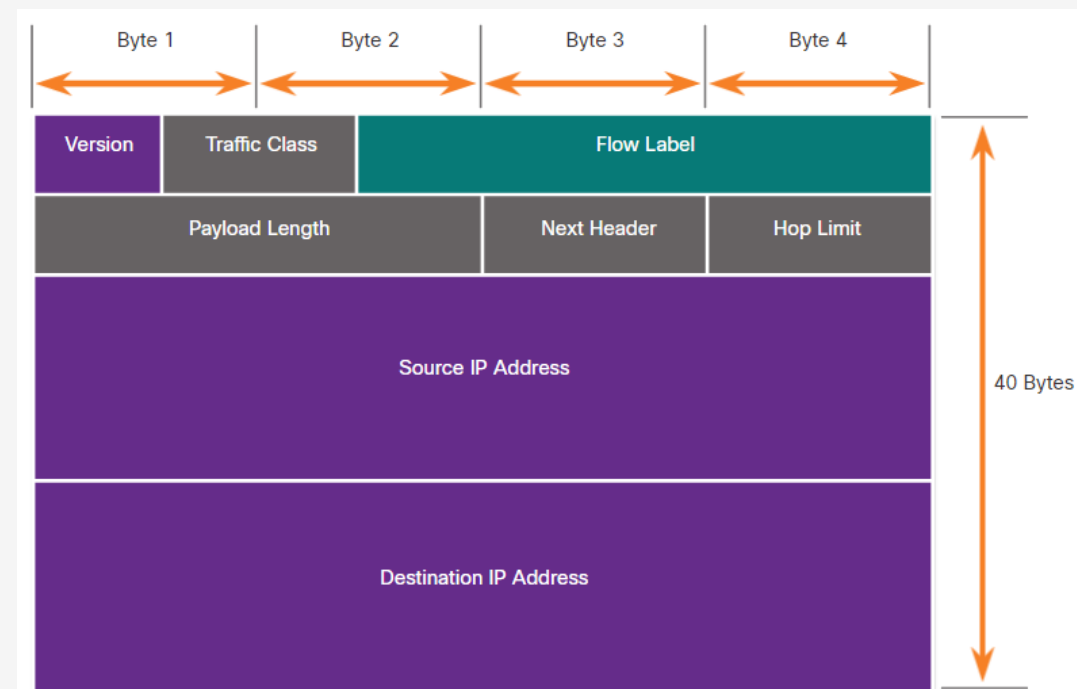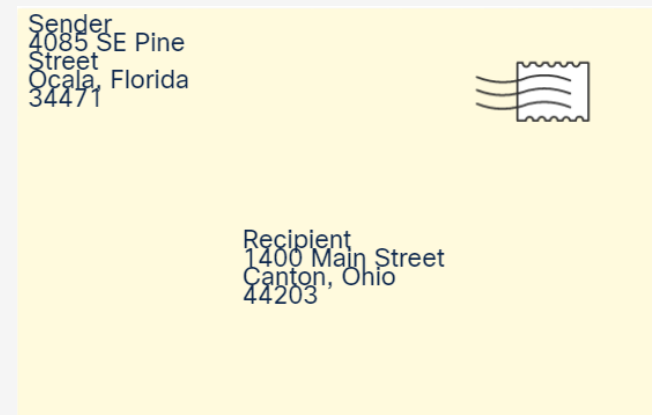| Topic Title	Topic Objective
Encapsulation and the Ethernet Frame	Explain the process of encapsulation and Ethernet framing.
Hierarchical Network Design	Explain the function at each layer of the 3-layer network design model.
The Access Layer	Explain how to improve network communication at the access layer.
Broadcast Containment	Explain why it is important to contain broadcasts within a network.

Encapsulation and the Ethernet Frame

Encapsulation

Each message is encapsulated into a specific format, called a frame, that includes the source and destination addresses.

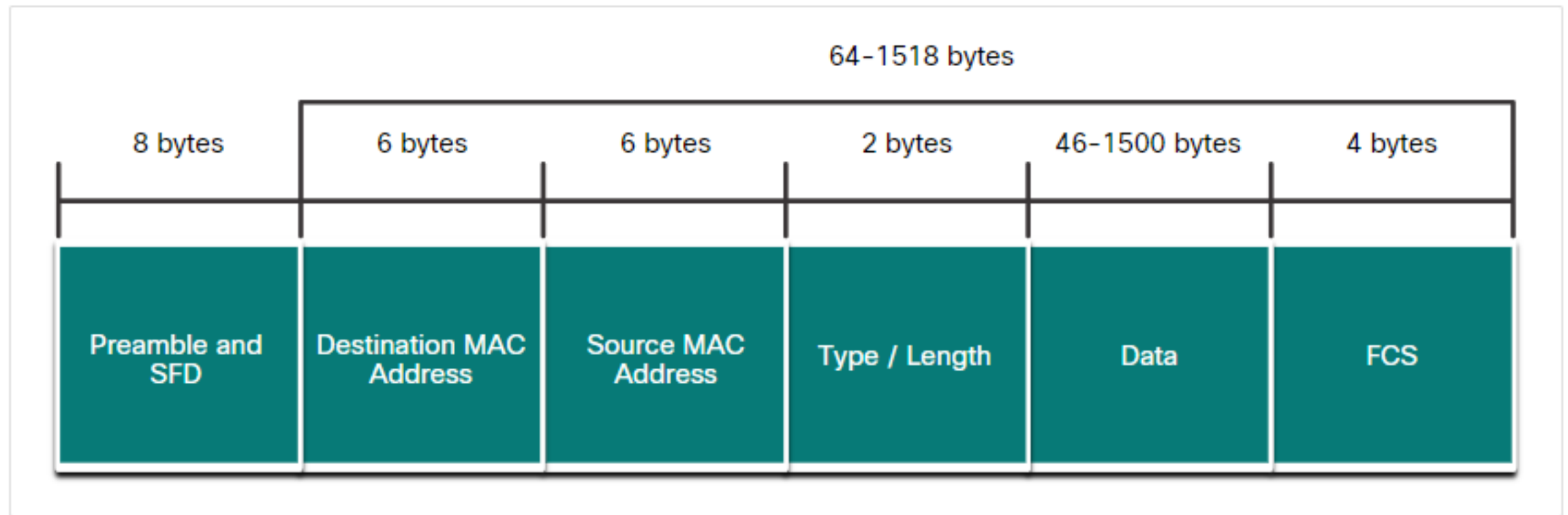- An example is how a letter is put (encapsulated) inside an envelope.

For communication on an IP network, the format is very specific and includes a source and destination address.

Sender
4085 SE Pine
Street
Ocala, Florida
34471

Recipient
1400 Main Street
Canton, Ohio
44203

Byte 1	Byte 2	Byte 3	Byte 4
Version	Traffic Class	Flow Label	
Payload Length		Next Header	Hop Limit
Source IP Address			
Destination IP Address			

40 Bytes

CISCO

Ethernet Frame

On an Ethernet network, messages are put into a frame or Layer 2 protocol data units (PDUs).

Ethernet Frame Fields

|				64-1518 bytes	
8 bytes	6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes
Preamble and SFD	Destination MAC Address	Source MAC Address	Type / Length	Data	FCS

Hierarchical Network Design

Physical and Logical Addresses

Both a physical address and logical IP address are needed for a device to communicate on an Ethernet network.

- A physical address (MAC address) does not change.
    - Burned into the NIC
- A logical address (IP address) can change and is commonly assigned by a network administrator.
   - Two parts: network and host

Logical
addressing
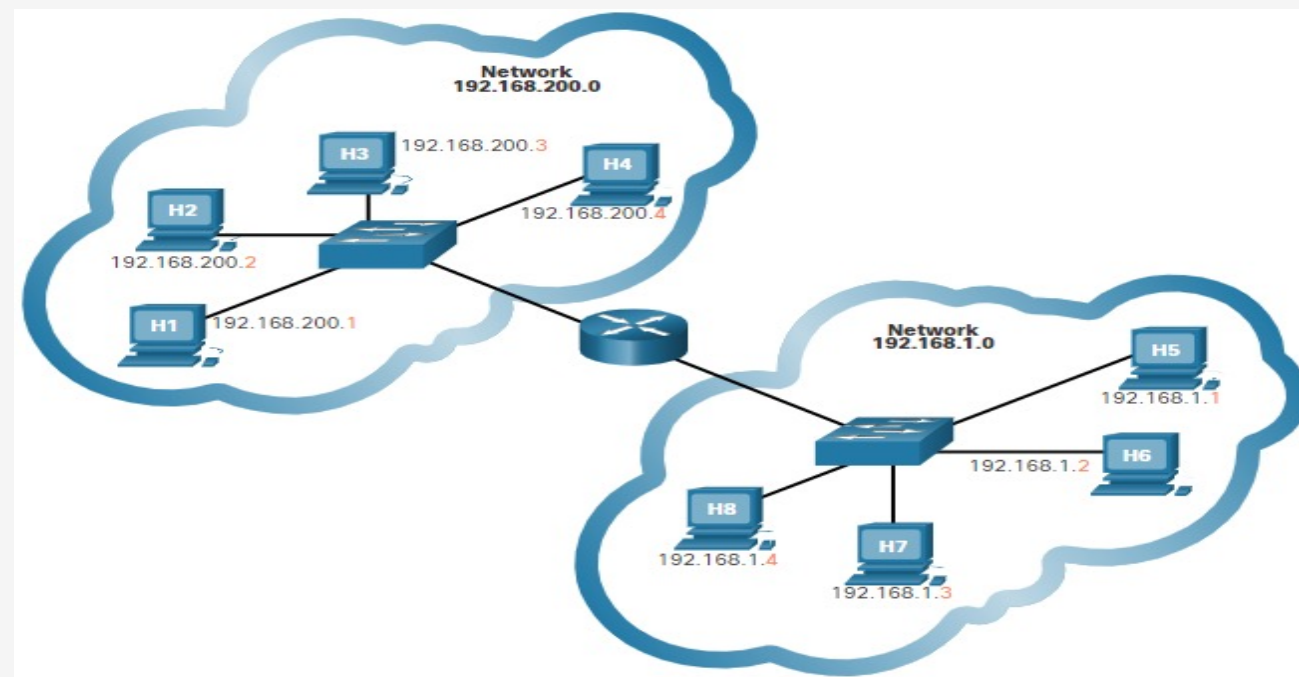
Benefits of a Hierarchical Design

A hierarchical, layered design provides:

- Increased efficiency
- Optimization of function
- Increased speed
- A way in which to scale the network without impacting the performance of existing ones

Three layers:

- **Access Layer** - This layer provides connections to hosts in a local Ethernet network.
- **Distribution Layer** - This layer interconnects the smaller local networks.
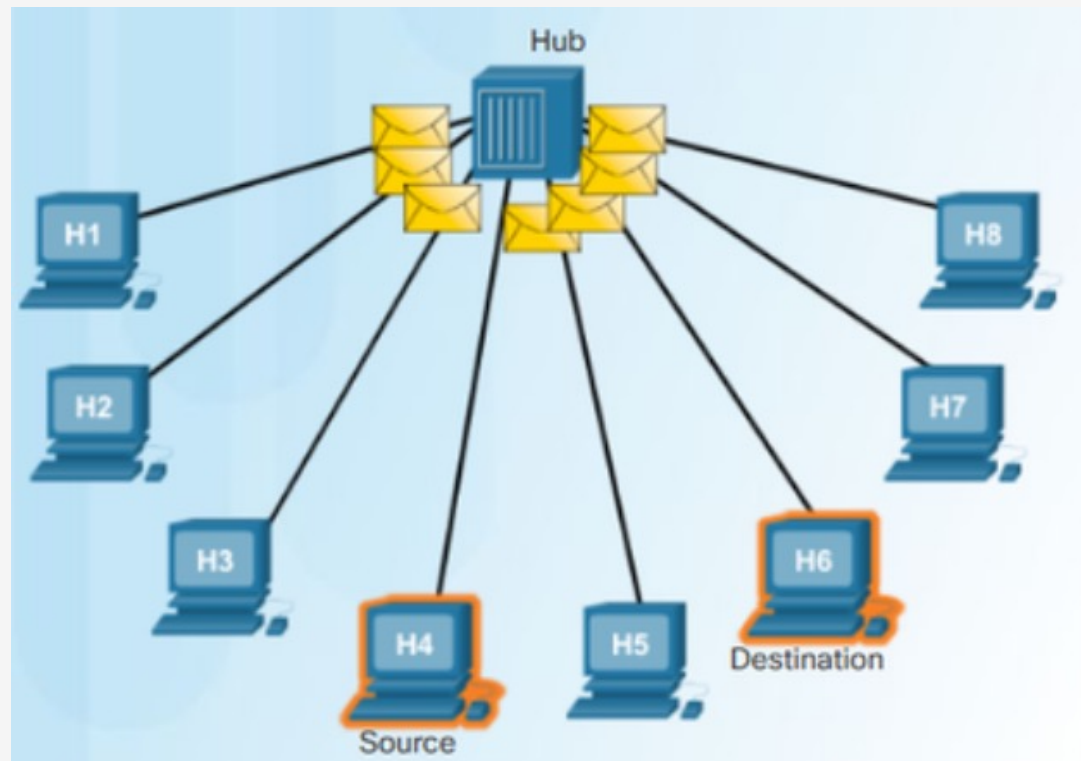- **Core Layer** - This layer provides a high-speed connection between distribution layer devices.

Access Layer   Distribution Layer   Core Layer
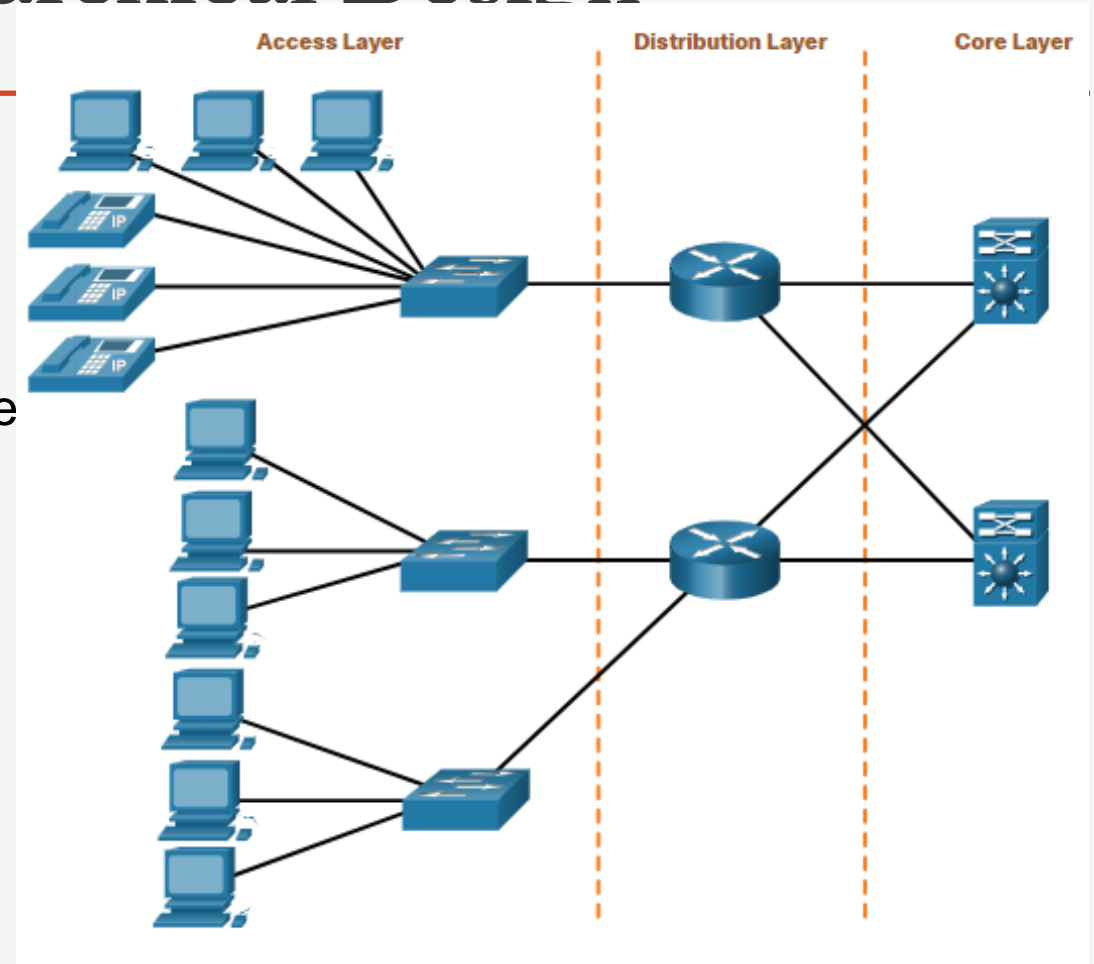
The Access Layer

Access Layer Devices

- Access layer devices provide access so hosts can join a wired (or wireless) network.

- In a wired network, each host connects to an access layer network device such as a switch.
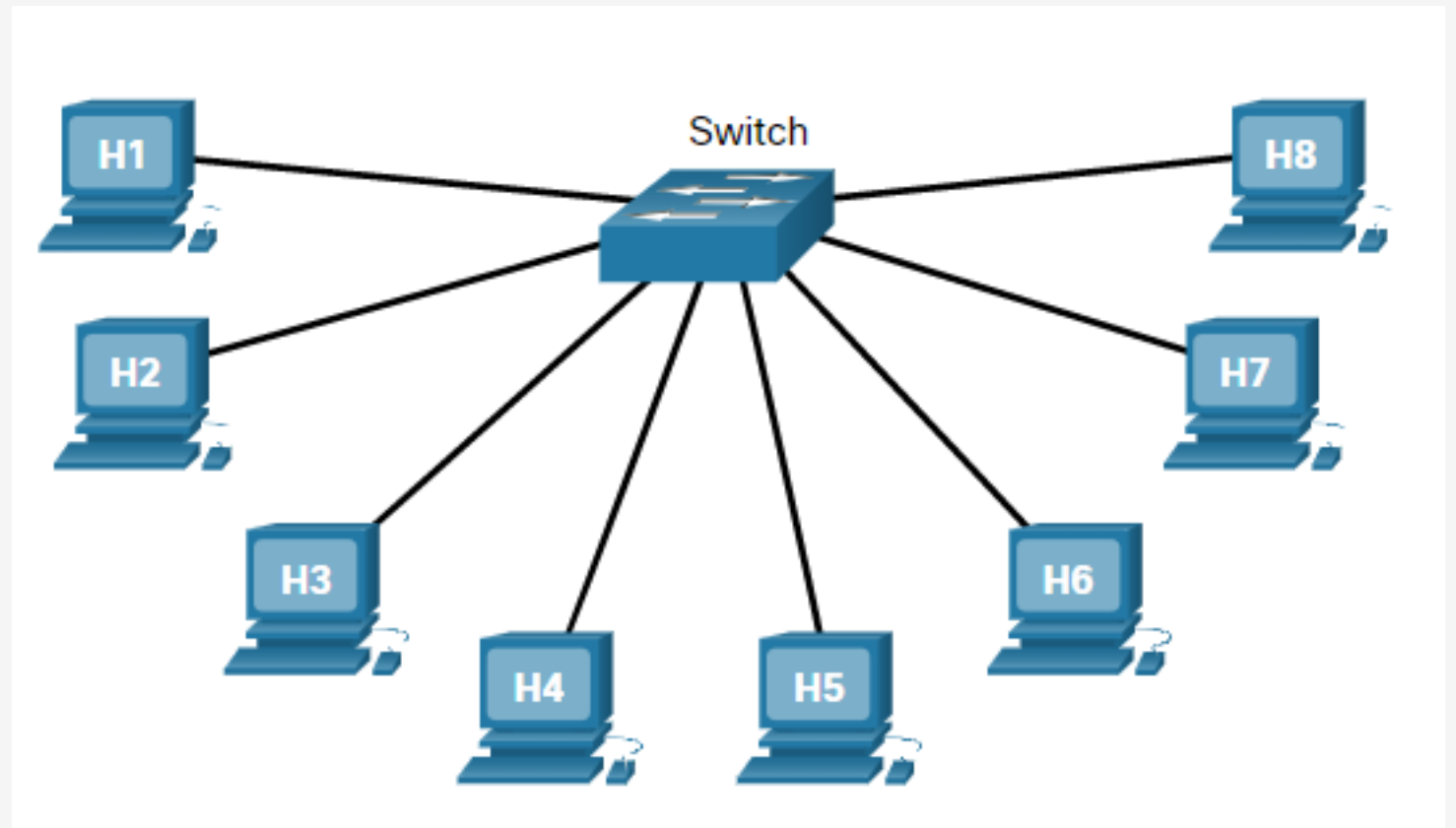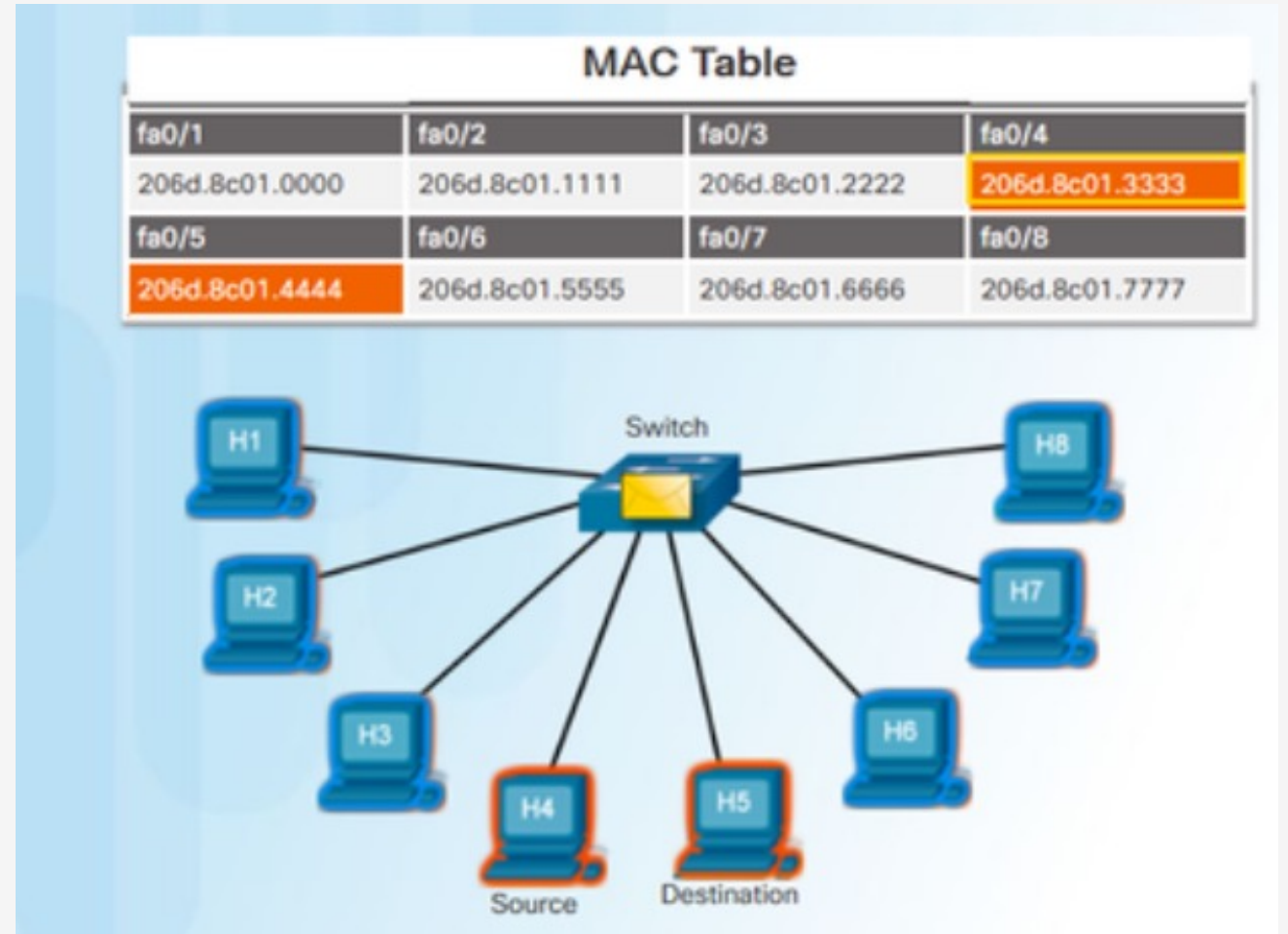
Ethernet Hubs

- Only one message can be sent through an Ethernet hub at a time.

- Hubs take signals from one port and sends the message out all of the other ports.

Ethernet Switches

An Ethernet switch is an access layer device.

- A switch builds a MAC address table.
- A switch uses the MAC address table to send the message to a specific port.

The MAC Address Table

MAC Table			
fa0/1	fa0/2	fa0/3	fa0/4
260d.8c01.0000	260d.8c01.1111	260d.8c01.2222	260d.8c01.3333
fa0/5	fa0/6	fa0/7	fa0/8
260d.8c01.4444	260d.8c01.5555		260d.8c01.7777

H1
H8
H2
H7
Destination
H3
Source
H4
H5
H6
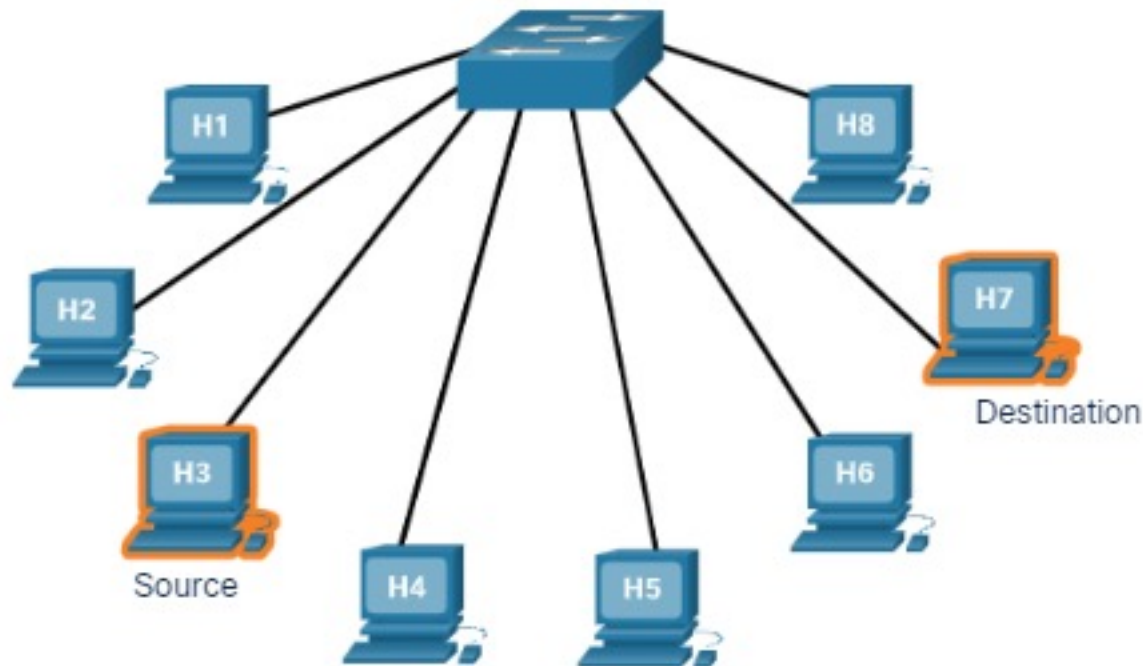
- A switch builds a MAC address table by examining a frame as it comes into the switch.
- A switch adds the source MAC address of the device connected to the port through which the frame came in on.
- A switch forwards a frame out to a specific port when the destination MAC address is in the MAC address table.
- A switch forwards a frame out to all hosts (except the sending host) when the destination MAC address is not in the MAC address table.
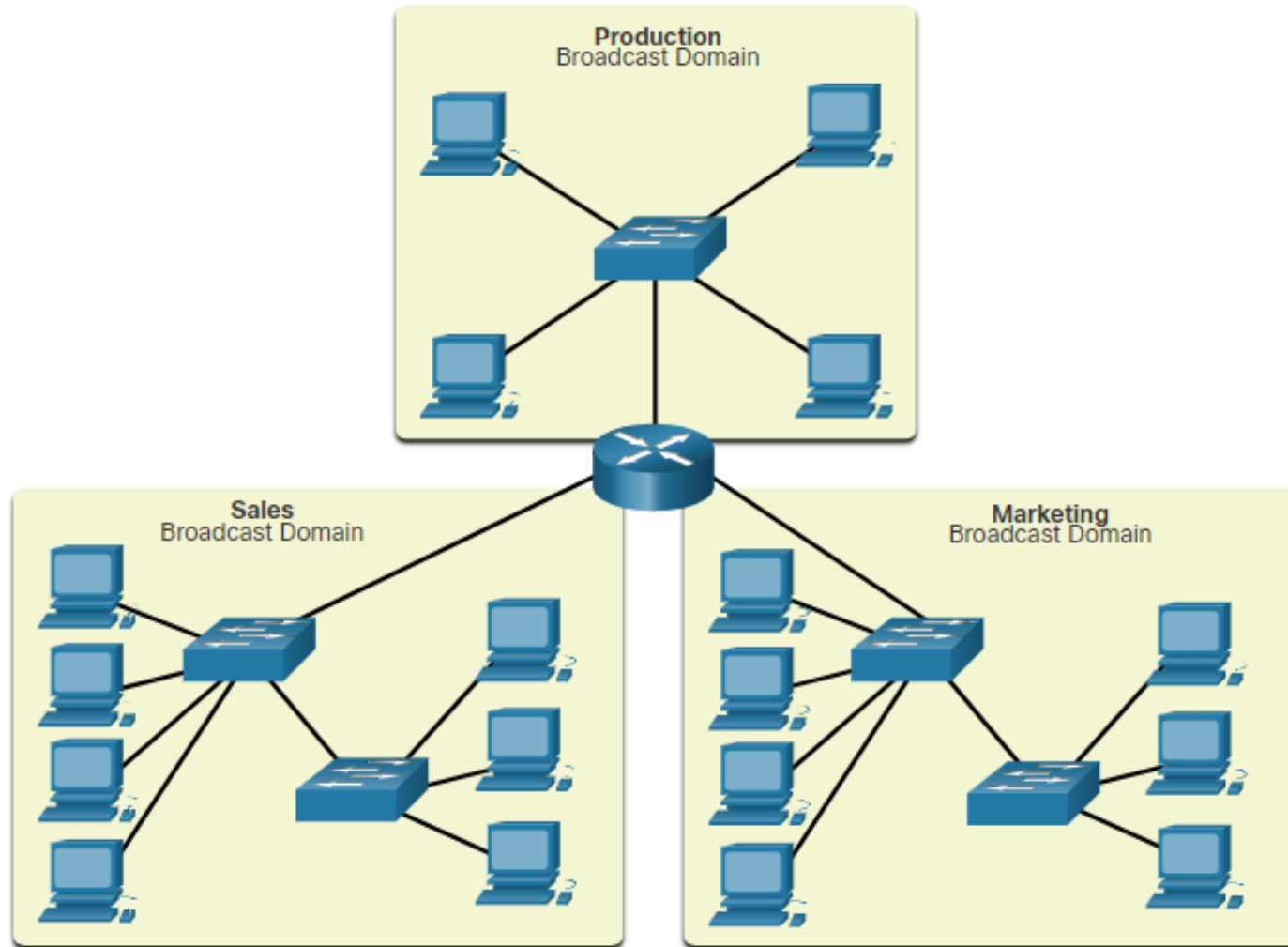
Broadcast Containment

Ethernet Broadcasts in the Local Network

- A broadcast message is used to contact every other device on the local network.

- An Ethernet broadcast is all 1s in the destination MAC address – FFFF.FFFF.FFFF.
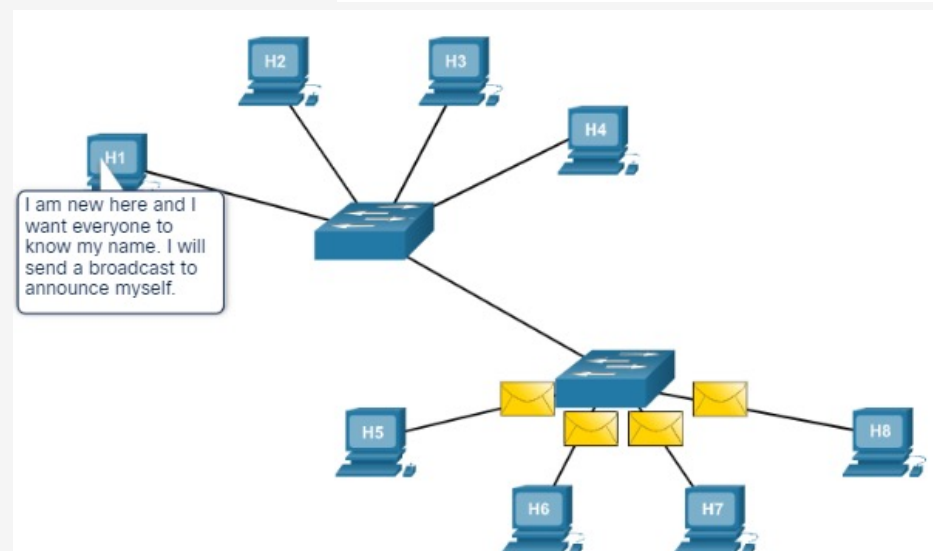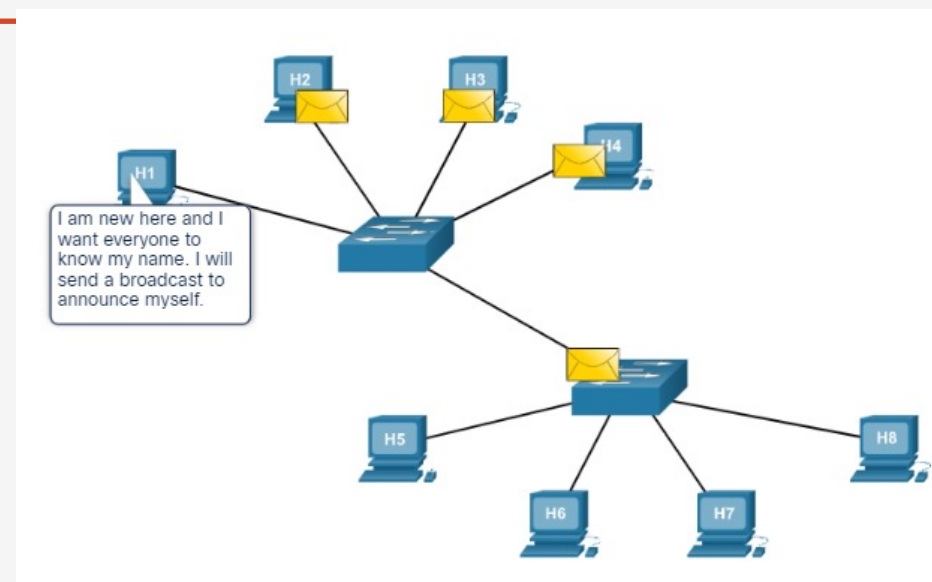
Broadcast Domains

- A broadcast domain is the area through which a broadcast message can travel.

- Each local Ethernet network is a broadcast domain.

- Routers are used to divide the network into multiple broadcast domains.

Access Layer Communication

- In order to send information from a device that is on an Ethernet network, the device must supply its own source MAC address, a destination MAC address, its own source IP address, as well as a destination IP address.
- The address resolution protocol (ARP) is used to discover the MAC address of a device on the same local network.
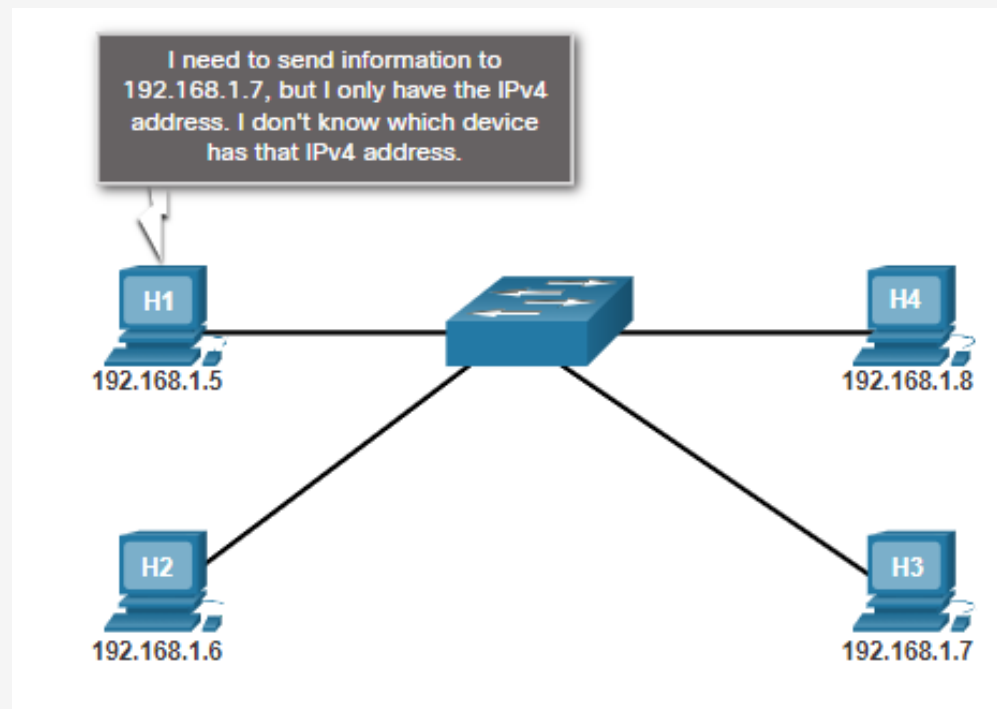
ARP

ARP uses 3 steps to discover and store the MAC address of a host on the local network when only the IPv4 address of that host is known.

1. The sending host creates and sends a frame addressed to a broadcast MAC address. Contained in the frame is a message with the IPv4 address of the intended destination host.

2. Each host on the network receives the broadcast frame and compares the IPv4 address contained in the message with its own IPv4 address. The host with the matching IPv4 address sends its own MAC address back to the original sending host.

3. The sending host receives the message and stores the MAC address and the IPv4 address in an ARP table.
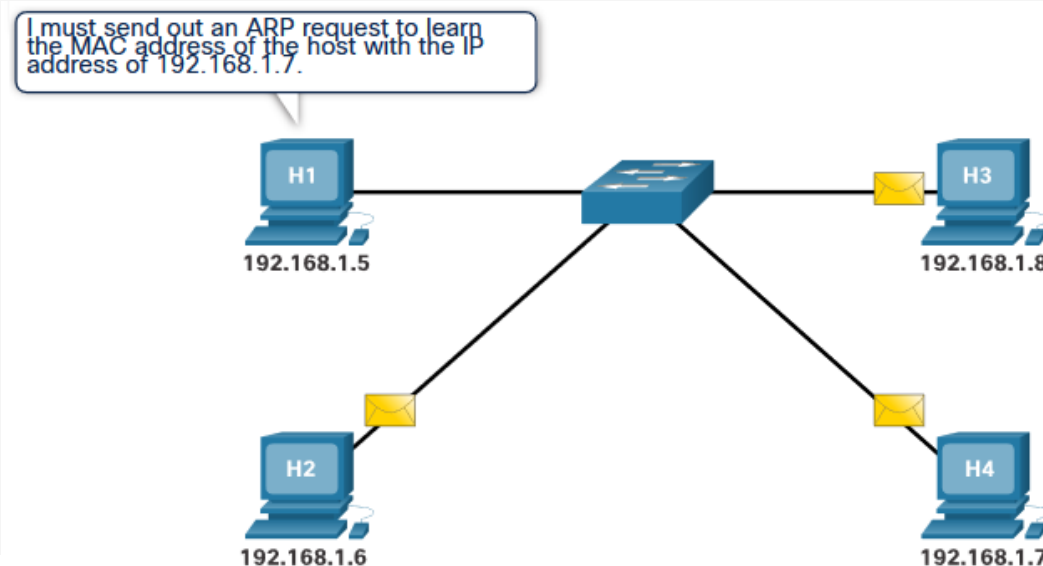
Network Design and Access Layer Summary

What Did I Learn in this Module?

- Encapsulation is the process of placing one message format inside another message format.
- A part of the encapsulation process on an Ethernet network is to create a frame that includes the source and destination MAC address.
- Networks have a hierarchical design of IP addressing that includes a network portion and a host portion.
- Networks can be designed using a hierarchical design model with three layers: access, distribution and core.
- An access layer device provides connections so hosts can get onto a network.
- The distribution layer connects networks.
- The core layer provides a high speed connection between distribution layer devices.
- Hubs takes signals from one port and sends the same message out all other ports. All connected devices share the bandwidth.
- Switches build a MAC address table by examining and saving the source MAC address from a received frame.

What Did I Learn in this Module? (Cont.)

- Switches build transmit messages based on the destination MAC address and comparing it to the addresses found in the MAC address table.
- If a destination MAC address is not in the MAC address table, flooding is used to forward the message out all ports except the port that has the sending host attached.
- ARP is used to send a broadcast message of all ones (FFFF.FFFF.FFFF) to discover the MAC address of a particular host.
- Routers divide the network into multiple broadcast domains.
- A broadcast can only be received on a local network.

Network Design and Access Summary
New Terms and Commands

- encapsulation
- frame
- Ethernet frame
- physical address
- MAC address
- logical address
- IP address
- hierarchical design
- hierarchical design model

- access layer
- distribution layer
- core layer
- Ethernet hub
- Ethernet switch
- MAC address table
- broadcast
- broadcast domain
- ARP
- broadcast containment

End of the Lecture – 5
Thank You