Network Devices

Lecture 5

Agenda

➡ LAN devices & components:

1. **NIC**
2. Repeaters
3. Hub
4. Bridge
5. **Switch**
6. **Multilayer switch**
7. **Access point (wireless / wired)**
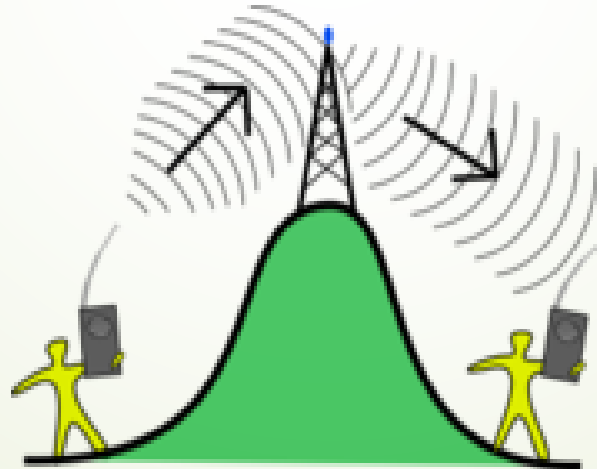8. **Load balancer**

Components of a network

A network bridge

A network switch


A Hub

A wireless repeater

A router

Network Interface Cards (NIC)

➢ A piece of computer hardware designed to allow computers to communicate over a computer network.

➢ It allows users to connect to each other either by using **cables or wirelessly.**

➢ Needs a **driver** in order for the OS to manage and use it.

➢ Related to the **physical layer** of the **OSI** model.

➢ Its **interface depends on the media** used by the network (utp-RJ45, BNC, Fiber, WiFi)

Each client and server needs a NIC rather than a modem

Network Interface Card (NIC)

In each PC
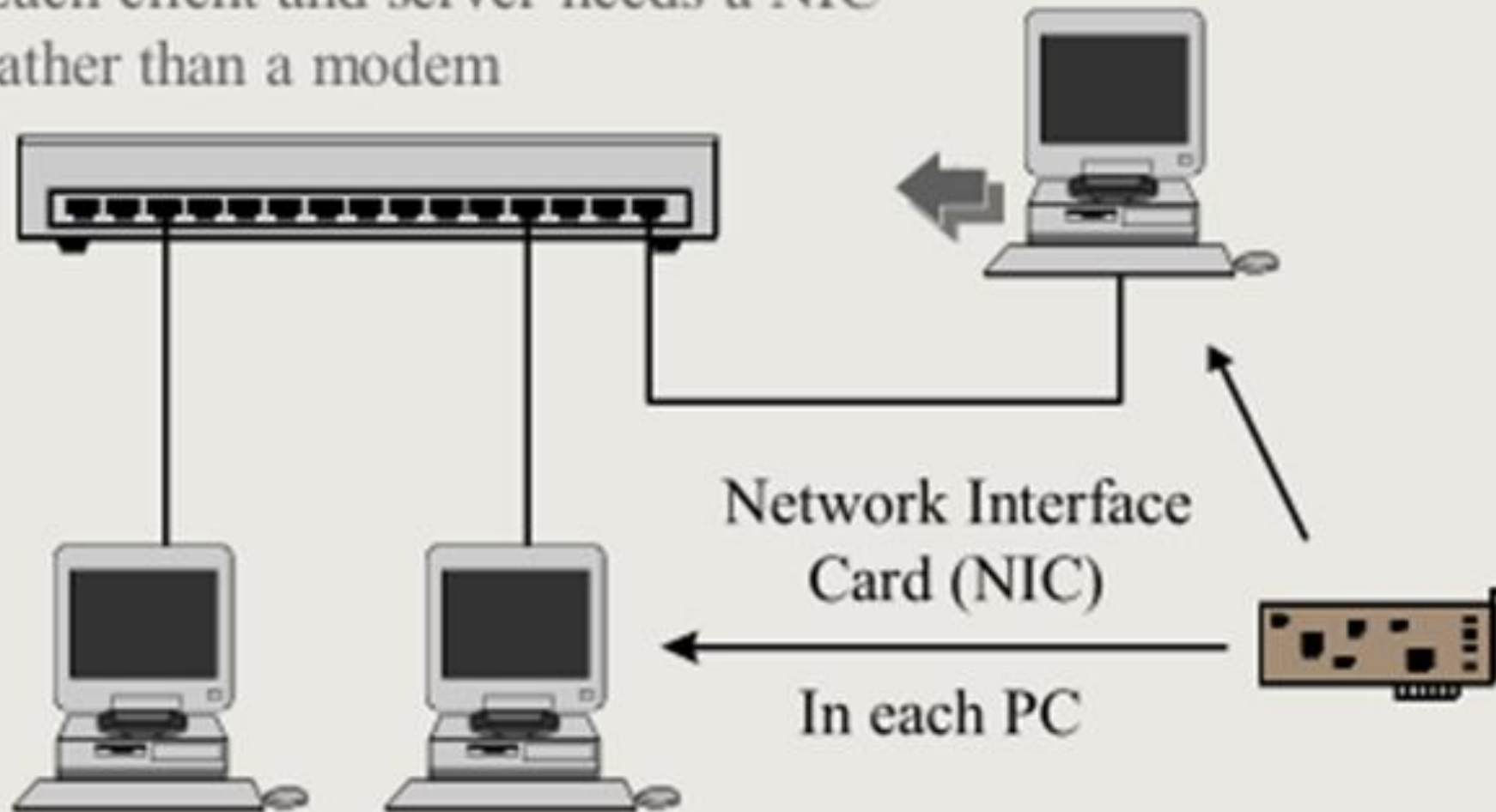
Network segmentation

- *Network segmentation* : **Breaking up** a larger network into a number of smaller ones, and it's accomplished using some **network devices** like *Routers Switches* and *bridges*

- ***Why*** *to segment the network?*

  - *LAN traffic **congestion**.*

  - *LAN management*

  - *Security*

Collision domain

- is a **network segment** connected by a **shared medium** where data packets may **collide** with one another while being sent.

- A network **collision occurs** when more than one device **attempts to send** a packet on a network segment **at the same time**.

- Collisions also **decrease network efficiency** on a collision domain as collisions require devices to **abort** transmission and **retransmit** at a later time.

Broadcast domain

- A logical **division** of a computer **network**, in which <u>all nodes can **reach each other** by broadcast</u> at the **data link layer.**

- Can be within the **same** LAN segment or it can be bridged to **other** LAN segments.

- **Collision** domains are generally **smaller** than, and contained within, **broadcast** domains.
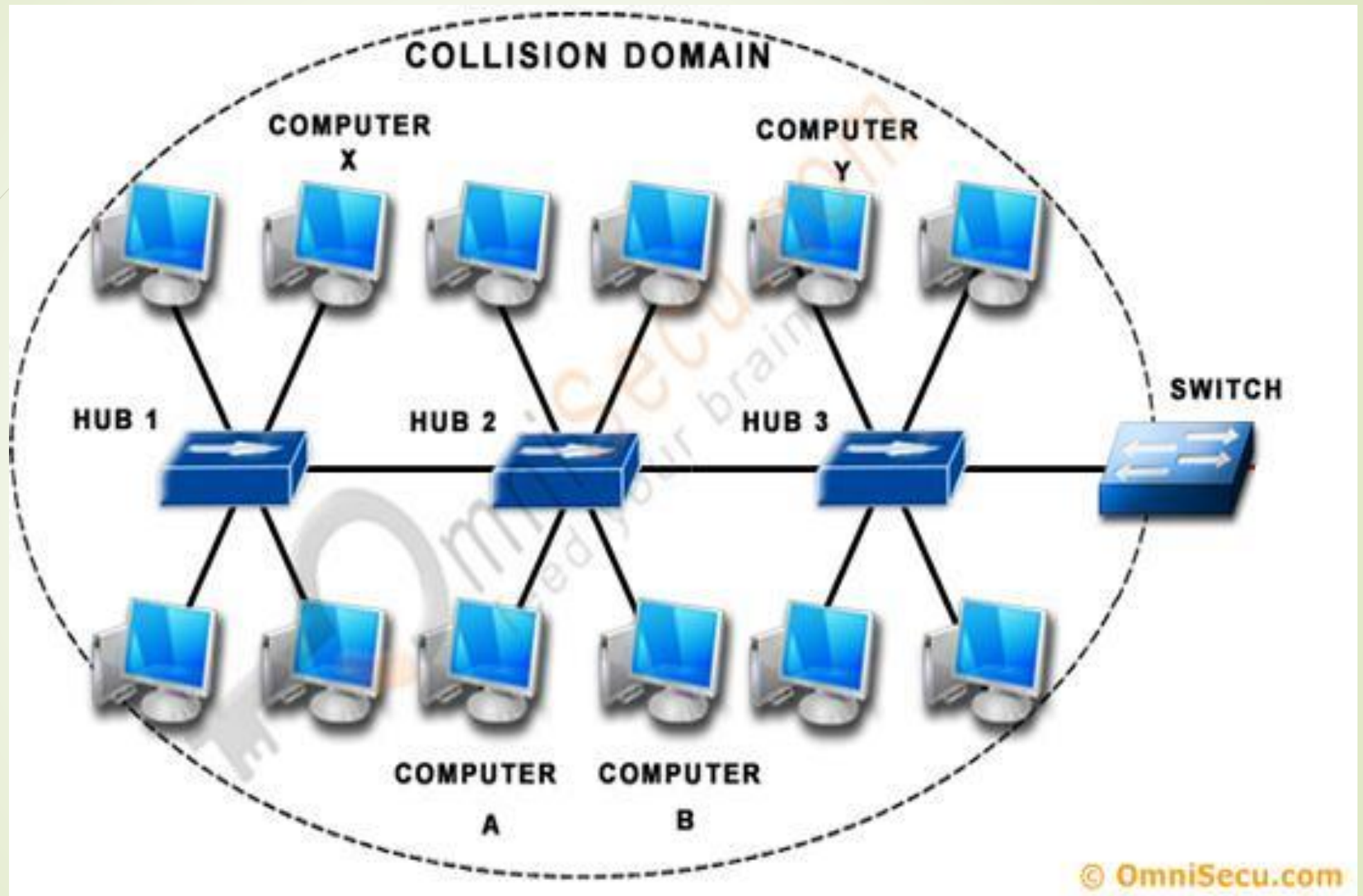
Repeaters

➢ It is an electronic **device** that receives a signal and **retransmits it at a higher power level** so that the signal can cover **longer distances** without degradation. This is done **without looking at any data**.

➢ In most twisted pair Ethernet configurations, repeaters are required for cable runs **longer than 100 meters** away from the computer.

➢ It is a **layer 1 device** per the OSI model

HUB

- A hub is really a **multiple-port repeater**.

- When a packet arrives at one port, it is **reamplified** and **transmitted out all ports** of the hub.

- This means **all devices** plugged into a hub/hubs are in the **same collision domain** as well as in the **same broadcast domain**.
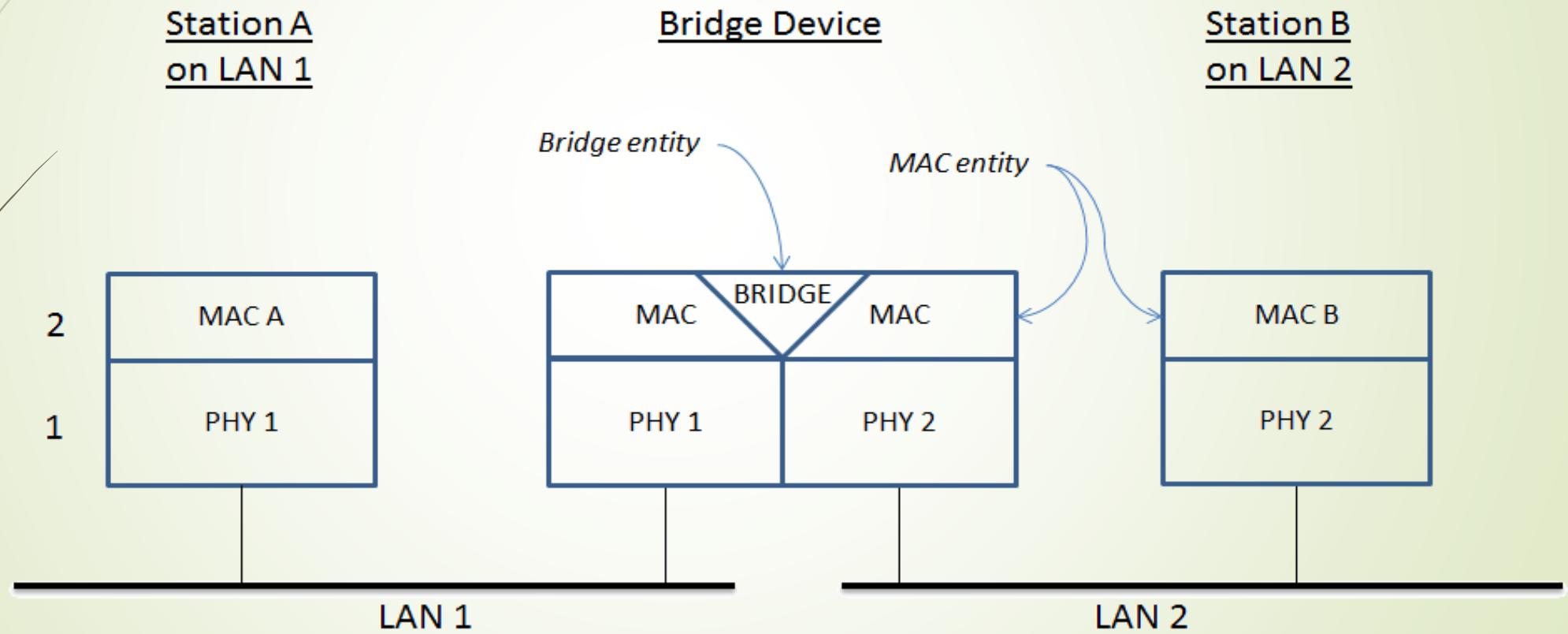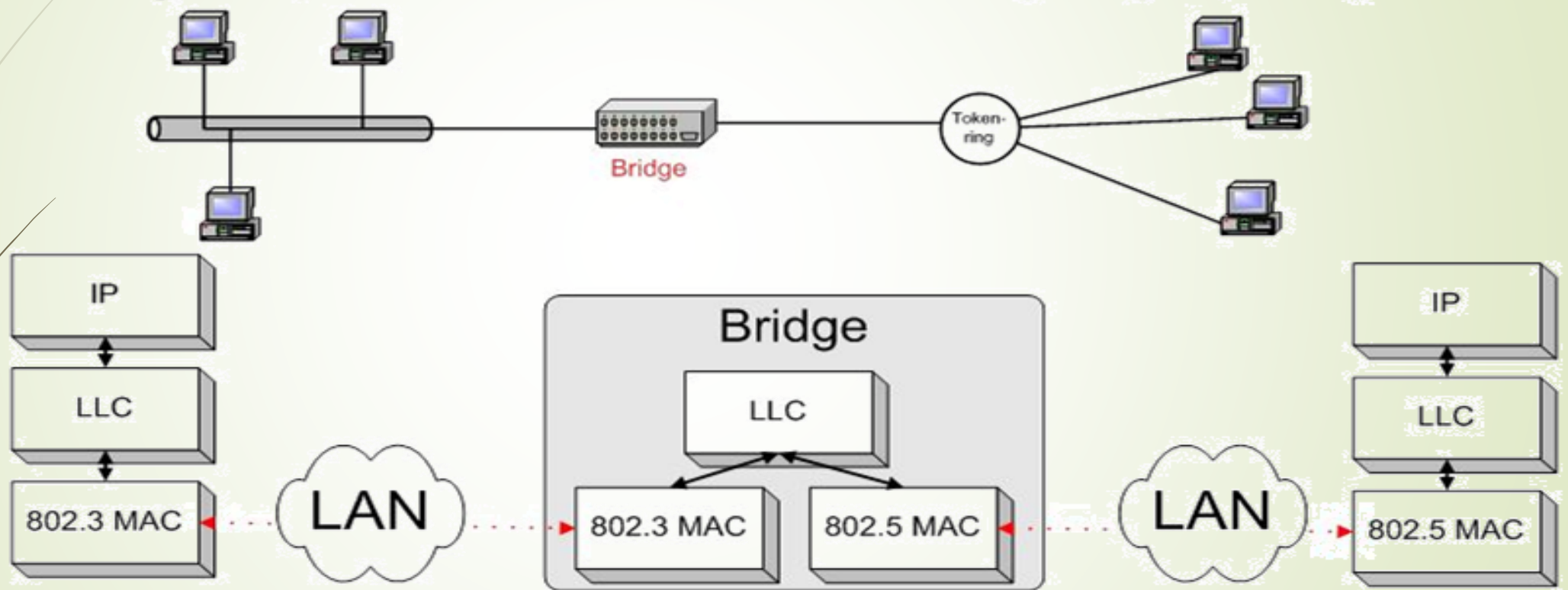
COLLISION DOMAIN

COMPUTER X

COMPUTER Y

SWITCH

HUB 1   HUB 2   HUB 3

COMPUTER A   COMPUTER B

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Network Bridge

- Connects multiple **network segments** to create a **single aggregate** network.

- Once the bridge **associates a physical port and an address (MAC**), it will send traffic **for that address only to that port**.

- Works at the **data link layer (L2)** of the (**OSI**) model.

- Breaks up **collision domains**.(**multiple collision domains**)

- Although bridges are used to segment networks, they will **not isolate** broadcast or multicast packets.(**single broadcast domain**)

- A **store and forward** technique is typically used for forwarding. The **integrity** of the message is **verified** before forwarding it.

A bridge connecting two LAN segments
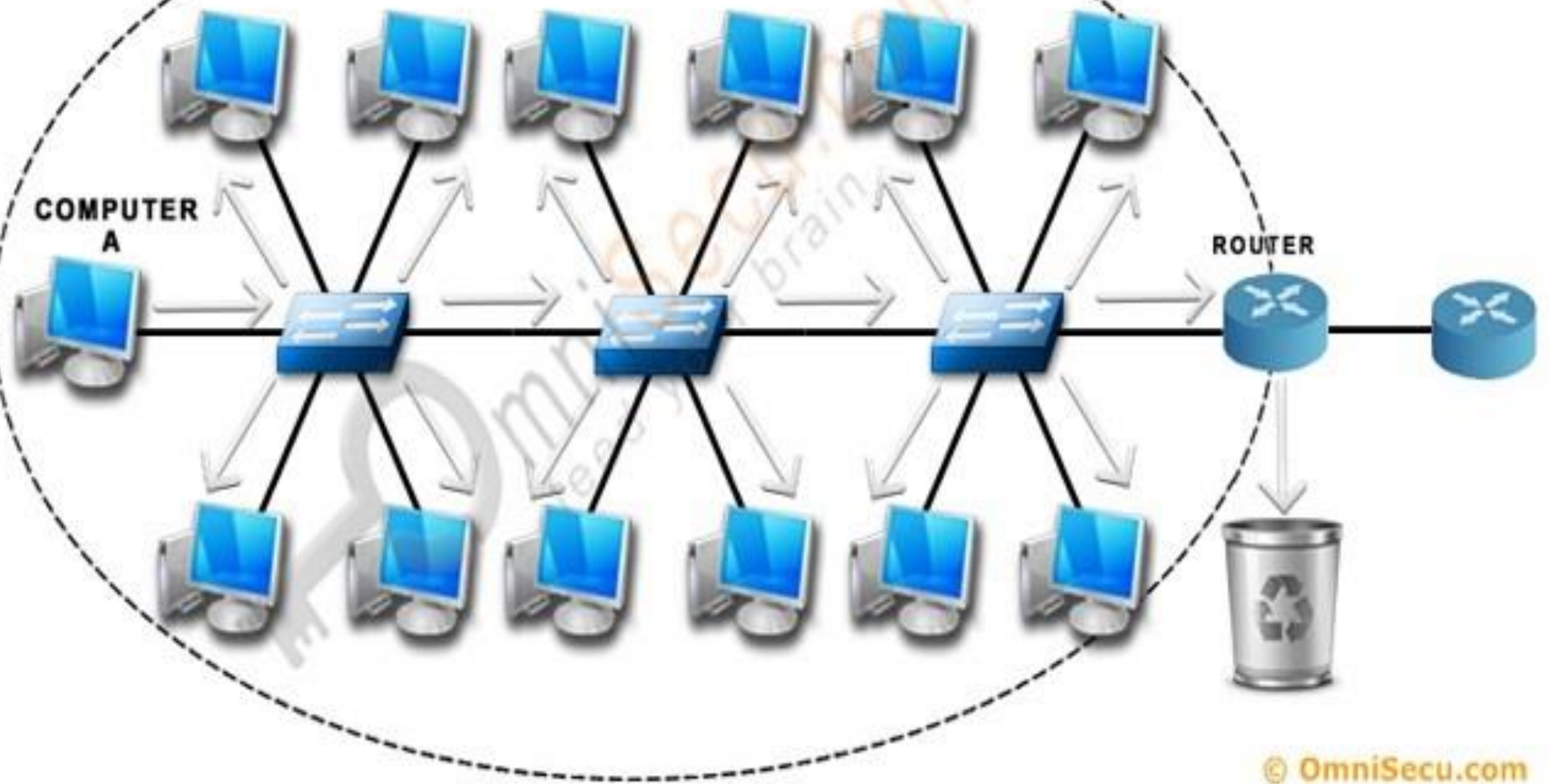
Network bridge

Switches

➤ A network switch is an advanced **multiport** network **bridge** that **uses hardware addresses** to process and forward data at the data link layer **(layer 2)** of the OSI model.

➤ Each port on a switch is actually **its own collision domain**.

➤ Multiple collision domains, single broadcast domain.

BROADCAST DOMAIN
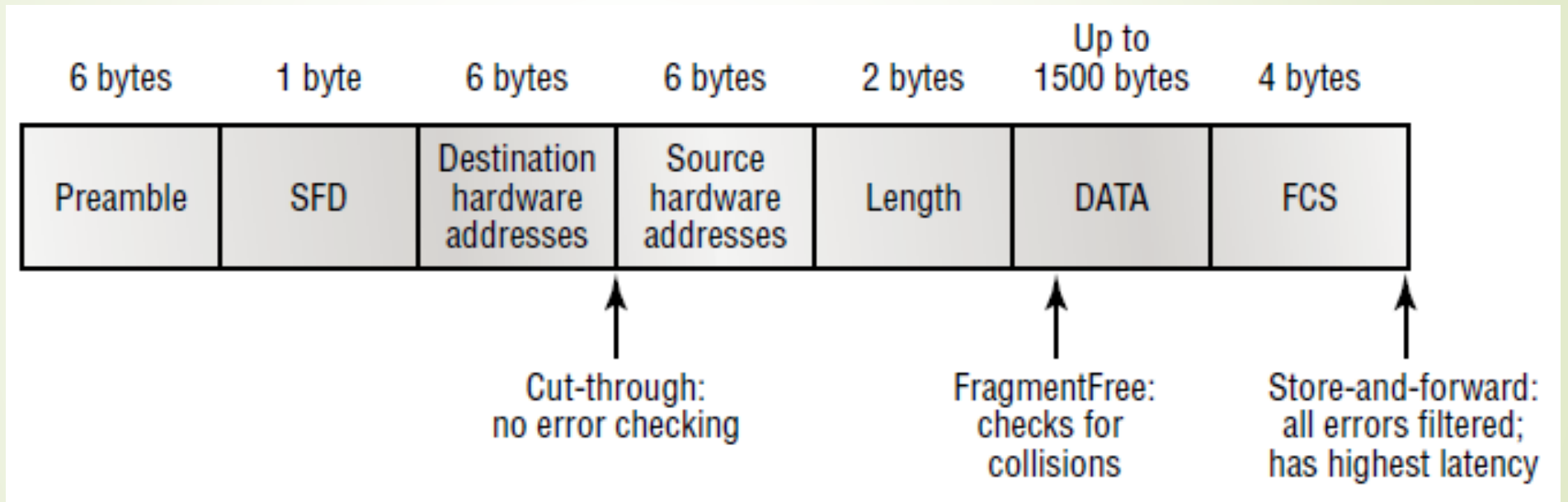
COMPUTER A

ROUTER

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Packet forwarding methods

- **Store and forward:** the switch buffers and **verifies each frame** before forwarding it; a frame is received in its entirety before it is forwarded.

- **Cut through:** the switch starts forwarding after the frame's **destination address is received**. There is **no error checking** with this method. When the outgoing port is busy at the time, the switch falls back to store-and-forward operation. Also, when the egress port is running at a faster data rate than the ingress port, store-and-forward is usually used.

- **Fragment free:** a method that attempts to retain the benefits of both store and forward and cut through. Fragment free **checks the first 64 bytes** of the frame, where addressing information is stored. According to Ethernet specifications, **collisions should be detected during the first 64 bytes** of the frame, so frames that are in error because of a collision will not be forwarded. This way the frame will always reach its intended destination. **Error checking of the actual data in the packet is left for the end device**.

Different switching modes within a frame

6 bytes	1 byte	6 bytes	6 bytes	2 bytes	Up to 1500 bytes	4 bytes
Preamble	SFD	Destination hardware addresses	Source hardware addresses	Length	DATA	FCS

Cut-through: no error checking

FragmentFree: checks for collisions

Store-and-forward: all errors filtered; has highest latency

Address Learning

➧ When a switch is first powered on, the **MAC forward/filter table** is empty.

➧ When a device transmits and an interface receives a frame, the switch places the frame's **source address in the MAC forward/filter table**, allowing it to remember which interface the sending device is located on.

➧ The switch then has no choice but to **flood** the network with this frame because it has no idea where the destination device is actually located.

Address Learning… 2

- If a device **answers** this broadcast and sends a frame back, then the switch will take the **source address** from that frame and place that **MAC address in its database** as well,

- The two devices can now make a **point-to-point connection**. And the switch doesn't need to broadcast as it did the first time,

Host A communicating with Host B
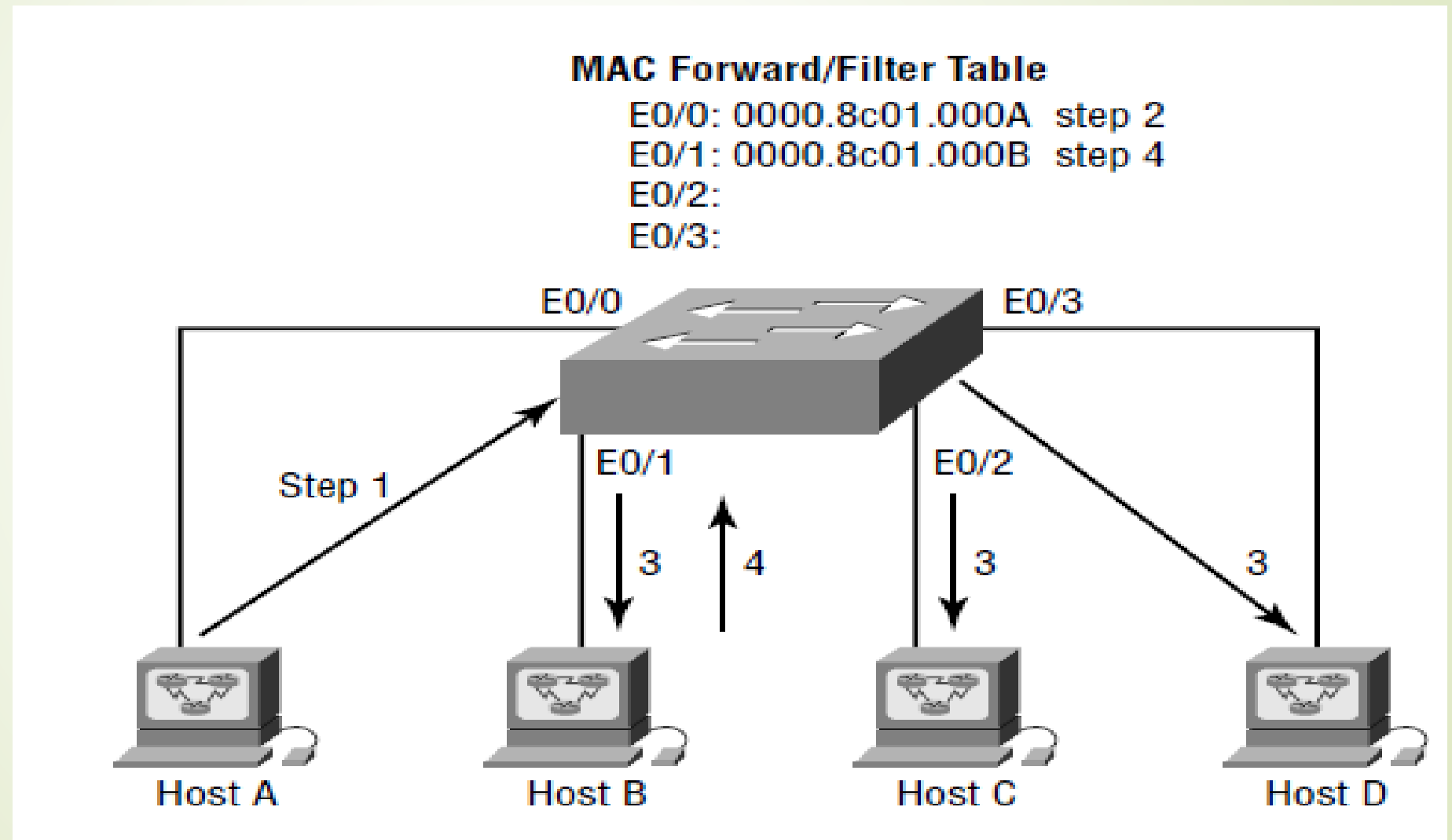
Spanning Tree Protocol (IEEE 802.1D)

➡ STP's main task is to **stop network loops** from occurring on your layer-2 network (bridges or switches).

➡ It **monitors** the network to find all links, making sure that **no loops occur** by shutting down any redundant ones.

➡ STP uses the spanning-tree algorithm (**STA**) to first **create a topology database**, then search out and **destroy redundant links**.

➡ With STP running, frames will **only be forwarded** on the premium, STP-picked links.

Homework

- Submit a report that shows in details how STP works….

- Due date: Sunday 25/3/2018 at class.
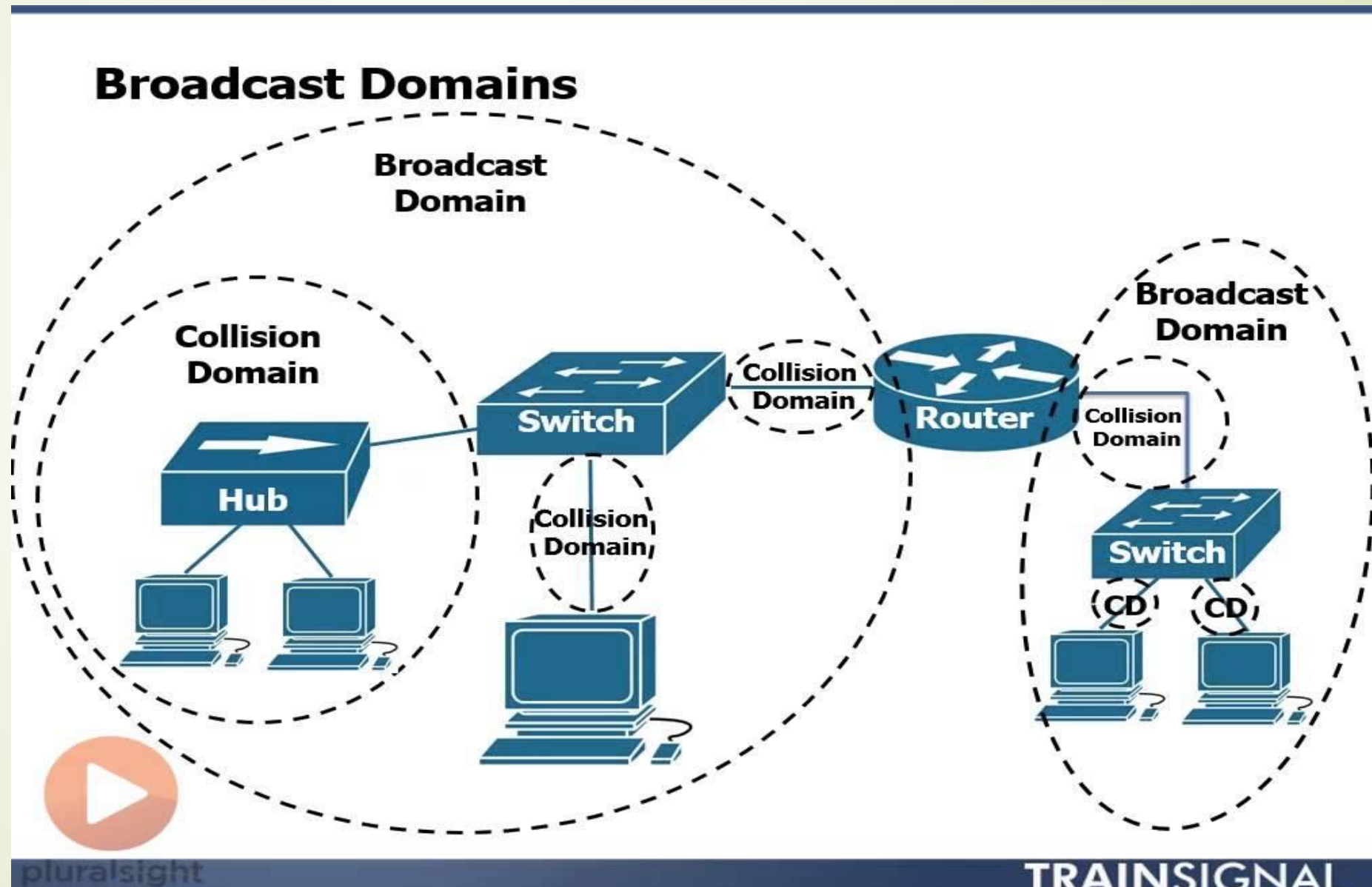
Break 10 minutes

Hubs vs. Switches

	Hub	Switch
Layer	Physical layer. Hubs are classified as Layer 1 devices per the OSI model.	Data Link Layer. Network switches operate at Layer 2 of the OSI model.
Function	To connect a network of personal computers together, they can be joined through a central hub.	Allow connections to multiple devices, manage ports, manage VLAN security settings
Data Transmission form	Electrical signal or bits	Frame (L2 Switch) Frame & Packet (L3 switch)
Transmission Type	Hubs always perform frame flooding; may be unicast, multicast or broadcast	First broadcast; then unicast & multicast as needed.
Ports	4/12 ports	Switch is multi port Bridge. 24/48 ports
Device Type	Passive Device (Without Software)	Active Device (With Software) & Networking device
Used in (LAN, MAN, WAN)	LAN	LAN
Table	A network hub cannot learn or store MAC address.	Switches use content accessible memory CAM table which is typically accessed by ASIC (Application Specific integrated chips).

Transmission Mode	Half duplex	Half/Full duplex
Broadcast Domain	Hub has one Broadcast Domain.	Switch has one broadcast domain [unless VLAN implemented]
Definition	An electronic device that connects many network device together so that devices can exchange data	A network switch is a computer networking device that is used to connect many devices together on a computer network. A switch is considered **more advanced** than a hub because a switch will on send msg to device that needs or request it
Speed	10Mbps	10/100 Mbps, 1 Gbps
Address used for data tramsmission	Uses MAC address	Uses MAC address
Device Category	non intelligent device	Intelligent Device
Collisions	Collisions occur commonly in setups using hubs.	No collisions occur in a full-duplex switch.
Spanning-Tree	No Spanning-Tree	Many Spanning-tree Possible

Collision/Broadcast domains exercise

Questions?