Yildiz Technical University
Computer Engineering Department
BLM 6196
Computer Networks And Communication Protocols

Hubs and Switches

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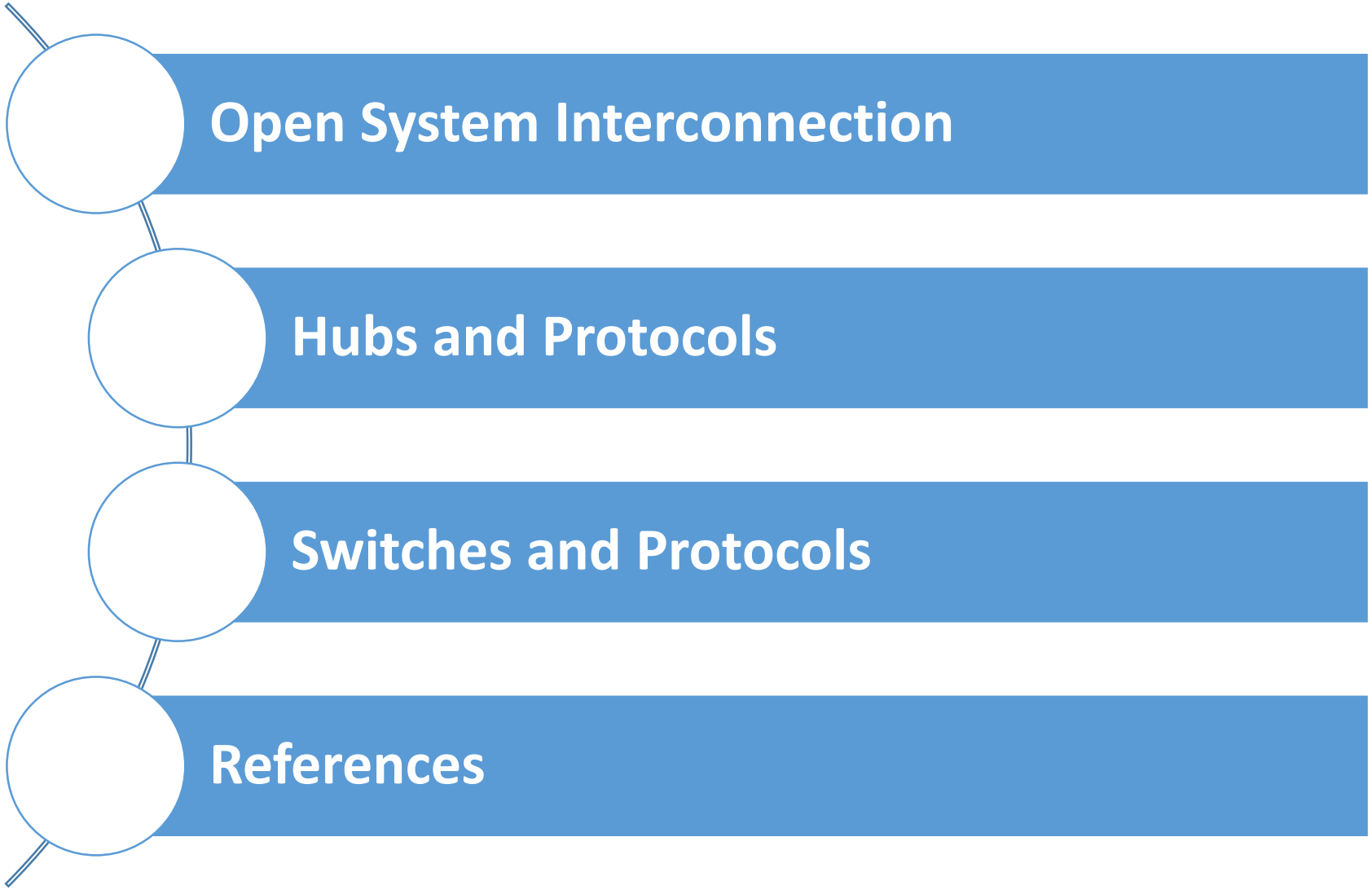
AGENDA:


Open System Interconnection
Hubs and Protocols
Switches and Protocols
References

Open System Interconnection:

- Open System Interconnection (OSI) network model was build in 1984 by International Organization for Standardization (ISO)
- OSI model is consist of seven layers
- Data is passed from the user application down the other layers of the OSI model
- Each lower layers add a header or trailer containing protocol information specific to that layer.
- Headers are called Protocol Data Units (PDUs).
- Process of adding headers is referred to as encapsulation.

OSI and their layer PDUs :

- The PDU of each lower layer is identified with a unique term.
- Hubs are in Layer-1 and Switches are in Layer-2.

- Reduces complexity
- Standardizes modular engineering
- Accelerates evolution
- Simplifies teaching and learning
- Divide and Conquer

# Layer	PDU Name
7. Application	-
6. Presentation	-
5. Session	-
4. Transport	Segments
3. Network	Packets
2. Data-link	Frames
1. Physical	Bits

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Hubs and Protocols

HUBs

- Hubs are network devices that physically connect network devices together for communication.
- Has multiple input/output ports, which a signal introduced at the input of any port appears at the output of every port except the original incoming.
- Works at the physical layer (layer – 1) of the OSI model
- Only broadcasting

They are also called as:

- Ethernet Hub
- Active Hub
- Network Hub
- Repeater Hub
- Multiport Repeater

HUBs

A Ethernet hub/repeater has no memory to store any data in it;

- A packet must be transmitted while it is received.
- When a collision occurs, the packet will lost and the sender should detect this and retry the transmission.
- Due to this hubs can only run in half – duplex mode.

- **Half – duplex allows a host to either transmit or receive data, but not simultaneously.**
- **Once a part begins receiving a signal, it must wait for the transmitter to stop transmitting, before replying.**

Half – duplex Ethernet utilizes Carrier Sense Multiple Access with Collision Detect (CSMA/CD) to control media access.

- Carrier sense specifies that a host will monitor the physical link, to determine whether a signal or carrier is currently being transmitted.
- The host will ONLY transmit a frame if the link is idle.
- If any two devices connected to a hub send a frame simultaneously, a collision will occur.
- Thus, all ports on a hub belong to the same collision domain.
- A collision domain is simply defined as any physical segment where a collesion can occur.

HUBs

Hub is aware of physical layer packets, it detect their start, an idle and sense a collision which it propagates by sending a jam signal.

But a hub cannot further examine or manage any of the traffic that comes through it.

- Any packet entering any port is rebroadcast on all other ports.

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Switches and Protocols

Switches

A **network switch** is a computer networking device that connects devices together on a computer network, by using packet switching to receive, process and forward data to the destination device.

Unlike Hub a Network Switch:

- Broadcast: Forward data to all devices or ports
- Multicast: Forward data to multiple devices that need to receive it.
- Unicast: Forward data to on device that need to receive it.

Avaya ERS 2550T-PWR, a 50-port Ethernet switch

Switchs and Ethernet Protocol

- **network switch is a multiport network bridge that uses hardware addresses (MAC Addresses) to process and forward data at the data link layer (layer – 2) of OSI model.**

Each device connected to switch can be identified by its Media Access Control (MAC) address, allowing the switch to regulate the flow of traffic.

- This maximizes the security and efficiency of the network

Layer – 2 switches build MAC address tables, that at minimum contains:

- MAC addresses for hosts
- The port each MAC address it associated with.

By using above information, switches will make intelligent forwarding decisions based on the frame (data-link) headers.

So a frame can be forwarded out only the appropriate destination port, instead of all ports (unicasting instead of broadcasting)

Switches and Ethernet Protocol

Ethernet switches build MAC address tables through a dynamic learning process.

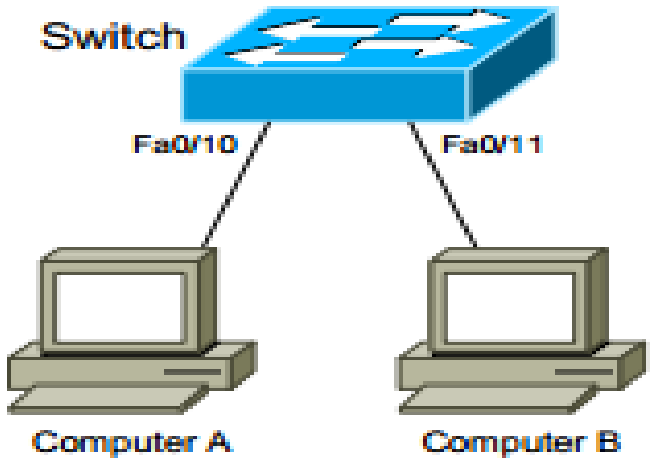
A switch behaves like a hub when first powered on.

The switch will flood every frame, including unicasts, out every port but the originating port.

Then the switch build the MAC-address table by examining the source MAC address of each frame.

As the MAC-address table becomes populated;

- **Flooding of frames will decrease**
- **Switch perform more efficient forwarding decisions.**



Switches

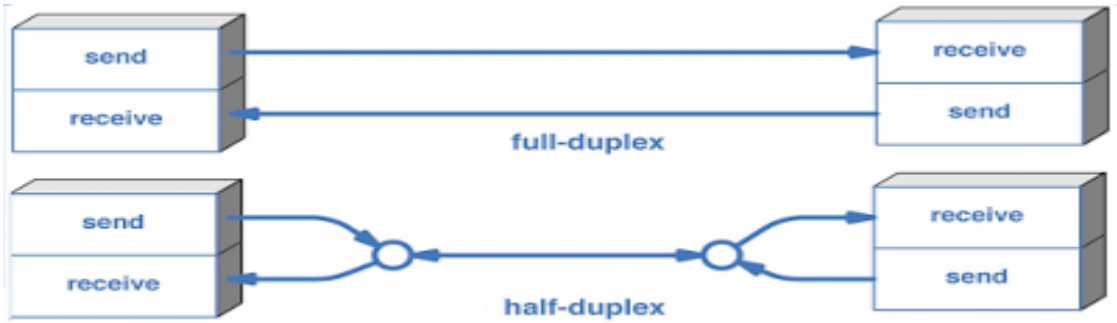
While hubs were limited to half-duplex communication, switches can operate in full-duplex.

Each individual port on a switch belongs to its own collision domain.

- Switches create more collision domains, that results in fewer collisions.

- **IEEE 802.3 is a collection of IEEE standards produced by the working group defining the physical layer and data link layer's media access control (MAC) of Ethernet.**

- **Full – duplex allows communication in both direction simultaneously.**



VLAN Protocol, IEEE 802.1 Q

A Virtual Local Area Network (VLAN) is used to logically group network devices together, which share the same physical network.

This way, the network traffic of a VLAN group is only visible to the network devices which are members of this group.

A network administrator will have to logically group the network devices together and provide a unique VLAN ID for each of these groups.

- Then he will attach each port on each participating (Ethernet) switch with one or several of these ID's.
- After that, the switch will forward incoming VLAN tagged packets only to the network devices which are in the specific VLAN.

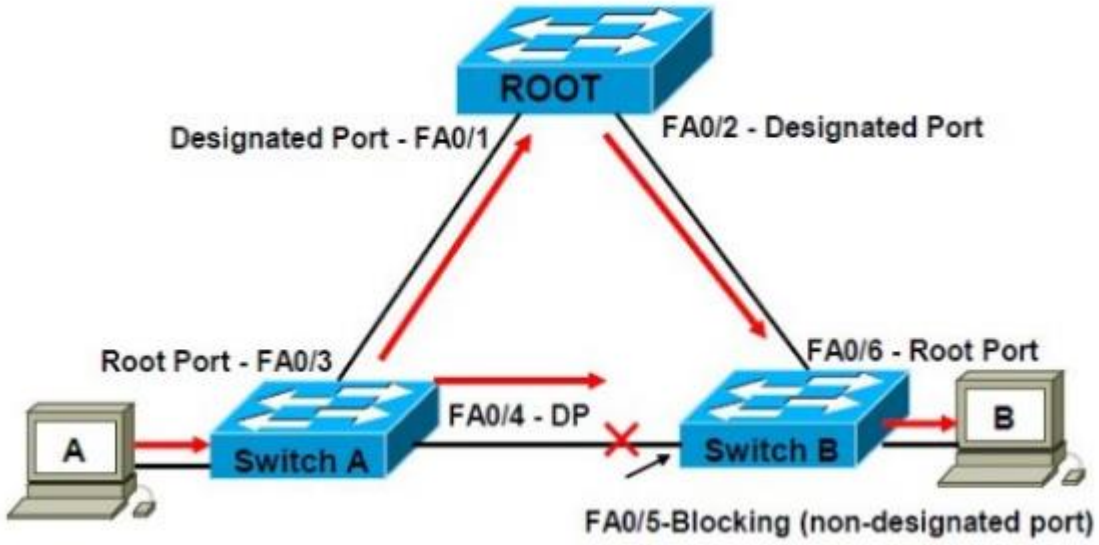
➢ **a VLAN packet on an Ethernet will typically look like this:**

Destination MAC address	Source MAC address	Type (VLAN: 0x8100)	VLAN Tag	User Data
6	6	2	4	46 - 1500

Spanning-Tree Protocol (STP):

- Spanning-Tree Protocol (STP) prevents loops from being formed when switches are interconnected via multiple paths.
- STP implements the 802.1D IEEE algorithm by exchanging BPDU messages with other switches to detect loops.
- Then removes the loop by shutting down selected bridge interfaces.
- This algorithm guarantees that there is one and only one active path between two network devices.

- Bridge Protocol Data Units (BPDUs) are frames that contain information about the STP.
- The switches need to share information about themselves and their connection for STP algorithms to function, So what they share are BPDUs.



Hubs and Switchs

- **Remember, there are three things that switches do and hubs do not:**
  - **MAC address learning**
  - **Intelligent forwarding of frames (Unicasting and Multicasting)**
  - **Loop avoidance (by STP protocol)**

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