

I. Objectives:

- Get to know basic network devices
- Understand functions of network devices
- Able to connect different network devices together to form a simple network

II. Content

1. Get to know network devices:

- ✓ Network Interface Card (NIC)
- ✓ Cables
- ✓ Hub
- ✓ Switches
- ✓ Routers
- ✓ Access Points
- ✓ Modems

2. Understanding functions of network devices

a. Network Interface Card (NIC)

- NIC functions: support for I/O interrupt, direct memory access (DMA) interfaces, data transmission, network traffic engineering and partitioning.

- Code of NIC processors:

- Check NIC of a computer, what is its MAC address? (58-11-22-EA-60-5B)

*Cable to connect NIC to a network:

- Type: Ethernet cable

- Standard: Dual Band 802.11

b. Hubs

- Roles of hub in a network: Hub acts as a common connection point for devices

- Main characteristics: A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

- Weaknesses of hub:

+It runs half-duplex

+Can not filter information.

+ Extend the collision

+ Passes packet to all connected segment

+ It will broadcast to all the port

+ It does not have a mechanism to reduce the network traffic

+ It can not connect different type of network architecture such as a token ring and Ethernet extra

+ Can not reduce network traffic

- Hub ports: 4

c. Switches

- Roles of switches in a network: connect devices in a network and use packet switching to send, receive or forward data packets or data frames over the network.
- Main characteristics of switches: It uses packet switching technique to receive and forward data packets from the source to the destination device.
- Differences between hubs and switches:

+Data Forwarding:

Hub: Broadcasts data to all devices connected to it.

Switch: Sends data only to the specific device that the data is intended for by using the MAC address.

+Performance:

Hub: Operates in half-duplex, which limits performance.

Switch: Operates in full-duplex, allowing faster, more efficient communication.

+Collision Domains:

Hub: Extends the collision domain to all devices connected to the hub.

Switch: Creates separate collision domains for each port, reducing the chance of collisions.

+Traffic Control:

Hub: Cannot manage or control network traffic.

Switch: Can efficiently manage and direct network traffic, reducing congestion.

+Layer of Operation:

Hub: Operates at the Physical Layer (Layer 1) of the OSI model.

Switch: Operates at the Data Link Layer (Layer 2), and in the case of some advanced switches, at the Network Layer (Layer 3).

- Weaknesses of switches:

+More Expensive than Hubs: Switches are more expensive to implement compared to hubs due to their intelligent data forwarding capabilities.

+Potential for Bottlenecks: If too many devices are connected to a single switch, or if a switch is poorly configured, network bottlenecks can occur.

+Broadcast Traffic: Although switches reduce unnecessary traffic by forwarding data only to specific devices, broadcast frames (like ARP requests) are still forwarded to all ports, which can cause network congestion in large networks.

+Vulnerable to Security Issues: Switches can be vulnerable to attacks like MAC flooding, where an attacker overloads the switch's MAC address table, causing it to behave like a hub and broadcast traffic to all ports.

+Limited Layer 3 Capabilities (for Layer 2 switches): Layer 2 switches do not perform routing functions and rely on routers to route traffic between different networks.

- Switch ports: 4,8,16,24,48

d. Routers

- Roles of routers in a network: helps direct data packets to their destination IP address.
- Main characteristics of routers: is a device that connects two or more packet-switched networks or subnetworks. It serves two primary functions: managing traffic between these networks by forwarding data packets to their intended IP addresses, and allowing multiple devices to use the same Internet connection.

- Differences between routers and switches:

- + A router connects different networks together, while a switch connects multiple devices together to create a network.
- + Switches use content accessible memory CAM table which is typically accessed by ASIC, while routers use every port has its own Broadcast domain.
- + A router works in network layer, while a switch works in data link layer.
- + A router is used by LAN as well as MAN, while a switch is used to connect various devices simultaneously.


Router ports: over 65000 ports you can use

d. Access Points

- Roles of access points: lets you create a wireless network within your existing wired network, so you can accommodate wireless devices.
- Main characteristics of access points: is a networking device that allows wireless-capable devices to connect to a wired network. It is simpler and easier to install WAPs to connect all the computers or devices in your network than to use wires and cables.
- Access point's interfaces: An access point only provides an interface/portal for wireless clients to connect to your existing LAN. It does not route traffic between different networks, rather provides wireless access to an already existing local wired network.
- Compare access point and other networking devices mentioned above: Access Points primarily enable wireless connectivity and act as a bridge between wired and wireless networks, supporting various devices and managing wireless traffic.

e. Modem

Differentiate:

Feature	Dial-up Modem	ADSL Modem	Cable Modem
Connection Type	Connects through traditional telephone lines.	Connects through standard telephone lines using DSL technology.	Connects through coaxial cable (used for cable TV).
Data Transmission	Transmits data over analog signals.	Transmits data over digital signals using twisted pair wiring.	Transmits data over high-frequency channels on coaxial cables.
Speed	Typically up to 56 Kbps (kilobits per second).	Offers speeds from 256 Kbps to 100 Mbps or higher.	Offers speeds typically between 10 Mbps to 1 Gbps or more.
Simultaneous Use	Cannot use the phone line for voice calls while connected.	Allows simultaneous voice calls and internet access (using different frequencies).	Allows simultaneous TV and internet service over the same cable.
Setup	Requires a phone line and a dial-up service provider.	Requires a DSL line and compatible modem; may require configuration. 	Requires cable service and compatible modem; typically a plug-and-play setup.

Distance Limitation	Distance from the service provider's central office significantly affects speed and reliability.	Speed decreases with distance from the provider's DSLAM (Digital Subscriber Line Access Multiplexer).	Less affected by distance; performance depends more on the service provider's infrastructure.
Common Uses	Mostly used in remote areas or for basic internet access.	Used in residential and small business environments for broadband internet.	Used for high-speed internet access in residential and commercial settings.
Modulation Technique	Uses modulation techniques like PCM (Pulse Code Modulation) .	Uses modulation techniques like DMT (Discrete Multitone Modulation) .	Uses modulation techniques like QAM (Quadrature Amplitude Modulation) .
Equipment Cost	Generally cheaper and widely available.	Moderately priced; requires a DSL modem.	Prices vary based on speed and service, generally higher than dial-up.

For each type of modem describe its roles and characteristics:

- Dial-up Modems provide basic internet connectivity over telephone lines with limited speed and cannot support simultaneous voice calls.
- ADSL Modems offer higher speeds and allow simultaneous voice and internet access over the same line but are distance-sensitive.
- Cable Modems provide the fastest speeds of the three, using coaxial cables to connect to the internet while allowing simultaneous cable TV access, making them ideal for high-speed internet services.

3. Connecting network devices:

Identify the type of network cable can be used for below network connections:

- a) Computer and hub _____ Straight-through Ethernet cable _____
- b) Computer and switch _____ Straight-through Ethernet cable _____
- c) Computer and router _____ Straight-through Ethernet cable _____
- d) Computer hub and hub _____ Crossover Ethernet cable _____
- e) Hub and switch _____ Straight-through Ethernet cable _____
- f) Hub and router _____ Straight-through Ethernet cable _____
- g) Switch and switch _____ Crossover Ethernet cable _____
- h) Switch and router _____ Straight-through Ethernet cable _____
- k) Router and router _____ Crossover Ethernet cable _____