Network Programming

Section two

- **A network :** Some of Devices like computers or smart phones , printer are Connected Together, to share information and resources Like Printer , Internet .

The purpose of a network:

1. Data sharing : Exchange files and information.
2. Resource sharing : Share printers, storage, Internet etc.
3. Communication : Enable you to send email, messaging, and calls.
4. Collaboration : Work with teams on tasks and projects.
5. Remote access : Access data or systems , anything from anywhere.

Network Components:

1. Hardware (HW): The physical parts of a network, like routers, switches, cables, and Wi-Fi access points, that help connect devices and send data.
2. Operating System (OS): Software on devices (like Windows, macOS, or Linux) that controls the network's functions and allows communication between connected devices.
3. Protocols: The rules that devices follow to communicate properly. For example, the internet uses a protocol called TCP/IP to send and receive data between computers
4. Network Media: The physical medium , Data Transfer way (Wire such as cables, fiber optics, or wireless signals) that carry data across the network between devices.

❖ Network types:

➢ Network types are divided based on Two criteria:

1- Geographical Area: The geographical range of my network, how large of an area can it cover , ***Like*** (LAN , PAN , MAN , WAN)

2- Host Role: The role of each device in the network, whether it's a client or a server , Which

a. **Client :** Any Device That Required Service

b. **Server :** Any Device That Provide Service

Like (p2p , Client / Server)

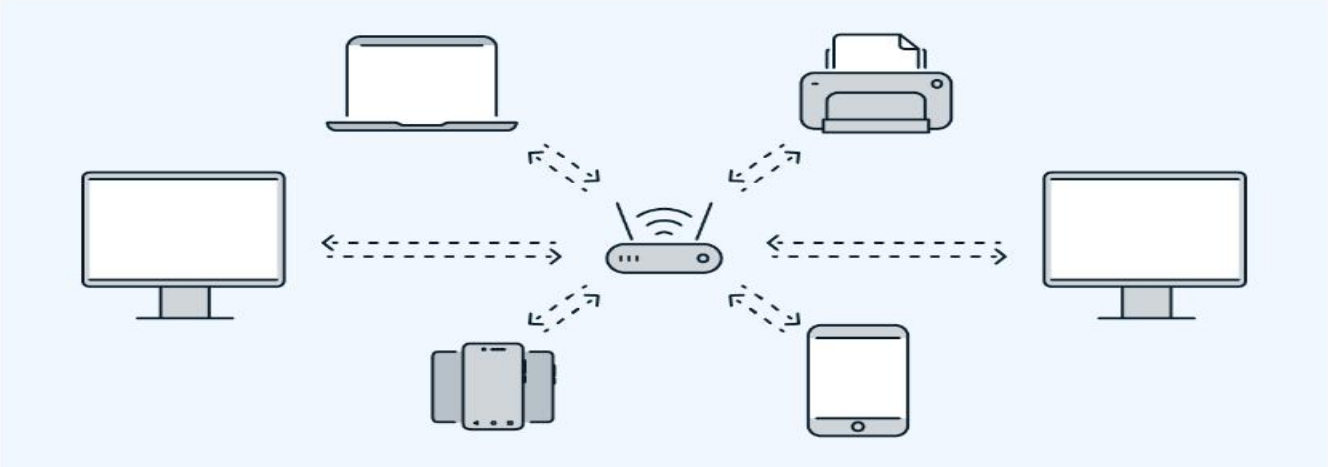
❖ Different network types:

- **LAN (Local Area Network)** : Connects devices within a small area like a home or office.
- **WAN (Wide Area Network)** : Connects devices over large distances, like cities or countries (e.g., the internet).
- **MAN (Metropolitan Area Network)** : Covers a city or large campus.
- **PAN (Personal Area Network)** : Small network around a person (e.g., Bluetooth devices).
- **P2p (peer to peer)** : allows devices to connect directly to each another Without Needing a Central Server

- **Client Server Network** : Clients (like computers) ask servers for services or resources.

1- Local Area Network (LAN):

- **Definition**: is a group of devices in the same geographical location (at The Same building).
- **Characteristics**:
  - ✧ Limited Geographical Area
  - ✧ Connect Devices With a small Area
  - ✧ Fast data speed
  - ✧ Low Delay
  - ✧ Connect Using Ethernet Or Wifi.
- **Use Cases**: Ideal for sharing files, printers, and communication within a local space.



2-Metropolitan Area Network (MAN)

- **Definition:** A Metropolitan Area Network (MAN) connects multiple local networks (LANs) across a city or large area.
- **Characteristics:**
  - ✧ Connect More Than LAN Inside City
  - ✧ Cover Geographical Ara More Than LAN
  - ✧ Connect Using Fiber Optical Cables (High Speed To Transfer data)

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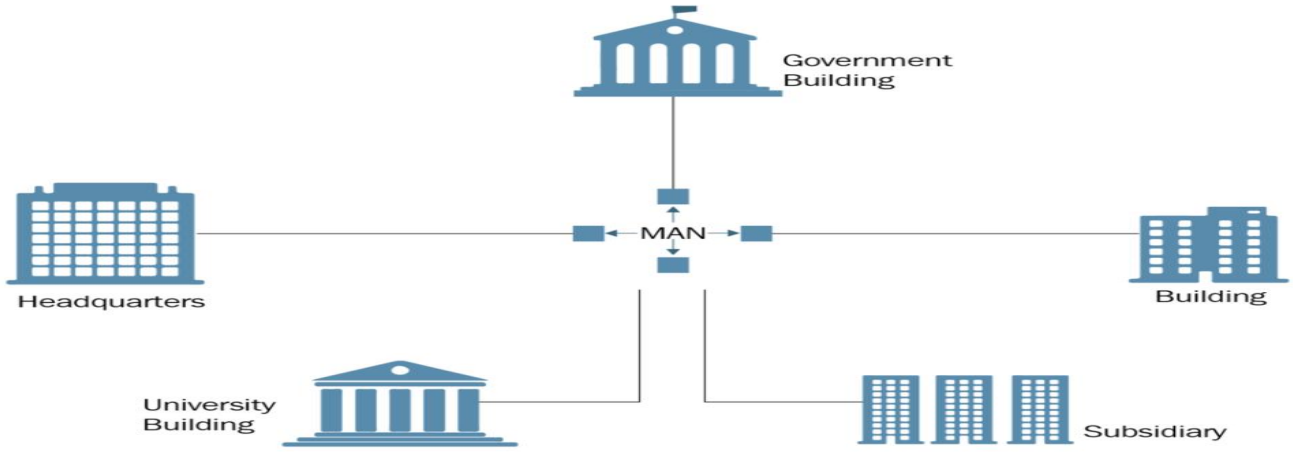
- **Use Case:** Used by service providers to connect businesses, schools, and government offices across a city.

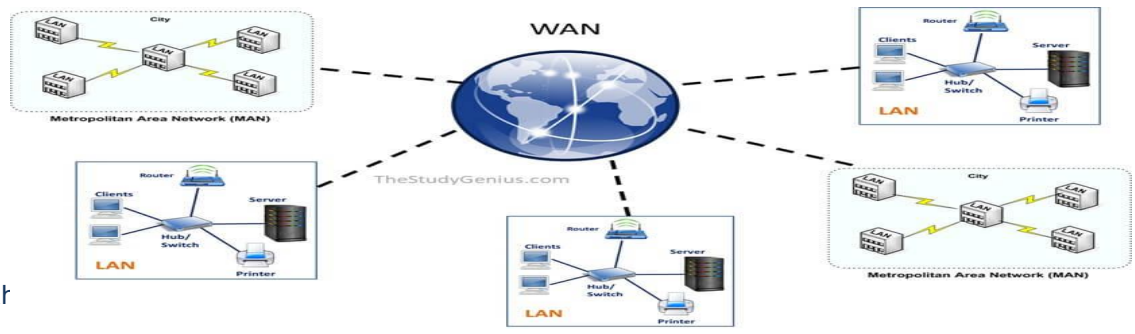


- ✧ Covers a city or large campus.

3-Wide Area Network (WAN):

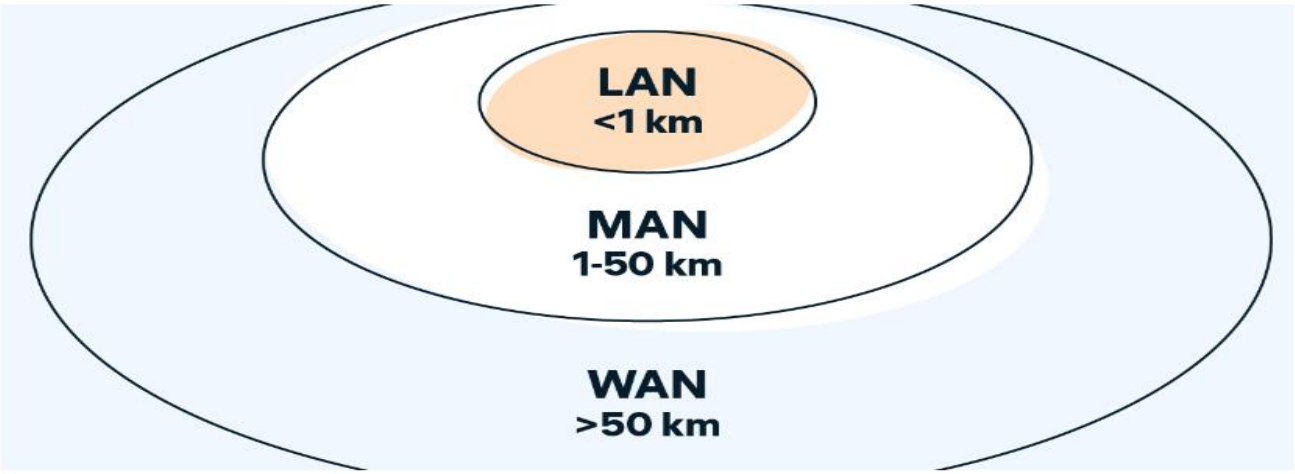
- **Definition**: WAN covers a broad geographic area and connects LANs or remote locations.
- **Characteristics**:
  - ✧ Connect More Than LAN Out Side City
  - ✧ Large Distance Than (LAN , MAN)
  - ✧ EX) Internet is the best Example For WAN

- **Use Cases**: Used to connect offices in different locations Around The World



❖ What are the differences between LANs, MANs, and WANs ?

Area of coverage is the biggest difference between LAN, MAN, and WAN networks. A LAN covers a small, localized area like a home, office, or campus. A MAN may cover a geographical area such as a city, and a WAN can span across seas and continents via underwater cables and other existing network infrastructure. The internet itself is a great example of a WAN.



Coverage area of LANs, MANs, and WANs.

4-Personal Area Network (PAN):

- **Definition:** PAN is a small network that connects personal devices in a short distance (like a few meters).
- **Characteristics:** It's wireless or Wired , covers a small area, and is used for devices like phones and laptops.
- **Use Case:** Connecting your smartphone to wireless headphones via Bluetooth.

- ✧ Small network around a person (e.g., Bluetooth devices).

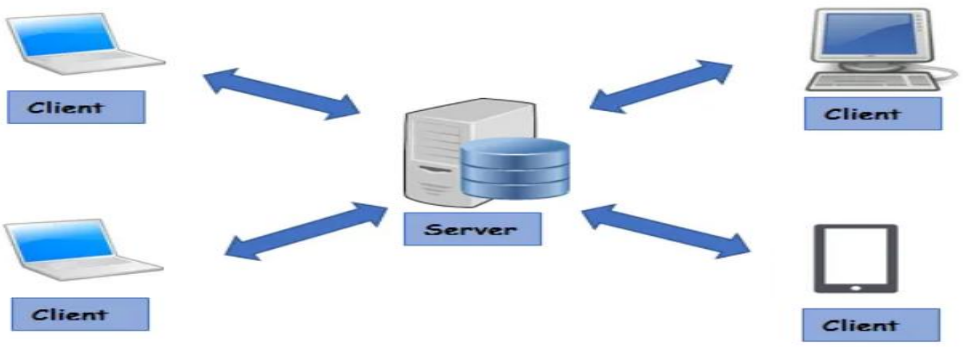
5-Peer-to-Peer (P2P) Network:

- ➢ **Definition:** A Peer-to-Peer (P2P) network lets devices connect directly to share files or resources without needing a central server.
- ➢ **Characteristics:**
  - ✧ Each device acts as both a client and a server, making the network decentralized.
  - ✧ No Centralization
  - ✧ Without Role
- ➢ **Use Cases:** Commonly used for file sharing (like torrents), video calls, and decentralized apps (like cryptocurrencies).

- ✧ allows devices to connect directly to each another Without Needing a Central Server.

6- Client-Server Network

- **Definition:** Clients (like computers) ask servers for services or resources.
- **Characteristics:**
  - ✧ Centralized servers manage and provide data to multiple clients.
  - ✧ Data Centralized
  - ✧ Any Device has a role
- **Use Cases:** Often used in businesses for storing and managing data efficiently.



- ✧ ask servers for services

Network devices (HW Components)

- ❖ **Network devices** are tools that help connect and manage communication between computers and other devices in a network.
- ❖ **Purpose :**
  - ✧ Use To Facilities Transmit data Between Devices Across Network
  - ✧ Ensure that the packet has reached from the source IP to the destination IP

- ✧ Ensures High Security
- ✧ Reduce Redundancy

❖ **Here are some common ones:**

1. **Hub**: Connects multiple devices Within a single internal network.
2. **Router**: Directs data between different networks (like home and the internet).
3. **Switch**: Connects multiple devices within the same network to share data.
4. **Modem**: Converts internet signals from your service provider for home use.
5. **Access Point**:Gives Wi-Fi access to devices so they can connect wirelessly.
6. **Firewall**: Protects the network by controlling incoming and outgoing traffic.
7. **Network Bridge**: Joins two networks together so they work as one.
8. **Gateway** :Connects two networks that use different protocols and translates data between them

✧ **"All these devices form networks, but the difference lies in how each device handles the data."**

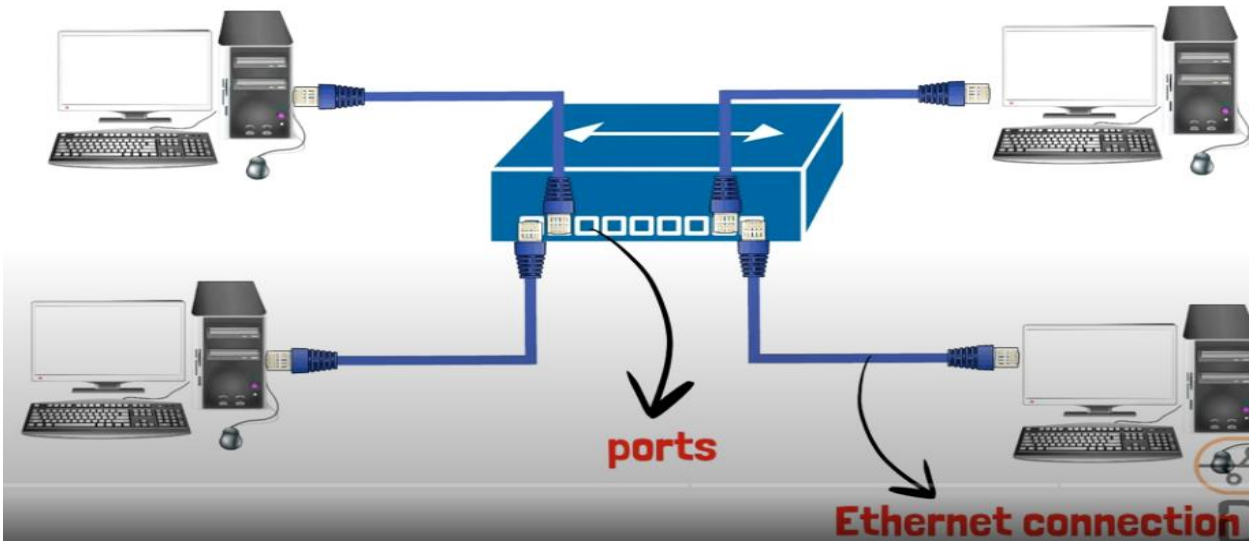
1.Hub:

➢ **Function:** Connects multiple devices Within a single internal network.

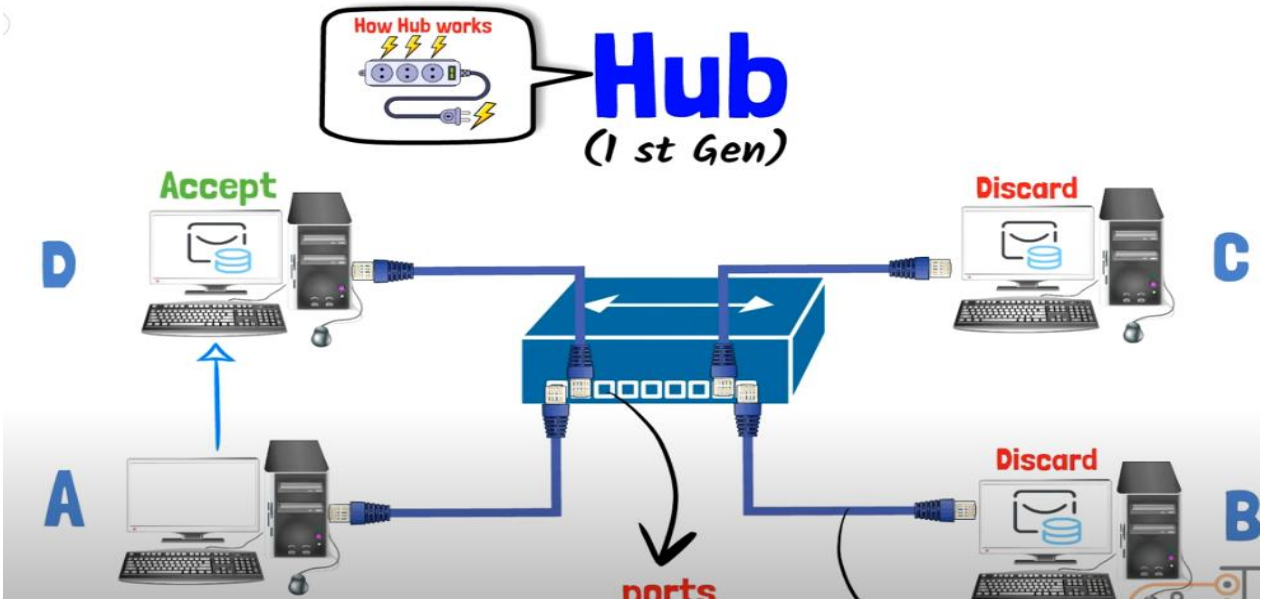
➢ **Key Features:**

- ✓ Simple design
- ✓ does not filter or manage traffic
- ✓ Operates at Layer (1) Physical Layer Deal With data Only Without IP and MAC address

➢ **Use Cases:** Used in small networks to connect devices Because the number of ports is limited, but less common now due to inefficiency compared to switches.



❖ How Hub Work ?

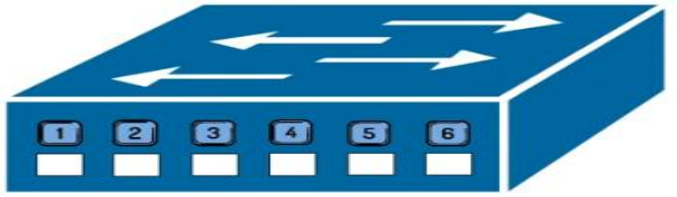


❖ Disadvantage ?

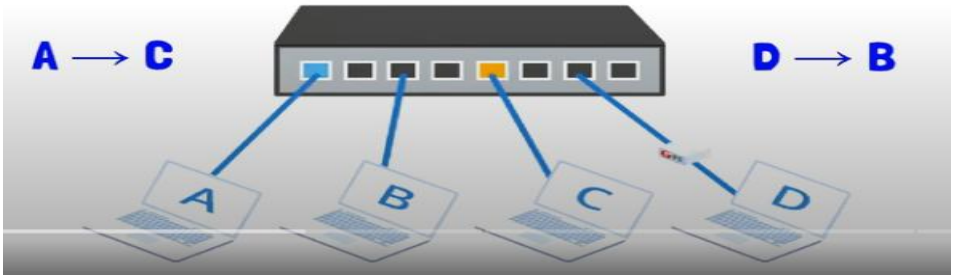
1. **No Intelligence**
2. **Security**
3. **Unnecessary Traffic**
4. **Old Technology** due to inefficiency compared to switches

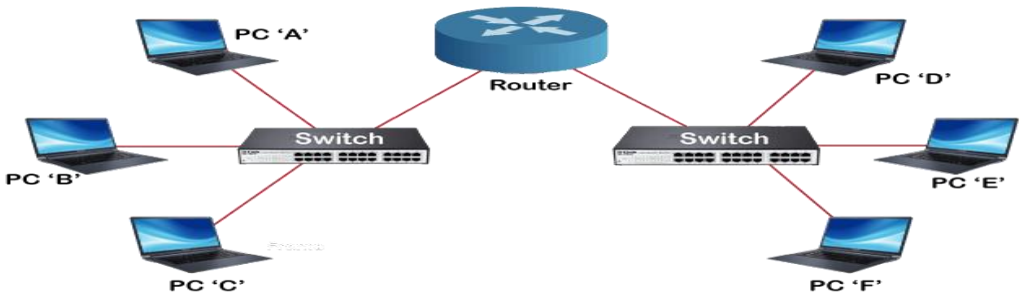
2-Switch:

- **Function:** Links devices within a single network (like a Hub) and sends data to the right device using MAC addresses.
- **Key Features:**
  - ✓ Has a MAC address table So send Data To The Right Device
  - ✓ Operates at Layer (2) Data Link Layer
- **Use Cases:**
  - ✓ Helps organize network traffic
  - ✓ speeds up data transfer
  - ✓ improves network performance in offices or homes
  - ✓ High Security.



❖ How Switch Work ?





3. Router:

➢ Function:

- ✓ The gateway from the original network to the outside world
- ✓ Sends data between different networks using IP addresses
- ✓ helping devices on separate networks communicate.

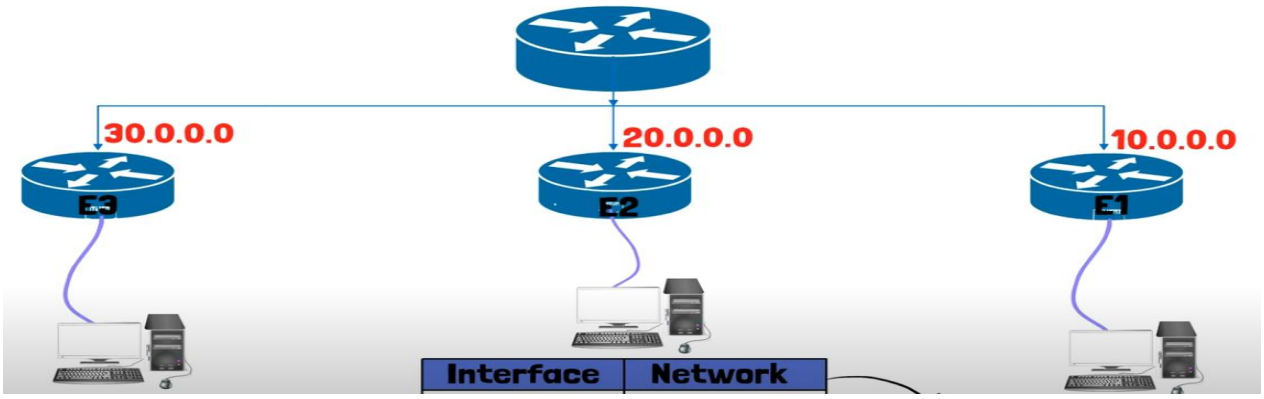
➢ Key Features:

- ✓ Has Routing Tables: Handles network address translation (NAT)
- ✓ uses routing rules
- ✓ includes a firewall for security.

➢ Use Cases:

- ✓ Connects local networks (LANs) to larger networks (WANs),
- ✓ manages internet traffic
- ✓ ensures data reaches the right place.

❖ How Router Work ?



4-Firewall:

- **Function:**

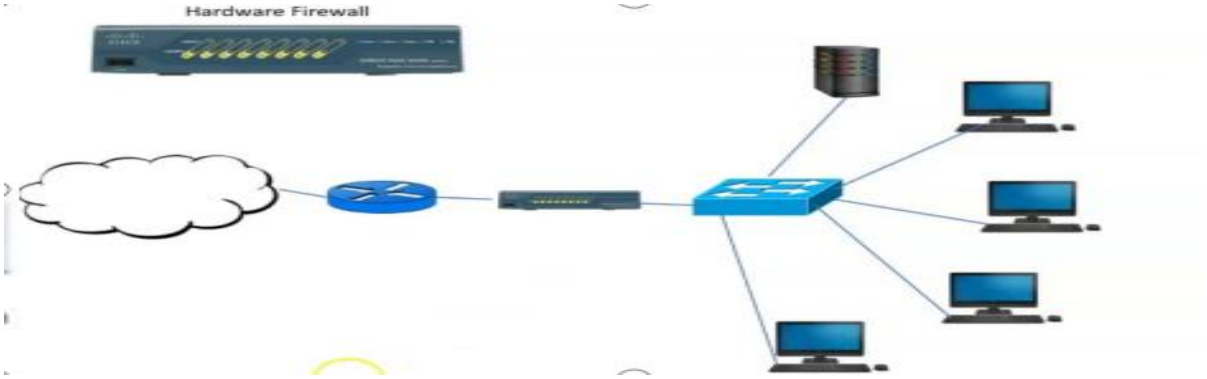
  - ✓ Works as a security shield between your network and outside threats
  - ✓ controlling what data comes in or goes out.

- **Key Features:**

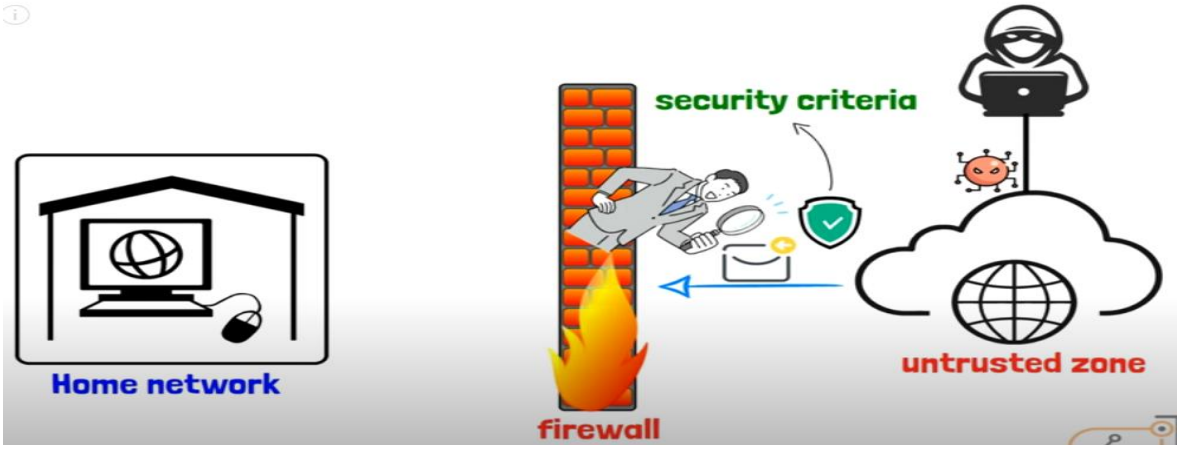
  - ✓ Filters harmful data
  - ✓ monitors ongoing connections
  - ✓ blocks attacks.

- **Use Cases:**

  - ✓ Keeps your network safe from hackers
  - ✓ Malware and unauthorized access.



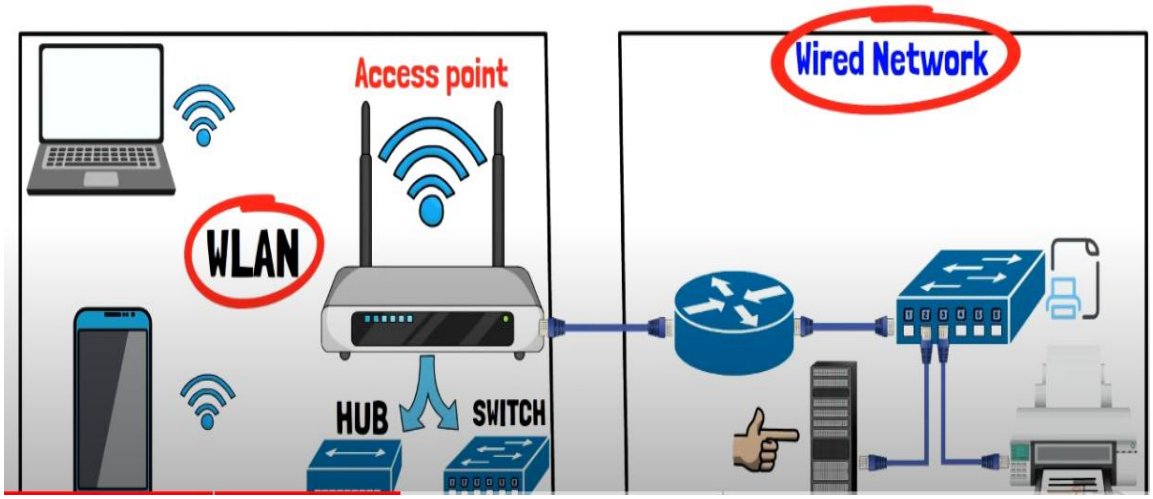
❖ How Firewall Work ?



5-Wireless Access Points (WAPs):

- **Function:** Lets wireless devices (like phones and laptops) connect to a wired network using Wi-Fi.
- **Key Features:**
  - ✓ Can set up Wi-Fi names (SSID)
  - ✓ secure connections with encryption
  - ✓ supports different Wi-Fi types (like 802.11ac, 802.11ax)
  - ✓ Operates at Layer (2) Data Link Layer
- **Use Cases:** Used to provide Wi-Fi in homes, offices, and public areas.

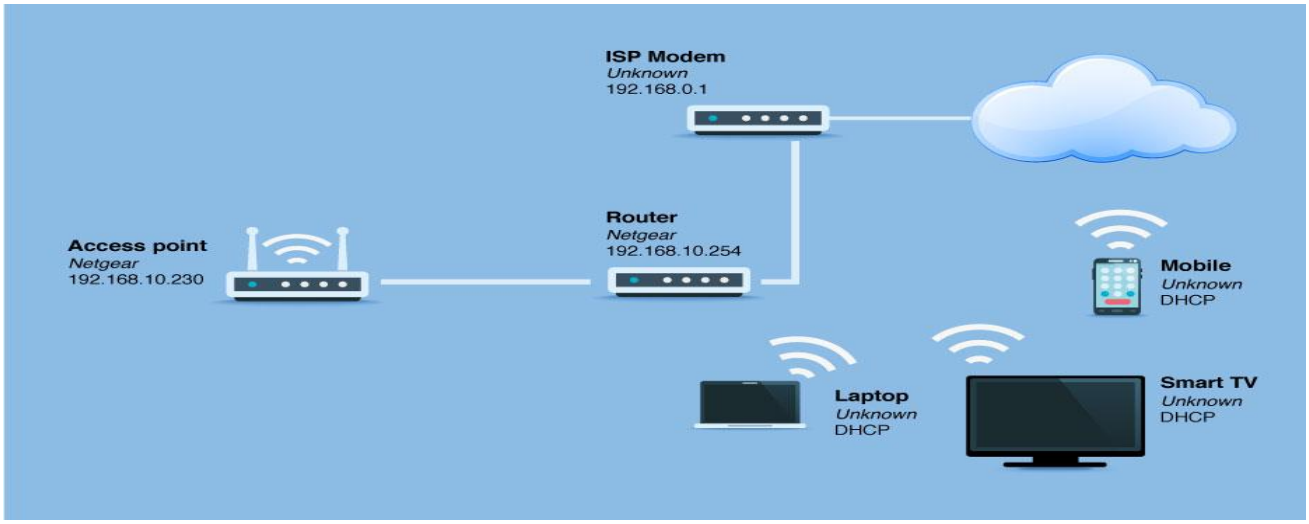
How Access Point Work ?



6-Modem:

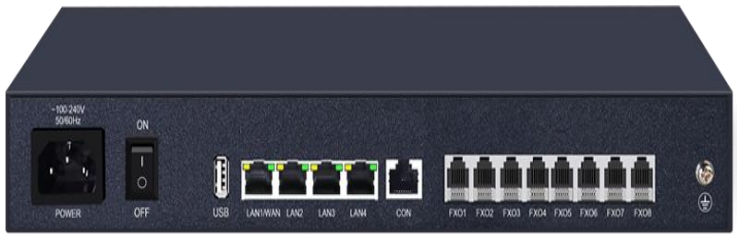
- **Function:** Changes digital data from your computer into signals that can travel over phone lines or cable.
- **Key Features:** Works with different types of connections like ADSL, cable, and DSL.
- **Use Cases:** Connects homes and businesses to the internet using broadband or DSL services.

How Modem Work ?

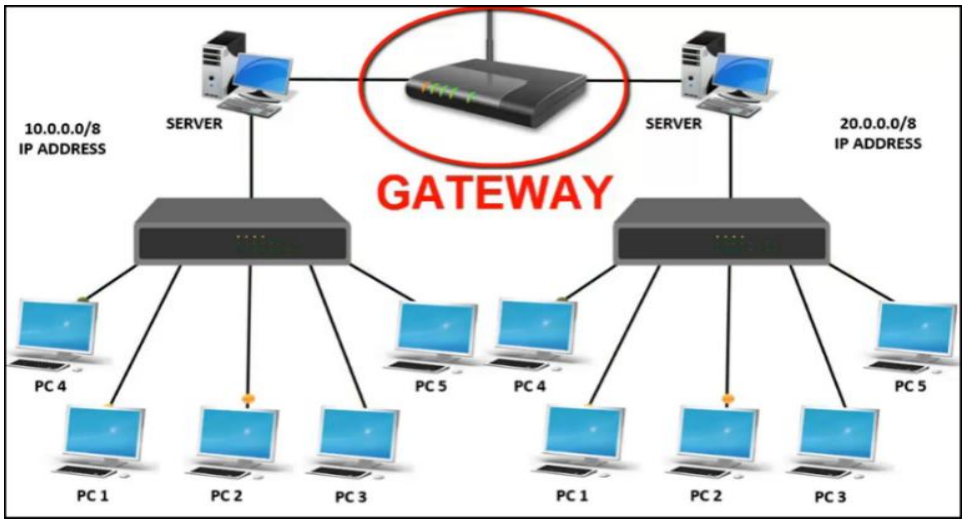


7-Gateway:

- **Function:** Connects two networks that use different protocols and translates data between them.
- **Key Features:** Can convert protocols and often includes routing functions.
- **Use Cases:** Links networks with different communication types, like connecting a home network (LAN) to the internet (WAN).



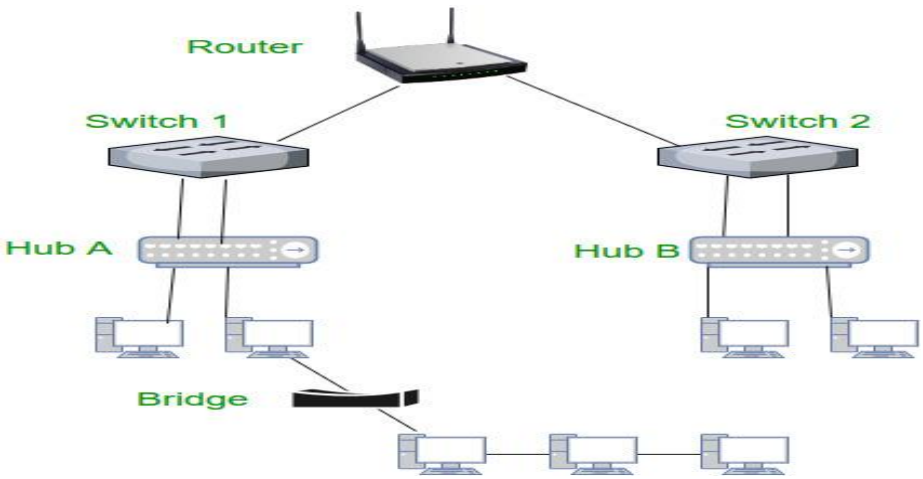
How Gateway Work ?



8-Network Bridge:

- **Function:** Connects and manages traffic between two or more network segments
- **Key Features:**
  - ✓ It acts as a bridge that allows data to pass through but does not let it return, thereby solving the looping problem that existed with the hub.
  - ✓ Can filter data based on MAC addresses and helps segment networks.
  - ✓ usually operating at the data link layer (Layer 2).
- **Use Cases:** Breaks up large networks, isolates broadcast traffic, and enhances overall network efficiency.

How Bridge Work ?



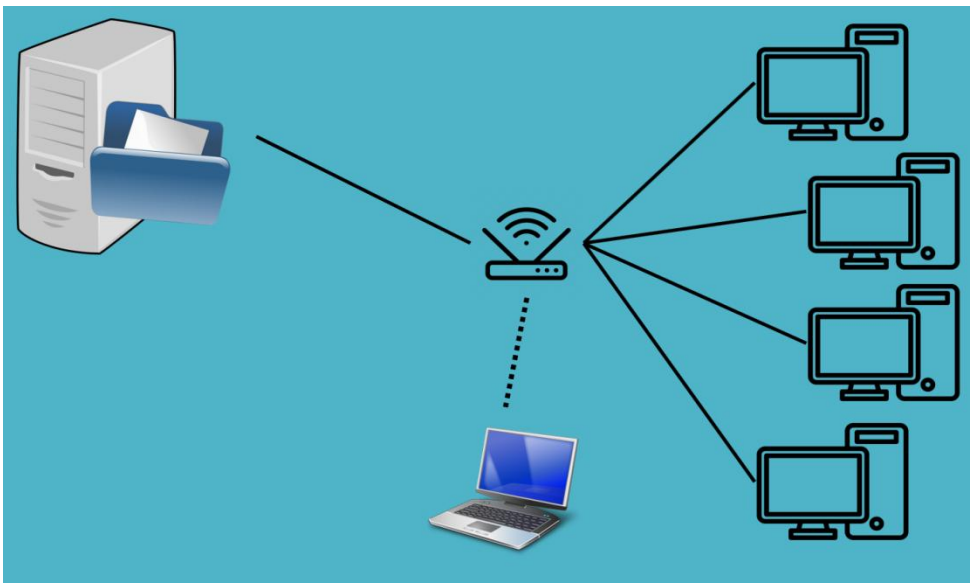
Examples for networks

Scenario 1: Small Office File Server

Objective: Establish a small office network with a file server for data storage and sharing with 4 pcs and one laptop.

Solution:

- File server.
- Router with Wi-Fi and Ethernet ports.
- Desktop computers and laptops.
- Ethernet cables or Wi-Fi adapters.
- File server software (e.g., Windows Server, NAS software).
- Network configuration tools.



Assignment

Essay Question

1) What is a Network?

2) What is the Purpose of a Network?

3) Compare between proxy and vpn ?

4) Describe the Key Components of a Network and Their Roles?

5) Explain the Different Types of Networks Based on Geographical Area and Host Role ?

6) Compare LAN, MAN, and WAN Networks.

7) Describe Common Network Devices and Their Functions?