Advanced Computer Networks

MODULE-1

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Computer Network?

- **Computer Network** is a group of computers connected with each other through wires, optical fibres or optical links so that various devices can interact with each other through a network.
- It is a group of computers that use a set of common communication protocols over digital interconnections for the purpose of sharing resources located on or provided by the network nodes.
- The aim of the computer network is the sharing of resources among various devices.

Advantages of a Computer Network

- Helps you to connect with multiple computers together to send and receive information when accessing the network.
- Helps you to share printers, scanners, and email.
- Helps you to share information at very fast speed
- Electronic communication is more efficient and less expensive than without the network.

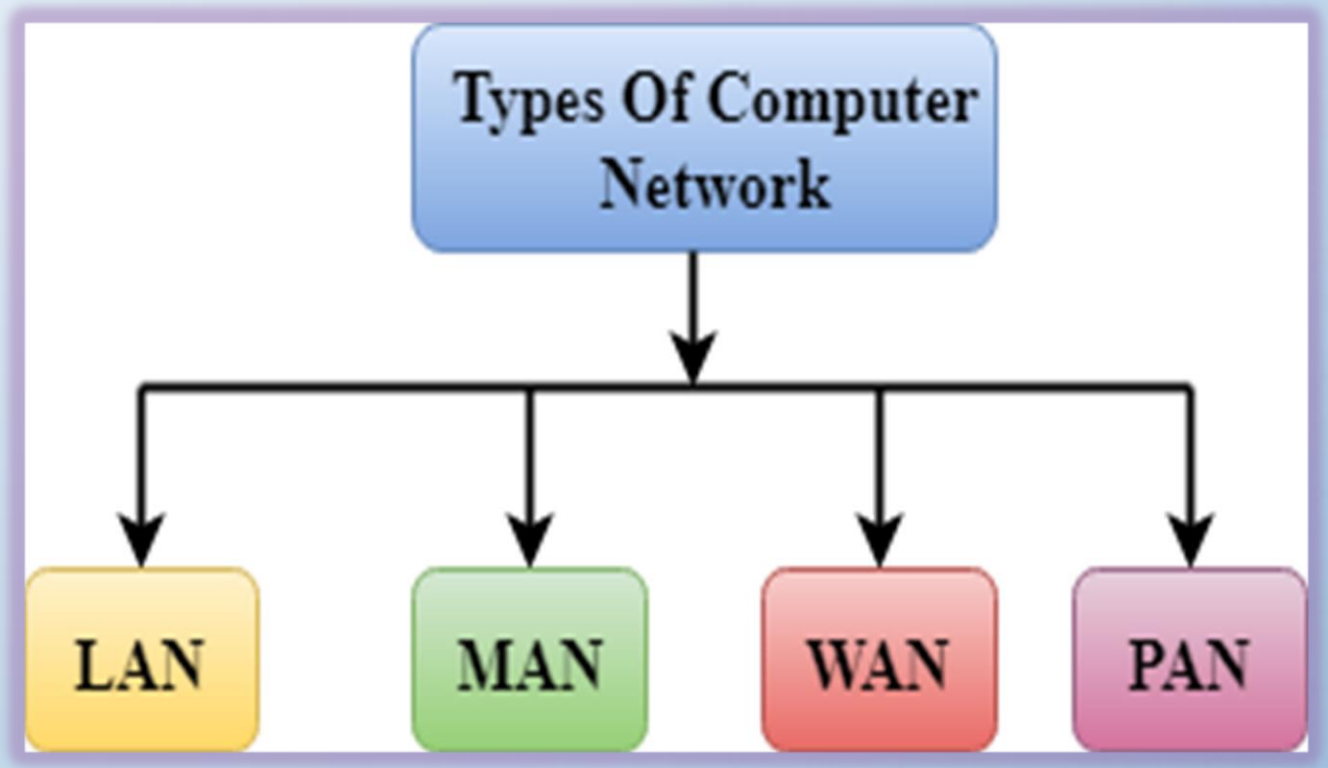
- A computer network can be categorized by their size.
- A computer network is mainly of four types:

✓ LAN(Local Area Network)

✓ PAN(Personal Area Network)

✓ MAN(Metropolitan Area Network)

✓ WAN(Wide Area Network)



LAN(Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

PAN(Personal Area Network)

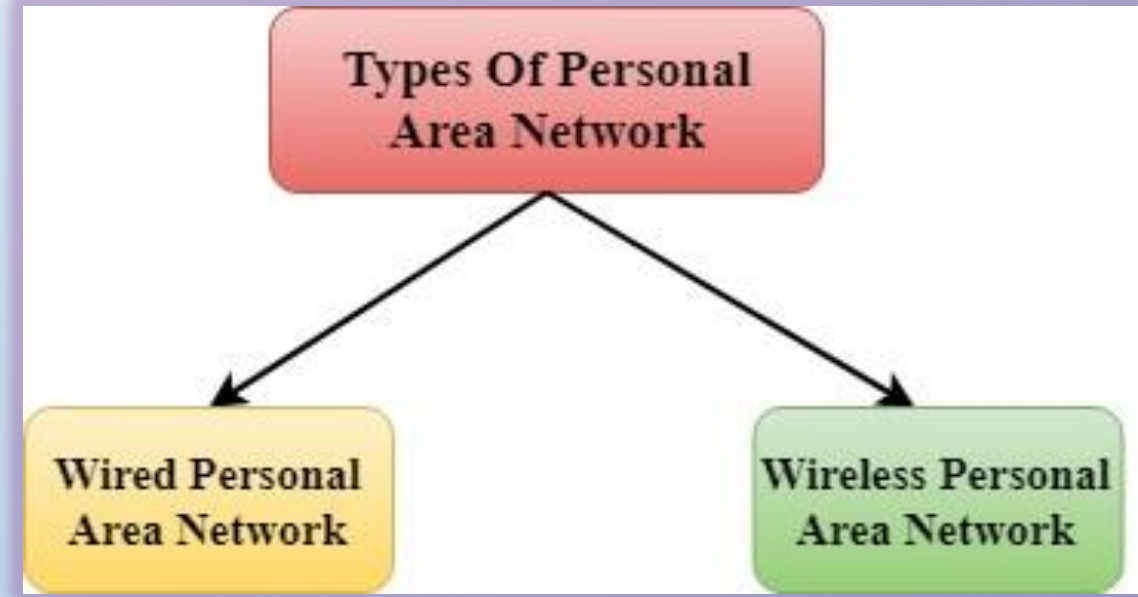
- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.
- Personal Area Network is used for connecting the computer devices of
personal use is known as Personal Area Network.
- Personal Area Network covers an area of **30 feet**.
- Personal computer devices that are used to develop the personal area
network are the laptop, mobile phones, media player and play stations.

There are two types of Personal Area Network:

- Wired Personal Area Network
- Wireless Personal Area Network

- **Wireless Personal Area Network:** Wireless Personal Area Network is developed by simply using wireless technologies such as WiFi, Bluetooth. It is a low range network.

- **Wired Personal Area Network:** Wired Personal Area Network is created by using the USB.



MAN(Metropolitan Area Network)

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected to each other through a telephone exchange line.
- It has a higher range than Local Area Network(LAN).

Uses Of Metropolitan Area Network:

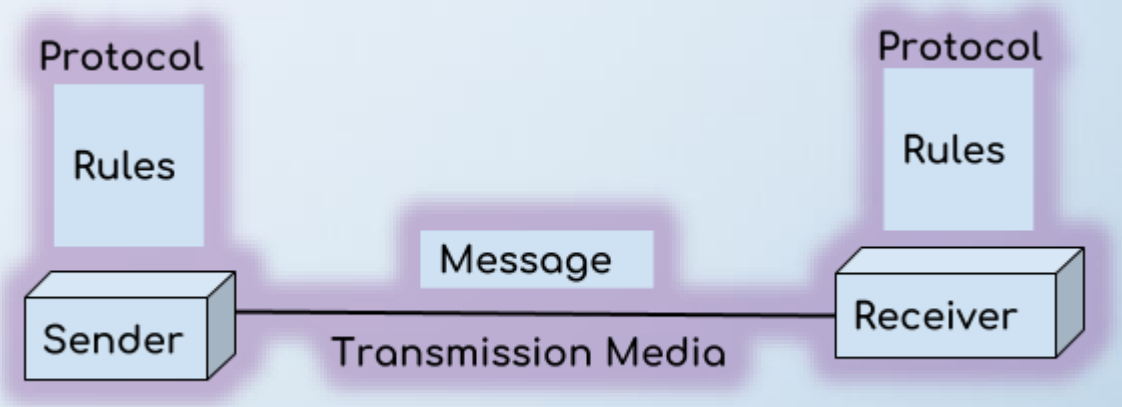
- MAN is used in communication between the banks in a city.
- It can be used in an Airline Reservation.
- It can be used in a college within a city.
- It can also be used for communication in the military.

WAN(Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education

Computer Network Components

There are five **basic components** of a computer network



- **Message**: It is the data or information which needs to be transferred from one device to another device over a computer network.

- **Transmission Media/Channels** - Transmission media are the facilities used to interconnect computers in a network. Transmission media are sometimes called channels, links or lines. The technical name of channels is network circuit. It is the pathway over which information travels between the different computers that comprise the network.

- **Sender**: Sender is the device that has the data and needs to send the data to other device connected to the network.

- **Receiver**: A receiver is the device which is expecting the data from other device on the network.

Transmission media: In order to transfer data from one device to another device we need a transmission media such as wires, cables, radio waves etc.

- **Protocols/protocol suite**: A protocol is a set of rules that are agreed by both sender and receiver, without a protocol two devices can be connected to each other but they cannot communicate**.**A protocol is a rule or guideline followed by each computer for data communication. Protocol suite is a set of related protocols that are laid down for computer networks. The two popular protocol suites are −
  a. OSI Model (Open System Interconnections)
  b. TCP / IP Model

In order to establish a reliable communication or data sharing between two different devices we need set of rules that are called protocol.

For example, http and https are the two protocols used by web browsers to get and post the data to internet, similarly SMTP protocol is used by email services connected to the internet.

Major computer network components

Computer networks components comprise both physical parts as well as the software required for installing computer networks, both at organizations and at home.

The hardware components are

- ❖ Sender
- ❖ Receiver
- ❖ Transmission medium
- ❖ Connecting devices/Network devices.

The software components are

- ❖ operating system
- ❖ protocols.

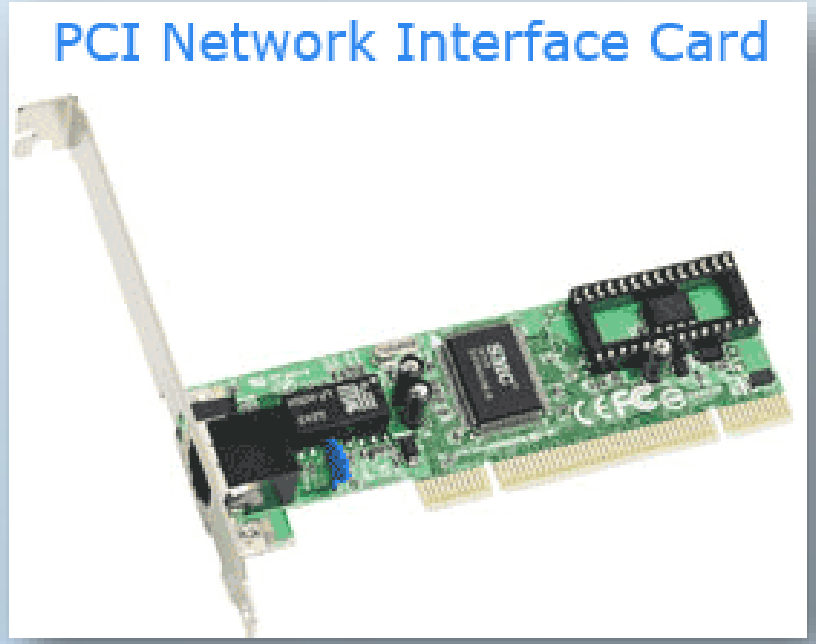
Connecting devices/Network Devices

These are the middleware between computers and networks which binds them together. Some of the connecting devices are given below

- ✓ Network Interface Card (NIC)
- ✓ Hub
- ✓ Switches
- ✓ Router
- ✓ Repeaters
- ✓ Bridges
- ✓ Gateways
- ✓ Cables and connectors

Network Interface Card (NIC)

- ✓ Each computer in a network has a special expansion card called a network interface card (NIC).
- ✓ The NIC prepares(formats) and sends data, receives data, and controls data flow between the computer and the network.
- ✓ NIC converts the data packets between two different data transmission technologies.



- ✓ There are two types of NIC:
  - **Wired NIC:** The Wired NIC is present inside the motherboard. Cables and connectors are used with wired NIC to transfer data.
  - **Wireless NIC:** The wireless NIC contains the antenna to obtain the connection over the wireless network. For example, laptop computer contains the wireless NIC.

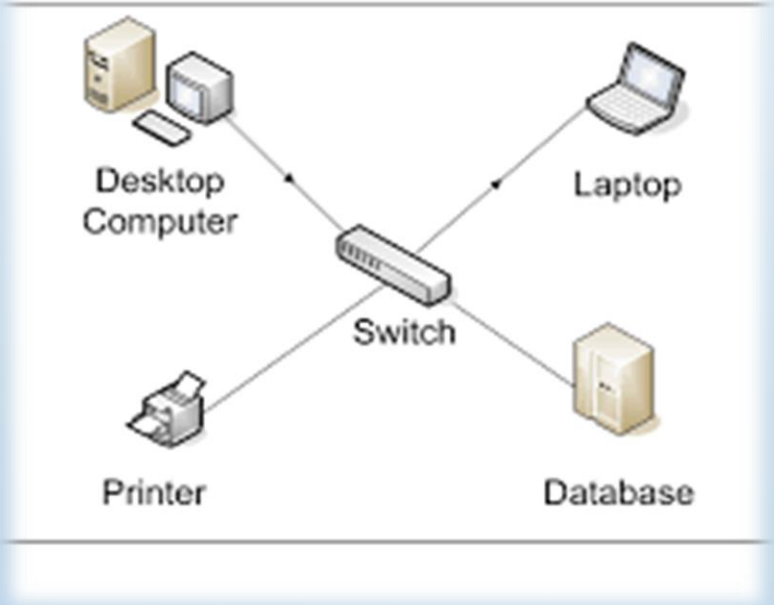
- Serial data transmission sends data bits one after another over a single channel.
- Parallel data transmission sends multiple data bits at the same time over multiple channels.

- A PC uses parallel data transmission technology to transmit the data between its internal parts while the media that provides connectivity between different PCs uses serial data transmission technology.

Hub

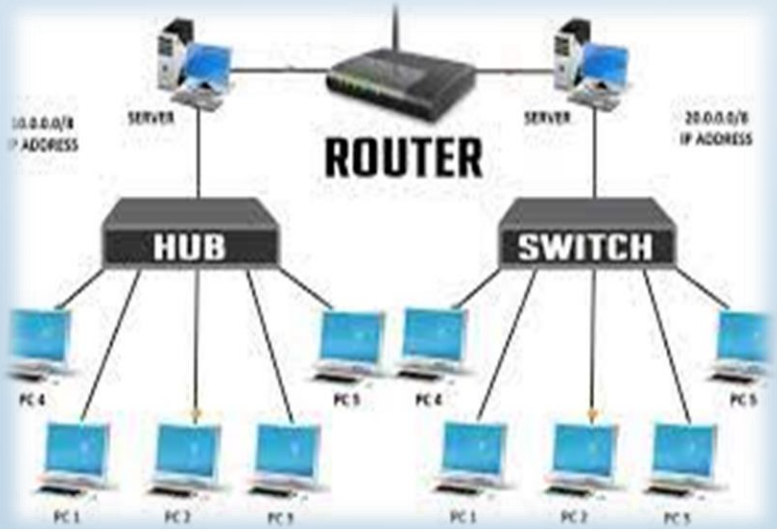
- Several networks need a central location to connect media segments together. These central locations are called as **hubs**.
- The hub organizes the cables and transmits incoming signals to the other media segments.
- It is like a distribution center. When a computer request information from a network or a specific computer, it sends the request to the hub through a cable.
- The hub will receive the request and transmit it to the entire network.
- Each computer in the network should then figure out whether the broadcast data is for them or not.
- The three types of hubs are: Passive hub, Active Hub, Intelligent Hub

Switch



- It supports transmitting, receiving and controlling of traffic with other computers on the network.
- As the hub is used for data transferring, whereas a switch is used for filtering & forwarding the data. So this is the more clever technique to deal with the data packets.
- Whenever a data packet is obtained from the interfaces in the switch, then the data packet can be filtered & transmits to the interface of the proposed receiver.
- Due to this reason, a switch maintains a content addressable memory table to maintain system configuration as well as memory.
- This table is also named as FIB (forwarding information base) otherwise forwarding table.

Router



- The router connects the different network segments. It switches the data packets between those networks which are either located in the different logical segments or built with the different network layer protocols.
- When a router receives a data packet on any of its interface, it checks the destination address of that packet and based on that destination address, it forwards that data packet from the interface which is connected with the destination address.
- To forward a data packet to its destination, router keeps the records of connected networks. These records are maintained in a database table known as the Routing table.

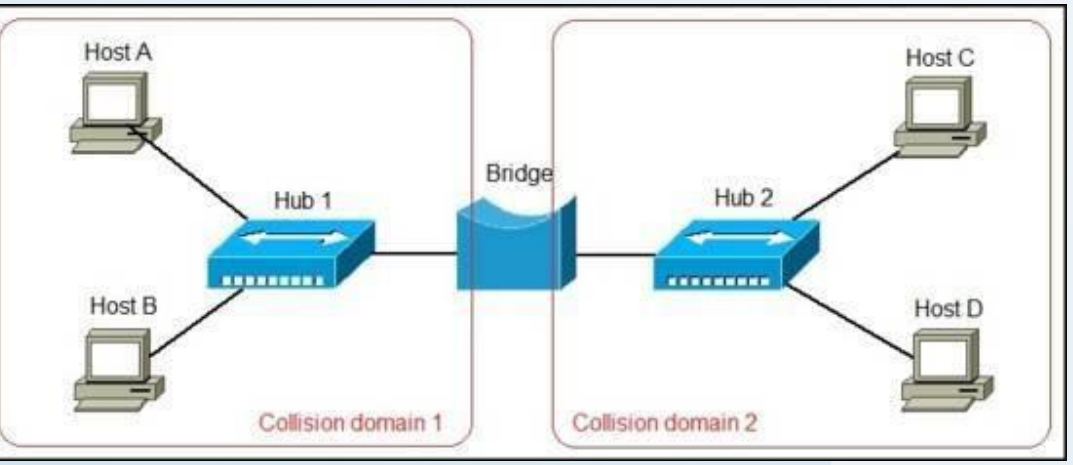
What's the Difference? Hub vs Switch vs Router

	Hub	Switch	Router
Data Transmission form	electrical signal or bits	frame & packet	packet
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	Direct data in a network
Used in(LAN, MAN, WAN)	LAN	LAN	LAN, MAN, WAN
Transmission mode	Half duplex	Half/Full duplex	Full duplex
Address used for data transmission	MAC address	MAC address	IP address

Repeater

- The main function of this device is to reproduce the signal on a similar network before the signal gets weak otherwise damaged.
- The significant point to be noted regarding these devices is that they do not strengthen the signal.
- Whenever the signal gets weak, then they reproduce it at the actual strength.
- A repeater is a two-port device.

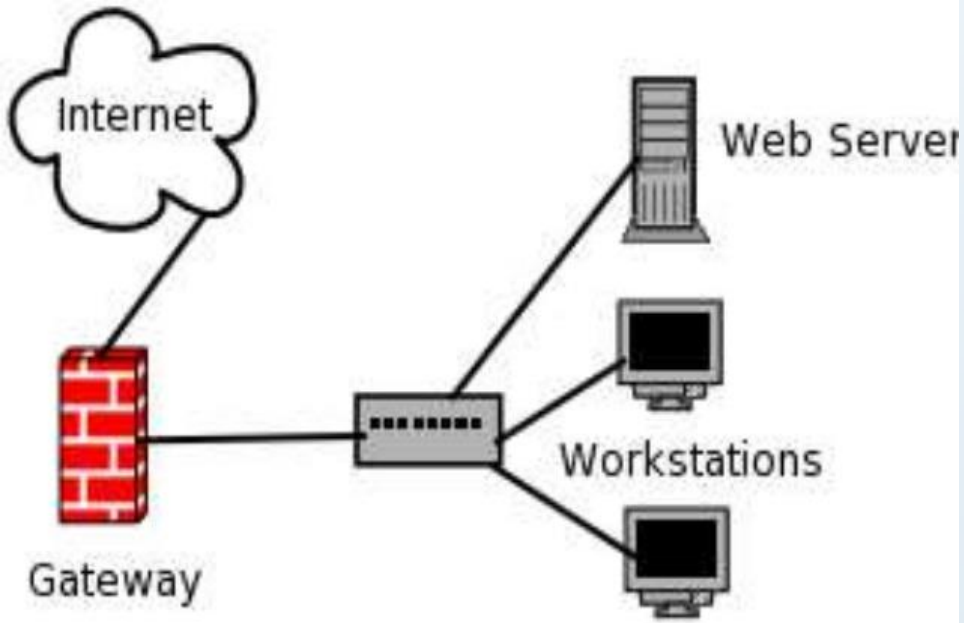
Bridges



- In a network, different LANs can be connected to form a larger LAN.
- This form of aggregating networks is called as network bridging.
- The bridge connects different LANs so that they appear as a part of single network.
- Thus, a bridge connects two or more different LANs which have similar protocol and provides communication between the devices between them.
- A network bridge acts to divide a network into such logical segments that the collision between the data packets being sent over the network is reduced.
- This leads to improvement in performance of a network.

Gateways

- **Gateway** is a network device used to connect two or more dissimilar networks. In networking parlance, networks that use different protocols are **dissimilar networks**
- In a network, a Gateway is a translator between two systems that use different communication protocols, data formats or architectures. Thus, they serve a transitional task. They help in the conversion of one type of protocol into another. A gateway could be used for both, LAN and WAN (wide Area network) interconnections.
- A Gateway can be defined as a node which acts as an entrance for other nodes in the network. It is also responsible to enable traffic flow within the network. It uses more than one protocol for communication, therefore, its activities are much more complex than a switch or a router.



Cables and connectors

- Cable is a transmission media used for transmitting a signal.
- Some of the different types of cables used in transmission:
  - Twisted pair cable
  - Coaxial cable
  - Fibre-optic cable
- Some of the Connectors are
  - USB (Universal Serial Bus)
  - RJ-11 (Registered Jack)
  - RJ-45 (Registered Jack)

Unique Identifiers of Network

Below given are some unique network identifiers:

⁂ **IP Address:**

IP (Internet Protocol) address is as a unique identifier for each device on the Internet. Length of the IP address is 32-bits. IPv6 address is 64 bits.

⁂ **NS Server:**

DNS stands for Domain Name System**.** It is a server which translates URL or web addresses into their corresponding IP addresses.

⁂ MAC Address:

MAC (Media Access Control Address) is known as a physical hardware address is a unique identifier of each host and is associated with the NIC (Network Interface Card). General length of MAC address is : 12-digit/ 6 bytes/ 48 bits

⁂ Port:

Port is a logical channel which allows network users to send or receive data to an application. Every host can have multiple applications running. Each of these applications are identified using the port number on which they are running.