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DATA COMMUNICATION & NETWORKS

Data communication is the process of transferring data between two or more devices using computing and communication technologies:

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DATA COMMUNICATION & NETWORKS

What is Data communication?

Data communication is the process of transferring data between two or more devices using communication and computing technologies. This can include the exchange of text, audio, images, videos, and multimedia files.

How many type of data communication?

There are three main types of data communication based on the direction of data flow between the sender and receiver:

- **Simplex**: Data is sent from the sender to the receiver
- **Half-duplex**: Data can be sent in both directions, but not simultaneously

Full-duplex: Data can be sent in both directions at the same time

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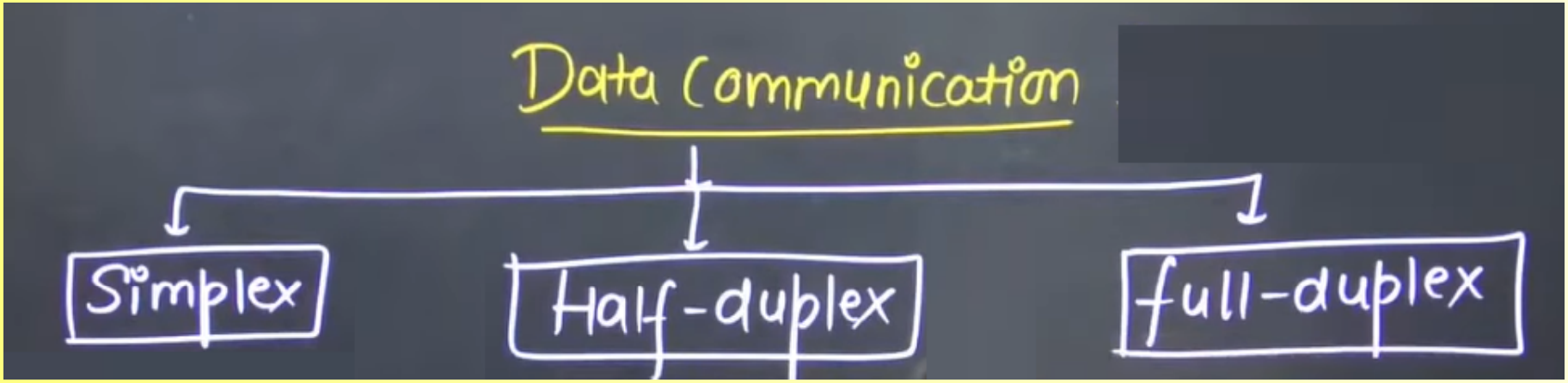

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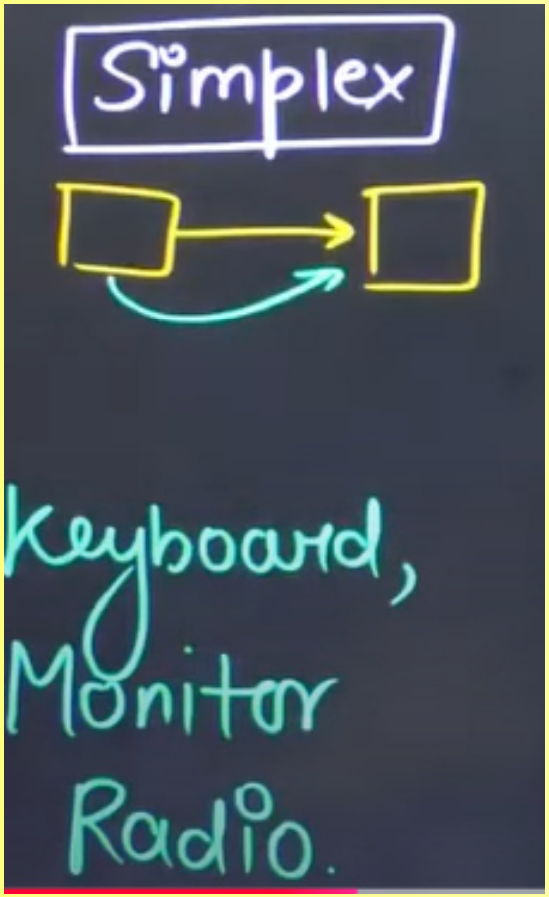

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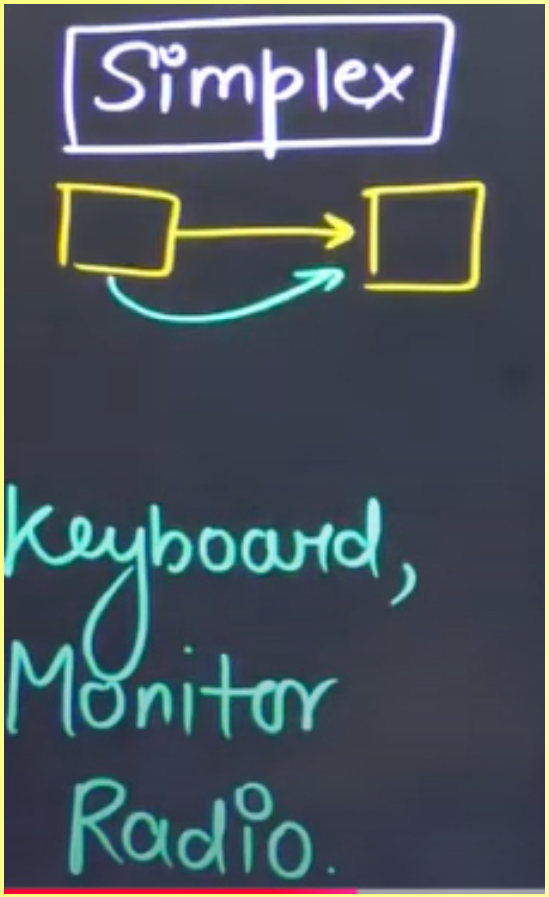

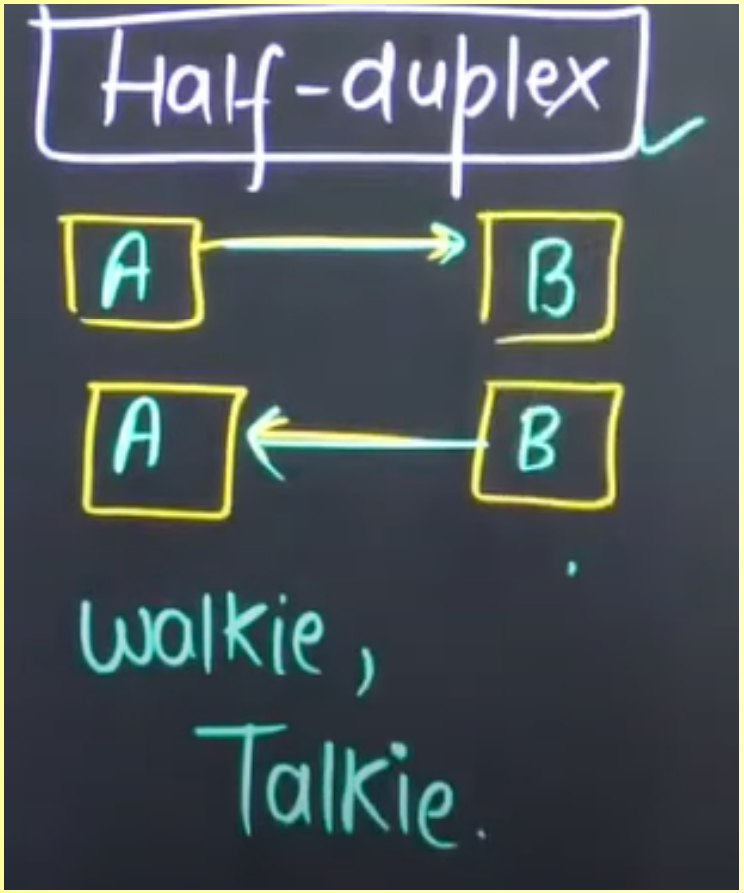

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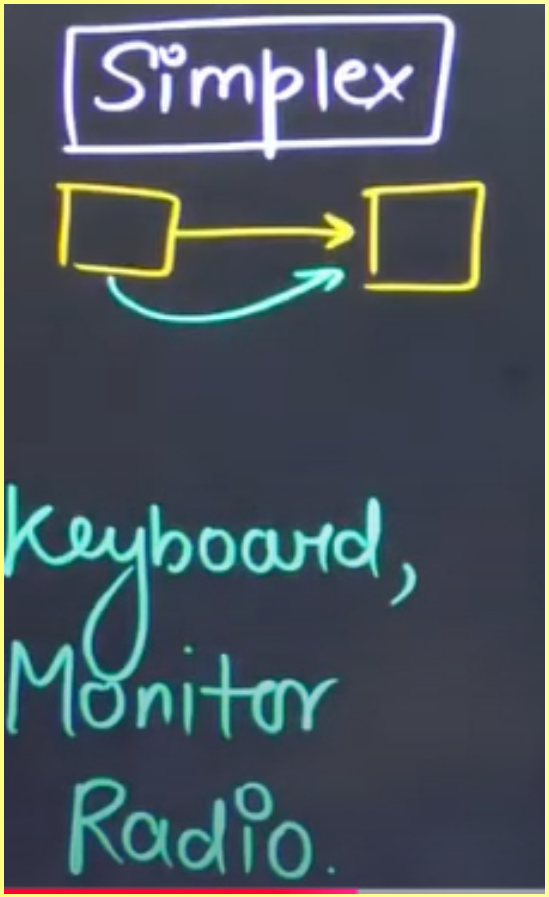

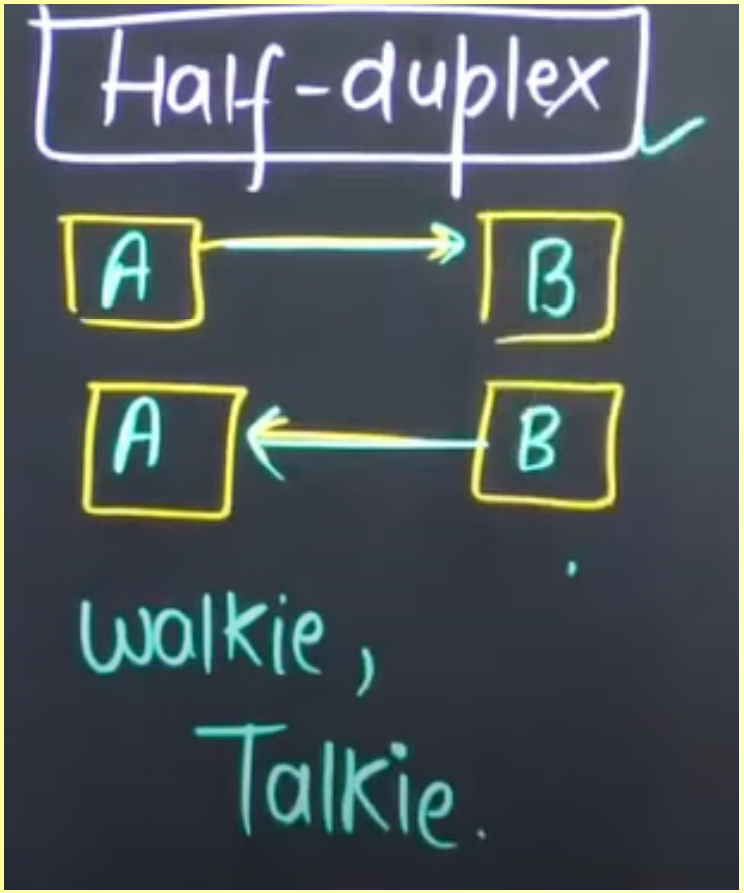

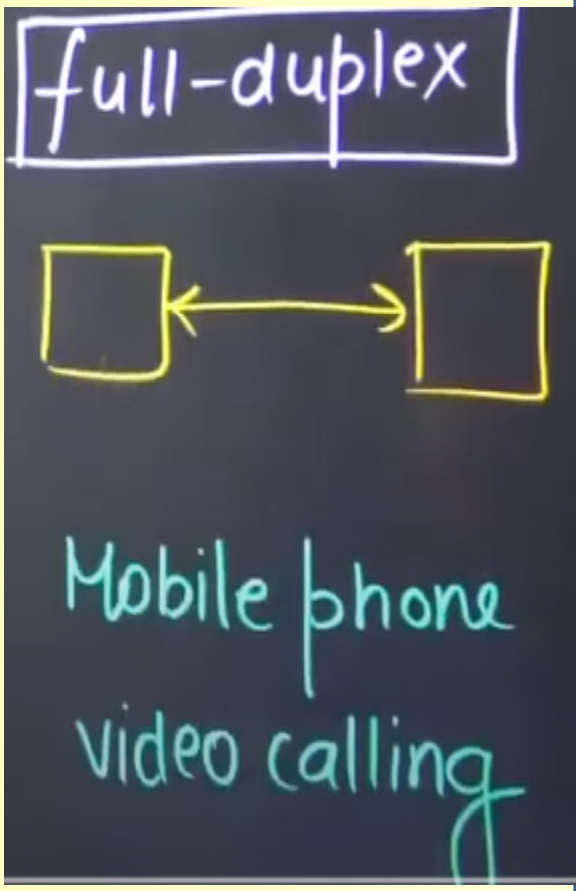

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COMPUTER NETWORKS

What is Computer Network?

A computer network is a system of connected devices that can share resources and communicate with each other. It allows devices to access shared information, transfer data, and collaborate.

Write some types of Network?

Local area network (LAN)
A network that connects devices and computers in a limited geographical area, such as a school, home, or office building. LANs are typically used by small companies or as test networks for prototyping.

Wide area network (WAN)
A network that connects offices, data centers, cloud storage, and cloud applications over a large geographical area, like cities or states. WANs are used for secure and dependable long-distance communication.

Ring topology
A network where devices are connected in a circular structure, with each device connected to two others. Data travels in one or both directions through each device until it reaches its destination.

Mesh topology
A network where every device is connected to every other device. This provides multiple paths for data, so if one path fails, another can take over.

Tree topology
A combination of star and bus topology, which is good for organizing large networks and allows for easy expansion.

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COMPUTER NETWORKS

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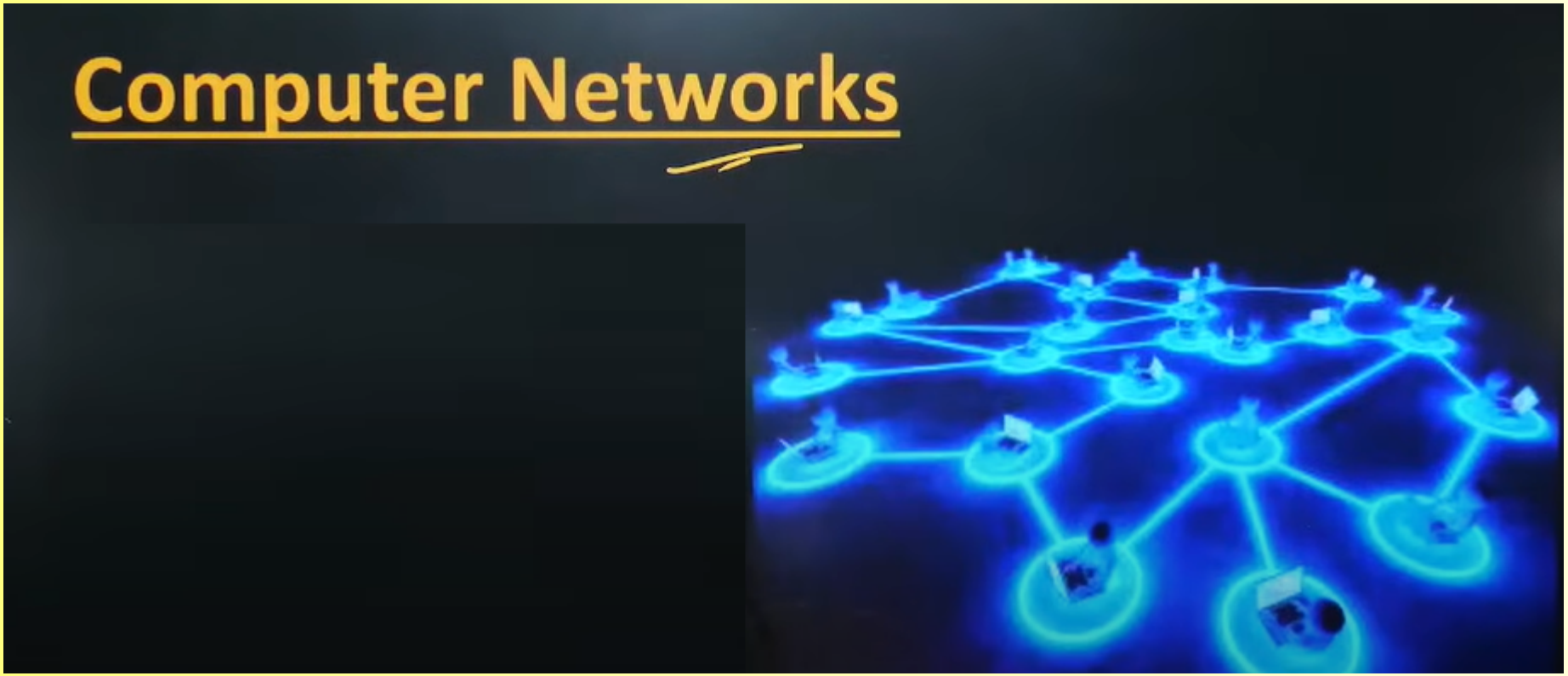
COMPUTER NETWORKS



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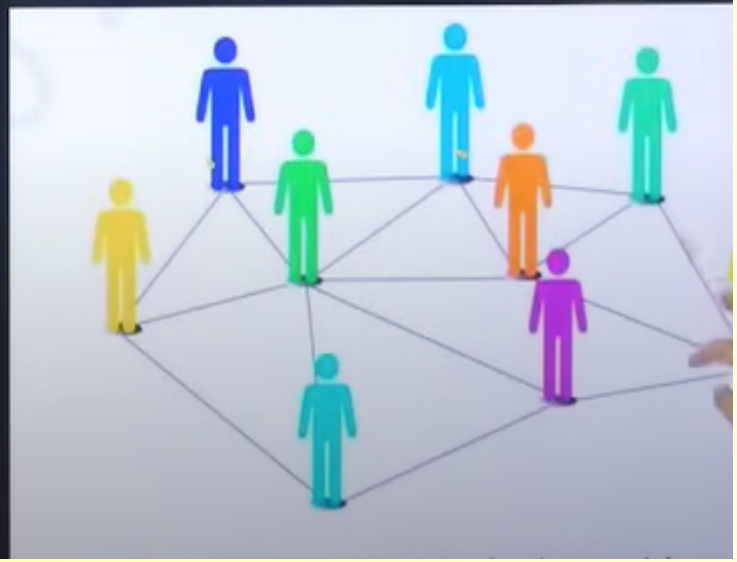
COMPUTER NETWORKS

COMPUTER NETWORK?

- A group of two or more similar things or people interconnected with each other is called network (Figure 10.1). Some of the examples of network in our everyday life includes:
  - Social network
  - Mobile network
  - Network of computers
  - Airlines, railway, banks, hospitals networks



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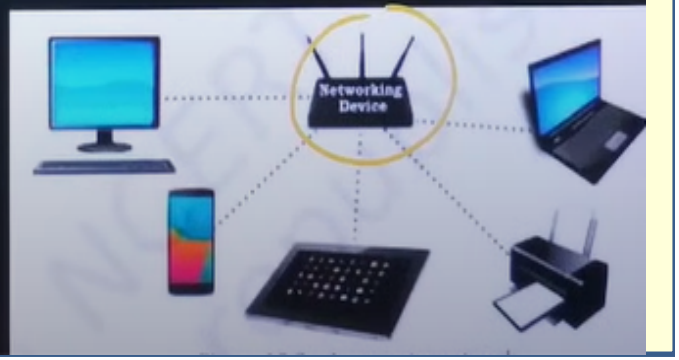
COMPUTER NETWORKS

- A computer network (Figure 10.2) is an interconnection among two or more computers or computing devices.

Such interconnection allows computers to share data and resources among each other.

- The network size may vary from small to large depending on the number of computers it connects. A computer network can include different types of hosts (also called nodes) like server, desktop, laptop, cellular phones.



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COMPUTER NETWORKS

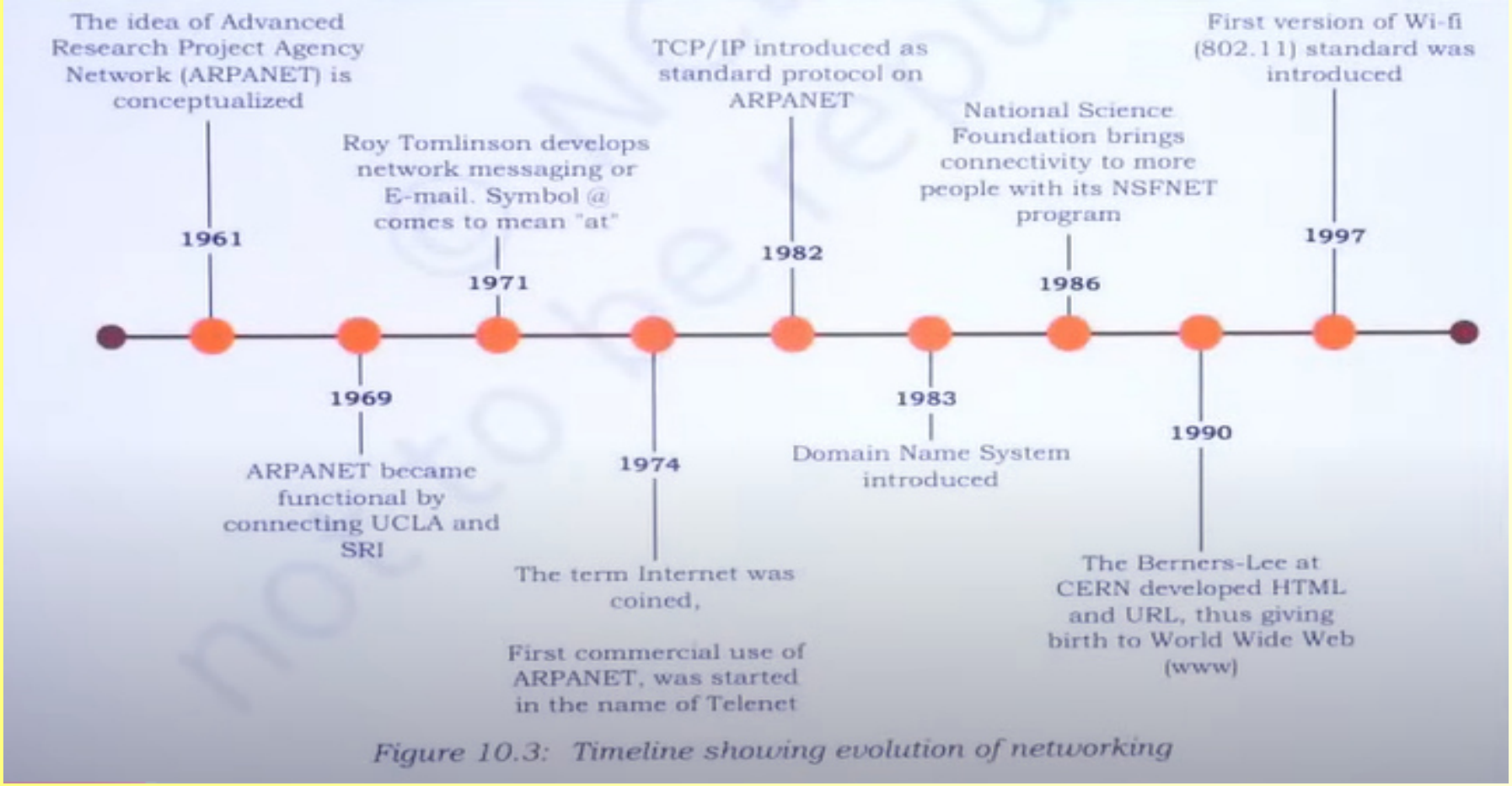

Figure 10.3: Timeline showing evolution of networking

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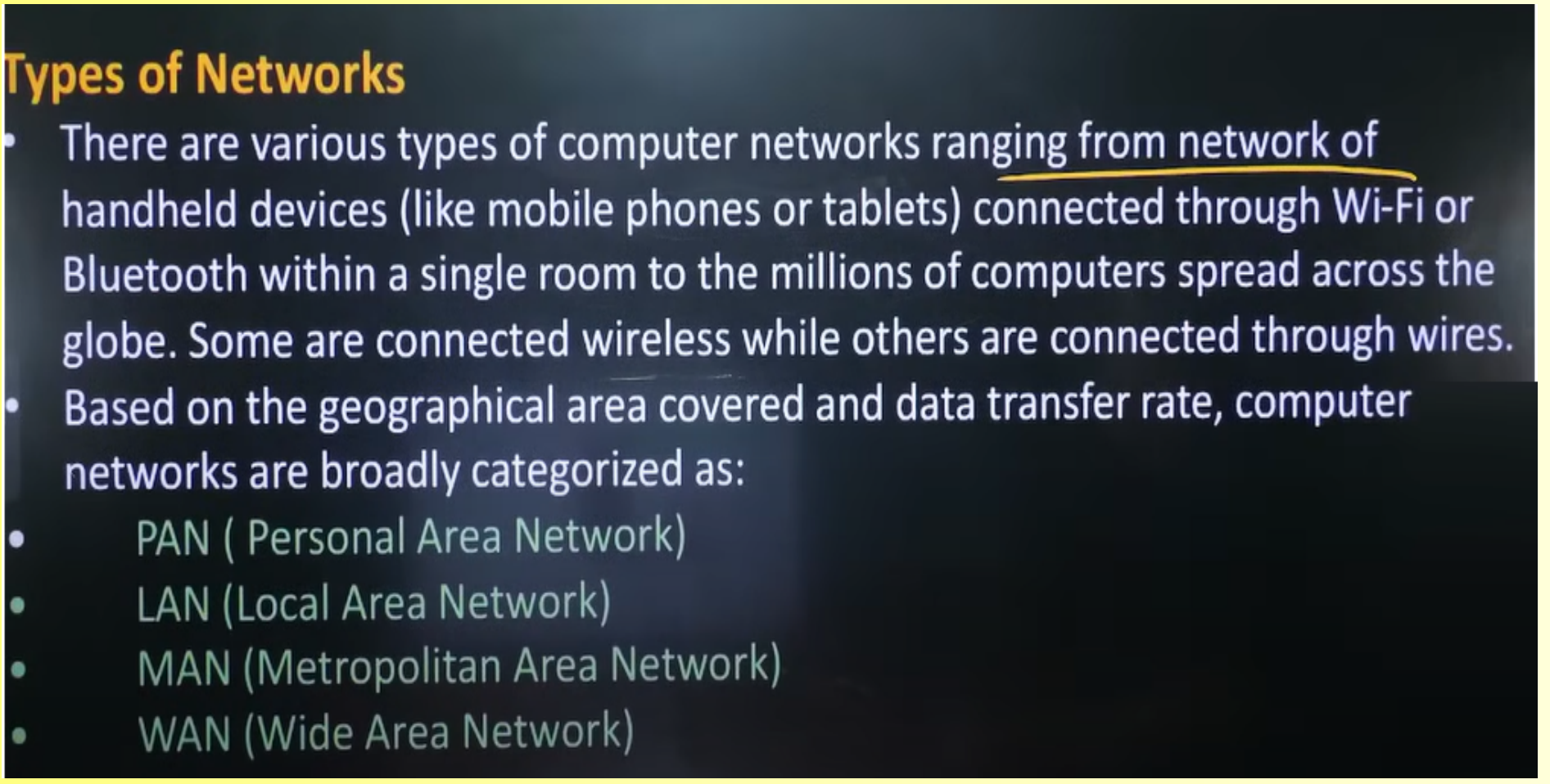
COMPUTER NETWORKS



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COMPUTER NETWORKS

Personal Area Network (PAN)

- It is a network formed by connecting a few personal devices like computers, laptops, mobile phones, smart phones, printers etc., as shown in Figure 10.4. All these devices lie within an approximate range of 10 metres.
- A personal area network may be wired or wireless.
- For example, a mobile phone connected to the laptop through USB forms a wired PAN while two smartphones communicating with each other through Bluetooth technology form a wireless PAN or WPAN.

Figure 10.4: A Personal Area Network

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COMPUTER NETWORKS

Local Area Network (LAN)

- It is a network that connects computers, mobile phones, tablet, mouse, printer, etc., placed at a limited distance.
- The geographical area covered by a LAN can range from a single room, a floor, an office having one or more buildings in the same premise, laboratory, a school, college, or university campus.
- These types of networks can be extended up to 1 km.

Data transfer in LAN is quite high, and usually varies from 10 Mbps (called Ethernet) to 1000 Mbps (called Gigabit Ethernet), where Mbps stands for Megabits per second.

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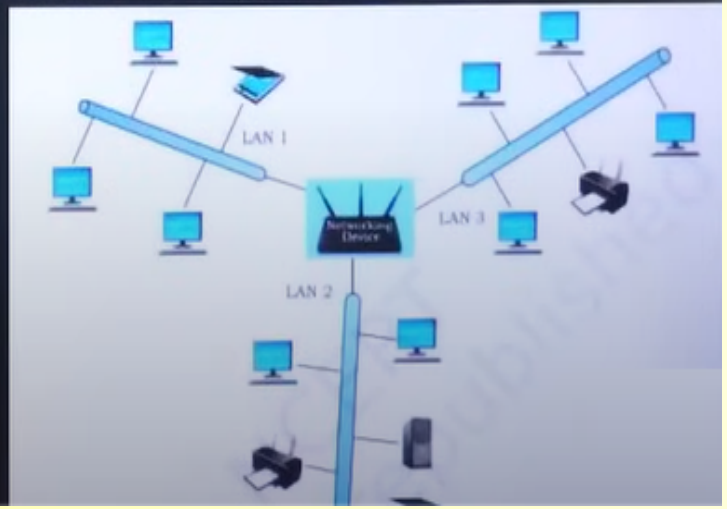
COMPUTER NETWORKS

Metropolitan Area Network (MAN)

- Metropolitan Area Network (MAN) is an extended form of LAN which covers a larger geographical area like a city or a town.
- Data transfer rate in MAN also ranges in Mbps, but it is considerably less as compared to LAN. Cable TV network or cable based broadband internet services are examples of MAN. This kind of network can be extended up to 30-40 km. Sometimes, many LANs are connected together to form MAN, as shown in Figure 10.6.



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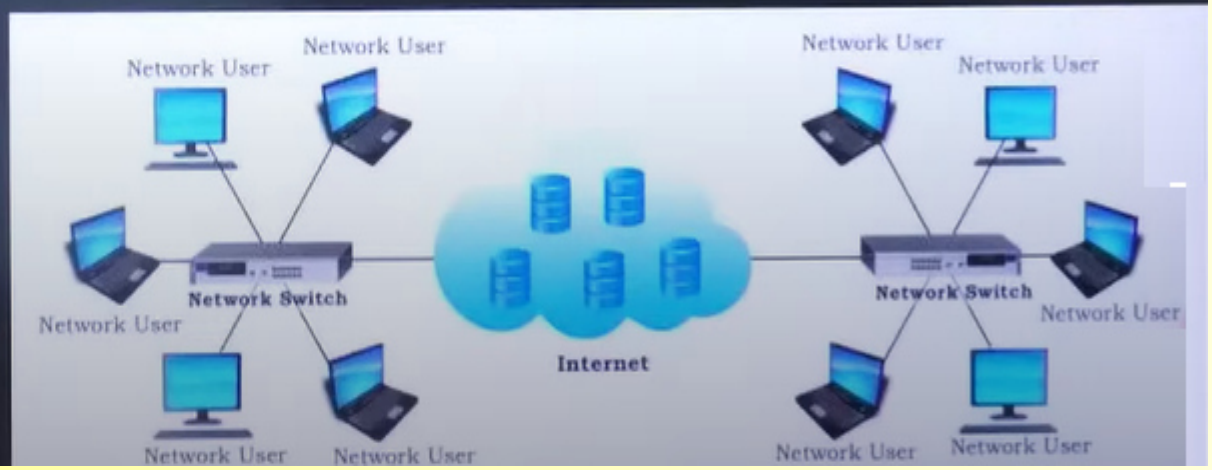
COMPUTER NETWORKS

Wide Area Network (WAN)

- Wide Area Network connects computers and other LANs and MANs, which are spread across different geographical locations of a country or in different countries or continents.
- A WAN could be formed by connecting a LAN to other LANs (Figure 10.7) via wired/wireless media.



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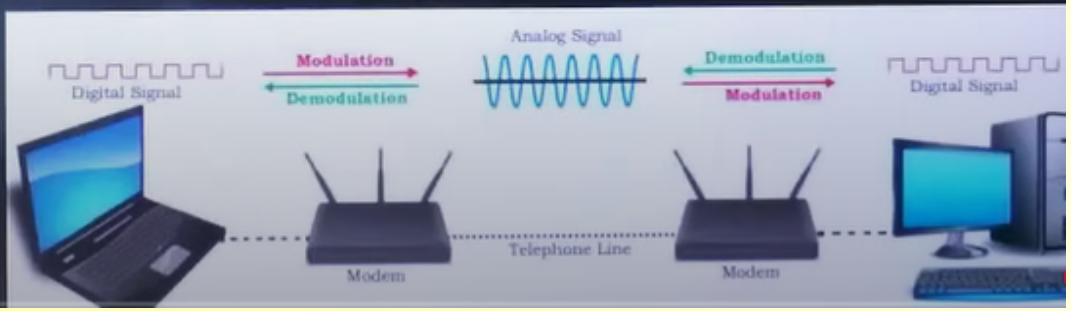
COMPUTER NETWORKS

Network Devices

- To communicate data through different transmission media and to configure networks with different functionality, we require different devices like **Modem, Hub, Switch, Repeater, Router, Gateway, etc.**

❖ Modem

Modem stands for 'MOdulator DEModulator'. It refers to a device used for conversion between analog signals and digital bits. We known computers store and process data in terms of 0s and 1s.



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COMPUTER NETWORKS

❖ Ethernet Card

- Ethernet card, also known as Network Interface Card (NIC card in short) i a network adapter used to set up a wired network.
- It acts as an interface between computer and the network
- Ethernet cards can support

data transfer between 10 Mbps and 1 Gbps (1000 Mbps).

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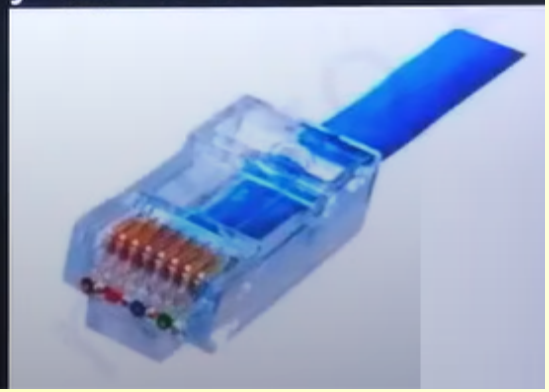
COMPUTER NETWORKS

❖ 3RJ45

- RJ 45 or Registered Jack-45 is an eight-pin connector (Figure 10.10) that is used exclusively with Ethernet cables for networking.
- It is a standard networking interface that can be seen at the end of all network cables.
- Basically, it is a small plastic plug that fits into RJ-45 jacks of the Ethernet cards present in various computing devices.



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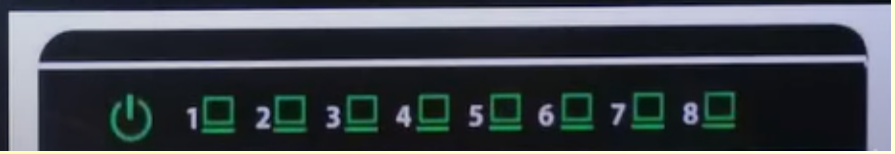
COMPUTER NETWORKS

❖ Repeater

A repeater is an analog device that works with signals on the cables to which it is connected. The weakened signal appearing on the cable is regenerated and put back on the cable by a repeater.

❖ Hub

An Ethernet hub (Figure 10.11) is a network device used to connect different devices through wires. Data arriving on any of the lines are sent out on all the others. The limitation of Hub is that if data from two devices come at the same time, they will collide.



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COMPUTER NETWORKS

❖ Switch

- A switch is a networking device (Figure 10.12) that plays a central role in a Local Area Network (LAN).
- When data arrives, the switch extracts the destination address from the data packet and looks it up in a table to see where to send the packet.
- Ethernet switches are common in homes/offices to connect multiple devices thus creating LANs

or to access the Internet.

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COMPUTER NETWORKS

❖ Router

- A router (Figure 10.13) is a network device that can receive the data, analyse it and transmit it to other networks. A router connects a local area network to the internet.
- A router can be wired or wireless. A wireless router can provide Wi-Fi access to smartphones and other devices. Usually, such routers also contain some ports to provide wired Internet access.

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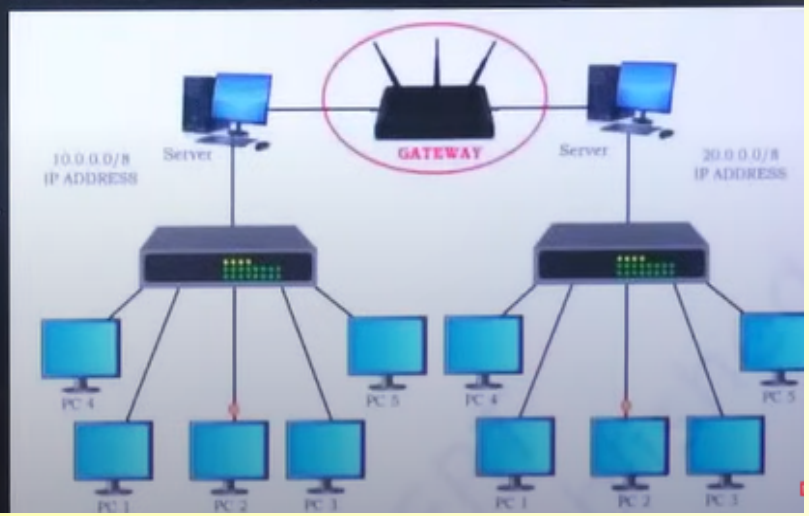
COMPUTER NETWORKS

❖ Gateway

- As the term "Gateway" suggests, it is a key access point that acts as a "gate between an organization's network and the outside world of the Internet (Figure 10.14). Gateway serves as the entry and exit point of a network, as all data coming in or going out of a network must first pass through the gateway in order to use routing paths.
- Generally, a router is configured to work as a gateway device in computer networks. But a gateway can be implemented completely in software, hardware, or a combination of both.



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COMPUTER NETWORKS

Networking Topologies

- The arrangement of computers and other peripherals in a network is called its topology.
- Common network topologies are **Mesh, Ring, Bus, Star and Tree**

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COMPUTER NETWORKS

Mesh Topology

In this networking topology, each communicating device is connected with every other device in the network as shown in Figure 10.15

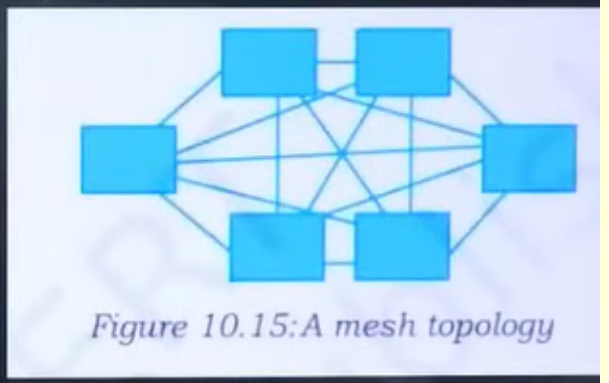

Figure 10.15:A mesh topology

Ring Topology

In ring topology (Figure 10.16), each node is connected to two other devices, one each on either side, as shown
in Figure 10.16.

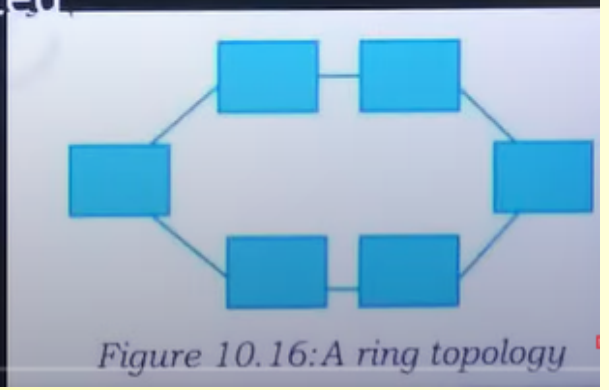

Figure 10.16:A ring topology

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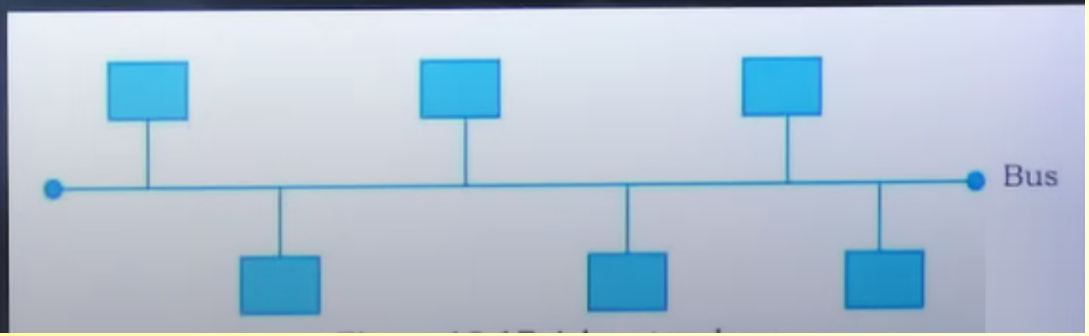
Bus Topology

- In bus topology (Figure 10.17), each communicating device connects to a transmission medium, known as bus topology.
- In this topology, a single backbone wire called bus is shared among the nodes, which makes it cheaper and easier to maintain.



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COMPUTER NETWORKS

Star Topology

- In star topology (Figure 10.18), each communicating device is connected to a central node, which is a networking device like a hub or a switch, as shown in Figure 10.18.
- Star topology is considered very effective, efficient and fast as each device is directly connected with the central device.
- The central node can be either a broadcasting device means data will be transmitted to all the nodes in the network, or a unicast device means the node can identify the destination and forward data to that node only.

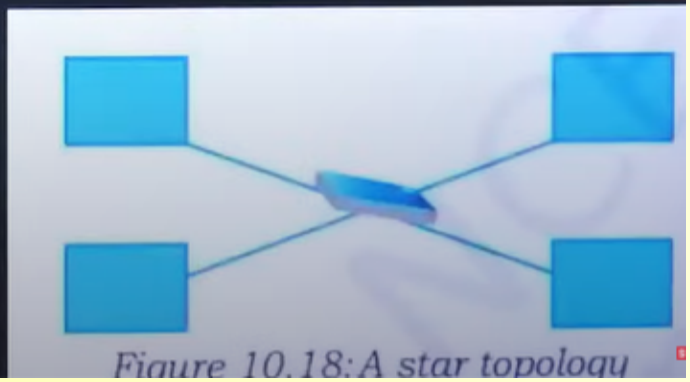

Figure 10.18: A star topology

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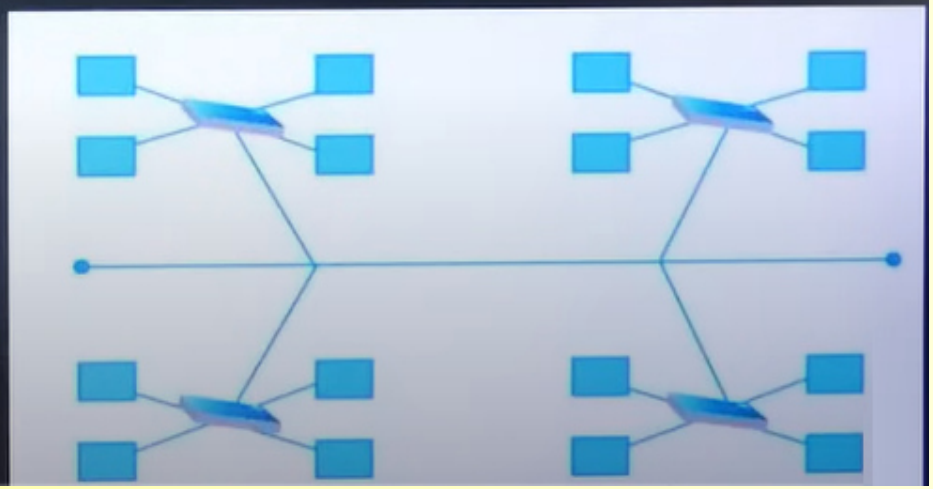
Tree or Hybrid Topology

- It is a hierarchical topology, in which there are multiple branches and each branch can have one or more basic topologies like star, ring and bus.
- Such topologies are usually realised in WANs where multiple LANs are connected.
- Star and Bus Topology used.



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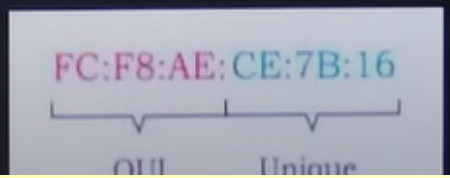
COMPUTER NETWORKS

Identifying Nodes in a Networked Communication

- Each node in a network should be uniquely identified so that a network device can identify the sender and receiver and decide a routing path to transmit data.

❖ MAC Address

- MAC stands for Media Access Control. The MAC address, also known as the physical or hardware address, is a unique value associated with a network adapter called a NIC.
- Each MAC address is a 12-digit hexadecimal numbers (48 bits in length), of which the first six digits (24 bits) contain the manufacturer's ID called Organisational Unique Identifier (OUI) and the later six digits (24 bits) represents the serial number assigned to the card by the manufacturer.
- A sample MAC address looks like



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COMPUTER NETWORKS

❖ IP Address

- IP address, also known as Internet Protocol address, is also a unique address that can be used to uniquely identify each node in a network.
- Thus, if we know a computer's IP address, we can communicate with that computer from anywhere in the world. However, unlike MAC address, IP address can change if a node is removed from one network and connected to another network.
- The initial IP Address called version 4 (IPV4 in short), is a 32 bit numeric address, written as four numbers separated by periods, where each number is the decimal (base-10) .A sample IPV4 address looks like: **192:168:0:178**
- Thus, a 128 bits IP address, called IP version 6 (IPV6 in short) was proposed. An IPv6 address is represented by eight groups of hexadecimal (base-16) numbers separated by colons. A sample IPV6 address looks like:

2001:CDBA:0000:0000:0000:0000:3257:9652