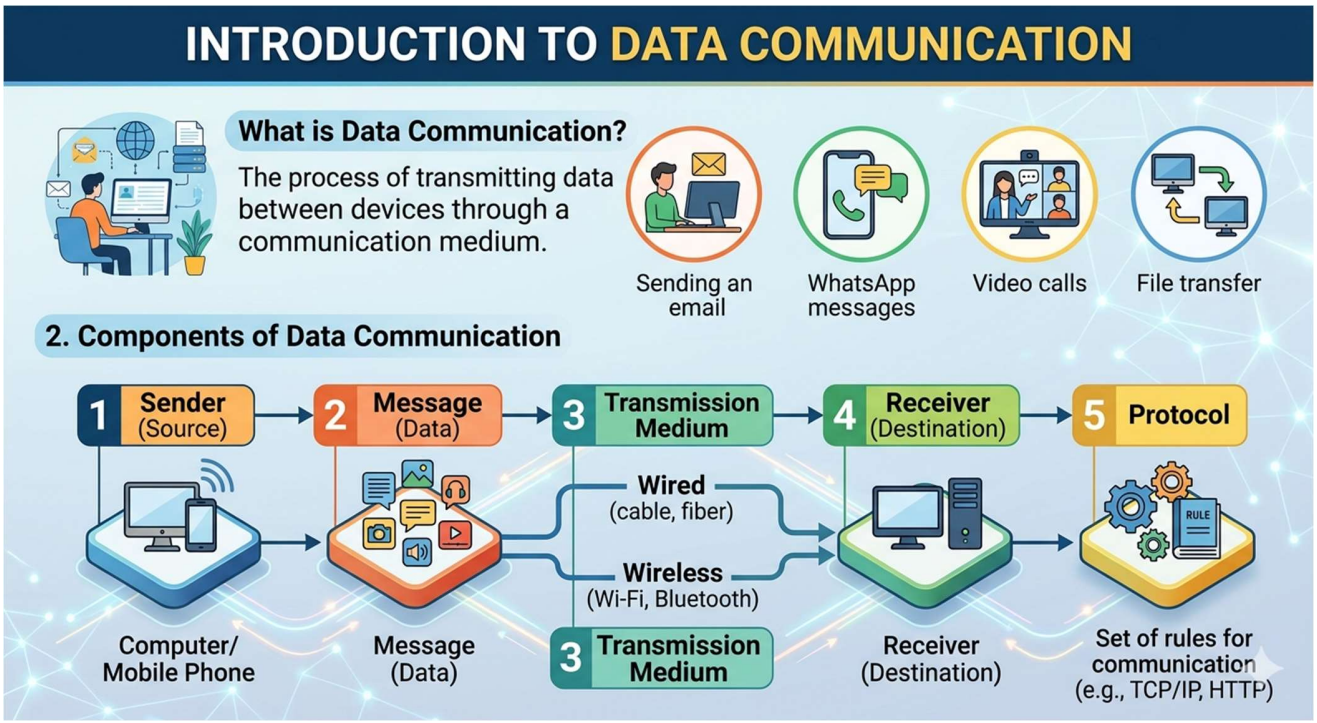
Computer Networking

Information Practices | Unit I | Study Notes

PART 1: Data Communication



What is Data Communication?

Definition: Data Communication is the process of transmitting data between two or more devices through a communication medium (like cables, wireless signals, etc.).

Examples

- Sending an email
- WhatsApp messages
- Video calls
- File transfer between computers

2. Components of Data Communication

A data communication system has 5 basic components:

1	**Sender (Source)** Device that sends data. **Example:** *Computer, mobile phone*
2	**Receiver (Destination)** Device that receives data. **Example:** *Another computer, server*
3	**Message (Data)** Information being sent. **Example:** *Text, image, audio, video*
4	**Transmission Medium** Path through which data travels. **Example:** *Wired (cable, fiber) | Wireless (Wi-Fi, Bluetooth)*
5	**Protocol** Set of rules for communication. **Example:** *TCP/IP, HTTP*

3. Characteristics of Effective Data Communication

For communication to be successful, it must have:

Characteristic	Requirement
1. Delivery	Data must reach the correct destination
2. Accuracy	Data must be error-free
3. Timeliness	Data must arrive on time
4. Jitter	Delay variation should be minimal

4. Data Representation

Data can be in different forms:

Data Type	Description
Text	Characters, words, sentences — encoded in ASCII or Unicode
Numbers	Integers, decimals — represented in binary (0s and 1s)
Images	Pixels of colour values stored as bitmap or compressed formats
Audio	Sound waves digitized and stored as waveforms
Video	A sequence of images (frames) combined with audio

5. Transmission Modes

Serial Transmission

- Data sent one bit at a time
- Slower but reliable

Parallel Transmission

- Multiple bits sent at once
- Faster but expensive

6. Data Communication Modes

There are three modes of transmitting data from one point to another:

1	**Simplex** Communication takes place in only one direction. Devices connected in such a circuit are either send only or receive only. **Example:** *Keyboard → Computer*
2	**Half Duplex**

A half duplex system can transmit data in both directions, but only in one direction at a time. Hence, a half duplex line can alternately send and receive data. It requires two wires.
Example: *Walkie-talkie*

3

Full Duplex
Full duplex allows information to flow simultaneously in both directions on the transmission medium.
Example: *Telephone call*

Mode	Flow	Description	Example
Simplex	A → B	One direction only	Keyboard → Computer
Half-Duplex	A ⇄ B (one at a time)	Alternating direction	Walkie-talkie
Full-Duplex	A ⇄ B (simultaneous)	Both at same time	Telephone

7. Advantages & Disadvantages of Data Communication

☑ Advantages

- Fast data transfer
- Resource sharing
- Communication over long distances
- Easy information access

✕ Disadvantages

- Security risks
- Data loss possibility
- Network failures

PART 2: Computer Networks

◈ What is a Computer Network?

Definition: A computer network is a system in which two or more computers are connected to share information, resources, and services. It is like a **group of computers talking to each other.** They can share:

- Files
- Internet
- Printers

Why do we have Computer Networks?

Advantages of networked computers over stand-alone computers:

1. Resource Sharing
2. Access to remote database
3. Communication facilities
4. Reliability
5. Cost saving
6. Collaborative user interaction
7. Time saving
8. Increased storage

1

Resource Sharing

The aim is to make all programs, data and peripherals available to anyone on the network irrespective of the physical location of the resources and user. This resource sharing also leads to cost-saving.

2

Access to Database

Another major area of network use is access to remote database. It is easy for the average person sitting at his PC to make reservations for airplanes, trains, hotels and so on anywhere in the world with instant confirmation.

3

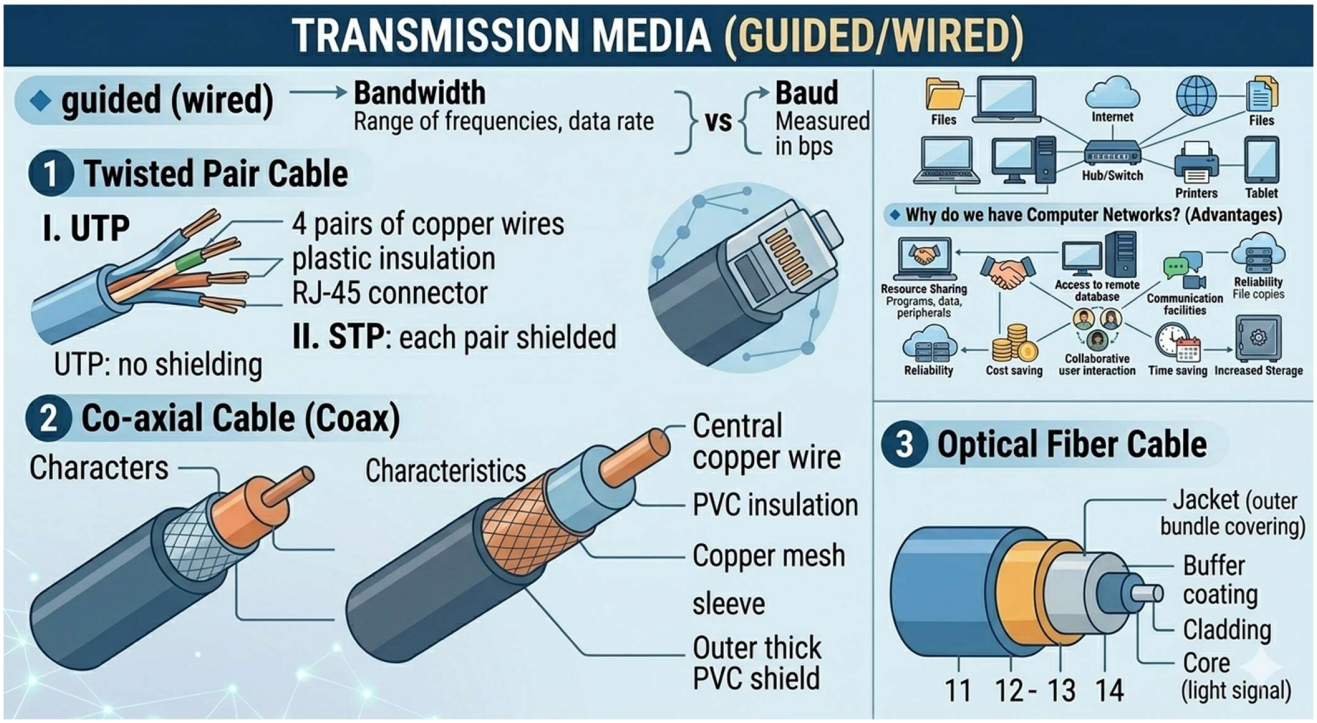
Communication Facilities

A computer network can be used as a communication medium. It takes negligible time to send and receive messages and watch live videos of one another irrespective of terrestrial distances. If e-mail or chatting is done for some useful purpose, it leads to increased productivity, cost-saving as well as time-saving.

4	**Reliability** A file can have copies on two or three different machines, so if one of them is unavailable, the other copies could be used.
5	**Increased Storage** On a network, same data may be replicated on multiple computers to ensure the availability of data in the case of some computer getting faulty.

PART 3: Networking Hardware & Transmission Media

Transmission Media



Definition: A medium of data transmission over a computer network is called a channel or a transmission medium. Computers on a network are able to share data and other resources and can communicate with each other. To make all this possible there must be some medium over which the data can travel from one computer to another.

A transmission medium may be guided (wired) or unguided (wireless).

Data Transmission Speed

- **Bandwidth:** Range of frequencies available for data transmission. It refers to data transmission rate. Higher the bandwidth, the more data it can transmit.
- **Baud:** Unit of measurement of data transfer rate. Measured in bits per second (bps).

A. Wired Media

A number of various types of cables are used to transfer data over computer networks. These are Twisted Pair Cable, Co-axial Cable, and Optical Fiber Cable.

1. Twisted Pair Cable

A twisted pair consists of four pairs of thin copper wires enclosed separately in a plastic insulation, then twisted around each other to reduce interference by adjacent wires. This is probably the most widely used cable for creating small computer networks. These pairs are colour coded. An RJ-45 connector is used to connect this cable to a computer.

I. UTP (Unshielded Twisted Pair)

As the name suggests in UTP cables individual pairs are not shielded.

Characteristics of UTP Cable:

1. It is a low-cost cable available for setting up small networks.
2. It is a thin and flexible cable and therefore it offers ease of installation.
3. It can carry data up to a length of 100m at a stretch.

II. STP (Shielded Twisted Pair)

It is the same cable as the UTP, but with each pair shielded individually. An outer shield then covers all the pairs like in UTP. STP data connectors are used to connect STP cable to the computer.

Characteristics of STP Cable:

4. As compared to UTP, STP offers better immunity against internal and external electromagnetic interferences.
5. It is more expensive than UTP cable.
6. As compared to UTP cable, STP cable is difficult to install.

2. Co-axial Cable (Coax)

A coaxial cable consists of two conductors that share a common axis which is able to transmit data at high rates. The inner conductor is a straight wire and the outer conductor is a shield that might be braided or a foil. It consists of a central copper wire surrounded by a PVC insulation over which a sleeve of copper mesh is placed. The metal sleeve is again shielded by an outer shield of thick PVC material.

Characteristics of Co-axial Cable:

7. It can carry data for a larger distance (185m - 500m) at a stretch.
8. Less susceptible to electromagnetic fields.
9. Bulkier and less flexible than twisted pair.

10. Due to its thickness and less flexibility, it is difficult to install as compared to twisted pair cable.

3. Optical Fiber Cable

Optical Fibers are long, thin strands of glass or glass-like material about the thickness of a human hair. They are arranged in bundles called optical fiber cables and used to transmit data through light signals over long distances.

Parts of an Optical Fiber:

11. Core - It is the thin glass rod at the center through which the light travels.
12. Cladding - It is the outer optical material surrounding the core that reflects the light back into the core.
13. Buffer coating - It is the plastic coating that protects the cable from damage and moisture.
14. Jacket - These optical fibers are arranged in bundles of hundreds and thousands and are protected by the cable's outer covering, called jacket.

Characteristics of Optical Fiber Cable:

15. It can carry data for a very large distance at a stretch.
16. Not susceptible to electromagnetic fields.
17. Especially skilled people are required to install optical fiber cables.
18. Till date it is the most expensive and at the same time the most efficient cable available for computer networks.

Comparison: Wired Media

Cable Type	Distance	Cost	Speed	Interference
Twisted Pair (UTP)	Up to 100m	Low	Up to 100 Mbps	Moderate
Twisted Pair (STP)	Up to 100m	Medium	Up to 100 Mbps	Low
Co-axial	185–500m	Medium	Up to 500 Mbps	Low
Optical Fiber	Very long	High	Very high (Gbps)	None

B. Wireless Media (Unguided)

Electromagnetic waves are used for wireless communication over computer networks. Frequencies of waves are measured in Hertz (Hz). Based on their frequencies, electromagnetic waves are categorized into: radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and Gamma rays.

Out of these, only radio waves, microwaves, and infrared rays are used for wireless communication.

1. Radio Waves

Radio waves have a frequency range of 3 KHz to 3GHz. Radio waves are used for communication over distances ranging from a few meters (in walkie-talkies) up to covering an entire city. These waves are easy to generate, can travel long distances and can penetrate buildings easily. Cordless phones, AM and FM radio broadcast, Garage door openers etc. are examples of radio wave transmission.

Characteristics of Radio Wave Transmission:

19. These waves are omni-directional (spread in all the directions), so the transmitting and receiving antennas need not be aligned.
20. Relatively inexpensive than wired media.
21. It offers ease of communication over difficult terrain.
22. The transmission can be interfered by motors or other electrical equipment.
23. Permission from concerned authorities is required for use of radio wave transmission.
24. Less secure mode of transmission.

2. Micro Waves

Micro waves have a frequency range of 300 MHz (0.3 GHz) to 300 GHz. Microwaves travel in straight lines and cannot penetrate any solid object. Therefore for long distance microwave communication, high towers are built and microwave antennas are put on their tops. Distance between two microwave towers depends on many factors including frequency of the waves being used and heights of the towers. The sending and receiving antennas have to be aligned with each other.

3. Infrared Waves

Infrared waves have a frequency range of 300 GHz to 400 THz. Infrared waves are so called because they have a frequency range of just less than that of red light. These waves are used for short range communication (approx. 5m) in a variety of wireless communications, monitoring, and control applications. Home-entertainment remote-control devices, cordless mouse, and intrusion detectors are some of the devices that utilize infrared communication. These waves are easy to build but have a major drawback — they do not pass through solid objects. On the other hand, because they do not pass through solid walls, an infrared system in one room will not interfere with a similar system in adjacent rooms.

PART 4: Network Technologies

1. Bluetooth

Bluetooth is a wireless technology for exchanging data over short distances (approx. 10m). Bluetooth uses globally available unlicensed radio waves in the frequency range of 2.402 GHz to 2.480 GHz. Laptops, door openers, and cell phones are some of the devices that utilize Bluetooth communication. The IEEE standardized Bluetooth as IEEE 802.15.1.

Characteristics of Bluetooth Transmission:

25. Line of sight between communicating devices is not required.
26. Bluetooth can connect up to eight devices simultaneously.
27. Slow data transfer rate (up to 1 Mbps).

2. Wi-Fi

WiFi is a local area wireless computer networking technology that allows electronic devices to network, mainly using 2.5 gigahertz and 5 gigahertz radio bands. The WiFi alliance defines Wi-Fi as any wireless local area network (WLAN) product based on the IEEE 802.11 standards. Many devices can use WiFi e.g., personal computers, video game consoles, smartphones, digital cameras. These can connect to a network resource via a wireless network access point (Hotspot). It has a range of about 20 meters indoors and a greater range outdoors. WiFi can be less secured than wired connections, precisely because an intruder does not need a physical connection.

3. Ethernet

Ethernet is a contention media access method that allows all hosts on a network to share the same bandwidth of a link (medium). Ethernet is the most widely used LAN technology because it is relatively economical and fast. It was introduced by Digital, Intel and Xerox in 1980. The network topology used for Ethernet is multi access bus. Data transfer rate is 10 Mbps (Ethernet), 100 Mbps (Fast Ethernet) and up to 1 GB (Gigabit Ethernet).

Ethernet networking uses CSMA/CD (Carrier Sense Multiple Access with Collision Detection), a protocol that helps devices to share the bandwidth evenly without having two devices transmit at the same time over the medium.

A message is transmitted from one node to another by breaking it into frames and then broadcasting the frames to the bus. An address designator is associated with each frame. As the frame travels on the bus each node checks whether the frame is addressed to it; only the addressee node picks up the message.

When a host wants to transmit over the network, it first checks for the presence of a digital signal on the wire. If all is clear (no other host is transmitting), the host will then proceed to transmit. The transmitting host constantly monitors the wire to make sure no other hosts begin transmitting. If the host detects another signal on the wire, it sends out a jam signal that causes all other nodes to stop sending data. The nodes respond to the jam signal by waiting a while before attempting to send again. Backoff algorithms

determine when the colliding stations can retransmit. If collisions keep occurring after 15 tries, the nodes attempting to send will then timeout.

Technology	Key Features
Bluetooth	~10m range, 2.4 GHz, IEEE 802.15.1, up to 1 Mbps, no line-of-sight needed
Wi-Fi	~20m indoors, 2.4/5 GHz, IEEE 802.11, WLAN, Hotspot access
Ethernet	LAN standard, 10/100/1000 Mbps, CSMA/CD, bus topology

PART 5: Network Devices

Other than the transmission media, many other devices are required to form computer networks. Some of these devices along with their functionalities are mentioned below:

1	**NIC (Network Interface Card)** An NIC is a device that enables a computer to connect to a network and communicate. Any computer which has to be a part of a computer network must have an NIC installed in it. Nowadays, in most PCs and laptops, NIC is an integral part of the motherboard.
2	**Hub** A Hub is an electronic device that connects several nodes to form a network and redirects the received information to all the connected nodes in broadcast mode. A hub has ports into which the cables from individual computers' NICs are inserted. There are two types: Passive hub and Active hub.
3	**Modem** Modem is short for Modulator/DEModulator. Modem is a special device used for conversion of digital data to analog form (modulation) and vice-versa (demodulation). It is an essential piece of hardware where two digital devices (say two computers) want to communicate over an analog transmission channel (say a telephone line).
4	**Switch**

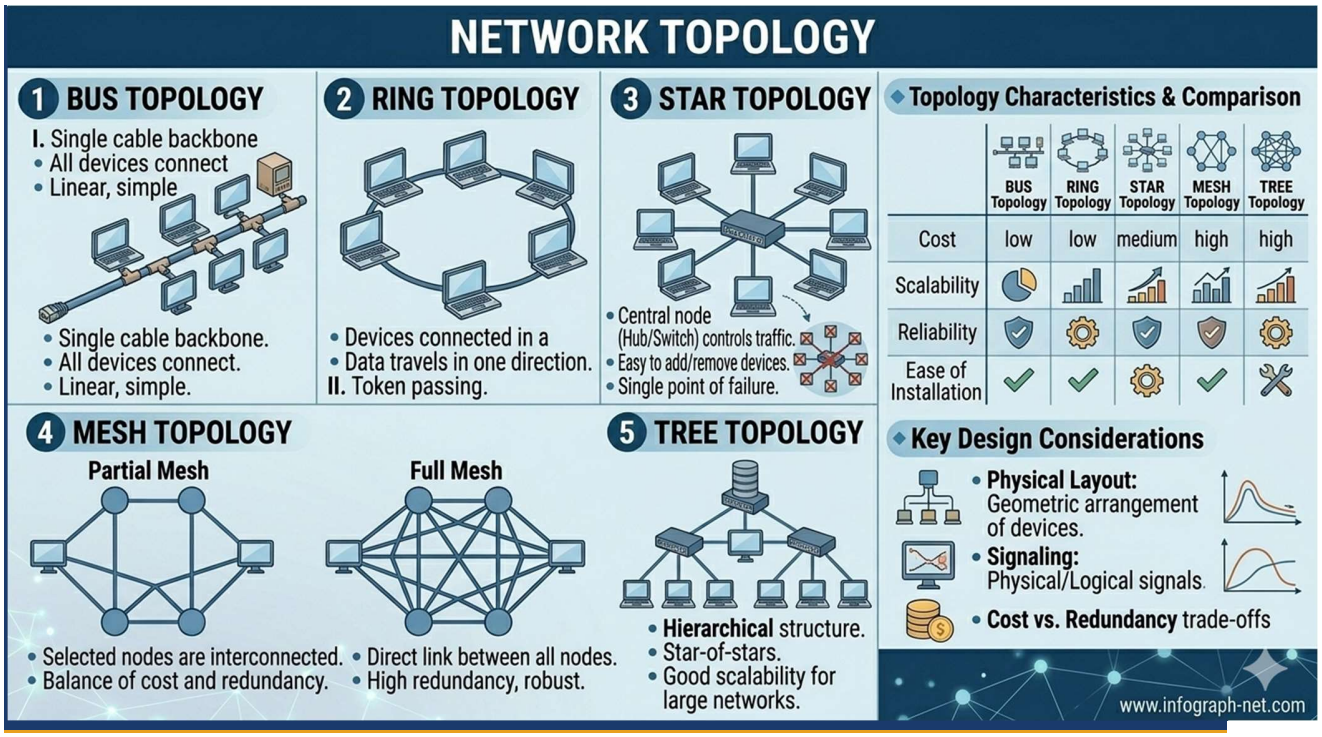
	A Switch is an intelligent device that connects several nodes to form a network and redirects the received information only to the intended node(s). Unlike a hub, instead of broadcasting the received information, a switch sends the information selectively only to those computers for which it is intended. This makes a switch more efficient than a hub.

5	**Repeater** A Repeater is a device that is used to regenerate a signal which is on its way through a communication channel. When data is transmitted over a network for long distances, the data signal gets weak after a certain distance. A repeater regenerates the received signal and re-transmits it to its destination.

6	**Gateway** A Gateway is a device used to connect different types of networks and perform the necessary translation so that the connected networks can communicate properly. A gateway is capable of understanding address architectures used in different networks and seamlessly translating between these address architectures. Example: Internet, which contains a large number of different types of networks spread over the globe.

Device	Description/Function
NIC	Connects computer to network; integral to motherboard in modern PCs
Hub	Connects nodes; broadcasts to all connected devices (passive/active)
Modem	Modulates/demodulates digital ↔ analog; needed for telephone-line internet
Switch	Intelligent hub; sends data only to intended node — more efficient
Repeater	Regenerates weak signals for long-distance transmission
Gateway	Connects different network types; translates between incompatible networks

PART 6: Network Topologies



Definition: The way/arrangement in which the computers/network devices are physically interconnected to form a network is called a Topology.

There exist different network topologies:

- Bus topology
- Star topology
- Ring topology
- Mesh topology (Completely Connected)
- Tree topology
- Hybrid topology

i

Bus Topology

In bus topology all the nodes are connected to a main cable called backbone. If any node has to send some information to any other node, it sends the signal to the backbone. The signal travels through the entire length of the backbone and is received by the node for which it is intended. A small device called terminator is attached at each end of the backbone. When the signal reaches the end of backbone, it is absorbed by the terminator and the backbone gets free to carry another signal. This prevents the reflection of signal back on the cable and hence eliminates the chances of signal interference.

Characteristics of Bus Topology:

- It is easy to install.
- It requires less cable length and hence it is cost effective.
- Failure of a node does not affect the network.
- In case of cable (backbone) or terminator fault, the entire network breaks down.
- Fault diagnosis is difficult.
- At a time only one node can transmit data.

ii

Ring Topology

The circular or ring arrangement of a computer network, in which each computer has communicating subordinates, but there is no master computer for controlling other computers. A node receives data from one of its two adjacent nodes. The only decision a node has to take is whether the data is for its own use. If it is addressed to it, it utilizes it. Otherwise it merely passes it on to the next node.

Advantages of Ring Topology:

9. The ring topology works well where there is no central site computer system.
10. It is more reliable than a star network. If a link between computers breaks or if one of the computers breaks down, alternate routing is possible.

iii

Mesh Topology (Completely Connected)

A mesh topology has a separate link for connecting each node to any other node. Each computer of such a network has a direct dedicated link called point-to-point link, with all other computers in the network. The control is distributed with each computer deciding its communication priorities.

Advantages of Mesh Topology:

11. This type of network is very reliable, as any link breakdown will affect only communication between the connected computers.
12. Communication is very fast between any two nodes.

iv

Star Topology

In star topology each node is directly connected to a hub/switch. If any node has to send some information to any other node, it sends the signal to the hub/switch. This signal is then broadcast (in case of a hub) to all the nodes but is accepted by the intended node(s). In the case of a switch, the signal is sent only to the intended node(s). Star topology generally requires more cable than bus topology.

Characteristics of Star Topology:

- It is more efficient topology as compared to bus topology.
- It is easy to install.
- It is easy to diagnose the fault in Star topology.
- It is easy to expand depending on the specifications of central hub/switch.
- Failure of hub/switch leads to failure of entire network.
- It requires more cable length as compared to bus topology.

v **Tree Topology:**
A hierarchical structure where star-configured networks are connected to a main bus cable.

Characteristics of Tree Topology:

- It offers easy way of network expansion.
- Even if one network (star) fails, the other networks remain connected and working.
- Maintenance can be an issue.

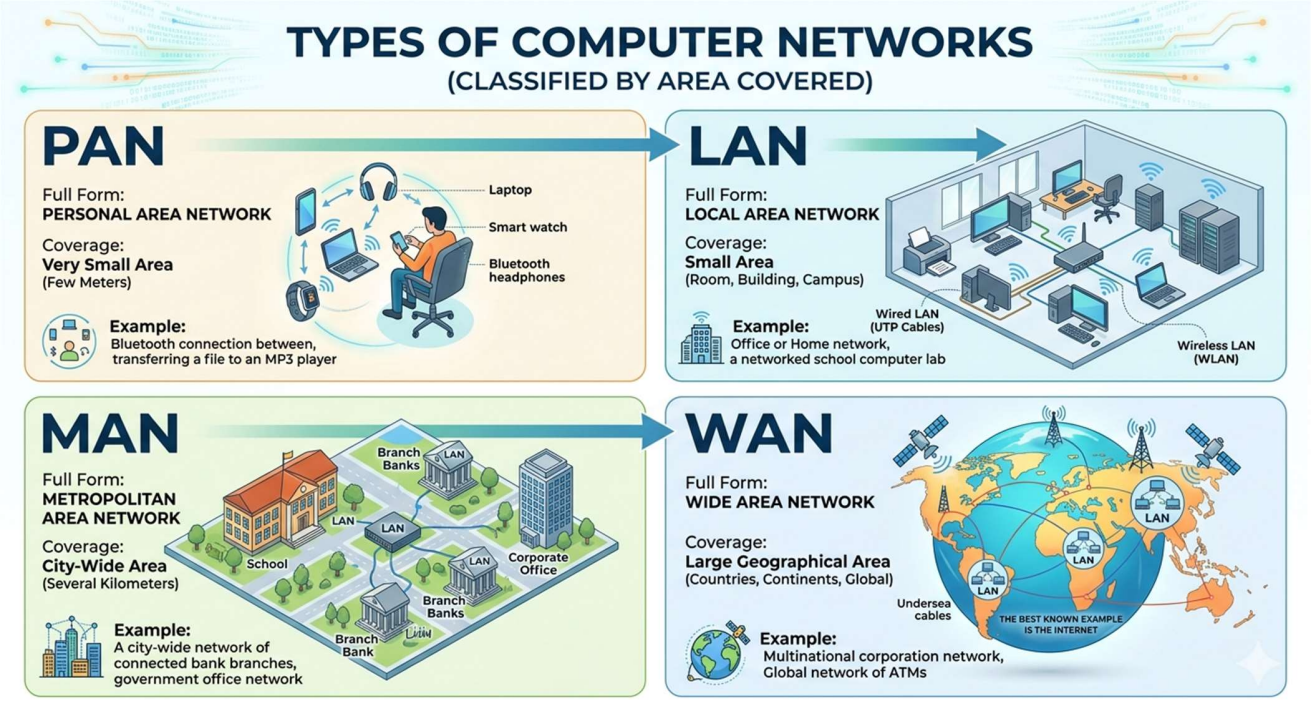
vi **Hybrid Topology**
Different network configurations have their own advantages and limitations. Hence, in reality a pure star or ring or completely connected network is rarely used. Instead, an organization will use a sort of hybrid network, which is a combination of two or more different network topologies. Hybrid topology may have components of star, ring and mesh topologies.

PART 7: Network Protocol

Network Protocol: A network protocol is a set of rules for communication among networked devices.

Protocols generally include rules of how and when a device can send or receive data, how the sent data is packaged, and how it reaches its destination. The network devices will be able to communicate with each other only after they know the rules of communication. There are a number of protocols defined for computer networks. e.g. HTTP, TCP/IP, PPP.

PART 8: Types of Networks



A computer network may span any amount of geographical area. It can be on a table, in a room, in a building, in a city, in a country, across continents or around the world. On the basis of area covered, computer networks are classified as:

- PAN - Personal Area Network
- LAN - Local Area Network
- MAN - Metropolitan Area Network
- WAN - Wide Area Network

1	**PAN (Personal Area Network)** A PAN is a network of communicating devices (Computer, Phone, MP3/MP4 Player, Camera etc.) in the proximity of an individual. It can cover an area of a few meters radius. There can also be multiple devices in PAN. A PAN can be set up using guided media (USB cable) or unguided media (Bluetooth, Infrared, WiFi). Example: When you transfer songs from one cell phone to another, you set up a PAN of two phones. When files are transferred from a PC to an MP3 player, a PAN is set up between the two.
2	**LAN (Local Area Network)** A LAN is a network of computing/communicating devices in a room, building, or campus. It can cover an area of a few meters to a few kilometers radius. A networked office building, school, or home usually contains a single LAN. A LAN is owned, controlled, and managed by a

	single person or organization. A LAN can be set up using wired media (UTP cables, Co-axial cables etc.) or wireless media (Infrared, radio waves). If a LAN is set up using unguided media, it is known as WLAN (wireless LAN).
3	**MAN (Metropolitan Area Network)** A MAN is a network of computing/communicating devices within a city. It can cover an area of a few kilometers to a few hundred kilometers radius. Networks of schools, or banks, or Government offices etc., within a city, are examples of MANs. A MAN is usually formed by interconnecting a number of LANs and individual computers. A MAN is typically owned and operated by a single entity such as a government body or a large corporation. A good example of a MAN is the interconnected offices of a state government.
4	**WAN (Wide Area Network)** A WAN is a network of computing/communicating devices crossing the limits of a city, country, or continent. It can cover an area of over hundreds of kilometers radius. A network of ATMs, banks, national government offices, international organizations' offices etc., spread over a country, continent, or covering many continents are examples of WANs. WANs usually contain a number of interconnected individual computers, LANs, MANs, and maybe other WANs. The best known example of a WAN is the internet.

Type	Full Form	Coverage	Example
PAN	Personal Area Network	Few meters	Bluetooth phone transfer
LAN	Local Area Network	Room to campus	School/office network
MAN	Metropolitan Area Network	City-wide	Bank branches in a city
WAN	Wide Area Network	Country/global	Internet, ATM network

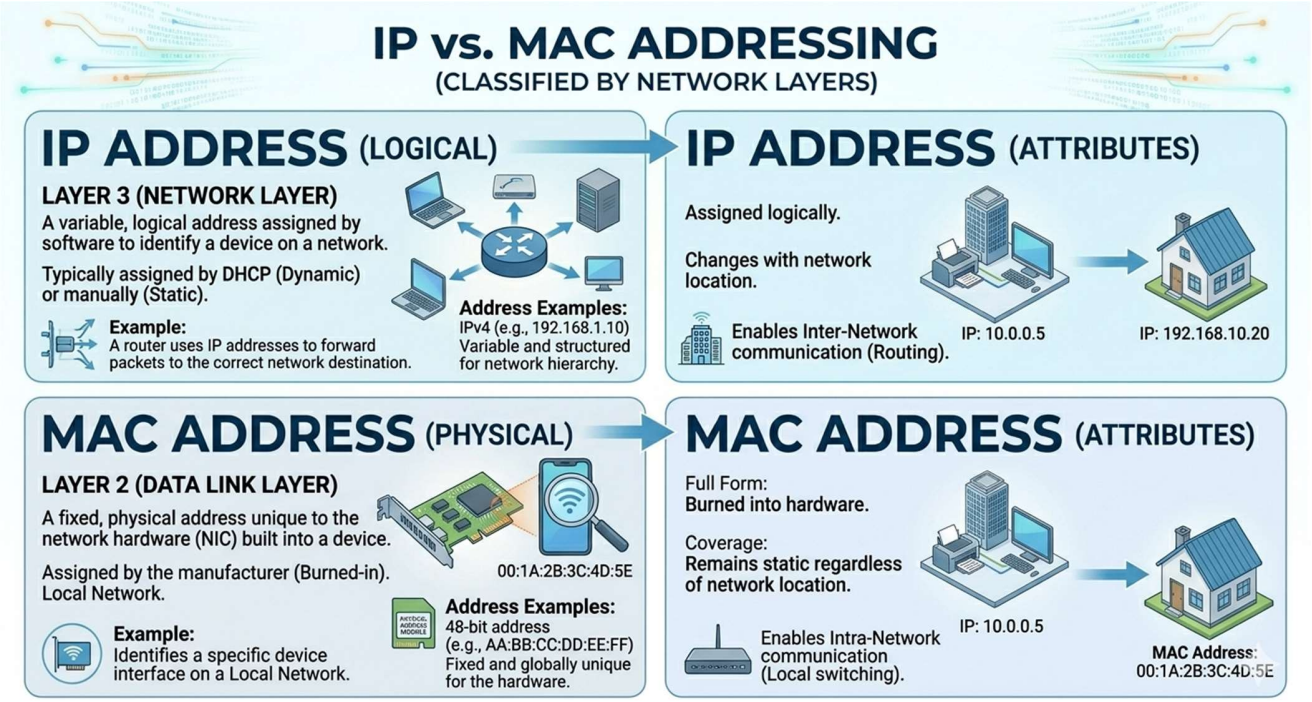
PART 9: Identification of Computers over a Network

Once a network has been set up, the nodes can communicate among themselves. But for proper communication, the nodes should be uniquely identifiable. If a node X sends

some information for node Y on a network, then it is mandatory that nodes X and Y are uniquely identifiable on the network.

NODE: Any device (Computer, Scanner, Printer, etc.) which is directly connected to a computer network is called a node. Suppose you are working on a PC at your home and then you connect it to internet. As soon as it becomes a part of internet (which is a computer network), it becomes a node. Similarly, in your school, all the computers which are linked to school's computer network are nodes.

1. MAC (Media Access Control) Address



A MAC (Media Access Control) address is a unique 12 digit hexadecimal number (6 bytes) assigned to each NIC by its manufacturer. This address is known as the MAC address of the card. It means that a machine with an NIC can be identified uniquely through its NIC's MAC address. MAC address of an NIC is permanent and does never change. By convention, MAC addresses are usually written in one of the following two formats:

Formats: MM:MM:MM:SS:SS:SS or MM-MM-MM-SS-SS-SS The first half (MM:MM:MM) contains the ID number of the adapter manufacturer. The second half (SS:SS:SS) represents the serial number assigned to the adapter (NIC) by its manufacturer.

2. IP Address

An IP Address is a numeric identifier assigned to each machine on an IP Network. It designates the specific location of a device on the network. An IP address is a software address used for finding hosts on a local network.

An IP address consists of 32 bits. These bits are divided into four sections referred to as octets or bytes, each containing 1 byte. IP address can be written using one of three methods:

i. Dotted-Decimal, as in 172.16.30.56
ii. Binary, as in 10101100.000100000.00011110.00111000
iii. Hexadecimal, as in AC.10.1E.38

Every IP address consists of two parts: one identifying the network (Network ID) and one identifying the node (Host ID). The Class of the address determines which part belongs to the network address and which part belongs to the node address.

Summary of IP Address Classes:

Class	8-bit (1st)	8-bit (2nd)	8-bit (3rd)	8-bit (4th)
Class A	NID	HID	HID	HID
Class B	NID	NID	HID	HID
Class C	NID	NID	NID	HID
Class D	Multicast	—	—	—
Class E	Research	—	—	—

IP Address vs MAC Address

Feature	IP Address / MAC Address
Assigned by	Network administrator or ISP
Type	Logical/Software address
Changes?	Changes when moved to a new network
Length	32 bits (IPv4)

PART 10: Domain Names & DNS

Domain Name: The common name assigned to an IP address is called a Domain Name. Whenever we have to communicate with a computer on internet, we can do so by using its IP address. But it is practically impossible

for a person to remember the IP addresses of all the computers one may have to communicate with. Therefore, a system has been developed which assigns common names to IP addresses and maintains a database of these names and corresponding IP addresses. Examples: cbse.nic.in, sikkimipr.org, indianrailway.gov.in. Domain names are used in URLs to identify particular Web servers. For example, in the URL http://www.cbse.nic.in/welcome.htm, the domain name is www.cbse.nic.in.

A domain name usually has more than one part: top level domain name or primary domain name and sub-domain name(s). There are only a limited number of top level domains, and these are divided into two categories: Generic Domain Names and Country-Specific Domain Names.

Generic Domain Names:

Domain	Meaning
.com	Commercial business
.edu	Educational institutions
.gov	Government agencies
.mil	Military
.net	Network organizations
.org	Organizations (nonprofit)

Country-Specific Domain Names:

Domain	Country
.in	India
.au	Australia
.ca	Canada
.ch	China
.nz	New Zealand
.pk	Pakistan
.jp	Japan
.us	United States of America

Domain Name Resolution

Domain Name Resolution is the process of getting the corresponding IP address from a domain name. It happens as follows:

Suppose you mention a URL in the web-browser to visit a website. The browser first checks your computer (HOSTS file) to find if the IP address of the server corresponding to the Domain Name (embedded in the URL) is present. If this address is present then with the help of this address, the corresponding server is contacted and then the website opens in your browser. Otherwise the browser sends this domain name to the domain name server to find the corresponding IP address. Once the IP address is known, the server is contacted and then the website opens in your browser.

Exam Questions (JKBOSE Style)

Short Answer Questions

1. Define data communication.
2. What is a protocol?
3. Name the components of data communication.
4. What is a computer network?
5. What is a MAC address?
6. What is an IP address?
7. What is a domain name?
8. Define bandwidth and baud.
9. Name the types of network topologies.
10. What is a node?

Long Answer Questions

1. Explain the components of data communication.
2. Describe types of communication (Simplex, Half-duplex, Full-duplex).
3. Explain characteristics of effective data communication.
4. Explain different types of computer networks (PAN, LAN, MAN, WAN).
5. Describe all network topologies with their advantages and disadvantages.
6. Explain different types of transmission media (wired and wireless).
7. Describe network devices: NIC, Hub, Switch, Modem, Repeater, Gateway.
8. Explain IP address, MAC address and the difference between them.
9. What is Domain Name Resolution? Explain with an example.
10. What are the advantages of networked computers over stand-alone computers?

Quick Revision Summary

Concept	Key Point
Data Communication	Exchange of data between devices via a communication medium
5 Components	Sender, Receiver, Message, Transmission Medium, Protocol
Comm. Types	Simplex (one-way), Half-Duplex (alternate), Full-Duplex (simultaneous)
Effective Comm.	Accurate, Timely, Delivered correctly, Minimal Jitter
Transmission Modes	Serial (one bit at a time), Parallel (multiple bits at once)
Wired Media	Twisted Pair (UTP/STP), Co-axial, Optical Fiber
Wireless Media	Radio Waves (3KHz–3GHz), Microwaves (300MHz–300GHz), Infrared (300GHz–400THz)
Network Technologies	Bluetooth (10m, 1Mbps), Wi-Fi (IEEE 802.11), Ethernet (CSMA/CD)
Network Devices	NIC, Hub, Modem, Switch, Repeater, Gateway
Network Types	PAN < LAN < MAN < WAN
Topologies	Bus, Ring, Star, Mesh, Tree, Hybrid
MAC Address	Unique 48-bit hardware address; permanent; assigned by manufacturer
IP Address	32-bit logical address; assigned by ISP/admin; changes with network
Classes	A (1 NID+3 HID), B (2+2), C (3+1), D (Multicast), E (Research)
Domain Name	Human-readable alias for IP address; e.g. cbse.nic.in
DNS	Resolves domain name → IP address via domain name server

End of the Unit I