Computer Network and Communication

1. Define Communication and Data Communication.

The process of sending and receiving data and information between two or more people is known as communication.

Data communication is the process of transferring digital data and information between computers and other electronic devices. Some examples of data communication are email, e-commerce, chat, e-banking etc.

2. What is Telecommunication? Give examples of telecommunication.

Telecommunication is the transmission of data and information over long distances using electronic signals or electromagnetic waves through cables or wireless media for communication purposes. Examples: Telephone, television, mobile phones, VoIP, satellite communication, and telegrams.

3. What is broadband? Write its uses and list its types.

Broadband is a high-speed internet connection that transmits large amounts of data over a wide bandwidth.

Any two uses of broadband

a. Video streaming and online entertainment
b. Video conferencing and online classes

Types of Broadband

a. Digital Subscriber Line (DSL): Uses telephone lines to provide internet without interrupting voice calls. Example: ADSL connection from a local ISP.
b. Cable Broadband: Uses coaxial cables (TV cables) to deliver high-speed internet. Example: Internet provided through cable TV service.
c. Fiber Optic Broadband (FTTH): Uses optical fiber to transmit data as light signals for very high speed. Broadband services provided by an ISP.
d. Wireless Broadband: Provides internet without cables using radio signals. Examples: Wi-Fi and mobile data.
e. Satellite Broadband: Uses satellites to provide internet, especially in remote areas. Example: Satellite internet used in rural or mountainous regions.

4. What is Bandwidth? List the units of bandwidth in digital devices.

Bandwidth is the maximum capacity of a communication channel to transmit data in a given period of time. It is measured in bits per second (bps) in digital systems and in hertz (Hz) for analog systems. The units of bandwidth in digital devices are bps, kbps (kilobits per second), Mbps (megabits per second), and Gbps (gigabits per second).

5. What is throughput? List its measurement units.

Throughput is the actual amount of data that is successfully transmitted or received over a network in a given period of time. It shows the real speed of data transfer between devices. Throughput is usually measured in bits per second (bps), kilobits per second(kbps), megabits per second (Mbps), and gigabits per second (Gbps).

6. What is generation of mobile communication?

Mobile communication has developed through different stages known as generations (G). Each generation represents an improvement in speed, services, and technology.

7. Define 3G, 4G and 5G with features

Third Generation (3G) : Third-generation mobile network that provides faster data transfer than 2G and supports internet browsing, video calls, and multimedia services.

Features of 3G

- Introduced mobile internet
- Supported video calls, internet browsing, and multimedia services
- Faster than 2G
- Example: Early smartphones with internet access

Fourth Generation (**4G) :** Fourth-generation mobile network that offers high-speed internet for HD video streaming, online gaming, and fast downloads.

Features of 4G

- High-speed internet technology
- Supports HD video streaming, online gaming, and fast downloads
- Much faster and more stable than 3G
- Example: YouTube HD, WhatsApp video calls, Netflix

Fifth Generation (5G): Latest mobile network technology with ultra-fast speed, very low delay (latency), and support for advanced technologies like IoT, smart cities, and autonomous systems.

Features of 5G

- Latest generation of mobile technology
- Extremely high speed and very low delay (latency)
- Supports IoT, smart cities, autonomous vehicles, AR/VR
- Example: Smart cars, real-time remote control systems

8. Define Data Packets and Frequency

Data packets are small units of data into which information is divided before being sent over a network. At the destination, these packets are reassembled to form the original message.

Frequency means the number of times a signal is transmitted or repeated in one second through a communication channel. It helps determine how fast and clearly data can be sent through wires or wireless networks. Frequency is measured in hertz (Hz).

9. Comparison of Different Technologies and Their Uses

Technology / Use	**Frequency Range**	**Purpose / Use**
Bluetooth	2.4 – 2.5 GHz	Connecting wireless devices (earbuds, speakers, etc.)
AM Radio Broadcasting	530 – 1710 kHz	Long-distance radio transmission, especially at night
5G Cellular (mmWave)	24 – 100 GHz	Very high-speed mobile communication (short range)
RFID (UHF)	860 – 960 MHz	Smart cards and inventory tracking
Television Broadcasting (UHF)	470 – 890 MHz	Digital TV signal transmission

10. What is data transmission mode? List the different types of data transmission mode.

The direction of the flow of data between two communication devices connected on a network is known as data transmission mode.

The different modes of data transmission are as follows:

a. Simplex : The data transmission mode in which data is transmitted only in one direction. Examples: Television, radio broadcasting, newspapers, books, etc. →

b. Duplex : The data transmission mode in which data can be transmitted in both directions.

   i. Half Duplex : The data transmission mode in which data travels in both directions, but only one direction at a time. Example: Walkie-talkie ⇄

   ii. Full Duplex Transmission : In full duplex transmission, data travels in both directions at the same time. Examples: Telephone, computers, mobile phones, etc. ↔

11. What is communication channel? Give examples

A communication channel or network transmission medium is the path through which data or information is transmitted from one device or computer to another in a network.

There are two types of communication media.

a. Guided/Bound/Wired Communication Media
b. Unguided/Unbound/Wireless Communication Media

12. Differentiate between wired and wireless communication channel.

Guided media/Bound/Wired	Unguided media/Unbound/Wireless
It is suitable for LAN	It is suitable for WAN
Often cables are used	Uses electromagnetic waves
Guided media are comparatively stable, secure, consistent, and reliable.	Unguided media are less secure, less reliable but inexpensive
Example: Optical fiber, coaxial cable, STP, UTP	Examples: Radio waves, Microwaves etc.

13. What is bound/guided/ wired communication channel? Give examples

The transmission media that use cables to guide data signals along a fixed path are called guided communication channels.

a. CAT6: CAT6 (Category 6 cable): CAT6 is a type of network cable used to connect computers, routers, switches, and other devices to the Internet.

Advantages of CAT6

i. Fast and stable connection
ii. Flexible and durable
iii. Inexpensive

Disadvantages of CAT6

i. Signals may be affected by electromagnetic interference (EMI)
ii. Less bandwidth than fiber-optic cables
iii. A repeater or network extender is required to extend the range beyond 100 meters.

b. Optical Fiber: It is an advanced transmission medium that uses light signals instead of electrical signals. It is made of very thin glass or plastic fibers. It commonly uses SC and ST connectors.

Advantages of Fiber Optic:

- Very high speed and bandwidth
- No electromagnetic interference (EMI)
- Best for long-distance communication

Disadvantages of Fiber Optic:

- Expensive
- Fragile (easily breakable)
- Difficult to install and repair

14. What is unbound/unguided/wireless communication channel?

The transmission media that send data through the air without cables using electromagnetic waves are called unguided communication channels.

a. Wi-Fi : Wi-Fi (Wireless Fidelity) is a wireless technology that allows devices to connect to the Internet without using cables. It uses radio signals to send and receive data and works on 2.4 GHz and 5 GHz frequency bands
b. Bluetooth : Bluetooth is a wireless technology that allows devices to share data over short distances without using any cables. It is commonly found in smartphones, tablets, computers, smartwatches, and fitness bands.
c. RFID : RFID is a wireless technology that uses radio waves to identify and track objects using tags and readers.
d. Satellites: Satellite communication is a method of transmitting data globally using artificial satellites as relay stations.

15. Connectors : A connector is a device that is used to join cables or a cable to a device. Examples: RJ-45, RJ-11, T-connector, etc.

Types of connectors: RJ-45, Media Converters, and SC Connector

a. RJ-45: The jack used to connect network cables in a Local Area Network (LAN).
b. Media Converters: A media converter is a device that converts electrical signals into light signals

and vice versa to connect different types of network cables.

c. SC-Connector : An SC connector is a fiber-optic cable connector that uses a push-pull latching mechanism.

16. Networking Devices

a. Repeaters: A repeater is a network device that receives, regenerates and retransmits signals at their original strength. It is a signal amplifier used to amplify weak signals and extend the network range.

b. Hub: A hub is a device that enables communication between workstations and servers using multiple ports. It is used to receive incoming data, amplify it and distribute it. There are three types of hub: active hub, passive hub and hybrid hub.

c. Switch : A device that connects computers, network devices and network segments.

d. Bridge : Bridge connects the networks using the same communications protocols. It is used to store and forward device used to connect different or similar networks. It is classified into two categories: Local Bridge and Remote Bridge.

e. Routers: Routers are highly intelligent bridges, which select the best path to route messages based on destination and source addresses. It is highly intelligent, protocol sensitive linking device used to connect similar or dissimilar LANs.

f. Network Interface Card (NIC): A network interface card is a small circuit board or card that physically connects a computer to a network cable.

17. What is Network Topology?

The physical layout or configuration of network computers and devices is known as network topology. A network topology describes the geographic orientation and arrangement of networking components. It is a map of the physical network.

List the types of network topologies. Bus Topology, Ring Topology, Star Topology, Mesh Topology, Tree Topology, Hybrid Topology, Cellular Topology

18. What is Bus Topology? Write its advantages and disadvantages

The topology in which all computers are connected through a common backbone cable (trunk). It is also known as linear topology.

Advantages of Bus topology

a. It is simple and easy to configure.
b. It requires less cable and reduces installation cost.
c. Suitable for low-traffic networks

Disadvantages of Bus topology.

a. If a problem occurs in the backbone cable, the entire network will go down.
b. It tends to slow down under heavy use.
c. Troubleshooting could be difficult.

19. What is Ring Topology? Write its advantages and disadvantages.

The topology in which nodes are connected to each other in a circular path or closed loop by a single communication cable. In a traditional ring topology, data usually travels in one direction around the ring. It is also called loop network.

Advantages of Ring topology

a. One cable connection between the devices
b. Short cable connections increase network reliability.
c. Each computer has equal access facility to the resource.

Disadvantages of Ring topology.

a. Failure of any node may cause network failure.
b. It is difficult to reconfigure.
c. Difficult to diagnose faults.

20. What is Star Topology? Write its advantages and disadvantages

In star topology all the computers are connect to a central connecting device, hub. Data in this topology passes through the hub before continuing to its destination.

Advantages of star topology

a. Easy to add new nodes.
b. Easy to detect faults.
c. All the links stay active even if one link fails to work

Disadvantages of star topology.

a. Long cable length, since each device is directly connect to the central hub
b. The entire network fails if the central hub stops working.

21. What is Hybrid Topology? Write its advantages and disadvantages.

A hybrid topology is a combination of two or more different network topologies such as star, bus, ring, or mesh, within a single network. It allows for greater flexibility and scalability by leveraging the strengths of multiple topologies to meet the specific needs of large organization and enterprise network.

Advantages of hybrid topology

a. It is flexible and scalable network
b. It is suitable for large networks.
c. It takes advantage of the best features of different network designs to improve speed and efficiency

Disadvantages of hybrid topology

a. It is complex to design.
b. Higher installation cost
c. Troubleshooting can be difficult

22. What is computer network?

A computer network is an interconnection of two or more than two computers with cable or without cables, in order to share resources like hardware, data and software.

23. List the types of computer network on the basis of geographical area.

a. A Personal Area Network (PAN) is a network that is used for connecting devices close to an individual, typically within a range of a few meters. Example :Bluetooth connection between earphone and smartphone.
b. Local Area Network (LAN) : A group of computers and other devices dispersed over a relatively limited area and are connected by a communication link that enables any device to interact with any other on the network. This network may be in one room, one floor of a building or throughout one or more buildings. Example: Schools network , Organization network.
c. Metropolitan Area Network (MAN): A network that is limited within a city, village or metropolis and covers large geographical area than LAN is known as Metropolitan Area Network. Example : Cable Television Network
d. Wide Area Network (WAN): WAN is a large group of computers linked together through satellite communication in an unlimited area. This network may be across town, between cities, countries, or continents. Example: Internet.

24. Define Network Architecture and list the types of Network Architecture.

Network architecture defines how the computer communicates and interacts with each other on network. The combined form of topologies and data transmission mode that defines how computer communicates and interacts with each other on network.

Types of Network Architecture

a. Client/Server Network Architecture
b. Peer-to-Peer Network Architecture

25. What is Client/Server Network Architecture? Write its advantages and disadvantages

The client server architecture is type of broadcasting structure in which workstations or nodes are

connected with main server or host. The packet of data sent by one computer, at first reaches to server, and then passes to each local computer.

Advantages of Client –Server Network

a. Centralized user accounts and access controls.
b. More powerful equipment means more efficient access to network resources
c. A single password for network login delivers to all

Disadvantages of Client –Server network

a. At worst, server failure leads to whole network failure.
b. Complex, special purpose server software requires allocation of expert.
c. Expensive to setup dedicated server and other equipments.

26. What is Peer-to-Peer Network Architecture? Write its advantages and disadvantages

The technique of data transmission from node to node fashion in which each node behaves like as server or host temporarily is called peer to peer architecture.

Advantages of Peer to Peer network

a. Easy to install and configure
b. Individual machines do not depend on the presence of dedicated server.
c. Individual users control their own shared resources.
d. It's inexpensive to purchase and operate
e. No dedicated administrators are needed to run the network.

Disadvantages of Peer-to-Peer Network

a. Network security applies only to a single resource at a time.
b. Users may be forced to use as many passwords as there are shared resources.
c. The expansion of network is limited.

27. Write difference between client/server and peer-to-peer network architecture

Differentiate between peer-to-peer and client-server network architectures.

Peer to Peer	Client-Server
In peer to peer there is no dedicated server.	In client server there is a dedicated server.
Every computer acts as a server as well as client computer.	Server and client computers are different computers.
It is suitable for small sized network	It is suitable for large network.
Security level of network is poor	It is highly secured compared to peer to peer

28. What is network Protocol? Give examples of network protocols

A formal description of message formats and the set of rules two computers must follow to exchange those messages. The term protocol refers to the set of rules and procedures that govern the transmission of message over a physical networking medium. Some protocols are: TCP/IP, FTP, SMTP, HTTP, IPTV etc.

29. What is IP addressing? Write its importance

IP Addressing is the process of assigning a unique numerical address to each device connected to a computer network that uses the Internet Protocol (IP). These addresses help devices identify and communicate with each other over a network or the internet.

Importance of IP addressing

a. IP addresses uniquely identify each device on a network.
b. They allow computers, smartphones, printers, and servers to communicate with each other.

30. Define the different versions of IP addresses with example

There are mainly two versions of IP addresses:

a. IPv4 (Internet Protocol Version 4)
   Uses 32-bit addresses, for example: 192.168.1.1

b. IPv6 (Internet Protocol Version 6)
Uses 128-bit addresses, for example: 2001:0db8:85a3::8a2e:0370:7334

31. Define Internet Intranet and Extranet with examples and uses

a. Internet

The Internet is publicly accessible global system of interconnected computer networks that allows millions of computers and electronic devices around the world to communicate and share information using standard communication protocols such as TCP/IP. It provides services like web browsing, email, e-commerce, video conference, online gaming etc.

Some uses of Internet

- Searching information online
- Sending and receiving emails
- Online education and research
- Social networking and communication
- E-commerce and online banking
- Video conferencing and entertainment

b. Intranet

An Intranet is a private computer network designed for use within an organization such as a school, office, hospital, or company. It uses internet technologies like web browsers and TCP/IP protocols, but access is restricted only to authorized users within the organization.

Uses of Intranet

- Sharing internal documents and notices
- Communication among employees
- Managing employee records and data
- Internal meetings and collaboration

c. Extranet

An Extranet is a private network that allows an organization to share information with selected external users such as customers, suppliers, vendors, or business partners through the internet. It provides controlled access to people outside the organization.

Uses of Extranet

- Sharing business information with partners
- Online customer support and services
- Supply chain and inventory management
- Secure document sharing with external users