Data Comunication

1. Concept of Data Communication

- **Data Communication** is the exchange of data (text, image, audio, video, multimedia) between two or more networked devices.
- Devices must be able to send and receive data over a communication medium (e.g., computer, mobile, laptop, printer, server, switch).

2. Components of Data Communication

- **Sender**: Device that sends data (computer, mobile, smartwatch, etc.).
- **Receiver**: Device that receives data (computer, printer, mobile, etc.). Sender and receiver are called **nodes**.
- **Message**: Data or information exchanged (text, numbers, images, audio, etc.).
- **Communication Media**: Path (wired or wireless) through which data travels (e.g., cables, satellite, microwaves).
- **Protocol**: Set of rules followed for successful communication (e.g., Ethernet, HTTP).

3. Measuring Capacity of Communication Media

- **Bandwidth**: Range of frequencies available in a channel (measured in Hertz, Hz).
  - 1 KHz = 1000 Hz, 1 MHz = 1,000,000 Hz.
- **Data Transfer Rate (Bit Rate)**: Number of bits transmitted per second (bps, Kbps, Mbps, Gbps, Tbps).

4. Types of Data Communication

- **Simplex**: One-way only (e.g., keyboard to computer, controlling home appliances).
- **Half-duplex**: Both ways, but not at the same time (e.g., walkie-talkie).
- **Full-duplex**: Both ways, simultaneously (e.g., telephone, mobile).

5. Switching Techniques

- **Circuit Switching**: Dedicated path for the whole communication (e.g., old telephone calls).
- **Packet Switching**: Data split into packets, sent independently, may take different paths (e.g., Internet).

6. Transmission Media

a. Wired (Guided) Media

- **Twisted Pair Cable**: Two copper wires twisted (UTP, STP), used in LAN and telephone lines.
- **Coaxial Cable**: Central copper core, insulated and shielded; used for higher frequencies.
- **Optical Fiber**: Data as light; high bandwidth, immune to EMI, expensive, unidirectional, used in backbone networks.

b. Wireless (Unguided) Media

- Data travels as electromagnetic waves (radio, microwave, infrared, visible light).
- **Radio Waves**: Omnidirectional, long distances, can penetrate walls.
- **Microwaves**: Unidirectional, needs line-of-sight, used for radar, satellite.
- **Infrared**: Short distance, cannot penetrate walls, used in remotes, Bluetooth.

7. Wireless Technologies

- **Bluetooth**: Short-range, connects devices up to 10 meters, uses 2.4 GHz, forms piconet.
- **Wireless LAN (Wi-Fi)**: Standard 802.11, uses access points, allows device mobility within the network.

8. Mobile Telecommunication Technologies

- **1G**: Analog voice only.
- **2G**: Digital voice, SMS, MMS.
- **3G**: Digital voice & data, internet access.
- **4G**: Faster data, supports multimedia, wireless broadband.
- **5G**: Under development, supports IoT, machine-to-machine communication, ultra-fast data.

9. Protocols

- **Purpose**: Flow control, access control, addressing, error handling, packet arrangement.
- **HTTP**: Accesses World Wide Web, client-server model.
- **FTP**: Transfers files between machines.
- **PPP**: Direct link between two devices.
- **SMTP**: Email delivery protocol.
- **TCP/IP**: Foundation of the Internet, packet-based communication, ensures delivery and sequencing.

Question and Answers

1. Q: Device sending data
A: Sender
2. Q: Device receiving data
A: Receiver
3. Q: Data transfer path
A: Transmission media
4. Q: Rules for communication
A: Protocol
5. Q: Range of channel frequencies
A: Bandwidth
6. Q: Data transfer rate unit
A: bps (bits/sec)
7. Q: One-way communication
A: Simplex
8. Q: Two-way, not simultaneous communication
A: Half-duplex
9. Q: Two-way, simultaneous communication
A: Full-duplex
10. Q: Dedicated path switching
A: Circuit switching
11. Q: Packet-based switching
A: Packet switching
12. Q: Medium using copper twisted wires
A: Twisted pair
13. Q: Medium using central copper core
A: Coaxial cable
14. Q: Medium using glass, transmits light
A: Optical fiber
15. Q: Omnidirectional wireless wave
A: Radio waves
16. Q: Unidirectional, line-of-sight wave
A: Microwaves
17. Q: Short-range, device-to-device wireless
A: Infrared
18. Q: Bluetooth frequency band
A: 2.4 GHz
19. Q: Wireless LAN standard
A: 802.11 (Wi-Fi)
20. Q: First generation mobile network
A: 1G

21. Q: Email protocol
A: SMTP
22. Q: Web browsing protocol
A: HTTP
23. Q: File transfer protocol
A: FTP
24. Q: Internet foundational protocol
A: TCP/IP
25. Q: Protocol for direct link
A: PPP
26. Q: Unit of frequency
A: Hertz (Hz)
27. Q: Frequency range of radio waves
A: 3 KHz - 1 GHz
28. Q: Full form of SMS
A: Short Message Service
29. Q: Full form of MMS
A: Multimedia Messaging Service
30. Q: Twisted-pair cable used in LANs
A: UTP/STP
31. Q: Number of devices in a Bluetooth piconet (max)
A: 255
32. Q: Highest data speed mobile generation
A: 5G
33. Q: Protocol for mail transfer
A: SMTP
34. Q: Protocol for the web
A: HTTP
35. Q: Protocol for file transfer
A: FTP
36. Q: Unit: 1 Gbps = ? Mbps
A: 1024
37. Q: Range of electromagnetic spectrum for wireless
A: 3 KHz - 900 THz
38. Q: Protocol for reliable, sequenced data delivery
A: TCP
39.Q . What is data communication and what are its main components?
A: Data communication is the exchange of data (such as text, audio, video, images) between two or more devices over a network. The main components are:

1. Sender (transmits data)
2. Receiver (accepts data)
3. Message (the information being exchanged)
4. Communication media (path for data transfer, wired/wireless)
5. Protocol (rules for data transmission).

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40. Q. Differentiate between simplex, half-duplex, and full-duplex communication with examples.
A:

- **Simplex:** Data flows in only one direction (e.g., keyboard to computer).
- **Half-duplex:** Data can flow both ways, but not at the same time (e.g., walkie-talkies).
- **Full-duplex:** Data can flow simultaneously in both directions (e.g., telephone conversation).

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41. Q. What is bandwidth, and how does it affect data transmission?
A: Bandwidth is the range of frequencies available for data transmission in a communication channel, measured in Hertz (Hz). Higher bandwidth allows more data to be transmitted per second, increasing the speed and capacity of data communication.

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42. Q. Explain the difference between circuit switching and packet switching.
A:

- **Circuit Switching:** Establishes a dedicated communication path for the entire duration of the session (used in traditional telephone networks).
- **Packet Switching:** Divides data into packets, which are sent independently and may take different routes; efficient and commonly used in computer networks and the Internet.

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43. Q. What are the main types of transmission media? Give one example for each.
A:

- **Wired (Guided) Media:** Physical cables such as twisted pair cable (used in LANs), coaxial cable (used for TV), and optical fiber (used for high-speed backbone networks).
- **Wireless (Unguided) Media:** Electromagnetic waves like radio waves (FM radio), microwaves (satellite), and infrared (remote controls).

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44. Q. List and explain three key wireless technologies used in data communication.
A:

- **Bluetooth:** Short-range wireless technology for connecting devices within 10 meters (e.g., headphones, keyboards).
- **Wi-Fi (802.11):** Wireless LAN technology providing internet connectivity within a specific area using access points.
- **Infrared:** Short-range, line-of-sight technology used in remote controls and some device communications.

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45. Q. What are the generations of mobile telecommunication, and what does each offer?
A:

- **1G:** Analog voice communication only.
- **2G:** Digital voice, text messaging (SMS), and MMS.
- **3G:** Digital voice and high-speed data for internet access.
- **4G:** High-speed data, supports video streaming and broadband internet.
- **5G:** Ultra-fast data, IoT support, low latency (under development).

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46. Q. What is the role of protocols in data communication? Name two examples and their use.
A: Protocols define rules for data transmission, addressing, error detection, flow control, and packet arrangement.
Examples:

- **HTTP:** Used for web browsing (accessing websites).
- **SMTP:** Used for sending and receiving emails.

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47. Q. What is the difference between bandwidth and data transfer rate (bit rate)?
A:

- **Bandwidth:** Range of frequencies that a communication channel can transmit (Hz).
- **Data transfer rate (bit rate):** Number of bits transmitted per second (bps, Kbps, Mbps, etc.). Higher bandwidth often results in a higher data transfer rate.

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48. Q. How does optical fiber transmission differ from copper-based cables?
A: Optical fiber transmits data as pulses of light through glass or plastic, offering high speed, large

bandwidth, and immunity to electromagnetic interference. Copper-based cables (twisted pair, coaxial) use electrical signals, are slower, have lower bandwidth, and are more prone to interference.

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49. Q. What is a protocol suite? Give one example and its significance.
A: A protocol suite is a collection of protocols that work together to provide complete network functionality.
Example: **TCP/IP suite**, which powers the Internet by handling addressing, routing, transmission, and error detection.

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50. Q. What is a piconet in Bluetooth communication?
A: A piconet is a small network created using Bluetooth, where one device acts as a master and up to seven active devices act as slaves; up to 255 devices can be inactive participants.

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51. Q. Describe the function of the SMTP protocol.
A: SMTP (Simple Mail Transfer Protocol) is used to transfer electronic mail (email) messages between mail servers and from client to server, ensuring reliable delivery of email.

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52. Q. Name and briefly describe two error control techniques in data communication.
A: Parity Check: Adds a parity bit to detect single-bit errors in transmitted data.

- **Checksum:** A calculated value based on the data, sent along with the message to verify integrity at the receiver.

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53. Q. What is the basic difference between Wi-Fi and Bluetooth?
A: Wi-Fi is designed for wireless local area networking (covering larger areas, higher speeds, and more devices), while Bluetooth is intended for short-range device-to-device connections, typically within a 10-meter range.