**1. What is HTTP, and which layer of the OSI model does it belong to?**

**HTTP (HyperText Transfer Protocol)** is a protocol used to transfer web pages on the internet.

* It belongs to the **Application Layer (Layer 7)** of the OSI model.

**2. What is the difference between persistent and non-persistent HTTP connections?**

* **Non-persistent:** A new TCP connection is opened for each HTTP request/response pair.
* **Persistent:** A single TCP connection is reused for multiple requests/responses, reducing overhead.

**3. How does HTTP handle multiple requests in persistent connections?**

HTTP uses **pipelining or multiplexing (in HTTP/2)** to send multiple requests without waiting for each response, improving efficiency.

**4. What are the different types of HTTP message formats?**

* **Request message:** Contains request line (e.g., GET/POST), headers, and optional body.
* **Response message:** Contains status line, headers, and body (like HTML content or JSON).

**5. What is FTP, and how does it work?**

**FTP (File Transfer Protocol)** is used for transferring files between client and server.

* It uses two separate connections:
  + **Control connection (port 21)** for commands
  + **Data connection (port 20 or dynamic)** for transferring files

**6. What are the two modes of FTP: active and passive?**

* **Active Mode:** Server initiates the data connection to the client.
* **Passive Mode:** Client initiates both control and data connections (used to bypass firewalls).

**7. What is SMTP, and how does it work?**

**SMTP (Simple Mail Transfer Protocol)** is used for sending emails from client to server or between servers.

* It works via a series of text-based commands and responses over TCP (port 25/587).

**8. What is the format of an email message?**

* **Header:** Includes To, From, Subject, Date, etc.
* **Body:** Contains the actual content (plain text or HTML).
* (Optional) **Attachments** are encoded and included in the body using MIME format.

**9. What is the role of POP3 and IMAP in email retrieval?**

* **POP3 (Post Office Protocol v3):** Downloads and removes email from the server.
* **IMAP (Internet Message Access Protocol):** Keeps emails on the server; allows syncing across multiple devices.

**10. What is DNS, and why is it important?**

**DNS (Domain Name System)** translates domain names (e.g., google.com) into IP addresses.

* It's essential for browsing websites using human-readable names.

**11. What are the different types of DNS servers?**

* **Root DNS servers**
* **Top-Level Domain (TLD) servers**
* **Authoritative DNS servers**
* **Recursive resolvers (local DNS)**

**12. What are the key services provided by DNS?**

* **Name resolution** (domain to IP)
* **Load balancing** (via multiple IPs)
* **Email routing** (via MX records)
* **Service discovery** (via SRV records)

**13. What is the main function of the Transport Layer in networking?**

* Provides **end-to-end communication**, **error detection**, **retransmission**, **flow control**, and **segmentation** of data between devices.

**14. What is the difference between connection-oriented and connectionless services?**

* **Connection-oriented (e.g., TCP):** Establishes a session before data transfer; reliable.
* **Connectionless (e.g., UDP):** Sends data without prior connection; faster but unreliable.

**15. Explain the difference between flow control and congestion control.**

* **Flow control:** Manages data rate between sender and receiver to avoid overwhelming the receiver.
* **Congestion control:** Prevents too much data from being sent across the network, avoiding overload.

**16. What are the key differences between the Transport Layer and the Network Layer?**

| **Feature** | **Transport Layer** | **Network Layer** |
| --- | --- | --- |
| Main Protocols | TCP, UDP | IP, ICMP |
| Role | End-to-end communication | Routing of packets |
| Data Unit | Segment (TCP), Datagram (UDP) | Packet |
| Reliability | Yes (TCP) | No (best-effort delivery) |

**17. What is UDP, and how does it differ from TCP?**

**UDP (User Datagram Protocol)** is a simple, connectionless protocol.

* **No reliability**, **no ordering**, **no flow control** – just fast data delivery.
* Unlike TCP, it does not guarantee delivery or maintain connections.

**18. What are the advantages and disadvantages of using UDP?**

**Advantages:**

* Faster, lightweight
* Low latency
* Good for real-time apps

**Disadvantages:**

* No guarantee of delivery
* No error correction or sequencing

**19. What are some real-world applications of UDP?**

* Online gaming
* Video/audio streaming (e.g., VoIP, Zoom)
* DNS lookups
* Live broadcasts

**1. What is a computer network?**

A **computer network** is a system of interconnected computers and devices that share resources and communicate using networking protocols.

**2. What are the types of computer networks?**

* **LAN** (Local Area Network)
* **MAN** (Metropolitan Area Network)
* **WAN** (Wide Area Network)
* **PAN** (Personal Area Network)
* **CAN** (Campus Area Network)

**3. Difference between LAN, MAN, and WAN**

| **Feature** | **LAN** | **MAN** | **WAN** |
| --- | --- | --- | --- |
| Size | Small (home, office) | City-wide | Global |
| Speed | High | Medium | Lower |
| Cost | Low | Medium | High |

**4. What is the OSI model? Name its layers.**

A 7-layer model that standardizes network communication.  
**Layers (top-down):**

1. Application
2. Presentation
3. Session
4. Transport
5. Network
6. Data Link
7. Physical

**5. Function of each OSI layer:**

1. **Application** – User interface & services
2. **Presentation** – Data formatting, encryption
3. **Session** – Establish/manage sessions
4. **Transport** – Reliable delivery, segmentation
5. **Network** – Routing & logical addressing
6. **Data Link** – MAC addressing, error detection
7. **Physical** – Transmits raw bits

**6. What is the TCP/IP model? How does it differ from OSI?**

A 4-layer model used practically in networks:

1. Application
2. Transport
3. Internet
4. Network Access

**Difference:** OSI is conceptual (7 layers), TCP/IP is practical (4 layers) and used in real-world networking.

**7. Difference between TCP and UDP**

| **TCP** | **UDP** |
| --- | --- |
| Connection-oriented | Connectionless |
| Reliable, ordered | Unreliable, unordered |
| Slower | Faster |

**8. What is an IP address? Types of IP addresses:**

A unique identifier for devices on a network.  
**Types:**

* Public vs Private
* Static vs Dynamic
* IPv4 vs IPv6

**9. Difference between IPv4 and IPv6**

| **IPv4** | **IPv6** |
| --- | --- |
| 32-bit | 128-bit |
| Decimal | Hexadecimal |
| 4.3B addresses | Virtually unlimited |
| Example: 192.168.0.1 | 2001:0db8::1 |

**10. What is a MAC address?**

A **unique hardware identifier** assigned to a network interface card (NIC). Used at the Data Link layer.

**11. What is DNS and why is it used?**

**Domain Name System** converts domain names to IP addresses (e.g., google.com → 142.250.190.14).

**12. What is DHCP?**

**Dynamic Host Configuration Protocol** automatically assigns IP addresses to devices on a network.

**13. Router vs Switch**

* **Router:** Connects different networks, assigns IPs, routes data
* **Switch:** Connects devices in a LAN and forwards data based on MAC

**14. What is a protocol? Give examples.**

A **set of rules** for data communication.  
Examples: HTTP, FTP, TCP, UDP, IP, DNS, SMTP

**15. What is a subnet mask?**

Used to **divide IP addresses** into network and host portions.  
Example: 255.255.255.0 means first 3 octets are the network part.

**16. What is NAT?**

**Network Address Translation** maps private IPs to a public IP to allow internet access.

**17. Differences: Hub vs Switch vs Router**

| **Device** | **Function** |
| --- | --- |
| Hub | Broadcasts to all devices (dumb) |
| Switch | Sends to intended device using MAC |
| Router | Routes between networks using IP |

**18. Bandwidth vs Latency**

* **Bandwidth:** Max data transfer rate (Mbps)
* **Latency:** Delay in data transfer (ms)

**19. Packet switching vs Circuit switching**

* **Packet:** Data sent in chunks (Internet)
* **Circuit:** Dedicated path (Traditional telephony)

**20. What is ARP?**

**Address Resolution Protocol** maps IP addresses to MAC addresses.

**21. Connectionless Datagram Delivery**

Packets are sent independently without prior connection (e.g., UDP, IP).

**22. Characteristics of Internet Protocol (IP)**

* Connectionless
* Unreliable (no delivery guarantee)
* Best-effort delivery
* Provides logical addressing

**23. Why is IP considered connectionless?**

Because each packet is treated independently with no session or state retention.

**24. Importance of IP in network communication**

* Enables data routing across networks
* Provides logical addressing
* Foundation for the internet

**25. IPv4 vs IPv6 datagram format differences**

* IPv6 has simplified header
* No checksum field in IPv6
* IPv6 has **Flow Label** for QoS
* Larger address space

**26. Datagram encapsulation in other layers**

* **Application data** → Transport layer adds header (TCP/UDP)
* Transport segment → Network layer adds IP header
* IP packet → Data Link adds MAC header (Frame)
* Sent as bits via Physical Layer

**27. What is MTU?**

**Maximum Transmission Unit** is the largest size of a packet that can be transmitted without fragmentation.

**28. What happens when datagram > MTU?**

The packet is **fragmented** (in IPv4) or dropped (in IPv6 if not using Path MTU Discovery).

**29. What is IP fragmentation?**

Splitting a large IP packet into smaller ones to fit the MTU. Occurs in IPv4.

**30. How does IP handle reassembly?**

Reassembly is done at the **destination host**, using fragment offset and ID fields in IPv4.

**31. IPv6 fragmentation vs IPv4**

* IPv6 fragmentation is handled **only by the sender**
* Routers do **not** fragment in IPv6
* Uses **Fragment Header**

**32. What is the TTL field in IPv4?**

**Time To Live** defines max number of hops a packet can take. Decreases by 1 at each hop. Prevents infinite loops.

**33. What is Hop Limit in IPv6?**

Same as TTL, but named **Hop Limit**. Functions identically but specified in IPv6.