1.Client-Server Model

The Client-Server Model is a network architecture in which one device (the client) requests services or resources, and another device (the server) provides those services or resources.

Client - device that requests resources.

Server - device that provides resources.

2.OSI (Open Systems Interconnection)

Physical Layer (Layer 1)

Responsible for the actual physical connection between the devices Specifies the physical medium, signalling methods, and hardware interfaces.

Physical layer contains information in the form of **bits.**

Data Link Layer (Layer 2)

Responsible for node-to-node data transfer

error detection/correction.

Flow Control

Organizes data into **frames.**

Network Layer (Layer 3)

Routing of data packets between devices

The best route for delivery

Segment in the Network layer is referred to as **Packets.**

Transport Layer (Layer 4)

Ensures data is correctly ordered and reassembled.

The transport layer also provides the acknowledgment of the successful data transmission and re-transmits the data if an error is found.

TCP - Connection-Oriented Service

UDP - Connection-less Service

Session Layer (Layer 5)

Responsible for connections (Session Establishment, Maintenance, and Termination)

Dialog Controller

The session layer allows two systems to start communication with each other in half-duplex or full duplex.

Presentation Layer (layer 6)

Formatting

Encryption

process used to secure data by converting it from its original, readable form into an unreadable format using an algorithm and a key.

Application Layer (Layer 7)

This layer interacts directly with application software.

3.Encoding

Encoding is the process of converting data from one format into another, typically for the purpose of standardization, efficient transmission, or storage.

4. Encryption

Encryption **i**s the process of converting data from its original form (plaintext) into a unreadable format (ciphertext) using an algorithm and a key. This transformation ensures that the data remains confidential and secure, protecting it from unauthorized access, even if intercepted during transmission.

5. TCP/IP (Transmission Control Protocol/Internet Protocol)

IP (Internet Protocol)

Routes packets of data from the source to the destination based on IP addresses. Provides addressing and routing of packets across networks. IP is a **connection-less protocol**, which means it doesn't guarantee delivery nor does it provide error checking and correction.

TCP (Transmission Control Protocol)

TCP is a **connection-oriented protocol** that ensures **reliable**, **ordered**, and **error-free delivery** of data between devices. It breaks data into smaller packets, sends them over the network, and reassembles them at the destination.

6. ICMP (Internet Control Message Protocol)

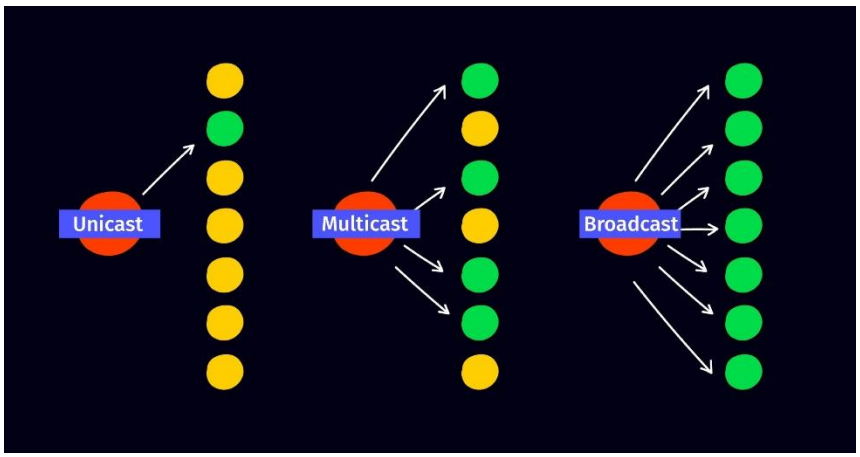
ICMP (Internet Control Message Protocol) is a **network layer protocol** used to send control messages and **error reporting in Internet Protocol** (IP) networks. It is an **essential protocol for diagnosing and troubleshooting network issues**.

7. ARP (Address Resolution Protocol)

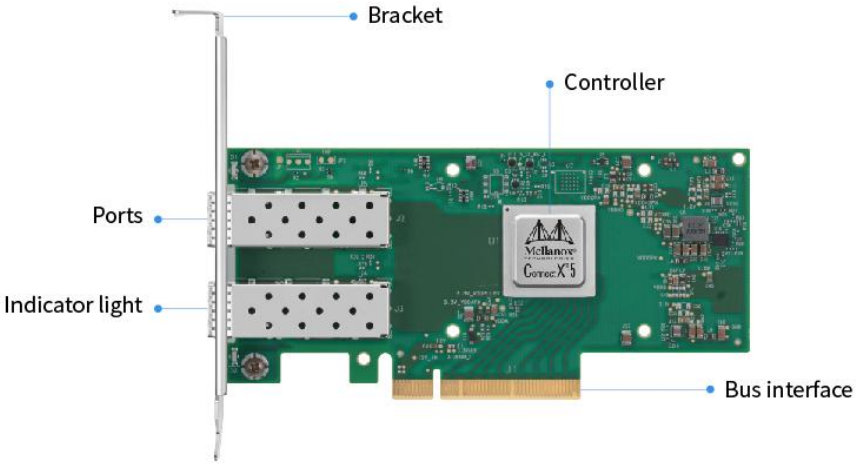
ARP (Address Resolution Protocol) is a protocol used in computer networks to map a device's **IP address** (Internet Protocol address) to its **MAC address** (Media Access Control address). This mapping is necessary because while IP addresses are used for routing data between devices on a network, the actual transmission of data between devices on the same local network (LAN) relies on MAC addresses, which are unique hardware addresses assigned to network interface cards (NICs).

8. IGMP (Internet Group Management Protocol)

IGMP (Internet Group Management Protocol) is a network-layer protocol used by hosts and adjacent routers on an **IP network** to manage the membership of **multicast groups**. Multicast allows one-to-many communication, where data is sent from a single sender to multiple receivers in an efficient manner, as opposed to broadcasting to all devices or unicasting to a single device.



9. NIC (Network Interface Card)



A NIC (Network Interface Card) is a hardware component that allows computers and other devices to connect to a network.

10.Submarine Cable

Submarine cables are specialized undersea cables that transmit data across oceans and seas, forming the backbone of the global internet infrastructure. These cables carry the majority of international communications, including internet traffic, telephone calls, and private data transfers. Submarine cables are a critical component of the global communication network, connecting continents and facilitating rapid data transmission across vast distances.

11. Fiber-optic cable

Fiber-optic cable is a high-performance cable used for transmitting data over long distances at very high speeds using light signals.

12.Nodes/Hosts/Client and servers/Protocol

Node: node is any device or point that can send, receive, or forward data

Hosts: A host is any device that has an IP address and can be a source or destination for data on a network.

Client: device that **requests** services or resources from a server.

Servers: device that **provides** resources, data, or services to clients.

Protocol: A set of rules that define how data is transmitted and handled between devices in a network.

13.LAN/MAN/WAN

LAN (Local Area Network)

A **Local Area Network (LAN)** is a network that spans a small geographic area, such as a **home**, **office**, or **building**. It is typically used to connect devices like computers, printers, servers, and other networked devices within a limited physical area.

MAN (Metropolitan Area Network)

A **Metropolitan Area Network (MAN)** is a larger network that spans a **city** or a **large campus** and is typically used to connect multiple LANs within a metropolitan area.

WAN (Wide Area Network)

A **Wide Area Network (WAN)** is a network that covers a **large geographic area**, often spanning multiple cities, regions, or even countries. WANs are used to connect multiple LANs and MANs, allowing devices from different locations to communicate with each other. The **internet** itself is the largest example of a WAN.

14. Modem/Router

Modem

A **modem** (short for **Modulator-Demodulator**) is a device that **connects your home or office network to the internet** through your **Internet Service Provider (ISP)**. It converts digital signals from your computer or network into analog signals.

Router

A **router** is a device that **routes data** between your modem and all the devices on your local network. Routers often include security features like firewalls to protect your internal network from outside threats.

15. Scalability/Elasticity

Scalability

potential to accommodate growth and increased demand without compromising performance or efficiency.

vertical - scale up/down [CPU/Resources]

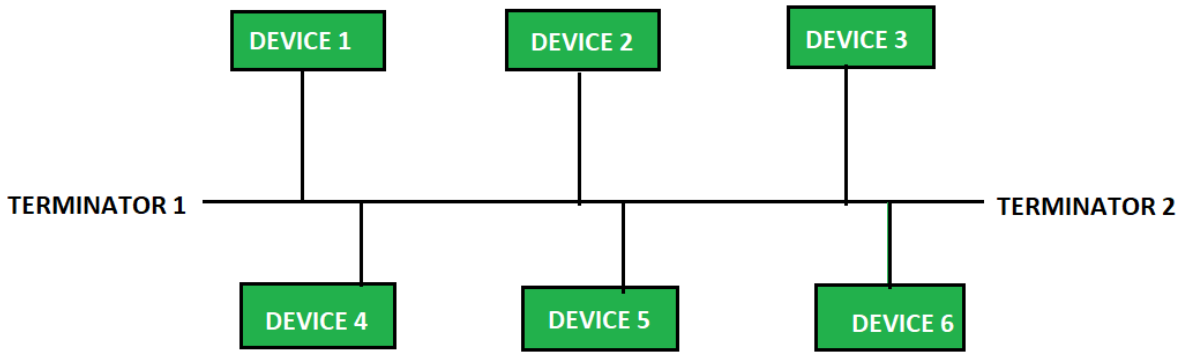
horizontal - scale in/out [adding/removing more machines]

Elasticity

Elasticity refers to a system's **ability to dynamically allocate and deallocate resources** as demand increases or decreases.

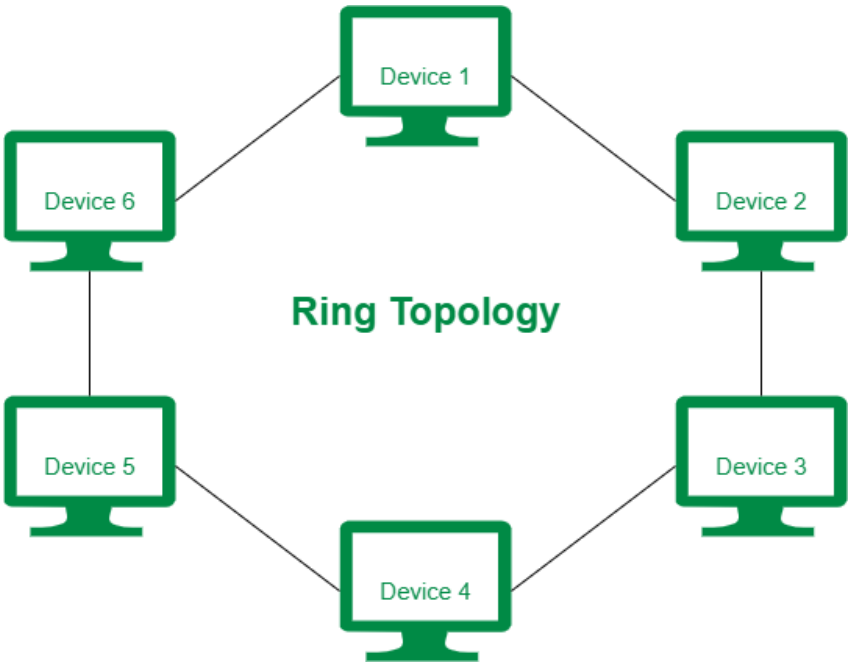
16. Network topology

Bus Topology



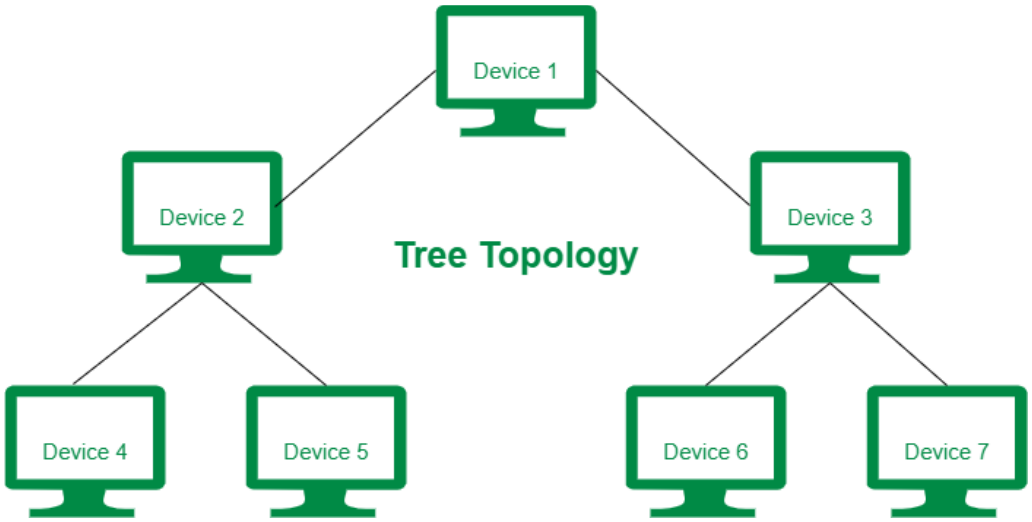
Bus topology is one of the simplest network topologies, where all devices are connected to a single central cable (called the bus or backbone). Data sent by a device is available to all other devices on the network, but only the intended recipient processes the data.

Ring Topology



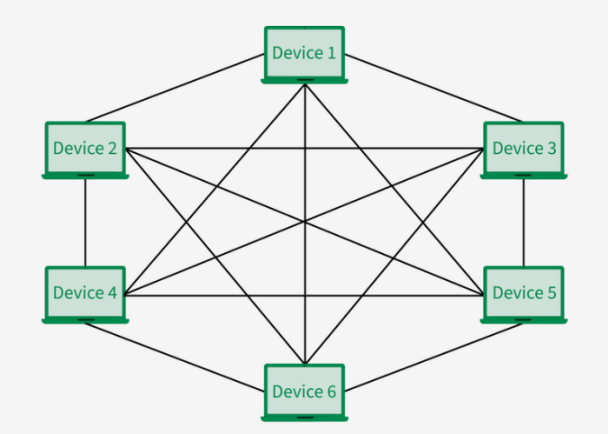
In ring topology, devices are connected in a closed loop or ring, where each device is connected to two other devices. Data travels in a circular path, passing through each device until it reaches the destination.

Tree Topology



tree topology is a type of network topology that resembles a tree. In a tree topology, there is one central node (the “trunk”), and each node is connected to the central node through a single path. Nodes can be thought of as branches coming off the trunk. Tree topologies are often used to create large networks.

Mesh Topology



Mesh topology involves each device being directly connected to every other device in the network, forming a fully interconnected network.

17. Peer-to-Peer (P2P)

Peer-to-Peer (P2P) is a type of network architecture where each device (or "peer") on the network has equal status and can act both as a **client** and a **server**. In a P2P network, devices communicate directly with each other without the need for a central server or authority to manage the interactions. Each device can share resources (like files, processing power, or storage) with other devices on the network.

18.Socket/Port

Socket: A Socket is a combination of port and IP address.

Port: A port is an access point where protocols are used in a network to locate the processes or services within a device

19. HTTP (Hypertext Transfer Protocol) Methods

GET: The **GET** method is used to request data from a specified resource.

POST: creating a resource. POST requests typically include a **request body**, which contains the data to be submitted.

PUT: The **PUT** method is used to **update** a resource on the server.

DELETE: The **DELETE** method is used to **delete** a specified resource from the server.

20. HTTP Response Code

Informational response: 100 – 199

Success response: 200 – 299

Redirection response: 300 -399

Client Errors response: 400 – 499

Server Errors response: 500 -599

21. Cookies

cookie is a small piece of data that a server sends to a client (typically a web browser) in the form of key-value pairs. The client stores these cookies locally, and they are sent back to the server with every subsequent request to the same domain. Cookies help maintain stateful information for HTTP, which is inherently stateless.

- **Session Cookies**: Temporary cookies that are deleted once the browser is closed.
- **Persistent Cookies**: Stored on the device for a set period or until deleted.

22. VPN (Virtual Private Network)

A **Virtual Private Network (VPN)** is a technology that enables a secure and private connection over the internet, providing users with a way to transmit data safely, even over unsecured networks like public Wi-Fi. VPNs encrypt the user's internet traffic and create a private tunnel through which data is transmitted, effectively masking the user's real IP address and location.

Tunnelling is a technique used in computer networks to encapsulate data in a way that allows it to be securely transmitted across a public or untrusted network.

Types of VPNs

1.Remote Access VPN (Tunnelling)

Remote Access VPN allows individual users to connect securely to a remote network (usually a corporate network) from anywhere in the world.

2. Site-to-Site VPN

A **Site-to-Site VPN** connects two or more separate private networks, typically located in different geographic locations, through a public network.

3. Cloud VPN

A **Cloud VPN** secures the connection between the client and a cloud infrastructure, allowing users to access cloud-hosted resources securely over the internet.

4. Mobile VPN

A **Mobile VPN** is designed to support mobile devices (smartphones, tablets, laptops) that may switch between different networks.

5. SSL VPN (Secure Sockets Layer VPN)

An **SSL VPN** uses SSL or its successor TLS (Transport Layer Security) protocols to provide a secure connection between the client and the server. It is commonly used for secure web-based access, allowing users to connect to a private network via a web browser without needing specialized VPN client software.

6. Double VPN

A **Double VPN** is a security feature that routes the internet traffic of the user through two VPN servers instead of just one.

23. Checksum

A **checksum** is a value calculated from a data set (such as a file, message, or packet of data) and used to verify the integrity of that data. It's essentially a form of redundancy check to detect errors that might have been introduced during the data transmission or storage process.

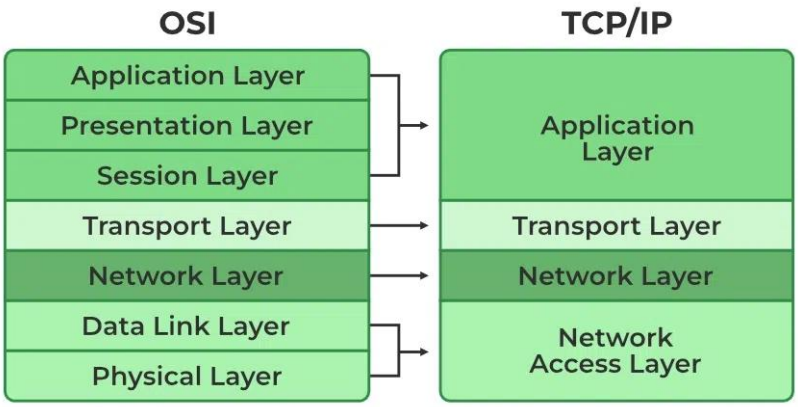
24.Ping

Ping is a network diagnostic tool used to test the connectivity between two devices on a network, typically between a computer and a remote server or another device on the internet or local network.

It works by sending a special type of message called an **ICMP Echo Request** to a target device and waiting for an **ICMP Echo Reply**.

The time it takes for the message to travel to the destination and back is measured, which is known as **round-trip time**.

25.TCP/IP



Application Layer (Layer 4 in TCP/IP)

This layer deals with **application-level protocols** and provides network services directly to end-users or applications. It enables communication between software applications running on different systems.

Transport Layer (Layer 3 in TCP/IP)

Responsible for **reliable data transfer** between two devices on a network, ensuring **error-free and complete data delivery**. This layer defines how data is packaged, transmitted, and verified between devices.

Internet Layer (Layer 2 in TCP/IP)

This layer is responsible for **routing packets** of data across different networks and ensures that data reaches its correct destination by addressing and routing it. The most important component of this layer is the **IP (Internet Protocol)**.

Network Access Layer (Layer 1 in TCP/IP)

This layer is responsible for the **physical transmission of data** over the network hardware (such as Ethernet, Wi-Fi, etc.). It deals with the **hardware addressing, data link, and physical transmission of data between devices.**

26. Subnetting

Subnetting is the process of dividing a larger network into smaller, more manageable sub-networks, known as **subnets**. This is done by borrowing bits from the host portion of an IP address to create additional network bits. Subnetting helps improve network performance, security, and address management.

27. NAT (Network Address Translation)

Network Address Translation (NAT) is a technique used in networking to modify the source or destination IP addresses in the header of IP packets as they pass through a router or firewall. NAT enables multiple devices on a local network to **share a single public IP address** for accessing external networks like the internet.

28.SSL/TSL/HTTPS

SSL: SSL is a cryptographic protocol designed to provide secure communication over a computer network. SSL encrypts the data transmitted between the client and server.

TSL: TLS is the successor to SSL, designed to improve upon SSL's weaknesses and provide stronger security for internet communications.

HTTPS: HTTPS is a secure version of the **HTTP** protocol, which is used for transferring data over the web.

29. Symmetric and Asymmetric Encryption

Symmetric: In **symmetric encryption**, the **same key** is used for both **encryption** and **decryption.**

Asymmetric: In **asymmetric encryption**, two **different keys** are used: a **public key** and a **private key**. The public key is used to encrypt data, while the private key is used to decrypt it.

30. Monolithic Architecture

Monolithic architecture refers to a traditional model of software design where an entire application is built as a single, unified unit.

31. Microservices Architecture

The key idea behind microservices is to break down a monolithic application into smaller, modular pieces, each responsible for a specific aspect of the business logic or functionality.

//**Authentication** is the process of verifying the identity of a user, system, or entity attempting to access a resource. It answers the question: *"Who are you?"*

// Authorization is the process of granting or denying access to a specific resource or action based on the identity that was authenticated. It answers the question: *"What can you do?"*

//10-01-2025

32.Firewall

A Firewall is a network security device that monitors and filters incoming and outgoing network traffic based on an organization's previously established security policies. At its most basic, a firewall is essentially the barrier that sits between a private internal network and the public Internet. A firewall's main purpose is to allow non-threatening traffic in and to keep dangerous traffic out.

Stateful Firewall: A stateful firewall maintains a table of the state of each active connection, so it can track and validate whether a response is from an established connection. This helps ensure that only legitimate return traffic is allowed.

Stateless Firewall: A stateless firewall does not keep track of connection states. It filters packets based solely on pre-configured rules (such as source/destination IP address or port).

33. API Gateway

An **API Gateway** is a server or service that acts as an intermediary between a client (such as a web or mobile application) and multiple backend services (often microservices). It provides a unified entry point for accessing different APIs, making it easier for clients to interact with multiple services without needing to know the specifics of each one.

34. Personal Access Token (PAT)

PATs are used as an alternative to traditional username/password authentication, and they provide a more secure and flexible way of authenticating users or applications.

35.Server Farm

A **server farm** is a large collection of servers that work together to provide a high level of computing power and storage capacity for various applications, websites, and services. These servers are usually housed in a **data center** and are configured to work as a unified system, often using load balancing, redundancy, and virtualization technologies to ensure scalability, high availability, and reliability.

36. IPSec (Internet Protocol Security)

IPSec (Internet Protocol Security) is a suite of protocols used to secure IP communications by authenticating and encrypting each IP packet in a communication session. It is commonly used to implement **Virtual Private Networks (VPNs)** and to protect data traffic across untrusted networks, such as the internet.

IPSec operates at the **Network Layer** (Layer 3) of the OSI model and can secure communication between devices such as routers, firewalls, and gateways, as well as between hosts (e.g., computers, servers). Its primary purpose is to ensure data confidentiality, integrity, and authenticity.

37. Threat, Vulnerability, and Risk in Cybersecurity

Threat: A **threat** refers to any potential danger or event that could exploit a vulnerability and cause harm to a system, network, or data.

Vulnerability: A **vulnerability** is a weakness or flaw in a system, network, application, or process that can be exploited by a threat actor to gain unauthorized access or cause harm.

Risk: Risk is the potential impact of a threat exploiting a vulnerability, expressed in terms of likelihood and consequences.

38. Reverse Proxy

A **reverse proxy** is a server that sits between client devices and a backend server.

39.IPV4/IPV6

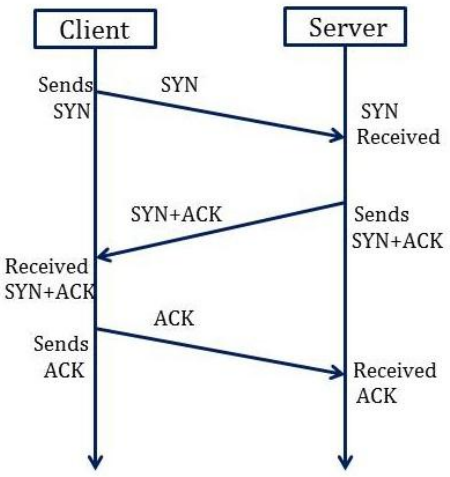
IPV4

- IPv4 is a 32-bit address.
- IPv4 is a numeric address that consists of 4 fields which are separated by dot (.).
- IPv4 has 5 different classes of IP address that includes Class A, Class B, Class C, Class D, and Class E.
- It supports manual and DHCP configuration.

IPV6

- IPv6 is a 128-bit address.
- IPv6 is an alphanumeric address that consists of 8 fields, which are separated by colon.
- IPv6 does not contain classes of IP addresses.
- It supports manual, DHCP, auto-configuration, and renumbering.

40. 3-Way Handshake



- SYN (client to server)
- SYN-ACK (server to client)
- ACK (client to server)

41. DHCP (Dynamic Host Configuration Protocol)

DHCP (Dynamic Host Configuration Protocol) is a network management protocol used to dynamically assign IP addresses and other network configuration information to devices (known as **clients**) on a network.

42. Switch and Router

Switch
A **switch** is a network device that connects multiple devices (like computers, printers, and servers) within a local area network (**LAN**) and uses **MAC addresses** to forward data packets between devices.

Router
Definition:
A **router** is a device that connects multiple networks together, typically a local area network (**LAN**) and the internet, and forwards data packets between them using **IP addresses**.

43.Port forwarding

Port forwarding is a network configuration technique used to allow external devices or services to access specific services or devices within a private internal network. It works by redirecting communication requests from an external IP address (often the public IP address of a router) to a specific device or service on the internal network, using a particular port number.

44.Hub and switch

Hub:
A **hub** is a basic networking device that connects multiple devices in a network, enabling them to communicate with each other. It operates at **Layer 1** (Physical Layer) of the OSI model and is often referred to as a **"network hub"**.

Switch:
A **switch** is a more advanced network device that connects devices within a local network and uses **MAC addresses** to forward data only to the intended recipient. It operates at **Layer 2** (Data Link Layer) of the OSI model.

45. VLAN (Virtual Local Area Network)

A **VLAN** (Virtual Local Area Network) is a logical grouping of devices within a physical network, allowing them to communicate as if they are on the same local network, regardless of their actual physical location. VLANs enable network administrators to segment networks into smaller, more manageable parts, improving security, performance, and organization.

46.