Computer Networks Interview Preparation Guide

OSI Model Layers

- **Physical (L1)**: Raw bit transmission; cables, signals, hardware

- **Data Link (L2)**: Node-to-node delivery; MAC addressing, error detection; Ethernet, PPP

- **Network (L3)**: Routing between networks; IP addressing, logical addressing; IP, ICMP

- **Transport (L4)**: End-to-end communication; port addressing, segmentation; TCP, UDP

- **Session (L5)**: Session establishment, maintenance, and termination; NetBIOS, RPC

- **Presentation (L6)**: Data translation; encryption, compression; SSL/TLS, JPEG

- **Application (L7)**: User interface and services; HTTP, SMTP, FTP, DNS

TCP/IP Model

- **Link Layer**: Physical and data link functionality; Ethernet, ARP

- **Internet Layer**: Routing packets across networks; IP, ICMP

- **Transport Layer**: End-to-end communication; TCP, UDP

- **Application Layer**: User-facing services; HTTP, DNS, SMTP

IP Addressing

- **IPv4**: 32-bit address (4 bytes); written as 4 decimal numbers (0-255)

- **Classful Addressing**:
  - Class A: 0.0.0.0 to 127.255.255.255 (Large networks)

  - Class B: 128.0.0.0 to 191.255.255.255 (Medium networks)

  - Class C: 192.0.0.0 to 223.255.255.255 (Small networks)

- **Subnetting**: Dividing network into smaller logical networks

- **CIDR**: Classless Inter-Domain Routing; notation like 192.168.1.0/24

- **IPv6**: 128-bit address (16 bytes); written in hexadecimal with colons

TCP vs UDP

- **TCP (Transmission Control Protocol)**:
  - Connection-oriented, reliable

  - Flow control and congestion control

  - Ordered, error-checked delivery

  - Uses: Web (HTTP), Email (SMTP), File Transfer (FTP)

- **UDP (User Datagram Protocol)**:

- Connectionless, unreliable

- No flow control or congestion control

- Faster transmission with less overhead

- Uses: DNS, Streaming media, VoIP, Online gaming

Networking Devices

- **Hub**: L1 device; broadcasts to all ports (obsolete)

- **Switch**: L2 device; forwards based on MAC address

- **Router**: L3 device; forwards based on IP address

- **Gateway**: Connects networks with different protocols

- **Firewall**: Filters traffic based on security rules

- **Load Balancer**: Distributes traffic across servers

Routing Protocols

- **Distance Vector**:
  - RIP: Hop count metric, max 15 hops

  - EIGRP: Cisco proprietary, composite metric

- **Link State**:
  - OSPF: Dijkstra's algorithm, area-based hierarchy

  - IS-IS: Similar to OSPF, used in ISP networks

- **Path Vector**:
  - BGP: Used for internet backbone routing

DNS (Domain Name System)

- **Function**: Translates domain names to IP addresses

- **Hierarchy**: Root → TLD → Domain → Subdomain

- **Record Types**:
  - A: Maps domain to IPv4

  - AAAA: Maps domain to IPv6

  - CNAME: Alias for another domain

  - MX: Mail exchange server

  - NS: Name server for zone

HTTP/HTTPS

- **HTTP**: Hypertext Transfer Protocol; stateless, text-based

- **Methods**: GET, POST, PUT, DELETE, HEAD, OPTIONS
- **Status Codes**:
  - 1xx: Informational
  - 2xx: Success (200 OK)
  - 3xx: Redirection (301 Moved, 304 Not Modified)
  - 4xx: Client Error (404 Not Found, 403 Forbidden)
  - 5xx: Server Error (500 Internal Server Error)
- **HTTPS**: HTTP with TLS/SSL encryption
- **HTTP/2**: Binary protocol with multiplexing, header compression
- **HTTP/3**: Uses QUIC protocol over UDP instead of TCP

Wireless Networks

- **Wi-Fi Standards**:
  - 802.11a/b/g/n/ac/ax (Wi-Fi 6)
  - Frequencies: 2.4 GHz vs 5 GHz
- **Security**:
  - WEP: Weak encryption (obsolete)
  - WPA2/WPA3: Strong encryption
  - Authentication: Pre-shared key vs Enterprise (802.1X)

Network Security

- **Encryption**: Symmetric vs Asymmetric
- **Security Protocols**: SSL/TLS, IPsec, SSH
- **Attacks**:
  - DoS/DDoS: Overwhelming server with traffic
  - Man-in-the-Middle: Intercepting communications
  - Packet Sniffing: Capturing and analyzing packets
  - IP Spoofing: Falsifying source IP address
- **Security Mechanisms**:
  - Firewalls: Filter traffic based on rules
  - IDS/IPS: Detect and prevent intrusions
  - VPN: Secure tunnel for remote access

Common Interview Questions

OSI Model

1. **Explain OSI model layers and functions?** Seven layers from Physical to Application, each with specific functions.

2. **Why layered architecture?** Simplifies design, standardizes interfaces, allows independent layer development.

3. **TCP/IP vs OSI model?** TCP/IP has 4 layers, more practical; OSI has 7 layers, more theoretical.

IP Addressing

1. **What is subnetting?** Dividing larger network into smaller networks to improve efficiency.

2. **Explain CIDR notation?** /24 means first 24 bits are network portion, remaining are host portion.

3. **Public vs Private IP?** Private (10.x.x.x, 172.16-31.x.x, 192.168.x.x) not routable on Internet.

TCP/UDP

1. **TCP handshake process?** SYN → SYN-ACK → ACK (3-way handshake).

2. **TCP congestion control?** Slow start, congestion avoidance, fast retransmit, fast recovery.

3. **When to use UDP over TCP?** When speed matters more than reliability (streaming, gaming).

Routing

1. **Static vs Dynamic routing?** Static: manually configured; Dynamic: automatically learns routes.

2. **How does OSPF work?** Link-state protocol using Dijkstra's algorithm to find shortest path.

3. **What is route redistribution?** Sharing routes between different routing protocols.

Security

1. **How does SSL/TLS work?** Handshake to establish secure connection, then symmetric encryption for data.

2. **What is a DDoS attack?** Distributed Denial of Service; multiple sources flood target.

3. **VPN technologies?** Site-to-site vs Remote access; IPsec vs SSL VPNs.

Advanced Topics

SDN (Software Defined Networking)

- Separates control plane (decision making) from data plane (forwarding)
- Centralized controller programs network devices
- Benefits: Programmability, automation, visibility

Network Virtualization

- **VLAN**: Logical segmentation of physical network

- **VxLAN**: Overlay network for cloud environments

- **NFV**: Network functions as software instead of dedicated hardware

Protocols for IoT

- **MQTT**: Lightweight publish/subscribe messaging

- **CoAP**: RESTful protocol for constrained devices

- **LoRaWAN**: Long range, low power wireless protocol

Cloud Networking

- **VPC**: Virtual Private Cloud; isolated network in cloud

- **Load Balancing**: Distributing traffic across instances

- **Content Delivery Network (CDN)**: Distributed servers for content

Performance Optimization

- **QoS (Quality of Service)**: Prioritizing critical traffic

- **Traffic Shaping**: Controlling bandwidth allocation

- **Caching**: Storing frequently accessed content locally

- **Protocol Optimization**: Tuning TCP parameters, using HTTP/2

- **Network Monitoring**: Tools like Wireshark, tcpdump, Netflow