

Networking Concepts and Protocols

OSI model

From lowest to highest:

1. Physical — bits, signals, cables.
2. Data Link — frames, MAC addressing, switches.
3. Network — packets, IP addressing, routing.
4. Transport — ports, TCP/UDP, end-to-end delivery.
5. Session — session control.
6. Presentation — encryption, compression, translation.
7. Application — user-facing network services.

Mnemonic from low to high: Please Do Not Throw Sausage Pizza Away.

For fast MCQs: routing = Network layer; MAC = Data Link; port number = Transport; HTTP/DNS = Application.

TCP versus UDP

TCP	UDP
connection-oriented	connectionless
reliable, ordered byte stream	no delivery/order guarantee
acknowledgements, retransmission, flow/congestion control	lower overhead and latency
web pages, file transfer, mail	streaming, gaming, DNS commonly

TCP three-way handshake: SYN → SYN-ACK → ACK.

IP addressing and subnetting

IPv4 has 32 bits. CIDR slash length gives network bits; host bits = 32 – slash length.

Prefix	Host bits	Total addresses	Traditional usable hosts
/24	8	256	254
/25	7	128	126
/26	6	64	62
/27	5	32	30

Prefix	Host bits	Total addresses	Traditional usable hosts
/28	4	16	14
/29	3	8	6

Traditional usable hosts = $2^{\text{hostbits}} - 2$, excluding network and broadcast. Treat special /31 and /32 rules as exceptions unless specifically asked.

Example: mask 255.255.255.224 = /27. It leaves 5 host bits, so 30 traditional usable hosts/subnet.

Common protocols and ports

Service	Purpose	Default port
HTTP	web	80
HTTPS	secure web	443
DNS	name to IP lookup	53
DHCP	IP configuration	UDP 67/68
SSH	secure remote shell	22
FTP	file transfer control	21
SMTP	sending email	25
POP3	retrieving email	110
IMAP	synchronised email access	143
Telnet	insecure remote terminal	23

Essential services

- DNS translates domain names to IP addresses.
- DHCP dynamically provides IP configuration: address, mask, gateway, DNS.
- ARP maps an IPv4 address to a MAC address on a local network.
- NAT translates private internal addresses to public addresses.
- Router forwards between networks; switch forwards frames within a LAN.

HTTP status codes

Code	Meaning
200	success
201	resource created

Code	Meaning
301/302	redirect
400	bad request
401	unauthenticated/credentials required
403	authenticated but forbidden
404	resource not found
500	server error

Security basics

- Encryption protects confidentiality.
- Hashing provides one-way integrity/checking; hashes are not encryption.
- TLS protects HTTP traffic as HTTPS.
- Firewall filters traffic based on rules.
- VPN creates an encrypted tunnel over an untrusted network.

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