Unit 1

1. What is a computer network?

    o A graph consisting of end-systems connected by communication links and packet switches.

2. What is the internet?

    o A global network interconnecting billions of computing devices.

3. Who invented the World Wide Web?

    o Tim Berners-Lee.

4. What is an ISP?

    o Internet Service Provider, which provides internet access to end-users.

5. Define PoP.

    o Point-of-Presence, where end systems connect to an ISP.

6. What does TCP/IP stand for?

    o Transmission Control Protocol/Internet Protocol.

7. What is DARPA's role in internet history?

    o It funded the development of ARPANET, the precursor to the internet.

8. What is packet switching?

    o Data is broken into packets, transmitted, and reassembled at the destination.

9. What is a MAC address?

    o A unique hardware address used for network communication at the link layer.

10. Which layer of the OSI model does IP operate on?

- Network Layer.

11. What is circuit switching?

- A dedicated communication path is established between two hosts before data transmission.

12. Explain time-division multiplexing (TDM).

- Time slots are allocated for different transmissions on the same communication link.

13. What is queuing delay?

- The time a packet waits in a queue before being transmitted.

14. Numerical: How long does it take to send a file of 640,000 bits over a 1.536 Mbps link with TDM using 24 slots per second?

- Solution: Slot time = 1/24 sec; Transmission delay = file size / link rate.

15. What is the role of a router in a network core?

- To forward packets from one link to the appropriate outgoing link.

16. Explain packet loss in a network.

- It occurs when packets are dropped due to congestion or errors.

17. What is propagation delay?

- The time it takes for a signal to travel from the sender to the receiver.

18. How is reliability ensured in packet-switched networks?

- Through protocols like TCP that handle retransmission of lost packets.

19. What is the main advantage of packet switching over circuit switching?

- Better utilization of network resources.

20. Numerical: How long does it take to send 800 Mb over a 10 Mbps link with a 0.5-second propagation delay?

- Solution: Total time = transmission time + propagation delay.

21. What is a subnet mask?

- A 32-bit mask used to divide an IP address into network and host portions.

22. What is DNS?

- Domain Name System, which translates domain names to IP addresses.

23. Explain the concept of multiplexing in networking.

- Combining multiple signals into one signal over a shared medium.

24. What does RFC stand for?

- Request for Comments, a type of publication from the Internet Engineering Task Force (IETF).

25. What is MPLS?

- Multiprotocol Label Switching, a method for speeding up and shaping network traffic flows.

26. What is meant by a Tier 1 ISP?

- An ISP that can reach every other network on the internet without purchasing transit.

27. What is the role of IANA?

- Internet Assigned Numbers Authority manages IP address allocation.

28. Numerical: Calculate the bandwidth-delay product for a 10 Mbps link with a 150 ms propagation delay.

- Solution: Bandwidth-delay product = link rate × propagation delay.

29. What is the difference between IPv4 and IPv6?

- IPv4 uses 32-bit addresses, while IPv6 uses 128-bit addresses.

30. What is peering in networking?

- A voluntary interconnection of administratively separate networks for traffic exchange.

31. Define a distributed application.

- An application that runs on multiple hosts, communicating via a network.

32. What are the two types of switching in network cores?

- Circuit switching and packet switching.

33. Explain encapsulation in networking.

- Wrapping data with protocol information before transmission.

34. What is a socket in networking?

- An endpoint for sending and receiving data between two devices.

35. What is the primary function of the transport layer?

- To ensure reliable data transfer between hosts.

36. Numerical: Consider a 10 Mbps link with an RTT of 100 ms. How much time would it take to send 1 MB of data?

- Solution: Time = size of data / link rate + RTT.

37. What is TCP three-way handshake?

- SYN, SYN-ACK, ACK.

38. What is the role of DNS servers in resolving IP addresses?

- To map domain names to their respective IP addresses.

39. What is the purpose of HTTP?

- To define how messages are formatted and transmitted on the web.

40. Explain persistent HTTP.

- A single TCP connection is used to transfer multiple files.

41. Numerical: Calculate the total delay when fetching a webpage containing two embedded objects over a link with 100 ms RTT and 10 Mbps rate.

- Solution: Delay = RTT + data transmission time.

42. What does "stateless protocol" mean in the context of HTTP?

- Each request is treated independently without knowledge of previous requests.

43. Define a proxy server.

- An intermediary server that forwards requests and responses between clients and servers.

44. What is a persistent connection in HTTP/1.1?

- A connection that remains open to serve multiple requests, reducing latency.

45. Numerical: Suppose a web page consists of a base HTML file and 5 embedded images. What is the total access delay if each request involves 1 RTT?

- Solution: Delay = RTT + time to download each file.

46. What are the main differences between GET and POST methods in HTTP?

- GET requests data; POST submits data to be processed.

47. What is congestion control in TCP?

- Mechanisms to prevent network congestion by adjusting the rate of data transmission.

48. Explain the difference between client-server and peer-to-peer architecture.

- Client-server has a dedicated server responding to clients; peer-to-peer allows any host to act as both a client and server.

49. What is bandwidth-delay product, and why is it important?

- It represents the maximum amount of data that can be in transit; important for understanding network performance.

50. What is flow control in TCP?

- A mechanism to prevent the sender from overwhelming the receiver.

51. Numerical: Given a network with 10 Mbps bandwidth and a 50 ms propagation delay, how many bits can be in flight?

- Solution: Bandwidth-delay product = bandwidth × delay.

52. What does the status code 404 mean in HTTP?

- Not Found: The requested resource does not exist on the server.

53. What is a firewall?

- A security system that controls incoming and outgoing network traffic based on security rules.

54. What is SSL/TLS?

- Secure Sockets Layer / Transport Layer Security, protocols for encrypting data between clients and servers.

55. Explain time-to-live (TTL) in networking.

- A value in IP packets that limits the lifespan of a packet to prevent it from looping endlessly.

56. What is load balancing?

- Distributing network traffic across multiple servers to ensure no single server is overwhelmed.

57. What is the purpose of HTTP cookies?

- To store data on the client side to maintain session state.

58. Numerical: How much time will it take to transfer a 10 MB file over a 100 Mbps link?

- Solution: Time = file size / link rate.

59. What is packet fragmentation?

- Splitting a large packet into smaller packets to accommodate the MTU of a network.

60. What is a VPN?

- Virtual Private Network, a secure connection over a public network.

61. Numerical: Suppose there is a 10 Mbps link with a 100 ms propagation delay. Calculate the time to send a 1 MB file over this link.

- Solution: Transmission time + propagation delay.

62. What is the difference between lossless and lossy compression?

- Lossless compression allows exact reconstruction, while lossy sacrifices some quality for higher compression rates.

63. What is jitter in networking?

- The variation in packet arrival times.

64. What is the role of the link layer in networking?

- To provide node-to-node data transfer and detect errors in frames.

65. What does ICMP stand for?

- Internet Control Message Protocol.

66. Explain NAT in networking.

- Network Address Translation, mapping private IP addresses to a public IP address.

67. Numerical: Suppose a 640,000-bit file is to be transmitted over a 1.5 Mbps link. What is the transmission time?

- Solution: Transmission time = file size / link rate.

68. What is ARP?

- Address Resolution Protocol, used to map IP addresses to MAC addresses.

69. Define subnetting.

- Dividing a large network into smaller subnetworks.

70. What is a default gateway?

- A device that routes traffic from a local network to external networks.

71. Numerical: Calculate the queuing delay for 5 packets each 1,500 bytes long on a 10 Mbps link.

- Solution: Queuing delay = (packet size × number of packets) / link rate.

72. Explain DNS caching.

- Storing DNS query results locally to reduce lookup times for subsequent requests.

73. What is a digital certificate?

- A file used to verify the identity of an entity in secure communications.

74. What is multicast communication?

- Sending a single message to multiple recipients simultaneously.

75. What is QoS?

- Quality of Service, ensuring certain performance metrics in a network.

76. Numerical: How long does it take to transmit a 2 MB file over a 20 Mbps link?

- Solution: Time = file size / link rate.

77. What is a hop in networking?

- The traversal of a packet from one router or switch to the next.

78. What is the role of a data center in networking?

- To house servers that process, store, and distribute data.

79. What is the primary difference between FTP and HTTP?

- FTP is used for file transfers, while HTTP is used for web communication.

80. What is a DDoS attack?

- Distributed Denial of Service, where multiple systems flood a target with traffic.

81. Numerical: Suppose a 10 Mbps link with a 1-second RTT is used to transfer a 5 MB file. How long will it take?

- Solution: Total time = transmission time + RTT.

82. What is the difference between symmetric and asymmetric encryption?

- Symmetric uses the same key for encryption and decryption; asymmetric uses a public and private key.

83. Explain dynamic IP addressing.

- IP addresses are assigned automatically, typically via DHCP.

84. What is network latency?

- The delay between sending a request and receiving a response.

85. What is SSL handshake?

- A process that establishes a secure connection between a client and server.

86. Numerical: If a file transfer takes 5 seconds over a 100 Mbps link, what is the file size?

- Solution: File size = link rate × time.

87. What is a checksum in networking?

- A value calculated from a data set to detect errors during transmission.

88. Explain the concept of load balancing in network design.

- Distributing traffic across multiple servers to optimize resource use.

89. What is a VPN used for?

- Creating secure connections over a public network.

90. Numerical: Suppose a network has a bandwidth of 50 Mbps and a propagation delay of 200 ms. What is the bandwidth-delay product?

- Solution: Bandwidth-delay product = bandwidth × delay.

91. What is HTTP/2?

- An updated version of HTTP that supports multiplexing, message prioritization, and server pushing.

92. What does CDN stand for?

- Content Delivery Network.

93. What is the role of DHCP in a network?

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

94. Explain the difference between flow control and congestion control.

- Flow control prevents sender overload; congestion control prevents network congestion.

95. Numerical: If it takes 3 seconds to transmit a 9 MB file over a link, what is the link rate?

- Solution: Link rate = file size / time.

96. What is a ping command used for?

- To test the reachability of a host on a network.

97. What is a reverse proxy?

- A server that sits between a client and backend servers, forwarding client requests to the backend.

98. What is BGP in networking?

- Border Gateway Protocol, used to exchange routing information between different networks.

99. Explain the purpose of a DNS zone file.

- It contains mappings between domain names and IP addresses.

100. What is port forwarding?

- Redirecting a communication request from one address and port number to another.

Subjective questions:

Explain the process of DNS resolution with an example.

Compare and contrast circuit switching and packet switching.

What is the purpose of the transport layer in the OSI model?

Explain TCP's congestion control mechanism.

Discuss the differences between IPv4 and IPv6.

Explain the role of firewalls in network security.

How does the HTTP request-response cycle work?

Compare client-server and peer-to-peer architectures.

Explain how SSL/TLS provides secure communication.

Discuss the significance of the three-way handshake in TCP.

How does NAT work, and why is it used in modern networks?

Explain encapsulation and decapsulation in network communication.

Compare persistent and non-persistent HTTP connections.

Explain the function of the MAC address in the data link layer.

What are the differences between symmetric and asymmetric encryption?

How does TCP handle flow control?

Explain the purpose of a VPN and how it works.

Discuss the differences between HTTP/1.1 and HTTP/2.

What is bandwidth-delay product, and why is it important in networking?

Explain how load balancing improves network performance.

Numerical Questions:

Numerical: A 2 Mbps link is used to send a file of size 500,000 bits with a round-trip time (RTT) of 200 ms. Calculate the total transmission time, considering that the file is segmented into 10 packets and each packet needs to be acknowledged before the next is sent.

Numerical: Calculate the queuing delay for 8 packets of size 1,200 bytes each arriving simultaneously at a 5 Mbps link. Assume the link transmits one packet at a time.

Numerical: A web server needs to deliver a webpage of 200,000 bits and 3 embedded objects of 100,000 bits each. The RTT is 50 ms, and the link speed is 10 Mbps. Calculate the total access delay assuming a persistent HTTP connection.

Numerical: A user sends a 4 MB file over a 1 Gbps link with a propagation delay of 10 ms. Calculate the total time required to transmit the file, including the propagation delay.

Numerical: A video file of size 100 MB is transmitted over a 50 Mbps link with a 100 ms RTT. If the file is divided into 500 KB chunks and each chunk requires an acknowledgment before the next is sent, calculate the total transmission time.

Numerical: Calculate the effective throughput for a 5 Mbps link with a packet size of 1,500 bytes and a 25 ms RTT if the link uses a stop-and-wait protocol for each packet transmission.