
Answer any 12 Questions from 1 to 14 [12×2 Marks = 24 Marks] + 1 Mark

1. A user is streaming a high-definition video and simultaneously downloading a large pdf file. Explain why packet switching is more suitable than circuit switching for this scenario, considering resource utilization.
2. A company wants to build a network that connects two offices in different cities. They are considering using a layered architecture for their network design. Justify this choice by explaining two key advantages of a layered approach.
3. A user experiences significant latency when playing an online game, but their internet connection has high bandwidth. Explain the difference between latency and bandwidth, and why high bandwidth does not necessarily guarantee low latency.
4. Explain the concept of statistical multiplexing and why it is a fundamental principle of the internet compared to TDM and others.
5. A user is accessing a website hosted on a server in another country. Trace the journey of a request from the user's browser to the web server, naming at least three different types of networks the request is likely to traverse.
6. Explain the difference between a protocol and an interface in the context of network architecture. Provide an example of each.
7. Explain why the two-dimensional parity scheme is capable of detecting any error pattern that flips exactly three bits. Provide an illustration of a four-bit error case that goes unnoticed by this method.
8. A company is designing a new application that requires real-time video streaming. They are considering using either the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP) at the transport layer. Which protocol would you recommend and why? Justify why other one is not suitable.

9. Two modified versions of the Stop-and-Wait protocol are being considered. Assume there are no packet losses and no delayed acknowledgements in the network.

- Protocol A uses a timeout and NACK mechanism. The receiver sends a NACK only when an error occurs; if the frame is correct, no feedback is given. (No ACKs are used.)
- Protocol B uses a timeout and ACK mechanism. The receiver sends an ACK for every correctly received frame. (No NACKs are used.)

- (a) Between Protocol A and Protocol B, which one achieves higher channel utilization? Justify your answer.
- (b) For reliable communication, is it necessary to employ sequence numbers in Protocol A and Protocol B? Explain why or why not.

10. A router has a single outgoing network link with a maximum capacity of 1 Gbps (Gigabits per second). The router serves an office with 600 employees. During peak business hours, each employee's computer sends an average of 2 Mbps (Megabits per second) of traffic that must pass through this link.

- (a) Calculate the total traffic arriving at the router's outgoing link in Mbps.
- (b) Based on your calculation, determine the link's utilization as a percentage. What is the impact on the network operation?

11. A network administrator is trying to improve the performance of a network link used for transferring large backup files. They run a test and find the link has a throughput of 1 Gbps and a round-trip time (RTT) of 100 ms. Explain that simply increasing the link's throughput to 10 Gbps, will significantly speed up the transfer of a single large file if the protocol's window size is too small i.e., 100 Bytes. (Assume that you are not using the sliding window protocol and still working stop and wait protocol).

12. A network designer must choose an encoding scheme for a link where the receiver's clock might drift. Why would Manchester encoding be a safer choice than Non-Return to Zero (NRZ) in this scenario, and what is the main disadvantage of choosing Manchester?

13. How do you generate frames using a 4b/5b encoding scheme? Consider the frame byte sequence is SYN, SOH (start of Header), Header, STX (Start of Text), Payload/Body, ETX (End of Text). Consider SYN, SOH, STX and ETX are each sentinel character is one byte. How do you encode and how do you ensure that sentinel characters will not appear in the body. Assume if mistakenly Sentinel Characters appear how the receiver reacts?

14. In the Sliding Window protocol, the range of sequence numbers must be larger than the Sender window size. Using an example, explain the ambiguity that would occur if the sequence number range was exactly equal to the sender window size.

15. Explain how the Stop-and-Wait protocol becomes extremely inefficient on a network link with a high bandwidth-delay product (BDP), such as a satellite link. (1 Mark)

***** ALL THE BEST!! *****