Bachelor of Information Technology 2nd Year 2nd Semester Examination 2025

Sub: Computer Networks

Full Marks: 100 Time: 3 hours

Answer all questions. Answers must be brief and to the points.

1. (4 + 4 + 4 + 2 + 2)

i. Describe what procedure might be involved inside the network in making a telephone connection. Now consider a personal communication service that provides a user with a personal telephone number. When the number is dialed the network establishes a connection to wherever the user is located at the given time. What functions must the network now perform to implement this service?

ii. Standard containers are developed for the transportation of goods. These standard containers could fit on a train car, on a truck or in specially designed container ship. The standard size of the containers makes it possible to load and unload them much more quickly than non-standard containers of different sizes. Draw an analogy to packet switching communication networks. In your answer identify what might constitute a container and speculate on the advantages that may come from standard size information container.

iii. Two musicians located in different cities want to have a jam session over a communication network. Find the maximum possible distance between the musicians if they are to interact in real time, in the sense of experiencing the same delay haring each other as if they were 10 meters apart. The speed of sound is approximately 330 meters/second and assume that the network transmits the sound at the speed of light in cable 2.3×10^8 meters/second.

iv. How does the network layer in a connection-oriented packet switching network differs from the network layer in a connectionless packet switching network?

v. Suppose the algorithms used to implement the operations at layer k is changed. How does this impact operations at layer k - 1 and k + 1?

2. (5 + 4 + 7)

i. ATM uses an 8-bit CRC on the information contained in the header. The header has six fields: GFC (4bits), VPI (8bits), VCI (16bits), Type (3bits), CLP (1bit), CRC (8 bits). The generator polynomial is $x^8 + x^2 + x + 1$. Find the CRC bits if the GFC, VPI, Type, and CLP fields are all zero and the VCI field is: 00000000 00001111. Assume the GFC bits are at the MSB position.

ii. Two computers are connected by an intercontinental link with a one-way propagation delay of 100 ms. The computers exchange 1 MB files that they need delivered in 250 ms or less. The transmission lines have a speed of R Mbps, and the bit error rate is 10^{-8}. Design a transmission system by selecting the bit rate R, the ARQ protocol, and the frame size.

iii. A bidirectional link uses selective repeat ARQ with a window size 4. Assume all frames are one unit long, use a time-out value of 2, the one-way propagation delay is 0.5 time unit, the processing times are negligible, and the ACK timer is one unit long. Assuming station A and B begin with their sequence numbers set to zero, show the pattern of transmissions and associated state transitions for the following sequences of events: a) Station A sends six frames in a row, starting at t=0. All frames are received correctly. b) Station A sends six frame in a row, starting at t=0. All frames are received correctly, except frame 3 is lost. c) Station A sends six frames in a row, starting at t=0. Station B sends six frames in a row starting at t=0.25. All frames are received correctly.

OR

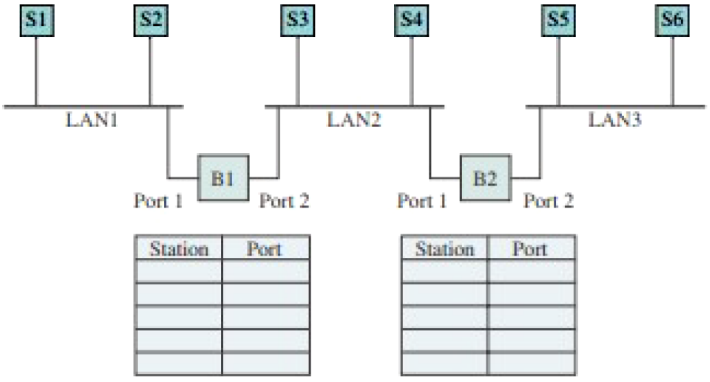
A 64 KB message is to be transmitted from the source to the destination as shown below. The network limits packets to a maximum size of 2 KB and each packet has a 32B header. The transmission lines in the network have a bit error rate of 10^{-6}, and Stop-and-Wait ARQ is used in each transmission line. How long does it take on the average to get the message from the source to the destination? Assume that the signal propagates at a speed of 2×10^5 km/second.

3. (3 + 3 + 4 + 6)

i. What is the length of a contention slot in CSMA/CD for a 2-km twin-lead cable (signal propagation speed is $0.82 \times 2.46 \times 10^8$ m/s) and a 40-km multimode fiber optic cable (signal propagation speed is $0.65 \times 1.95 \times 10^8$ m/s)?

ii. Provide a brief answer and explanation for each of the following questions: (a) under a light load, which LAN has a smaller delay: Ethernet or Token Ring? (b) Under a high load, which LAN has a smaller delay: Ethernet or Token Ring?

iii. Six stations (S1-S6) are connected to an extended LAN through transparent bridges (B1 and B2), as shown in the figure below. Initially, the forwarding tables are empty. Suppose the following stations transmit frames: S2 transmits to S1. S5 transmits to S4. S3 transmits to S5. S1 transmits to S2, and S6 transmits to S5. Fill in the forwarding tables with appropriate entries after the frames have been completely transmitted.



iv. M terminals are attached by a dedicated pair of lines to a hub in a star topology. The distance from each terminal to the hub is *d* meters, the speed of the transmission lines is *R* bits/sec, all packets are of length 12,500 bytes, and the signal propagates on the line at a speed of 2.5×10^8 m/s. For the four combinations of the following parameters (d = 25 meters or d = 2500 meters; R = 10 Mbps or R = 10 Gbps), compare the maximum network throughput achievable when the hub is implementing slotted ALOHA and CSMA/CD.

OR

A 1-km-long, 10-Mbps CSMA/CD LAN (not 802.3) has a propagation speed of 200 m/μsec. Repeaters are not allowed in this system. Data frames are 256 bits long, including 32 bits of header, checksum, and other overhead. The first bit slot after a successful transmission is reserved for the receiver to capture the channel in order to send a 32-bit acknowledgement frame. What is the effective data rate, excluding overhead, assuming that there are no collisions?

4. (4 + 4 + 2 + 3 + 3)

i. Suppose that an interactive video game is accessed over a communication network. What requirements are imposed on the network if the network is connection-oriented? Connectionless?

ii. Explain how the use of hierarchy enhances scalability in distance vector routing and link state routing algorithm.

iii. Describe two major differences between the ECN method and the RED method of congestion control.

iv. How the following policies at the data link layer affects congestion in the network?

Retransmission, Out-of-Order packet caching.

v. Suppose a network uses link state routing , Explain what happens if:

a. The router fails to claim a link that is attached to it.

b. The router claims to have a link that does not exist.

5. (4 + 4 + 2 + 4 + 6)

i. Suppose that network addresses are scarce and are assigned so that they are not globally unique, in particular, suppose that the same block of addresses may be assigned to multiple organizations. How can the organizations use these addresses? Can users from two such organizations communicate with each other?

ii. What are the pros and cons of en-route reassembly versus reassembly at the final destination?

iii. Can we have a single bit subnet? Explain.

iv. A router is blasting out IT packets whose total length is 1024 bytes. Assuming that packets live for 10 sec, what is the maximum line speed the router can operate at without danger of cycling through the IP datagram ID number space?

v. Suppose the population of the world is 6 billion people and that there is an average of 1000 communicating devices per person. How many bits are required to assign a unique host address to each communicating device? Suppose that each device attaches to a single network and that each network on average has 10000 devices, how many bits are required to provide unique network ids to each network. What is the size of the address?

OR

An ISP is granted a block of addresses starting with 190.100.0.0/16. The ISP needs to distribute these addresses to three groups as follows: The first group has requested 16300 addresses. The second group has requested 16400 addresses. The third group has requested 8192 addresses. Show what addresses are assigned to which group? How many addresses are left to the ISP?

6. (3 + 3 + 4 + 6)

i. Imagine that a two-way handshake rather than a three-way handshake were used to set up connections. In other words, the third message was not required. Are deadlocks now possible? Give an example or show that none exist.

ii. Lost TCP acknowledgements do not necessarily force retransmissions. Explain why?

iii. Suppose that the TCP congestion window is set to 18 KB and a timeout occurs. How big will the window be if the next four transmission bursts are all successful? Assume that the maximum segment size is 1 KB.

iv. Suppose that a TCP source (with unlimited amount of information to transmit) begins transmitting onto a link that has 1 Mbps in available bandwidth. Sketch congestion window versus time trajectory. Now suppose that another TCP source (also with unlimited amount of information to transmit) begins transmitting over the same link. Sketch the congestion window versus the time for the initial source.

OR

What problem does TCP Reno have with multiple packet losses from a window? Give an example to illustrate.