

Indian Statistical Institute
I year 2nd semester examination: 2019
Course Name: M. Tech in Computer Science
Subject Name: Computer Networks

Date: 22-04-2019

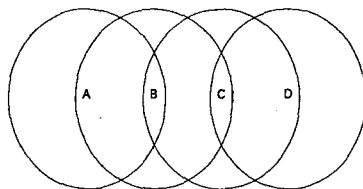
Maximum Marks: 110

Duration: 3 hours

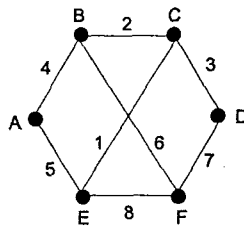
Instructions:

You may attempt all questions which carry a total of 110 marks. However, the maximum marks you can score is only 100.

1. (a) A channel has a data rate of 4 kbps and one way propagation delay of 20 ms. For what range of frame sizes does stop-and-wait give an efficiency of at least 50%? [5]
- (b) Suppose you want to transfer a file from Berkeley to Los Angeles. For this problem, assume the following:
 - The size of file is 116800 bytes. It will be transferred in 1500-byte data packets, of which 40 bytes are taken up with headers. The size of acknowledgement packets is 40 bytes including header. Every packet is acknowledged.
 - The communication is bidirectional and the bandwidth is 12 Mbps (megabits/sec) in each direction.
 - The propagation delay between Berkeley and Los Angeles is 12 ms in each direction.
 - Assume that time to process a packet is very small, so the receiver can send an acknowledgement as soon as it receives a data packet entirely.
 - Likewise, for sliding window the sender can send packets back-to-back (to the degree that the window size permits).
 - Assume no packet loss.
 - i. Using sliding window with Send Window Size = Receive Window Size = 8 packets, how long will it take to transfer the file? [5]
 - ii. If Send Window Size and Receive Window Size are set to the bandwidth-delay product, then how long does it take to transfer the file? [5]
2. (a) A large population of Aloha users manages to generate 50 requests/sec, including both new requests and retransmissions. Time is slotted in units of 40 msec. What is the chance of success on the first attempt? [5]
- (b) In a CDMA/CD network with a data rate of 10 Mbps, the minimum frame size is found to be 512 bits for the correct operation of the collision detection process. What should be the minimum frame size if we increase the data rate to 100 Mbps? [5]
- (c) How long does the station having largest ID has to wait in the worst case before it can start transmitting its data frame over a LAN that uses bitmap protocol. Assume that there are N stations in this multiaccess network and the network is heavily loaded (every station always has data to send). Also assume that each data frame is d bits long. [5]
- (d) Consider the following topology of wireless laptops A, B, C and D. The circles indicate the range of wireless transmissions for each node. For example, B is within range of A, A & C are within range of B, B & D are within range of C and only C is within range of D.



- i. Using the above figure, explain hidden terminal problems. [4]
 - ii. Assume that each node uses an RTS/CTS based MAC protocol. Explain how RTS/CTS can help solve hidden terminal problem. [4]
3. (a) Consider the subnet shown below where communication delays are shown as labels on the bidirectional links. Distance vector routing is used, and the following vectors have just come into router *C*: from *B*: (5, 0, 8, 12, 6, 2); from *D*: (16, 12, 6, 0, 9, 10); and from *E*: (7, 6, 3, 9, 0, 4). The measured delays to *B*, *D*, and *E*, are 6, 3, and 5, respectively. What is *C*'s new routing table? Mention both the outgoing link to be used and expected delay. [10]



- (b) A leaky bucket is at the host network interface. The data rate on the network is 2MByte/s and the data rate on the link from the host to the bucket is 2.5Mbyte/s. Suppose the host has 250 Mbytes to send onto the network and it sends the data in a burst. What should be the minimum capacity of the bucket (in bytes) in order that no data is lost? [5]
 - (c) A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled with a rate 1 Mbps. The bucket is initially filled to capacity with 1 Mb. How long can the computer transmit at the full 6 Mbps? [5]
 - (d) What is the purpose of DF, MF and Fragment Offset field in the IPv4 header. [3]
4. (a) Do the IP addresses 128.114.48.62 and 169.232.56.135 belong to the same class of IP address? [4]
- (b) A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle? [4]
- (c) Indicate whether each of the following subnet masks is valid or invalid? For each invalid one, briefly indicate why it is invalid. [4]
- i. 255.255.255.252
 - ii. 255.255.255.112
- (d) Indicate whether each of the following IP addresses is a valid host address? For each invalid one, briefly indicate why it is invalid. [4]
- i. 197.15.136.64/26
 - ii. 110.212.80.127/27

- (e) A large number of consecutive IP address are available starting at 198.16.0.0. Suppose that four organizations, A, B, C and D request 4000, 2000, 4000, and 8000 address, respectively, and in that order. Suppose also that each organization is assigned the lowest address values possible at the time of its request. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation. [10]
5. (a) What is NAT box and how does it work? [7]
- (b) Suppose we have a 10-gigabit/second network with a roundtrip time of 100 milliseconds. The Maximum Segment Size (MSS) is 1500 bytes.
- i. How long will it take for a TCP connection to reach maximum speed after starting in slow-start mode? [4]
 - ii. Assume that current window size is 1 MSS. Now consider a scenario where first segment was successfully sent and acknowledged but the second segment was lost. What will be the window size after time out on the acknowledgement of the second segment? After this scenario, how long will it take the TCP connection to achieve maximum speed, assuming no further packet loss? [4]
- (c) Describe the method by which the appropriate value of retransmission timeout is determined in TCP. [8]