Indian Statistical Institute

LAB TESTS

Course: M. Tech. in Computer Science

Subject: Computer Networks

Date: May 13, 2025, Duration: 1 hour

Instructions: Attempt any one of the following two questions, each of which carries 20 marks.

1. (a) Write a client program that takes an integer from the user and sends it to a server using Socket APIs. The client awaits for a reply from the server, and then prints that reply value. The client then takes another integer from the user and repeats this process. If the input value is 0, the client closes the connection.

   (b) Write a corresponding server program that can receive a number from a client and sends another as a reply. The server maintains a running counter for the number of ODD integers seen so far. The server checks whether the received number is ODD or not and updates the counter value accordingly. The server sends the counter value as a reply. If the received value is 0, the server closes the connection.

2. Suppose we need to find maximum of n numbers stored in an array A, using the Remote Procedure Call APIs. Therefore, we need to send the array A of size n to the remote procedure and get back the maximum element of A.

   (a) Write the specification file (.x file) for this purpose.

   (b) Use rpcgen to generate the required files. [Modify the generated makefile if required.]

   (c) Modify the generated client and server programs so that the client first takes the size n of the array A, followed by the elements of the array from the user. Then the client invokes the remote procedure with this array A and n. The remote procedure finds the maximum element of the array and returns the value. The client should also display the resultant maximum value.

Indian Statistical Institute
Semester Examination: 2025
Course Name: M. Tech in Computer Science
Subject Name: Computer Networks

Date: 29-04-2025 Maximum Marks: 100 Duration: 3 hours
Instructions: You **may** attempt **all** the questions which carry a total of **110** marks. However, the maximum marks you can score is only **100**.

1. (a) A bitstuffing based framming uses 01111110 as the flag. If the output bitstring after stuffing is 100111110010. Find the input bitstring. Find two input bitstrings of length 12 each, so that the corresponding output bitstrings produce maximum and minimum stuffed bits. [2+2+2=6]

   (b) Consider a 45 kbps network link connecting the earth to the moon. The two way propagation delay between the earth and the moon is 2.8 seconds.

   i. Suppose 9000 bits packets are sent over this link using a stop-and-wait protocol. What data transfer rate can be achieved? What is the utilization of the link?

   ii. If a sliding-window protocol is used instead, what is the smallest window size that achieves the maximum data rate? If a window size of 20 packets is used, what data rate will be achieved? Assume that no errors have occurred. [(3+2)+(3+2)=10]

   (c) Suppose a 40 Mbps line is used for 40 simultaneous sessions. Each session generates Poisson traffic with 25 packets/second. Packet lengths are exponentially distributed with a mean of 8000 bits. Which of the two options below has a lower average network delay?

   i. Each of the 40 sessions is given a dedicated 1 Mbps channel.

   ii. All 40 sessions compete for a single 40 Mbps shared channel. [6]

   (d) Two users A and B use a shared link of bandwidth 1 Mbps to connect to the Internet. Consider the following two strategies for accessing the shared link:

   - *FDMA*: Each user gets an equal share of 1 Mbps.
   - *Taking turns*: Each user needs to add an overhead of 0.05 Mbps before taking the turn. After getting the turn, the user can make use of as much bandwidth as necessary out of the available 1 Mbps.

   In each of the following two cases, which strategy would you pick and why?

   i. Both A and B send a 0.48-Megabit file every 1 second.

   ii. A sends 0.70-Megabit files, while B sends 0.10-megabit files, every 1 second. [4+4=8]

2. (a) A 10-node network runs the CSMA MAC protocol. The maximum data rate of the network is 10 Megabits/s. Including retries, each node sends traffic at an average rate of 1 Megabit/s per node. Suppose the network's utilization is 0.75. What percentage of packets, sent by the nodes (including retries), do experience a collision? Assume that no packets get dropped in the network except due to collisions. [5]

   (b) In a slotted ALOHA system, suppose there are 4 nodes, in which each node transmits a frame with probability p. What is the probability that in a given time slot, one of the 4 nodes successfully transmits a frame? Find p that maximizes such probability. [2+3=5]

   (c) Consider a CDMA/CD network that transmits data at a rate of 10^8 bps over a 1 km cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (meter/second) in the cable? [5]

   (d) Under what condition bit-map performs better than contension based protocols and why? [5]

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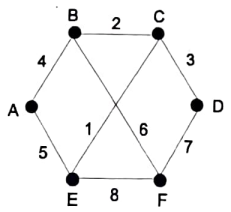
3. (a) What problems will occur if the CSMA/CD protocol is used in wireless LANs? How does CSMA/CA address the problems? [4+4=8]

(b) Suppose a packet of 10,000 bits is sent from A to B over a network. There is a router R between A and B which has sufficient buffer space. The network is lightly loaded so that there are no queuing delays. Propagation delay is also negligible.

i. Suppose the network is a store and forward packet-switched network. Both the links $A \rightarrow R$ and $R \rightarrow B$ have a transmission rate of 10 kbps. How long does it take to send the packet from A to B?

ii. Suppose the network is a circuit-switched network, whose circuit setup time is 1 second. Let the transmission rate of the circuit between A and B be X kbps. For which values of X will the circuit-switched network require less, equal, or more time than the packet-switched network for transmitting the packet from A to B? [4+3=7]

(c) 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 2, 3, and 1, respectively. What is C's new routing table? Mention both the outgoing link to be used and expected delay. [7]



(d) A token bucket has a token generation rate $R = 10$ Kbytes/s, an infinite maximum output rate M, a bucket size $B = 50$ KBytes, and that the bucket is full initially. Assume that a sender emits 15 KBytes every 0.5 seconds in a periodic manner, starting at $t = 0.5$ seconds.

i. How many tokens are left in the bucket after 1.5 seconds?

ii. How long will it take until packets start to be queued?

iii. What would the maximum burst size (KBytes) be if the token bucket were modified to impose a maximum output rate M of 20 KBytes/s? [3+2+3=8]

4. (a) A server has an IP address 160.36.30.110 and network mask 255.255.254.0. Find the broadcast address, network ID, and the number of hosts that can be supported. [2+2+2=6]

(b) A large number of consecutive IP addresses are available starting at 54.128.128.0. Suppose that three organizations, A, B, and C request 1000, 3000, and 500, addresses, respectively, and in that order. 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. [3+3+3=9]

(c) A customer is using a Class C network of 192.168.10.0 subnetted with a 28-bit subnet mask. How many subnets can be created by using this subnet mask? Remember that a class C network has a natural mask of 24 bits. [3]

(d) Let the size of the congestion window of a TCP connection be 32 KBytes when a timeout occurs. The maximum segment size is 2 KBytes. What is the congestion window after it sends out 11 packets and receives acks for all of them? [5]

(e) Describe the method used to calculate the proper TCP retransmission timeout value. [7]