EE122 Midterm 1 Exam
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Question 1 (15 pt)
Layering is a key design principle in computer networks. Name **two** advantages, and **one** disadvantage to layering. Explain. Use no more than three sentences to describe each advantage or disadvantage.

Question 2 (20 pt)
Let l = 1000 bit be the minimum size of an Ethernet packet. Let c=2*10^8 m/sec be the speed of light in the Ethernet cable. The Ethernet has a bandwidth of 10 Mbps. What is the maximum distance d between two end-hosts on an Ethernet cable? Justify your answer.

Question 3 (20 pt)
(a) Explain the TCP slow-start. What is its goal and how does it work? (8pt)

(b) Assuming that the available link capacity and the receiver window are infinite how many round-trip times does it take in TCP to send the first 10 packets? In general, how many round-trip times does it take to send the first k packets? (12pt)

Question 4 (15 pt)
The sliding window algorithm is used in TCP for error control and flow control. Due to the finite space of sequence numbers, even with infinite link speed and host processing power, the maximum throughput between two hosts is still limited. What is the maximum throughput between two TCP hosts with a round-trip time of 10ms?

(Note: Recall that the TCP sequence numbers are 32-bit long.)

Question 5 (20 pt)
Consider a sliding window flow control protocol between hosts A and B. Suppose the link propagation delay is 1 time unit, the retransmission timeout is 3 time units, and the window size is 3. Assume the link drops every third data packet, i.e., the link drops the 1st, 4th, 7th, ... data packets. (Note that here "kth packet" means the kth packet transmitted on the link, and **not** the sequence number of the packet.) How long does it take to transmit 6 packets between A and B?

(Note: Ignore the transmission times and the queueing delay, and assume that no acknowledgements are lost.)

Question 6 (20 pt)
Token ring is an alternative to Ethernet to arbitrate the access to a shared medium. With token ring, a special packet (called "token") is circulated in the clock-wise direction around a ring to which N hosts are connected. When it receives the token, a node can send one packet, if it has any packets to send. After it sends a packet, the node passes the token to the next node on the circle. If it doesn't have any packets to send, the node passes the token immediately to the next node.

Consider the following scenario based on the figure below. Initially, A has the token and has a packet to send. Thus, A sends its packet and then passes the token to B. Suppose B has several packets to send when it receives the token. B sends only one of its packets and then passes the token to C. Suppose C does not have any packet to send, when it receives the token. As a result, C passes the token immediately to D. If D has at least a packet to send when it receives the token, D sends one packet and passes the token to A. This process repeats indefinitely.

Suppose the propagation delay along the ring is d, and that the time to process the token is negligible. Thus, when no node has packets to send, it takes the token time d to make a complete round. Let n be the number of hosts connected to the ring that have packets to send, let C be the link capacity, and let l be the packet size (assume all packets have the same size). What is the utilization of the token ring?

(Note: Define the utilization as the ratio between the maximum total number of bits that were sent by all hosts during one round and the total number of bits that can be carried by the ring during one round, i.e., C*TRound, where TRound is the time it takes the token to complete a round).