National University of Computer and Emerging Sciences, Karachi
FAST School of Computing
Midterm II Examination, Fall 2021
29th Nov 2021, 11:00 am to 12:00 noon

Course Code: CS3001	Course Name: Computer Networks
Instructor Names: Dr. Aqsa Aslam, and Mr. Shoaib Raza	
Student Roll No: 19K-1037	Section No: SE-A

Instructions:-

- Return the question paper.
- All questions must be answered in the answer script and according to the sequence given in the question paper. There are 5 questions on 2 pages. Each question carries 10 points.
- In case of any ambiguity, you may make an assumption, however, your assumption should not contradict any statement in the question paper.

Time: 60 minutes

Max Points: 50 points

Question 1: Imagine that a sender uses Reliable Data Transfer (RDT) 3.0 with stop-and-wait. This sender sends packets of length 10 KB over a link of 1 Mbps. The average round trip time RTT is equal to 250ms.

a) Calculate the channel utilization and then explain the result.
b) How can the channel utilization may be increased?

Question 2: Consider the sender and receiver operating over a channel that can corrupt packets, in which ACK or NAK packets could be corrupted. Design a protocol between the sender and receiver sides of the protocol that handles corrupted ACKs or NAKs. Specify your protocol using finite state machines for the sender side only.

Question 3: Consider the scenario in figure 1, in which three hosts, with private IP addresses 10.0.0.1, 10.0.0.2, and 10.0.0.3 are in a local network behind a NATed router that sits between these three hosts and the larger Internet. The IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. Suppose that the host with IP address 10.0.0.1 sends an IP datagram destined to host 138.76.29.7. The source port is 3345, and the destination port is 80.

a) Consider the datagram at step 1 in the figure 1, after it has been sent by the host but before it has reached the router. What is the source and destination IP address for this datagram?
b) At step 2, after the datagram, has been transmitted by the router. What are the source and destination IP addresses for this datagram?
c) Now consider the datagram at step 3, just before it is received by the router. What are the source and destination IP addresses for this datagram?
d) At step 4, after the datagram, has been transmitted by the router but before it has been received by the host. What are the source and destination IP addresses for this datagram?

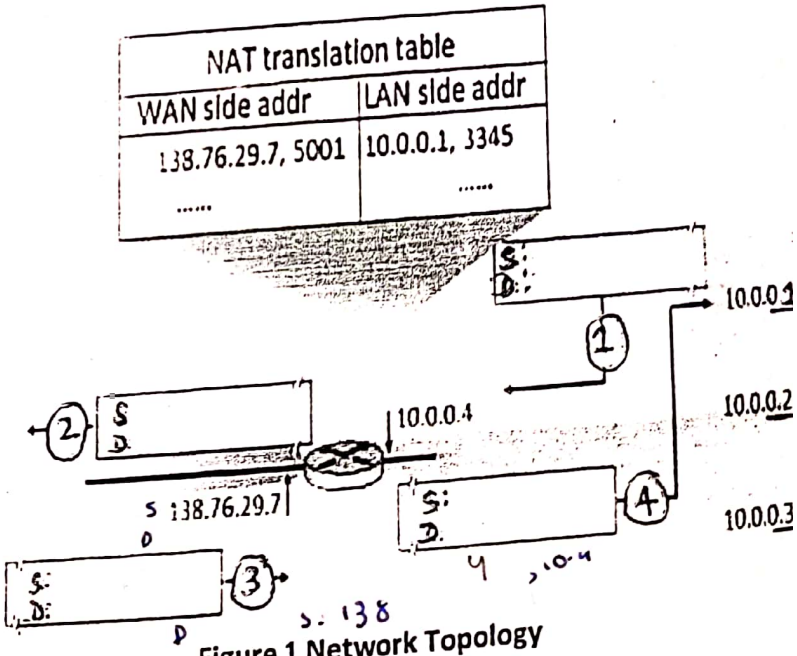

Figure 1 Network Topology

Question 4: Assign a class C IP address 220.23.16.0/24 to all interfaces of subnets in the network shown in figure . Assume a maximum host count of 30 or less, which are connected to switches S1, S2, S3 and router interfaces 1, R2, and R3 respectively. Note: Points will only be awarded on showing detail working related to subnet alculations including network and broadcast address.

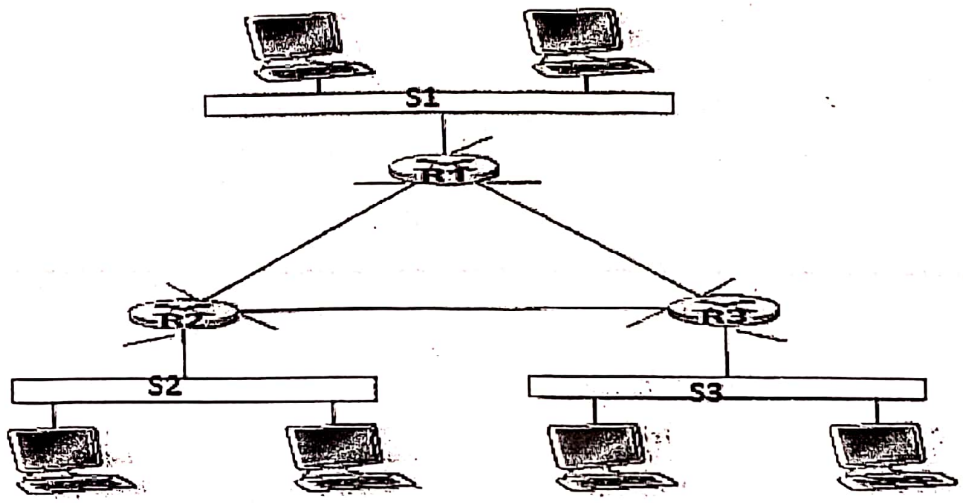

Figure 2 Network Topology

Question 5: The Transmission Control Protocol uses a method called congestion control to regulate the traffic entering the network. The behavior of TCP congestion control can be represented as a graph in which the x-axis indicates the time, and the y-axis indicates congestion window size. Please use the graph shown below to answer the following questions. Note that the graph does not explicitly show timeouts, but you should be able to figure out when timeouts happened based on the events shown.

a) **Slow Start:** identify the intervals of time when TCP slow start is operating.
b) **Congestion Avoidance:** identify the intervals of time when TCP congestion avoidance is operating.
c) **Fast Retransmission:** identify the intervals of time when TCP fast retransmission is used.
d) **Fast Recovery:** identify the intervals of time when TCP fast recovery is operating.

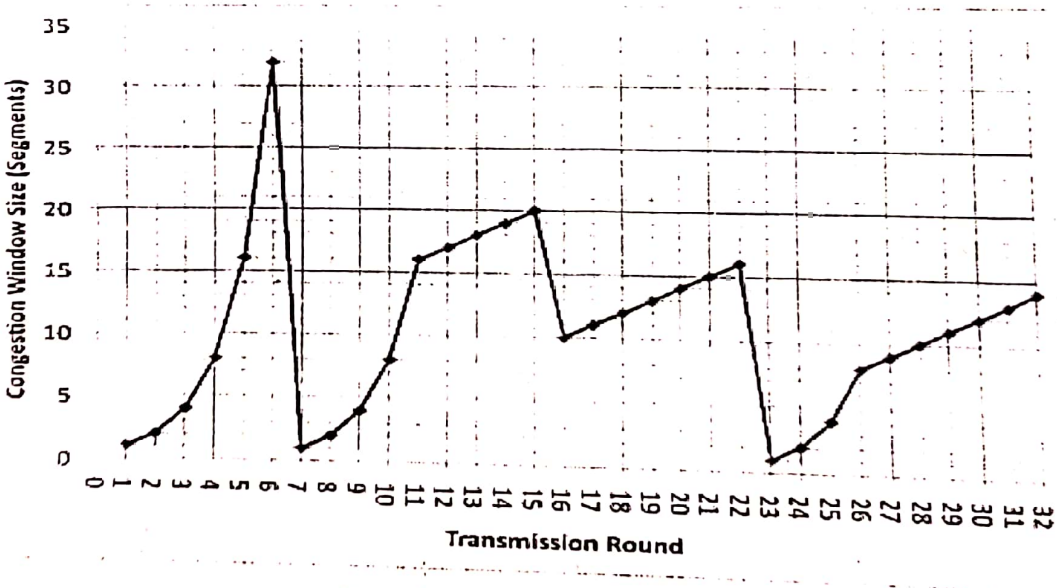

Figure 3 TCP Congestion Control

Best of luck!