COMSATS University Islamabad, Lahore Campus

Terminal Examination – Semester Fall 2020

Course Title:	Data Communications and Computer Networks		Course Code:	CSC339	Credit Hours:	3(2,1)
Course Instructor/s:	Mr. Imran Raza, Dr. M. Hasanain Ch., Dr. Atif Saeed, Mr. Junaid, Mr. Khurram Zahoor		Program Name:	BS Computer Science, BS Software Engineering		
Semester:	5th & 6th	Batch:		Section:	All sections	Date:
Time Allowed:	**3 Hours**		**Maximum Marks:**	**100**		

Important Instructions / Guidelines:

- All questions are compulsory

1. Answer the following short questions: [20]

a. Consider a simple application-level protocol built on top of UDP that allows a client to retrieve a file from a remote server residing at a well-known address. The client first sends a request with a file name, and the server responds with a sequence of data packets containing different parts of the requested file. To ensure reliability and sequenced delivery, the client and server use a stop-and-wait protocol. Ignoring the obvious performance issue, do you see a problem with this protocol? Think carefully about the possibility of processes crashing. (5)

b. Most IP datagram reassembly algorithms have a timer to avoid having a lost fragment tie-up reassembly buffers forever. Suppose that a datagram is fragmented into four fragments. The first three fragments arrive, but the last one is delayed. Eventually, the timer goes off and the three fragments in the receiver's memory are discarded. A little later, the last fragment stumbles in. What should be done with it? (5)

c. Suppose Bob joins a BitTorrent torrent, but he does not want to upload any data to any other peers (so-called free riding). (5)

i. Bob claims that he can receive a complete copy of the file that is shared by the swarm. Is Bob's claim possible? Why or why not?

ii. Bob further claims that he can further make his "free-riding" more efficient by using a collection of multiple computers (with distinct IP addresses) in the computer lab in his department. How can he do that?

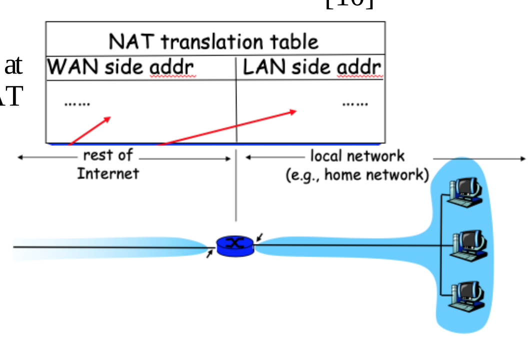
d. Discuss the problems with IP fragmentation and reassembly. What alternatives will you consider? (5)

2. Consider the given network setup, suppose that the ISP assigns the router the address 12.[illegible]102.215 and that the network address of the home network is 172.16. 0.0/16. [10]

a. Assign addresses to all interfaces in the home network. (4)

b. Suppose each host has six ongoing TCP connections, all to port 20 at host 118.109.20.96. Provide all corresponding entries in the NAT translation table. (4)

c. Discuss the advantages and disadvantages of NAT. (2)



3. Suppose a new TCP congestion protocol TCPN is developed. It is similar to the congestion protocol we have discussed in the class but only has 2 phases: The Slow-Start phase and the Congestion-Avoidance phase. TCPN starts in the Slow-Start phase with CWND initially set to 1 (i.e., at RTT 0, CWND = 1), and ssthresh (slow-start threshold) set to 37. Its actions upon receiving each acknowledgment (Ack) in each of its phases are defined as follows. [15]

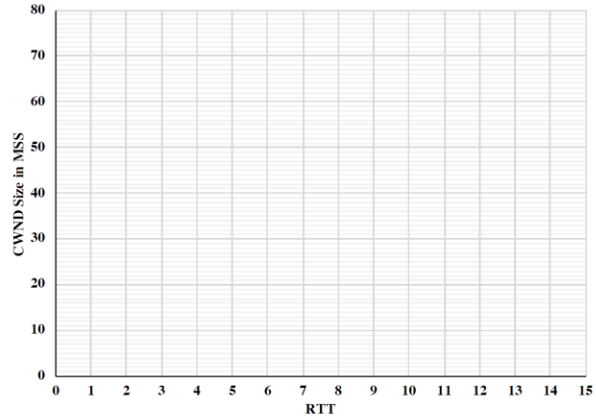
- Slow-start phase: for each Ack, CWND +=2
- Congestion-Avoidance Phase: for each Ack, CWND = CWND +2 / CWND

When CWND ≥ ssthresh, TCPN exits Slow-Start and enters the Congestion-Avoidance phase.

On a packet loss, TCPN always goes back to the Slow-Start phase and adjusts as follows.

- ssthresh = CWND / 4
- CWND = 1

Finally, when dividing, TCPN rounds numbers up to the nearest integer (e.g., 5/4 = 2, 9/2 = 5).
Based on the protocol described above, answer the following questions:

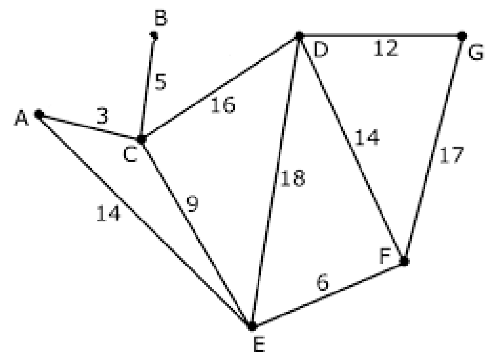


a. Using TCPN, draw a CWND-size vs. RTT graph for the first 14 RTTs. Assume a packet loss is detected right after the 7th RTT has passed. Clearly label the CWND size value for each RTT. (10)

b. Does TCPN ensure equal bandwidth sharing among multiple flows? Briefly explain why or why not. (2)

c. Assume no loss happens and header size is negligible. Assume the MSS of your transport protocol to be 1500 bytes and RTT is fixed at 200 ms. Calculate the average throughput (in Mbps) using TCPN for the first 5 RTTs. Assume 1 Mbps = 10^6 bps. (3)

4. Consider the network shown below: [15]



a. Show the operation of Bellman Ford's (Distance Vector) algorithm for computing the least cost path from ***C*** to all destinations. Only compute the table of ***C.*** (5)

b. Identify the path with the "count to infinity" problem and discuss its impact on the convergence of the algorithm in case of a change in the link cost. Why? Will it be resolved on its own? Assume that the poison reverse is not in use. (5)

c. Define Spanning Tree formally? Build a Minimum Spanning Tree (MST) using Reverse Path Forwarding (RPF) at node ***C*** to all nodes in the given network. (5)

5. Suppose Datagrams are limited to 1000 bytes (including header) between Host A and Router X. The MTU is 500 bytes (including header) between Router X and Router Y and the MTU is 1000 bytes (including header) between Router Y and Destination B. Assume an IP-header of size 20 bytes. In total, how many datagrams reach the destination B if Host A is required to send an MP3 file of 8 million bytes? Explain neatly with the help of a figure the various fragments that are generated, their sizes, and all the key fields of the datagram like fragmentation offset, identifier, and flags (DF, MF). [10]
The network connection is as follows:

Host A→ Router X → Router Y → Host B

6. Consider the Random Early Detection (RED) algorithm with MinThreshold = 100, MaxThreshold= 200, maximum buffer size =250 and maxP= 0.1. Draw the curve that gives the packet drop probabilities for all values of average queue lengths. Suppose that a packet arrives when the average queue length is 140, what is the minimum probability that it will be dropped? What is the minimum probability that it will be dropped if the average queue length is 95? [10]

7. A bitstream is 10011101 is transmitted using the standard CRC method. The generator polynomial is x3+1. Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show this error is detected at the receiver's end. [10]

8. Develop a subnetting scheme for the network requirements given below. [10]

a. Would you prefer using VLSM or FLSM for the given scenario? (2)

b. Identify the total number of required subnets? (2)

c. What is the subnet mask of each subnet? (3)

d. List down the subnet ids and host address range of all the subnets. (3)

IP address 204.172.1.0/24	
Segment	**Hosts**
Computer Science	112
Management Sciences	62
Media Studies	32
WAN Link 1	2
WAN Link 2	2
WAN Link 3	3