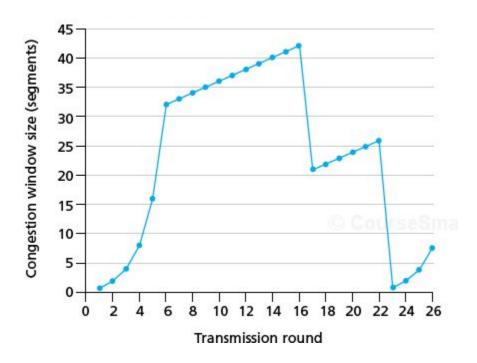
Cpr E 489 Spring 2024

Homework #6

Due Date: 5/2/2024 (Thu) by 11:59 PM

Type or scan your answers and submit on Canvas.

1. (50 points) Consider a TCP sender that runs the <u>TCP Reno</u> congestion control scheme. Suppose this TCP sender is experiencing the behavior shown in the "Transmission Round vs. Congestion Window Size" figure below. Initially, *cwnd* = 1. Answer each of the following questions and provide a short discussion to justify your answer.



- a) Identify the time intervals when TCP Slow Start is operating.
- b) Identify the time intervals when TCP Congestion Avoidance is operating.
- c) What is the value of *ssthresh* at the 5th transmission round?
- d) What is the value of ssthresh at the 10th transmission round?
- e) What is the value of ssthresh at the 20th transmission round?
- f) What is the value of ssthresh at the 25th transmission round?
- g) After the 16th transmission round, is the segment loss detected by a 3rd duplicate ACK or a timeout?
- h) After the 22nd transmission round, is the segment loss detected by a 3rd duplicate ACK or a timeout?
- i) During which transmission round is the 220th data segment sent?
- j) Assuming a segment loss is detected after the 26th round by a 3rd duplicate ACK, what will be the new values of *cwnd* and *ssthresh*?

2. (50 points) Suppose two TCP stations (a sender and a receiver) have established a connection between them successfully. Suppose that (i) the sender runs the <u>TCP New Reno</u> congestion control scheme and, initially, cwnd = 1 data segment and ssthresh = 4 data segments; (ii) the receiver has informed the sender that rwnd = 10 data segments; (iii) data segments #14 and #18 are lost on the first attempt, while all other transmissions (including re-transmitted data segments and ACK frames) are successful. The sender behavior at time 4*RTT (Round-Trip Time) is shown as an example in the table below. Complete the rest of the table for the sender behavior at 5*RTT, 6*RTT, and 7*RTT.

Time	Packet Received	Action Taken	List of	Total#	Estimated #	ssthresh	cwnd	cwnd	# new packets	
			unACKs packets	dup ACKs	outstanding packets	value	size	range	to send	
4 RTT	A9		9,10,11,12			4	5+1/5	9,10,11,12,13	1: #13	
	A10		10,11,12,13			4	5+2/5	10,11,12,13,14	1: #14	(#14 is lost)
	A11		11,12,13,14			4	5+3/5	11,12,13,14,15	1: #15	
	A12		12,13,14,15			4	5+4/5	12,13,14,15,16	1: #16	
	A13		13,14,15,16			4	6	13,14,15,16,17,18	2: #17, #18	(#18 is lost)
5 RTT										
6 RTT										
7 RTT										