CS 4310: Homework #4

Due on Monday, May 1, 2017

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You may discuss this problem set with other students. However, you must write up your answers on your own. You must also write the names of other students you discussed each problem with. Each problem has a different weight. Please state any assumptions you are making in solving a given problem. Late assignments will not be accepted. Please start early, understand what each problem is asking and email me/come see me, if you have questions.

Problem 1

Consider the following TCP connection between a sender and a receiver. You can assume that this transfer took place over a network of 10 msec of propagation delay and 1 Mbps capacity, in each direction. You can assume that the receiver has piggybacked its request with the third segment of the 3-way handshake. You can assume that the request was of 50 bytes (without headers). Only focus on TCP/IP headers and ignore the link layer headers. Answer the following questions [**20 points**]:

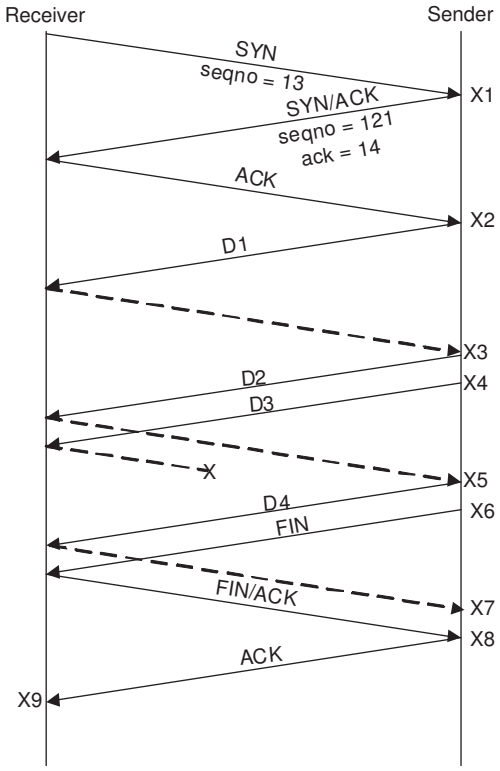

Figure 1: Time-line Diagram

(a) If segments D1, D2 D3, and D4, have the following sizes (in bytes with headers), 1000, 1000, 1000, and 500, respectively. What is the total size of the file being transferred?

(b) Complete the timing information (x1 through x9).

(c) State the sequence numbers of D1, D2, D3 and D4.

(d) Can you tell whether the transmissions of D2 and D3 were triggered by slow start versus the normal AIMD?

(e) For the sender and receiver specified, list the states (obtained from the TCP state transition diagram) they visited and how long they spent in each state (indicate the starting time and ending time in each state).

Problem 2

Consider a TCP connection starting with a congestion window (congwnd) size of 1 packet. Assume that the advertised window size is infinite (and hence we can ignore its effect). Furthermore, we can ignore the effect of extra queueing delay on our RTT calculations. Answer the following questions [**10 points**]:

(a) How many RTTs would take this connection to transmit a 100-packet sized file, just by using TCP AIMD mechanism, when no packets are lost during the transfer? (*Assume slow-start is not used.*)

(b) How many RTTs would take this TCP connection to transmit the same file, if slow start is used and the slow start congestion threshold was set to 32 packets? (*Again, you may assume no packets are lost.*)

Problem 3

Consider a TCP connection operating over a 1-Gbps network. Answer the following question [**10 points**]:

(a) How long would it take the sequence numbers to wrap around completely, if the connection was able to utilize the full bandwidth continuously.

(b) If we added a 32-bit time-stamp field that gets incremented 1000 times during the wraparound time found above. How long would it take the timestamp to wrap around?

(c) If no packets are allowed to be buffered in this network, can TCP utilize the full bandwidth of the network? Explain why or why not. How long would it take the sequence numbers to wrap around then (assume no times-tamp is used)?