

Homework 5

*Assigned: October 13**Due: October 19*

1. Calculate the throughput of the Stop-and-Wait protocol, assuming no bit errors or lost packets, under the following two environments:
 - The link has one-way propagation delay equal to 1 msec and speed equal to 28.8 Kbps. The data packets are 10,000 bytes long and the acknowledgements are 20 bytes long.
 - The link has one-way propagation delay equal to 25 msec and speed equal to 155 Mbps. The data packets are 53 bytes long and the acknowledgements are 53 bytes long.
2. Suppose hosts A and B are communicating over a TCP connection. Assume that A selects initial sequence number 52 and B selects initial sequence number 107. Further, assume the MSS is 512 bytes. A has 700 bytes to send, and B has 1030 bytes to send. Using a diagram, show all of the segments exchanged between A and B, starting with the connection setup segments. Minimize the number of segments by including acknowledgements and data in the same segment whenever possible. For each segment, give the sequence number, ack number, size of the payload, and flags that are set.
3. You can find a copy of the TCP connection management diagram on the class webpage. Give a timing diagram (similar to those used in class with one vertical line for the client and one for the server) that shows the exchange of packets between a client and server that causes the client to go from the state ESTABLISHED to FIN-WAIT-1 to TIMED-WAIT to CLOSED.
4. Compute the left and right boundaries of the TCP sending window after receiving each of the following (cumulative) pairs of acknowledgement field and flow control window field values. (I have used the variables a and b to denote these fields in class.) The idea is that this sequence of pairs represents the content of a sequence of packets that the TCP sender has gotten back from the TCP receiver.

You should state the range of **new** bytes that can be sent after each (a, b) pair is processed. Assume that there is no congestion control in place, so only flow control determines the window size. Be sure to check that the sequence of (a, b) pairs are valid; if an invalid pair is detected, state that. Assume the initial sending window size is 2048 bytes and that the first byte has sequence number 0.

Show the results for the following sequence of pairs: $(512, 1536)$, $(1024, 1024)$, $(1536, 1024)$, $(2560, 512)$, $(3072, 2048)$, $(3584, 1024)$
5. Suppose you are running TCP with a maximum segment size of 1500 bytes. Assume the last acknowledgement received had an acknowledgement field of 500. Give the (new) value of the TCP sending window under the following conditions:
 - (a) The current congestion window is 3000 bytes, and the current threshold is 4000 bytes. An acknowledgement has just been received with an acknowledgement field of 2000 and a window field of 5000.
 - (b) Same conditions as part (a) except the current threshold is 2000 bytes.