CSEE-5110: Problem Set 5, Fall 2015

1. Consider a reliable data transfer protocol that uses only negative acknowledgements. Suppose the sender sends data only infrequently

   (a) Would a NAK-only protocol be preferable to a protocol that uses ACKS? Why?

   (b) Now suppose the sender has a lot of data to send and the end-to-end connection experiences few losses. In this second case, would a NAK only protocol be preferable to a protocol that uses ACKS? Why?

2. UDP and TCP use 1s compliment for their checksums. Suppose you have the following three 8-bit bytes: 01010111, 01110100, 01011100.

   (a) What is the 1s compliment of the sum of these 8-bit bytes?

   (b) Why is it the UDP takes the 1s compliment of the sum and not just the sum?

   (c) With the 1s compliment scheme, how does the receiver detect errors?

   (d) Is it possible that a 1 bit error will go undetected?

   (e) Is it possible a 2 bit error will go undetected?

3. Suppose two stations A and B are connected with a high speed 1Gbps link. Suppose the round trip propagation delay on the link is 40ms. Packet lengths are 1,000 bytes (8,000 bits).

   (a) How big would the window size have to be for the channel utilization to be 90 percent?

4. Consider a scenario in which Host A and Host B want to send messages to Host C. Hosts A and C are connected by a channel that can lose and corrupt (but not reorder) messages. Hosts B and C are connected by another channel (independent of the channel connecting A and C) with the same properties. The transport layer at Host C should alternate in delivering messages from A and B to the layer above (that is, it should first deliver the data from a packet from A, then from B, and so on).

   (a) Design a stop-and-wait-like error-control protocol for reliably transferring packets from A and B to C, with alternating delivery at C as described above. Give FSM descriptions of A and C. (*Hint:* The FSM for B should be essentially the same as A.)

   (b) Give a description of the packet format(s) used.

5. Consider a GBN protocol with a sender window size of 3 and a sequence number range of 1,024. Suppose that at time t, the next in-order packet that the receiver is expecting has a sequence number of k. Assume that the medium does not reorder messages.

   (a) What are the possible sets of sequence numbers inside the sender's window at time t? Justify your answer.

   (b) What are all the possible values of the ACK field in all possible messages currently propagating back to the sender at time t? Justify your answer.

6. Consider the GBN and SR protocols. Suppose the sequence number space is of size k.

   (a) What is the largest allowable sender window that will avoid the occurrence of problems caused by exhausting sequence numbers?

7. Consider transferring an enormous file of L bytes from Host A to Host B. Assume a MSS of 1,460 bytes.

   (a) What is the maximum value of L such that sequence numbers are not exhausted?

   (b) For the L you have obtained above, find how long it takes to transmit the file over a 100Mbps link if there are 66 bytes of header added to each segment? Ignore flow and congestion control.

8. (PD) Explain the three sequences of state transitions during a TCP connection teardown.

9. (PD) Consider the following TCP connection teardown sequence: FIN-WAIT-1 to TIME-WAIT and labelled FIN+ACK/ACK. Explain the circumstances that result in this fourth teardown sequence.

10. Explain why during a TCP connection setup, sequence numbers usually will not start at 1.