CS4850 Homework 2 Due: Friday, September 15, at beginning of class

From the Computer Networks book (by L. Peterson and B. Davis, 5th edition):

Chapter 2, Ex. 2, 5, 18, 24, 27, 31, 35

Notes:
For problem 2, assume that a 0 was transmitted right before the start of the given bit sequence.
For problem 27, "next expected frame" means the next frame in the frame sequence (which excludes retransmitted frames).

2. Show the 4B/5B encoding, and the resulting NRZI signal, for the following bit sequence:
1110 0101 0000 0011

5. Assuming a framing protocol that uses bit stuffing, show the bit sequence transmitted over the link when the frame contains the following bit sequence:
110101111101011111101011111110
Mark the stuffed bits.

18. Suppose we want to transmit the message 11100011 and protect it from errors using the CRC polynomial X^3 +1.

(a) Use polynomial long division to determine the message that should be transmitted.

(b) Suppose the leftmost bit of the message is inverted due to noise on the transmission link. What is the result of the receiver's CRC calculation? How does the receiver know that an error has occurred?

24. Suppose you are designing a sliding window protocol for a 1-Mbps point-to-point link to the moon, which has a one-way latency of 1.25 seconds. Assuming that each frame carries 1 KB of data, what is the minimum number of bits you need for the sequence number?

27. Implicit in the stop-and-wait scenarios of Figure 2.17 is the notion that the receiver will retransmit its ACK immediately on receipt of the duplicate data frame. Suppose instead that the receiver keeps its own timer and retransmits its ACK only after the next expected frame has not arrived within the timeout interval. Draw timelines illustrating the scenarios in Figure 2.17(b) to (d); assume the receiver's timeout value is twice the sender's. Also redraw (c) assuming the receiver's timeout value is half the sender's.

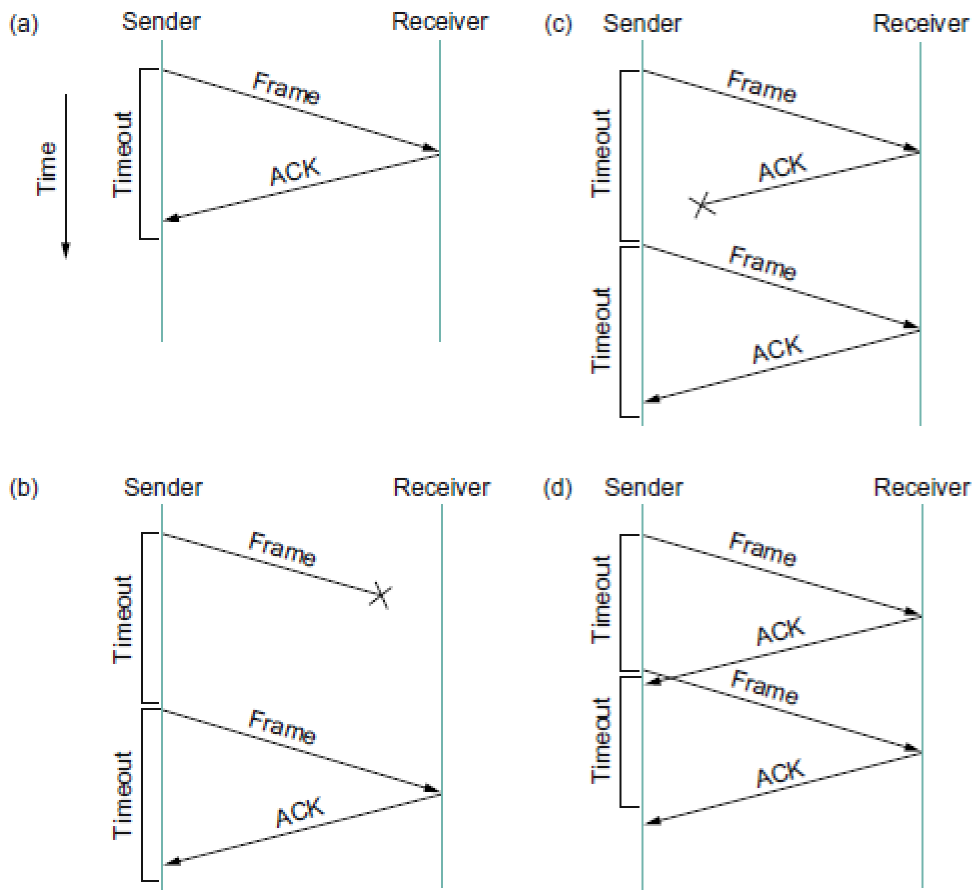

FIGURE 2.17 Timeline showing four different scenarios for the stop-and-wait algorithm. (a) The ACK is received before the timer expires; (b) the original frame is lost; (c) the ACK is lost; (d) the timeout fires too soon.

31. Draw a timeline diagram for the sliding window algorithm with SWS = RWS = 3 frames, for the following two situations. Use a timeout interval of about 2×RTT.

(a) Frame 4 is lost.

(b) Frames 4 to 6 are lost.

35. Suppose that we run the sliding window algorithm with SWS = 5 and RWS = 3, and no out-of-order arrivals.

(a) Find the smallest value for MaxSeqNum. You may assume that it suffices to find the smallest MaxSeqNum such that if DATA[MaxSeqNum] is in the receive window, then DATA[0] can no longer arrive.

(b) Give an example showing that MaxSeqNum−1 is not sufficient.

(c) State a general rule for the minimum MaxSeqNum in terms of SWS and RWS.