P27

P27. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 126. Suppose Host A then sends two segments to Host B back-to-back. The first and second segments contain 80 and 40 bytes of data, respectively. In the first segment, the sequence number is 127, the source port number is 302, and the destination port number is 80. Host B sends an acknowledgment whenever it receives a segment from Host A.

1. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?
2. If the first segment arrives before the second segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number, the source port number, and the destination port number?
3. If the second segment arrives before the first segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number?
4. Suppose the two segments sent by A arrive in order at B. The first acknowledgment is lost and the second acknowledgment arrives after the first timeout interval. Draw a timing diagram, showing these segments and all other segments and acknowledgments sent. (Assume there is no additional packet loss.) For each segment in your figure, provide the sequence number and the number of bytes of data; for each acknowledgment that you add, provide the acknowledgment number.

P28. Host A and B are directly connected with a 100 Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send its application data into its TCP socket at a rate as high as 120 Mbps but Host B can read out of its TCP receive buffer at a maximum rate of 50 Mbps. Describe the effect of TCP flow control.

P32. Consider the TCP procedure for estimating RTT. Suppose that . Let *SampleRTT1* be the most recent sample RTT, let *SampleRTT2* be the next most recent sample RTT, and so on.

1. For a given TCP connection, suppose four acknowledgments have been returned with corresponding sample RTTs: *SampleRTT4,* *SampleRTT3*, *SampleRTT2*, and *SampleRTT1*. Express *EstimatedRTT* in terms of the four sample RTTs.
2. Generalize your formula for *n* sample RTTs.
3. For the formula in part (b) let *n* approach infinity. Comment on why this averaging procedure is called an exponential moving average.

P34. What is the relationship between the variable *SendBase* in **Section 3.5.4** and the variable *LastByteRcvd* in **Section 3.5.5** ?

P35. What is the relationship between the variable *LastByteRcvd* in **Section 3.5.5** and the variable y in Section **3.5.4**?

P36. In **Section 3.5.4,** we saw that TCP waits until it has received three duplicate ACKs before performing a fast retransmit. Why do you think the TCP designers chose not to perform a fast retransmit after the first duplicate ACK for a segment is received?

P40. Consider **Figure 3.58.** Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.



1. Identify the intervals of time when TCP slow start is operating.
2. Identify the intervals of time when TCP congestion avoidance is operating.
3. After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
4. After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
5. What is the initial value of *ssthresh* at the first transmission round?
6. What is the value of *ssthresh* at the 18th transmission round?
7. What is the value of *ssthresh* at the 24th transmission round?
8. During what transmission round is the 70th segment sent?
9. Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congestion window size and of *ssthresh?*
10. Suppose TCP Tahoe is used (instead of TCP Reno) and assume that triple duplicate ACKs are received at the 16th round. What are the *ssthresh* and the congestion window size at the 19th round?
11. Again, suppose TCP Tahoe is used, and there is a timeout event at 22nd round. How many packets have been sent out from 17th round till 22nd round, inclusive?