

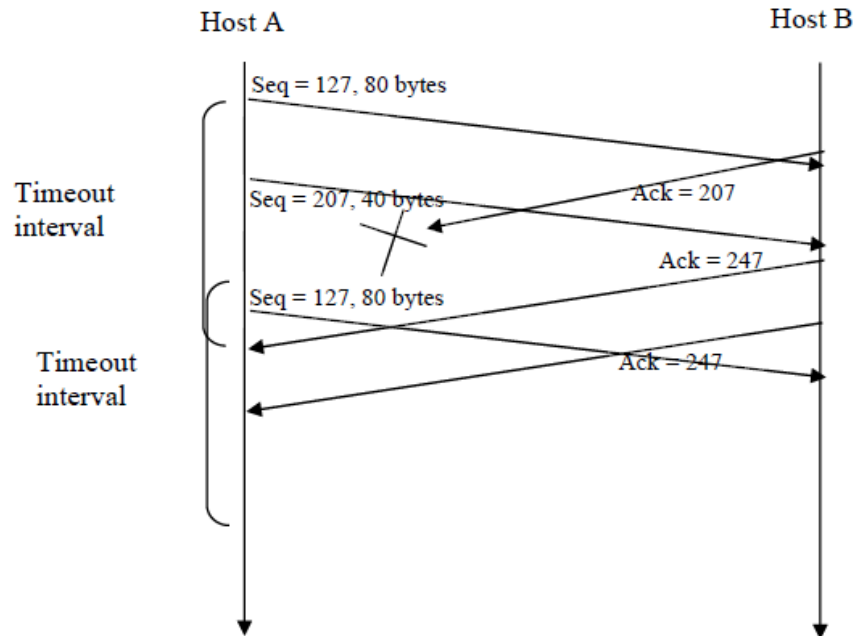
P27. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 126. Suppose Host A then sends two segments to Host B back-to-back. The first and second

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.

- a. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?
- b. 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?
- c. If the second segment arrives before the first segment, in the acknowledgment of the first arriving segment, what is the acknowledgment number?
- d. 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.

Problem 27

- a) In the second segment from Host A to B, the sequence number is 207, source port number is 302 and destination port number is 80.
- b) If the first segment arrives before the second, in the acknowledgement of the first arriving segment, the acknowledgement number is 207, the source port number is 80 and the destination port number is 302.
- c) If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, the acknowledgement number is 127, indicating that it is still waiting for bytes 127 and onwards.
- d)



- P40. Consider Figure 3.61. 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.
- Identify the intervals of time when TCP slow start is operating.
 - Identify the intervals of time when TCP congestion avoidance is operating.
 - After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
 - After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?

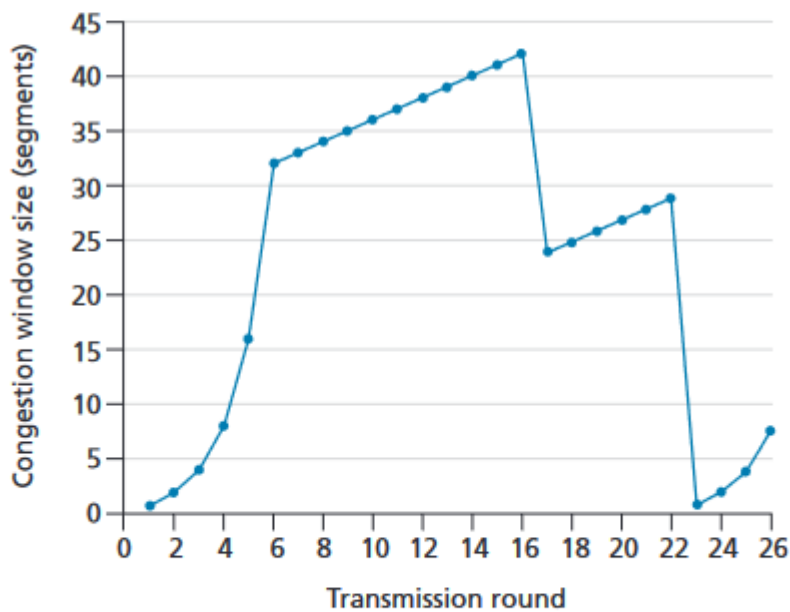


Figure 3.61 ♦ TCP window size as a function of time

- e. What is the initial value of `ssthresh` at the first transmission round?
- f. What is the value of `ssthresh` at the 18th transmission round?
- g. What is the value of `ssthresh` at the 24th transmission round?
- h. During what transmission round is the 70th segment sent?
- i. 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`?
- j. 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?
- k. 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?

Problem 40

- a) TCP slowstart is operating in the intervals [1,6] and [23,26]
- b) TCP congestion avoidance is operating in the intervals [6,16] and [17,22]
- c) After the 16th transmission round, packet loss is recognized by a triple duplicate ACK. If there was a timeout, the congestion window size would have dropped to 1.
- d) After the 22nd transmission round, segment loss is detected due to timeout, and hence the congestion window size is set to 1.

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- e) The threshold is initially 32, since it is at this window size that slow start stops and congestion avoidance begins.
- f) The threshold is set to half the value of the congestion window when packet loss is detected. When loss is detected during transmission round 16, the congestion window size is 42. Hence the threshold is 21 during the 18th transmission round.
- g) The threshold is set to half the value of the congestion window when packet loss is detected. When loss is detected during transmission round 22, the congestion window size is 29. Hence the threshold is 14 (taking lower floor of 14.5) during the 24th transmission round.
- h) During the 1st transmission round, packet 1 is sent; packet 2-3 are sent in the 2nd transmission round; packets 4-7 are sent in the 3rd transmission round; packets 8-15 are sent in the 4th transmission round; packets 16-31 are sent in the 5th transmission round; packets 32-63 are sent in the 6th transmission round; packets 64 – 96 are sent in the 7th transmission round. Thus packet 70 is sent in the 7th transmission round.
- i) The threshold will be set to half the current value of the congestion window (8) when the loss occurred and congestion window will be set to the new threshold value + 3 MSS. Thus the new values of the threshold and window will be 4 and 7 respectively.
- j) threshold is 21, and congestion window size is 1.
- k) round 17, 1 packet; round 18, 2 packets; round 19, 4 packets; round 20, 8 packets; round 21, 16 packets; round 22, 21 packets. So, the total number is 52.