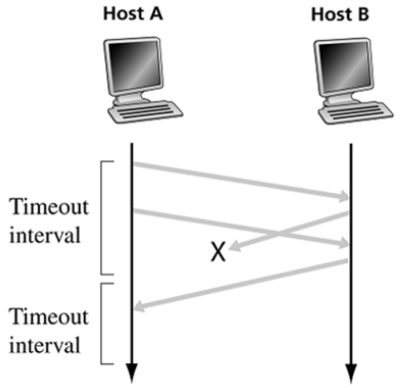
Review Minggu ke-5

1. True or false?
   a) Host A is sending Host B a large file over a TCP connection. Assume Host B has no data to send Host A. Host B will not send acknowledgments to Host A because Host B cannot piggyback the acknowledgments on data.
   b) The size of the TCP rwnd never changes throughout the duration of the connection.
   c) Suppose Host A is sending Host B a large file over a TCP connection. The number of unacknowledged bytes that A sends cannot exceed the size of the receive buffer.
   d) Suppose Host A is sending a large file to Host B over a TCP connection. If the sequence number for a segment of this connection is m, then the sequence number for the subsequent segment will necessarily be m + 1.
   e) The TCP segment has a field in its header for rwnd.
   f) Suppose that the last SampleRTT in a TCP connection is equal to 1 sec. The current value of TimeoutInterval for the connection will necessarily be ≥ 1 sec.
   g) Suppose Host A sends one segment with sequence number 38 and 4 bytes of data over a TCP connection to Host B. In this same segment the acknowledgment number is necessarily 42.

2. 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 an enormous file to Host B over this connection. Host A can send 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.

3. Consider sending a large file from one host to another over a TCP connection that has no loss.
   a) Suppose TCP uses AIMD (Additive Increase multiple decrease) for its congestion control without slow start. Assuming CWND (Congestion Window) increases by 1 MSS every time an ACK is received and assuming approximately constant round-trip times, how long does it take for CWND to increase from 1 MSS to 5 MSS (assuming no loss events and constant RTT)?
   b) What is the average throughput (in terms of MSS and RTT) for this connection up through time = 4 RTT?

4. Host A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 144. Suppose that Host A then sends two segments to Host B back-to-back. The first and second segments contain 20 and 40 bytes of data, respectively. In the first segment, the sequence number is 145, source port number is 303, and the destination port number is 80. Host B sends an acknowledgement 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 acknowledgement 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 acknowledgement 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 acknowledgement is lost and the second segment arrives after the first timeout interval, as shown in the figure below. Complete the diagram, showing all other segments and acknowledgements sent. (Assume there is no additional packet loss.) For each segment you add to the diagram, provide the sequence number and number of bytes of data; for each acknowledgement that you add, provide the acknowledgement number.

5. 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.
   a) Identify the intervals of time when TCP slow start is operating.
   b) Identify the intervals of time when TCP congestion avoidance is operating.
   c) After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
   d) After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
   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?