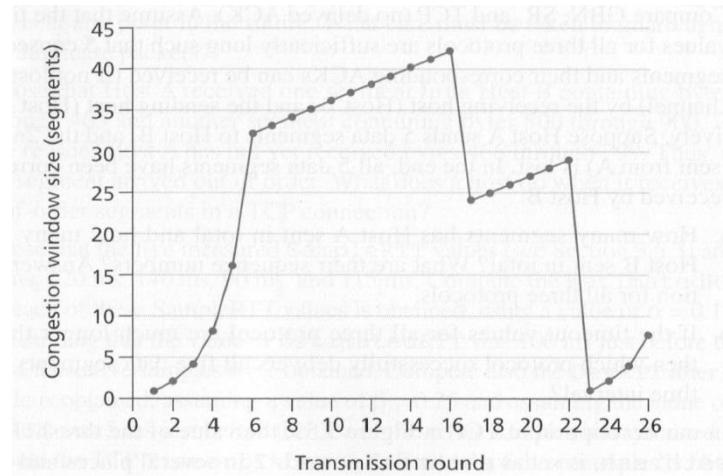


Problem 1. Consider the following Figure. Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.



- Identify the intervals of time when TCP slow start is operating.
- Identify the intervals of time when TCP congestion avoidance (CWND linear increase) 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?
- What is the initial value of ssthresh at the first transmission round?

- A) 16
- B) 32
- C) 33
- D) 34

- What is the value of ssthresh at the 18th transmission round?

- A) 18
- B) 19
- C) 20
- D) 21

- What is the value of ssthresh at the 24th transmission round?

- A) 10
- B) 12
- C) 14
- D) 16

h. During what transmission round is the 70th segment sent?

- A) 7
- B) 8
- C) 9
- D) 10

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 ssthresh and of congestion window size?

- A) 3, 7
- B) 3, 8
- C) 4, 7
- D) 4, 8

j. Suppose TCP Tahoe is used (which always sets CWND to 1 for either timeout or triple dup ack), 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?

- A) 21, 3
- B) 21, 4
- C) 22, 3
- D) 22, 4

P2. TCP congestion control decreases its transmission rate in the face of increasing congestion (loss), while UDP sources need not, and it is possible for UDP sources to crowd out TCP traffic. Does it mean that TCP is fairer than UDP?

P3. Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number of 65; the second has sequence number 92.

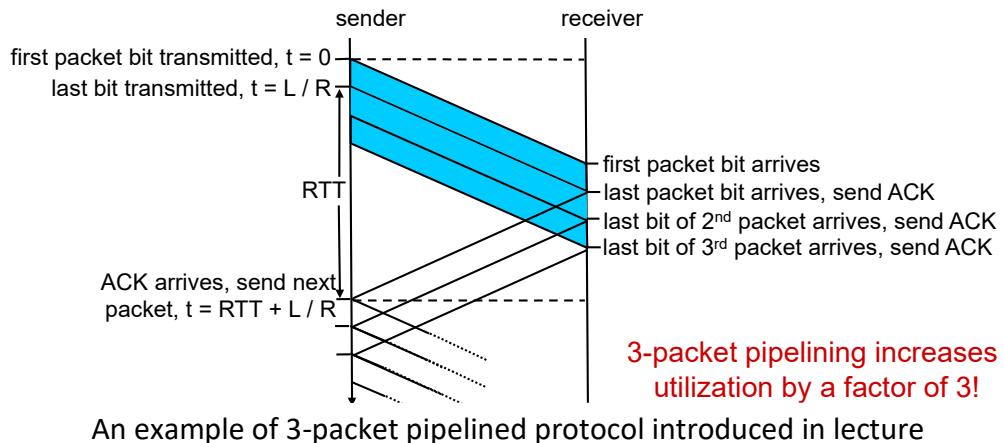
- a) How much data is in the first segment (in bytes)?

- A) 25
 - B) 26
 - C) 27
 - D) 28

- b) Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgement that Host B sends to Host A, what will be the acknowledgement number? Suppose no other segments are lost.

- A) 65
 - B) 66
 - C) 91
 - D) 92

P4. Consider the pipelined protocol introduced in the lecture. How big would the sending window size have to be for the channel utilization to be greater than 97 percent? Suppose that the transmission rate of the channel is 10^9 bit/second, the size of a packet is 1,200 bytes, and the RTT is 30 msec.



- A) 1011
 - B) 2022
 - C) 3033
 - D) 4044