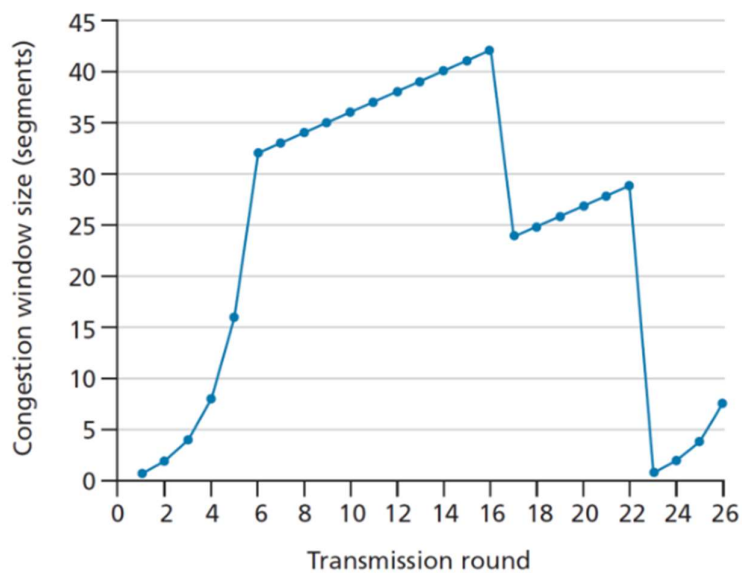**COMP 311 – Computer Networks**

Problem Set # 4

May 06, 2024

HAFSAH SHAHBAZ – 251684784

Consider the Figure given below. Assuming TCP Reno is the protocol experiencing the behavior 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.
   1 to 6 and 23 to 26
   In the graph, this corresponds to the steep rise in the window size, from 0 window size.

b. Identify the intervals of time when TCP congestion avoidance is operating.
   6 to 16 and 17 to 22
   In the graph, this occurs after the initial steep rise and before any significant decrease, characterized by a plateau in the congestion window size.

c. After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
   Triple duplicate ACK.

This is indicated by the sudden drop in the congestion window size. If detection is by three duplicate ACKs, a new congestion avoidance phase starts. If there was a timeout, the congestion window size would have dropped to 1.

d. After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
Timeout
This is evident from the sharp decrease in the congestion window size to 1 after the 22nd transmission round. A new slow start phase starts after it.

e. What is the initial value of ssthresh at the first transmission round?
32
When connection begins, increase rate exponentially until first loss event or till threshold after which it increases only by 1 – additive increase. And slow start stops and congestion avoidance begins.

f. What is the value of ssthresh at the 18th transmission round?
42 / 2 = 21
After the multiplicative decrease when 3 duplicate ACK when packet lost.
ssthresh is set to 1/2 of cwnd

g. What is the value of ssthresh at the 24th transmission round?
29/2 = 14.5 on loss event, ssthresh is set to 1/2 of cwnd just before loss event. And cwnd is set to 1.

h. During what transmission round is the 70th segment sent?
7th transmission round.

- Round 1: Packet 1 (1 packet)
- Round 2: Packets 2-3 (2 packets)
- Round 3: Packets 4-7 (4 packets)
- Round 4: Packets 8-15 (8 packets)
- Round 5: Packets 16-31 (16 packets)
- Round 6: Packets 32-63 (32 packets)
- Round 7: Packets 64-96 (33 packets)

Packets size increase exponentially till 32 packets and then it increases only by 1

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?

Current value of cwdn at 26 is 8. Ssthresh is ½ the current value of cwdn

Ssthresh = 8/2 = 4

The congestion window size is the ssthresh+3 = 4 + 3 = 7

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?
    ssthresh is 21, and congestion window size is 1.

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?

    Round 17: 1 packet
    Round 18: 2 packets
    Round 19: 4 packets
    Round 20: 8 packets
    Round 21: 16 packets
    Round 22: 21 packets
    total = 52