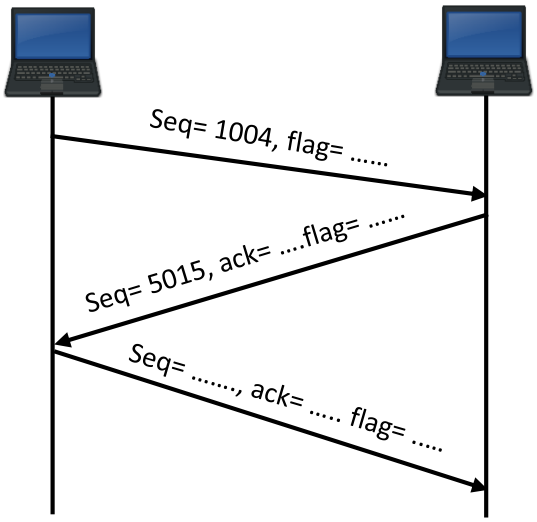
Assignment 3 - Solution

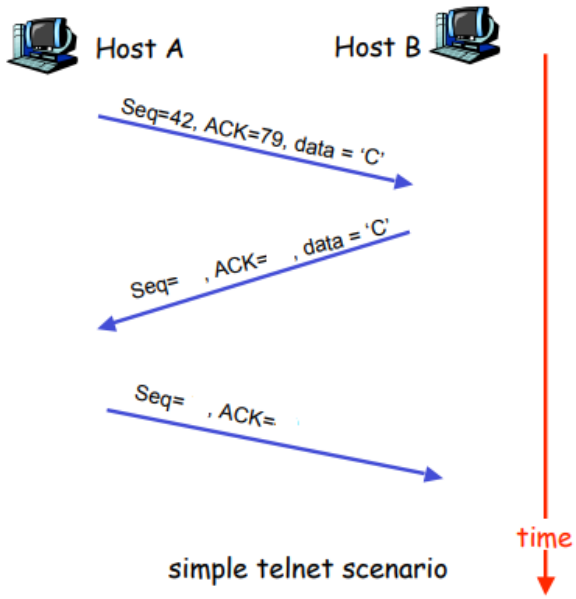
Covered Topics:-
Transport Layer (TCP)

Problem 1

Fill in the missing sequence numbers and acknowledgement numbers, knowing that each character is 1 Byte long.

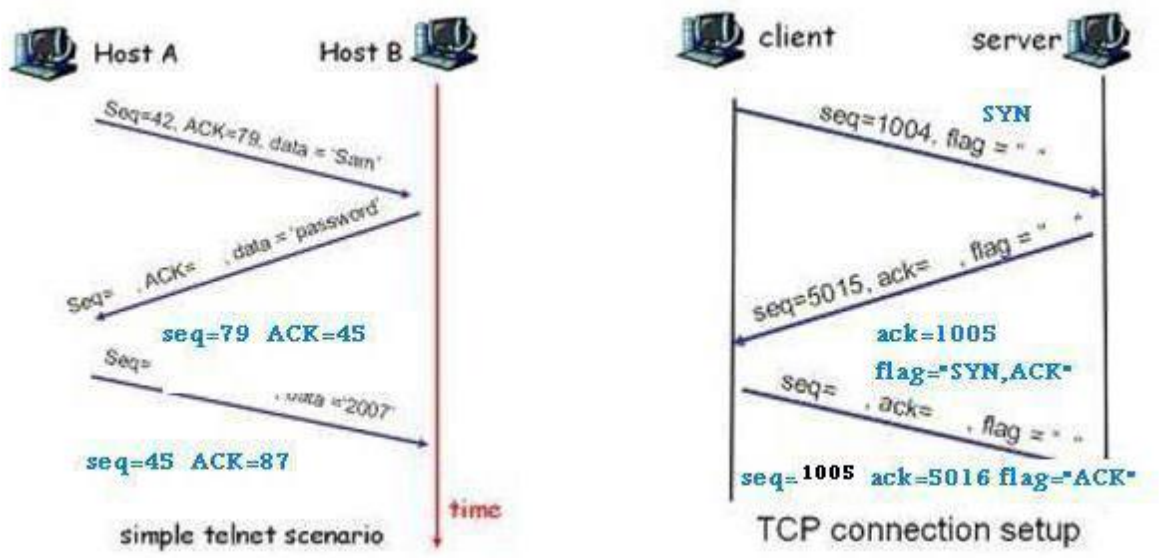


TCP Connection Setup



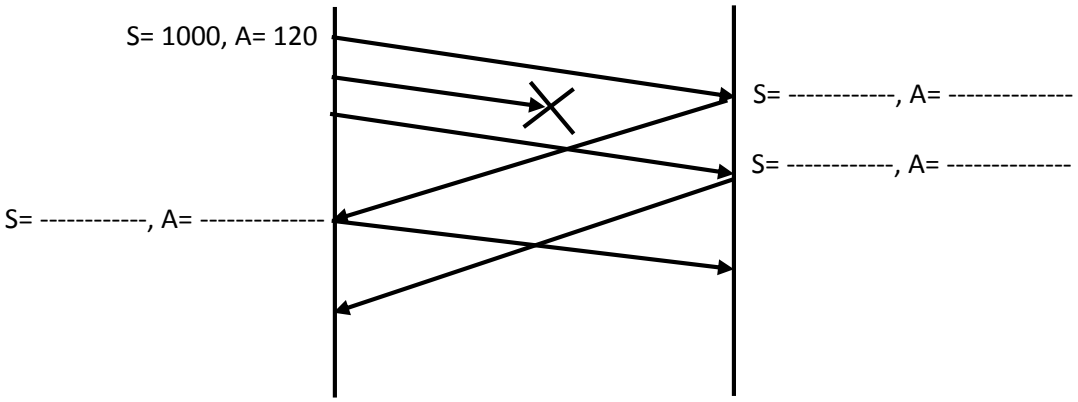
simple telnet scenario

Solution:-

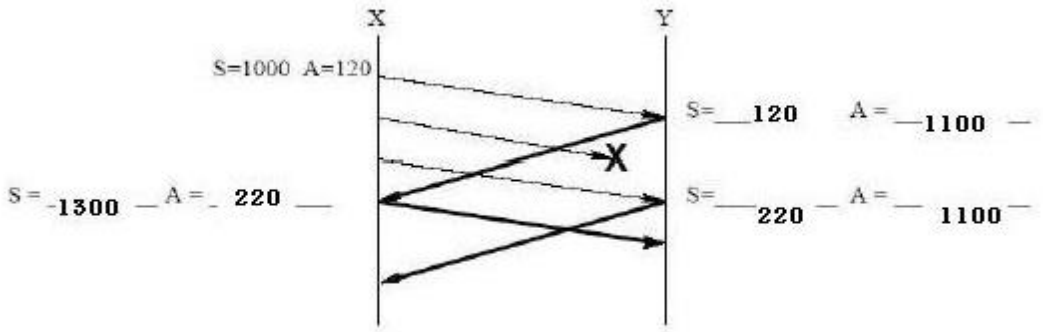


Problem 2

The following figure shows two hosts X and Y communicating over a channel using TCP. Hosts X and Y are sending data to each other. If each TCP segment contains 100 bytes of data and the 2nd segment sent by X is lost, complete the below figure by adding the missing sequence numbers and acknowledgment numbers



Solution: -



Problem 3

Consider the effect of using slow-start on a line with 20ms RTT and no congestion. The receiver window is 40 KB and the maximum segment size is 1 KB, the slow-start threshold is equal to 16 KB. How long does it take before the 1st full window can be sent?

Solution: -

The window size will grow as shown in the following table:

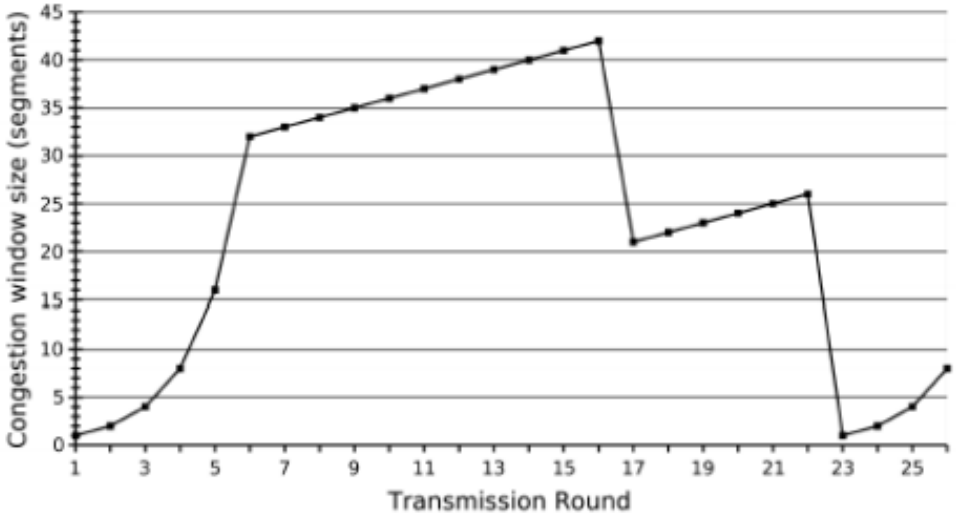
Transmission Number	1	2	3	4	5	6	7	…….	28	29
Congestion Window Size (in KB)	1	2	4	8	16	17	18	…….	39	40

Total time taken before reaching the ssthreshold = 5 rounds × 20ms = 100ms

So the first full window size can be sent after 29 rounds × 20ms = 580ms

Problem 4

Consider the graph below which shows the size of the TCP sender congestion control window as a function of time (transmission round) in an idealized timing scenario where the sender sends a window worth of packets and then receives ACKs (if any) at the end of the RTT.



a) Why does the congestion window curve have one form from rounds 1 to 6, and then another form from rounds 6 through 16?
b) What event occurs at t=16, given that the result of this event is the sender cutting its congestion control window in half.
c) What event occurs at t=23, given that the result of this event is the sending cutting its congestion window to 1? How is this event different from that which happened at t=16?

Solution: -

a) Because at first we are in the slow start phase, and the congestion window increases exponentially (it doubles every RTT) until we reach the threshold. Then, we enter the congestion-avoidance phase where the congestion window increases 1 MSS every RTT.
b) At t=16, the sender discovers that there is a lost packet because it received 3 duplicate ACKs.

c) A t=23, a packet loss was detected by a timeout. When a timeout occurs, the congestion window is reset to 1, the threshold is cut to half of the last congestion window size and the sender enters the slow-start phase again.