37

1.

a. The sender window has size N. At time t, whether it has received ACK or not, the window will contain k-1. So it can be from k-N to k.

10

b. The receiver is expecting packet k, so it has sent ACK for packet k-1 and the packets before. It must receive ACK of packet k-N-1. The sender window has size N, so ACK for k-N to k-1 can be there.

c. Yes.

For example, an ACK message of receiver is delayed. Sender will resend and update the window. Then the ACK falls out of the window.

2. One example is that the sender initially sends 0, 1, 2, and 3 but the ACKs are lost. The receiver has already received the message and it is expecting 4,5,6,0. Sender will resend because it hasn't received ACK. But receiver is not expecting that.

10

3.

1
0

a.

1 packet = 1400 bytes

100 packets

transimission time = (1500+150)*8/(150*10^6) = 0.089 ms

propagation delay 16 ms

time = 100*(0.089+16) = 1608.9 ms

b.

140000*8/1608.9*1000= 696171 bps

c.

transmission time = (20*1500+150)*8/(150*10^6) = 1.608 ms

total transimission time = 5*(1.609+16) = 88 ms

throughput = 140000*8*1000/88.04= 12721490 bps

d.

(150*10^6) * 16*10^(-3) = 2400000 bytes

time of transmission = (100*1500+150)*8/(150*10^6) = 8.0 ms

total transmission time = 8.01 + 16 = 24ms

throughput = 140000*8*1000/24.01= 46647230 bps

7 4.

a.

Use iteration to calculate the fifth value. And the answer is 0.7311

b.

if α=0.7: RTT(5) = 0.7983

if α=0.9: RTT(5) = 0.9328

Smaller α makes the value change more.

c.

Sender cannot tell the source of ACK when retransmitting and it cannot calculate the RTT correctly.

The Karn-Partridge algorithm avoid this by double the current estimated RTT