P36：

Packets can arrive out of order from the Internet Protocal layer. So, whenever an out of order packet would be received, it would generate a duplicate acknowledgement(ACK).If we perform retransmission after the first duplicate ACK, it would lead the sender to introduce too many redundant packets in the network.

Hence, the TCP designers chose not to perform a fast retransmit after the first duplicate ACK for a segment is received.

P41:

![Diagram

Description automatically generated]()

P43:

In this problem, there is no danger in overflowing the receiver since the receiver’s receive buffer can hold the entire file. Also, because there is no loss and acknowledgements are returned before timers expire, TCP congestion control does not throttle the sender. However, the process in host A will not continuously pass data to the socket because the send buffer will quickly fill up. Once the send buffer becomes full, the process will pass data at an average rate or R << S.

P44:

a)

Given data:

 Assuming cwnd increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times.

Then transmission rate  of TCP = w bytes/RTT

cwnd increases by 1 MSS if every batch of ACKs received.

          The below steps are take for cwnd to increase from 6 MSS to 12 MSS:

* 1 RTTs to  to 7 MSS.
* 2 RTTs to 8 MSS.
* 3 RTTs to 9 MSS.
* 4 RTTs to 10 MSS.
* 5 RTTs to 11MSS.
* 6 RTTs to 12 MSS.

b)

Given data:

Connection up through time = 6 RTT

Average throughout (in terms of MSS and RTT) =(6+7+8+9+10+11)/6

46:

a). The maximum window size:

10^6\*0.15/(8\*1.5\*10^3) = 125. Therefore, the maximum window size is 125 segments.

b). Average window size is 2\*W/3 = 84 segments

sand average throughput is 84\*1500\*8/0.15 = 6.72 Mbps

c). It would take 84/2\*0.15 = 6.03 sec.

53:

Table

Description automatically generated

Text

Description automatically generated

P54:

An advantage of using the earlier values of cwnd and ssthresh at t2 is that TCP would not have to go through slow start and congestion avoidance to ramp up to the throughput value obtained at t1. A disadvantage of using these values is that they may be no longer accurate. In particular, if the path has become more congested between t1 and t2, the sender will send a large window’s worth of segments into an already (more) congested path.