

# Matthew Bentz HW3

1. The purpose of sequence numbers associated with packets sent from sender to receiver are for the receiver to tell if the packet is a duplicate or already received packet (helpful in re-assembly). ACK's sent from receiver to sender allow the receiver to know the packet sent was received and it can move over to the next state in the transfer. So, once an ACK is received, duplicate ACKs will be ignored because the sender has already transitioned into the next state, meaning sequence numbers on the ACK packets are unnecessary.

2.  $\text{Estimated RTT} = (1-\alpha)(\text{Estimated RTT}) + (\alpha)(\text{Sample RTT})$   
 $\text{DevRTT} = (1-\beta)(\text{DevRTT}) + (\beta)(|\text{SampleRTT} - \text{EstimatedRTT}|)$   
 $\text{TimeoutInterval} = \text{EstimatedRTT} + (4)(\text{DevRTT})$   
 $\alpha = 0.2 \quad \beta = 0.25$

Sample 1: 85ms

- Estimated RTT =  $0.8(110) + 0.2(85) = 105\text{ms}$
- DevRTT =  $0.75(10) + 0.25(|85-110|) = 13.75\text{ms}$
- Timeout Interval =  $105 + 4(13.75) = 160\text{ms}$

Sample 2: 130ms

- Estimated RTT =  $0.8(105) + 0.2(130) = 110\text{ms}$
- DevRTT =  $0.75(13.75) + 0.25(|130-105|) = 16.5625\text{ms}$
- Timeout Interval =  $110 + 4(16.5625) = 176.25\text{ms}$

Sample 3: 108ms

- Estimated RTT =  $.8(110) + .2(108) = 109.6\text{ms}$
- DevRTT =  $.75(16.5625) + .25(|108-110|) = 12.99\text{ms}$
- Timeout Interval =  $109.6 + 4(12.99) = 161.56\text{ms}$

Sample 4: 72ms

- Estimated RTT =  $.8(109.6) + .2(72) = 102.08\text{ms}$
- DevRTT =  $.75(12.99) + .25(|72-109.6|) = 19.1425\text{ms}$
- Timeout Interval =  $102.08 + 4(19.1425) = 178.65\text{ms}$

Estimated RTT of sample A

Sample 5: 142ms

$$\text{EstimatedRTT} = .8(102.08) + .2(142) = 110.064\text{ms}$$

$$\text{DevRTT} = .75(19.1425) + .25(142 - 102.08) = 24.34\text{ms}$$

$$\text{TimeoutInterval} = 110.064 + 4(24.34) = 207.424\text{ms}$$

Sample 6: 64ms

$$\text{EstimatedRTT} = .8(110.064) + .2(64) = 100.85\text{ms}$$

$$\text{DevRTT} = .75(24.34) + .25(164 - 110.064) = 29.77\text{ms}$$

$$\text{TimeoutInterval} = 100.85 + 4(29.77) = 219.93\text{ms}$$

Sample 7: 153ms

$$\text{EstimatedRTT} = .8(100.85) + .2(153) = 111.28\text{ms}$$

$$\text{DevRTT} = .75(29.77) + .25(153 - 100.85) = 35.365\text{ms}$$

$$\text{TimeoutInterval} = 111.28 + 4(35.365) = 252.74\text{ms}$$

3. a.) Sequence number =  $257 + 90 = 347$

Source port = 3120

Destination port = 5470

b.) ACK# is 257

c.) ACK# is 347

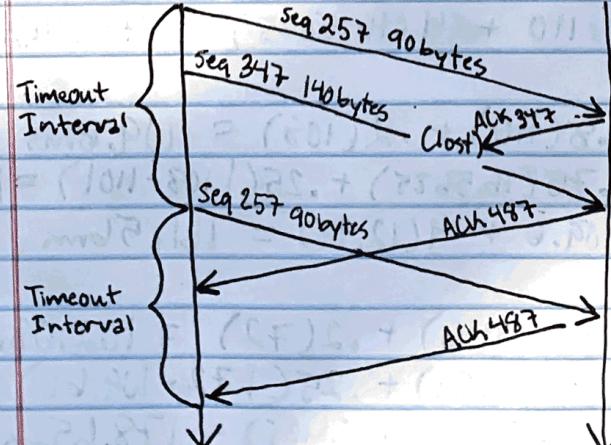
Source port = 5470

Destination port = 3120

d.)

Host A

Host B



4. To avoid having an overlap between the sender and receiver windows, we would need a window size at least twice as <sup>small</sup> the sequence number space.  $X \geq 2(\text{window size})$

	Transmission #	Congestion Window	Threshold
(MSS 6kb)	0	6kb	32kb
	1	12kb	32kb
	2	24kb	32kb
	3	30kb	32kb
	4	36kb	32kb
(cwnd = 1MSS)	5	42kb	32kb
Timeout	6	48kb	24kb
	7	6kb	24kb
	8	12kb	24kb
	9	24kb	24kb
	10	30kb	24kb
(cwnd = $\frac{cwnd}{2}$ )	11	36kb	24kb
Triple Duplicate	12	18kb	18kb
(threshold = $\frac{cwnd}{2}$ )	13	24kb	18kb
	14	30kb	18kb
	15	36kb	18kb
	16	42kb	18kb
	17	48kb	18kb

6. a.) GBN:

- Host A sends  $7 + 5 = 12$  total segments

7 original 1, 2, 3, 4, 5, 6, 7

5 resend 3, 4, 5, 6, 7

- Host B sends 11 ACKs

1, 2, 2, 2, 2, 2, 3, 4, 5, 6, 7

SR:

- Host A sends 8 segments

1, 2, 3, 4, 5, 6, 7, 3

- Host B sends 7 ACKs

1, 2, 4, 5, 6, 7, 3

TCP:

- Host A sends 8 segments

1, 2, 3, 4, 5, 6, 7, 3

- Host B sends 7 ACKs

~~2, 3, 3, 3, 3, 3, 8~~ ~~2, 3, 3, 3, 3, 3, 8~~

3, 3, 3, 3, 3, 3, 8

b.) TCP will deliver all segments in the shortest time interval due to the fast retransmit that does not wait until timeout.