Assignment 6

Deepak Konidena

1. The sequence number must not wrap around in the Maximum segment lifetime. In 60 sec, if the bandwidth is 100 Mbps, around

100 Mbps X 60 sec => 750 MB can be transmitted.

30 bits allow a sequence space of 1024 MB and hence the numbers will not wrap in 60 seconds.

The advertised window should be large enough to keep the pipe full.

Delay(RTT) X Bandwidth = 100 ms X 100 Mbps = 1.25 MB.

And that requires around **21 bits** for the **AdvertisedWindow** field.

2. a) The sequence number field in TCP header is 32 bits, or in other words 2^{32} B or 4 GB worth of data can be sent before the sequence numbers start wrapping around. The bandwidth of the given link is 1-Gbps or 1000 Mbps or 125 MB/ sec. So it would take

4 GB/ (125 MB/ sec) = 32 seconds.

b) The added 32-bit time stamp increases 1000 times every 32 seconds or 1 time every 32 ms. So, it would take

2^{32} X 32 ms => 4 X 10^9 X 32 ms => 4 X 32 X 10^6 sec => approx 4 years (since 32 X 10^6 sec is an year) for the timestamp to wrap around.

3. At

t = 0 sec , 'a' is sent
t = 1 sec , 'b' is collected in the send buffer
t = 2 sec , 'c' is collected in the send buffer
t = 3 sec , 'd' is collected in the send buffer
t = 3 sec , 'e' is collected in the send buffer
t = 4.1 sec , ACK of 'a' is received and 'bcde' is sent
t = 5 sec , 'f' is collected in the send buffer
t = 6 sec , 'g' is collected in the send buffer
t = 7 sec , 'h' is collected in the send buffer
t = 8 sec , 'i' is collected in the send buffer
t = 8.2 sec , ACK of 'bcde' is received and 'fghi' is sent

4. Karn-partridge algorithm

Timeouts occur whenever there is congestion in the network. And that means to send fewer packets from the bandwidth's point of view. Exponential backoff gives the network longer time (twice) to deliver packets thus aiding the overtaxed routers. It accommodates sharp increases in RTT.

5. alpha = 0.9
mu = 1
phi = 4
delta = 1/8 = 0.125

Difference = Sample RTT – Estimated RTT
Estimated RTT = Estimated RTT + (delta * Difference)
Deviation = Deviation + delta [|Difference| - Deviation]
Jacobson/Karel's Timeout = mu* Estimated RTT + phi * Deviation
Original Algorithm's Timeout = 2*Estimated RTT

Lets assume there these sample RTTs are from successively transmitted segments.

	Sample RTT	Estimated RTT	Deviation	Difference	**EstimatedRTT+ 4*Deviation**	**2*EstimatedRTT**
		1.0	0.1		1.4	2.0
1	5.0	1.5	0.59	4.0	3.85	3.0
2	5.0	1.94	0.95	3.5	5.74	3.88
3	5.0	2.32	1.22	3.06	7.18	4.64
4	5.0	2.66	1.40	2.68	8.25	5.32
5	5.0	2.95	1.51	2.34	8.99	5.90
6	5.0	3.20	1.57	2.05	9.48	6.40
7	5.0	3.42	1.59	1.80	9.78	6.84
8	5.0	3.61	1.58	1.58	9.93	7.22
9	5.0	3.78	1.55	1.39	9.98	7.56
10	5.0	3.93	1.50	1.22	9.93	7.86

Jacobson/ Karels algorithm

TimeOut = EstimatedRTT+ 4*Deviation

There are a total of three timeouts, two for packet 1 and one for packet 3.

The maximum value for TimeOut, is 9.98 at Row 9, after which point TimeOut decreases toward 5.0.

Original algorithm

TimeOut = 2*EstimatedRTT

There are five timeouts for packets 1, 2, 4, 6, 8.

TimeOut continues to increase towards 10.0, as EstimatedRTT converges on 5.0.