Chris
Bero

HW 8
CPE 448

1. The TCP Sequence number can wrap around in under $2^{32}-1$ bytes because the first number is chosen at random, so the first byte can have a large Sequence num.

2. TCP, 1 Gbps network, RTT 100ms, max segment life 30s.
   a. delay x bandwidth = $0.1s \times 1 \times 10^9 b/s = 12.5MB$
   $2^{24} = \sim 16.8MB$, enough to handle full transmission, so the Advertised Window field should be 24 bits.
   In 30s: $30s \times 1GB/s = 3.75GB$, $2^{32} = \sim 4.29GB$, so the Sequence Num field should be 32 bits.
   b. RTT can be pretty directly measured by a utility similar to ping. Bandwidth would probably be gathered from the slowest link in the connection. Segment lifetime is a pretty uncertain value, and has to be tuned to the network.

3. 1 Gbps link. Sequence Num field 32 bits → 4.3 GB.
   1 Gbps → 125 MBps → 0.125 GB/s
   $4.3GB / 0.125 GB/s = \boxed{34.4s}$
   b. 32-bit timestamp → 4,294,967,296; must increment 4,294,967 times to overflow.
   $4,294,967 \times 34.4s = \boxed{147\,746\,864.8s}$ → 41K hours → ~4½ years

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4.

Packet	Flow	Size	F_i	Weighted F_i
1	1	100	100	100
2	1	100	200	200
3	1	100	300	300
4	1	100	400	400
5	2	190	190	95
6	2	200	390	195
7	3	110	110	110
8	3	50	160	160

a) Transmit order by F_i for fair queuing:
1, 7, 8, 5, 2, 3, 6, 4

b) Transmit order by F_i with weighted fair queuing:
5, 1, 7, 8, 6, 2, 3, 4

5.

Time	1	2	3	4	5	6	7	8	9
Flow A	A_1	A_2		A_4			A_7		A_9
Flow B		B_2	B_3		B_5	B_6			
Flow C	C_1		C_3	C_4	C_5		C_7	C_8	C_9
Ai Part	1/2	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Ai Total	1/2	5/6	1 1/6	1 4/6	2	2 2/6	2 4/6	3	3 2/6

a) Output: A_1 C_1 B_2 A_2 C_3 B_3 A_4 C_4 B_5 A_7 C_5 B_6 A_9 C_7 C_8 C_9

Flow A	Fi
1	1.5
2	2.5
4	3+3/6
7	4+3/6
9	5+3/6

Flow B	Fi
2	1+5/6
3	2+5/6
5	3+5/6
6	4+5/6

Flow C	Fi
1	1.5
3	2+3/6
4	3+3/6
5	4+3/6
7	5+3/6
8	6+3/6
9	7+3/6

b)

Flow C	Fi
1	1
3	1 4/6
4	2 1/6
5	2 4/6
7	3 1/6
8	3 4/6
9	4 1/6

Output: C_1 A_1 C_3 B_2 C_4 A_2 C_5 B_3 C_7 A_4 C_8 B_5 C_9 A_7 B_6 A_9