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CS-421-002, Homework 1.

(Q1)

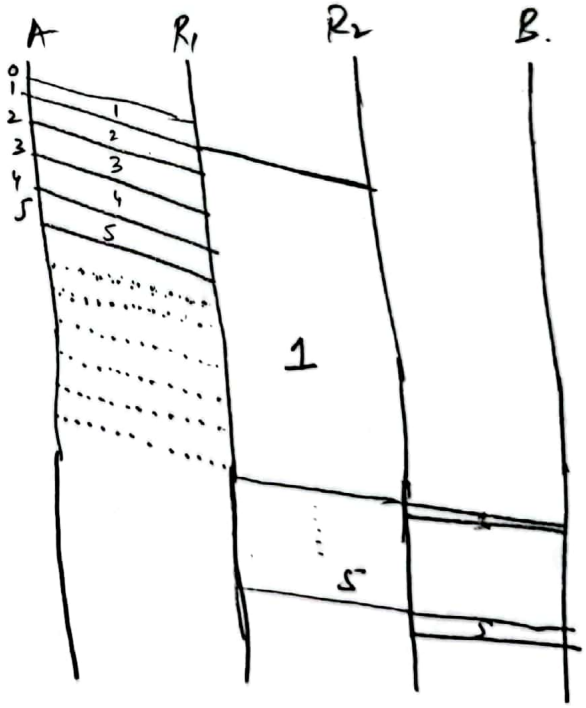
$$T_{\substack{A-R_1 \\ \& \\ R_2-B}} = \frac{1250 \times 8 \text{ bits}}{10 \times 10^6} = \frac{10,000}{10 \times 10^6} = 1\text{ms}.$$

$$T_{R_1-R_2} = \frac{1250 \times 8}{1 \times 10^6} = 10\text{ms}. \quad \& \quad T_{prop} = \frac{400}{2 \times 10^8} = 2\text{ms} \text{ for each link.}$$

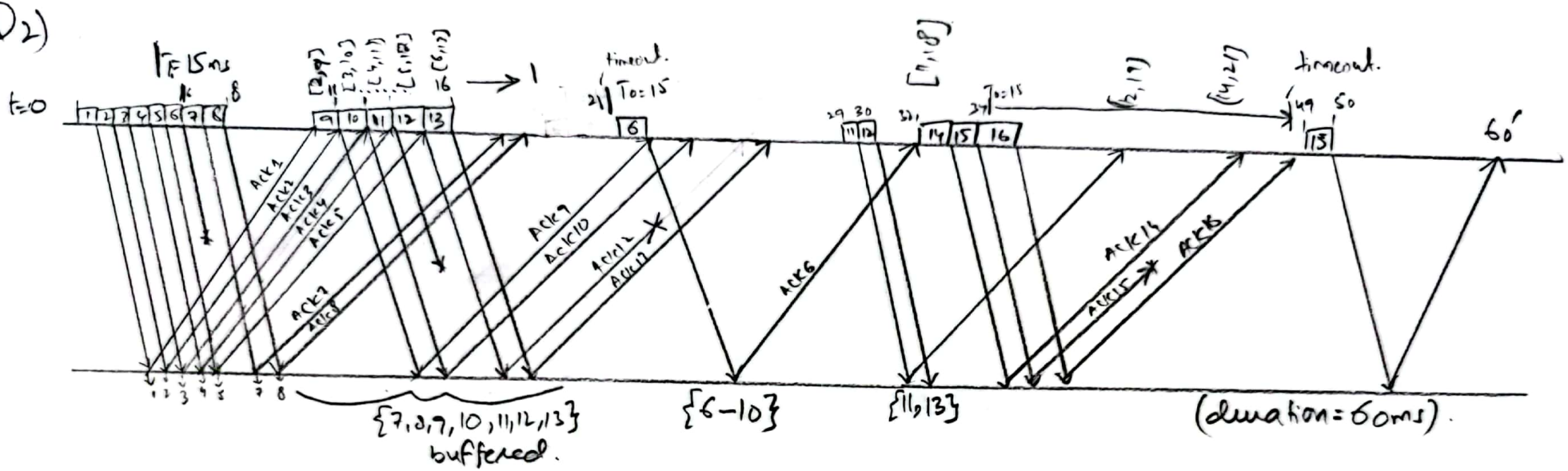
The total delay occured is =>

$$T = (3 \times 2\text{ms}) + 1\text{ms} + (5 \times 10\text{ms}) + 1\text{ms}$$

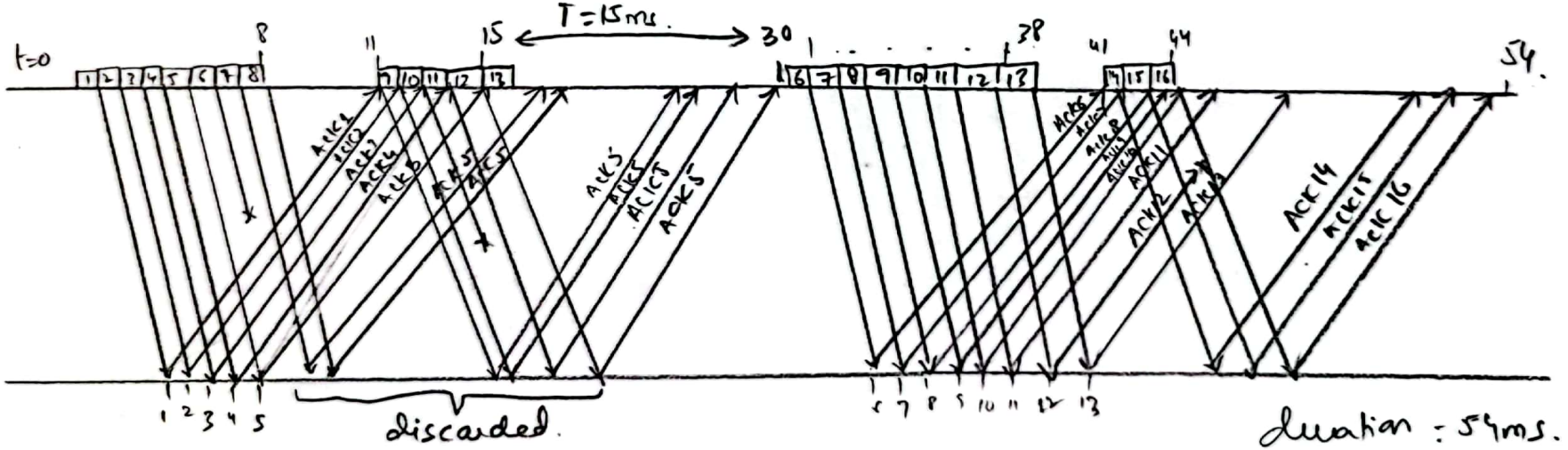
$$\Rightarrow 58\text{ms}.$$



(Q2)



(Q3)

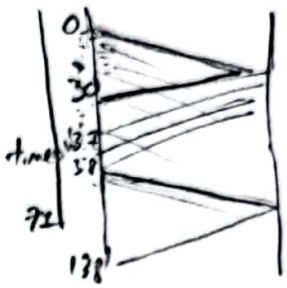


(Q4) Estimated RTT = $[30 \times 0.9 + 100 \times 0.1] = 37$ ms.

devRTT = $|44-30| \times 0.9 + |44-100| \times 0.1 = 18.2$ ms.

(i) Timeout = $2 \times 37 = 74$ ms.

10% of packets assumed lost.



(ii) Timeout = $37 + (4 \times 18.2) = 72.8 + 37 \Rightarrow 109.8$.

10% of packets still assumed lost.

(Q6) (i) congWin < ssthresh ⇒ slow start phase

congWin after three ACKs = $5000 + 3 \times 1000 = 8000$ bytes

TCP win = min {congWin, RcvWind} = min {8000, 3000} =

⇒ 3000 Bytes.

no. of unacknowledged bytes at time=t is 2000 bytes,

Hence, sender can send 3000 − 2000 = 1000 bytes more.

(ii) TCPwind = min {8000, 12000} = 8000 bytes.

Hence, sender can send 8000 − 2000 = 6000 bytes more.

(Q7) $Rtt_1 = \frac{RTT_3}{6}$, $RTT_2 = \frac{RTT_3}{3}$ ⇒ $Thr_1 = 6Thr_3$ &

$Thr_2 = 3Thr_3$

$Thr_1 + Thr_2 + Thr_3 = 1000$ Mbps

⇒ $Thr_1 = 60$ Mbps, $Thr_2 = 30$ Mbps, $Thr_3 = 10$ Mbps.

(Q8)(i) Delay-bandwidth = 10 Mbps × 10 ms = 10^5 bit

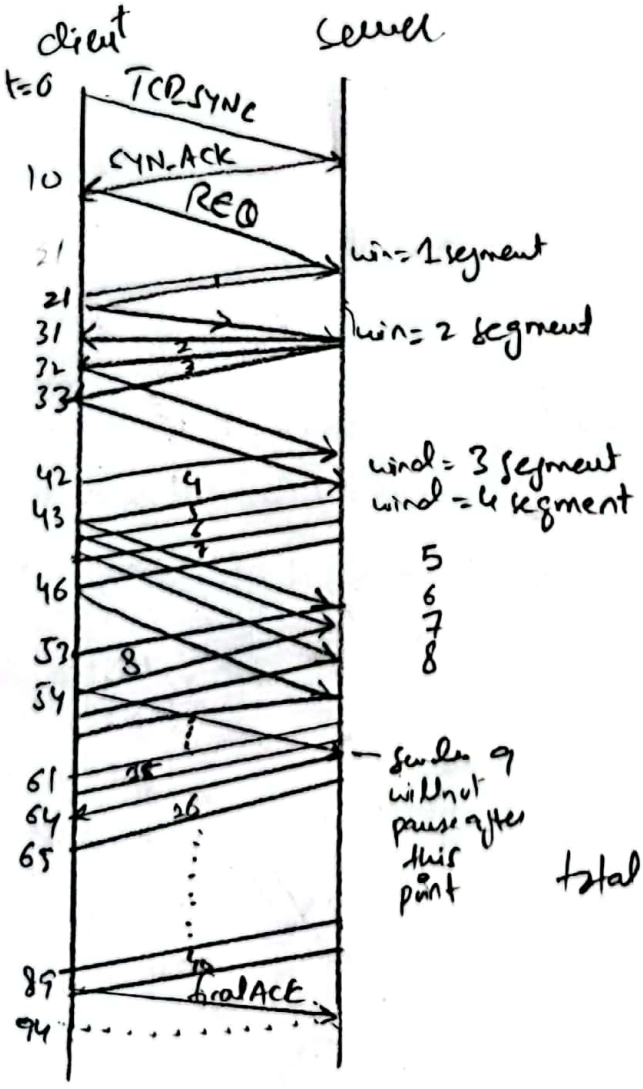
= 12.5 kBytes.

Since, no buffer is available, when window reaches 12.5 kB, there will be a loss event and window will shrink. Therefore, max window size = 12.5 kB.

(ii) Delay-bandwidth product = 125 kBytes

since RecWin = 64 kBytes, which is limited by the 16-bit receive window field in TCP header, max window size is 64 kB.

(Q10)



$T = \frac{1250 \times 8}{10 \times 10^6} = 1\text{ms}.$

total Delay = 94 ms.