CSI4118

Assignment2 – Part 1 Mehezabin Ahamed 8524484

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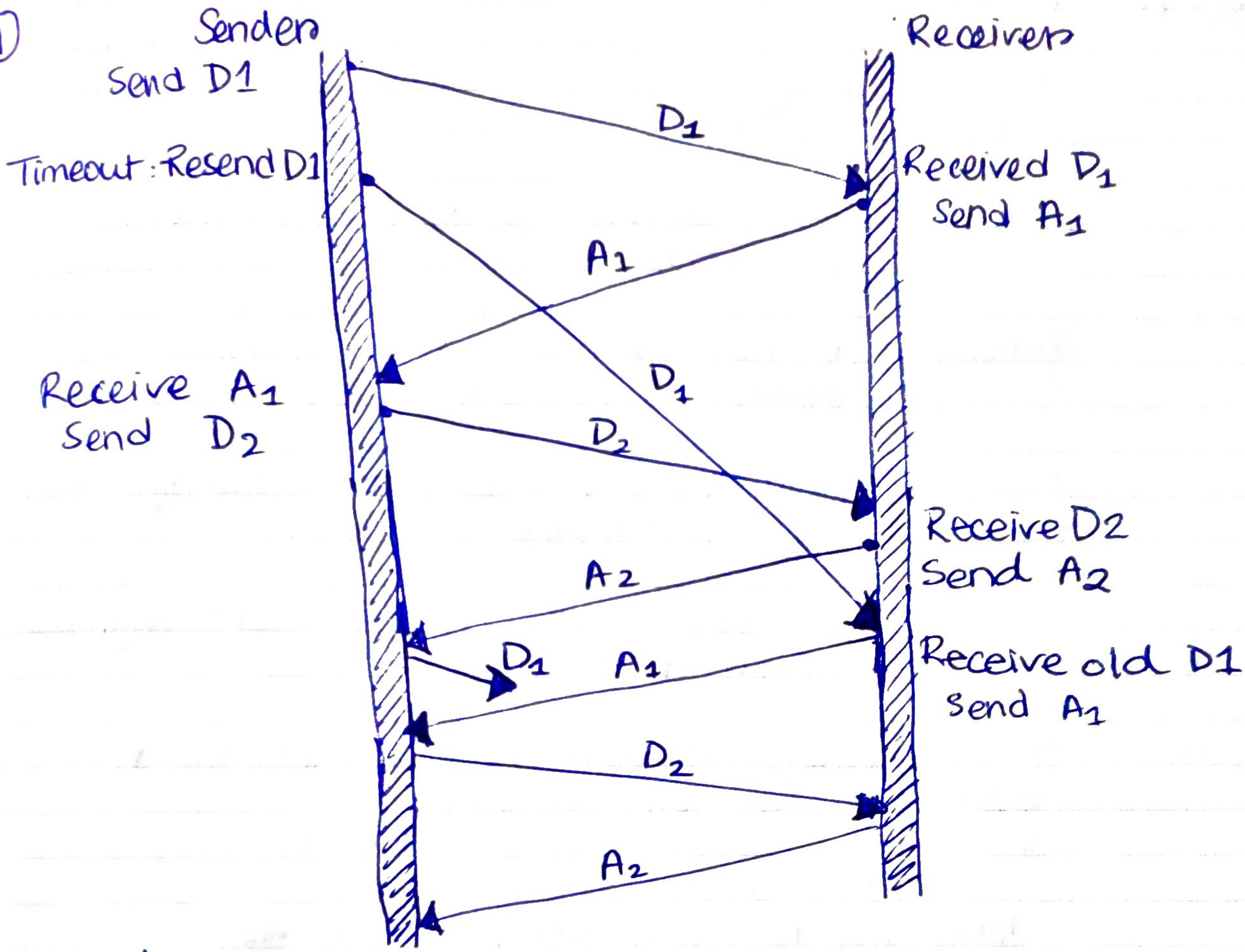

In the diagram, D1 & D2 are data with sequence no. 1 & 2 and same for A1 & A2 acknowledgements.

2. (a) Bandwidth = 1 Gbps , segment size = 576 octets.

1 octet = 8 bits. $\qquad$ 60 ms = 0.06 s

1 Gb = 10^9 bits

Window Size $= \frac{10^9 \times 0.06}{576 \times 8} \approx$ 13,000 segments.

Following timeout, window size halves.
$\Rightarrow$ window size $\approx$ 6500 segments

From this point, there will be exponential growth before the congestion threshold is passed.

Window size increases to 2^{13} = 8192 segments, where RTT = 13.

Now, it follows additive increase until we reach the full window size.
This takes $\quad$ 13000 − 8192 = 4808 RTT.
Total RTT = 4808 + 13 = 4821
Total time to reach full window
$\Rightarrow$ 4821 x 0.06
= 289.26 seconds.

(b) Window size $= \frac{10^9 \times 0.06}{16 \times 10^3 \times 8} \approx$ 460 segments.

Threshold when halved after timeout = 230 seg

2^8 = 256 segments, where RTT = 8

For additive increase, 460 − 256 = 204 RTT
Total RTT = 212 RTT

Total time to reach full window size,
$\Rightarrow$ 212 x 0.06
= 12.72 seconds.

(3) Arrival rate $= 300$ packets/sec $= \lambda$
Packet length $=$ 500 bytes $=$ 4000 bits.
Link Capacity $= 1.5$ Mbps $= 1.5 \times 10^6$ bits/sec

$$\mu = \frac{1.5 \times 10^6 \text{ bits/s}}{4000} = 375 \text{ packets/sec}$$

$$\text{Utilization, } \rho = \frac{\lambda}{\mu} = \frac{300}{375} = 0.8$$

Mean ~~#~~ of packets in queue,

$$\Rightarrow \frac{\rho}{1-\rho} = \frac{0.8}{1-0.8} = 4$$

Probability that queue has

(1) packet

$$(1-\rho)(\rho^2)$$
$$= (1-0.8)(0.8^2)$$
$$= 0.128$$

$\boxed{\text{one packet is being served at all times}}$

(2) packets

$$(1-\rho)(\rho^3)$$
$$= (1-0.8)(0.8^3)$$
$$= 0.102$$

(10) packets

$$(1-\rho)(\rho^{11})$$
$$= (1-0.8)(0.8^{11})$$
$$= 0.017$$

(4) The input rate ~~per~~ (second) $= \dfrac{50 \text{ gal}}{60 \text{ sec}} = 5/6$ gal/sec

The output rate (second) $= \dfrac{8}{60} = 2/15$ gal/sec

Hence, capacity $= (5/6 \times 10) - (2/15 \times 10)$

$= 7$ gal