Computer Networks

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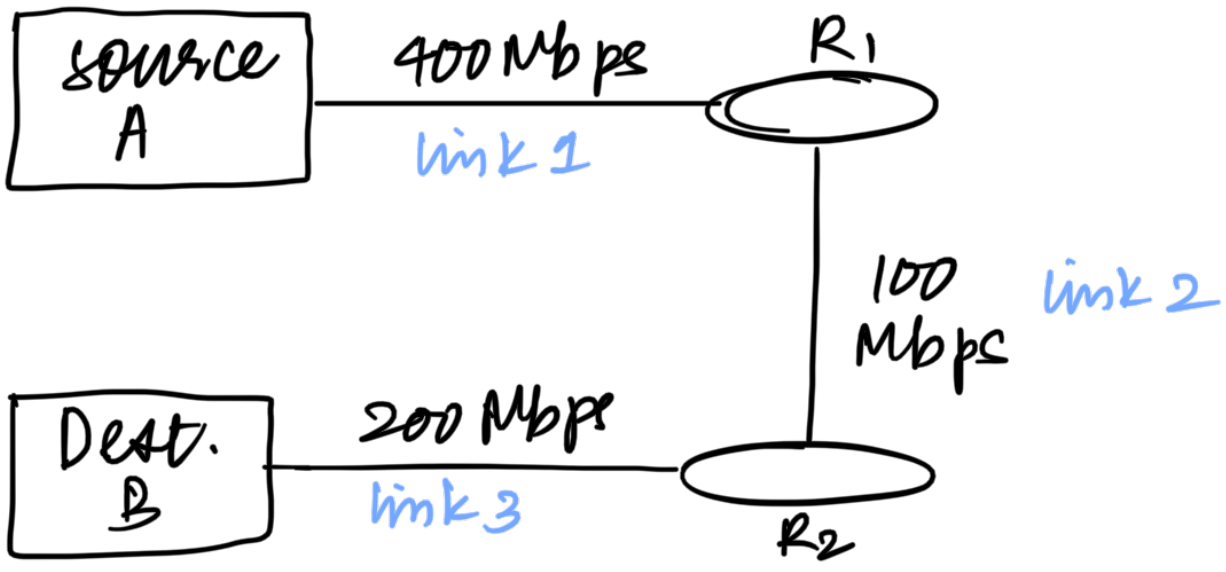
Assignment 1 : part 2

(2)



Message size : 100 kilobytes = 10^5 bytes

Metadata : 100 bytes

1 packet :

packet size = 100000 + 100

= 100100 bytes = 800800 bits

transmission delay (for link 1) = $\frac{100100 \cdot 8}{400 \cdot 10^6}$

= 250.25 × 8 μs

for link 2 = $\frac{100100 \cdot 8}{100 \cdot 10^6}$ = 1001 × 8 μs

for link 3 = $\frac{100100 \cdot 8}{200 \cdot 10^6}$ = 500.5 × 8 μs

total time = 1751.75 × 8 μs

= 14.014 ms

10 packets :

$$\text{packet size} = \frac{100000}{10} + 100 = 10100 \text{ bytes}$$

$$= 10100 \times 8 \text{ bits}$$

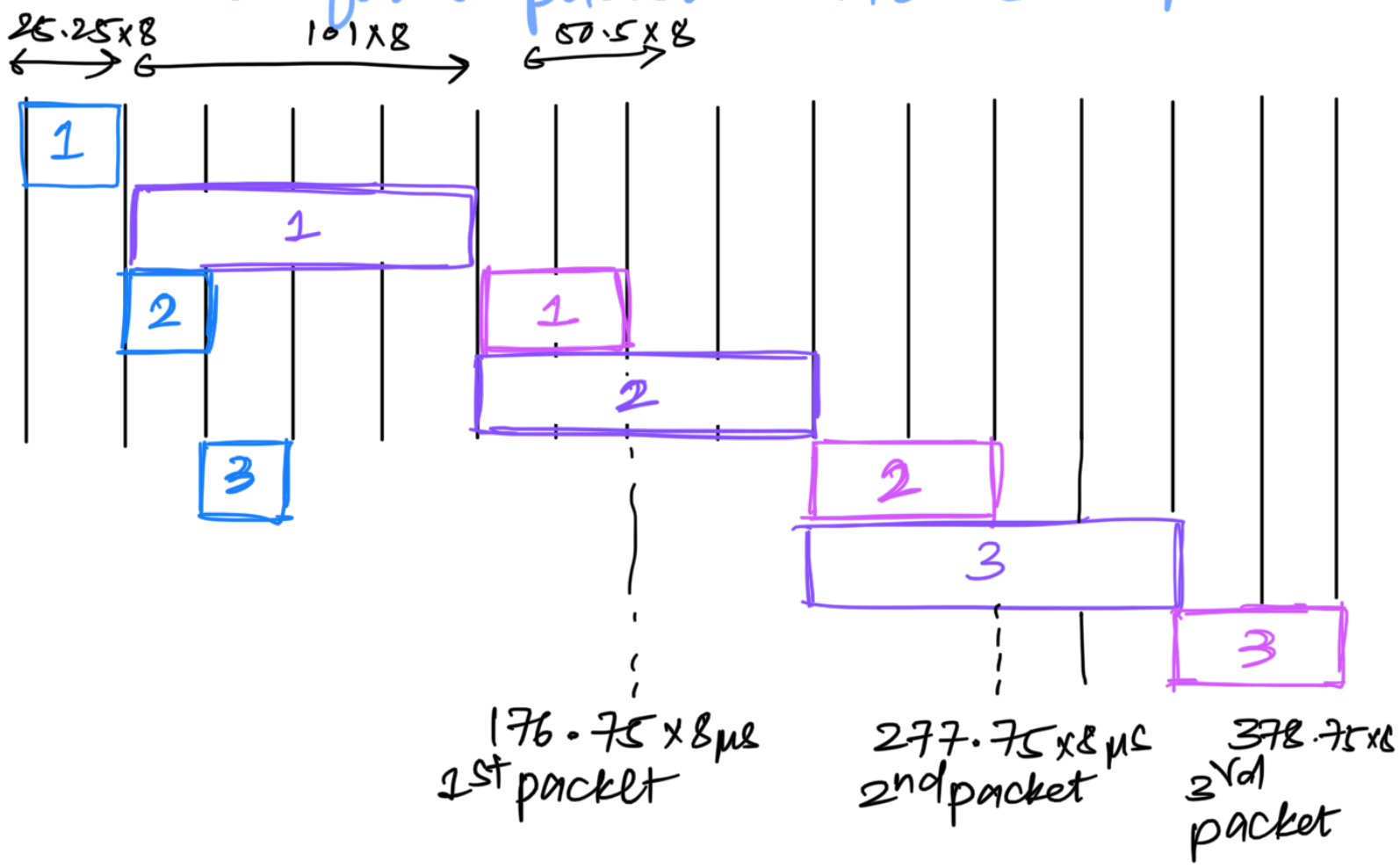
transmission delay:

Link 1 : 25.25×8 μs

Link 2 : 101×8

Link 3 : 50.5×8 μs

time for 1 packet = 176.75×8 μs



time for 10 packets = $(25.25 + 50.5 + 10(101)) \times 8$

$= 1085.75 \times 8$ μs

$= 8.686$ ms

50 packets :

$$\text{packet size} = \frac{100000}{50} + 100 = 2100 \text{ bytes}$$

$$= 2100 \times 8 \text{ bits}$$

transmission rate :

$$\text{link 1}: \frac{2100 \times 8}{400 \times 10^6} = 5.25 \times 8\ \mu s$$

$$\text{link 2}: \frac{2100 \times 8}{100 \times 10^6} = 21 \times 8\ \mu s$$

$$\text{link 3}: \frac{2100 \times 8}{200 \times 10^6} = 10.5 \times 8\ \mu s$$

$$\text{total time} = (5.25 + 10.5 + 21 \times 50) \times 8$$
$$= 8.526\ ms$$

100 packets:

$$\text{packet size} = \frac{100000}{100} + 100 = 1100 \text{ bytes}$$
$$= 1100 \times 8 \text{ bits}$$

$$\text{total time} = \left(\frac{1100}{400} + \frac{1100}{200} + 100 \times \frac{1100}{100}\right) \times 8$$
$$= (2.75 + 5.5 + 1100) \cdot 8$$
$$= 8866\ \mu s$$
$$= 8.866\ ms$$

delivery time for:

1 packet	=	14.014 ms
10 packets	=	8.686 ms
50 packets	=	8.526 ms
100 packets	=	8.866 ms

∴ 50 packets give the lowest delivery time

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(a) propagation delay : time taken for 1st bit to travel from sender to receiver

$$= \frac{\text{distance}}{\text{speed of propagation}}$$

$$= \frac{10 \times 1000 \text{ meters}}{\frac{2}{3} \times 3 \times 10^8 \text{ m/s}}$$

$$= \frac{10^4}{2 \cdot 10^8} \text{ s}$$

$$= 50 \mu s$$

(b) It takes 50 μs for the first bit sent by R1 to reach R2

no. of bits that R1 can send

$$= 50 \mu s \times 100 \text{ Gbps}$$

$$= 50 \times 10^{-6} \times 100 \times 10^9$$

$$= 5 \times 10^6 \text{ bits} = 5 \text{ Mb}$$

(c) bit width $= \frac{10 \text{ kms}}{5 \times 10^6 \text{ bits}} = \frac{10 \times 1000}{5 \times 10^6}$

$$= 2 \times 10^{-3} \text{ meters} = 2 \text{ mm}$$

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RTT : 10 ms

webpage size : 1KB + 10 objects of 100KB

let timetaken to load 1KB be t s.

(a) HTTP 1.0 (non-persistent)

total time required :

1 + 1 + 2×10

for connection ↙ for webpage ↓ for 10 objects + connections →

= 22 RTT + time to load files

= 22 × 10ms + 1001.t

= 1001t + 0.22s

(b) HTTP 1.1 (persistent)

total time required :

1 + 1 + 10 = 12 RTT + time taken to load files

for connection ↙ for webpage ↓ for 10 objects →

= 1001t + 0.12 s

(c) HTTP 2.0 (persistent + pipelined & data frames of 1KB each)

= 1 + 1 + 1 = 3RTT + 1001t

for connection ↙ for webpage ↓ for all the files →

= 1001t + 0.03s