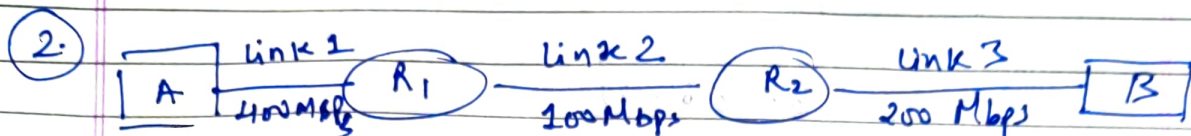


19110207

VISHAL SONI



Message size = $100 \text{ KB} = 10^5 \text{ bytes}$.

Metadata = 100 bytes.

1 Packet \Rightarrow

$$\begin{aligned} \text{packet size} &= 100000 + 100 \\ &= 100100 \text{ bytes} \\ &= 800800 \text{ bits} \end{aligned}$$

$$\begin{aligned} \text{transmission delay (Link 1)} &= \frac{100100 \times 8}{400 \times 10^6} \\ &= 250.25 \times 8 \text{ } \mu\text{s} \end{aligned}$$

$$\begin{aligned} \text{Link 2} &= \frac{100100 \times 8}{100 \times 10^6} = \frac{1001}{100} \times 8 \text{ } \mu\text{s} \\ &= 10.01 \times 8 \text{ } \mu\text{s} \end{aligned}$$

$$\begin{aligned} \text{Link 3} &= \frac{100100 \times 8}{200 \times 10^6} = 50.05 \times 8 \text{ } \mu\text{s} \\ &= 50.05 \times 8 \text{ } \mu\text{s} \end{aligned}$$

$$\begin{aligned} \text{total time} &= 1751.75 \times 8 \text{ } \mu\text{s} \\ &= 14.014 \text{ ms} \end{aligned}$$

10 packets \Rightarrow

$$\begin{aligned} \text{packet size} &= \frac{100000}{10} + 100 = 10100 \text{ bytes} \\ &= 10100 \times 8 \text{ bits} \end{aligned}$$

transmission delay \Rightarrow

$$L1: 25.025 \times 8 \text{ } \mu\text{s}$$

$$L2: 10.01 \times 8$$

$$L3: 50.05 \times 8 \text{ } \mu\text{s}$$

$$\begin{aligned} \text{time for 1 packet} &= 176.75 \times 8 \text{ } \mu\text{s} \\ &= 176.75 \times 8 \text{ } \mu\text{s} \end{aligned}$$

Time for 10 packets =

$$21000 = (25 \cdot 25 + 50 \cdot 5 + 10(10)) \times 8 \text{ ms}$$
$$\boxed{8.686 \text{ ms}}$$

$$21000 = 21000 = 2518 \text{ packets/s}$$

50 packets \Rightarrow

$$\text{packet size} = \frac{100000}{50} + 100 = 2100 \text{ bytes}$$
$$= 2100 \times 8 \text{ bits}$$

transmission rate \Rightarrow

$$11: \frac{2100 \times 8}{400 \times 10^6} = 5.25 \times 8 \text{ ms}$$

$$12: \frac{2100 \times 8}{100 \times 10^6} = 2108 \text{ ms}$$

$$13: \frac{2100 \times 8}{200 \times 10^6} = 10.5 \times 8 \text{ ms}$$

$$\text{total time} = (5.25 + 10.5 + 21000) \times 8$$
$$= 8.526 \text{ ms}$$

100 packets \Rightarrow

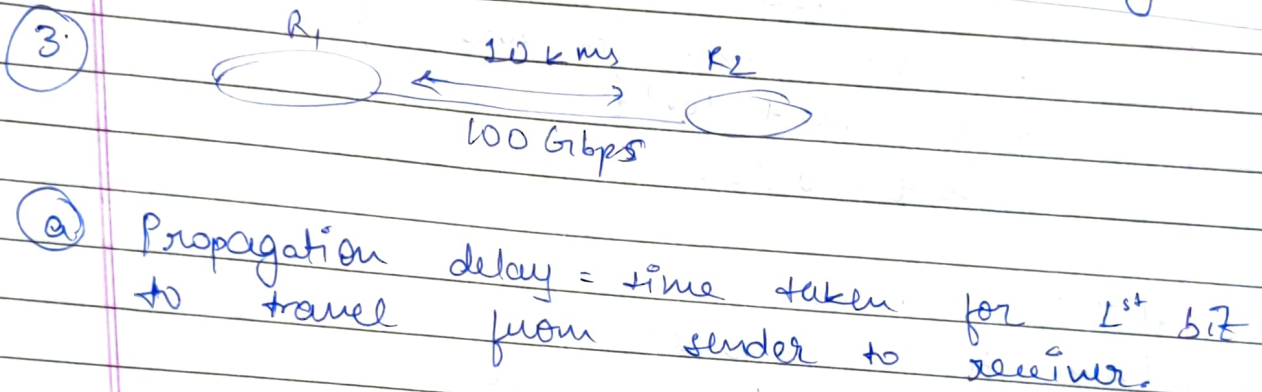
$$\text{packet size} = \frac{100000}{100} + 100 = 1100 \text{ bytes}$$
$$= 1100 \times 8 \text{ bits}$$

$$\text{total time} = \left(\frac{1000}{400} + \frac{1000}{200} + \frac{100 \times 1100}{100} \right) \times 8 \text{ ms}$$
$$= 8.866 \text{ ms}$$

Delivery time for \rightarrow

1 Packet	:	14.014 ms
40 Packets	:	8.686 ms
50 "	:	8.526 ms
100 "	:	8.866 ms

\therefore 50 Packets give the lowest delivery time.



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

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

$$= 50 \text{ ns}$$

(b) It takes 50 ns for the first bit sent by R_1 to reach R_2 . ~~no. of bits sent~~
 no. of bits that R_1 can send
 $= 50 \text{ ns} \times 100 \text{ Gbps}$
 $= 5 \text{ Mb}$

(c) bit width = $\frac{10 \text{ km}}{5 \times 10^6 \text{ bits}} = \frac{10 \times 1000}{5 \times 10^6} = 2 \text{ mm}$

4.

$$RTT = 10ms$$

Web page size = 1KB + 10 objects of 100 KB

Let time taken to load 1KB $\rightarrow t$ sec

a) HTTP 1.0 (non-persistent)

total time required =

$$1 + 1 + 2 \times 10$$

$$= 22 RTT + \text{time for loading files}$$

$$= 22 \times 10ms + 1001t$$

$$= 1001t + 0.22s$$

b) HTTP 1.1 (persistent)

total time required =

$$1 + 1 + 10 = 12 RTT$$

$\downarrow \quad \downarrow \quad \downarrow$
connection webpage 10 objects + time taken to load files.

$$= 1001t + 0.12s$$

c) HTTP 2.0 (persistent + pipelined &

data transfer of 1KB each)

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

$\downarrow \quad \downarrow \quad \downarrow$
conn webpage files

$$= 1001t + 0.03s$$