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Networks Assignment - 2

27 (A) —Link1 400 Mbps— (R1) —Link2 100 Mbps— (R2) —Link3 200 Mbps— (B)

Msg size = 100 KB

Additional meta data = 100 bytes (header)

Given $T_{proc} = T_{PRop} = 0$

(a) 1 Packet & Packet size = 100×10^3 bytes + 100 bytes

= 1001 x 800 bits

$T = \frac{size}{Bandwidth}$

Total time = $T_1 + T_2 + T_3$

$= 1001 \times 800 \left(\frac{1}{400 \times 10^6} + \frac{1}{100 \times 10^6} + \frac{1}{200 \times 10^6} \right)$

$= \frac{1001 \times 800}{10^8} \left[\frac{1}{4} + 1 + \frac{1}{2} \right]$

$= \frac{1001 \times 2}{10^6} \left[\frac{1 + 4 + 2}{4} \right]$

$= \frac{1001 \times 2 \times 7}{10^6}$ s

Ans = 14.014 ms

(b) 10 packets & Sending the next packet as soon as the packet reaches the receiver of the link.

Packet size = $\frac{100 \times 10^3}{10}$ + 100 bytes

= 10100 x 8 bits

Transmission delays

For link 1 :- $\frac{\text{size}}{\text{Bandwidth}} = \frac{10100 \times 8}{400 \times 10^6} = 202\,\mu s$

For link 2 :- $\frac{\text{size}}{\text{Bandwidth}} = \frac{10100 \times 8}{100 \times 10^6} = 808\,\mu s$

For link 3 :- $\frac{\text{size}}{\text{Bandwidth}} = \frac{10100 \times 8}{200 \times 10^6} = 404\,\mu s$

link 2 > link 3 > link 1

- Our bottleneck is link 2. It takes the most time.

Total time $= t_1 + t_2 + t_3$

$= 202 + n \times 808 + 404$ (n ↑ no of packets)

$n = 10$ here

$T = (202 + 10 \times 808 + 404)\,\mu s$

$T = 8.686\ ms$

The general formula for the given network's delay is:

$$T = T_{l_1} + n \times T_{l_2} + T_{l_3}$$

(c) 50 packets :- Packet size $= \frac{100 \times 10^3}{50} + 100$

$= \frac{100 \times 1000}{50} + 100$

$= 2100 \times 8$ bits

Transmission delays:

$T_{l_1} = \frac{2100 \times 8}{400 \times 10^6} = 42\,\mu s$

$T_{l_2} = \frac{2100 \times 8}{100 \times 10^6} = 168\,\mu s$

$T_{l_3} = \frac{2100 \times 8}{200 \times 10^6} = 84\,\mu s$

$\therefore$ $T = 42 + 50 \times 168 + 84 = 8576\ \mu s$

$\boxed{T = 8.576\ ms}$

(d) 100 packets : Packet size $= \frac{100 \times 10^3}{100} + 100$

$= 1100 \times 8$ bits

Transmission delays :

$T_{L1} = \frac{1100 \times 8}{400 \times 10^6} = 22\ \mu s$

$T_{L2} = \frac{1100 \times 8}{100 \times 10^6} = 88\ \mu s$

$T_{L3} = \frac{1100 \times 8}{200 \times 10^6} = 44\ \mu s$

$T = 22 + 100 \times 88 + 44 = \boxed{8.866\ ms}$

Hence the lowest time taken is $T = 8.526$ ms for $\boxed{n = 50 \text{ packets}}$

3) Bandwidth = 100 Gbps

Propagation speed $= \frac{2c}{3}$ where $c = 3 \times 10^5$ m/s

length = 10 kms

(a) Propagation delay : $\frac{\text{Distance}}{\text{speed}} = \frac{10 \times 10^3}{3 \times 10^8 \times \frac{2}{3}}$

$= 5 \times 10^{-5}$

$= \boxed{50\ \mu s}$

(b) Max number of bits sent by R1 until first bit reaches R2.

No of bits = Propagation delay × Bandwidth
= $50 \times 10^{-6} \times 100 \times 10^9$
= 3Mb

(c) Bit width = $\frac{\text{Distance}}{\text{Max bits in that distance}}$

= $\frac{10 \times 10^3}{5 \times 10^6}$ = 2m/b

4) RTT = 10ms
Size of webpage = 1KB
object size = 100KB 10 objects

→ Let us assume that the file transmission time is 't' seconds for 1KB data.
↳ My choice to minimize calculation.

(a) HTTP 1.0 (Non persistent connection)

$T = \sum_{i=1}^{n} (RTT + RTT) + (1 \times 10 \times 100)t$

Total requests; Total size of files to be transmitted in KB.

= $2 \times n \times RTT + 1001t$
= $220ms + 1001t$
$T = (0.22 + 1001t)s$

(b) HTTP 1.1 (Persistent connection)

$T = RTT + \sum_{i=1}^{n} RTT$ + total transmission time

$= 10ms + n \times 10ms + 100lt$ (n = 11)

$= 120ms + 100lt$

$\boxed{T = (0.12 + 100lt)\,s}$

(c) HTTP 2.0 (Persistent + Pipelined + Dataframes of 1KB)

$T =$ RTT (connection) + RTT (webpage) + RTT (objects) + File transmission time

$T = (10+10+10)ms + 100lt$

$= 30ms + 100lt$

$\boxed{T = (0.03 + 100lt)\,s}$