CHP 01 PRACTICE QUESTIONS

day / date:

21K-3202
Sec 6F

Q1) Total bandwidth = 2 Mbps

Bandwidth per user = $\frac{\text{Total bandwidth}}{\text{No. of users}}$

{for one user}

$$M = \frac{2M}{N}$$

$$N = 2M/M$$
$$N = 2 \text{ users}$$

{since 1Mbps is transmitted by a user
∴ 2 users}

Q2) $L = 1000$ bytes
$d = 2500km = 2.5 * 10^6 m$
$R = 2 Mbps = 2 * 10^6 bps$
$d_{prop} = ?$
$S = 2.5 * 10^8 m/s$

$$d_{prop} = \frac{d}{S} = \frac{2.5 * 10^6}{2.5 * 10^8} = 1 * 10^6 s$$

Q3) $R_1 = 500kbps = 5.0 \times 10^5 bps$
$R_2 = 2Mbps = 2.0 \times 10^6 bps$
$R_3 = 1Mbps = 1.0 \times 10^6 bps$

a. Throughput $= \min(R_1, R_2, R_3)$
$= \min(5.0 \times 10^5, 2.0 \times 10^6, 1.0 \times 10^6)$
$= 5.0 \times 10^6 bps$

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b. File size = 4Mb = 4×10^6 bytes

time taken to transmit data in bits = ?

$T \therefore \dfrac{\text{File size}}{\text{throughput}} = \dfrac{4 \times 10^6}{5 \times 10^5} = 8$ sec / ~~bit~~ byte

$\therefore$ in ~~bytes~~ bit $= 8 * 8 = 64$ bytes

c. $R_2 = 100$ Kbps $= 100 \times 10^3 = 1.0 \times 10^5$ bps

$R_1 = 5.0 \times 10^5$ bps

$R_3 = 1.0 \times 10^6$ bps

Throughput $= \text{MIN}(1.0 \times 10^5, 5.0 \times 10^5, 1.0 \times 10^6)$

$= 1.0 \times 10^5$ bps

$T' = \dfrac{\text{File size}}{\text{throughput}} = \dfrac{4 \times 10^6}{1 \times 10^5} = 40$ seconds

$\therefore 40 \times 8 = 320$ seconds {in bits}

Q4) Number of switches = 4

Number of connections = 4

a. $\therefore$ Total connections = No. of switches × No. of connections

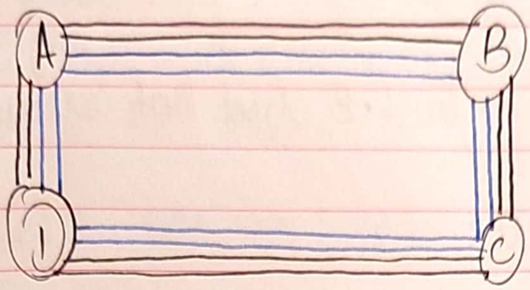
$= 4 \times 4 = 16$ possible connections

b. Connection b/w A and C = 2 switches * 4 connections

= 8 Connections

c. 2 lines b/w A and C (black)

2 lines b/w B and D (blue)



Q5) a. Rate $= R$ bps   packet size $= L$ bits

$d = m$ meters

$s = s$ meters/s

$d_{prop} = ?$

$$d_{prop} = \frac{d}{s} = \frac{m}{s}$$

bits $\frac{}{4}$

b. $d_{trans} = \frac{L \text{ bits}}{R \text{ bps}} = \frac{L \text{ bits}}{R * 8 \text{ bits/s}} = \frac{1}{8}\frac{L}{R}$ s

c. $d_{end\text{-}end} = ?$

$d_{queue} = ? \; 0$

$d_{proc} = ? \; 0$

$$d_{end\text{-}end} = d_{prop} + d_{proc} + d_{trans} + d_{queue}$$
$$= \frac{m}{s} + 0 + \frac{1}{8}\frac{L}{R} + 0$$
$$= m/s + 1/8 \; L/R = d_{prop} + d_{trans}$$

d. at $t = d_{trans}$, last bit is about to leave the source.
at $t=0$, first bit of packet is placed onto the wire.
at $t = d_{trans}$, all bits placed onto the wire

{d_{trans} is how long it takes to push all bits to the network}

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e. $d_{prop} > d_{trans}$ then:

- packets on their way to host B, but not arrived yet.

f. $d_{prop} < d_{trans}$ then:

- first packet has reached host B, and remaining packets are placed onto the network.

g. $s = 2.5 \times 10^8$ m/s
$L = 1500$ bytes
$R = 10 \times 10^6$ bps

$d_{prop} = d_{trans}$

$$\frac{d}{s} = \frac{L}{R}$$

$$\frac{m}{2.5 \times 10^8} = \frac{1500}{10 \times 10^6}$$

$$m = \frac{1500 \times 2.5 \times 10^8}{10 \times 10^6} = 3.75 \times 10^4 \text{ m}$$

Q6) $S = 2.4 * 10^8$ m/s
Bandwidth $= 10$ Mbps $= 10 \times 10^6$ bps $= 1 \times 10^7$ bps
$d_{prop} = ?$
picture sent every 60 seconds

$\therefore$ ~~distance b/w Earth and satellite~~ $= \cancel{\frac{1 \times 10^7 \text{ bps}}{60 \text{ s}}} =$

$d = 3.6 \times 10^7$ m

$\therefore d_{prop} = d/s = \frac{3.6 \times 10^7}{2.4 \times 10^8} = 0.15$ s

Q7) $L = 20000\,km = 2.0 \times 10^7\,m$
$R = 5\,Mbps = 5 \times 10^6\,bps$
$s = 2.5 * 10^8\,m/s$

a. file size = 800,000 bits

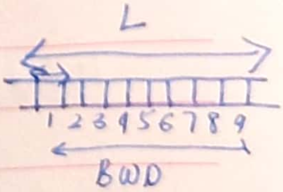
$$d_{trans} = \frac{5 \times 10^6}{2 \times 10^7} = 0.25\,s$$

$$d_{prop} = \frac{d}{s} = \frac{2.0 \times 10^7}{2.5 \times 10^8} = 0.08\,s$$

∴ Maximum bits that can be transferred on link $= R \times d_{prop}$
$= 5 \times 10^6 \times 0.08$
$= 400000$ bits
or
4×10^5 bytes

b. Bandwidth delay product can be referred to as the maximum amount of data that can be on the link at any given time. It can be calculated by the following formula:
BW Delay $= R \times d_{prop}$

c. Width of a bit in the link $= \dfrac{\text{Length of wire / link}}{\text{Bandwidth delay}}$



{BWD is no. of bits on the link at a time}

$$= \frac{2 \times 10^7}{4 \times 10^5} = 50\,m$$

An average football field is 100m long, hence no.

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Q8) Caravan consists of 10-cars

a) $d_{trans} = 10 \times 2 = 20$ seconds

$S = 100\,Km/hr = 1 \times 10^5\,m/hr = 27.77\,m/s$

$d = 175\,Km = 1.75 \times 10^5\,m$

$d_{prop} = \frac{d}{S} = \frac{1.75 \times 10^5}{27.77} = \frac{6301.764\,s}{3600} = 1.75$ hrs

$= 1$ hr 45 mins

$d_{queue} = 0$, $d_{proc} = 0$

Each booth takes 20 seconds to service 10 cars

$\therefore$ Total booths $= 3$

$\therefore$ Total $d_{trans} = 20 \times 3 = 60$ seconds

$d_{end-end} = d_{trans} + d_{prop} = 6301.764 + 60 = 6361.764s$

OR

1.76 hrs

or 1 hr 46 mins

b) $d_{trans} = 8 \times 2 = 16s$

$S = 27.77\,m/s$

$d = 1.75 \times 10^5\,m$

$d_{prop} = 1.75$ hrs or $6301.764s$

Total $d_{trans} = 16 \times 3 = 48s$

$\therefore d_{end-to-end} = 6301.764 + 48 = 6349.764s$

OR

1.763 hrs

or

1 hr 45.7 min

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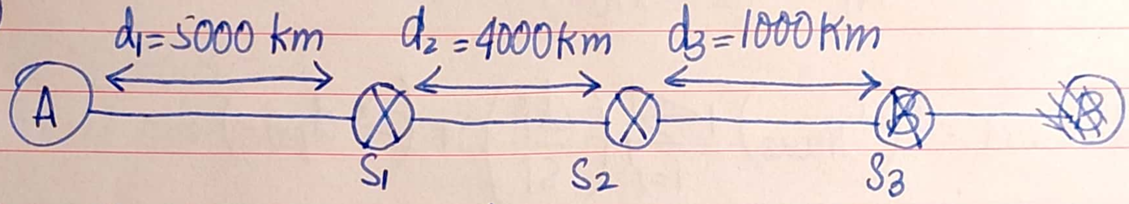
Q9) Total bandwidth = 3 Mbps = 3×10^6 bytes
bandwidth per user = 150 Kbps = 1.5×10^6 bytes

a. Total users = $\dfrac{\text{Total bandwidth}}{\text{bandwidth per user}} = \dfrac{3\times10^6}{1.5\times10^5} = 20$ users

Q10)



$R_1 = R_2 = R_3 = 2.5 \times 10^6$ bps
$S_1 = S_2 = S_3 = 2.5 \times 10^8$ m/s

packet length $= L = 1500$ bytes
$= 1500 \times 8$
$= 1.2 \times 10^4$ bits

$d_{prop_1} = ?$, $d_{prop_2} = ?$, $d_{prop_3} = ?$
packet switch delay $= d_{proc} = 3 \times 10^{-3}$ s

* Packet switch delays occur at each node b/w transmitting and receiving host

$\therefore$ No. of nodes b/w A and $S_3 = 2$

$\therefore (2 * d_{proc})$

$$\therefore d_{end\text{-}to\text{-}end} = 3\left(\frac{L}{R_i}\right) + \sum_{i=1}^{3}\left(\frac{d_i}{S_i}\right) + (2^* d_{proc})$$

$$= L\sum_{i=1}^{3}\left(\frac{1}{R_i}\right) + \sum_{i=1}^{3}\left(\frac{d_i}{S_i}\right) + (2^* d_{proc})$$

$$= L\sum_{i=1}^{3}\left[\left(\frac{1}{R_i}\right) + \left(\frac{d_i}{S_i}\right)\right] + (2^* d_{proc})$$

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$d_{prop_1} = d_1/s_1 = 5000\times10^3/2.5\times10^8 = 0.02s$

$d_{prop_2} = d_2/s_2 = 4\times10^6/2.5\times10^8 = 0.016s$

$d_{prop_3} = d_3/s_3 = 1\times10^6/2.5\times10^8 = 0.004s$

$3(d_{trans}) = \frac{L_i}{R_i} = 3\left(\frac{1.2\times10^4}{2.5\times10^6}\right) = 0.0144s$

$d_{end-to-end} = 3(d_{trans}) + \sum_{i=1}^{3}\left(\frac{d_i}{s_i}\right) + (2 * d_{proc})$

$= 0.0144 + [(0.02+0.016+0.004)] + (2*3*10^{-3})$

$= 0.0604s$

Ans

Q11) $R_1 = R_2 = R_3 = 2.5\times10^6$ bps

$d_{proc} = 0$

Since no queuing for packet

$\therefore d_{trans} = \frac{1.2\times10^4}{2.5\times10^6} = 4.8\times10^{-3}s$

$d_{prop_1} = 0.02\ s$

$d_{prop_2} = 0.016\ s$

$d_{prop_3} = 0.004\ s$

$\therefore d_{end-to-end} = 4.8\times10^{-3} + 0.02 + 0.016 + 0.004$

$= 0.0448s$

Ans

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Q12) Packet length $= 8 \times 10^6$ bits
Bandwidth of each link $= 2 \times 10^6$ bps

$d_{prop} = d_{queue} = d_{proc} = 0$

a) Time to send message from source to packet 1 $= \frac{8 \times 10^6}{2 \times 10^6} = 4s$

No. of hops $= 3$
$\therefore$ Total time taken $= 3 * 4 = 12\,s$

b) Length of each packet $= 1 \times 10^4$ bits
$\therefore$ Time to send message from source to packet switch 1 $= \frac{1 \times 10^4}{2 \times 10^6} = 0.005\,s$

Time at which 2nd packet is received at switch 1 $= 0.005 * 2 = 0.01\,s$

c) Total time taken to send first packet from source to destination $= 3 * 0.005 = 0.015\,s$

Time at which last packet send from source to destination $= (799 \times 0.005) + (0.015) = 4.01\,s$

Delay has been reduced to $\frac{1}{3}$rd

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d) ① There are chances of single-bit errors if message segmentation is not used. As a result, the whole message has to be re-transmitted rather than a single packet.

② Large files like HD videos would suffer huge delays because routers have to accomodate huge packets. Therefore, small segments are created for even and smooth distribution of data

e) ① Requires many headers, thus increasing the ration control/data (because of many small packets)

② If one segmented packet is missing, then the overall file cannot be read

③ Packets have to be put in sequence at the destination