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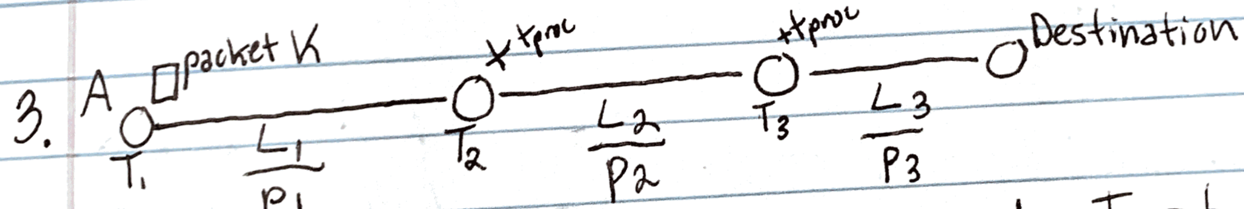
1. a.) Packet switching would be more appropriate. Since data is sent irregularly, the network will perform optimally with switching packets vs. circuit.
b.) No congestion control is needed since the applications only send a maximum of 1,640Kbps, or 1.64Mbps, which is less than the link capacity.

2. a.) 15000Kbps link / 500 Kbps per user = 30 users
b.) 15% given in the problem statement
c.) $P(X=x) = \binom{180}{x}(.15)^x(.85)^{180-x}$
d.) $P(X>40) = 1 - \sum_{x=0}^{40} \binom{180}{x}(.15)^x(.85)^{180-x} = .00367$

3. 

Where L_i = length p_i = propagation speed T_i = transmission rate

end-to-end delay $= \frac{K}{T_1} + \frac{K}{T_2} + \frac{K}{T_3} + \frac{L_1}{p_1} + \frac{L_2}{p_2} + \frac{L_3}{p_3} + 2(t_{proc})$

Solve for $K = 4000b$ (.004Mb); $p_i = 2.2\times10^8$ m/s; $T_i = 10$Mbps; $t_{proc} = .005$ sec
$L_1 = 2{,}000{,}000$m $L_2 = 5$mil m $L_3 = 3$mil m

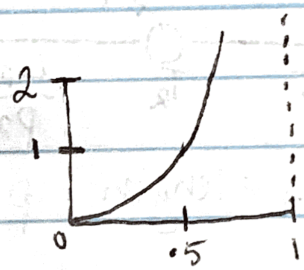
E2E delay = .056 seconds

4. If the server can only use one path, the maximum throughput will be the minimum of the transmission rates $R_1 \ldots R_N$ from the path S with the highest minimum.
In other terms, Max (min(path 1)... min(path S))
If the server can use all S paths, the max throughput will be the sum of the minimum transmission rates in all paths S.
Other terms, min(path 1) + min(path 2)... + (min(path S))

5. a.) $\frac{TP}{R(1-T)} + \frac{P}{R}$ (P: packet size; R: trans rate) $= \frac{TP+P(1-T)}{R(1-T)} = \frac{TP+P-PT}{R(1-T)}$

$= \frac{P/R}{1-T}$

b.) plotting $f(x) = \frac{x}{1-x\alpha}$



as $x \to 1$ infinite

c.) $\frac{1}{\mu - \alpha}$

6. a.) $\frac{8\text{Mbps}}{10\text{Mbps}}$ = 0.8 seconds to first packet swith
.8 × 3 = 2.4 seconds from source to destination
b.) $\frac{500b}{10{,}000{,}000b}$ = .00005 seconds // .0001 seconds for paket #2

c.) .00015 seconds + .00005(16,000 − 1) = .8001 seconds
Message segmentation adds an insignificant .0001 seconds
d.) The biggest drawback is the necessary reassembly which adds complexity and time while hurting reliability.