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Comp 4320 Homework 1

1(a). Packet-switched networks would be more appropriate as it is able to handle variable bit rates.

(b). Congestion control is not needed. The intermediate link in the application has a capacity of 1.8 Mbps. The total bit rate of the network is (640 Kbits + 520 Kbits + 480 Kbits) $\Rightarrow$ 1640 Kbits $\Rightarrow$ 1.601 Mbps which is within the capacity.

2 (a). 15 Mpbs $\Rightarrow$ 15000 Kbps

15000 Kbps / 500 Kbps = 30 maximum users

(b) probability = 1/15 = 0.67

(c). $P(x) = \binom{180}{x} p^x (1-p)^{180-x}$

(d). $P = 1 - \sum_{0}^{41} \binom{180}{x} p^x (1-p)^{180-x}$

3. Li = length K = 4000 bytes tproc = 5 msec

Pi = propagation speed $pi = 2.2 \times 10^8$ m/s (all three)

Ti = transmission rate Ti = 10 Mbps (all three)

i = 1,2,3 $L_1 = 2000$ Km $L_2 = 5000$ Km $L_3 = 3000$ Km

Find end-to-end delay

Solution: $\left(3(4000) \text{ bytes} / 10 \text{ Mbps}\right) + \left(2000 + 5000 + 3000 \text{ Km} / 2.2 \times 10^8 \text{ m/s}\right) + 2(15)$ m/s

*conversions: 1 Km = 10^3 m 1 sec = 10^3 msec

1 byte = 8 bits

1 M = 10^6

solution continued using conversions:

$\left(3(4000)(8) / 10(10)\right) + \left(10000(10^3) / 2.2(10^8)\right) + 30$

$\Rightarrow$ 9.6 + 45.45 + 30 msec = **85.05 msec**

4. If the server can only use one path to send to the client, the maximum throughput is $\{R_i^i\}$.

If the server can use all S paths to send data, the maximum throughput = $\{\min\{R_1^i, R_2^i, .. R_N^i\}\}$.

5 (a). Formula = $P/R(1-T)$

(b). using T in formula above, total delay = $P/R(1 - P\alpha/R)$

using P/R as x, total delay = $x/1-\alpha x$

(c). $p = {}^{R}/_{P}$

$T = {}^{P\alpha}/_{R} \Rightarrow {}^{\alpha}/_{P}$

total delay: ${}^{P}/_{R(1-T)}$ using substitution:

${}^{1}/_{P(1-{}^{\alpha}/_{P})} = {}^{P}/_{(p-\alpha)}$

$= \boxed{{}^{1}/_{(p-\alpha)}}$

6 (a). ${}^{8 \times 10^6}/_{10 \times 10^6} = 0.8$ sec (2) = 1.6 sec

(b). 16000 packets 5 msec

500 bits 10 msec

(c). 30 msec · 5 msec = 6.0 sec

(d). Message segmentation results in packages that are smaller in size. The total amount of header bytes are increased. In addition, packets must be sequenced at the destination.