Revanth Yamani
104971055
Discussion 1B

CS118 Homework 1

Problem 1

a) Circuit switching: established links are in service the entire time.

$\frac{100\text{Mbps}}{10\text{Mbps}} = 10$ users supported

b) Probability that a user is transmitting: given that they transmit 25% of time.

probability = 0.25 = 25%

c) binomial distribution, N = 100 users:

$$P(100, n) = \binom{100}{n} 0.25^{n} (0.75)^{100-n}$$

probability that n users are transmitting simultaneously

d) Probability that there are 21+ users = 1 − P(There are 20 or less users)

$$= 1 - \sum_{i=0}^{20} \binom{N}{i} 0.25^{i} (0.75)^{N-i}$$

* Assuming N total users

Problem 2

a) N packets; each length L; link transmission rate $= R$; avg. queue delay?

1st packet = 0 delay; 2nd packet $= \frac{L}{R}$ 3rd $= \frac{L}{R} + \frac{L}{R}$ (2 packets before)

avg. delay: have to sum up delays of each packet, then divide by # of packets

$$\frac{0 + \frac{L}{R} + \frac{2L}{R} + \ldots + \frac{(N-1)L}{R}}{N} = \frac{0 + \sum_{i=1}^{N-1} i\frac{L}{R}}{N} = \frac{\frac{(N-1)N}{2} \cdot \frac{L}{R}}{N}$$

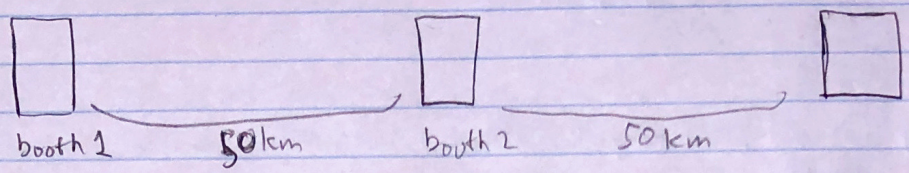
$$= \boxed{\frac{(N-1)L}{2R} \text{ seconds avg delay}}$$

b) Total transmission time of 1 batch of N packets: $\frac{LN}{R}$

new batch sent at time $\frac{LN}{R}$; when the new batch is sent,

the last batch has just finished transmitting all of its packets, and the queue becomes fully empty; therefore, the average delay is the same $= \boxed{\frac{(N-1) \cdot L}{2R} \text{ seconds average delay per packet}}$

Problem 3



a) 5 car caravan: Propagation speed = 100 km/hr

$\frac{12 \text{ sec}}{\text{car}} \cdot 5 \text{ cars} = 60 \text{ seconds}$ for caravan to pass through booth 1

$50 \text{ km} \cdot \frac{1 \text{ hr}}{100 \text{ km}} = 0.5 \text{ hours}$ to assemble caravan in front of booth 2

$\frac{12 \text{ sec}}{\text{car}} \cdot 5 \text{ cars} = 60 \text{ seconds}$ for caravan to pass through booth 2

$50 \text{ km} \cdot \frac{1 \text{ hr}}{100 \text{ km}} = 0.5 \text{ hours}$ to assemble caravan in front of booth 3

$\frac{12 \text{ sec}}{\text{car}} \cdot 5 \text{ cars} = 60 \text{ seconds}$ for caravan to pass through booth 3

Total end to end delay: $60s + 0.5h + 60s + 0.5hr + 60s =$ **63 minutes**

b) 8 car caravan:

only difference from part a = time it takes for the caravan to pass through each toll booth

$\frac{12 \text{ sec}}{\text{car}} \cdot 8 \text{ cars} = 96 \text{ seconds}$ for caravan to pass through each caravan

Total end to end delay $= (96s \times 3) + 0.5h + 0.5h$

$= 288s + 1hr$

$= 4 \text{ min } 48s + 60 \text{ min}$

$=$ **64 minutes, 48 seconds**

Problem 4

$\frac{64\,kb}{1\,sec} \cdot \frac{1000\,bits}{1\,kb} = 64000\,bps$ $\qquad 56\,byte \cdot \frac{8\,bits}{8\,byte} = 448\,bits$

$\frac{2\,Mb}{1\,sec} \cdot \frac{1{,}000{,}000\,bits}{1\,Mb} = 2000000\,bps$; $10\,msec = 0.01\,sec$ propagation delay

Time elapsed from time the first bit of one packet is created until the packet is received by host B?

= generation delay + propagation delay + transmission delay

$\frac{(56 \times 8)\,bits}{64 \times 10^3\,bps} = 0.007\,sec$ (generation delay)

$\frac{448\,bits}{2000000\,bps} = 0.000224\,sec$ (transmission delay)

$= 0.007 + 0.000224 + 0.01$

Time elapsed ≈ 0.017224 seconds

Problem 5

$1\,TB = 1000\,GB$ $\qquad 1\,GB = 10^9\,Bytes = 8\times10^9\,bits$

$1\,TB = 10^{12}\,Bytes = 8\times10^{12}\,bits$

$$2\,Gbps = \frac{2\,Gb}{1\,sec}\cdot\frac{10^9\,bits}{1\,Gb} = 2\times10^9\,bits/sec$$

$$50\,TB = \frac{8\times10^{12}\,bits}{1\,TB} \qquad 400\times10^{12}\,bits = 4\times10^{14}\,bits$$

$$\frac{4\times10^{14}\,bits}{2\times10^9\,bps} = 2\times10^5\,s = 200000\,seconds\cdot\frac{1\,hr}{3600\,sec} = 55.56\,hours > 24\,hours$$

I would prefer the Fedex overnight delivery over transmitting the data via data link. This is because the entire transmission would take over 55 hours, well above one day's time (24 hours). Therefore, the Fedex delivery would be optimal since it would take less than 24 hours.