Comp 4320 Homework 1

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1.) ***a.)*** **Packet switching** would be more appropriate for this since the data being transmitted is in bursts instead of a steady stream of data.

b.) Since the sum of the data rates(1.64Mbps) is less than the given link capacity(1.8Mbps), **no congestion control** will be needed.

2.) ***a.)*** 15Mbps = 15000 Kbps link, each user needs 500 Kbps, so we get 15000 / 500 = 30 meaning a total of **30 users** can be supported.

b.) The probability = **0.15**

c.) So to get this we will use the equation:

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

where p = 0.15 and x is the number of users transmitting.

d.) To find this we can use the equation:

$$P = 1 - \sum_{x=0}^{40} \binom{180}{x} p^x (1-p)^{180-x}$$

where p = 0.15 and x is the number of users transmitting per iteration of the sum.

3.) In order to find the end-end delay we must use the formula:

$$d_{end-end} = \frac{k}{T_1} + \frac{k}{T_2} + \frac{k}{T_3} + \frac{L_1}{p_1} + \frac{L_2}{p_2} + \frac{L_3}{p_3} + d_{proc} + d_{proc}$$

Where k = 4,000b, $T_{(1,2,3)}$ = 10Mbps, L_1 = 2,000km, L_2 = 5,000km, L_3 = 3,000km, $p_{(1,2,3)}$ = $2.2*10^8$m/s, d_{proc} = 5msec. Solving for this equation we get **0.05665 sec** or **56.65 msec.**

4.) To find the max throughput using only a single path we can use:

$$\frac{\{R_1^i, R_2^i, R_3^i ... R_N^i\}}{1} = min\{R_1^i, R_2^i, R_3^i ... R_N^i\}$$

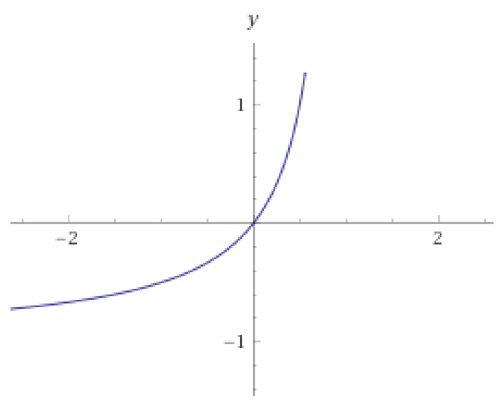
To find the max throughput using all S paths we can use the answer above divided by the total paths:

$$\frac{min\{R_1^i, R_2^i, R_3^i ... R_N^i\}}{S}$$

5.) ***a.)*** The formula for the total delay would be:

$$\frac{TP}{R(1-T)} + \frac{P}{R} = \frac{\frac{P}{R}}{1-T}$$

b.)



c.) Given that ρ = transmission rate we get the new formula:

$$\frac{1}{\rho - \alpha}$$

6.) ***a.)*** $(8*10^6) / (10*10^6)$ = **0.8sec** to get from source to first packet switch.
0.8 * 3 = **2.4sec** to get from source to destination.

b.) $(5*10^2) / (10*10^6)$ = **$5*10^{-5}$sec** or **0.05msec** for the first packet to reach first switch
2 * 0.05 = **0.1msec** for the second packet to be fully received at the first switch.

c.) So we know that the first packet will be received at the first switch after 0.05msec meaning that it will reach the destination at 3*0.05msec = 0.15msec. After it reaches the destination every 0.05msec another packet will reach the destination which gives us: 0.15msec + 15999 * 0.05msec = **800.1msec** to receive the entire message.

d.) The main drawback of message segmentation is the need for the message to be reassembled at the destination host. This means that if a single packet is missing then the message cannot be read. This method will also use much more bandwidth