CSC467

Assignment 1

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a) From what I have found it seems that the minimum required for a single concurrent call is 100Kbps but it is recommended to have 3MBps both up and down. Comparing to the student plan that is offered by Shaw in Victoria, I have experienced no problems or interruptions with 1.5MBps upload speed (which is the given maximum).

b) Using the service Twitch.tv, they recommend 3MBps up and down. I have streamed before but have had to lower my framerate from the typical 60 down to 30 in order to achieve acceptable viewing quality.

c) It is estimated at 1.4Mbps on the low end, and 3.4Mbps on the high end. Since N networks peak at 54Mbps and G at 22Mbps, this isn't a problem.

d) It seems that depending on the video service that you choose, there will be different recommended requirements for viewing at certain qualities. For example, Netflix recommends: 1 Mbps for viewing on a laptop computer, 2 Mbps for SD video on a TV, 4 Mbps for 720p HD video, and 5 Mbps for "the best video and audio experience" (according to Netflix).

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Using the Erlang B formula where the number of lines is N=5 (trunks), and the arrival rate is A=5 erlangs, the blocking is $P_b = 0.285$.

The call arrival rate is the calculation where A = $\frac{\lambda}{\mu}$ but as we know A and μ then we need to calculate λ, which for A = 5 erlangs and $\mu = 3$ minutes, then $\lambda = 1.67$.

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a) The delay is 0.05 seconds per trip, and the bandwidth is 1Mbps = 1000 kpbs = 1 000 000 bps.

Then the D x d(prop) = 0.05*2 $\times$ 1000000 bps = $10^5 b$

b) As the message is being sent continuously, there is a buffer and only 1/4 of the message is on the line at any given time. It will take 200ms for a full transfer assuming no packet loss on the full trip in a single direction.

c) The bandwidth delay product is an amount of data measured in bits or bytes that is equivalent to the maximum amount of data on the network circuit at any given time (data that has been transmitted but not yet acknowledged).

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a) At any given time there can only be 4 people using the network link. Because their transmit time is only 10%, this means that 10 times the quantity of people could theoretically use it with circuit switching. Therefore there can be 40 simultaneous connections.

b) There will be no delay with 2 people because the total bandwidth used is only 1Mbps where there is a total availability of 2Mbps. If five people are using the same connection, there is an over-request on the available bandwidth and so the outgoing packets will be set into a queue to be transmitted when space frees up. This could be avoided if each client recieves a hit on bandwidth and transmits at a slower speed.

   Note: circuit switching requires everything to be sent over the same path, but packet switching can use a different path, and depending on the network can alleviate congestion.

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a) Assuming each node(link) can provide n circuits, and there are 4 nodes, then there can be a maximum number of $n \times 4$ simultaneous connections at any one time.

b) As there are only two interacting nodes on the given network that can providen n circuits, then there will only be $n \times 2$ simultaneous connections at any one time.

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a) If we have 10,000 bits per packet, 10 users sending packets, and 1,000,000,000 bps capability, then: $\frac{1{,}000{,}000{,}000}{10{,}000 \times 10} = 10,000 \textit{ packets per second} = \mu$.

b) Under the assumption that we want to have no queue on the router we can say that $\lambda = \mu = 10,000 \textit{ packets per second}$.

c) Yet again, because we assumed that we want to maintain stability and that there should be no more than the available link capacity of packets arriving to the router at any given time, we can say that $r = \lambda = \mu = 10,000 \textit{ packets per second}$

d) For the different values of p= 0.1, 0.2, 0.4. 0.6, 0.8: the value that can change is λ. For $p = \frac{\lambda}{\mu}$ and for values of p = 0.1, 0.2, 0.4. 0.6, 0.8, the values for λ= 1000,2000,4000,6000,8000 respectively. This generates values for $d_{queue} = 1.11 * 10^{-4},\ 1.125 * 10^{-4},\ 1.66 * 10^{-4},\ 2.5 * 10^{-4},\ 5 * 10^{-4}$ respectively.

e) Assuming that each packet takes an additional 0.1ms to transmit due to delays in reaching the next hop in the router, the overall throughput capacity of the router changes. $10,000p/s \times 1s = x \times 1.0001s$ gives us a new value of 9,999 packets per second.

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1) 9600 bits are being generated by the network every 8 seconds, which means that that is 1200bps and falls within the outgoing bandwith limit.

2) 9600 bits are being generated by the network every 5 seconds, which means that that is 1920bps and falls within the outgoing bandwith limit.

3) 15360 bits are being generated by the network every 8 seconds, which means that that is 1920bps and falls within the outgoing bandwith limit.

4) 64000 bits are being generated by the network every 8 seconds, which means that that is 8000bps and falls within the outgoing bandwith limit of 9600bps.

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a) The throughput would be determined by the slowest link and therefore 500Kb/s.

b) Approximately 8 seconds.

c) Assuming convention, it would be halved at 250Kb/s.

d) The throughput would be determined by the slowest link and therefore 100Kb/s and the file would take approximately 40 seconds to transfer.

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