**COMP 4320**

**Introduction to Computer Networks**

**2022 Summer Mini-Semester II**

Homework 1

Due: 11:55 pm July 14, 2022

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**Question 1a.** A **packet switch network** would be appropriate for this type of data flow since it appears to be transmitting in **bursts**, contrary to a steady-stream, which would be more applicable for circuit-switching.

**Question 1b.** Assuming the given rates do not change, **congestion control may not be necessary** (though may be helpful if the Tx rates change). In this example, congestion control is not necessary because the Tx rate (1.64Mbps) is less than the total capacity of 1.8Mbps.  
  
**HOWEVER** if we consider the data rate capacity to be limited to an equal and evenly distributed transmit (Tx) rate throughout the entire second, then any data rate above 540 bits over the period of 3/10 second would exceed the throughput limitation. Since the app bursts at a rate of 640 bits for the first .3 seconds, an argument could be made that **congestion control may be necessary**.   
  
Considering both scenarios, **implementing congestion control is likely the wiser decision**.

**Question 2a.** Dividing 15Mbps by 500 Kbps (per user), would allow **a maximum of 30 users** to transmit at one time before overloading the network.

**Question 2b.** Per the given information, a user will Tx 15% of the time or p = **0.15**.

Diagram

Description automatically generated**Question 2c.** If there are 180 users online and an unknown X are transmitting simultaneously, to find X we would need to use the equation:

**Question 2d.** The probability that 41 or more users are transmitting could be found by using the above equation from 0 to 40 (how many people are not transmitting) and subtracting that from the total (1 in this case), leaving you with the probability of 41 or more transmitting.

Diagram, venn diagram

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This would yield a result of: **0.00367**

**Question 3.** To solve this, we need to sum up the packet size (4kb) divided by the transmission rate (10Mb) for each hop (3), the total distance traveled (10k km) divided by the speed of light, and the processing rate (0.05 msec) at each packet switch (2).

Diagram, schematic

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= 0.05665 seconds   
or approximately **56.67 msec**.

**Question 4.**

To solve for the maximum throughput a server can achieve using only one path:

To solve for the maximum throughput a server can achieve using all S paths:

**Question 5a.**

**Question 5b.**

*I’m not quite sure how to plot this.*

**Question 5c.**

**Question 6a.** In this diagram there are 3 hops a packet will take between source and destination. Since the message is 8E6 and the Tx rate is 10E6, ignoring processing, propagation, and delays, this would take the packet 0.8 secs each hop, for a total of **2.4 seconds** to reach the destination.

**Question 6b.** 500b / 10E6 bps = 0.05 msec per hop.   
0.05 msec \* 2 = **0.1msec** for the second packet to reach the first packet-switch.   
(This is the time it takes to Tx plus the delay of sending the first packet).

**Question 6c.** 0.05 msec per hop. || 0.15 msec for first packet to reach destination.

15,999 packets remaining \* 0.05 msec delay from first hop to Tx. Sum = **800.1 msec.** This is 3 as fast as the result in part (a).

**Question 6d. With message segmentation means that packets must be reassembled at the destination which takes time and processing resources. Additionally, since the message is segmented, message overhead such as headers etc. create more information to send, lowering the overall efficiency.**