CSE489/589: Modern Networking Concepts
Homework 1

Due Date: Feb 29th (11:59 PM)

NOTES:

- **Academic integrity**: Print the following statement at the very beginning of your homework file: *"I have read and understood the course academic integrity policy in the syllabus of the class. I confirm that the work presented in this report is my own. Where information has been derived from other sources, I confirm that this has been indicated in the report."* Your homework will NOT be graded if you didn't print the sentence.
- For the calculation, you need to write down how the results are derived and your final answer also should be correct to obtain the credits for that question. Please state any assumptions you are making while answering a question.
- Submit the homework through UBLearns as PDF files.

Question 1

Consider the network scenario in Figure 1. K sources are connected to the Internet via links of capacity R_S, and within the network fairly share a common link of capacity R, to K destinations. Each destination is connected to the network by a link of capacity R_D. You can assume that there are no other links or source-destination pairs in the network. Suppose that every source S_i has an infinitely large file it wants to send to its destination D_i (i.e., each source sends to a different destination). (30 points)

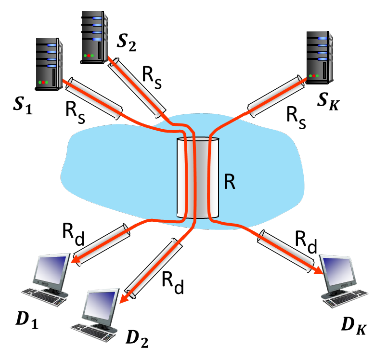

Figure 1: K sources transmits to K destinations.

1. Suppose that $K = 10$, $R_S = 100Mbps$, $R_D = 54Mbps$, and $R = 50Gbps$. What is the throughput between each source-destination pair? Where are the bottleneck links? (10 pints)
2. Suppose now that $K = 10$, $R_S = 100Mbps$, $R_D = 1Mbps$, and $R = 0.75Gbps$. What are the throughputs between each source-destination pair? Where are the bottleneck links? (10 pints)
3. In scenario 2 above, suppose we increase the capacity of the destination links R_D to 100 Mbps. Will this increase the throughput between sources and destinations? Explain your answer. (10 pints)

Question 2

Consider a scenario where two end hosts, denoted as A and B, are connected by a link. The length of the link is 6000 kilometers, and data transmits between the hosts at the speed of light, specifically 3×10^8 meters per second. The link capacity is $20Mbps$. (40 points)

1. Calculate the time it takes for a single bit to travel from host A to host B along the link. (5 points)
2. Suppose we intend to transmit a file with a size of $1000Mbits$ from host A to host B. Assuming that the transmission begins at time 0 seconds, determine the time when the last bit of the file exits host A. (5 points)
3. When the last bit of the file left host A, have the first bit of the file been received by B? Explain your answer. (5 points)

4. Following the above question, please calculate the time when B finishes receiving the whole file. (5 points)
5. Suppose we intend to transmit a file with a size of $0.1Mbits$ from host A to host B, when the last bits of the file leave host A, has its first bit been received by B? Explain your answer. (10 points)
6. When the first bit of the file with $0.1Mbits$ arrives at B, where is the last bit of the file (how far from B)? (10 points)

Question 3

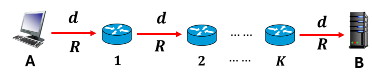

Figure 2: Link configuration between A and B.

Consider a scenario where two end hosts, labeled A and B, are interconnected by a network comprising K network switches, as illustrated in Figure 2. The distance between A, B, and any switch is $d = 3000$ kilometers, and data transmission between the hosts occurs at the speed of light, precisely 3×10^8 meters per second. The link capacity between any end hosts and any switches remains consistent, specifically $R = 100$ Mbps. Assuming negligible processing delays at the end hosts and switches, with $K = 9$, determine the time delay from the moment A transmits its first bit until B receives the last bit of a file sized at 0.5 Mbit. (30 points)