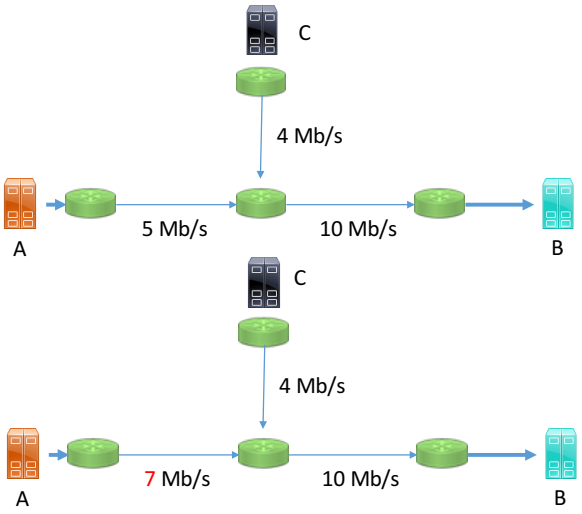
CSEE 4119 Spring 2016: Assignment 1

1. *End-to-end delay:* Using the `ping` command and the –s option to vary the packet size, measure the round-trip latency to a university web site, at least 1000 km away from New York (in order to make propagation delay meaningful). Measure at least 100 samples. (a) Based on your measurements, estimate the total propagation, transmission and queueing delay. (b) For the latter, give an estimate of mean and standard variation. (c) Compare the approximate geographical distance to the network-measured distance obtained via the propagation delay. (For (a) through (c), be sure to discuss how you arrived at your results.)
2. *Packet loss:* Consider a path with three routers, i.e., a total of four links, connecting a client to a server. Each link has a packet loss probability of p, and packet losses are independent. What is the probability that a packet sent by the client arrives at the server?
3. *Throughput:* In the figure below, both A and C are sending data at the same time to host B. Compute the throughput for both the upper and lower figure. There may be multiple good answers, so justify how you arrived at your conclusion.



4. *Message segmentation:* In most packet networks, the source hosts divides (segments) long application layer messages such as a file transfer into smaller packets, each of size *M*, with the receiver re-assembling the packets. Consider a store-and-forward packet

network with *R* routers, each connected to the next via a link of throughput *b* (e.g., measured in b/s). There is no other traffic, i.e., no queueing delay. Each packet is encapsulated in lower-layer headers totaling H bytes. Below, be careful with units (Mbytes vs. Mb/s, for example).

(a) Assume that there is no segmentation. How long does it take the file to arrive completely at the destination? Compute the result for a file of 50 Mbytes, three routers, a header size of 50 bytes and a link speed of 5 Mb/s.

(b) Derive an equation that shows the end-to-end delay for transmitting a file of F bytes as function of *b*, *M, H* and *R.*

(c) How would you compute the optimum packet size? What would it be for the numeric values in (a)?

(d) What would happen if there is a bit error that corrupts the message or packet?

5. *File transfer:* You need to urgently move a very large file of data from New York to Chicago. You have a 1 Gb/s link available to you, via Internet2, or you can use a disk-based delivery like the Amazon Snowball appliance[1] using FedEx overnight delivery. When would you use Internet2 and when FedEx? Assume that the University pays for FedEx, so cost is not a major concern. (By the way, digital movies are distributed that way to movie theaters…)
6. *Protocols:* Describe the protocol for an in-person payment transaction, e.g., in a restaurant, identifying the actions, messages and error conditions. Consider both cash and credit card. Use a flow chart or other graphical rendering. Are there equivalents of the physical, link and application layer (or other layers)?

[1] https://aws.amazon.com/importexport/details/