IS 504 – Homework #1

Due: October 22, 2023 Sunday – 22:30

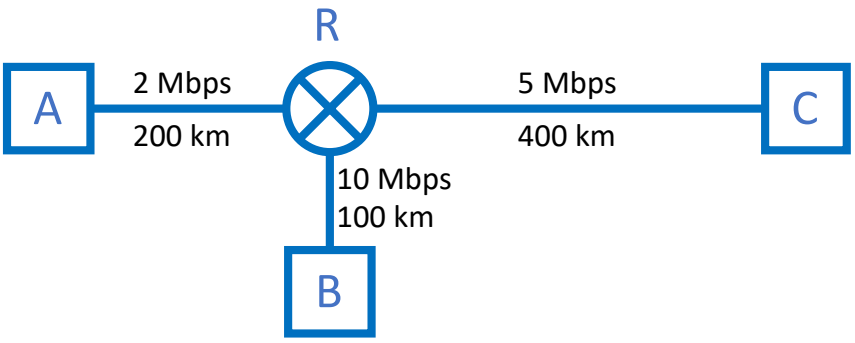
Submission and Grading Policy

- Submit your assignments to the corresponding assignment link at https://odtuclass.metu.edu.tr.
- Solutions should be submitted in a single doc, docx, or pdf file named: <metu-username>_HW_1.<extension> (e.g., "e123456_HW_1.pdf").
- Late submissions will be accepted by October 25, 2023 - 23:30, with a 15% per day penalty.
- This is an individual assignment. You have to adhere to the academic integrity principles.

Questions

In the following network,

- Host A is connected to router R via a 200 km ($200*10^3$ meters) link with a bandwidth of 2 Mbps ($2*10^6$ bits/sec),
- Host B is connected to router R via a 100 km link with a bandwidth of 10 Mbps
- Host C is connected to router R via a 400 km link with a bandwidth of 5 Mbps
- The propagation speed in the links is $200*10^6$ m/sec
- Router R operates in the store-and-forward mode
- The router R has a large but finite buffer space available for queued packets
- Links are reliable (i.e., there is not bit error, packet loss)
- The hosts and the router immediately begin transmitting packets when the output link is available.
- Packet processing delays are very short and can be ignored
- Each packet contains a fixed-length 25-byte (200 bits) header part and a variable-length data part of 0-1000 bytes (0-8000 bits).



1. (10 pts) For the following cases, compute the transmission delays and propagation delays on the specified links (please do not forget to take packet headers into account):
    a. A is sending a packet containing a 100-byte message.
    b. B is sending a packet containing a 100-byte message.
    c. C is sending a packet containing a 100-byte message.
    d. A is sending a packet containing a 1000-byte message.
    e. B is sending a packet containing a 1000-byte message.
    f. C is sending a packet containing a 1000-byte message.
2. (10 pts) Host A sends a 1000-byte message to host C in a single packet and transmission starts at time t=0. When does host C receive the message?
3. (15 pts) Host A sends a 1000-byte message to host C by dividing it into ten 100-byte chunks, each encapsulated in a separate packet. The transmission of these packets begins at time t=0.
    a. When does host C receive the message (i.e., the last packet)?
    b. What is the average queuing delay experienced by the packets?
4. (10 pts) Host B sends a 1000-byte message to host C in a single packet and transmission starts at time t=0. When does host C receive the message?
5. (15 pts) Host B sends a 1000-byte message to host C by dividing it into ten 100-byte chunks, each encapsulated in a separate packet. The transmission of these packets begins at time t=0.
    a. When does host C receive the message (i.e., the last packet)?
    b. What is the average queuing delay experienced by the packets?
6. (25 pts) Suppose host A is sending a short 100-byte message to host C and host B is sending a long 1000-byte message to host C. Both transmissions start at time t=0. Host A is sending its message in a single packet but host B has two options: It can send its message in a single packet or divide the message into 10 equal chunks of 100 bytes and send these chunks in separate packets. Which option is the best? Explain your reasoning and justify your answer.
7. (15 pts) Host A is periodically sending a 1000-byte message to host C every 10 milliseconds. Each message is encapsulated in a separate packet and each packet transmission occurs at regular intervals of time. Concurrently, Host B is sending a 1000-byte to host C every T seconds, in the same manner. What should be the constraint on T (i.e., T is smaller and/or larger than some value) to ensure that no packet loss occurs at router R?