IS 504 – Homework #2

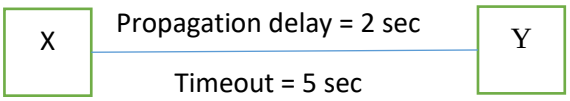
Due: December 3, 2023 Sunday – 23:30

Submission and Grading Policy

- Submit your assignments to the corresponding assignment link in https://odtuclass.metu.edu.tr.
- You can solve the questions on paper and send the pictures of your solutions.
- Solutions should be submitted in a single doc, docx or pdf file named: <metu-username>_HW_2.<extension> (e.g., "e123456_HW_2.pdf").
- Late submissions will be accepted by December 6, 2023, 23:30 with 15% per day penalty.
- This is an individual assignment. You have to adhere to the academic integrity principles.

Questions (2 questions – attempt all questions)

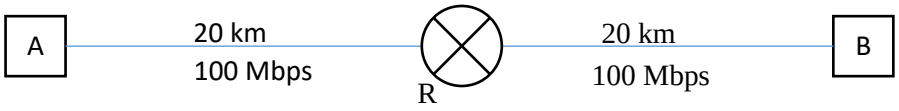
1. Consider the following one hop network shown below. Suppose **one-way propagation delay over the link is 2 second**, **timeout is set to 5 seconds** when needed, and transmission and processing delays for data and acknowledgement packets are short and can be ignored. The following reliable data transfer protocols will be used to reliably transfer five messages "a", "b", "c", "d", and "e" from host X to host Y, and each message will be carried in a separate packet.



For each of the following cases, draw a time-space diagram to show the packet exchange between X and Y **until both sides stabilize**. In the diagram, **indicate the window contents (where applicable) and important events (such as "timeout", "duplicate detected", "packet discarded", and "deliver data to app")**.

   a. (10 pts) The Stop-and-Wait protocol (i.e., rdt 3.0 in the lecture notes) is used and only the first acknowledgement sent after receiving the packet containing "b" and the first data packet containing "d" are lost.
   b. (10 pts) The Go-Back-N protocol with window size=3 is used and there is no bit error/packet loss in the network.
   c. (10 pts) The Go-Back-N protocol with window size=3 is used and only the first acknowledgement sent after receiving the packet containing "b" and the first data packet containing "d" are lost.
   d. (10 pts) The Selective Repeat protocol with window size=3 is used and there is no bit error/packet loss in the network.
   e. (10 pts) The Selective Repeat protocol with window size=3 is used and only the first acknowledgement sent after receiving the packet containing "b" and the first data packet containing "d" are lost.

2. Consider the network shown below:



Host A, Host B, and Router R are interconnected by a 20 km (20000 m) full duplex links which operates at 100 Mbps ($100*10^6$ bits/sec) in both directions, the signal propagation speed in the medium is $200*10^6$ m/sec, and the router operates in the store-and-forward mode. Host A is going to send 100 data packets to B, the length of each data packet sent by A is 1 kByte (8000 bits), the length of each acknowledgement packet sent by B is 50 bytes (400 bits), there is no other traffic in the network, processing delays can be ignored, and the link is reliable (i.e., there is no error/loss in the network). Suppose the hosts use the Go-Back-N protocol to reliably transfer data packets.

a. (15 pts) How long does it take to transfer 100 data packets to host B (until host A is sure that host B has received the packets) with the window size equal to 3?
b. (20 pts) Find the minimum window size that minimizes the time required to transfer 100 data packets to Host B.
c. (15 pts) How long does it take to transfer 100 data packets to host B (until A is sure that B received the packets) with the window size found in part (b)?