

CS408 – Computer Networks – Fall 2022 - HW 1 – Due October 31, 2022, 14:30

- Please submit manually (hardcopy printed on paper) by the end of the class.
- You have to type your answers over computer and then take a printout. No handwritten submissions please. And please do not ask if you can submit handwritten homework since if I could say yes to that question, I would not write all of these stuff.
- No late submissions
- Everyone must submit his/her own work! Plagiarized homework will be graded as minus 100 and will be reported to the Dean's office according to university regulations.
- If you find solution manual or key for any of these questions from somewhere, you are not allowed to use them. Using such material will be considered as plagiarism.
- BE AWARE OF ALL TYPE OF UNIT CONVERSIONS. BE CAREFUL ABOUT THE ARITHMETIC. NO PARTIAL GRADES!!!!!!

1) (40 points) Consider a packet switched network for the communication of two end points A and B . There are two switching nodes, X and Y , between A and B . The capacity of the link between A and X is 2 Mbps (2,000,000 bps). The capacity of the link between Y and B is also 2 Mbps. The capacity of the link between X and Y is 10 Mbps (10,000,000 bps). The switching node X imposes 0.001 sec processing delay before forwarding a packet to Y (no other processing delays in the network).

A wants to send a file of 10 Kbytes (10,000 bytes) using this packet switching network. One packet has 1250 bytes of data and 50 bytes of header. After receiving the entire file, B immediately sends an acknowledgment back to A through the same network. Assume there is no transmission time and processing time for the acknowledgment.

The network is not used for another communication until acknowledgment is received.

The distance between A and X is 30 km: Moreover, the distance between X and Y is 60 km. Finally, the distance between Y and B is 30 km. The speed of signal is 300,000 km/s.

- a) What is the round-trip time for sending the file and receiving its acknowledgment in the abovementioned scenario? Show your work.
- b) What is the utilization of the link between A and X in this model? Show your work.

Notice: be aware of bit and byte conversion

2) (40 points) Once upon a time, the only long distance communication method was using homing pigeons (*posta güvercini* in Turkish). However, this method is not reliable since it is possible that the pigeon may not arrive at the destination. Suppose two distant friendly armies (say army A and army B) use homing pigeons, i.e. an unreliable transport layer, to set up a landing plan during a war. Landing would become successful only when both of the friendly armies act simultaneously. Thus, it is very crucial for army A and army B to be at the same level of understanding about the landing date and time.

The protocol that army A and B use is as follows.

1. First army A sends a message (via a pigeon) containing the date, time and place of the landing.

2. If this pigeon arrives safe at army B , then army B sends **two** acknowledgments using two pigeons to army A .
3. Finally, if army A receives one of these acknowledgment (i.e. at least one of the pigeons carrying the acknowledgment arrives at army A), then army A sends another acknowledgment using a pigeon to acknowledge the receipt of acknowledgement.

If army B receives the last acknowledgment, then the commander of army B carries out the plan for landing; otherwise he does not. On the other hand, if army A receives one of the acknowledgments sent in the second message, then the commander of army A carries out the plan for landing; otherwise he does not.

All messages and acknowledgements are sent via homing pigeons.

Suppose the probability that a homing pigeon successfully arrives at its destination and delivers the message/acknowledgment is 0.7.

- a) What is the probability that both armies carry out the landing plan (i.e. the probability of victory)?
- b) What is the probability that only one of the armies carries out the landing plan?

3) (20 points) Consider a direct link with capacity 1 Mbps (1,000,000 bits per second) between two end points A and B . One of the parties, say A , wants to send a file of 5000 bits in one or more packet(s). Header size of a packet is 200 bits. What is the optimal value for the number of packets that maximizes the throughput of this file transmission? What is this maximum throughput value? Assume no processing and propagation delays. Explain and show your work. Hint: Think simple!