

TELCOM 2310: Applications of Networks

Fall 2022

Midterm Exam: October 26th, 2022

This test is to be taken individually. You are free to consult class notes and the textbook, the TA and the instructor - **absolutely no one and nothing else!** In particular, you CANNOT use anything except a scientific calculator for calculations and you CANNOT access the Internet.

The exam is due within 24 hours from the time it is picked up or October 27th, Thursday, by 10.30 a.m. whichever is earlier. The exam question sheet is to be returned along with all material you wish graded. Sign the honor pledge below after completing the exam.

Pledge:

On my honor I pledge that I have not given or received aid on this exam. I have not violated the policies stated above. I have also not spent more than 24 hours on the exam after picking it up.

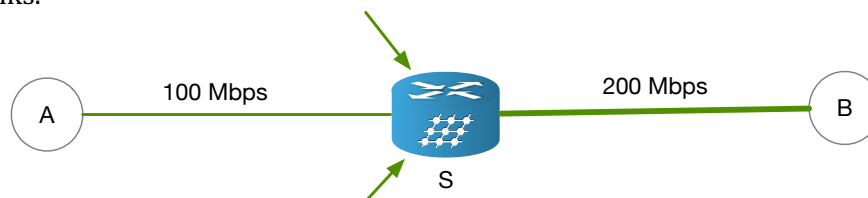
Signature: _____

Name: _____

General Instructions:

Answer all questions. Read the questions carefully to understand what is being asked. Avoid writing unnecessary things in the answers but write all the essential steps in solving any problem. Explain the steps. If you are not able to do any numerical calculation explain clearly what you would do to solve the problem. **THERE WILL BE NO PARTIAL CREDIT FOR VAGUE ANSWERS OR UNCLEAR STEPS. I SHOULD BE ABLE TO UNDERSTAND WHAT YOU WERE TRYING TO DO WITHOUT YOUR VERBAL EXPLANATION LATER.**

1. Answer the following questions in no more than 6 lines each: $3 \times 5 = 15$
 - a. What are two specific ways in which Content Distribution Networks (CDNs) can improve Web performance.
 - b. List one way in which TCP's reliable data transfer protocol is similar to Go-Back-N and one way it differs from Go-Back-N.
 - c. Explain the notion of an Erlang in circuit switched telephony.
2. Consider the network shown in the figure with two links. Host A is connected to Host B through these two links.



Suppose the speed of the signal on the link A-S is 3×10^8 m/s and the speed on link S-B is 2×10^8 m/s. Also let A-S be 1 km long and B-S be 5 km long.

- a. Assuming no queueing or processing delays, what is the round trip (total) time for a packet of size 1500 bytes to be sent from A to B through S and an acknowledgment of size

100 bytes to come back from B to A. Assume that A-S and S-A are identical and S-B and B-S are identical. (10)

- b. Consider host A retrieving a Web page from host B with a base HTML file that contains 8 referenced objects from the same server. Suppose that the base HTML file is 5 KBytes in size, each referenced object is 200 KBytes, and each control message (i.e., messages used to establish TCP connection, HTTP requests) is 200 bits. How long will it take to retrieve all objects:
 - i. Using basic non-persistent HTTP? (10 points)
 - ii. Using non-persistent HTTP with parallel TCP connections? Assume the base file is retrieved first over a single TCP connection, and then 8 parallel TCP connections are opened to retrieve the 8 referenced objects. Assume the 8 TCP connections each receive $1/8$ of the available bandwidth. (10 points)

Assume no queueing/processing delays at S. You can use the delay calculations from Q2(a) here.

3. The slow start threshold in the case of a TCP implementation at the beginning of transmission round 0 is 8 MSSs. There is a timeout at the sender before transmission round 1. In plots similar to the one below, show what will be the CW size under the following circumstances:
 - a. All subsequent packets are received correctly as are their ACKs.
 - b. There is another timeout after six more rounds, but subsequent packets are received correctly as are their ACKs.

You have to clearly explain in words your two figures. (15)

