

CS 3251
Fall 2002 - Second Exam

Problem	Possible	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

This test is closed book and closed notes. Answer the questions in the space provided. When answering questions, please state any and all assumptions you are making. You may use a calculator. For questions involving calculation, indicate your final answer by circling it.

Some formulas you may or may not find useful.

- $Utilization = \frac{K}{1+2a}$ where $a = \frac{T_{prop}}{T_{frame}}$
- $c = \text{speed of light} \approx \frac{300,000,000 \text{ meters}}{\text{second}}$
- $e = mc^2$

Part 1: TCP Packet Exchange (20 points)

An application wishes to exchange the following messages:

1. Client application sends 50 bytes of data and the server receives it.
2. Server application responds with 200 bytes of data and the client receives it.
3. Client in turn responds by sending 50 bytes of data and the server receives it.

Give the **complete TCP packet exchange** required to support this communication. Use a packet flow diagram (two vertical lines, packets exchanged between) as we used in the class examples. Use initial sequence numbers of 300 for the client and 1999 for the server. Assume that no other data has been or will be exchanged between these applications.

Part 2: UDP Packet Exchange (20 points)

1. **(10 pts)** For TCP, we studied the connection management state diagram. However, UDP is sometimes described as a “stateless” protocol. What is meant by this? Why did we not study a state diagram for UDP?

2. **(10 pts)** What services does UDP provide that are not already available from IP?

Part 4: ARQ Performance (20 points)

I have a reliable ARQ protocol that uses a fixed packet size of 500 bytes and a fixed window size of 32 packets. I am currently using it on a 16Mb/sec (Megabit = Million bits) network interface.

1. **(5 pts)** Assuming that the hardware's performance is bounded by the speed of light, what is the maximum distance I can separate two network nodes using this protocol and still achieve 100 percent utilization of the link?
2. **(5 pts)** New hardware was just released and I can upgrade my network interfaces to support 100Mb/sec data rates. Assuming I want to maintain the same distance limits, what change should I make in my ARQ protocol so that I can still get 100 percent utilization.
3. **(5 pts)** One problem with the new higher speed interfaces is that the bit-error rate is noticeably higher than it was at lower speeds. Given this, which ARQ algorithm is most appropriate for this new network and why?
4. **(5 pts)** In general, how many bits are needed for the sequence number field of an ARQ protocol? Assume the number is used to count packets, not bytes as is done with TCP.

Part 5 Flow and Congestion Control (20 points)

What is the purpose of each of the following:

1. (3 pts) Flow Control

2. (3 pts) Congestion Control

Briefly describe how they are performed in TCP and in UDP.

1. (7 pts) Flow Control

2. (7 pts) Congestion Control