Indian Institute of Technology Kharagpur

Department of Computer Science and Engineering

Class Test-2, Spring 2020-21

Computer Networks (CS31006)

Students: 155 **Date**: 20-February-2021

Full marks: 30 **Time**: 60 minutes

Credit: 20%

INSTRUCTIONS: This is an OPEN-BOOK, OPEN-NOTES test. Please write your answers in a text file/.doc file, convert it to PDF, and submit this PDF file containing ONLY YOUR ANSWERS on Moodle. PLEASE DO NOT SUBMIT SCANNED HAND-WRITTEN ANSWERS, SUCH ANSWER-SCRIPTS WILL NOT BE GRADED. DO NOT FORGET TO WRITE YOUR NAME AND ROLL NUMBER AT THE TOP OF YOUR ANSWER SHEET. ANY DETECTED CASE OF PLAGIARISM WILL BE DEALT WITH STRICTLY, WITH ALL THE IMPLICATED STUDENTS RECEIVING ZERO IN THIS TEST. You may use calculators if required. This question paper contains two pages. ANSWER ALL QUESTIONS.

1. Consider two processes P_1 and P_2. Let there be two transport layer connections between P_1 and P_2. How do you separate out the transport layer segments between these two connections? Clearly write down the parameters that will help you to differentiate between the two connections. Which packet headers (application header, transport header, network header or data link header) will contain those parameters?

   [1 + 2 = 3]

2. We use connection establishment at the transport layer for synchronizing the initial sequence numbers between the two end hosts. However, this step may be avoided if both the ends agree on a fixed initial sequence number, say every connection starts from sequence number 1. Do you see any problem in this approach? Explain your answer. **[2]**

3. Consider two connected transport entities, A and B. A wants to terminate the connection, and hence, it initiates a connection release by sending a *Disconnect Request* (DR) segment to B. Assume that the two-parties implement the DR-DR-ACK mechanism of connection release taught in class. Further, assume that the one-way transmission delay between A and B to be a parameter d (in milliseconds), which remains constant for the entire session. The parameter d can be calculated from your roll number, by adding all the letters and digits, and then calculating the remainder modulo-10. The letters are assumed to have the following numerical values: A=1, B=2, $\cdots$ Z=26. For example, if your roll number is 15YZ12345, then $d = (1 + 5 + 25 + 26 + 1 + 2 + 3 + 4 + 5) \pmod{10} = 2$ ms. Assume the delay to be symmetric in both the directions, and assume that segment processing and required actions happen instantaneously (incurring zero delay) at the two ends of the connection. Also, assume that the time-out interval for any segment sent by either party is $3d$, and that unilateral connection release happens at A if there is no response after $N = 5$ timeouts following the initial sending of the DR segment, and that at B happens after a time interval $15d$ since the first response DR has been sent back to A. Given your roll number, calculate the time interval after the first DR segment is sent out by A, at which A and B will release the respective connections at their ends, in the following situation: (a) no segment sent by either party is lost; (b) the first DR segment sent by B in response to the DR segment received from A is only lost, and, (c) only the first DR segment sent from A to B is successfully delivered, every following segment from either parties is lost. **[3+3+4=10]**

4. Consider a connection in which segments are numbered starting from 0, and outgoing segments are generated by the sender at the rate of one segment per millisecond. The connection starts at time $t = 0$ ms, and the sender crashes at a time $(t_c + 10)$ ms, where the numerical value of t_c can be calculated from your roll number in the same way that the parameter d was calculated in Question-3. Suppose, the expected lifetime of datagrams in the network between the sender and the receiver is 15 ms. Determine the coordinates of the vertices of the *forbidden region* on a plot of segment sequence no. (along vertical axis) vs. time (in ms, along horizontal axis). To simplify your analysis, ignore discretization of time. **[3]**

5. Three-way handshaking ensures correctness during connection establishment; however it alone cannot ensure loss-free connection release – why? **[2]**

6. State whether each of the following statements is True or False, with a brief (1-2 sentence(s)) explanation in support of your answer:

   (a) The rate at which segments are delivered to the application layer from the transport layer depends only on the datagram routing delay of the network layer. **[2]**

   (b) One bit sequence number is sufficient for stop-and-wait ARQ. **[2]**

   (c) The choice of sliding window protocols over stop-and-wait ARQ is always desirable. **[2]**

   (d) Timestamping every segment, while ensuring that not more than one segment is sent out per physical/logical clock-tick, is an effective solution to the *delayed duplicate* problem. **[2]**

   (e) *Multiplicative Increase Additive Decrease* (MIAD) is an effective alternative to the widely used AIMD technique for congestion control. **[2]**