COE 768: Mid-Term Test

2015

- There are **Four** questions. Answer **ALL** of them. The points assigned to the questions are indicated at the beginning of the questions. The total points of this paper are 100.
- If doubt exists as to the interpretation of any question, the student is urged to submit with the answer paper, a clear statement of any assumption made.
- Time limit: 1 hour 50 minutes.

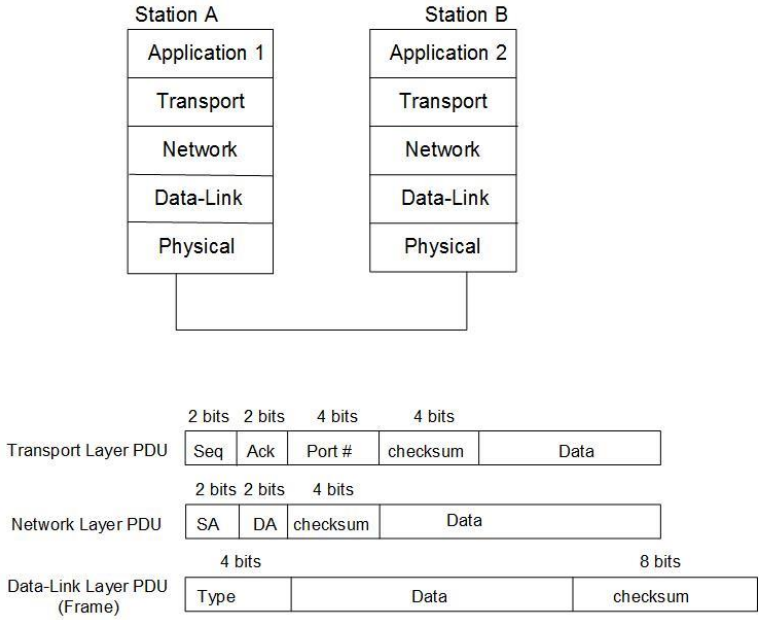
Student Name:

Student ID:

Question	Marks
Question 1 (25%)	
Question 2 (25%)	
Question 3 (25%)	
Question 4 (25%)	
Total (100%)	

Question 1

Consider the connection between two stations as illustrated in the following figure. The protocol stack has five layers. The figure also shows the PDU formats of the transport, network and data-link layers.



In the transport layer PDU, the port number identifies the application. The Seq and Ack are sequence number and acknowledgement number used for error control. In the network layer PDU, SA and DA stand for source and destination network addresses, respectively. The transport and network layers use 1's complement to derive the checksum. The checksum used in the transport layer will check the transmission error of the complete PDU while the checksum used in the network layer is used to check the transmission error in the PDU header only. The data-link layer uses CRC to compute the checksum. The generator polynomial for the CRC is $G(x) = x^8+x^2+x+1$. Finally, the data-link layer PDU is transmitted using the technique of USB-2 (i.e. NRZI where polarity change represents binary zero and no polarity change represents binary one).

In this question, the following parameters' values are given:

- Network addresses of station A and station B are 00 (in binary) and 01 (in binary), respectively.
- The application entities are attached to port 1001 (in binary).
- The Type field of the data-link layer PDU has the value of 0001 (in binary).

In addition, the window status at the transport layer of station A are given as:

$S_n = 3$, $S_f = 2$, $R_n=2$

a) **(7 points)** Based on the formats of the PDUs above, deduce the kinds of error control services offered by the data-link layer and transport layer. There are three choices: unacknowledged

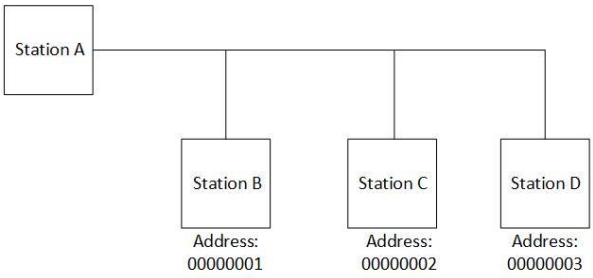
connectionless service, acknowledged connectionless service and connection-oriented service. You must provide full explanation of your choices.

b) **(10 points)** Suppose Application 1 sends one byte of data with value 11111111 to Application 2, determine the content of the corresponding data-link layer PDU, excluding the SD (start delimiter) and ED (end delimiter) and the CRC checksum field.

c) **(8 points)** Sketch the waveform of part (b), assuming the first bit has a positive polarity.

Question 2

Consider the following point-to-multipoint configuration:



Station A is the primary station and stations B, C and D are secondary stations. The figure above also shows the addresses of the secondary stations. The secondary stations communicate with the primary station using HDLC Normal Response Mode (NRM) with go-back-n protocol. The window statuses of the secondary stations are given below:

- Station B: $S_n = 3$, $S_f = 3$, $R_n=2$
- Station C: $S_n = 4$, $S_f = 4$, $R_n=3$
- Station D: $S_n = 5$, $S_f = 5$, $R_n=4$

Let's also assume that the window statuses of station A are synchronized with its secondary stations. Based on the information given, answer the following questions:

a) **(6 points)** If station A wants to poll station B, determine the header of the frame sent by Station A to station B.
b) **(7 points)** This is the continuation of part (a). If station B sends two data frames in response to the poll, determine the headers of these two frames.
c) **(6 points)** This is the continuation of part (b). If the first data frame received by station A contains transmission errors while the second frame does not, determine the header of the frame sent by station A in response to the detection of transmission errors.
d) **(6 points)** This is the continuation of part (c). Describe the action to be taken by station B after it receives the frame sent by station A.

Question 3

You are requested to design a communication system that supports the communications between two high-end servers over a communication link with the following parameters:

- One-way Propagation delay = 20 msec
- Channel data rate = 10 Mbps
- Frame size = 8000 bits

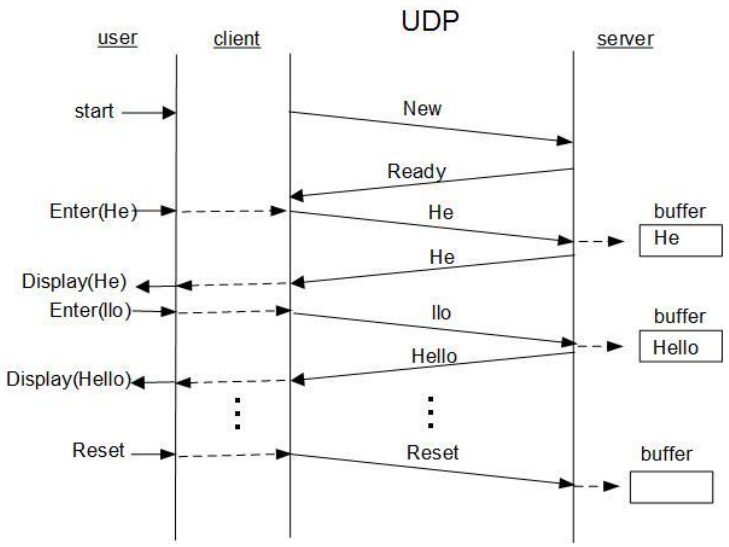
The link is fairly noisy and will introduce, on the average, one bit error for every 100000 bits of transmission. The main goal of your design is to maximize the link efficiency. Consider the following issues in your design:

- **(5 points)** Error-Control protocol – Choose one of the three connection-oriented error control protocols: Stop-and-Wait, Go-Back-n and Selective Repeat.
- **(15 points)** The number of bits used for the sequence number in the data frames.
- **(5 points)** The re-transmission timeout period, suppose negative acknowledgement is utilized. Consider 4 possible choices: 10 msec, 20 msec, 30 msec, 50 msec.

You **must provide enough justifications** to support your design.

Problem 4 (25 points)

Design and write a modified "echo" application based on UDP. The following time diagram illustrates the protocol of the application.



As illustrated in the diagram, the client initiates the service by sending a "new" message. The server responds with a "Ready" message to indicate the start of the session. After receiving the "ready" message, the client can send text messages entered by the user through the keyboard. The server echoes with the cumulative message sent by the user since the start of the session. For example, based on the scenario illustrated from the above diagram, the first message sent by the client is "He", so the server will echo the message "He"; if the next message sent by the client is "llo", then the server will echo the cumulative message "Hello". The user can terminate the session by sending a "reset" message. To simplify the program, make the following assumptions:

- The server has a large enough buffer to store all the messages of the session.
- The cumulative message is small enough to be carried by one datagram.

Note: You only need to provide **the code of the server program**.