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. Engg. SWE 4th Semester 16 May 2023

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **SUMMER SEMESTER, 2021-2022**
DURATION: 3 HOURS **FULL MARKS: 150**

CSE 4411: Data Communication and Networking

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 6 (six)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

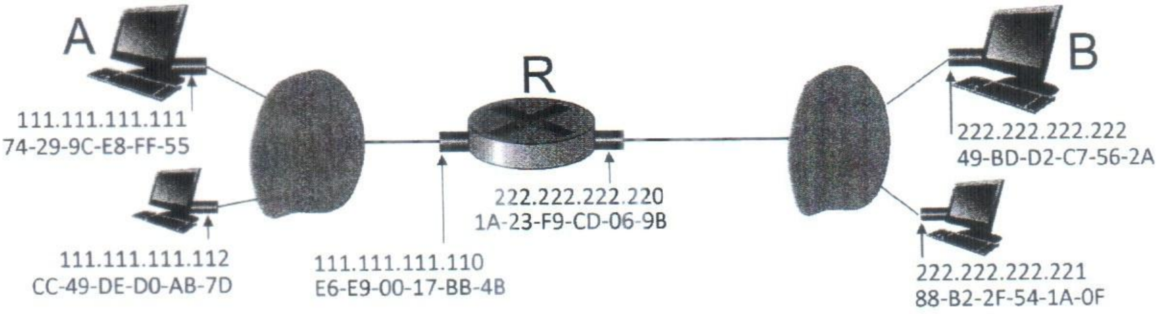

Figure 1: Figure for Question 1. a)

1. a) i. Assume that an ICMP packet is transmitted from end device *A* in one subnet to end-device *B* in another subnet depicted in Figure 1. Write down a walkthrough of the transmission of the packet (i.e, from which hop to which hop the packet will move). What are the source and destination IP address and MAC address present in the frame in each hop? How will the addresses be selected by that hop? Assume that *A* knows *B*'s IP address, IP address of the first hop router *R*, and *R*'s MAC Address. 10 + 5 (CO2) (PO1)

   ii. How can *A* determine the IP address and MAC address of the first hop router *R* in the scenario mentioned above?

   b) What is the motivation for configuring a VLAN in an institution? Explain with a figure. 10 (CO1) (PO1)

2. a) Explain the protocol of Carrier Sense Multiple Access with Collision Avoidance with the necessary diagram. 10 (CO1) (PO1)

   b) Why is there a constraint on the minimum frame size in CSMA/CD? How is it calculated? Show it with the necessary diagram(s). 5 (CO2) (PO1)

   c) In the network layer, an intermediatory router may fragment a received IP datagram. 4 + 6 (CO2) (PO1)

   i. When does a router fragment a datagram? Is it possible to avoid fragmentation?

   ii. What are the changes applied on a received datagram before sending it out for each of the following cases?
   Case 1: A non-fragmented datagram needs to be fragmented.
   Case 2: A fragmented datagram (not the last datagram) needs to be fragmented.
   Case 3: A fragmented datagram (last fragment) needs to be fragmented.

3. a) Assume that you are using two-dimensional parity code on a 24-bit data word which is divided into rows of 7-bit. Answer the following questions with one example for each:
   i. What is the maximum number of errors that can be corrected with a guarantee?
   ii. What is the maximum possible number of errors that can be corrected?
   iii. What is the maximum number of errors that can be detected with a guarantee?
   iv. What is the maximum possible number of errors that can be corrected?

   b) An IPv4 datagram is under preparation with the following information in the header (in hexadecimal): 7 (CO2) (PO1)
   Ox 45 00 00 54 00 13 58 50 20 06 00 00 7C 4E 03 02 B4 0E 0F 02
   See Figure 2 for the format of IPv4 datagram.

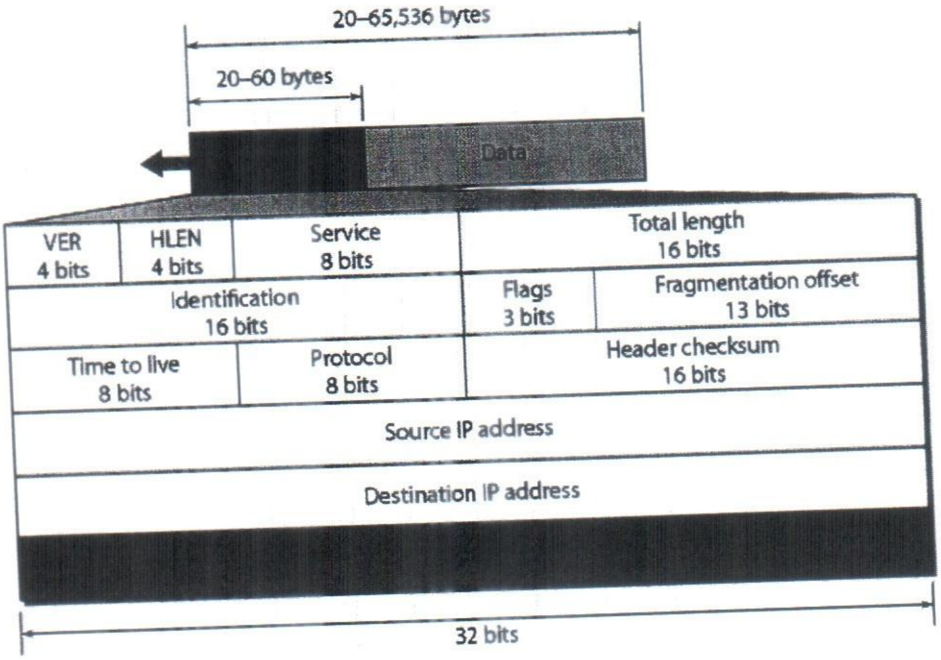

Figure 2: Format of IPv4 datagram for Question 3. b)

   The network layer will calculate the header checksum and generate the final IPv4 datagram. Show the steps of header checksum calculation and find out the final IPv4 datagram.

   c) How can linear block code can be used to correct burst errors? Explain it with an example. 7 (CO1) (PO1)

   d) Assume that you need to design a hamming code where the dataword needs to be at least 7 bits. Calculate the values of k and n that satisfy this requirement. 3 (CO1 (PO1

4. a) In NRZ encoding scheme, positive voltage defines bit 1 and zero voltage defines bit 0. In NRZ-L, the level of the voltage determines the value of the bit. On the other hand, in NRZ-I, the change or lack of change in the voltage level determines the bit's value. If there is no change in voltage level, the bit is 0. If there is a change, the bit is 1. oNRZ-I scheme is similar to NRZ-I. The only difference is that if there is no change in the voltage level the bit is 1 and if there is a change, the bit is 0. 10 (CO2 (PO1

Now, explain the following pitfalls and scenarios in which these four schemes will face these pitfalls.

- DC Component
- Self-Synchronization
- Baseline Wandering

Scenarios are long strings of 0 and 1 in the input signal.

b) Convert the hexadecimal string **6B 42 27 2F 6A 38** to the 8B6T signal. Draw the signal with notations. You can use multiple lines if it does not fit in a single line. A partial conversion table of 8B6T is given in Figure 3. 10 (CO2) (PO1)

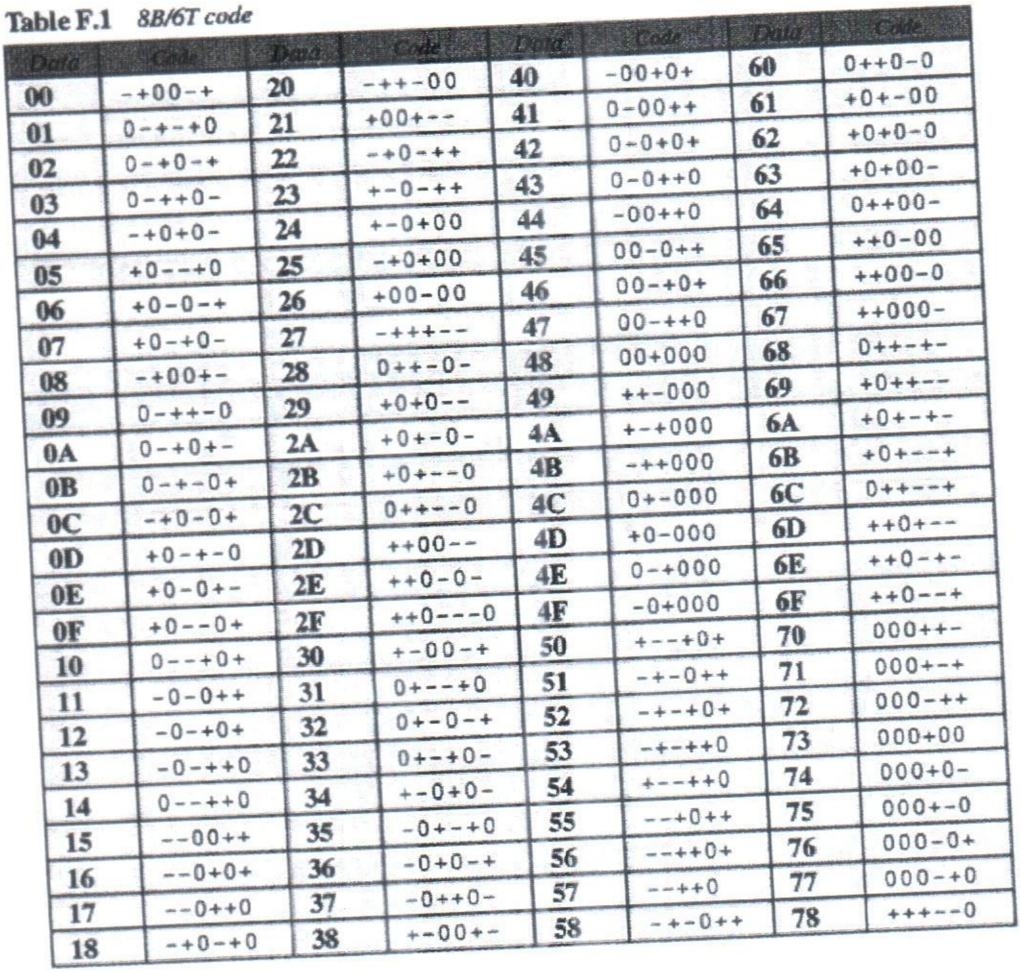

Table F.1 *8B/6T code*

Data	Code	Data	Code	Data	Code	Data	Code
00	-+00-+	20	-++-00	40	-00+0+	60	0++0-0
01	0-+-+0	21	+00+--	41	0-00++	61	+0+-00
02	0-+0-+	22	-+0-++	42	0-0+0+	62	+0+0-0
03	0-++0-	23	+-0-++	43	0-0++0	63	+0+00-
04	-+0+0-	24	+-0+00	44	-00++0	64	0++00-
05	+0--+0	25	-+0+00	45	00-0++	65	++0-00
06	+0-0-+	26	+00-00	46	00-+0+	66	++00-0
07	+0-+0-	27	-+++--	47	00-++0	67	++000-
08	-+00+-	28	0++-0-	48	00+000	68	0++-+-
09	0-++-0	29	+0+0--	49	++-000	69	+0++--
0A	0-+0+-	2A	+0+-0-	4A	+-+000	6A	+0+-+-
0B	0-+-0+	2B	+0+--0	4B	-++000	6B	+0+--+
0C	-+0-0+	2C	0++--0	4C	0+-000	6C	0++--+
0D	+0-+-0	2D	++00--	4D	+0-000	6D	++0+--
0E	+0-0+-	2E	++0-0-	4E	0-+000	6E	++0-+-
0F	+0--0+	2F	++0---0	4F	-0+000	6F	++0--+
10	0--+0+	30	+-00-+	50	+--+0+	70	000++-
11	-0-0++	31	0+--+0	51	-+-0++	71	000+-+
12	-0-+0+	32	0+-0-+	52	-+-+0+	72	000-++
13	-0-++0	33	0+-+0-	53	-+-++0	73	000+00
14	0--++0	34	+-0+0-	54	+--++0	74	000+0-
15	--00++	35	-0+-+0	55	--+0++	75	000+-0
16	--0+0+	36	-0+0-+	56	--++0+	76	000-0+
17	--0++0	37	-0++0-	57	--++0	77	000-+0
18	-+0-+0	38	+-00+-	58	-+-0++	78	+++--0

Figure 3: A partial conversion table of 8B6T for Question 4. b)

c) What is the difference between flow control and congestion control? 5 (CO1) (PO1)

5. a) Each node in the computer network needs a unique IP address. However, it is time-consuming to assign IP addresses to all the nodes manually. Describe the strategy to obtain an IP address automatically by a new client arriving in the network. Your answer must contain the labeled diagram of interactions of different agents participating in the strategy. 12 (CO2) (PO1)

b) Suppose you are interested in detecting the number of hosts behind a NAT. You observe that the IP layer stamps an identification number sequentially on each IP packet. The identification number of the first IP packet generated by a host is a random number, and the identification numbers of the subsequent IP packets are sequentially assigned. Assume all IP packets generated by hosts behind the NAT are sent to the outside world.

i. Assume that you can sniff all the packets sent by the NAT to the outside. Based on the aforementioned scenario, can you outline a simple technique that detects the number of unique hosts behind a NAT? Justify your answer.

ii. If the identification numbers are assigned randomly instead of sequentially, would your technique work? Justify your answer.

(CO
(PO

6. a) Explain the procedure of a SYN flood attack. How can you prevent this attack?

5
(CO1)
(PO1)

b) Figure 4 represents a data transfer protocol. Use this figure to answer the following questions:

4 + 6
(CO2)
(PO2)

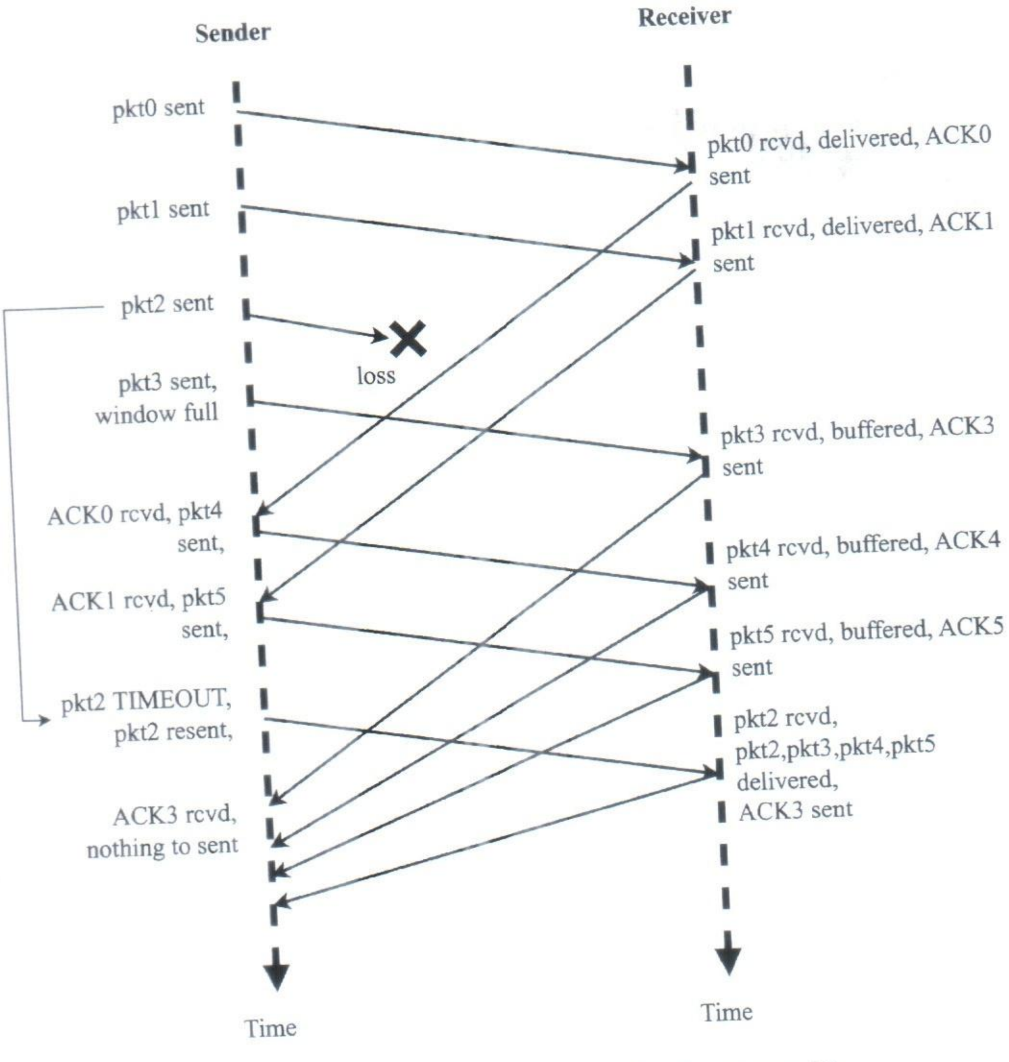
Sender
Receiver
pkt0 sent
pkt0 rcvd, delivered, ACK0 sent
pkt1 sent
pkt1 rcvd, delivered, ACK1 sent
pkt2 sent
loss
pkt3 sent, window full
pkt3 rcvd, buffered, ACK3 sent
ACK0 rcvd, pkt4 sent,
pkt4 rcvd, buffered, ACK4 sent
ACK1 rcvd, pkt5 sent,
pkt5 rcvd, buffered, ACK5 sent
pkt2 TIMEOUT, pkt2 resent,
pkt2 rcvd, pkt2,pkt3,pkt4,pkt5 delivered, ACK3 sent
ACK3 rcvd, nothing to sent
Time
Time

Figure 4: Data transfer protocol for Question 6. b)

i. Which data transfer protocol is represented in Figure 4? Justify your answer.

ii. Redraw Figure 4 with sequence numbers and current window status after each action. Note that you need to choose the sequence number size and window size in such a way that matches the constraints in the figure. You need to draw a box surrounding sequence numbers to represent the current window.

c) Describe the steps of the closing procedure of a TCP connection with a labeled timing diagram of interactions between the client and the server.

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