

TECHNOLOGICAL UNIVERSITY DUBLIN

Grangegorman

TU856 – BSc. (Honours) in Computer Science

TU858 – BSc. (Honours) in Computer Science (International)

Year 2

SEMESTER 2 EXAMINATIONS 2023/24

CMPU 2005 Data Communications

Internal Examiners

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Instructions to candidates:

Answer 4 out of 5 questions.

All questions carry 25 marks.

Duration: 2 hours.

Special Instructions: Strike out excess questions answered.

1. In relation to multiplexing techniques:

- (a) Describe the main motivation for using multiplexing techniques. In your answer, explain whether the end-host devices are aware of the MUX and DEMUX devices.

(7 marks)

- (b) For each multiplexing technique: FDM and STDM, use an appropriate diagram to illustrate how *channels* can usefully be viewed. Hint: one of the diagrams will show a Frequency Domain representation of channels and the other will show a Time Domain representation.

(8 marks)

- (c) STDM is a *digital* system. Explain what this means in terms of: the type of signal (digital or analogue) accepted at the input of the MUX device and, the type of data (digital or analogue) it can deal with.

(5 marks)

- (d) FDM is an *analogue* system. Explain what this means in terms of: the type of signal (digital or analogue) accepted at the input of the MUX device and, the type of data (digital or analogue) it can deal with.

(5 marks)

2. Consider two computers (Hosts A and B) communicating using the HDLC protocol and employing modulo 8 numbering.

The following table (Table 1 – *Incoming and outgoing buffers*) identifies two distinct events on the top row. Times t_1 and t_2 represent separate time periods with no correlation between them. All transmissions from Host A to Host B at times t_1 and t_2 are the first attempt to send these frames. The following scenarios are to be explored using appropriate sequence numbers:

- (a) Prior to time t_1 , identify the incoming data frame, with appropriate sequence numbers, received by Host A that resulted in this host transmitting the frames identified in its outgoing buffer at time t_1 . Justify your choice of sequence numbers.

(6 marks)

- (b) At time t_1 , and with reference to frames contained in each hosts' buffers, explain what has happened to A's transmissions. In your answer identify which error control protocol is in use: *Go-back-N* or *Selective Reject*. Justify your answer, referencing appropriate frame numbers in Host B's incoming buffer.

(6 marks)

Q2 continues on the next page

- (c) For the event occurring at time t_1 , explain how Hosts A and B will interact to rectify the situation identified in (b) above. In your answer, identify appropriate control messages and frames transmitted from each host, with appropriate sequence numbers and, identify the frames contained in each buffer after this situation has been resolved.

(7 marks)

- (d) At time t_2 , Host B has cleared its incoming buffer and transmitted a positive acknowledgement (ACK) as an S-frame for all frames identified in Host A's outgoing buffer. However, this ACK never arrives at Host A. Identify the ACK message and, identify how Host A will respond to this missing ACK should a timer expire for one of the frames contained in its outgoing buffer. In your answer, justify your choice of frame numbers.

(6 marks)

| | <u>Time t_1</u> | <u>Time t_2</u> |
|--------------------------|---|--------------------------------|
| Host B's incoming buffer | I(1,4), I(3,4), I(4,4), I(5,4) | |
| Host A's outgoing buffer | I(1,4), I(2,4), I(3,4), I(4,4), I(5,4) | I(4,1), I(5,1), I(6,1), I(7,1) |

Table 1 – Incoming and outgoing buffers.

3. In relation to the use of Bridge devices to extend the reach of Local Area Networks (LANs):

- (a) Explain how *Address Learning* works in relation to the population of a Bridge's routing table. In your answer, explain how the Bridge deals with incoming frames when the routing table is empty and, when it is complete. Also, identify which address(es), source and/or destination are used to populate the table and which address(es) are used for routing.

(10 marks)

Q3 continues on the next page

- (b) Refer to Figure 1 – A *bridged* network. Ignoring the introduction of Bridge 2, copy the routing table for Bridge 1 into your answer book and populate the table identifying the port number for each of the hosts: A-D inclusive.

(4 marks)

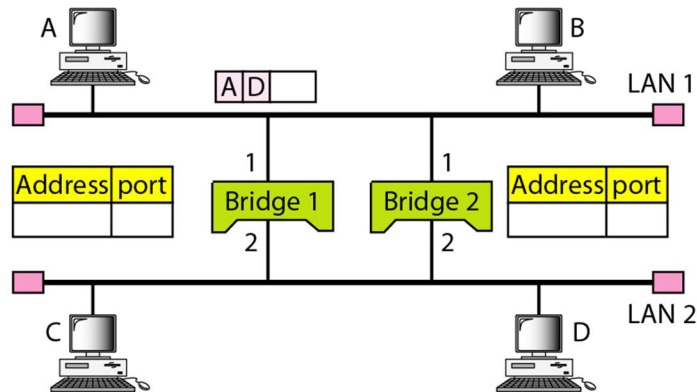


Figure 1 – A *bridged* network.

- (c) Consider the implementation of a second bridge, Bridge 2 as shown in Figure 1. Assuming the routing table on each bridge is initially empty, demonstrate how a routing loop can occur during the *Address Learning* phase by considering the transmission of a single frame from Host A to Host D. In your answer, show the effects of the routing loop by highlighting how entries in each of the routing tables change.

(11 marks)

4. Refer to Figure 2 - *An Internetwork*.

Given the network address 192.168.0.0/23, you are required to sub-net this address block using VLSM, for the network shown in Figure 2.

The following are the host address requirements for the networks shown: Net A = 60 host addresses, Net B = 200 host addresses, Net C = 120 host addresses and, each of the three inter-router connections: R1-R2, R2-R3 and R3-R1 = 2 host addresses.

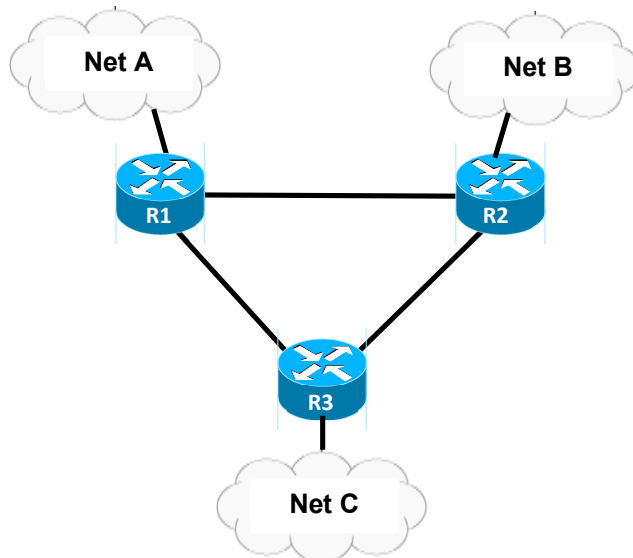


Figure 2 - *An Internetwork*.

Copy the following table into your answer book and insert the required IP addresses in *Dotted Decimal Notation* with Masks in *CIDR* notation. In your answer, show how the address masks were calculated for each sub-net and, show how the *Magic Number* technique is used to determine the starting address for each sub-net in adherence to the VLSM approach for address allocation.

| N/W. | Mask | N/W Address | Starting Host | End Host | Broadcast Address |
|-------|------|-------------|---------------|----------|-------------------|
| A: | | | | | |
| B: | | | | | |
| C: | | | | | |
| R1-R2 | | | | | |
| R2-R3 | | | | | |
| R3-R1 | | | | | |

Table: (12 marks)
Calculations: (13 marks)

5. Refer to Figure 3: *Two Digital Signals, A and B*:

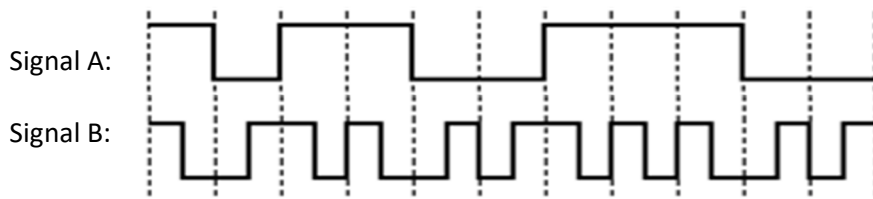


Figure 3 – *Two Digital Signals, A and B*.

- (a) Identify the encoding technique used to create each signal. Justify your answer with reference to the length of the pulses and/or the location of the signal transitions. (6 marks)
- (b) Starting from left to right, identify the bit stream encoded onto each of the signals. In your answer explain the encoding rules used by each technique to represent the bits. (7 marks)
- (c) Explain the concept of a *D.C. Component*. In your answer, highlight the characteristic of each signal, A and B, that demonstrates the presence of a DC component, or otherwise. (6 marks)
- (d) Explain the concept of *Synchronisation*. In your answer, highlight the characteristic of signal A that demonstrates the problem of synchronisation and, highlight the characteristic of signal B that ensures this is not a problem. (6 marks)