UNIVERSITY OF ABERDEEN

SESSION 1999-00

Degree Examination in ES 3561 Communications Engineering 1B

Thursday 25th May 2000 (2:00 pm - 5:00 pm)

Notes:
(i)   Candidates are permitted to use approved calculators
(ii)   Candidates are not permitted to use the Engineering Mathematics Handbook
(iii)   An information sheet of protocol headers is provided

Candidates should attempt THREE questions. All questions carry 20 marks.

1.   (a) Ethernet is now the most common networking technology for the construction of *Local Area Networks (LANs)* and supports a range of physical media. Explain the differences between 10BT and 10B2 cabling.   [8 marks]

(b) Ethernet supports a protocol known as *Carrier Sense Multiple Access with Collision Detection (CSMA/CD).* Explain how CSMA/CD works, by first explaining the *Carrier Sense* process, and then describing Collision Detection, and then showing how a sender ensures a low probability of subsequent collision when two nodes attempt to transmit at the same time.
[10 marks]

(c) What is the purpose of the four byte "Jam sequence"?   [2 marks]

2.   (a) The following frame transition diagram (figure 1) shows an exchange of Ethernet frames between two computers, A and B connected via a 10BT Hub. Each frame sent by Computer A contains 1500 B of Ethernet *Medium Access Control (MAC)* payload data, while each frame sent by Computer B contains 40 B of Ethernet MAC payload data. Calculate the average *Utilisation* of the media during this exchange.   [6 marks]
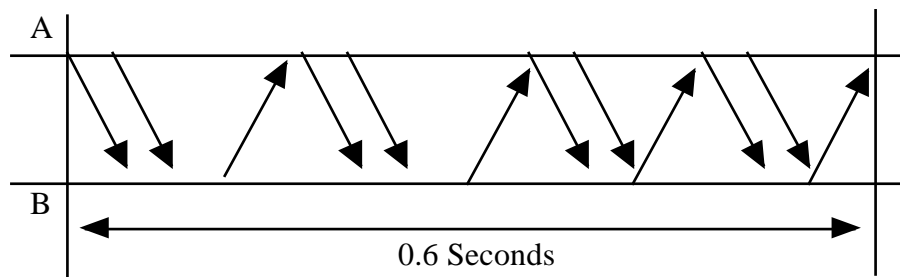

FIGURE 1: Frame Transition Diagram for Communication Between A and B

(b) Is the exchange in figure 1 best described as *Full Duplex*, *Half Duplex,* or *Simplex*?
[2 marks]

(c) What is the throughput of the transfer from A to B when measured at the TCP layer?
[6 marks]

(d) Two Ethernet LANs are connected by an Ethernet bridge. Explain how the bridge automatically recognises which packets are to be forwarded and which are to be discarded by observing the MAC header of the received packets.   [4 marks]

(e) What complication arises when a second Ethernet Bridge is connected in parallel with the first, forming a loop between the two LAN segments?   [2 marks]

3. (a) What is the *Open Systems Interconnection (OSI) Reference Model*? Provide a description of the *services* provided by each of the seven layers defined by the model.   [8 marks]

    (b) What *layer* of the OSI reference model best describes the *Internet Protocol (IP)*? [1 mark]

    (c) Explain how the Ethernet link layer identifies the first **and** last byte of data within a frame.

    (i)   First Byte of Frame Header in an Ethernet frame
    (ii)   Last Byte of Frame Checksum in an Ethernet frame   [5 marks]

    (d) Explain how the link layer identifies the first **and** last byte of data within a frame when it is sent over a link using the *High Level Data Link Control (HDLC)* protocol.

    (i)   First Byte of Frame Header in HDLC
    (ii)   Last Byte of Frame Checksum in HDLC   [6 marks]

4. (a) When an *Internet Protocol (IP)* packet is carried in a link layer frame, it contains addresses at both the link and network layers.

    (i)   How does the node identify its own hardware address?   [4 marks]
    (ii)   How does the node identify the hardware address of the intended recipient? [4 marks]
    (iii)   How does the node identify it's own IP address?   [2 marks]
    (iv)   What protocol is used to find out the IP address of an intended destination
            end system, when only the name of the system is known?   [2 marks]

    (b) A path between two End Systems consists of three Ethernet links with a respective *Maximum Transmission Unit (MTU)* of 1500 B, 1450 B, and 1500 B.

    (i) Explain how a sender uses Path MTU Discovery to determine the smallest MTU   [4 marks]
    (ii) Calculate the *Path-MTU*, and so determine how many IP packets are received at the destination when a UDP datagram with 8 KB of data is sent over the above path.   [4 marks]

5. (a) Explain the features of an IP router, and the way a router may be used to forward packets between two different subnetworks.   [6 marks]

    (b) The following Ethernet packet was received by a router from an interface.

```
  0: 0100 5e02 dc3e 00d0 bbf7 c6c0 0800 4500
 16: 00cc e206 0000 7111 a1a9 84b9 8476 e002
 32: dc3e 7982 7982 00b8 08a0 8005 dbc6 d721
 48: 69c0 0752 bb5f fe39 3600 8808 b120 8933
     ...
208: 8a29 0183 fb15 b888 0d4c
```

FIGURE 2: A Hexadecimal Dump of an Ethernet Frame received by a Router.

    Determine the transport layer protocol used by decoding the IP *protocol type* field, given the following decimal Service Access Point Values: TCP=6, UDP=17, ICMP=4.   [2 marks]

    (c) Determine the hardware destination address, and IP network destination address. By examining the addresses used, determine whether the packet is *multicast* or *unicast*. [4 marks]

    (d) All transport layer *Protocol Data Units (PDUs)* include a checksum, what is the checksum value in the above frame (figure 2).   [2 marks]

    (e) What is the purpose of this checksum? (In what ways does it differ from the *Cyclic Redundancy Check (CRC)* used at the link layer?)   [6 marks]