UNIVERSITY OF ABERDEEN SESSION 1998-99

Degree Examination in EG 3561 Communications Engineering

25th May 1999 2:00pm – 5:00 pm

Candidates should attempt THREE questions.

All questions carry 20 marks.

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

1. (a) The Ethernet *Local Area Network (LAN)* uses *Carrier Sense Multiple Access* with *Collision Detection (CSMA/CD)* to share the transmission medium. In the context of CSMA/CD, what is meant by the following terms?

   (i) Carrier Sense **[3 marks]**
   (ii) Collision Detection **[3 marks]**
   (iii) Collision Domain **[3 marks]**

   (b) Describe the phenomenon of *Ethernet Capture* **[5 marks]**

   (c) A TCP session sends 10 packets per second over an Ethernet *Local Area Network (LAN)*. Each packet has a total size of 1480 B (excluding the *preamble* and *cyclic redundancy check (CRC)*). What is the TCP throughput of the session? **[6 marks]**

2. A small *Local Area Network (LAN)* has the topology shown in figure 1 below:

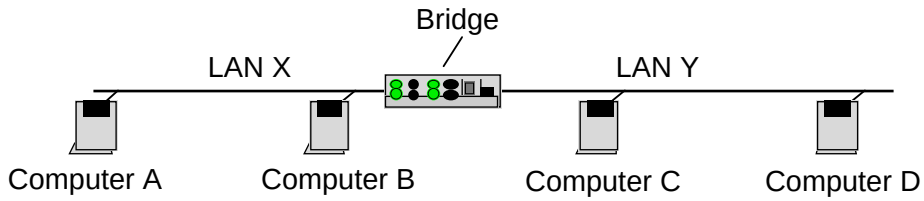

Figure 1: Four computers, A, B, C and D connected via a LAN.

(a) The computer A sends a graphics file of size 10 MB using three simultaneous *Unicast* transfers to computers B, C, and D. The data are sent using the*Universal Datagram Protocol (UDP).*Calculate the *utilisation* of LAN X, given that each frame carries 1024 B of UDP payload data, and transmission is at 50 packets per second to each destination.
[8 marks]

(b) What is the utilisation for LAN Y? **[2 marks]**

(c) How does *Multicast* transmission differ from *Unicast* transmission? Illustrate your answer by describing the use of unicast and multicast addresses in Ethernet. **[8 marks]**

(d) Calculate the utilisation for LAN Y when the file is sent using multicast packets instead of the unicast packets used in section (a). **[2 marks]**

3. (a) Summarise the functions of the lowest three layers of the *Open System Interconnection (OSI)* reference model. Ensure your answer includes a sketch of the model with each of the three layers labelled. **[6 marks]**

   (b) With reference to the *Open System Interconnection (OSI)* reference model describe the terms:

   (i) End-to-End **[2 marks]**
   (ii) Hop-by-Hop **[2 marks]**

   (c) What are the requirements for *reliable* data transfer? **[4 marks]**

   (d) Which layer provides reliability in the TCP/IP protocol suite? **[1 mark]**

   (e) Explain the operation of *Automatic Repeat Request (ARQ)* protocols, and illustrate your drawing by showing how *Stop and Wait ARQ protocol* may recover from the loss of a single packet within a network. **[5 marks]**

4. (a) The *High Level Data Link Control* (HDLC) protocol provides transparent framing of the data to be transmitted. Calculate the number of bits which will be transmitted when an HDLC link serialises the following bytes:

   `0xFE 0xF1 0xF0 0xFF` **[6 marks]**

   (b) Describe the differences between a *Local Area Network (LAN)* and a *Metropolitan Area Network (MAN).* **[4 marks]**

   (c) Why is HDLC preferable to 10 Mbps shared Ethernet in a MAN environment? **[2 marks]**

   (d) With the help of diagrams explain how a Router may connect the two types of network. **[8 marks]**

5. (a) Computers in a network are identified by either a *name* or a *address*. Explain the following terms relating to addresses:

   (i) An address *cache* **[2 marks]**
   (i) A *network address* **[2 marks]**
   (ii) A *network name* **[2 marks]**

   (c) Explain the operation of the *Domain Name Service* (DNS)) **[7 marks]**

   (d) The following bytes were captured on an Ethernet LAN and correspond to an arp packet (with an Ethernet type code of 0x0806):

```
ffff ffff ffff 0800 200b b083 0806 0001
0800 0604 0001 0800 200b b083 8b85 cc11
ffff ffff ffff 8b85 cc50 0000 0000 0000
0000 0000 0000 0000 0000 0000
```

   (i) Sketch the protocol encapsulation used to construct this message **[3 marks]**
   (ii) By observing the Medium Access Control (MAC) header, determine if this is an arp request (query) or an arp response **[2 marks]**
   (iii) What is the target IP address which is to be resolved? **[2 marks]**