UNIVERSITY OF ABERDEEN   SESSION 1998-99

Degree Examination in ES 3567 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. Define the following terms:

    (i)   Carrier Sense   **[3 marks]**

    (ii)   Collision Detection   **[3 marks]**

    (iii)   Collision Domain   **[3 marks]**

(b) Describe how *Ethernet Capture* allows a single computer to dominate the use of the medium when it has excessive amounts of data to transmit.   **[5 marks]**

(c) A TCP session sends 10 packets per second over an Ethernet *Local Area Network*. Each packet has a total size of 1480 B (excluding the *preamble* and *cyclic redundancy check (CRC)*). Determine the size of the PDU headers using the chart, and hence the TCP payload. Using this, calculate the TCP throughput of the session?   **[6 marks]**

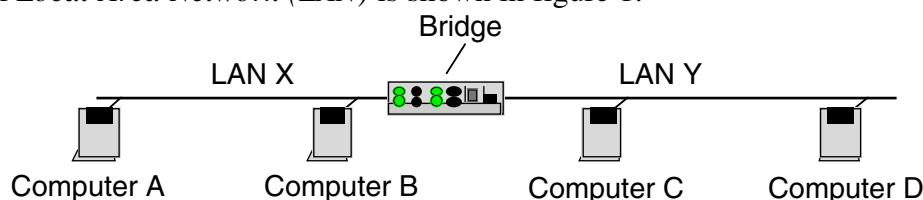2. A small *Local Area Network (LAN)* is shown in figure 1:

Figure 1: Four computers, A, B, C and D connected to a LAN. The LAN is formed from two *shared* Ethernet segments joined via a bridge.

(a) The computer A sends three simultaneous *Unicast* file transfers to computers B, C, and D. In each case, the data is encapsulated by the *Universal Datagram Protocol (UDP)*. Calculate the size of each frame, given that it carries 1024 B of UDP payload data. Using this information, calculate the Utilisation of LAN X, assuming that transmission is at 50 packets per second to each of the three destinations.   **[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) Explain how the utilisation for LAN Y is smaller when using multicast packets instead of the unicast packets used in section (a).   **[2 marks]**

3. (a) Summarise the functions of the physical, link and network layers of the seven layer *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 communication between layers in 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 four 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 a *Stop and Wait ARQ protocol* may retransmit a single packet which was previously corrupted and discarded within a network. **[5 marks]**

4. (a) The *High Level Data Link Control* (HDLC) protocol uses a technique known as *0–Bit Insertion* to provide transparency. 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 using Carrier Sense Multiple Access with Collision Detection (CSMA/CD) for a MAN environment? **[2 marks]**

(d) With the help of diagrams explain how a Router may connect the two types of network at the network layer of the OSI reference model. **[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* (as used in the Domain Name Service (DNS)) **[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)   Using the PDU header chart, sketch the protocol encapsulation used to construct this message **[3 marks]**
    (ii)   By observing the type of destination address in the *MAC* header, can you determine if this packet is a request or a response? **[2 marks]**
    (iii) What is the target IP address which is to be resolved? **[2 marks]**