UNIVERSITY OF ABERDEEN
SESSION 2002-03

Degree Examination in ES 3567 Communications Engineering 1B

Tuesday 27th May 2003   (09:00 am - 12:00 noon)

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

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

1. (a) Compare the operation of *Message Switching* and *Packet Switching*. [8 marks]

   (b) Sketch a diagram showing each of the seven layers in the *Open Systems Interconnection* (OSI) *Reference Model*. Label each protocol layer in your diagram. [6 marks]

   (c) What is the function of the *Transport Layer* in the *OSI Reference Model?* [3 marks]

   (d) A session uses the *User Datagram Protocol* (UDP). It sends a series of packets over an Ethernet LAN. The payload of each UDP packet has a size of 690 bytes. Determine the total size of the Ethernet frame using the information provided in the attached PDU Header Chart. [3 marks]

2.(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* [4 marks]
   (ii) *Collision Detection* [4 marks]
   (iii) *Collision Domain* [4 marks]

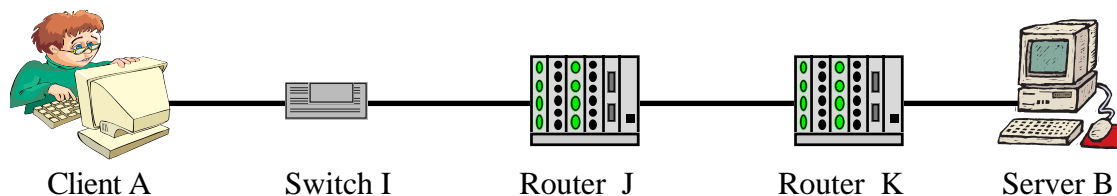Client A   Switch I   Router J   Router K   Server B

Figure 1: An Internet Path between two End Systems, A and B

   (b) The *traceroute program* may be used to determine an end-to-end *Internet Path* through a network. Explain (using appropriate diagrams) the set of packets that are exchanged when Client A uses the *traceroute* program to find the *Intermediate Systems* along the path to Server B. [8 marks]

3. (a) Give 4 reasons why the packets received by an IP Router may not be forwarded. [4 marks]

   (b) The *Trivial File Transfer Protocol (TFTP)* may be used to provide a *reliable* service. What set of guarantees must a reliable protocol offer? [5 marks]

   (c) An *End System* sends 5 packets per second using the *User Datagram Protocol (UDP)* over a full duplex 100 Mbps Ethernet LAN connection. Each frame consists of 1500 bytes of Ethernet payload data. At the transport layer, determine the amount of payload carried by each UDP packet, and hence calculate the UDP transport layer throughput. [8 marks]

   (e) Given that the Ethernet CRC-32 protects the integrity of frames sent across a *Local Area Network*, why does a transport protocol (e.g. the User Datagram Protocol, UDP) also include a checksum? [3 marks]

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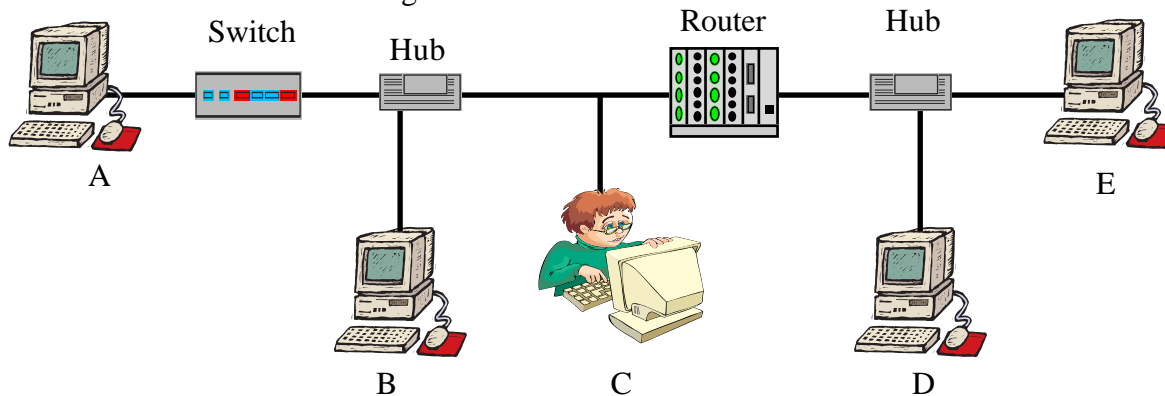
4. Consider the network shown in Figure 3:

Figure 3: An Ethernet LAN

(a) The *End System* C uses the *Transmission Control Protocol* (TCP) to send a packet to *End System* E with a payload of 100 bytes. Sketch the Ethernet frame that is sent, showing each of the protocol headers, and the packet payload. Ensure that your sketch also shows **the addresses at both the MAC and IP layers**. [6 marks]

(b) An *Internet Protocol* (IP) packet is broadcast by B. Which *End Systems* will receive this? [2 marks]

(c) *End System* A sends packets to *End System* E. Outline the process of *Path Maximum Transfer Unit (MTU) Discovery* that may be used by the *End System* A to determine the largest MTU that is supported by the router . [4 marks]

(d) Explain in detail the operation of *Address Learning by* an Ethernet *Switch*. Your answer should refer to the Ethernet switch shown in Figure 3. [8 marks]

5.
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0800 2086 354B 00E0 F726 3FE9 0800 4500
0028 AAFE 0000 FC06 3A55 8A84 E902 8B85
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Figure 4: Hexadecimal dump of the Header of a Packet received on an Ethernet interface

(a) Assuming the frame contains a Medium Access Control (MAC) header and an IP payload, use the supplied information about the packet header formats to determine the IP *Source Address* of the packet shown in Figure 4. [4 marks]

(b) What is the value of the Ethernet Frame Type in the frame shown in Figure 4? Your answer must **also** describe the use of this value by the system that receives this frame. [4 marks]

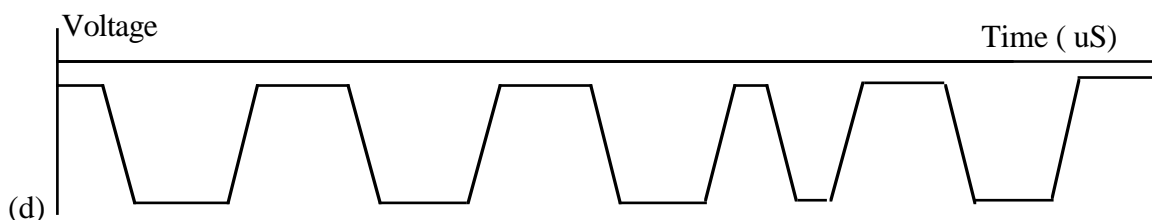(c) Explain what is meant by the term "*Preamble*" used by 10 Mbps Ethernet. [6 marks]

(d)

Figure 5: Waveform recorded on a coaxial Ethernet cable

(d) The waveform in Figure 5 shows a part of a *Manchester* encoded Ethernet frame. How many bits before the *Start of Frame Delimiter* (SFD) are shown in this Figure? [4 marks]

(e) Ethernet LANs traditionally used copper cable. Name two other Ethernet media. [2 marks]