UNIVERSITY OF ABERDEEN   **SESSION 1997-98**

Degree Examination in ES 3561 Communications Engineering

Xday X 1998 (??? - ???)

Notes: ***Candidates are permitted to use approved calculators***
           An information sheet of protocol headers is provided

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

1. (a) The Open Systems Interconnection (OSI) reference model describes the communications between protocol layers as *peer-to-peer*. Describe how some *peer-to-peer* communication is *End-to-End* while other communication is *Link-by-Link* (also known as *Hop-by-Hop*).   Explain these two terms, and provide an appropriate diagram to illustrate End-to-End and Link-by-Link communication..   **[8 marks]**

    (b) A Universal Datagram Protocol (UDP) packet is sent via an Ethernet network. Draw a diagram to show the frame of data as it would appear on the Ethernet network. Your diagram should include all the protocol headers.   **[4 marks]**

    (c) What is the purpose of a pre-amble and why is it sometimes needed for synchronous communications?.   **[2 marks]**

    (d) A client program sends one UDP packet with 60 B of data each second to a server and receives a corresponding reply also with 60 B of data. The client and server are connected by an Ethernet Local Area Network (LAN). Calculate the total number of bits sent via the Ethernet network by this program in each second. From the number of bits per second calculate the *Utilisation*, given that the Ethernet LAN operates at 10 Mbps.   **[6 marks]**

2. (a) Explain the properties of the *Physical Layer which is the lowest layer of the Open Systems Interconnection* (OSI) *Reference Model.*   **[4 marks]**

    (b) Provide a description of the following terms:

        (i) *Asynchronous Transmission*
        (ii) *Synchronous Transmission*
        (iii) *Non Return to Zero* (NRZ)
        (iv) *Encoded Clock*   **[8 marks]**

    (c) Compare the properties of *Alternate Mark Inversion (AMI)* and *Manchester* encoding.   **[4 marks]**

    (d) Plot the waveform (voltage v. time) which you would observe on an oscilloscope when a byte with the hexadecimal value of 0x57 is transmitted along an Ethernet coaxial cable. (Your answer should also show the transmit clock waveform on the same horizontal axis)   **[4 marks]**

3. (a) A link using the *High Level Data Link Control* (HDLC) protocol may provide either a best effort or a reliable transmission service. In this context, define what is meant by *Best Effort* and *Reliable*. **[6 marks]**

(b) What type of network service is provided by the *Internet Protocol (IP)*? **[1 mark]**

(c) Provide a detailed description of *Stop and Wait Error Recovery*. Your answer should include a frame transition diagram showing two cases: normal operation, and recovery following a transmission error. **[8 marks]**

(d) HDLC uses a continuous transmission mode. Explain how this improves the throughput performance compared to Stop and Wait error recovery over links with a high bandwidth delay product. **[5 marks]**

4. (a) Explain in detail the operation of an *Ethernet bridge* when used to connect two Ethernet LAN segments. **[6 marks]**

(b) Provide a description of the key differences between a *10BaseT hub*, an *Ethernet Bridge*, and an *IP Router*. Your answer should include appropriate diagrams and may include a table comparing the features provided by each equipment. **[8 marks]**

(c) Ethernet supports *Broadcast*, *Unicast* and *Multicast* transmission modes, explain in detail what is meant by each term. **[6 marks]**

5 (a) Define the following terms with reference to the Internet Protocol:

        (i) *Internet Protocol* (IP) Network Address
        (ii) Fragmentation (or Segmentation)
        (iii) *Maximum Transmission Unit* (MTU)
        (iv) IP Router   **[8 marks]**

(b)
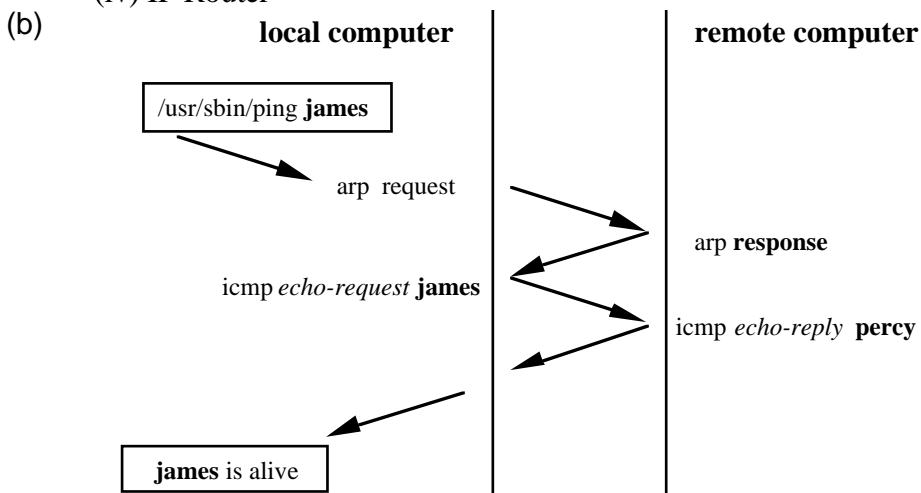
The *Address Resolution Protocol* (ARP).is used when, percy, a local computer (with *Medium Access Control* (MAC) address x) wishes to communicate with a remote computer, james, (with mac address y). Redraw the diagram above describing what happens at each stage and provide notes to give a detailed explanation of the operation of ARP. Ensure you specify which addresses are used as the source and destination addresses of each frame. **[6 marks]**

(c) Outline the protocol headers which are present in each of the four Ethernet frames Using the protocol header information on the data sheet provided calculate the total size of each of the four frames (in bytes), given the ICMP payload is 100 bytes. **[6 marks]**