

These questions are intended to help students assess their own progress and understanding

### **TUTORIAL 1: Origins of Ethernet**

- (a) **The IEEE 802.x family of LAN specifications support many physical media, explain with the aid of diagrams the differences between 10B5 and 10B2 media.**

### **TUTORIAL 2: Ethernet Frames**

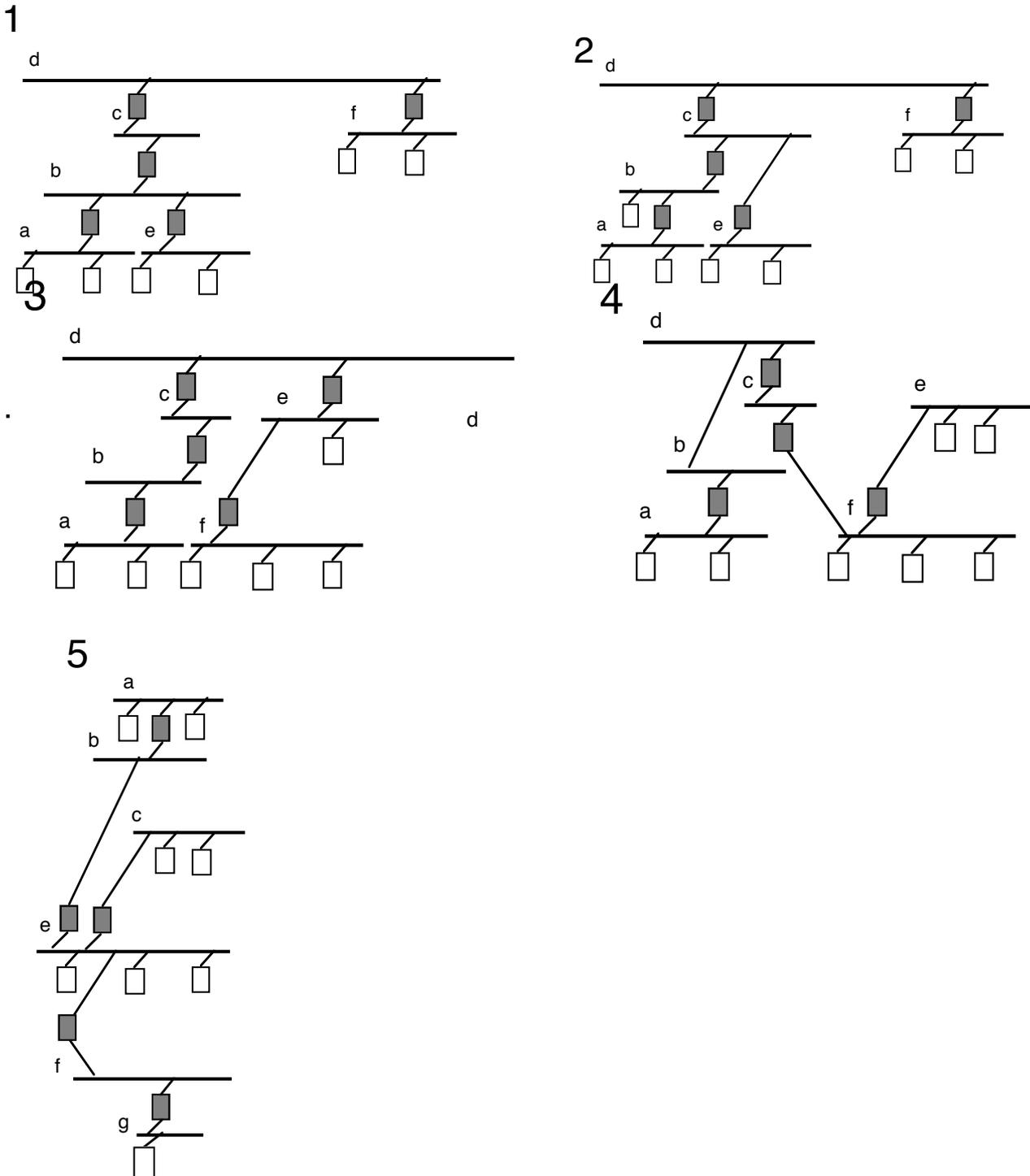
- (a) **How does a manufacturer decide which address to use?**
- (b) **Why is the first bit never set in an Ethernet source address?**
- (c) **What is the Carrier Sense Circuit in the transceiver used for? Explain the “CS” and “CD” functions.**
- (d) **What is Ethernet Capture?**

### **TUTORIAL 3: Ethernet Transmission**

- (a) **Sketch the format of an Ethernet frame carrying 1000 B of data. Your answer should show all the protocol fields (headers) present in the frame.**
- (b) **Sketch an outline block diagram of the process by which a byte is Manchester encoded by an Ethernet processor prior to transmission by the physical layer. Use the example of sending a byte with the hexadecimal value of 0x57.**
- (c) **Explain the function of the Ethernet Preamble**
- (d) **Plot the waveform which you would observe on an oscilloscope when the first byte of the preamble is sent along an Ethernet coaxial cable.**
- (e) **Explain the function of the Ethernet Cyclic Redundancy Check (CRC)**

**TUTORIAL 4: Collision Domains and Repeaters**

- (a) The Ethernet standard states that each frame should carry two addresses: What is the Ethernet destination address used for?
- (b) Explain with the aid of diagrams the key features of 10BT cables and suggest two situations where optical fibre is preferable to copper cabling.
- (c) What is the 5-4-3 Repeater Rule?
- (d) Here are 5 networks, can you explain whether they pass the 5-4-3 Repeater rule and if not, why not?



**TUTORIAL 5: Bridges and Switches**

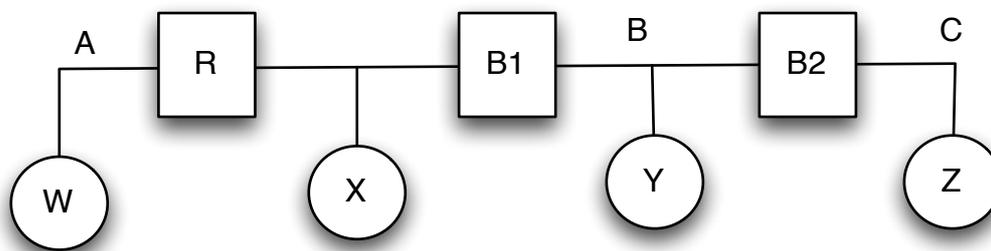
(a) Explain in detail the operation of an Ethernet bridge, and describe how the bridge filters frames which need not be forwarded between Ethernet segments.

(b) What is the role of the Ethernet Source Address?

(c) Explain the concept of a Collision Domain

**TUTORIAL 5.1 Bridge v Repeaters**

(a) Four computers (W,X,Y,Z) are connected by 3 Ethernet segments (A,B,C) using a Repeater (R) and a Bridge/Switch (B).



Which computers receive (at the network level) the following frames? (Make sure your answer also shows which LAN segments carry each frame.)

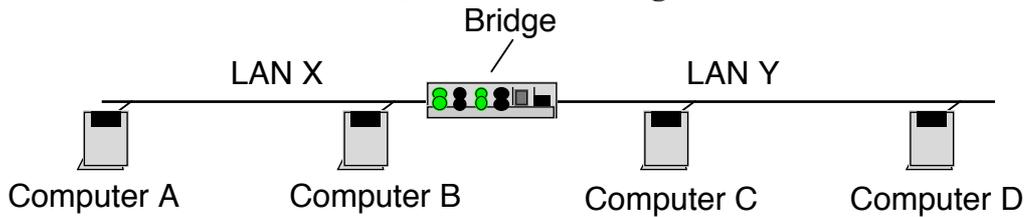
(b) The computers W and X have MAC addresses of  $W = 0x00102030$  and  $X = 0x00102040$ . They are both also members of the multicast group  $0x23$ . Sketch the MAC header for a multicast frame sent from X to the multicast group  $0x23$ .

(c) Which LAN segments carry a multicast frame?

(d) Which of the following may be used to extend a LAN to allow computers to be connected by more than 5 cable segments?

**TUTORIAL 5.3: Bridges and Switches - Supplementary Question**

A small Local Area Network (LAN) is shown in the figure:



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

- The computer A sends three simultaneous Unicast file transfer packets. each to computers B, C, and D. Calculate the size of a frame, given that it carries 1032 B of IP network payload data. Using this information, calculate the Utilisation of LAN X, assuming that the transmission continues at 50 packets per second to each of the three destinations.
- What is the utilisation on LAN Y?
- How does Multicast transmission differ from Unicast transmission?
- Calculate the utilisation for LAN Y when the file is sent using multicast packets instead of the unicast packets used in section (a).

**TUTORIAL 6: Faster Ethernet**

- In the context of Fast Ethernet explain how the following sequence of bits {1 0 0 1 1 0 } are encoded using Multi-Level Threshold, MLT-3 line encoding.
- What is the purpose of 4b/5b encoding?
- Explain the operation of the physical layer used by a Gigabit Ethernet Network Interface Card (NIC).

### TUTORIAL A.1: IP

(a) Define the following terms:

- (i) The IP Version Number
- (ii) The IP Network Number
- (iii) The Network Layer Address

(b) Describe in detail how a computer connected to an Ethernet LAN determines its own Ethernet address and how it determines the Ethernet address of other computers with which it needs to communicate.

(c) Two computers, A and B, are connected by an Ethernet LAN. A has not previously sent any packets to the LAN. It sends 20B of data to B in a single IP datagram.

- (i) What is the type of the first Ethernet frame sent by A?
- (ii) To which MAC address is the first frame sent?
- (iii) What is the IP source address of the first IP packet received by B?

### TUTORIAL A.3: ARP - Supplementary Question

(a) An Ethernet Local Area Network (LAN) connects two workstations (A and B). The following information is provided about the IP interfaces of the computers connected to the LAN, also giving the hardware address (ha, or MAC address) for each interface.

A: IP = 139.101.1.7; h.a.= 08:00:20:02:b7:f9  
B: IP = 133.101.1.63; h.a.= 08:00:20:ff:00:00

The computer A has not previously sent any packets to the Ethernet LAN. The user at A runs a program which sends one IP packet and has a destination address of B. Explain the hardware address values in the first frame which is sent by the computer A.

(b) What are the hardware source and destination addresses and the source and destination IP addresses of the first network layer packet which is received by B?

(c) Calculate the time taken to transmit one ARP packet using an Ethernet LAN operating at 10 Mbps. Your answer should first calculate the total size of the ARP packet including ALL overhead introduced by each layer during the transmission process.

### TUTORIAL B.1: IP

(a) An end to end connection may be checked in an IP internet using the ping program which uses the Internet Control Management Protocol, ICMP. Describe the operation of the ICMP echo request and ICMP echo reply to perform this check, and how this may measure the round trip delay across the network.

(b) Provide a step by step explanation using diagrams to show the way an Ethernet network interface card and the network layer protocol process an IP frame received from an Ethernet transceiver.

(c) For each packet, specify which computers addresses are used for the source and destination address at both the link layer AND the network layer.

**TUTORIAL C: Transport Layer**

- (a) What is the transport service provided by the transport layer?
- (b) Explain the function of each of the fields in the UDP packet header.
- (c) A UDP packet containing 50 B of payload data is transmitted using IP over an Ethernet LAN. What is the total size of the frame transmitted on the Ethernet LAN

**TUTORIAL D: Packet Decodes**

(a) Define the following terms

- (i) IP Header Checksum
- (ii) UDP Checksum

(b) An Ethernet protocol analyser observes the following frame:

08 00 20 00 70 DF 08 00 20 01 62 F0 08 00 45 00 00 1E 4A 02 00 00 3C 17 84 53 8B 85 CC 16 8B 85  
CC 13 06 1B 04 25 00 0A 00 00 42 42 00 00 00 00 ...

By decoding the hexadecimal bytes of this frame using the header chart supplied, determine the values for the MAC source address, the EtherType field; the IP and UDP Checksums.

*Note Decoding, Traceroute and DNS will be topics of assessment in a “practical” exercise!*