ENGINEERING TRIPOS PART IIB

ELECTRICAL AND INFORMATION SCIENCES TRIPOS PART II

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Saturday 26 April 2003 2.30 to 4.00

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Module 4B15

ADVANCED TELECOMMUNICATIONS NETWORKS

*Answer not more than **three** questions.*

*All questions carry the same number of marks.*

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator

(TURN OVER

1. (a) Describe the function required in the data-link layer of the open systems interconnect (OSI) reference model for designing communications protocols. What is the role of a service access point (SAP) in this process? Explain why the medium access control (MAC) sub-layer is important in creating local area network (LAN) structures. [25%]

(b) What is the role of a bridge when creating catenets of existing LAN structures. Why are hard invariants a vital consideration compared to soft invariants? Give an example of a bridge scenario when a hard invariant could be broken and suggest possible solutions. [25%]

(c) One of the most important features in the structure of a catenet of LANs is the MAC address. Explain the format of the MAC address for both the source and the destination stations. What is the maximum number of addresses available for a globally unique network interface card manufacturer? How can the range of globally unique station addresses be further extended? [25%]

(d) Describe three ways in which a MAC address can be recognised in a bridge address table. How can the frame check sequence be used to simplify this process for destination MAC addresses? Why will this technique not work for source MAC addresses? [25%]

2 (a) Using the system of interconnected bridges shown in Figure 1, explain how an infinite loop arises. Suggest two possible methods of avoiding this problem. Explain how this process can be automated. [25%]

(b) In a source routed network, there are two main types of frame, specifically routed and explorer frames. Explain what the role of each frame type is and how they are utilised in a source routed network. [25%]

(c) In the process of routing a frame by source routing, the route must first be discovered. Describe two possible methods of route discovery, including route selection, using the frame types described in part (b). [25%]

(d) Discuss the relative merits of source routing against destination or transparent routing. Which is the better method for a globally connected network such as the internet? [25%]

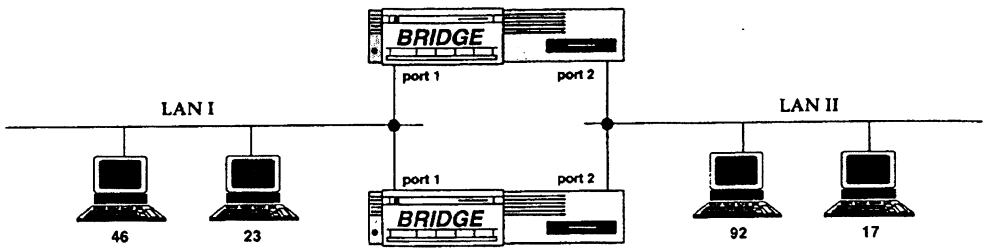


Figure 1

3 (a) What is a "strictly non-blocking" switching network. Give two examples. [20%]

(b) What is the probability P(x) that $x$ calls arrive in time $T$ in a telephone network in which all call arrivals and terminations are random events and in which the generation of traffic is a stationary and random process? Sketch this probability distribution. [20%]

(c) By analogy with (b) write down the probability that in a packet switch, $k$ packets arrive at a given output port in time $t$. What does this assume? Deduce the mean fraction of packets that make it to the output of a fully loaded, strictly non-blocking switch. [30%]

(d) What problem does this result pose and how in principle may this problem be reduced? [30%]

4 (a) Briefly outline the differences between plesiochronous and synchronous transport modes. [30%]

(b) Sketch an Synchronous Transport Module -1 frame and describe how a 2 Mbit $s^{-1}$ plesiochronous channel maps into it. [35%]

(c) Describe the functionality of a cross-connect and of an add-drop multiplexer. How do these modules differ in the synchronous digital hierarchy (SDH) and in a wavelength division multiplexed (WDM) network. [35%]

**END OF PAPER**