ENGINEERING TRIPOS PART IIB

Wednesday 28th April 2010 2.30 to 4.00pm

Paper 4B15

ADVANCED TELECOMMUNICATIONS NETWORKS

*Answer not more than **two** 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.*

There are no attachments.

STATIONERY REQUIREMENTS
Single-sided script paper

SPECIAL REQUIREMENTS
Engineering Data Book
CUED approved calculator allowed

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

tdw03

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 with soft invariants? Give an example of a bridge frame queuing 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 is the organisationally unique identifier a key factor in this process? Why will this technique not work for source MAC addresses? [25%]

2 (a) Using the system of interconnected bridges shown in Fig. 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%]

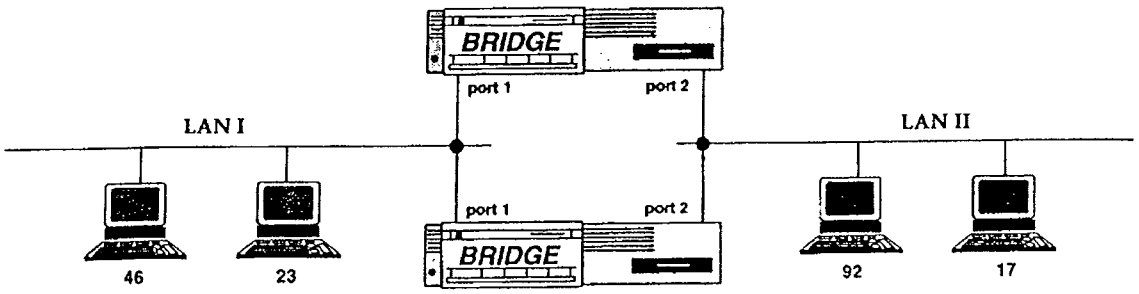

Fig. 1

3 (a) Explain what is meant by the *fast path* when considering how the internet protocol (IP) routes packets. Sketch the basic structure of the fast path and give two examples of non-fast path operations and how they are detected and processed. [25%]

(b) The key process in the operation of the fast path is the look up of the IP address in the router's routing table. How does the format of the IP address aid this process and explain how the router performs this procedure. What sort of electronic technology can be exploited to speed up this look up process greatly? [25%]

(c) The routing process requires that an up to date record of the internetwork structure is stored in the routing table. One of the most popular ways of maintaining an optimal graph of a set on interconnected nodes is Dijkstra's algorithm. Explain how Dijkstra's algorithm is used to select an optimum path through such an internetwork. Use the internetwork shown in Fig 2 to demonstrate Dijkstra's algorithm. [25%]

(d) One of the most important aspects of running a modern internetwork is the concept of quality of service (QoS). Give an example of two different routing protocols that have been set up or adapted to provide QoS. Are they really effective? What are their limitations? [25%]

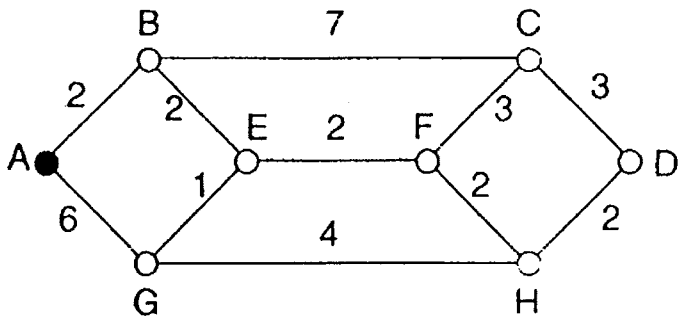

Fig 2. Interconnected nodes with associated path costs.

END OF PAPER