ENGINEERING TRIPOS PART IIB

Wednesday 3rd May 2006 2.30 – 4.00pm

Module 4B15

ADVANCED TELECOMMUNICATION 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

1. (a) Explain the main concepts behind layer 2 interconnection of local area networks (LANs). What is meant by hard and soft invariants? How can these invariants be both a useful feature as well as a hindrance to the process of interconnecting LANs? [25%]

(b) Sketch a diagram showing the way in which a bridge connects between the layers in the open systems interconnect (OSI) model. Give two reasons why it is not desirable to use the logical link control (LLC) functions in this bridging process. [25%]

(c) Describe how the sub network access protocol (SNAP) can be used to expand the number of higher layer clients available in the logical link control (LLC) frame format. Show how SNAP can be used to connect a type encapsulated Ethernet LAN to a SNAP based token ring LAN. What other considerations have to be made when making such an interconnection? [25%]

(d) Give two reasons why interconnection at layer 2 is a limiting factor in creating a global internetwork of LANs. Explain how this limitation can be overcome. What is the cost in terms of performance in implementing such a change to the interconnection strategy? [25%]

2 (a) Explain what is meant by the terms *wirespeed* and *full duplex* in the context of an Ethernet based local area network (LAN). How have these two concepts radically changed the way in which LAN protocols operate at layer 2? Use a sketch to show how this development has changed the topology of Ethernet LANs. [25%]

(b) Sketch a diagram showing how the two concepts in part (a) can be used to perform link aggregation. Why is this a useful feature when considering interconnection in a LAN? Suggest two ways in which link aggregation can be implemented without breaking the layer 2 hard invariants. How are medium access control (MAC) addresses managed during the process of link aggregation? [25%]

(c) Explain how a simple form of flow control can be implemented at layer 2 by using the medium access control (MAC) protocol to compensate for congestion. How does this technique compare with flow control implemented in the higher layer transport control protocol (TCP)? [25%]

(d) Link aggregation is normally implemented at the layer 2 level. How could it be implemented at layer 3? Is this really a useful mechanism for enhancing the throughput of a link or does the added complexity of the layer 3 processing negate any serious benefit from the aggregation? [25%]

3 (a) Explain what is meant by *shortest path routing* in an internetwork. How does Dijkstra's algorithm select an optimum path through such an internetwork? Use the internetwork shown in Figure 1 to demonstrate Dijkstra's algorithm. [30%]

(b) What are the limitations of using shortest path routing? How do distance vector routing algorithms help minimise these limitations? Give an example of how a vector routing algorithm operates. [30%]

(c) Define the 5 main stages in implementing a link state based routing algorithm. Give two examples of possible link state metrics. Why is this choice important? Use a simple example to demonstrate how link state routing can be simplified by using a hierarchical structure. [40%]

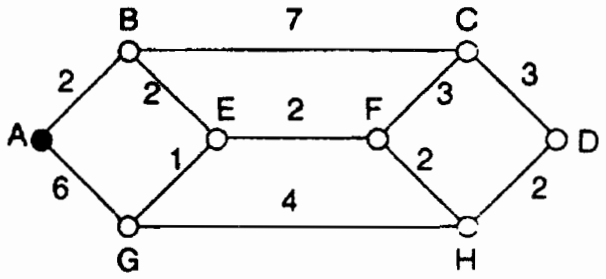

Figure 1. Interconnected network nodes with associated path costs.

END OF PAPER