UNIVERSITY OF CAMBRIDGE

ENGINEERING TRIPOS PART IIB

Wednesday 4 May 2005 2:30 to 4:00

Module 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

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

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1. (a) Describe the structure of the medium access control (MAC) address in a local area network (LAN). Why has this structure become a vital part of the expansion of LANs and the popularity of LAN protocols? [20%]

(b) Show, with the aid of diagrams, how a 1000 byte data segment is processed by the transmission control protocol (TCP) combined with the internet protocol (IP). The packet is then transmitted over a local area network (LAN) using a logical link control (LLC) and ethernet medium access control (MAC). Explain the role of the service access points (SAPs) in this procedure and give a simple example of how they are used. [30%]

(c) Explain how the sub-network access protocol (SNAP) is implemented in a LAN and why it is a useful addition to the standard LLC processes. [20%]

(d) Explain how a type encoded ethernet frame is converted by a translational bridge into a frame suitable for transmitting over a token ring LAN. [15%]

(e) Why is there a potential problem with frames being sent in the reverse direction in the catenet of part (d)? Describe two possible solutions to this problem. [15%]

2 (a) Explain why layer 2 switching is suitable for local area networks (LANs) but is not very well suited to wider area connections such as those used in a global network like the internet. [15%]

(b) What is the role of the 'fast path' when implemented within a layer 3 switch or router. Sketch a flow diagram of the fast path for the internet protocol (IP) and explain what sort of decisions are associated with it's use. [25%]

(c) Calculate the total number of IP version 4 addresses that are possible. Why is this number not a very realistic estimate of the total address space? Estimate roughly how many unique unicast IP addressed nodes are in fact available for use. Suggest two possible solutions to this limitation and explain the advantages and disadvantages of each one. [25%]

(d) Explain the role of ports within the transmission control protocol (TCP). What sort of service is offered by TCP through its use of ports? Given TCP running over IP, describe under what sort of conditions this service is actually possible. [20%]

(e) What is meant by the term 'layer 4 switch'? Why is switching at layer 4 not really a practical suggestion. [15%]

3 (a) Explain what is meant by 'link aggregation'. What are the potential advantages and disadvantages of this technique? At what layer of the open systems interconnect (OSI) reference model would this process be implemented? Give your reasons why this is the best choice. [20%]

(b) Given a single wavelength optical fibre network explain why all optical switching is more desirable than pure electronic switching? List three limiting factors on the size of an all-optical switch and explain your choices. [20%]

(c) A crossbar switch with 16 inputs and 16 outputs is required in an optical network. Sketch how this would be implemented as a Clos network with the minimum number of crosspoints. Is this switch strictly non-blocking? How would you alter the design to make it strictly non-blocking? How many crosspoints are needed for this new design? [20%]

(d) Why is the Clos network in part (b) not ideally suitable for use as a packet switch? Describe two methods which could be used to improve this limitation. [20%]

(e) How could the use of wavelengths improve the capacity of an optical crossbar switch? Sketch a diagram for such a switch structure and explain the different technologies you would require to construct it. [20%]

END OF PAPER