Department of Computer Science
University College London

Cover Sheet for Examination Paper to be sat in May 2000

COMP2B10: Computer Architecture II

Time allowed 2.5 hours

Calculators are NOT allowed

Answer TWO questions from Section A and TWO questions from Section B

Checked by First Examiner: Date:

Approved by External Examiner: Date:

Section A

1a.   Explain the operation of the *Carrier-Sense, Multiple Access* (*CSMA*) channel allocation algorithm. Distinguish between the *persistent* and *non-persistent* versions of this algorithm and describe, informally, the performance characteristics of these two strategies as network load increases.   [11 marks]

1b.   Consider a non-persistent CSMA system with packets of constant size, inter-arrival times negative-exponential distributed and negligible collision rate. The total arrival rate of packets from all stations is *G* per packet time. A portion of these arrivals coincides with ongoing transmissions; this happens at a rate *D* per packet time. Packets are delivered at a rate *S* per packet time. By considering the proportion of time that the network is doing useful work or otherwise, derive an equation linking *D*, *G* and *S*; hence find an equation for *S* in terms of *G*. Show your reasoning clearly.   [6 marks]

1c.   Explain the operation of the *Carrier-Sense, Multiple Access with Collision Detection* (*CSMA-CD*) channel allocation algorithm and discuss how its performance compares with that of pure CSMA strategies. Show that the CSMA-CD algorithm requires a minimum frame size to be set.   [8 marks]

2a Explain the difference between circuit-switching and packet-switching. Describe the advantages and disadvantages of these two switching techniques when applied to data transfer between computers   [9 marks]

2b. Packet-switched networks may operate using either *virtual circuits* (*VC*) or *datagrams*; explain the differences between these two approaches. Explain why the virtual-circuit approach was selected for networks using *Asynchronous Transfer Mode* (*ATM*).   [9 marks]

2c. The diagram below shows *Virtual-Circuit Identifiers* (*VCI*) currently allocated on a small packet-switched network.
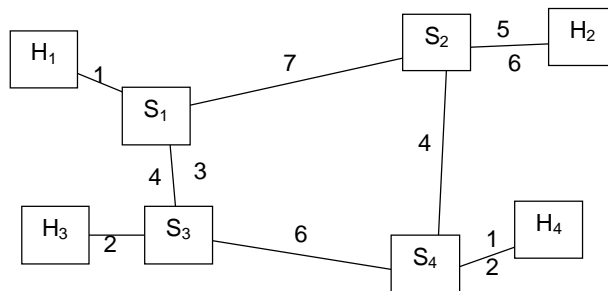
The VCIs identify three uni-directional Virtual Circuits;

$H_1 \rightarrow S_1 \rightarrow S_3 \rightarrow S_4 \rightarrow H_4$

$H_2 \rightarrow S_2 \rightarrow S_1 \rightarrow S_3 \rightarrow H_3$

$H_2 \rightarrow S_2 \rightarrow S_4 \rightarrow H_4$

Complete the two forwarding tables below:

Table for S_2

Incoming link	Incoming VCI	Outgoing link	Outgoing VCI
H_2	5	S_4	
H_2			

Table for S_1

Incoming link	Incoming VCI	Outgoing link	Outgoing VCI
S_2			3

[7 marks]

3a.   Outline the way in which an *Internet Service Provider* (*ISP*) provides service to a set of "dial-in" customers. Your answer should include a description of the main components the ISP is likely to have at its site and the way in which IP addresses are managed. [9 marks]

3b.   What is the role of the *Transmission Control Protocol* (*TCP*) in the Internet architecture? Explain how TCP implementations act to combat congestion in the Internet. [6 marks]

3c.   There is now great interest in using the IP protocol to carry voice ("Voice over IP"). Give reasons why this is an attractive idea and briefly outline why achieving it is technically challenging. Briefly discuss the possible roles of TCP and "play-out buffers" in implementing voice over IP. [10 marks]

Section B

4a.   What are the important characteristics of *processes* and why are they needed?

[6 marks]

4b.   What are the important characteristics of *threads* and why are they needed?

[6 marks]

4c.   Under what circumstances do *deadlocks* arise? What strategies can be used to deal with them?   [13 marks]

5a.   Identify the main components and their function in a *Remote Procedure Call* implementation in a distributed, heterogeneous system.   [7 marks]

5b.   Discuss the main problems in passing parameters and results between distributed applications? Describe a solution.   [7 marks]

5c.   Discuss the following statement, using examples to illustrate your points:

> *"Modern operating systems are becoming so complex that we will shortly face a crisis because neither the tools nor the skilled staff exist to provide robust and consistent systems"*   [11 marks]

6.   You have been commissioned to design a high performance file server. Discuss the main issues and the probable best solutions relating to:

6a.   Performance   [8 marks]

6b.   Security   [8 marks]

6c.   Client-Server protocol   [9 marks]

[END OF PAPER]