THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma

DISTRIBUTED & PARALLEL SYSTEMS

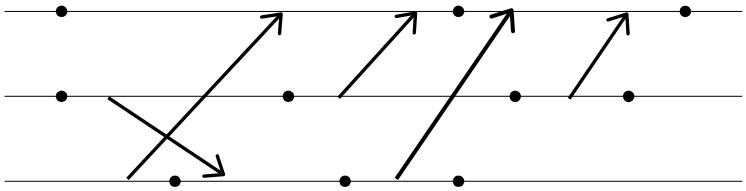
9th May 2002, 2.30 p.m.-5.30 p.m.
Answer THREE questions out of FIVE. All questions carry equal marks.
Time: THREE hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. *a)* A distributed system is characterised by the absence of a common clock and a shared memory. With regard to the lack of a common clock, explain how a modern distributed system, such as the Internet, copes with time across many domains. **(6 marks)**

b) Explain how and why the notion of a logical clock enables a distributed system to handle message exchange adequately. **(5 marks)**

c) Consider a distributed computation over three sites where events and message exchange are as shown:



Label the diagram using a system of logical clocks. **(5 marks)**

d) With regard to the lack of shared memory, explain what is meant by the problem of distributed mutual exclusion. **(4 marks)**

e) Explain one method of achieving distributed mutual exclusion. **(5 marks)**

2. *a)* Distinguish between availability and reliability in a distributed system. **(6 marks)**

b) Give TWO examples of applications requiring both continuous operation and high availability. **(6 marks)**

c) Distinguish between replication and switchover as a means of handling failure in a distributed systems and discuss how:

i) failure over data,
ii) failure over communications, and
iii) failure over hardware may be handled. **(6 marks)**

d) Describe the worst possible behaviour that could be exhibited by a server in a distributed system and thus indicate how many replicas are needed to cover *n* faulty servers under these conditions. **(7 marks)**

3. Searching is one of the most common activities performed on serial computers.

a) Specify *either* formally *or* pragmatically a searching algorithm that would be appropriate for *either* a parallel *or* distributed architecture. Provide a detailed explanation of the specification technique used. In addition outline the target architecture. **(15 marks)**

b) Compare the theoretical performance of the specified algorithm on the target architecture and on a conventional architecture. Comment on the validity of the comparison. **(10 marks)**

4. There are a number of tools or subsystems available (for example PVM, MPI and P4) that enable applications to be programmed to run in parallel. Many of these tools run under the native operating system of a cluster machine, with one copy of the operating system on each member of the cluster.

a) Identify such a tool. Explain, with examples, how parallel processes are defined and co-ordinated with this tool. **(15 marks)**

b) Compare the execution of a program on a single processor without this tool and on a cluster of processors with this tool. Illustrate your answer with examples with which you are familiar. **(10 marks)**

5. You have agreed to talk for 30 minutes at the next meeting of your local BCS branch. The title of your talk is "Three tier Architectures – an Overview of their use".

Sketch out the contents of approximately eight overhead slides, and provide associated notes, that you would use for your talk. **(25 marks)**