THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma

NETWORK INFORMATION SYSTEMS

25th April 2003, 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. The scope for open, configurable distributed systems is enhanced if the file service is structured as three components. These three components are, as shown in **Figure 1** below: a flat file service, a directory service and a client module.

    a) Explain the operation and the relationships between the various entities shown in the diagram.

    (5 marks)

    b) Define and discuss the division of responsibilities between the three components. In your answer refer to unique file identifiers (UFIDs). **(10 marks)**

    c) Discuss the design issues involved in providing a range of services to address the requirements of clients with different goals with respect to these three components and the issue of fault tolerance. **(10 marks)**
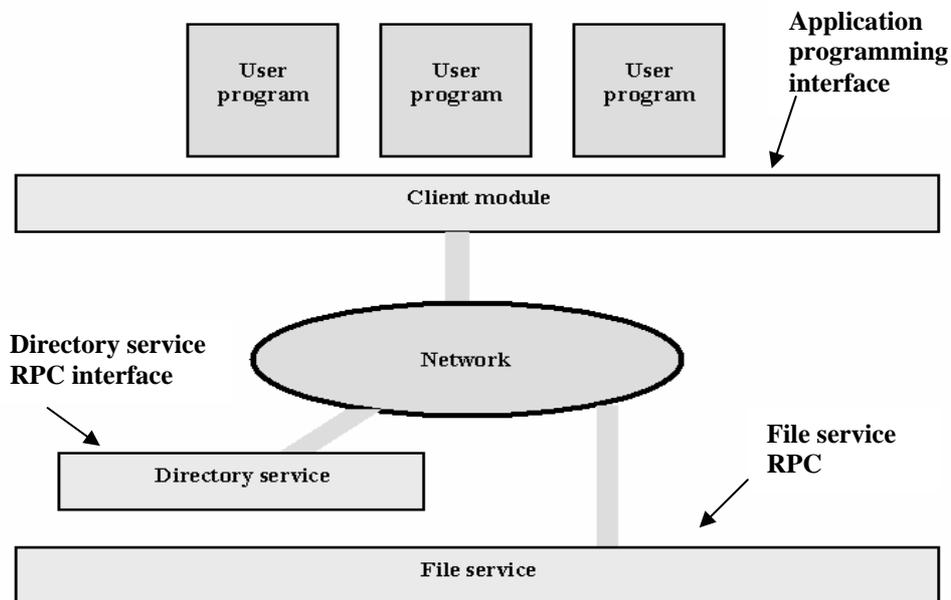
**Figure 1: File service components**

2. *a)* Describe the principles of public key encryption and show how public key encryption can be used to transmit confidential information between two parties. **(8 marks)**

b) Identify the problems associated with the integrity of public and secret keys. **(4 marks)**

c) A user wishes to download a file from a Web site with confidence that the data has not been tampered with. Describe how a message digest can be used to achieve this and identify the main problem associated with this mechanism. **(9 marks)**

d) Describe a digital certificate and indicate how a digital certificate can provide confidence to the browser of a secure Web site. **(4 marks)**

3. Very often the designer of a distributed system or application must consider issues that are largely unrelated to its distribution, such as software engineering techniques, human-computer interaction and algorithm design. However, you have been asked by your manager to restrict your attention to design issues that arise specifically from the distributed nature of systems. A full report covering these design issues would therefore consist of five sections to deal with: Naming, Communication, Software Structure, Workload Allocation and Consistency Maintenance.

You are required to produce a draft report, using suitable diagrams where necessary, covering only the section on Workload Allocation. Your report should be divided into the following 4 sections:

a) The Workstation-server model. **(6 marks)**

b) The processor-pool model. **(6 marks)**

c) Use of idle workstations. **(6 marks)**

d) Shared-memory multiprocessors. **(7 marks)**

4. *a)* Describe the most direct mechanism by which an electronic mail message can be sent between two users on separate workstations connected over the Internet using Mail User Agents (MUAs), Mail Delivery Agents (MDAs) and Mail Transfer Agents (MTAs). Give examples of actual software which can be used for each of MUAs, MDAs and MTAs. **(15 marks)**

b) Describe how POP3 can be used to receive mail on a computer which is not permanently connected to the Internet. **(5 marks)**

c) Define the terms *spoofing* and *spamming*. Explain how an MTA which is an open mail relay can be used by a spammer. **(5 marks)**

5. Replication is the maintenance of on-line copies of data and other resources. For example, the USENET system maintains a replica of each item posted to electronic bulletin boards across the Internet, with each replica being held within, or close to, the various organizations that provide access to it.

a) Discuss the motivation for replication in terms of: performance enhancement, enhanced availability, and fault tolerance. **(9 marks)**

b) **Figure 2** below shows a basic architectural model for the management of replicated data.
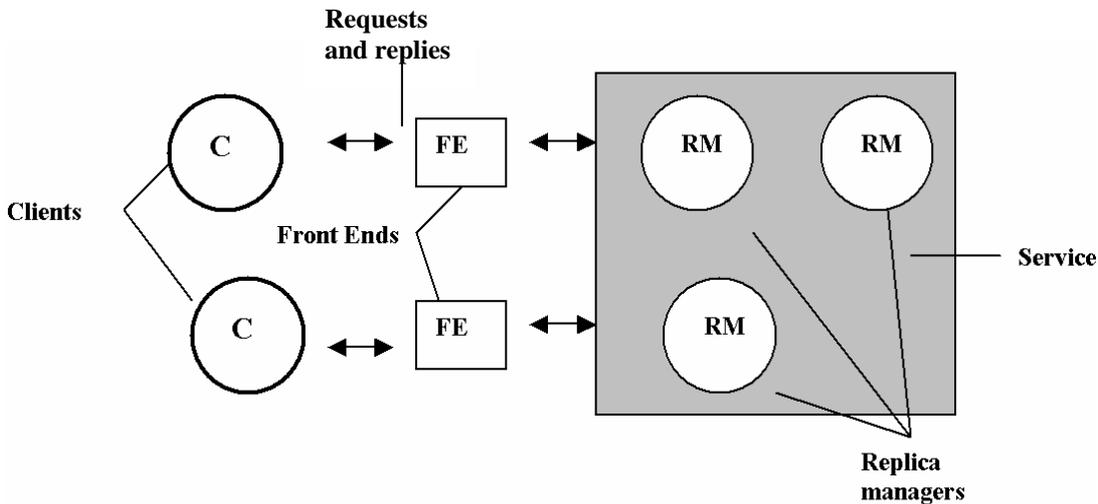
Figure 2. A basic model for the management of replicated data

i) Briefly explain the operation of the model. **(3 marks)**

ii) If the clients and replica managers are separate processes, the model becomes what is commonly referred to as the 'gossip' model. With the aid of a modified version of the above diagram explain the gossip model. **(5 marks)**

iii) To enhance availability, the 'primary' copy model is often used. Modify the above diagram and explain the operation of this modified model. Suggest an architecture for a shared editor which might be used in a multi-user collaboration environment and referred to as 'groupware'. **(8 marks)**