UNIVERSITY OF DUBLIN

TRINITY COLLEGE

Faculty of Engineering and Systems Sciences
Department of Computer Science

B.A.(Mod.) Computer Science
B.A. (Mod.) Information & Communications Technology
Senior Sophister Examination

Trinity Term 2005

4ICT1 / 4BA8

Communications IV / Distributed Systems

Monday 30th May 2005 Goldsmith Hall 14:00 – 17:00

Mr. Stephen Barrett, Mr. Jim Dowling,
Mr. Brendan Tangney, Prof. Vinny Cahill

Instructions to Candidates:

- Answer FIVE questions in all.
- All questions carry equal marks.

Materials permitted for this examination:

Q1. Outline the operation of the well-known two-phase commit protocol paying particular attention to its operation in the presence of failures.

(10 marks)

Outline the Two Generals Problem. Comment on the feasibility of finding a solution to the problem and say what this result illustrates.

(5 marks)

Discuss whether and to what extent the two-phase commit protocol solves the Two Generals Problem.

(5 marks)

Q2. Consider the problem of implementing a fault-tolerant service intended to tolerate the failure of the processors(s) on which it executes using *active replication*. In particular, you may assume that the processor service has partial amnesia crash failure semantics and that the service manages persistent data whose consistency must be maintained.

i) Outline the design of such a service exhibiting crash failure semantics and required to tolerate up to k simultaneous processor failures (i.e., assuming that the only source of failure is processor crash).

(12 marks)

ii) In what way would your design need to be modified if the service can exhibit response failures (e.g., assuming that the code for the program is buggy)?

(4 marks)

iii) Comment on the implications of network partition for your design of part (i) above.

(4 marks)

Q3. Assuming that one does not have to deal with legacy issues describe the design for a brand new distributed file system to be deployed in a university environment such as TCD. Your design should include the following. Justify your design decisions.

i. The network architecture upon which the system will run. (4 marks)
ii. Expected file usage properties. (4 marks)
iii. File naming. (4 marks)
iv. File sharing and caching. (4 marks)
v. Fault tolerance. (4 marks)

Q4.

(i) Distributed systems programming has evolved from Sockets to Distributed Object Computing and more recently to Component-Based Systems. Starting with Sockets, outline the main developments and abstractions that have been introduced to aid programmers in making it *easier to program* distributed systems and how those developments have affected building distributed systems that are *more robust*.

(10 marks)

(ii) Design a simple chat room service that will operate on a local area network using a distributed programming model of your choice. In the chat room service, each chat message should be sent to all chat clients, and it is assumed that chat clients remain active when connected to a chat session. Include some sample code in your solution. Justify your choice of programming model.

(10 marks)

Q5.

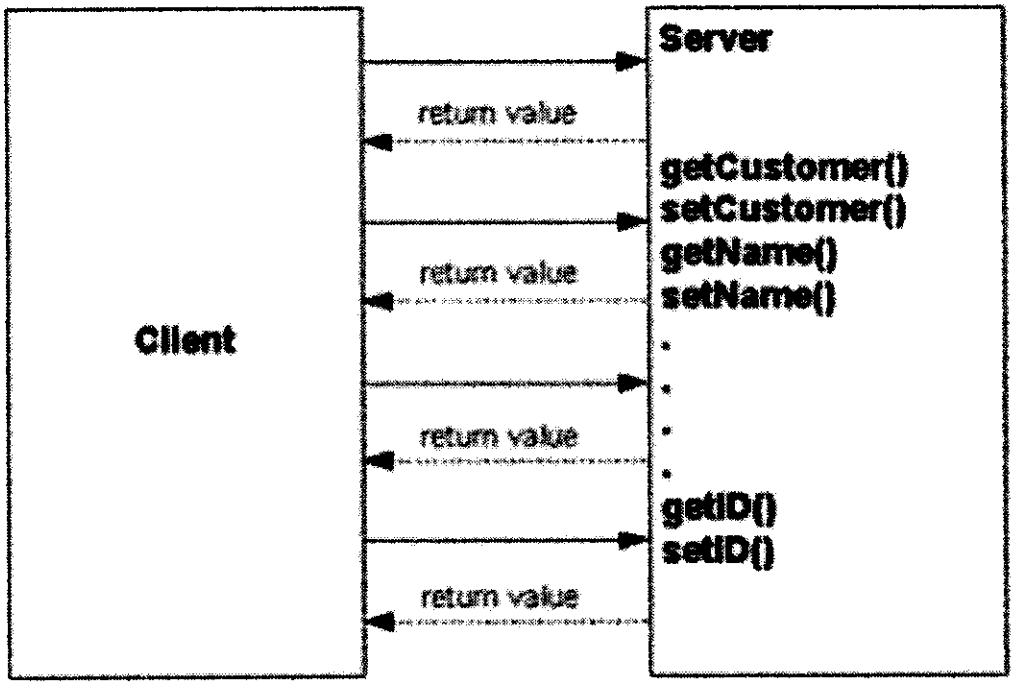

Figure 1 Creating a Customer

(i) Consider the scenario in Figure 1 for creating a customer in a client-server distributed system. Many calls are made by the client to create a customer on the server. Discuss the appropriateness of such an interface design for a web service that is invoked across the Internet.

(5 marks)

(ii) Outline a more suitable and complete WSDL interface (or equivalent java mapping of the WSDL interface) for creating a customer in the above scenario.

(3 marks)

(iii) Discuss the main differences between designing interfaces for distributed object computing systems and web services.

(6 marks)

(iv) Service oriented computing has the goal of enabling producers and consumers of services to be more loosely coupled. Explain the role of UDDI in helping web services realise the goals of service-oriented computing.

(6 marks)

Q6.

Explain the operation of the Berkley algorithm. How is it resilient to failure?

(10 marks)

In distributed systems, many algorithms reliant on centralised services can have decentralised alternatives. Discuss in detail this in the context of achieving mutual exclusion.

(10 marks)

Q7. Agreement is more important than efficiency. Discuss in the context of distributed systems technology.

(8 marks)

Describe the operation of the bully algorithm. Explain why it is resilient in face of ongoing failure. Compare this algorithm to any other election algorithm you know of.

(12 marks)