UNIVERSITY OF DUBLIN

TRINITY COLLEGE

FACULTY OF ENGINEERING & SYSTEM SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

B.A. (Mod.) Computer Science   Trinity Term 2000

SS Examination

4BA8 - Distributed Systems

Thursday 25th May   Drawing Office   14.00 – 17.00

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Answer 5 Questions

Q1.

i)   Compare and contrast the approaches to handling scale used in each of the following algorithms – the UPS overnight package delivery service and DNS. (8 marks)

ii)   Compare and contrast the approaches to resolving contention used in each of the following algorithms. Electing a new monitor in a token ring network. Concurrent access to a shared resource in the absence of a fixed central point of control - Token Passing and CSMA/CD. (12 marks)

Q2.   Outline the high level design of a system to monitor and control the Irish Rail Network. The system should control all signals, junctions, level crossings etc. and have a sufficiently up-to-date knowledge of each trains location and speed.

Your design should cover the hardware infrastructure (6 marks) as well as the software architecture (14 marks). The system should be timely, fault tolerant and cost effective.

Q3. i) Outline the rationale and design of the AFS file caching mechanism. (12 marks)

ii) If AFS were to run in the following environments what changes, if any, would need to be made to the caching mechanism. (8 marks)

a) TCD's computer science department where all staff and postgraduate students use an 8MB per second wireless local area network.

b) TCD's computer science department, where all staff and postgraduate students use very high performance workstations and a Giga bit per second local area network.

c) A sales company in which individual sales representatives travel extensively within the country and abroad.

d) A technology rich, intelligent, home.

Q4. Distributed objects (as provided by CORBA) and process groups (as provided by ISIS) represent two different paradigms for building distributed applications. Compare and contrast these two paradigms and assess when it might be appropriate to use each. (8 marks)

Outline how we might provide CORBA programmers with a model of replicated objects (or "object groups") by borrowing from the process group model. Consider what changes to CORBA IDL would be necessary to support such a model, if any, and outline how such a model would change the semantics of object invocation in CORBA. (10 marks)

Is such a hybrid model a realistic proposition? (2 marks)

Q5. Outline the facilities that should be provided by any toolkit that supports the use of process groups to build distributed applications. (6 marks)

Group membership management is concerned with the problem of maintaining a consistent (agreed) view of the membership of a group in the face of processes joining and leaving the group as well as various types of failures. Outline the design of an algorithm for reaching agreement on the new membership of a group when a change to the membership is (thought to be) needed. Are there any circumstances in which it is not possible to reach agreement on the new membership of the group? If so, outline how your algorithm handles this situation. (14 marks)

Q6 What is a nested transaction and why are nested transactions particularly useful in distributed systems? What does it mean to say that the commit of a subtransaction is dependent on that of its parent? What are the implications of the abort of a subtransaction for its parent? (5 marks)

Explain how versions are used to allow multiple subtransactions of a common top-level transaction to read or modify an object. Your description should include consideration of what happens in each of the following cases: (15 marks)

- subtransactions acquire read locks on the object;
- substractions at different nesting levels acquire write locks on the object;
- a substraction that had a write lock on the object aborts;
- a substraction that had a write lock on the object commits;
- the top-level transaction commits.

Q7. Answer **each** of the following. (5 marks each)

i)   A developer of a distributed application, based upon the Monopoly board game, has approached you looking for advice on which distributed IPC technology to use. What would you recommend and why?

ii)   In what fundamental ways does a LAN based distributed system differ from the Internet?

iii)   Briefly outline the technique of sender-based message logging and the constraints that it imposes on applications that use it.

iv)   Compare and contrast logical time with vector time.

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