UNIVERSITY OF DUBLIN

TRINITY COLLEGE

FACULTY OF ENGINEERING & SYSTEM SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

B.A. (Mod) in Computer Science Trinity Term 2004

4BA8 - Distributed Systems

Tuesday 1st June Goldsmith Hall 09:30 - 12:30

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Attempt four questions

(all questions carry equal marks)

Q1.

(i) Define the so-called "ACID" properties that are classically provided by transactions.

(4 marks)

(ii) Discuss whether and/or when it might be possible and/or desirable to relax some or all of these properties and the consequences of doing so.

(4 marks)

(iii) Briefly explain the Two Generals Problem.

(2 marks)

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

(10 marks)

Q2.

(i) Outline the underlying services typically required to support process groups and, in doing so, consider how the need for distributed consensus affect their implementation if at all.

(10 marks)

(ii) Describe how middleware supporting the process group paradigm could be used to implement active replication of processes where processes may suffer partial amnesia crash failures and the underlying network may corrupt or loose messages or be partitioned.

(10 marks)

Q3.

(i) Outline a simple protocol that implements at-most-once semantics for a remote procedure call.

(5 marks)

(ii) Discuss the different roles that entity and session beans fulfil in Enterprise Java Beans ™ applications.

(6 marks)

(iii) In distributed programming what is meant by binding? How is binding done with each of the following and what information is needed in each case: Enterprise Java Beans™, Web Services and Java RMI.

(9 marks)

Q4.

(i) Why is it useful to define the interface of a distributed object in an Interface Definition Language? Why does Java RMI distinguish a server's interface from its implementation?

(4 marks)

(ii) Compare and contrast Java RMI and Enterprise Java Beans™ with respect to:

- Support for building secure, transactional distributed systems
- Legacy system integration capability
- Differences with standard Java Programming Model

(7 marks)

(iii) Explain the UDDI, WSDL AND SOAP in terms of the following categories: Discovery, Description and Protocol.

(9 marks)

Q5.

(i) In 1992 Peter Deutsch published his "The Eight Fallacies of Distributed Computing" in which he stated that

"Essentially everyone, when they first build a distributed application, makes the following eight assumptions. All prove to be false in the long run and all cause *big* trouble and *painful* learning experiences.
1. The network is reliable 2. Latency is zero 3. Bandwidth is infinite 4. The network is secure 5. Topology doesn't change 6. There is one administrator 7. Transport cost is zero 8. The network is homogeneous."

Comment upon the extent to which you think each of these issues is pertinent to today's distributed computing environments.

(8*2 marks)

(ii) Suggest, and justify, two items that you would add to the list today.

(2*2 marks)

Q6.

(i) Describe in *detail* the features of DNS that allow it to scale.

(7 marks)

(ii) Describe a design for a naming system that could be used in a global mobile phone network. (The format of the number is country code : supplier network : customer number.) Show how your design would handle each of the scenarios below. Assume that the caller's number is (353-87-1234567) and the callee's number is (353-86-7654321).

i. Caller and callee with both in the 353 region when the call is made.
ii. Caller is abroad (roaming) and callee is at home (353 region).
iii. Both caller and callee are outside their home region (353).
iv. The callee's number is 44-778-7525068

(10 marks).

(iii) How would your design handle a subscriber changing their network supplier without having to change their supplier network code?

(3 marks)

Q7. Write brief notes on **ALL** of the following

(i) Modify the following piece so that it does what it is intended to do. Explain the changes you make.

```
Max = 100;
T := GetTime() ;
For I:=1 to Max Do
    F := FileOpen("RemoteFile")
    While NOT (EOF(F)) DO
            FileRead(F,Buffer++,SizeOf(Buffer))
    FileClose(F)
End
Print("Operation took", ((GetTime()-T)/MAX))
```

(5 marks)

(ii) Dynamic uniformity as it applies to failure-atomic multicast.

(5 marks)

(iii) The difficulty of using time to establish the order of events in a distributed system.

(5 marks)

(iv) Describe the main differences between engineering local and distributed objects.

(5 marks)