

W249/403

**DUBLIN INSTITUTE OF TECHNOLOGY
KEVIN STREET, DUBLIN 8.**

BSc Information Systems / Information Technology

Stage 4

WINTER EXAMINATIONS 2007

DISTRIBUTED SYSTEMS

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WEDNESDAY, 10TH JANUARY 2007, 14:00 TO 16:00

ATTEMPT 4 QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

1. (a) Explain clearly what is meant by *layering* and *encapsulation* in relation to networked communication and protocol stacks. **(6 marks)**

(b) Describe the main shortcoming of the IPv4 protocol, and describe in detail *one* method employed to overcome this shortcoming. **(9 marks)**

(c) Demonstrate the operation of a *sliding window protocol* and discuss its relevance for transport layer communication. **(10 marks)**

2. (a) Present your own definition of the term *distributed system*. Explain why your definition fully describes such systems. **(6 marks)**

(b) Discuss clearly the relevance of the *two generals problem* to distributed system design and implementation. Use examples to help illustrate your answer. **(9 marks)**

(c) Demonstrate and evaluate the *Cristian* and *Berkeley* methods for clock synchronisation in a distributed system. **(10 marks)**

3. (a) What is the purpose of the `wait` and `notify` methods in Java objects? Use a simple example to help illustrate your answer. **(6 marks)**

(b) Consider a distributed system comprised of processes with a tendency to crash and recover. At any time, one (and only one) process must be serving as the *coordinator*. Describe one method which could be employed by the system to elect the *coordinator*. Evaluate its effectiveness for the problem at hand. **(9 marks)**

(c) Consider that the elected coordinator from part (b) above is intended to serve as a coordinator for a distributed transaction. Demonstrate the operation of a protocol it could employ to manage the distributed transaction, and present your opinion on the strengths and weaknesses of the protocol. **(10 marks)**

4. (a) Describe clearly the important differences between *local method invocations* and *remote method invocations* in a distributed object system. **(6 marks)**
- (b) Discuss *how* and *why* each of the following invocation semantics could be implemented in a middleware platform intended to support remote method invocations:
- i. maybe
 - ii. at-least-once
 - iii. at-most-once
- (9 marks)**
- (c) Consider the situation where a football-score-service can provide scores to client applications in real time, as scores change. Present a design for a distributed object system to for such a service. Clearly illustrate the role of remote objects and proxy objects. Evaluate your design. **(10 marks)**
5. (a) Describe clearly each of the following security threats in a distributed system:
- i. Eavesdropping
 - ii. Masquerading
 - iii. Replaying
- (6 marks)**
- (b) Describe, compare and contrast the two main classes of cryptographic algorithms used in distributed systems. **(9 marks)**
- (c) What does it mean to *digitally sign* a document? Show how each of the two main classes of cryptographic approaches can be used to create digital signatures. **(10 marks)**