

UNIVERSITY OF DUBLIN

TRINITY COLLEGE

FACULTY OF ENGINEERING AND SYSTEM SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

**B.A. (Mod.) Information and
Communications Technology
Senior Sophister Examination**

Trinity Term 2004

4ICT9 MOBILE COMMUNICATIONS

Monday, 31st May 2004

Sam Beckett Rooms

09.30 – 12.30

Ms. Meriel Huggard, Dr. Ciarán Mc Goldrick

Candidates should attempt FOUR questions

QUESTION 1 must be attempted.

Clearly labeled diagrams should be used to illustrate answers (where appropriate).

Students may avail of the HANDBOOK OF MATHEMATICS FOR COMPUTER SCIENCE.

1

The Acme Space Corporation intend to populate Mars with a large number of robotic explorers. They plan to land ten modules on Mars within a 10km^2 area. Each module contains a robot controller station and ten robotic explorers. Upon landing, the robotic explorers will leave the module and begin their exploration of the surface of the planet. These roving robots should be capable of being located, receiving instructions from and relaying information to one or more controller stations.

You are contracted to provide the Acme Space Corporation with technical advice, analysis and recommendations. In particular you must determine the wireless infrastructure required to make their plan a reality. This infrastructure should take advantage of the latest developments in mobile communication technologies and be as future proof as possible.

Your deliverable is a detailed technical report that outlines possible solutions and associated problems, identifies the optimum solution, thoroughly documents the salient technical aspects of the proposed solution and its interactions, and provides a detailed technical basis for management to make an informed decision.

(40 marks)

2

Wireless communications systems are an integral part of the ubiquitous computing vision. In this future, interconnected computers are embedded unobtrusively in everyday appliances and environments and co-operate to provide information and services on behalf of their human users. Provide a critical analysis of this statement with reference to the key characteristics of ubiquitous computing systems, their physical integration and spontaneous interoperation. In doing so address the security and availability of the communication channels used by these systems.

(20 marks)

3

(a) Explain, in detail, the principles of operation of (i) a frequency hopping spread spectrum, and (ii) a direct sequence spread spectrum wireless LAN.

(b) Describe how, if at all, the performance of such systems may be improved in the presence of (i) a strong narrowband interference signal within the operational frequency band, or (ii) strong broadband background noise signals across the operational frequency spectrum.

(c) Explain the implementation and importance of spread spectrum in a Code Division Multiple Access scheme.

(20 marks)

4

Mobile positioning techniques are viewed as key enablers for new and emergent telecommunications services. Identify appropriate technologies for providing accurate positioning information on (i) a global basis, (ii) a national basis, and (iii) a localized (individual building) basis. Describe how such technologies operate, the accuracies attainable with each, and highlight how convergence across networks benefits such emergent services.

(20 marks)

5

Mobile IP (RFC2002) for IPv4 has the aim of enabling seamless mobile networking and computing so that network-dependent activities are not disrupted when devices change their point of attachment to the Internet.

(a) Describe the Mobile IP processes that allow mobile computing devices to detect a change in their point of attachment to the Internet and to discover Mobile IP agents when they have detected such a move, detailing the uses that Mobile IP makes of existing networking protocols.

(b) Explain the purpose of packet tunneling in Mobile IP networks. In particular address the use of Mobile IP using IP-in-IP, minimal routing encapsulation and generic routing encapsulation. Discuss the advantages and disadvantages of these three approaches.

(20 marks)

6

(a) Briefly outline the features of Service Discovery Protocols (SDP) that facilitate the seamless expansion of communications networking.

(b) Describe a scenario that illustrates an appropriate use of the UPnP protocol, outlining its benefits and drawbacks for the chosen scenario.

(c) Provide a detailed overview of the architecture of the Jini SDP, detailing how it allows for the description, querying and provisioning of services.

(20 marks)

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