

# UNIVERSITY OF DUBLIN

CS4CT91

## TRINITY COLLEGE

FACULTY OF ENGINEERING & SYSTEMS SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

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

**Trinity Term 2001**

4ICT9 MOBILE COMMUNICATIONS

Wednesday, 30th May 2001

Mansion House

9:30–12:30

Dr. C. McGoldrick, Mr. T. Forde, Ms. M. Huggard

Attempt **four** questions out of six.

Attempt at least **one** question from each section.

Please use separate answer books for each question.

### SECTION A

**Q 1.** It is necessary to understand some of the fundamental aspects of wireless transmission in order to appreciate the methods needed to handle wireless transmission impairments. Examples of wireless transmission impairments that may occur include Intersymbol interference (ISI) and narrowband interference.

- (a) Describe the physical processes that lead to multipath propagation effects and detail how these give rise to ISI. Discuss ways in which ISI may be mitigated.
- (b) Explain how narrowband interference may be overcome and detail two methods which can be used, discussing their relative merits.
- (c) The two most important aspects to consider when planning a cellular wireless telecommunications network are coverage and cost. Discuss.

**Q 2.** *You have been employed as a wireless network consultant by Trinity LAN Ltd. Along with a colleague, you have been assigned to work on a project which involves the installation of a LAN within a recently refurbished hospital. The hospital has been listed for preservation. You have been instructed to minimise the amount of alteration to the building structure that may be required in order to install the LAN. Your colleague is an expert in the planning, design and implementation of wired networks but has no experience of wireless networks and is depending on you for detailed information and advice.*

*The building contains a number of X-ray rooms, the interior of each of these is lined with lead. It is intended to transfer digital X-rays taken in these rooms to consultants in other parts of the building. There are also numerous small rooms scattered throughout the building which will be used as offices by the hospital consultants. Finally, there are a number of large rooms, some of these will be used as meeting rooms for staff and some will be used as open-plan office areas for administrative staff.*

You have been asked to explore possible wireless LAN solutions for use within the building. Your colleague will deal with the planning, design and implementation of any wired network infrastructure that you feel is required.

Write a report for your colleague giving a detailed description of possible wireless LAN solutions for use within the building, along with their advantages and disadvantages. Identify what you believe to be an optimum solution for the building, given the constraints involved. Document the main technical aspects of the proposed solution and how you envisage it will interact with a wired network infrastructure.

## SECTION B

**Q 3.** Both (a) and (b) must be attempted.

- (a) *Mobile IP (RFC 2002) 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.*

Detail the Mobile IP mechanisms that allow data to be routed to a mobile computing device once it has registered its new location with the relevant Mobile IP entities. Briefly describe the benefits/drawbacks, if any, that the various encapsulation options would have on the Mobile IP routing process.

Outline any optimisations that may be made to the Mobile IP routing process.

- (b) *In the absence of fixed, centralised, infrastructure-based networks such as the Internet or a LAN, there is now a perceived need for mobile computing devices with wireless communication abilities to have in-built mechanisms that enable the formation of dynamic temporary ad hoc networks. The route discovery mechanisms of such ad hoc networks have evolved from those of the original static, wired, hierarchical networks.*

Outline the evolution of these route discovery algorithms, highlighting the effects that the changes to underlying network characteristics have had on the design of new and evolving route discovery algorithms.

Where appropriate, labelled diagrams should be used to illustrate your answers.

- Q 4.** *For some time the Department of Computer Science has been acquiring new properties in various areas of College resulting in traditional computer services, such as printers, scanners and web servers, being located at different geographical locations and at different addresses on the Department's computer network. After consultation with both staff and students the Department are now also eager to provide innovative Internet-based teaching services to their expanding student body; lecture note databases, personally tailored tutorials, laboratory aides, subject discussion forums etc.*

*Increasingly, the users of the Departments' facilities are migrating towards the use of mobile devices based on varying operating systems and are connecting to the network using both fixed and wireless technologies for varying periods of time. The Department has decided to deploy an automated service discovery system and have already narrowed their choice down to either Sun's Jini or the IETF's Service Location Protocol (SLP). The system administrators are concerned about the impact that a SDP will have on their systems. If the SDP deployment is successful it will be rolled out on a College-wide basis.*

You have been commissioned to provide the Department with a technical overview, protocol-specific analyses and a final recommendation. Your report should include the following:

- A brief introductory outline of the structure of an optimal service discovery protocol (SDP), highlighting the effect that specific underlying networks, user devices and proposed services will have on the Department's ultimate choice.
- A detailed description of the processes and network entities that enable both of the above-mentioned protocols to provide dynamic service discovery and invocation for both the proposed and existing services.
- A concluding statement of the overall strengths and weaknesses of both protocols, identifying the protocol that you recommend for their present and proposed needs.

## SECTION C

**Q 5.** The College Golf Cart Company is a manufacturer of prestige, luxury golf carts. They want to incorporate the latest in mobile communications technology in their new top-of-the-range golf carts. You are contracted to provide them with technical advice, analysis and recommendations.

Your design brief is as follows:

To document and specify a cost-effective system for each golf cart that will provide the following facilities: mobile phone and data facilities to include SMS, WAP and GPRS services; extremely precise vehicle location information to be securely transmitted to a central monitoring station at the golf club for billing, security or emergency location purposes.

Your deliverable is a report that succinctly 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.

Note:

Your solution should not affect the structural design of the vehicle. A single discreet additional antenna may be permitted.

You may assume that the local mobile telephony service providers offer GSM, SMS, WAP and GPRS support.

The location information provided should be as accurate as possible to facilitate high throughput on the golf course.

**Q 6.** Secure Sockets Layer (SSL) is a technology that provides encryption, integrity and authentication services for data traffic on the Internet. Newer standards such as Transaction Layer Security (TLS) and Wireless TLS (WTLS) have evolved from SSL.

Provide a detailed technical description and analysis of SSL and show how TLS and WTLS have evolved from SSL.

In doing so you should highlight, and comment on, the strengths and weaknesses of each approach. Where appropriate, diagrams should be used to illustrate your answer.