UNIVERSITY OF DUBLIN

TRINITY COLLEGE

FACULTY OF ENGINEERING AND SYSTEM SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

B.A. (Mod.) Information and   **Trinity Term 2005**

Communications Technology

B.A. (Mod.) Computer Science

Senior Sophister Examination

MOBILE COMMUNICATIONS (4ICT9)

Monday, 23 May 2005   Arts Block, Room 3074   09:30 – 12:30

Ms. Meriel Huggard, Dr. Ciarán Mc Goldrick

Candidates should attempt FOUR questions.

QUESTION 1 must be attempted.

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

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

Non-programmable calculators are permitted for this examination – please indicate the make and model of your calculator on each answer book used.

1.

The Irish Bird Conservation Society (IBCS) has provided funding for research into two species of bird. For each of these species they wish to develop a behavioural profile through the accurate and timely gathering of appropriate field data. The birds chosen for this study are the Greenland White-fronted Goose and the Gannet. The Greenland White-fronted Goose migrates between Greenland and Ireland while the Gannet is a seabird that nests and lives in large colonies in Irish coastal waters. The aims of the research project are as follows:

    (a) The Greenland White-fronted Goose:
        (i) To accurately identify the migratory routes used by these birds,
        (ii) To determine environmental and atmospheric factors that may influence their migration.

    (b) The Gannet:
        (i) to accurately establish their daily routine and movements,
        (ii) to identify the principal feeding areas used by each colony,
        (iii) to gather data relating to the behaviour and movements of both individual gannets and the colony as a whole.

The IBCS have mandated the use of wireless and mobile communications technologies to help them achieve these aims. They are anxious to avoid solutions involving the transmission of field data via satellite as it is both cumbersome and costly.

You are contracted to provide the IBCS with technical advice, analysis and recommendations. In particular you must determine the wireless functionality required to make their plan a reality. Your solution 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 (or solutions),

thoroughly documents the salient technical aspects of the proposed solution(s) and its interactions, and provides a detailed technical basis for management to make an informed decision.

Marks will be awarded as follows:

Possible Solutions and Associated Problems: 10 marks

Optimum solution (or solutions) and supporting arguments: 10 marks

Technical Description and Interactions: 15 marks

Detailed Technical Basis for Management: 5 marks

[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 how these properties affect the design of ubiquitous computing environments.

[20 marks]

3.

An Irish Bank hopes to become a leader in the deployment of mobile "Smart Purse" technology. A "Smart Purse" can be viewed as an electronic device that can store "credit" – similar in concept to an electronic purse or wallet. The purse can have credit added to it, or removed from it, across a wireless link and the Bank has mandated the use of an 802.11 interface for such purposes.

You are contracted to produce a detailed technical Wireless Threat Taxonomy for the implementation, and to provide specific advice on how to maximally secure data transfers across the air interface.

The following Glossary contains Words, Phrases and Acronyms commonly used when describing aspects of Wireless Security systems. It may be of assistance in formulating your answer.

Active, AES, Analysis, AP, ARP, Association, Authorisation, Authentication, Availability, Attacks, CBC, CCMP, Cipher, Confidentiality, Communications, Countermeasures, Credential, Cryptography, DES, Distribution, DoS, DSSS, EAP, Eavesdrop, Encryption, ESSID, Exchange, FHSS, High-jack, Host, Integrity, Interception, Initialisation Vector, IPSec, Key, MAC, Man-in-the-Middle, Packet, Payload, Passive, Port, Radius, Rekey, Replay, RSN, Security, Session, Shared, Space, Spoofing, SSh, SSL, SSID, SYN, TCP, TKIP, TLS, TTLS, Transmission, Tunnel, Token, WEP, Wi-Fi, WTLS, WPA.

[20 marks]

4.

(a) Peter and John are both subscribers to "WeDropYourCall" – a large Irish GSM network operator. Peter makes a GSM call to John. Assuming both are on their home network at the time the call connection is established, describe the flow of events and messages that occurs within the GSM network, and between the network and each handset. Clearly identify the network components involved.

(12 marks)

(b) Inter-BSC, Intra-MSC Handover occurs during the call. Concisely identify and describe the typical signal flow involved in such a handover. Identify possible reasons and triggers for the handover. Give examples of other types of handover and possible causes or triggers for these handovers.

(8 marks)

[20 marks]

5.

In the absence of fixed, centralized, infrastructure-based networks such as the Internet or a LAN, there is 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 that enable such ad hoc networks have evolved from the routing mechanisms employed by the original static, wired, hierarchical networks.

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

(8 marks)

(b) Ad hoc routing protocols can be generally classified as "table driven" and "source initiated". Clearly explain what is meant by "table driven" and "source initiated". Provide an example of a routing protocol for each of these categories and document their operation.

(12 marks)

[20 marks]

6.

"As more and more low-cost high-quality devices appear on the market and new applications emerge every day, short-range wireless personal area network (WPANs), both low and high-data-rate, are on the horizon."

(a) Compare and contrast the features, functions and feasibility of the two emerging WPAN technologies, IEEE802.15.3 and IEEE802.15.4.

(14 marks)

(b) Outline three possible scenarios where these technologies may be deployed.

(6 marks)

[20 marks]