UNIVERSITY OF CAMBRIDGE

ENGINEERING TRIPOS PART IIB

Friday 29 April 2005 9 to 10.30

Module 4F5

DIGITAL COMMUNICATIONS

Answer not more than three questions.

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

There are no attachments.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator

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1 (a) Describe the principal features of a cellular telephone system which aim to raise system capacity. Illustrate your answers with diagrams. [20%]
Why is *handoff* or *handover* required in a cellular system? [20%]

(b) Describe the options available to raise the capacity of a cellular system. In particular how does "going digital" affect system capacity? [30%]

(c) Describe the techniques employed by the GSM digital cellular telephone system to improve its performance in the presence of both fading channels and co-channel interference. [30%]

2 (a) Outline the general concept of *thin-client* systems. [20%]

(b) Note four possible advantages in the design and use of a thin-client terminal compared with that of a personal computer. [20%]

(c) Give a brief description of two different methods of delivering remote bitmap graphics to a thin-client terminal, identifying some of their relative merits. [40%]

(d) Explain the "total cost of ownership" principle for a computing environment, noting some of the direct and indirect costs that should be considered when evaluating it. [20%]

3 (a) TESLA is a stream authentication protocol.

(i) Describe the problem that TESLA was designed to solve. [15%]

(ii) Explain how TESLA works. [30%]

(iii) Draw a diagram of a TESLA packet, briefly explaining each field. [15%]

(b) Using Visual Cryptography it is possible to conceal a secret bitmap message in a set of two random-looking transparencies, called *shares*. The message is decrypted and revealed by stacking the shares. There is also a steganographic variant in which the shares themselves are recognizable bitmaps, but produce a third independent bitmap when combined.

(i) Draw the pixel shares for the basic 2 out of 2 encoding, indicating how to use them. [10%]

(ii) Draw the pixel shares for the steganographic 2 out of 2 encoding, indicating how to use them. [30%]

4 (a) Describe the principles of ultra-wideband radio transmission (UWB). [25%]

(b) How can UWB be used for in-building location? Indicate how a 3D position is calculated. What level of accuracy can be expected? [25%]

(c) Indicate how orientation information about objects being tracked with UWB tags can be computed. [25%]

(d) Describe the operation of a scaleable cellular in-building location system. Indicate how use of resources is optimised. [25%]

END OF PAPER