Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Mobile Systems

Date: Friday 22nd May 2009
Time: 14:00 – 16:00

Please answer Question ONE and TWO other Questions from the remaining THREE questions provided

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text
1. **Compulsory**

Answer all of the following parts of this question (2 marks each)

a) What is meant by forward error correction?

b) What is "MP3" an abbreviation for?

c) What is the Hamming distance between between the two 8-bit binary codes 10011001 and 10100100?

d) How many extra check-bits are required to provide Hamming code single error correction for a 64-bit word?

e) What bandwidth is used for a landline telephone voice channel?

f) What range of frequencies can a young human hear?

g) What sample rate is used for CD recordings? What is the data-rate from a CD?

h) What is meant by aliasing in the context sound sampling? Give another common example where the effects of aliasing becomes apparent.

i) SpiNNaker is an example of an attempt to send data over a potentially unreliable network. Explain how this is achieved.

j) Why are text messages low-cost (to the network provider) in a GSM system?
2. a) Briefly explain (in non-technical language) the principle behind a convolution encoder such as Viterbi. What sort of errors does this type of encoder protect against?

b) A 4-state Viterbi decoder is shown in Fig 1. Enumerate the state table for this encoder.

c) Plot the possible transitions of the 4-state Viterbi decoder on a trellis diagram.

d) Show on the trellis diagram the transitions for the data stream 1 0 1 1.

e) If the output x-bit corresponding to the second input bit (“0”) produced by the encoder of Fig. 1 is corrupted (i.e. inverted), plot the path back through the trellis decoder to show how the original signal is recovered.

[Figure 1]

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[PTO]
3. a) In a broadcast network, identify the various multiple access protocols that may be used. (5 marks)

b) Explain the principles of operation behind the Aloha network. What is the difference between a slotted Aloha network and a non-slotted network? (5 marks)

c) Give a mathematical analysis to demonstrate that a slotted Aloha network offers better channel utilisation than a non-slotted scheme. (5 marks)

d) Discuss the differences between using a wired and a wireless channel and the effect on the choice of protocols used. (5 marks)

4. a) What is meant by "psychoacoustics"? How are psychoacoustic models used to achieve sound compression? (5 marks)

b) Explain the role played by time-to-frequency transforms in MP3 compression. (5 marks)

A city council wishes to encourage community engagement in bringing local problems such as graffiti, fly-tipping, broken street furniture, potholes in the roads, overhanging trees etc to its attention. To this end it has set up a website FixMyNeighbourhood.org and intends to issue handheld devices to local community activists to assist in the reporting of local problems and to allow residents to monitor progress on complaints filed.

c) Outline the system design of such a handheld device, considering such issues as cost, battery-life, storage, communications etc. How might the functionality of the total system be divided between the website and the handheld device? (10 marks)