

## ITM1010 Assignment #4

**Due time:** 5:00pm on Tuesday, 25 November 2003 to the tutor or me.

### Question 1.

- (a) Describe the multiple access method used in the pure Aloha network.
- (b) What is the advantage of slotted-Aloha network over pure Aloha network? Why?
- (c) In a multiple access system with carrier sense, data collision is still possible. List two reasons for this.
- (d) Compare 1-persistent CSMA with 0-persistent CSMA.
- (e) In a CSMA/CD network, the bit rate is 10Mbps. The largest length between two nodes of the network is 5km. Assume that the speed of the EM wave traveling in the cable of this network is  $2 \times 10^8$  m/s. Calculate the minimum packet size (in bits) such that collision detection is guaranteed.

### Question 2.

- (a) Using a zero-run-length-encoding method, compress the thirty-two 7-bit numbers listed below:  
0 0 0 5 8 0 0 0 0 120 127 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 11 170 10 0 0 0
- (b) What is the compression ratio achieved by RLE in part (a)?
- (c) Use the Lempel-Ziv-Welch (LZW) compression algorithm to encode the following binary bit stream: 10011010100100100.

### Question 3.

- (a) Devise a Huffman code (using the method described in lectures) for the eight symbols tabulated below:

Symbol	Probability of being transmitted
S1	0.25
S2	0.22
S3	0.20
S4	0.15
S5	0.08
S6	0.05
S7	0.04
S8	0.01

- (b) Calculate the entropy of the set of symbols tabulated above and the average number of binary digits that would be sent per message using the Huffman code from part (a).
- (c) Describe the audio compression technique applied in MP3.
- (d) List four types of redundancies that are exploited by MPEG-1 to achieve high compression ratios.

### Question 4.

- (a) Why is the concept of “cellular network”(or space division) important for mobile communication systems?
- (b) Why can a digital cellular network have a larger capacity than an analog cellular network?
- (c) Compare a communication system that uses a single geo-stationary satellite with a communication system that uses a single low-earth orbit satellite.
- (d) Why does downlink in satellite communications usually use lower carrier frequencies than uplink?
- (e) What are the modal dispersion and the material dispersion in optical fibers?
- (f) Dispersion can limit the data rate that can be carried in an optical fiber. Explain why.