Data Provided: None

The University Of Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Autumn Semester 2006-2007 (2 hours)

Multimedia Systems 1

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.**

1.

a. What are the chief desirable features of any computer network? **(3)**

b. List three of the main functions of the *Transmission Control Protocol* (TCP). **(3)**

c.

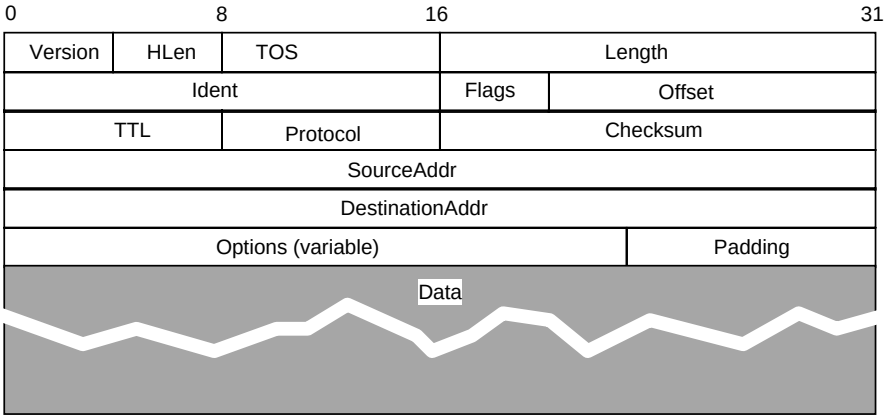

Fig. 1

Fig. 1 shows the header structure of an IP datagram. Name 3 fields that are used for reassembly of the fragmented datagram units at the destination host and briefly explain the function of each of the three fields. **(6)**

d. (i) Explain what is meant by *connectionless* communication.

(ii) Give an example for a transport layer protocol that uses connectionless communication. **(3)**

e. Calculate the time to send a 200 byte IP datagram across a 100 km coaxial cable link working at 200 Kbps. Assume the propagation velocity is 1×10^8 ms^{-1}. **(5)**

2.

a. List three advantages of representing signals in a digital format rather than in an analogue one. **(3)**

b. (i) In relation to the sampling of a continuous signal, state *Nyquist's Sampling Limit*.

(ii) Graphically indicate what the reconstructed signal looks like if the sampling is above or below the Nyquist Limit. **(4)**

c. Draw a block diagram of a system for digitisation of an audio signal and briefly explain the functionality of the main components of the system. **(5)**

d. The digitisation of an analogue audio signal with amplitude varying between values 0.5 V and -0.5V results in a digital signal with 352 kbps data rate. The digitisation process uses a sampling clock with frequency 32 kHz.

(i) What is the highest frequency of a signal that can be recorded using this digitisation process?

(ii) What is the quantisation step used in the quantiser in this analogue-to-digital conversion? **(6)**

e. CD quality audio is digitised using 44.1 kHz sampling rate with 16 bits per sample quantisation. What will be the effect on the audio quality if 8 bits per sample quantisation is used, instead of 16 bits per sample? **(2)**

3.

a. State why multimedia data compression is possible and why it is often necessary. **(3)**

b. What is the difference between *lossless* image compression and *lossy* image compression?

Give an example and an application of each. **(4)**

c. An information source outputs 6 different symbols {A, B, C, D, E, F} with the corresponding probabilities of occurrence as {0.4, 0.06, 0.08, 0.12, 0.25, 0.09}, respectively.

Derive the Huffman code for this restricted alphabet. **(7)**

d. If the output samples in the question **3.c.** are originally represented using the *fixed length binary code*, what compression ratio can be achieved by using the Huffman code derived in question **3.c.**? **(4)**

e. Verify that the derived code in question **3.c.** is unambiguous. **(2)**

4. **a.** Explain why we use the luminance and two chrominance signals form (Y C_b C_r) rather than the additive primary colour form (Red-Green-Blue) for colour television broadcasting? **(3)**

b. You have been asked to assist in the development of a television broadcast system for an alien species, the *Clangers*, who have different visual abilities to our own.

Using the information given below, carry out these requirements – giving, where appropriate, brief explanations of your working.

i. Calculate the required resolution of the display in terms of number of pixels. **(4)**

ii. Calculate the practical memory requirements, in bytes, to store one frame. **(4)**

iii. Estimate the channel bandwidth required for uncompressed television transmissions. **(3)**

iv. If the *Clangers* are like us and possess inferior ability to perceive fine detail in the chrominance information, explain how this can be exploited to obtain a 50% reduction of the overall bandwidth need. **(4)**

v. Recommend a digital video compression standard that can be used for further reduction of the data rate. **(2)**

Information on Clangers' visual system and other requirements:

- Aspect ratio of television display (width:height) = 4:3.
- *Clangers'* spatial frequency cut-of (horizontal and vertical) = 150 cycles/degree subtended to their eye.
- *Clangers* have only two types of colour receptor on the retinas, can perceive approximately 38,000 different colours (hues) and can distinguish some 200 different intensity levels.
- *Clangers* can detect intensity flicker up to 80 Hz at the illumination levels typical in television displays. They, like us, are less prone to perceive flicker over small areas.
- *Clangers* sit, on average, 12 times the display height away from their televisions.
- Available transmission bandwidth is at a premium and every effort needs to be made to minimise it.

GCKA / NMA