

# EEL 4781 - Homework 1

Due October 8, 2009

## Problem 1:

You have a car which travels at an average speed of 65 miles per hour. You carry your harddrive with 1TB of data. For what range of distances your car has a higher data rate than an OC-3 line with 155Mbps?

## Problem 2:

Which layer (or layers) handle(s):

- (a) dividing the transmitted bit stream into frames
- (b) determining the route to use
- (c) error detection and correction
- (d) flow control

## Problem 3:

Frames are the units exchanged at the data link layer. Packets are the units exchanged at the network layer. Are:

- (a) packets encapsulated in frames or
- (b) frames encapsulated in packets?

Explain.

## Problem 4:

Discuss the similarities and the differences between the TCP/IP model and the ISO model.

## Problem 5:

Television channels are 6MHz wide. How many bits/sec can be sent if four level digital signals are used? Assume a noiseless channel.

## Problem 6:

Why is the PCM sampling time set to 125 microseconds?

### Problem 7:

Let us assume a CDMA system in which the chip sequence of the stations are:

**A:** -1 -1 -1 +1 +1 -1 +1 +1

**B:** -1 -1 +1 -1 +1 +1 +1 -1

**C:** -1 +1 -1 -1 -1 -1 +1 -1

**D:** -1 +1 -1 +1 +1 +1 -1 -1

A CDMA receiver gets the following chips:

0 0 0 -2 -2 -2 2 0

Which stations transmitted, and what bits they have each transmitted?

### Problem 8:

Explain the differences between CDMA, TDMA and FDMA.

Which ones can be combined? What would be the advantages and disadvantages of such combinations?

### Problem 9:

An upper layer packet is split into 8 frames, each of them having an 90 percent chance of arriving undamaged (eg. a very noisy WiFi environment). Assume no error control at the data link layer.

- In average, how many times must the packet be resent at the higher level until it gets through?
- What about if the chance of a frame to arrive undamaged is 99.999%?

Note: you can either do probabilistic calculations, or you can write a small simulation program.

### Problem 10:

The following encoding is used in a data link protocol:

**A:** 01000111

**B:** 11100011

**C:** 10101111

**FLAG:** 01111110

**ESC:** 11100000

Show the bit sequence transmitted for the frame "C A ESC B FLAG" (this is the binary code, the ESC and FLAG should appear as such).

What is the output if the framing method is:

- Character count
- Flag bytes with byte shifting
- Starting and ending flag bytes with bit stuffing.

**Problem 11:**

- (a) Find the CRC of 01010011 with the generator polynomial  $x^3+1$  (1001).
- (b) Show the actual bit stream transmitted.
- (c) Assume that the third bit from left is flipped in the transmission due to noise. Show how the error is detected at the receiving side.

**Problem 12:**

Trace the operation of a sliding window protocol with a window size 4 and selective retransmission for the transmission of 10 packets P1,P2... P10. Assume that every 3<sup>rd</sup> packet is damaged during transmission.