CSE 123 Fall 2010 Homework 1

Due 10/7/2010 beginning of class.

Exercise 1

“Dry loop DSL” is a DSL connection that does not include a POTS (plain old telephone service) connection - this frees up some “room” on the line for more bandwidth to your DSL modem, in some cases enough for an additional 256 kbit/s of capacity.

Use Shannon’s theorem to show the necessary signal-to-noise ratio for 3,000 Hz of bandwidth that will provide (a) 256 kbps, and (b) 128 kbps.

Exercise 2

Consider a variation of the 4B/5B NRZI encoding scheme which sends the first 4 bits of the data unchanged, and sets the 5th bit to the value one no matter what. What design considerations/features of the 4B/5B encoding in the book does this scheme provide? Which does it not provide?

Exercise 3

Your boss has tasked you with implementing an Intrusion Detection System at Layer 1, using nothing but an oscilloscope and a tap on the wire, held together with duct tape. This widget reads every voltage change off of the wire and sends them to your program, absent of any bad samples or bit errors. As a first iteration, you will want to detect repetitions of the character 0x90 two or more times. 0x90 is the x86 NOP instruction, long repeated strings of this character can indicate an exploit attempt.

Illustrate the bit sequence corresponding to hexadecimal value 0x9090 for NRZ, Manchester, and 4B/5B encoded NRZI signal for this bit sequence.

Exercise 4

USB uses a 5 bit CRC with polynomial $x^5 + x^2 + 1$. Find a pair of distinct values that share the same CRC value, and show that they are the same either via a mathematical argument or polynomial long division as in the book. You may find it helpful to write the CRC portion of the project, modify it for this CRC length and polynomial, and use that code as part of a program that searches for CRC value pairs.