Winter 2010 CSE3213 Communication Networks
Assignment # 3
Instructor: Foroohar Foroozan

Review chapter 3 (Sections 3.6- 3.7) Garcia before attempting the assignment.

Line Coding

1. Most digital transmission systems are "self-clocking" in that they derive the bit synchronization from the signal itself. To do this the systems use the transitions between positive and negative voltage levels. These transitions help define the boundaries of the bit intervals.

a. The nonreturn-to-zero (NRZ) signaling method transmits a 0 with a +1 voltage of duration T, and a 1 with a −1 voltage of duration T. Plot the signal for the sequence n consecutive 1s followed by n consecutive 0s. Explain why this code has a synchronization problem.

b. In differential coding the sequence of 0s and 1s induces changes in the polarity of the signal; a binary 0 results in no change in polarity, and a binary 1 results in a change in polarity. Repeat part (a). Does this scheme have a synchronization problem?

c. The Manchester signaling method transmits a 0 as a +1 voltage for T/2 seconds followed by a −1 for T/2 seconds; a 1 is transmitted as a −1 voltage for T/2 seconds followed by a +1 for T/2 seconds. Repeat part (a) and explain how the synchronization problem has been addressed. What is the cost in bandwidth in going from NRZ to Manchester coding?

2. Consider a baseband transmission channel with a bandwidth of 10 MHz. What bit rates can be supported by the bipolar line code and by the Manchester line code?

Modulation

3. Suppose a CATV system uses coaxial cable to carry 100 channels, each of 6 MHz bandwidth. Suppose that QAM modulation is used.

a. What is the bit rate/channel if a four-point constellation is used? eight-point?

b. b. Suppose a digital TV signal requires 4 Mbps. How many digital TV signals can each channel handle for the two cases in part (a)?

4. A phase modulation system transmits the modulated signal $A\cos(2\pi f_c t + \varphi)$ where the phase φ is determined by the 2 information bits that are accepted every T-second interval:

for 00, $\varphi = 0$; for 01, $\varphi = \pi/2$; for 10, $\varphi = \pi$; for 11, $\varphi = 3\pi/2$.

a. Plot the signal constellation for this modulation scheme.

b. Plot approximately the output of the phase modulation system for a sequence 110110001001

c. Explain how an eight-point phase modulation scheme would operate.

5. Suppose that the receiver in a QAM system is not perfectly synchronized to the carrier of the received signal; that is, it multiplies the received signal by $2\cos(2\pi f_c t + \varphi)$ and by $2\sin(2\pi f_c t + \varphi)$ where φ is a small phase error. What is the output of the demodulator?