Tutorial 6, CS1031

1. Modulation and spectrum

A digital radio system is being designed for a digital radio station. The system needs to reproduce high-fidelity music, using 16 bits per sample quantisation, with each signal composed of two channels (i.e., for stereo transmission) each with maximum frequency of 22KHz.

(a) What is the bit rate generated by the system?

(b) What is the lowest digital modulation (QAM or PSK) you can use that fits in the frequency band between 1.2300 GHz and 1.2306 GHz?

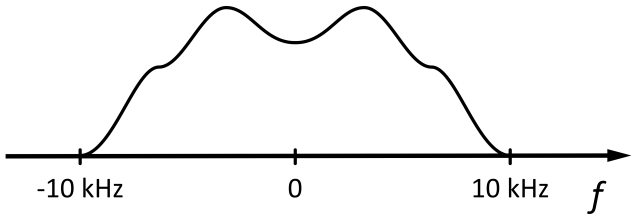
2. Modulation and spectrum

To transmit a voice signal over a walkie talkie radio, with a frequency spectrum similar to the one shown in the figure below, we use the carrier frequency of 400 MHz. The radio is digital, thus, you need to sample, quantize and modulate the signal.

(a) Specify the sampling rate and quantization you would use and state what bandwidth you require if the maximum number of levels allowed by your digital modulator is 16.

(b) What could you do if you needed to reduce the bandwidth of the signal to less than 10 kHz (still the maximum number of levels allowed by your modulator is 16).

(c) Show a plot of the frequency spectrum of the modulated signal.



3. Digital multi-level modulations

You need to transmit the following sequence of bits over a transmission channel, using a 8-ASK digital modulation: 100110010111001011.

(a) Draw a plot of the square wave signal representing the baseband multi-level transmission in the time domain

(b) Draw a plot of the modulated signal in the time domain.

(c) Draw a plot of the modulated signal in the frequency domain using the following parameters: the symbol rate of the modulated signal is 1 Mbaud, the carrier frequency is 100MHz and the value of d for the modulation is equal to 1.

4. Comparing analogue and digital modulations

(a) What is the main difference between digital and analog modulations?

(b) Which one is more resilient against noise? Explain why.