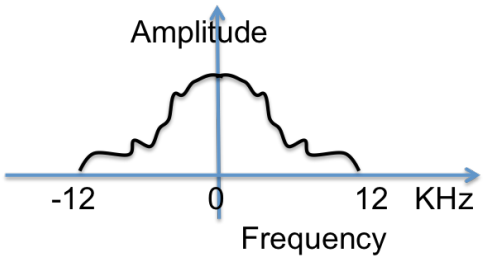
Tutorial 5, CS1031

1. Modulation and spectrum

A voice conversation has a frequency spectrum similar to the one shown in the figure below. You need to transmit the voice signal over a walkie talkie radio, operating at a carrier frequency of 500 MHz. The radio is digital, so you need to sample, quantize and modulate the signal.

a) Specify the sampling and quantization you would use and state what bandwidth do you require if the maximum number of levels allowed by your modulator is 64.
b) What could you do if you needed to reduce the bandwidth of the signal to less than 12KHz (still the maximum number of levels allowed by your modulator is 64).
a) Show a plot of the frequency spectrum of the modulated signal.



2. Data rates

A server contains a file of 10 MB. Bearing in mind that you have a connection to this server of 1 Mbps, what would be the time between the moment the server starts to transmit and the moment that the client receives the last bit? Assume first a null propagation time and then a propagation time of 150 ms.

3. Signal digitization

An audio recorder uses 16 bits to quantize a piece of music sampled at 32 kHz.

1. At what bit rate do you need to read the music to play it seamlessly?
2. If the range of the analogue to digital converter is between +3 Volt and -3 Volt (i.e., the amplitude axis expressed in Volts [V]), what is the size of each quantization interval assuming equal levels?
3. What happens if the input signals has an amplitude larger than 3?