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What Is Bluetooth?

GFSK Differences & Advantages over FSK Modulation

Original Post: Can anyone explain GFSK ?? (SIG Forum) Date: 2000-05-03

The Bluetooth radio chip uses GFSK Modulation. It is natural to assume that GFSK is quite like FSK Modulation, however the differences between the 2 are substantial in implementation and results (output)

Question 1

What are the physical Differences between an FSK & GFSK Modulator, and how results vary?

Answer 1

An FSK Modulator is much the same as a GFSK Modulator, but GFSK uses a Gaussian filter as well. In a GFSK modulator everything is the same as a FSK modulator **except** before the baseband pulses (-1, 1) go into the FSK modulator, it is passed through a Gaussian filter to make the pulse smoother so to limit its spectral width.

Question 2

What is Gaussian Filtering?

Answer 2

Gaussian filtering is one of the very standard ways for reducing the spectral width called Pulse Shaping. If we use -1 for $f_c - f_d$ and 1 for $f_c + f_d$, once when we jump from 0 to -1, the modulated waveform changes rapidly, which introduces large out-of-band [spectrum](#). If we change the pulse going from -1 to 1 as -1, -.98, -.9396, .99, 1, etc, use this smoother pulse to modulate the carrier, the out-of-band spectrum will be reduced.

Question 3

So, why is GFSK implemented in [Bluetooth Radios](#), and not FSK, is it cheaper?

Answer 3

The spectral width for FSK is unlimited, comparatively, there is a limitation on GFSK: "climbs slowly" to f_d in GFSK. However, in the case of FSK, f_c "jumps sharply" to f_d , greatly decreases spectral efficiency.

GFSK is not implemented in the Bluetooth radio unit for cheaper chips (since you put an extra pulse-shaping filter in front of the modulator), but for spectral efficiency.