

The Difference Between Digital Transmission System (DTS) and Frequency Hopping Spread Spectrum (FHSS)

The purpose of this document is to assist customers in understanding the differences between the two main RF protocol modulations techniques used in Radiotronix embedded wireless radios.

This will highlight the unique advantages of each of our radios to allow customers the information needed to select the correct radio for their application. In addition, it will also provide a better understanding of latency and sync time in Wi.232 family of radios.

What is DTS?

It is a modulation technique that uses the digital spread spectrum provision in FCC part 15 rules. Under this provision, transmitters can operate at a higher output power if the transmission bandwidth is at least 500kHz without having to use spreading techniques, such as Frequency Hopping Spread Spectrum (FHSS) or Direct Sequence Spread Spectrum (DSSS). Through an encoding technique we call DirectSpread™, our DTS radios are capable of achieving +12 dBm of output power without having to use FHSS or DSSS. DTS also allows the use of more channels in the same bandwidth. For example, the Wi.232DTS module has 32 communications channels.

What is FHSS?

Frequency hopping is one of two basic modulation techniques used in spread spectrum signal transmission. It is the repeated switching of frequencies during radio transmission, often to reduce interference, but also mandated by the FCC rules for increased output power

In an FHSS system, a transmitter "hops" between available frequencies according to a specified algorithm, which can be either random or preplanned. The transmitter operates in synchronization with a receiver, which remains tuned to the same center frequency as the transmitter. A short burst of data is transmitted on a narrowband. Then, the transmitter tunes to another frequency and transmits again. The receiver thus is capable of hopping its frequency over a given bandwidth several times a second, transmitting on one frequency for a certain period of time, then hopping to another frequency and transmitting again. Frequency hopping requires a much wider bandwidth than is needed to transmit the same information using only one carrier frequency.

The following are the differences between the DTS and FHSS in Radiotronix modules:

Digital Transmission System (DTS)

- * Operates on one frequency at a time
- * Does not require synchronization to communicate with another DTS
- * Takes 7-8ms to wake from sleep or power down.

SUBJECT: Differences between Digital Transmission System (DTS) and Frequency Hopping Spread Spectrum (FHSS) protocols

- * Has ~100kbps throughput with a 144 byte MTU at maximum RF data rate (encoding loss included).
- * Modulation is wideband FSK that exploits the 15.247 rules for a digitally modulated system. Data is “whitened” (energy is spectrally smeared) by the encoding algorithm slightly. Power output is limited to 25mW because of power spectral density rules.
- * PHY replacement- no addressing built-in

Frequency Hopping Spread Spectrum (FHSS)

- * Operates on 26 frequencies at a time (hop sequence)
- * Requires synchronization at the beginning of each hop. This extra transmission allows other modules to “find” the transmitter and join the hop sequence. This synchronization takes 25ms every 400ms at max data rate.
- * Takes 7-8 ms to wake from sleep or power down.
- * Has ~90kbps throughput with a 128 byte MTU at maximum data rate (sync and encoding losses included).
- * Modulation is FSK and is considered DTS because of bandwidth usage. However, it is a true frequency-hopping radio in all other respects.
- * Three addressing modes built-in (GUID, USER16, USER32). These are explained in greater detail in the FHSS-25 user’s manual.

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