

Peer-to-peer FHSS Technology

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Application Note

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Abstract

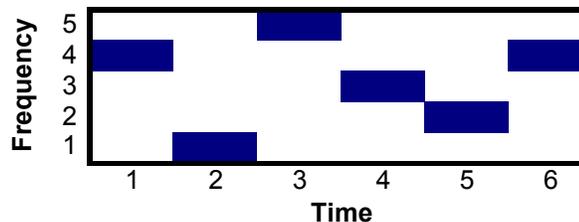
MaxStream has a revolutionary method of synchronizing the radio modules in a network that does not require the use of a master or server. This technology allows for very robust communications even in the presence of interference and enables flexible network topologies that are not possible with modules from other vendors. This Application note covers: a general overview of Frequency Hopping Spread Spectrum (FHSS) systems, a synopsis of the master – slave system often used by our competitors and advantages of the peer-to-peer architecture of MaxStream’s modules.

Explanation of FHSS

A simple single channel transmitter system modulates data on a carrier at a fixed frequency. In contrast, FHSS systems transmit data on one frequency for a period of time, before hopping to another frequency to continue the transmission. FCC regulations stipulate the number of frequencies used for hopping based on the transmit power of the system (usually 25 or 50 frequencies). Because the system actually transmits using a number of frequencies, the communication is more reliable and resistant to interference than a system transmitting on only one frequency.

The frequencies are used in a predefined pseudo-random sequence that both the transmitter and receiver know. In the simple example below, the five frequencies are used in the sequence 4, 1, 5, 3, 2. The pattern starts over at time 6.

Frequency hopping - pseudo random sequence



For communication to take place, the receiver must be listening on the frequency that the transmitter is talking as they hop together through the sequence. Or in other words, they must stay synchronized.

Competitors Master – Slave systems

MaxStream modules do not use a master – slave type system but many FHSS systems require a master or server radio to coordinate the hopping sequence. Each of the slaves or clients must follow the master and may transmit only when allowed to by the master. Before communication can occur, each radio must be configured as either a master or a slave. When the radios are first turned on, the system requires a certain time period to synchronize the slaves to the master. Peer-to-peer (ad-hoc) networking is not possible because of the strict master-slave relationships that cannot be easily redefined.

Limitations of master – slave type systems:

- Masters transmit constantly (increases power use and interferes with other systems)

- Initial system synchronization time
- Limited low power options on slaves
- No direct slave-to-slave communication
- Configuration required before communication is possible
- Limitations on network configurations – no ad-hoc networking

MaxStream's Peer-to-peer system

MaxStream modules take a fundamentally different approach. MaxStream has pioneered a very sophisticated synchronization technology that allows the entire network to synchronize within 35ms. This allows the network to operate without maintaining a synchronized time base.

The system is best understood as a roaming master system where each module assumes the role of the master during the time it has data to transmit, then drops back to a slave role when the data transmission is complete. Any module will synchronize all modules within range, transfer the data, and then release the communication channel. This peer-to-peer technology allows for flexible ad-hoc type networks. Each module is able to initiate communication with any other module within range.

The freedom from a global time base allows any module to operate in any of three power-down modes as low as 50uA or have the supply voltage removed entirely. A module is ready to transmit less than 50ms after power is re-applied. Also, this proprietary technology allows MaxStream the distinction of being the only FHSS technology provider with a Transmit only module. This module does not have any receiver circuitry installed and can be made available at much lower price points that previously thought possible. Instead of having a master which constantly transmits to maintain the time base of the network, all modules in a MaxStream network remain completely quiet until the moment that they actually have data to transmit.

Summary of functionality gained through peer-to-peer operation:

- Works with absolutely no configuration
- Fast startup times (no need to acquire network synch)
- Transmitter only modules available
- Allows flexible (ad-hoc) networking topologies
- Power saving modes
- Multi-drop bus support
- Only key up transmitter for actual data – no constant synch pulses