

# Two types of spread spectrum computer science

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There are two types of spread spectrum that have been approved for use. This article analyzes the approach in to determining performance comparison of Frequency Hopping and Direct Sequence Spread Spectrum Systems in the 2.4 GHz range. "The analyses till present show that up to 13 collocated FH networks can be placed before network throughput peaks." (A. Carl, S. Harris & B. Palm, n. d.). The article further lists in categorizing the advantages and limitations of spread spectrum and the comparisons between the Frequency Performance and Direct Sequence. The article details itself via valid resources obtained from researched websites and journals with more details available with those references being provided.

The Spread-spectrum is or are a series of techniques which are methods by which a signal that could be of electrical or electromagnetic or acoustic signals that are being generated in an exacting bandwidth which is then by design spread in the frequency domain, ensuing in a signal with a vast or wider bandwidth. These techniques are utilized for a range of reasons, together with the establishment of safe and sound communications, increasing resistance to natural interference and congestions, to prevent uncovering, and to frontier power flux density. Out of many Spread Spectrums, this report analyses the two main spread spectrum systems which are the 'Frequency Hopping and Direct Sequence' and in addition an overview of the 'Chirp Spread' Spectrum.

Spread Spectrum technologies

The spread spectrum technology is more of a technique in which a telecommunication signal is transmitted on a bandwidth significantly bigger than the regularity content of the original information.

“ Spread-spectrum telecommunications is a signal structuring technique that employs direct sequence, frequency hopping, or a hybrid of these, which can be used for multiple access and/or multiple functions.”(Anonymous, 2007).

This technique reduces the possible intrusion to other receivers while achieving privacy. Spread spectrum in general makes use of a chronological noise-like signal formation to spread the normally narrowband information signal over a comparatively wideband (radio) band of frequencies. The receiver correlates the received signals to retrieve the original information signal. Initially there were two motivations: either to resist enemy efforts to jam the communications known as an Anti-Jam or to conceal the fact that communication was even taking place, sometimes called low probability of intercept.

#### Spread-spectrum clock signal generation

The Spread-spectrum clock generation is used in some synchronous digital systems, especially those containing microprocessors, to cancel of the spectral density of the electromagnetic interference that these systems generate. “ A synchronous digital system is one that is driven by a clock signal and because of its periodic nature, has an unavoidably narrow frequency spectrum.” (Anonymous, 2007). In fact, a perfect clock signal would have all its power determined at a single frequency and its harmonics, and would therefore radiate energy with an inestimable spectral

concentration. Practical synchronous digital systems radiate electromagnetic force on a number of narrow bands spread on the clock frequency and its harmonics, follow-on in a frequency spectrum that, at certain frequencies, can exceed the regulatory limits for electromagnetic interference

## The Spread Spectrum Systems Overview

### Frequency Hopping Spread Spectrum

This is a method of transmitting radio signals by speedily switching a mover among many frequency channels, using a pseudorandom cycle known to both transmitter and receiver. It is utilized as a several access method in the frequency-hopping code division multiple access scheme.

The three main advantages over a fixed-frequency transmission:

- Its signals are highly resistant to narrowband intervention. The procedure of re-collecting a spread signal spreads out the interfering signal, causing it to retreat into the background.

- Spread-spectrum signals are tricky to interrupt. A Frequency Hopping Spread Spectrum signal plainly appears as a boost in the background noise to a narrowband receiver. An eavesdropper would only be able to seize the transmission if the pseudorandom sequence was known.

- The Spread-spectrum transmissions can contribute to a frequency band with many types of conventional transmissions with minimum interference. The spread-spectrum signals affix minimal noise to the narrow-frequency

communications, and vice versa. As an effect, bandwidth can be utilized more resourcefully.

### The Basic algorithm

The initiation of a Frequency Hopping Spread Spectrum (FHSS) communication is as follows:

- The initiating party sends a request via a predefined frequency or control channel.
- The receiving party sends a number, known as a seed.
- The initiating party uses the number as a variable in a predefined algorithm, which calculates the sequence of frequencies that must be used. Most often the period of the frequency change is predefined, as to allow a single base station to serve multiple connections.
- The initiating party sends a synchronization signal via the first frequency in the calculated sequence, thus acknowledging to the receiving party it has correctly calculated the sequence.
- The communication begins, and both the receiving and the sending party change their frequencies along the calculated order, starting at the same point in time.

### Technical considerations

The overall bandwidth necessary for frequency hopping is a great deal, wider than that required to transmit the same information using only one carrier

frequency. Nevertheless, because transmission occurs only on a small segment of this bandwidth at any given time, the effectual interference bandwidth is actually the same. Even as providing no extra protection against wideband thermal noise, the frequency-hopping approach does reduce the deprivation caused by narrowband interferers.

One of the challenges of frequency-hopping systems is to coordinate the transmitter and receiver. One approach is to have an assurance that the transmitter will use all the channels in a set period of time. The receiver can then discover the transmitter by picking a random channel and listening for suitable data on that channel. The transmitter's data is recognized by a unique series of data that is unlikely to occur over the section of data for this channel and the segment can have a checksum for reliability and further detection. The transmitter and receiver can use fixed tables of channel sequences so that once synchronized they can maintain communication by following the table. On each channel segment, the transmitter can send its current position in the table.

### Direct Sequence Spread Spectrum

Direct-sequence spread spectrum (DSSS) is a modulation method. As with other spread spectrum technologies, the transmitted signal takes up more bandwidth than the information signal that is being modulated.

In this technology the transmissions multiply the data being transmitted by a "noise" signal. "This noise signal is a pseudorandom sequence of 1 and a?1 values, at a frequency much higher than that of the original signal, thereby

spreading the energy of the original signal into a much wider band.” (W. Jimmy, n. d.)

The resultant signal resembles white noise, like an audio recording of “static”. On the other hand, this noise-like signal can be used to precisely recreate the original data at the receiving end, by multiplying it by the same pseudorandom sequence. This process, known as “de-spreading”, mathematically constitutes a correlation of the transmitted PN sequence with the PN sequence that the receiver believes the spreader is using.

For de-spreading to operate correctly, the transmit and receive sequences must be synchronized. This requires the receiver to coordinate its sequence with the transmitter’s sequence via some sort of timing search process. However, this noticeable drawback can be a significant benefit: if the sequences of multiple transmitters are synchronized with each other, the relative synchronizations the receiver must make between them can be used to resolve relative timing, which, in turn, can be used to compute the receiver’s position if the transmitters’ positions are known. This is the base for many satellite direction-finding systems.

The resultant outcome of enhancing signal to noise ratio on the channel is called ‘process gain’.

#### Benefits in Direct Sequence Spread Spectrum

- It is resistant to planned or unintentional jamming.
- The sharing of a single channel between numerous users.

- Reduced signal/background-noise level hampers interception (stealth).
- Determination of relative timing between transmitter and receiver.

### Chirp Spread Spectrum

On the other hand, the Chirp spread spectrum (CSS) is a spread spectrum technique that uses wideband linear frequency modulated chirp pulses to encode information. " A chirp is a sinusoidal signal whose frequency increases or decreases over a certain amount of time." (W. Jimmy, n. d.)

Chirp Spread Spectrum is ideal for applications requiring low power usage and needing relatively low amounts of data rate.

CSS uses its entire owed bandwidth to televise a signal, building it robust to channel noise. Further, because the chirps utilize a broad band of the spectrum, Chirp Spread Spectrum is also challenging to multi-path fading even when working at very low power. However, it is not like direct-sequence spread spectrum or frequency-hopping spread spectrum in that it does not add any pseudo-random elements to the signal to help differentiate it from noise on the channel, instead relying on the linear nature of the chirp pulse. Moreover, Chirp Spread Spectrum is resistant to the Doppler Effect, which is typical in mobile radio applications.

### Comparisons against Performance between Frequency Hopping and Direct Sequence Spread Spectrum Systems

### A Simulated Model/Design

### Conclusion

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