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FREQUENCY HOPPING SPREAD SPECTRUM FOR IMPROVED SECURITY

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Abstract: **To improve the fruition of short-range wireless communications, channel attribute must be improved by dodging interference and multi-path fading. Frequency hopping spread spectrum (FHSS) is a hauling technique where the carrier hops from frequency to frequency. For frequency hopping, arrangement must be designed so that the dossier can be transmitted in a clear channel and avoid congested channels. Adaptive frequency hopping is a system which is used to revamp immunity towards frequency barring by avoiding use of congested frequency channels in hopping sequence for improved security and armament in communication. In this paper mathematical modeling is used to simulate and assay the performance improvement by using FHSS with popular modulation schemes, and also the hopping channel situations are investigated.**

Keywords: **Frequency Interference, Multi-path fading, Frequency hopping, Improved Security.**

I INTRODUCTION

A.INTRODUCTION

According to the authors in the paper [1], Spread spectrum is a digital modulation technology and an approach based on the percept of spreading of signals among bounteous frequencies to avert interference and signal detection. As the name shows it is know-how to spread the transmitted spectrum over a ample range of frequencies. As per the authors in the paper [2] spread spectrum technique hadinitiated to be employed by military applications because of its Low Probability of Intercept (LPI) or demodulation, interference and anti-jamming (AJ) from detractor side. The idea of spreading the spectrum is to spread signal over a large frequency band to use greater bandwidth than the Data Bandwidth while the power remains the same. And as far as the spread signal looks like the noise signal in the same frequency band it will be difficult to perceive the signal which this feature of spreading provides security to the transmission.Compared to a narrow band signal, spread spectrum spreads the signal power over a wideband and the overall SNR is enhanced because only a small part of spread spectrum signal will be affected by interference. In a communication system at transmitter and receiver sides, one spreading generator is located which is based on the spreading technique. They synchronize the received modulated spectrum.Frequency-hopping spread-spectrum (FHSS) systems have been extensively used in military communications. Frequency Hoppers (FH) are a more sophisticated and arguably better family of spread spectrum techniques than the simpler Direct Sequence (DS) systems. However, performance comes with a price tag here, and FH systems are significantly more complex than DS systems. The central idea behind a FH system is to retune the transmitter RF carrier frequency to a pseudo randomly determined frequency value. In this fashion the carrier keeps popping up different frequencies, in a pseudorandom pattern. The carrier itself may be convoluted directly with the data using one of many possible schemes. The available radio spectrum is thus split up into a discrete number of frequency channels, which are occupied by the RF carrierpseudo randomlyin time.

Unless you know the PN code used, you have no idea where the carrier wave is likely to pop up next; therefore eavesdropping will be quite difficult. Frequency hoppers as shown in figure 1 are typically divided into fast and slow hoppers. A slow frequency hopper will change carrier frequency pseudo randomly at a frequency which is much slower than the data bit rate on the carrier. A fast frequency hopper will do so at a frequency which is faster than that of the data message.

The most important utilization of the spread spectrum technique is the code division multiple access (CDMA).The author in the paper [3] has elucidatedCDMA as a multiuser communication system in which many users can access the feasible channel bandwidth simultaneously. To avoid their interference each user is allotted a particular sequence using PN code generators. These code progressions are used by the receivers to encounter their signals in the presence of other nonessential signals.

The author in paper [4] describes about the benefits of using the spread spectrum technologies and basically about the commercial applications of using the FHSS technology. The major purpose to develop the system of FHSS was to enhance the security attributes in order to be able to move to a safer communication system. Likewise the author in the paper [5] described about the facilities available to develop such system which are less prone to jamming and interference. It primarily describes about the benefits of using the spread spectrum technique which is responsible for non-interception and jamming.

The work done here is the combination of all the theoretical aspects described in all the referred papers. We have tried to develop the coding technique with the help of matlab which will help in the transmission and reception of the information in a secured way. The use of the spread spectrum technique or more specifically frequency hopping spread spectrum helps us to perform data transmission in an efficient manner.

The main purpose of our work is to improve the security attribute which is desired during the communication process. The basic inherent quality of the system helps us make the communication system much more efficient and secured.

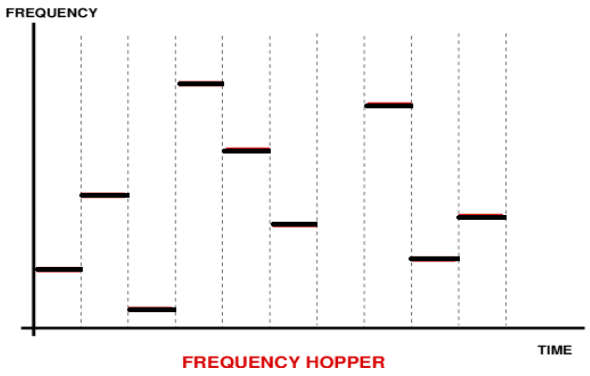

Figure1:Frequency.Hopper
(Courtesy: www.ausairpower.net)

B. SYSTEM MODEL

In the Frequency hopping system the hopping rate is higher than user data rate. Therefore there are many hopes per frequency bit. It is given in the block diagram of frequency hopping spread spectrum Transmitter as shown in figure 2 & receiver.

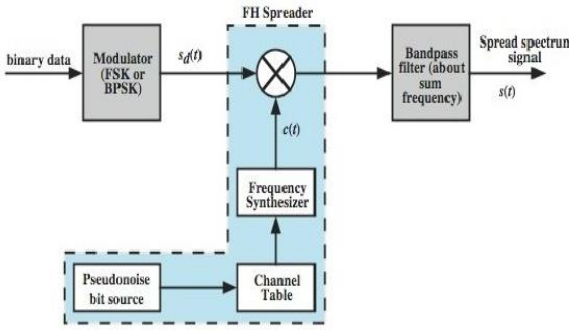

Figure 2: FHSS Transmitter

Frequency hopping spread spectrum is a transmission technology used in wireless networks and a technique to generate spread spectrum by hopping the carrier frequency FHSS uses narrow band signal which is less than 1 MHz, in this method data signal is modulated with a narrow band carrier that "hops" in a random and hopping happens in pseudo-random "predictable" sequence in a regular time from frequency to frequency which is synchronized at both ends. Using FHSS technology improves privacy, it is a powerful solution to avoid interference and multi path fading(distortion), it decreases narrow band interference increases signal capacity, improve the signal noise ratio, efficiency of bandwidth is large and difficult to intercept also this transmission can share a frequency bandwidth types of conventional transmission with minimal interference or frequency hopping a mechanism must be defined to transmit data in a clear channel and to avoided the congested channels. Frequency hopping is the periodic change of transmission frequency and hopping happens over a frequency bandwidth which consists of numbers of channels. Channel which is used as a hopped channel is instantaneous bandwidth while the hopping spectrum is called total hopping bandwidth.

II. ALGORITHM/FLOW CHART

Following algorithm is used in this work as shown in figure3.

STEP 1: The initiating party sends a request via a predefined frequency or control channel.

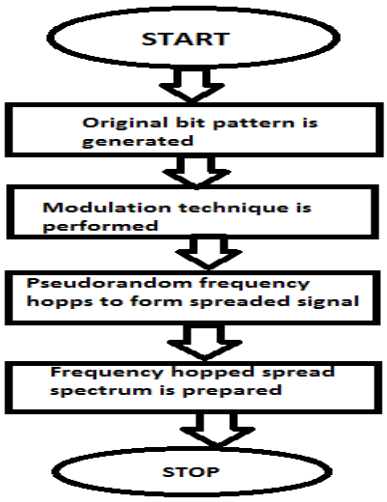

Figure 3: Flowchart for FHSS signal

STEP2: The receiving party sends a number, known as a seed.

STEP3: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.

STEP4: 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.

STEP5: 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.

In some uses, most often military, a predefined frequency-hopping sequence is negotiated, and after completing the first step the procedure is continued from number 5.

III. IMPLEMENTATION

The work is implemented using MATAB.Afourth generation programming language allows matrix manipulations, plotting of functions and data. Matrix laboratory is dynamic software that can be used in education and is popular amongst scientists involved in image processing.

The work is implemented using MATLAB codingwhich is divided into five modules described as under.

Module1: In this module original bit pattern is generated using 25 random bits as shown in figure 4.

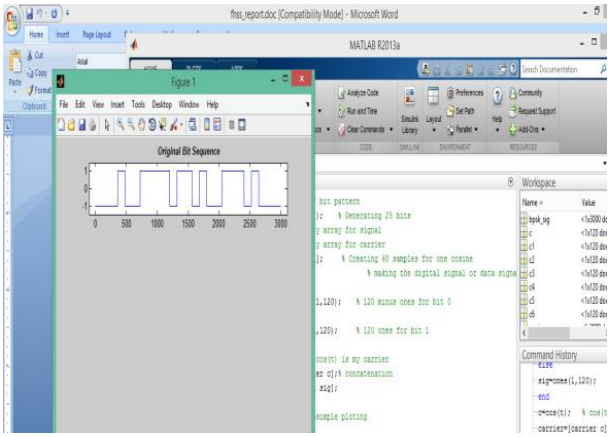

Figure 4: Original bit sequence as an output

Module 2: In this module modulation technique is performed and BPSK modulated signal is generated whose output is given as in figure 5.

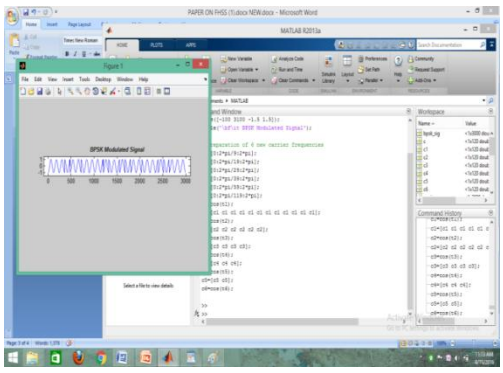

Figure 5: BPSK modulated signal

Module 3: In this module 6 new carrier frequencies are prepared so that random frequency hops to form a spreaded signal as shown in figure 6.

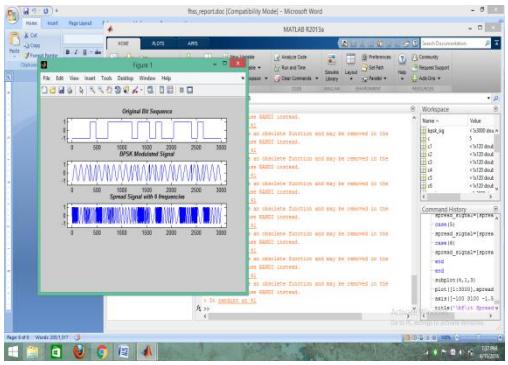

Figure 6: Spreaded signal

Module 4: In this module BPSK signal is spreaded into wider band with total of 12 frequencies and frequency hopped spread spectrum is formed as shown in figure 7.

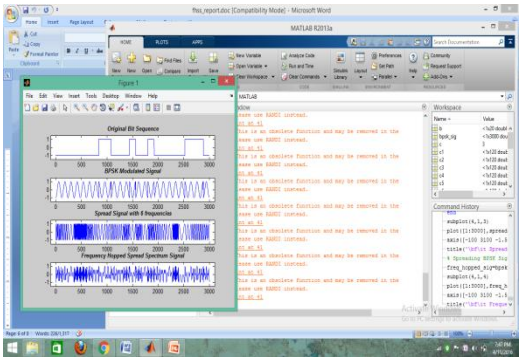

Figure 7: Spreaded BPSK signal

Module 5: Inthis module the frequency hopped spread spectrum is represented in its fast Fourier transform. It is shown in figure 8.

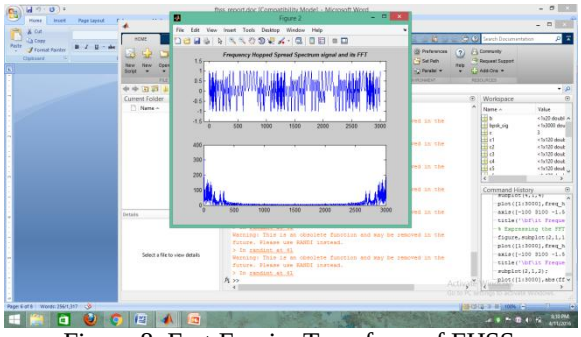

Figure 8: Fast Fourier Transform of FHSS

IV.RESULT AND DISCUSSION

All the output signals BPSK modulated signal, spread signal with 6 frequencies, frequency hopped spread spectrum signal corresponding to original bit sequence are shown in the figure 9.

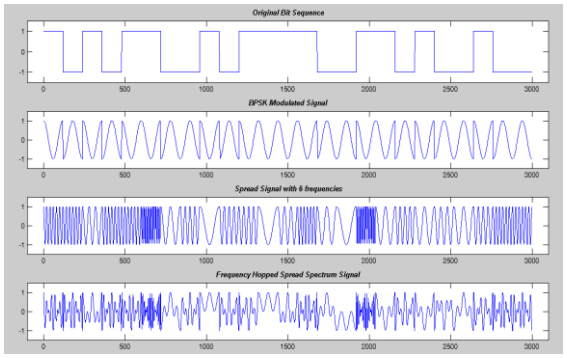

Figure 9: Output signals

In this work BPSK modulation technique is used in the implementation and its efficiency and performance are found to be much better as compared to the other modulation techniques as mentioned in Table 1.

TABLE 1 Comparative Study of Various Modulation techniques

Modulation Technique	Noise Error	Bandwidth utilization	Power consumption
ASK	More	3 fb	More
BFSK	Less	4 fb	less
BPSK	Lesser	2 fb	Lesser
M-ary	-	2fb/N where N=number of bits per symbol	_
QPSK	-	2fb/N where N=2 ; fb	_

wherefb=1/tb; tb is bit rate.

Using BPSKmodulation technique for generating FHSS makes the system much simpler to implement and giving good performance in terms of noise error, BW utilization and securityin multipath environment.

V. CONCLUSION

Here in this paper frequency hopped spread spectrum using binary phase shift keying modulation technique and combining it with the pseudorandom sequence is generated. Whole system is developed with the help of MATLAB Codes.

Fundamentally this system design is much simpler to implement along with better range which is possible due to lower receiver sensitivity. No near/far problems occur and hence it gives better performance in multipath environments.

VI. APPLICATIONS

FHSS modulation technique is used for military purposes. Cryptographic algorithms are used to generate the chipping/spreading code, which is shared between the sender and receiver.

FHSS modulation is used in wireless LANs (WLANs). FHSS works on almost 97 frequencies. The range of frequenciesfrom 2.402Hz to 2.480Hz.

FHSS modulation is used in Global Positioning System (GPS).

FHSS is used in IS-95. It is a digital cellular radio system using CDMA technique for communication of voice.

FHSS modulation is also used in Bluetooth technologies.

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