Simulation and Analysis of Direct Sequence Spread Spectrum on Lab VIEW

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***Abstract*— The information may be transmitted from one place to another using either digital or analog communication system. Due to various advantages of digital communication (e.g. Error free communication, Low Probability of Detection, Jam resistant capability etc.), it is widely used in modern arena. The Spread Spectrum Communication technique provides moderate degree of jam resistant capability and Low Probability of Detection to unfriendly receiver. The transmission environment in which DSSS yield desirable performance is based on Lab VIEW 8.5 and named as BPSK-Spreading transceiver. The typical three path propagation and anti-jamming capability associated with DSSS were carried out through the combination of Lab VIEW. At the transmitter, the NRZ data stream is first mapped into BPSK symbols and then spread-out using different PN code like Hadamard code, Gold or Kasami sequences. The receiver first performs de-spreading and finally BPSK de-symbol mapping. The simulation result show that the correctness of theoretical model was confirmed which would give certain reference to analysis and design of the practical system. Furthermore, BPSK-Spreading transceiver should be analyzed for their performance, multipath scenario and interference.**

***Index Terms*— Lab VIEW 8.5, Hadamard code, Gold or Kasami sequences.**

I. Introduction

A major issue of concern with digital communication has been that of providing for the efficient utilization of bandwidth and power. The justification for preoccupation with this issue is simply the fact that bandwidth and power are the two primary communication resources and it is therefore essential that they are used with care in the design of most communication systems. Nevertheless, wireless communication technologies for un-licensed band application are the situations where it is necessary to sacrifice the efficient utilization of these two resources in order to meet certain other design objectives *i.e.* ability to reject the interference whether among the various signal. This requirement is catered to by a class of signaling techniques known collectively as *spread-spectrum modulation.* The anti-jamming capability, associated with spread spectrum makes this technology suitable for un-licensed band applications.

For developing a reliable wireless communication we take a novel extension called the direct sequence spread spectrum (DSSS) in addition to binary phase shift keying (BPSK) to support high spectral efficiency and improve the link quality over multipath fading channels, while maintaining the low power and improving the bit error rate (BER) performance. This may be called as BPSK-Spreading transceiver. It should be consider what done prior to spreading it is the digitization of analog signal, perform with the pulse code modulation, which includes sampling quantization and encoding.

The wireless transmission environment in which DSSS yield desirable performance is based on Lab VIEW. The data is voltage levels of an NRZ bit stream which makes excursion between +1 and -1 at the rate f_b . The chipping waveform make excursion between +1 and -1 at the rate f_c and changed the characteristics according to data stream. The spread spectrum transmitter first perform the BPSK symbol mapping using sinusoidal carrier and then spread the spectrum using Hadamard code, Gold or Kasami sequences. Spreading consists of multiplying the input data by a pseudo-random or pseudo-noise (PN) sequence, the bit rate of which is much higher than the data bit rate. This increases the data rate while adding redundancy to the system.

II. AIM & OBJECTIVE

The present work has been undertaken with the following objectives:

a) Study of digital communication concepts, spread spectrum technique using Lab VIEW.
b) Interact with the system to develop & analyzed the BPSK Spreading transceiver for their performance and anti-jamming capability**.**
c) Interact with the system to develop & analyzed the BPSK, MSK without Spreading transceiver for their performance and comparison in different manner.

III. REQUIREMENTS

For proper visualization and simulation the software platform is needs that meet the entire requirement to analyze the particular model. Lab VIEW 8.5 is available software, which provided signalized and digitized simulation of the model chosen for the analysis.

Lab VIEW 8.5:

Lab VIEW is a powerful and complex graphical dataflow programming environment, is short for **Lab**oratory **V**irtual **I**nstrument **E**ngineering **W**orkbench. Lab VIEW programs are called virtual instruments, or VIs, because their appearance and operation imitate physical instruments, such as oscilloscopes and millimeters. Lab VIEW contains a comprehensive set of tools for acquiring, analyzing, displaying, and storing data, as well as tools to help us to troubleshoot, code our write. In Lab VIEW, we build a user interface, or front panel, with controls and indicators. Controls are knobs, push buttons, dials, and other input mechanisms. Indicators are graphs, LEDs, and other output displays. After we build the user interface, we add code using

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VIs and structures to control the front panel objects. The block diagram contains this code.

BPSK symbol mapping and spreading:

To use spreading technique over a band-pass channel, we may incorporate *coherent binary phase-shift keying* (BPSK) into the transmitter, therefore transmitter involve two stages of modulation. The first stage consists of a product modulator or multiplier with data sequence and carrier signal to perform BPSK modulation. The second stage consists of a PN sequence spreading. The phase modulation $s(t)$ of $d(t)$ has two values, 0 and π, depending on the polarities of the data sequence $d(t)$ at time t in accordance with the truth table of table 1

S.No.	Input digital signal	Bipolar NRZ signal $b(t)$	BPSK output signal
1.	Binary 0	$b(t) = -1$	$-\sqrt{2P}\cos\omega_c t$
2.	Binary 1	$b(t) = +1$	$+\sqrt{2P}\cos\omega_c t$

In a coherent binary PSK system, the pair of signals, $s_1(t)$ and $s_2(t)$ used to represent binary symbols 1 and 0 respectively, are defined by

$$s_1(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t)$$

$$s_2(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t + \pi) = -\sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t)$$

Where $0 \le t < T_b$, and E_b is the transmitted signal energy per bit, and carrier frequency f_c is chosen to n_c/T_b for some fixed integer n_c.

In BPSK the $d(t)$ is a stream of binary digits with voltage levels which, as a matter of convenience we take to be at +1*V* and -1*V*. When $d(t)$ = 1*V* we say it is at logic level 1 and when $d(t)$ = -1*V* we say it is at logic level 0. Hence BPSK is given by bipolar NRZ level as

$$S(t) = d(t)\sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_c t)$$

For the second stage modulation *i.e.* spreading is performed by applying information bearing signal $s(t)$ and *pseudo noise* (PN) *sequences* to product modulator. We know from Fourier transform theory that multiplication of two unrelated signals produces a signal whose spectrum equals the convolution of the spectra of the two component signals. Thus if $s(t)$ is narrowband and the PN sequence $c(t)$ is wideband, the product signal $x(t)$ will have a spectrum that is nearly the same as the PN sequence, *i.e.* in context of our present application, the PN sequence perform the role of a spreading code. We may thus express the transmitted signal as

$$x(t) = c(t)s(t).$$

De-spreading and BPSK symbol de-mapping:

Accordingly, the channel output is given by

$$y(t) = x(t) + n(t)$$
$$= c(t)s(t) + n(t)$$

Where $s(t)$ the binary PSK is signal, and $c(t)$ is the PN sequence. In the receiver, the received signal $y(t)$ is first multiplied by the PN sequence $c(t)$ yielding an output that equals the coherent detector input $u(t)$.

$$u(t) = c(t)y(t)$$
$$= c^2(t)s(t) + c(t)n(t)$$
$$u(t) = s(t) + c(t)n(t)$$

In the above equation, we have noted that, by design, the PN sequence *c(t)* satisfies it's property, that reproduced hear for convenience:

$$c^2(t) = 1$$

The of equation $u(t)$ shows that the coherent detector input $u(t)$ consist of a binary PSK signal *s(t)* imbedded in additive code- modulation interference denoted by $c(t)n(t)$.

IV. BPSK Spreading Transceiver based on Lab-VIEW

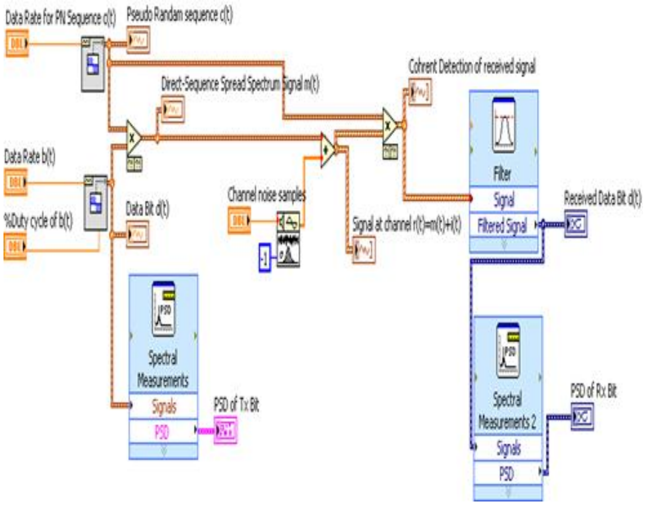

Fig. 1: Spreading Transceiver without BPSK System

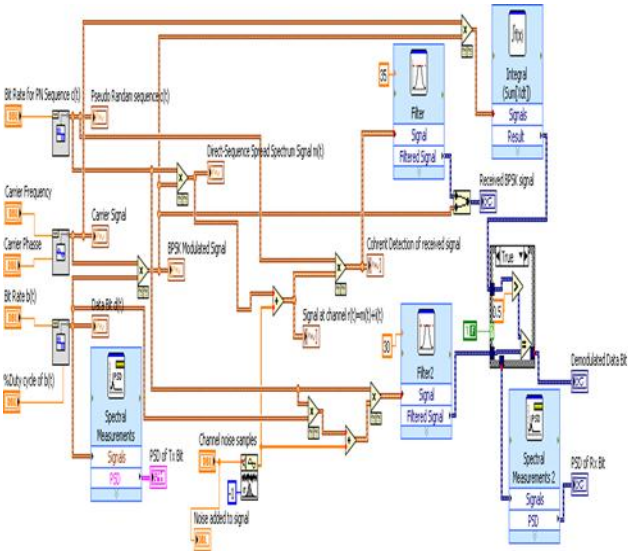

Fig-2: Spreading Transceiver with BPSK System

V. RESULTS

The direct sequence spread spectrum based 2-PSK spreading transceiver system is analyzed for their anti-jamming capability, low SNR, concealment and for typical three path propagations. Except first simulation other subsequent simulation demonstrated to the performance of 2-PSK spreading transceiver system.

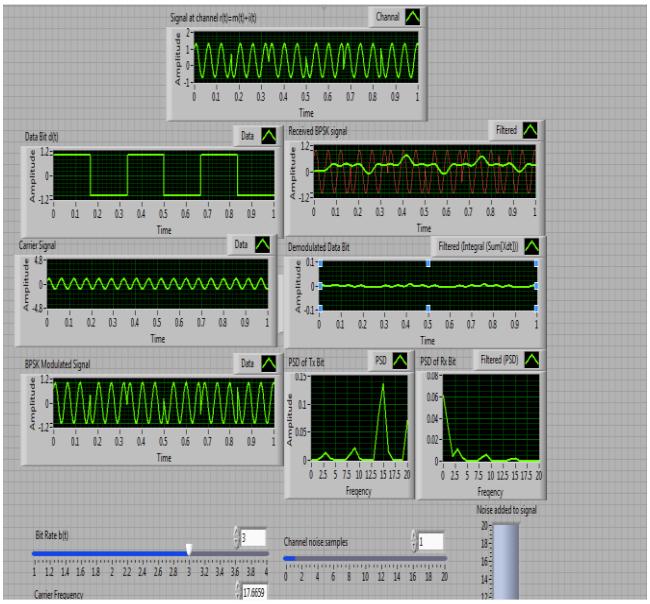

Fig. 3- Result of spreading transceiver without BPSK system

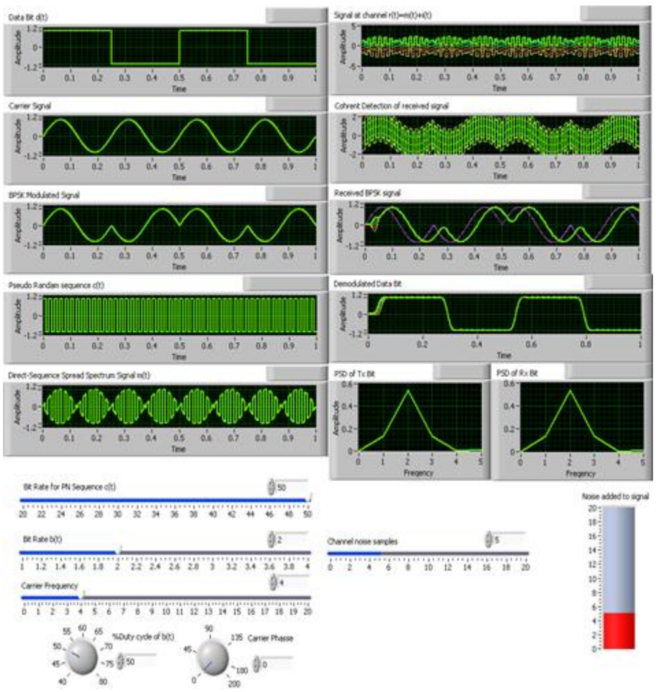

Fig. 4- Result of spreading transceiver with BPSK system

VI. CONCLUSION

In summary, the main advantages of proposed technique *i.e.* high concealments, anti-jamming capability and low SNR property, provided that, any unauthorized receiver can't detect the information, only the user detected it who is authorized for it, increased the channel capacity and required low transmitting power. In Short we can say that the technique Direct Sequence Spread Spectrum *(DSSS)* is attain more robust performance, and outperformed then the other digital communication system, it can conserved both power and bandwidth *i.e.* the primary sources of any communication system. More importantly, the technique *Direct Sequence Spread Spectrum (DSSS)*, is exceed the other communication system BER performance and have robustness against channel estimation errors. Its low SNR value properties has been designed provide the quality performance, because of low transmitting power is required, which increases the efficiency of the overall system. Technique DSSS have also increases the No. of User for accessing the same channel, by which this technique increase the entire capacity of the channel, and the technique is commonly known as CDMA.

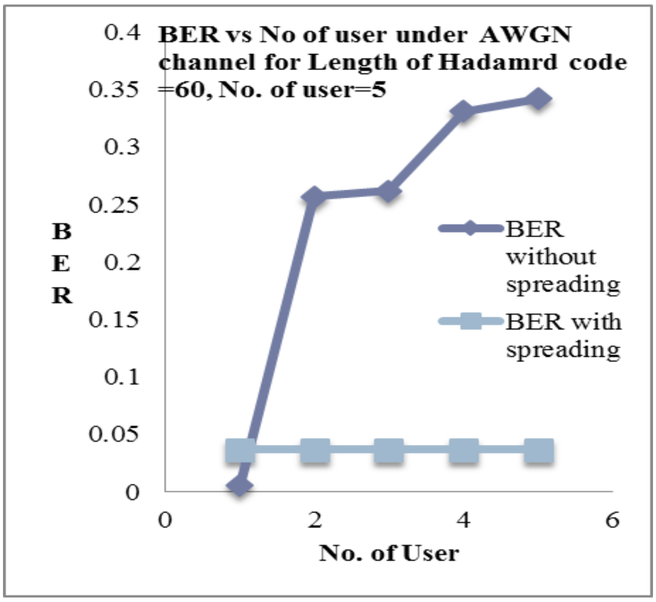

Fig. 5- Bit error rate vs no. of users in both systems (i.e, without spreading and with spreading)

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