# Wireless Communication Project : Spread Spectrum

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**Abstract**

This report has mainly recorded the process of the project of the Wireless Communication. It includes the Spread Spectrum theory exploration and the simulation with Labview and some development. The contents are as follows: The basic theory of Direct Sequence Spread Spectrum(DSSS) System and how it is made up.From some equation we can see the features of the spread spectrum especially the advantages in the real communication. Yet the evaluation equation is complex to some degree. So to understand the theory further,we use some simulation such as Labview and Matlab. Yet Labview is a very view friendly and graphic programming software, so we can easily see the results from the simulation results.

This article is used as the basis of scores and the materials to communicate among students and teachers who are interested in this field. For the lack of time, there may be some errors. Any comment is welcome.

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# Contents

# Chapter 1

# Introduction

## 1.1 The Background

In the middle of 1950s, the US Army has begun to research on the spread spectrum technology. Since then, this technology has been exclusive to the military communication, and has been used wisely in communication, electronic warfare, navigation, measurement and other fields. It was until 1980s that the spread spectrum technology has been used in civilian communications. With the arrival of the era of information, communications technology continues to develop. It appears especially important to optimize communication, improve communication reliability and security. The spread spectrum technology happens to meet these needs.

## 1.2 Spread Spectrum theory
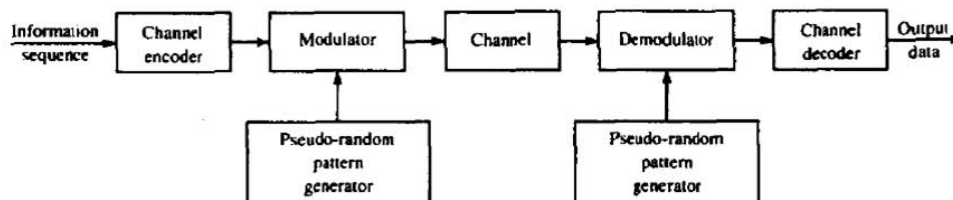
### 1.2.1 The communication diagram description



FIGURE 1-1 Model of spread spectrum digital communication system.
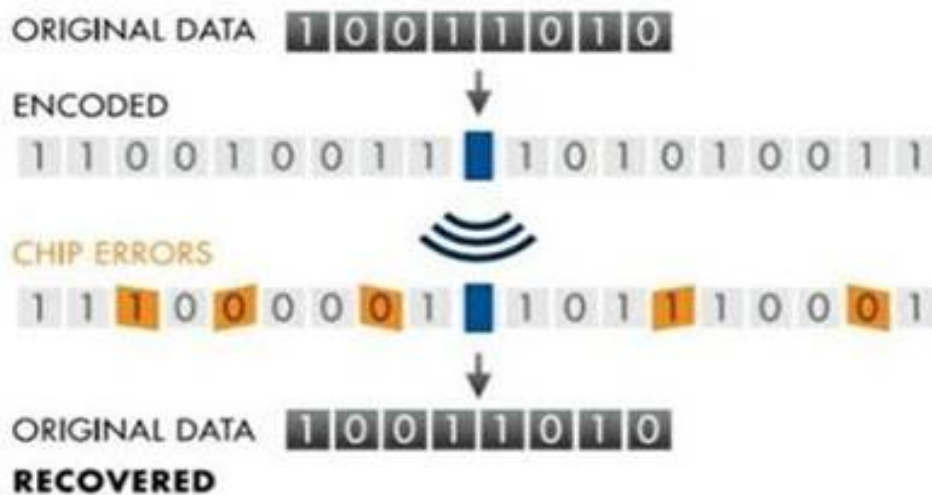
Figure 1.1: Spread Spectrum diagram

Figure 1.2: The DSSS theory

### 1.2.2 The theory basis

The Spread Spectrum system has two obvious features: the reliability and the security. We can draw this conclusion based on the Shannon Theorem

$$C = W \log_2 \left( 1 + S/N \right)$$

When S/N is very small,

$$W = C/1.44 \times N/S$$

From the equation above, we can see if the S/N is a very low level, we can still get a relatively high capacity, namely high data rate as long as the bandwidth is large.As to the security, in the whole power distribution of the noise, if the signal has broadened the distribution, so the power has been kept in a low level, in this way, it is hard to intercept because the SNR is quite low in the process of transmission.

## 1.3 The Direct Sequence Spread Spectrum(DSSS) System

According to the figure given, the DSSS has used the XOR algorithm, because it is also easy to despread. The despread way is just used the XOR again, which is the feature of XOR. Here we must use the PN signal which is the pseudo randomized sequence. PN signal is used to spread the original signal. The producing ways is like the figure. One bit of the message signal is related to several PN signal bits.
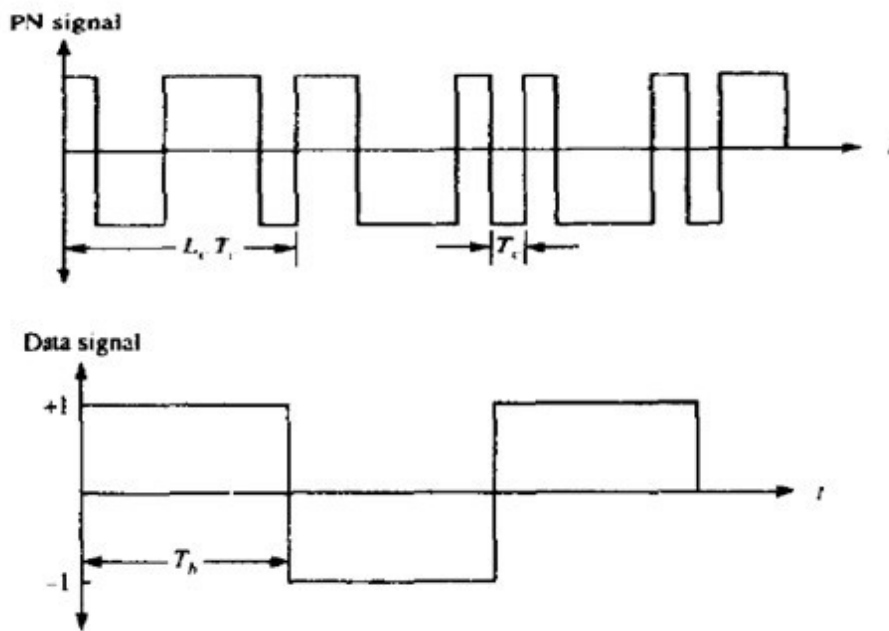
3

PN signal



Data signal
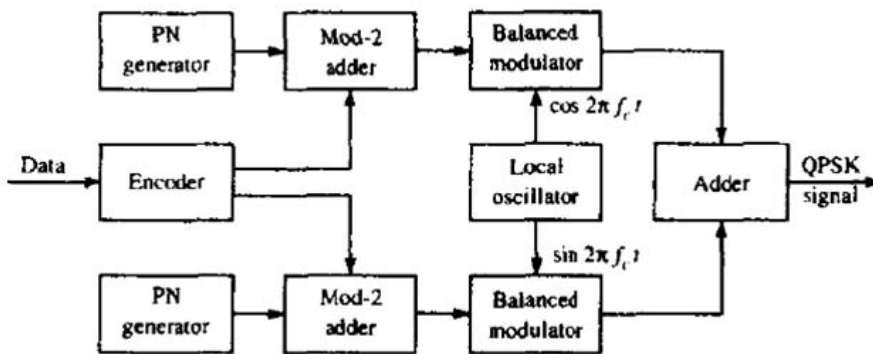


Figure 1.3: The PN sequence



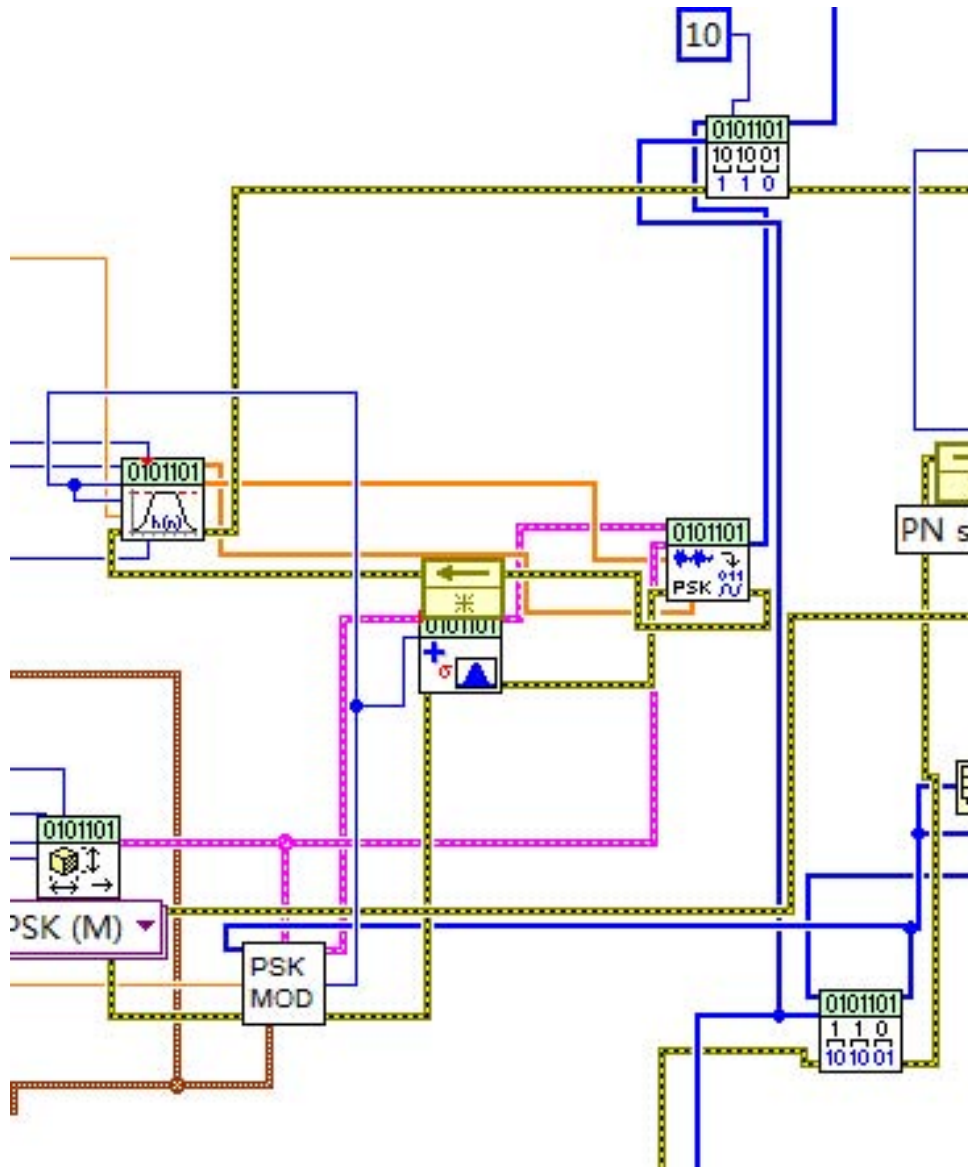Figure 1.4: The DSSS system with QPSK

4

Figure 1.5: Labview Programming(Main part)

## 1.4 Simulation

Labview is a kind of graphic programming software and there are some hardware to be connected to it. Here we can also use the USRP hardware to simulate the real communication in the real channel.

After being familiar with Labview, I have tried many times to program well. And the main task of my project is just this programming part with Labview.To program, we must figure out the composed parts: The message signal, PN signal, The spreading part, The PSK modulation ,The AWGN modulation in the transmission, The PSK demodulation, The despread part and the part to compute the bit error rate. So we can program like this:

Figure 1.6: Labview Programming(Main part)

And through simulation, we can easily see the result. We can see the BER is quite low in comparison to that system without spread spectrum.