Designing Finest Transceiver For Data Transformation Using Zigbee Protocol

S.Raj Kumar[1], J.Jackline Mercy[2], A.Raja Lakshmi[3], R.Prabhavathi[4]
[1]Assistant Professor, Dept of Electronics And Communication Engineering
[2, 3, 4]Dept of Electronics And Communication Engineering
[1, 2, 3, 4] Sacs Mavmm Engineering College, Madurai

Abstract- *ZIGBEE is usually used as a wireless Personal Area Networks (PAN) that aimed at control or monitor application due to its low data rate and low power consumption. Zigbee is used to transmit in 2.49GHz. In the transmitter, spreading is done using a PN Sequence at chip rate of 2 Mcps and then the spreaded bits are modulated using OQPSK modulator. In the receiver side, OQPSK demodulation is done first, then the spreaded bits are despreaded using the delayed version of PN chip sequence. The delay in transmitted and received bits is 3 to 4μs.*

I. INTRODUCTION

ZigBee standard is developed by ZigBee Alliance, which has hundreds of member companies, from the semi-conductor industry and software developers to original equipment man-ufacturers and installers. The ZigBee alliance was formed in 2002 as a nonprofit organization open to everyone who wanted to join. The ZigBee standard has adopted IEEE 802.15.4 as its Physical Layer (PHY) and Medium Access Control (MAC) protocols. Therefore, a ZigBee compliant device is compliant with the IEEE 802.15.4 standard as well.

ZigBee is a low-cost, low-power, wireless mesh networking standard. First, the low cost allows the technology to be widely deployed in wireless control and monitoring applications. Second, the low power-usage allows longer life with smaller batteries. Third, the mesh networking provides high reliability and more extensive range. ZigBee is a standard that defines a set of communication protocols for low
data rate short range wireless networking. ZigBee based wireless devices operate in 868MHz, 915MHz and 2.4GHz frequency bands. It is targeted mainly for battery power applications where low data rate, low cost and long battery life are main requirements. In many ZigBee applications, the total time the wireless device is engaged in any type of activity is very limited. The device spends most of its time in power saving mode, also known as sleep mode.

ZigBee standard is specifically developed to address the need for very low cost implementation of low data rate wire-less networks with ultra low power consumption. The ZigBee Standard reduced the implementation cost by simplifying the communication protocols and reducing the data rate. The minimum requirements to meet ZigBee and IEEE 802.15.4 specifications are relatively relaxed compared to other stan-dards such as IEEE 802.11, which reduces the complexity and cost of implementing ZigBee compliant transceivers.

II. ZIGBEE & BLUETOOTH

ZIGBEE	BLUETOOTH
• Zigbee aims at automation. • Zigbee uses low data rates, low power consumption on small packet devices. • Zigbee networks support longer range devices and more in number. • Zigbee's almost instant network join times (30 milliseconds) its more suitable for critical applications.	• Bluetooth aims at connectivity of mobile devices in close proximity. • Bluetooth uses higher data rates, higher power consumption on large packet devices. • Bluetooth networks whose range is small. • Bluetooth's longer join time is detrimental (3 seconds).

III. EXISTING METHOD

Using MSK Modulator & Demodulator. The transmission bandwidth, which contains 99% of the total power, is less 20% higher than the bit rate < 1.2 Tb/s. Delay in transmitted and received bits is 10 to 20μs.

IV. PROPOSED METHOD

Using OQPSK Modulator & Demodulator. Bandwidth that is a bit more than eight times the bit rate > 8 Tb/s. For the null- to-null bandwidth, OQPSK are more spectrally efficient than MSK Delay in transmitted and received bits is 3 to 4μs.

V. ZIGBEE - OQPSK

According to the specifications of ZigBee technology, the modulation is done with Offset Quadrature Phase Shift Keying (OQPSK) with Half sine pulse shaping. Thus, it is necessary to review the OQPSK sheme and the purpose of half sine pulse shaping

A. Offset Quadrature Phase Shift Keying (OQPSK)

OQPSK is a variant of Quadrature Phase Shift keying (QPSK) modulation sheme. The main difference between QPSK and OQPSK is that in OQPSK, after splitting the bit stream into an odd bit stream and an even bit stream, one of them is shifted by a half bit period.

Unlike QPSK, OQPSK can have abrupt phase changes. This may result in spectral components in high frequency and low pass filtering to suppress the side lobes can lead to inter symbol interference. Instead, half sine pulse shaping is applied to overcome such difficulty.

In OQPSK, the signal has a constant amplitude. However, abrupt phase change of 90°can occur. Thus, the waveform is filtered to suppress the sidebands. The problem is that the filter will change the amplitude.

To avoid this issue, nonlinear power output stages are employed in the transmitter. The nonlinearity will result in spectral components outside the main lobe. Half sine pulse shaping will help overcome this problem.

B. BLOCK DIAGRAM

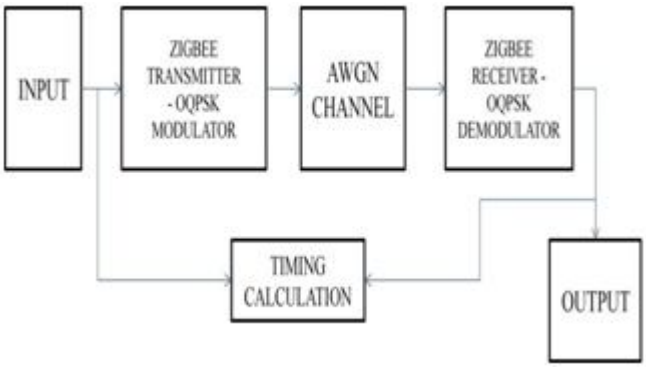
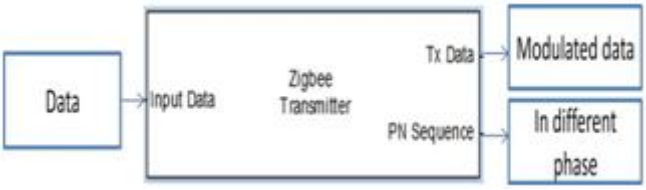


Fig. 1. ZIGBEE Block diagram

C. TRANSMITTER



This section shows the design of ZigBee transmitter system. The implementation was done on Matlab/Simulink using fun-damental components in Simulink to demonstrate how reliably complex modulation schemes can be built, cost effectively and efficiently. The design of ZigBee transmitter using OQPSK modulation with half sine pulse shaping is shown in the Figure 1 given below. Here, the input bit stream is having a data rate of 250Kbps.

- OQPSK -Offset Quadrature Phase Shift Key
- PN Sequence - Pseudorandom Noise
- AWGN Channel - Additive White Gaussian Noise

VI. OQPSK MODULATION

Variant of phase-shift keying modulation using 4 different values of the phase to transmit.Applies pulse shape filtering to the input. 2 bits per symbol & a delay of 1 bit in the quadrature signal. Oversampling of two or greater in order to delay (or offset) the quadrature channel by 90 degree. Oversampling is achieved through pulse shape filtering. The main difference between QPSK and OQPSK is that in OQPSK, after splitting the bit stream into an odd bit stream and an even bit stream, one of them is shifted by a half bit period.

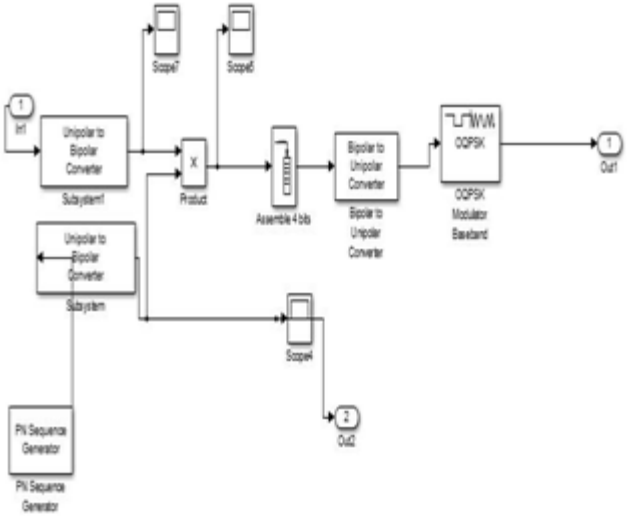
A. PN SEQUENCE:

Generates a sequence of MAXIMUM length of binary numbers directly using a LFSR. 1's & 0's occur with equal probability High auto-correlation & low cross-correlation Periodic. Very easy to generate, regenerate and synchronize at the receiver

B. AWGN Channel :

Used 10db AWGN channel in this project. Used in information theory to mimic the effect of many random process that occur in nature. Additive – it is added to any noise that might be intrinsic to the information system. Statistically random radio noise characterized by a wide frequency range with regards to a signal in the communication channel. Used as a channel model in which only impairment to communication is a linear addition of white noise with constant spectral density.

VII. SIMULINK MODEL – TRANSMITTER



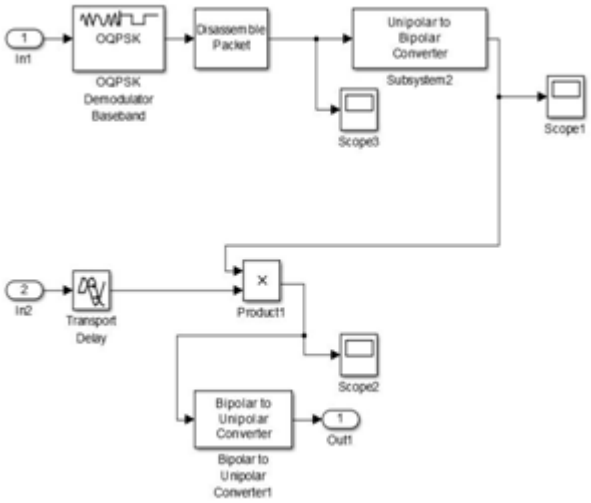
A. UNIPOLAR TO BIPOLAR CONVERTER

The unipolar input signal to a bipolar output signal. If the input consists of integers between 0 and M-1, where M is the M-ary number parameter, then the output consists of integers between -(M-1) and M-1. If M is even, then the output is odd.

B. BIPOLAR TO UNIPOLAR CONVERTER

Bipolar to Unipolar Converter block maps the bipolar input signal to a unipolar output signal. If the input consists of integers in the set {-M+1, -M+3, -M+5,..., M-1}, where M is the M-ary number parameter, then the output consists of integers between 0 and M-1.

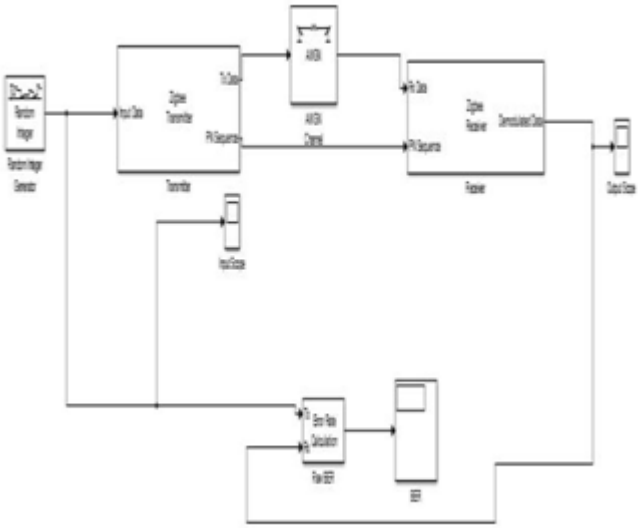
VIII. SIMULINK MODEL – RECEIVER



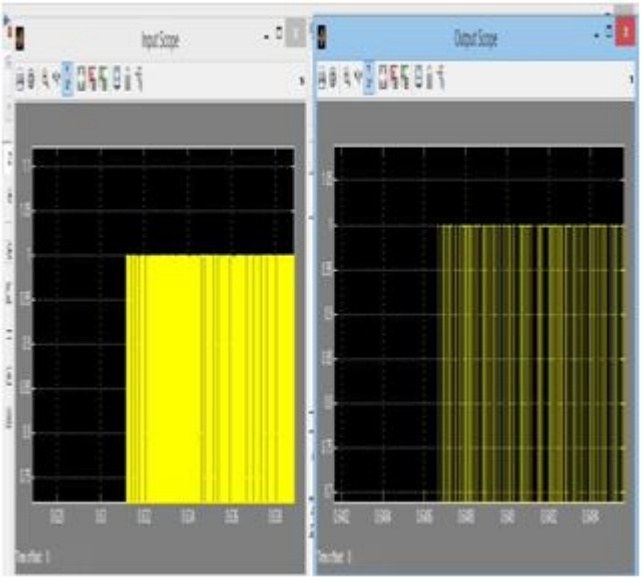
A. OQPSK DEMODULATOR:

The OQPSK Demodulator block applies pulse shape filtering to the input waveform.

IX. SIMULINK MODEL - ZIGBEE



X. OUTPUT



A. TOOL USED

• MATLAB 14a

XI. APPLICATION

- Remote monitoring of high speed rail transportation.
- Military data transformation.

XII. ADVANTAGES

- Easy data transformation.
- Transfer from random signal to individual receiver.
- Multiuser data transfer application.

XIII. CONCLUSION

Implement a transceiver for ZigBee wireless communication system using Matlab/Simulink. Without using mathematically complex blocks, we designed and tested a ZigBee wireless transceiver in Matlab/Simulink. Half sine pulse shaping avoids the abrupt phase shifts in the transmitted signal so that it reduced lot of burden and the modulated signal is amplifier friendly in real time scenario. The use of direct spread spectrum technique reduces the interference effects. The bandwidth of Zigbee is 2MHz.

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