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Implementation of different Codes for Base Band Wireless Communication Systems

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Abstract— **This paper is about different Base Band codes that can be used in Base Band wireless communication systems. The aim of this paper is to provide sufficient reliability for the transmission. We studied different codes like NRZ, Manchester, Bipolar and Miller Base Band codes along with filters, effect of noise on coded signal etc.,. This Base Band communication is mostly used in variety of applications like RS 232, Ethernet communications. We analysed different codes in MATLAB, which give better understanding.**

Keywords: NRZ, Manchester, Bipolar, Miller, RS 232.

I. INTRODUCTION

Wireless communication is more advantageous than other modes of communications. For this reason we have implemented different codes like NRZ, Manchester, Bipolar, Miller codes with the help of MATLAB. The Base Band communication is still very used now days, For instance NRZ code is used for RS 232 communications on the COM ports of computers, and Manchester code is used for Ethernet communications.

A communication is said "Base Band" when data is sent with no modulation. It means that the frequency of the signal suits the Bandwidth of the communication medium. It enables to minimise the power loss, through the transmission line, because each medium has its own Bandwidth and would act as a filter is its input signal was not in the frequency band. As modulation often needs more Bandwidth, Base Band system enables to save the Bandwidth. This is the advantage of using Base Band communication.

The signal is nearly all the time a square wave form, where high or low voltage states are representative of a logical state: 1 or 0. The data is, indeed coded for the transmission. The aim of this code is to provide sufficient reliability for transmission over longer distances. Here the signal will be submitted to noise and attenuation. So the receiver has to be sure of what it retrieves. The different codes include some clues that the receiver will check to verify that any error occur during the transmission. The codes aim at avoiding long continuous signals which would be hard to manage to the receiver; its clock would tend to de synchronize. If someone wants to send an analogue signal with a Base Band communication they may have to convert into digital first and to analogue after the transmission.

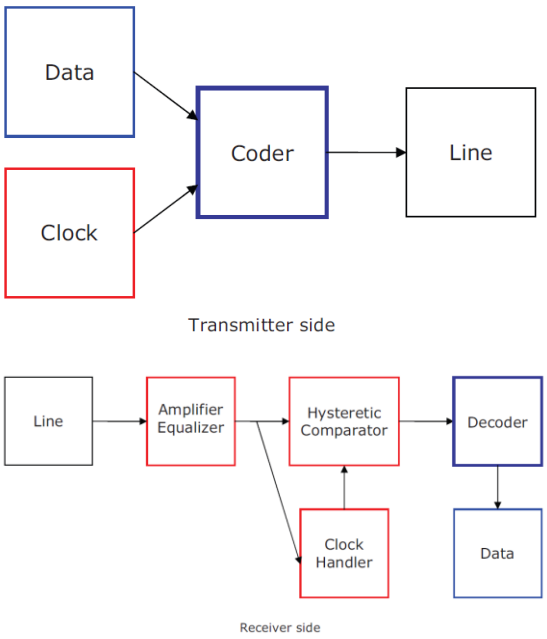

Fig. 1 general schematic of Base Band wireless communication system.

II. NRZ CODE

In telecommunication, a non-return-to-zero (NRZ) line code is a binary code in which 1's are represented by one significant condition (usually a positive voltage) and 0's are represented

by some other significant condition (usually a negative voltage), with no other neutral or rest condition. The pulses have more energy than a RZ code. Unlike RZ, NRZ does not have a rest state. NRZ is not inherently a self-synchronizing code, so some additional synchronization technique (for example a run length limited constraint or a parallel synchronization signal) must be used to avoid bit slip.

The coding rule that is used the state "1" is represented by one significant condition and state "0" represented by another so there is no neutral condition.

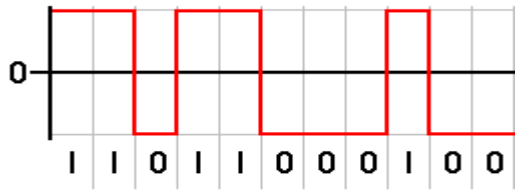

Fig. 2 "11011000100" coded in NRZ

The NRZ code is straight forward to do when we have a matrix composed of 0's and 1's. We multiply it by 2 so we obtain a matrix of 0 and 2. Then we subtracted 1 so we finally have a matrix composed of -1 and 1. Then we multiply our matrix by 5 to simulate a +5/-5 V signal.

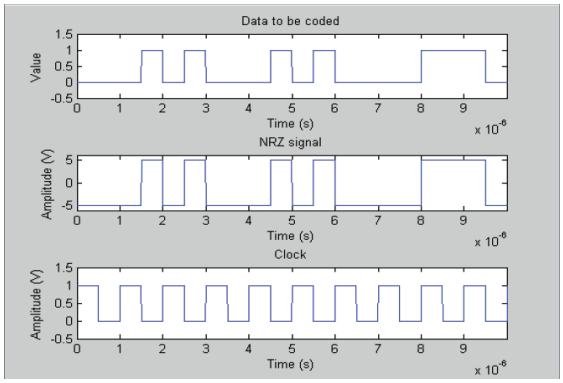

Fig. 3. Data decoded using NRZ coding.

2.1. Spectrum of NRZ coded signal

In this we apply a Fast Fourier Transform on the signal to obtain its frequency representation. We created a function which takes as a first argument any coded signal with proper length. So we reused it for other section of this study.

The main function to study a spectrum is

FT = abs(fft(input signal));

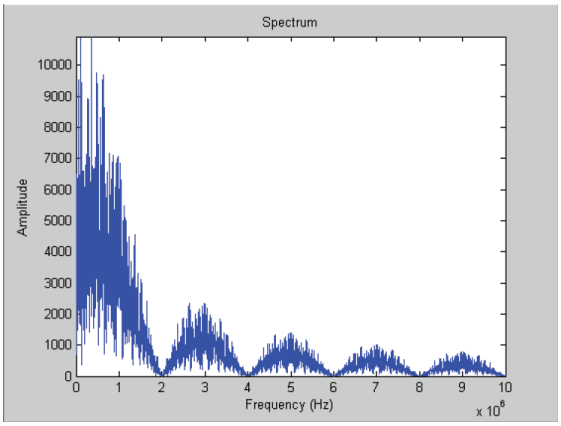

Fig. 4. Spectrum of NRZ coded signal.

III. BIPOLAR CODING

This code can be called as AMI, which stands for Alternative Mark Inversion. This is a 3 state coding technique, which uses positive, negative and ground pulses to represent logical values. The coding rule in this technique, a logical "0" is represented by ground or absent pulse. A "1" is represented by pulses of alternative polarity.

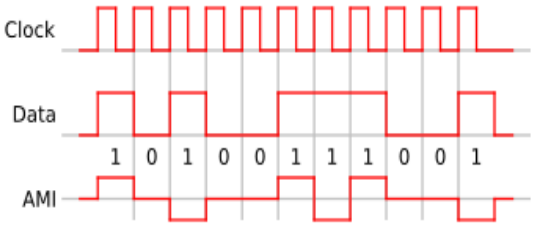

Fig. 5. Data "10100111001" decoded using Bipolar coding.

3.1. Spectrum of Bipolar coded signal

In the spectrum of Bipolar signal the power is concentrated in a shorter frequency band than for a two state signal. Moreover there is not energy on the null frequency.

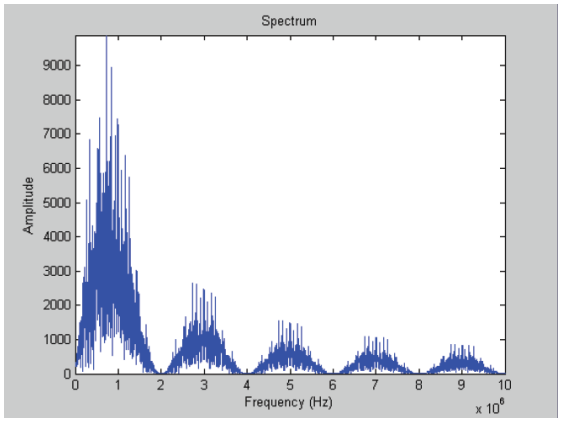

Fig. 6. Spectrum of Bipolar coded signal.

The AMI prevents build up of a DC voltage in the channel which means that the cable may also be used to carry an additional small DC current to power intermediate equipment such as line repeaters.

The problem of synchronization can be as in of NRZ technique can be solved by tampering data.

IV.MANCHESTER ENCODING

Manchester encoding (also known as Biphase code) involves a transmitter that encodes clock and data signals in a synchronous bit stream, such that each bit represents a signal transition. It is a form of digital encoding in which data bits are represented by Manchester encoding.

The Manchester coding rules are:

1. If the original data is logic "0" the Manchester code is 0 to 1 (upward transition at bit centre).
2. If the original data is logic "1" the Manchester code is 1 to 0 (downward transition at bit centre).

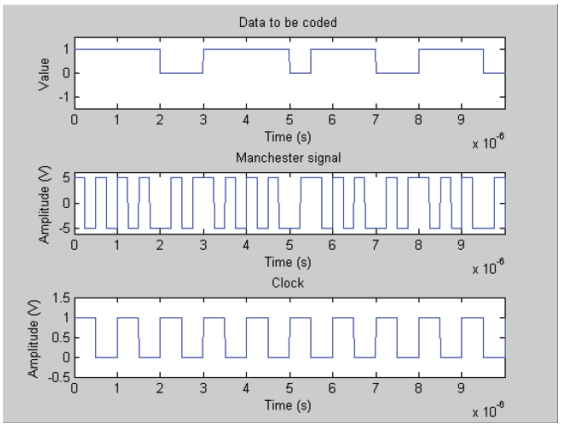

Fig. 7. Data encoded using Manchester encoding.

4.1. Spectrum of Manchester coded signal

Here we use the same function as in NRZ coding technique.the spectrum of Manchester is given below.

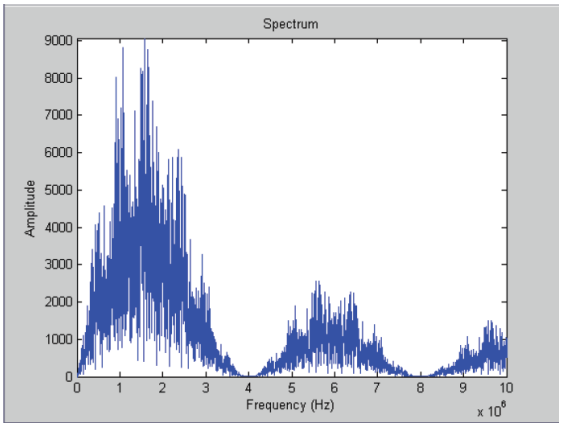

Fig. 8. Spectrum of Manchester code.

The penalty for introducing frequent transitions is that the Manchester coded signal **consumes more Band width** than the original signal in NRZ.

The chief advantage of Manchester encoding is the fact that the **signal synchronizes itself**.

V. MILLER ENCODING

Miller encoding also known as Delay encoding, is a method of encoding serial data. All encoded information is contained in spacing between the transitions; the polarity does not matter.

In this the input of "1" always produces a transition at the end of bit period. An input of "0" never produces a transition. "0" produce a transition in the middle of the bit period unless there was a transition at the start of period.

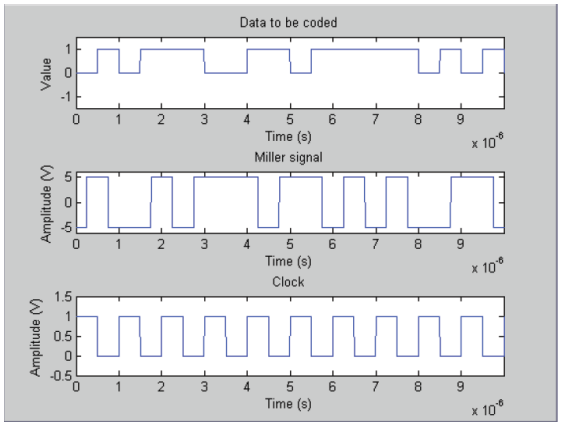

Fig. 9. Data encoded using Miller coding.

5.1. Spectrum of Miller coded signal

Here is the spectrum of signal coded with Miller.

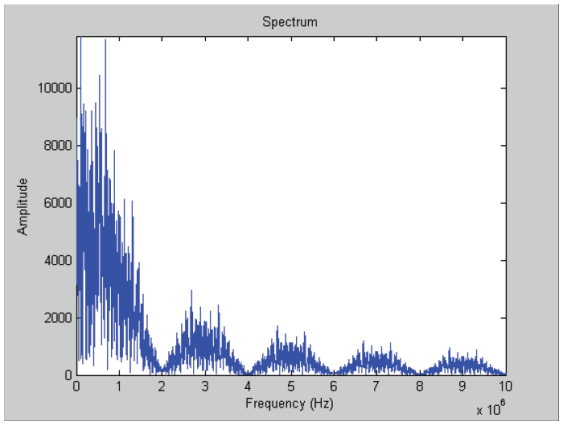

Fig. 10. Spectrum of Miller coded signal.

Delay encoding is used primarily for encoding radio signals because the frequency spectrum of the encoded signal contains less low frequency energy than a conventional NRZ signal and less high frequency energy than a Biphase signal.

VI.CONCLUSION

To conclude, we have found this project very profitable to us for two main reasons:

Firstly, this project helped us to become more familiar with base band transmission processes: we have learnt the strengths and weakness of these four coding methods compared to one another, in terms of bandwidth or clock synchronizing.

Concerning the simulation itself, we found that the study of transmission with added noise was all the more interesting because it brought a realistic aspect on the simulation and made us more aware of a very common problem in telecommunication, which is finding the best balance between alleviating noise and retrieving a correct signal.

Secondly, the project helped us to improve ours skills in programming with MATLAB, even if the functions we use didn't represent the extent of what offers this piece of software.

VII.REFERENCES

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