

LINE CODING: AN OVERVIEW

¹Oshin Kharola, ²Nisha Sharma

^{1,2}UG, Department Of Electronics and Communication Engineering,
Raj Kumar Goel Institute of Technology for Women. Ghaziabad (India)

ABSTRACT

The ways of sending data in form of 1's and 0's. In this advantage and disadvantage of such method is going to shown. This paper propose the way of transmission of data in the form of binary signal 0's and 1'. there are different types of with their power spectral density diagram and efficiency of each line code.

I. INTRODUCTION

In today's scenario, upgrading the things is the basic necessity. Therefore, the same rules follow in communication system also. In communication technology the advances requires upgrading of the transmission of different types of information such as audio, data, graphic and real time video. In this paper we analyses one of the important parameter of digital signal transmission i.e. line coding. There are different types of line coding. Signal generated from the information source can be in 2 forms.

A) Analog

B) digital

When we are talking about analog the transmission of information takes place only when analog signal is converted to digital signal. we can termed them as baseband signals. When theses signals are transmitted without modulation i.e. not super imposing the carrier signal on message signal is known as baseband communication system. We can use different method to convert analog signal into digital signal but there is an efficient method for conversion of analog signal to digital signal in communication system i.e. the pcm.

The various steps in pulse code modulation are sampling, quantizing and coding due to ISI the pulse code modulation signal cannot be directly transmitted there is less synchronization between transmitter and receiver and undesired dc level occur if a long string of 1 and 0 is present in the data. A another problem associated with pulse code modulation is large channel bandwidth and high signaling rate which can be overcome delta modulation.

II LINE CODING

Binary data is represented in the form 1 and 0. Which can be transmitted using different types of pulses. The choice of particular pair of pulses which represent 1's and 0's is called line coding. Following consideration should be choosing while deciding type of line coding.

- 1) Presence or absence of dc level
- 2) Power spectral density
- 3) Bandwidth
- 4) BER performance
- 5) Transparency

Line codes are essentially used in pulse code modulation system, satellite communication system, fiber optic, data link, magnetic recording system, Ethernet network, token ring networks.

2.1 The desirable properties are:

1. Transmission bandwidth: it should be kept as small as possible for given bandwidth. Its value should be as small as possible and zero probability error.
2. Error detection and correction capability: some of the line codes are having error detection as well as correction capability. E.g. bipolar
3. Favourable power spectral density: the value of dc component should be zero
4. Adequate timing content: From the line codes we should be able to extract timing from the pulses.
5. Transparency: It prevents long strings of 0's and 1's in any data.

III TYPES OF LINE CODING

- 1) Unipolar RZ and NRZ
- 2) Polar RZ and NRZ
- 3) Bipolar NRZ
- 4) Manchester
- 5) High density bipolar signaling
- 6) B8zs

3.1 POWER SPECTRAL DENSITY

Power spectral density is defined as the amount of power per unit of frequency as the function of frequency. It can be defined as a function that gives the distribution of power of the signal in frequency domain. We can represent PSD as Fourier transform autocorrelation function.

IV UNIPOLAR SIGNALING

Unipolar signal is known as on-off keying in this type of line coding. When 0 is transmitted it represents the presence of a pulse. There are two types of unipolar signaling

4.1 Unipolar NRZ (non – return to zero)

In nrz line coding 1 represents the positive voltage while 0 represents no signal

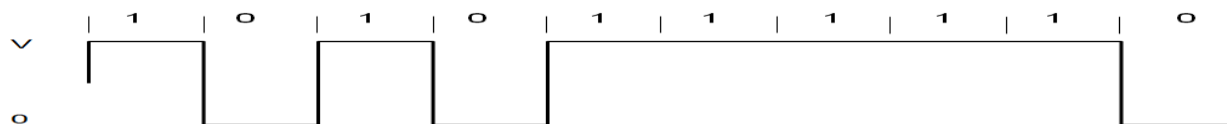


Figure 4.1: Unipolar NRZ waveforms

4.2 Unipolar RZ(return to zero)

In unipolar RZ 0 represent no signal and 1 represent signal of v volt. inrz the v volt is present for T period if smb1 is transmitted and for remainig T wave will return to zero

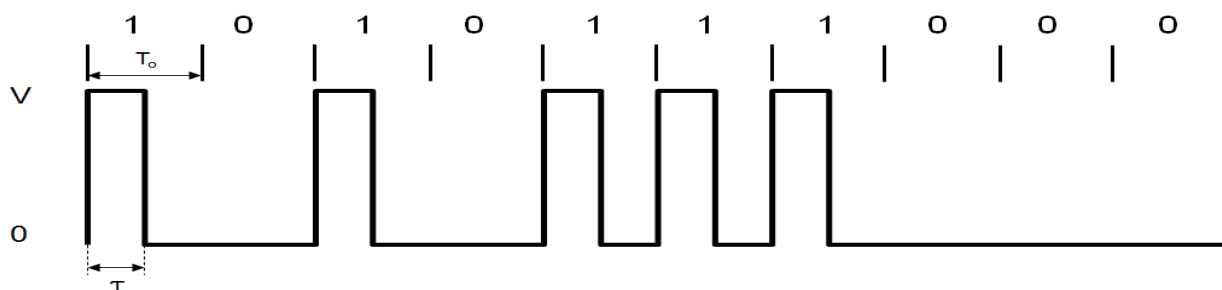


Figure 4.2:Unipolar RZ

V POLAR SIGNALING

It is of two types polar NRZ and polar RZ.

5.1 Polar NRZ

In this type of coding binary 1 represent the positive pulse $f(t)$ and binary 0 represent negative pulse $f(t) = -f(t)$

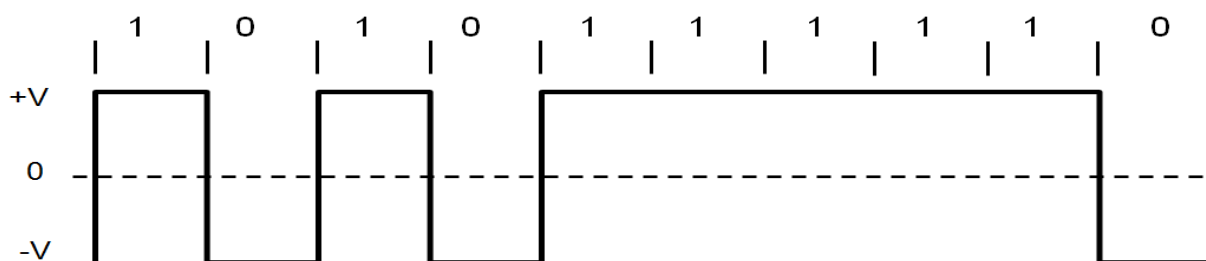


Figure 5.1 : polar NRZ

5.2 Polar RZ :

In RZ system, binary 1 represent the positive voltage polarity where as 0 represent the negative voltage polarity just it is a RZ format, the pulses transmitted only for the half time period.

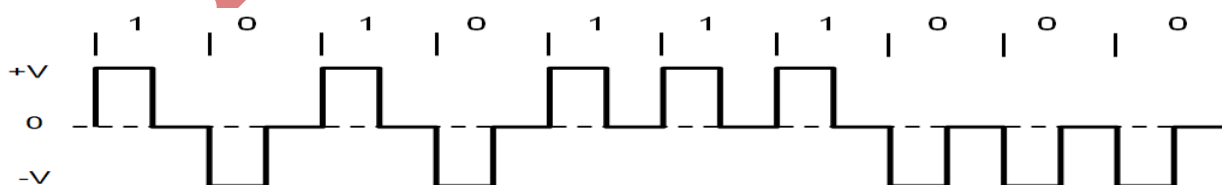


Figure 5.2 : polar RZ

ADVANTAGE

1) It is simple and implementation. 2) there is no dc component.

DISADVANTAGE

1) It cannot correct error itself 2) there is absence of any clocking component for ease of synchronization.

6) BIPOLAR SIGNALING

6.1 Bipolar NRZ

Bipolar signaling is also known as alternate mark inversion (AMI). In alternate mark inversion take place, the successive 1's are represented by pulses with alternate polarity and 0's represent by no pulses. In other words, 0 represent the absence of pulse where as 1 represented by the alternating voltage level of $+V$ and $-V$.

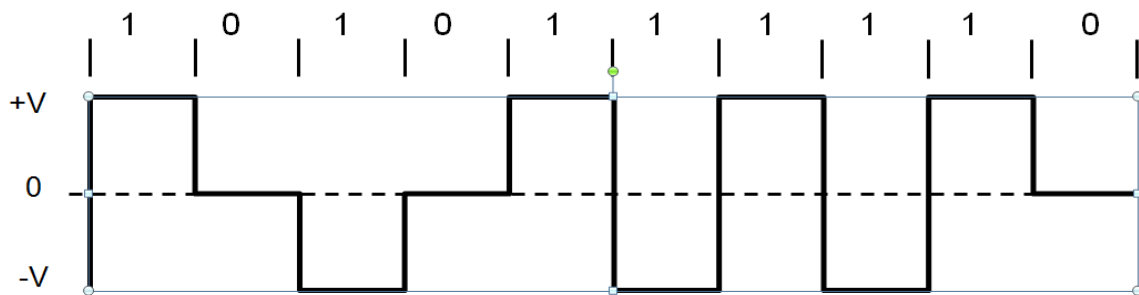


Figure 6.1 : Bipolar NRZ

6.2 Bipolar RZ

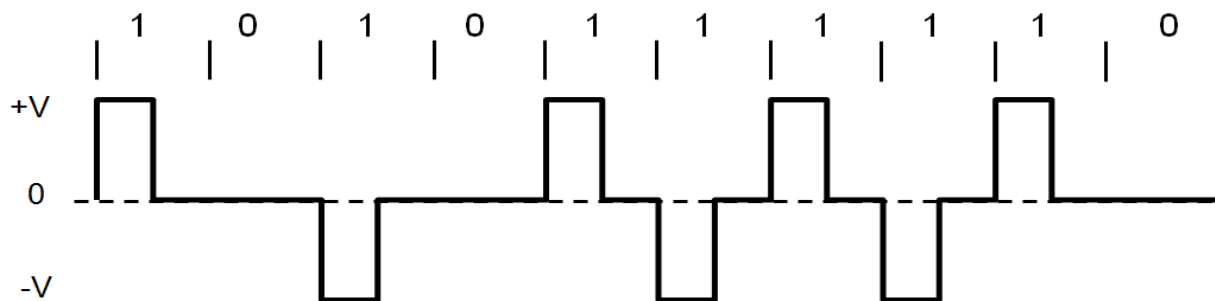


Figure 6.2: Bipolar NRZ

Advantages

- 1) In this there is no dc component
- 2) Unlike unipolar and polar RZ, AMI occupies less bandwidth
- 3) It can detect single error

- 4) Clock timing can be extracted by rectifying the receive signal

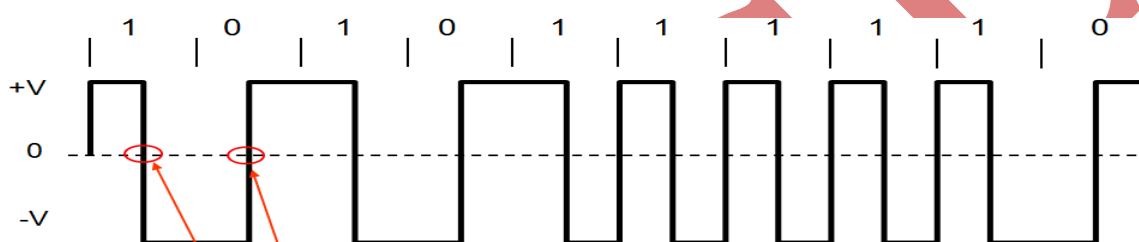
Disadvantage

- 1) It is not transparent

VII MANCHESTER SIGNALING

In this type of line coding, the duration of the bit is divided into two halves where as the voltage always remain at one level during the first half and moves to other level during the second half.

- 1) 1 is positive in first half and negative in the second half
- 2) 0 is negative in first half and positive in the second half



Note: There is always a transition at the centre of bit duration.

Figure 7.1: Manchester signaling

Advantage

- 1) It is a self synchronizing coding
- 2) Dc component is not available
- 2) It does not suffer from signal droop

Disadvantage

- 1) It occupies large bandwidth due to greater number of transition
- 2) It cannot detect error

Manchester signaling is used in WAN, LAN such as Ethernet and token ring.

VIII HIGH DENSITY BIPOLAR SIGNALING

In previous line coding, the long sequence of 0's can cause problems in synchronization at the receiver. this problem can be resolved by high density bipolar coding (HBDN), where $n = 1, 2, 3, \dots$

In previous line coding, the long sequence of 0's can cause problems in synchronization at the receiver. this problem can be resolved by high density bipolar coding (HBDN), where $n = 1, 2, 3, \dots$

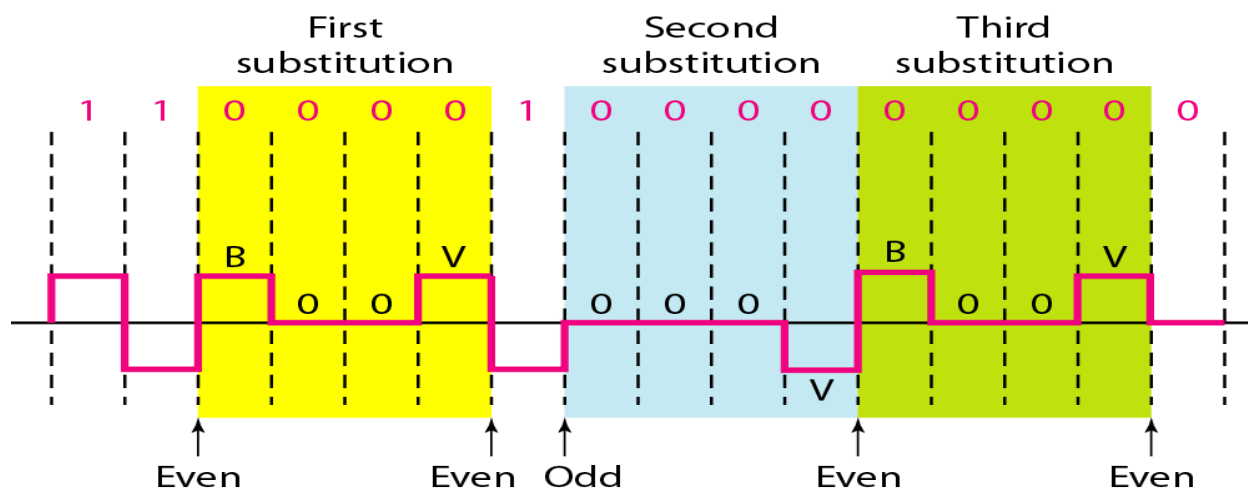


Figure 8.1: High density bipolar signaling

IX B8ZS

B8ZS: it is the modified version of bipolar AMI with 8 zeros substitution

As we know that in order to have synchronization between the transmitter and receiver, the line code needs to cross the zero line frequently. as per the U.S. T1 standards, not more than 15 0's can be sent in succession to ensure proper synchronization between transmitter and receiver

So, to resolve this issue a special line code was generated known as Binary 8 zeros suppression (B8ZS) was introduced whenever 8 successive 0's will be detected, it will automatically insert a special 8 bit sequence containing a bipolar violation. The violation will distinguish between a byte substituted for all 0's from a normal byte which contains 1's

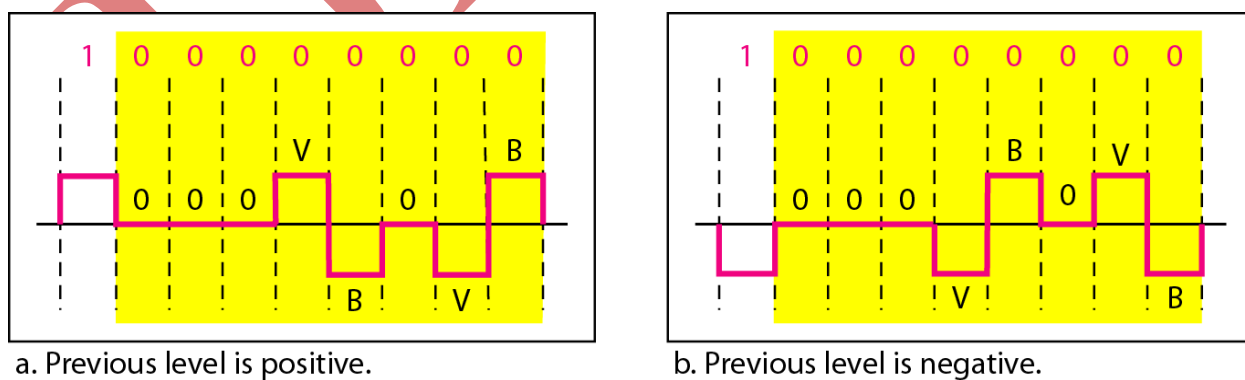


Figure 9.1 : B8ZS

X REFERENCES

- [1] Herbert Taub Donald L. Schilling, GoutamSaha, Principles Of Communication Systems, Tata McGraw Hill Publishing Company private Limited, (Third Edition)
- [2] Leon W. Couch II, Digital and Analog Communication Systems, Pearson Education, {Sixth Edition}
- [3] Sanjay Sharma, Communication System (Analog and Digital), S kKataria and Sons Publishers of Engineering and Computer Books, Fourth Edition
- [4] Data encoding: AMI, NRZ, RZ, Polar, BipolarManchester...at:<http://www.mathworks.com/matlabcentral/fileexchange/13553-data-encoding-ami-nrz-rz-polar-bipolar-manchester>
- [5] Intersymbol Interference and Equalization at: <http://www.dsp.ufl.edu/~twong/Notes/Comm/ch4.pdf>