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Topic

- Digital Data
- Digital Signal
- Line coding
- Unipolar
- Polar
- Bipolar
- Techniques

- NRZ-L
- NRZ-I
- Bipolar-AMI
- Pseudoternary
- Manchester
- Differential Manchester


Digital Data

Digital Data

Digital data consists of separate discrete units. Digital data is data that represents other forms of data using specific machine language systems that can be interpreted by various technologies.

The most fundamental of these systems is a binary system, which simply stores complex audio, video or text information in a series of binary characters, traditionally ones and zeros, or "on" and "off" values.

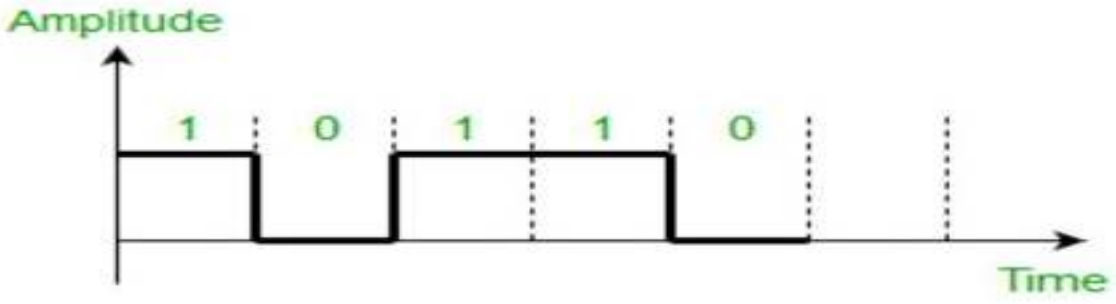
From the earliest primitive digital data designs to new, highly sophisticated and massive volumes of binary data, digital data seeks to capture elements of the physical world and simulate them for technological use.

One simple example is the conversion of a physical scene to a digital image. In this way, new digital data is somewhat similar to older data systems that converted a physical view or scene to chemical film.

One of the major differences is that digital data records visual information into a bitmap, or pixelated map, that stores a particular color property for each bit on a precise and sophisticated grid.


Digital Signal

Digital signal is the discrete. It can have only a limited number of defined value, often as simple as 1 and 0.



Advantages

- Digital signals can carry more information per second than analog signals.
- Digital signals maintains their quality over long distances better than analog signals.

- Digital storage is cheap.
- Most flexible.
- Often easier system upgrade.
- Data easily stored.

Disadvantages

- Digital signals can be complex.
- Output subject to quantity error from sampling.
- Processor speed is limited.
- Digital system requires greater bandwidth than analog to carry same information.
- Quality is easily lost.


Line coding

Line coding is the process of converting **digital data to digital signals**. By this technique we converts a sequence of bits to a digital signal.

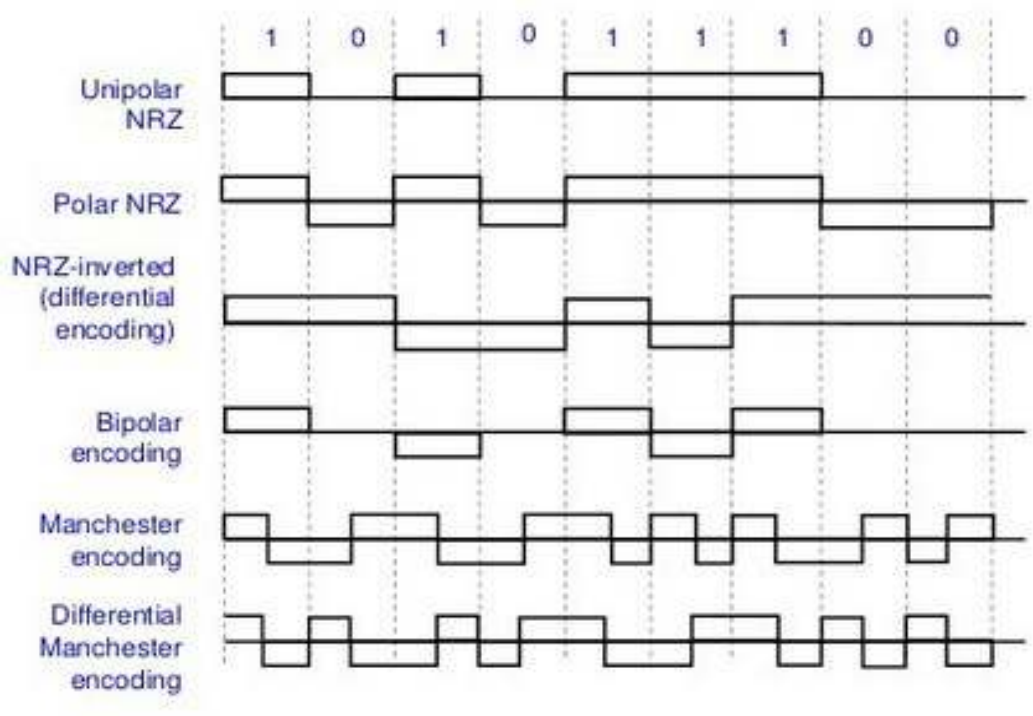
Data in the form of text, number, graphical images, audios and videos, are stored in computer memory as sequence of bits.

At the sender side digital data are encoded into a digital signal and at the receiver side the digital data are recreated by decoding the digital signal.

Line coding schemes

- Unipolar
- Polar
- Bipolar
- Bipolar-AMI
- Pseudoternary
- Manchester
- Differential Manchester

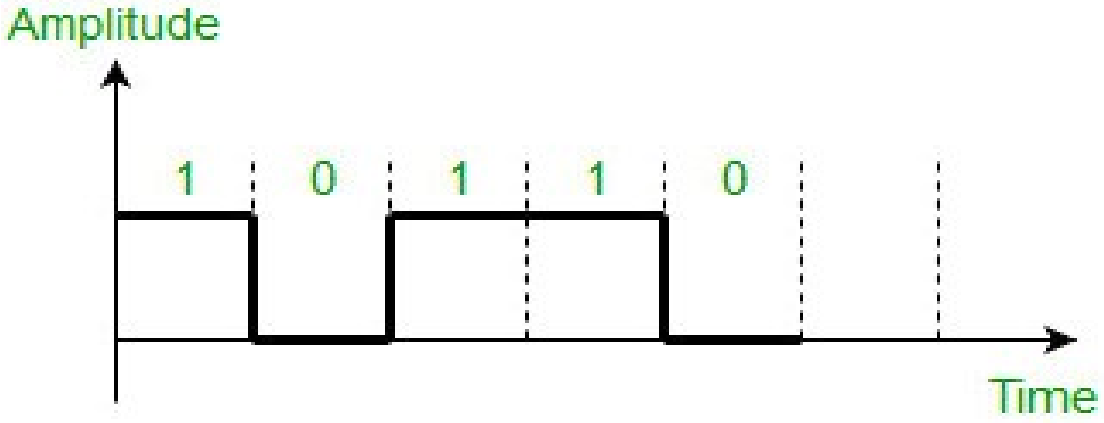
Line coding example




Unipolar

In this scheme, all the signal levels are either above or below the axis.

Non return to zero (NRZ) – It is unipolar line coding scheme in which positive voltage defines bit 1 and the zero voltage defines bit 0. Signal does not return to zero at the middle of the bit thus it is called NRZ. For example: Data = 10110.



But this scheme uses more power as compared to polar scheme to send one bit per unit line resistance.


Polar

In polar schemes, the voltages are on the both sides of the axis.

Polar encoding uses two voltages levels (positive and negative)

By using level the average voltage level on the line is reduce and DC component problem of unipolar encoded is reduced.

Most popular variation of polar coding

- Non return to zero(NRZ)

  In NRZ encoding, the level of signal is always either positive or negative as it does not return to zero.

  Most popular methods of NRZ transmission are:

  - NRZ-L(NRZ Level)
  - NRZ-I(NRZ Inversion)

- Return to zero(RZ)

NRZ-L

In NRZ level encoding the type of signal depends on the type of bit it represent.

- A positive voltage usually the bit 0.
- A negative voltage means bit is 1 or vice versa.

Thus the level of voltage depends on the level of bit.

NRZ-I

It is method, in which the inversion of the voltage level represents a 1 bit.

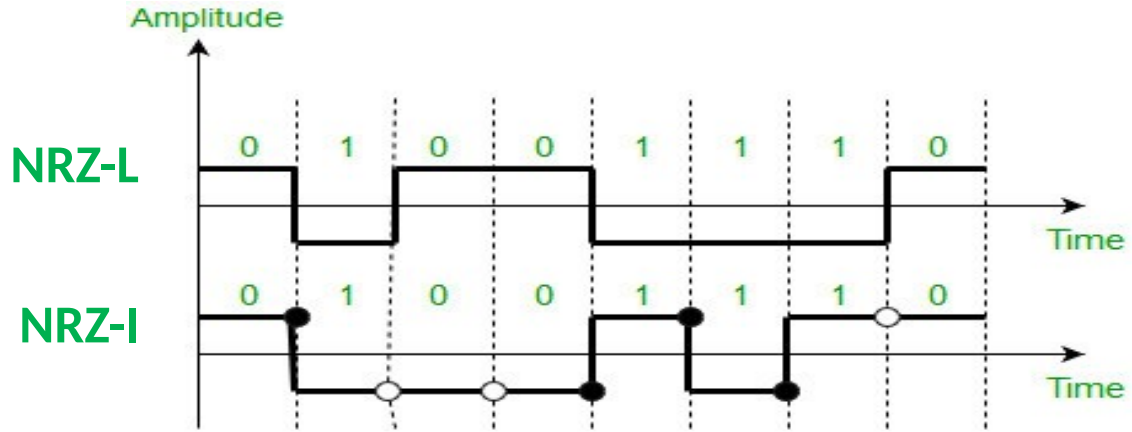
- It is the transmission between the positive and negative voltage, not the voltages themselves that represents 1 bit.
- A 0 bit represented by no change.

Comparison NRZ-L AND NRZ-I

Out of two methods the NRZ-I is superior to NRZ-L due to the synchronization provide by the signals change each time a 1 bit is encountered. The existence of 1’s in the data stream allows the receiver to the resynchronize.

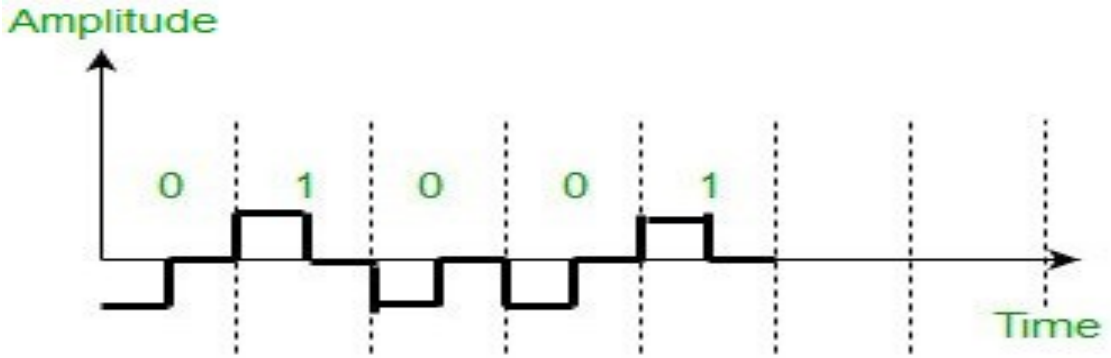
Tips

- In a NRZ-L the level of signal is dependent upon the state of bit.
- In a NRZ-I the signals are inverted if a 1 is encountered.

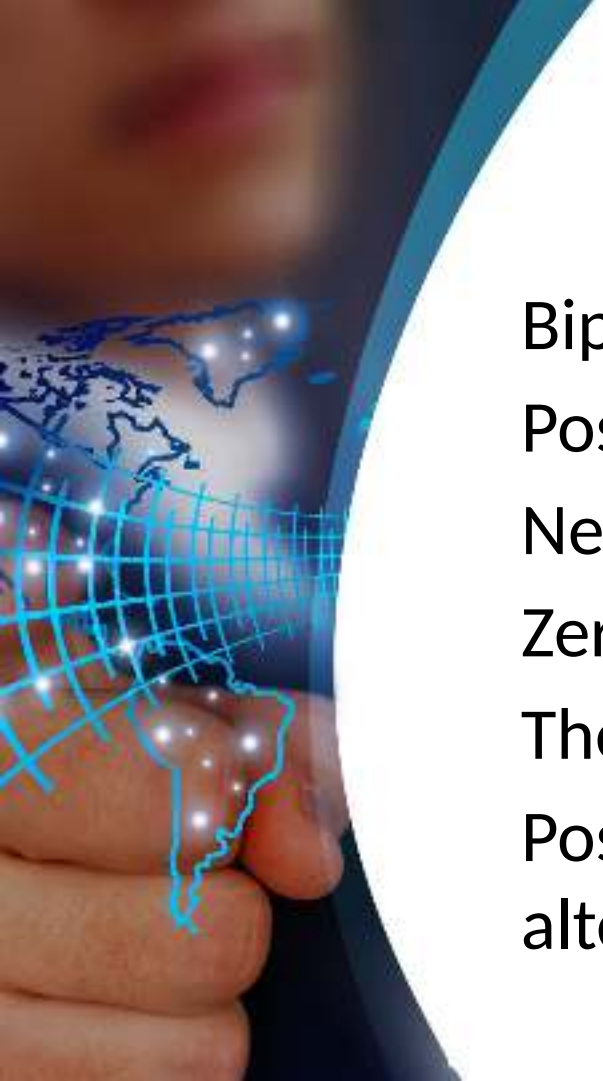


RZ

RZ scheme, which uses three values positive, negative, and zero. In this scheme signal goes to 0 in the middle of each bit.




Bipolar



Bipolar encoding uses three voltages level

Positive

Negative

Zero

The zero level is used to represent binary 0.

Positive and negative voltages represents alternating 1's,(if 1st one +ve, 2nd is -ve).


Bipolar-AMI

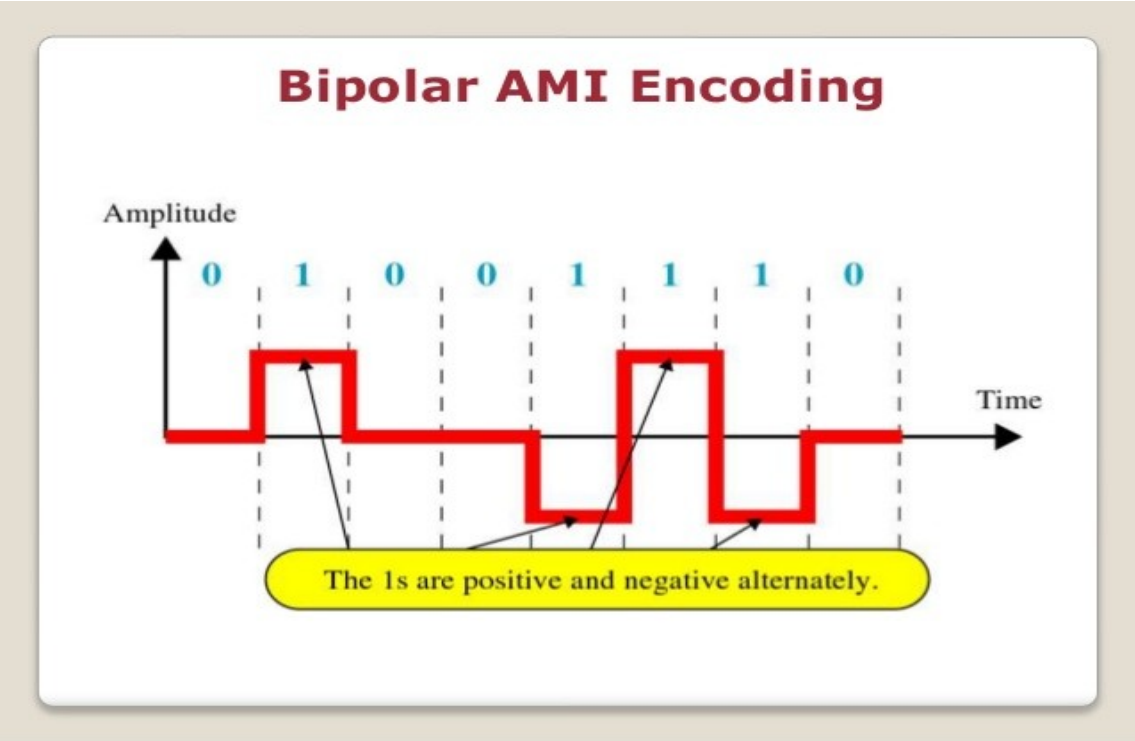
Bipolar-AMI

AMI stand for alternate mark inversion.

AMI means alternate 1 inversion. The neutral, zero voltages represents binary 0.

Binary 1’s are represented by alternating positive and negative voltages.

Example


Bipolar AMI Encoding
Amplitude
0 1 0 0 1 1 1 0
Time
The 1s are positive and negative alternately.


Techniques

Three techniques digital to digital conversion

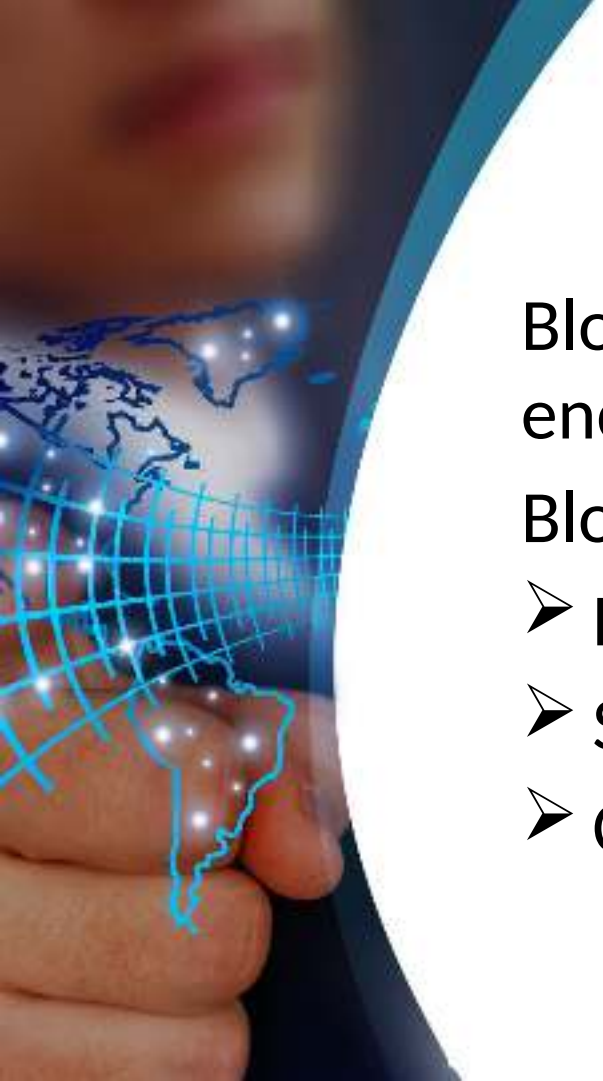
- Line coding
- Block coding
- Scrambling

Line coding is always needed

Block coding and scrambling are needed or may not be needed.

Line coding is process of converting digital data to digital signals.

In **Block coding** we divide our message into blocks, each of k bits, called data words. We add r redundant bits to each blocks to make the length n = k+r . The resulting n bits block are called code words.



Block coding one to one (same data words encoding always to same code words).

Block coding is done in three steps:

- Division
- Substitution
- Combination

Scrambling is a techniques that doesn’t increase a number of bits and does provide synchronization.

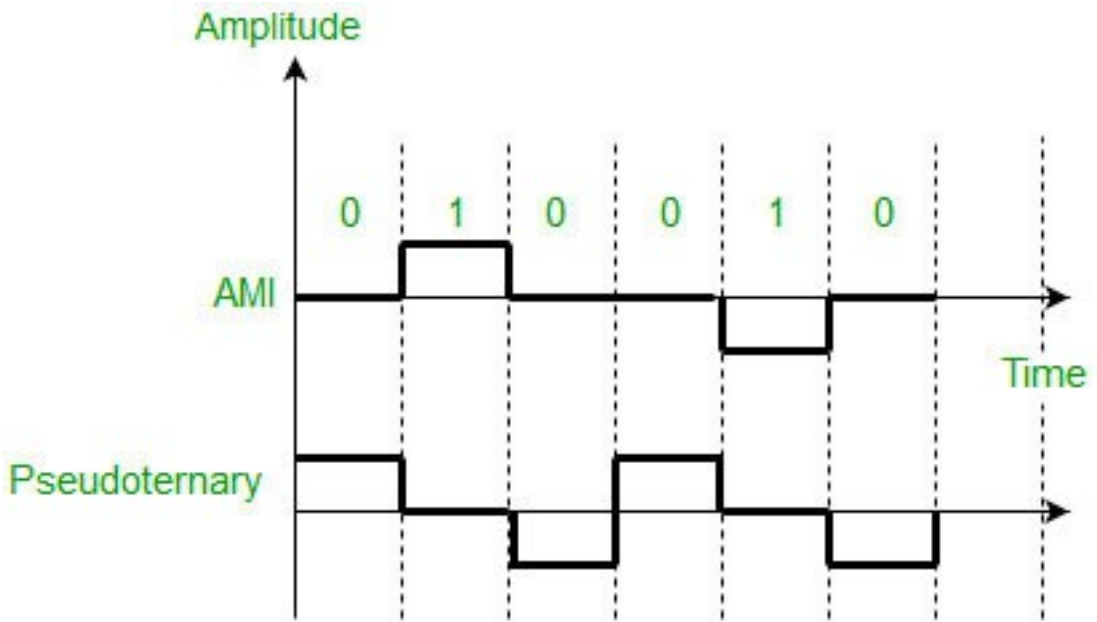

Pseudoternary

Bit 1 is encoded as a zero voltage and the bit 0 is encoded as alternating positive and negative voltages i.e., opposite of AMI scheme. Example: Data = 010010.

Example

0 = Positive, Negative

1 = zero



The bipolar scheme is an alternative to NRZ. This scheme has the same signal rate as NRZ , but there is no DC component as one bit is represented by voltage zero and other alternates every time.


Manchester

Manchester encoding is somewhat combination of the RZ (transition at the middle of the bit) and NRZ-L schemes. The duration of the bit is divided into two halves. The voltage remains at one level during the first half and moves to the other level in the second half. The transition at the middle of the bit provides synchronization.

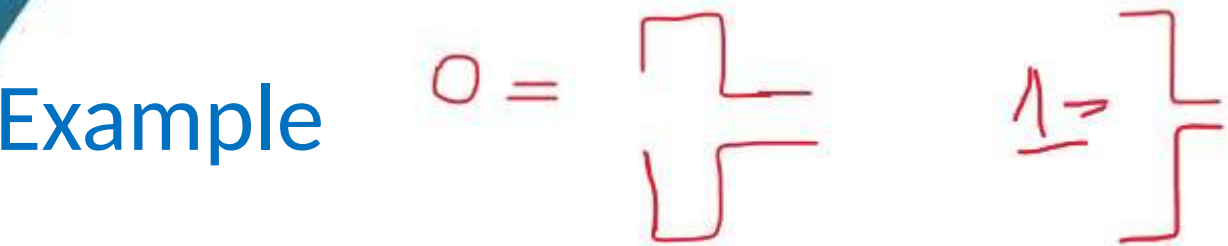
The logic we are using here to represent data using Manchester is that for bit 1 there is transition form -V to +V volts in the middle of the bit and for bit 0 there is transition from +V to -V volts in the middle of the bit.

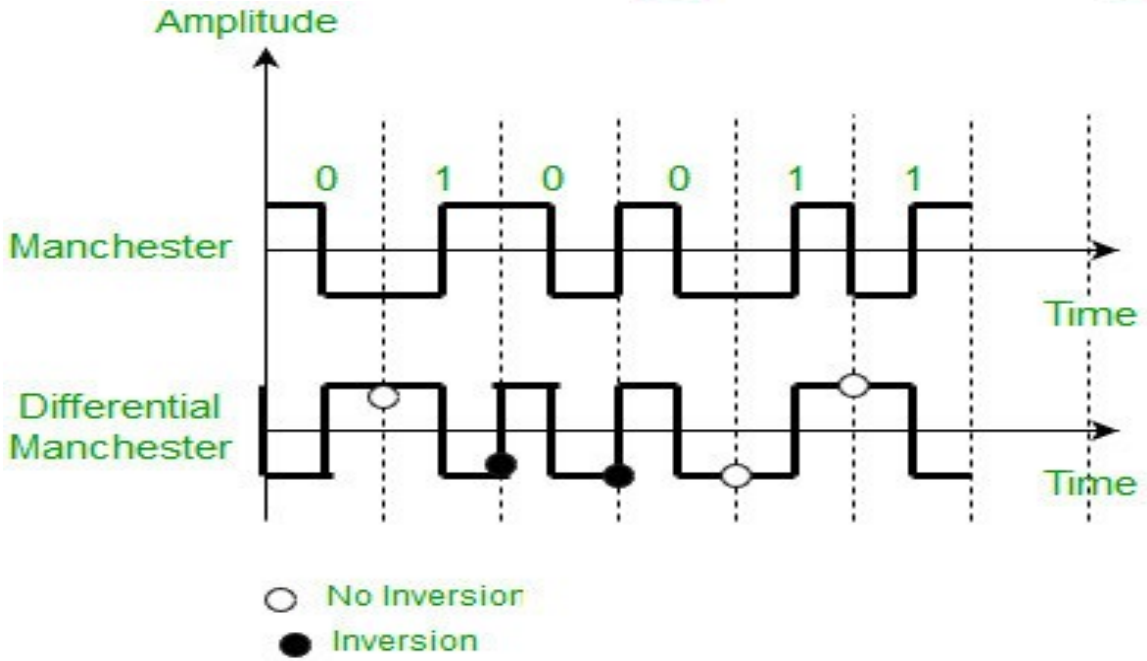

Differential
Manchester

Differential Manchester is somewhat combination of the RZ and NRZ-I schemes. There is always a transition at the middle of the bit but the bit values are determined at the beginning of the bit. If the next bit is 0, there is a transition, if the next bit is 1, there is no transition.

For differential Manchester we are assuming in the example that previous signal before starting of data set “010011” was positive. Therefore there is transition at the beginning and first bit “0” in current data set “010011” is starting from -V.
Example: Data = 010011.

Example


0 =
1 =


Amplitude
0
1
0
0
1
1
Manchester
Time
Differential
Manchester
Time
No Inversion
Inversion


THANK YOU