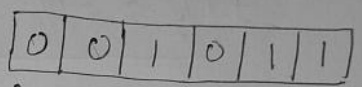
→ "Digital to Digital Conversion"

It is also known as "line coding".

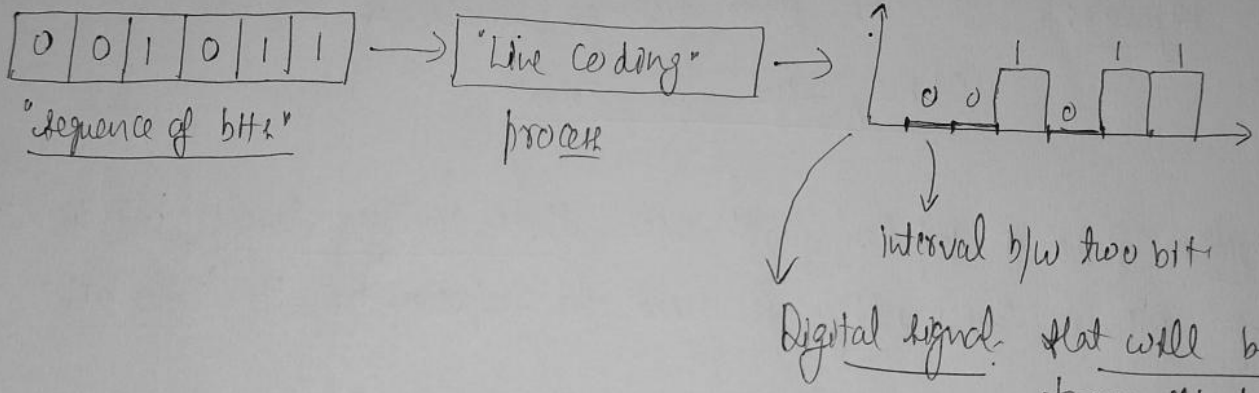
Line-Coding :- It is defined as the process of converting a binary data or a sequence of bits into a digital signal.

Now before transmitting the sequence of bits, we need to convert it into a digital form. (digital signal)

Let's say we have a sequence of bits



sequence of bits or binary data



Classification of Line Codes :-

- Unipolar
  - RZ (Return to Zero)
  - NRZ (Not Return to Zero)
- Polar
  - RZ
  - NRZ
  - Manchester
- BiPolar
  - AMI

Let's now understand what Unipolar means.

1> Unipolar :- It uses only one voltage level other than zero.

This means the voltage of a signal is either ("A") or it is ("zero")

'1' → represented using +A voltage.

& '0' → represented using '0' voltage.

2> Polar :- It uses two voltage levels other than zero

$+A/2$ & $-A/2$, other than zero.

3> Bipolar :- It uses three voltage levels & they are

"+ive, -ive & zero"

Note :- Polar & Bipolar both uses three voltage levels, but in case of Bipolar, "zero" voltage is used for representing the "zero bit"

→ Properties of Line Codes :-

(i) Bandwidth used is reduced.

(ii) Power is efficiently used.

(iii) Probability of error is reduced.

(iv) Error detection & correction capabilities are present in Line Codes.

(v) crosstalk b/w channels must be minimized.

So, these are some of the properties of Line-Codes.

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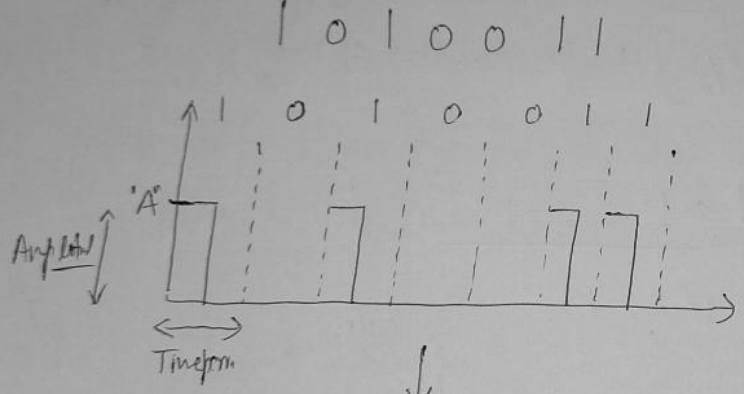
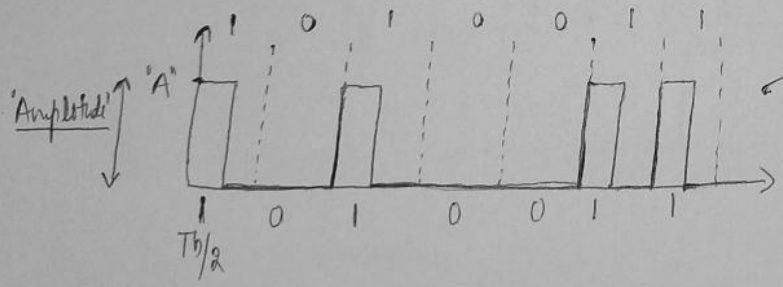
Various types of Line codes :-

(i) **Unipolar RZ format :-** Each "0" is represented using off pulse. means its amplitude ($a_K = 0$).

& Each "1" is represented using ON pulse with an amplitude of ($a_K = A$) and duration of $T_b/2$ followed by return to Zero level.

Eg :- (1 0 1 0 0 1 1) let's convert this binary sequence into "Unipolar-RZ format".

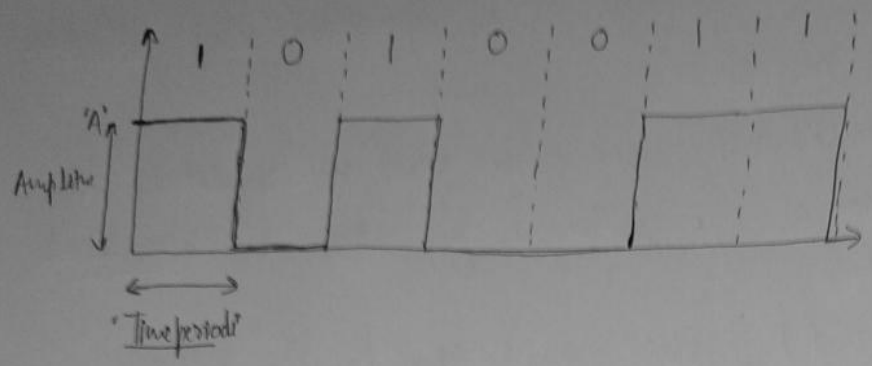




"Waveform"
Unipolar RZ format.

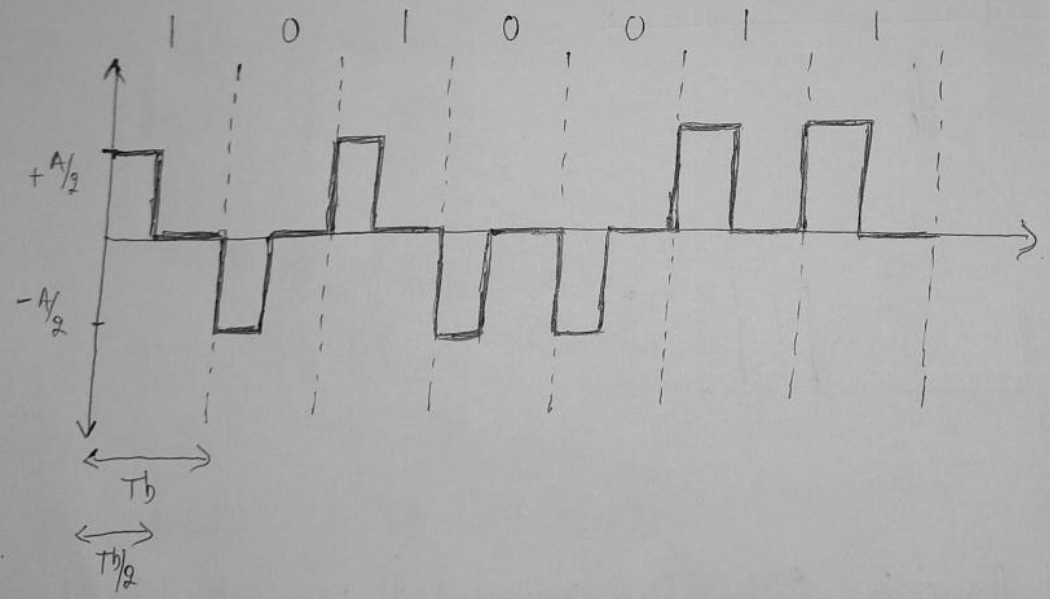
(ii) **Unipolar NRZ format :-** Each "1" is represented using ON pulse with an amplitude of "+A" & duration of T_b (full duration) & Each "0" is represented using OFF pulse.

Eg:- Bit sequence is :- ("1 0 1 0 0 1 1")



(iii) POLAR RZ format :- "Logic 1" is represented using ["+A/2"] & "Logic 0" is represented using ["-A/2"] & bit duration is "Tb/2".

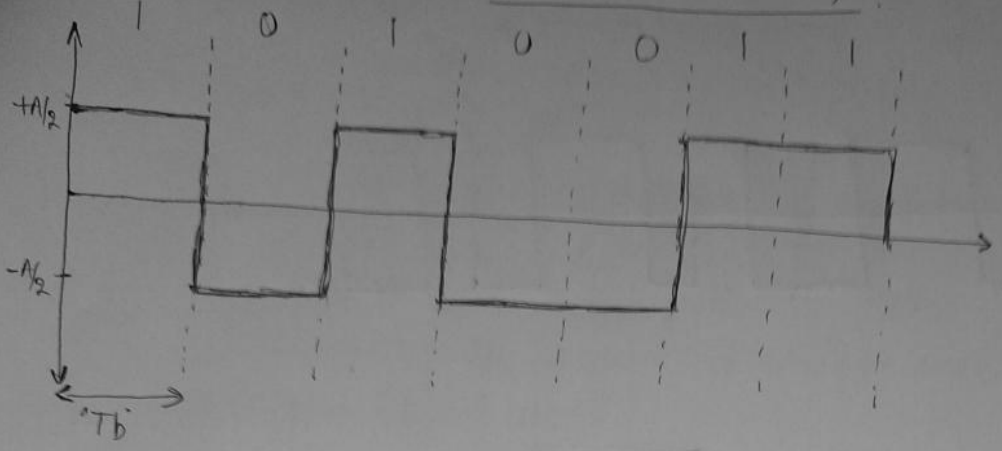
Eg:- Bit sequence is :- ("1 0 1 0 0 1 1")



(iv) Polar NRZ format :- "Logic 1" is represented using ["+A/2"] for complete duration of "Tb" & "Logic 0" is represented using ["-A/2"] for complete duration of "Tb"

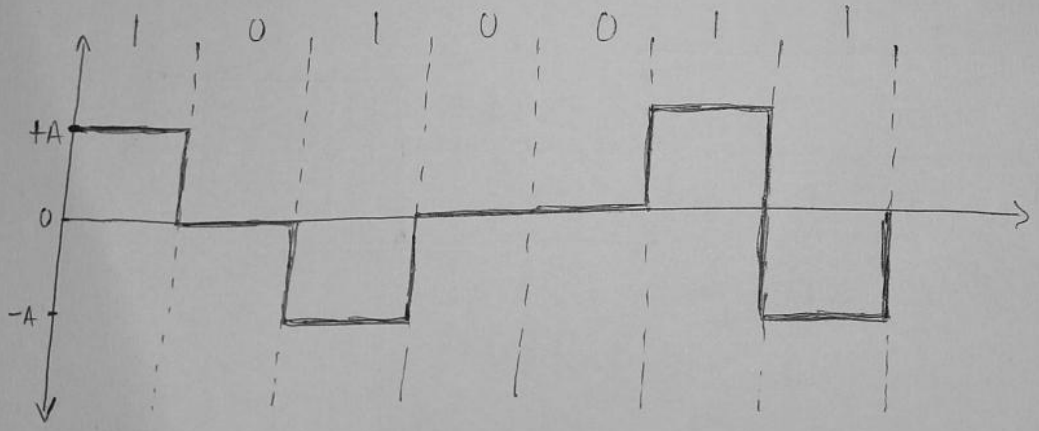
P.T.O

Eg:- Bit sequence is :- ("1 0 1 0 0 1 1")



(V) "Bipolar NRZ format" :- Successive 1's are represented by pulses with alternating polarity. For logic "0", no pulse is transmitted. Three levels = '+A', '0' & '-A'.

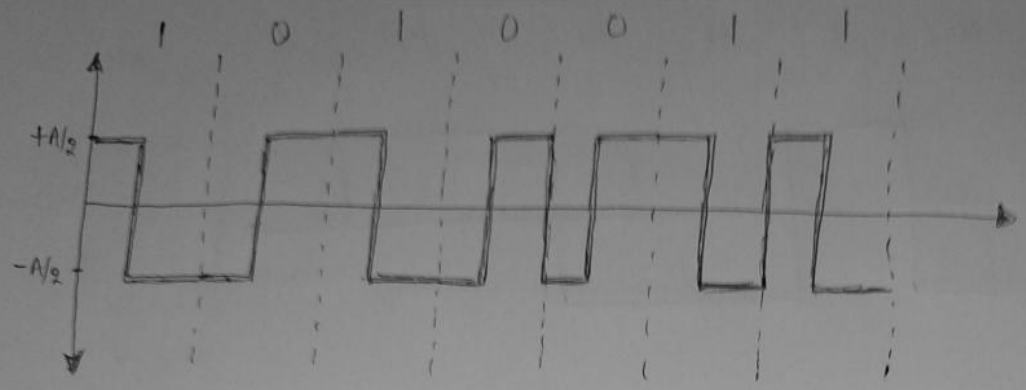
Eg:- Bit sequence is :- ("1 0 1 0 0 1 1")



(Vi) "Split Phase Manchester Format" :- Logic '1' is represented by positive pulse of +A/2 amplitude for one half of symbol '1' duration followed by negative pulse of -A/2 amplitude for remaining half duration. For "logic 0" follow reverse order.

P.T.O

Eg:- Bit sequence is :- ("1 0 1 0 0 1 1")



(vii) "POLAR QUATERNARY NRZ format" :- (we are format bit frame)

00 → -3/2 A
01 → -A/2
10 → A/2
11 → 3A/2

→ These are the amplitude values for complete time duration.

Eg:-