represent dig data by dig signals

Digital to digital conversion

3 techniques : 1) Line coding (always need)
2) Block coding
3) Scrambling

Signal Element	Data Element
smallest entity : digital signal	bit
what we can send	what we need to send

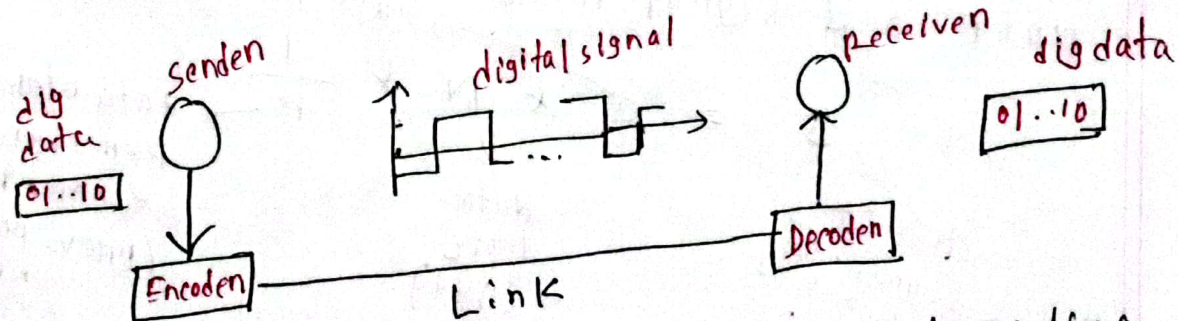
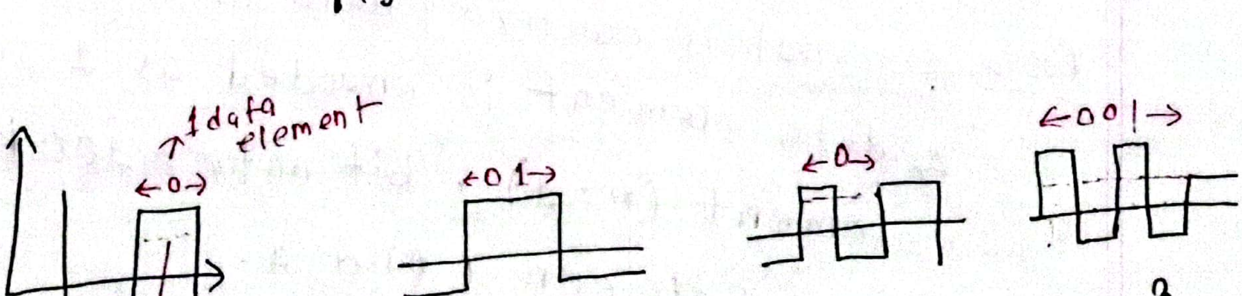


Fig : Line coding and decoding



1 signal $r = \frac{1}{1} = 1$

2 data/1 signal $r = \frac{2}{1} = 2$

1 data/2 signal $r = \frac{1}{2}$

$r = \frac{3}{4}$

Data rate (N)	Signal rate (S)
no. of data elements (bits) sent in 1 s.	no. of signal elements sent in 1 s
unit: $\boxed{\text{bps}}$	unit: baud
bit rate	✓ pulse rate ✓ modulation rate ✓ baud rate

Relationship between data rate and signal rate

$$S = c \times N \times \frac{1}{r}$$

S → no. of signal elements (baud)

c → case factor

N → data rate (bit)

r → data elements per signal element (prev. page pics)

Ex: A signal is carrying data in which 1 data element is encoded as 1 signal element ($r = 1$). bit rate = 100 kbps

c is between 0 and 1.

avg. value of baud rate = ?

$\Rightarrow S = \frac{0+1}{2} \times (100 \times 1000) \times \frac{1}{1} = 50000$ baud

N.B: Bandwidth of digital signal

→ actual = ∞

effective → finite

Ex: max. data rate, N_{max} (bit rate) $= 2 \times B \times \log_2 L$ (nyquist)

Does this agree with prev. formula? → yes

prev.: $S = c \times N \times \frac{1}{r}$

$N = \frac{S r}{c}$

→ $1/2 = c$ (assume)

$$\boxed{N_{max} = \frac{1}{\underset{\swarrow\, 1/2}{c}} \times B \times r} = \underline{\underline{2}} \times B \times \log_2 L$$

$$B_{min} = \frac{N c}{r}$$

* **Baseline:** In decoding a digital signal to digital data, the receiver calculates $\boxed{\text{avg. of received signal power}}$

long string of 0's and 1's sent

Baseline wandening: make difficult for receiven to decode connectly.

not good line coding scheme

Ex: the recieven clock is 0.1% fasten than senden clock. How many extna bps does the receiven recieve, data rate = 1 kbps and 1 Mbps

=> 1) N = 1000 bps
+ 1 (extna)
1001 bps

$1000 \times \frac{0.1}{100}$
= 1

2) N = 1,000,000
+ 1000
1001000 bps

$1{,}000{,}000 \times \frac{0.1}{100}$
= 1000

DC components: v = constant,
f → low

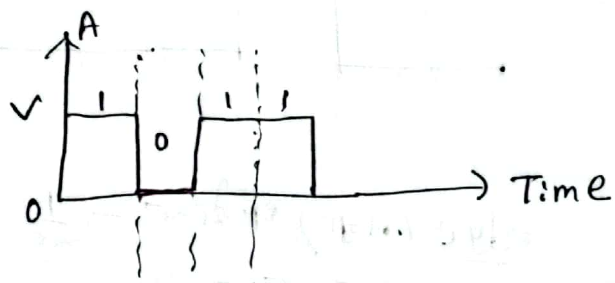
NRZ(L) → Level
NRZ(I) → Inversion

bit level এর mid এ zero back করে না ← NRZ — Non-return to 0
AMI — Alternate Mark Inversion

Line coding schemes (5)

1) Unipolar — NRZ
2) Polar — NRZ, RZ, biphase < Manchester, ~~Differential~~ Differential Manchester
   (NRZ: NRZL, NRZI)
3) Bipolar — AMI, pseudoternary
4) multilevel — 2B/1Q, 8B/6T, 4U-PAM 5
5) multitransition – MLT-3

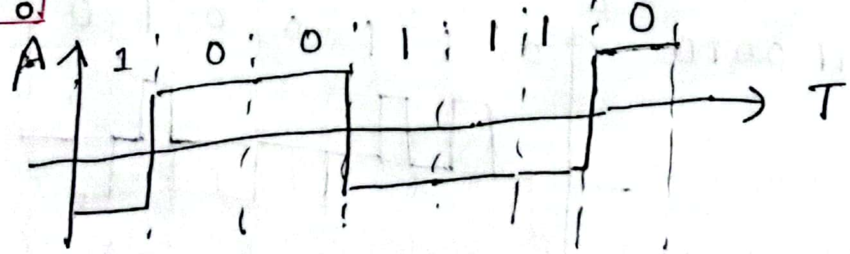
Unipolar: all signal levels – on 1 side of time axis



positive V – 1
zero V – 0

Polar:
NRZ:
$\boxed{\text{NRZ-L}}$:
1 → neg V
0 → pos V

$\boxed{1001110}$ → convert to dig. signal



NRZ-I

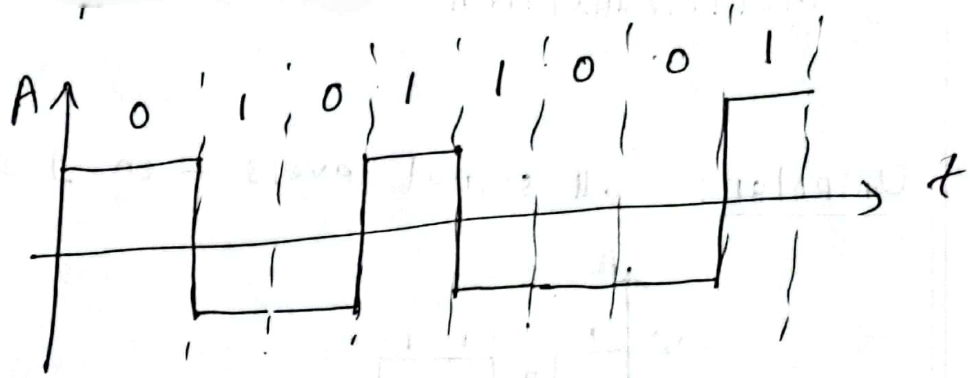
1 → transition
0 → no "

convention:
first 0 হলে high হবে

সামনে 1
আসলে 0
add করে নিব

01011001

data to signal

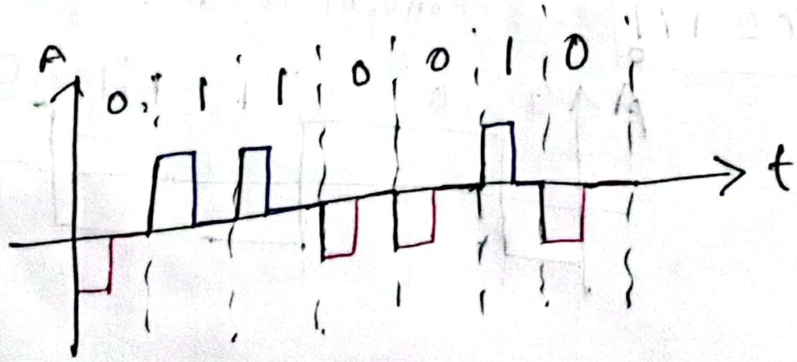


signal to data: edge (লম্বা) পাইলে – 1
বাকিগুলো – 0

RZ:

1 → pos to zero
0 → neg to zero

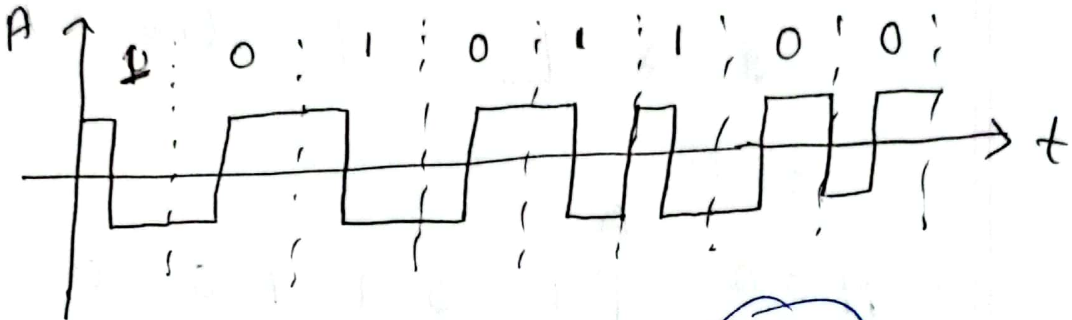
0110010



Dr. Thomas

biphase: **manchesten:** 0 → neg to pos
1 → pos to neg

10101100



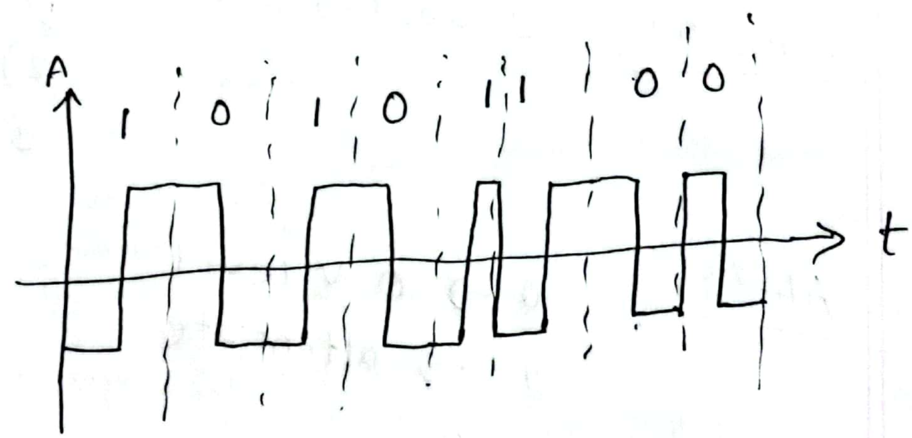
mention করা না থাকলে কোনো manchasten follow this

~~Differential manchasten~~ / manchesten (IEEE)

→ manchasten এর উল্টো

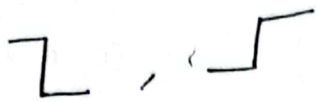
0 → pos to neg
1 → neg to pos

10101100

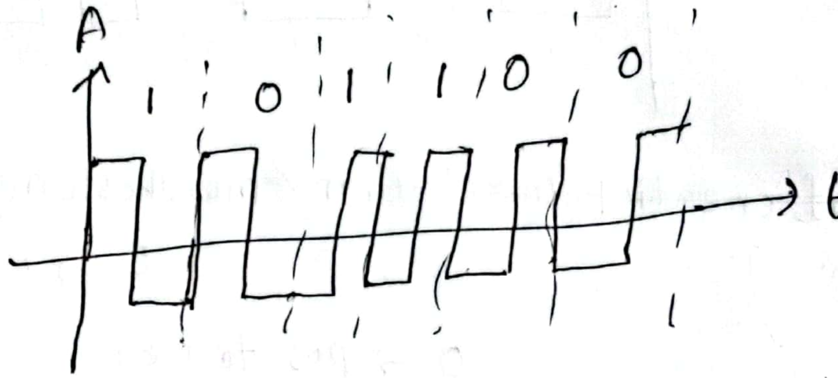


Differential Manchester

0 →  (transition)

1 →  (no ")

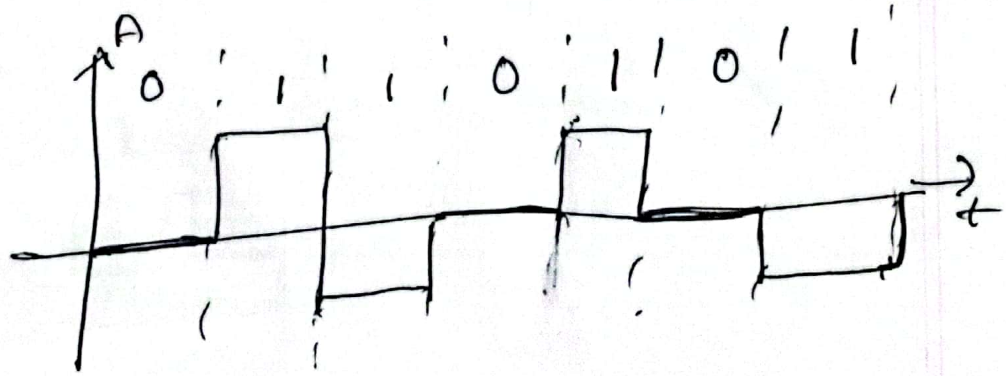
1011 0 0



Bipolar: 3 voltage level: 1) pos
2) zero
3) neg

AMI: 0 → 0 v level
1 → alternate

0110101:



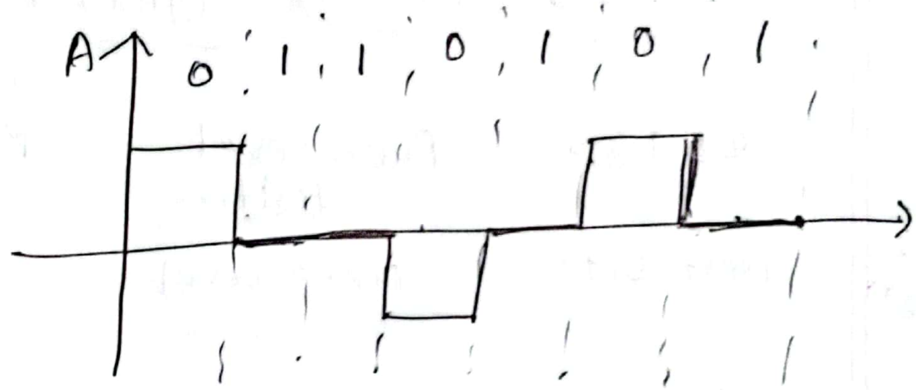
AMI এর উল্টো

Pseudotennany:

1 → zeno voltage

0 → altennate

0 110101



Multilevel: 2B1Q

mBnL

m → length of binany pattenn — no. of data pattenn = 2^m

B → Binany data

n → length of signal pattenn — no. of signal pattenn = L^n

L — no. of levels in signaling

B (Binany) — L = 2

T (Tenneny) — L = 3

Q (Quantennany) — L = 4

In 2B1Q $m = 2$, $n = 1$, $L = 4$

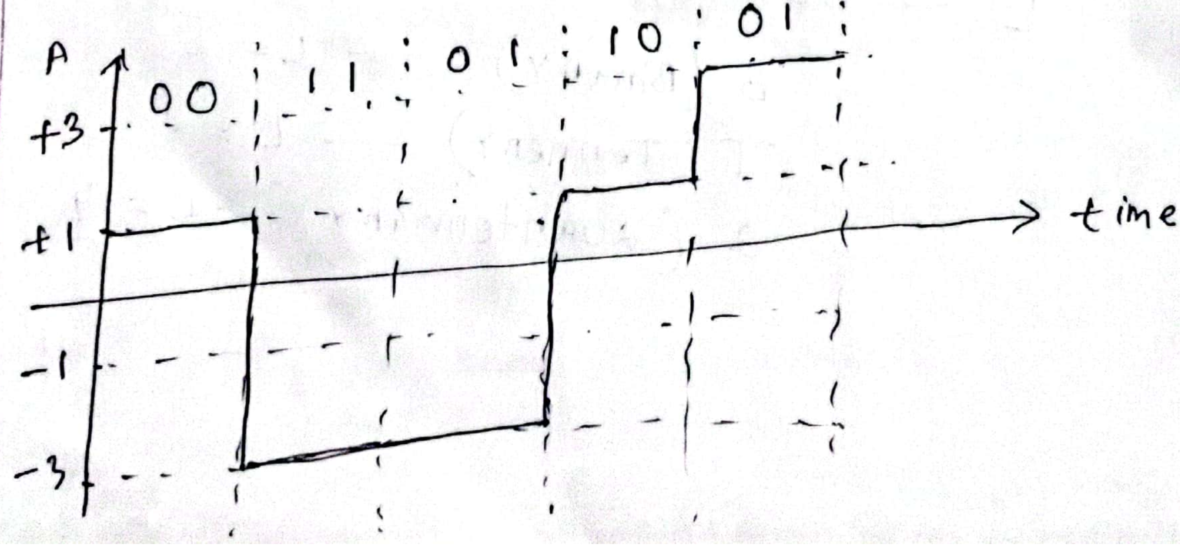
00/10/11/01 no. of ~~da~~ binary pat. $= 2^2 = 4$

$\pm 1, \pm 3 \leftarrow$ no. of signal pat. $= 4^1 = 4$

Table given

2B1Q Next Bit	Prev. Level Positive Next Level	Prev. Level Negative Next level
00	+1	−1
01	+3	−3
10	−1	+1
11	−3	+3

Dig. data: 00 11 01 10 01



+ - 0

8B6T: $m = 8$, $n = 6$, $L = 3$

no. of binary pat $= 2^8 = 256$ 2^m

no. " signal " $=$ ~~$6^3 = 216$~~

L^n $3^6 = 729$

unused

Redundant signal $= 729 - 256 = 473$

- synchronization
- error detection
- DC balance

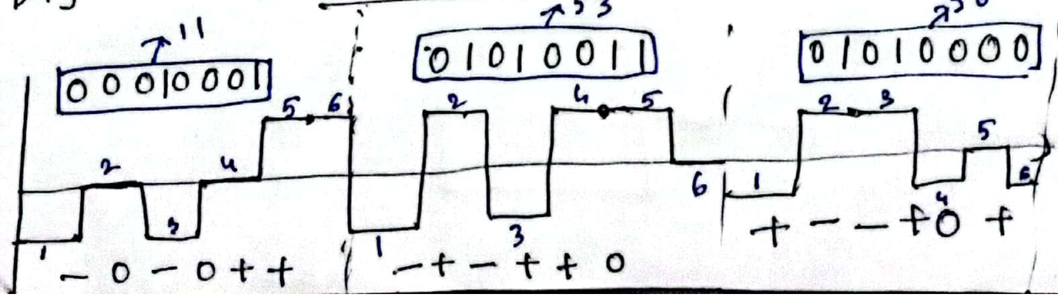
Data	code	Data	code
00	- + 0 0 - +	2A	+ 0 + - 0 -
11	- 0 - 0 + +	50	+ - - + 0 +
0A	0 - + + - 0	53	- + - + + 0
8bit	6bit	8bit	6bit

Hexadecimal

DC balance: - - + + 0 + : weight +1

- 0 - 0 + + : weight 0

Dig. Data: 00010001 01010011 01010000



Hex Bin

0001·0001 → 11 → − 0 − 0 + +

weight : 0

01010011 → 53 → − + − + + 0

wt : +1

[1st +1 → no change]

01010000 → 50 → $\boxed{+ - - + 0 +}$ $\boxed{wt : +1}$

2nd +1 ; invent

− + + − 0 − [only for দ্বিতীয়

(graph এর main টাই উল্টাবে)

$\boxed{wt : -1}$

necieven
find negative
— দুটো দিলে invent
করা হয়েছে

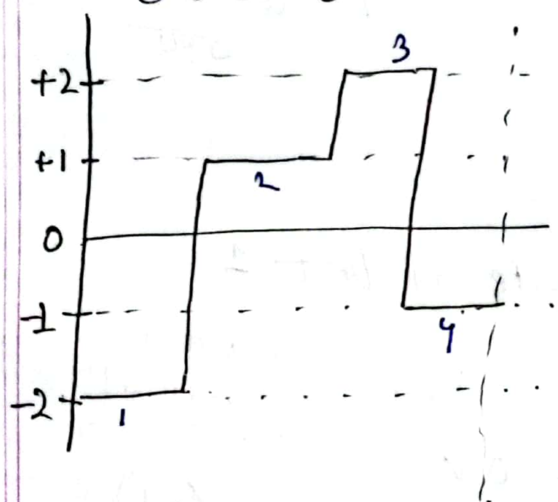
So, pnev. gnaph total wt = 0 + (+1) + (−1)
= 0 (tanget)

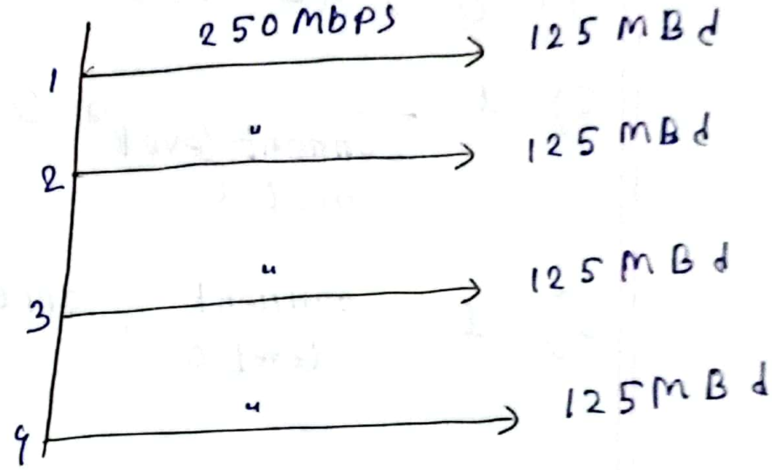
$2^8 = 256$ Redundant → zero

$5^4 = 625$ $= 625 - 256 = 369$

4D – PAM5

0 0 0 1 0 1 1 1





Suppose, wire no. = 1

0 → redundant (বাদ)

this → 8B4Q

no. of binary pattern $= 2^8 = 256$

" " signal " $= 4^4 = 256$

Multi transition :

MLT-3

Rules:

+ 0 −

1st level = 0 ধরে

1) 0 → no transition

2) 1 $\xrightarrow[\text{current level not } 0]{}$ 0

3) 1 $\xrightarrow[\text{level } 0]{\text{current}}$ opposite of last 1

If ques এ দেয়া থাকে না

* suppose, $\boxed{\text{last level} = 0\text{V} \quad \text{last non-zero} = \text{neg } (-1)}$

Dig. data 01011011