Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

BIRLA INSTITUTE OF APPLIED SCIENCES
BIAS

New 2020 Syllabus

Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
- MTech from Indian Institute of Information Technology, Gwalior
- Scopus Profile: https://www.scopus.com/authid/detail.uri?authorId=57203239026
- Google Scholar: https://scholar.google.com/citations?user=UZ_8yAMAAAAJ&hl=hi
- Contact: gyancity@gyancity.com, +91-7428640820 (For help in this Subject @ BIAS and Guidance for future MS from Europe and USA after BIAS)

About Course Outline

- UNIT 1: Lecture No 1-4, Lecture 29
- UNIT 2: Lecture No 5-8
- UNIT 3: Lecture No 14-18
- UNIT 4: Lecture No 19-21, Lecture 12-13
- Student Assignment Presentation: Lecture 22-23
- Lab on Vivado: Lecture 9-11
- Lab on Packet Tracer and C: Lecture 24-28
- Extra Lecture on Routing Algorithm: Lecture 36 by Director Sir
- UNIT 5: Lecture No 30-35
- Lecture No 37-40: Discuss Previous Year Question of UKTU

OUTLINE OF LECTURE 29

- Ethernet Cable:
  - Types, Performance & Pinout - Cat 5, 5e, 6, 6a, 7, 8
- RJ45, RJ232, RJ11
- Unipolar
- Polar
  - Non Return to Zero NRZ (NRZ-L, NRZ-I)
  - Return to Zero
  - Bi-phase Encoding
- Bipolar Encoding
- Block Coding

Ethernet Cable

- The commonly used network cables: Cat 5, Cat 5e, Cat 6, Cat 6a, Cat7 all have different levels of performance, and therefore to is necessary to buy or select the right cable for the right application.

ETHERNET CABLE PERFORMANCE

CATEGORY	SHIELDING	MAX TRANSMISSION SPEED (AT 100 METERS)	MAX BANDWIDTH
Cat 3	Unshielded	10 Mbps	16 MHz
Cat 5	Unshielded	10/100 Mbps	100 MHz
Cat 5e	Unshielded	1000 Mbps / 1 Gbps	100 MHz
Cat 6	Shielded or Unshielded	1000 Mbps / 1 Gbps	>250 MHz
Cat 6a	Shielded	10000 Mbps / 10 Gbps	500 MHz
Cat 7	Shielded	10000 Mbps / 10 Gbps	600 MHz
Cat 8		Details to be released later	

Connectors

- **RJ-11 (Registered Jack 11)**
- **RJ-45 (Registered Jack 45)**
- **RS-232 (Recommended Standard 232)**

RJ-11 (Registered Jack 11)

- **RJ-11** is a physical interface often used for terminating telephone wires.
- It is probably the most familiar of the registered jacks, being used for single line Plain Old Telephone Service (POTS) telephone jacks in most homes across the world.
- **RJ-14** is similar, but for two lines, and **RJ-25** is for three lines.
- The telephone line cord and its plug are more often a true RJ-11 with only two conductors.

RJ-45 (Registered Jack 45)

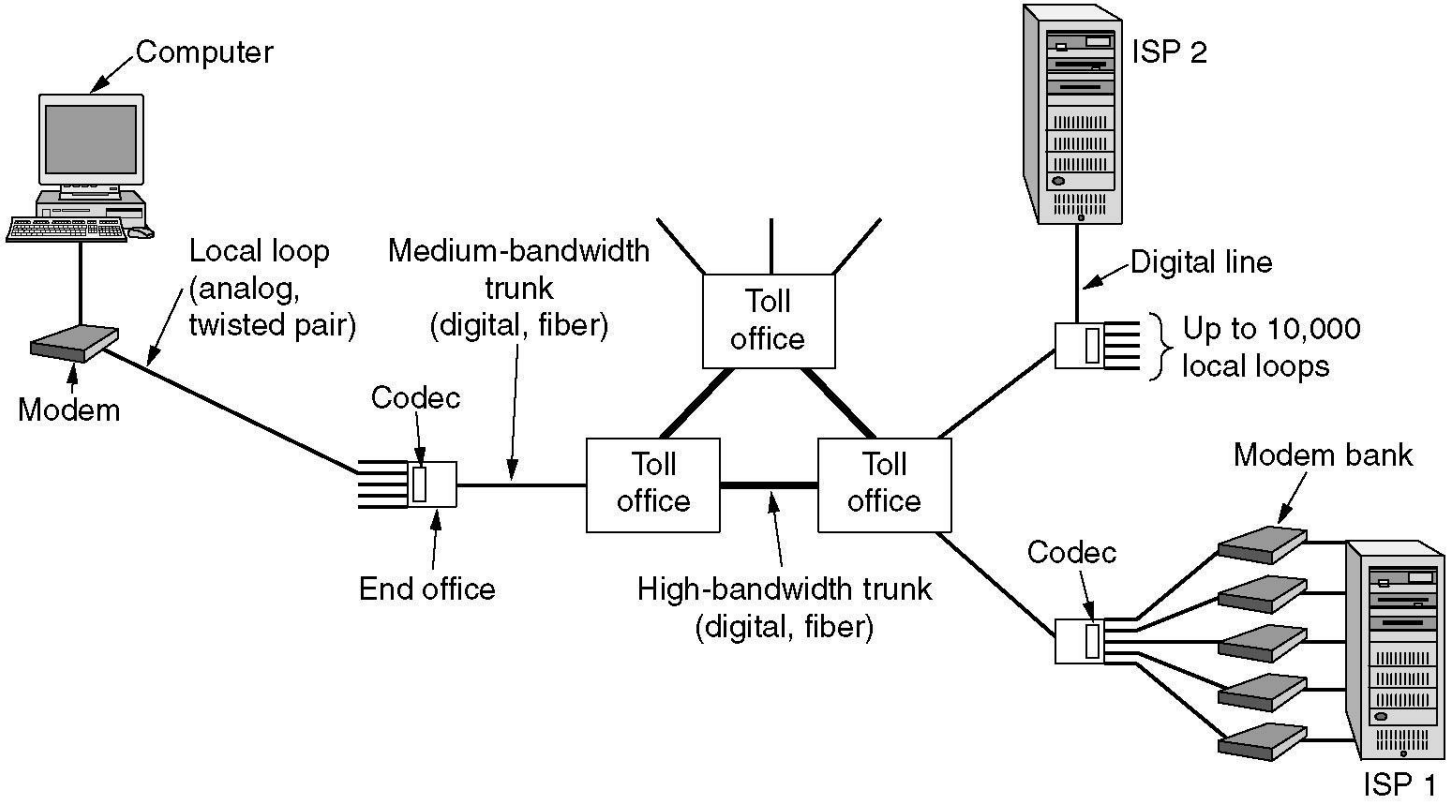
- The **8 Position 8 Contact (8P8C)** (often incorrectly called **RJ-45**) plugs and sockets are most regularly used as an Ethernet connector. 8P8C connectors are typically used to terminate twisted pair cable.

BIRLA INSTITUTE OF APPLIED SCIENCES
BIAS

RS-232

- RS-232 (Recommended Standard 232) is a standard for serial binary data signals connecting between *DTE* (Data Terminal Equipment) and *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.

Analog and Digital Transmissions

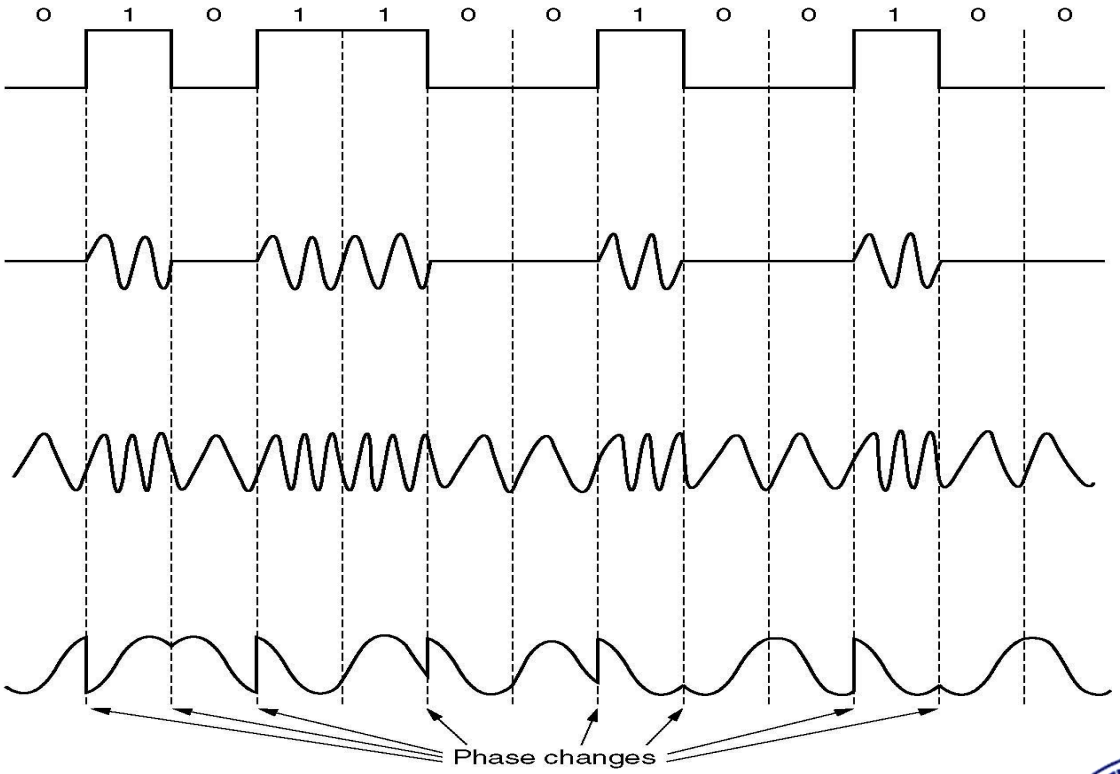


A binary signal (a)

Amplitude modulation (b)

Frequency modulation (c)

Phase modulation (d)

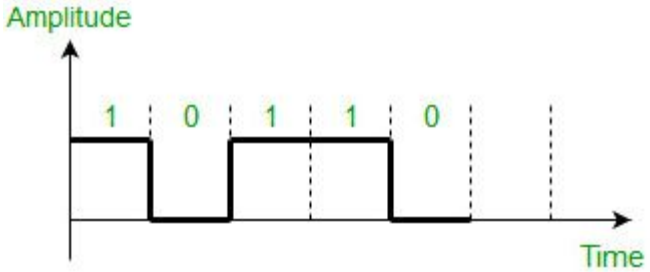


Digital to Digital Encoding Techniques

- Data Encoding Techniques
  - Unipolar
  - Polar
    - Non Return to Zero NRZ (NRZ-L, NRZ-I)
    - Return to Zero
    - Bi-phase Encoding
      - Bi-phase Manchester
      - Differential Manchester
  - Bipolar Encoding
  - Block Coding

Unipolar Encoding

- Use Single Voltage Level to represent data
  - 0: Low Voltage is transmitted
  - 1: High Voltage is transmitted



Polar Encoding

- Use Multiple Voltage Level to represent binary values
- Types of Polar Enconding
  - Non Return to Zero
    - NRZ
    - NRZ-L, Level Signal
    - NRZ-I, Inverted Signal
  - Return to Zero
  - Bi-phase Encoding
    - Bi-phase Manchester
    - Differential Manchester

NRZ (Non-Return-to-Zero) Codes

- Uses two different voltage levels (one positive and one negative) as the signal elements for the two binary digits.

NRZ-L (Non-Return-to-Zero-Level)

The voltage is constant during the bit interval.

1 ⇔ negative voltage

0 ⇔ positive voltage

NRZ (Non-Return-to-Zero) Codes

NRZ-I (Non-Return-to-Zero-Invert on ones)

The voltage is constant during the bit interval.

1 ⇔ existence of a ***signal transition*** at the beginning of the bit time
(either a low-to-high or a high-to-low transition)

0 ⇔ **no *signal transition*** at the beginning of the bit time

NRZI is a *differential encoding* (i.e., the signal is decoded by comparing the polarity of adjacent signal elements.)

Bi –Phase Codes

- Bi- phase codes – require at least one transition per bit time and may have as many as two transitions.
- The maximum modulation rate is twice that of NRZ
- Greater transmission bandwidth is required.
- Advantages:
- Synchronization – with a predictable transition per bit time the receiver can “synch” on the transition [self-clocking].
- Error detection – the absence of an expected transition can used to detect errors.

Manchester encoding

- There is **always** a mid-bit transition {which is used as a clocking mechanism}.
- The **direction** of the mid-bit transition represents the digital data.
- Consequently, there may be a second transition at the beginning of the bit interval.
- Used in 802.3 baseband coaxial cable and CSMA/CD twisted pair.

1 ⇔ **low-to-high** transition

0 ⇔ **high-to-low** transition

BIRLA INSTITUTE OF APPLIED SCIENCES
BIAS

Differential Manchester encoding

- mid-bit transition is **ONLY** for clocking.
- Differential Manchester is both differential and bi-phase.
- Note – the coding is the opposite convention from NRZI.
- Used in 802.5 (token ring) with twisted pair.
- Modulation rate for Manchester and Differential Manchester is twice the data rate
- Inefficient encoding for long-distance applications.

1 ⇔ **absence** of transition at the beginning of the bit interval

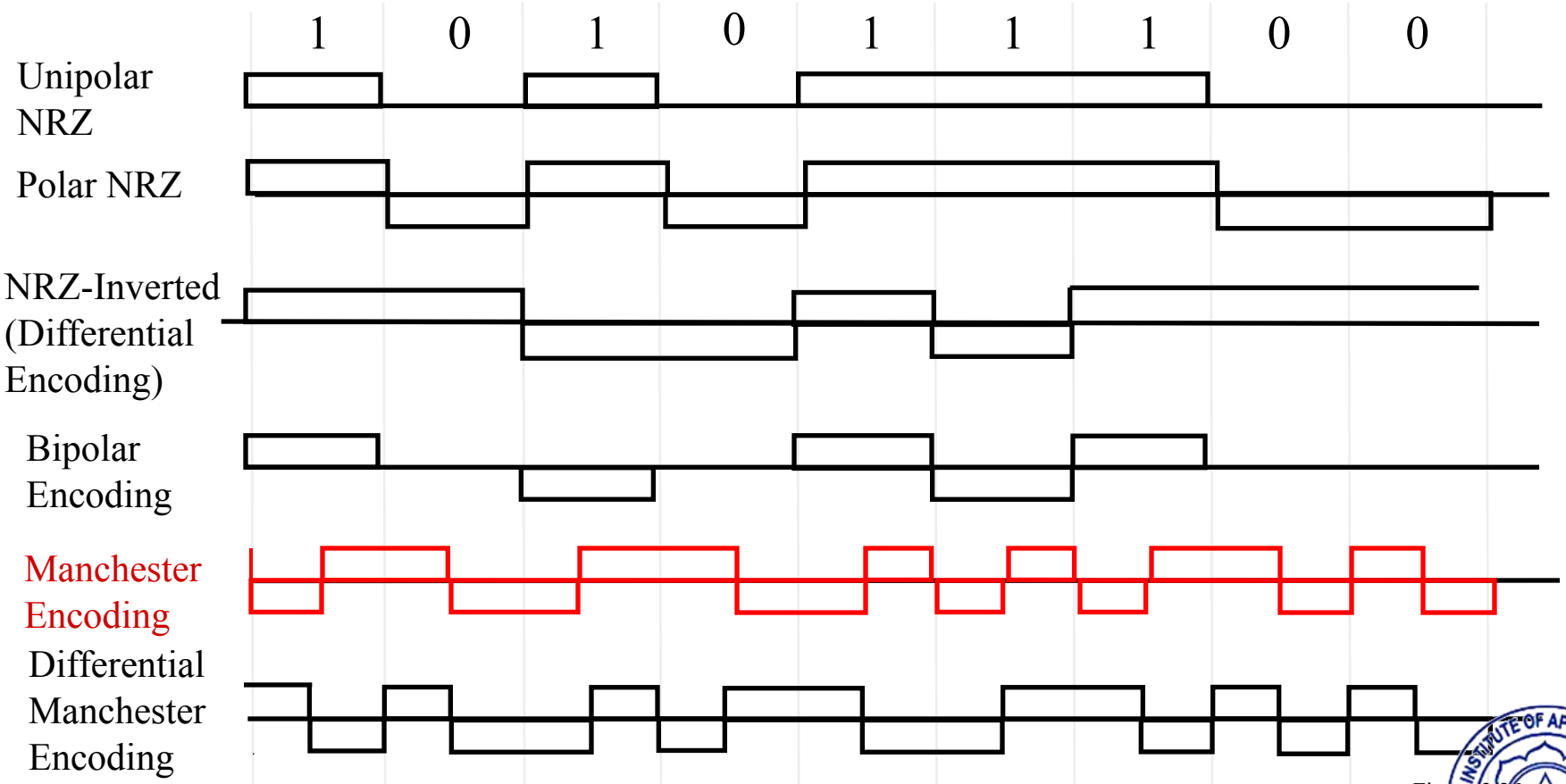
0 ⇔ **presence** of transition at the beginning of the bit interval

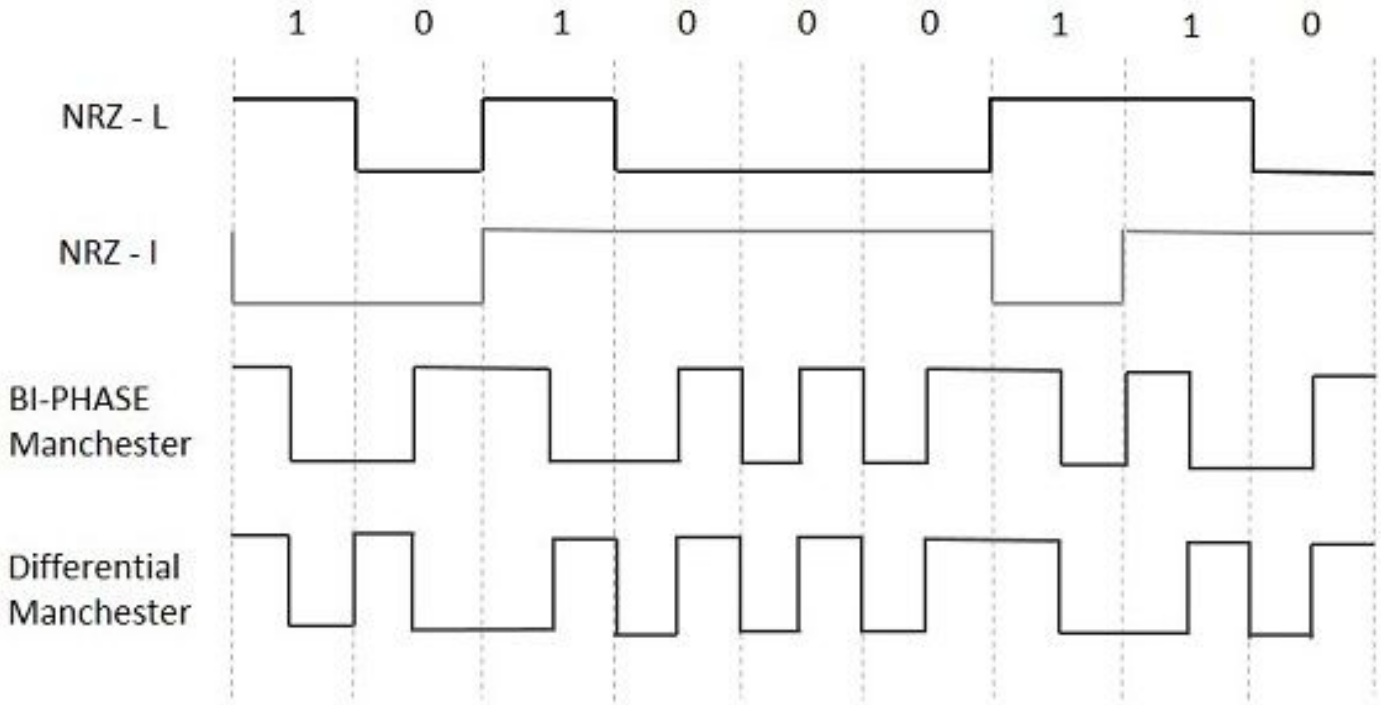
Bi-Polar Encoding

- Has the same issues as NRZI for a long string of 0's.
- A systemic problem with polar is the polarity can be backwards.

1 ⇔ **alternating** +1/2 , -1/2 voltage

0 ⇔ **0** voltage




1 0 1 0 0 0 1 1 0
NRZ - L
NRZ - I
BI-PHASE
Manchester
Differential
Manchester

Block Coding

- Among the types of block coding, the famous ones are 4B/5B encoding and 8B/6T encoding.
- The number of bits are processed in different manners, in both of these processes.

4B/5B Encoding

- In Manchester encoding, to send the data, the clocks with double speed is required rather than NRZ coding.
- Here, as the name implies, 4 bits of code is mapped with 5 bits, with a minimum number of 1 bits in the group.
- The clock synchronization problem in NRZ-I encoding is avoided by assigning an equivalent word of 5 bits in the place of each block of 4 consecutive bits. These 5-bit words are predetermined in a dictionary.
- The basic idea of selecting a 5-bit code is that, it should have one leading 0 and it should have no more than two trailing 0s.

8B/6T Encoding

- We have used two voltage levels to send a single bit over a single signal. But if we use more than 3 voltage levels, we can send more bits per signal.
- For example, if 6 voltage levels are used to represent 8 bits on a single signal, then such encoding is termed as 8B/6T encoding.
- These are the techniques mostly used for converting digital data into digital signals by compressing or coding them for reliable transmission of data.