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IQRA National University

Department of Electrical Engineering
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Course Details

Course Title: Advance Computer Networks **Module:** Mid term
Instructor: DR Naeem Ahemad Jan **Total Marks:** 30

Student Details

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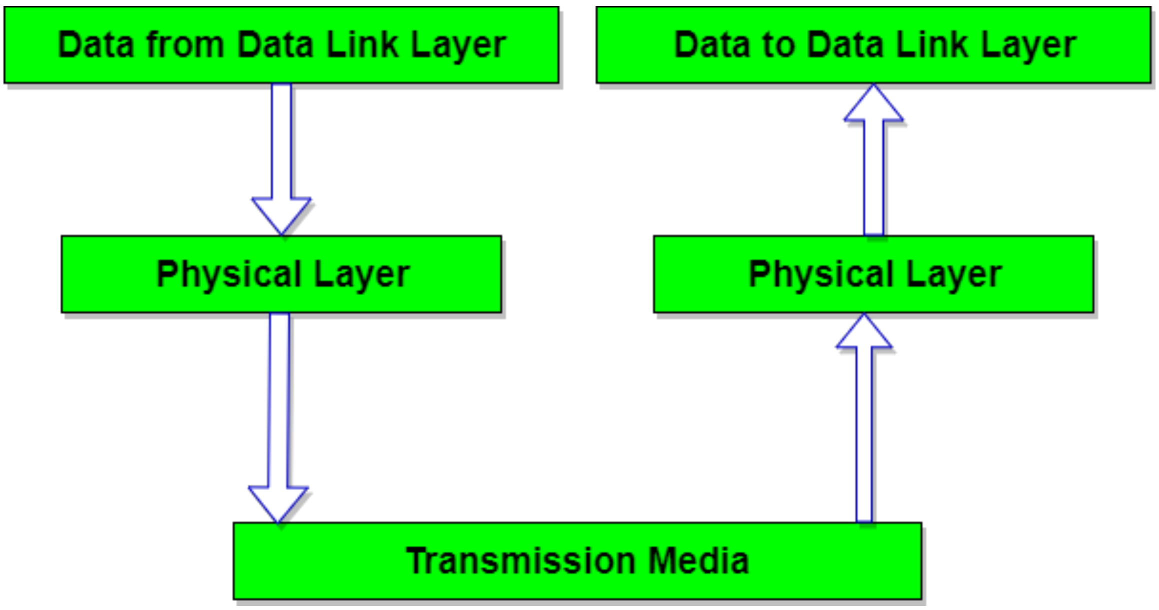
Q 1.	(a)	Explain Physical layer services and Transmission Impairments?	Marks 6
	(b)	Express a period of 1 ms in microseconds, and express the corresponding frequency in kilohertz and A sine wave is offset one-fourth of a cycle with respect to time zero. What is its phase in degrees and radians?	Marks 4
Q 2.	(a)	Explain the classification of digital-to-digital conversion? Difference between data element and signal element?	Marks 6
	(b)	We want to digitize the human voice. What is the bit rate, assuming 7 bits per sample?	Marks 4
Q 3.	(a)	Explain the responsibilities of different layers of TCP/IP in detail?	Marks 6
	(b)	Convert the following data 01110010 to Manchester coding and Bipolar AMI?	Marks 4

Q =1 Explain physical layer services and transmission Impairments

Physical Layer

Physical layer is the simply layer of OSI network model, which basically allocates through the physical connectivity of two different locations. This layer describes the hardware equipment, cabling, wiring, frequencies, pulses used to represent binary signals etc. Physical layer delivers its assistances to Data-link layer.



Physical layer is the low-level layer of the OSI mention model. It is responsible for sending bits from one computer to another. This layer is not concerned with the meaning of the bits and deals with the setup of physical connection to the network and with transmission and reception of signals.
Following are the various functions performed by the Physical layer of the OSI model.

Representation of Bits: Data in this layer contains of stream of bits. The bits must be encoded into signals for transmission. It defines the sort of encoding i.e. how 0's and 1's are changed to signal.

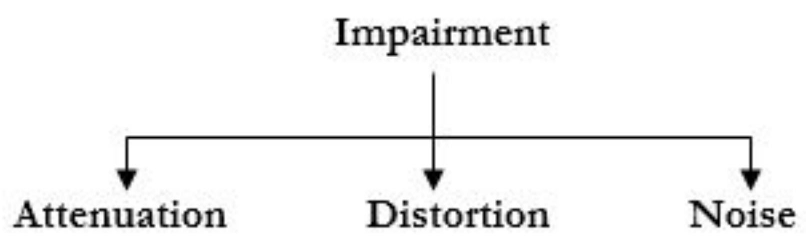
Data Rate: This layer defines the rate of transmission, which is the number of bits per second.

Synchronization: It deals with the synchronization of the transmitter and receiver. The sender and receiver are synchronized at bit level.

Interface: The physical layer defines the transmission interface between devices and transmission medium.
Line Configuration: This layer connects devices with the medium: Point-to-Point configuration and Multipoint configuration.
Topologies: Devices should be connected using the following topologies: Mesh, Star, Ring and Bus.
Transmission Modes: Physical Layer defines the direction of transmission between two devices Simplex, Half Duplex, and Full Duplex.
Allocates with baseband and broadband transmission

Transmission Impairment

In communication system, analog signals travel through transmission media, which tends to deteriorate the quality of analog signal. This imperfection causes signal impairment. This means that received signal is not same as the signal that was send. It means change in the shape of signal.

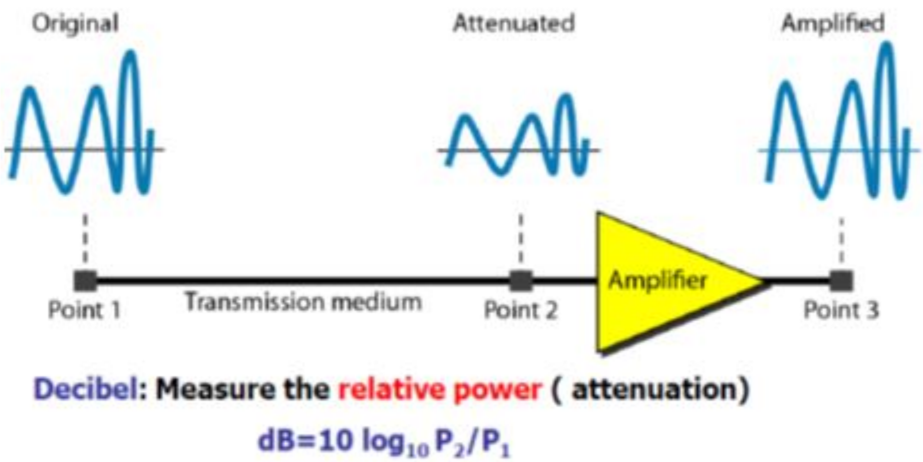


In any communication system, the received signal is never is identical to the transmitted one due to some transmission impairments. The quality of analog signals will deteriorate due to transmission impairments as given above.

Attenuation:
The strength of a signal decrease with the increase in distance travelled over a medium. Attenuation means loss of energy. When any signal travels over a medium or channel, it loses some of its energy in the form of heat in the resistance of the medium. Attenuation decides the signal to noise ratio hence the quality of received signal. Attenuation is given in decibels as:
Attenuation (dB) = 10log10 (Pout/Pin)
Where, Pin= Power at the sending end
Pout= Power at the receiving end

Distortion (Harmonic):
Another meaning of distortion is change in shape of the signal. This type of distortion is observed for the composite signals made by different frequencies. If the medium is not perfect, then all the frequency components present at the input will not only be equally attenuated and will not be proportionally delayed.

Noise:
When the data travels over a transmission medium, noise gets added to it. Noise is a major limiting factor in communication system performance. Noise can be categorized into four types as follows:
(i) Thermal noise (ii) Intermodulation noise (iii) Crosstalk (iv) Impulse noise



Question # 1 Part B.

Solution:

$1 \text{ ms} = 1 * 10^{-3}$ S

Milli second = 10^{-3} S

Micro second = 10^{-6} S

Kilo = 10^{3}

We can also write this

$= 10^{-3} * 10^{3} * 10^{-3}$ S

$= 10^{3} * 10^{-6}$ S

$= 10^{3}$ μS

1 ms = 10^{3} μS

As 1 ms = 10^{-3} S

As f =1 / t

so

f = 1 / 10^{-3} Hz

f = 10^{3} Hz

f= 1000 Hz

f = 1 KHz

a sin wave is offset one forth of a cycle with respect to time zero its phase in degree is :

As Complete cycle is 360°

Therefore ¼ cycle is

¼ * 360 = **90°**

a sin wave is offset one forth of a cycle with respect to time zero its phase in radian is :

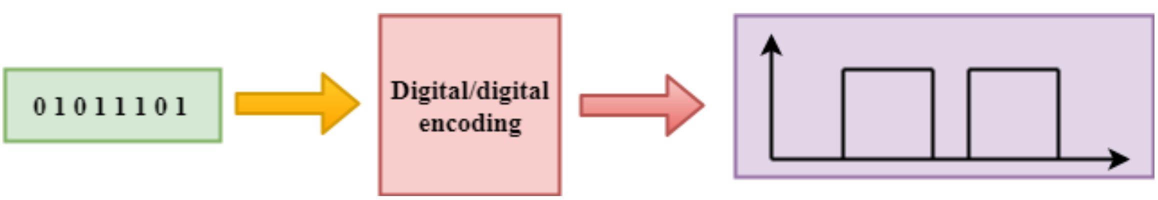
$90° * \frac{2\pi}{360} = \frac{\pi}{2} =$ **1.5708 radian**

Question # 2 Explain the classification of digital-to-digital conversion? Difference between data element and signal element?

DIGITAL-TO-DIGITAL CONVERSION

Digital-to-digital encoding is the exemplification of digital information by a digital signal. When binary 1s and 0s produced by the computer are translated into a sequence of voltage pulses that can be propagated over a wire, this process is known as digital-to-digital encoding.
Digital-to-digital encoding is divided into three categories:

Unipolar Encoding
Polar Encoding
Bipolar Encoding



Digital-to-digital encoding is the representation of digital information by a digital signal. When binary 1s and 0s generated by the computer are translated into a sequence of voltage pulses that can be propagated over a wire, this process is known as digital-to-digital encoding.

A computer network is designed to send information from one point to another. This information needs to be converted to either a digital signal or an analog signal for transmission.
We discussed data and signals. We said that data can be either digital or Analog. We also said that signals that represent data can also be digital or analog. In this section, we see how we can represent digital data by using digital signals. The conversion involves three techniques:

Line coding,
Block coding,
Scrambling.

Line coding is always needed; block coding and scrambling may or may not be needed.
Line coding is the process of converting digital data to digital signals. We assume that data, in the form of text, numbers, graphical images, audio, or video, are stored in computer memory as sequences of bits Line coding converts a sequence of bits to a digital signal. At the sender, digital data are encoded into a digital signal; at the receiver, the digital data are recreated by decoding the digital signal.

Difference between data element and signal element

A data element is the smallest individual that can represent a piece of information (a bit). A data element (bit) is the smallest quantity that can represent a piece of information.
While a signal element is the shortest unit (Time wise) of a digital signal. Data elements are what we need to send; signal elements are what we can send. Data elements are being carried; signal elements are the carriers
In other words

- Data elements are what we need to send.
- Signals elements are what we can send.

Bit Rate, Baud rate and Minimum BW

Summary of the Terms:

Term	Units	Definition
Data element	Bits	A single binary one or zero
Data rate	Bits per second (bps)	The rate at which data elements are transmitted.
Signal element	Digital: a voltage pulse of constant amplitude Analog: a pulse of constant frequency, phase and amplitude	That part of a signal that occupies the shortest interval of a signaling code
Signaling rate or modulation rate	Signal elements per second (baud)	The rate at which signal elements are transmitted.

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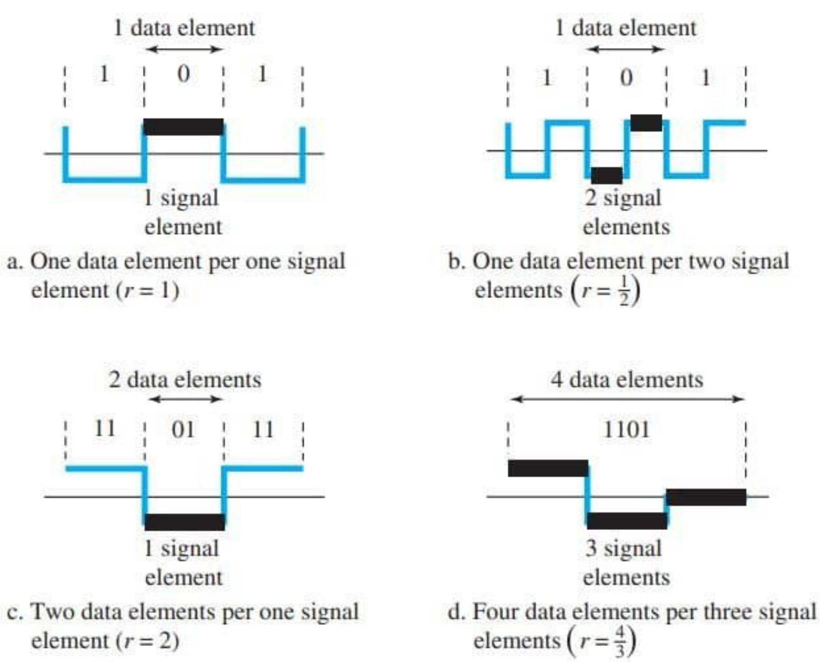
Figure 4.2 *Signal element versus data element*



Question # 2 part B Question #2 Part B

Human Voice

The human voice consists of sound made by a human being using the vocal tract, such as talking, singing, laughing, crying, screaming, shouting, yelling etc. The human voice frequency is specifically a part of human sound production in which the vocal folds are the primary sound source.

- Human voice frequency is 4000Hz
- Sampling Rate = 4000* 2 = 8000 sample /s

  Bit Rate = Sample Rate x Number of bits /sample

Solution:

Bit Rate = 8000 x 7bits = 56000bps or **56Kbps**

Answer 56Kbps

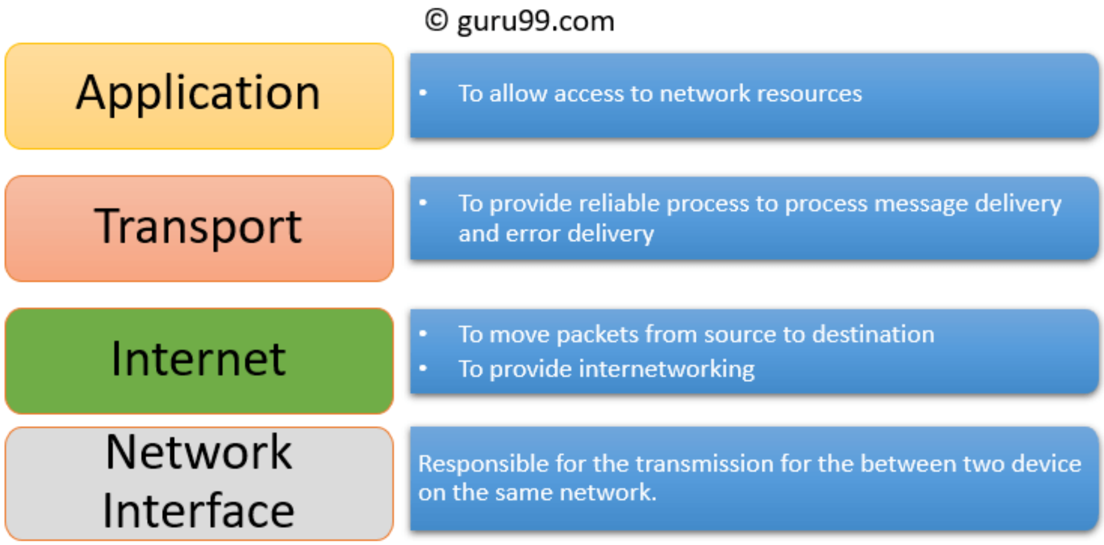
Question # 3
Explain the responsibilities of different layers of TCP/IP in detail?

TCP/IP Model

TCP/IP Model helps you to determine how a specific computer should be connected to the internet and how data should be transmitted between them. It helps you to create a virtual network when multiple computer networks are connected together. The purpose of TCP/IP model is to allow communication over large distances.
TCP/IP stands for Transmission Control Protocol/ Internet Protocol. It is specifically designed as a model to offer highly reliable and end-to-end byte stream over an unreliable internetwork.

Four Layers of TCP/IP

- Application Layer
- Transport Layer
- Internet Layer
- Network Interface



Application Layer

Application layer interacts with an application program, which is the highest level of OSI model. The application layer is the OSI layer, which is closest to the end-user. It means the OSI application layer allows users to interact with other software application.
Application layer interacts with software applications to implement a communicating component. The interpretation of data by the application program is always outside the scope of the OSI model.
Example of the application layer is an application such as file transfer, email, remote login, etc.

Transport Layer

Transport layer builds on the network layer in order to provide data transport from a process on a source system machine to a process on a destination system. It is hosted using single or multiple networks, and also maintains the quality of service functions.
It determines how much data should be sent where and at what rate. This layer builds on the message which are received from the application layer. It helps ensure that data units are delivered error-free and in sequence.
Transport layer helps you to control the reliability of a link through flow control, error control, and segmentation or de-segmentation.
The transport layer also offers an acknowledgment of the successful data transmission and sends the next data in case no errors occurred. TCP is the best-known example of the transport layer.

Internet Layer

An Internet layer is a second layer of the TCP/IP model. It is also known as a network layer. The main work of this layer is to send the packets from any network, and any computer still they reach the destination irrespective of the route they take.
The Internet layer offers the functional and procedural method for transferring variable length data sequences from one node to another with the help of various networks.
Message delivery at the network layer does not give any guaranteed to be reliable network layer protocol.
Layer-management protocols that belong to the network layer are:
Routing protocols
Multicast group management
Network-layer address assignment.

The Network Interface Layer

Network Interface Layer is this layer of the four-layer TCP/IP model. This layer is also called a network access layer. It helps you to defines details of how data should be sent using the network.
It also includes how bits should optically be signaled by hardware devices which directly interfaces with a network medium, like coaxial, optical, coaxial, fiber, or twisted-pair cables.
A network layer is a combination of the data line and defined in the article of OSI reference model. This layer defines how the data should be sent physically through the network. This layer is responsible for the transmission of the data between two devices on the same network.

Question # 3 part B

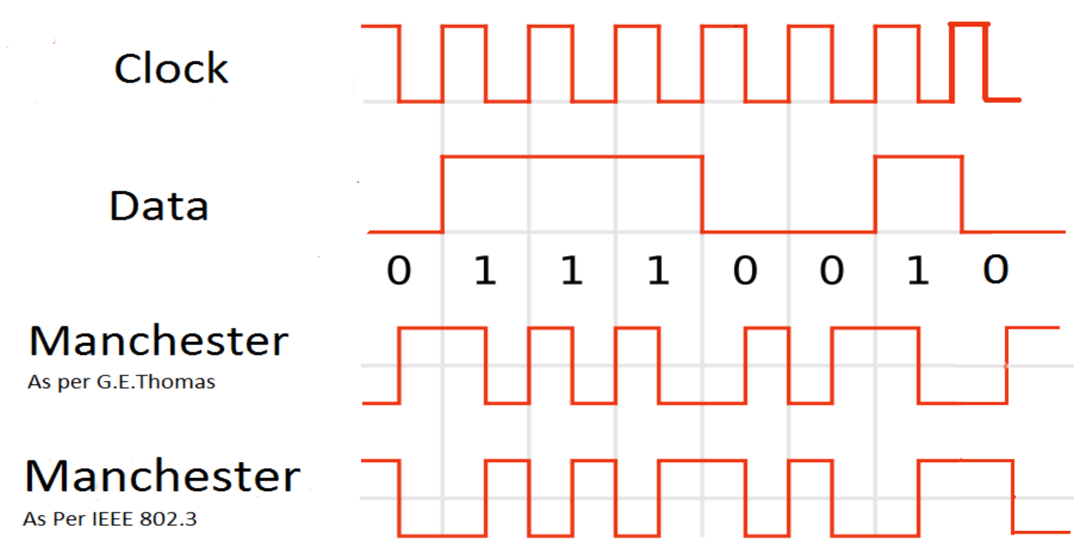
Manchester encoding

In data Transmission Manchester encoding is a method of transmitted bitts that allows the receiver to easily synchronize with the sender. Manchester encoding splits each bit period into two, and ensures that there is always a transition between the signal levels in the middle of each bit. In Manchester encoding "1" is transmitted as 0 in the first half of the clock and 1 in the second half of the clock. And "0" is transmitted as 1 in the first half of the clock and 0 in the second half of the clock.
In telecommunication and data storage, Manchester code is a line code in which the encoding of each data bit is either low then high, or high then low, for equal time. It is a self-clocking signal with no DC component. As a result, electrical connections using a Manchester code are easily galvanically isolated.

Manchester encoding (first published in 1949) is synchronous clock-encoding technique used by the physical layer encode the clock and data of a synchronous bit stream. In this technique, the actual binary data to be transmitted over the cable are not sent as a sequence of logic 1's and 0's (known technically as NON-return to Zero (NRZ) Instead, the bits are translated into a slightly different format that has a number of advantages over using straight binary encoding (i.e. NZR). In the Manchester encoding shown (as defined by IEEE 802.3 standards for 10 Mbps), a logic zero is indicated by a 1 to 0 transition at the Centre of the bit and a logic one is indicated by a 0 to 1 transition at the center of the bit. The signal transitions do not always occur at the 'bit boundaries' (the division between one bit and another), but that there is *always* a transition at the Centre of each bit. The Manchester encoding rules are summarized below:

Original Data	Value Sent
Logic 0	1 to 0 (downward transition at bit Centre)
Logic 1	0 to 1 (upward transition at bit Centre)

Note that in some cases you will see the encoding reversed, with 0 being represented as a 0 to 1 transition. The two definitions have co-existed for many years. Because many physical layers employ an inverting line driver to convert the binary digits into an electrical signal, the signal on the wire is the exact opposite of that output by the encoder. Differential physical layer transmission, (e.g. 10BT) does not suffer this inversion ambiguity.



So data encodes to **1001010110100110**

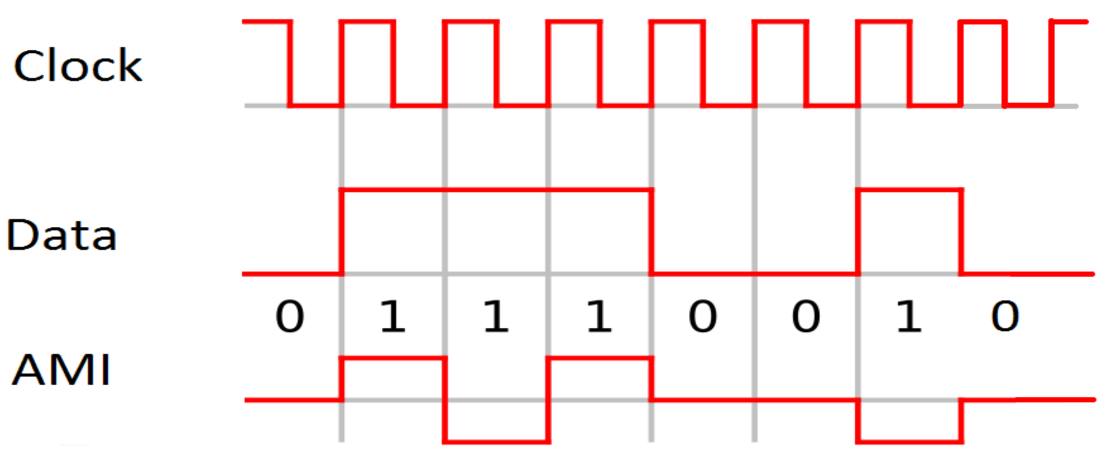
Bipolar AMI

In telecommunication, bipolar encoding is a type of return-to-zero (RZ) line code, where two nonzero values are used, so that the three values are +, −, and zero. Such a signal is called a duo binary signal.

Bipolar Alternate Mark Inversion (AMI): Bipolar alternate mark inversion (AMI) is the simplest type of bipolar encoding. in the name alternate mark inversion, the word mark comes from telegraphy and means 1 so (AMI) means alternate 1 inversion. A neutral, zero voltage represents binary 0. Alternating positive and negative voltage represents binary 1s. A Variation of bipolar (AMI) is called pseudo ternary, in which binary 0 alternates between positive and negative voltages. By inverting on each occurrence of a 1. Bipolar AMI accomplishes two things: - first, the DC component is zero. Equation (1) shows the summation of the output bits.

(DC) component = Σ (b0 + b1 + b2 + b3 +…………………………..+ bn) … (1)

Where; b0 + b1 + b2 + b3 +..+ bn = > voltage of output bits - second, a long sequence of 1s stays synchronized. There is no mechanism to ensure the synchronization of a long string of 0s. Two variations of bipolar AMI have been developed to solve the problem of synchronizing sequential 0s, especially for long-distance transmission. The first, used in North America, is called bipolar 8-zero substitution (B8ZS). The second, used in Europe and Japan, is called high-density bipolar 3 (HDB3). Both are adaptations of bipolar AMI that modify the original pattern only in the case of multiple consecutive 0s.



So data encodes to **0 +1 -1 +1 0 0 -1 0**