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1KN18CS097
CSE 'A' sec

1) What is Data communication? Explain different forms of data representation.

> Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Data representations:

Text: In data communications, text is represented as a bit pattern, a sequence of bits. Different sets of bit patterns have been designed to represent text symbols. Each set is called a code, and the process of representing symbol is called coding.

Numbers: Numbers are also represented by bit patterns. However a code such as ASCII is not used to represent numbers; the number is directly converted to a binary number to simplify mathematics operations.

Images: Images are also represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels, where each pixel is a small dot. The size of the pixel depends on the resolution.

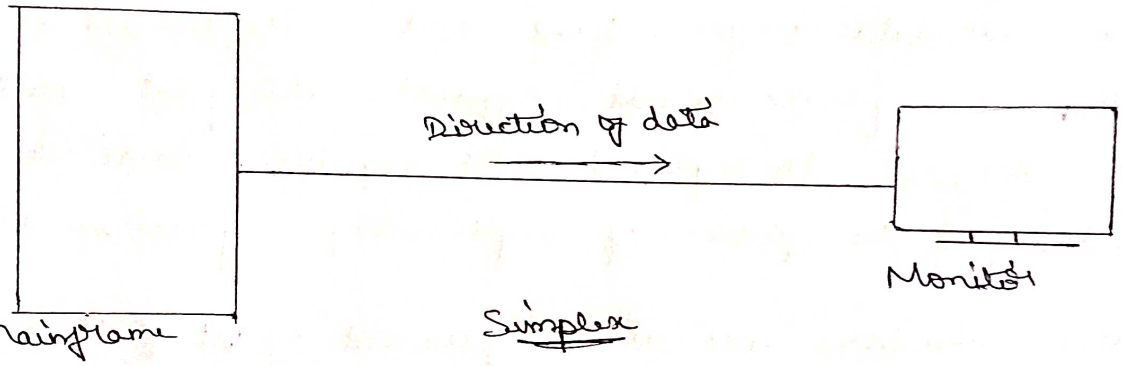
After an image is divided into pixels, each pixel is assigned a bit pattern. The size and the value of the pattern depend on the image.

Audio: Audio refers to the recording or broadcasting of sound or music. Audio is by nature different from text, numbers, or images. It is continous, not discrete.

Even when we use a microphone to change voice or music to an electric signal, we create a continuous signal.

Video: video refers to the recording or broadcasting of a picture or movie. video can either be produced as a continuous entity, or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion.

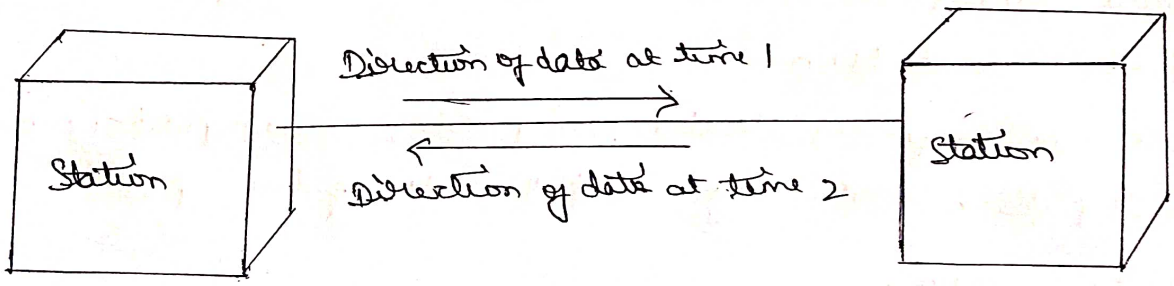
(2) Describe Simplex, half duplex and full duplex with respect to data communication.




Simplex

Simplex:

In Simplex mode, the communication is unidirectional, as on a one-way street. only one of the two devices on a link can transmit; the other can only receive. Keyboards and traditional monitors are examples of Simplex devices. The keyboard can only introduce input; the monitor can only accept output.




Half-duplex

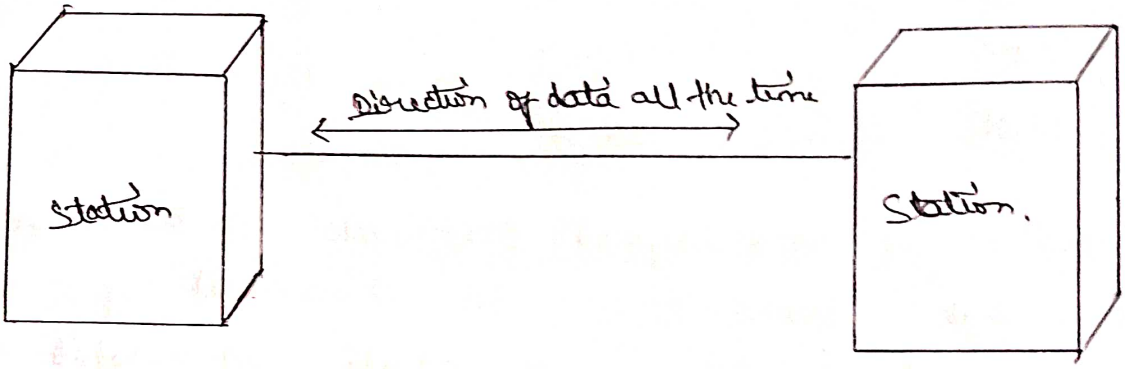
Half-Duplex:

In half duplex mode, each station can both transmit and receive but not at the same time, when one device is sending, the other

can only receive, and vice-versa.

In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time. walkie-talkie and CB are both half-duplex systems.

The half-duplex mode is used in cases where there is no need for communication in both directions at the same time.



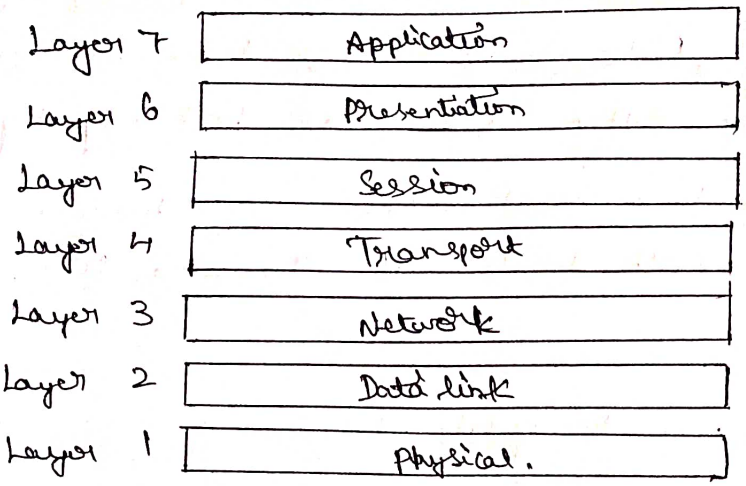

Full-Duplex:

In full duplex mode, both stations can transmit and receive simultaneously. In full-duplex mode, signals going in the one direction share the capacity of the link with signals going in the other direction.

This sharing can occur in two ways: Either the link must contain two physically transmission paths, one for sending and the other for receiving; or the capacity of the channel is divided between signals travelling in both directions.

The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however, must be divided between two directions.

(3) Explain OSI model with neat diagram.




The OSI Model is a layered framework for the design of network system that allows communication between all types of computer systems. It consists of seven separate but related layers, each of which defines a part of the process of moving information across a network. Open Systems Interconnection (OSI) model. It was first introduced in the late 1970's.

An open system is a set of protocols that allows any two different system to communicate regardless of their underlying architecture. The purpose of the OSI model is to show how to facilitate communication between different systems without requiring changes to the logic of the underlying hardware and software.

The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible, robust, and interoperable. The OSI model was intended to be the basis for the creation of the protocols in the OSI stack. The OSI model is a layered framework for the design of network systems that allows communication between all types of computer systems. It consists of seven separate but

related layers, each of which defines a part of the process of moving information across a network.

(4) With a short note on :

i) Shannon Capacity :-

> In reality, we cannot have a noiseless channel; the channel is always noisy.
For noisy channel, the Shannon capacity formula defines the theoretical maximum bit-rate.

$$\text{Capacity} = \text{bandwidth} \times \log_2(1 + \text{SNR})$$

where, bandwidth = bandwidth of channel in bps,
SNR = Signal-to-noise Ratio.
Capacity = Capacity of channel in bps.

This formula does not consider the no. of levels of signals being transmitted.

ii). Nyquist theorem in communication.

> $$\text{Bitrate} = 2 \times \text{Bandwidth} \times \log_2 L.$$

where, bandwidth = bandwidth of the channel.
L = number of signal-levels used to represent data Bit Rate.

According to the formula,

- By increasing number of signal-levels, we can increase the bit-rate.
- Although the idea is theoretically correct, practically there is a limit.
- When we increase the number of signal-levels, we impose a burden on the receiver.

- If no. of levels is 64, the receiver must be very sophisticated to distinguish b/w 64 different levels.
- In other words, Increasing the levels of a signal reduces the reliability of the system.

(5) Explain digital to digital conversion.

> Data can be analog or digital, So can be the signal that represents it.

Signal Encoding is the conversion from analog/digital data to analog/digital signal.

Line - Coding is the process of converting digital - data to digital - signals.

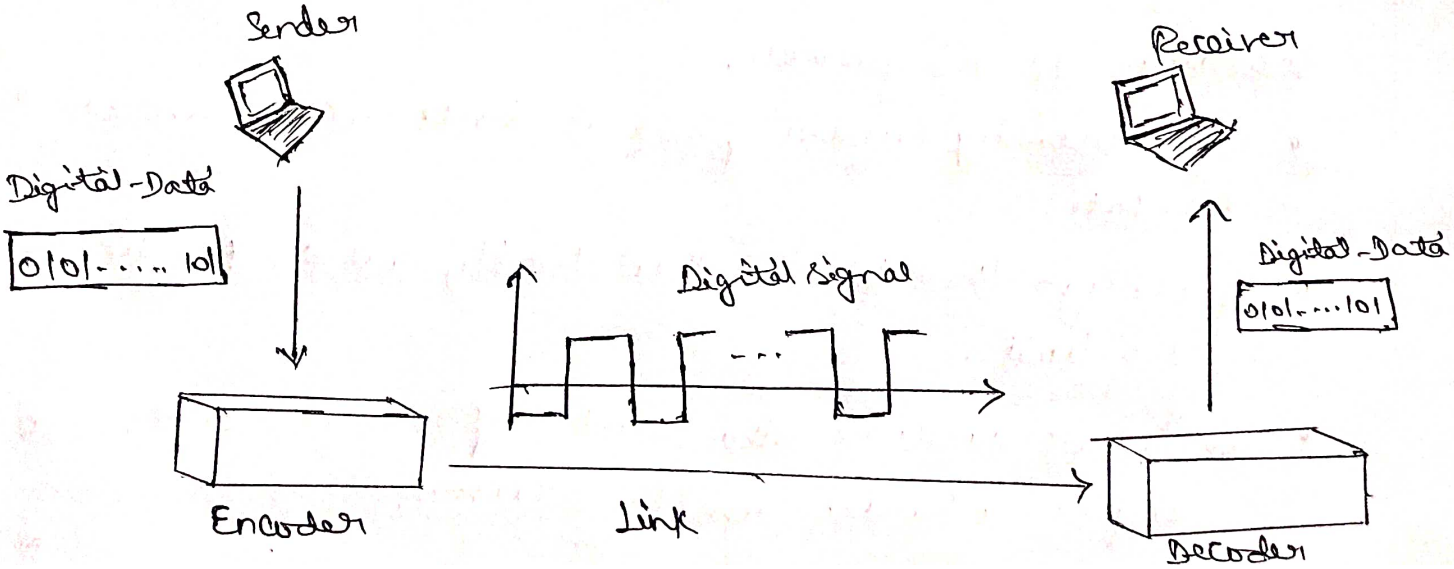
The data may be in the form of text, numbers, graphical images, audio or video.

The data are stored in computer memory as sequences of bits (0s and 1s).

Line - coding converts a sequence of bits to a digital - signal.

At the sender, digital - data is encoded into a digital signal.

At the receiver, digital - signal is decoded into a digital data.



(6) An analog signal has a bit rate of 8000 bps, and a baud rate of 1000 baud. How many data elements are carried by each signal element? How many signal elements do we need?

>

Bit Rate, $N = 8000$ bps

$S = 1000$

$r = ?$

$L = ?$

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

$r = \frac{N}{S} = \frac{8000}{1000} = 8$ bits/baud //.

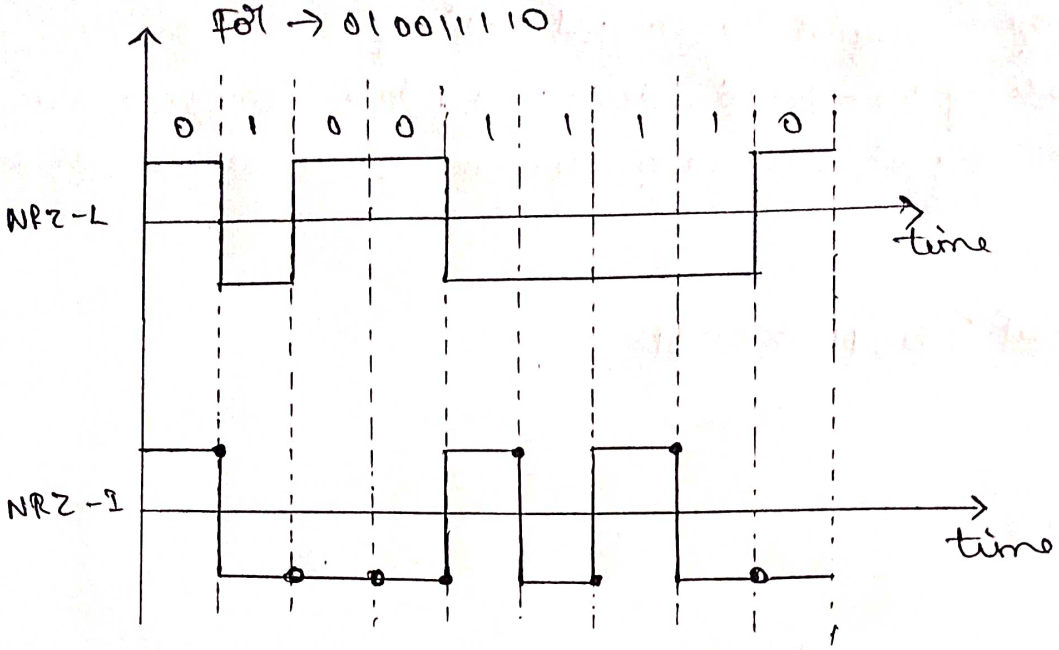
$r = \log_2 L = 2^r$

$L = 2^r = 2^8 = 256$ //.

(7) Define Line coding. Enumerate the changes in the line coding. Draw the line code of the sequence 01001110 using Polar NRZ-L and NRZ-I schemas.

> Line-coding :- It is the process of converting digital-data to digital-signals.

- The data may be in the form of text, numbers, graphical images, audio or video.
- The data are stored in computer memory as sequence of bits.
- Line-coding converts a sequence of bits to a digital-signal.
- At the sender, digital-data is encoded into a digital-signal.
- At the receiver, digital-data is decoded into a digital-data.




0 → No inversion; Next bit is 0.

• → Inversion; Next bit is 1.

Polar NRZ-L and NRZ-I schemes.

(8) In a digital transmission, the receiver clock is 0.3 percent faster than the sender clock. How many extra bits per second does the receiver receive if the data rate is 1Mbps.

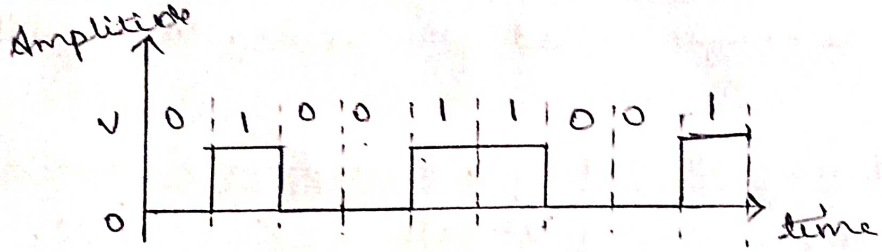
At 1Kbps, the receiver receives 1001 bps instead of 1000 bps.

1000 bits sent → 1001 bits received → 1 extra bit per/s

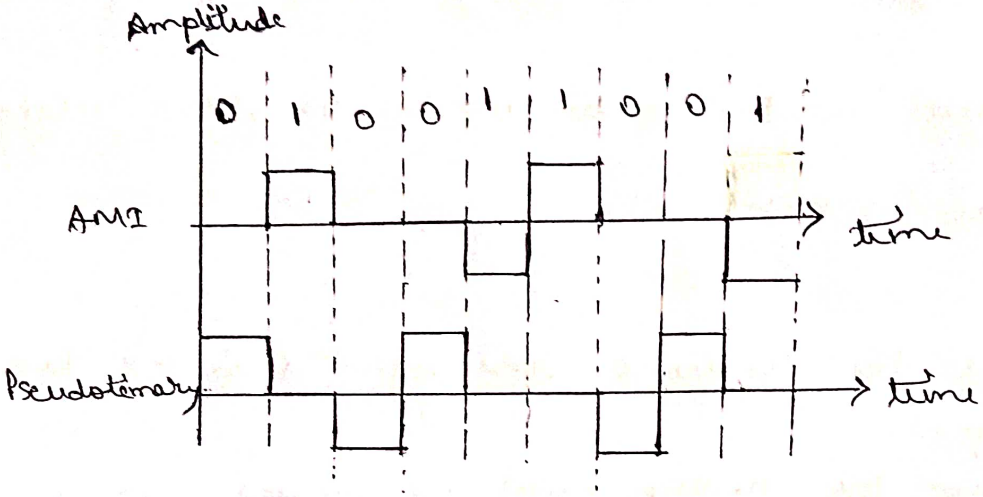
At 1Mbps, the receiver receives 1,001,000 bps instead of 1,000,000 bps.

1,000,000 bits sent → 1,001,000 bits received → 1000 extra bps.

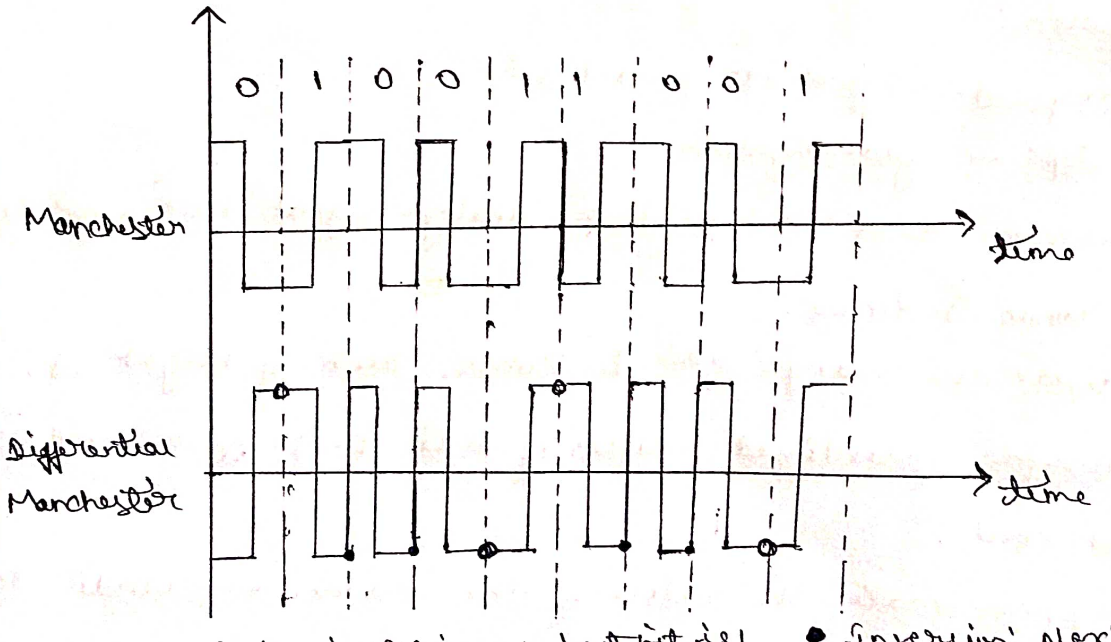
(9) Draw line code for the sequence 0 1 0 0 1 1 0 0 1 using NRZ, Bipolar, Manchester and differential Manchester.




NRZ




Bipolar schemes : AMI and pseudoternary




0 No - inversion : Next bit is 1 • Inversion: Next bit is 0

Polar - Biphase / Bipolar Manchester & differential manchester

(10) Explain the PCM technique used for analog to digital conversion.

> An analog-signal may created by a microphone or camera.
To change an analog - to digital data, we use PCM.

PCM:

- PCM is a technique used to change an analog signal to digital data.
- PCM has encoder at the sender and decoder at the receiver.

- The encoder has 3 processes:

1. Sampling:
   - > we convert the continuous time signal into the discrete time signal.
   - > Pulses from the analog-signal are sampled every $T_s$ sec,
   - > The inverse of the sampling-interval is called the sampling frequency.

2. Quantization:
   The sampled-signal is quantized.
   Four steps in quantization.
   - > we assume that the original analog-signal has amplitudes b/w $V_{min}$ & $V_{max}$.
   - > we divide the range into L zones, each of height $\Delta$.
   - > we assign quantized values of 0 to (L-1) to the midpoint of each zone.
   - > we approximate the value of the same amplitude to the quantized values.

3. Encoding:

- The quantized values are encoded as n-bit code word.
- Relationship b/w number of quantization levels & number of bits is given by $n = \log_2 L$ or $2^n = L$.
- The bit rate is given by:

Bit Rate = Sampling rate × number of bits / sample

$= f_s \times n$ ∴ Quantized Signal