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Data-Communication 1st Summary

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BASICS

- Data can be defined as information suitable for processing or storage by a computer.
- Signal can be defined as information transmitted by means of a modulated current or an electromagnetic wave.

Types of Data/Signal

- Analog (continuous information) example is analog watch.
- Digital (discrete information) example is digital watch.

Data Communications is the exchange of data between two devices via some form of transmission medium in a reliable and efficient manner.

Components of data communication.

1. **Message.** The **message** is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
2. **Sender.** The **sender** is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
3. **Receiver.** The **receiver** is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
4. **Transmission medium.** The **transmission medium** is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.
5. **Protocol.** A **protocol** is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

Data Representation

- Text
- Numbers
- Images
- Audios
- Videos

Data Flow

Communication between two devices can be simplex, half duplex and full duplex

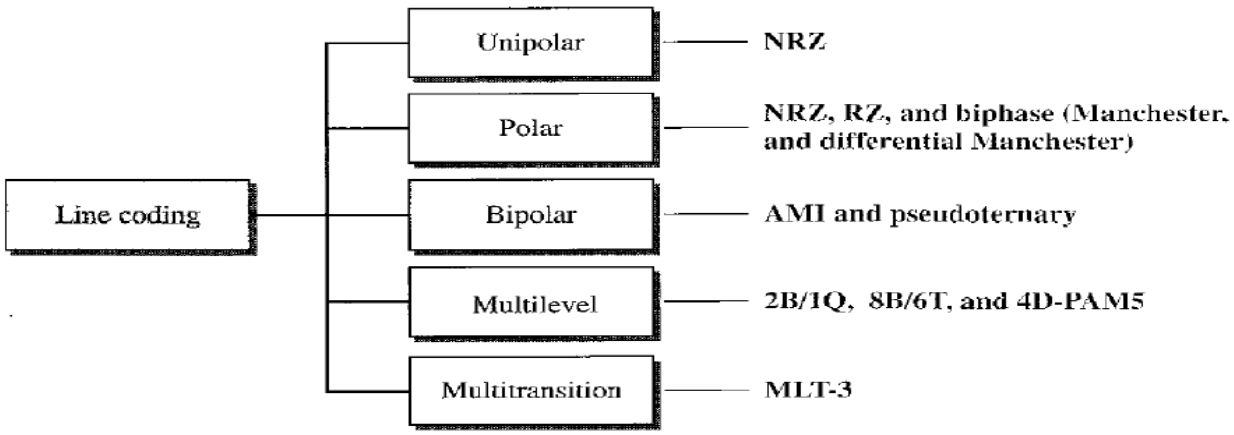
- Simplex (it is unidirectional i.e. only one device can receive and the other can only transmit e.g. a keyboard can only introduce input and a monitor can only accept output).
- Half duplex (each station can both transmit and receive but not at the same time i.e. when one is transmitting the other can only receive and vice versa. E.g. walkie-talkie [over-over]).
- Full duplex (both can receive and transmit simultaneously e.g. telephone network).

For transmission, data (analog or digital) has to be converted into signals (analog or digital).
Base on
The basic of analog signaling is a constant frequency signal known as carrier signal which is compatible with transmission media being used so that it can transvel a long distance with minimum attenuation and distortion.

Data transmitted using carrier signal by a process of modulation where one or more fundamental parameters amplitude frequency and phase is changed.

Technique of Encoding Data

1. **Digital data-Digital signal.**

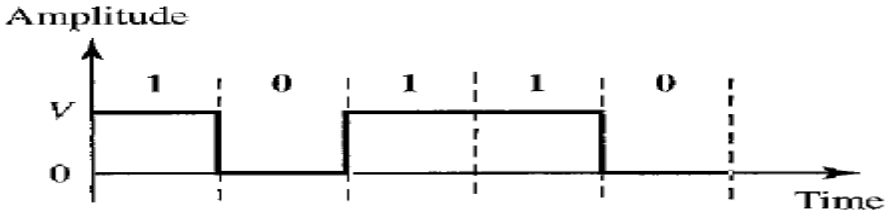


The technique used is known as line coding (i.e. converting digital data to digital signal). There are of three types

- Unipolar; all the signal levels are on one side of the time axis. Either above or below.
  - Positive voltage for 1 bit
  - Negative voltage for 0 bit.

Or vice versa.

Example



❖ Polar NRZ(non-return to zero)

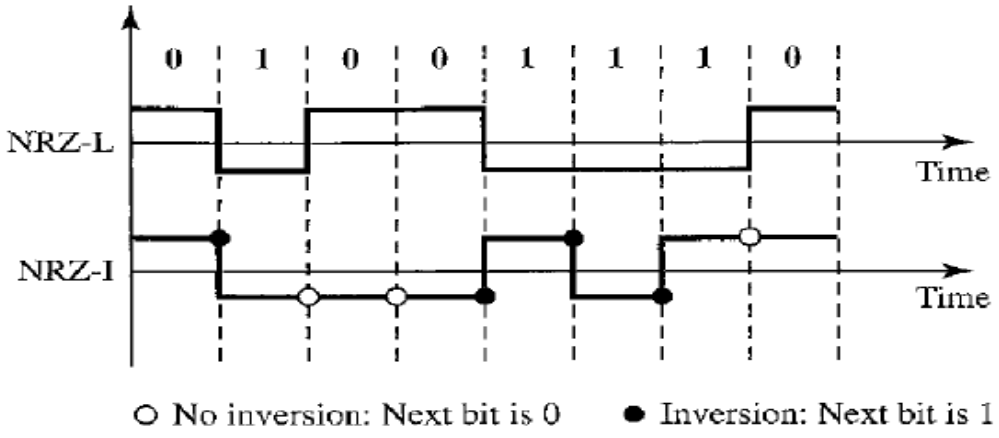
1 for a high (positive voltage)

0 for a low (negative voltage) or vice-versa

Here it is divided into two

- NRZ-L (Non return to zero level); it uses two voltage levels, the level of voltage determines the value of bit.
- NRZ-I (Non return to zero inversion); the change or lack of change in the level of the voltage determines the value of bit. If there is no change, the bit is zero if there is the bit is one.

Example;



❖ Biphase is used to overcome the limitation of NRZ coding e.g. Manchester and differential Manchester coding.

- Manchester coding there are transition at the middle of each bit period

. Manchester coding translation

1 bit low-to-high transition

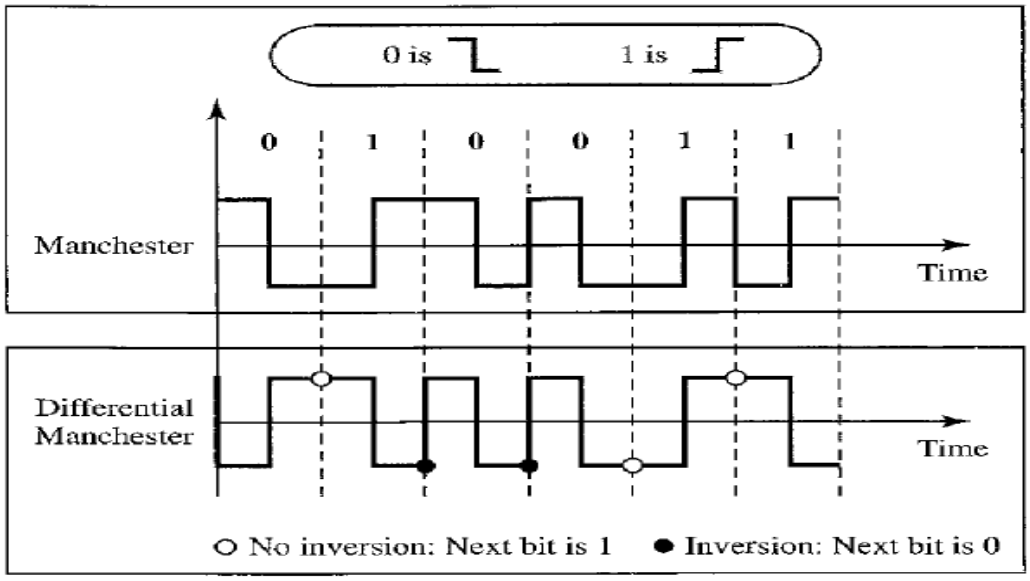
0 bit high-to-low transition

- Differential Manchester; inversion in the middle of each beat used for synchronization

0 bit presence of transition both at the beginning and the middle

1 bit absence of transition at the beginning.

In Manchester and differential Manchester encoding, the transition at the middle of the bit is used for synchronization.

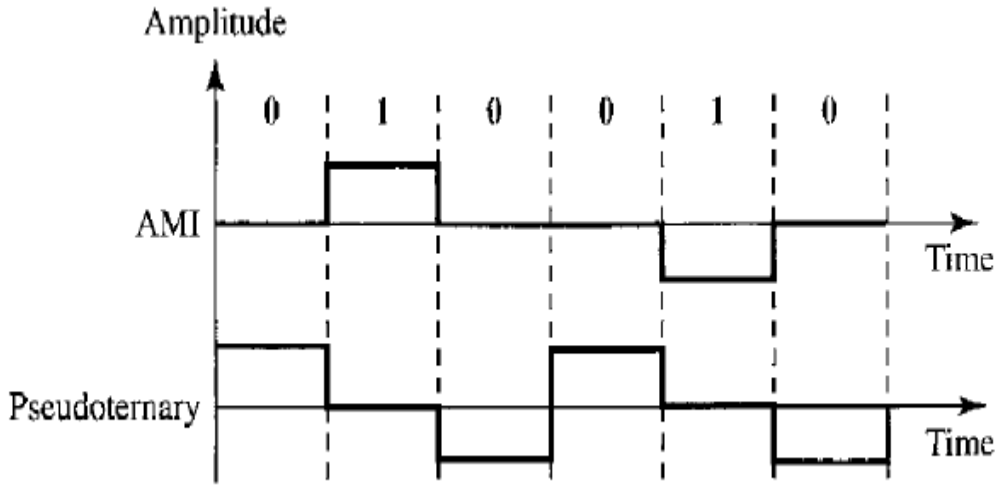


❖ **Bipolar Schemes;**

There are three voltage levels, positive, negative and zero. The voltage level of one bit element is at zero and the other alternate between positive and negative. There are of two types.

- AMI (Alternate Mark Inversion); the word "mark" comes from telegraphy and means 1.so AMI means alternate 1 inversion. A neutral zero voltage is represented by binary 0 and binary 1s are represented by alternating positive and negative voltages.
- Pseudoternary ; this is the opposite of AMI.

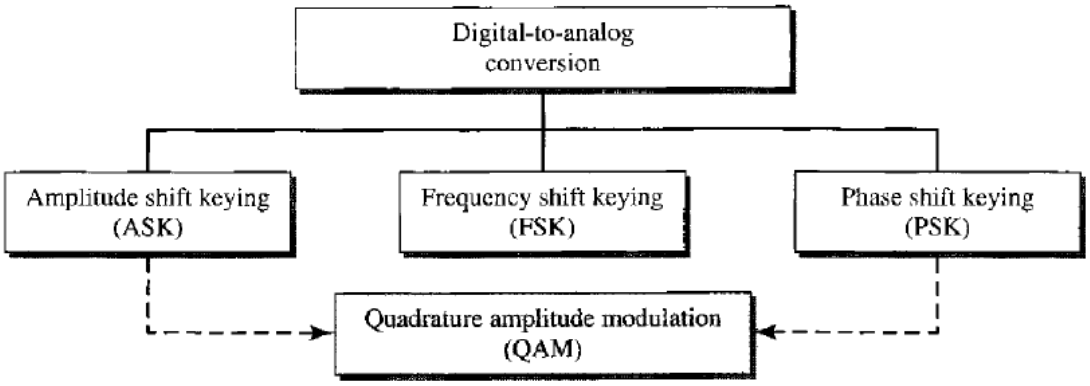
Example,



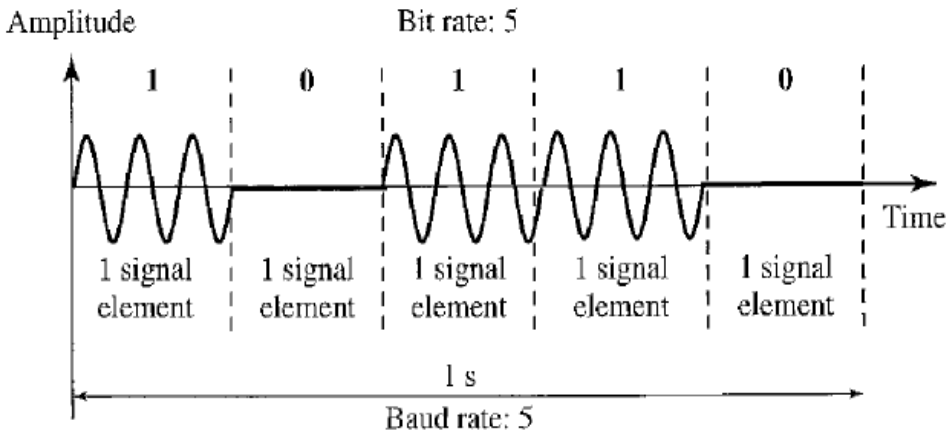
AMI can be used for large distances, it is developed as an alternative for NRZ. It has the problem of synchronization when a long sequence of zero id present in the data.

2. Digital to Analog Conversion.

Basis for this signaling is a constant frequency signal known as carrier signal.

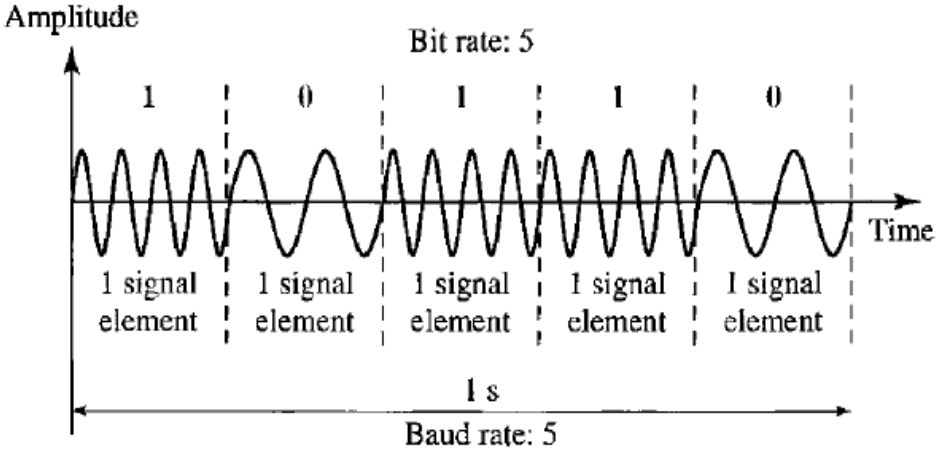


- Amplitude shift keying (ASK); here the amplitude of the carrier signal is varied while keeping phase and frequency constant.



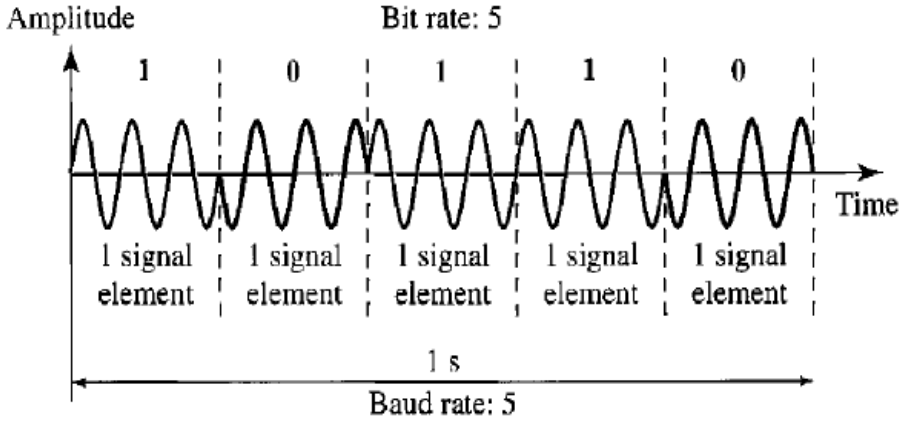
❖ **Frequency Shift Keying;**

The frequency of the carrier signal is varied to represent data. The frequency is constant for one of the modulated signal but changes for the next data element if the data element changes. Here the phase and the amplitude is kept constant.



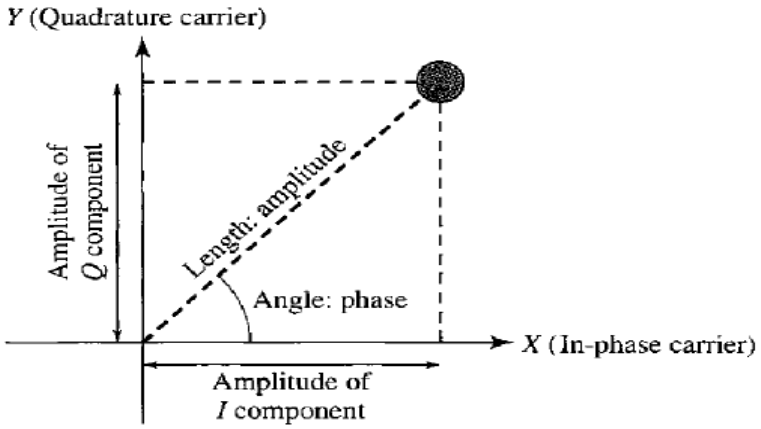
❖ **Phase shift keying;**

The phase of the carrier is varied to represent different signal element. The frequency and the amplitude is keep constant.



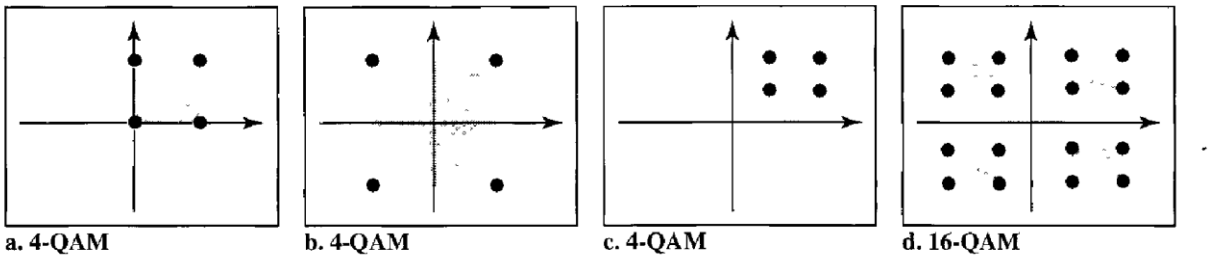
❖ **Quadrature Amplitude Modulation (QAM).**

Before going into the Quadrature Amplitude Modulation, the knowledge of CONSTELLATION DIAGRAM should be obtained. A constellation diagram can help define the amplitude and phase of a signal element, particularly when two carriers are used. In a constellation diagram, a signal element is represented by a dot. The bit or number of bits it can carry can be written next to it.



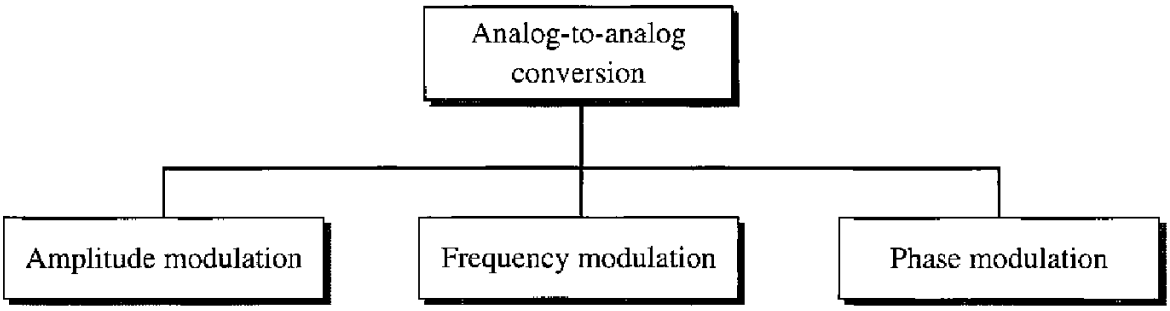
The diagram has two axis. The horizontal axis X is related to the in-phase carrier, thee vertical y-axis is related to the quadrature axis.

The QAM combines both the PSK and ASK for its operation.



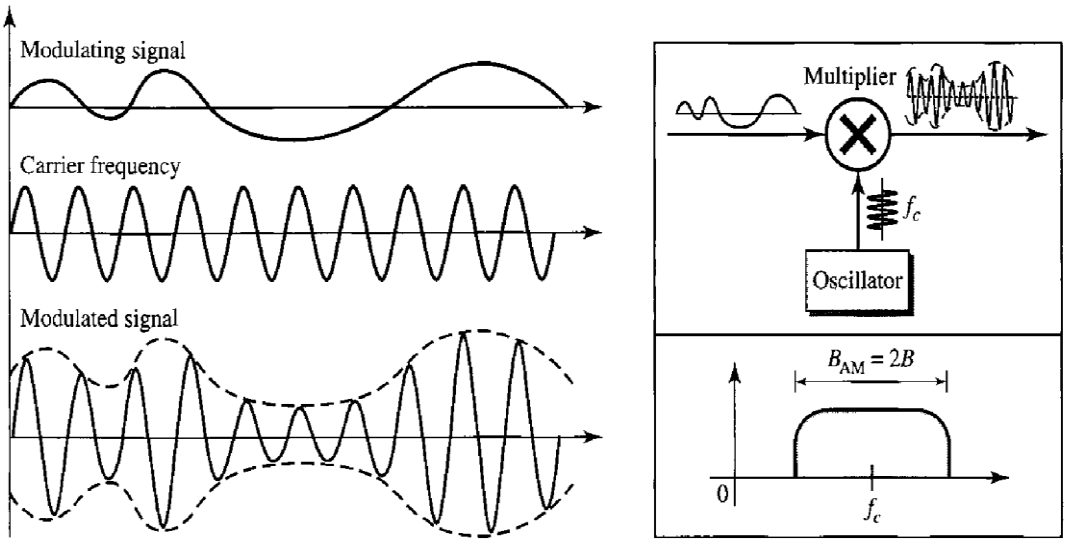
Most of the modems used transfer data using QAM techniques.

3. Analog data to Analog signal.



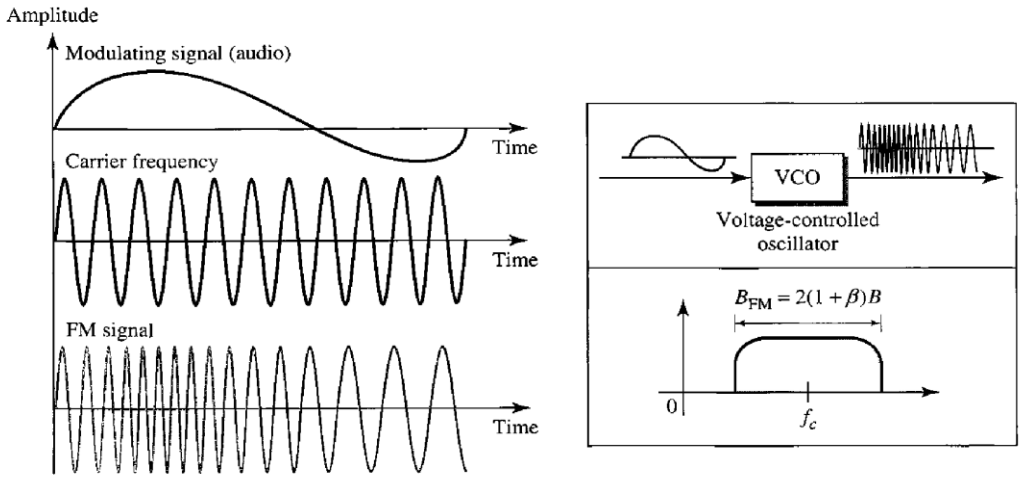
❖ **Amplitude Modulation (AM);**

The carrier signal is modulated so that its amplitude varies with the changing amplitude of the modulating signal (message signal or baseband message). The frequency and the phase of the carrier remains the same; only the amplitude changes to follow the variations in the information.



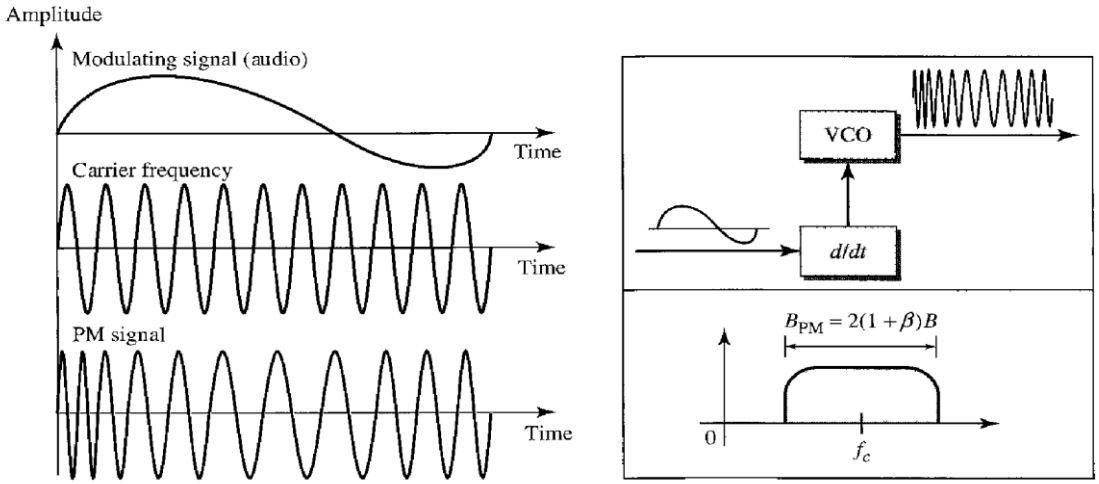
❖ **Frequency Modulation (FM);**

The frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and the phase of the carrier signal remains the same, but as the amplitude of the modulating signal changes, the frequency of the carrier changes correspondingly.



❖ **Pulse Modulation (PM);**

The phase of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal.

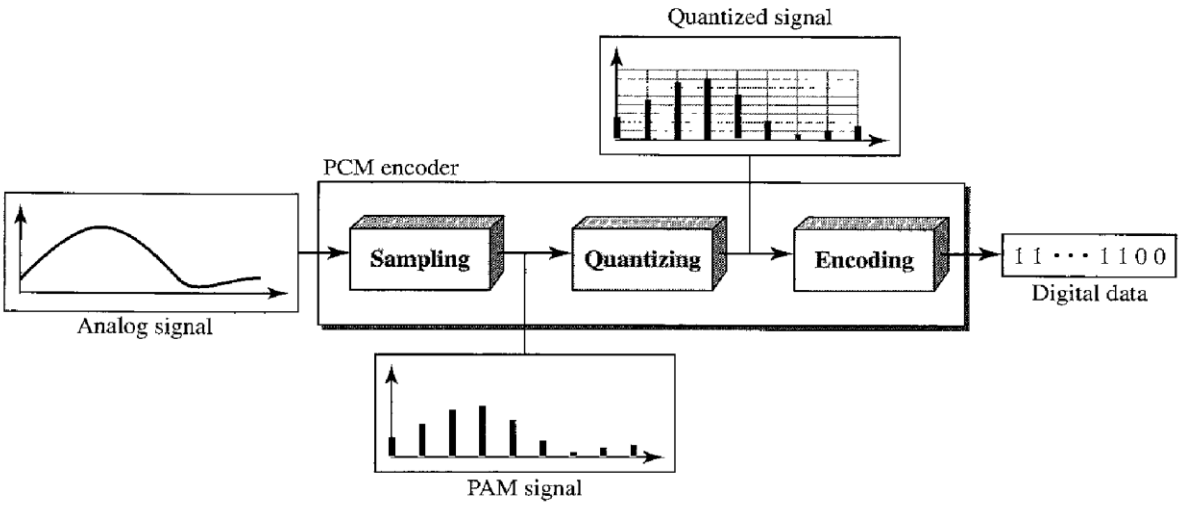


4. Analog Data to Digital signal; There are two techniques used to convert an analog data into digital signal. The whole idea here is to convert the analog data into digital data then one of the techniques mentioned above could be used to convert the digital data into digital signal.

❖ **Pulse Code Modulation (PCM);**

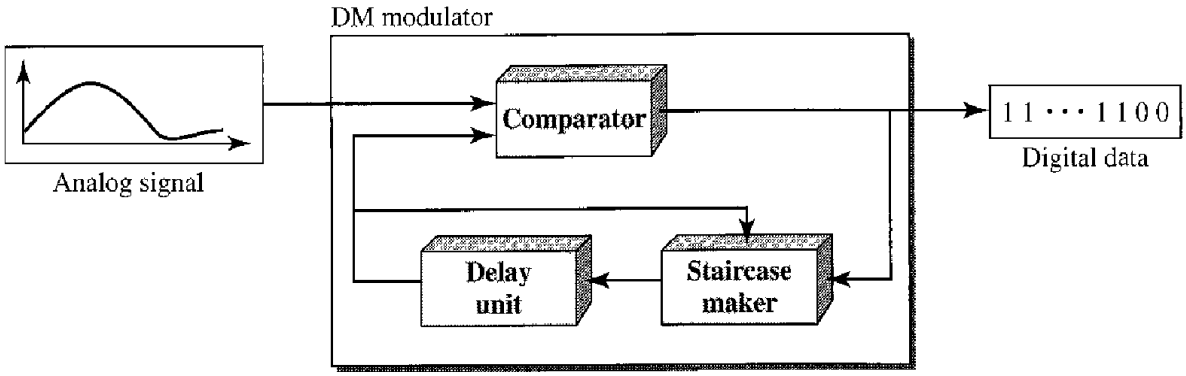
The most common technique to change an analog signal to digital data (digitizing) is the PCM. It has three process. A digital encoder has three process.

- Sampling
- Quantizing
- Encoding.



- **Delta Modulation;**

  PCM is a very complex technique. Therefore other techniques are developed to reduce the complexity.



Summary by TOBENNA CALISTUS

Solution to 2years Pastquestion Paper Will Be Solved and Uploaded On Smartbukites. Latest 11th Week of the Semester

Reference

1. Behrouz A. Forouzan and Sophia Chung Fegan “Data Communication And Networking” Fourth edition
2. Data Communication lecture notes by DR. DAHIRU SANI SHUAIBU.