BCA TDC PART -3

Data Communication and Network

Data communication refers to the exchange of data between a source and a receiver. Souce is a device that generate and prepared the data for communication and receiver is also a device that receive the data transmitted by source .Data communication is said to be local if communicating devices are in the same building or a similarly restricted geographical area. A data communication Process may simply shown as :

Simple Data Communicative System

A data communication system may collect data from remote locations through data transmission circuits, and then outputs processed results to remote locations. Communication channels (Wired / Wireless) are responsible to carry the data signals from source to destination i.e sender device to receiver device. Different techniques are adopted to convert the data according to channels and the devices where data are generated and received. Mostly , the data at the end of sender device and receiver device are in the mode of digital signal where the on the transmission medium it is in the form of analog signal . Conversion between digital to analog and analog to digital is taken place in data communication through transmitting device trans receiver/modem as per the nature of the channel .

The distance between sender and receiver depends upon the types of network used in between .As the source and the device that receives the transmitted data known as a receiver.

Data communication aims at the transfer of data and maintenance of the data during the process, but not the actual generation of the information at the source and receiver. Data mean the facts, information statistics or the like deriving by calculation or experimentation. The facts and information so gathered are processed in accordance with defined systems of procedure. Data can exist in a Variety.of forms such as numbers, text, bits and bytes. The Figure is an illustration of a simple data communication system.

A communication system has following components:

Message: It is the information or data to be communicated: It can consist of text, numbers, pictures, sound or video or any combination of these.

Sender: It is the-device/computer that generates and sends that message.

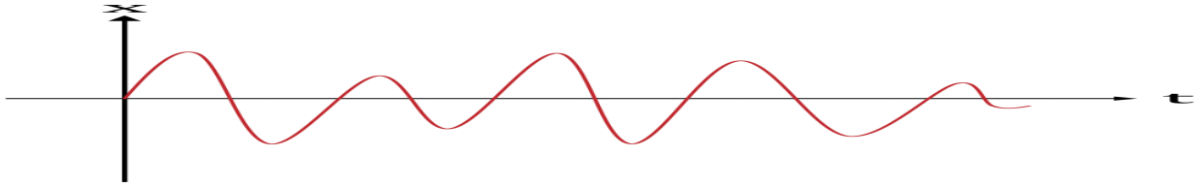
Receiver: It is the device or computer that receives the message. The location of receiver computer is generally different from the sender computer.
Medium: It is the channel or physical path through which the message is carried from sender to the receiver. The medium can be wired like twisted .pair wire, coaxial cable, fiber-optic cable or wireless like laser, radio waves, and microwaves.
Protocol: It is a set of rules that govern the communication between the devices. Both sender and receiver follow same protocols to communicate with each other.

Signals are electric or Electromagnetic encoding of data and signaling is Propagation of signal along suitable communication medium.

Analog and Digital Signal

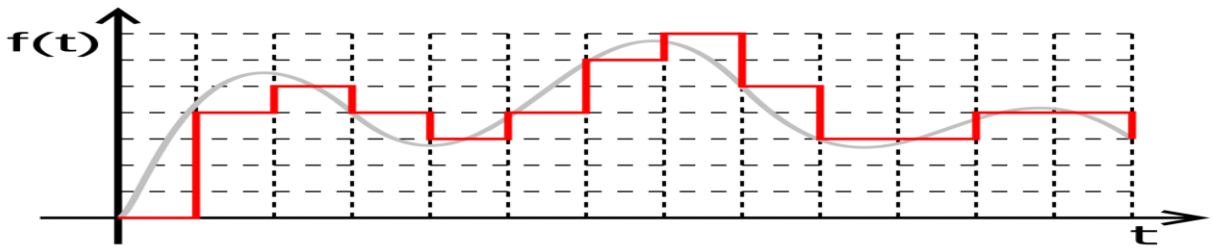
An analog signal is one type of continuous time-varying signals, and these are classified into composite and simple signals. A simple type of analog signal is nothing but a sine wave, and that can't be decomposed, whereas a composite type analog signal can be decomposed into numerous sine waves. An analog signal can be defined by using amplitude, time period otherwise frequency, & phase. Amplitude streaks the highest height of the signal, frequency streaks the rate at which an analog signal is varying, and phase streaks the signal position with respect to time nothing. An analog signal is not resistant toward the noise, therefore; it faces distortion as well as reduces the transmission quality. The analog signal value range cannot be fixed.

Analog Signal



Digital signals carry the data although it is a bit different. These signals are discrete or not continuous. A digital signal carries the data in the form of binary because it signifies in the bits. These signals can be decomposed into sine waves which are termed as harmonics. Every digital signal has amplitude, frequency, & phase like the analog signal. This signal can be defined by bit interval as well as bit rate. Here, bit interval in nothing but the required time for transmitting an only bit, whereas the bit rate is bit interval frequency.

Digital signals are more resistant toward the noise; therefore, it barely faces some distortion. These waves are simple in transmitting as well as more dependable while contrasted to analog waves. Digital signals include a limited variety of values which lies among 0-to-1



Digital Signal

Characteristics and Differences of Analog and Digital Signals

1. Analog signals are less adjustable for a range of use, whereas digital signals are more adjustable for a range of use.
2. Analog signals use a continuous variety of amplitude values whereas digital signal takes a limited set of distinct values at consistently spaced spots in the time
3. Analog signals are continuous in nature, whereas digital signals are discrete.
4. Analog signal wave type is sinusoidal, whereas a digital signal is a square wave
5. Analog signal medium of transmission is wire or wireless, whereas a digital signal is a wire
6. Analog signal value type if positive as well as negative, whereas a digital signal is positive.
7. The security of an analog signal is not encrypted, whereas a digital signal is encrypted.
8. The analog signal bandwidth is low, whereas the digital signal is high.
9. Analog signal hardware is not elastic, whereas digital is elastic in execution

10. Analog signals are portable similar to the thermometer and low cost, whereas digital signals are portable similar to computers and expensive.
11. The data storage of an analog signal is in the wave signal form,whereas digital signal stores the data in the binary bit form.
12. In analog, the signal can be deterioration due to noise throughout transmission, whereas digital signal can be noise resistant throughout transmission devoid of any deterioration
13. The data transmission rate in the analog signal is slow, whereas in the digital signal it is faster.
14. Analog devices use more power, whereas digital devices use less power.

Modes of transmission.

Data Transmission mode defines the direction of the flow of information between two communication devices. It is also called Data Communication or Directional Mode. It specifies the direction of the flow of information from one place to another in a computer network

In the Open System Interconnection(OSI) Layer Model, the **Physical Layer** is dedicated to data transmission in the network. It mainly decides the direction of data in which the data needs to travel to reach the receiver system or node.

The data transmission modes can be characterized in the following three types based on the direction of exchange of information:

1. Simplex - **Simplex is the data transmission mode in which the data can flow only in one direction, i.e., the communication is unidirectional.** In this mode, a sender can only send data but can not receive it. Similarly, a receiver can only receive data but can not send it.

   This transmission mode is not so popular because we cannot perform two-way communication between the sender and receiver in this mode. It is mainly used in the business field as in sales that do not require any corresponding reply. It is similar to a one-way street.

For Example, Radio and TV transmission, keyboard, mouse, etc.

Following are the advantages of using a Simplex transmission mode:

1. It utilizes the full capacity of the communication channel during data transmission.
2. It has the least or no data traffic issues as data flows only in one direction.

Following are the disadvantages of using a Simplex transmission mode:

1. It is unidirectional in nature having no inter-communication between devices.
2. There is no mechanism for information to be transmitted back to the sender(No mechanism for acknowledgement).

2. Half-Duplex - **Half-Duplex is the data transmission mode in which the data can flow in both directions but in one direction at a time. It is also referred to as Semi-Duplex.** In other words, each station can both transmit and receive the data but not at the same time. When one device is sending the other can only receive and vice-versa.

   In this type of transmission mode, the entire capacity of the channel can be utilized for each direction. Transmission lines can carry data in both directions, but the data can be sent only in one direction at a time.

   This type of data transmission mode can be used in cases where there is no need for communication in both directions at the same time. It can be used for error detection when the sender does not send or the receiver does not receive the data properly. In such cases, the data needs to be transmitted again by the receiver.

   For Example, Walkie-Talkie, Internet Browsers, etc.

Following are the advantages of using a half-duplex transmission mode:

1. It facilitates the optimum use of the communication channel.

2. It provides two-way communication.

Following are the disadvantages of using a half-duplex transmission mode:

1. The two-way communication can not be established simultaneously at the same time.
2. Delay in transmission may occur as only one way communication can be possible at a time.

3. Full Duplex - **Full-Duplex is the data transmission mode in which the data can flow in both directions at the same time. It is bi-directional in nature.** It is two-way communication in which both the stations can transmit and receive the data simultaneously.

   Full-Duplex mode has double bandwidth as compared to the half-duplex. The capacity of the channel is divided between the two directions of communication. This mode is used when communication in both directions is required simultaneously.

   For Example, a Telephone Network, in which both the persons can talk and listen to each other simultaneously.

Following are the advantages of using a full-duplex transmission mode:

1. The two-way communication can be carried out simultaneously in both directions.
2. It is the fastest mode of communication between devices.

Following are the disadvantages of using a half-duplex transmission mode:

1. The capacity of the communication channel is divided into two parts. Also, no dedicated path exists for data transfer.
2. It has improper channel bandwidth utilization as there exist two separate paths for two communicating devices

According to the synchronization between the transmitter and the receiver the transmission modes are :

1. Synchronous - The Synchronous transmission mode is a mode of communication in which the bits are sent one after another without any start/stop bits or gaps between them. Actually, both the sender and receiver are paced by the same system clock. In this way, synchronization is achieved.

   In a Synchronous mode of data transmission, bytes are transmitted as blocks in a continuous stream of bits. Since there is no start and stop bits in the message block. It is the responsibility of the receiver to group the bits correctly. The receiver counts the bits as they arrive and groups them in eight bits unit. The receiver continuously receives the information at the same rate that the transmitter has sent it. It also listens to the messages even if no bits are transmitted.

   In synchronous mode, the bits are sent successively with no separation between each character, so it becomes necessary to insert some synchronization elements with the message, this is called "**Character-Level Synchronization**".

   For Example, communication in CPU, RAM, etc.

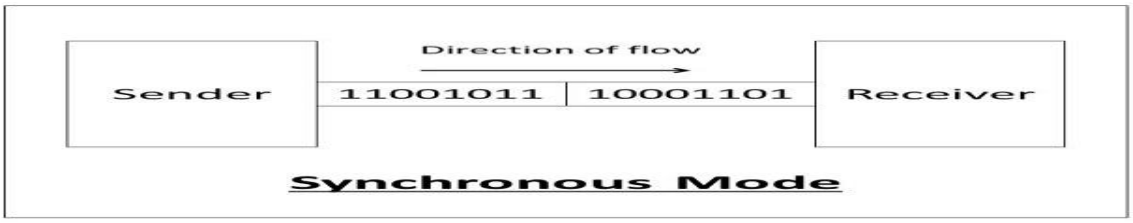
   Following are the advantages of using a Synchronous transmission mode:

1. Transmission speed is fast as there is no gap between the data bits.

   Following are the disadvantages of using a Synchronous transmission mode:

1. It is very expensive.

   For Example, if there are two bytes of data, say(10001101, 11001011) then it will be transmitted in the synchronous mode as follows:



2. Asynchronous- **The Asynchronous transmission mode is a mode of communication in which a start and the stop bit is introduced in the message during transmission.** The start and stop bits ensure that the data is transmitted correctly from the sender to the receiver.

   Generally, the start bit is '0' and the end bit is '1'.Asynchronous here means 'asynchronous at the byte level', but the bits are still synchronized. The time duration between each character is the same and synchronized.

   In an asynchronous mode of communication, data bits can be sent at any point in time. The messages are sent at irregular intervals and only one data byte can be sent at a time. This type of transmission mode is best suited for short-distance data transfer.

   For Example, Data input from a keyboard to the computer.

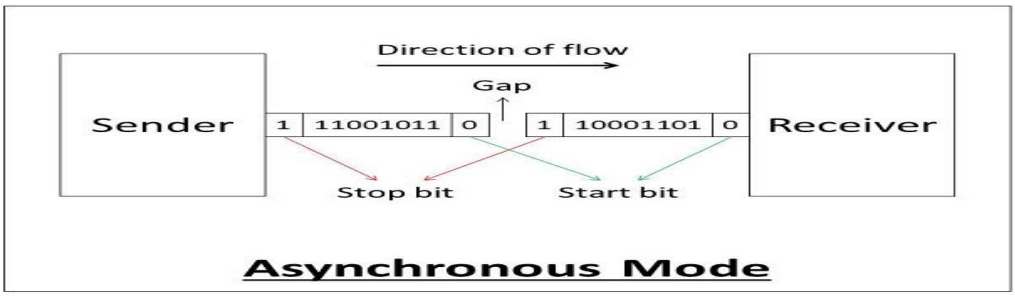
   Following are the advantages of using an Asynchronous transmission mode:

   1. It is a cheap and effective mode of transmission.
   2. Data transmission accuracy is high due to the presence of start and stop bits.

   Following are the disadvantages of using an Asynchronous transmission mode:

   1. The data transmission can be slower due to the gaps present between different blocks of data.

For Example, if there are two bytes of data, say(10001101, 11001011) then it will be transmitted in the asynchronous mode as follows:



According to the number of bits sent simultaneously in the network the transmission modes are :

1. Serial - **The Serial data transmission mode is a mode in which the data bits are sent serially one after the other at a time over the transmission channel.**

   It needs a single transmission line for communication. The data bits are received in synchronization with one another. So, there is a challenge of synchronizing the transmitter and receiver.

   In serial data transmission, the system takes several clock cycles to transmit the data stream. In this mode, the data integrity is maintained, as it transmits the data bits in a specific order, one after the other.

   This type of transmission mode is best suited for long-distance data transfer, or the amount of data being sent is relatively small.

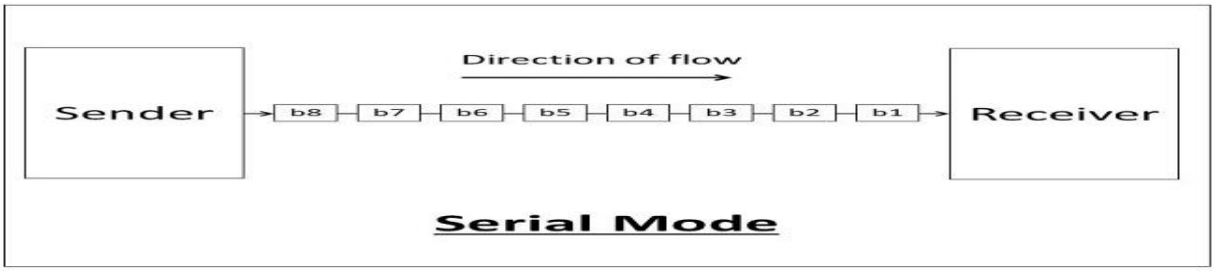
   For Example, Data transmission between two computers using serial ports.

   Following are the advantages of using a serial transmission mode:

1. It can be used for long-distance data transmission as it is reliable.
2. The number of wires and complexity is less.
3. It is cost-effective.

   Following are the disadvantages of using a serial transmission mode:

1. The Data transmission rate is slow due to a single transmission channel.



2. Parallel - **The Parallel data transmission mode is a mode in which the data bits are sent parallelly at a time.** In other words, there is a transmission of n-bits at the same time simultaneously.

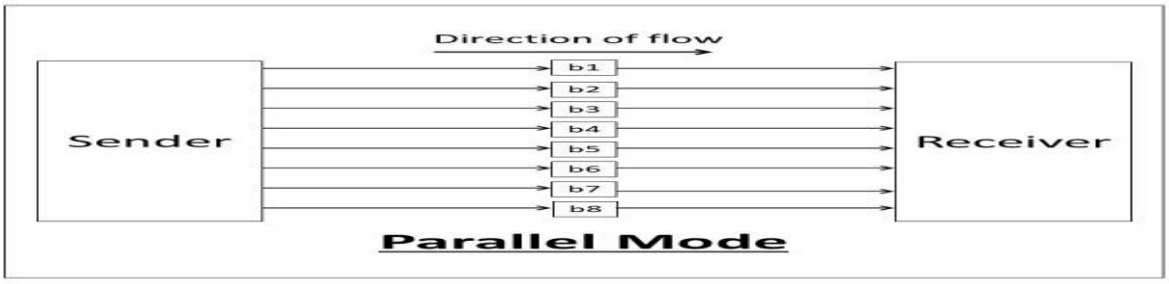
   Multiple transmission lines are used in such modes of transmission. So, multiple data bytes can be transmitted in a single system clock. This mode of transmission is used when a large amount of data has to be sent in a shorter duration of time. It is mostly used for short-distance communication.

   For n-bits, we need n-transmission lines. So, the complexity of the network increases but the transmission speed is high. If two or more transmission lines are too close to each other, then there may be a chance of interference in the data, degrading the signal quality.
   For Example, Data transmission between computer and printer.
   Following are the advantages of using a parallel transmission mode:

   1. It is easy to program or implement.
   2. Data transmission speed is high due to the n-transmission channel.

   Following are the disadvantages of using a parallel transmission mode:

   1. It requires more transmission channels, and hence cost-ineffective.
   2. Interference in data bits, likewise in video conferencing.



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