Unit 14

Comminication

Teaching Periods 6 *Weightage %* 4

Communication has wide impact in all fields. It has brought visible effect in our lives and has made our lives more comfortable. The common examples of modern communications are satellites, microwave systems, fiber optics, cellular phones, internet,

In this unit student should be able to:

- Describe how the information may be carried by number of different channels, including wire-pairs, coaxial cables, radio and microwave links, optic fibers and Satellites.
- Describe relative merits of channels of communication.
- Describe that information can be transmitted by radio waves.
- Understand the term modulation and be able to distinguish between amplitude modulation and frequency modulation.
- Define the term Bandwidth.
- Demonstrate an awareness of relative advantages of AM and FM transmission.
- Understand the advantages of transmission of data in digital form, compared with the transmission of data in analog form.
- Understand that the digital transmission of speech or music involves analog to digital (ADC) before transmission and digital to analog conversion after reception.

Communication can be defined as the exchange of information between two or more bodies. In today's world, exchange of information is not only between people, but also information exchange also takes place between machines or systems. For instance Data services like Social Media – Direct Message (DM), Instant Message (IM), SMS Text Messaging, Email Marketing, Blogging, Voice Calling, Video Chat and web browsing are some of the examples of communication.

14.1 Communication Channels:

The communication channel is the medium chosen by the sender (transmitter) for the transmission of the signal to the receiver.

In any communication system, channels are the vital part. They may be used on land, sea or even in space. The Communication channel can be broadly classified into two categories- Cable and Broadcast. These categories are further divided into its following main components.

Cable:

____ Twisted Pair Cable
____ Coaxial Pair Cable
____ Optical Fibre Cable

Broadcast:

____ Radio or Infrared link
____ Microwave link
____ Satellite

Fig: 14.1
Telephone, telegraph, and power lines over the streets of New York City during the Great Blizzard of 1888.

14.1.1 Information Carried By Different Channels:

Twisted-Pair Cable:

Twisted –pair cable was invented by Alexander Graham Bell in 1881. It becomes widely used for telephone communication and as well as in Ethernet (joining two computers) networks. Two conducting wires are twisted forming a circuit that can transmit data and to prevent various signal interference.

There are two types of Twisted-pair cable: Shielded Twisted –pair cable (STP) and Unshielded Twisted-pairs cable (UTP). STP is used to provide protection against crosstalk, noise and electromagnetic interference. However, UTP is used in Ethernet Installation

Fig: 14.2
Unshielded Twisted-Pair Cable

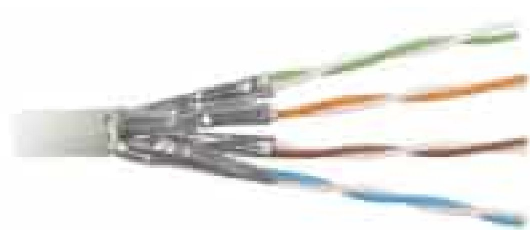


Fig: 14.3
Shielded Twisted-Pair Cable

Coaxial Cable:

The concept of Coaxial cable was given by an English Physicist and Mathematician Oliver Heariside in 1880. It consists of a copper core surrounded by an inner dielectric insulator which is then surrounded by woven copper shield. Covering this shield is the insulating jacket. In this way it has two insulating and two conducting materials act simultaneously.

Fig: 14.4 Coaxial Cable

DO YOU KNOW?

Coaxial Cable was first used in 1858 but its theory was not described and in 1990 Oliver Heariside patented the design of Coaxial Cable and was accepted by the scientific community.

Optical Fiber:

Fiber optics sends information coded in a beam of light down a glass or plastic pipe. It works on the principle of total internal reflection. A fiber-optic cable is made up of incredibly thin strands of glass or plastic known as optical fibers; one cable can have as few as two strands or as many as several hundred. Each strand is

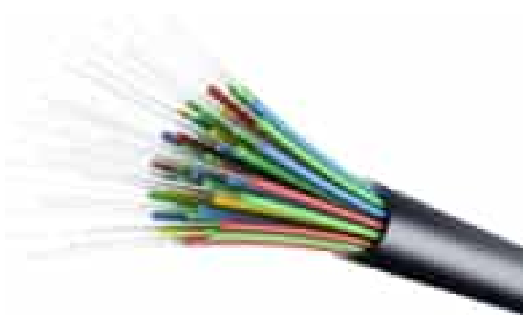


Fig: 14.5 Optical Fiber

less than a tenth as thick as a human hair and can carry something like 25,000 telephone calls, so an entire fiber-optic cable can easily carry several million calls. The optical fibre is consist of fibre core wrapped by cladding, coating, buffer, strength members and finally surrounded by outer insulating jacket as shown in figure.14.5

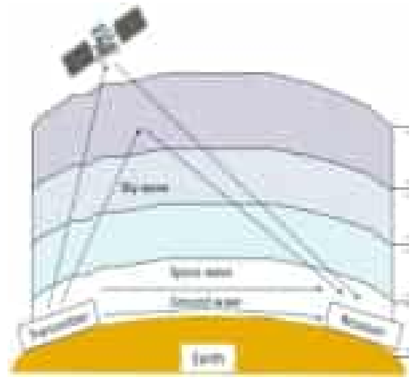


Fig: 14.6 Modes of radio waves propagation

Radio Waves:

Radio waves as already discussed in chapter 13, are the lowest-energy, lowest-frequency and longest-wavelength electromagnetic waves. In communication of radio wave. the emission of electromagnetic waves takes place by the transmitter antenna at one place and reached the receiving antenna at the other place after travelling through the space.

Propagation of Radio Waves:

The three modes for radio waves propagation are:

1. **Ground Wave or Surface Wave Propagation:** The radio waves propagate over the earth's surface from transmitting antenna to receiving antenna in low and medium frequencies up to 2 MHz are called Ground waves. These are used for local broad casting.
2. **Sky Wave Propagation:** Sky Wave propagation, also called ionospheric propagation, It is either the reflected or refracted to the earth from the ionosphere It is suitable for frequency between 2 MHz to 30 MHz and used for long distance radio communication.
3. **Space Wave Propagation:** These waves are suitable for 30 MHz to 300 MHz and used in television communication and radar communication. It is also called line of sight communication as these waves travel straight from transmitting antenna to receiving antenna.

Microwaves:

Electromagnetic waves having frequency range from 1 to 300 GHz are known as microwaves .They can be used to transmit signals over large distances through the space without the use of cable. As microwave signals cannot pass obstacles like hill, the transmitter and receiver should be in a line of sight. Microwaves are broadly used for point-to-point communications as their small wavelength permits suitably-sized antennas to direct them in narrow beams, which can be pointed directly at the receiving antenna. In radar, microwave communication is used to locate the flying objects in space.

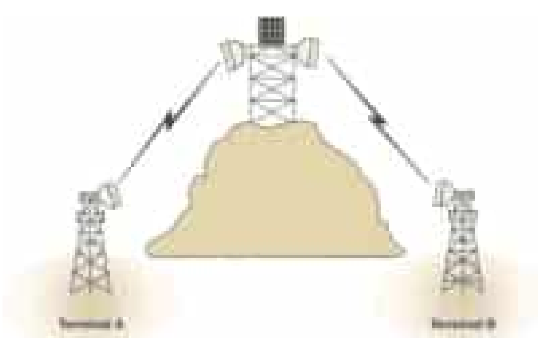


Fig: 14.7 A Microwave Link

Satellite Communication:

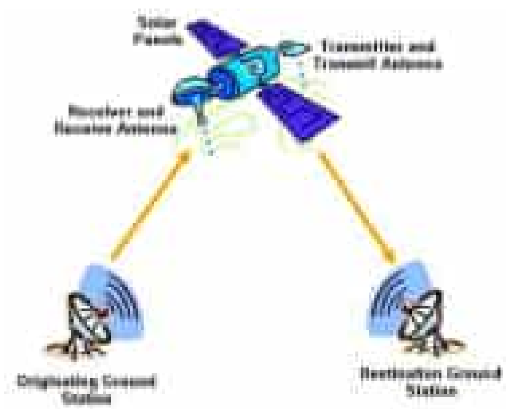


Fig: 14.8 Satellite Communication

Satellites are used for larger distance communication which revolves around the earth in elliptical orbits. Watching the Cricket match of a world cup from anywhere in the world friends would have been impossible without this. A communication satellite is an artificial satellite that transmits the signal via a transponder by creating a Channel between the transmitter and the receiver located at different locations on the Earth. They have a wide range of applications like radio, navigation, military, atmospheric conditions, crop monitoring, etc. Hence, satellites have become an integral part of our daily life.

14.1.2 Merits of Channel of Communication:

Twisted Wire Pair: Easy to implement and low cost for short distances. Breakage in a segment doesn't affect the whole network. Less vulnerable to interference.

Coaxial Cable: Suitable for analog and digital data transmission, higher bandwidth, and cost-effective compared to fiber optic cables.

Optical Fiber: High bandwidth and speed, cost-effective for long distances, and minimal signal loss compared to copper wires.

DO YOU KNOW?

Three geostationary satellites, each separated by 120 degrees of longitude, can provide coverage of the entire earth.

Microwave Radio Systems: Transmit large data volumes over long distances without physical cables, using repeaters. Lower construction costs than other transmission methods.

Satellite Communication is versatile and location-independent, providing mobile and wireless communication. A single satellite can cover wide areas, entire countries, or regions. It is easy to install and manage ground stations. Used for audio, data, video, internet, and GPS applications, it has various uses like forecasting, broadcasting, military intelligence, navigation, global mobile communication, and connecting remote areas..

Self-Assessment Questions:

1. What are the major parts of a communication system?

2. What is the purpose of a transducer at the transmitting end?

3. Which communication channel is best for mobile and other wireless communication applications?

14.2. Modulation:

Modulation is the process of transmitting a message signal with a carrier signal to cover longer distances while maintaining message quality. It uses high-frequency carrier waves for energy and overcoming obstructions during transmission. Antennas translate audio signals to higher frequencies for effective operation. Modulation varies the carrier wave's characteristic with time. Both analog and digital information can be encoded using modulation, enabling efficient communication systems like cell phones that convert voice into electrical signals for transmission and reception.

> **DO YOU KNOW?**
>
> The length of the antenna should be λ/4 times of the modulating signal in order to get effective communication ($H_{min} = \lambda/4$)

Mathematically, a carrier wave is represented by a sinusoidal waveform

$V_c(t) = A \sin(2\pi f_c t + \phi)$ ……….. 14.1

Where

A – represents the amplitude of the carrier wave

f_c – represents the frequency of the carrier wave

ϕ– represents the phase angle

The waveform represented by Eq.14.1 is sketched in Fig: 14.9

A signal tone (i.e a tone having one frequency) modulating signal can be represented by

$V_m(t) = B \sin 2f_m t$

Where B and f_m represents the amplitude and frequency of the modulating signal respectively.

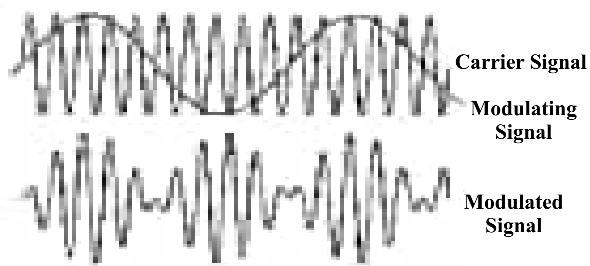


Fig: 14.9 Modulating

Types of Modulation:

A signal possesses multiple parameters like Amplitude, Frequency and Phase. In case of modulation, any of these parameters of a carrier signal are modified with respect to the message signal (baseband signal) which differentiates the types of modulation being used. The Analogue Modulation which is largely divided into two major types.

1. **Amplitude Modulation**
2. **Angle Modulation**

The Angle modulation is further divided into two main types:

1. **Frequency Modulation**
2. **Phase Modulation.**

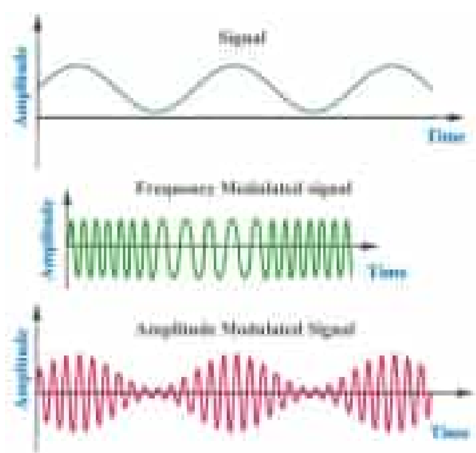


Fig: 14.10 Amplitude Modulation

We will only discuss Frequency Modulation as a scope of this book.

Amplitude Modulation:

It is the type of modulation in which the amplitude of the carrier signal is varied in proportion to the message signal whereas the frequency and phase of the carrier are constant. Television Broadcast is an example of AM.

Expression for Amplitude Modulated Wave:

We have carrier wave and modulating signal,

$m(t)=A_m \sin\omega_m t$ and $c(t)=A_c \sin\omega_c t\}$ ……………..1

$m(t)$ = modulating signal and $c(t)$ = carrier wave.

A_m and A_c are Amplitude of modulating signal and carrier wave respectively in Amplitude modulation. Amplitude-modulated wave $C_m(t)$ will be

$C_m(t) = (A_c + A_m \sin \omega_m t) \sin \omega_c t$ ……………….. 2

This is the general form of amplitude modulated wave.

Where,

$A = A_c + A_m \sin \omega_m t$ = Amplitude of the modulated wave

$\sin w_c t$ = Phase of modulated wave

$C_m(t)=A_c(1+A_m/A_c \sin\omega_m t)\sin\omega_c t$

$=A_c\sin\omega_c t+A_m/A_c\, A_c\sin\omega_m t\sin\omega_c t$

Where,

$A_m/A_c=\mu$=modulation index

$C_m(t) = A_c \sin\omega_c t + A_c\mu\sin\omega_m t\sin\omega_c t$

Frequency Modulation:

It is the type of modulation in which the frequency of the carrier signal varies in proportion to the message signal and the amplitude of a carrier wave remains constant. Cellular communication is an example of FM.

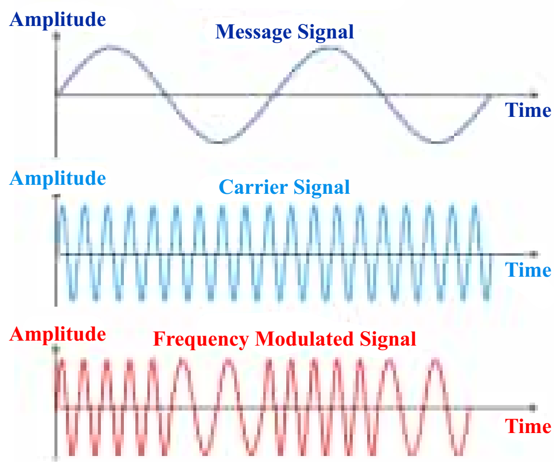


Fig: 14.11 Frequency Modulation

Expression for Frequency Modulated Wave:

As we know from amplitude modulation, we need two sine (or) cosine waves for modulation.

$m(t) = A_m \cos(\omega_m t)$ and $c(t) = A_c \cos(\omega_c t)$ ………… 1

or

$m(t) = A_m \cos(2\pi f_m t)$ and $c(t) = A_c \cos(2\pi f_c t)$

Then frequency modulated wave will be;

$f_m(t) = f_c + k A_m \cos(2\pi f_m t)$ ……………………… 2

$f_m(t) = f_c + k\, m(t)$

Where,

fm(t) = is frequency modulated wave

$f_c \rightarrow$ frequency of the carrier wave

$m(t) \rightarrow$ modulating signal and $k \rightarrow$ proportionality constant.

DO YOU KNOW?

Modulation Index signifies the level of distortion or noise. A lower value of modulation index indicates a lower distortion in the transmitted signal.

Advantages of AM (Amplitude Modulation):

1. Simplicity: AM modulation is relatively simple to implement, making it cost-effective and widely used in broadcasting.
2. Efficient use of bandwidth: AM occupies a narrower bandwidth compared to FM, making it suitable for long-range communication and more efficient use of available frequencies.
3. Compatibility: AM receivers can pick up weak signals, making it suitable for reception in areas with weaker signals or during atmospheric disturbances.
4. Immunity to sudden interference: AM signals are less affected by sudden noise or interference, allowing for clearer reception during temporary disturbances.

Advantages of FM (Frequency Modulation):

1. Better sound quality: FM provides better sound quality compared to AM, making it ideal for broadcasting music and high-fidelity audio.
2. Noise immunity: FM is less susceptible to noise and static interference, resulting in clearer and more consistent reception.
3. Wider frequency range: FM has a wider frequency range, allowing for more channels and better transmission of stereo signals.
4. Higher signal-to-noise ratio: FM provides a higher signal-to-noise ratio, enhancing the overall signal quality and reducing the impact of background noise.

In summary, AM is advantageous for simplicity, cost-effectiveness, and long-range communication, while FM offers superior sound quality, noise immunity, and a wider frequency range, making it suitable for broadcasting high-quality audio and music. The choice between AM and FM depends on the specific requirements and objectives of the communication system or broadcasting application.

14.2.3 Bandwidth:

The bandwidth is closely linked to the capacity at which network transmit data or information. It is the total range of frequency required to pass a specific signal that has been modulated to carry data without distortion or loss of data. If v_1 and v_2 are the lower and upper-frequency limits of a signal, then the bandwidth, BW = $v_2 - v_1$.

In communication system, the message signal can be voice, music, and picture or computer data. All of these have different ranges of frequencies. For example, for speech signals frequency range is from 300 Hz to 3100 Hz. Similarly, for music signal transmission approximately a bandwidth of 20 KHz is required.

Relative Advantages of AM and FM Transmissions:

Amplitude modulation is simple, economical and easily obtainable (circuit with fewer components). As it doesn’t require any specialized components, the receivers of AM are inexpensive. AM waves can travel a long distances and have low bandwidth. However, in FM receivers the noise can be reduced by increasing the frequency deviation and hence FM reception is immune to noise as compared to AM reception. In AM transmission most of the power has been wasted in the transmitted carrier. Whereas, FM transmitters are highly efficient and their power wastage is very low. FM can be implemented at low power stages of a transmitter so a two-way radio application system is feasible for FM. Due to a large number of side bands, FM can be used for the stereo sound transmission.

Distinguish between AM and FM:

Frequency Modulation (FM) and Amplitude Modulation (AM) are two distinct methods of modulating electromagnetic waves for radio communication. AM varies the carrier wave's amplitude in proportion to the modulating signal, while FM changes the carrier wave's frequency based on the signal variations. FM signals have constant amplitude but varying frequency, offering better audio quality and resistance to noise. However, they require a wider bandwidth. AM signals have constant frequency but varying amplitude, making them more susceptible to noise, yet they require a narrower bandwidth. FM is preferred for high-fidelity broadcasting, while AM is used for long-range transmission and amplitude-sensitive applications.

Self-Assessment Questions:
1. Write two factors which justify the need of modulating a low frequency signal into high frequencies before transmission.
2. What type of modulation is employed in Pakistan for radio transmission?

14.3 Digital Communication System:

In a Digital Communication System, generally the messages generated by the source are in analog form. They are converted to digital format before transmission. At the receiver end, the received digital data is converted back to analog form, which is an approximation of the original message.

A digital communication system consists of six basic blocks. The functional blocks at the transmitter are responsible for processing the input message, encoding, modulating, and transmitting over the communication channel. The functional blocks at the receiver perform the reverse process to retrieve the original message.

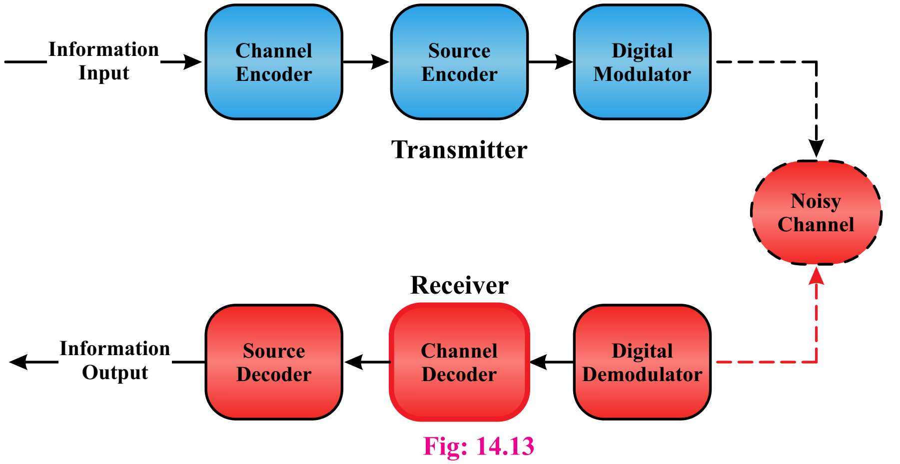


Fig: 14.13
Block Diagram of a Digital Communication System

14.3.1 Advantages of the Transmission of Data in Digital Form Over Transmission in Analog Form:

There are many differences between analog and digital transmission, and digital transmission has many clear advantages over traditional analog transmission. Let's look first at the older form of transmission, analog. In analog transmission we convey data, signal, image, video information, and voice through a continuous signal. However, in digital transmission, the transfer of information and data takes place by using digital signals (a series of discrete pulses, representing one bits and zero bits) over a wired and wireless medium.

The main advantages of digital transmission that made it much superior to its analog counterpart are given below:

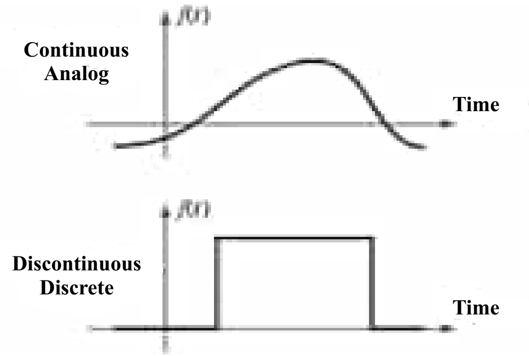


Fig: 14.14 Analog and Discrete Signals

1. **Performance:** Analog signals suffer from distortion and noise, even if they are small. In digital signal transmission can be made perfect due to less noise and distortion.
2. **Compression and Security:** Source and error control codes provide maximum accuracy, fidelity, compression and security to digital transmission that cannot be attained with analog signals. Digital signals can be saved and recovered more easily than analog signals.
3. **Multiplexing:** Multiplexing of several different digital signals can be done easily. For example, combining digital signals using Time Division Multiplexing (TDM) is much easier than combining analog signals using Frequency Division Multiplexing (FDM).
4. **Storage:** In analog signal storage quality cannot be sustained over time. Whereas, Digital signals can be stored and retrieved more accurately and inexpensively by the use of transistors and error control codes.
5. **Signal Processing:** Signal Processing of Digital signals can be achieved in a simple and flexible way by using different program updates. Furthermore, we can change protocols and algorithms as per our requirement. This provides much more flexibility as compared to analog signal processing.
6. **Reconstruction:** Digital signals can be faultlessly carried over larger distances by using repeaters. However, analog signals have become gradually weaker along the channel due to severe noise and distortion. This behavior limits the range of transmission of analog signals governed by the input power.
7. **Cost:** Digital communication systems depend on computing devices like processors and very large-scale integrated (VLSI) circuits that increasingly benefit from Moore’s law: the number of transistors in an integrated circuit (IC) has been increased rapidly and almost doubled about every two years. This lead to cost and performance advantages over a long period of time.

8. **Secrecy:** Cross-talk is rarely happening in digital communication due to encryption and compression of data in digital transmission to maintain the secrecy of the information.
9. **Quality of Copies:** Quality of copies in analog transmission is not good as compared to its original while due to error free digital transmission, copies can be made definitely.

Digital transmission of speech or music:

If nature produces analog signals, how do we create digital signals from them? Before we start digital transmission, we must convert the signal of interest into a digital format. The natural signal (e.g., speech) or music that we want to transmit will be acquired using an analog device. The analog signal will be translated into a digital signal using a method called analog-to-digital (A/D) conversion. The device used to perform this translation is known as an analog-to-digital converter (ADC). This process is depicted in Fig 14.15.

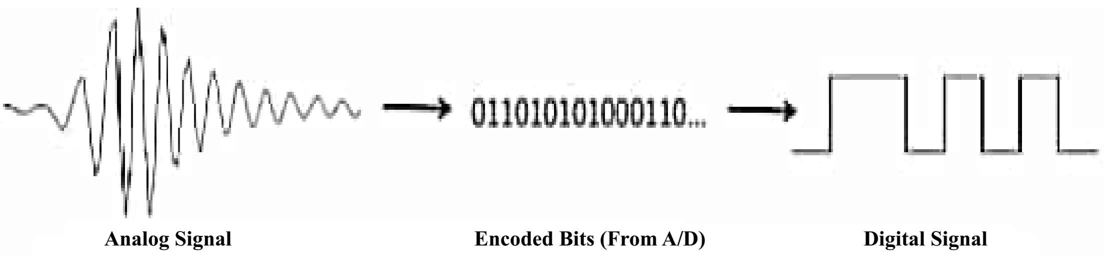


Fig: 14.15 A to D Conversion

Steps for A/D conversion:

There are three processes involved in conversion of Analog to Digital signals:

1. Sampling:

This is a process of inspecting the value (voltage) of an analog signal at regular time intervals. The time between samples is referred to as the sample period (T, in seconds), and the number of samples taken per second is referred to as the sample frequency (fs, in samples/second or Hz).

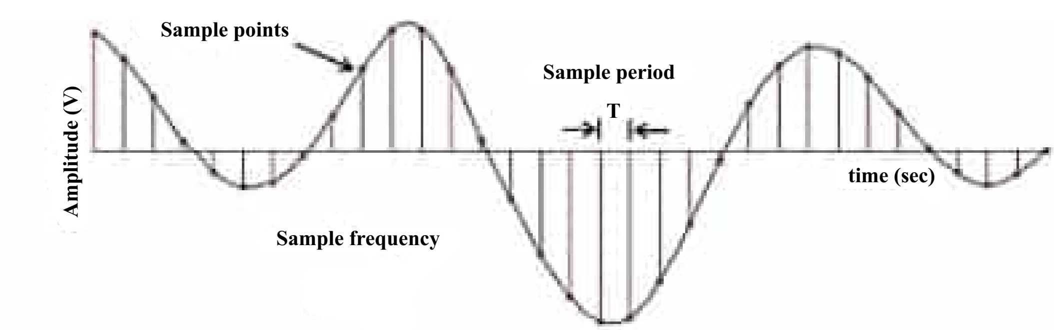


Fig: 14.16 Sampling Waveform

The receiver must convert the bits it receives into sample values, and then recreate what it thinks the analog signal looks like from the samples. One must sample faster than the Nyquist sampling rate (also called the Nyquist rate), f_N, given by the formula $f_N = 2f_{max}$, where f_{max} is the highest frequency component of the analog signal. To avoid distortion of your signal $F_s > f_N$. Some examples of common sample rates are given in the table14.1.

Common Sample rates Table 14.1

Signal	Signal frequency range	Standard Sample Rate
Voice	300 Hz-3 kHz	8KHz
Music	0-20 kHz	44.1 kHz CD Quality
Music	0-20 kHz	192 kHz DVD Quality

2. Quantizing:

Quantizing is the process of mapping the sampled analog voltage values to discrete voltage levels, which are then represented by binary numbers (bits). For example, if a sine wave of amplitude 1V is being sampled, the sample values could be between -1V and +1V… an infinite number of possibilities. However, only a finite number of values can be used to represent the samples. Converting a sample value from infinite possibilities to one of a finite set of values is called quantization. These values are referred to as quantization levels.

DO YOU KNOW?

Digital telephony uses 8-bit A/D quantizing ($2^8 = 256$ quantization levels) and CD audio, which uses 16-bit A/D ($2^{16} = 65,536$ quantization levels.

An N-bit A/D converter has 2^N quantization levels and outputs binary words of length N. For example, a 3-bit A/D system has $2^3 = 8$ quantization levels, so all samples of a 1V analog signal will be quantized into one of only 8 possible quantization levels and each sample will be represented by a 3-bit digital word. In general, the A/D converter will partition a range of voltage from some V_{min} to some V_{max} into 2^N voltage intervals, each of size q volts, where

$$q = \frac{V_{max} - V_{min}}{2^N}$$

3. Encoding:

After quantization the samples are converted to N-bit binary code words. For the first sample point at time 0, the voltage is 0.613 V, which means that sample is assigned a binary value of 110.

The A/D then creates a voltage signal that represents these bits. The binary representation of the above signal is:

110 101 100 011 011 100 110 110 100 010 000 000 001.

In this example, every sample produces 3 bits (3 bits/sample). The sample rate was 2000 samples/sec. The bit rate (R_b) produced from this:

$$R_b = \frac{3\text{ bits}}{\text{sample}} \times \frac{2000\text{ samples}}{\text{sec}} = 6000\text{ bits/sec (bps)}$$

Bit rate is the speed of transfer of data given in number of bits per second.

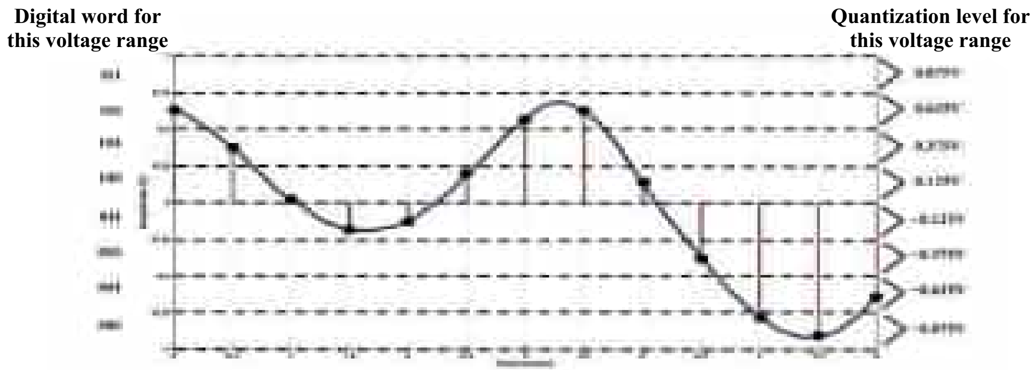


Fig: 14.17 Coding Waveform

Conversion from Digital to Analog (D/A):

The receiver converts these N-bit digital words back into an analog signal. This process is called digital-to-analog (D/A) conversion. The analog signal is reconstructed by converting the N-bit digital words into the appropriate quantization levels, and this voltage is "held" for one sample period, creating a stair-step type signal shown below.

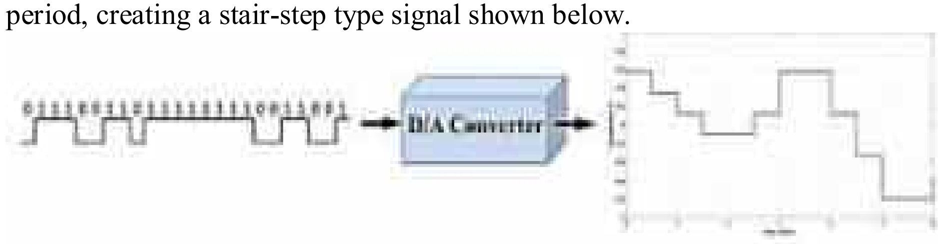


Fig: 14.18 D to A Conversion

The reconstructed analog signal for is shown in a thick black line in the figure 14.19, along with the 3bit digital word that represents each sample. The original analog signal is also shown in the continuous line. Even if we perform filtering to smooth out the reconstructed signal to remove its staircase appearance it will still not quite be the same as the original red signal. It is called quantization error.

Quantization error can be reduced by increasing the number of bits N for each sample. This will make the quantization intervals smaller.

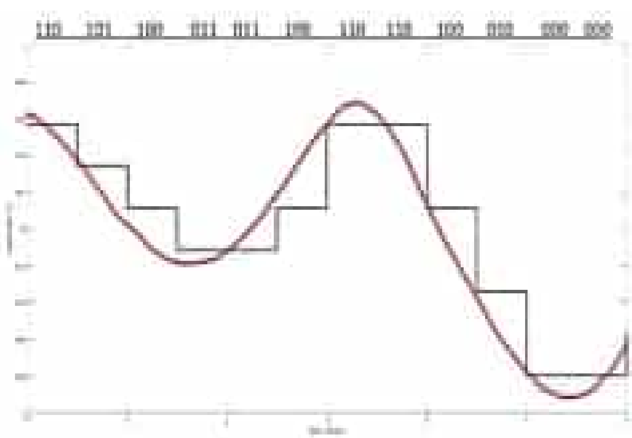
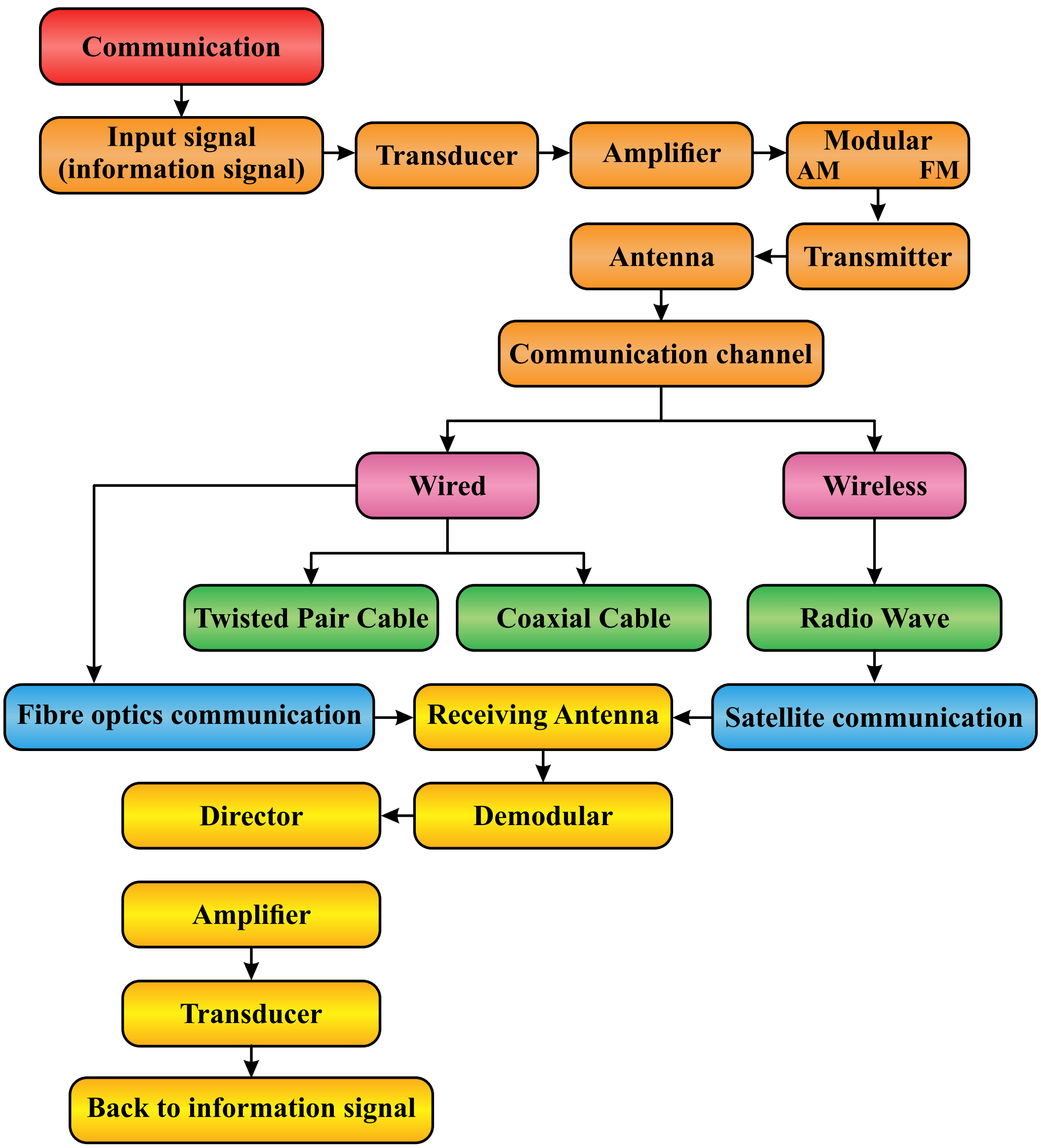


Fig: 14.19
Reconstruction of Analog Signal

SUMMARY

- Communication can be defined as the exchange of information between two or more bodies.
- There are two types of data, analog data or signal is continuous and digital data which has discrete values. For transmission of information analog or digital a transmission system consists of three parts
  (i) transmission equipment
  (ii) communication medium or channel providing the physical link between sender and receiver and
  (iii) receiving equipment.
- A communication channel refers either to a physical transmission medium such as a wire, or to a logical connection over a multiplexed medium such as a radio channel in telecommunications.
- There are different types of channels used for transmission a thin-diameter wire (22 to 26 gauges) commonly used for telephone and network cabling.
- Coaxial cable supports 10 to 100 Mbps and is relatively inexpensive, although it is costlier than UTP on a per-unit length.
- Optical fiber refers to the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand or fiber..
- Satellite is also a source of sending information. Satellite communications, use the very high-frequency range of 1–50 gigahertz.
- The process of imposing an input signal onto a carrier wave is called modulation. There are two types of modulation Amplitude modulation and Frequency modulation.
- Bandwidth is the total range of frequency required to pass a specific signal that has been modulated to carry data without distortion or loss of data.
- Digital transmission is the transfer of information and data using digital signals over a wired and wireless medium. In a Digital Communication System, the messages generated by the source which are generally in analog form are converted to digital format and then transmitted.
- The natural signal (e.g., speech) or music that we want to transmit will be acquired using an analog device.
- The analog signal will be translated into a digital signal using a method called analog-to-digital (A/D) conversion.
- There are three processes involved in conversion of Analog to Digital signals
  1. Sampling 2. Quantizing 3. Encoding
- We recover the analog information after it has been converted to digital by Digital to analog conversion (D/A). It is very similar to being the reverse of the analog-to-digital conversion process. The analog signal is reconstructed by converting the N-bit digital words into the appropriate quantization levels.

CONCEPT MAP


Communication
Input signal (information signal)
Transducer
Amplifier
Modular
AM FM
Transmitter
Antenna
Communication channel
Wired
Wireless
Twisted Pair Cable
Coaxial Cable
Radio Wave
Fibre optics communication
Receiving Antenna
Satellite communication
Director
Demodular
Amplifier
Transducer
Back to information signal

EXERCISE

Section (A): Multiple Choice Questions (MCQs)

1. In Radio and Television broadcast, the information signal is in the form of :
   a) analog signal b) digital signal
   c) Both analog & digital signals d) neither analog nor digital signal
2. A communication channel consists of:
   a) transmission line only b) optical fibre only
   c) free space only d) All of them
3. Voltage signal generated by a microphone is:
   a) digital in nature b)analog in nature
   c) hybrid in nature d) consists of bits & bytes
4. As compared to sound waves frequency of radio waves is:
   a) higher b) equal c) lower d) may be higher or lower
5. The process of superimposing signal frequency on the carrier wave is known as:
   a) transmission b)detection c)reception d)modulation
6. What is the frequency range of signals that can be transmitted in case of twisted pair of wires?
   a)10MHz. to 15MHz. b)5MHz. to 10MHz.
   c)100Hz. to 5MHz. d)10Hz. to 100Hz.
7. The maintenance of a satellite's orbital position is called:
   a) maintenance keeping b) station keeping
   c)station maintenance d)attitude control
8. Process of mapping the sampled analog voltage values to discrete voltage levels is called:
   a) sampling b)sampling frequency
   c) quantizing d)encoding
9. AM is used for broadcasting because:
   a) it requires less transmitting power compare with other systems
   b) it is more noise immune than other modulation system
   c)No other modulation can provide the necessary bandwidth faithful transmission
   d) its use avoids receiver complexity
10. Data in compact disc is stored in the form of :
   a) analog signal b)digital signal
   c) noise d)both (a) &(b)

Section (B): Structured Questions

CRQs:

1. A male voice after modulation-transmission sounds like that of a female to the receiver. Give reason.
2. Why is an AM signal likely to be more noisy than a FM signal upon transmission through a channel?
3. Write 5 differences between analog and digital transmission.
4. Define core and cladding. On what principle does optical fibre work?
5. What is a Digital Communication System? Why it is advantageous to use digital communication over analog communication.
6. Give 5 advantages of satellite communication.
7. Write advantages and disadvantages of frequency modulation.
8. What are limitations of amplitude modulation?

ERQs:

1. What is modulation? Why it is needed for the transmission of signals?
2. How many types of modulation are there? Explain each type of modulation in detail.
3. What is A/D conversion? Explain sampling, quantizing and encoding involved in A/D conversion in detail.
4. Define communication channel. How information carried through UTP, STP and Coaxial cable? Write their advantages and disadvantages.
5. What is optical Fibre? How information carried out through optical fibre? Give advantages of using optical fibre over other communication channels.
6. What are the main components of a Satellite? How communication takes place in a satellite. Explain three orbits of a satellite.