1.2 Elements of Communication System :

➤➤➤ **[Asked in Exam : April 2004, Oct. 2004, April 2005, Oct 2005, April 2006, Oct. 2006, April 2007, Oct. 2007, April 2008 !!!]**

- The block diagram of the simplest possible communication system is as shown in Fig.1.2.1.

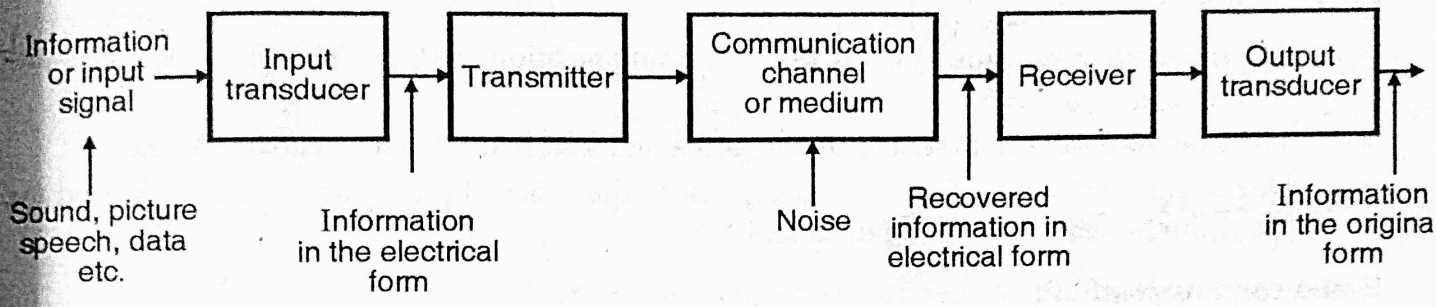

Fig. 1.2.1 : Block diagram of the basic communication system

- As seen from the Fig. 1.2.1, the elements of a basic communication system are transmitter, a communication medium and the receiver.
- When the transmitted signal is travelling from the transmitter to the receiver, noise gets added to it.
- The elements of basic communication system are as follows :

1. Information or input signal
2. Input transducer
3. Transmitter
4. Communication channel or medium
5. Noise
6. Receiver
7. Output transducer

Information or Input signal :

- The communication systems have been developed for communicating useful information from one place to the other.
- This information can be in the form of a sound signal like speech or music, or it can be in the form of pictures (TV signals) or it can be data information coming from a computer.

Input transducer :

- The information in the form of sound, picture or data signals cannot be transmitted as it is.
- First it has to be converted into a suitable electrical signal. The input transducer block does this job.
- The input transducers commonly used in the communication systems are microphones, TV camera etc.

Transmitter :

- The function of the transmitter block is to convert the electrical equivalent of the information to a suitable form.
- In addition to that it increases the power level of the signal. The power level should be increased in order to cover a large range.
- The transmitter consists of the electronic circuits such as amplifier, mixer, oscillator and power amplifier.

Communication channel or medium :

The communication channel is the medium used for transmission of electronic signal from one place to the other. The communication medium can be conducting wires, cables, optical fibre or free space. Depending on the type of communication medium, two types of communication systems will exist. They are :

- Wire communication or line communication
- Wireless communication or radio communication

1. Line communication :

- The line communication systems use the communication mediums like the simple wires or cables or optical fibers.
- The examples of such systems, are telegraph and telephone systems, cable T.V. etc.
- Due to physical connection from one point to the other, these systems cannot be used for the communication over long distances.

2. Radio communication :

- The radio communication systems use the free space as their communication medium. They do not need the wires for sending the information from one place to the other.
- The radio or TV broadcasting, satellite communication are the examples of the wireless communication. These systems transmit the signal using a transmitting antenna in the free space.
- The transmitted signal is in the form of electromagnetic waves. A receiving antenna will pick up this signal and feed it to the receiver.
- Radio communication can be used for the long distance communication such as from one country to the other or even from one planet to the other.

Noise :

- Noise is an unwanted electrical signal which gets added to the transmitted signal when it is travelling towards the receiver.
- Due to noise, the quality of the transmitted information will degrade. Once added, the noise cannot be separated out from the information.
- Hence noise is a big problem in the communication systems.
- The noise can be either natural or man made. The sources of natural noise are lightning or radiation from the sun and stars etc.
- The man made noise includes the noise produced by electrical ignition systems of the automobiles, welding machines, electric motors etc.
- Eventhough noise cannot be completely eliminated, its effect can be reduced by using various techniques.

Receiver :

- The reception is exactly the opposite process of transmission. The received signal is amplified, demodulated and converted into a suitable form.
- The receiver consists of electronic circuits like mixer, oscillator, detector, amplifier etc.

Output Transducers :

- The output transducer converts the electrical signal at the output of the receiver back to the original form i.e. sound or TV pictures etc.

- The typical examples of the output transducers are loud speakers, picture tubes, computer monitor etc.

1.3 The Electromagnetic Spectrum :

- The information signal should be first converted into an electromagnetic signal before transmission because the wireless transmission takes place using the electromagnetic waves.
- The electromagnetic waves consist of both electric and magnetic fields. The electromagnetic waves can travel a long distance through space.
- The electromagnetic signals are also called as radio frequency (RF) waves.
- The EM waves oscillate, they are sinusoidal and their frequency is measured in Hz.
- The frequency of EM signal can be very low or it can be extremely high. This entire range of frequencies of EM waves is called as **Electromagnetic spectrum.**
- The electromagnetic spectrum consists of signals such as 50 Hz line frequency and voice signals at the lower end.

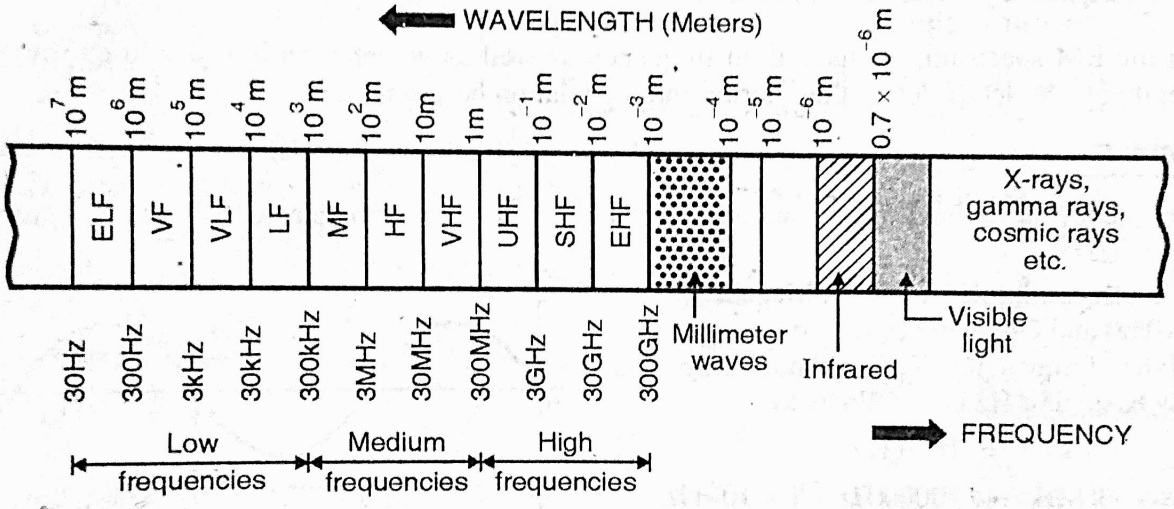

Fig. 1.3.1 : Complete electromagnetic (EM) spectrum

- The radio frequencies which are used for the two way communication reside at the center of the EM spectrum. These frequencies are used for the applications such as radio or TV broadcasting as well.
- The infrared and visible light are at the upper end of the EM spectrum.
- Fig. 1.3.1 shows the entire electromagnetic spectrum.
- The short forms used in the EM spectrum of Fig. 1.3.1 have the following meanings.

Table 1.3.1 : Segments of the electromagnetic spectrum

Sr. No.	Name	Frequency	Wavelength
1.	Extremely low frequency (ELF)	30-300 Hz	10^7 to 10^6 m
2.	Voice frequencies (VF)	300-3000 Hz	10^6 to 10^5 m
3.	Very low frequencies (VLF)	3-30 kHz	10^5 to 10^4 m
4.	Low frequencies (LF)	30-300 kHz	10^4 to 10^3 m

Sr. No.	Name	Frequency	Wavelength
5.	Medium frequencies (MF)	300 kHz - 3 MHz	10^3 to 10^2 m
6.	High frequencies (HF)	3-30 MHz	10^2 to 10 m
7.	Very high frequencies (VHF)	30-300 MHz	10 to 1 m
8.	Ultra high frequencies (UHF)	300 MHz-3GHz	1 to 10^{-1} m
9.	Super high frequencies (SHF)	3-30 GHz	10^{-1} to 10^{-2} m
10.	Extremely high frequencies (EHF)	30-300 GHz	10^{-2} to 10^{-3} m
11.	Infrared	–	0.7 to 10 μm
12.	Visible light	–	0.4 μm to 0.8 μm

1.3.2 EM Spectrum and Communication Application :

- In the radio communication system the frequencies ranging from a few kilohertz to many gigahertz all are being used for various purposes.
- Let us see the applications of various frequency bands.
- The frequencies most commonly used in early days were from about 300 kHz to 3 MHz and were called as **medium frequencies (MF).** The frequencies in the range 30 kHz to 300 kHz are known as the **low frequencies (LF).**
- The frequencies in the range 3 kHz to 30 kHz are called as **very low frequencies (VLF).** On the higher frequency side **high frequencies (HF)** will cover the frequency range from 3 MHz to 30 MHz. Then **very high frequency (VHF)** from 30 MHz to 300 MHz and so on.

Table 1.3.2 gives you the details of entire usable frequency spectrum and its applications.

Table 1.3.2 : The Radio Frequency Spectrum

Sr. No.	Frequency band	Wavelength	Applications
1.	30 Hz - 300 Hz. Extremely low frequencies ELF.	10^4 km to 10^3 km	Power transmission.
2.	300 Hz - 3 kHz. Voice frequencies (VF)	10^3 km to 100 km	Audio applications.
3.	3 kHz – 30kHz. Very low frequencies (VLF)	100 km to 10 km	Submarine communications. Navy, Military communications
4.	30 kHz - 300 kHz. Low frequencies (LF)	10 km to 1 km. Long waves.	Aeronautical and marine, navigation, these frequencies act as sub carriers.
5.	300 kHz - 30 MHz Medium frequencies (MF)	1 km to 100 m. Medium waves.	AM radio broadcast, Marine and aeronautical communications.
6.	3 MHz - 30 MHz. High frequencies (HF)	100 m to 10 m Short waves.	Short-wave transmission, Amateur and CB communication.
7.	30 MHz - 300 MHz Very high frequencies (VHF)	10 m to 1 m	TV broadcasting, FM broadcasting.
8.	300 MHz - 3 GHz Ultra high frequencies (UHF)	1 m to 10 cm. Microwaves.	UHF TV channels ,Cellular phones, Military applications
9.	3 GHz - 30 GHz (SHF)	10^{-1} m to 10^{-2} m	Satellite communication and Radar
10.	30 - 300 GHz (EHF)	10^{-2} m to 10^{-3} m	Satellites and specialized radars

1.4 Types of Communication Systems :

➤➤➤ **[Asked in Exam : Oct. 2004 !!!]**

- The electronic communication systems can be classified into various categories as shown in Fig. 1.4.1. It shows that the electronic communication systems can be basically categorised into three groups based on :
  1. Whether the system is unidirectional or bidirectional.

2. Whether it uses an analog or digital information signal.
3. Whether the system uses baseband transmission or uses some kind of modulation.

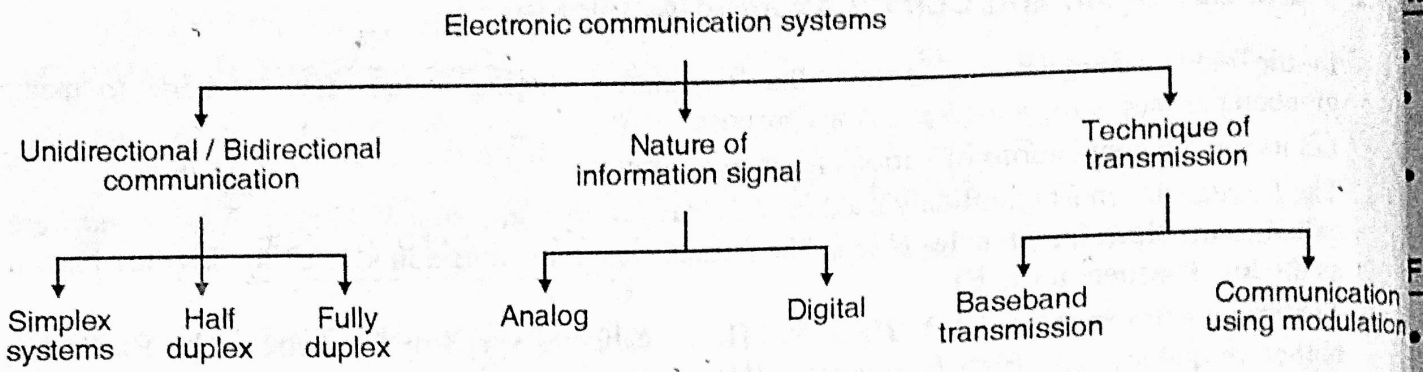

Fig. 1.4.1 : Classification of electronic communication systems

1.4.1 Classification Based on Direction of Communication :

- Based on whether the system communicates only in one direction or otherwise, th communication systems are classified as,
  1. Simplex systems.
  2. Half duplex systems.
  3. Full duplex systems.
- Fig. 1.4.1(a) shows this classification.

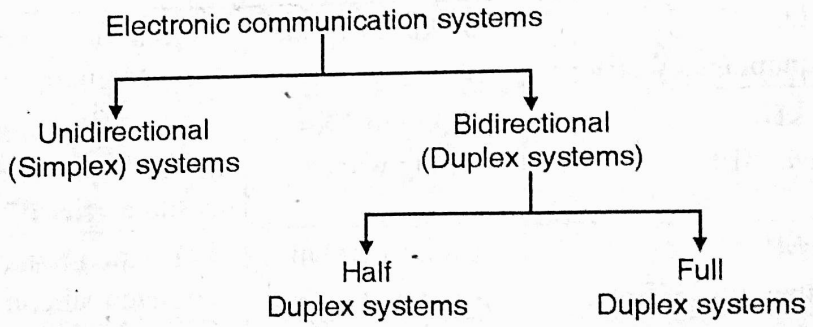

Fig. 1.4.1(a) : Types of electronic communications

Simplex Systems :

- In these systems the information is communicated in only one direction. For example the radio o TV broadcasting systems can only transmit. They cannot receive.
- Another example of simplex communications is the information transmitted by the telemetry system of a satellite to earth.
- The telemetry system transmits information about the physical status of the satellite such as its position or temperature.
- The simplex system are demonstrated in Fig. 1.4.1(b).

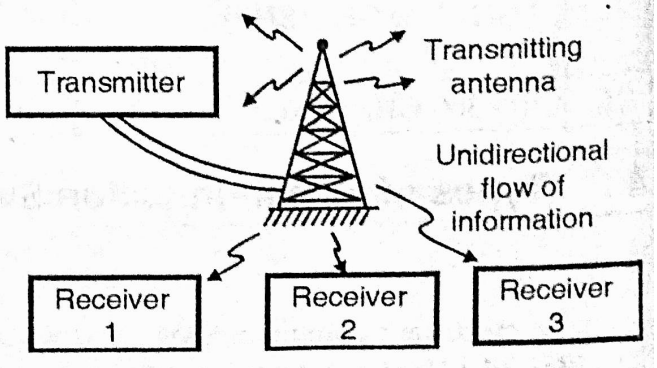

Fig. 1.4.1(b) : Simplex system

Half Duplex Systems :

➤➤➤ [Asked in Exam : April 2005 !!!]

- These systems are bidirectional, i.e. they can transmit as well as receive but not simultaneously.
- At a time these systems can either transmit or receive, for example a transreceiver or walky talky set.
- The direction of communication alternates. The radio communications such as those used in military, fire fighting, citizen band (CB) and amateur radio are half duplex system.

Full Duplex Systems :

➤➤➤ [Asked in Exam : Oct. 2005 !!!]

- These are truly bidirectional systems as they allow the communication to take place in both the directions simultaneously.
- These systems can transmit as well as receive simultaneously, for example the telephone systems.
- The bulk of electronic communications however is two-way.
- The best example of full duplex communication system is the telephone system.
- Fig. 1.4.1(c) illustrates the concept of duplex communication.

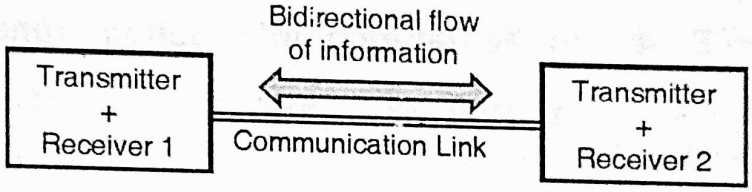

Fig. 1.4.1(c) : Duplex communication

Comparison of Half Duplex and Full Duplex Systems :

Sr. No	Parameter	Half Duplex	Full Duplex
1.	Definition	Communication is two way but one at a time.	Communication is two way.
2.	Examples	Walky Talky	Telephone

Comparison between Simplex and Duplex Systems :

Sr. No.	Parameter	Simplex	Duplex
1.	Definition	Communication is one way	Communication is two way.
2.	Examples	Radio/TV broadcast	Telephone