

PHYSICS

CLASS NOTES FOR CBSE

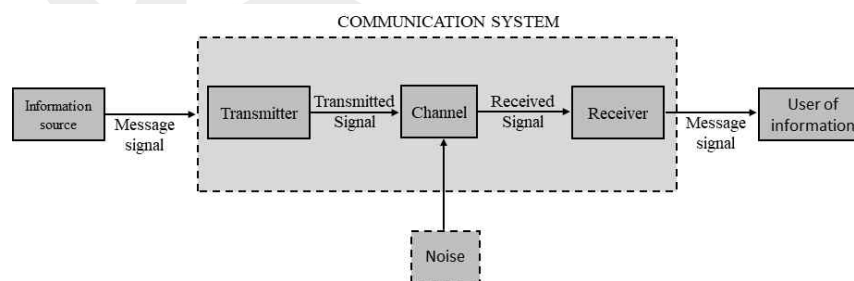
Chapter 31. Communication Systems

01. Introduction

The act of transmission and reception of information is known as communication.

02. Elements of a Communication System

Every communication system has three essential elements, transmitter, medium and receiver.



There are two basic modes of communication: point-to-point and broadcast.

03 Basic Terminology of Communication Systems

- (i) **Transducer** : Device that converts one form of energy into another.
- (ii) **Signal**: Information converted in electrical form and suitable for transmission. Signals can be either *analog* or *digital*.
- (iii) **Noise**: The unwanted signals that tend to disturb the transmission and processing of message signals
- (iv) **Transmitter**: Processes the incoming message signal so as to make it suitable for transmission through a channel and subsequent reception
- (v) **Receiver**: Extracts the desired message signals from the received signals at the channel output.
- (vi) **Attenuation**: It is the loss of strength a signal while propagating through a medium.
- (vii) **Amplification**: The process of increasing the amplitude of a signal using an electronic circuit called the amplifier.
- (viii) **Range** : Largest distance between a source and a destination up to which the signal is received with sufficient strength
- (ix) **Bandwidth**: Frequency range over which an equipment operates or the portion of the spectrum occupied by the signal.

- (x) **Modulation:** Original low frequency message/information signal cannot be transmitted to long distances because of obvious reasons. Therefore, at the transmitter, information contained in the low frequency message signal is superimposed on a high frequency wave, which acts as a carrier of the information
- (xi) **Demodulation:** The process of extraction of information from the carrier wave at the receiver
- (xii) **Repeater:** A combination of receiver and a transmitter. Communication satellite is essentially a repeater station ins space.

NOTE ✍ Undesirable effects in the course of signal transmission are

- (i) **Attenuation :** decrease in signal strength due to energy loss.
- (ii) **Distortion :** waveform perturbation
- (iii) **Interference :** contamination by extraneous signals.
- (iv) **Noise :** due to random electrical signal

03. Types of Transmission Media

Broadly, transmission media have been divided into two types

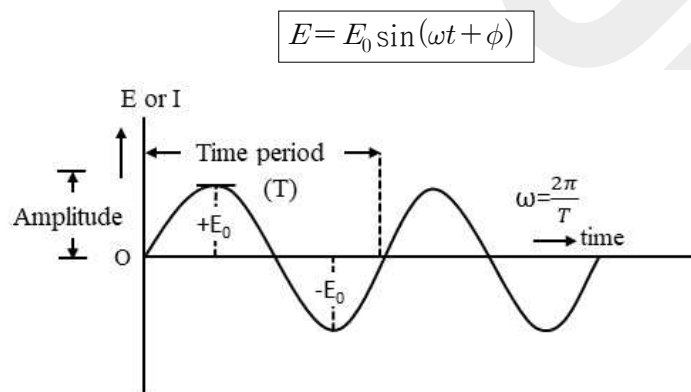
- (i) **Guided transmission medium:** That communication medium of channel which is used in point to point communication between a single transmitter and receiver.
- (ii) **Unguided transmission medium:** communication medium which is used, where there is no point to point contact between the transmitter and receiver.

Characteristics and quality of transmission medium depends upon

- (i) Nature of transmission medium
- (ii) Nature of signal

The electrical signals are of two types:

- (i) **Analog signals:** An analog signal is that in which current or voltage value varies continuously with time



Examples of Analog signals are speech, music, sound produced by a vibrating tuning fork.

- (ii) **Digital signals:** A digital signal is discontinuous function of time, in contrast to an analog signal, wherein current or voltage value varies continuously with time.

Examples of Digital signals are (i) letters printed in a book (ii) listing of any data (iii) output of a digital computer (iv) electronic transmission of document at a distant place via telephone



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04. Propagation of Electromagnetic Waves

An antenna at the transmitter in communication using radio waves, radiates the electromagnetic waves which travel through space and reach the receiving antenna at the other end.

05. Ground Wave

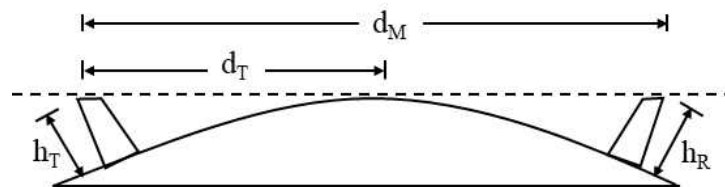
The antennas should have a size comparable to wavelength of signal. At longer wavelengths the antennas have large physical size and they are located on or very near to the ground.

06. Sky Waves

Long distance communication can be achieved by ionospheric reflection of radio waves back towards the earth. The phenomenon of bending of em waves so that they are diverted towards the earth is similar to total internal reflection.

07. Space wave

A space wave travels in a straight line from transmitting antenna to the receiving antenna. Space waves are used for line-of-sight (LOS) communication as well as satellite communication.



Where R is the radius of the earth

$$d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

where h_R is the height of receiving antenna.

08. Determination of range

The range is determined by the height of transmitting antenna. The range AP or PB can be easily calculated by geometrical consideration. Suppose height of the tower is h and the radius of earth is r (that is $OA = OB = OP = r$). in the right-angled triangle OQA , we have

$$OQ^2 = QA^2 + OA^2$$

$$\therefore QA \approx AP = d$$



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