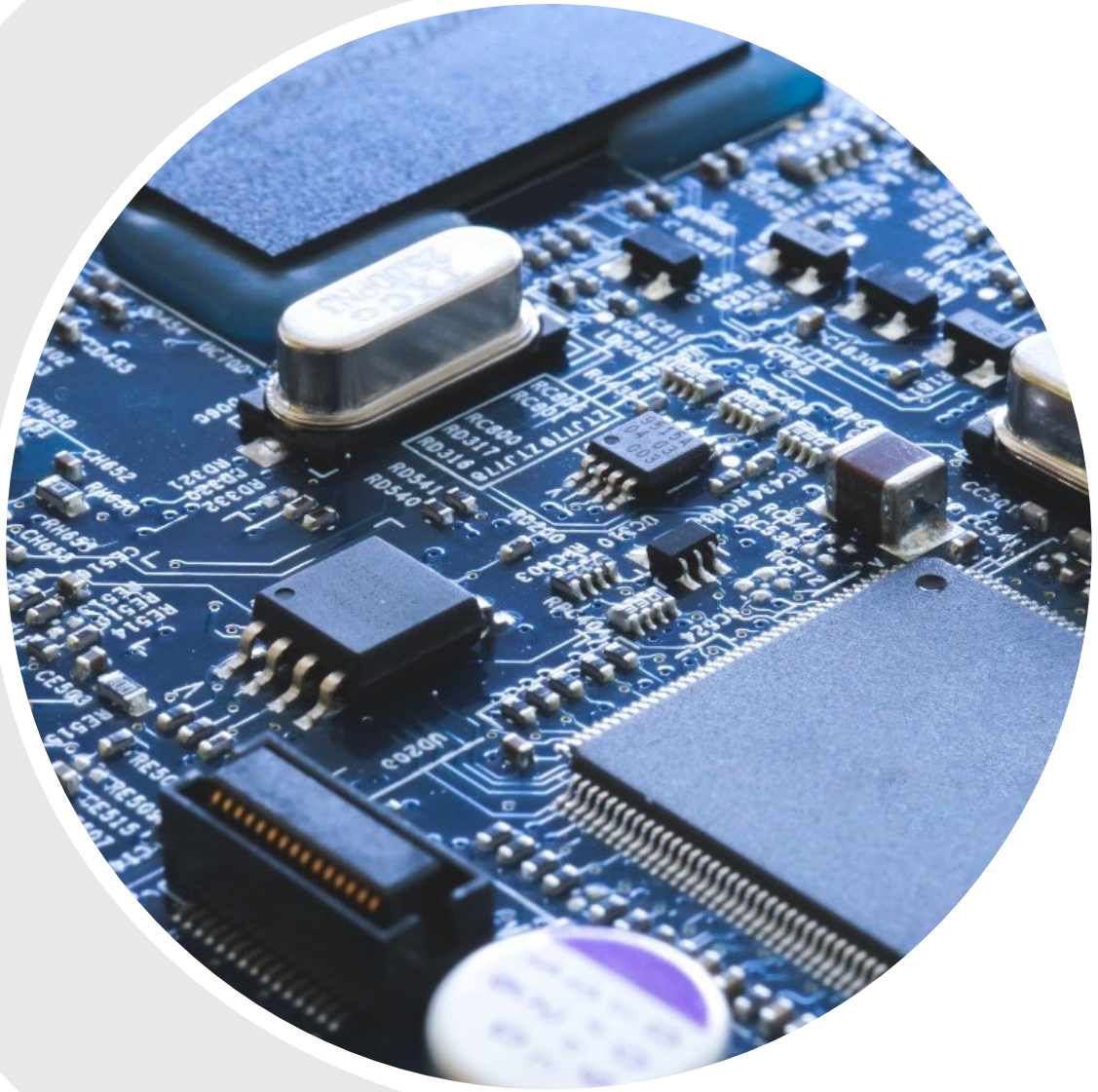

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BASIC ELECTRONICS

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Module 5
COMMUNICATIONS

SYLLABUS

Communications

Introduction to Communication, Communication System, Modulation

Text Book

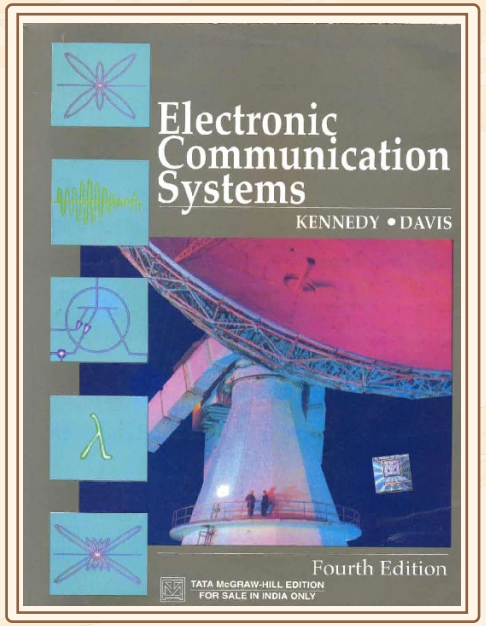
Electronic Communication Systems

George Kennedy and Bernard Davis

4th Edition

Tata McGraw-Hill

2005



Introduction

Introduction to Communication

- In a broad sense, the term *communications* refers to the sending, receiving and processing of information by electronic means.
- Communications started with wire telegraphy in the 1840s, developing with telephony some decades later and radio at the beginning of 20th century.
- *Radio* communication was greatly improved by the work done during World War II.
- It subsequently became even more widely used and refined through the invention and use of the transistor, integrated circuits and other semiconductor devices.

Introduction to Communication

- The use of satellites and fiber optics has made communications even more widespread, with an increasing emphasis on computer and other data communications.
- A modern *communications system* is first concerned with the sorting, processing and sometimes storing of information before its transmission.
- The actual transmission then follows, with further processing and the filtering of noise.
- Finally we have reception, which may include processing steps such as decoding, storage and interpretation.

Introduction to Communication

- In this context, forms of communications include
  - Radio telephony and telegraphy
  - Broadcasting
  - Point-to-point and mobile communications (commercial or military)
  - Computer communications
  - Radar
  - Radiotelemetry
  - Radio aids to navigation

Communication Systems

Communication Systems

- A block diagram of a general communications system is shown in the figure.

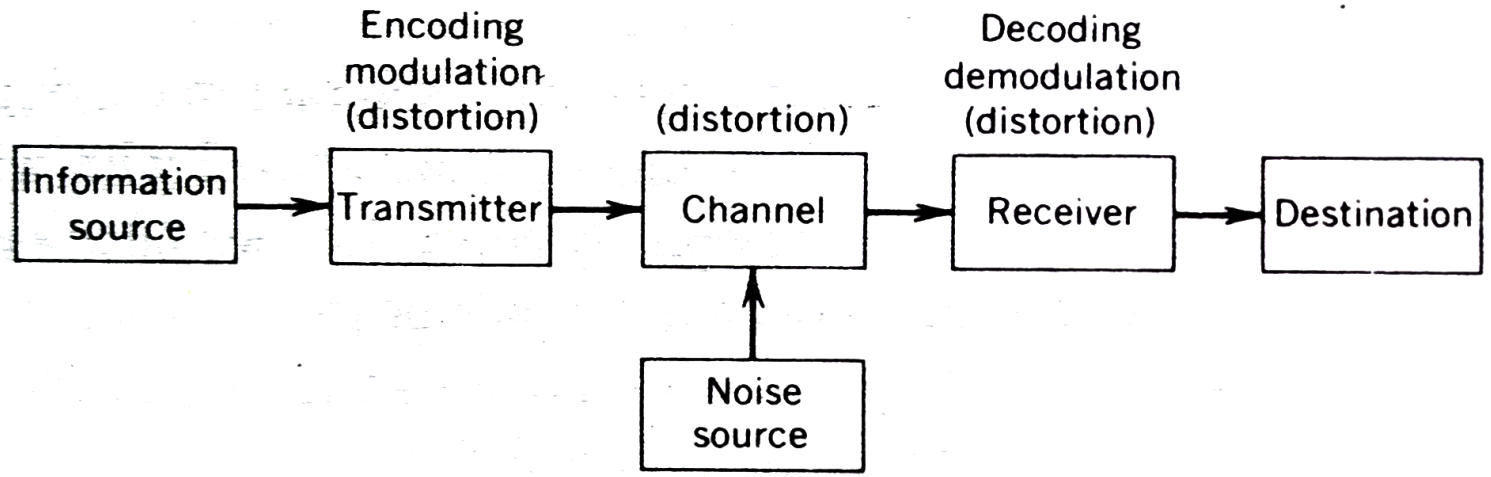


FIGURE 1-1 Block diagram of communications system.

Information

- The main aim of a communication system is to convey a message.
- This message originates from the information source.
  - The source normally selects one message from a group of messages.
- The *set*, or total number of messages, consists of individual messages which may be distinguished from one another.
- These may be words, groups of words, code symbols or any other prearranged units.
- The amount of information contained in any given message can be measured in *bits* or in *dits*.

Transmitter

- The transmitter processes the input message signal to make it suitable for sending it over the channel.
- This operation is called modulation.
  - It is a process that changes or modulates the characteristics of a high frequency signal called the carrier in accordance with the message signal.
- Modulation may be amplitude modulation, frequency modulation, pulse modulation or any variation or combination of these, depending on the requirements.

Transmitter

- Figure shows a high-level amplitude-modulated broadcast transmitter.

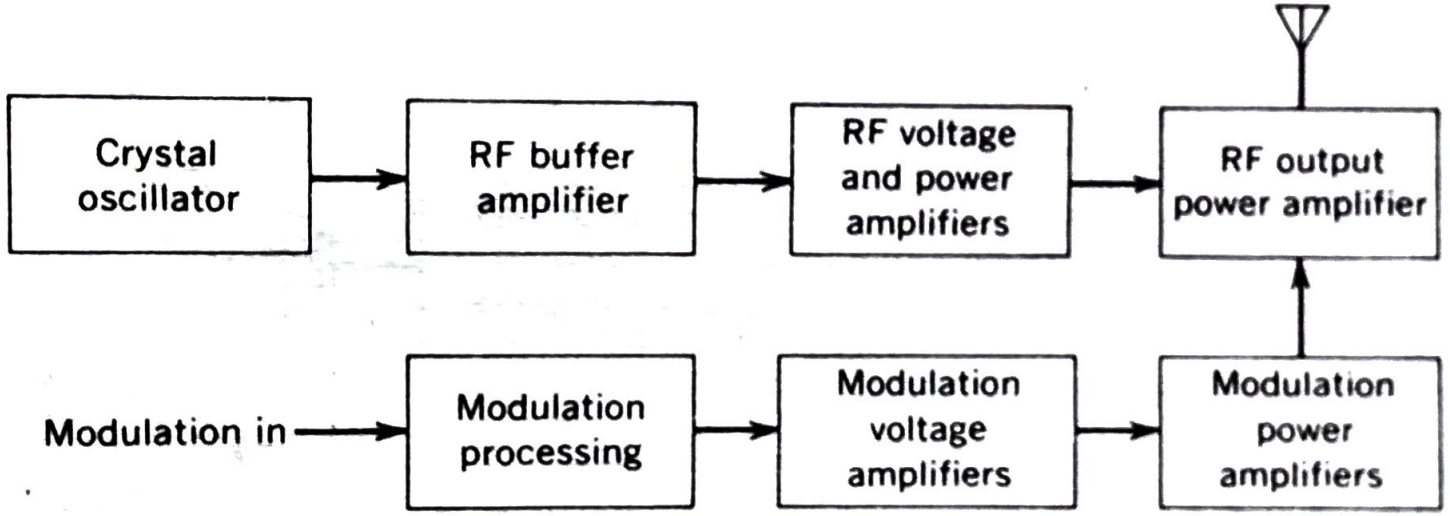


FIGURE 1-2 Block diagram of typical radio transmitter.

Channel

- It is the physical medium or path that connects the transmitter and receiver.
- This may be a pair of wires or free space.
- The term channel is often used to refer to the frequency range allocated to a particular service or transmission such as a television channel.

Noise

- Noise is an unwanted energy that gets added to the message signal during transmission over the channel.
- It is random in nature and has its greatest effect when the message signal is weakest.

Receiver

- The receiver processes the signal and makes an estimate of the actual message that is transmitted.
- It performs a process called demodulation, which is the reverse of modulation and extracts the information superimposed on the carrier wave.
- The receiver, in addition to demodulation, also performs amplification and filtering.

Receiver

- Figure shows the block diagram of a simple AM broadcast receiver (superheterodyne receiver).

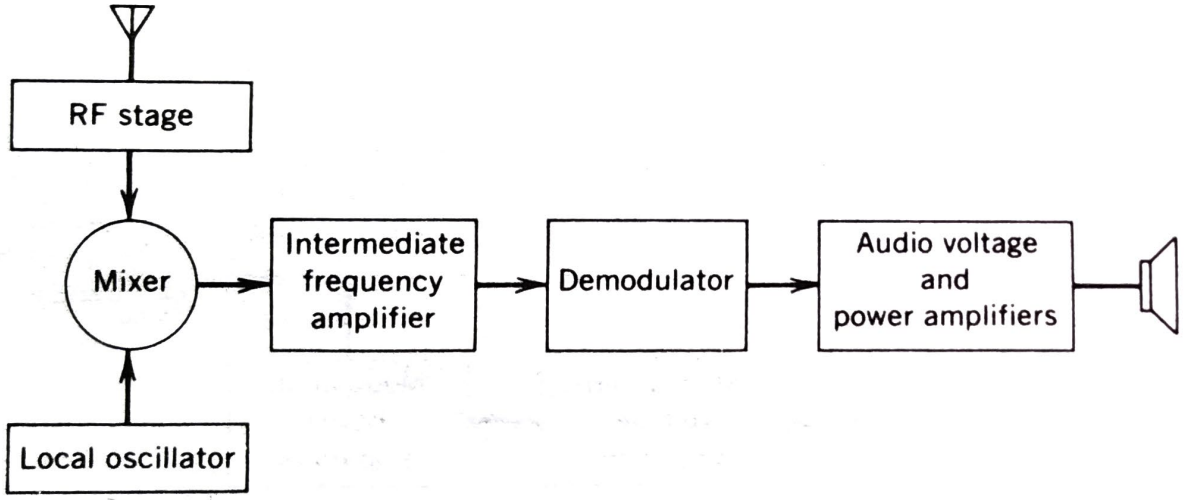


FIGURE 1-3 Block diagram of AM superheterodyne receiver.

Modulation

Modulation

- Modulation is a process by which some characteristic or property of a high frequency signal called the carrier is varied in accordance with the instantaneous amplitude of the message signal.
- The instantaneous value of the carrier is given by

$$v_c = V_c \sin(\omega_c t + \theta)$$

where V_c is the peak or maximum amplitude of the carrier

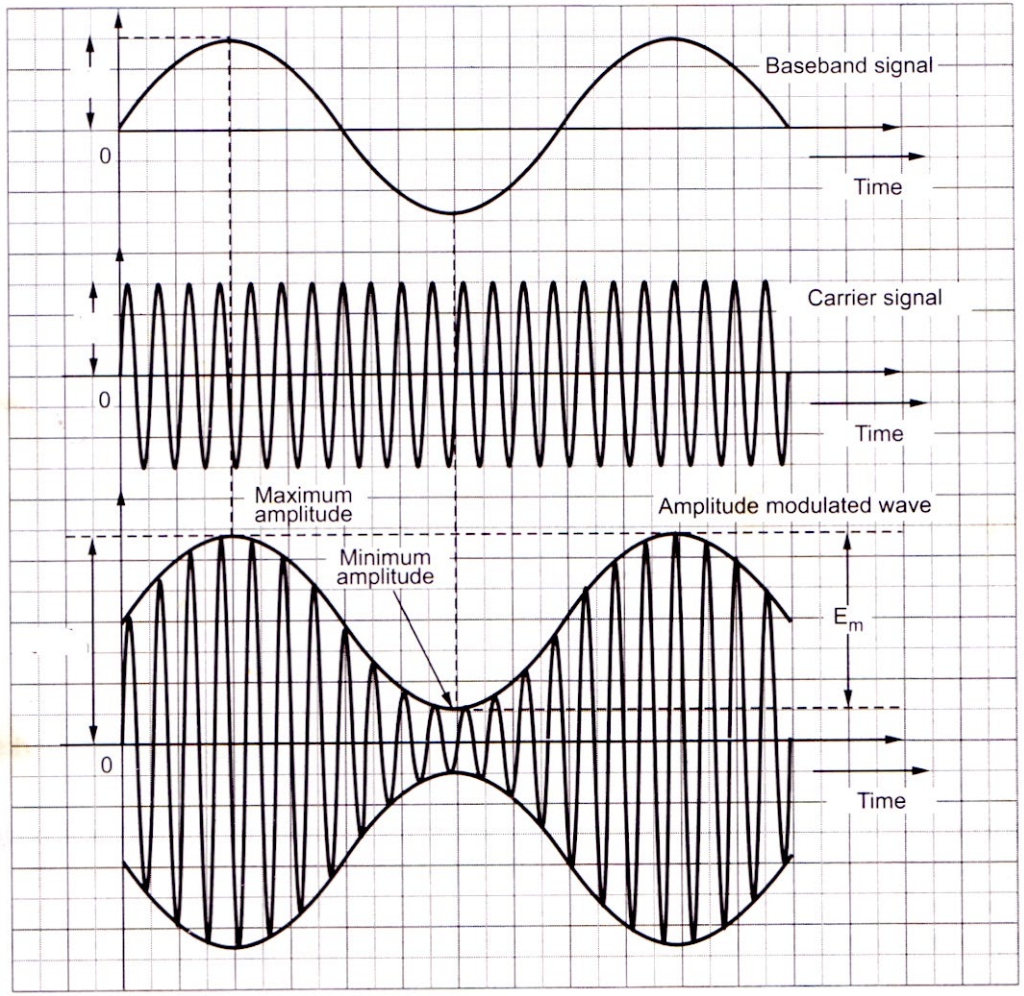
ω_c is the angular frequency of the carrier

θ is the phase angle of the carrier

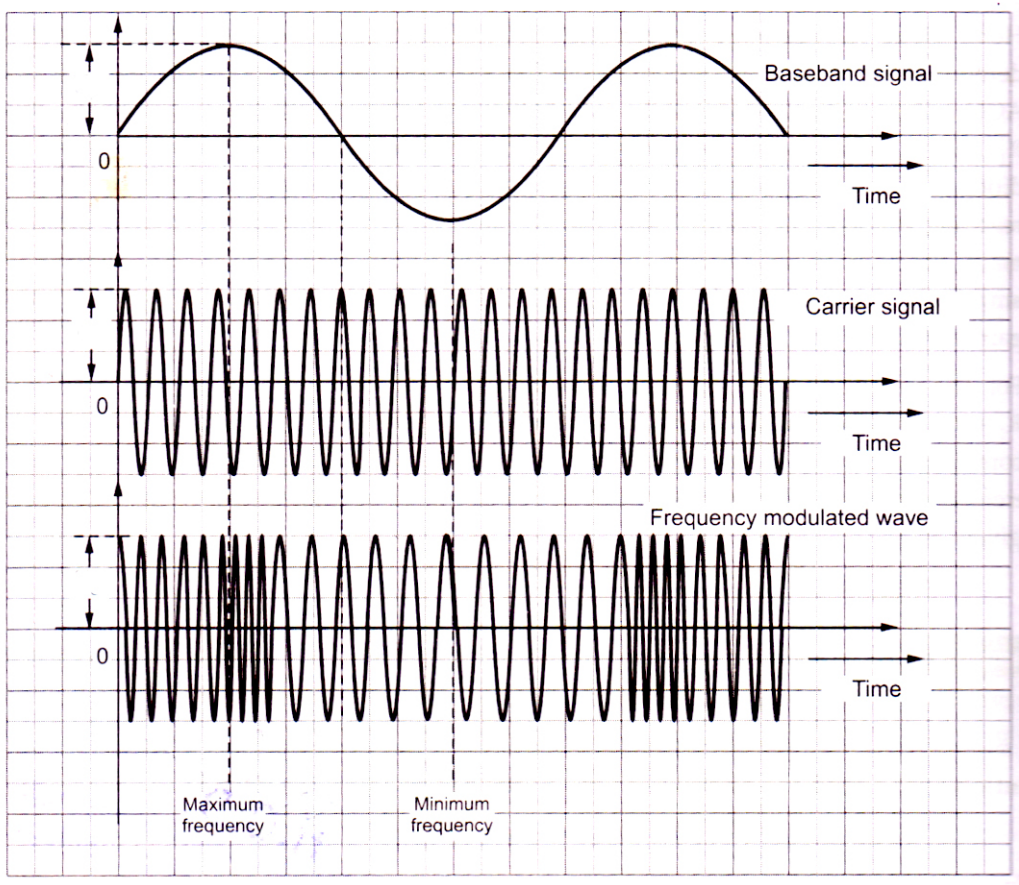
Modulation

- The characteristic of the carrier wave that is modified may be amplitude, frequency or phase angle.
- Accordingly, we have three types of modulation:
  - Amplitude modulation
  - Frequency modulation
  - Phase modulation

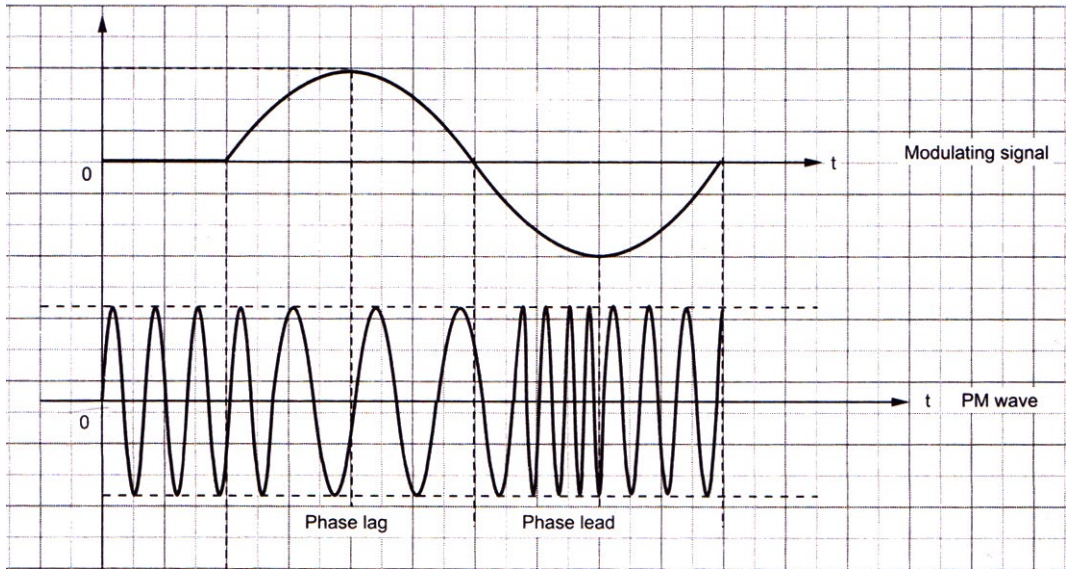
Amplitude Modulation (AM)



Frequency Modulation (FM)



Phase Modulation (PM)



Need for Modulation

1. It reduces the height of antenna
   - For the transmission of radio signals, the antenna height must be multiple of $\lambda/4$,where λ is the wavelength.

$$\lambda = c/f$$

   - The minimum antenna height required to transmit a baseband signal of f = 10 kHz is calculated as

$$Minimum\ antenna\ height = \frac{\lambda}{4} = \frac{c}{4f} = \frac{3 \times 10^8}{4 \times 10 \times 10^3} = 7500\ m$$

   - The antenna of this height (7.5 km) is practically impossible to install.

Need for Modulation

- Now, let us consider a modulated signal at f = 1 MHz . The minimum antenna height is given by,

$$Minimum\ antenna\ height = \frac{\lambda}{4} = \frac{c}{4f} = \frac{3 \times 10^8}{4 \times 1 \times 10^6} = 75\ m$$

- This antenna can be easily installed practically.
- Thus, modulation reduces the height of the antenna.

Need for Modulation

2. Avoids mixing of signals
   - If the baseband sound signals are transmitted without using the modulation by more than one transmitter, then all the signals will be in the same frequency range i.e. $0\ to\ 20\ kHz$.
   - Therefore, all the signals get mixed together and a receiver can not separate them from each other.
   - Hence, if each baseband sound signal is used to modulate a different carrier then they will occupy different slots in the frequency domain (different channels).
   - Thus, modulation avoids mixing of signals.

Need for Modulation

3. Increases the range of communication
   - The frequency of baseband signal is low, and the low frequency signals can not travel long distance when they are transmitted.
     - They get heavily attenuated.
   - The attenuation reduces with increase in frequency of the transmitted signal, and they travel longer distance.
   - The modulation process increases the frequency of the signal to be transmitted.
   - Therefore, it increases the range of communication.

Need for Modulation

4. Allows multiplexing of signals
   - Multiplexing is a process in which two or more signals can be transmitted over the same communication channel simultaneously.
   - This is possible only with modulation.
   - Multiplexing allows the same channel to be used by many signals.
   - E.g. Many TV channels can use the same frequency range, without getting mixed with each other or different frequency signals can be transmitted at the same time.

Need for Modulation

5. Improves quality of reception
   - With frequency modulation (FM) and the digital communication techniques such as Pulse Code Modulation (PCM), the effect of noise is reduced to a great extent.
   - This improves quality of reception