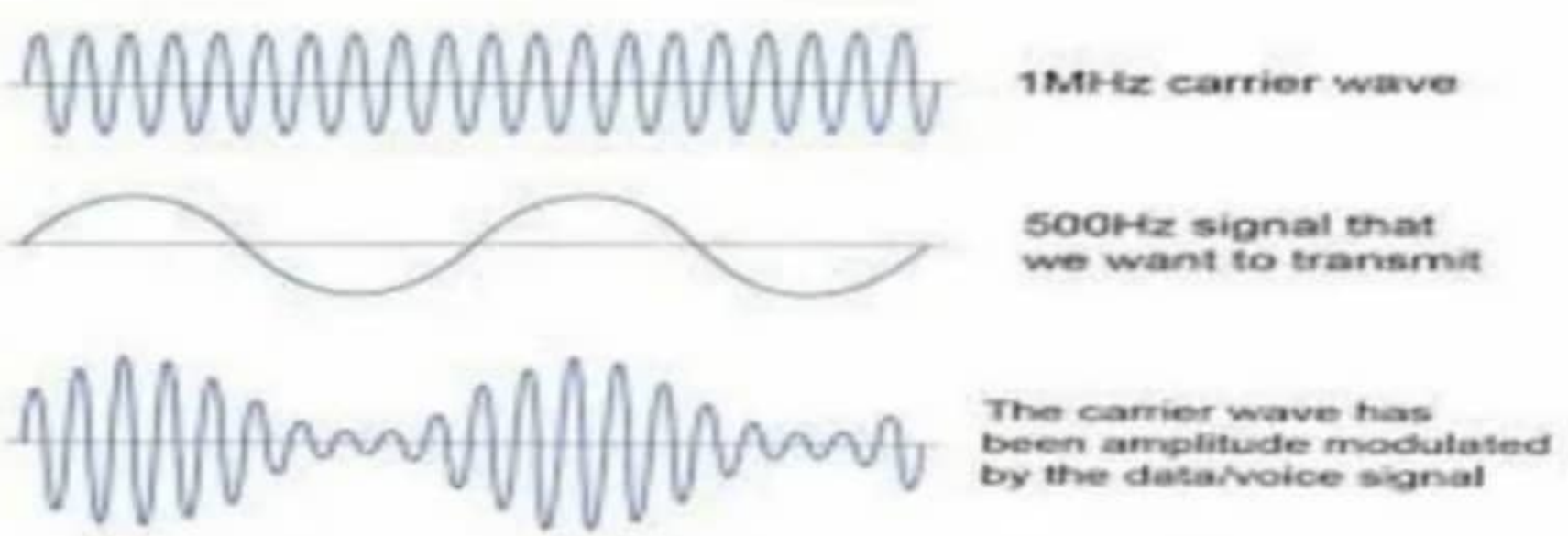
Carrier wave:

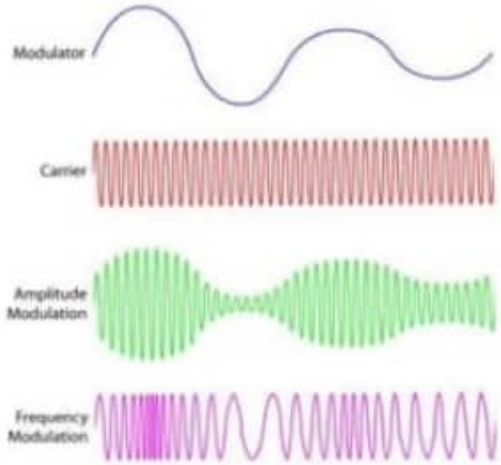
A High-Frequency Electromagnetic wave modulated in Amplitude or Frequency to convey a Signal is called Carrier wave.



Figrure 1: Carrier wave representation.

What is Modulation

Modulation is the process of encoding information from a message source in a way that is suitable for transmission by changing the parameters of the carrier signal, in accordance with the instantaneous values of the modulating signal.



Importance of Modulation

Need for Modulation

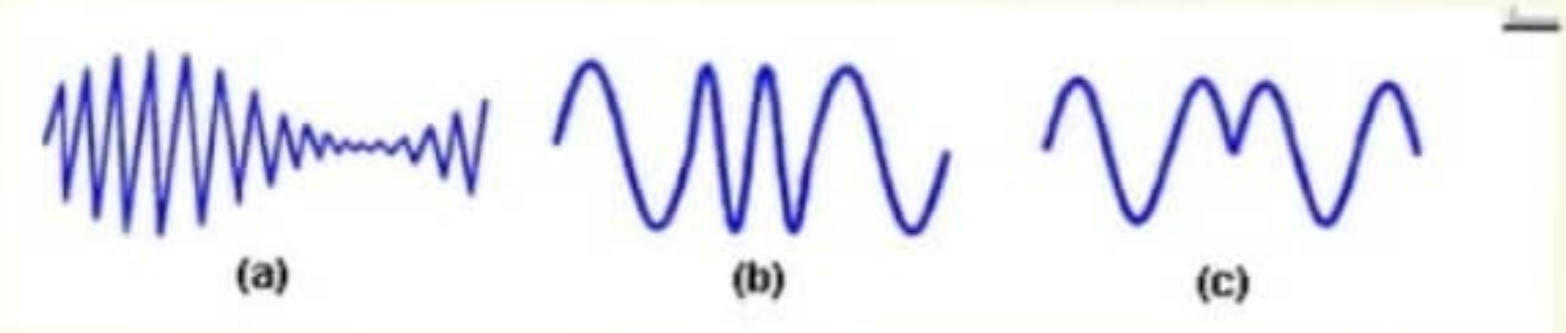
The baseband signals are incompatible for direct transmission. For such a signal, to travel longer distances, its strength has to be increased by modulating with a high frequency carrier wave, which doesn't affect the parameters of the modulating signal.

Advantages of Modulation

1. Antenna size gets reduced.
2. No signal mixing occurs.
3. Communication range increases.
4. Multiplexing of signals occur.
5. Adjustments in the bandwidth is allowed.
6. Reception quality improves.

Modulation Types

- b) Amplitude modulation (AM)
- b) Frequency Modulation (FM)
- c) Phase Modulation (PM)
- d) Pulse coded Modulation (PCM)
- e) Pulse Duration Modulation (PDM)



Phase Modulation

- The phase of a carrier wave is varied in response to the vibrations of the sound source in phase modulation (PM).

Pulse-coded modulation (PCM),

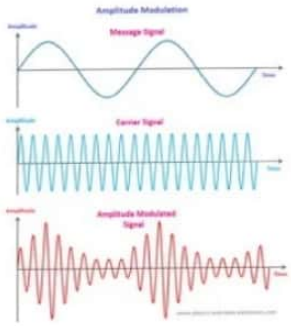
- In the intelligence signal converts the carrier into a series of constant-amplitude pulses spaced in such a manner that the desired intelligence is contained in coded form.

Pulse-duration modulation (PDM),

- Another kind of pulse modulation is in which intelligence is represented by the length and order of regularly recurring pulses.

What is AM Modulation

If the amplitude of the high frequency carrier wave is varied in accordance with the instantaneous amplitude of the modulating signal, then such a technique is called as **Amplitude Modulation**.

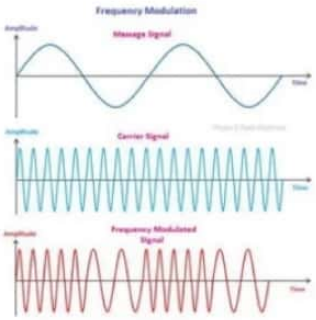


Applications of AM & FM Modulation

Applications of Amplitude modulation	Applications of Frequency Modulation
1. AM is used for broadcasting in long wave or medium wave or short wave bands. **2.** The Very High Frequency (VHF) transmission is processed by AM. Radio communication uses VHF. **3.** An special type of AM is Quadrature Amplitude Modulation (QAM). It is used for data transmission from short range transmission to cellular communications.	**1.** Frequency modulation can be used for the broadcasting of FM radio. This helps in larger signal to noise ratio. **2.** It is also used in music synthesis, some systems that use video-transmission and also for magnetic tape-recording systems. **3.** Telemetry, radar and seismic prospecting, EEG monitoring of new-born's etc. also use the technique of frequency modulation.

What is FM Modulation

If the frequency of the carrier wave is varied, in accordance with the instantaneous value of the modulating signal, then such a technique is called as **Frequency Modulation**.



Terms Related to Modulation

3 basic properties of Wave

1) Amplitude – the height of the wave
2) Frequency – a number of waves passing through in a given second
3) Phase – where the phase is at any given moment.

Modulating Signal

It is a baseband signal, which has to undergo the process of modulation, to get transmitted. Hence, it is called as the **modulating signal**.

Carrier Signal

The high frequency signal which has a certain phase, frequency, and amplitude but contains no information, is called a **carrier signal**. It is an empty signal. It is just used to carry the signal to the receiver after modulation.

Modulated Signal

The resultant signal after the process of modulation, is called as the **modulated signal**. This signal is a combination of the modulating signal and the carrier signal.

Modulation and demodulation

Modulation is the process of encoding information in a transmitted signal, while demodulation is the process of extracting information from the transmitted signal. Many factors influence how faithfully the extracted information replicates the original input information. Electromagnetic interference can degrade signals and make the original signal impossible to extract. Demodulators typically include multiple stages of amplification and filtering in order to eliminate interference.

A device that performs both modulation and demodulation is called a modem -- a name created by combining the first letters of MOdulator and DEModulator.

Comparison of AM & FM Modulation

	AM	FM
Stands for	AM stands for Amplitude Modulation	FM stands for Frequency Modulation
Origin	The first successful audio transmission was carried out in the mid-1870s	Developed in 1930 by Edwin Armstrong, in the United States
Modulating differences	In AM, a radio wave known as the "carrier" or "carrier wave" is modulated in amplitude by the signal that is to be transmitted. The frequency and phase remain the same.	In FM, a radio wave known as the "carrier" or "carrier wave" is modulated in frequency by the signal that is to be transmitted. The amplitude and phase remain the same.
Frequency Range	AM radio ranges from 535 to 1705 KHz	FM radio ranges in a higher spectrum from 88 to 108 MHz.
Noise	AM is more susceptible to noise because noise affects amplitude, which is where information is "stored" in an AM signal.	FM is less susceptible to noise because information in an FM signal is transmitted through varying the frequency, and not the amplitude.
Pros and cons	AM has poorer sound quality compared with FM, but is cheaper and can be transmitted over long distances. It has a lower bandwidth so it can have more stations available in any frequency range.	FM is less prone to interference than AM. However, FM signals are impacted by physical barriers. FM has better sound quality due to higher bandwidth.