

MODULATION & ITS NEED

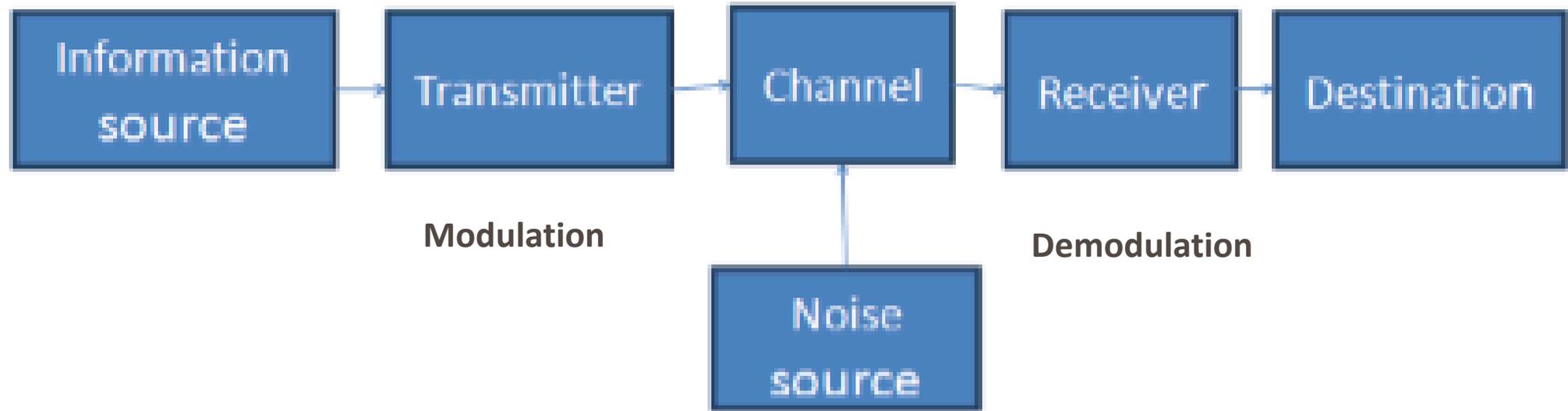
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Communication

- Transfer of Information from one place to another
- Should be efficient, reliable & secure
- **Communication System:** components or subsystems act together to accomplish transfer of Information from one place to another

Block diagram of basic communication system

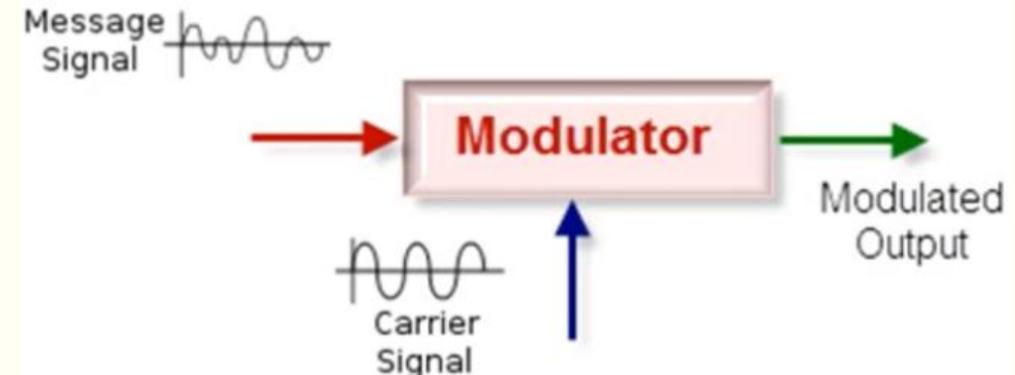


The baseband signals are incompatible for direct transmission. For such a signal, to travel longer distances, its strength has to be increased by modulating with a high frequency carrier wave, which doesn't affect the parameters of the modulating signal.

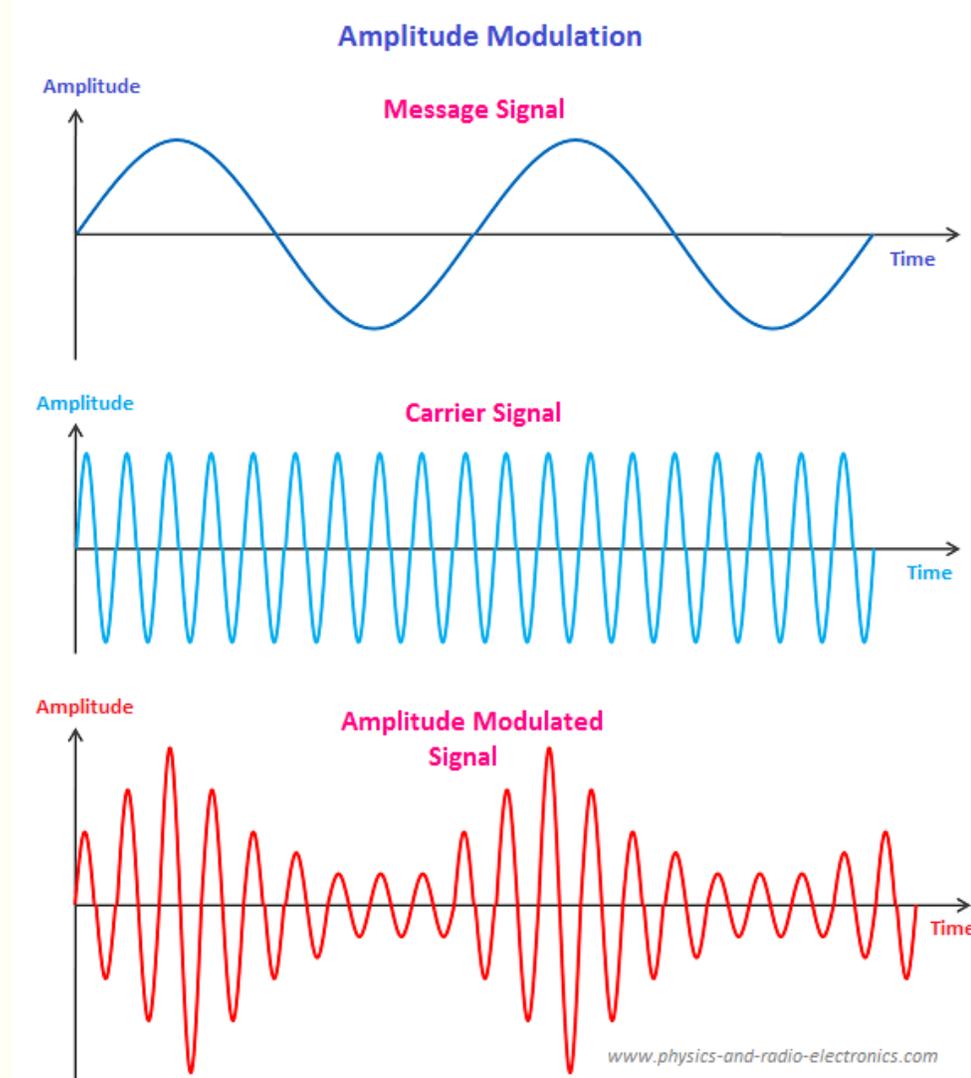
What is Modulation?

- Modulation is a process of mixing low energy message signal with high energy carrier signal to produce a new high energy signal which carries information to a long distance.
- **Definition:** Modulation is the process of changing some parameters of the **carrier signal** (such as amplitude, frequency or phase) in accordance with the instantaneous values of the modulating signal (**message signal**).

Signals in the Modulation Process		
Message or Modulating Signal (baseband Signal)	Carrier Signal	Modulated Signal



Example of Modulation



Need for Modulation

- Reduce the height of Antenna.
- Avoid mixing of signals.
- Increases range of Communication.
- Multiplexing of signals.
- Adjustment in bandwidth.
- Improve quality of Reception.

Reduction in the height of antenna

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

We can write $\lambda = c / f$ where c : velocity of light
 f : frequency of the signal to be transmitted

The minimum antenna height required to transmit a baseband signal of $f = 10$ kHz is :

$$\text{Minimum antenna height} = \frac{\lambda}{4} = \frac{c}{4f} = \frac{3 \times 10^8}{4 \times 10 \times 10^3} = 7500 \text{ meters i.e. } 7.5 \text{ km}$$

The antenna of this height is practically impossible to install.

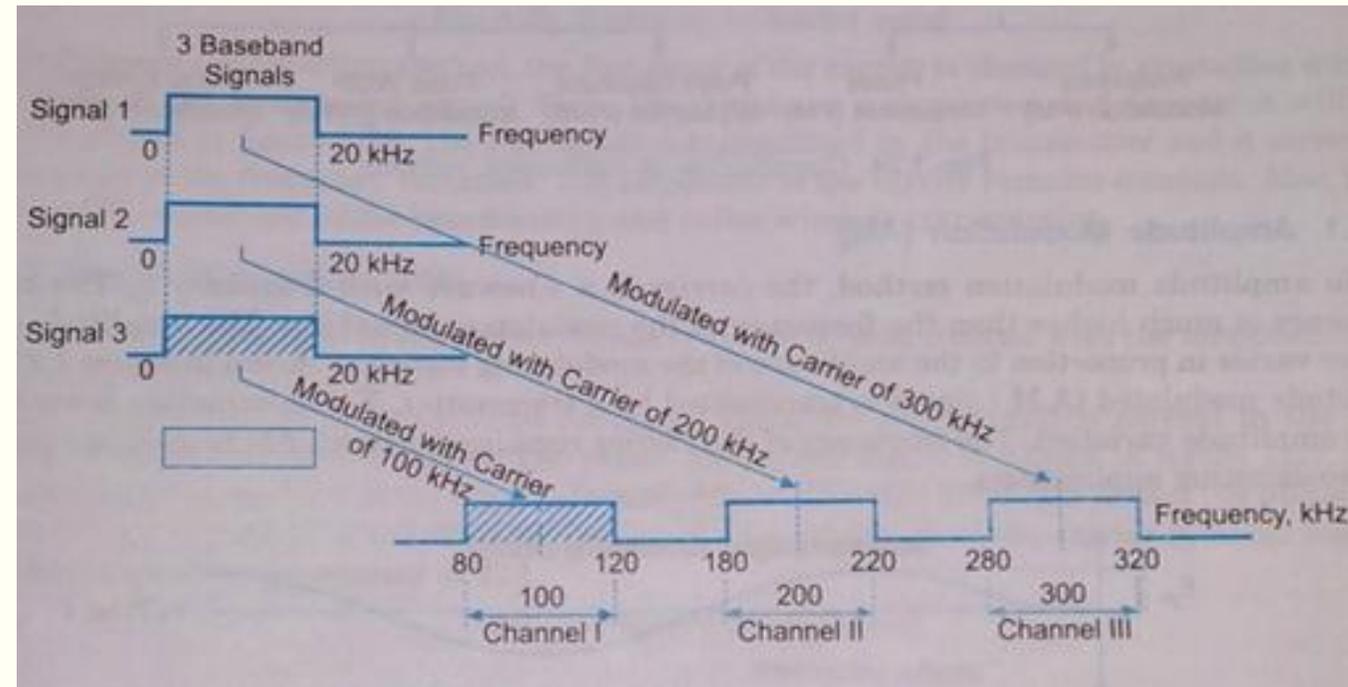
Now, let us consider a modulated using carrier of $f = 1$ MHz . The minimum antenna height is:

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

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

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 .
- 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 .

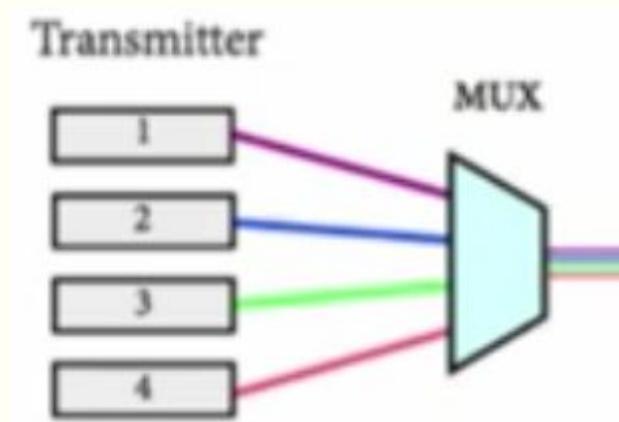


Increase the Range of Communication

- 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.

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.
- The multiplexing allows the same channel to be used by many signals . Hence, 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 .



Adjustment in bandwidth.

- Bandwidth of modulated signal may be made smaller or larger than the original signal.
- Signal to noise ratio, which is the function of signal bandwidth can be improved by proper control of bandwidth.

Improves Quality of Reception

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

Types of Modulation

