PRELUDE

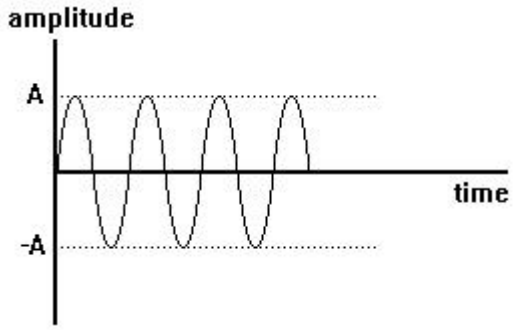
- ✓ refers to all types of data transmission from voice to video.
- ✓ is the transmission of signals over a distance for the purpose of communication.
- ✓ A telecommunication system consists of three basic elements:
  - o a sender that sends information
  - o a transmission medium that carries the information and,
  - o a receiver that receives the information and converts it back into usable information.
- ✓ Telecommunication over a telephone line is called point-to-point communication because it is between one transmitter and one receiver.
- ✓ Telecommunication through radio broadcasts is called broadcast communication because it is between one powerful transmitter and numerous receivers.

The information carrying signals are divided into two broad classes;

- ✓ Analog
- ✓ Digital

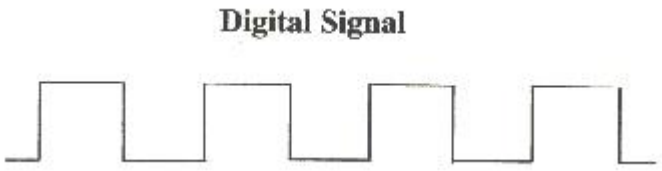
ANALOG SIGNALS

- ✓ Analog signals are continuous electrical signals that vary in time.
- ✓ Analog systems are very tolerant to noise, make good use of bandwidth, and are easy to manipulate mathematically.
- ✓ analog signals require hardware receivers and transmitters that are designed to perfectly fit the particular transmission. While working on a new system, one needs to completely change your transmitters and receivers if there is a change in analog signal.



DIGITAL SIGNALS

- ✓ A digital signal is a discrete signal. It is depicted as discontinuous values of voltage.
- ✓ A digital signal has the following characteristics:
  - o Holds a fixed value for a specific length of time
  - o Has sharp, abrupt changes
  - o A preset number of values allowed



- ✓ Digital signals are intolerant to noise, and digital signals can be completely corrupted in the presence of excess noise. In digital signals, noise could cause a 1 to be interpreted as a 0 and vice versa, which makes the received data different than the original data.
- ✓ Imagine if the army transmitted a position coordinate to a missile digitally, and a single bit was received in error? This single bit error could cause a missile to miss its target by miles. Luckily, there are systems in place to prevent this sort of scenario, such as checksums and CRCs, which tell the receiver when a bit has been corrupted and ask the transmitter to resend the data. The primary benefit of digital signals is that they can be handled by simple,

standardized receivers and transmitters, and the signal can be then dealt with in software (which is comparatively cheap to change).

MODULATION

- ✓ is the process, or results of the process, whereby some characteristic of one signal is varied in accordance with another signal. The modulated signal is called the carrier.
- ✓ Is the process of changing some characteristics of the carrier wave (high frequency wave used to carry the signals) is modulation.
- ✓ The carrier may be modulated in three fundamental ways: by varying the amplitude, called amplitude modulation; by varying the frequency, called frequency modulation; by varying the phase, called phase modulation.
- ✓ A device that performs modulation is known as a modulator and a device that performs the inverse operation of modulation is known as a demodulator (sometimes detector or demod). A device that can do both operations is a modem (short for "Modulator-Demodulator").

WHY MODULATION?

Modulation is necessary in communication due to the following reasons.

- ✓ **Antenna Length**: In order to transmit a wave efficiently, the length of the transmitting antenna should be nearly equal to the wavelength of the wave. So, for transmitting audio wave of very high wavelength, very long antennas are required which is practically impossible.
- ✓ **Operation Range**: The energy of a wave depends upon its frequency. The greater the frequency of the wave, the greater the energy possessed by it. As the audio signal frequencies are small, they cannot be transmitted over long distance.
- ✓ **Wireless Communiation:** At audio frequencies, radiation is not practical because the efficiency of radiation is poor at low frequencies. Hence, wireless communcation would be impractical in such case.

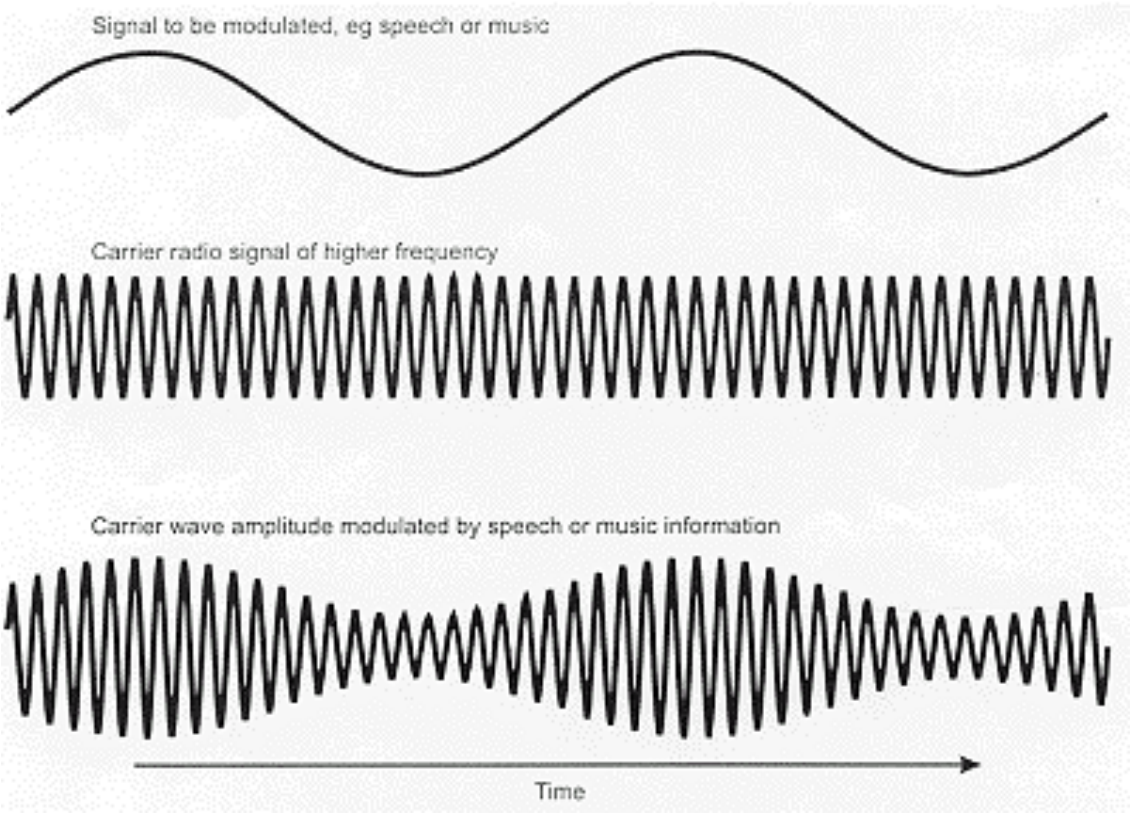
The only practical solution for the above problems is to modulate a high frequency carrier wave with the audio signal and permit the transmission to occur at this high frequency.

TYPES OF MODULATION

1. Amplitude Modulation (AM)
2. Frequency Modulation (FM)
3. Phase Modualtion (PM)

1. Amplitude Modulation (AM)

- ✓ When the amplitude of the high frequency carrier wave is changed in accordance with the intensity of the signal it is called amplitude modulation.
- ✓ The amplitude of the carrier wave changes according to the intensity of the signal.
- ✓ The amplitude variations of the carrier wave is at the signal frequency
- ✓ The frequency of the amplitude moduated wave remains the same - carrier frequency.
- ✓ The depth of modulation is defined by a modulation factor. It determines the extent to which the amplitude of the carrier wave is changed.
- ✓ AM radio ranges from 535 to 1705kHz



Limitations of Amplitude Modulation

- ✓ Noise Reception: In an AM wave, the signal is in the amplitude variations of the carrier. Practically, all natural and human voices consist of electrical amplitude disturbances. A radio receiver can't distinguish between amplitude vibrations that represent noise and those that contain the desired signal, reception is generally noisy.
- ✓ Small Operting Range: Due to low frequency of amplitude modulation, transmitters employing this method have a small operating range.
- ✓ Lack of audio quality: In order to attain high-fidelity reception all audio frequencies upto 15 KHz must be reproduced. This necessitates bandwidth of 30 KHz, but AM broadcasting stations are assigned bandwidth of only 10KHz to minimize interference from adjacent broadcating stations. This means that the highest modulating frequency can be 5 KHz, which is hardly sufficient to reproduce the signal properly.

2. Frequency Modulation (FM)

- ✓ Frequency modulation conveys information over a carrier wave by varying its frequency and the amplitude of the carrier remains constant.
- ✓ The FM radio band goes from 88 to 108 MHz

Advantages

- It gives noiseless reception. Noise is a form of amplitude vibration and FM receivers reject such signals.
- Operating range is quite large.
- It gives high-fidelity (quality) reception
- The efficiency of transmission is very high.

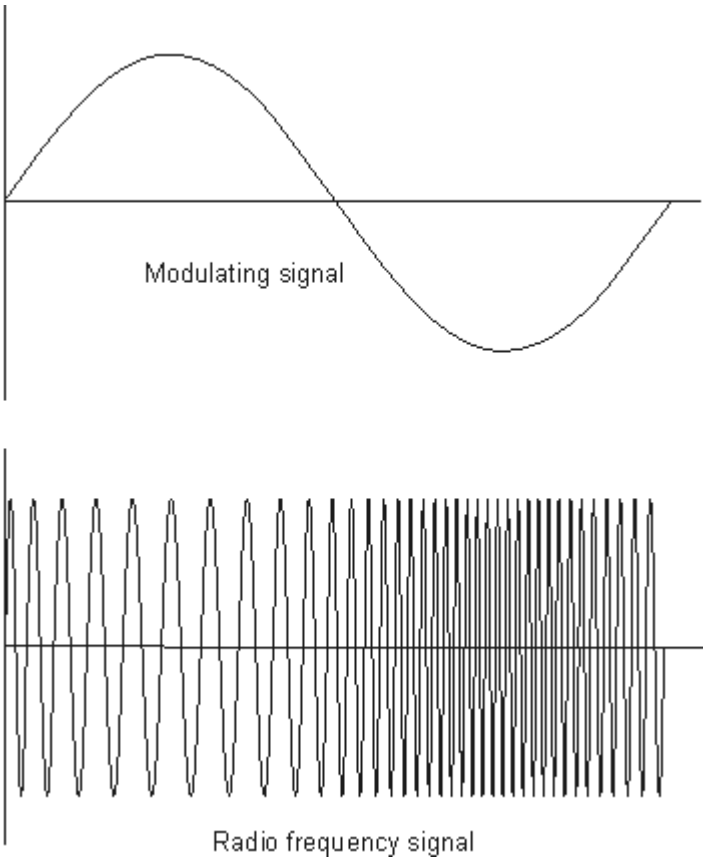


Fig: Frequency Modulation

3. Phase Modulation

- ✓ Phase modulation is the change in the carrier phase angle.
- ✓ The phase angle cannot change without affecting a change in frequency. Hence, it is taken as a second form of frequency modulation.

MODEMS

- ✓ Modem is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.
- ✓ The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data.
- ✓ Modems can be used over any means of transmitting analog signals, from driven diodes to radio.
- ✓ Modems are generally classified by the amount of data they can send in a given time, normally measured in bits per second, or "bps". They can also be classified by Baud, the number of times the modem changes its signal state per second.

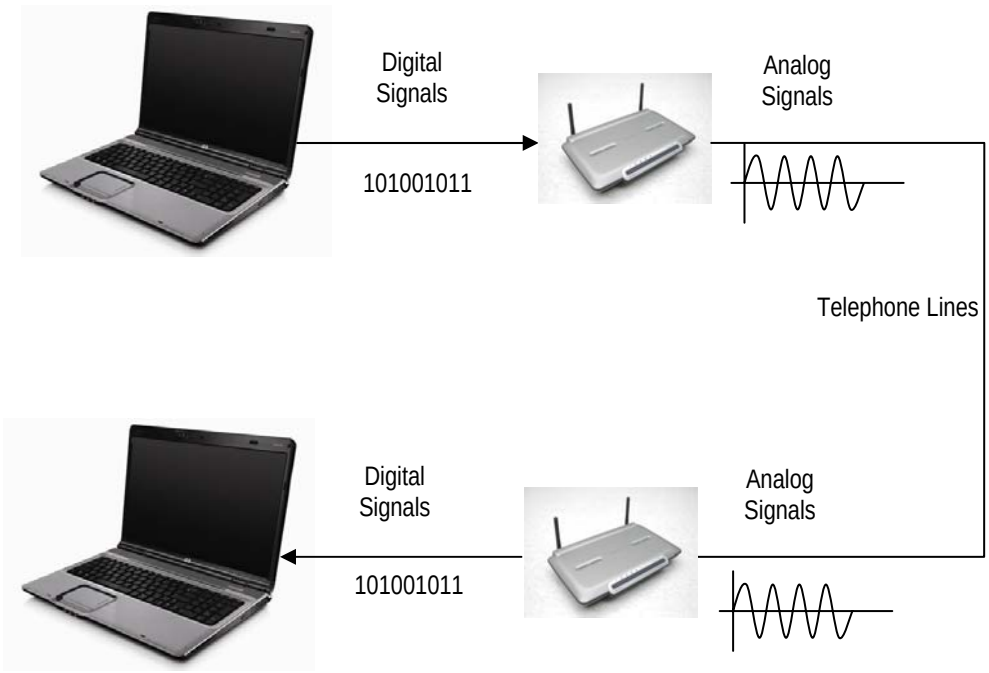


Fig: How MODEM Works

Transfer Speeds

- ✓ Measured in bps (bits per second)
- ✓ General MODEM used for internet connection are 14.4 kbps modems
- ✓ 28.8 kbps, 33.6 kpbs, 56 kbps modems are available in the market.