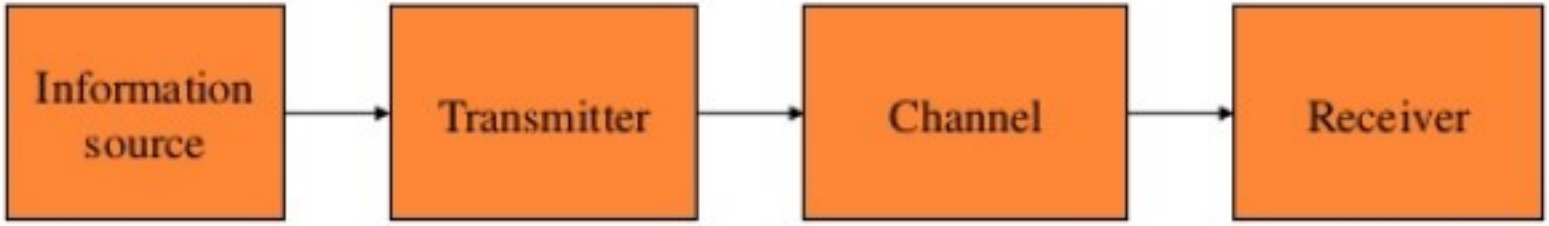
Electronic Communication

INTRODUCTION

- What is communication



A communication system

- Process of conveying message or information
- Transmitter modifies the message signal into a form which is suitable for transmission over channel which is achieved by

MODULATION

WHAT IS MODULATION

- MODULATION is the basic requirement for transmitting the message signal through free space

- It is the process of transmission of information signal (low frequency audio signal) using a high frequency **carrier signal**

WHY MODULATION?

- Carrying one signal to another : uses carrier (having high frequency , smaller wavelength)
- Modulated signal is transmitted
- Problems with transmitting baseband signal/
  Need of modulation

  - Height of transmitting and receiving antenna
  - Noise and interference from other sources at low frequencies: Multiplexing
  - Narrow banding

PRACTICABILITY OF ANTENNAS

$h=\lambda/4$, for efficient transmission.

For f=30 Hz => h= 2500 km

f=3kHz => h= 25 km

f=3MHz => h= 25 m

Thus as

Frequency increases height of the antenna decreases

MODULATION

- Defined as

" The process by which some characteristics of a signal called carrier varied in accordance with the instantaneous value of another signal called modulating signal "

- The information bearing signal is called modulating signal
- The signal resulting from process of modulation is known as modulated signal

TYPES OF MODULATION

- **Continuous wave Modulation** : carrier is continuous in nature (usually sinusoidal) (AM,FM,PM)

- **Pulse Modulation** :Carrier is pulse type waveform

TYPES OF MODULATION

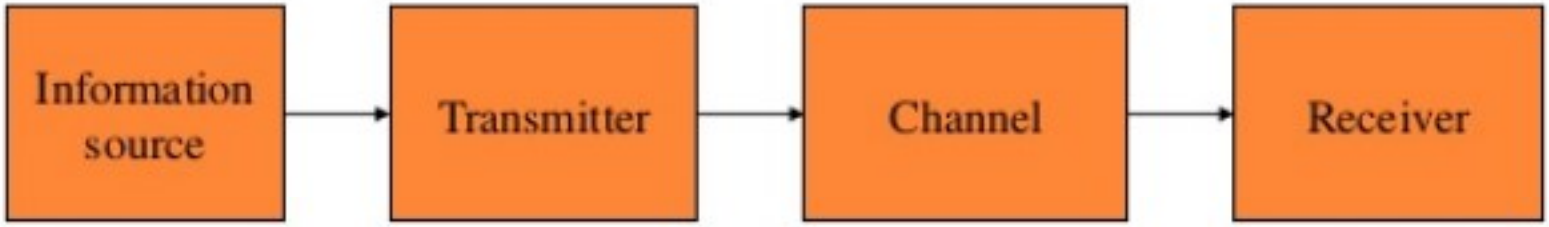
- Sine wave (carrier) described by 3 parameters:
  amplitude, frequency and phase.
- Let carrier signal be:

$$v(t) = A \sin(\omega t + \varphi)$$

So can have

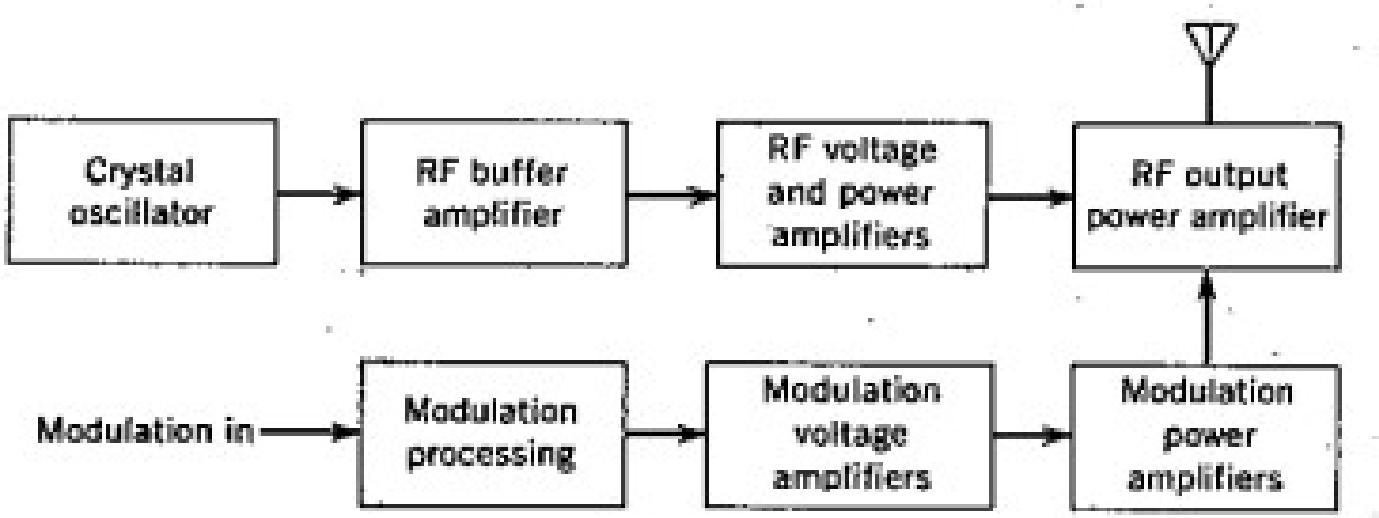
- **– Amplitude modulation (AM)**
- **– Frequency modulation (FM)**
- **– Phase modulation (PM)**

Frequency and phase combined are known as Angle Modulation

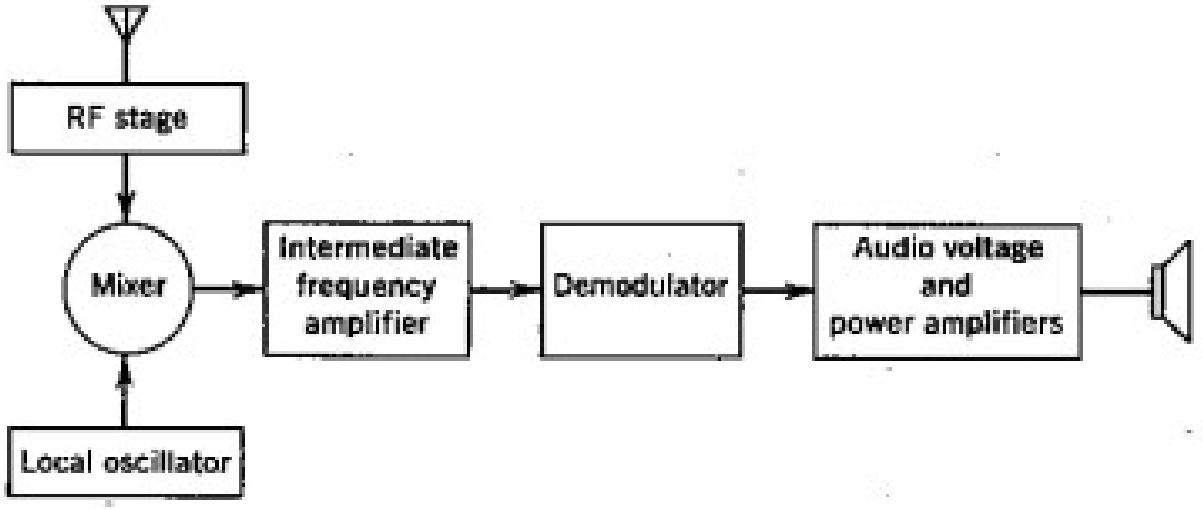


A communication system

Transmitter



Receiver


RF stage
Mixer
Intermediate frequency amplifier
Demodulator
Audio voltage and power amplifiers
Local oscillator

Types and modes of electronic communications

- Email. ...
- Instant messaging and live chat
- Websites and blogs
- SMS/text messaging
- Phone and voicemail
- Video.

What is channel ?

The channel is the medium that carries the message. The channel might be wires, the air or space in the case of radio and television transmissions, or fibre-optic cable.

What is baseband?

Baseband in the transmission of communications signals means only one path is available to send and receive digital signals between devices. Baseband communication systems have been in use for many years and is still used in technologies such as Ethernet and wireless communications.

Baseband technology is used in several ways:

•Information is carried in digital form on a single signal channel that isn't multiplexed and uses a transmission medium, such as copper twisted-pair wires. Baseband network technology is used in various types of networks, including Ethernet and token ring local area networks.

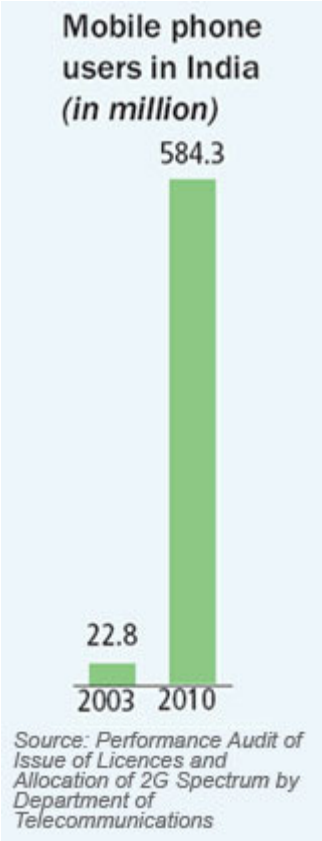
•With multiplexing, a transmission channel derives additional paths over a baseband channel.

•A baseband signal transmits data streams as analog signals using modulation technology.

•With any frequency band on which information is superimposed, baseband can be used whether or not the band is multiplexed and information is sent on subbands. In this application, it's assumed that the carrier frequency band used isn't shifted to a different frequency band but remains at its original place in the electromagnetic spectrum.

Frequency allocation for radio communication system in India:

When the mobile phone was first launched about two decades ago, not many envisioned that such a bulky and expensive device would go on to become one of the world's most indispensable modes of communication.
But despite its omnipresence many people are still ignorant how it functions.



Energy travels in the form of waves known as electromagnetic waves.

These waves differ from each other in terms of frequencies. This whole range of frequencies is called the spectrum. In telecommunication like TV, radio and GPRS, radio waves of different wavelengths are used.

They are divided into bands based on frequencies (see 'Radio spectrum').

Mobile phones use two technologies based on different parts of the radio spectrum—GSM (global system for mobile communications) and CDMA (code division multiple access). Most of the radio spectrum is reserved in countries for defense.

The rest is available for public use. But following an increase in the number of phone users and new services, countries started auctioning the frequencies to telecom companies.

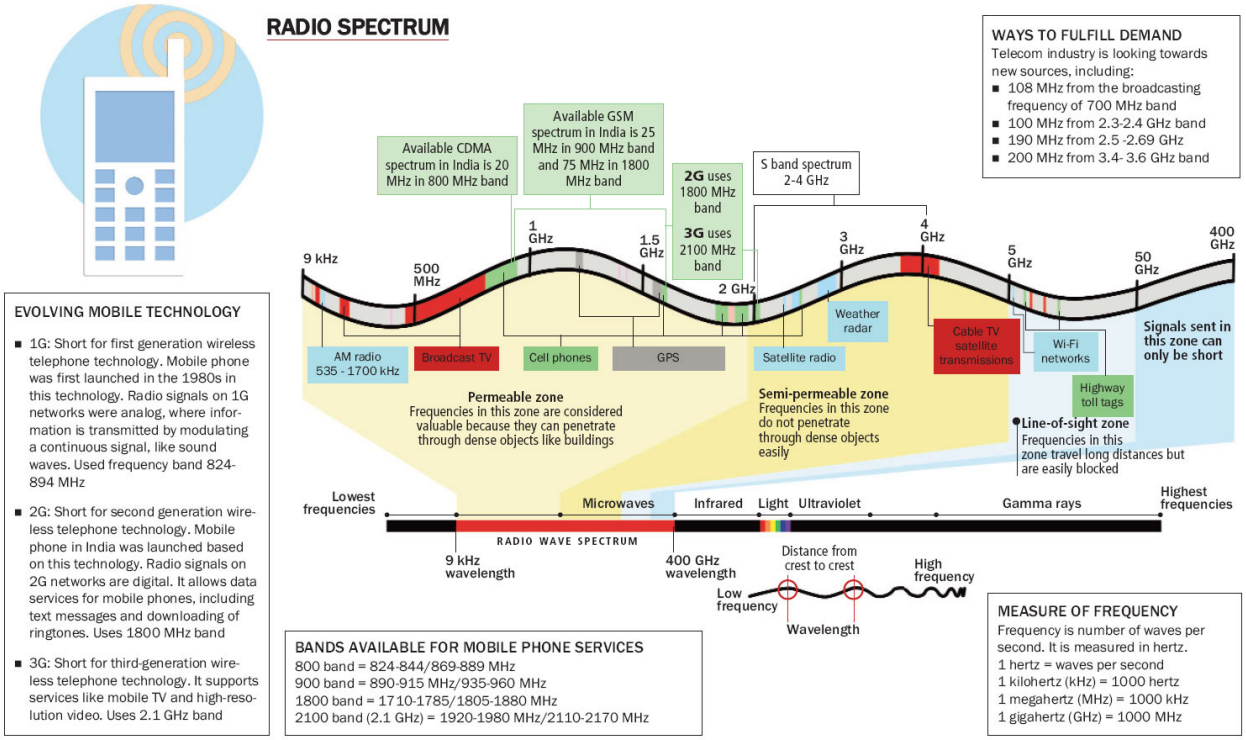
This sale has become a major revenue earner for governments around the world.

But in India, it is currently auctioning the spectrum in the range of 1959-1979 MHz.

2G versus 3G

Generation	Characteristics	Average rate of message delivery (kbps)*
2G	Allows transfer of voice or low-volume digital data	9.6
3G	Allows simultaneous transfer of voice and high-speed digital data	384

*kilobits per second



TRAI:

The Telecom Regulatory Authority of India (TRAI) is a statutory body set up by the Government of India under section 3 of the Telecom Regulatory Authority of India Act, 1997. It is the regulator of the telecommunications sector in India. It consists of a Chairperson and not more than two full-time members and not more than two part-time members. The TRAI Act was amended by an ordinance, effective from 24 January 2000, establishing a Telecom Disputes Settlement and Appellate Tribunal (TDSAT) to take over the adjudicatory and disputes functions from TRAI.

Noise: **In common use, the word noise means any unwanted sound. In communication unwanted signal are called noise.**

Classification of Noise:

There are several way to classify Noise, but conveniently Noise is classified as
1) External Noise
2) Internal Noise

External Noise:

External noise is defined as the type of Noise which is general externally due to communication system. External Noise are analysed qualitatively. Now, External Noise may be classified as

a) Atmospheric Noise : Atmospheric Noise is also known as static noise which is the natural source of disturbance caused by lightning, discharge in thunderstorm and the natural disturbances occurring in the nature.

b) Industrial Noise : Sources of Industrial noise are auto-mobiles, aircraft, ignition of electric motors and switching gear. The main cause of Industrial noise is High voltage wires. These noises is generally produced by the discharge present in the operations.

c) Extraterrestrial Noise : Extraterrestrial Noise exist on the basis of their originating source. They are subdivided into
i) Solar Noise
ii) Cosmic Noise

Internal Noise:

Internal Noise are the type of Noise which are generated internally or within the Communication System or in the receiver. They may be treated qualitatively and can also be reduced or minimized by the proper designing of the system. Internal Noises are classified as

1) Shot Noise : These Noise are generally arises in the active devices due to the random behaviour of Charge particles or carries. In case of electron tube, shot Noise is produces due to the random emission of electron form cathodes.
2) Partition Noise : When a circuit is to divide in between two or more paths then the noise generated is known as Partition noise. The reason for the generation is random fluctuation in the division.
3) Low- Frequency Noise : They are also known as FLICKER NOISE. These type of noise are generally observed at a frequency range below few kHz. Power spectral density of these noise increases with the decrease in frequency. That why the name is given Low- Frequency Noise.
4) High- Frequency Noise : These noises are also known TRANSIT- TIME Noise. They are observed in the semi-conductor devices when the transit time of a charge carrier while crossing a junction is compared with the time period of that signal.
5) Thermal Noise : Thermal Noise are random and often referred as White Noise or Johnson Noise. Thermal noise are generally observed in the resistor or the sensitive resistive components of a complex impedance due to the random and rapid movement of molecules or atoms or electrons.

Signal to Noise Ratio:

In terms of definition, SNR or signal-to-noise ratio is the ratio between the desired information or the power of a signal and the undesired signal or the power of the background noise.

Also, SNR is a measurement parameter in use in the fields of science and engineering that compares the level of the desired signal to the level of background noise. In other words, SNR is the ratio of signal power to the noise power, and its unit of expression is typically decibels (dB). Also, a ratio greater than 0 dB or higher than 1:1, signifies more signal than noise.

Noise Figure:

Noise figure is a number by which the noise performance of a radio receiver, amplifier, mixer or other circuit block can be specified. The lower the value of the noise figure, the better the performance.

Essentially the noise figure defines the amount of noise an element adds to the overall system. It may be a pre-amplifier, mixer, or a complete receiver. Often the noise figure may be used to define the performance of a receiver and in this way it can be used instead of the signal to noise ratio.

In view of its widespread applicability, noise figure is a particularly important parameter for a wide variety of radio communications systems from fixed or mobile radio communications systems, two way radio communications systems, and satellite radio communications systems.

Noise figure is a parameter which is often used in the RF circuit design of radio receivers to understand the noise performance of any radio being developed, or the performance of one that may need to be selected for any system, etc.

Noise figure N can be defined as:

$$N = 10 \log_{10} \left(\frac{S_i N_i}{S_o / N_o} \right)$$

Where

S_i is the signal at the input
N_i is the noise at the input
S_o is the signal at the output
No the noise at the output

As an example if the signal to noise ratio at the input was 4:1, and it was 3:1 at the output then this would give a noise factor of 4/3 and a noise figure of 10 log (4/3) or 1.25 dB. Alternatively if the signal to noise ratios are expressed in decibels then it is quite easy to calculate the noise figure simply by subtracting one from another because two numbers are divided by subtracting their logarithms. In other words if the signal to noise ratio was 13 dB at the input and only 11 dB at the output then the circuit would have a noise figure of 13 - 11 or 2 dB.