

18ECO05 - Principles of Communication Engineering

UNIT-1

UNIT 1

BASICS OF COMMUNICATION

- Introduction
- Elements of communication system
- Classification of signals-
- Communication channels
- Analog and digital types of communication.

Introduction

- The word communication arises from the Latin word “commūnicāre”, which means “**to share**”.
- Communication is the basic step for the **exchange of information**.
- **Communication** can be defined as the process of exchange of information through means such as **words, actions, signs, etc.**, between two or more individuals.

Example

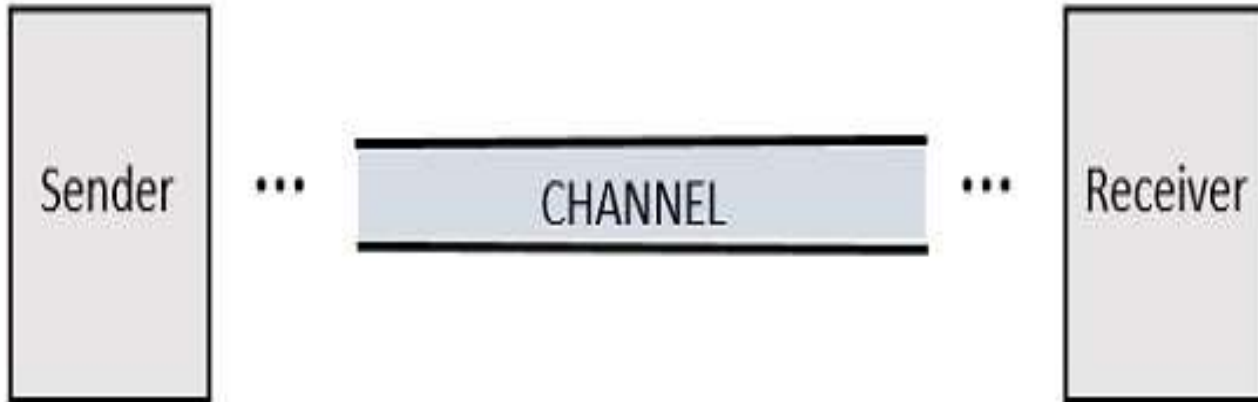
- I. A baby in a cradle, communicates with a **cry** that she needs her mother.
- II. A cow **moos** loudly when it is in danger. A person communicates with the help of a language. Communication is the bridge to share.

Need for Communication

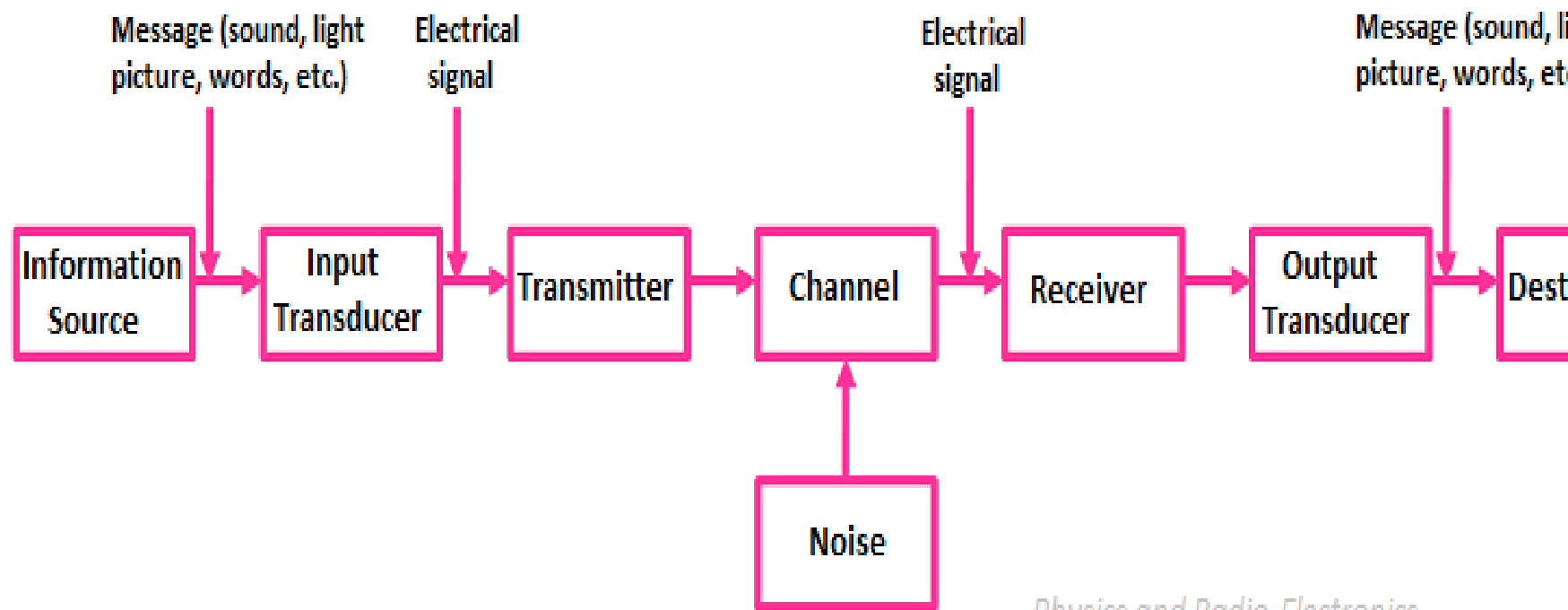
- For any living being, there occurs the **necessity of exchange of some information**. Whenever a need for exchange of information arises, some means of communication should exist.
- While the means of communication, can be anything such **as gestures, signs, symbols, or a language**, the need for communication is inevitable.

- Language and gestures play an important role in **human communication**, while sounds and actions are important for **animal communication**.
- However, when some message has to be conveyed, a communication has to be established

Parts of Communication System



- The **Sender** is the person who sends a message. It could be a **transmitting station** from where the signal is transmitted.
- The **Channel** is **the medium through which the message signals travel** to reach the destination.
- The **Receiver** is the person who receives the message. It could be a **receiving station** where the signal transmitted is received



Information Source

- The message can be voice, music, Data, Video, Temperature, Light, Pressure etc

Input Transducer

- The input can be in any energy form (temperature, pressure, light) but for transmission purposes, this needs to be **converted to electrical energy**. Transducer does this.
- A transducer is a device which converts **one form of energy or signal into another form** of energy or signal.

Transmitter:

- It converts information into a signal that is suitable for transmission over a medium.
- Transmitter **increases the power of the signal** through power amplifiers and also provides interfaces to match the transmission medium, such as an antenna interface, fiber interface and so on.

Channel

- A channel in a communication system just refers to the medium through which an **electrical signal travels**.
- The communication channel is **a wired or wireless medium** through which the signal (information) travels from source (transmitter) to destination (receiver)

Noise

- Noise is **an unwanted signal that enters the communication system** via the communication channel and interferes with the transmitted signal.
- The noise signal (unwanted signal) degrades the transmitted signal (signal containing information).

Receiver

- The receiver is a device that receives the signal (electrical signal) from the channel and **converts the signal (electrical signal) back to its original form (light and sound)** which is understandable by humans at the destination.`

Output Transducer

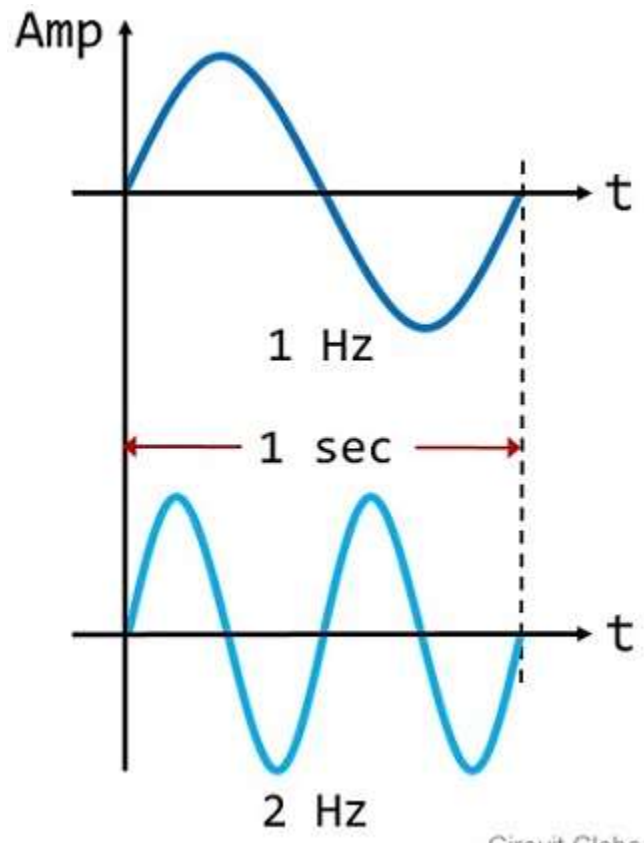
- The transducer that is present at the **output side of the communication** system is called output transducer.
- Generally, the output transducer converts the **electrical signal into a non-electrical signal** (sound signal, light signal, or both sound and light signal).

Destination

- The destination is the **final stage** in the communication system.
- For example, if you are watching TV, you are considered as the destination.

Definition of frequency

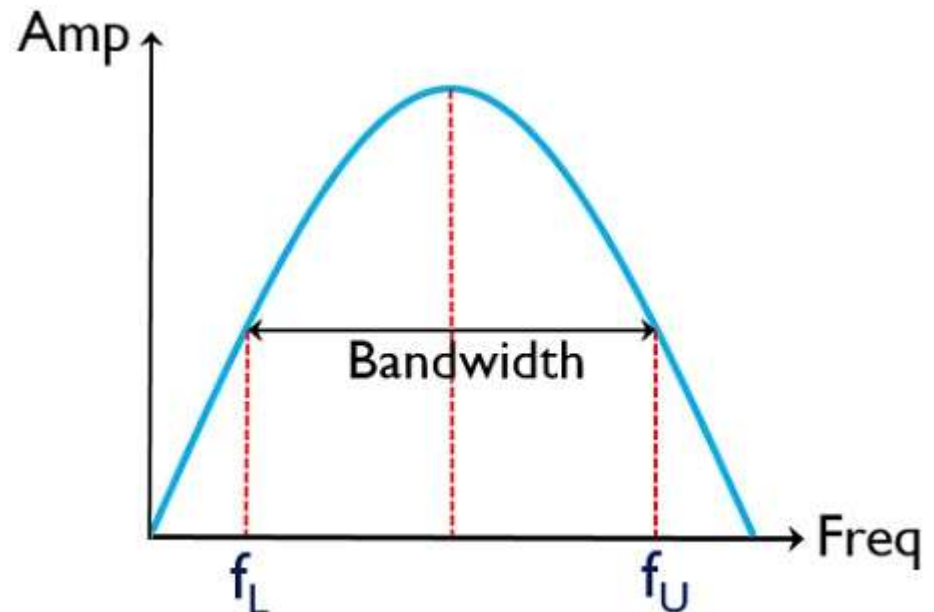
- Frequency is defined as the total number of wave cycles present in each second of a waveform.
- It basically shows the occurrence of overall complete wave cycles in the unit time.



Definition of bandwidth

- Bandwidth is the range of frequencies.
- Bandwidth is defined as the difference in the **upper and lower frequency components** present in a signal.

$$BW = f_U - f_L$$



Differences Between Frequency and Bandwidth

- The frequency of a signal defines the total number **of complete cycles of a waveform** that are existing per sec.
- While bandwidth is the **range of frequency** of signal while transmission thus shows its capacity of data flow.
- The frequency of a signal is specified as **cycles/second**.
- While bandwidth is generally specified in terms of **bits/sec**.

Definition of wavelength

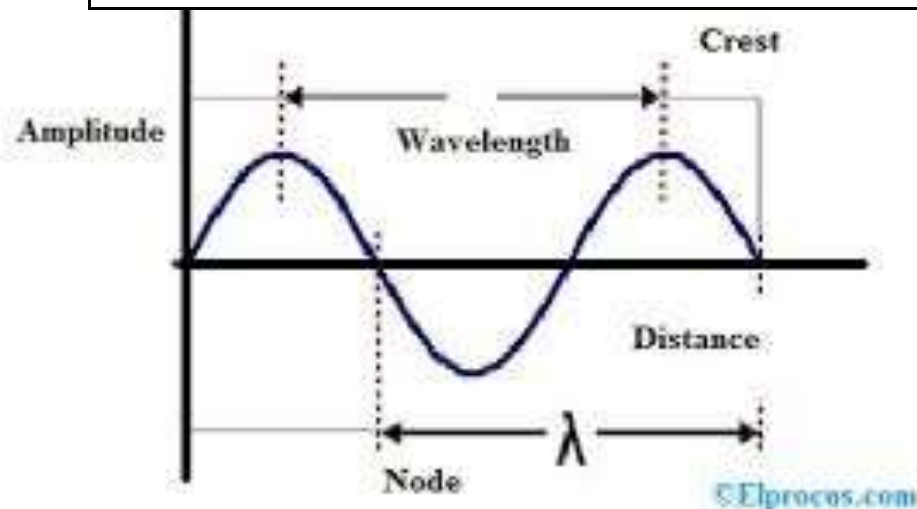
- Wavelength is the distance between identical points (adjacent crests) in the adjacent cycles of a waveform signal propagated in space or along a wire.

Wavelength calculated

$$\lambda = \frac{v}{f}$$

Labels: λ (WAVELENGTH), v (VELOCITY), f (FREQUENCY)

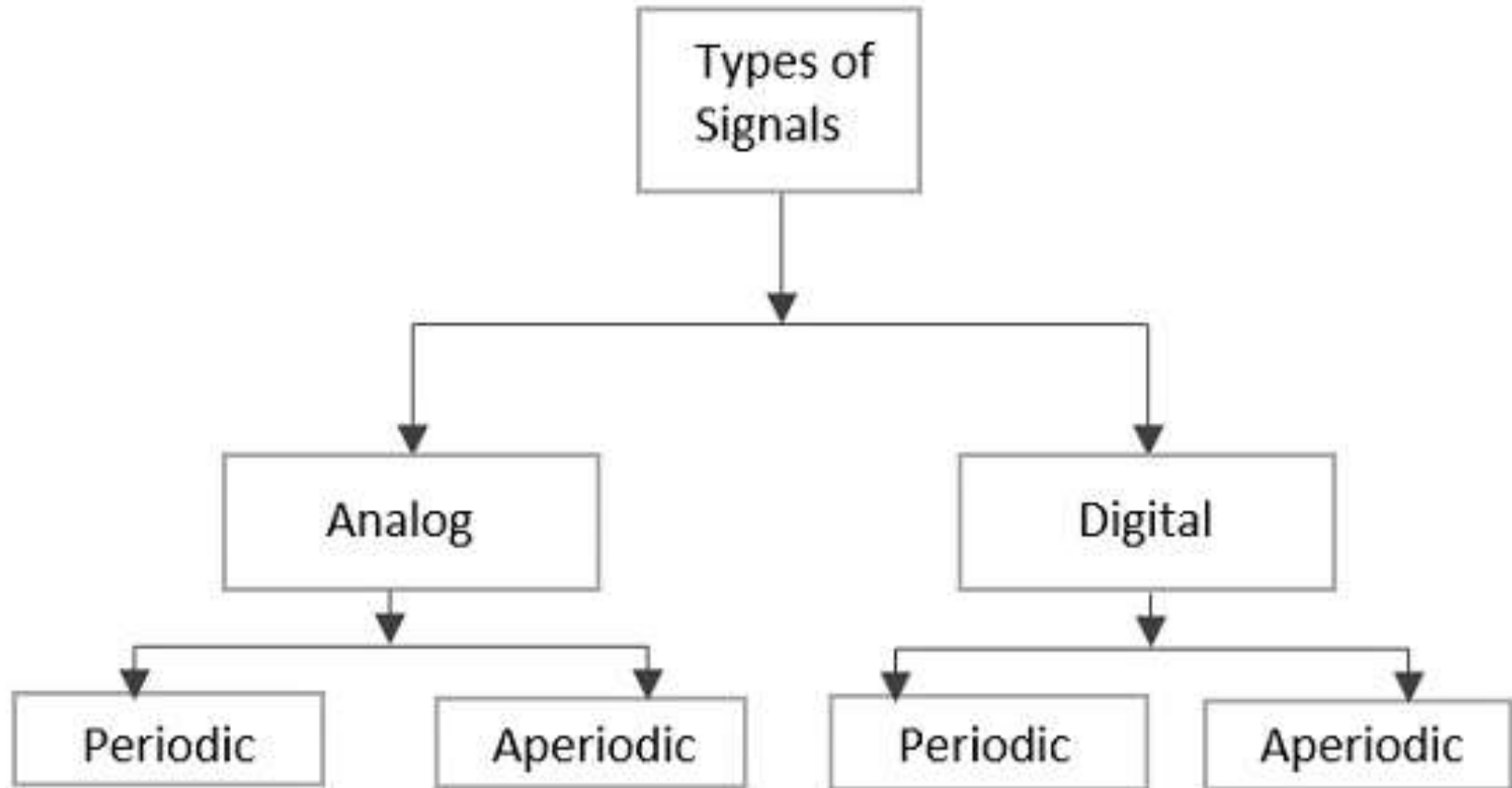
$$\text{Wavelength} = \frac{\text{Speed of Light}}{\text{Frequency of Oscillation}}$$
$$\text{Frequency of Oscillation} = \frac{\text{Speed of Light}}{\text{Wavelength}}$$



Signal

- Conveying an information by some means such as gestures, sounds, actions, etc., can be termed as **signaling**.
- Hence, a signal can be a **source of energy which transmits some information**.
- This signal helps to **establish communication** between a sender and a receiver.

Classification of signals

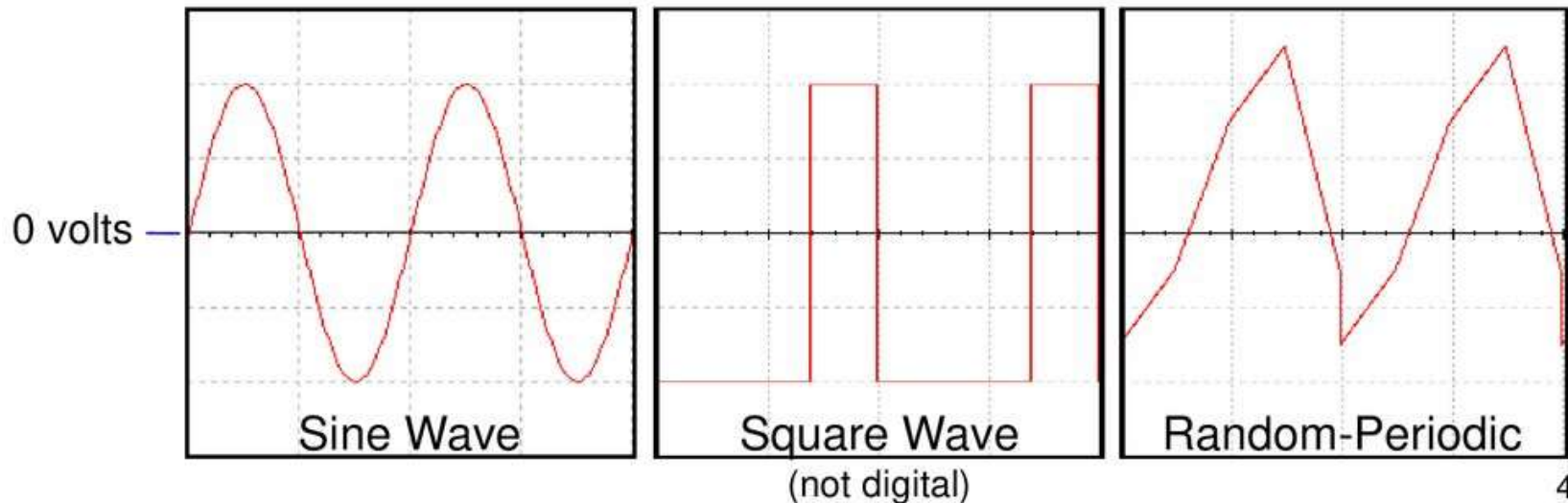


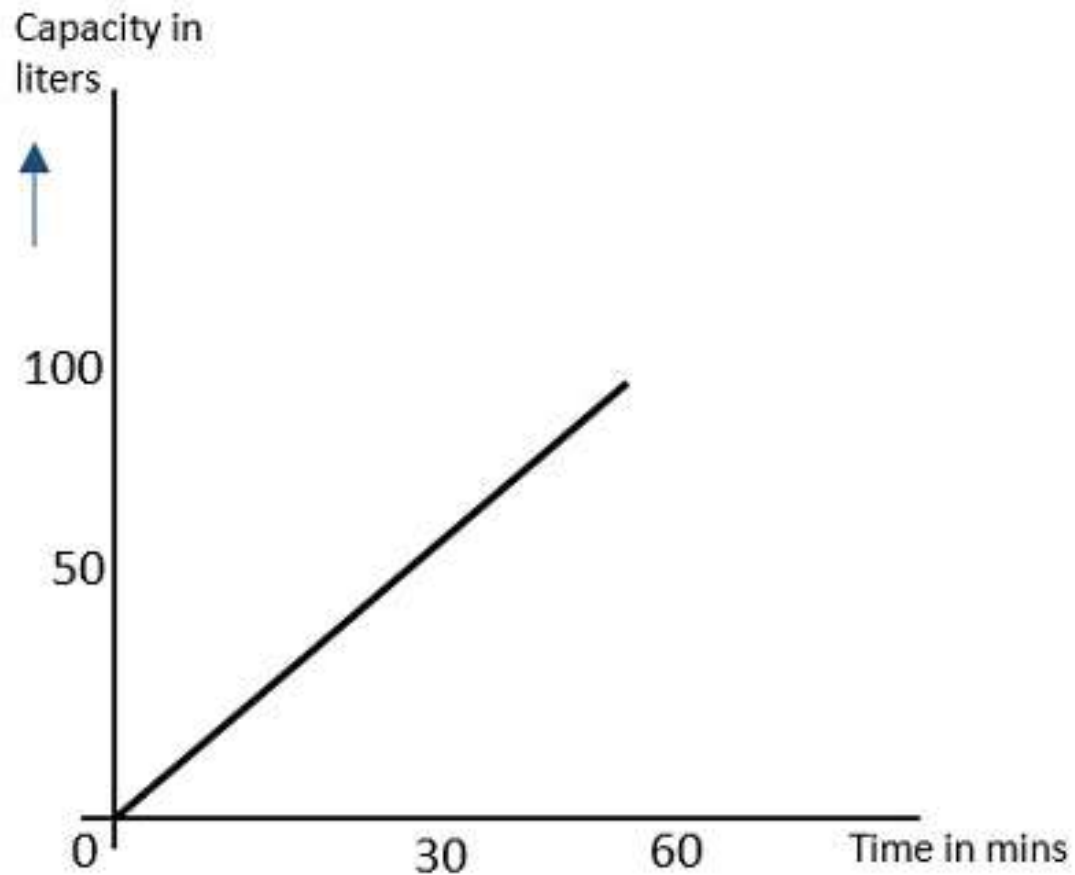
Analog Signal

- A continuous time varying signal, which represents a time varying quantity can be termed as an **Analog Signal**.
- This signal keeps on **varying with respect to time**, according to the instantaneous values of the quantity, which represents it.

Example of Analog Signals

- An analog signal can be any time-varying signal.
- Minimum and maximum values can be either positive or negative.
- They can be periodic (repeating) or non-periodic.
- Sine waves and square waves are two common analog signals.
- Note that this square wave is not a digital signal because its minimum value is negative.





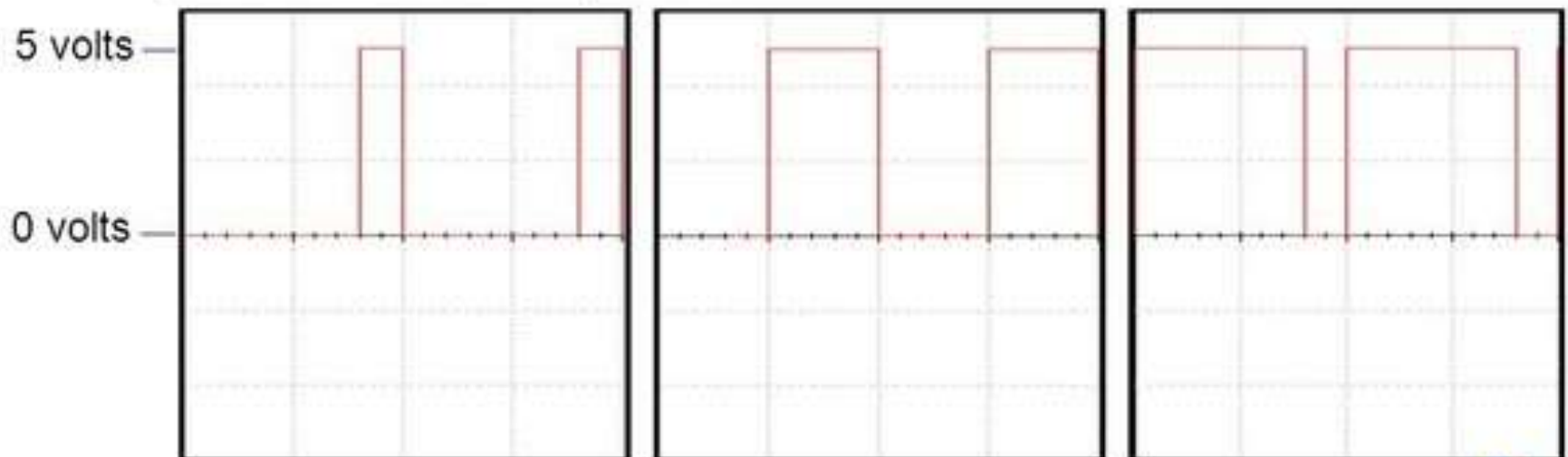
time varying quantity can be understood as Analog quantity.

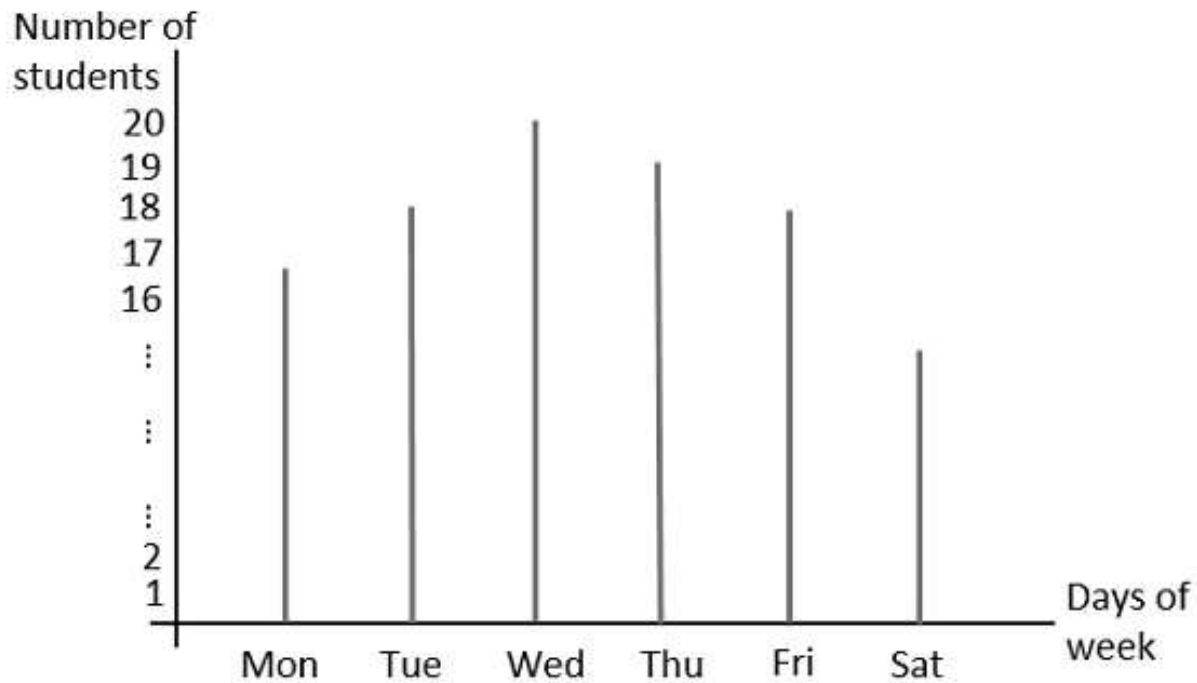
Digital Signal

- A signal which is discrete in nature or which is **non-continuous** in form can be termed as a Digital signal.
- This signal has individual values, denoted separately, which are not **based on the previous values**, as if they are derived at that particular instant of time.

Example of Digital Signals

- Digital signals are commonly referred to as square waves or clock signals.
- Their minimum value must be 0 volts, and their maximum value must be 5 volts.
- They can be periodic (repeating) or non-periodic.
- The time the signal is high (t_H) can vary anywhere from 1% of the period to 99% of the period.

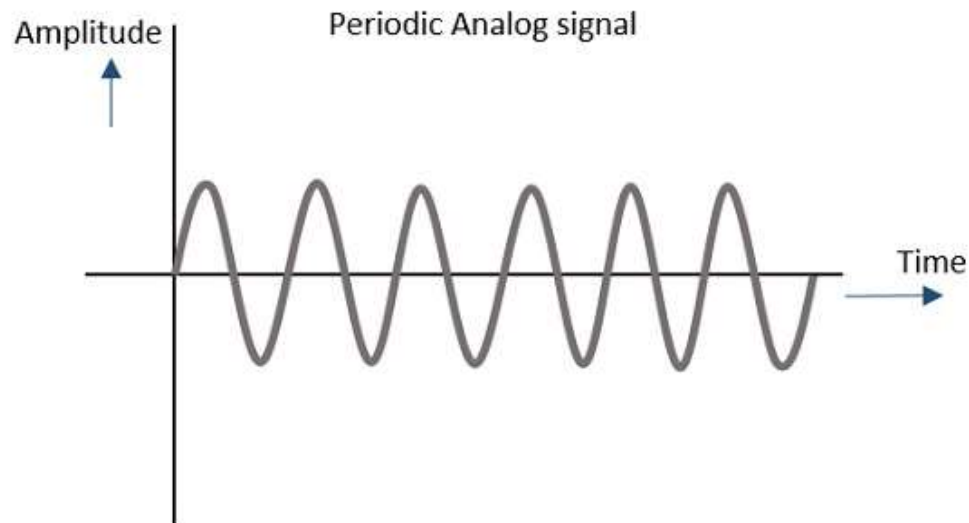




The values can be considered individually and separately or discretely, hence they are called as **discrete values**.

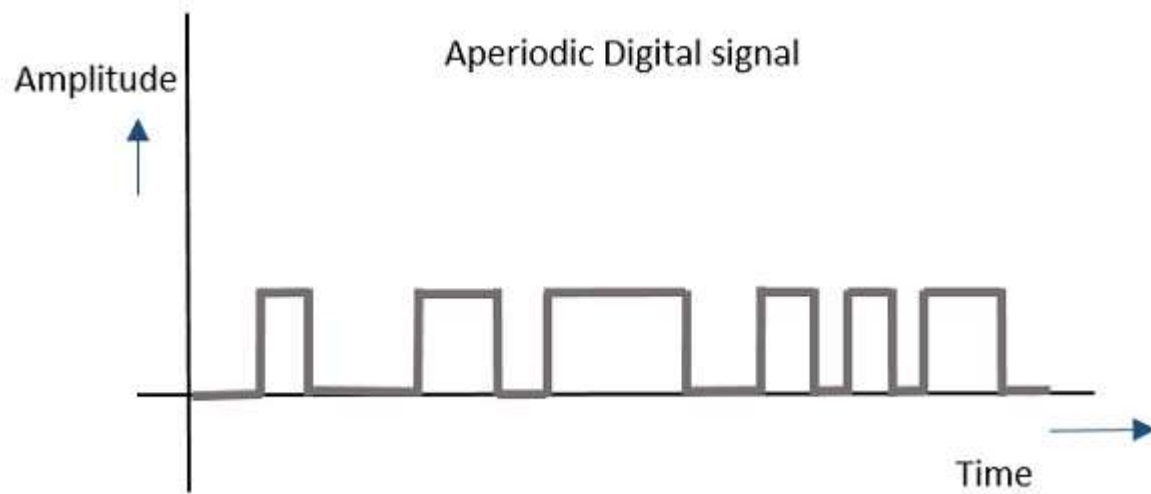
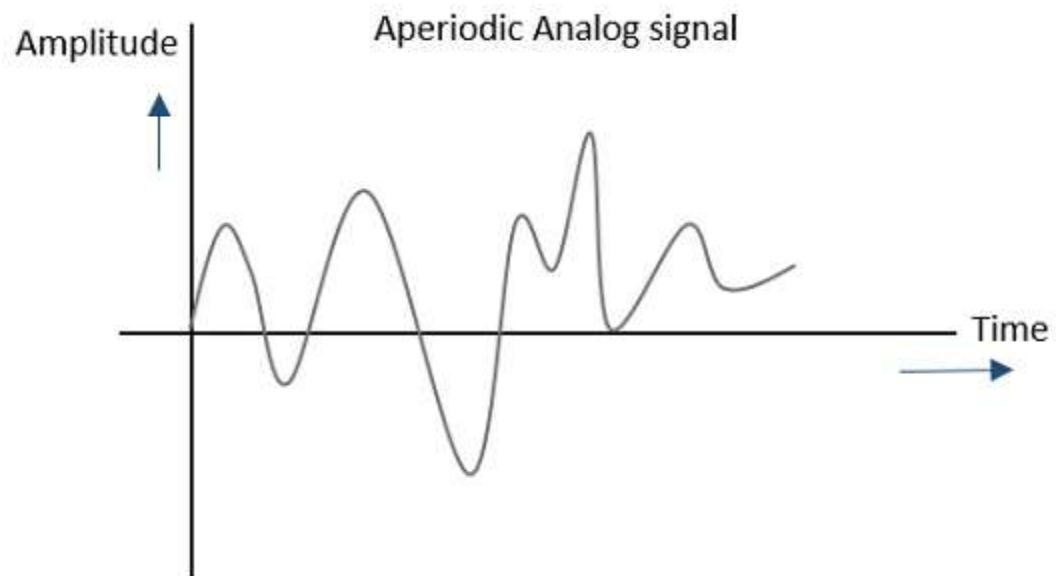
Periodic Signal

- Any analog or digital signal, that **repeats its pattern over a period of time**, is called as a Periodic Signal. This signal has its pattern continued repeatedly and is easy to be assumed or to be calculated.



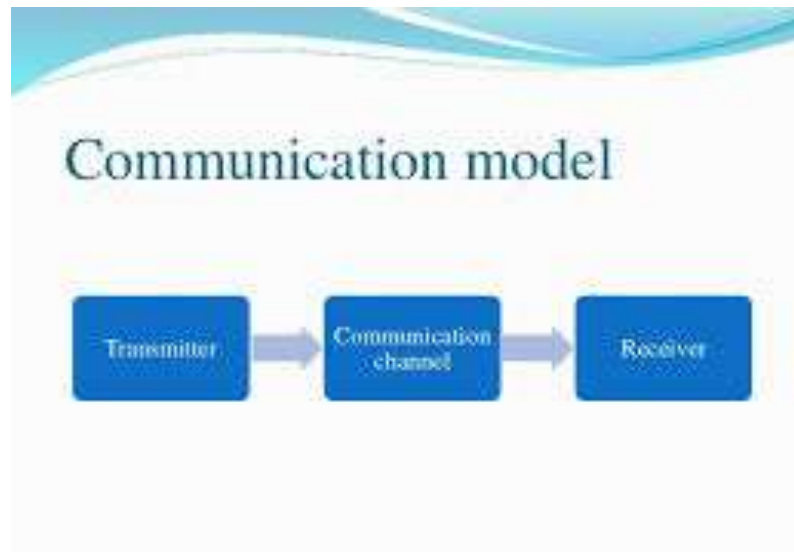
Aperiodic Signal

- Any analog or digital signal, that **doesn't repeat its pattern over a period of time**, is called as Aperiodic Signal.
- This signal has its pattern continued but the pattern is not repeated and is not so easy to be assumed or to be calculated.

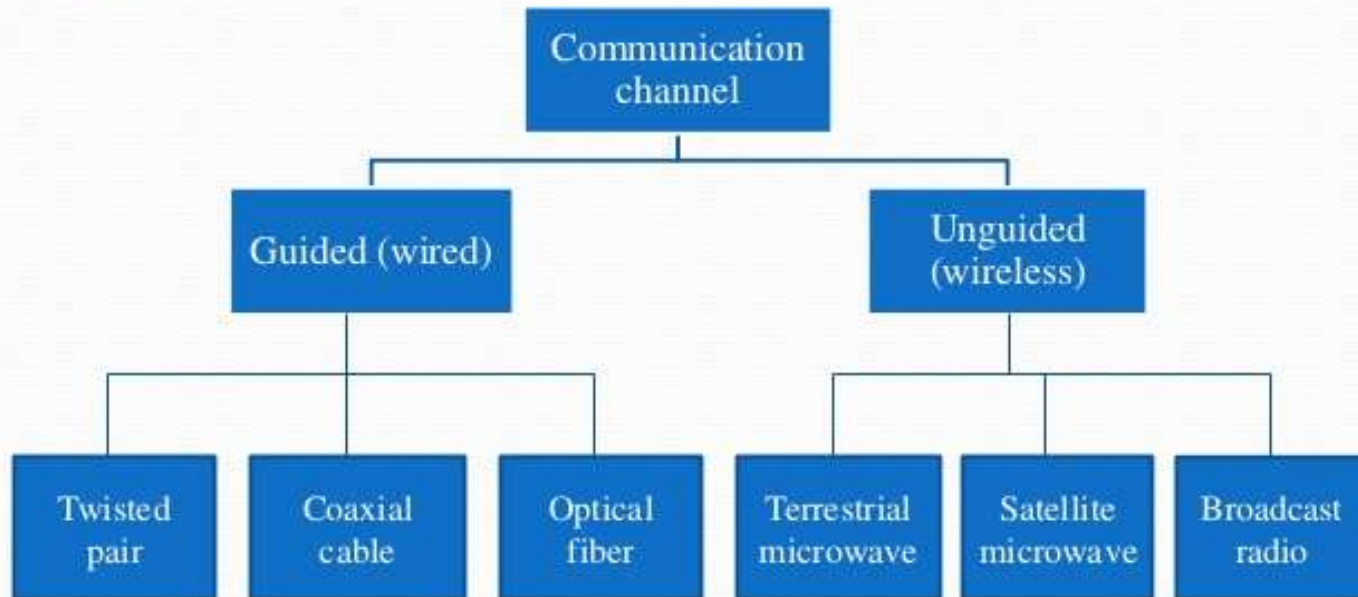


Communication channels

- Communication channel is **a connection between transmitter and receiver** through which data can be transmitted.
- Communication channel is also called as communication media or channel media.



Types of Communication channel

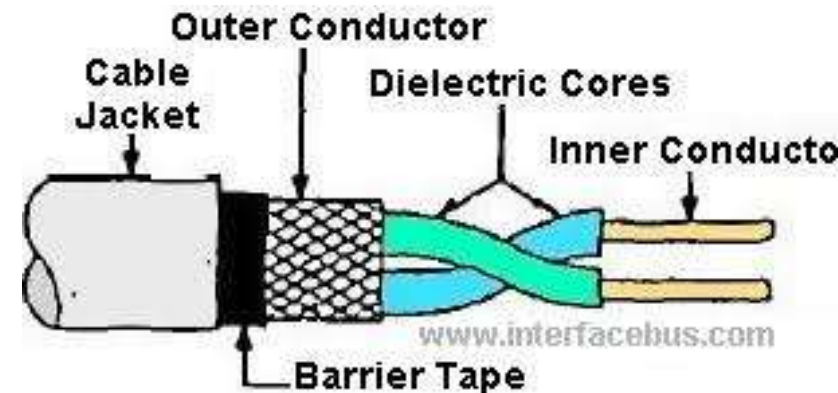
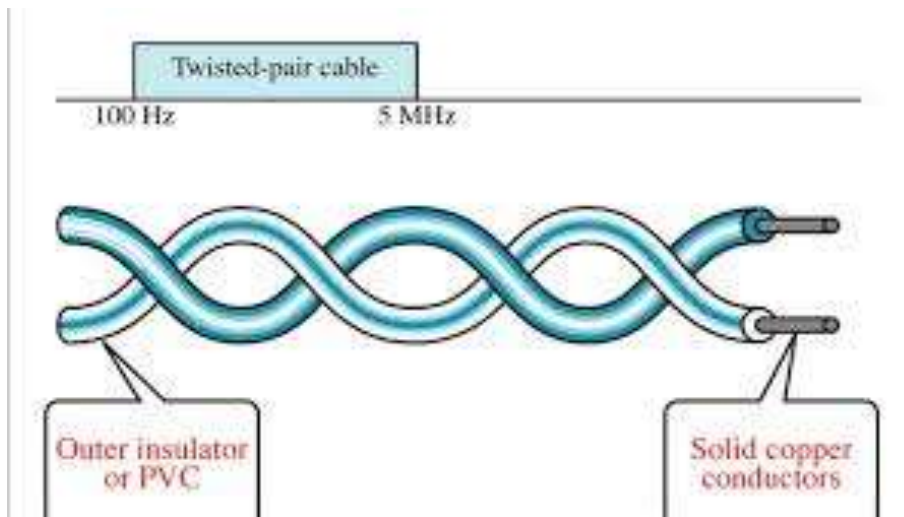


- Other types are Under Water Acoustic Channels, Storage Channels like magnetic tapes, magnetic disks etc.

Wired communication channel

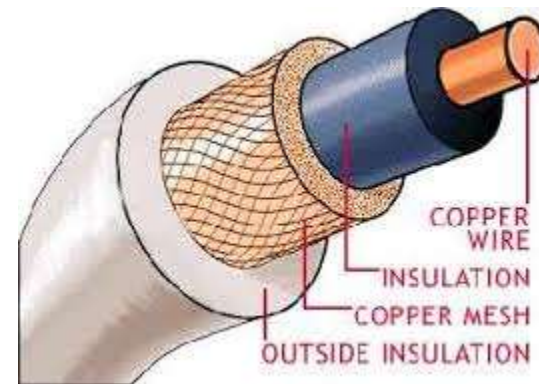
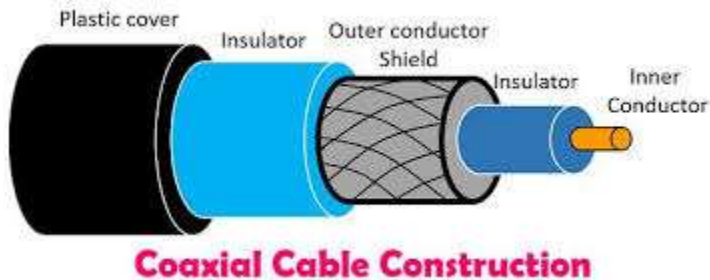
Twisted pair

- One wire carries signal and other is used only as ground reference.
- Ex: Telephone wiring



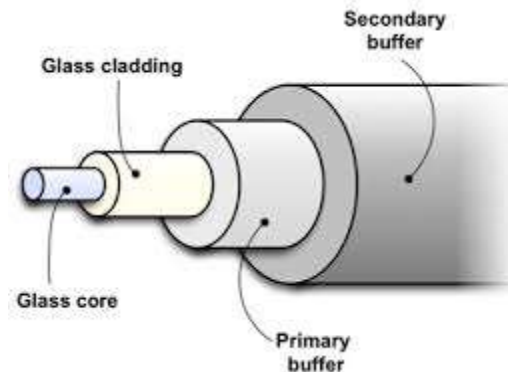
Coaxial Cables

- Used for both **analog and digital signal**.
- Effectively used at higher data rate and higher bandwidth.
- Ex: cable Tv and internet cable



Optical fibre cable

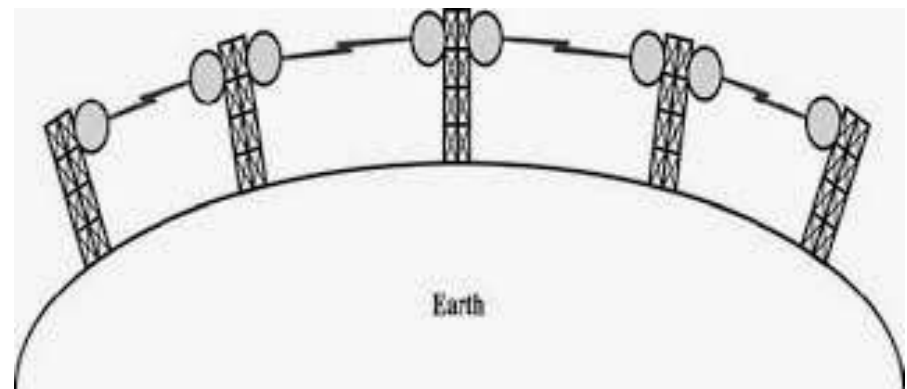
- Digital data is transmitted through the cable via rapid pulses of light.
- The receiving end of a fiber optic transmission translates the light pulses into binary values, which can be read by a computer.



Wireless communication channel

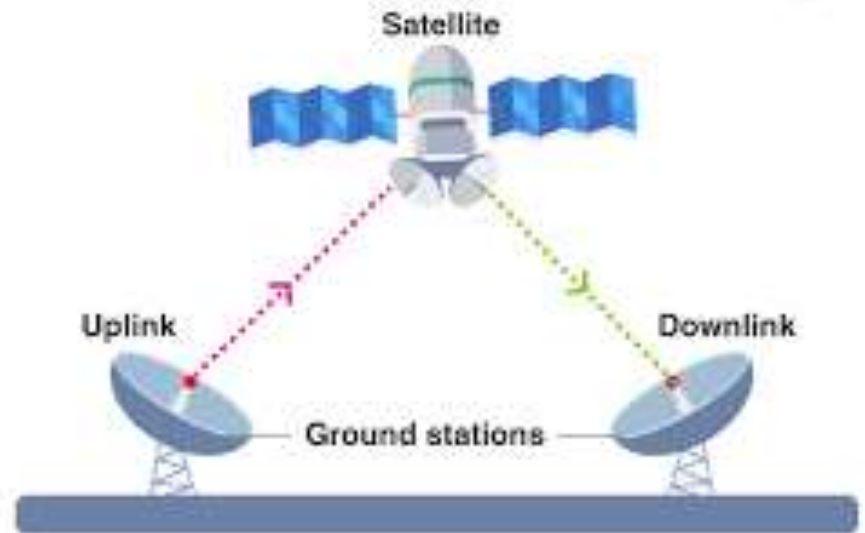
Terrestrial Microwave

- Uses the radio frequency spectrum 2 to 40 GHz.
- The transmitter is **a parabolic dish** (shaped like a bowl) and is mounted as high as possible to get the best frequency and transmission.
- Ex: radio (voice) and television transmission



Satellite Microwave

- Covers 1/3 of earth's surface.
- Provides high quality communication.
- Receives on one frequency and transmits on another frequency.

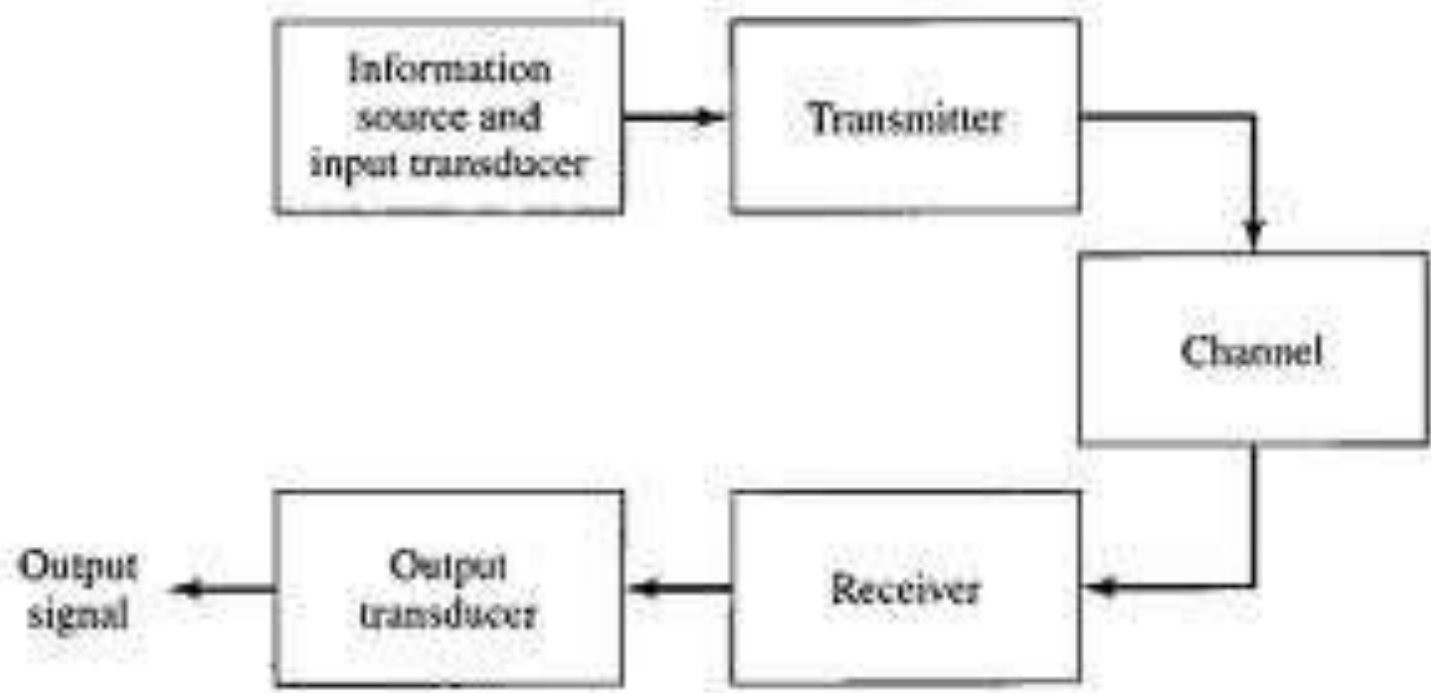


Broadcast radio

- Radio frequency range is 3kHz to 300GHz
- Ex: FM radio

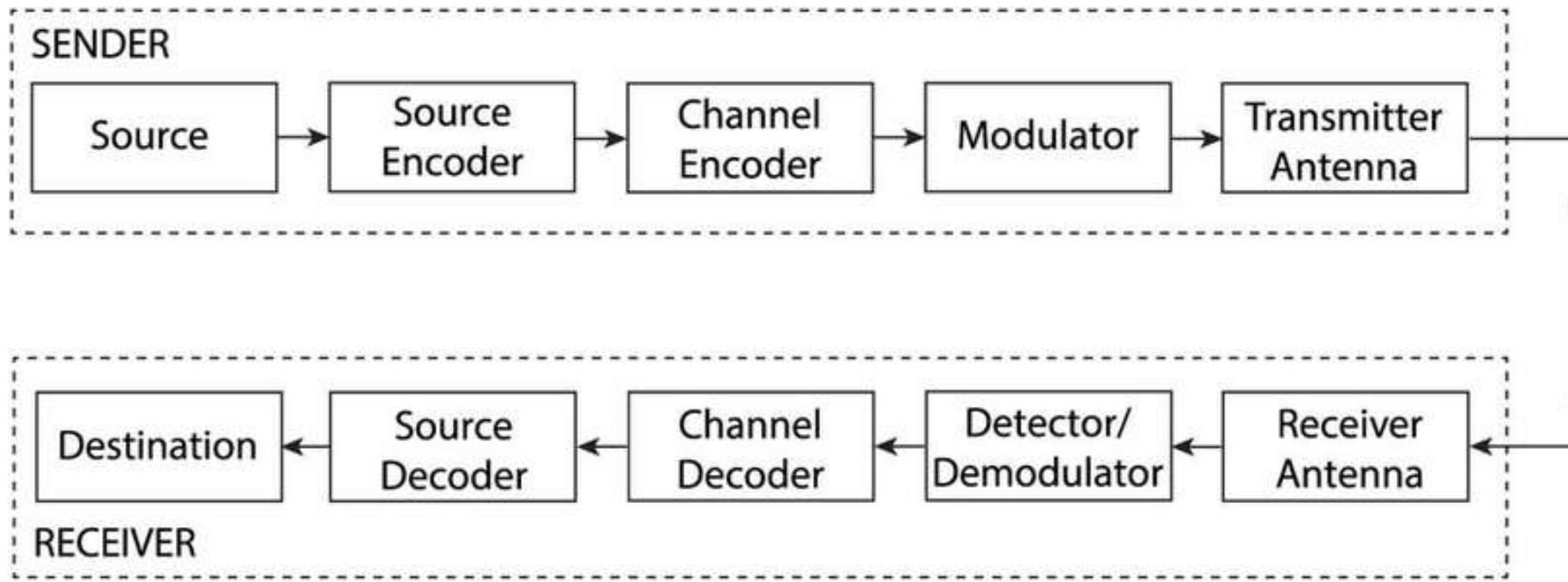
Analog communication

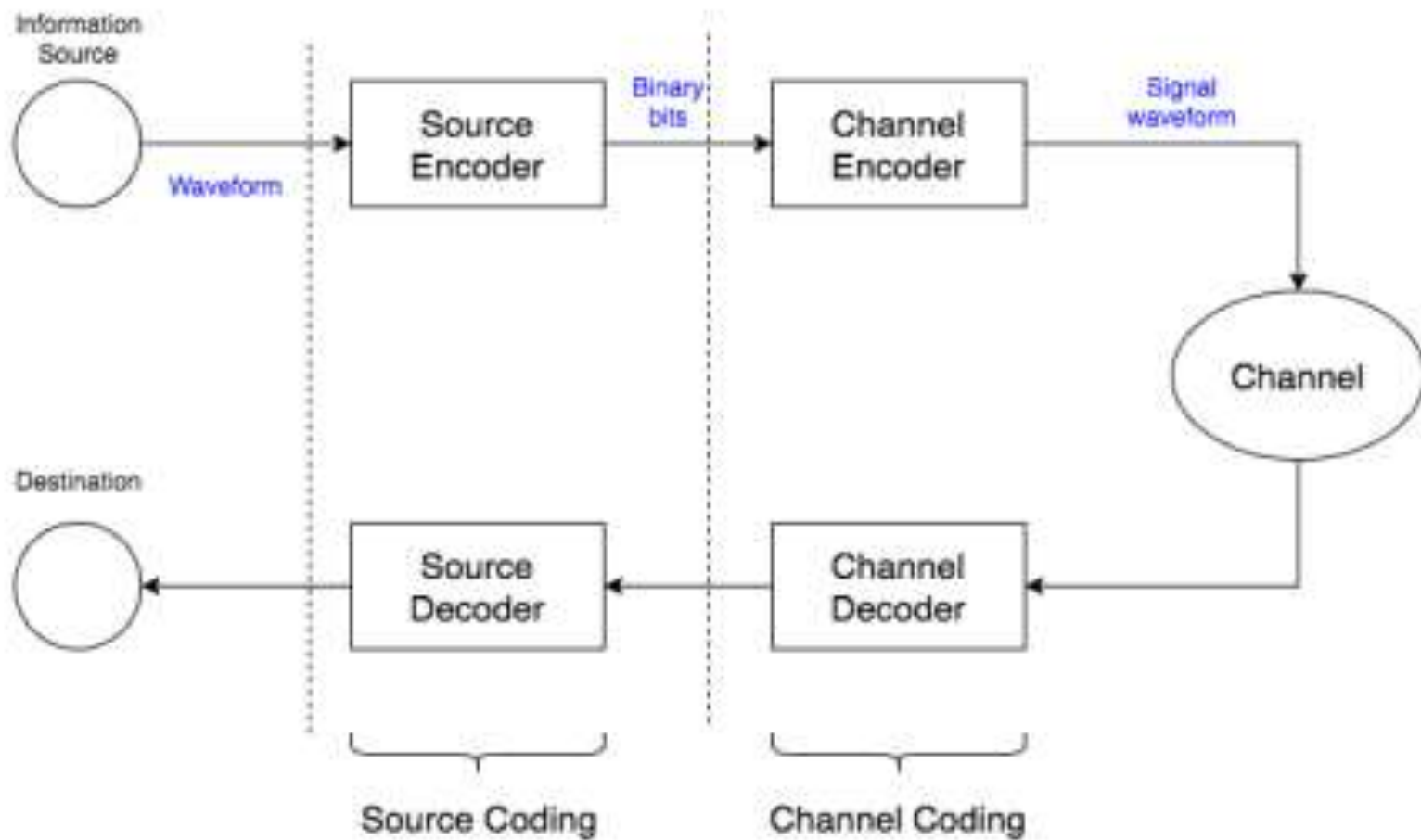
- In Analog Communication, the message or the information to be transmitted is **analog in nature**.
- This analog message is obtained from the source such as **speech, video, audio** etc. Message signal in this case are modulated at high carrier frequency inside the transmitter in order to produce modulated signal.
- This modulated signal is then transmitted with the help of transmitting antenna to travel across the transmission channel.



Digital communication

- The overall purpose of these systems are to message or sequence of symbols that are coming out from the source to the destination point at a very high data rate and accuracy as possible.





- **Source coding:** The source **encoder converts information waveforms to bits**, while the decoder converts bits back to waveforms.
- **Channel coding:** The channel encoder **converts bits to signal waveform**, while the decoder converts received waveform back to bits.

Reference links

Basics of communication system :

<https://www.youtube.com/watch?v=QnCBCQa-2XU>

Classification of signal:

<https://www.youtube.com/watch?v=E4E1GftPD1M>

Types of communication

<https://www.youtube.com/watch?v=qhjj6WG7Rgc>