

# Quiz

Q1. What is a communication system?

Q2. Give four examples of communication systems?

Q3. Explain the three types of transmission directions?

Q4. How many methods of communication system? Give three examples for each and explain which method is the best and why ?

Q5. Draw the basic block diagram of communication system?

Tishk International University (TIU)

Mechatronics Engineering Department

Communication Systems ME 316

Lecture 2 : 21 -10-2019



# Elements and Types of Communication Systems

Mr. Ali Sabah

[ali.sabah@ishik.edu.iq](mailto:ali.sabah@ishik.edu.iq)

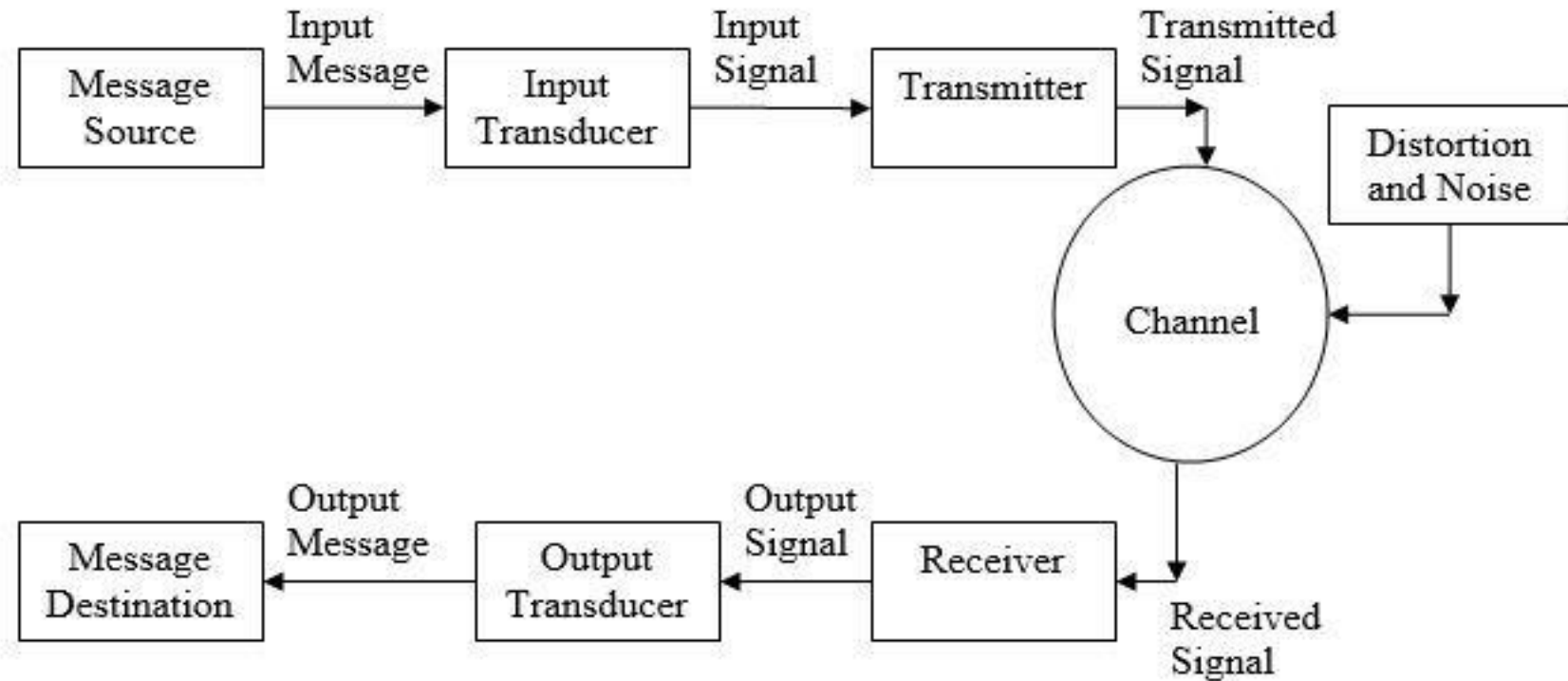
# Outlines

- Elements of Communication Systems
- Communication Systems and Signals
- Types of Communication System
- Noise and Distortion
- Noise Sources
- Signals and Noise

# Elements of Communication Systems

The communication system is composed of the following:

1. Source
2. Input Transducer
3. Transmitter
4. Channel
5. Receiver
6. Output Transducer
7. Destination

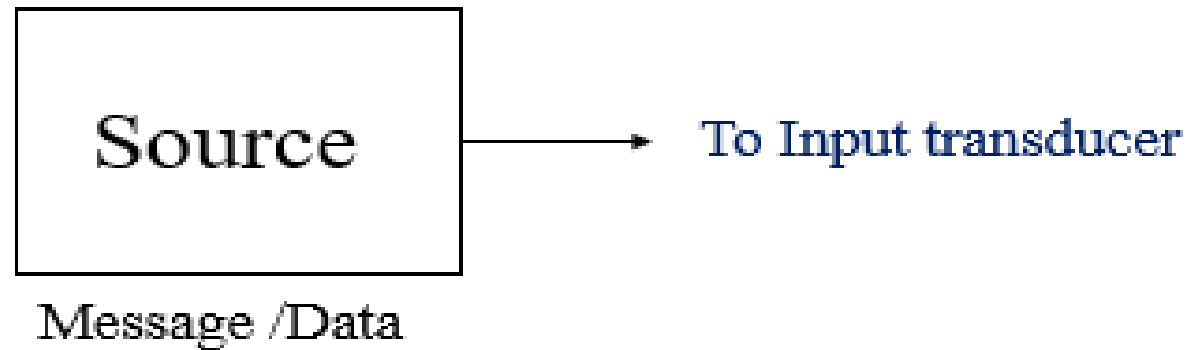


Block Diagram of Communication System

# Elements of Communication Systems

## 1. Source

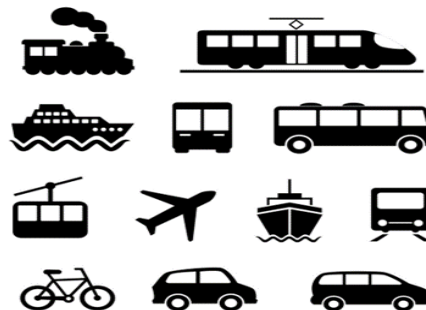
- The Source /Sender based on create / generate the data/ message/ voice which should be either Analog or Digital signals.



- Examples:**



Speech /Voice waves



Sound waves



Music

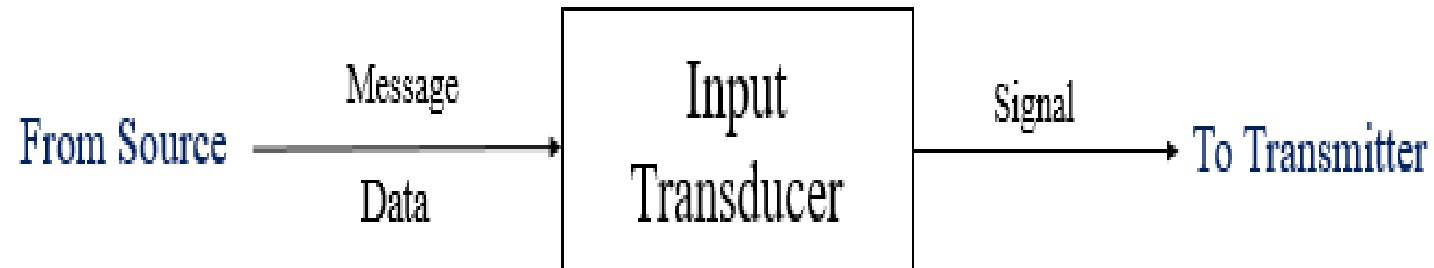


Text Message

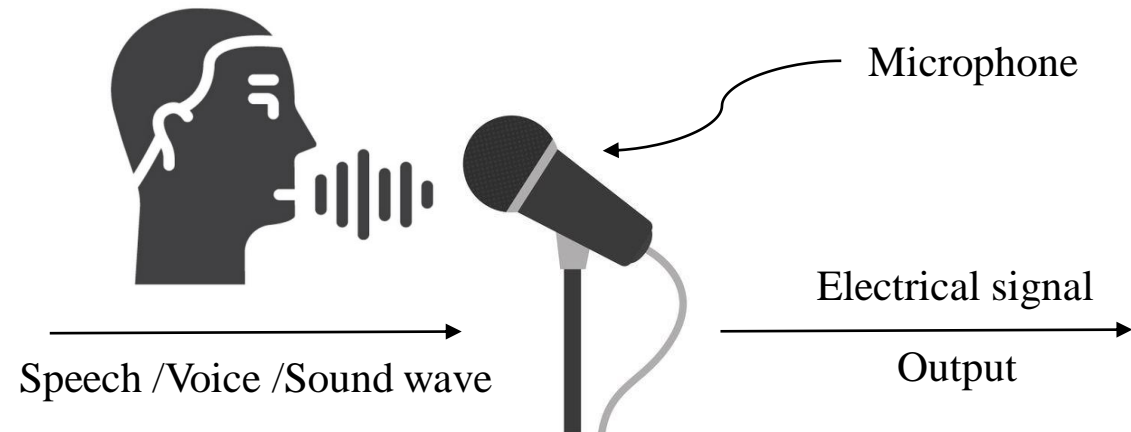
# Elements of Communication Systems

## 2. Input Transducer

- The Input Transducer: Converts the message which generated/ created by the source to a form that suitable for the specific type of communication system.
- Convert the energy form of the input wave/signal to another (Electrical signal) which acceptable for entire system.



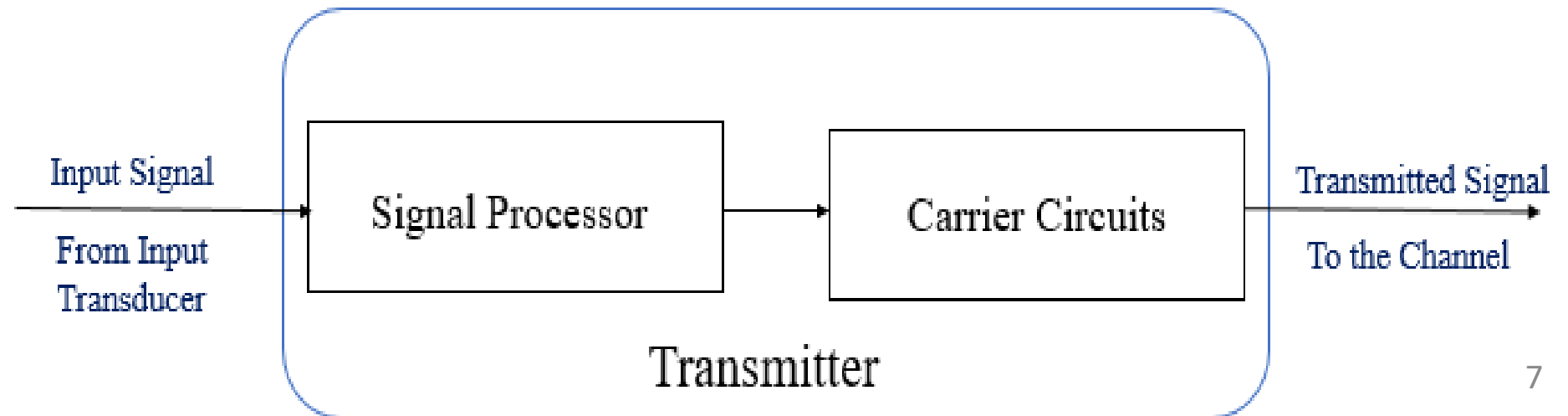
- **Example:**



# Elements of Communication Systems

## 3. Transmitter

- The processes of transmitter based on convert the input signal to form which is suitable for the transmission channel or medium, This technique is called “**Modulation**”.
- The transmitter function divided into Signal Processor and Carrier Circuits, the signal processor in analog system may work as analog low-pass filter (LPF) , while in mixed system may work as Analog-to-Digital Converter (ADC), the carrier circuits convert the processed baseband signal into a frequency band which suitable/fit for the transmission channel.
- **Operations:** Amplification and Modulation.
- **Advantages :** Multiplexing , reduce the noise and interference.
- **Examples :**
  - TV station
  - Radio Station
  - Web Server



# Elements of Communication Systems

## 4. Channel

- The physical medium for the propagation of signals from transmitter to receiver, which based on (wire or wireless).
- The medium of travels information from the sender/ source to the receiver and destination .
- The channel include **two main** basic modes :

a) **Point – Point** : the transmission between two points ( One Sender/ A – One Receiver/ B).

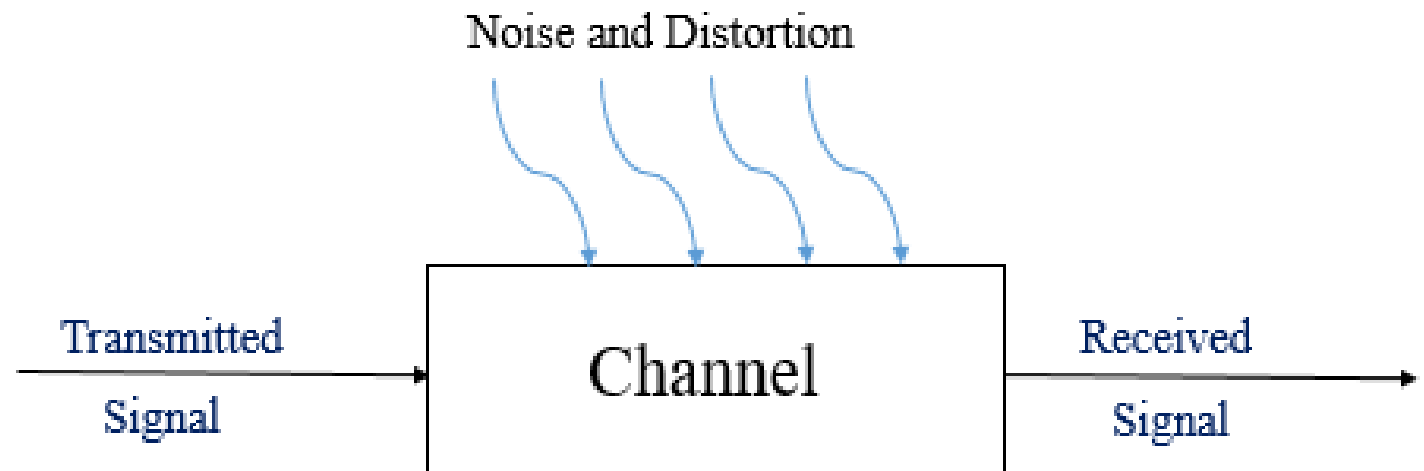
- Example : Wires (Coaxial cable , Copper cable , and Fiber Optic (FO)) .

b) **Broadcast**: the transmission between (One Sender – Large No. Receivers / Receiving Station).

- Example : Air (Radio broadcast and T.V broadcast).

- Every channel introduces some amount of:

- Distortion
- Noise
- Interference



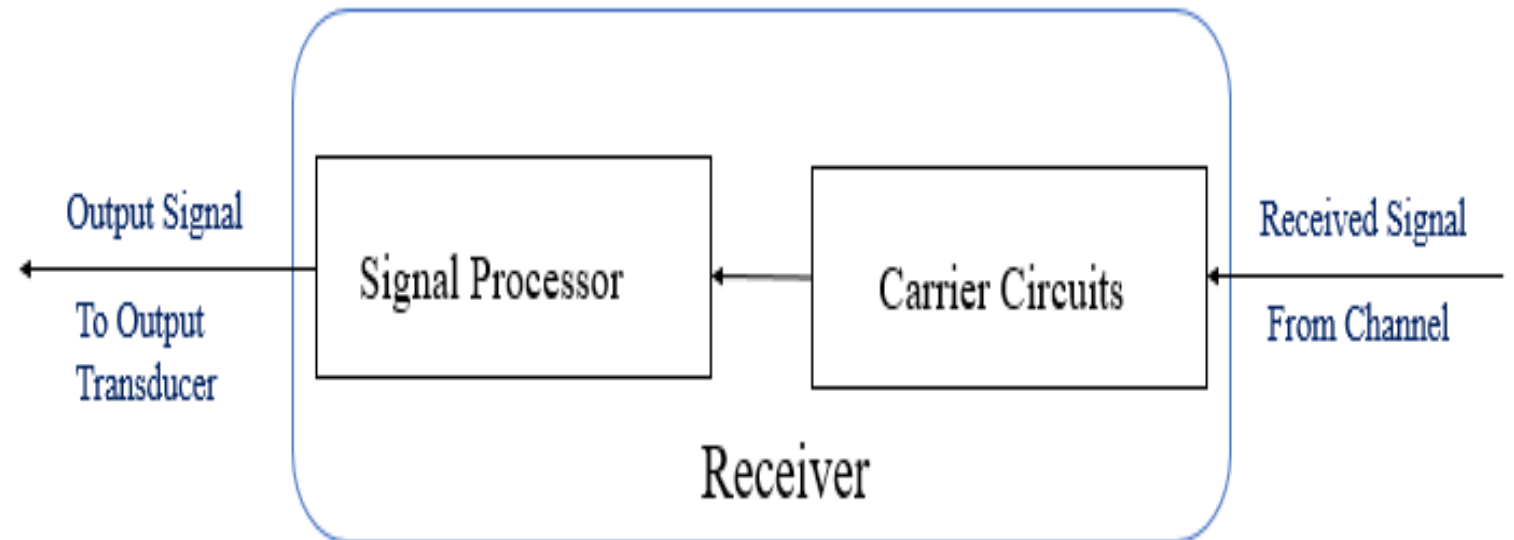
# Elements of Communication Systems

## 5. Receiver

- The processes of receiver based on convert the received signal from the transmission channel or medium to form which is suitable for output transducer. This technique is called “ **Demodulation**” .
- The receiver function divided into Carrier Circuits and Signal Processor, the Carrier Circuits converts the received frequency band signal into processed based band signal which suitable for the output transducer, the Signal Processor in mixed system may work as Digital-to-Analog Converter (DAC).
- **The operation** of receiver as Amplification and Demodulation .

- **Examples:**

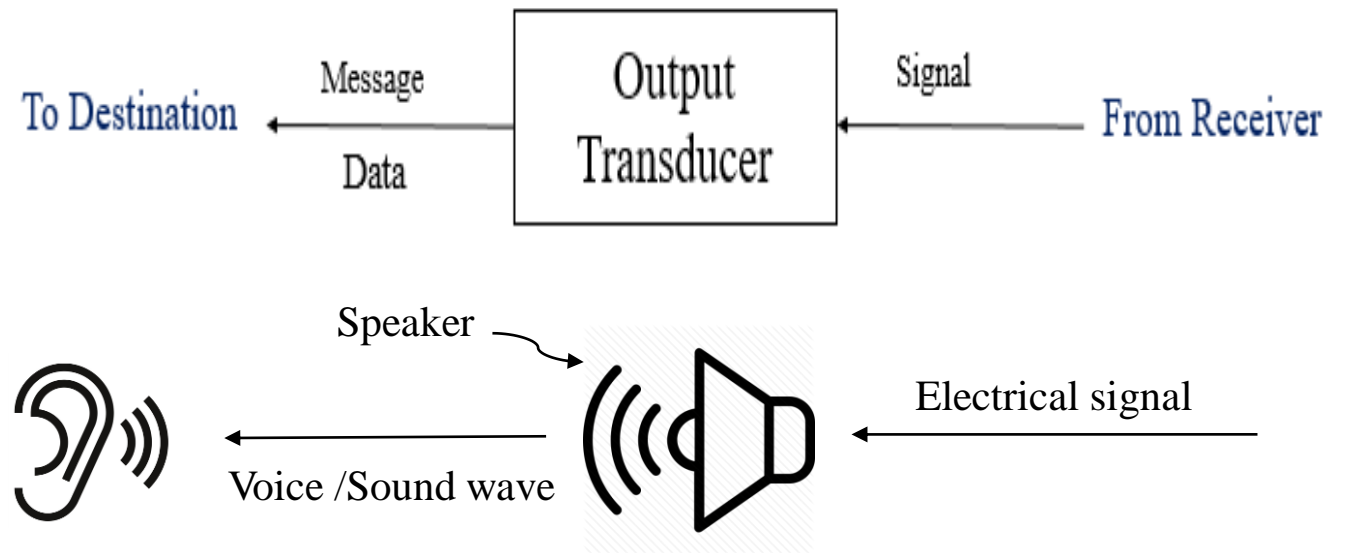
- TV set
- Radio set



# Elements of Communication Systems

## 6. Output Transducer

- The Output Transducer: Converts the Electrical signal into the form which is required by the communication system.
- The main concept of output transducer operation to convert the electrical signal to the original form that is mean the operation based on Energy Converter.



- **Example:**

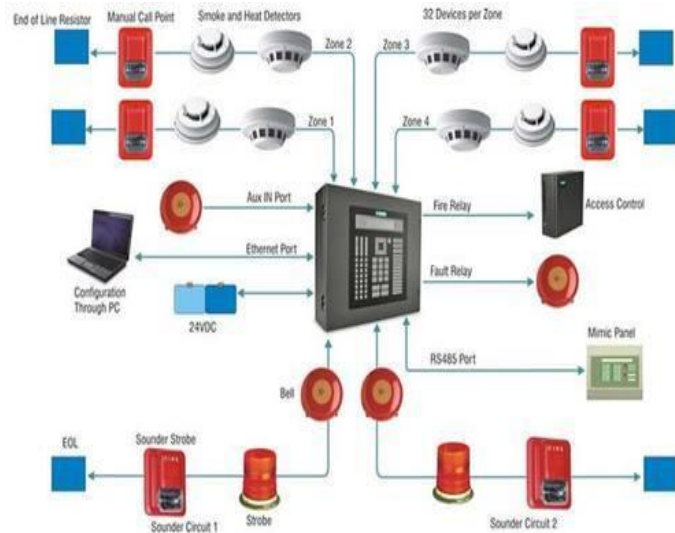
- Loudspeaker/Speaker
- Personal Computer (PC)

## 7. Destination

- The final step in the communication system such as message /information which is consume in/from the destination.
- **Example :** Human .

# Communication Systems and Signals

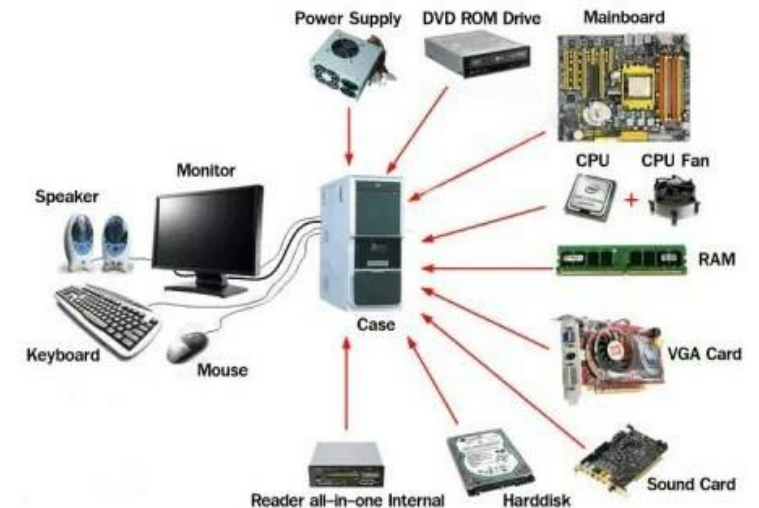
- The **Communication Systems** based on the type of **Communication Signals** .
- **System** : is the group / collection of elements /components which organized for a common objective /aim / target.
  - This word describe the communication with many hardware and software tools ,in addition, sometimes describes the organization of either individual communications networks/ transmission systems or the parts of large communication system such as ( Computer System , Mobile system, Fire alarm system ,CCTV system and Security system).



Fire alarm system



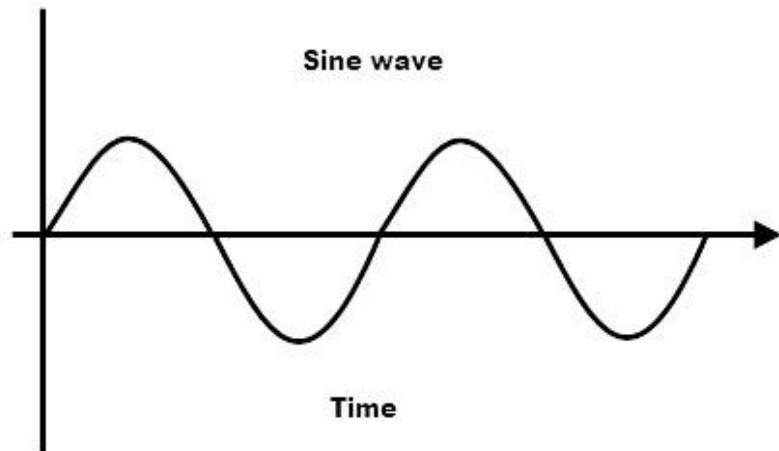
CCTV system



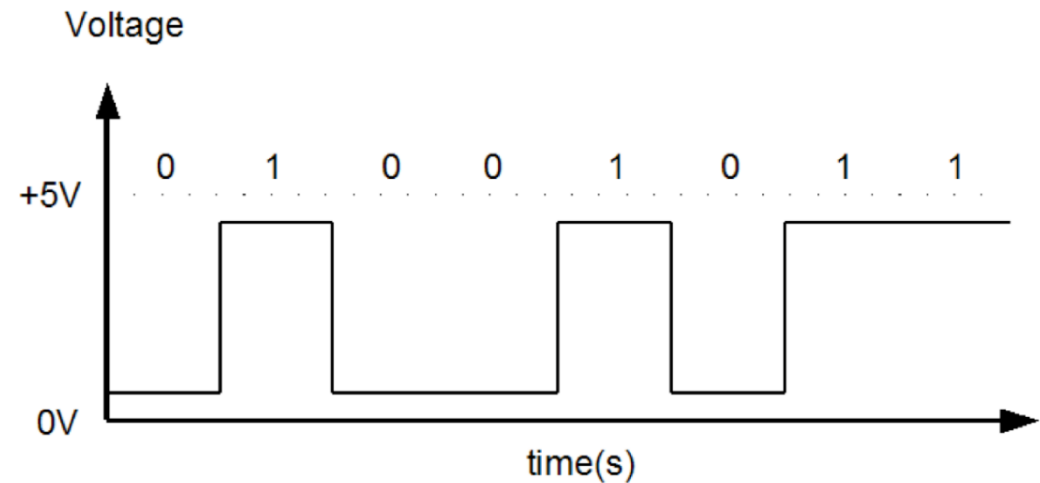
Computer system

# Communication Systems and Signals

- **Signal:** in general, is any thing you can sense , notice and measure using some devices, signals can carry information/data in different forms to knowing the situation of something , it is really very important for our life.
- Is an electrical or electromagnetic waves, that is used to carrying data from one device or network to another.
- In communications and electronics systems refer to any wave that carriers information/data such as “ current ,voltage or electromagnetic wave that change in a quantity with time .
- There are **two main** types of communication signals:



**Analog signal**



**Digital signal**

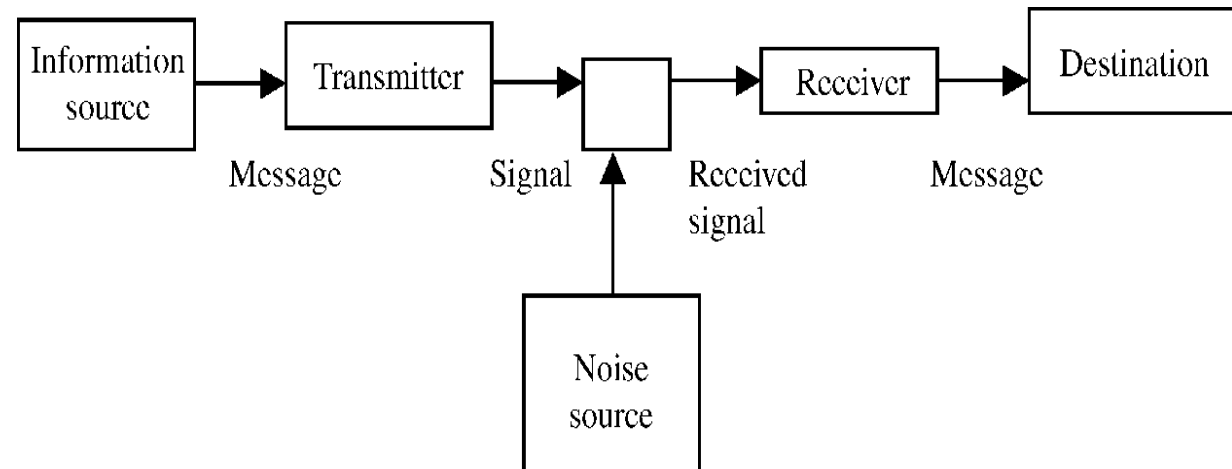
# Types of Communication System

## 1. Analog system

- The Analog communication system based on the transmission of **analog signals**.
- The principle of analog communication system to transfer the information from an analog source to the intended receiver / destination which is also called “The Sink”.
- Analog signals are continuous wave signals and the range of values that change with time and represented with the sine waves. The system not resistant to the noise and distortion that cause the reduced in transmission process quality.

- **Examples of Analog Signals :**

- Human voice
- Radio broadcast
- TV broadcast



Basic Block Diagram of Analog Communication System

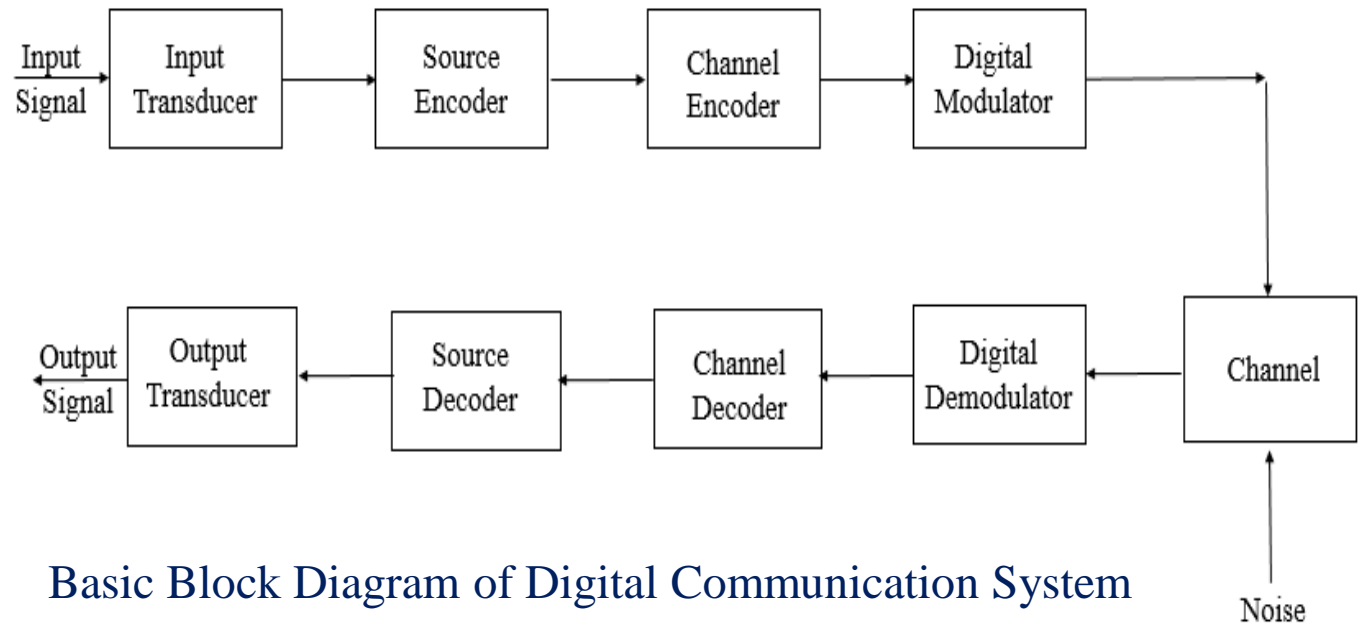
# Types of Communication System

## 2. Digital system

- The Digital communication system based on the transmission of **digital signals**.
- The principle of digital communication system to transfer the information from an digital source to the intended receiver /sink.
- Digital signals are discrete or not continuous wave signals and represented with square waves which carrier the data in the binary form .
- Digital signals are more resistant to the noise and hardly to faces some distortion, it is include a limited variety of values which lies among **0-to-1**.

- **Examples** of Digital Electronic Devices

- Computers
- Cell phones



Basic Block Diagram of Digital Communication System

# Noise and Distortion

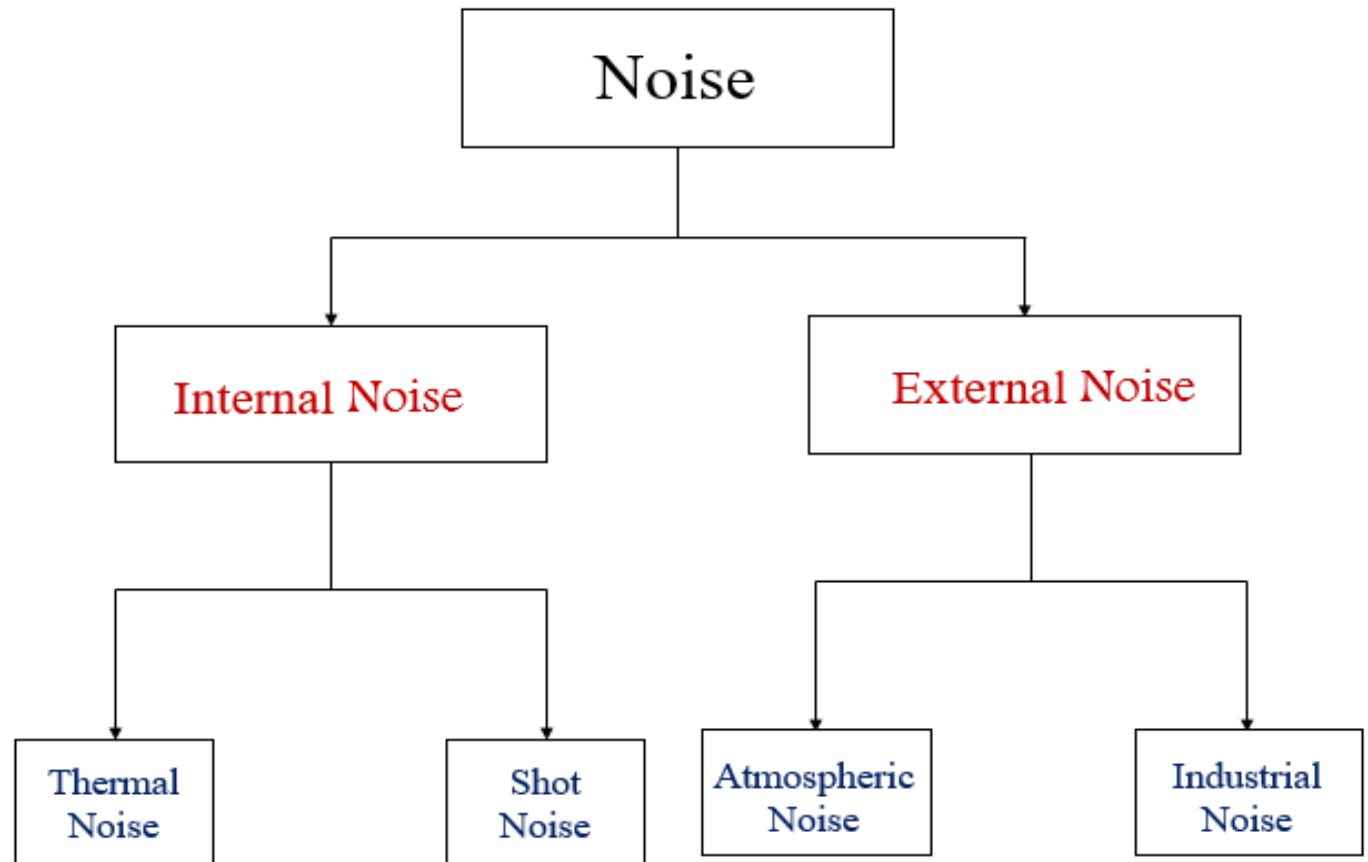
- **Noise** : is basically unwanted signals which is mixed with the information signal, that get randomly added to the actual information carrying signal, the term of (**Noise**) refer to the unwanted signal which affects a wanted signal or the random signal that exists in communication systems.
- **Distortion**: means that there is a difference between the received signal and its original form or shape , the noise cause this distortion , but there are other reasons of distortion in communication systems.
- **Noise effects** : the main effects of noise in communication systems as a following :
  - Reduce the efficiency of communication systems.
  - Receiver can not understand the original signal and can not work as it should be.
  - Decrease the performance of system for both analog and digital communication systems.

# Noise Sources

- **Noise** in communication system is mainly classified based on the source which generates that noise and depends on the type of noise source in communication channel , the noise sources divided into two main types:

1. **Internal Noise**

2. **External Noise**



# Noise Sources

**1. Internal Noise:** is the fundamental noise that gets generated by the electronic equipment involved in the system itself, due to random movement of electrons in the electronic circuit , the electronic components in a receiver and other elements of communication system, such as ( resistors, diodes and transistors) are the major sources of internal noise, designing a suitable communication system can reduce or overcome noise due to internal sources.

- **Examples:**

- **Thermal Noise** : is associated with the rapid and **random movement** of electrons within conductor due to thermal agitation ,this type of noise present in all electronic components and communication systems, it is increase with the number of devices in a circuit and when the temperature increases the movement of the free electrons will increase and the current flows through the conductor, it is the outcome of thermal action , thermal noise is sometimes referred as Johnson noise or white noise.
- **Shot noise** : is caused by the **random arrival** of carriers at output element of an electronic device , These random or not continuous movements are the result of cut out (disconnects) in the device which is being used by the system, this type of electronic noise that happen when the limited number of particles that carry energy such as electrons in an electronic circuit or photon in optical device.

# Noise Sources

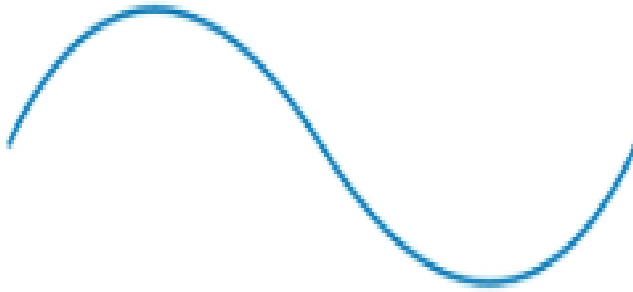
**2. External Noise:** is the type of noise that gets generated/ created in the transmission channel/medium which outside of communication system circuit components, this noise comes from sources over which we have little or no control such as (man-made noise and natural noise resources).

- **Examples:**

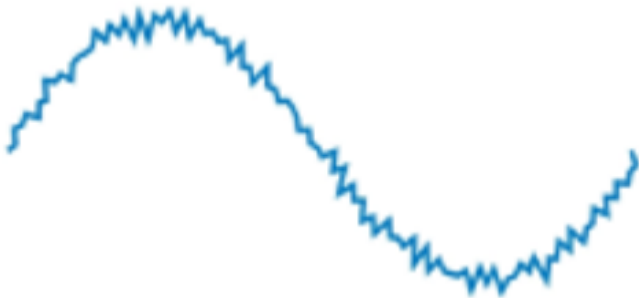
- **Atmospheric Noise:** this type caused by lightning discharges in thunderstorms and other natural reasons in the atmosphere, it propagates over the earth in the same way as ordinary radio waves of the same frequencies and become less severe at frequencies above 30 MHz.
- **Industrial Noise :** This type of noise is also known as Human –made noise. The nature of industrial noise is so variable that it is difficult to analyze ,The frequency of man-made noise lies between 1 MHz to 600 MHz, the main sources of this noise such as ( automobile , aircraft, electric motors and other heavy machine, broadcast communication systems , mobile phones, ...etc.).

# Signals and Noise

**Analog Signal**

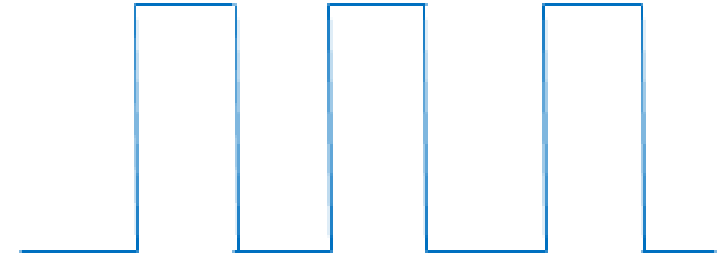


Noise



Analog Signal + Noise

**Digital Signal**

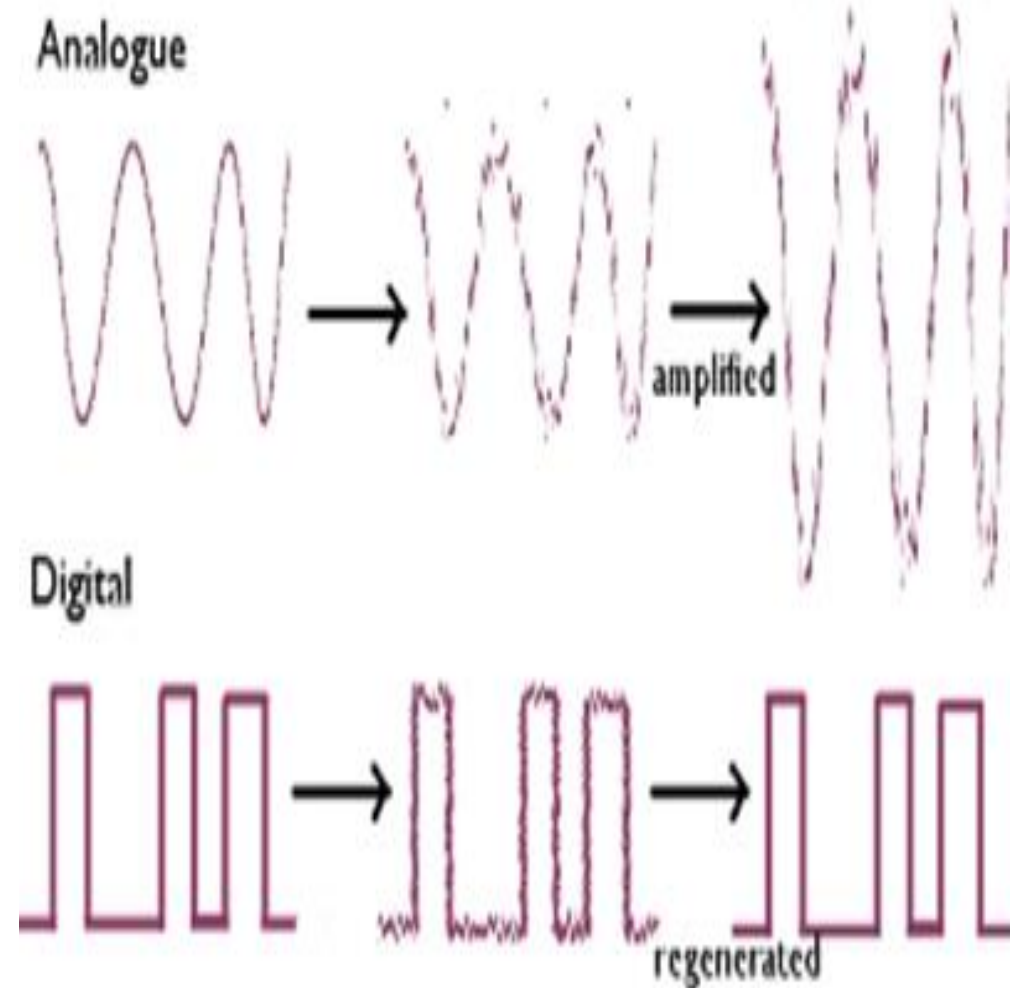
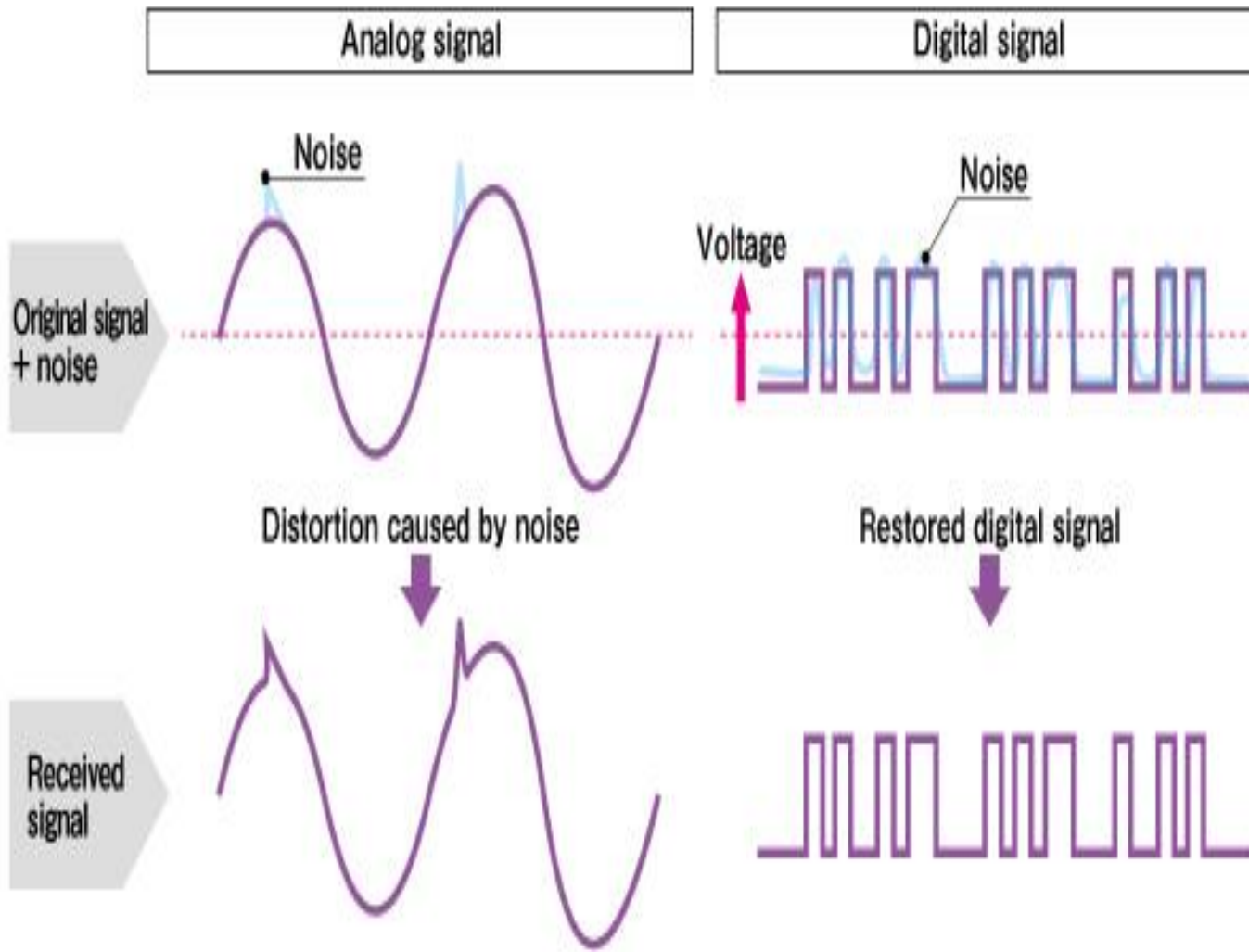


Noise



Digital Signal + Noise

# Signals and Noise



- **How to determine the noise in communication systems?**
- **Noise Effect** can be determine by measuring the different between the transmitted and received signals for both types of communication systems:
- **In Analog system the determine of noise based on the signal to noise ratio (SNR):**

$$\text{SNR}(S/N) = \frac{\text{Signal Power ,}(P_s)(\text{Watts})}{\text{Noise Power ,}(P_n) (\text{Watts})} , \quad \text{SNR (power)}$$

- The signal to noise in dB is express by :

$$\text{SNR}(S/N) \text{ dB} = 10 \log_{10} \left( \frac{S}{N} \right) = 10 \log \left( \frac{P_s}{P_n} \right) , \quad \text{SNR (Power) in dB}$$

- For the power in terms of voltage :

$$\text{SNR} (S/N) \text{ dB} = 20 \log_{10} \left( \frac{V_s}{V_n} \right) = 20 \log \left( \frac{V_s}{V_n} \right), \quad \text{SNR (Voltage) in dB}$$

- **In Digital system the determine of noise based on Bit Error Rate (BER):**

$$\text{BER} = \frac{\text{Number of bits in error (received )}}{\text{Total number of bits (transmitted)}}$$

- Answer the following questions:

### Question 1:

For an amplifier with an output signal power of 10W and an output noise power of 0.01W ,  
determine the SNR?

**Answer = 30 dB**

### Question 2:

For an amplifier with an output signal voltage of 4V, and an output noise voltage of 0.005V and  
input and output resistance of 50 Ohms , determine the SNR?

**Answer = 58.06 dB**

Analog Communication System	Digital Communication System
<b>Transmitted</b> signal is analog in nature	Transmitted signal is digital (train of digital pulses)
<b>Noise</b> resistance is poor for AM but improved for FM & PM	Noise resistance is excellent
Is not possible to <b>separate</b> out noise and signal .	It is possible to <b>separate</b> signal from noise
<b>smaller</b> bandwidth channel is required	<b>Larger</b> bandwidth channel is required
<b>Synchronization</b> problem is relatively easier	<b>Synchronization</b> problem is relatively difficult
<b>Coding</b> is not possible	<b>Coding</b> can be used to detect and correct the errors
Cannot <b>merge</b> data from different sources (only one source)	Can <b>merge</b> data from different sources (voice ,video & sound)
The <b>data transmission</b> rate in the analog signal is slow	The <b>data transmission</b> rate in in the digital signal it is faster
Difficult to detected and corrected the transmission errors	The transmission errors can be detected and corrected easily
Not suitable for transmission of <b>secrets</b> information in military applications	Due to coding is suitable for transmission of <b>secrets</b> information in military applications
<b>Signal</b> range will not be set	Signal is limited as well as ranges from 0 to 1