LECTURE #01

Introduction to Communication Systems.
(Reference: Principles of Communication Systems by Taub & Schilling)

1.1 Definition of Communication:

Communication is the process of transferring information from one place to another.
In earlier days only physical mode of communication existed where messages were carried physically from one place to another.

1.1.1 Drawback of physical mode of Communication:

- Very Slow speed of Trasmission
- No Secrecy of messages trasmitted
- Poor reliability.

1.2 Electronic Communication System: An Overview

Now there has been an overall development of Electronic communication System. This mode of communication is upbeat with advantages such as:

- Signals move with speed of light
  This trasmission is very fast.
- More secure trasmission possible
- High reliability
- Live connectivity & Communication possible

1.2.1 Examples of Electronic Communication Systems

- Television Telecast
- Radio Broadcast
- Wireless (W/L) Communication
- Telephone Landline
- Mobile Communication

→ Fax (Facsimile)
→ Internet, email
→ Automatic Teller machines (Credit/Debit Cards)
→ Global Positioning Systems
→ Radar & Satellite Communication.
→ Aircraft & Ship Guidance Systems. 1.1

1.2.2 Block Diagram of an Electronic Communication System

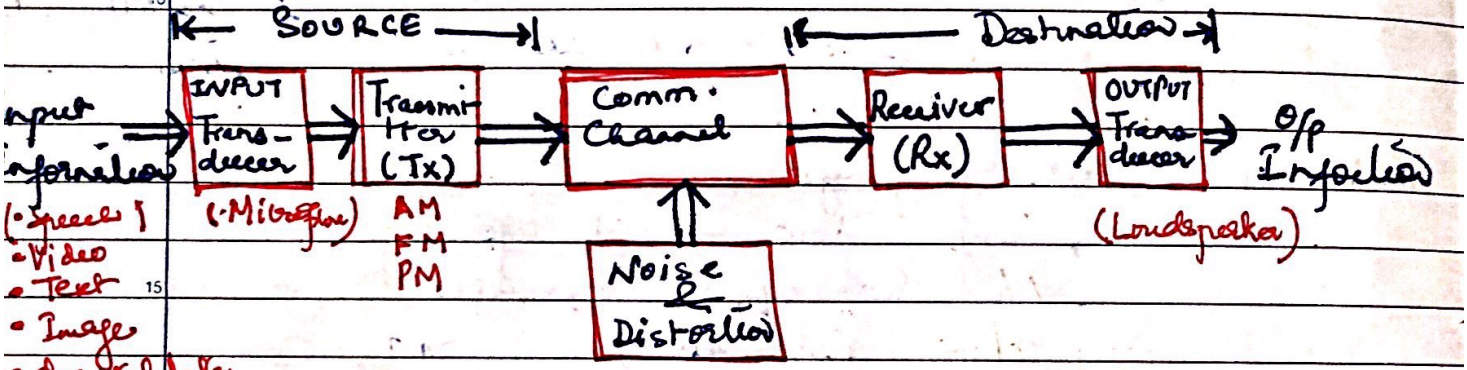

Fig 1.1 : A Simple block diagram of an Electronic Communication System. 1.1

1.2.3 Functionality of each block

Source Defn: The information is generated at the source. It travels through the communication channel over hundreds & thousands of kms to the Destination.

Source Mainly comprises of:-

1.2.3.1 Input Transducer:

The input transducer converts the information (Acoustic waves) to its Electrical Equivalent message signal. The equivalent electrical signals move with speed of light ($c = 3 \times 10^8$ m/s).

Examples of Input Transducer:

→ Microphone: It converts audio input (Acoustic pressure waves) like speech to an electrical signal.

1.2.3.2 Transmitter (Tx):

The transmitter is on the source side. It is a device that makes the input electrical information suitable for efficient transmission over a given channel. It is obvious that for different types of channels we have different types of Txs!

e.g → For electromagnetic waves – Channel is atmospheric medium

→ For light waves – Channel is an optical fibre.

Modulation & Multiplexing functionality of Tx

Modulation Functionality → The Tx modulates or changes some parameter eg. Amplitude (A), frequency (f_c) or phase (φ) of a high frequency Carrier signal

ie for simplicity in understanding the Tx generates a Carrier wave which is characterized by an amplitude (A) frequency (f_c) and phase (φ).

e.g Carrier signal $= A \cos(\omega_c t + \varphi)$ 1.5

$= A \cos(2\pi f_c t + \varphi)$ 1.6

m(t) → The (Baseband signal / message signal) is used to modulate in many ways eg AM, FM, PM

AM → Baseband signal m(t) modulates (A) of Carrier – Amplitude Modulation

FM → baseband signal m(t) modulates (f_c) of Carrier – Frequency Modulation

PM → baseband signal m(t) modulates (φ) of Carrier → Phase Modulation

{FM & PM} collectively are also referred to as Angle Modulation.

Hence output of Tx is AM-Carrier (Amplitude Modulated High freq Carrier)
or
FM-Carrier (Frequency Modulated high freq Carrier)
PM-Carrier (Phase Modulated High freq Carrier).

(Mux) Multiplexing functionality → Transmitter (Tx) also multiplexes to enable transmission of more than one signal for efficient utilization of the potential bandwidth of the comm. channel.

Multiplexed signal can be of two types

→ TDM (Time Division Multiplexing)
All signals to be transmitted over a signal Comm. channel are all staggered in time (see figure Fig 1.2.a)

→ FDM (Frequency Division Multiplexing)
All signals to be transmitted over a signal Comm. channel are all staggered in Frequency domain (see figure 1.2.b)

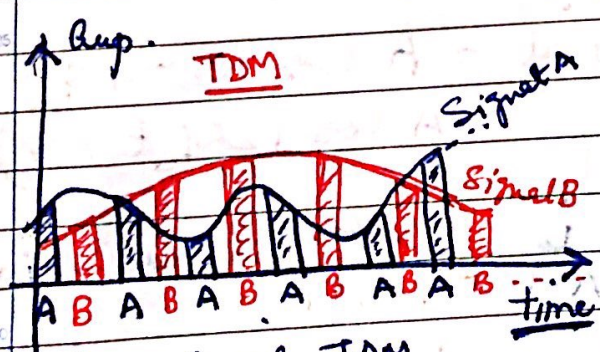

Fig 1.2.a: Two-signal TDM
Signal A, Signal B are staggered in time domain successively pulses

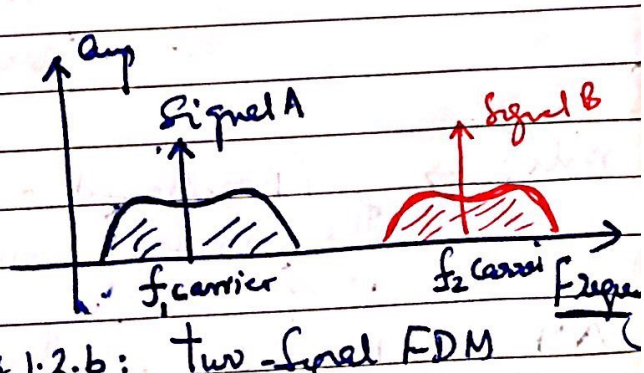

Fig 1.2.b: two-signal FDM
Signal A, B are staggered in frequency domain by translating around two different carriers f1 carrier & f2 Carrier.

1.2.3.3 Communication Channel:

Comm. Channel is the medium by which information (modulated signal) is sent. The Channel could be → wired link. eg Cu wire
→ physical link eg Optical fibre.
→ wireless link eg Atmospheric propagation

The Channel is characterized by two most important influences:
→ Noise
→ Distortion & Attenuation

The influence of Noise & Distortion is shown in figure 1.1 (pg 02) as feeding to the Comm Channel. These are influences which are unwanted & measures should be taken to reduce and avoid these unwanted influence of Noise, Distortion & Attenuation on the signal over the Communication Channel.

Bandwidth of Comm. Channel The Channel is also characterized by an important parameter called the Bandwidth (BW)
Bandwidth Defn: This is the amount

1.2.3.4 Receiver (Rx).

On the destination side the Rx is the device that receives information from Channel & extracts the intended electrical message from it.
Besides other functionality of converting modulated received signal to original electrical signals, the Rx also Amplifies the incoming attenuated signal; & removes noise & distortion from it. (PTO)

Demodulation & Demultiplexing (DeMux) functionality of a receiver!

Demodulation functionality

Demodulation is the reverse of modulation used to extract the message signal m(t) from the modulated carrier.
The demodulation procedure will depend on the types of modulation employed at Tx. Therefore demodulation of AM, FM & PM are different.

DeMux functionality

Demultiplexing is the reverse of multiplexing. Referring to fig 1.2.a, In case of TDM, the Demux (short of multiplex) extracts all pulses & separates signal A from signal B sending them to their desired destination.
In case of FDM, signal A, is reverse frequency translated back around baseband freq by Demux procedure. Similarly signal B is also reverse frequency translated to original spectral position.

1.2.3.5 Output Transducer

The output transducer converts received, detected electrical signal to a form of message as required by the user. eg. Speech, image, video, text etc.
Loudspeaker is an example of a transducer where electrical received signal is converted to Acoustic / audio o/p.

Tsheet # 01

Page: 07
Date: 17.04.20.

Questions to be answered for Lecture # 01

Q.1. Draw the basic block diagram of an Electronic Communication System.

Q.2. Explain the functionality of each block of the Electronic Comm. System.

Q.3. Define FDM & TDM. & also give its advantages.

Q.4 Give atleast ~~four~~ seven examples of transmission medias with brief description (Attenuation, BW etc)

[Hint] eg. Open Wire lines
Paired Cables
Quad Cables
Co-axial Cables
Radio
Waveguides
Optical fibre

Q.5. Name & briefly describe some sources or factors responsible for: (i) Noise
(ii) Distortion
(iii) Attenuation

Q.6. Define (i) Modulation & Demodulation
(ii) Mux & Demux.
(iii) Communication.