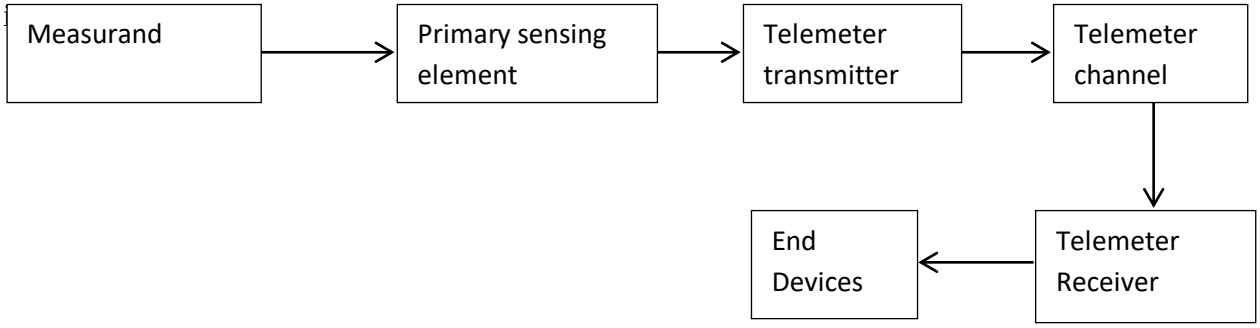
Chapter 5

Data Transmission

Data Transmission is the process by which information regarding the quantity being measured (may be using a transducer and signal conditioning equipment) is transferred to a remote location perhaps to be processed, recorded and displayed.

Telemetry is the technology which enables a user to collect data from several measurement points at inaccessible or inconvenient locations, transmit that data to a convenient location and present the several individual measurements in a usable form. A general telemetry system



The primary detector and the end devices of the telemetry system have the same position and functional roles as in a generalized measurement system.

The function of the telemeter transmitter is to convert the output of a primary sensing element into an electrical signal and to transmit it over a telemetering channel. The telemeter receiver placed at a remote location receives the signal in electrical format transmitted by the transmitter. This signal is converted into a usable form by a receiver and is recorded or indicated by an end device.

Types of telemetry systems

i. Landline Telemetry
ii. R.F (Radio Frequency) Telemetry

i. Landline Telemetry

It requires a telemeter channel which is a physical link between the telemetry transmitter and receiver. It is a direct transition of information through cables and transmission lines.

ii. R.F Telemetry

Here is no physical link between the telemeter transmitter and receiver i.e. transmitter channel is wireless. R.F telemetry is usually more suitable if the data is to be transmitted over distances greater than 1 km. Certain parts of the radio frequency spectrum have been allocated for telemetry and microwave links above 4 MHz. Radio Waves at these frequencies tend to travel in straight lines, requires repeater stations with disc like

antennas on high buildings and towers every 30 to 60 km. Different modulation techniques like amplitude modulation, frequency modulation and phase modulation are used for data transmission in radio frequency telemetry, which helps to maintain the size of antennas.

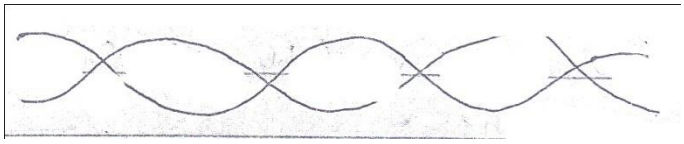
Data Transmission Mediums

Data needs to be transmitted between devices in an instrument system for record, display and analysis purposes. Data is transmitted in the form of bits. Generally various data transmission mediums are required to transmit data from one point to another within a data acquisition system. Data transmission medium may be wired or wireless depending upon the requirement.

1. **Wired Data Transmission Medium**

   There exists physical link between transmitter and receiver. Different types of wired data transmission medium are as follows.

a. Twisted Pair



- consists of two insulated copper wires arranged in a regular spiral pattern to minimize the electromagnetic interference between adjacent pairs.
- Often used at customer facilities and also over distances to carry voice as well as data communications.
- Low frequency transmission medium
- **Two types:**

  STP(Shielded Twisted Pair): The pair is wrapped with metallic foil to insulate the pair from electromagnetic interference and

  UTP (Unshielded Twisted Pair): Each wire is insulated with plastic wrap but the pair is encased in an outer covering.

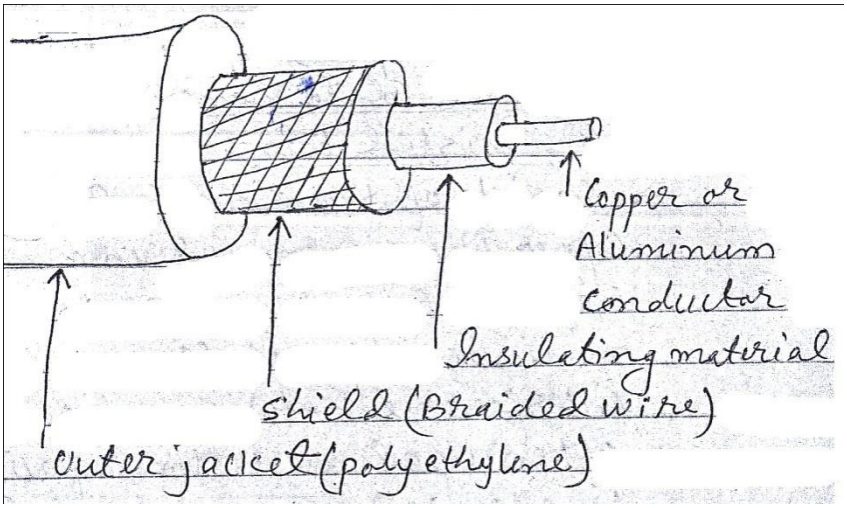
Advantages:

- Inexpensive and readily available
- Flexible and light weight
- Easy to work with and install

Disadvantages

- Susceptibility to interference and noise.
- Attenuation problem
  - For analog, repeaters are needed every 5 to 6 km
  - For digital, repeaters are needed every 2 to 3 km
- Relatively low bandwidth (3000 Hz)

b. Coaxial Cable



- Used for cable television, LANs , telephony.
- Has an inner conductor surrounded by a braided mesh
- Both conductors share a common center axial, hence the term "coaxial"

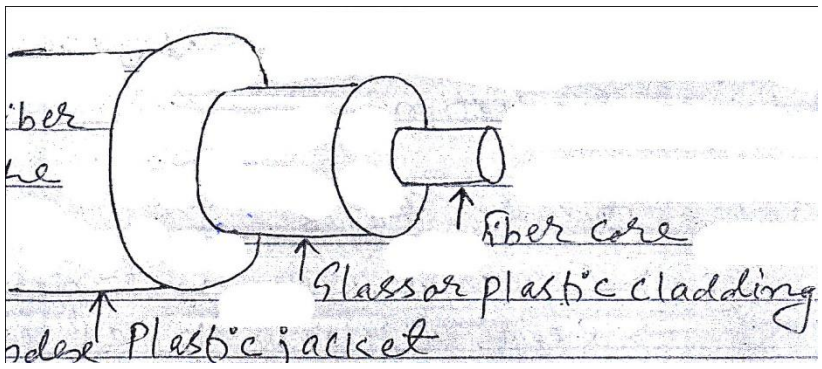
Advantages:

- Higher bandwidth
  - 400-600 MHz
  - Up to 10,800 voice conversations
- Can be tapped easily
- Much less susceptible to interference than twisted pair

Disadvantages:

- High attenuation rate makes it expensive over long distance
- Bulky

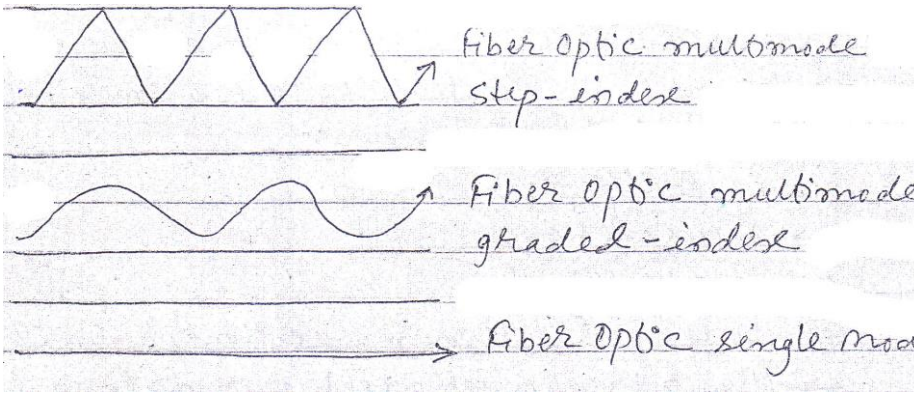
c. Optical Fiber



- Relatively new transmission medium used by telephone companies in place of long distance trunk line
- Also used by private companies in implementing local data communications networks

- Require a light source with injection laser diode(ILD) or light emitting diodes(LEDs)
- Consists of three concentric sections; core cladding and jacket
- **Types:**
  a. Multi-mode step-index fiber
     The reflective walls of the fiber move the light pulses to the receiver
  b. Multimode Graded-index fiber
     acts to refract the light toward the centre of the fiber by variations in the density.
  c. Single mode fiber
     The light is guided down the center of an extremely narrow core.
     Works on the principle of total internal reflection

Fiber Optic signals



Advantages:
- Greater capacity (bandwidth of up to 2 Gbps)
- Smaller size and light weight
- Lower attenuation
- Immunity to environmental interference
- Highly secure to tap difficulty and lack of signal radiation

Disadvantages:
- Expensive over short distance
- Requires highly skilled installers
- Adding additional nodes is difficult

2. Wireless data transmission medium

- Transmission and reception are achieved by means of an antenna which may be
  - Directional
    Transmitting antenna puts out focused beam
    Transmitter and receiver must be aligned

- Omnidirectional
  Signal spreads out in all directions
  Can be received by many antennas

Examples of wireless data transmission medium

a. Terrestrial microwave
- Parabolic dish
- Focused beam
- Line of sight
- Long haul telecommunications
- Higher frequencies give higher data rates

b. Satellite microwaves
- Satellite is a relay station
- Satellite receives on one frequency, amplifies or repeats signal and transmits on another frequency
- Requires geo-stationary orbit (height of 35,784 km)
- Used in television, long distance telephone, private business networks and so on.

c. Broadcast Radio
- Omnidirectional antenna is used.
- Suffers from multipath interference caused by reflections broadcast signal
- AM radio is an example

d. Infrared
- Modulate non coherent infrared light
- Line of sight or reflection
- Blocked by walls
- TV remote control is an example

Modes of Data Transmission

A transmission mode is the manner in which data is sent over the underlying medium. There are five possible different modes of data transmission which may fall into groups.

i) Serial/Parallel and
ii) Simplex/Half Duplex/Full Duplex

Serial Data Transmission
- One bit is transmitted at a time using a single wire
- Example : 01101101 being transmitted

Advantages:

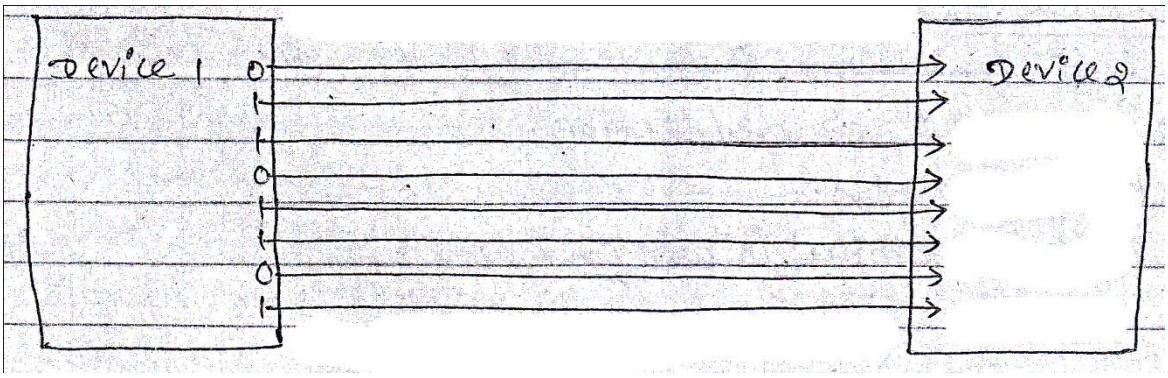
- Simple and reliable because the next bit is not transmitted until the current one has arrived at its destination

Disadvantages:

- Slow because only one bit can be transmitted at a time.

Parallel Data Transmission

Bits sent at the same time using more than one wire usually 8 wires, so a whole byte can be sent at once



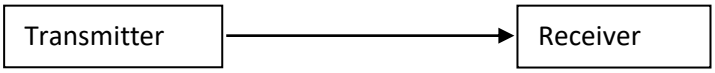
Advantages:

- Faster because all the bits are travelling at the same time .

Disadvantages:

- Due to fine tolerance (resistances) in the transmission, it is less reliable as the bites can become muddled up (as they may arrive out of order).

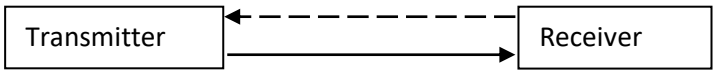
Simplex mode



- Data can only travel in one direction.
- used if only one direction is necessary. Example: Teletext information which is passed to a television receiver but there is no way to send data in the other direction.

Half Duplex Mode

- Data can pass in both directions but only in one direction at a time
- Used if both directions are necessary but not at the same time. Example :CB radio system in which each handset can either be set to receiver mode or send mode.



Duplex Mode

- Data can pass in both directions at the same time
- Used if both directions are necessary at the same time
- Example: A telephone conversation as both users can speak at the same time.