B1 U2 Data Transmission Basics & Transmission Media

Data comm^n Technology

Channel
medium used to transmit info b/w sender & receiver
↳ wired (electrons) ↳ wireless (EMR)
↳ Analog & Digital

Baud
unit of data transmission speed
In a sec., how many times a signal changes its state.
1 Bd = 1 bit/s (Bd)
Bit rate → Baud rate x bits in a Baud

Bandwidth
data carrying capacity of the channel.
- depends on length of channel
- Higher bandwidth ⇒ Higher throughput

frequency
Rate of repetition of an event per second (Hz)
No. of cycles completed by signal per sec.
$f = 1/T$

Mode of Data Transmission

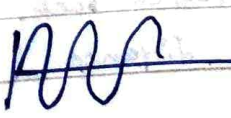
↳ Simplex, Half duplex, full duplex
↳ Serial & parallel comm^n
↳ Synchronous, Asynchronous, Isochronous
↳ hybrid form
↳ Analog & Digital

Transmission Impairments

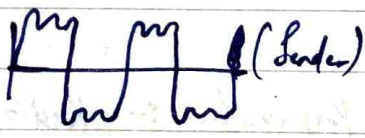
Attenuation
- loss in energy over distance due to resistance of medium.
- Amplifiers are installed
- Measured in dB.
- used to compare signal strengths.

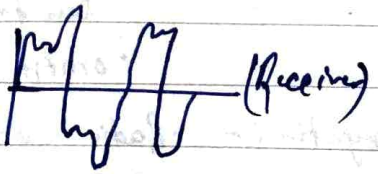

Original


Attenuated


Amplified

Distortion
- some change in original.
- delay distortion.


(Sender)


(Receiver)

Noise
- All signals other than the signal transmitted.
↳ Thermal noise
↳ Induced noise
↳ Impulse noise (energy spike)
↳ Crosstalk noise
↳ interference of one wire with another

Date :

Signal to Noise Ratio

used to define the quality of signal at any point.
lower Noise, higher SNR

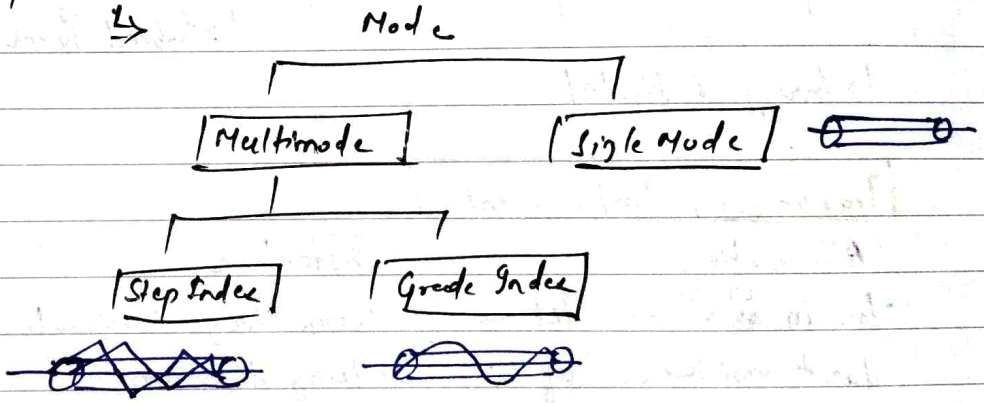
$$SNR = \frac{\text{Avg. signal power}}{\text{Avg. Noise power}}$$

Delays

- Transmission
- Propagation

Transmission media

Guided
- Twisted Pair cable
- Coaxial cable
- Fiber optic cable

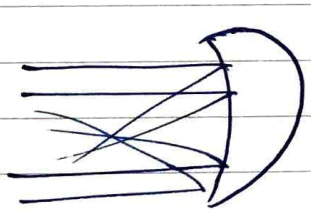


Unguided
- Ground Propagation :- • Radio waves close to earth surface.
  • low freq waves < 2 MHz are used
  • omnidirectional propagation
- Sky propagation :- • Radio waves with higher freq.
  - 2 MHz to 30 MHz
  • waves emitted towards the sky & after hiting ionosphere are reflected back.
  • for sending data over large distances.

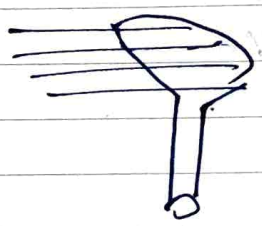
Date :

↳ Line of sight propagation
  ↳ used to transmit signals in a straight line b/w transmitting & receiving antennas.
  ↳ 30 MHz +
  ↳ should be visible

Wireless Transmission
↳ Microwave
  ↳ freq 1 to 300 GHz
  ↳ High freq, narrow focused, unidirectional
  ↳ Line of sight
  ↳ for long distances → tall antennas
  ↳ can't pass through obstacles



parabolic dish antenna (good for receiver end)



horn antenna (good for sender end)

Terrestial Microwave
  ↳ Sender - receiver located on earth
  ↳ 2-6 GHz or 21-23 GHz
  ↳ Line-of-sight
  ↳ Rain, fog, wind do not affect

Satellite Microwave
  ↳ Not line-of-sight locations.
  ↳ b/w two satellites
  ↳ lower freq. 4-6 GHz
  ↳ environmental factors affect it
    ↳ low signal in rx.

Date : _____

↳ Radiowave
  ↳ 3 KHz - 1 GHz.
  ↳ omnidirection
  ↳ No line-of-sight
  ↳ Not reusable
  ↳ can penetrate walls
    AM & FM radio

↳ Infrared / Millimeter waves
  ↳ short range comm^n → limited to some feet
  ↳ 300 GHz - 400 THz
  ↳ can't penetrate walls
  ↳ Generally used in remote control system.

↳ Wireless LAN

Communication is transfer of information from one person to another. But information transferred must be understandable to the receiver.

Essential Elements of Communication System

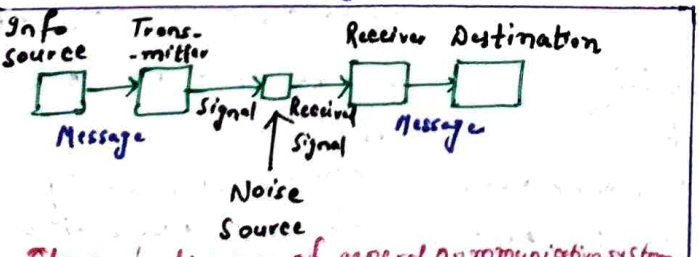
a) Information source :- Sources that produce a message.

b) Transmitter :- An element that functions on the message to generate a signal which can be delivered through a medium / channel.

c) Communication Channel :- This is a medium over which the signal (carrying the information that composes the message) is sent.

d) Receiver :- An element that intercept the signal and converts it back into the message.

e) Destination :- It can be a person / machine for whom / which the message is intended.



Shannon's diagram of general communication system

Noise :- The noise is considered as an error or unwanted disturbance which occurs during the transmission from natural and sometimes man-made sources.

Analog and Digital Communication

Analog Signal :- An analog signal is a continuous signal that changes over a time period.

Digital Signal :- A digital signal is a discrete signal that carries information in binary form.

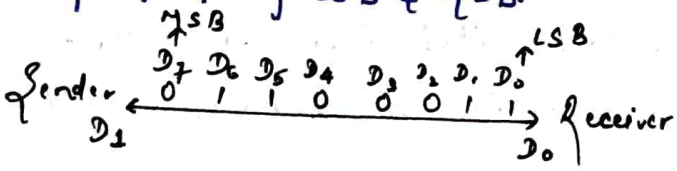
Differences between Analog & Digital Signal

Analog	Digital
1) Defn	1) Defn
2) In analog systems electronic circuits are used for transf-ormation of signals.	2) In digital systems Logic circuits are used for transformation of signals.
3) Analog signals are more likely to get affected by noise and results in reducing accuracy.	3) Digital signals are less affected, because noise response are analog in nature.
4) Analog devices are not very precise.	4) Digital systems are very precise.
5) Data Transmission is not of high quality.	5) Data Transmission is of high quality.

Serial & Parallel Transmission

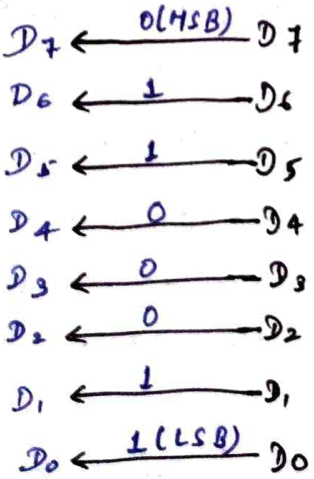
Serial transmission is the process of sending data one bit at a time, sequentially over a single data channel. Ex:- computer to modem

- It requires less processing and fewer chances for error. The start and stop of a communication is specified by LSB & MSB.



Parallel Transmission refers to simultaneous transmission of the bits over two or more separate channels. Multiple bits can be transmitted simultaneously.

Ex:- Computer to printer.



- It allows for higher data transmission rates that can't be achieved with serial transmission.
- It is less reliable for long distances because error correction is not very simple & economical.

Synchronous & Asynchronous Transmission

1.1.2

Synchronous Data Transmission

It is a data transfer method in which a continuous stream of data signals is accompanied by timing signals to ensure that the transmitter and the receiver are in sync with one another. The data is sent in blocks (called frames or packets) spaced by fixed time intervals.

Ex: Ethernet

Asynchronous Data Transmission

It is a data transfer method in which start and stop bits are used to signify the beginning and end. The sender and receiver are not in sync with one another. The data is sent in the form of byte or character.

Ex:- Telephone lines, keyboard.

Synchronous	Asynchronous
1) Defn	1) Defn
2) Data is sent in the form of frames or blocks	2) Data is transmitted in the form of byte or character.
3) The transmission of data is faster due to common clock pulse. (A)	3) The transmission of data is slower due to separate clocks. (D)
4) It is not very cost effective (D)	4) It is cost effective (A)
5) Less possibility of error, but (A) if an error takes place, the complete set of data (D) is lost instead of a single character	5) If there is an error in a character, other sequence (A) of characters are not effected. Error in start & stop bit may cause serious (D) problems in data transfer

Transmission mode in Computer Network

Simplex, Half Duplex & Full Duplex

Transmission/Communication mode refers to the mechanism of transmission of data between two devices connected over a network.

1) Simplex mode

It is a one-way transmission i.e. signals are transmitted in only one direction one station transmitter and the other is receiver.

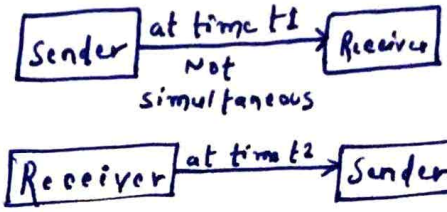
Simplex — Radio/TV Broadcasting

2) Half Duplex Mode

In this, data transmission can take place in both directions but not at the same time, both stations may transmit, but only one at a time.

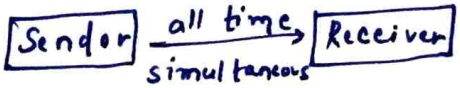
3) Full Duplex Mode

In this, data transmission can take place in both directions and at the same time, both stations may transmit simultaneously.



Half Duplex

walky-talky.



Full Duplex

Mobile or Telephone.

Applications of Computer Networking

Resource sharing :- Using networks we can share any resource, CPU processing power, peripherals like printers, scanners etc. information like files and data and even software. This sharing is done by communicating the machine through whom we want to share.

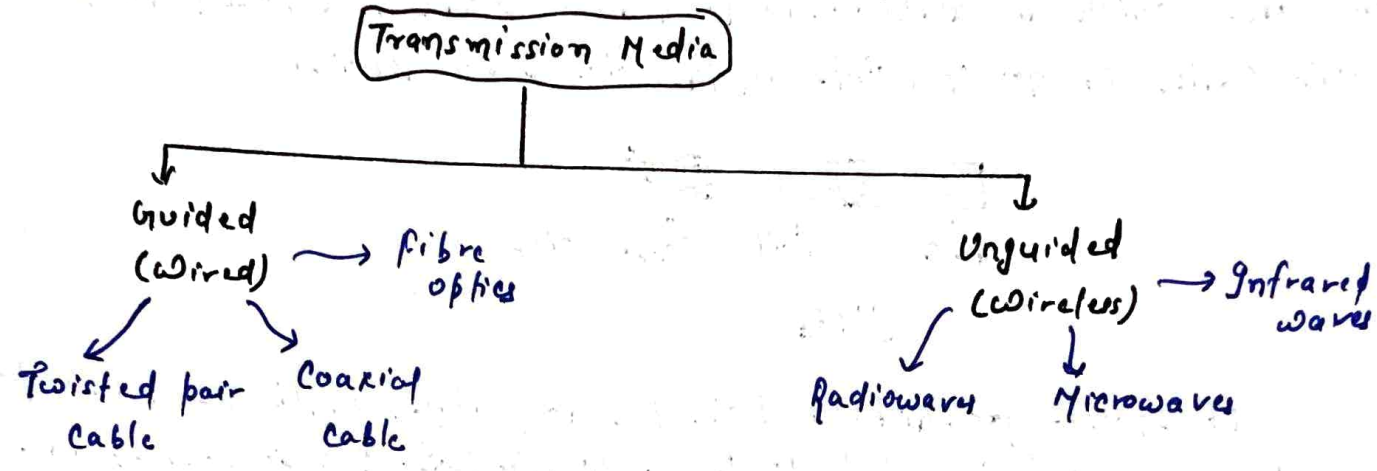
Personal Communication :- Personal communication be done through computer networks like email, chatting, audio/video conferencing etc.

Information Broadcasting & Search :- Computer network provides us tremendous opportunity for information broadcasting, display, searching and information retrieval.

Healthcare delivery :- Remote Diagnosis, TeleMedicine.

Collaborative Research & Development

Transmission Media :- The transmission medium is the physical path between transmitter and receiver in a data transmission system.



Guided Media :- In guided media, transmitted data travels through cabling system that has a fixed path.

1) **Twisted pair cable :-** A twisted pair cable is made of two plastic insulated copper wires twisted together to form a single media. The pairs are twisted to provide protection against crosstalk and noise (electromagnetic interference) generated by adjacent pairs.

Twisted pair cable

Advantages

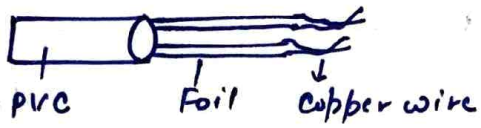
1) It is simple and physically flexible.
2) It is easy to install and maintain.
3) It can be easily connected.
4) It is very cheap.

Disadvantages

1) Because of high attenuation, it is incapable of carrying a signal over long distances without using repeaters.
2) It has a low bandwidth which makes it unsuitable for broadband applications.
3) Max data rates 1 mbps without conditioning, 10 mbps with conditioning.

There are two types of twisted pair cable:-

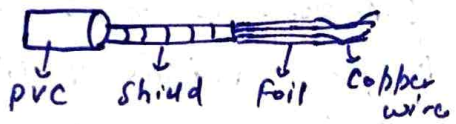
(i) UTP :- UTP stands for unshielded twisted pair cable. It is a normal twisted pair cable which is unshielded. To reduce crosstalk between the pairs in UTP cable, the no. of twists in the wire pairs varies.



UTP

(ii) STP :- STP stands for shielded twisted pair cable. In this cable an outer covering or shield is added to the ordinary twisted pair cables, the shield functions as ground.

The maximum segment length of STP cable is 100 metres.



STP

Difference between STP & UTP

UTP	STP
1) UTP stands for unshielded twisted pair.	1) STP stands for shielded twisted pair.
2) In UTP grounding cable is not necessary.	2) In STP grounding cable is required.
3) Data rate in UTP is slow compared to STP.	3) Data rate in STP is high
4) The cost of UTP is less.	4) The STP is costlier than UTP.
5) In UTP noise is high.	5) Noise is less in STP.
6) The generation of crosstalk is also high compared to STP.	6) The generation of crosstalk is less compared to UTP.

7) Attenuation is high in comparison to STP.

7) Attenuation is low in comparison to UTP.

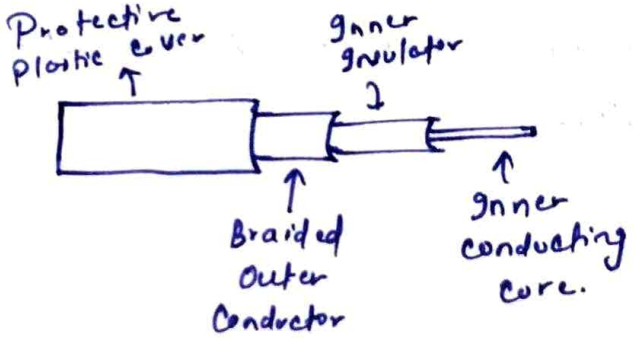
Application of Twisted pair cable

Telephone communications and Modern Ethernet Networks.

2) Coaxial cable :- These are copper cables with metal shielding designed to provide immunity against noise and greater bandwidth. Coax can transmit signal over larger distances at higher speed as compared to twisted pair cables.

Structure :-

Coax has a central core of stiff copper conductor for transmitting signals. This is covered by an insulating material. The insulator is encased by a closely woven braided ~~material~~ metal outer conductor that acts as a shield against noise. The outer conductor is again enclosed by a plastic insulating cover.



Applications

- In analog telephone networks :- A single coaxial network can carry about 10,000 voice signals.
- In digital telephone networks :- A coax has a data ratio of 600 Mbps.
- In cable TV Networks
- In traditional Ethernet LANs
- In MANs.

Fibre optic cable

Fibre optic cables transmit information as light pulses along a glass or plastic strand. It is used for long-distance and high-performance data networking.

Structure :-

It contains a varying number of glass fibers from a few up to a couple hundred. Surrounding the glass fibre core is another glass layer called cladding. A layer known as buffer tube protects the cladding, and a jacket layer acts as the final protective layer for the individual strand.

How it works?

Fiber optics transfer data in the form of light particles that pulse through a fiber optic cable. The glass fiber core and the cladding each have a different refractive index that bends incoming light at a certain angle. When light signals are sent through the fibre optic cable, they reflect off the core and cladding in a series of zig-zag bounces, known as Total Internal Reflection.