Data Communication Part-5

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Types of Wired Media :

1. Co-axial Cable
2. Twisted pair cable
3. Optical fiber cable

Twisted Pair Cables :-

The construction of twisted pair cable is as shown in the diagram given below . This is also commonly used medium and cheaper than the co-axial cable .

Types of Twisted Pair :

- There are basically two type of twisted pair cables :
  1. Unshielded twisted pair(UTP)
  2. Shielded twisted pair(STP)

(a) UTP   (b) STP
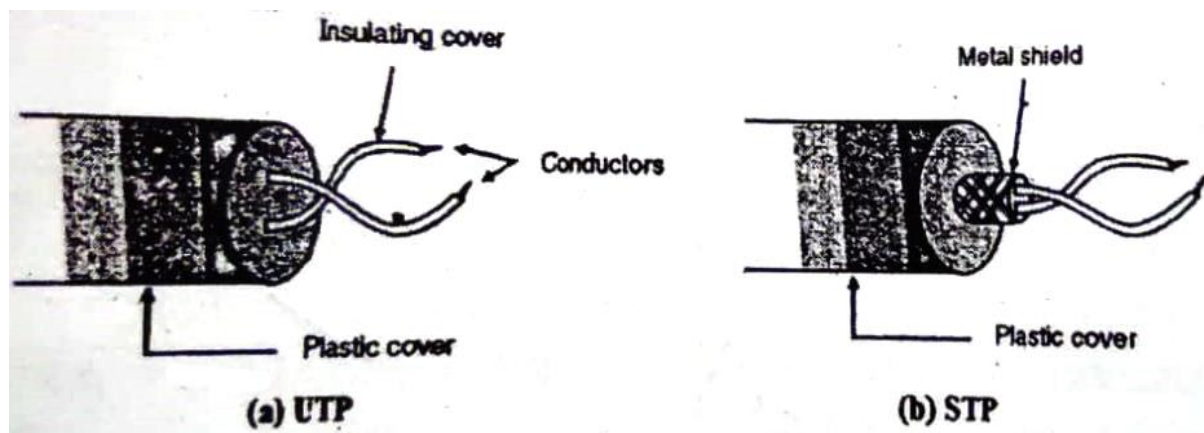
STP:

- STP cable has a metal foil or braided mesh to cover each pair of insulting conductors.
- This is known as the medal shield. It reduces the interference of the noise but makes the cable bulky and expensive.
- So practically STP is less used and UTP is more used. The STP was developed by IBM and is used primarily for the IBM only.
- Application of the twisted pair cables are in point to point to multipoint communications , telephone systems.
- Twisted pairs can be used for either digital or analog transmission. The bandwidth supported by the wire depends on the thickness of the wire and the distance travelled.
- Twisted pairs support several megabits/sec for a few kilometres and have less cost.

Characteristics of STP

1. The twisted conductors are shielded by a braided mesh to reduce noise interface.
2. Low cost medium
3. Used only for IBM computers
4. Support data rates upto several Mbps.

UTP:

- A twisted pair consists of two insulated conductor twisted together in the spiral form as shown in the table .
- The unshielded twisted pair cables are very cheap and easy to install . but they are badly affected by the noise interference

Why to twist the wires?

- Twisting of wires will reduce the effect of external interference or noise
- Number of twists per unit length will determine the quality of the cable. More twists means better quality.

Categories of UTP

Category	Bandwidth	Data Rate	Digital/Analog	Application
Cat 1	Very low	<100 kbps	Analog	Telephone
Cat 2	<2 MHz	2 mbps	Analog/Digital	T_1 line
Cat 3	16 MHz	10 mbps	Digital	LANs
Cat 4	20 MHz	20 mbps	Digital	LANs
Cat 5	100 MHz	100 mbps	Digital	LANs
Cat 6	200 MHz	200 mbps	Digital	LANs
Cat 7	600 MHz	600 mbps	Digital	LANs

- These cables have less crosstalk and a better quality signal over long distances . These cables are mostly suitable for high speed computer communication
- A connection diagram using UTP is shown below .
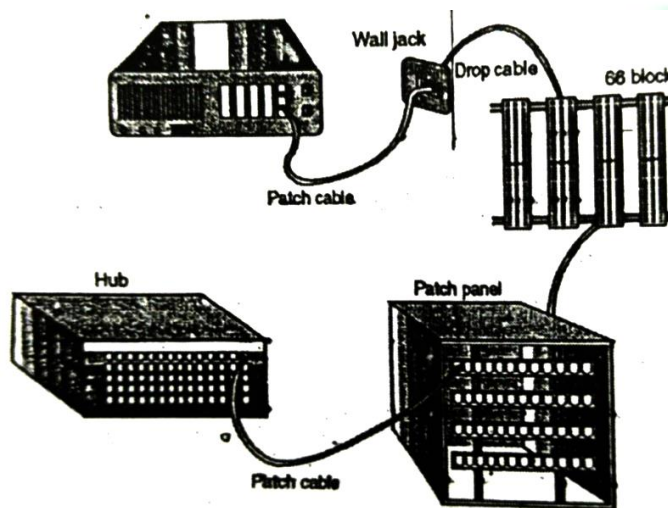
Characteristics of UTP :

- Shielding is not used
- Noise interference is high
- Low cost medium
- Can support data rate of several Mbps
- Installation is easy
- Used in applications like telephone, ADSL ,LANs and ISDN

Application of Twisted Pair Cables :

Some of the application of twisted pair cables are as follows :

- In telephone lines to carry voice and data channels

- In the local loop
- In the DSL line(ADSL)
- Local area network such as 10 Base-T and 100 Base-T . Use the twisted pair cable .
- In the ISDL (Integrated Service Digital Network)

Comparison of Cables :

S.No	Factors	UTP	STP
1	Bandwidth capacity	1-155 mbps(typically 10 mbps)	1-155 mbps(typically 16 mbps)
2	Node capacity per segment	2	2
3	Attenuation	High	High
4	EMI	Very high	High
5	Installation	Easy	Fairly easy
6	Cost	Lowest	Moderate

Connectors :

- For connecting one computer to other, we need to use some transmission medium such as a cable
- The cables are of different types of such as co-axial cables , twisted pair or fiber optic cables .
- For connecting these cables between two computer we have to use connectors on both ends of a cable
- Generally the connections are male-female type to ensure reliable connection.

Connectors for twisted Pair Cable :

- The unshielded twisted pair(UTP) cable is the most commonly used cable in computer communication.
- The most common UTP connection is RJ45 where Rj stands for register jack .it is male female type keyed connector as shown in the diagram given bellow .
- The connector can be inserted only one way.
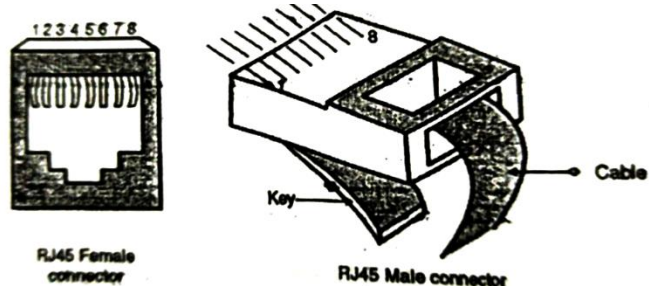
Co-axial Cable :

- The construction of co-axial cable is as shown in diagram below. It consists of concentric conductors separated by a dielectric material.
- The external conductor is metallic braid and used for the purpose of shielding. The coaxial cables may contain one or more co-axial pairs.
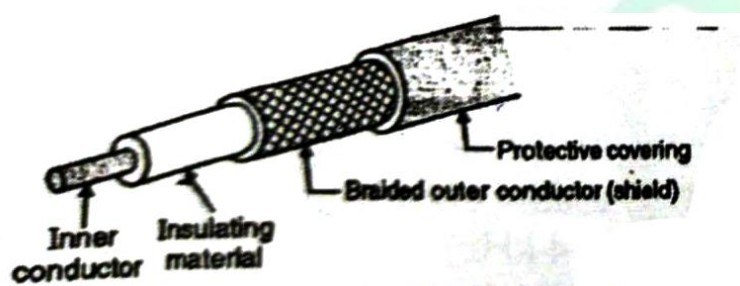
- The construction of a co-axial cable with other accessories as shown below .
- The wire mesh protects the wire from electromagnetic Interference (EMI). It is often called a shied
- A tough plastic jackets forms the cover of the cable as shown below providing insulation and protection .
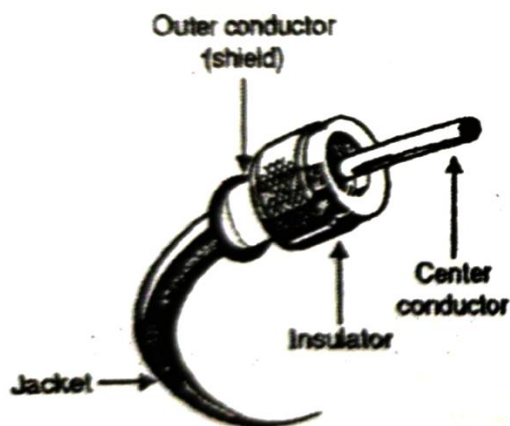
- The co-axial cable was initially developed as the backbone of analog telephone network where the single telephone cable would be used to carry more than 10,000 voice channels at a time.
- The digital transmission systems using the co-axial developed in 1970's . These systems operated in the range of 8.5 Mbps to 565 mbps .
- The most popular application of co-axial cable is in the cable TV system . The existing co-axial cable system has a range from 54 MHz to 500 MHz
- Other important application is cable modern , with the cable modem termination system(CMTS)
- One more application is Ethernet LAN using the co-axial cable . The co-axial cable is used for its large bandwidth and noise immunity .

Co-axial Cable Standards :

CATEGORY	IMPEDANCE	APPLICATION
RG-11	50Ω	Thick Ethernet
RG-58	50Ω	Thin Ethernet
RG-59	75Ω	Cable TV

Application of Co-axial Cables:

1. Analog telephone networks
2. Digital telephone network
3. Cable TV
4. Traditional Ethernet LANs
5. Digital transmission
6. Thick Ethernet

Advantages of Co-axial Cable :

1. Excellent noise immunity due to shield
2. Large bandwidth
3. Losses are small
4. Can support high data rates
5. Less attenuation
6. Ease of installation

Disadvantage

1. Costlier than the twisted pair cables
2. BNC connectors are required to be used for connection

Optical fiber cables:

- It consists of inner glass core surrounded by a glass cladding which has a lower refractive index.
- Digital signals are transmitted in the form of intensity- modulated light signal which is trapped in the glass core.
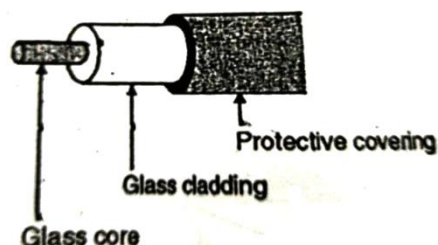
- Light launched into the fiber using the light source such as LED or laser
- It is detected on the other side using a photo detector such as a phototransistor
- The optical fiber cables are costlier than the other two types but they have many advantages over the other two types

Light sources for fiber :

- For data transmission to take place , the sending device that is transmitter must be capable of inducing data bits 0 to 1 into light source. At the receiver a photodiode is used to translate this light back into the data as shown in the diagram given below :
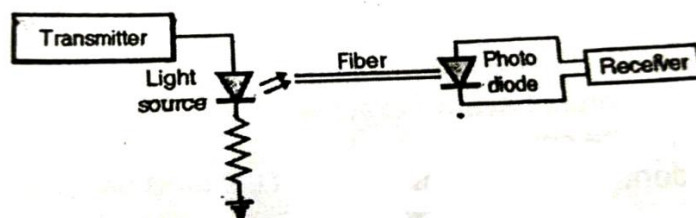
- The two type light source which is mostly used are :
  1. LED(light emitting diode)
  2. Injection laser diode(ILD)

- The LED is cheaper but the disadvantage is that it provide unfocussed light which hits the core boundaries and gets diffused
- The laser diode can provide a very focused beam which can be used for long distance communication .

Principal of light Propagation In Fiber :

- The light enters into a glass fiber from one ends , and gets reflected within fiber .It follows zigzag path along the length of fiber as shown bellow :
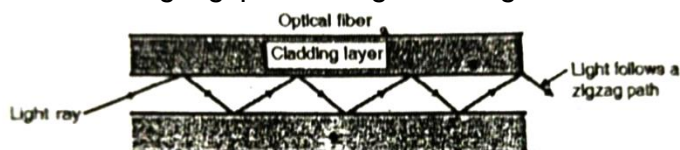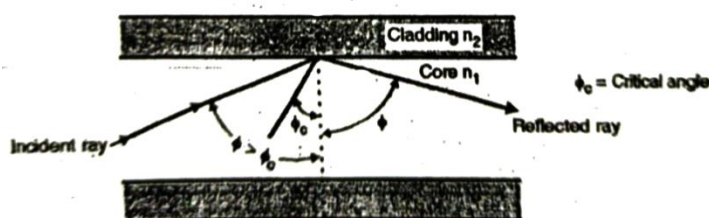

Fig. 2.7.3(a) : Light follows a zigzag path within the optical fiber

- When the light enters into a glass fiber from one end , the most of it propagates along the length of the fiber and comes out from the far end.
- A small portion of the incident light escapes through side wall of the fiber
- The light which travels from one end to the other end of the glass fiber is said to have "guided" through fiber .
- The light stays inside the fiber and does not escape through the walls because of the "total internal reflection" taking place inside the fiber
- This total internal reflection can take place only if following conditions are satisfied:
  1. The glass fiber core must have reflective index which is higher than the reflexive index of the cladding around the core.
  2. The angle of incident of light entering the fiber must be greater than the critical angle ."Φ_c"

$$\sin\Phi_c = n_2 / n_1$$

Advantages of optical Fiber :

1. Small size and light weight
2. Easy available and low cost

3. No electrical or electromagnetic interference

4. Large bandwidth

5. No cross talk inside the optical fiber cable

6. Signal can be sent upto 100 times faster

7. Intermediate amplifier are not required as the transmission losses in the fiber are low

8. Ground loops are absent

9. Installation is easy

10. These cable are not affected by the environment conditions

Disadvantages of optical fiber :

1. Sophisticated plants are required to manufacturing

2. The initial cost incurred is high

3. Joining the optical fibers is difficult

Comparison of wired media

S.No.	Twisted Pair Cable	Co-axial cable	Optical fiber
1	Transmission of signals takes place in electrical form over metallic conducting wires	Transmission signals takes place in the electrical form over the inner conductor of the cable	Signal transmission takes place in an optical form over a glass fiber
2	Noise immunity is low . That is more distortion	Higher noise immunity than the twisted pair cable due the present of shield conductor	Highest noise immunity as the light rays are unaffected by the electrical noise
3	Affected due to external magnetic field	Less affected due to external magnetic filed	Not affected by the external magnetic field .
4	Short circuit between two conductor is possible	Short circuit between two conductor is possible	Short circuit is not possible
5	Cheapest	Moderately expensive	Expensive
6	Can support low rate reset	Moderately high data rate	Very high data rate
7	Power loss due to conduction and radiation	Power loss due to conduction	Power loss due to absorption , dispersion , scattering and bending
8	Low bandwidth	Moderately high bandwidth	Very high bandwidth
9	Node capacity per segment is 2	Node capacity per segment is 30 to 100	Node capacity per segment is 2
10	Attenuation is very high	Attenuation is low	Attenuation is very low
11	Installation is easy	Installation is fairly easy	Installation is difficult
12	Electromagnetic interference (EMI) can take place	EMI is reduce due to shielding	EMI is not present

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