10

TRANSMISSION MEDIUM

Unit Structure

10.0 OBJECTIVES

In this chapter, you will understand:

- Definition of Transmission Medium and its types
- Different types of Guided Transmission medium
- Different types of UnGuided Transmission medium
- Different ways in which wireless signals are transmitted

10.1 INTRODUCTION

In Data Communication networking, it is worth understanding the medium through which data passes and what are the available

mediums and their types. This chapter give a thorough understanding of the different types of transmission medium used for data communication

10.2 TRANSMISSION MEDIA

- Transmission media is ameans by which a communication signal is carried from one system to another
- A transmission medium can be defined as anything that can carry information from a source to a destination.
- The transmission medium is usually free space, metallic cable or fiber – optic cable.

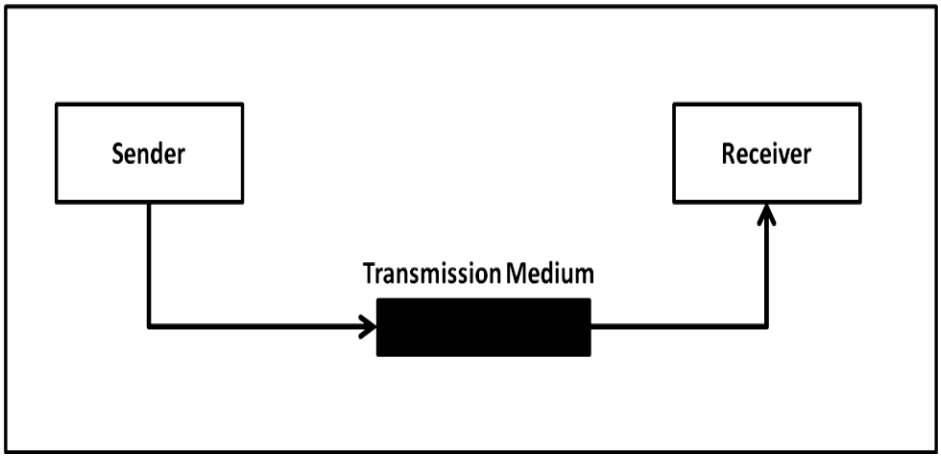

Figure: Transmission of data from sender to receiver through a medium

10.2.1 Categories of transmission media

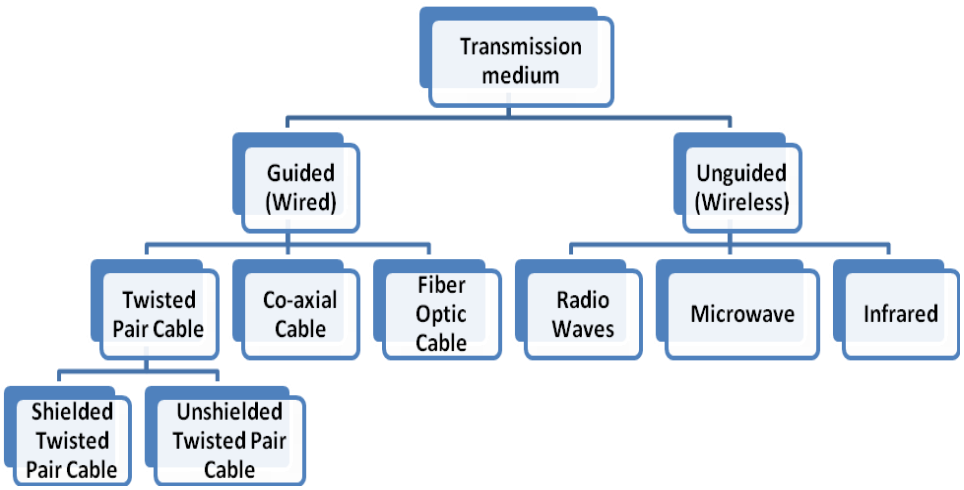

Figure : Categories of Transmission Medium

10.3 GUIDED MEDIA

- Guided Transmission media uses a cabling system that guides the data signals along a specific path.
- Guided media also known as Bounded media, which are those that provide a conduit from one device to another, include twisted-pair cable, coaxial cable, and fiber-optic cable.
- Out of these twisted-pair cable, coaxial cable transport signals in the form of electric signals and fiber-optic cable transport signals in the form of light.
- Types*:*
    1. Twisted-Pair Cable
    2. Coaxial Cable
    3. Fiber-OpticCable

10.3.1 Twisted-pair cable

Figure: Twisted Pair Cable

- The wires is twisted twisted together in pairs.
- Each pair would consist of wire used for the +ve data signal and a wire used for the —ve data signal. Any noise that appears on +ve/—ve wire of the pair would occur on the other wire.
- Because the wires are opposite polarities, they are 180 degrees out of phase (180 degree phases or definition of opposite polarity) when the noise appears on both wires, it cancels or nulls itself out at the receiving used.
- Twisted pair cables are most effectively used in a system that uses a balanced line method of transmission.

10.3.1.1 Unshielded Twisted Pair Cable (UTP)& Shielded Twisted Pair Cable (STP)

Fig. Unshielded Twisted Pair Cable

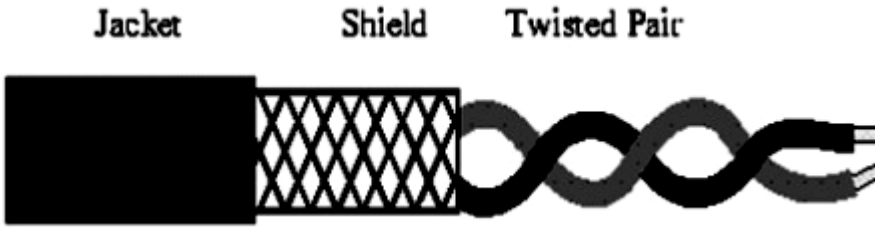

Fig. Shielded Twisted Pair Cable

- Cables with the shield are called shielded twisted pair and commonly abbreviated STP.
- Cables without a shield are called unshielded twisted pair or UTP.
- Twisting the wires together results in characteristics impedance for the cable.
- UTP or unshielded twisted pair cable is used on Ethernet
- UTP cables are used for Ethernet cabling where 4 twisted pair cables (a total of 8 wires are used)

- **10.3.2 Co-Axial Cable**

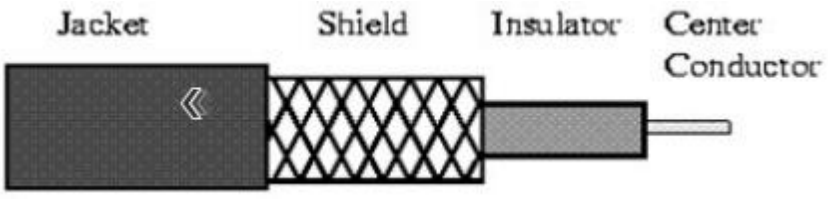

Figure: Co-axial cable

- Coaxial cable consists of 2 conductors.
- The inner conductor is contained inside the insulator with the other conductor weaves around it providing a shield.
- An insulating protective coating called a jacket covers the outer conductor.

- The outer shield protects the inner conductor from outside electrical signals.
- The distance between the outer conductor (Shield) and inner conductor plus the type of material used for insulating the inner conductor determine the cable properties or impedance. The excellent control of the impedance characteristics of the cable allow higher data rates to be transferred than twisted pair cable.

10.3.3 Fibre Optic Cable

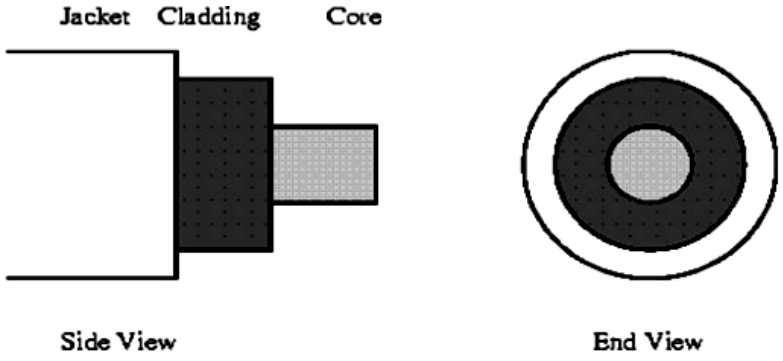

Figure Fiber Optic Cable

- Optical fiber consists of thin glass fiber that can carry information at frequencies in the visible light spectrum.
- The typical optical fiber consists of a very narrow strand of glass called the cladding.
- A typical core diameter is 62.5 microns.
- Typically cladding has a diameter of 125 minors. Coating the cladding is a protective coating consisting of plastic, it is called the jacket.
- The device generating the message has it in electromagnetic form (electrical signal); this has to be converted into light (i.e. optical signal) to send it on optic fiber cable. The process of converting light to electric signal is done on the receiving side.

Advantages:

1. **Small size and light weight**: The size of the optical fibers is very small.Therefore a large number of optical fibers can fit into a cable of small diameter.

2. **Easy availability and low cost**: The material used for the manufacturing of optical fibers is “Silica glass”. this material is easily available. So the optical fibers cost lower than the cables with metallic conductors.

3. **No electrical or electromagnetic interference:** Since the transmission takes place in the form of light rays the signal is not affected due to any electrical or electromagnetic Interference.

4. **Large Bandwidth**: As the light rays have a very high frequency in GHz range, the bandwidth of the optical fiber is extremely large.

5. **Other advantages**: - No cross talk inside the optical fiber cable. Signal can be sent up to 100 times faster.

10.4 UNGUIDED (WIRELESS) TRANSMISSION MEDIUM

- Unguided media transport data without using a physical conductor. This type of communication is often referred to as wireless communication.

- It uses wireless electromagnetic signals to send data.

- There are three types of Unguided Media
  (i) Radio waves
  (ii) Micro waves
  (iii) Infrared.

- Before understanding the different types of wireless transmission medium, let us first understand the ways in which wireless signals travel. These signals can be sent or propagated in the following three ways:
  1. Ground-wave propagation
  2. Sky-wave propagation
  3. Line-of-sight propagation

1. Ground-wave propagation

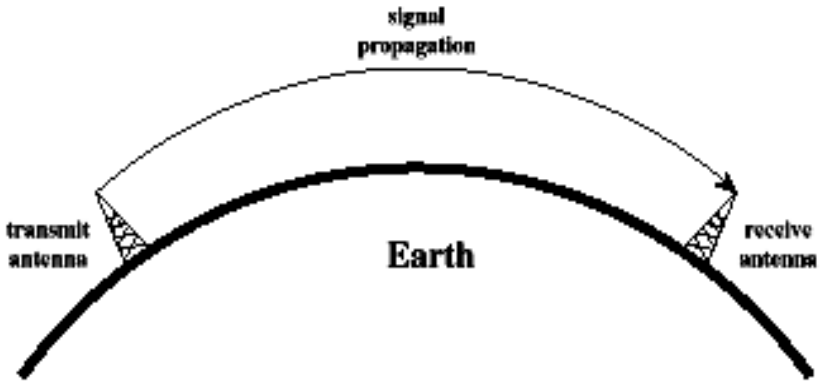

Figure : Ground Propagation of waves

Characteristics of Ground-wave propagation are as follows:

i. Follows contour of the earth
ii. Can Propagate considerable distances
iii. Frequencies up to 2 MHz
iv. Example
    a. AM radio

2. Sky-wave propagation

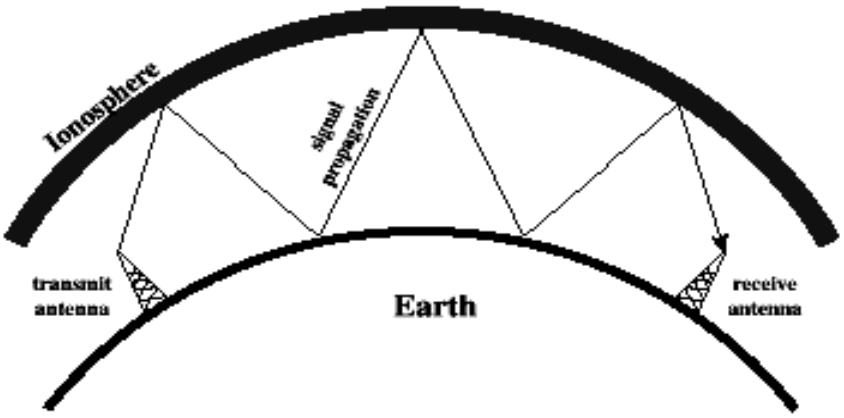

Figure :of waves

Characteristics of Sky Propagation are as follows:

i. Signal reflected from ionized layer of atmosphere back down to earth
ii. Signal can travel a number of hops, back and forth between ionosphere and earth's surface
iii. Reflection effect caused by refraction
iv. Examples
    a. Amateur radio
    b. CB radio

3. Line-of-sight propagation

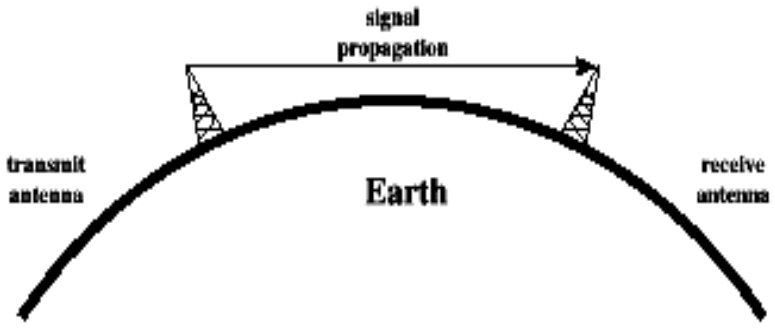

Figure : Line of Sight Propagation of waves

Characteristics of Line of Sight Propagation are as follows:

i. Transmitting and receiving antennas must be within line of sight
    a. Satellite communication – signal above 30 MHz not reflected by ionosphere
    b. Ground communication – antennas within *effective* line of site due to refraction

1. **Radio waves:**

- Electromagnetic wave ranging in frequencies between 3 KHz and 1GHz are normally called radio waves.

- Radio waves are omni-directional when an antenna transmits radio waves they are propagated in all directions. This means that sending and receiving antenna do not have to he aligned. A sending antenna can send waves that can be received by any receiving antenna.

- Radio waves particularly those waves that propagate in sky mode, can travel long distances. This makes radio waves a good candidate for long-distance broadcasting such as AM radio.

- Radio waves particularly those of low and medium frequencies can penetrate walls. It is an advantage because; an AM radio can receive signals inside a building. It is the disadvantage because we cannot isolate a communication to first inside or outside a building.

2. Microwaves:

- Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.

- Microwaves are unidirectional; when an antenna transmits microwaves they can be narrowly focused. This means that the sending and receiving antennas need to be aligned. The unidirectional property has an obvious advantage. A pair of antennas can be aligned without interfering with another pair of aligned antennas.

- Microwaves propagation is line-of-sight. Since the towers with the mounted antennas needs to be in direct sight of each other, towers that are far apart need to be very tall, the curvature of the earth as well as other blocking obstacles do not allow two short towers to communicate using microwaves, Repeaters are often needed for long distance communication very high frequency microwaves cannot penetrate walls.

- Parabolic dish antenna and horn antenna are used for this means of transmission

3. Infrared

- Infrared signals with frequencies ranges from 300 GHz to 400 GHz can be used for short range communication.

- Infrared signals, having high frequencies, cannot penetrate walls. This helps to prevent interference between one system and another. Infrared Transmissionin one room cannot be affected by the infrared transmission in another room.

- Infrared band, has an excellent potential for data transmission. Transfer digital data is possible with a high speed with a very high frequency. There are number of computer devices which are used to send the data through infrared medium e.g. keyboard mice, PCs and printers. There are some manufacturers provide a special part called the IrDA port that allows a wireless keyboard to communicate with a PC.

10.5 COMPARISON BETWEEN WIRED AND WIRELESS MEDIA

Wired media	Wireless media
The signal energy is contained and guided within a solid medium	The signal energy propagates in the form of unguided electromagnetic waves.
Twisted pair wires, coaxial cable, optical fiber cables are the examples of wired media.	Radio and infrared lights are the examples of wireless media.
Used for point to point communication	Used for radio broadcasting in all direction
Wired media lead to discrete network topology	Wireless media leads to continuous network topology
Additional transmission capacity can be procured by adding more wire	It is not possible procure additional capacity.
Installation is costly and time consuming	Installation needs less time and money
Attenuation depends exponentially on the distance	Attenuation is proportional to square of the distance.

10.6 COMPARISON BETWEEN TWISTED PAIR CABLE, CO-AXIAL CABLE AND OPTICAL FIBER

Twisted pair cable	Co-axial cable	Optical fiber
Transmission of signals take place in the electrical form over the metallic conducting wires.	Transmission of signals take place in the inner conductor of the cable	Signal transmission takes place in an optical form over a glass fiber.
Noise immunity is low. Therefore more distortion	Higher noise immunity than the twisted pair cable due to the presence of shielding conductor	Higher noise immunity as the light rays are unaffected by the electrical noise.
Affected due to external magnetic field	Less affected due to external magnetic field	Not affected by the external magnetic field.
Short circuit between the two conductor is possible	Short circuit between the two conductor is possible	Short circuit is not possible
Cheapest	Moderately expensive	Expensive
Can support low data rates	Moderately high data rate	Very high data rates.
Low bandwidth	Moderately high bandwidth	Very high bandwidth
Easy to installed	Installation is fairly easy	Installation is difficult

10.7 REVIEW QUESTIONS

1. Write short note on transmission medium and explain its different types.
2. Explain Twisted Pair Cables in detail
3. Explain Fiber Optic Cables with its advantages
4. Explain the different ways is which wireless signals propogate.

5. Write short notes on :
   a) Radio waves
   b) Microwaves
   c) Infrared

10.8 REFERENCES & FURTHER READING

a) Data Communication & Networking – BehrouzForouzan
b) Computer Networks – Andrew Tannenbaum