# *Chapter 7*

***“Transmission Media.”***

***Transmission media are actually located below the physical layer and are directly controlled by the physical layer.*** “Classes of transmission media”

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*“Guided (Wired).*

*“Twisted-pair cable.*

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*Consists:*

Consists of two conductors, each with its own plastic insulation, twisted together.

*Uses:*

One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference.

*“There are two types;*

*1-*unshielded twisted-pair (UTP)*:* The most common *in* communications and has not Metal.

*2-* *Shielded twisted-pair (STP): has metal shield,* covering *that encases each pair of insulated conductors and improves the quality of cable by preventing the penetration of noise or crosstalk*

*Our discussion focuses primarily on UTP* *because STP* *is seldom used outside of IBM.*

*“UTP cable categories:*

**Unshielded twisted -pair cables are classified into** **seven categories.**

**Categories are determined by cable quality.**

***The most common UTP connector is RJ45.***

***The RJ45 is a keyed connector, and*** ***can be inserted in only one way as shown in figure.***

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***“UTP performance:***

***To measure UTP performance* *is to compare attenuation versus frequency and distance.***

***Since with increasing frequency, the attenuation sharply increases with frequencies above 100 kHz.***

***“UTP Applications:***

***UTP Cables are*** ***used in telephone lines to provide voice and data channels and The DSL lines.***

***“Coaxial Cable:***

***Carries signals of higher frequency ranges than those in twisted-* *pair cable.***

***“Consists:***

***Coax has a central core conductor of solid or stranded wire* *enclosed in an insulating sheath,* *encased in an outer conductor of metal foil, braid, or a combination of the two.* The outer metallic wrapping serves both as a shield against noise and as the second conductor, which completes the circuit.** **And the whole cable is protected by a plastic cover.**

**Coaxial cable categories:**

***1\*RG-59 use in*** ***Cable TV.***

***2\**** ***RG-58*** ***use in Thin Ethernet.***

***3\**** ***RG-11 use in Thick Ethernet.***

***“Coaxial Cable Connectors:***

***Three popular types of these connectors:***

***1\*The BNC connector. 2\**** ***The BNC T connector. 3\**** ***The BNC terminator.***

***“Coaxial cable* *Performance:***

Since the attenuation is much higher in coaxial cable than in Double coiled cable.

***“Coaxial Cable Applications:***

***-Used in analog telephone networks.***

***-Used in digital telephone networks.***

***-Used in the traditional cable TV network.***

***“Fiber-Optic Cable”:*** ***is made of glass or plastic and transmits signals in the form of light.”***

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***Show*** ***in*** ***figure*** ***how a ray of light changes direction when going from a more dense to a less dense substance.***

***Optical fibers use reflection to guide light through a channel.***

***“Optical fiber”***



***“Propagation Modes “***

***”Multimode”*** Multimode is so named because multiple beams from a light source move through the core in different paths. How these beams move within the cable depends on the structure of the core.

***There are two types;***

***1- Multimode step-index fiber,*** the density of the core remains constant from the center to the edges. A beam of light moves through this constant density in a straight line until it reaches the interface of the core and the cladding. There is an abrupt change due to a lower density. As shown in figure.  


***2- Multimode graded-index fiber*** decreases this distortion of the signal through the cable. The word index here refers to the index of refraction. The index of refraction is related to density. Density is highest at the center of the core and decreases gradually to its lowest at the edge. As shown in figure. ****** “Single-Mod”

***Single-mode uses step-index fiber and a highly focused source of light that limits beams to a small range of angles,*** ***all close to the horizontal.*** ***The single-mode fiber itself is manufactured with a much smaller diameter than that of multimode fiber,*** ***and with substantially lower density.*** ***The decrease in density results in a critical angle that is close enough to 90° to make the propagation of beams almost horizontal.as shown in figure.***

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***“Fiber construction”***

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Made of either PVC or Teflon. Inside the jacket are Kevlar strands to strengthen the cable.

***“Fiber-Optic Cable Connectors”***

*There are three types of connectors for fiber-optic cables.*

***\*The subscriber channel (SC) connector.***

*\*****The straight-tip (ST) connector.***

***\*MT-RJ connector.***

*“Optical fiber performance”*

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*“Advantages and Disadvantages of Optical Fiber”*

***“Advantages”***

***\*Higher bandwidth.***

***\*Less signal attenuation.***

***\*Immunity to electromagnetic interference.***

***\*Resistance to corrosive materials.***

***\*Light weight.***

***\*Greater immunity to tapping.***

***“Disadvantages”***

***\*Installation and maintenance.***

***\*Unidirectional light propagation.***

***\*Cost.***

***“UNGUIDED MEDIA: WIRELESS”***

***Unguided medium transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication. Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.***

***Electromagnetic spectrum for wireless communication***

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***Propagation methods”***  *\*ground propagation, radio waves travel through the lowest portion of the atmosphere, hugging the earth. These low-frequency signals emanate in all directions from the transmitting antenna and follow the curvature of the planet. Distance depends on the amount of power in the signal: The greater the power,* *the greater the distance.*

*Sky Propagation, higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth. This type of transmission allows for greater distances with lower output power.*

*Line-of-sight Propagation, very high-frequency signals are transmitted in straight lines directly from antenna to antenna. Antennas must be directional, facing each other and either tall enough or close enough together not to be affected by the curvature of the earth.*

*“Radio Waves”*

*Although there is no clear-cut demarcation between radio waves and microwaves, electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves; waves ranging in frequencies between 1 and 300 GHz are called microwaves. However, the behavior of the waves, rather than the frequencies, is a better criterion for classification.*

*Omnidirectional Antenna”*

*Radio waves use omnidirectional antennas that send out signals in all directions. Based on the wavelength, strength, and the purpose of transmission, we can have several types of antennas.*

*“Applications”  
Radio waves are used for multicast communications, such as radio and television, and paging systems.*

*“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.*

*“Unidirectional Antenna”*

*Microwaves need unidirectional antennas that send out signals in one direction.*

*Two types of antennas are used for microwave communications: the parabolic dish and the horn.as shown in figure.*

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***Applications***

***Microwaves are used for unicast communication such as cellular telephones, satellite networks, and wireless LANs.***

*“Infrared”*

*Infrared waves, with frequencies from 300 GHz to 400 THz (wavelengths from 1 mm to 770 nm), can be used for short-range communication. Infrared waves, having high frequencies, cannot penetrate walls. This advantageous characteristic prevents interference between one system and another; a short-range communication system in one room cannot be affected by another system in the next room. When we use our infrared remote control, we do not interfere with the use of the remote by our neighbors.*

***“Applications”***

***Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.***