**SUMMARY OF CHAPTER FOUR**

**TRANSMISSION MEDIA**

**Transmission medium** is anything that carries information from a source to a destination. An example is two people having a networking conversation in air so the air is the transmission medium. For a written conversation, the transmission medium could be the mail carrier, a truck or a plane. We can say that transmission medium are usually free space, metallic cable, or fiber-optic cable. Transmission medium is located below the physical layer and is directly controlled by the physical layer.

**Guided media** provide conduit from one device to another, include twisted-pair cable, coaxial cable and fiber optic cable. A signal travelling along any of these media is directed and contained by the physical limits of the medium.

**Twisted-pair cable** consists of two conductors (normally copper), each with its own plastic insulation, twisted together. One of the wires is used to carry signal to the receiver, and the other is used only as ground reference. The twisted- pair cable is made up of two types, which are the unshielded twisted-pair (UTP) and the shielded twisted-pair (STP). The STP has metal casing which improve the quality of the quality of the cable more than the UTP cable. The Electronic Association (EIA) has categories twisted-pair cables into seven types. The categories determine the quality, with 1 being the lowest and 7 being the highest.

**Coaxial (coax) cable** has a central core conductor of solid or standard wire (copper) enclosed in an insulating sheath, which in, encased in an outer conductor of metal foil, braid or a combination of the two. The coax carries signals of higher frequencies than those in twisted-pair cables. This type of cable was used in analogue telephone networks. Later it is used in digital telephone networks. It is also used in cable TV network but lately providers are replacing it with fiber optic cables.

**Fiber-Optic Cable**

* This type of cable is made up of glass or plastic and it also transmits signal in a form of light. As we all know light travels in a straight line as long as it travels through a single uniform substance. Light may take a different direction only when it comes into contact with a substance with different density.
* **Propagation modes:** thiscurrent technology supports two modes (maximum and single mode).
* **Multimode:** multiple beams from a light source move through the core in different paths. The beams move depending on the structure of the core. Multimode can be implemented in two forms **step-index and graded-index.** In multimode step-index fiber, the density of the core remains constant from the center of the edges. In multimode graded-index fiber, it decreases the distortion of the signal through the cable. The word “index”refers to index of refraction.
* **Single-mode:** uses step-index fiber and a highly focused source of light that limits beams to a small range of angles, all closed to the horizontal. The single mode fiber is made with much smaller diameter than that of multimode fiber.
* Unguided media also known as wireless broadcast signals via free space and are available to anyone who has a device capable of receiving them. Some of the ways by which unguided media travel are:
* **Ground propagation** in which radio waves travel via the lowest portion of the atmosphere, hugging the earth.
* **Sky propagation:**  High frequency radio waves radiates up into the ionosphere where they are reflected back into the earth.
* **Line-of-sight propagation:** Very high frequency signals are transmitted in a straight line directly from antenna to antenna.

Wireless transmission are group into three which are;

* **Radio waves:**  Radio waves are omnidirectional and with a frequency ranging from 3kHz to 1GHz.
* **Microwave:** Microwave are unidirectional with frequencies between 1GHz to 300GHz.
* **Infrared wave:** These waves have frequencies ranging from 300GHz to 400THz and are therefore used for short range communication.

**Advantages of Optical Fiber**

* Higher bandwidth
* Less signal attenuation
* Immunity to electromagnetic interference
* Resistance to corrosive materials
* Light weight
* Greater immunity to tapping

**Disadvantages of Optical Fiber**

* Installation and maintenance
* Unidirectional light propagation
* Cost

**REVIEW QUESTIONS**

1. What is the position of the transmission media in the OSI or the internet?

**Answer:** The transmission media in the OSI is located beneath the physical layer and controlled by the physical layer.

1. Name the two major categories of transmission media?

**Answer:** The two major categories of transmission media are guided and unguided media.

1. How can guided media differ from unguided media?

**Answer:** Guided media have physical boundaries which include twisted-pair cable, coaxial cable, and fiber-optic cable while unguided media are unbounded which are basically free space.

1. What are the three major classes of guided media?

**Answer:** Twisted-pair, coaxial, and fiber optic cables are the three major classes of guided media.

1. What is the significance of the twisting in twisted-pair cable?

**Answer:** Twisting makes it probable that both wires are equally affected by external influences such as noise.

1. What is refraction? What is reflection?

**Answer:** Refraction is the bending of light as it passes from one medium to another. Reflection is defined as the bouncing back of light into the same medium, when it strikes a surface.

1. What is the purpose of cladding in an optical fiber?

**Answer:** Cladding is to provide a lower refractive index at the core interface in order to cause reflection within the core so that light waves are transmitted through the fiber.

1. Name the advantages of optical fiber over twisted-pair and coaxial cable.

**Answer:**

* Higher bandwidth
* Less signal attenuation
* Immunity to electromagnetic interference
* Resistance to corrosive materials
* Light weight
* Greater immunity to tapping

1. How does sky propagation differ from line-or-sight propagation?

**Answer:** Sky propagation possesses higher-frequency radio waves that radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth. Meanwhile, line-or-sight possesses very high-frequency signals that are transmitted in straight lines directly from antenna to antenna.

1. What is the difference between omnidirectional waves and unidirectional waves?

**Answer:** Omnidirectional waves are waves that are propagated in all directions while unidirectional waves are waves that send signals in only one direction.

1. Calculate the bandwidth of the light for the following wavelength ranges (assume a propagation speed of 2 \*108):
2. 1000 to 1200 nm

**Answer:** [(2\*108)/1000\*10-9] -

[(2\*108)/1200\*10-9] =33THz

1. 1000 to 1400 nm

**Answer:** [(2\*108)/1000\*10-9] -

[(2\*108)/1400\*10-9] =57THz

1. A light signal is traveling through a fiber. What is the delay **in** the signal if the length of the fiber-optic cable is 10 m, 100m, and 1 km (assume a propagation speed of 2\* 108 ill)?

**Answer:** Delay in the signal = (length of the capable)/(propagation speed)

Length of fiber-optic cable= 10m

Delay in the signal = 10m/(2\*108m/s)

Delay in the signal = 5\*10-8s

Length of fiber-optic cable = 100m

Delay in the signal = 100m/(2\*108m/s)

Delay in the signal = 5\*10-7s

Length of fiber-optic cable =1km: 1km = 1000m

Delay in the signal = 1000m/(2\*108m/s)

Delay in the signal = 5\*10-6s

1. A beam of light moves from one medium to another medium with less density. The critical angle is 60o. Do we have refraction or reflection for each of the following incident angles?
2. 40o
3. 60o
4. 80o

**Answer:**

1. With the incident angle being 40o and the critical angle as 60o, the ray refracts and moves closer to the surface.

**Reflected ray**

**I**

I< critical angle. Refraction

1. With the incident angle being 60o and the critical angle as 60o, the ray refracts and moves closer to the surface.

**I**

I = critical angle. Refraction

1. With the incident angle being 800 and the critical angle at 600, the ray reflects and travels again in the denser substance.