What is Communication

- **Communication** is the activity or process of exchanging information in mutual understanding form.
- A computer system can be vast resource of information. Once this system is connected to a network, this information can be shared among all other users.
- A communication media is required to connect different computer systems to facilitate the information exchange. Following diagram will give a clear picture of different type of transmission media

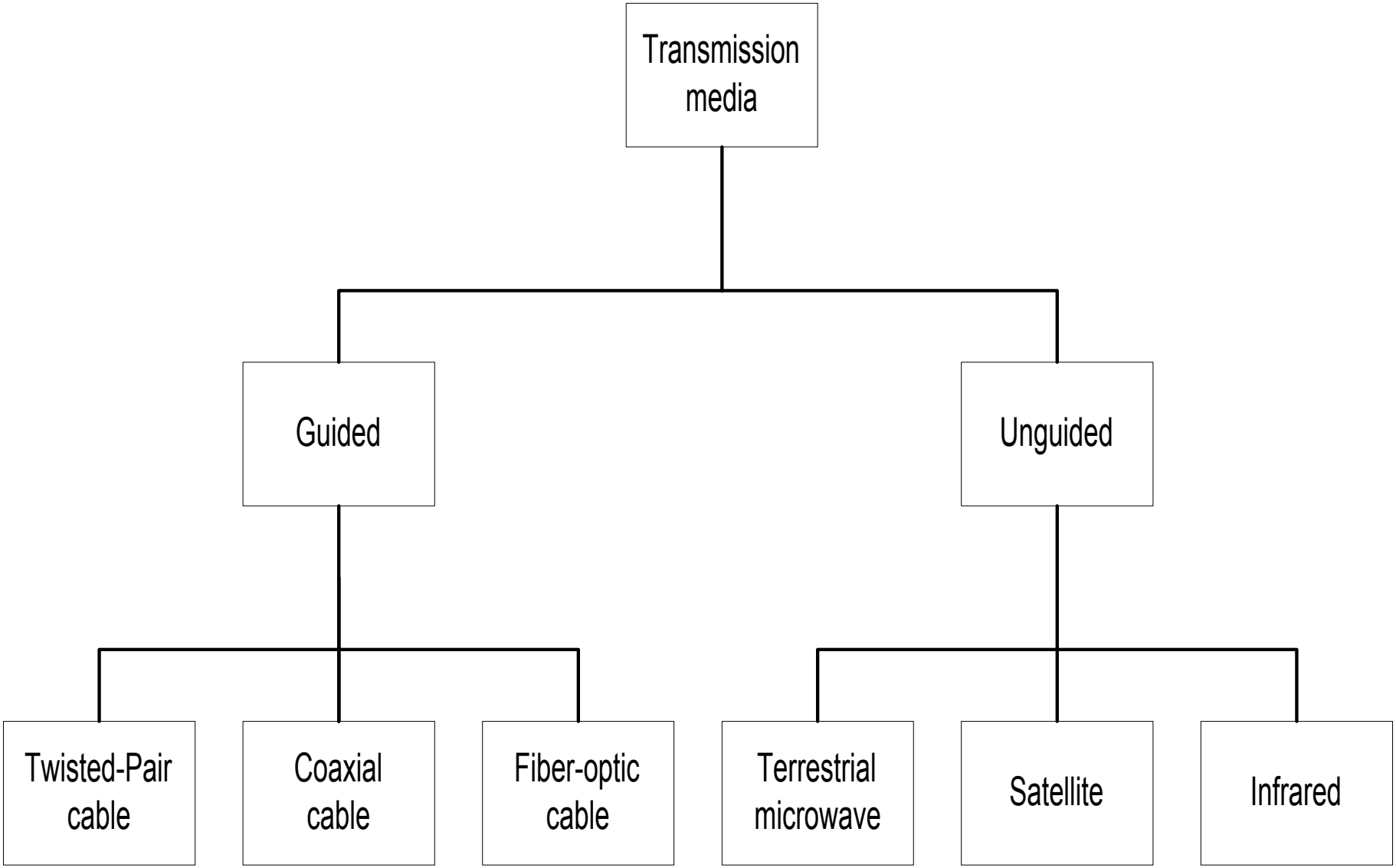


Figure 2.1 Types of transmission media

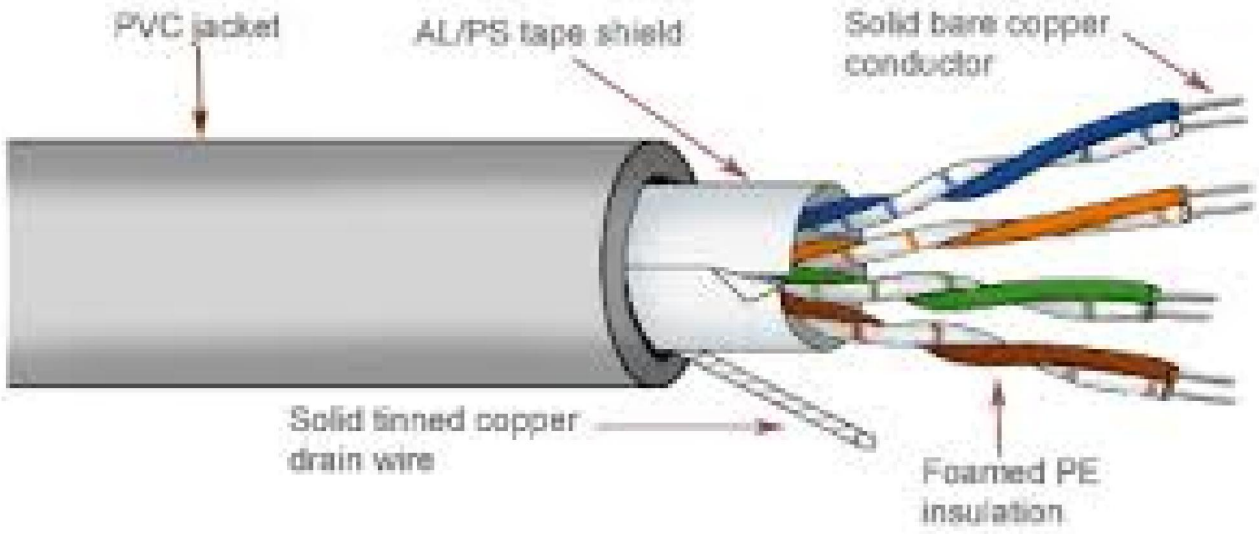
A. Guided Transmission Media

- Guided/physical/non-wireless/bounded media have a physical link between sender and receiver.
- Mainly there are three categories of guided media:
  1. Twisted-Pair,
  2. Coaxial, and
  3. Fiber-optic.

1. Twisted-Pair Cable

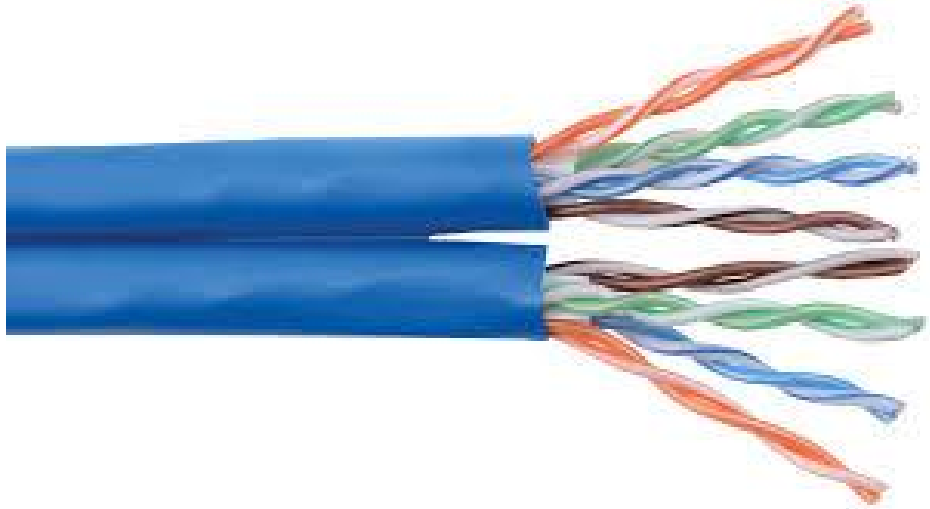
- A twisted consist of two conductors (usually copper), each with its own colored plastic insulation. In the past, two parallel wires were used for communication. However, electromagnetic interference from devices such as a motor can create over noise to those wires. If the two wires are parallel, the wire closest to the source of the noise gets more interference than the wire further away. Which results in an uneven load and a damaged signal.
- If, how ever, the two wires are twisted around each other at a regular intervals (between 2 to 12 twist per foot), each wire is the closer to the noise source for half the time and the further away the other half. With the twisting interference can be equalized for both wires. Twisting does not always eliminate the impact of noise, but does significantly reduce it
- Twisted cable comes in two forms: **unshielded and shielded**.

Twisted pair cable



a. Unshielded Twisted (UTP) cable

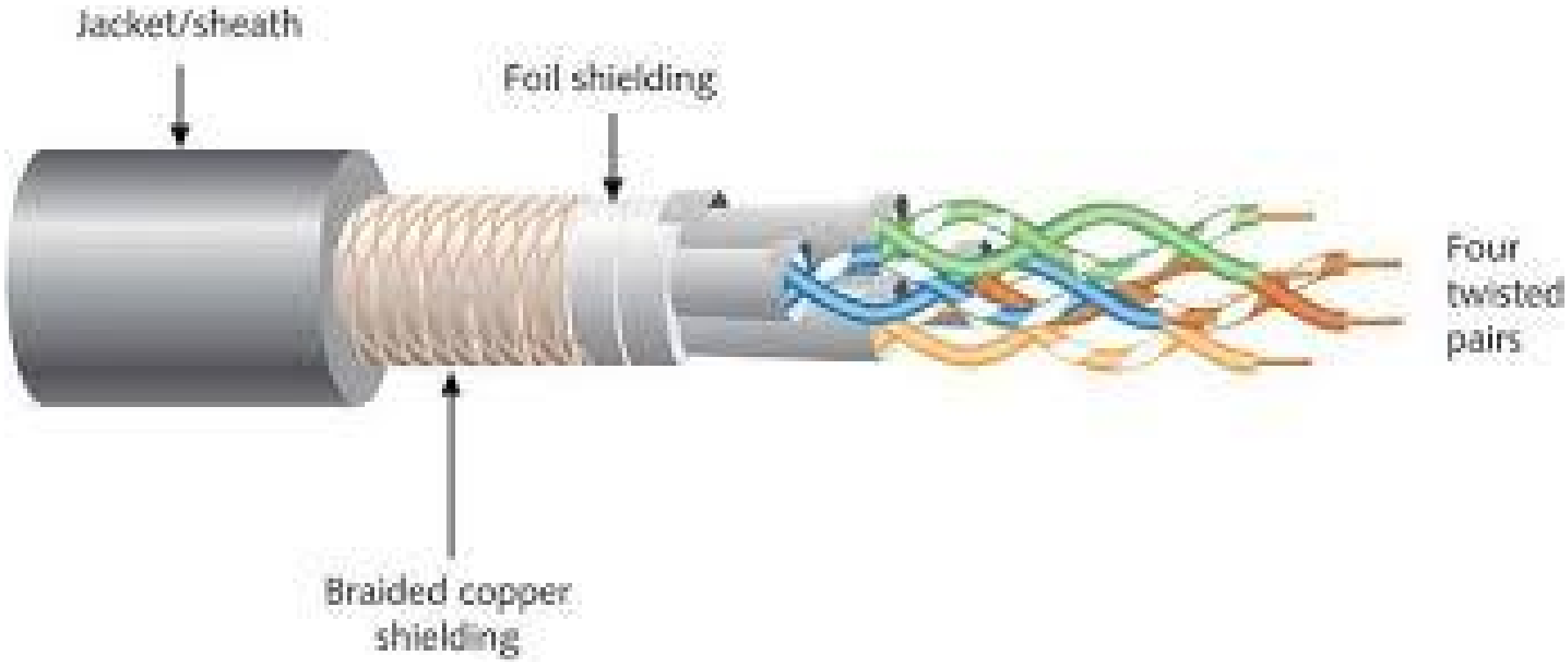
- UTP consists of a number of twisted pairs with simple plastic casing. UTP is commonly used in telephone system.
- The Electrical Industry Association (EIA) divides UTP into different categories by quality grade. The rating for each category refers to conductor size, electrical characteristics, and twists per foot.



a. Unshielded Twisted (UTP) cable

- **Category 1**: Applies to transmit traditional UTP telephones cabling, which is designed to carry voice but not data.
- **Category 2**: Certifies UTP cabling for bandwidth up to 4 Mbps and consists of four pair of wires. Since 4 Mbps is slower than most networking technologies in the use today. Category 2 is rarely encountered in networking environment.
- **Category 3**: Certifies UTP cabling for bandwidth up to 10Mbps. This includes most conventional networking technologies, such as 10BaseT Ethernet and 4Mbps token ring etc. Category 3 consists of four pairs, each having minimum 3 twist per foot.
- **Category 4**: Certifies UTP cabling for bandwidth up to 10Mbps. This includes primarily 10BaseT Ethernet and 16Mbps token ring. Category 4 consists of four pairs.
- **Category 5**: Used for data transmission up to 100Mbps Category 5 also consists of four pairs.
- UTP is particularly prone to cross talk, and the shielding included with STP is designed specifically to reduce this problem.
- **Cat** 5e
- **Category 6: Category 6 cable**, commonly referred to as**Cat 6**, is a standardized **cable** for Gigabit Ethernet and other network physical layers that is backward compatible with the **Category** 5/5e and **Category** 3 **cable** standards. Compared with **Cat** 5 and **Cat** 5e, **Cat 6** features more stringent specifications for crosstalk and system noise

b. Shielded twisted pair cable



b. Shielded Twisted (STP)

- STP includes shielding to reduce cross talk as well as to limit the effects of external interference. For most STP cables, this means that the wiring includes a wire braid inside the cladding or sheath material as well as a foil wrap around each individual wire. This shield improves the cable's transmission and interference characteristics, which, in tern, support higher bandwidth over longer distance than UTP.

2. Coaxial cable

- **Coaxial Cable**: Coaxial cable, commonly called coax, has two conductors that share the same axis. A **solid copper wire** runs down the center of the cable, and this wire is surrounded by plastic foam insulation. The foam is surrounded by a second conductor, **wire mesh tube**, **metallic foil**, or both. The wire mesh protects the wire from EMI. It is often called the shield. A **tough plastic jacket** forms the cover of the cable, providing protection and insulation.

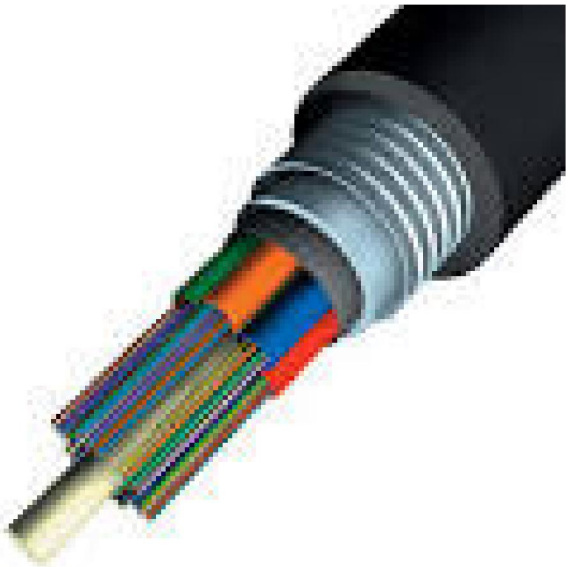
2. Coaxial cable cont...d

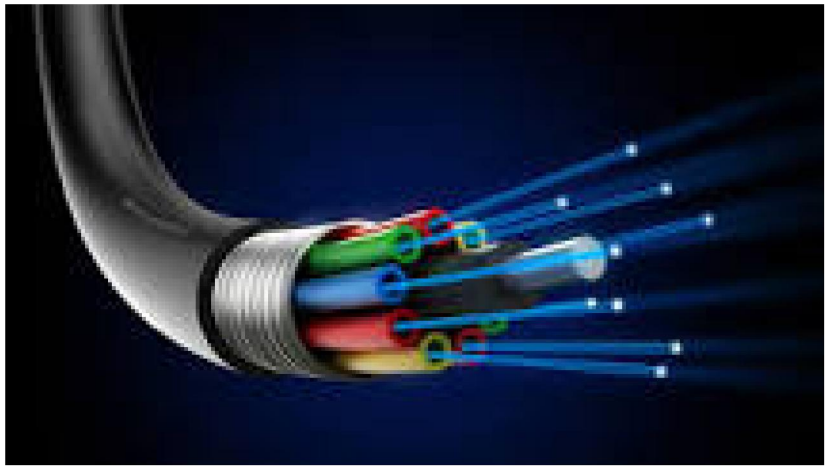
- Where Ethernet is concerned, there are two types of coaxial cable, called this **Ethernet** (also known as *thinnet or thinwire*,) and **thick Ethernet** (also known as *thicknet or thickwire*). The Institute of Electrical and Electronics Engineers (IEEE) designates these cable types as *10Base2* and *10Base5*, respectively, where these notations indicates:
- Total bandwidth for the technology: in this case, 10 means 10Mbps
- *Base*: indicates that the network uses baseband signaling and this applies to both types of cable.
- *2 or 5*: a rough indicator of maximum segment length, measured in hundreds of meters; thinwire support a maximum segment length of *185 meters*, which rounds up to 200; thickwire supports a maximum segment length of *500 meter*.

3. Fiber Optic Cable

- Fiber optic cable transmits ***light signals*** rather than ***electrical signals***. It is enormously more efficient than the other network transmission media. As soon as it comes down in price (both in terms of the cable and installation cost), fiber optic will be the choice for network cabling.
- An optical transmission system has three components: the **transmission medium**, the **light source** and the **detector**. The transmission medium is an *ultra-thin fiber of glass or fused silica*. The light source is either a *LED (Light Emit Diode) or a laser diode*, both of which emits light pulses when a electrical current is applied. The detector is a *photo diode*, which generates an electrical pulse when light falls on it.

Fiber optic cable





Fiber optic cont...d

- A cable may contain a single fiber, but often fibers are bundled together in the center of the cable. Optical fiber are smaller and lighter than copper wire. One optical fiber is approximately the same diameter as a human hair.

Advantages of Fiber Optic

- **Noise resistance:** it is immune to EMI
- **Less signal attenuation:** signal can run for miles without requiring regeneration
- **Higher bandwidth:** fiber optic cable can support dramatically higher bandwidths (and hence data rate) than all other cables. Currently, data rates and bandwidth utilization over fiber-optic cable are limited not by the medium but by the signal generation and reception technology available. A typical bandwidth for fiber optic is 100Mbps to 1Gbps.

Disadvantages of Fiber Optic

- **Cost :** most expensive among all the cables
- **Installation / maintenance:** is high
- **Fragility :** glass fiber is more easily broken than wire

Summary Table of the Characteristic of All Cable Type

Factor	UTP	STP	Coaxial	Fiber Optic
Cost	Lowest	Moderate	Moderate	Highest
Installation	Easy	Fairly easy	Fairly easy	Difficult
Bandwidth Capacity	10 Mbps	16 Mbps	10 Mbps	100 Mbps – 1 Gbps
Node Capacity Per Segment	2	2	30 (10Base2) 100 (10Base5)	2
Attenuation	High	High	Lower	Lowest
EMI	Most vulnerable to EMI	Less vulnerable than UTP	Less vulnerable than UTP	No effect by EMI

B. Unguided Transmission Media

- Unguided/non-physical/wireless/unbounded media have no physical link between sender and receiver.

1. Terrestrial Microwave

- Microwaves do not follow the curvature of the earth therefore *require line of sight transmission* and reception equipment.
- The distance coverable by line of sight signals depends to a large extend on the height of the antenna: the taller the antenna, the longer the sight distance.
- Height allows the signals to travel farther without being stopped by the curvature of the earth and raises the signals above many surface obstacles, such as low hills and tall buildings that would otherwise block transmission.

1. Terrestrial Microwave cont...d

- Microwave signals *propagate in one direction at a time*, which means that two frequencies are necessary for two ways communication such as telephone communication. One frequency is reserved for transmission in one direction and other for transmission in other. Each frequency requires its own *transmitter and receiver*. Today, both pieces of equipment usually are combined in a single piece of equipment called *transceiver*, which allows a single antenna to serve both frequencies and functions.

Microwave Transmission

- Terrestrial microwave systems are typically used when using cabling is very costly and difficult to set.

2. Satellite Communication

- **Satellite transmission** is much *like line of sight microwave transmission in which one of the stations is a satellite orbiting the earth*.
- The principle is the same as terrestrial microwave, with a satellite acting as a *super-tall antenna and repeater*.
- Although in satellite transmission, signals must still travel in straight lines, the *limitations imposed on distance by the curvature of the earth are reduced*. In this way, satellite relays allow microwave signals to span continents and ocean with a single bounce.
- Satellite microwave can provide transmission capability to and from any location on earth, no mater how remote

- This advantage makes high quality communication available to undeveloped parts of the world without requiring a huge investment in ground based infrastructure.
- Satellite themselves are extremely expensive, of course, but leasing time or frequencies on one can be relatively cheap.

3. Infrared Transmission

- Infrared media *uses infrared light to transmit signals*.
- **LEDs** transmit the signals, and **photodiodes** receive the signals.
- The remote control we use for television, VCR and CD player use infrared technology to send and receive signals.
- Because infrared signals are in high frequency range, they have good throughput. Infrared signals do have a downside; the signals cannot penetrate walls or other objects, and they are diluted by strong light sources.

Summary Table of the Characteristic of Wireless Communication Media

Factor	Terrestrial Microwave	Satellite Microwave	Infrared Transmission
Cost	Moderate to high	High	Moderate to high
Installation	About 1 to 10Mbps	About 1 to 10Mbps	100Kps to 16Mbps
Bandwidth capacity	About 1 to 10Mbps	About 1 to 10Mbps	100Kbps to 16Mbps
Node capacity per segment	2 (sender and receiver)	2 (sender and receiver)	2 (sender and receiver)
Attenuation	Depends on condition (affected by atmospheric conditions)	Depends on condition (affected by atmospheric conditions)	Depends on condition (affected by atmospheric conditions)
Security	Depends on condition (affected by atmospheric conditions)	Depends on condition (affected by atmospheric conditions)	Depends on condition (affected by atmospheric conditions)

Transmission Impairments

- The most significant impairments are the following:

Attenuation

- When an electromagnetic signal is transmitted along any medium, it gradually become weaker at greater distances, this is referred to as attenuation. To solve this problem ***amplifier*** is used. The amplifier boosts the signals and extends the transmission distance.

Noise

- Random electrical signals that can be picked up by the transmission medium and result in degradation of the data.