Ministry of Higher Education and Scientific Research

Al-Mustaqbal University College Department of Computer Engineering Techniques

3rd Stage

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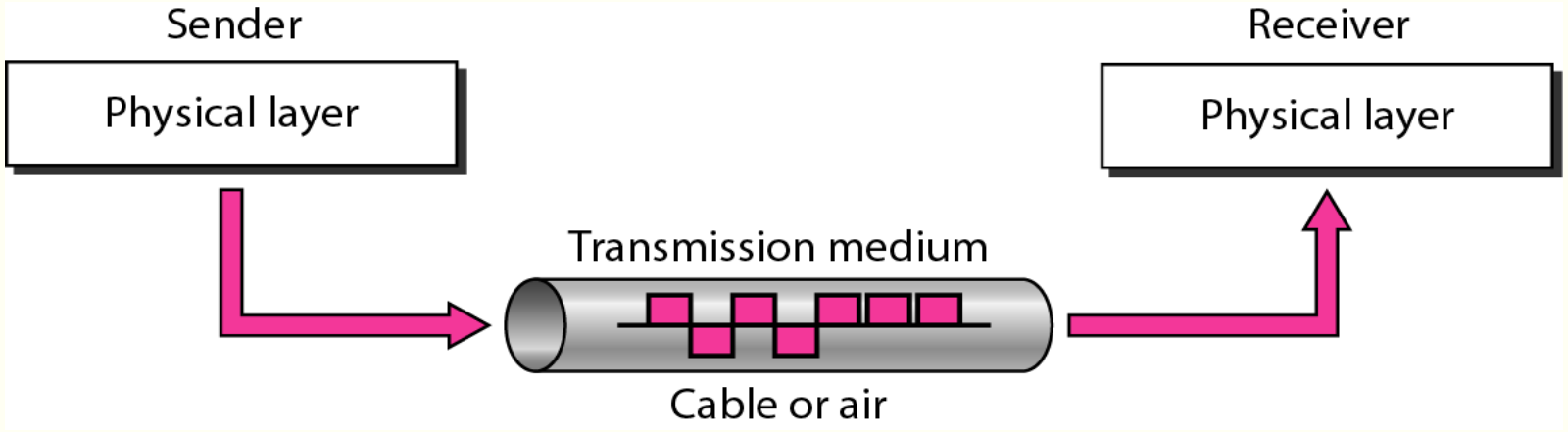
2021-2022

Transmission Media

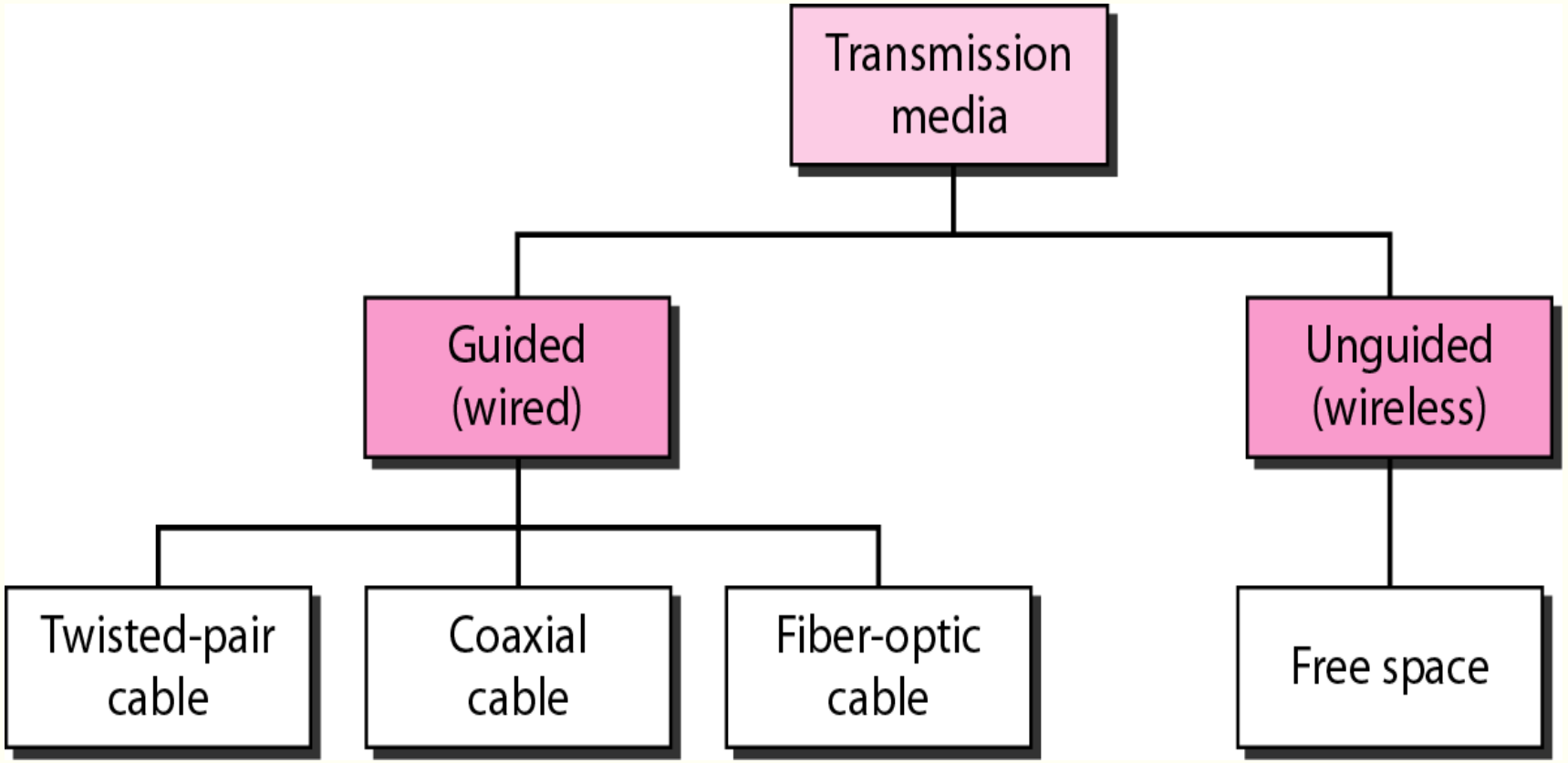
- Transmission media are actually located below the physical layer and are directly controlled by the physical layer.
- We could say that transmission media belong to layer zero.
- The transmission medium is usually **free space**, **metallic cable**, or **fiber-optic** cable.
- The information is usually a signal that is the result of a conversion of data from another form.



Transmission Media

Transmission media can be divided into two broad categories:

GUIDED and UNGUIDED.



Transmission Media

GUIDED MEDIA

provide a channel from one device to another, include:

- **Twisted-pair** cable.
- **Coaxial** cable.
- **Fiber-optic** cable.

Twisted-pair and coaxial cable use metallic (copper) conductors that accept and transport signals in the form of electric current.

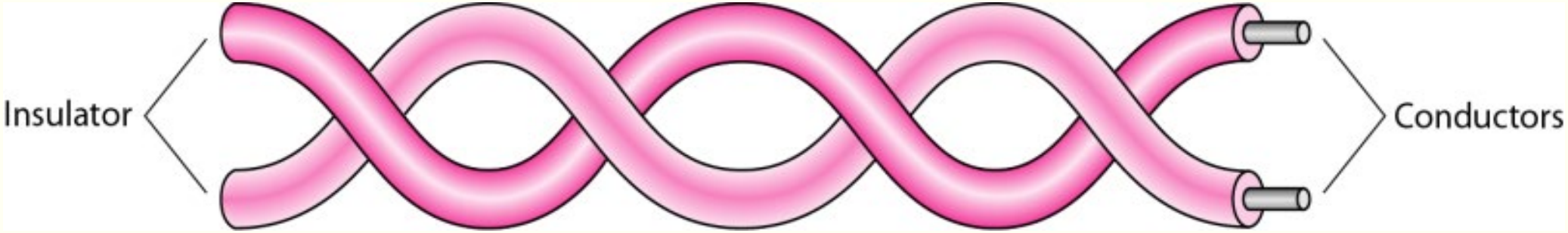
Optical fiber is a cable that accepts and transports signals in the form of light.

Transmission Media

➢ **Twisted-pair cable**.

A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together, as shown in Figure below.

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



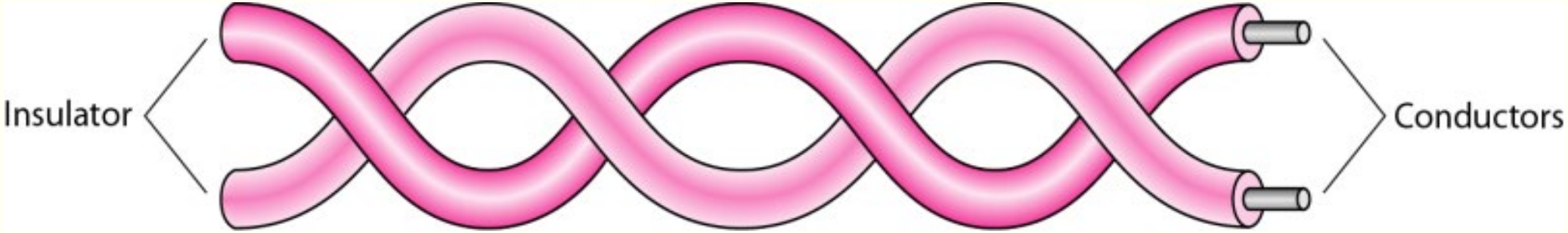
Transmission Media

➢ **Twisted-pair cable.**

the signal sent by the sender on one of the wires, **interference** (noise) and **crosstalk** may affect both wires and create unwanted signals.

Twisting makes it probable that both wires are equally affected by external influences.

This means that the receiver, receive no unwanted signals.



Transmission Media

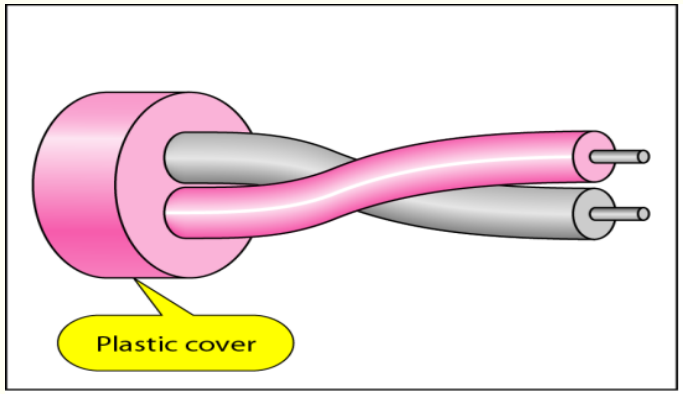
Unshielded Versus Shielded Twisted-Pair Cable

The most common twisted-pair cable used in communications is referred to as unshielded twisted-pair (UTP).

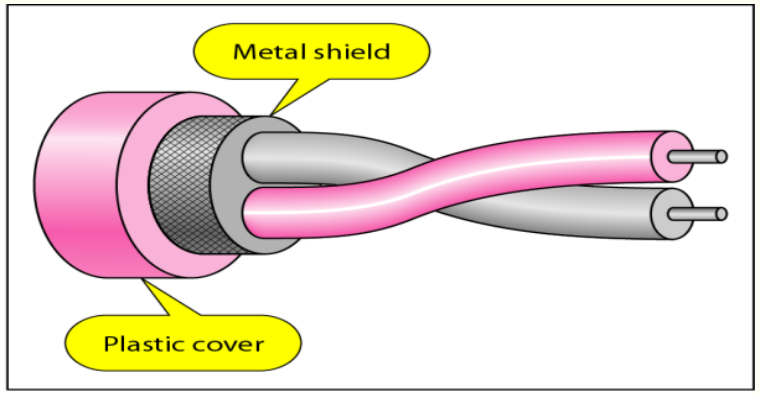
IBM has also produced a shielded twisted-pair (STP).

STP cable has a metal foil or braided mesh covering that encases each pair of insulated conductors.

Metal casing improves the quality of cable by **preventing the noise or crosstalk.**



a. UTP



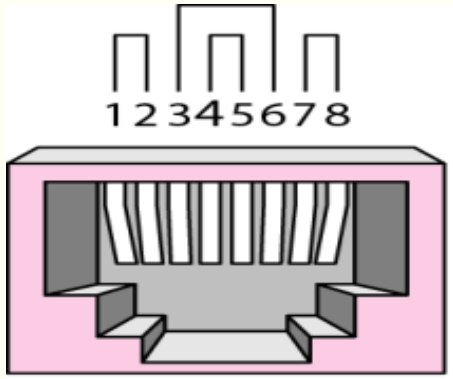
b. STP

Transmission Media

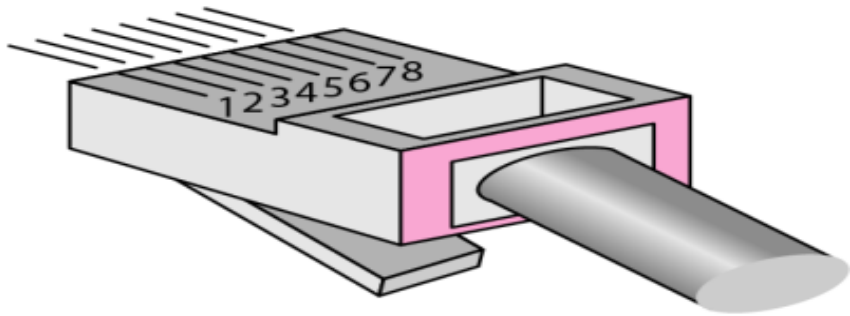
Unshielded Versus Shielded Twisted-Pair Cable

The most common UTP connector is RJ45 (RJ stands for registered jack), as shown below.

The RJ45 is a keyed connector, meaning the connector can be inserted in only one way.



RJ-45 Female



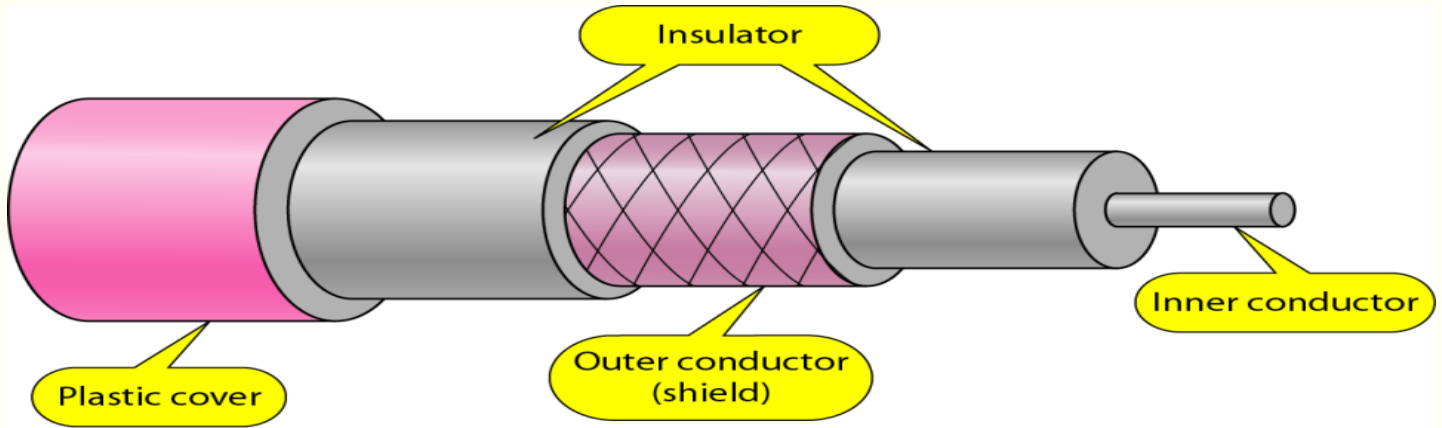
RJ-45 Male

Transmission Media

➢**Coaxial Cable**.

Coaxial cable (or coax) carries signals of higher frequency ranges than those in twisted pair cable.

coax has a central **core conductor** of solid or stranded wire (usually copper) enclosed in an **insulating sheath**, which is, in turn, 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. This outer conductor is also enclosed in an insulating sheath, and the whole cable is protected by a plastic cover.



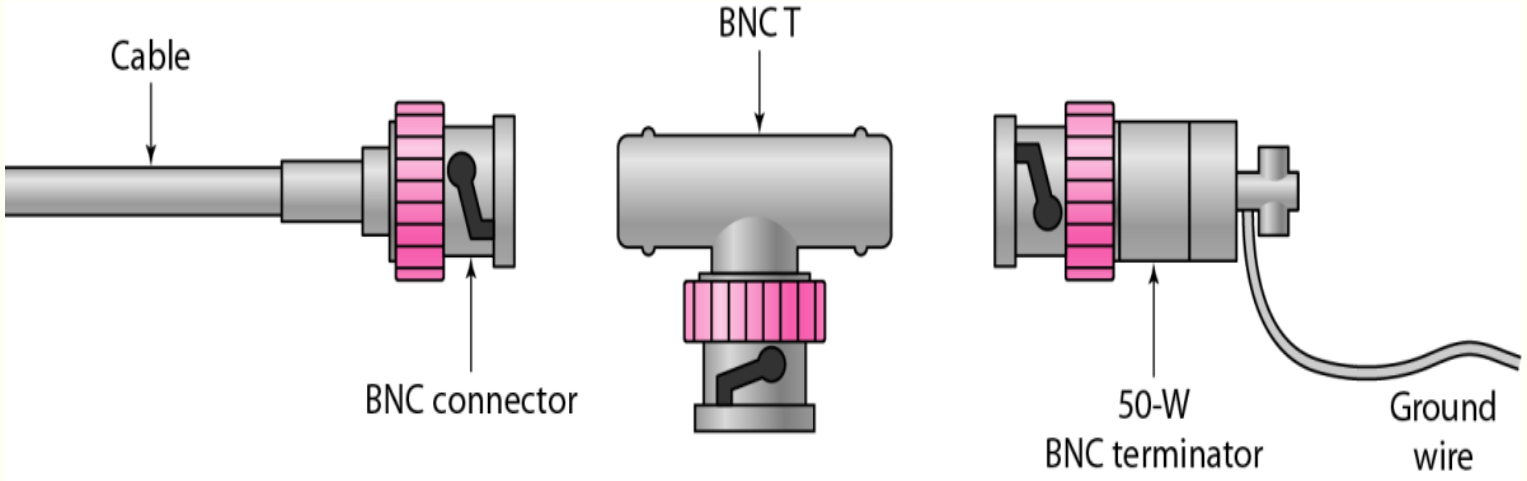
Transmission Media

➢Coaxial Cable.

To connect coaxial cable to devices, we need coaxial connectors.

The most common type of connector used today is the Bayone-Neill-Concelman (BNC), connector.

The three popular types of these connectors:



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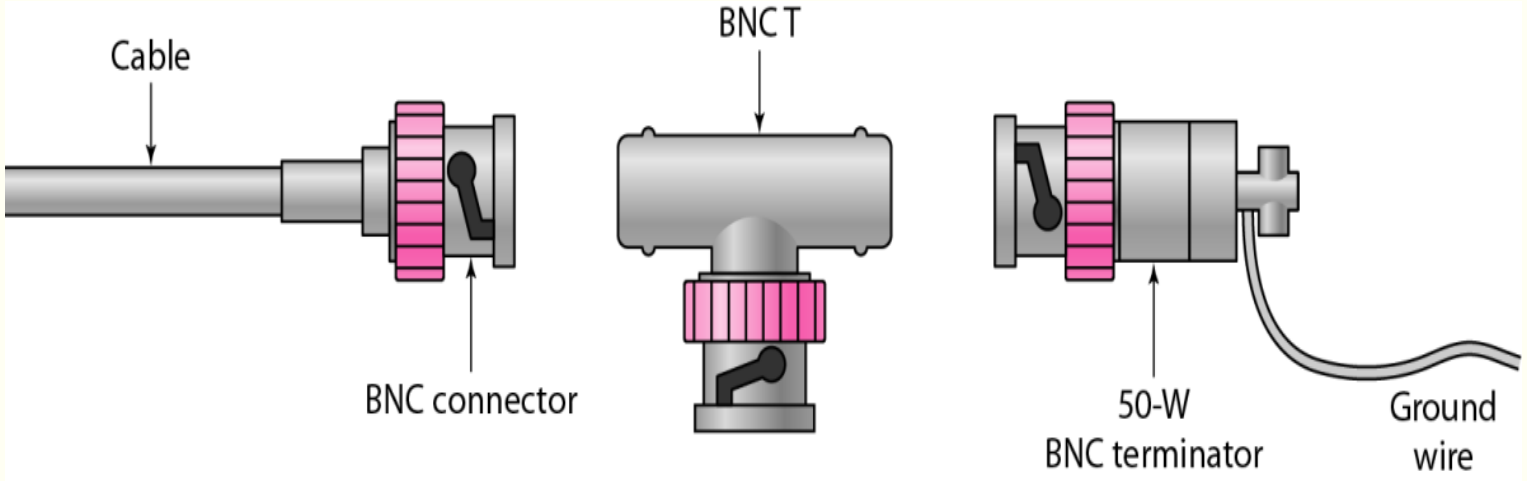


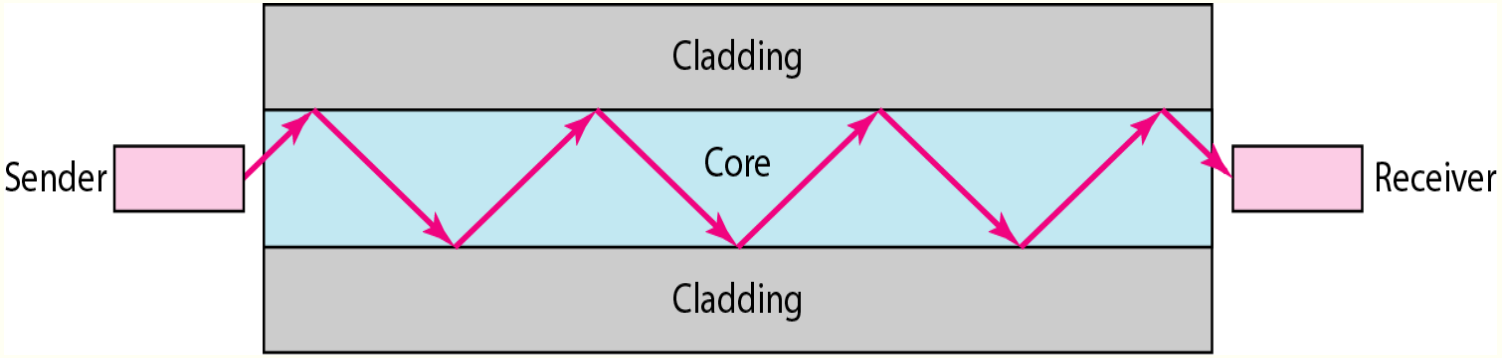
Transmission Media

➢ **Fiber-Optic Cable**.

A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.

Optical fibers use reflection to guide light through a channel.

A glass or plastic core is surrounded by a cladding of less dense glass or plastic.



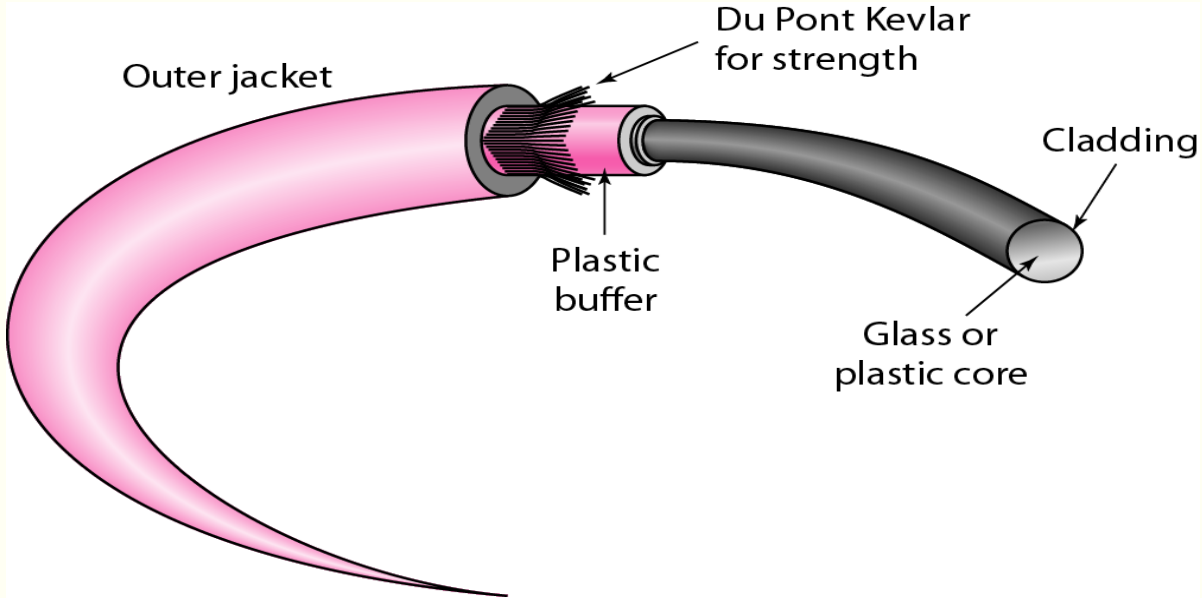
Transmission Media

➢ **Fiber-Optic Cable**.

Current technology supports two modes:

multimode and single mode

for propagating light along optical channels, each requiring fiber with different physical characteristics.



Transmission Media

➢ **Fiber-Optic Cable**.

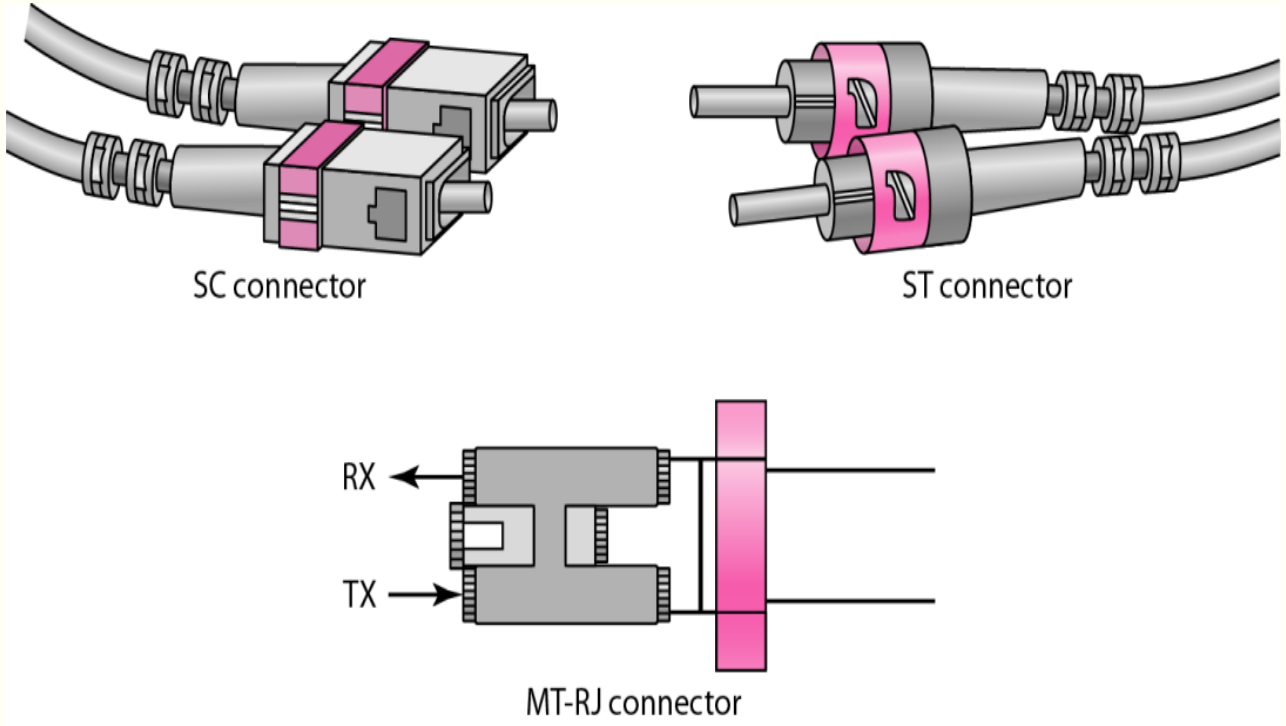
Different between single mode and multiple mode fiber optic.

Single Mode	Multiple Mode
1. Small Core	1. Large Core.
2. Less dispersion	2. Greater dispersion and therefore, loss of signal.
3. Suitable for long distance	3. Large distant but shorter than single mode.
4. Use lasers as light source	4. Use LED as source of light.

Transmission Media

➢ **Fiber-Optic Cable**.

There are three types of connectors for fiber-optic cables, as shown in Figure below.



Transmission Media / Advantages and Disadvantages of Optical Fiber

Advantages of Fiber-optic cable:

Higher bandwidth: higher bandwidths than either twisted-pair or coaxial cable.

- **Less signal attenuation:** Fiber-optic transmission distance is significantly greater than that of other guided media. A signal can run for 50 km without requiring regeneration.
- **Immunity to electromagnetic interference:** Electromagnetic noise cannot affect fiber-optic cables.
- **Resistance to corrosive materials:** more resistant to corrosive materials than copper.

Light weight: Fiber-optic cables are much lighter than copper cables.

- **Greater immunity to tapping:** Fiber-optic cables are more immune to tapping than copper cables. Copper cables create antenna effects that can easily be tapped.

Transmission Media / Advantages and Disadvantages of Optical Fiber

Disadvantages of Fiber-optic cable:

Installation and maintenance: Fiber-optic cable is a relatively new technology. Its installation and maintenance require **expertise** that is not yet available everywhere.

Unidirectional light propagation: Propagation of light is unidirectional. If we need bidirectional communication, two fibers are needed.

Cost: The cable and the interfaces are relatively more expensive than those of other guided media. If the demand for bandwidth is not high, often the use of optical fiber cannot be justified.

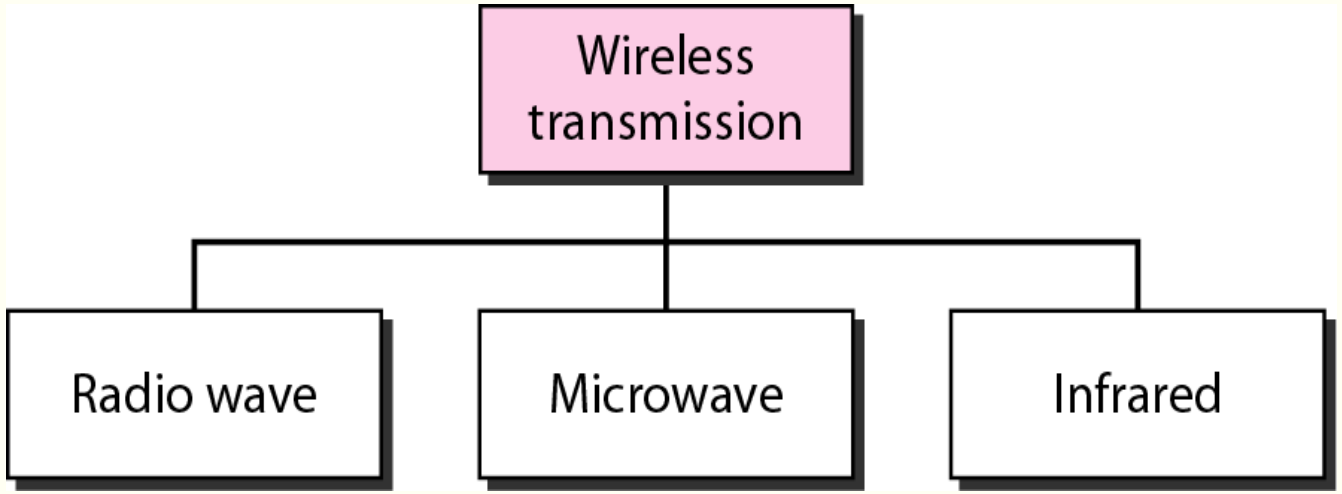
Transmission Media

UNGUIDED MEDIA (Wireless Communication):

Unguided media transport electromagnetic waves without using a physical conductor.

Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

There are three groups of Wireless Communication:



Transmission Media

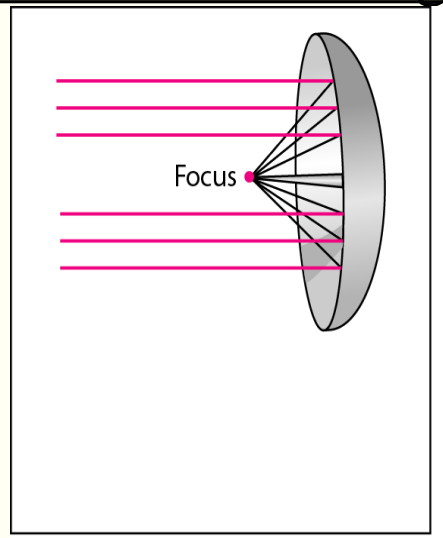
Radio Waves:

- Electromagnetic waves ranging in frequencies between **3 kHz and 1 GHz** are normally called radio waves.
- Radio waves, for the most part, are **Omni-directional**. When an antenna transmits radio waves, they are propagated in all directions.
- This means that the sending and receiving antennas do not have to be aligned.
- A sending antenna sends waves that can be received by any receiving antenna.
- Disadvantage is the radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.
- *Radio waves are used for multicast communications, such as radio and television, and paging systems.*

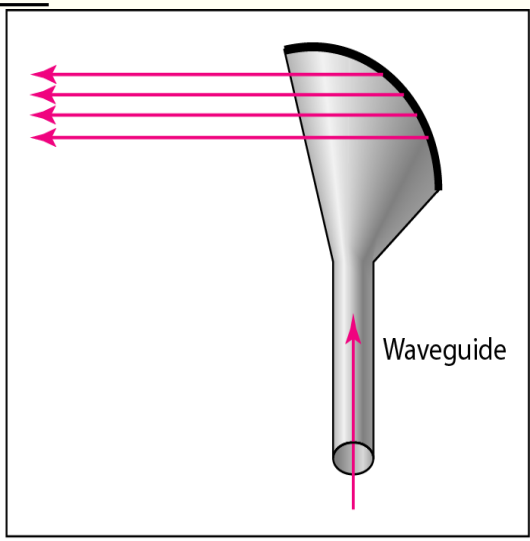
Transmission Media

Microwaves:

- Electromagnetic waves having frequencies between **1 GHz and 300 GHz** are called microwaves.
- Microwaves are unidirectional.
- When an antenna transmits microwave waves, they can be narrowly focused. This means that the sending and receiving antennas need to be aligned.
- Advantage is a pair of antennas can be aligned without interfering with another pair of aligned antennas.
- *Microwaves are used for unicast communication such as cellular telephones, satellite networks, and wireless LANs*



a. Dish antenna



b. Horn antenna

Transmission Media

Infrared:

- Infrared waves, with frequencies from **300 GHz to 400 THz**, can be used for short-range communication.
- Infrared waves, having high frequencies, cannot penetrate walls.
- The **advantage** of characteristic to 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.
- However, this same characteristic makes infrared signals useless for long-range communication.
- *Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.*