Tikrit University

COLLAGE OF COMPUTER SCIENCE AND MATHEMATICS

Computer Networking

Transmission Media Types

4th stage

Lecturer 3

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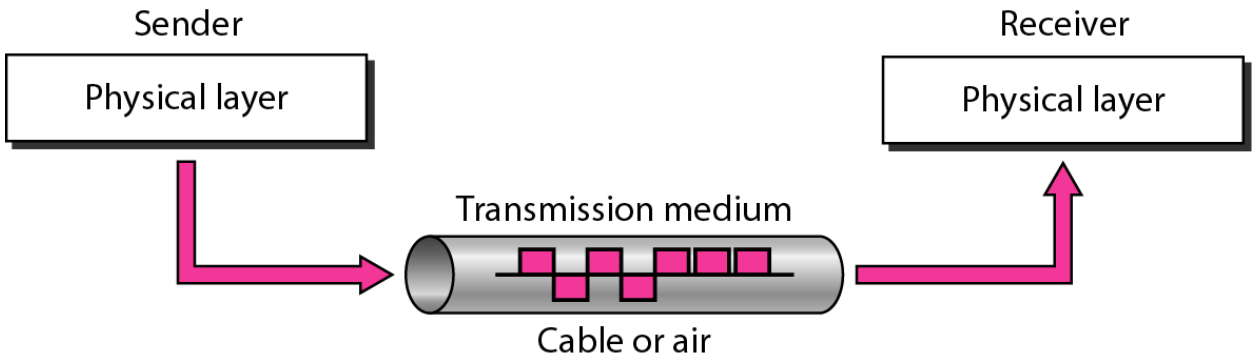
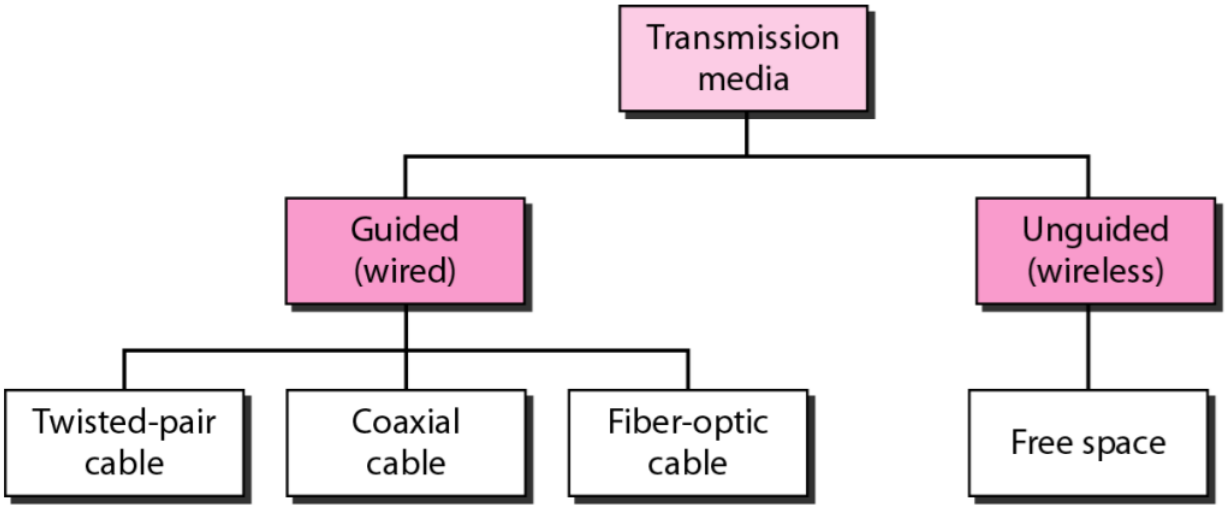
1- Transmission Media



In this subsection we provide a brief overview of these and other transmission media that are commonly used in the Internet.

The physical medium can take many shapes and forms and does not have to be of the same type for each transmitter-receiver pair along the path. Examples of physical media include twisted-pair copper wire, coaxial cable, multimode fiber-optic cable, terrestrial radio spectrum, and satellite radio spectrum. Physical media fall into two categories: guided media and unguided media. With guided media, the waves are guided along a solid medium, such as a fiber-optic cable, a twisted-pair copper wire, or a coaxial cable. With unguided media, the waves propagate in the atmosphere and in outer space, such as in a wireless LAN or a digital satellite channel.

The media over which the information between two computer systems is sent called transmission media. Transmission media comes in two forms.



A. GUIDED MEDIA

All communication wires/cables are guided media, such as Twisted Pair Cable, coaxial cables, and fiber Optics. In this media, the sender and receiver are directly connected and the information is sent (guided) through it.

1. Twisted-Pair Copper Wire

The least expensive and most commonly used guided transmission medium is twisted-pair copper wire. For over a hundred years it has been used by telephone networks. In fact, more than 99 percent of the wired connections from the telephone handset to the local telephone switch use twisted-pair copper wire. Most of us have seen twisted pair in our homes and work environments.

Twisted pair consists of two insulated copper wires, each about 1 mm thick, arranged in a regular spiral pattern. The wires are twisted together to reduce the electrical interference from similar pairs close by. Typically, a number of pairs are bundled together in a cable by wrapping the pairs in a protective shield. A wire pair constitutes a single communication link.

Unshielded twisted pair (UTP) is commonly used for computer networks within a building, that is, for LANs. Data rates for LANs using twisted pair today range from 10 Mbps to 10 Gbps. The data rates that can be achieved depend on the thickness of the wire and the distance between transmitter and receiver.

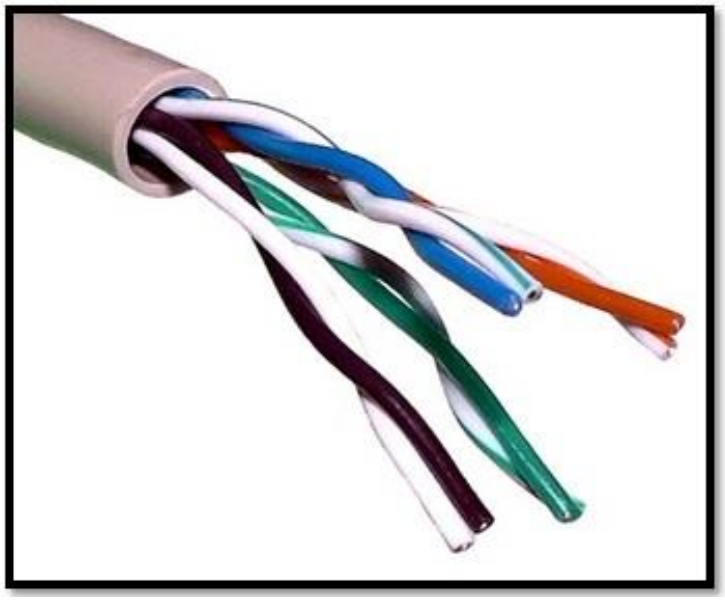
Twisted pair cabling is a type of wiring. There are two types Shielded Twisted Pair (STP) and unshielded Twisted pair (UTP).

The UDP is used in Cat.6 cables.

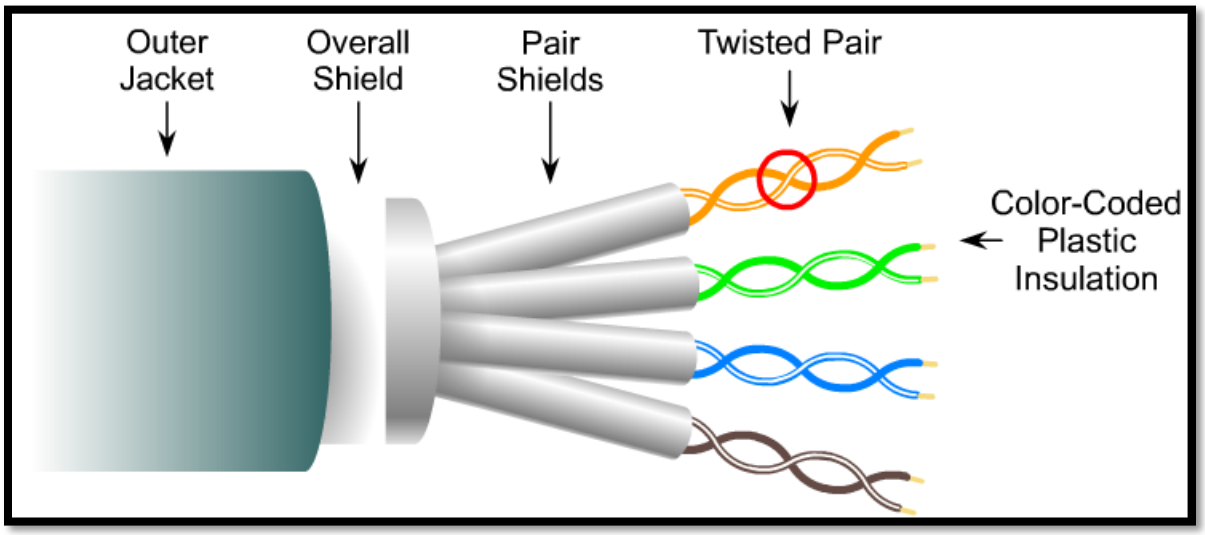
Cat 6 cable: Category 6 cable, commonly referred to as Cat 6, is a standardized cable for Ethernet, Fast Ethernet and Gigabit Ethernet.

Cat 6 cables consist of four unshielded twisted pairs (UTP) of copper wire terminated by RJ45 connectors.

Where RJ45 refer to Registered Jack 45, an eight-wire connector used commonly to connect computers to local area networks (LAN), especially Ethernets.



Cat 6 cable- Unshielded Twisted Pair UTP



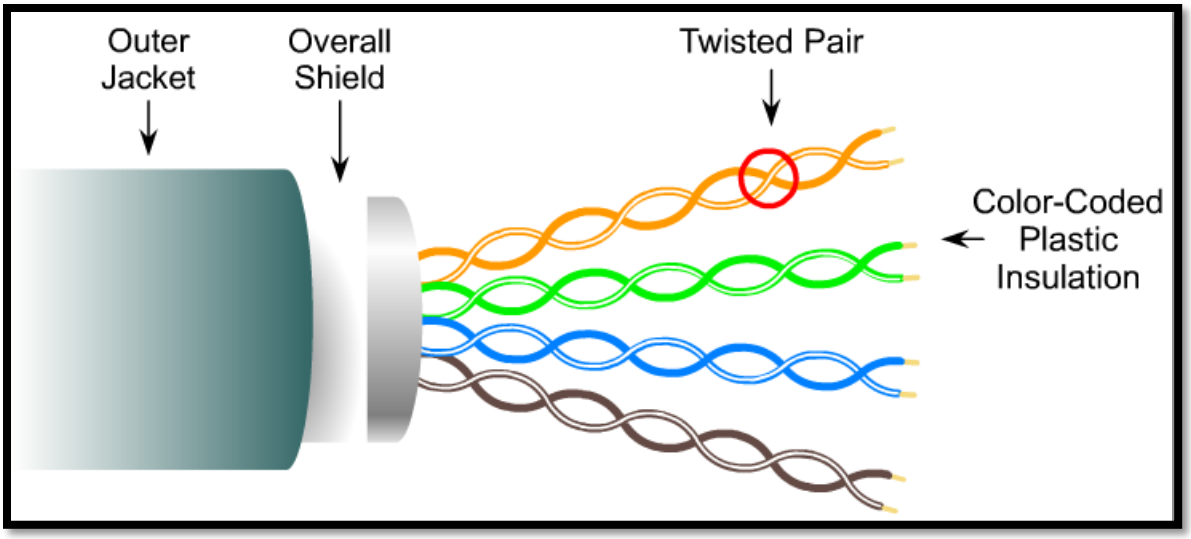
STP –Shielded Twisted Pair

Shielded twisted-pair cable (STP)combines the techniques of shielding, cancellation, and twisting of wires.

- Each pair of wires is wrapped in metallic foil.
- The four pairs of wires are wrapped in an overall metallic braid or foil.

A new hybrid of UTP with traditional STP is **Screened UTP (ScTP),** also known as **Foil Twisted Pair (FTP).**

- ScTP is essentially UTP wrapped in a metallic foil shield, or screen.

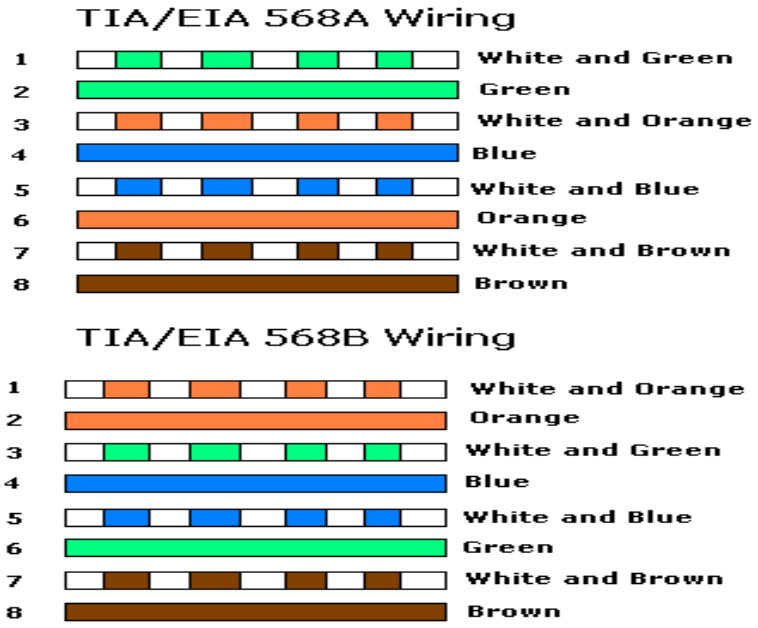


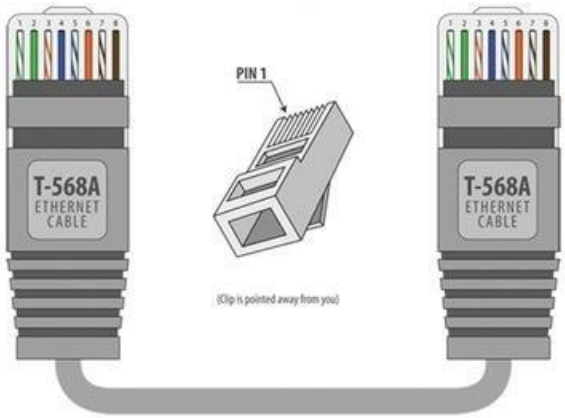
ScTP –Screened Twisted Pair

Applications

- Twisted-pair cables are used in telephone lines to provide voice and data channels.
- Local-area networks, such as l0Base-T and l00Base-T, also use twisted-pair cables.

There are two standards for Cat6 wiring arrange in RJ45, they are T-568A and T-568B

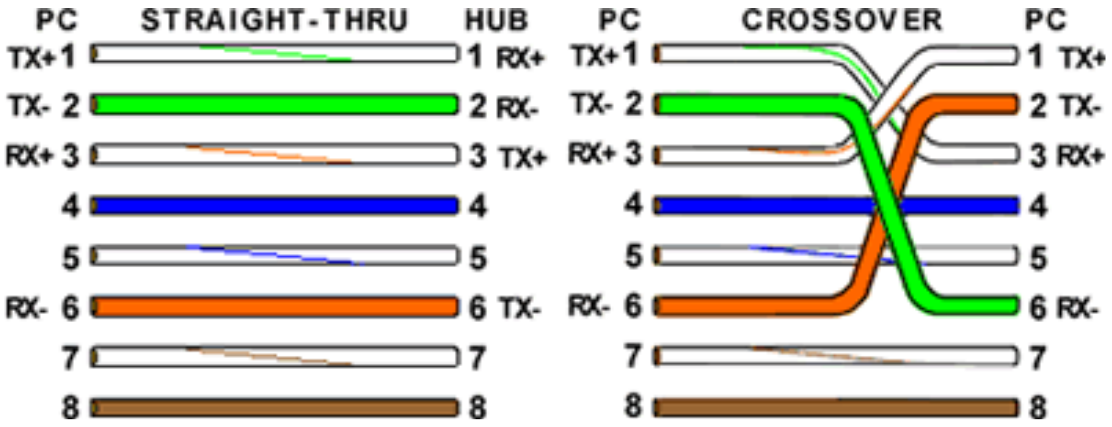




Crossover and straight through cable

An Ethernet crossover cable is a type of Ethernet cable used to connect computing devices together directly. It is most often used to connect two devices of the same type, such as two computers or two switches connect to each other. By contrast straight through cables are used to connect devices of different types, such as a computer or router to switch or hub.

The RJ45 termination use T568A or T568B for straight cable, while for crossover cable, use T-568A at one end and T-568B at the other end of cat6 cable.



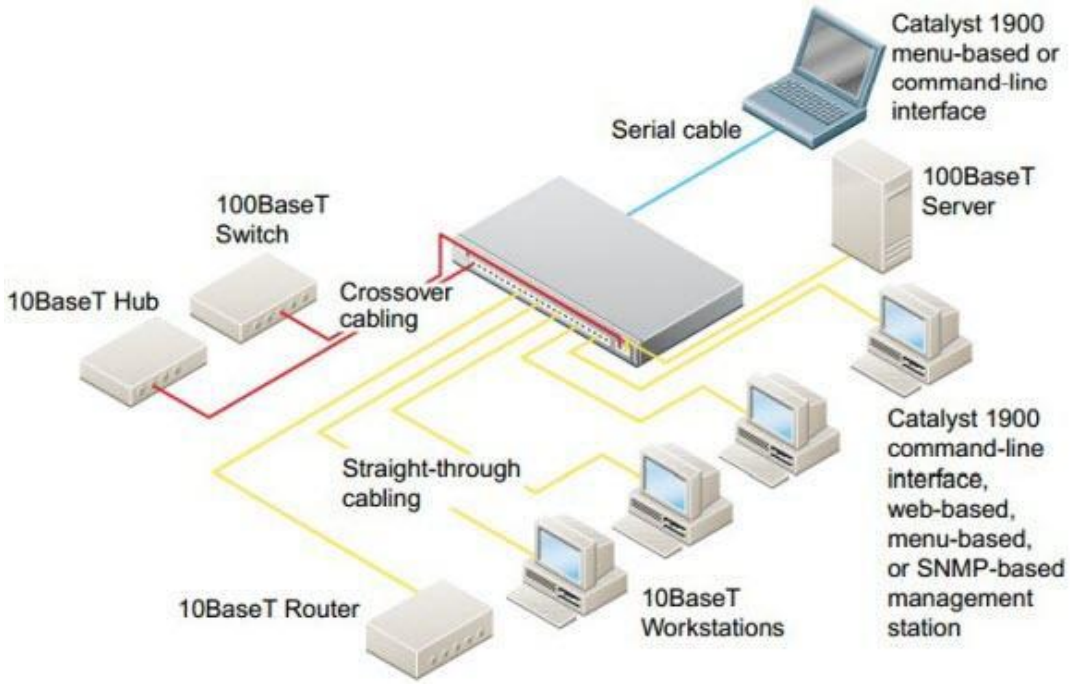
Straight-or- Crossover

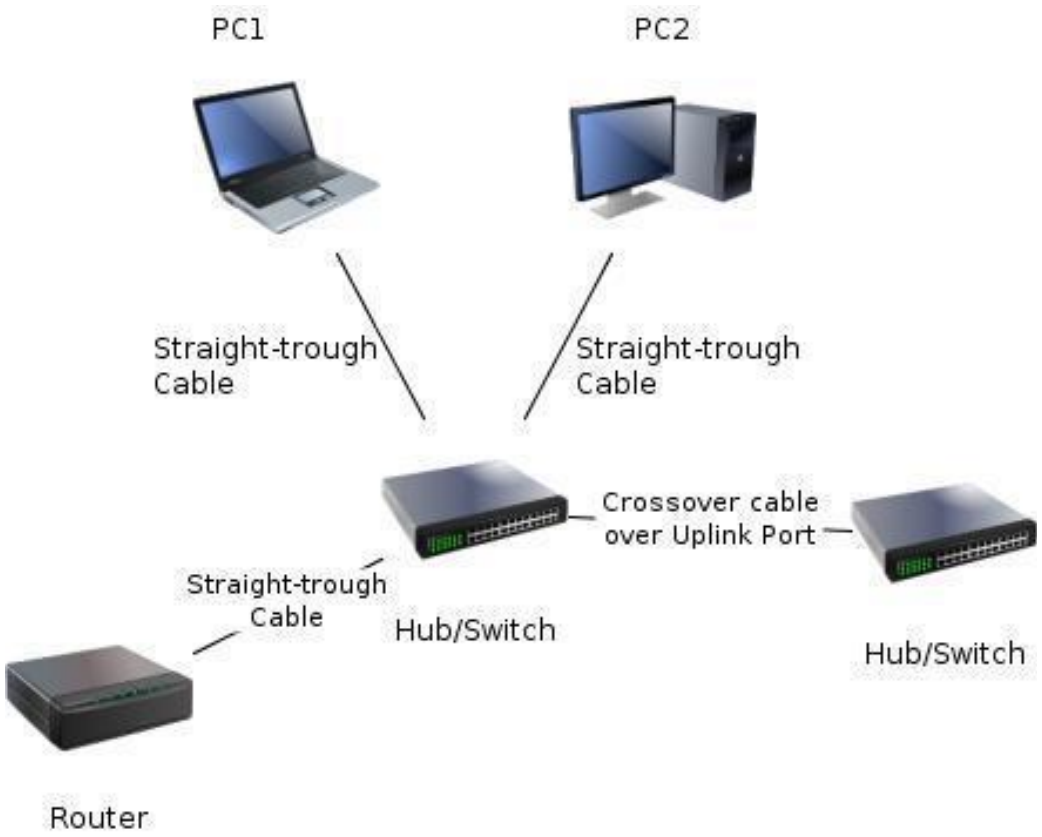
Use straight-through cables for the following cabling:

- •Switch to router
- •Switch to PC or server
- •Hub to PC or server

Use crossover cables for the following cabling:

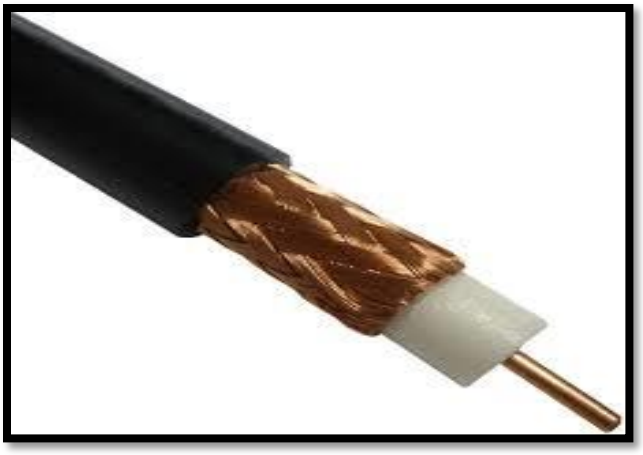
- •Switch to switch
- •Switch to hub
- •Hub to hub
- •Router to router
- •PC to PC
- •Router to PC





2. Coaxial Cable

Like twisted pair, coaxial cable consists of two copper conductors, but the two conductors are concentric rather than parallel. With this construction and special insulation and shielding, coaxial cable can achieve high data transmission rates. Coaxial cable is quite common in cable television systems.



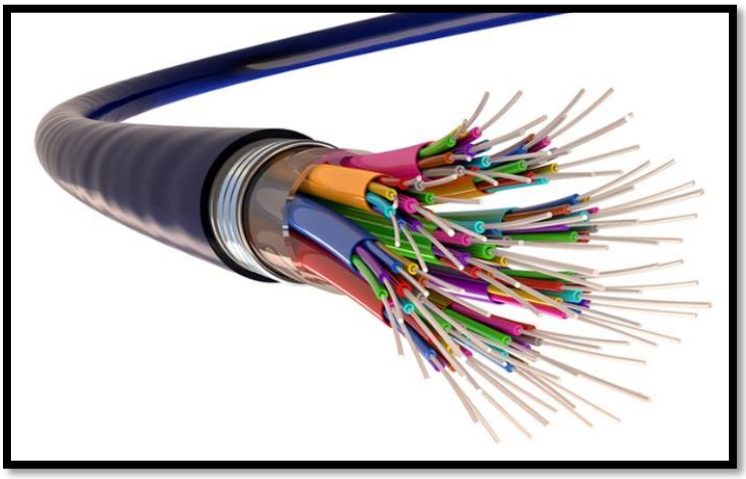
Coaxial Cable

Applications

- Coaxial cable was widely used in analog telephone networks, digital telephone networks
- Cable TV networks also use coaxial cables.
- Another common application of coaxial cable is in traditional Ethernet LANs

3. Fiber Optics

An optical fiber is a thin, flexible medium that conducts pulses of light, with each pulse representing a bit. A single optical fiber can support tremendous bit rates, up to tens or even hundreds of gigabits per second. They are immune to electromagnetic interference, have very low signal attenuation up to 100 kilometers, and are very hard to tap. These characteristics have made fiber optics the preferred long-haul guided transmission media, particularly for overseas links.



fiber optics

Applications

- Fiber-optic cable is often found in backbone networks because its wide bandwidth is cost-effective.
- Some cable TV companies use a combination of optical fiber and coaxial cable,thus creating a hybrid network.
- Local-area networks such as 100Base-FX network (Fast Ethernet) and 1000Base-X also use fiber-optic cable

Advantages and Disadvantages of Optical Fiber

Advantages

Fiber-optic cable has several advantages over metallic cable (twisted- pair or coaxial).

1. Higher bandwidth. Fiber-optic cable can support dramatically higher bandwidths (and hence data rates) than either twisted-pair or coaxial cable. 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.
2. Less signal attenuation. Fiber-optic transmission distance is significantly greater than that of other
3. guided media. A signal can run for 50 km without requiring regeneration. We need repeaters every 5 km for coaxial or twisted-pair cable.
4. Immunity to electromagnetic interference. Electromagnetic noise cannot affect fiber-optic cables.
5. Resistance to corrosive materials. Glass is more resistant to corrosive materials than copper.
6. Light weight. Fiber-optic cables are much lighter than copper cables.
7. Greater immunity to tapping. Fiber-optic cables are more immune to tapping than copper cables.
8. Copper cables create antenna effects that can easily be tapped.

Disadvantages

There are some disadvantages in the use of optical fiber.

1. Installation and maintenance. Fiber-optic cable is a relatively new technology. Its installation and maintenance require expertise that is not yet available everywhere.
2. Unidirectional light propagation. Propagation of light is unidirectional. If we need bidirectional communication, two fibers are needed.
3. 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.

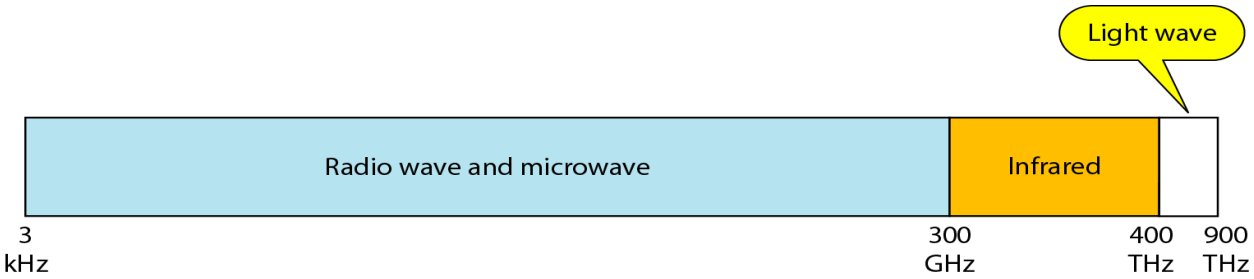
Media Comparison

Characteristics	UTP	STP	Coaxial Cables	Fiber Optic Cables
Bandwidth	10– 100 Mbps	10– 100 Mbps	10 Mbps	100 Mbps - 1 Gbps
Maximum cable segment	100 meters	100 meters	200 – 500 meters	2 k.m. – 100 k.m.
Interference rating	Poor	Better than UTP	Better than twisted pair wires	Very good as compared to any other cable
Installation cost	Cheap	Costly than UTP	Costly than twisted pair wires	Most costly to install
Security	Low	Low	Low	High

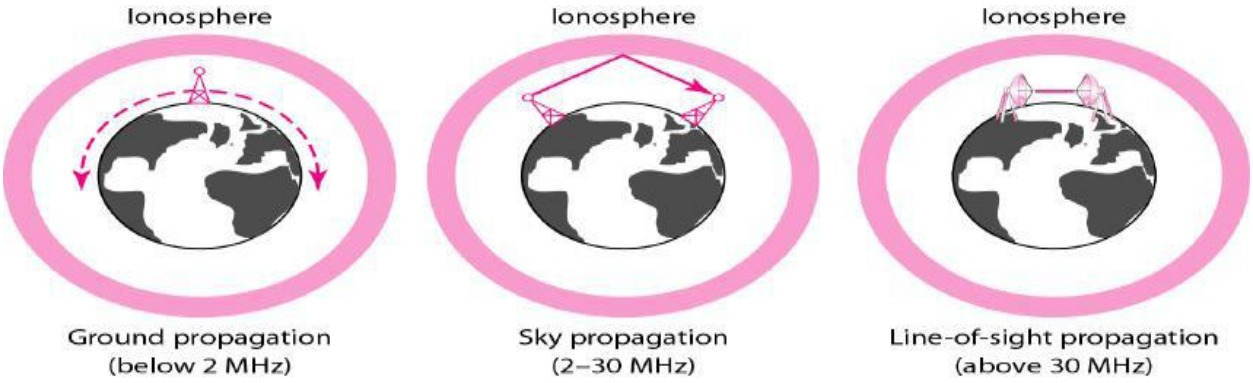
B. UNGUIDED MEDIA

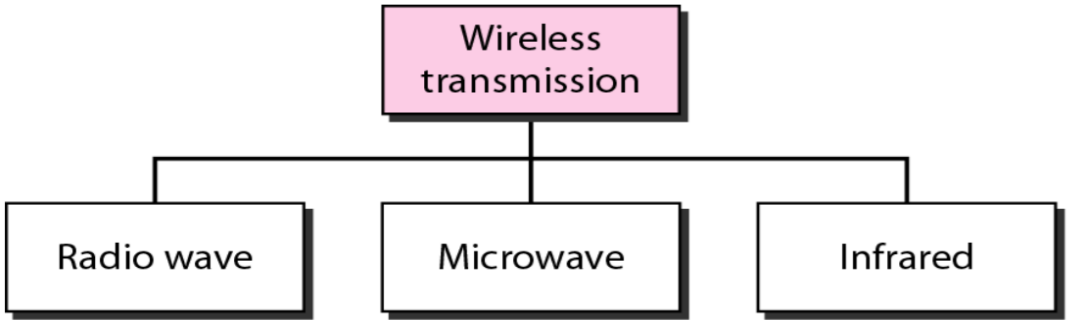
Wireless is said to be unguided media, because there is no connectivity between the sender and receiver. Information is spread over the air, and anyone within wireless signals range may collect the information e.g. radio transmission.

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



Unguided signals can travel from the source to destination in several ways:
ground propagation, sky propagation, and line-of-sight propagation, as shown in Figure





1. Radio Waves

Electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz 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 the sending and receiving antennas do not have to be aligned. A sending antenna sends waves that can be received by any receiving antenna.

The omni directional property has a disadvantage, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

Omni directional 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. Figure shows an omnidirectional antenna.

Applications

The Omni directional characteristics of radio waves make them useful for multicasting, in which there is one sender but many receivers. AM and FM radio, television, maritime radio, cordless phones, and paging are examples of multicasting.

2. Microwaves

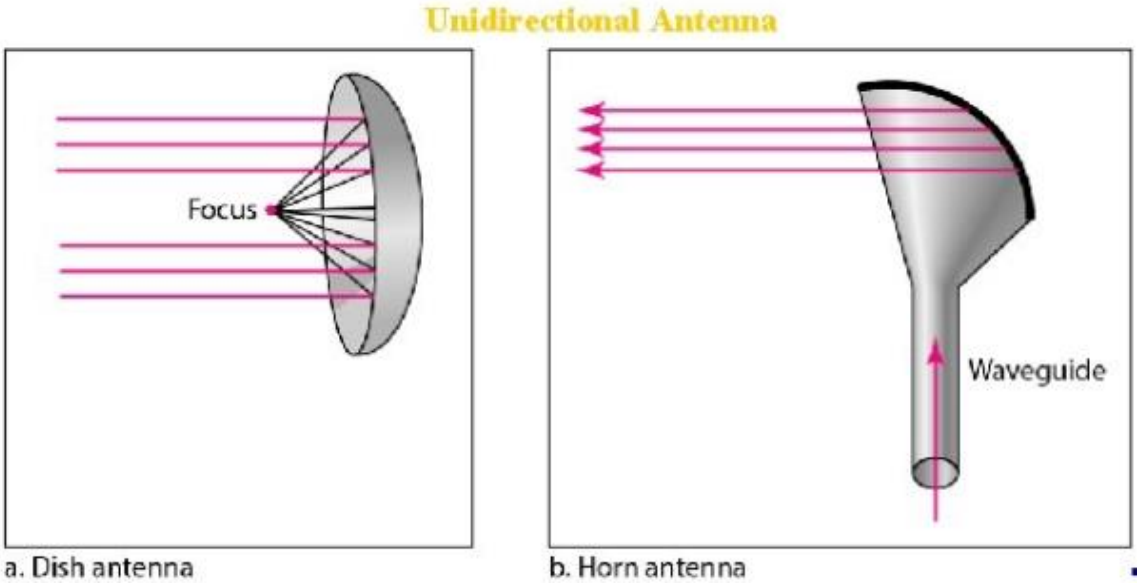
Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves. Microwaves are unidirectional. The sending and receiving antennas need to be aligned. The unidirectional property has an obvious advantage. A pair of antennas can be aligned without interfering with another pair of 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

Applications:

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



3. Infrared

Infrared waves, with frequencies from 300 GHz to 400 THz (wavelengths from 1mm 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. Infrared signals useless for long-range communication. In addition, we cannot use infrared waves outside a building because the sun's rays contain infrared waves that can interfere with the communication.

Applications:

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