

## Physical Layer

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## Network Topology Design

- Already discussed in previous classes.
  - It includes Mesh, Bus, Star and Ring topology

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## Types of connection

There are majorly two types of connections:

- Point-to-Point connections
- Multi-point-connection

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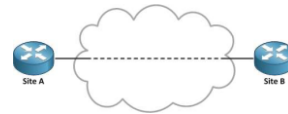
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## Types of connection

**Point-to-point Connection:**

- It Provides dedicated links between two devices
- For example, a wired system that connects two computers together can be thought of a point-to-point link



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## Types of connection

**Multi-point Connection:**

- It is a link between two or more devices.
- It is also known as Multi-Point configuration
- The networks having multipoint configuration are called broadcast networks



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## Transmission Mode

- It refers to the direction of information flow between two devices.
- Data flow is the flow of data between two devices
- Direction of data flow can be described as
  - Simplex Mode
  - Half Duplex Mode
  - Full Duplex Mode

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## Transmission Mode

### Simplex (SX)

- The communication is unidirectional, as on a one-way street.
- Only one of the two devices on a link can transmit; the other can only receive.
- Commercial radio broadcasting is an example.
- Simplex lines are also called receive-only, transmit-only or one-way-only lines.
- Ex: are Radio and Television broadcasts

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## Transmission Mode

### Half Duplex (HDX)

- Each station can both transmit and receive, but not at the same time.
- When one device is sending, the other can only receive, and vice versa.
- The half-duplex mode is used in cases where there is no need for communication in both directions at the same time; the entire capacity of the channel can be utilized for each direction.
- Citizens band (CB) radio is an example where push to talk (PTT) is to be pressed or depressed while sending and transmitting.

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## Transmission Mode

### Full Duplex (FDX)

- Called duplex, both stations can transmit and receive simultaneously.
- One common example of full-duplex communication is the telephone network.
- The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel must be divided between the two directions.

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## Transmission Mode

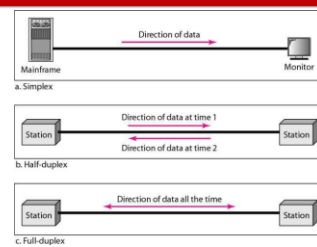


Figure: Data flow (simplex, half duplex, and full duplex)

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## Transmission Media

- Data Transmission occurs between sender and receiver over some Transmission Medium or Transmission Media
- Transmission Media may be classified into Two Types
  - Guided Media [Wired Technology]
  - Unguided Media [Wireless Technology]

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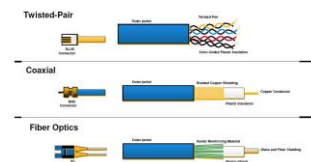
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## Transmission Media

i) Guided Media (Wired Network): In Guided Media Signals are Passed in a " same physical path "

### Example:

- Twisted pair Cable
- Coaxial Cable
- Fiber Optic Cable



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## Transmission Media

### Twisted pair Cable:

- These are a type of guided media.
- It was invented by Alexander Graham Bell.
- Twisted pair cables have two conductors that are generally made up of copper and each conductor has insulation.
- These two conductors are twisted together, thus giving the name twisted pair cables.



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## Transmission Media

### Applications of Twisted pair cables

- Twisted Pair cables are used in telephone lines to provide data and voice channels.
- The DSL lines make use of these cables.
- Local Area Networks (LAN) also make use of twisted pair cables.
- They can be used for both analog and digital transmission.
- RJ-45 is a very common application of twisted pair cables.

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## Transmission Media

### Twisted Pair Cables are further of two types

1. Unshielded Twisted Pair Cables (UTP)
2. Shielded Twisted Pair Cables (STP)

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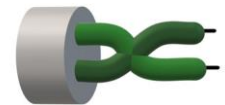
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## Transmission Media

### 1. Unshielded Twisted Pair Cables (UTP)

- These are a pair of two insulated copper wires twisted together without any other insulation or shielding and hence are called unshielded twisted pair cables.
- They reduce the external interference due to the presence of insulation.

Plastic Cover



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## Transmission Media

### 1. Unshielded Twisted Pair Cables (UTP)

#### Advantages

- These cables are **cost-effective and easy to install** owing to their compact size.
- They are generally **used for short-distance transmission** of both voice and data.

#### Disadvantages

- The connection established using UTP is **not secure**.
- They are efficient only for a distance up to 100 meters and have to be installed in pieces of up to 100 meters.
- These cables have limited bandwidth.

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## Transmission Media

### 1. Unshielded Twisted Pair Cables (UTP)

#### Cat 6 cable

- Category 6 cables support Gigabit Ethernet data rates of 1 gigabit per second.
- These cables can accommodate 10 Gigabit Ethernet connections over a limited distance—commonly about **180 feet** for a single cable.
- Cat 6 cable contains four pairs of copper wire and uses all the pairs for signaling to obtain its high level of performance.
- The cable is identified as Cat 6 by printed text along the insulation sheath.
- An enhanced version of Cat 6, called **Cat 6a**, supports up to 10 Gbps speeds at greater distances.

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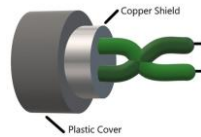
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## Transmission Media

### 1. Shielded Twisted Pair Cables (STP)

- Cables have extra insulation or protective covering over the conductors in the form of a copper braid covering.
- This covering provides strength to the overall structure of the cable.
- It also reduces noise and signal interference in the cable.



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## Transmission Media

### 1. Shielded Twisted Pair Cables (STP)

#### Advantages

- They are generally used for **long-distance communication** and transmission and are installed underground.
- The protective shield **prevents external electromagnetic noise** penetration into the cable.
- They have a **higher bandwidth** as compared to UTP.

#### Disadvantages

- These cables are **very expensive**.
- They require a **lot of maintenance** which increases the cost more.
- These can be installed **underground only**.
- The length of the segment is similar to UTP for these cables.

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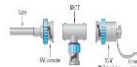
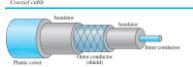
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## Transmission Media

### Coaxial cable (or coax)

- Carries signals of higher frequency ranges than those in twisted pair cable
- Instead of having two wires, 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.



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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**
- To understand optical fiber, we first need to explore several aspects of the nature of light
- Light travels in a straight line as long as it is moving through a single uniform substance
- If a ray of light traveling through one substance suddenly enters another substance of a different density, the ray changes direction

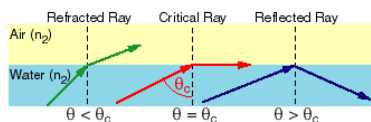
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## Transmission Media

### Fiber Optic Cable



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## Transmission Media

### Fiber Optic Cable

#### Advantages

- Higher bandwidth.
- Less signal attenuation.
- Immunity to electromagnetic interference.

#### Disadvantages

- Installation and maintenance
- Unidirectional light propagation
- Cost

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## Transmission Media

ii) Unguided Media (Wireless Network): In Unguided Media Signals are Passed in the form of "Electromagnetic Waves"

### Example

- Radio waves
- Satellite microwave
- Infrared

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## Transmission Media

### Radio Waves

- Radio waves, for the most part, are omnidirectional
- 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

Omnidirectional antenna



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## Transmission Media

### Radio Waves

- The omnidirectional 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
- Radio waves, particularly those waves that propagate in the sky mode, can travel long distances
- This makes radio waves a good candidate for long distance broadcasting such as FM radio

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## Transmission Media

### Microwaves

- 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
- Microwaves, due to their unidirectional properties, are very useful when unicast (one to one) communication is needed between the sender and the receiver.
- They are used in cellular phones, satellite networks and wireless LANs

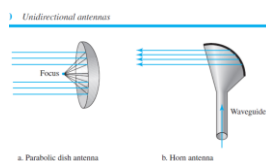
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## Transmission Media

### Microwaves



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## Transmission Media

### 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
- some manufacturers provide a special port called the IrDA port that allows a wireless keyboard to communicate with a PC.
- The standard originally defined a data rate of 75 kbps for a distance up to 8 m. The recent standard defines a data rate of 4 Mbps.

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Thank you!