

NETWORKING Note-1:

We are all familiar with networks. Our phone has network, our laptop has network and our TV also has network. When we talk about networks in our daily life we usually refer it to internet or telephone connection. But what is a network actually? The field of Networking or as it is popularly known Computer Networks is a very important field in computer science, as it is somehow connected to every branch of computer science either directly or indirectly.

Definition: A computer network is a group of computers that has the potential to transmit, receive and exchange voice, data, and video traffic. A network connection can be set up with the help of either cable or wireless media.

Computer networks are formed when two or more computers connect together over a channel or medium to share information or perform some specific task.

The google meet class you have is possible because my computer and your computer/mobile are able to connect with each other via google meet's own special computer known as Server and the Internet.

Evolution of Networking:

Before the moder day Internet came into picture and before YouTube, Instagram, video calling etc. Networking had very humble beginnings.

ARPANET: The story begins in the late 1950s. At the height of the Cold War, the U.S. DoD wanted a command-and-control network that could survive a nuclear war. At that time, all military communications used the public telephone network, which was considered vulnerable as telephonic connections back then used switching offices which were connected to thousands of telephones. This led to the development of ARPANET(Advanced Research Projects Agency NET).

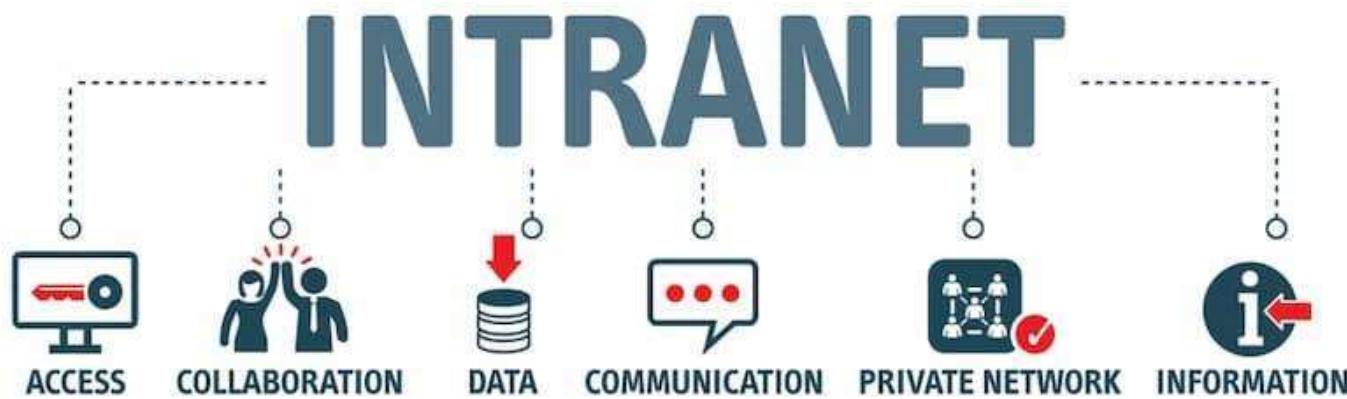
The main objective of creating ARPANET was to accommodate all the different research equipment with the packet switching technology. It also allowed the resources to be shared for the contractors of the Department of Defense. The network was used for connecting all the research centers along with several government locations and military bases as well. Soon, ARPANET became quite popular amongst all the researchers due to its collaboration with services such as electronic mail and much more.

You can read more on ARPANET here: <https://www.vedantu.com/full-form/arpanet-full-form>

INTERNET

- Internet is the latest technique of information broadcasting. It is basically a collection of computer networks through out the world. Thousands of computers are connected to each other in this network. Generally, computers are connected via telephone lines. Other option are also there for connection by which a computer can get connected to internet.
- Internet is not subject to any company or government but it has several servers which are related to various organizations or private companies. We can say that internet is a medium for world wide communication. It is an easy and feasible medium to analysis any product at an international level. It is an effective medium to publish various information like report, article etc.
- It is world's biggest WAN.





shutterstock.com • 1400185928



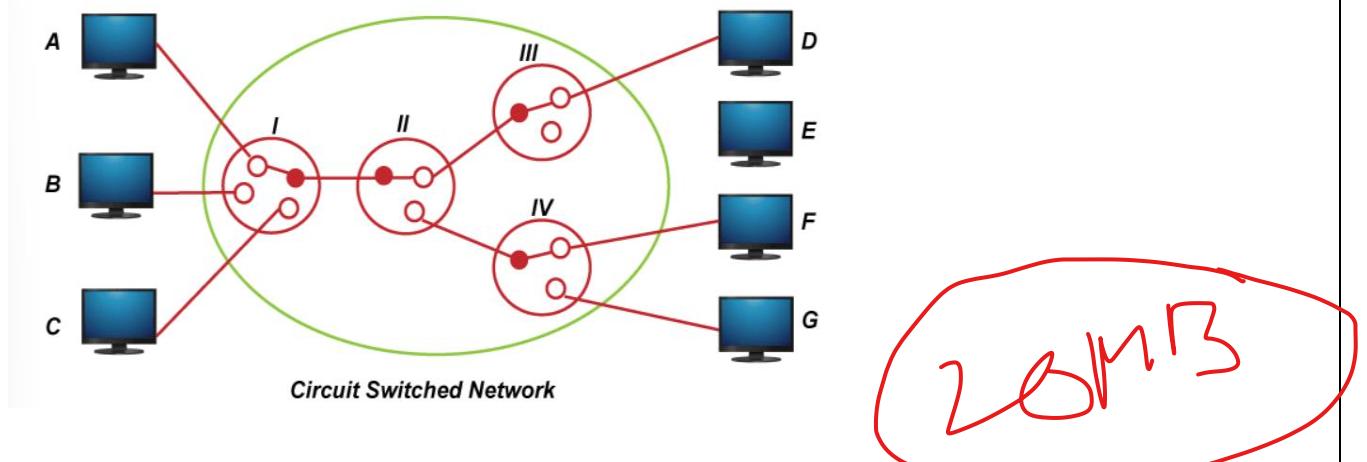
- Intranet is a private network of computers which works on internet protocols for working. Any organization can use intranet for secure transmission of information amongst its employees. Internet is a network between various organizations whereas intranet is a network of one organization only.

If two or more computers are connected in a network, then they are sure to exchange information. Think of information as transport vehicles from one computer to another. So these transport vehicles would definitely need a path through which they can travel to reach their destination. And they also need to make sure that the path they take is the best possible path. To determine the path which the information would take Switching Techniques are used.

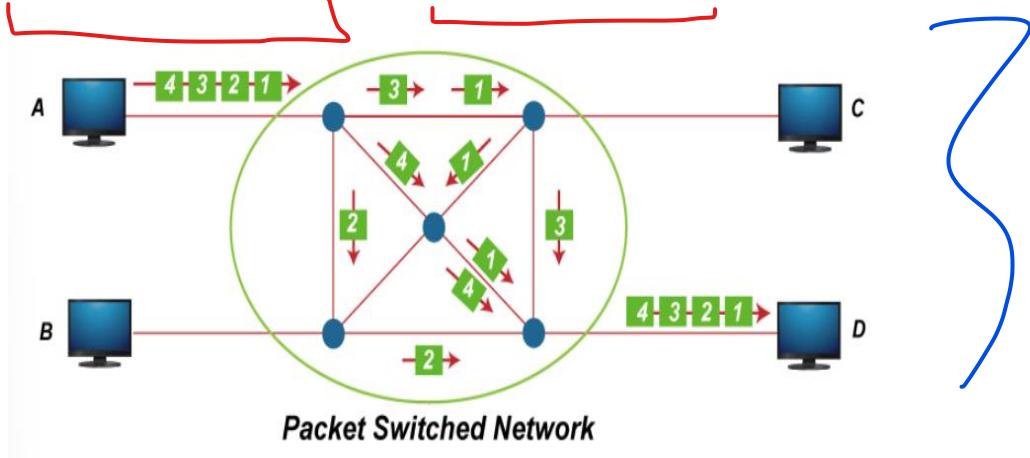
Definition: Switching technique is used to connect the systems for making one-to-one communication and decide the best route for data transmission.

There are mainly two types of switching:

- a. **Circuit Switching:** A circuit-switched network is one of the simplest data communication methods in which a dedicated path is established between the sending and receiving device. In this physical links connect via a set of switches.



- b. **Packet Switching:** In the Packet switching Network, the message is divide into packets. Each packet contains a header which includes the source address, destination address, and control information.



You will get to learn more about switching techniques and learn how these dedicated and non-dedicated routes work in higher classes.

Data Communication Technologies:

In the above part we learned how data is transferred from destination to source. Now we focus on through what, at what speed etc. of the data transmission.

Channel: Channels are nothing but mediums through which we exchange information in a network. Consider a network between two people when they speak to each other. The air molecules act as medium so that we can hear the other person's voice. Similarly to get the information shared from a source to the destination, a medium must exist.

Definition: The path over which data is sent or received is called data channel. This data channel may be a tangible medium like copper wire cables or broadcast medium like radio waves. Transmission channel may be analog or digital.

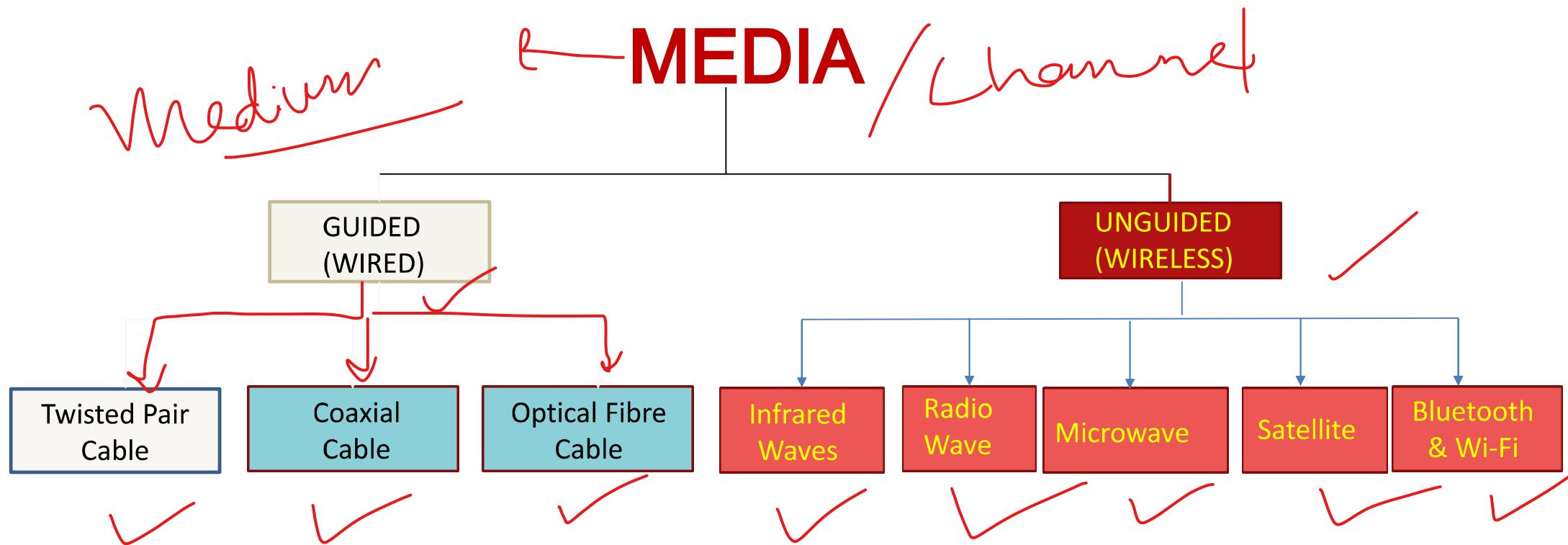
Data Transfer Rate: The speed of data transferred or received over transmission channel, measured per unit time, is called data transfer rate. The smallest unit of measurement is bits per second (bps). 1 bps means 1 bit (0 or 1) of data is transferred in 1 second.

- 1 Bps = 1 Byte per second = 8 bits per second
- 1 kbps = 1 kilobit per second = 1024 bits per second
- 1 Mbps = 1 Megabit per second = 1024 Kbps
- 1 Gbps = 1 Gigabit per second = 1024 Mbps

Bandwidth: Bandwidth in wireless communications is the maximum amount of data that can be transmitted over a given frequency band in a given amount of time. It is measured in Hertz (Hz), which is the unit of frequency.

Bandwidth is important in wireless communications because it determines the speed at which data can be transmitted. For example, a higher bandwidth allows for faster data transmission rates. This is important for applications such as streaming video and online gaming, which require a lot of data to be transmitted quickly.

COMMUNICATION/TRANSMISSION



TWISTED PAIR(Ethernet) CABLE

- 2 or 4 insulated wires are in twisted form in this cable. Twisting resists the effect of surrounding noise and electromagnetic interference. RJ-45 (registered jack) connector is used to connect computers.
- Cat-5 and Cat-6 specifications are generally used in LAN whereas other lower categories are used in telephone connections.
- It is further divided in to categories-unshielded and shielded twisted pair cable. Shielded twisted pair cable remains covered with insulation to reduce signal interference.

✓ Advantages :

- Cheap, light weight and flexible cable.
- It is easy to install and maintain.



Shielded Twisted Pair

✓ Disadvantages :

- It is effective up to 100 meters only after this, repeaters are required.
- It supports low bandwidth with the speed up to 100Mbps.



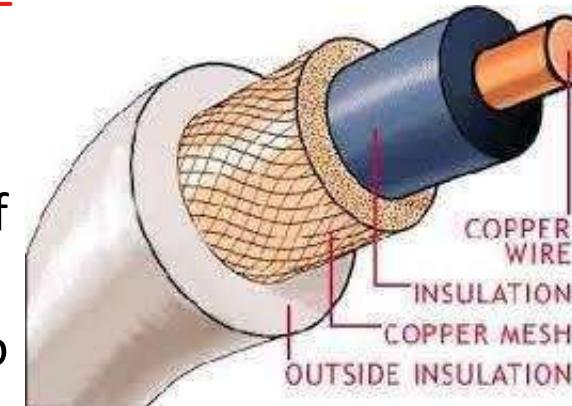
Unshielded Twisted Pair

COAXIAL CABLE(coax)

- In a coax, there are two solid insulated conductors which shares one common axis. Inner conductor is a straight wire surrounded by a wired mesh. Internal core carries signals and mesh works as a noise reflector. It is generally used in cable TV transmission.

~~• ADVANTAGES :~~

- It provides high bandwidth. It carries data up to the distance of 185-500 meters.
- It is suitable for broadband transmission(cable TV) and can also be useful in shared cable network.
- It is less sensitive towards electromagnetic fields.

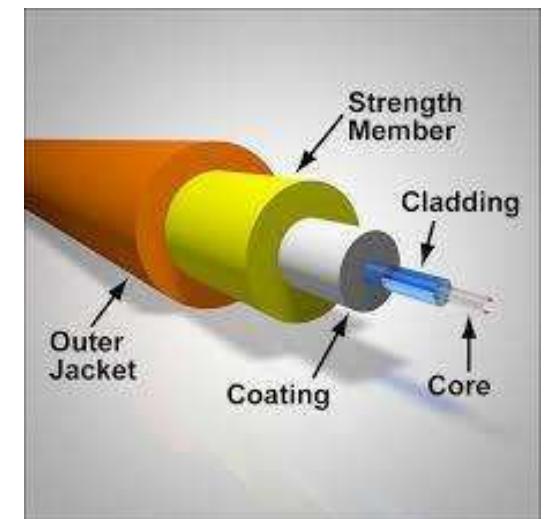
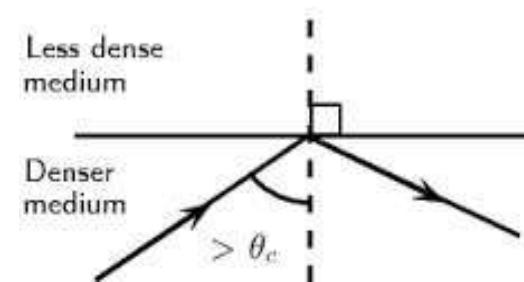


~~• DISADVANTAGES :~~

- As compared to twisted pair cable, it is less flexible and is expensive.
- Installation is not easy due to thickness of 1 cm diametere and poor flexibility.

OPTICAL FIBRE CABLE

- Its design is based on the concept of total internal reflection.
- It has glass tubes to carry signals in the form of light rays (photons). Signals are to be emitted by Light Emitting Diode (LED) or laser beam from source.
- It has following parts-
- **CORE(Glass/Plastic)** : it is a thin glass rode, light rays travels from one end to other.
- **CLADDING** : it is an optical material covering core that transforms the light and sends it back to the core.
 - **BUFFER COATING** : it is a plastic coating which prevents the cable from damage and moisture.
- **ADVANTAGES :**
 - It is free from Electromagnetic Interference(EMI).
 - It is secure and suitable for high speed transmission.
- **DISADVANTAGES :**
 - It is fragile and very expensive.
 - Its installation is very tough and expensive.

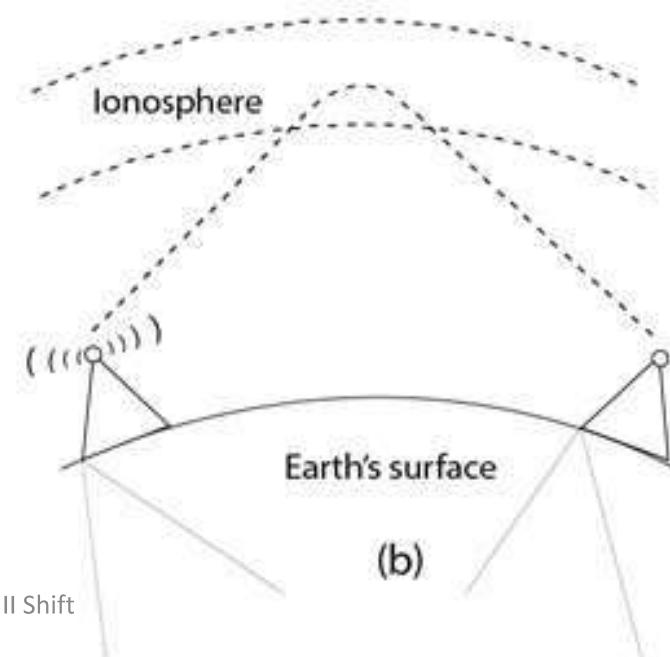
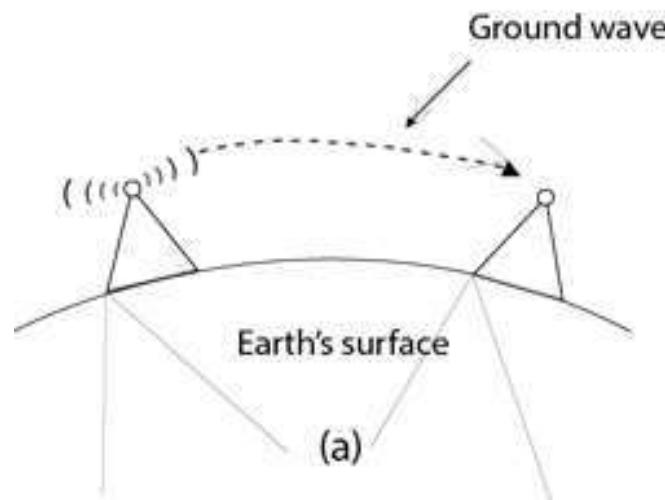


FACTORS	TWISTED PAIR CABLE	COAXIAL CABLE	OPTICAL FIBRE CABLE
DATA TRANSFER RATE	10 Mbps – 10 Gbps	100 Mbps	>100 Gbps
DISTANCE(range)	100 m	185-500 m	>10 KM
EMI susceptibility	More	Less	Nil
COST	Least cost	More than Twisted Pair	Very expensive

WIRELESS MEDIA

• **RADIO WAVES**

- Radio waves uses radio frequencies in the limit 3 GHz to 3 Ghz. Signals are modified on high speed radio wave carrier frequency using amplitude modulation (AM) and frequency modulation (FM). These waves uses ionosphere as shown in the diagram for signal transmission. It can be transmitted on long distance and supports mobility.
- Radio waves are used for communication from small walkie-talkie distances to sufficient distances within a city (AM/FM radio broadcasting).



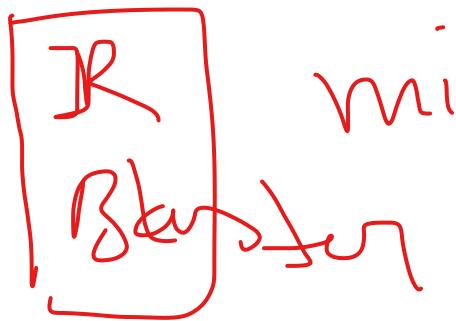
- ADVANTAGES :
 - Radio communication covers a big area and supports mobility.
 - Radio waves can disperse in all directions and can cross the solid walls as well.
 - These waves facilitates the communication in inaccessible areas.
 - It is not needed to physically aligned transmitter and receiver antenna.
- DISADVANTAGES :
 - It is expensive and unsecured communication medium.
 - It is very sensitive towards weather..
 - Permission from concerned departments is required for radio waves transmission.

MICROWAVES

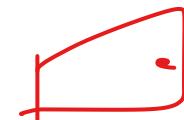
- In microwave transmission, two direct parabolic antennas are needed to install on towers/buildings/mountains for sending and receiving signals. They are needed to be aligned to each other.
- ADVANTAGES :
 - This facilitates transmission in tough areas.
 - It supports data transmission at the speed of 16 Giga bits per second.

DISADVANTAGES :

- It is an unsecured communication.
- Signals are distributed and transmitted in all directions.
- It gets affected by weather conditions.
- Cost of placing tower and antenna is high.



Neha Tyagi, KV 5 Jaipur II Shift



INFRARED WAVES

- Infrared waves allows transmission in devices up to small distances of 300 GHz to 400 THz (about 5 meters) using wireless signals. Infrared transmission technique used in computer is similar to the technique used in remote operated electronic equipment like TV, cordless phone toys etc.

- **Advantages:**

- It is a kind of line of sight transmission.
- It does not require government Licence.
- It is basically for less distance transmission.

- **Disadvantage:**

- It is a kind of line of sight transmission, therefore, at a time, only two devices can communicate with each other.
- It can not travels through solid materials.
- It gets affected by long distances.



SATELLITE LINK

- Satellite communication uses microwave (1.5GHz-20GHz) as a medium. Satellites like Geostationary or Polar satellites are used to set transmission on various center on earth.
- Services like DTH, VSAT, GPS Satellite phones, etc. have became possible by satellite transmission. A satellite works as a Trans-Receiver Antenna in space which receive, regenerate and redirect signals.
- **ADVANTAGE:**
 - It covers a large geographical area.
 - It provides secure, uninterrupted and high quality transmission.
 - Geographical conditions like mountains, tall building, towers does not raise interruption.
 - Signals sent or received by earth stations may be fixed or mobile.
- **DISADVANTAGE:**
 - These are slow than microwave transmission.
 - legal permissions are needed for these.
 - Installation is very complex.
 - Signals can be interrupted by external interference.