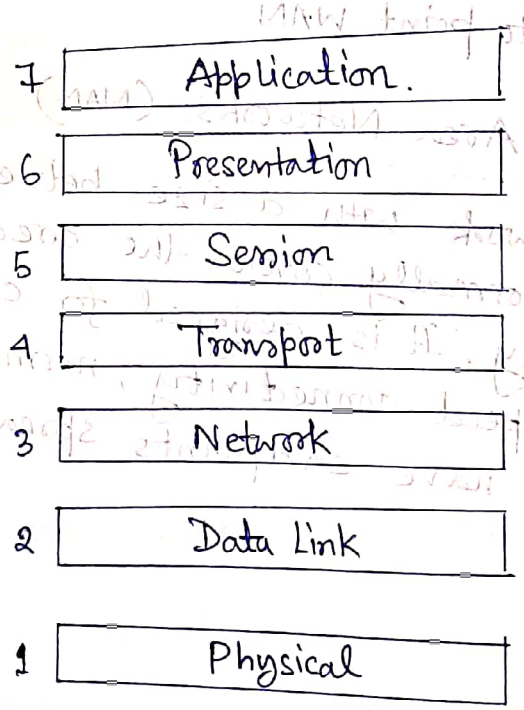
The OSI Model

The International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection model. An open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture.

The purpose of the OSI model is to show how to facilitate communication between different systems without requiring changes to the logic of the underlying hardware and software. The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible, robust and interoperable.



Layers in the OSI model

1. Physical Layer: The physical layer is responsible for movements of individual bits from one hop (node) to the next.

2. Data Link layer: The data link layer is responsible for moving frames from one hop(node) to the next.

Framing: The data link layer divides the stream of bits received from the network layer into manageable data units called frames.

3. Network layer: The network layer is responsible for the delivery of individual packets from the source host to the destination host.

4. Transport Layer: The transport layer is responsible for the delivery of a message from one process to another.

5. Session Layer: The session layer is responsible for dialog control and synchronization.

Dialog control: The session layer allows two systems to enter into a dialog. It allows the communication between two processes to take place in either half-duplex (one way at a time) or full-duplex (two ways at a time) mode.

Synchronization: The session layer allows a process to add checkpoints or synchronization points, to a stream of data. For example, if a system is sending a file of 2000 pages, it is advisable to insert checkpoints after every 100 pages to ensure that each 100 pages unit is received and acknowledged independently.

6. Presentation layer: The presentation layer is responsible for translation, compression and encryption

Translation: The processes in two systems are usually exchanging information in the form of character strings, number and so on.

The information must be changed to bit streams before being transmitted. Because different computers use different encoding systems. the presentation layer is responsible for interoperability between these different encoding methods. The presentation layer at the sender changes the information from its sender-dependent format to a common format. The presentation layer at the receiving machine changes the common format into its receiver-dependent forma

Compresion: Data compresion reduces the numbe of bits contained in the information.

7. Application Layer:

The application layer is responsible for providing services to the user.

File transfer, accen and management: This appli cation allows a user to accen files, in a remote host (to make changes or read data), to retrieve files from a remote computer for use in the local computer and to manage or control files in a remote computer locally.

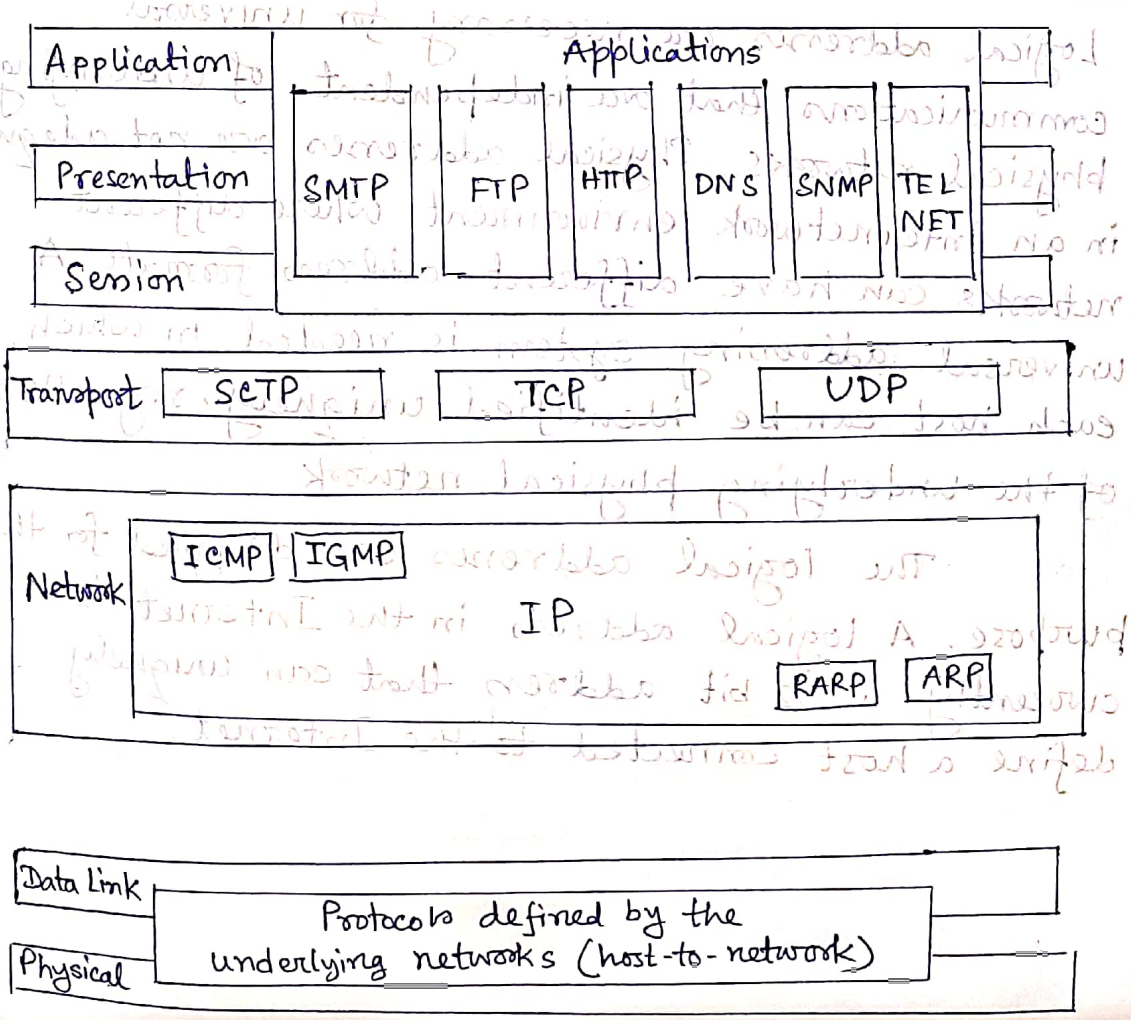
Mail services: e-mail forwarding and storage.

Directory services: provides distributed database sources and accen for global information about various objects and services.

TCP/IP Protocol Suite

The TCP/IP protocol suit was developed prior to the OSI model. Therefore, the layers in the TCP/IP protocol suit do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport and application. However, when TCP/IP is compared to OSI, we can say that the host-to-network layer is equivalent to the network layer and the application layers is roughly doing the job of the session, presentation and application layers! with the transport layer in TCP/IP taking care of part of the duties of the session layer.

We assume that the TCP/IP protocol suite is made of five layer's: physical, data link, network, transport and application.



ADDRESSING

Three levels of addresses are used in an internet employing the TCP/IP protocols: physical (link) addresses, logical (IP) addresses, port addresses.

Physical Address

The physical address, also known as the link address, is the address of a node as defined by its LAN or WAN. It is included in the frame used by the data link layer. The size and format of these addresses vary depending on the network. For example, Ethernet uses a 6 byte (48 bit) physical address that is imprinted on the network interface card (NIC). LocalTalk (Apple), however, has a 1-byte dynamic address that changes each time the station comes up.

Logical Address

Logical addresses are necessary for universal communications that are independent of underlying physical networks. Physical addresses are not adequate in an internetwork environment where different networks can have different address formats. A universal addressing system is needed in which each host can be identified uniquely, regardless of the underlying physical network.

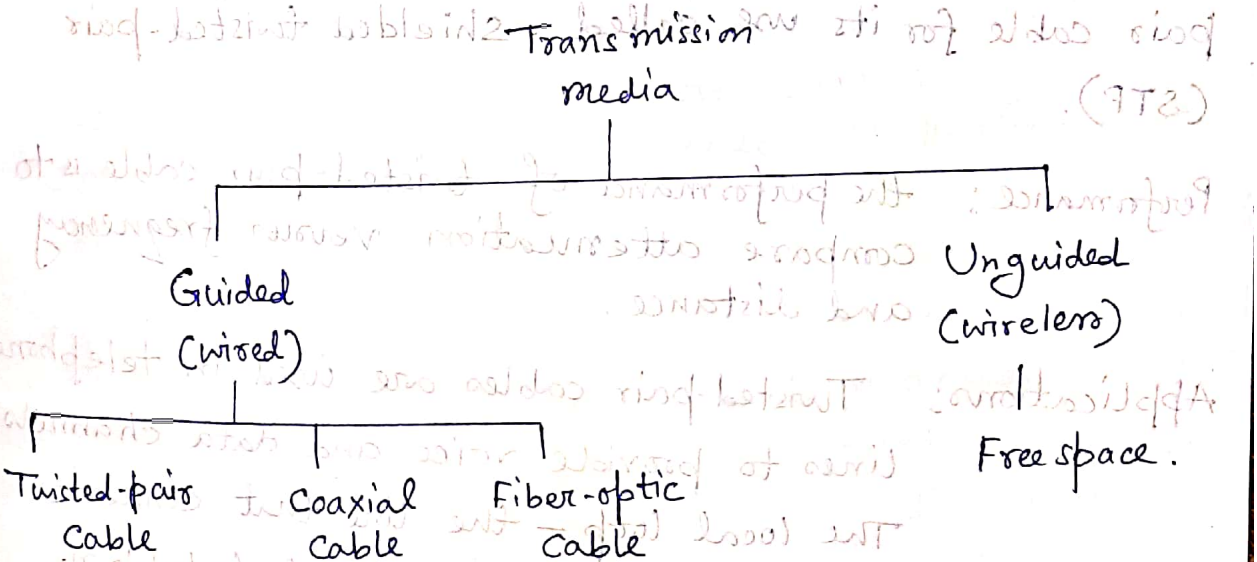
The logical addresses are designed for this purpose. A logical address in the Internet is currently a 32 bit address that can uniquely define a host connected to the Internet.

Port Addresses

Today, computers are devices that can run multiple processes at the same time. The end objective of Internet communication is a process communicating with another process. For example, computer A can communicate with computer C by using TELNET. At the same time, computer A communicates with computer B by using the File Transfer Protocol (FTP). For these processes to receive data simultaneously, we need a method to label the different processes. In the TCP/IP architecture, the label assigned to a process is called a port address. A port address in TCP/IP is 16 bits in length.

Transmission Media

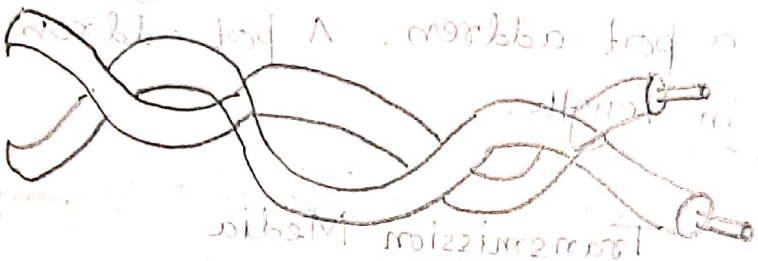
A transmission medium can be broadly defined as anything that can carry information from a source to a destination.



Twisted-Pair Cable

A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together. One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference. The receiver uses the difference between the two.

Twisting makes it probable that both wires are equally affected by external influences (noise, crosstalk).



Unshielded Versus Shielded Twisted-pair Cable:

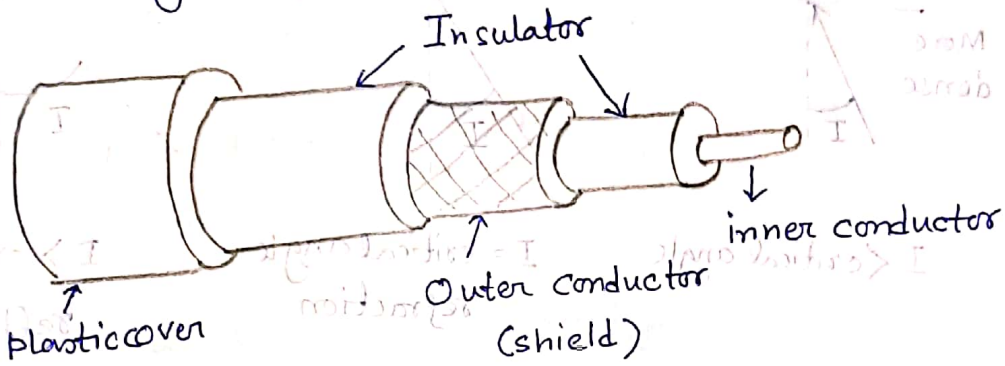
The most common twisted-pair cable used in communications is referred to as unshielded twisted-pair (UTP). IBM has also produced a version of twisted pair cable for its use called shielded twisted-pair (STP).

Performance: the performance of twisted-pair cable is to compare attenuation versus frequency and distance.

Applications: Twisted-pair cables are used in telephone lines to provide voice and data channels. The local loop – the line that connects subscribers to the central telephone office – commonly consists of unshielded twisted-pair cables.

Coaxial Cable:

Coaxial cable carries signals of higher frequency ranges than 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 sheild against noise and as the second conductor, which completes the circuit. This outer conductor is also enclosed in an insulting sheath. and the whole cable is protected by a plastic cover.



Coaxial Cable Connectors

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.

Applications

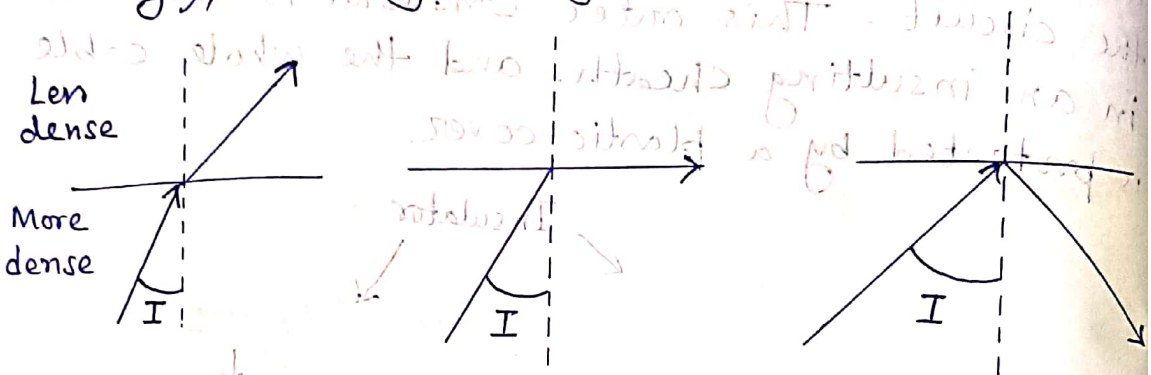
Coaxial cable was widely used in analog telephone network where a single coaxial network could carry 10,000 voice signals. Later it was used in digital telephoe networks where a single coaxial cable could carry digital data up to 600 Mbps.

Cable TV networks also use coaxial cable. Beacause of its high bandwidth and consequently high data rate, coaxial cable was chosen for digital transmission in early Ethernet LANs.

Fiber-Optic Cable

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



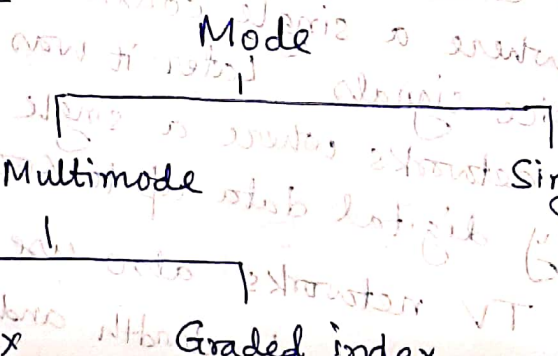
I < critical angle

I = critical angle
refraction

I > critical angle
reflection.

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. The difference in density of the two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refracted into it.

Propagation modes.



Multimode multiple beams from a light source move through the core in different paths.

multimode step-index fiber

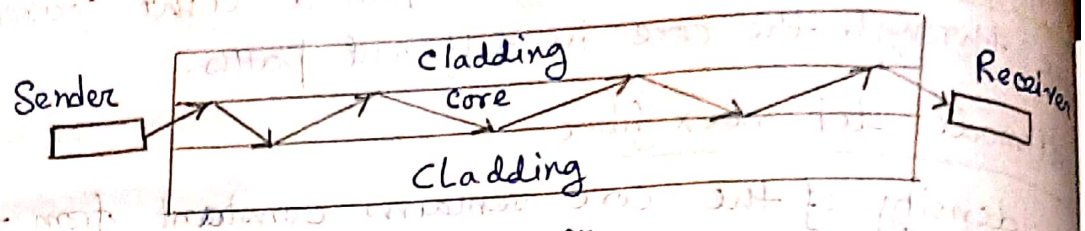
the density of the core remains constant from the center to the edges. A beam of light moves through this constant density in a straight line until it reaches the interface of the core and the cladding. At the interface, there is an abrupt change due to a lower density; this alters the angle of the beam's motion. The term step index refers to the sudden nes of this change, which contributes to the distor tion of the signal as it passes through the fiber.

multimode graded-index fiber

decreases this distortion of the signal through the cable. A graded-index fiber, therefore, is one with varying densities. Density is highest at the center of the core and decreases gradually to its lowest at the edge.

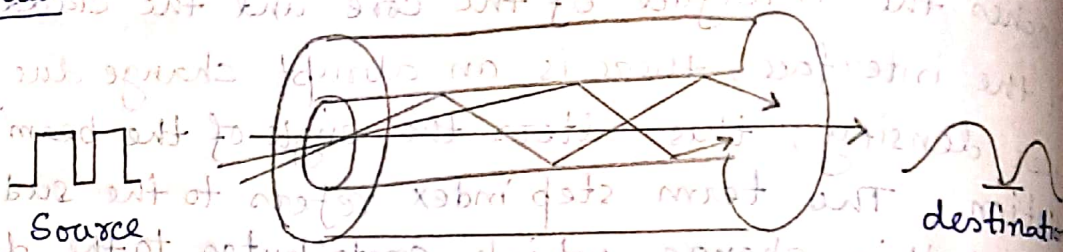
Single-Mode

The single mode fiber itself is manufactured with a much smaller diameter than that of multimode fiber, and with substantially lower density (index of refraction). The decrease in density results in a critical angle that is close enough to 90° to make the propagation of beams almost horizontal. In this case, propagation of different beams is almost identical, and delays are negligible.

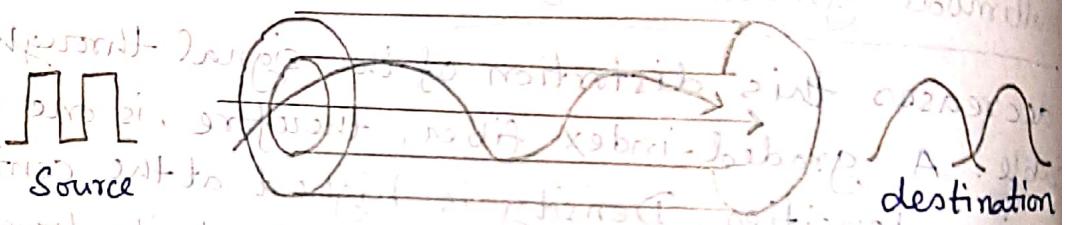


Optical fiber.

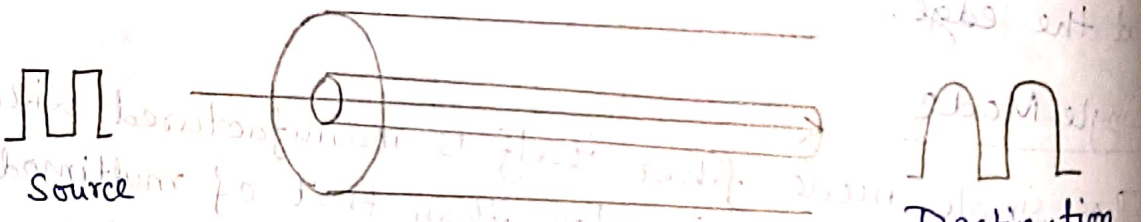
Modes



Multimode, step Index



Multimode, graded index



Single mode.

Fiber-Optic Cable Connectors.

The subscriber Channel (SC) connector is used f cable TV. It uses a push/pull locking syste The straight-tip (ST) connector is used for connect cable to networking devices.

Applications

Fiber-optic cable is often found in backbone net because its wide bandwidth is cost-effective.

we can transfer data at a rate of 1600 Gbps.

Some cable TV companies use a combination of optical fiber and coaxial cable.

Advantages and Disadvantages of Optical Fiber

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

(i) Higher bandwidth: Fiber-optic cable can support dramatically higher bandwidths than either twisted-pair or coaxial cable.

(ii) Less signal attenuation: Fiber-optic transmission distance is significantly greater than that of other guided media.

(iii) Immunity to electromagnetic interference: Electromagnetic noise cannot affect fiber-optic cables.

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

(v) Greater immunity to tapping: Fiber-optic cables are more immune to tapping than copper cables.

Disadvantages:

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

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

(iii) Cost: The cable and the interfaces are relatively more expensive than those of other guided media.

Unguided media : Wireless

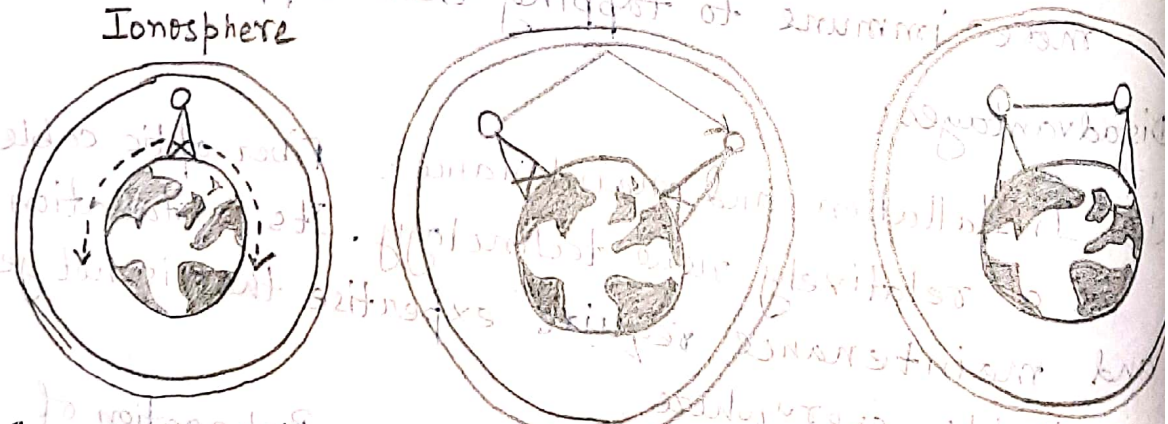
Unguided media transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.

unguided signals can travel from the source to destination in several ways:

1) ground propagation: radio waves travel through the lowest portion of the atmosphere, hugging the earth. These low-frequency signals emanate in all directions from the transmitting antenna and follow the curvature of the planet.

2) Sky propagation: higher-frequency radio waves radiate upward into the ionosphere where they are reflected back to earth.

3) Line-of-sight propagation: very high-frequency signals are transmitted in straight lines directly from antenna to antenna.



Ground propagation

Sky propagation

Line-of-sight propagation.