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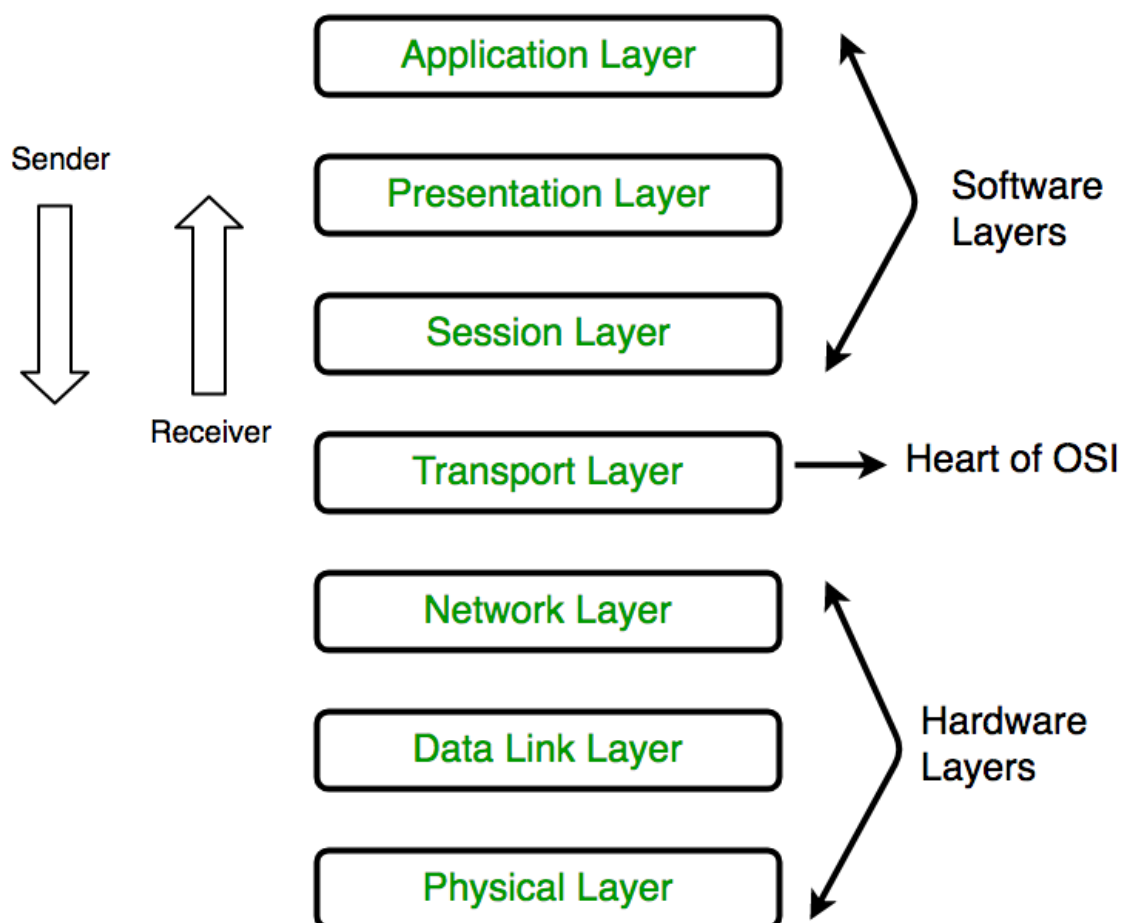
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LAB-1

STUDY OF DIFFERENT TYPES OF PHYSICAL LAYER WIRED/WIRELESS CONNECTIONS

OPEN SYSTEMS INTERCONNECTION(OSI) MODEL:

OSI stands for **Open Systems Interconnection**. It has been developed by ISO – ‘**International Organization of Standardization**’, in the year 1984. It is a 7 layer architecture with each layer having specific functionality to perform. All these 7 layers work collaboratively to transmit the data from one person to another across the globe.



PHYSICAL LAYER:

The lowest layer of the OSI reference model is the physical layer. It is responsible for the actual physical connection between the devices. The physical layer contains information in the form of **bits**. It is responsible for transmitting individual bits from one node to the next. When receiving data, this layer will get the signal received and convert it into 0s and 1s and send them to the Data Link layer, which will put the frame back together.

The functions of the physical layer are :

1. **Bit synchronization:** The physical layer provides the synchronization of the bits by providing a clock. This clock controls both sender and receiver thus providing synchronization at bit level.
2. **Bit rate control:** The Physical layer also defines the transmission rate i.e. the number of bits sent per second.
3. **Physical topologies:** Physical layer specifies the way in which the different, devices/nodes are arranged in a network i.e. bus, star or mesh topology.
4. **Transmission mode:** Physical layer also defines the way in which the data flows between the two connected devices. The various transmission modes possible are: Simplex, half-duplex and full-duplex.

REFERENCES:

<https://www.geeksforgeeks.org/layers-of-osi-model/>

WIRED TRANSMISSION:

Wired communication refers to the transmission of data over a wire-based communication technology. Wired communication is also known as **wireline communication**. Examples include telephone networks, cable television or internet access, and fiber-optic communication. Most wired networks use Ethernet cables to transfer data between connected PCs. Also waveguide (electromagnetism), used for high-power applications, is considered wired line. Local telephone networks often form the basis for wired communications and are used by both residential and business customers in the area. Many networks today rely on the use of fiber optic communication technology as a means of providing clear signaling for both inbound and outbound transmissions and are replacing copper wire transmission. Fiber optic technology is capable of accommodating far more signals than copper wiring while still maintaining the integrity of the signal over longer distances. Alternatively, communication technologies that don't rely on wires to transmit information (voice or data) are considered wireless, and are generally considered to have higher latency and lower reliability. In general, wired communications are considered to be the most stable of all types of communications services. They are relatively impervious to adverse weather conditions in comparison to wireless communication solutions. These characteristics have allowed wired communications to remain popular even as wireless solutions have continued to advance.

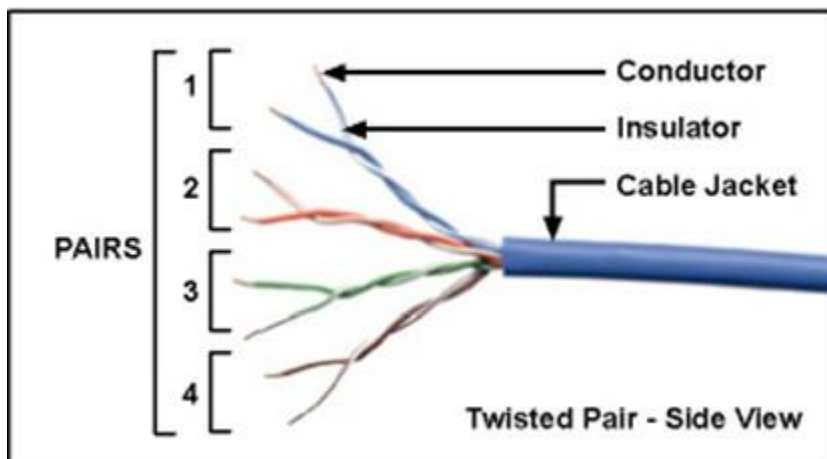
DIFFERENT TYPES OF WIRED MEDIA:

There are three types of media that are used to facilitate communication.

1) Twisted-Pair Wire(s) 2) Coaxial Cable(s) 3) Fiber-Optic Cable(s)

TWISTED PAIR CABLE:

A twisted pair wire is a copper wire that connects your personal computer at home or at work to the telephone line. It is called a twisted wire because two wires that are insulated to prevent wirecrossing are twisted together. Have you ever been on the phone to a friend and all of a sudden you pick up someone else's conversation? Many of you have and this may be due to a snag or untwist of the twisted copper pair wire. The insulation and twist help reduce the telephone lines from crossing. Since the twisted pair wire is made of copper it is deemed to be the least expensive media communication tool. The frequency at which it carries communication signals is relatively slow in comparison to the other medias averaging at carrying data at 1-128 megabits per second.



COAXIAL CABLE:

A coaxial cable is armored cable with a sheathed plastic that contains two concentric conductors or wires. One is typically an inner copper straight wire covered with a sheathed plastic (insulation) and the second wire is typically a mesh shielding protected with an outer insulation of plastic. It is also known as a co-ax. This design provides the coaxial cable with a special advantage: electrical interference is reduced because the two conductors are shielded and confined separately.

Its main uses are in transmission lines to carry signal or data. Coaxial cables are used primarily for TV standard-definition connection to transfer television signal, and for computer network (internet connection) such as Ethernet to carry data. Because it is much

less susceptible to interference, it might carry much more data. Also, it is used to carry radio signal, video signal, and measurement signal.

Coaxial cable was invented in 1929 and first used commercially in 1941. AT&T established its first cross-continental coaxial transmission system in 1940. Depending on the carrier technology used and other factors, twisted pair copper wire and optical fiber are alternatives to coaxial cable.



FIBER OPTIC CABLE:

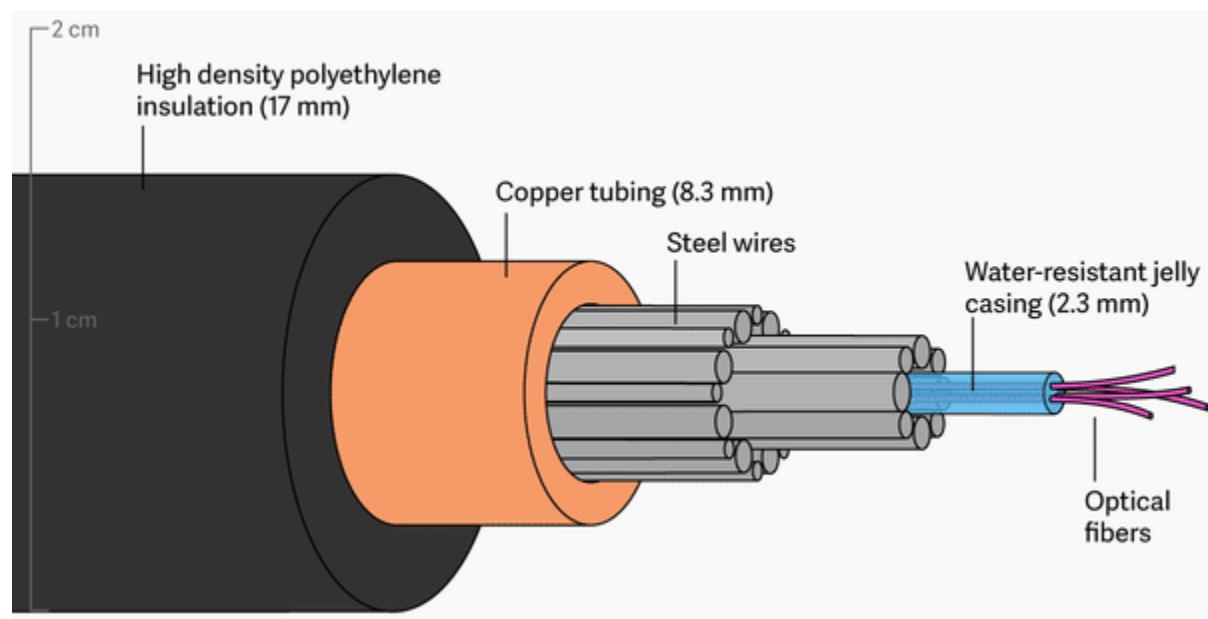
In almost one decade, fiber optic has become one of the most technological advances to transmit information. This innovated material has revolutionized the processes of the telecommunication.

The modern telecommunications use electricity, light or radio to send sounds, images and data. The fiber optic, instead of propagating sound waves, transmits data in form of light pulses with the great advantage which the luminous pulsations are transmitted without interruption. The transportation of information is by light waves not by electricity, this avoid the interefence of electrical noise and degradation of the signal. In conclusion, it is a medium for carrying data in the form of light.

One of the advantages of optical fiber system is that can carry the equivalent of an encyclopedia set (24 volumes, approximately 40 millions words) of information in a single second. Other benefits include long distance transmission of data (more than 100 kilometer), it is dielectric (non-conductivity), easy to install, and long continuous lengths (single-mode cable lengths up to 12 km) among others.

The fiber optic consist of one or several thin fibers of glass or plastic of 50 to 125 micrometers of diameter, we can say that it more or less of the thickness of a hair. The fiber optic cable is made up of a cylindrical region called nucleus, through the light is propagated,

the external zone of the coaxial nucleus is called coating. This coating is a plastic cover or made of other materials that protect it against the humidity.



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Wired transmission-https://en.wikipedia.org/wiki/Wired_communication

Different types of wired media-

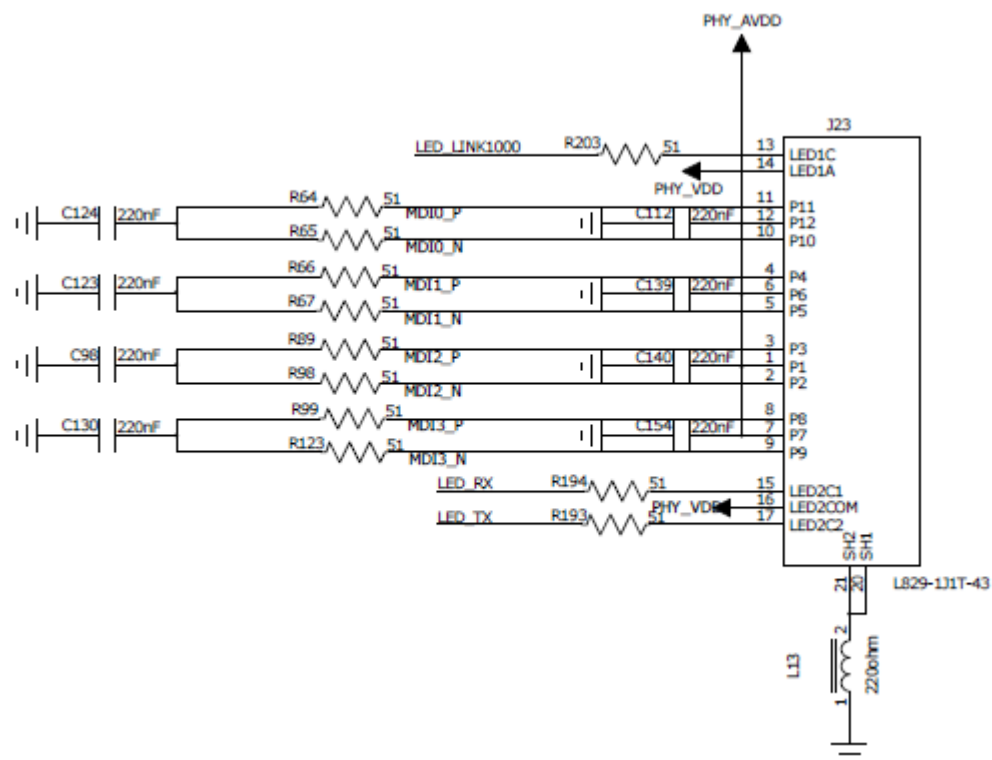
https://en.wikibooks.org/wiki/The_Computer_Revolution/Networks/Wired_Communications_Media#:~:text=Today%20there%20three%20types%20of,can%20be%20a%20bit%20high.

ETHERNET:

Ethernet is a family of computer networking technologies commonly used in local area networks (LAN), metropolitan area networks (MAN) and wide area networks (WAN). It was commercially introduced in 1980 and first standardized in 1983 as IEEE 802.3. Ethernet has since been refined to support higher bit rates, a greater number of nodes, and longer link distances, but retains much backward compatibility. Over time, Ethernet has largely replaced competing wired LAN technologies such as Token Ring, FDDI and ARCNET.

The original 10BASE5 Ethernet uses coaxial cable as a shared medium, while the newer Ethernet variants use twisted pair and fiber optic links in conjunction with switches. Over the course of its history, Ethernet data transfer rates have been increased from the original 2.94 megabits per second (Mbit/s) to the latest 400 gigabits per second (Gbit/s).

The Ethernet standards comprise several wiring and signaling variants of the OSI physical layer in use with Ethernet. Ethernet is widely used in homes and industry, and interworks well with Wi-Fi. The Internet Protocol is commonly carried over Ethernet and so it is considered one of the key technologies that make up the Internet.



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<https://en.wikipedia.org/wiki/Ethernet>

WIRELESS TRANSMISSION:

Wireless transmission is a form of unguided media. Wireless communication involves no physical link established between two or more devices, communicating wirelessly. Wireless signals are spread over in the air and are received and interpreted by appropriate antennas.

When an antenna is attached to electrical circuit of a computer or wireless device, it converts the digital data into wireless signals and spread all over within its frequency range. The receptor on the other end receives these signals and converts them back to digital data.

DIFFERENT WIRELESS MEDIA:

BLUETOOTH:

Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands, from 2.402 GHz to 2.480 GHz, and building personal area networks (PANs). It was originally conceived as a wireless alternative to RS-232 data cables.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 35,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics. The IEEE standardized Bluetooth as **IEEE 802.15.1**, but no longer maintains the standard. The Bluetooth SIG oversees development of the specification, manages the qualification program, and protects the trademarks. A manufacturer must meet Bluetooth SIG standards to market it as a Bluetooth device. A network of patents apply to the technology, which are licensed to individual qualifying devices. As of 2009, Bluetooth integrated circuit chips ship approximately 920 million units annually. Bluetooth is a standard wire-replacement communications protocol primarily designed for low power consumption, with a short range based on low-cost transceiver microchips in each device.

Ranges of Bluetooth devices by class			
Class	Max. permitted power		Typ. range ^[2] (m)
	(mW)	(dBm)	
1	100	20	~100
1.5 (BT 5 Vol 6 Part A Sect 3)	10	10	~20
2	2.5	4	~10
3	1	0	~1
4	0.5	-3	~0.5

NEAR FIELD COMMUNICATION (NFC):

Near-Field-Communication (NFC) is a set of communication protocols for communication between two electronic devices over a distance of 4 cm (1 ½ in) or less. NFC offers a low-speed connection with simple setup that can be used to bootstrap more-capable wireless connections.

NFC devices can act as electronic identity documents and keycards. They are used in contactless payment systems and allow mobile payment replacing or supplementing systems such as credit cards and electronic ticket smart cards. This is sometimes called NFC/CTLS or CTLS NFC, with contactless abbreviated CTLS. NFC can be used for sharing small files such as contacts, and bootstrapping fast connections to share larger media such as photos, videos, and other files.

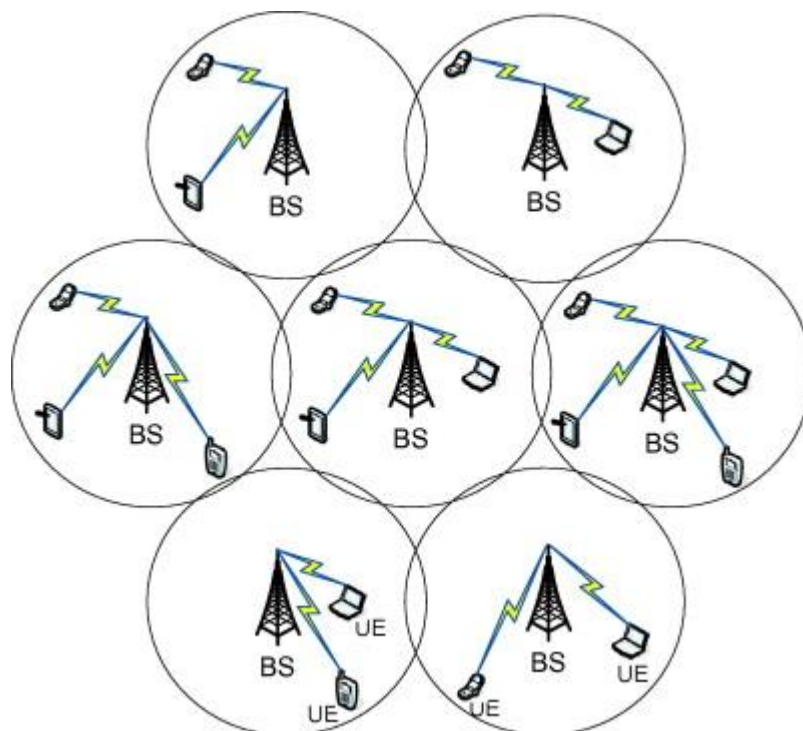
NFC is based on inductive coupling between two so-called antennas present on NFC-enabled devices—for example a smartphone and a printer—communicating in one or both directions, using a frequency of 13.56 MHz in the globally available unlicensed radio frequency ISM band using the ISO/IEC 18000-3 air interface standard at data rates ranging from 106 to 424 kbit/s.

CELLULAR NETWORK:

A **cellular network** or **mobile network** is a communication network where the last link is wireless. The network is distributed over land areas called "**cells**", each served by at least one fixed-location transceiver, but more normally, three cell sites or base transceiver stations. These base stations provide the cell with the network coverage which can be used for transmission of voice, data, and other types of content. A cell typically uses a different set of frequencies from neighbouring cells, to avoid interference and provide guaranteed service quality within each cell.

When joined together, these cells provide radio coverage over a wide geographic area. This enables numerous portable transceivers (e.g., mobile phones, tablets and laptops equipped with mobile broadband modems, pagers, etc.) to communicate with each other and with fixed transceivers and telephones anywhere in the network, via base stations, even if some of the transceivers are moving through more than one cell during transmission. A cellular network is used by the mobile phone operator to achieve both coverage and capacity for their subscribers. Large geographic areas are split into smaller cells to avoid line-of-sight signal loss and to support a large number of active phones in that area. All of the cell sites are connected to telephone exchanges (or switches), which in turn connect to the public telephone network.

In cities, each cell site may have a range of up to approximately $\frac{1}{2}$ mile (0.80 km), while in rural areas, the range could be as much as 5 miles (8.0 km). It is possible that in clear open areas, a user may receive signals from a cell site 25 miles (40 km) away.



ZIGBEE:

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network.

The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

Zigbee



A Zigbee module

International standard

[IEEE 802.15.4](#)

Developed by

Zigbee Alliance^[1]

Industry

Industrial, scientific, medical, and [IoT](#)

Physical range

10 to 20 meters

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Zigbee-

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DIFFERENT TYPES OF NETWORK ARCHITECTURES:

LAN(Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.
- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.

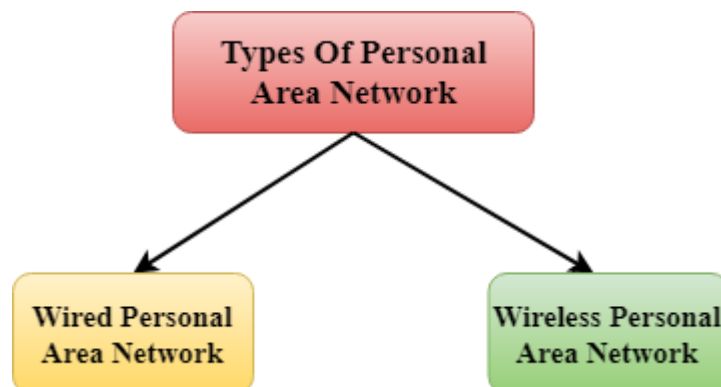


PAN(Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.
- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.
- **Thomas Zimmerman** was the first research scientist to bring the idea of the Personal Area Network.
- Personal Area Network covers an area of **30 feet**.
- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.



There are two types of Personal Area Network:



- Wired Personal Area Network
- Wireless Personal Area Network

Wireless Personal Area Network: Wireless Personal Area Network is developed by simply using wireless technologies such as WiFi, Bluetooth. It is a low range network.

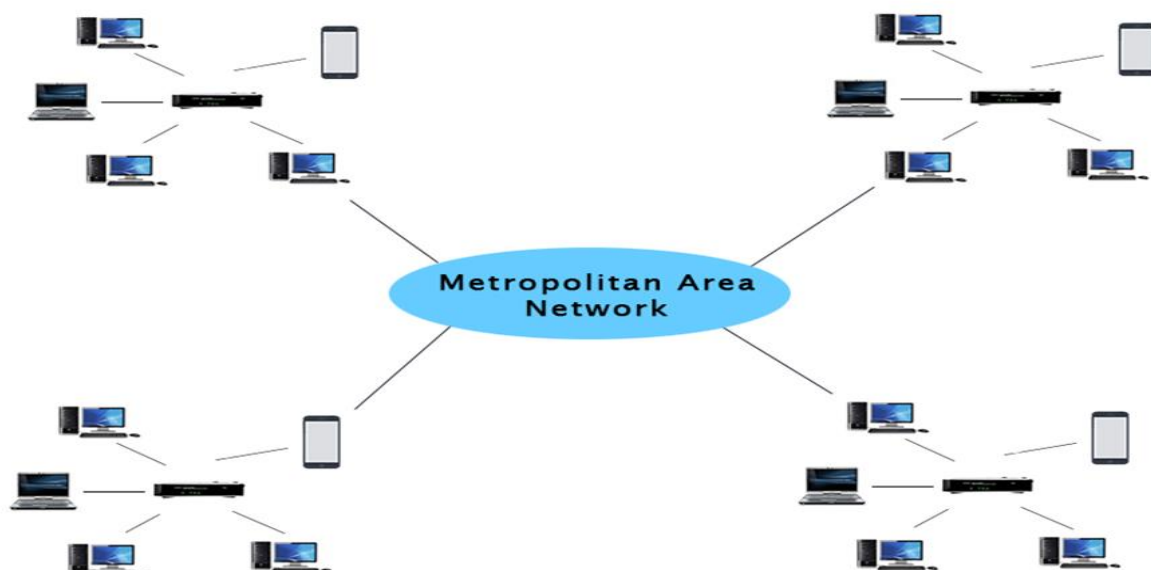
Wired Personal Area Network: Wired Personal Area Network is created by using the USB.

Examples Of Personal Area Network:

- **Body Area Network:** Body Area Network is a network that moves with a person. **For example**, a mobile network moves with a person. Suppose a person establishes a network connection and then creates a connection with another device to share the information.
- **Offline Network:** An offline network can be created inside the home, so it is also known as a **home network**. A home network is designed to integrate the devices such as printers, computer, television but they are not connected to the internet.
- **Small Home Office:** It is used to connect a variety of devices to the internet and to a corporate network using a VPN

MAN(Metropolitan Area Network)

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected to each other through a telephone exchange line.
- The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.
- It has a higher range than Local Area Network(LAN).

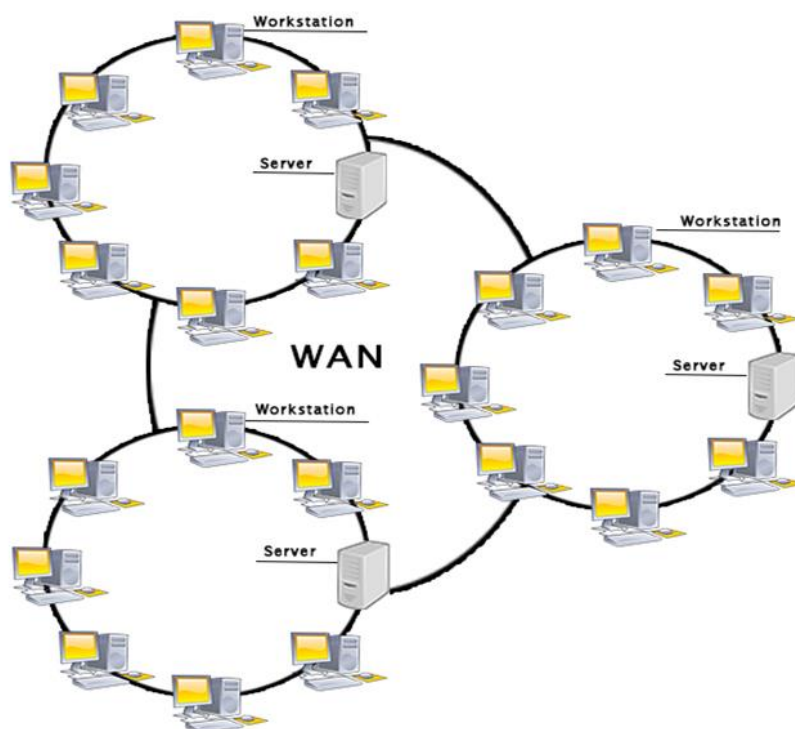


Uses Of Metropolitan Area Network:

- MAN is used in communication between the banks in a city.
- It can be used in an Airline Reservation.
- It can be used in a college within a city.
- It can also be used for communication in the military.

WAN(Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.



Examples Of Wide Area Network:

- **Mobile Broadband:** A 4G network is widely used across a region or country.
- **Last mile:** A telecom company is used to provide the internet services to the customers in hundreds of cities by connecting their home with fiber.

- **Private network:** A bank provides a private network that connects the 44 offices. This network is made by using the telephone leased line provided by the telecom company.

Advantages Of Wide Area Network:

Following are the advantages of the Wide Area Network:

- **Geographical area:** A Wide Area Network provides a large geographical area. Suppose if the branch of our office is in a different city then we can connect with them through WAN. The internet provides a leased line through which we can connect with another branch.
- **Centralized data:** In case of WAN network, data is centralized. Therefore, we do not need to buy the emails, files or back up servers.
- **Get updated files:** Software companies work on the live server. Therefore, the programmers get the updated files within seconds.
- **Exchange messages:** In a WAN network, messages are transmitted fast. The web application like Facebook, Whatsapp, Skype allows you to communicate with friends.
- **Sharing of software and resources:** In WAN network, we can share the software and other resources like a hard drive, RAM.
- **Global business:** We can do the business over the internet globally.
- **High bandwidth:** If we use the leased lines for our company then this gives the high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

Disadvantages of Wide Area Network:

The following are the disadvantages of the Wide Area Network:

- **Security issue:** A WAN network has more security issues as compared to LAN and MAN network as all the technologies are combined together that creates the security problem.
- **Needs Firewall & antivirus software:** The data is transferred on the internet which can be changed or hacked by the hackers, so the firewall needs to be used. Some people can inject the virus in our system so antivirus is needed to protect from such a virus.
- **High Setup cost:** An installation cost of the WAN network is high as it involves the purchasing of routers, switches.
- **Troubleshooting problems:** It covers a large area so fixing the problem is difficult.

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