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CLASS : TE COMPUTER

BATCH : B

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EXPERIMENT 1

AIM - To study different types of physical layer connections.

Physical Layer :

In the seven-layer OSI model of computer networking, the physical layer or layer 1 is the first and lowest layer. This layer may be implemented by a PHY chip.

The physical layer defines the means of transmitting raw bits over a physical data link connecting network nodes. The bitstream may be grouped into code words or symbols and converted to a physical signal that is transmitted over a transmission medium. The physical layer provides an electrical, mechanical, and procedural interface to the transmission medium. The shapes and properties of the electrical connectors, the frequencies to broadcast on, the line code to use and similar low-level parameters, are specified by the physical layer[1].

Ethernet :

The Ethernet physical layer is the physical layer functionality of the Ethernet family of computer network standards. The physical layer defines the electrical or optical properties of the physical connection between a device and the network or between network devices. It is complemented by the MAC layer and the logical link layer[4].

Guide to Ethernet Coding

10 at the beginning means the network operates at 10Mbps.

BASE means the type of signaling used is baseband.

2 or 5 at the end indicates the maximum cable length in meters.

T the end stands for twisted-pair cable.

X at the end stands for full duplex-capable cable.

FL at the end stands for fiber optic cable.

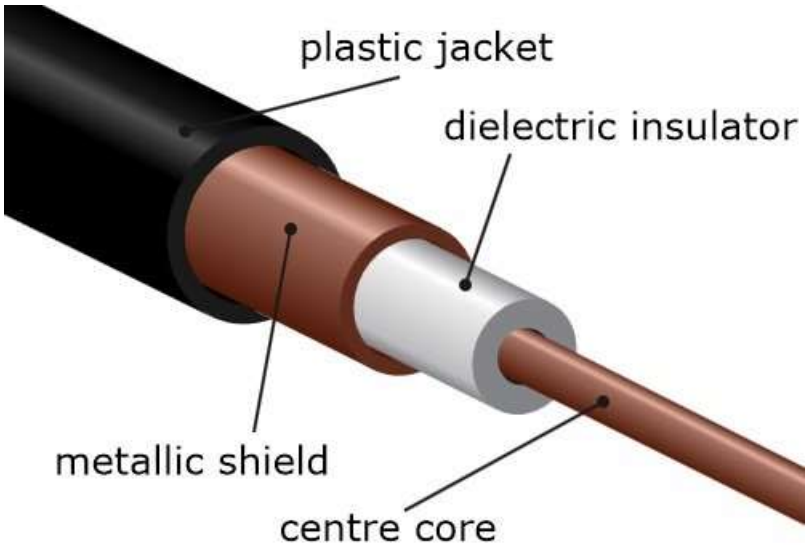
Name	IEEE Standard	Data Rate	Media Type	Maximum Distance
Ethernet	802.3	10 Mbps	10Base-T	100 meters
Fast Ethernet/ 100Base-T	802.3u	100 Mbps	100Base-TX 100Base-FX	100 meters 2000 meters
Gigabit Ethernet/ GigE	802.3z	1000 Mbps	1000Base-T 1000Base-SX 1000Base-LX	100 meters 275/550 meters 550/5000 meters
10 Gigabit Ethernet	IEEE 802.3ae	10 Gbps	10GBase-SR 10GBase-LX4 10GBase-LR/ER 10GBase-SW/LW/EW	300 meters 300m MMF/ 10km SMF 10km/40km 300m/10km/40km

Types of Ethernet cabling

There are three cable types commonly used for Ethernet cabling: coaxial, twisted pair, and fiber-optic cabling.

Coaxial cabling

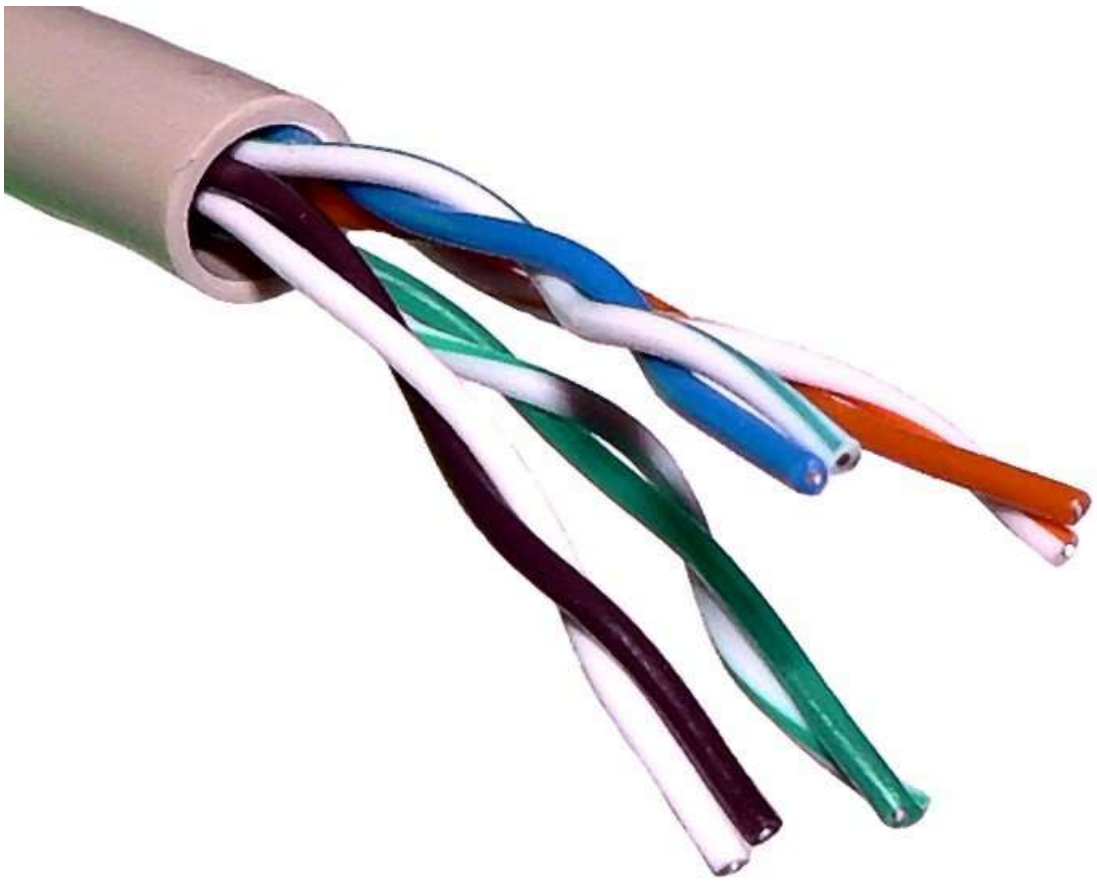
A coaxial cable has an inner conductor that runs down the middle of the cable. The conductor is surrounded by a layer of insulation which is then surrounded by another conducting shield, which makes this type of cabling resistant to outside interference. This type of cabling comes in two types – thinnet and thicknet. Both types have maximum transmission speed of 10 Mbps. Coaxial cabling was previously used in computer networks, but today are largely replaced by twisted-pair cabling



Twisted-pair cabling

A twisted-pair cable has four pair of wires. These wires are twisted around each other to reduce crosstalk and outside interference. This type of cabling is common in current LANs.

Twisted-pair cabling can be used for telephone and network cabling. It comes in two versions, UTP (Unshielded Twisted-Pair) and STP (Shielded Twisted-Pair). The difference between these two is that an STP cable has an additional layer of insulation that protects data from outside interferences.



Fiber-optic cabling

This type of cabling uses optical fibers to transmit data in the form of light signals. The cables have strands of glass surrounded by a cladding material

This type of cabling can support greater cable lengths than any other cabling type (up to a couple of miles). The cables are also immune to electromagnetic interference. As you can see, this cabling method has many advantages over other methods but its main drawback is that it is more expensive.

There are two types of fiber-optic cables:

Single-mode fiber (SMF) – uses only a single ray of light to carry data. Used for larger distances.

Multi-mode fiber (MMF) – uses multiple rays of light to carry data. Less expensive than SMF.

Bluetooth :

Bluetooth physical layer consists of baseband and radio specifications as defined in IEEE 802.15.1.

Bluetooth network is composed of one master and one to seven slave devices. This small region is referred as piconet. Once master device selects channel with frequency hopping sequence and time to transmit, the same is used by other devices also in the same piconet. One bluetooth device of piconet can also exist and function as either master or slave in the other nearby biconet, this overlapping region is referred as scatternet[1][5].

	BLUETOOTH V2.1	BLUETOOTH 4.0 (LE)	BLUETOOTH 5 (LE)
Range	Up to 100 m	Up to 100 m	Up to 400 m
Max range (free field)	Around 100 m (class 2 outdoors)	Around 100 m (outdoors)	Around 1,000m (outdoors)
Frequency	2.402 – 2.481 GHz	2.402 – 2.481 GHz	2.402 - 2.481 GHz
Max data rate	1- 3 Mbit/s	1 Mbit/s	2 Mbit/s
Application Troughput	0.7-2.1 Mbit/s	Up to 305 kbit/s	Up to 1,360 kbit/s
Topologies	Point-to-point, scatternet	Point-to-point, mesh network	Point-to-point, mesh network

Visible Light Communication :

Visible light communication refers to shortrange optical wireless communication using visible light spectrum from 380 to 780 nm. Enabled by recent advances in LED technology, IEEE 802.15.7 supports high-data-rate visible light communication up to 96 Mb/s by fast modulation of optical light sources which may be dimmed during their operation. IEEE 802.15.7 provides dimming adaptable mechanisms for flicker-free high-data-rate visible light communication[1].

Transfer jet Physical Layer :

TransferJet is a close proximity wireless transfer technology initially proposed by Sony and demonstrated publicly in early 2008.By touching (or bringing very close together) two electronic devices, TransferJet allows high speed exchange of data. The concept of

TransferJet consists of a touch-activated interface which can be applied for applications requiring high-speed data transfer between two devices in a peer-to-peer mode without the need for external physical connectors[1].

TransferJet's maximum physical layer transmission rate is 560 Mbit/s. After allowing for error correction and other protocol overhead, the effective maximum throughput is 375 Mbit/s. TransferJet will adjust the data rate downward according to the wireless environment, thereby maintaining a robust link even when the surrounding wireless condition fluctuates

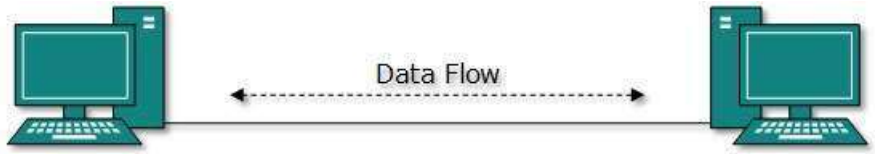
Center Frequency	4.48 GHz
Transmission Power	At or below -70 dBm/MHz (average) Corresponds to low-intensity radio wave regulation in Japan, and with local regulations in other countries and regions.
Transmission Rate	560 Mbps (max) / 375 Mbps (effective throughput) System can adjust the transmission rate depending on the wireless environment.
Connection Distance	A few centimeters
Topology	1-to-1, Point-to-point
Antenna Element	Electric induction field coupler

Network Topology :

A Network Topology is the arrangement with which computer systems or network devices are connected to each other. Topologies may define both physical and logical aspect of the network. Both logical and physical topologies could be same or different in a same network[3].

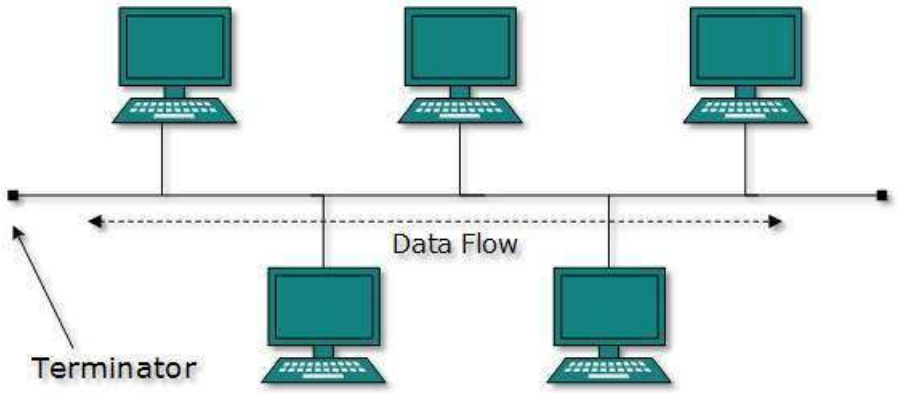
Point-to-Point

Point-to-point networks contains exactly two hosts such as computer, switches or routers, servers connected back to back using a single piece of cable. Often, the receiving end of one host is connected to sending end of the other and vice-versa.



Bus Topology

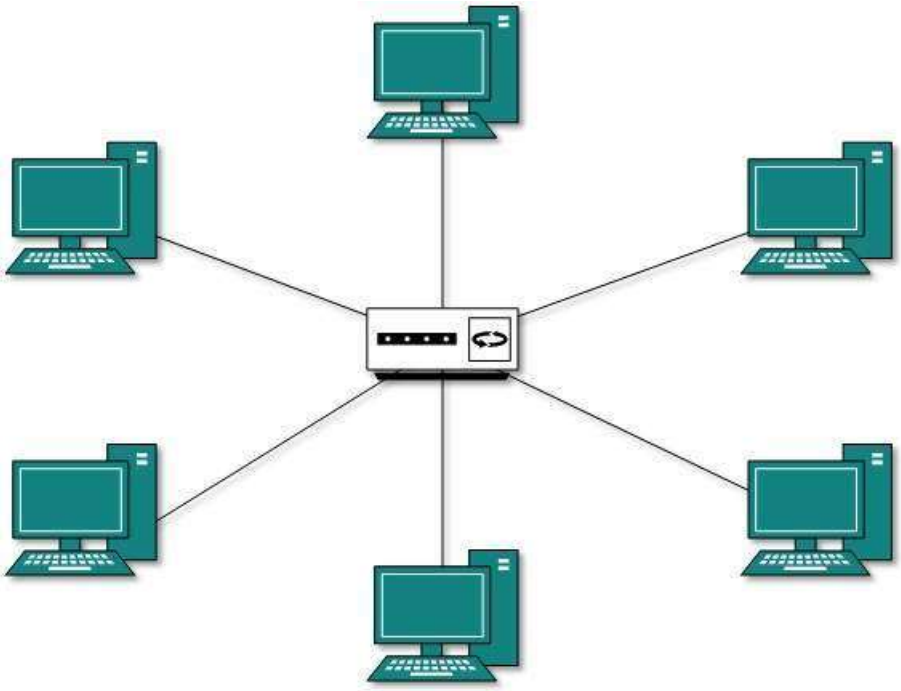
In case of Bus topology, all devices share single communication line or cable.Bus topology may have problem while multiple hosts sending data at the same time. Therefore, Bus topology either uses CSMA/CD technology or recognizes one host as Bus Master to solve the issue. It is one of the simple forms of networking where a failure of a device does not affect the other devices. But failure of the shared communication line can make all other devices stop functioning.



Star Topology

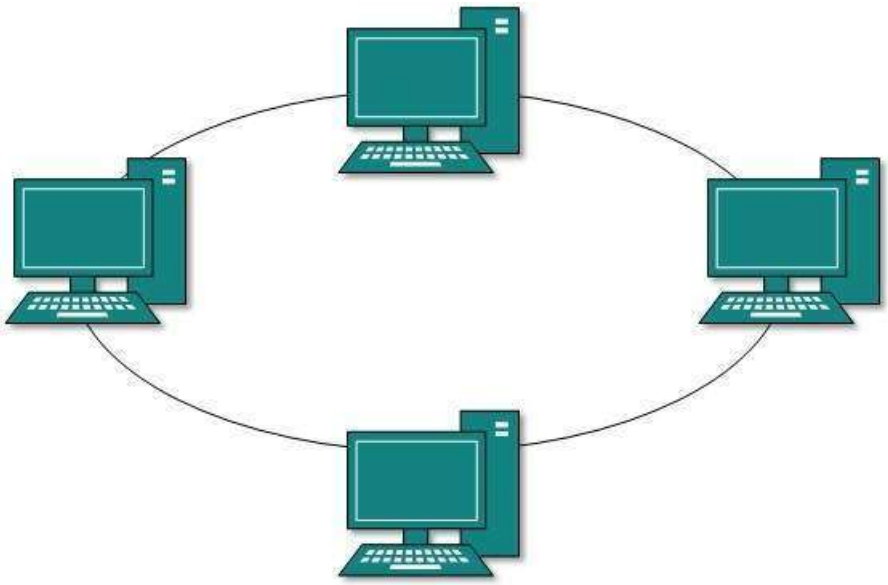
All hosts in Star topology are connected to a central device, known as hub device, using a point-to-point connection. That is, there exists a point to point connection between hosts and hub. The hub device can be any of the following:

- Layer-1 device such as hub or repeater
- Layer-2 device such as switch or bridge
- Layer-3 device such as router or gateway



Ring Topology

In ring topology, each host machine connects to exactly two other machines, creating a circular network structure. When one host tries to communicate or send message to a host which is not adjacent to it, the data travels through all intermediate hosts. To connect one more host in the existing structure, the administrator may need only one more extra cable



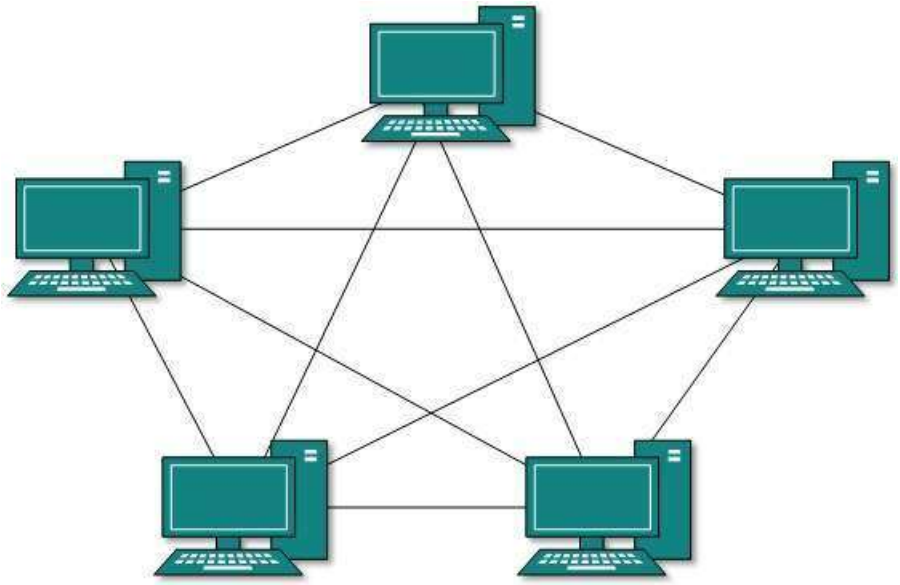
Mesh Topology

In this type of topology, a host is connected to one or multiple hosts.This topology has hosts in point-to-point connection with every other host or may also have hosts which are in point-to-point connection to few hosts only.

Hosts in Mesh topology also work as relay for other hosts which do not have direct point-to-point links. Mesh technology comes into two types:

- Full Mesh: All hosts have a point-to-point connection to every other host in the network. Thus for every new host n(n-1)/2 connections are required. It provides the most reliable network structure among all network topologies.

- Partially Mesh: Not all hosts have point-to-point connection to every other host. Hosts connect to each other in some arbitrarily fashion. This topology exists where we need to provide reliability to some hosts out of all.

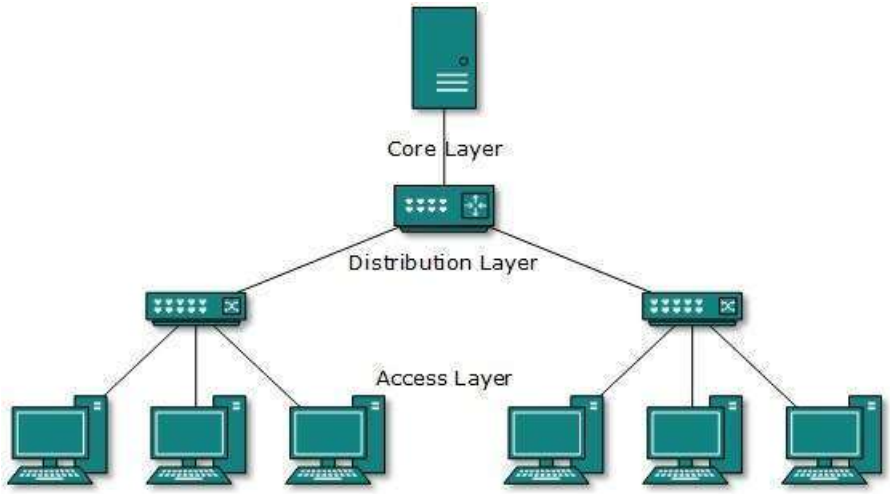


Tree Topology

Also known as Hierarchical Topology, this is the most common form of network topology in use presently.This topology imitates as extended Star topology and inherits properties of bus topology.

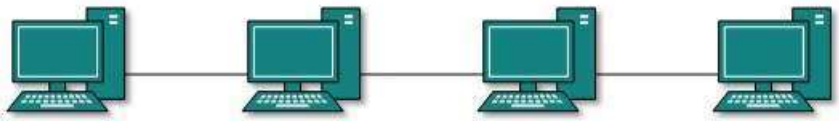
This topology divides the network in to multiple levels/layers of network. Mainly in LANs, a network is bifurcated into three types of network devices. The lowermost is access-layer where computers are attached. The middle layer is known as distribution

layer, which works as mediator between upper layer and lower layer. The highest layer is known as core layer, and is central point of the network, i.e. root of the tree from which all nodes fork.



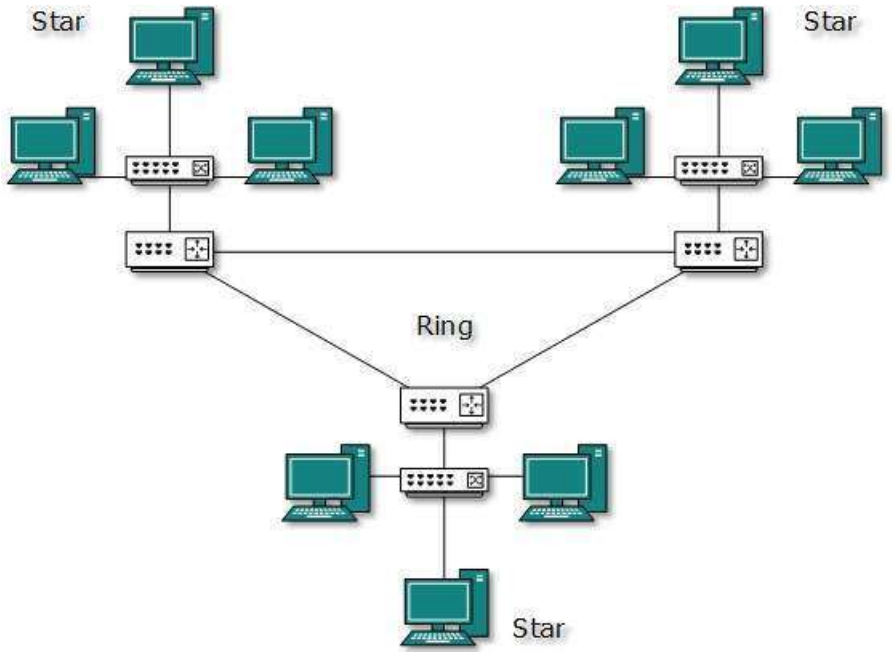
Daisy Chain

This topology connects all the hosts in a linear fashion. Similar to Ring topology, all hosts are connected to two hosts only, except the end hosts.Means, if the end hosts in daisy chain are connected then it represents Ring topology.



Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid topology. Hybrid topology inherits merits and demerits of all the incorporating topologies.



Types of Networks :

1. Personal Area Network (PAN)

The smallest and most basic type of network, a PAN is made up of a wireless modem, a computer or two, phones, printers, tablets, etc., and revolves around one person in one building. These types of networks are typically found in small offices or residences, and are managed by one person or organization from a single device[6].PAN can be implemented using bluetooth, Wi-Fi, USB.

2. Local Area Network (LAN)

We're confident that you've heard of these types of networks before – LANs are the most frequently discussed networks, one of the most common, one of the most original and one of the simplest types of networks. LANs connect groups of computers and low-voltage devices together across short distances (within a building or between a group of two or three buildings in close proximity to each other) to share information and resources. Enterprises typically manage and maintain LANs[6].LAN can be implemented using Ethernet.

Using routers, LANs can connect to wide area networks to rapidly and safely transfer data.

3. Wireless Local Area Network (WLAN)

Functioning like a LAN, WLANs make use of wireless network technology, such as Wi-Fi. Typically seen in the same types of applications as LANs, these types of networks don't require that devices rely on physical cables to connect to the network[6].WLAN can

be implemented using Wi-Fi.

4. Campus Area Network (CAN)

Larger than LANs, but smaller than metropolitan area networks (MANs, explained below), these types of networks are typically seen in universities, large K-12 school districts or small businesses. They can be spread across several buildings that are fairly close to each other so users can share resources[6].CAN can be implemented using Optical Fibre, Transfer Jet.

5. Metropolitan Area Network (MAN)

These types of networks are larger than LANs but smaller than WANs – and incorporate elements from both types of networks. MANs span an entire geographic area (typically a town or city, but sometimes a campus). Ownership and maintenance is handled by either a single person or company (a local council, a large company, etc.)[6].MAN can be implemented using modems and cables.

6. Wide Area Network (WAN)

Slightly more complex than a LAN, a WAN connects computers together across longer physical distances. This allows computers and low-voltage devices to be remotely connected to each other over one large network to communicate even when they're miles apart[6].

The Internet is the most basic example of a WAN, connecting all computers together around the world. Because of a WAN's vast reach, it is typically owned and maintained by multiple administrators or the public.WAN can be implemented using microwaves, optical fibres and satellites.

7. Storage-Area Network (SAN)

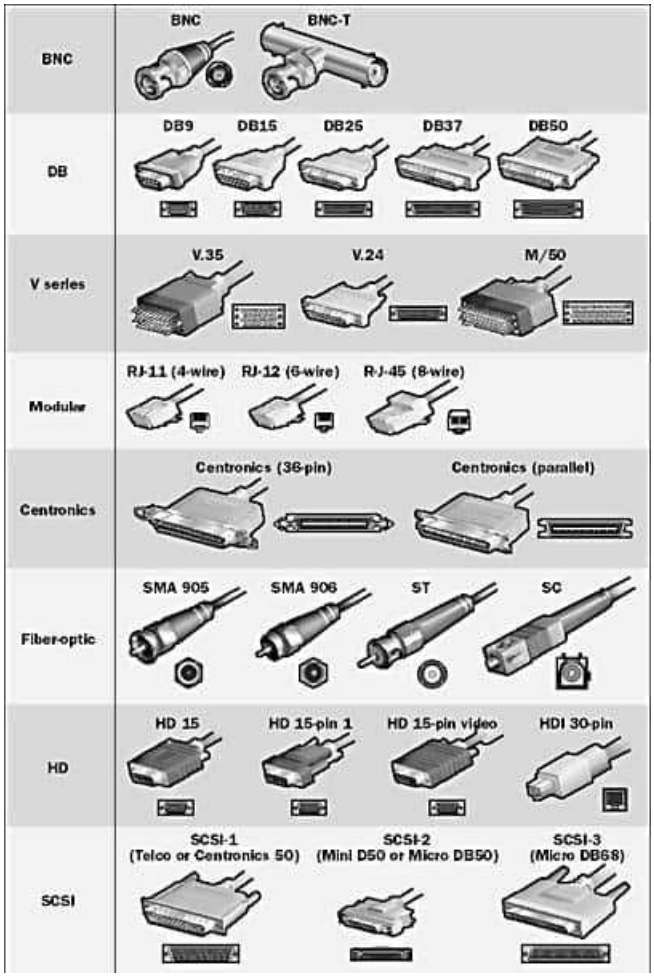
As a dedicated high-speed network that connects shared pools of storage devices to several servers, these types of networks don't rely on a LAN or WAN. Instead, they move storage resources away from the network and place them into their own high-performance network. SANs can be accessed in the same fashion as a drive attached to a server. Types of storage-area networks include converged, virtual and unified SANs[6].SAN can be implemented using optical fibre.

8. Passive Optical Local Area Network (POLAN)

As an alternative to traditional switch-based Ethernet LANs, POLAN technology can be integrated into structured cabling to overcome concerns about supporting traditional Ethernet protocols and network applications such as PoE (Power over Ethernet)[6]. A point-to-multipoint LAN architecture, POLAN uses optical splitters to split an optical signal from one strand of singlemode optical fiber into multiple signals to serve users and devices.

Physical Connector :

A device that terminates a segment of cabling or provides a point of entry for networking devices such as computers, hubs, and routers. Connectors can be distinguished according to their physical appearance and mating properties, such as jacks and plugs (male connectors) or sockets and ports (female connectors)[2].



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