Experiment - 1

Aim : Introduction to Local Area Network with its cables, connectors and topologies

Appaartus Required : Cables, Connectors and topologies

Hardware Required : PC, connector, Lan Cable, Lan Trainer Kit LAN Card Cable, Connectors, HUB, Switch and Crimping Tools

Software Required : Visual Studio.net, Windows 2003 server/Windows 2000 server

Theory:

Network : A network is a collection of computers, servers, mainframes, network devices, peripherals, or other devices connected\to allow data sharing. An example of a network is the Internet, which connects millions of people all over the world. To the right is an example image of a home network with multiple computers and other network devices all connected.

Local Area Network : A local area network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home. A LAN can be small or large, ranging from a home network with one user to an enterprise network with thousands of users and devices in an office or school.
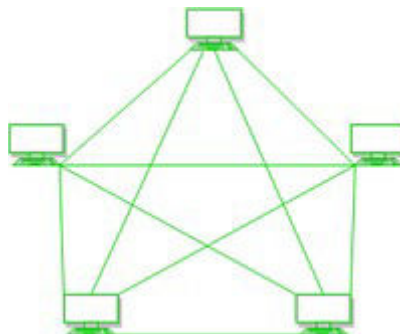
Network Topologies : A network topology is the physical and logical arrangement of nodes and connections in a network. Nodes usually include devices such as switches, routers and software with switch and router features. Network topologies are often represented as a graph.

Types of Network Topologies :

The arrangement of a network that comprises nodes and connecting lines via sender and receiver is referred to as network topology. The various network topologies are:

Mesh Topology:
In a mesh topology, every device is connected to another device via a particular channel. In Mesh Topology, the protocols used are AHCP (Ad Hoc Configuration Protocols), DHCP (Dynamic Host Configuration Protocol), etc.

Star topology:

Star topology is **a type of network topology in which every device in the network is individually connected to a central node, known as the switch or hub**. When represented visually, this topology resembles a star which gives it its name.

Star Topology
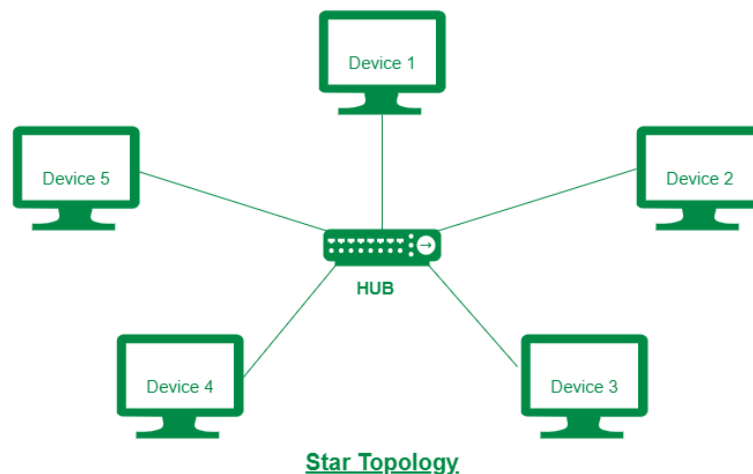
Bus topology:

Bus topology, also known as line topology, is **a type of network topology in which all devices in the network are connected by one central RJ-45 network cable or coaxial cable**. The single cable, where all data is transmitted between devices, is referred to as the bus, backbone, or trunk.
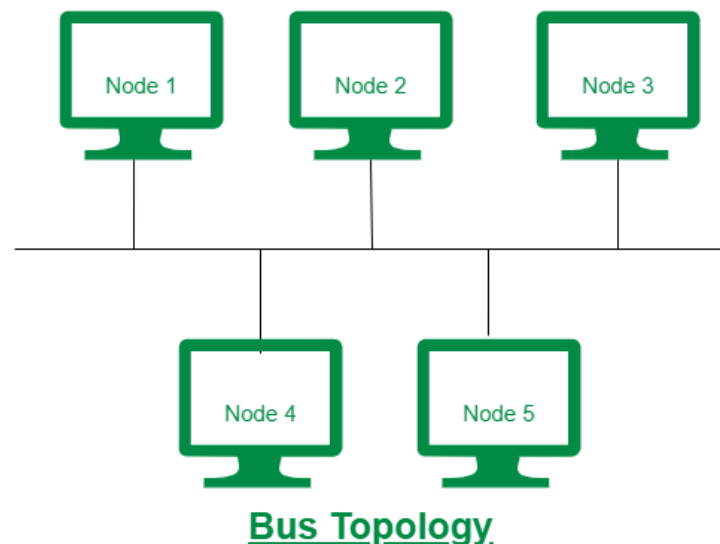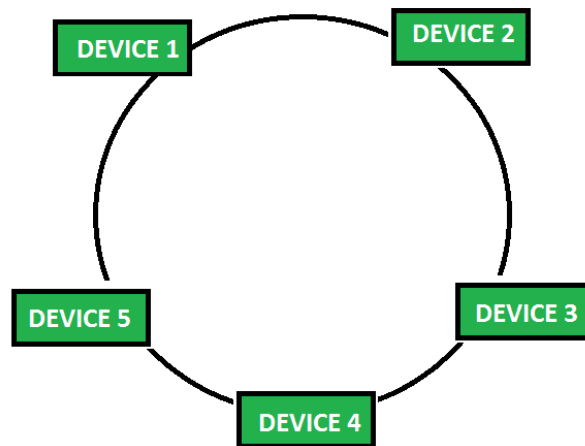

Bus Topology

Ring Topology:

In this topology, it forms a ring connecting devices with exactly two neighboring devices.

A number of repeaters are used for Ring topology with a large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have

to pass through 99 nodes to reach the 100th node. Hence to prevent dataloss repeaters are used in the network.

The data flows in one direction, i.e.., it is unidirectional, but itcan be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology. In-Ring Topology, theToken Ring Passing protocol is used by the workstations to transmit the data.

Tree Topology :
This topology is the variation of the Star topology. This topology has a hierarchical flow of data. In Tree Topology, SAC (Standard Automatic Configuration) protocols like DHCP and SAC are used.
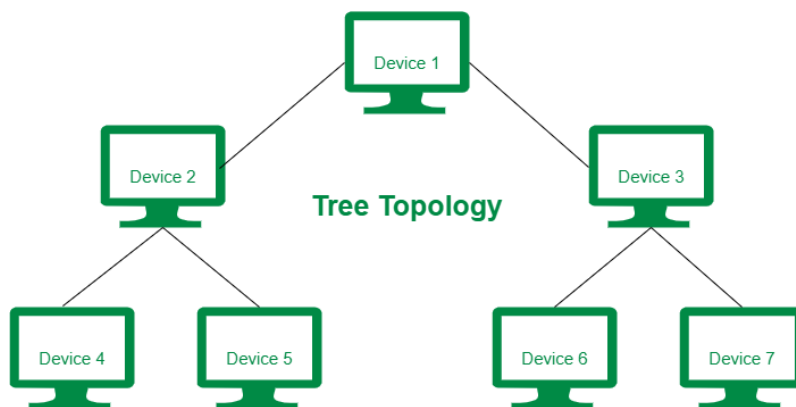
Hybrid Topology :
This topology technology is the combination of all the various typesof topologies we have studied above. It is used when the nodes are free to take any form. It means these can be individuals such as Ring or Star topology or can be a combination of various types of topologies seen above. Each individual topology uses the protocol that has been discussed earlier.
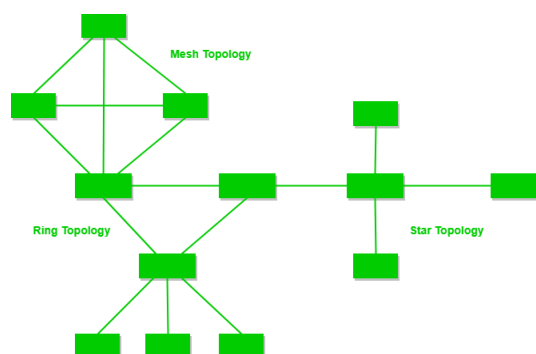

Figure - A Hybrid Topology

Transmission media

Wired

1. Coaxial Cables: A coaxial cable is used to carry high-frequency electrical signals with low losses. It uses 10Base2 and 10Base5 Ethernet variants. It has a copper conductor in the middle that is surrounded by a dielectric insulator usually made of PVC or Teflon. The dielectric insulator is surrounded by a braided conducting metallic shield which reduces EMI (Electromagnetic Interference) of the metal and outside interference; and finally, the metallic shield is covered by a plastic covering called a sheath usually made of PVC or some other fire-resistant plastic material. Its maximum transmission speed is 10 Mbps. It is usually used in telephone systems, cable TV, etc.
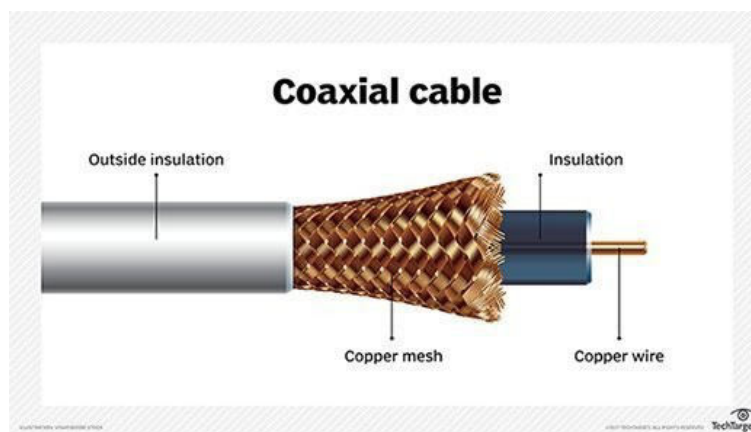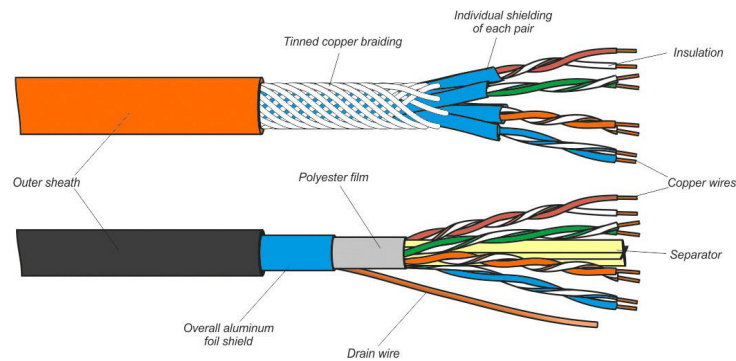

Advantages
1. Coaxial cables support high bandwidth.
2. It is easy to install coaxial cables.
3. coaxial cables have better cut-through resistance so they are more reliable and durable.
4. Less affected by noise or cross-talk or electromagnetic inference.
5. Coaxial cables support multiple channels

Disadvantages
1. Coaxial cables are expensive.
2. The coaxial cable must be grounded in order to prevent any crosstalk.
3. As a Coaxial cable has multiple layers it is very bulky.
4. There is a chance of breaking the coaxial cable and attaching a "t-joint" by hackers, this compromises the security of the data.

2. Twisted Pair Cable: Twisted pair is a copper wire cable in which two insulated copper wires are twisted around each other to reduce interference or crosstalk. It uses 10BASE-T, 100BASE-T, and some other newer ethernet variants. It uses RJ-45 connectors.
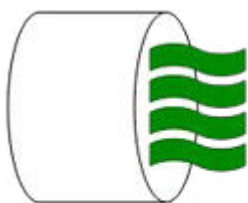
Advantages of Twisted pair cable :

- It are often wont to carry both analog and digital data.
- It's relatively easy to implement and terminate.
- It is the smallest amount expensive media of transmission for brief distances.
- If portion of a twisted pair cable is broken it doesn't effect the whole network.
- Less vulnerable to electrical interference caused by nearby equipment or wires.
- It cause interference themselves.
- Best performance in short distances.
- High-cost performance
- The twisted-pair cable is low in weight.
- Twisted pair cable is flexible to use
- Twisted Pair cable is easy to connect.
- These cable are suitable for Data and voice infrastructure.

Disadvantages of Twisted pair cable :

- It result signal distortion in a very effective manner.
- Attenuation is very high.
- It supports 10 mbps upto a distance of 100 meters on a 10BASE-T which are considered to be low bandwidth.
- It provides poor security and is relatively easy to tap.
- As they a thin so can be easily breakable.
- Low durability (must be maintained regularly).
- Susceptible to electromagnetic interference (EMI).

2.a Unshielded Twisted Pair (UTP):
UTP consists of two insulated copper wires twisted around one another. This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.
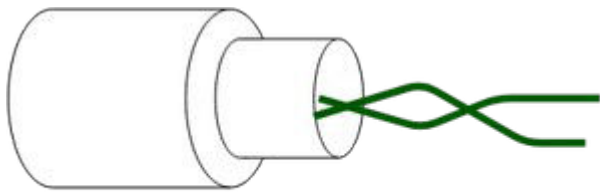

Unshielded Twisted Pair

Advantages:

⇢ Least expensive

⇢ Easy to install

⇢ High-speed capacity

Disadvantages:

⇢ Susceptible to external interference

⇢ Lower capacity and performance in comparison to STP

⇢ Short distance transmission due to attenuation

2.b Shielded Twisted Pair (STP):
This type of cable consists of a special jacket (a copper braid covering or a foil shield) to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.

Shielded Twisted Pair

Advantages:

⇢ Better performance at a higher data rate in comparison to UTP

⇢ Eliminates crosstalk

⇢ Comparatively faster

Disadvantages:

⇢ Comparatively difficult to install and manufacture

⇢ More expensive

⇢ Bulky

3. Fiber Optic Cable: Fiber optic cables use optical fibers which are made of glass cores surrounded by several layers of cladding material usually made of PVC or Teflon, it transmits data in the form of light signals due to which there are no interference issues in fiber optics. Fiber optics can transmit signals over a very long distance as compared to twisted pairs or coaxial cables. It uses 10BaseF, 100BaseFX, 100BaseBX, 100BaseSX, 1000BaseFx, 1000BaseSX, and 1000BaseBx ethernet variants. Hence, it is capable of carrying information at a great speed.

Advantages

- Bandwidth is above copper cables
- Less power loss and allows data transmission for extended distances
- Optical cable is resistance for electromagnetic interference
- Fiber cable is sized as 4.5 times which is best than copper wires
- As cable are lighter, thinner, in order that they use less area as compared to copper wires
- Installation is extremely easy thanks to less weight.
- Optical fiber cable is extremely hard to tap because they don't produce electromagnetic energy. These optical fiber cables are very secure for transmitting data.
- This cable opposes most acidic elements that hit copper wired also are flexible in nature.
- Optical fiber cable are often made cheaper than equivalent lengths of copper wire.
- Light has fastest speed within universe, such a lot faster signals
- Fiber optic cables allow much more cable than copper twisted pair cables.
- Fiber optic cables have how more bandwidth than copper twisted pair cables.

Disadvantages

- These cable are very difficult to merge so there'll be loss of beam within cable
- Installation of those cables is cost-effective. they're not as robust because wires. Special equipment is typically required to optical fiber.
- These cable are highly vulnerable while fitting
- These cables are more delicate than copper wires.
- Special devices are needed to ascertain transmission of fiber cable.
- Fiber optic cable is dear to put in. It needs costly splicing machines and trained specialists to place in fiber optic cables.

Wireless LANs

More and more networks are operating without cables, in the wireless mode. Wireless LANs use high frequency radio signals, infrared light beams, or lasers to communicate between the workstations, servers, or hubs. Each workstation and file server on a wireless network has
some sort of transceiver/antenna to send and receive the data. Information is relayed between transceivers as if they were physically connected. For longer distance, wireless communications an also take place through cellular telephone technology, microwave transmission, or by satellite.

broadcast of infrared transmissions sent out in multiple directions that bounces off walls and ceilings until it eventually hits the receiver. Networking communications with laser are virtually the same as line-of-sight infrared networks.

Wireless standards and speeds

The Wi-Fi Alliance is a global, non-profit organization that helps to ensure standards and interoperability for wireless networks, and wireless networks are often referred to as WiFi (Wireless Fidelity).The original Wi-Fi standard (IEEE 802.11) was adopted in 1997. Since then many variations have emerged (and will continue to emerge). Wi- Fi networks use the Ethernet protocol.

Standard Max Speed Typical Range

802.11a 54 Mbps 150 feet
802.11b 11 Mbps 300 feet
802.11g 54 Mbps 300 feet
802.11n 100 Mbps 300+ feet

Advantages :

1. **Freedom from wires:** Can be configured with the use of any physical connection.
2. **Easy to setup:** Wireless network is easy to expand and setup
3. **Better or global coverage:** It provides global reach by providing networking in places such as rural areas, battlefields, etc… where wiring is not feasible.
4. **Flexibility:** Wireless network is more flexible and adaptable compared to a wired network.
5. **Cost-effectiveness:** Since it is easy to install and doesn't require cables, the wireless network is relatively cheaper.
6. **Mobile and portable:** Wireless network is easy to carry and re-install in another place.
7. **Mobility -:** It has good mobility of usage.
8. **Data transmission is fast:** In wireless network data transmission is fast.
9. **Low maintenance:** In any wireless communication low maintenance cost.
10. It can be **accessed from anywhere and anytime**. for ex. professional can complete their work from remote location.
11. **Network planning**: Network planning in wireless communication is vey easy as compare to wired network due to wireless software configuration of frequency, power and other parameter.
12. **Expandable:** Wireless networks can server a large number of client without resorting the new hardware.

Disadvantages :

1. As communication is done through open space, it is less secure.
2. Unreliability
3. More open to interference.

4. Increased chance of jamming.
5. Transmission speed is comparably less.
6. it has a limited amount of bandwidth for communication and breaches of network security.
7. Wireless networks can be easily hacked.
8. Wireless networks require a careful radio frequency when they are installed.
9. Wireless networks are usually inexpensive, but the cost of installation is very high, setting up a wireless network is very costly.
10. Difficult to set up little experience people.