GLS University

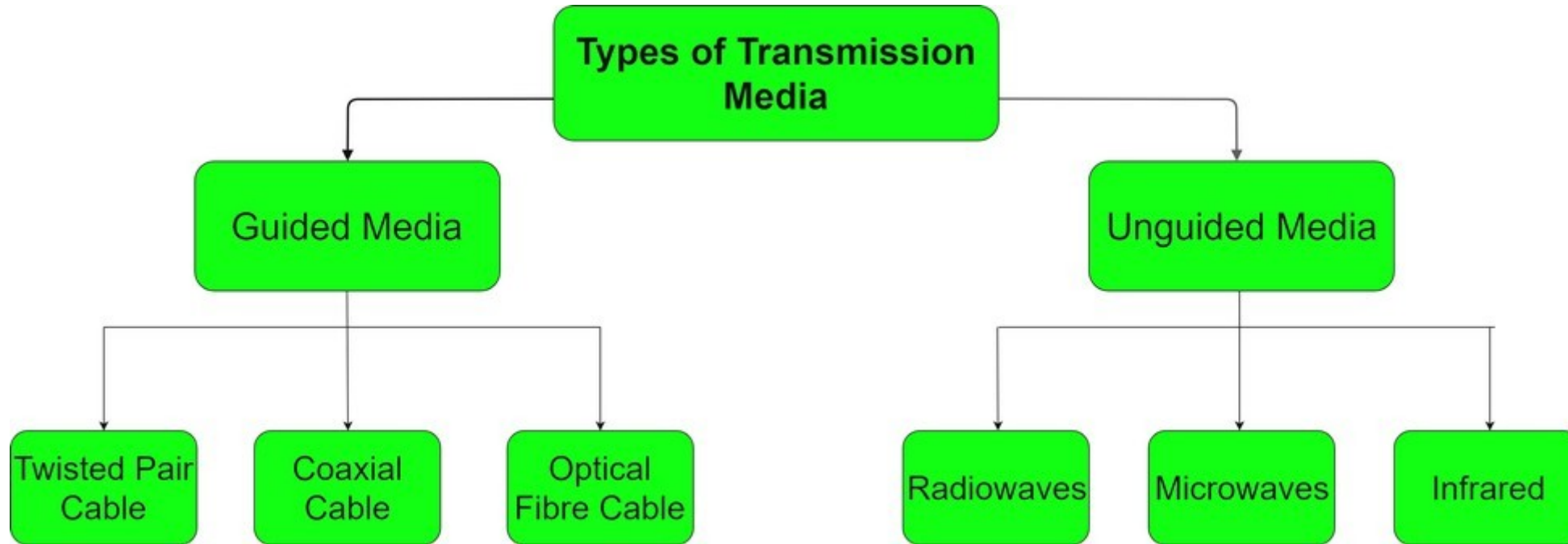# Data Communication & Networking (DCN) SY BCA Sem-4

UNIT -3

Transmission Media

"A transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one device to another".

Transmission Media is broadly classified into the following types:

Transcription Media

- Guided media is based on physical cable . **Twisted pair and coaxial cable** carry signal in form of **electric current** and **fiber optics** carry signal in the form of **light.**
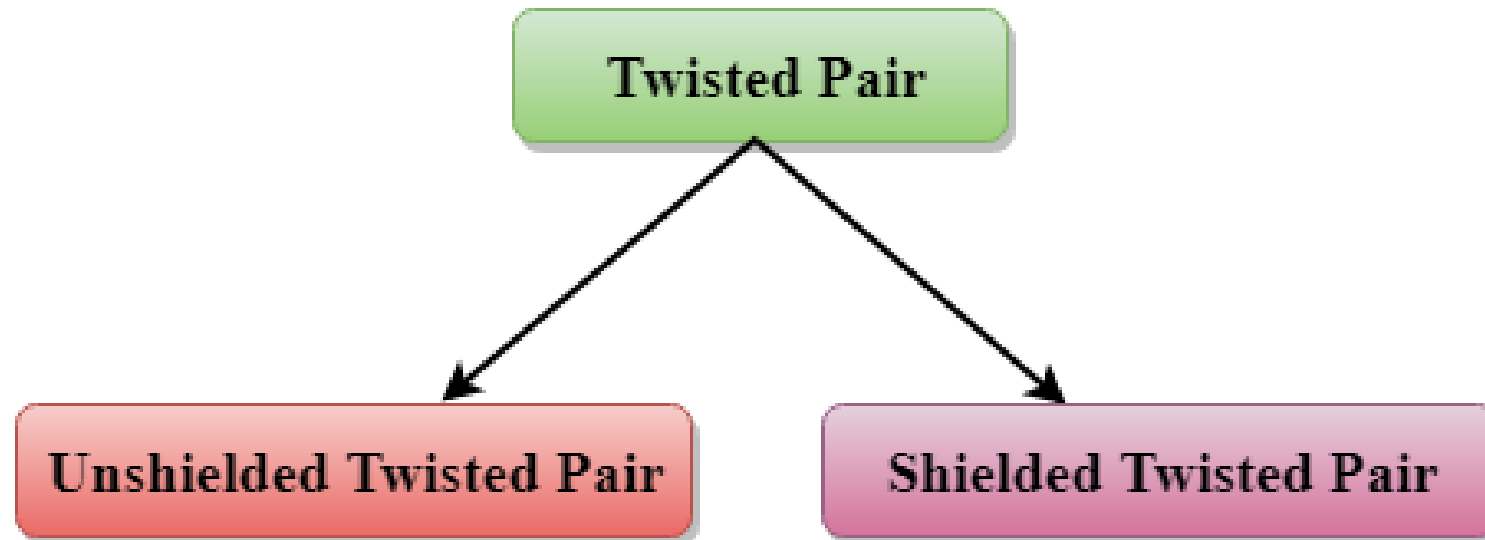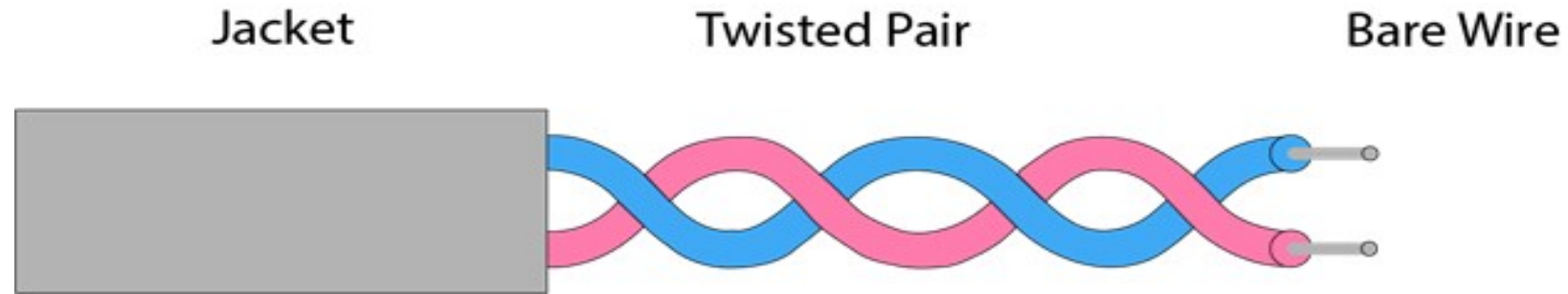
GUIDED MEDIA

► **Twisted-Pair Cable:**

 Twisted pair is a physical media made up of a pair of cables twisted with each other. A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable.

The frequency range for twisted pair cable is from 0 to 3.5KHz.

A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.

GUIDED MEDIA

Jacket

Twisted Pair

Bare Wire

Twisted Pair

Unshielded Twisted Pair

Shielded Twisted Pair

Guided Media- Unshielded Twisted Pair

Copper wires are the most common wires for data transmission due to its low cost and better performance.

They can carry voice as well as data signals.

An unshielded twisted pair is widely used in telecommunication.

Following are the categories of the unshielded twisted pair cable:
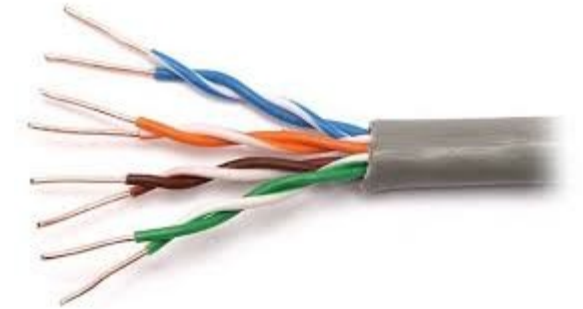
Category 1: Category 1 is used for telephone lines that have low-speed data.

Category 2: It can support upto 4Mbps.

Category 3: It can support upto 16Mbps.

Category 4: It can support upto 20Mbps. Therefore, it can be used for long-distance communication.

Category 5: It can support upto 200Mbps.

UTP of higer categories are also used in computer networks due to high speed and reliability.

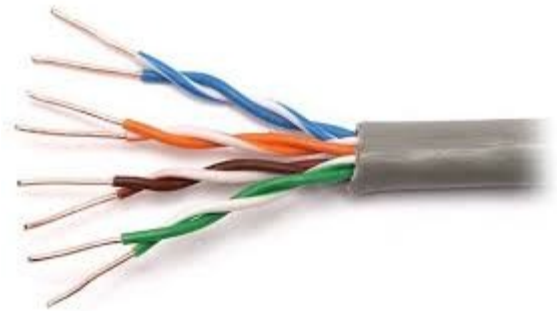# Guided Media- Unshielded Twisted Pair

Advantages:

It is cheap.

Installation of the unshielded twisted pair is easy.

It can be used for high-speed LAN.

Disadvantage:

This cable can only be used for shorter dista
because of attenuation.

Guided Media- Shielded Twisted Pair

A shielded twisted pair is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.

In this, the twisted pair wire itself is carried by a metal shield, and finally by a plastic cover.

The metal shield prevents penetration of electromagnetic noise, it helps to eliminate crosstalk.

Shielded Twisted Pair Cable

Guided Media- Shielded Twisted Pair

Characteristics Of Shielded Twisted Pair:

The cost of the shielded twisted pair cable is not very high and not very low.

An installation of STP is easy.

It has higher capacity as compared to unshielded twisted pair cable.

It has a higher attenuation.

It is shielded that provides the higher data transmission rate.

Guided Media- Shielded Twisted Pair

Disadvantages

It is more expensive as compared to UTP and coaxial cable.

It has a higher attenuation rate.
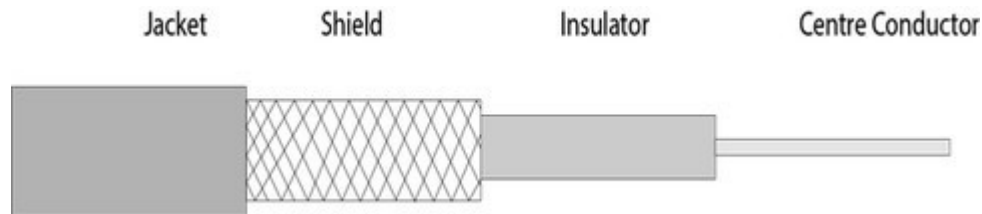
Guided Media- Coaxial Cable

Coaxial Cable:

Coaxial cable also called coax.

Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.

It has an inner central conductor surrounded by an insulating sheath, which in turn is enclosed in an outer conductor.

Then outer conductor is covered by a plastic cover.

Guided Media- Coaxial Cable

Coaxial Cable:

As compared to UTP or STP, coaxial cable is more expensive, less flexible and

more difficult to install in a building where a number of twists and turns are

required.

Coaxial cables are divided into various categories depending upon the thickness

and size of the shields, insulator and the outer coating, etc.

They are commonly used by cable companies to carry cable transmission.

Various coaxial cable standards are RG-8, RG-9, RG-11, RG-58 and RG-59

Guided Media- Coaxial Cable

Coaxial Cable:

Advantages Of Coaxial cable:

The data can be transmitted at high speed.

It has better shielding as compared to twisted pair cable.

It provides higher bandwidth.

Disadvantages Of Coaxial cable:

It is more expensive as compared to twisted pair cable.

If any fault occurs in the cable causes the failure in the entire network.

Guided Media- Optical Fiber

Optical Fiber:

Light is used as means of signal propogation, instead of electrical signals.

Optical fibres are made up of glass fibres that are enclosed in a plastic jacket, which allows fibres to bend and not break.

Fibre optics provide faster data transmission than copper wires.

A transmitter at the sender's end of the optical fiber sends a light emitting diode (LED) or laser to send pulses of light across the fiber.

A receiver at the other end makes use of a light-sensitive transistor to detect the absence or presence of light indicates a 0 or 1.
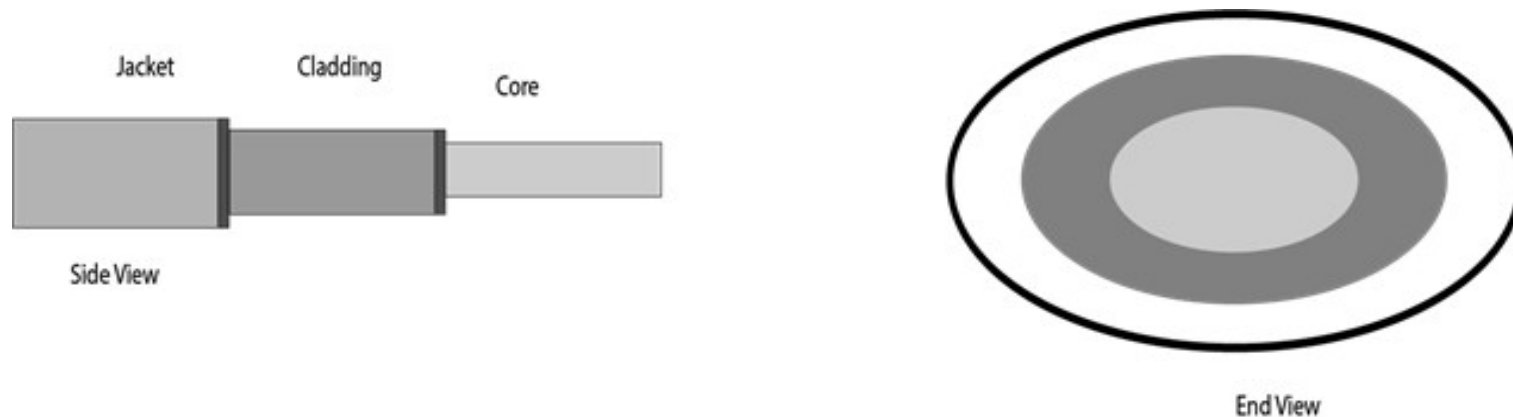
Guided Media- Optical Fiber

Basic elements of Fibre optic cable:

Core: The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.

Cladding: The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.

Jacket: The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

Guided Media- Optical Fiber

- Following are the advantages of fibre optic cable over copper:

- **Greater Bandwidth**: The fibre optic cable provides more bandwidth as compared copper. Therefore, the fibre optic carries more data as compared to copper cable.

- **Faster speed:** Fibre optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.

- **Longer distances**: The fibre optic cable carries the data at a longer distance as compared to copper cable.

- **Better reliability:** The fibre optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.

- **Thinner and Sturdier:** Fibre optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

Unguided Media

- Unguided media is a type of Transmission Media.

- A transmission medium is a physical path between the transmitter and the receiver.

- Unguided media transport electromagnetic waves without using a physical conductor.

- It is also known as unbounded or wireless media, and does not rely on physical pathways to transmit signals.

- Instead, they use wireless communication methods to propagate signals through the air or free space.

Unguided Media-Microwaves
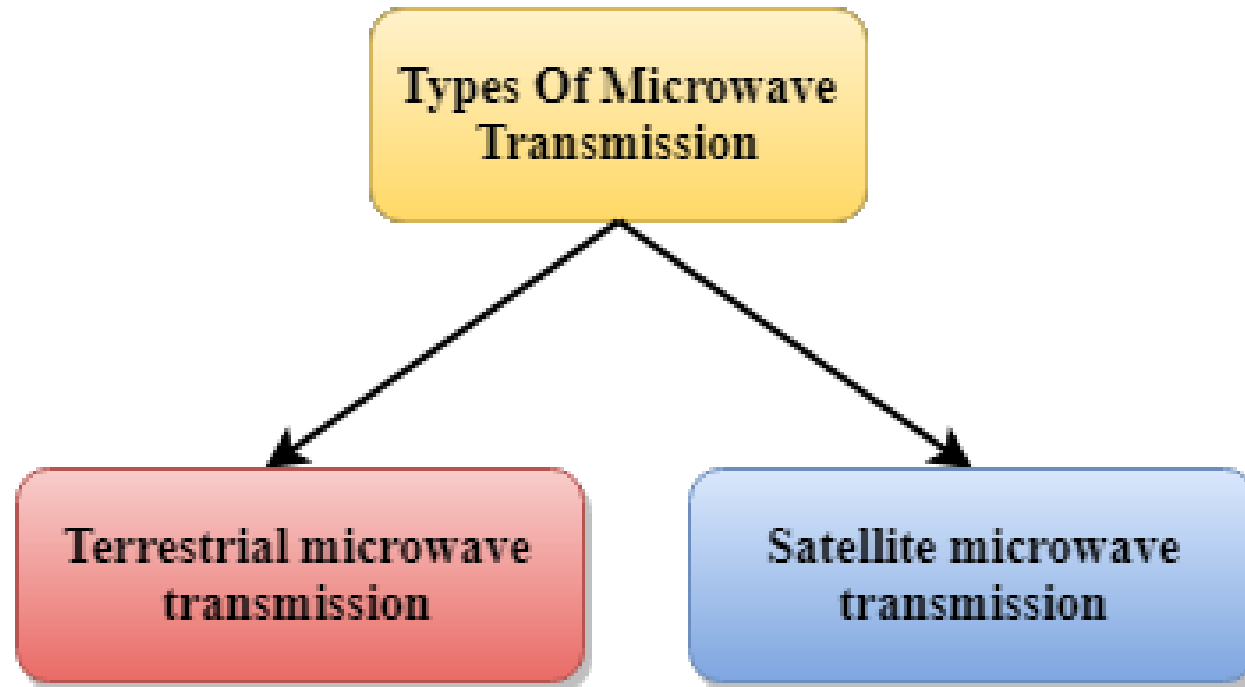
UNGUIDED MEDIA-MICROWAVE

Terrestrial Microwave Transmission

 Terrestrial Microwave transmission is a technology that transmits the focused beam of a radio signal from one ground-based microwave transmission antenna to another.

 Microwaves are the electromagnetic waves having the frequency in the range from 1GHz to 1000 GHz.

 Microwaves are unidirectional as the sending and receiving antenna is to be aligned, i.e., the waves sent by the sending antenna are narrowly focussed.

 In this case, antennas are mounted on the towers to send a beam to another antenna which is km away.

 It works on the line of sight transmission, i.e., the antennas mounted on the towers are the direct sight of each other.

UNGUIDED MEDIA-MICROWAVE

Characteristics of Microwave:

Frequency range: The frequency range of terrestrial microwave is from 4-6 GHz to 21-23 GHz.

Bandwidth: It supports the bandwidth from 1 to 10 Mbps.

Short distance: It is inexpensive for short distance.

Long distance: It is expensive as it requires a higher tower for a longer distance.

Attenuation: Attenuation means loss of signal. It is affected by environmental conditions and antenna size.

UNGUIDED MEDIA-MICROWAVE

Satellite Microwave Communication

 A satellite is a physical object that revolves around the earth at a known height.

Satellite communication is more reliable nowadays as it offers more flexibility than cable and fibre optic systems.

We can communicate with any point on the globe by using satellite communication.

UNGUIDED MEDIA-MICROWAVE

Advantages Of Satellite Microwave Communication:

 The coverage area of a satellite microwave is more than the terrestrial microwave.

 The transmission cost of the satellite is independent of the distance from the centre of the coverage area.

 Satellite communication is used in mobile and wireless communication applications.

 It is easy to install.

 It is used in a wide variety of applications such as weather forecasting, radio/TV signal broadcasting, mobile communication, etc..

UNGUIDED MEDIA-MICROWAVE

Disadvantages Of Satellite Microwave Communication:

Satellite designing and development requires more time and higher cost.

The Satellite needs to be monitored and controlled on regular periods so that it remains in orbit.

The life of the satellite is about 12-15 years.

UNGUIDED MEDIA-SATELLITE COMMUNICATION

Satellite communication is transporting information from one place to another using a communication satellite in orbit around the Earth.

A communication satellite is an artificial satellite that transmits the signal via a transponder by creating a channel between the transmitter and the receiver at different Earth locations.

Telephone, radio, television, internet, and military applications use satellite communications.

UNGUIDED MEDIA-SATELLITE COMMUNICATION
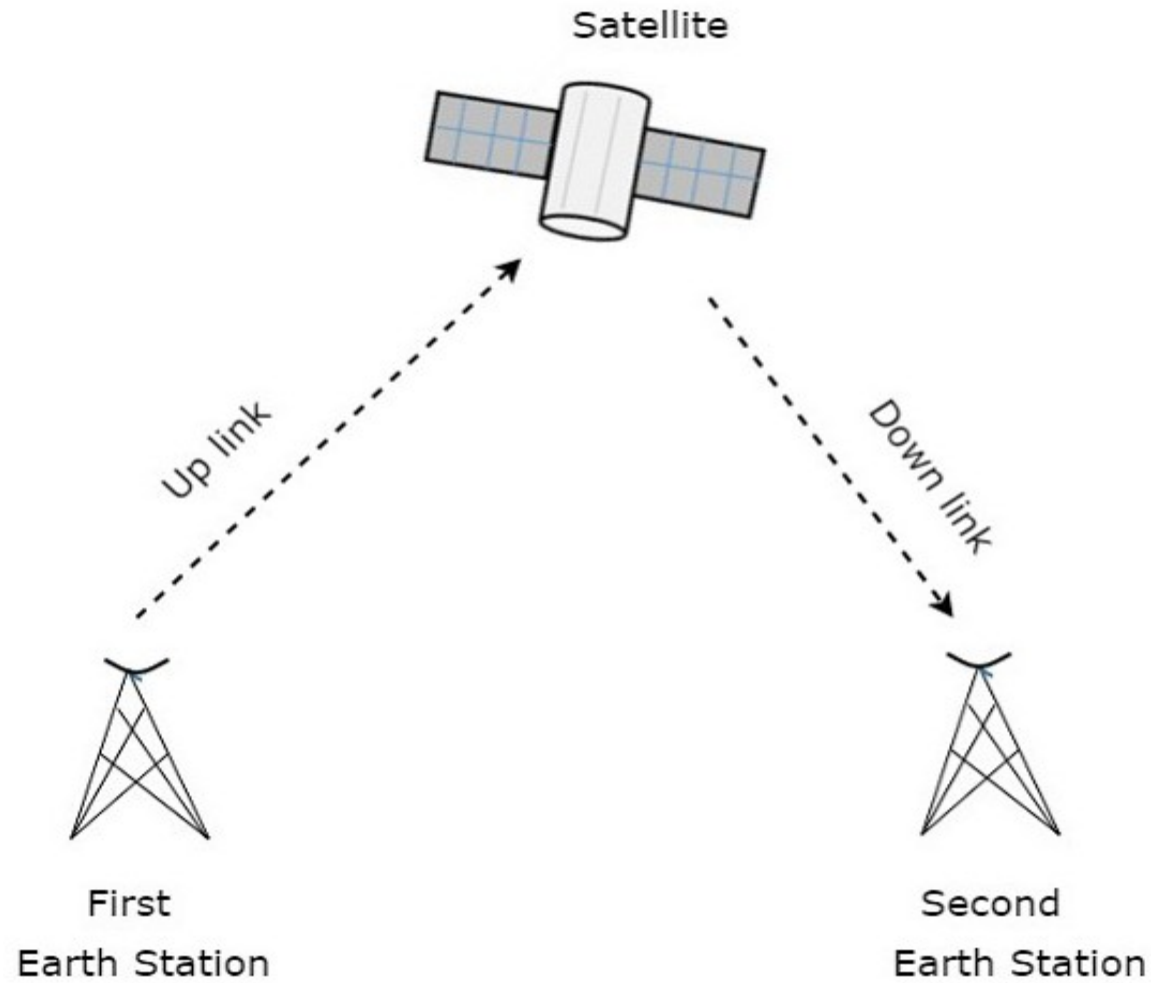
UNGUIDED MEDIA-WORKING OF SATELLITE COMMUNICATION

Let's consider an example of signals from a television.

In the first stage, the signal from the television broadcast on the other side of the earth is first beamed up to the satellite from the ground station on the earth.

This process is known as **uplink**.

The second stage involves **transponders** such as radio receivers, amplifiers, and transmitters.

These transponders boost the incoming signal and change its frequency so that the outgoing signals are not altered. Depending on the incoming signal sources, the transponders vary.

The final stage involves a **downlink** in which the data is sent to the other end of the receiver on the earth.

It is important to understand that usually, there is **one uplink and multiple downlinks.**

UNGUIDED MEDIA-CELLULAR TELEPHONES

Cellular telephone system

Cellular telephones use small antennas and low-powered radio transmitters and receivers to send information to cellular towers.

These towers are connected to a central switching station, which then connects to the rest of the telephone system.

UNGUIDED MEDIA-CELLULAR TELEPHONES

Cellular telephones use unguided media to transmit information between the phone and the cellular tower.

The atmosphere acts as the transmission medium for cellular calls.

Geographic areas are divided into cells, each served by a base station.

Each cell is assigned radio frequencies that are reused in non-neighboring cells to increase coverage and capacity.

UNGUIDED MEDIA-CELLULAR TELEPHONES

When a mobile user moves between cells, a mobile switching center hands off the call from one base station to another to avoid disconnection.
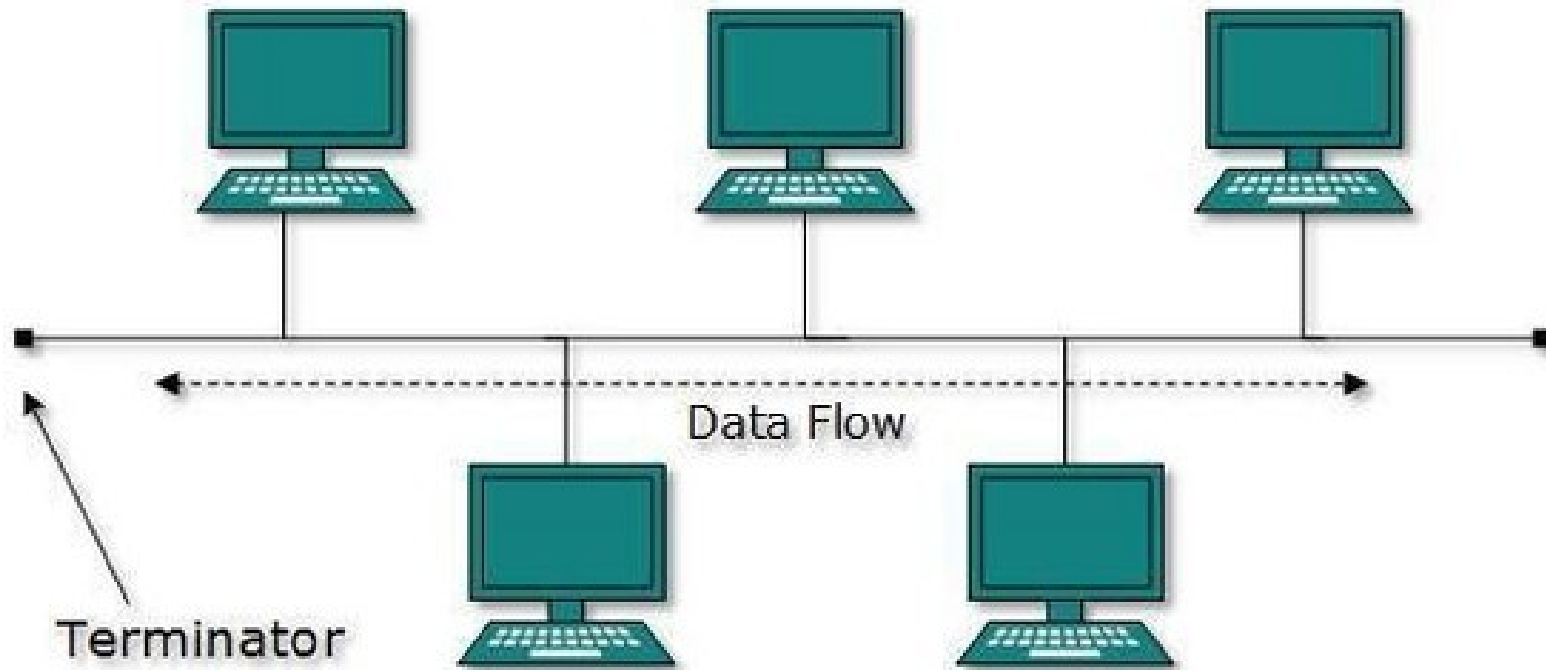
NETWORK TOPOLOGY

Bus

Star

Ring

Tree

Mesh

Hybrid

BUS TOPOLOGY

Data Flow

Terminator

BUS TOPOLOGY

It transmits data only in one direction.
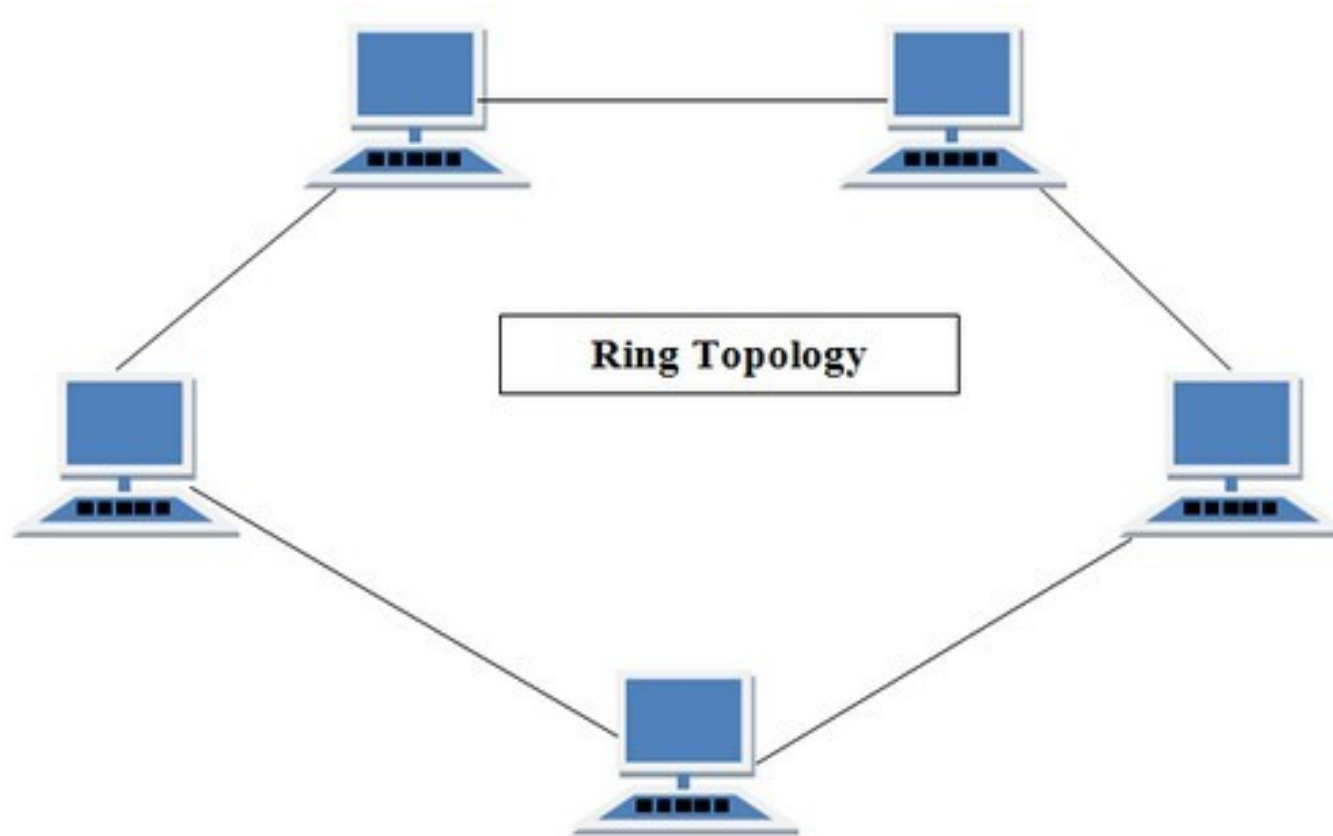Every device is connected to a single cable

Advantages
–Easy to implement
–Cheaper
–Cost effective
–Weight reduction

Disadvantages
–Limited cable and no of stations
–Cables fails then whole network fails
–Maintenance is higher
–Significant capacitive load

RING TOPOLOGY

Ring Topology

RING TOPOLOGY

Each packet is sent around the ring until it reaches its final destination

Advantages
–Each device has access
–Better than star topology
–Can create large network
–Doesnt require network server

Disadvantages
–Troubleshooting is difficult
- Adding or deleting the computers disturbs the network activity.
–Failure of one computer disturbs the whole network.

STAR TOPOLOGY
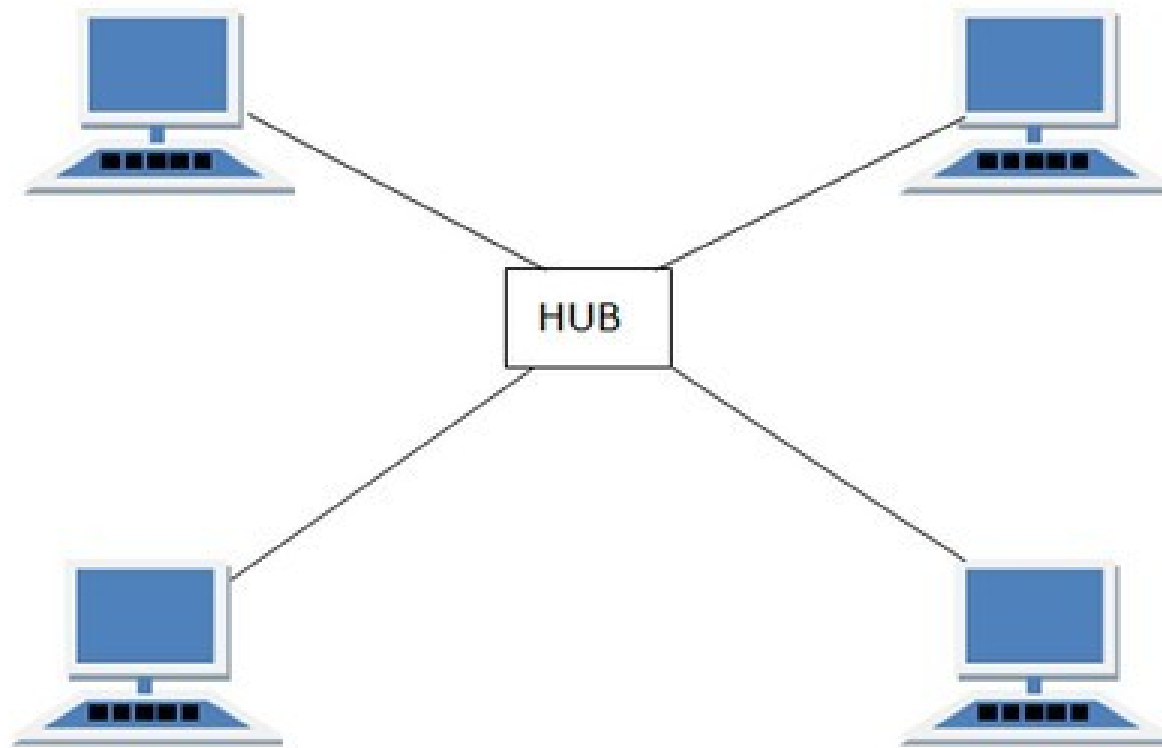
STAR TOPOLOGY

Every node has its own dedicated connection to the hub.
●Hub acts as a repeater for data flow.
●Can be used with twisted pair, Optical Fibre or coaxial cable.

Advantages
–Better & Fast performance with few nodes and low network traffic.
–Isolation(separation) of devices, Hub can be upgraded easily.
–Easy to troubleshoot.
–Benifits from centralization
–Easy to setup and modify.
–Only that node is affected which has failed, rest of the nodes can work smoothly.

STAR TOPOLOGY

Disadvantages

–High Dependence
–Network size is limited
–Cost of installation is high.
–Expensive to use.
–Physical Complexity
–If the hub fails then the whole network is stopped because all the nodes depend on the hub

MESH TOPOLOGY
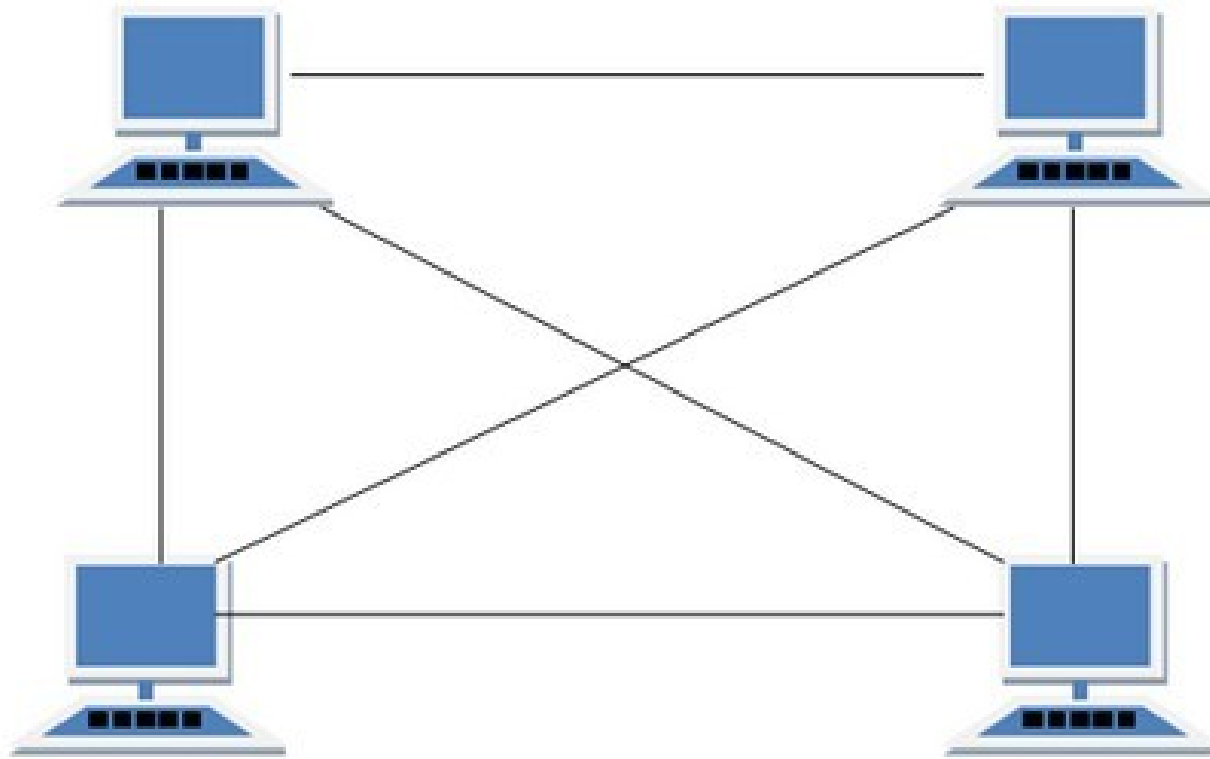
MESH TOPOLOGY

Advantages
–Provide redundent paths
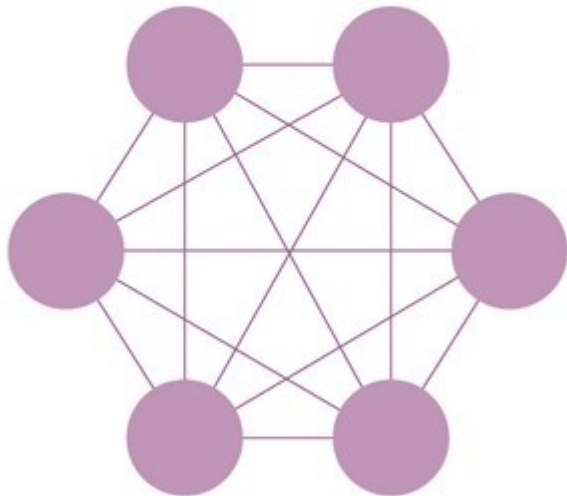–Network can be expanded without disruption to current Users

Disadvantages
–Requires more cable than other LAN topologies
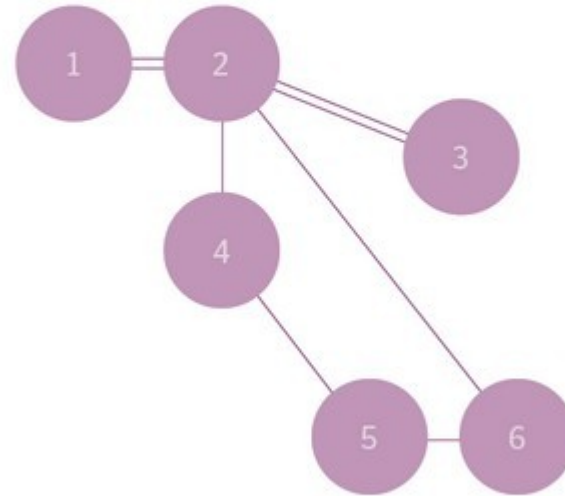–Complicated implementation
–Difficult to detect fault

FULL vs PARTIAL MESH TOPOLOGY

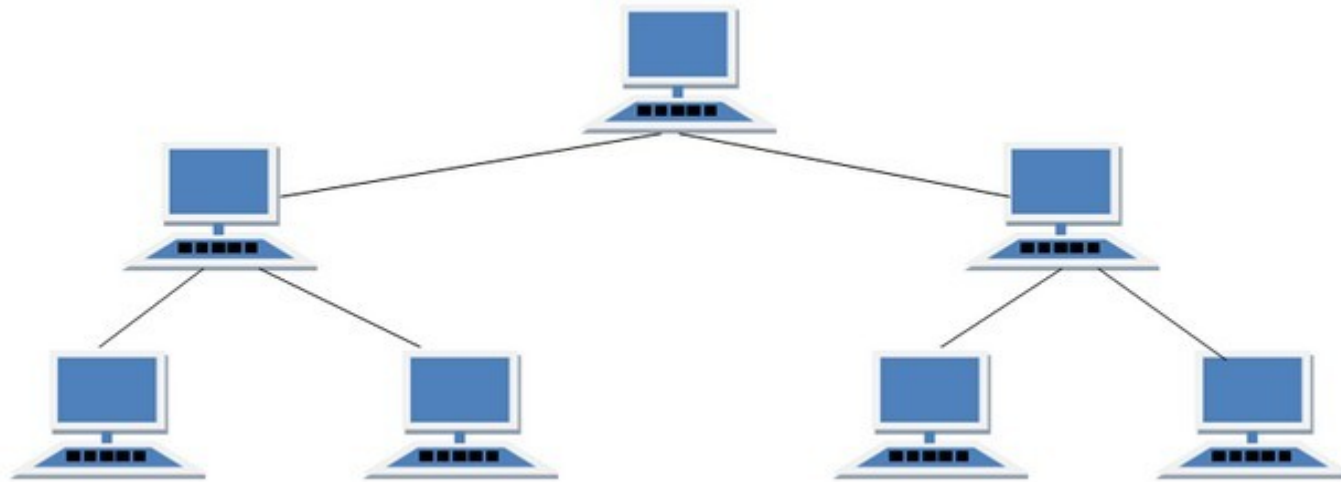
Full vs. partial mesh networks

FULL vs PARTIAL MESH TOPOLOGY

In a full mesh network topology, each node is connected directly to all the other nodes.

In a partial mesh topology, only some nodes connect directly to one another.

In some cases, a node must go through another node to reach a third node.

TREE TOPOLOGY

Ideal if workstations are located in groups.
Used in Wide Area Network.

FULL vs PARTIAL MESH TOPOLOGY

Advantages

–Point to point connection is possible

–Access to imidiate networks

–Best for branched out networks

Disadvantages

–Length is depend on type of cable

–Dependent on the main computer

–Difficult to configure

HYBRID TOPOLOGY

A hybrid topology is a type of network topology that uses two or more differing network topologies.

These topologies can include a mix of bus topology, mesh topology, ring topology, star topology, and tree topology.

The choice to use a hybrid topology over a standard

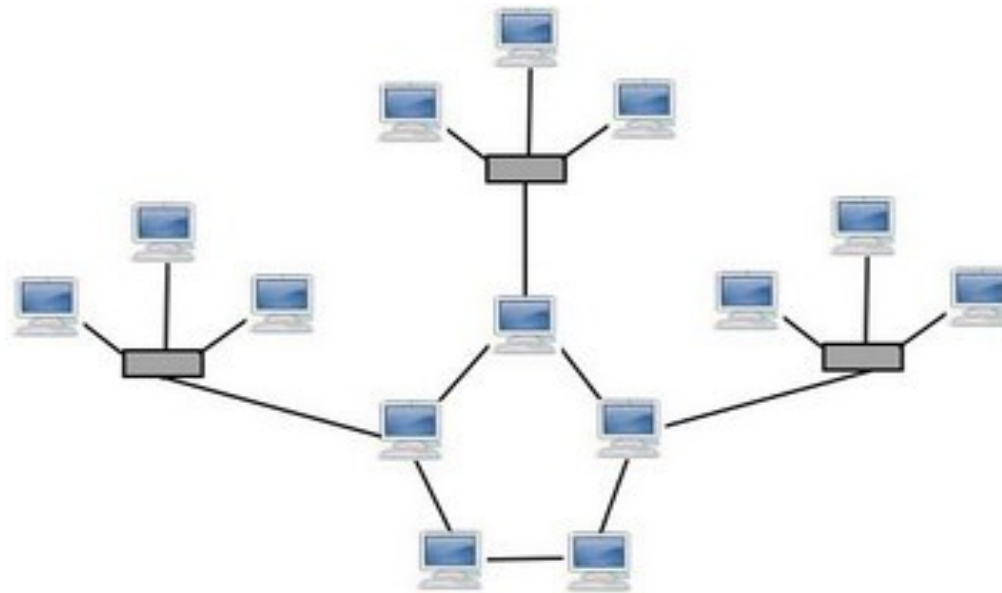topology depends on the needs of a business, school, or

the users.

The number of computers, their location, and

desired network performance are all factors in the

decision.

Star-Ring hybrid topology

A star-ring hybrid topology is a combination of the star topology and ring topology.

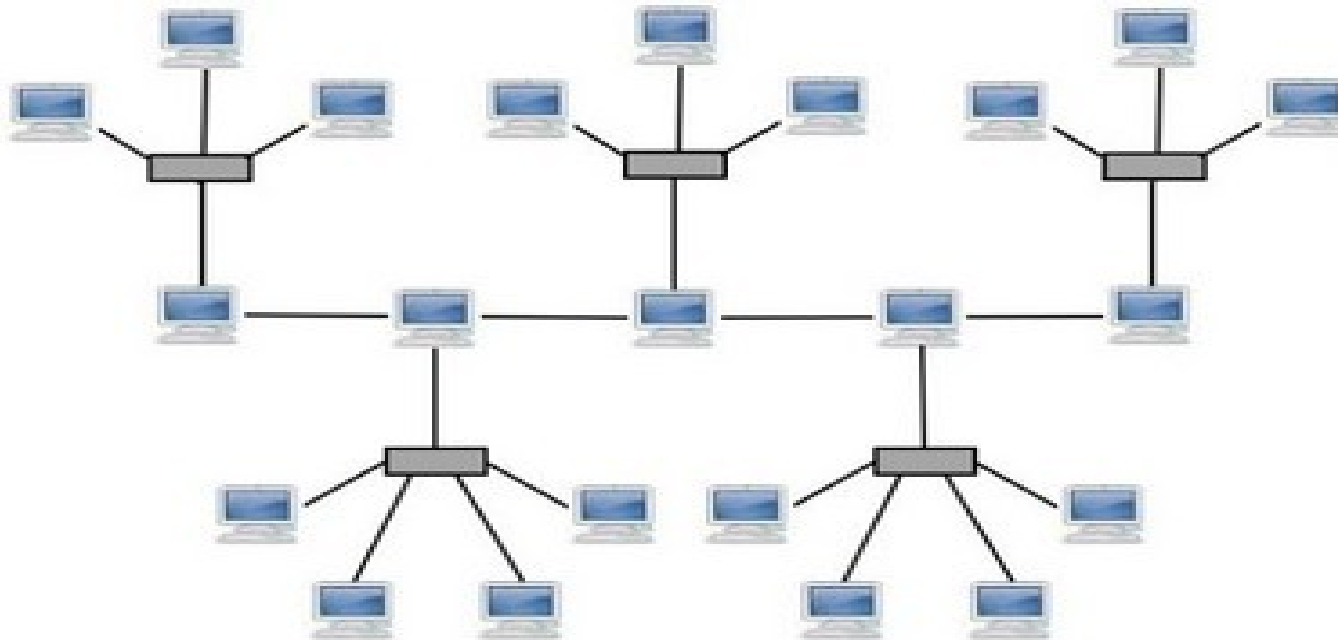Two or more star topologies are connected together through a ring topology.

Star-Bus hybrid topology

A star-bus hybrid topology is a combination of the star topology and bus topology.

Two or more star topologies are connected together through a bus topology.

ADVANTAGES OF HYBRID TOPOLOGY

This type of topology combines the benefits of different types of topologies in one topology.

Can be modified as per requirement.

It is extremely flexible.

It is very reliable.

It is easily scalable as Hybrid networks are built in a fashion which enables easy integration of new hardware components.

Error detecting and troubleshooting are easy.

Handles a large volume of traffic.

It is used to create large networks.

The speed of the topology becomes fast when two topologies are put together.

DISADVANTAGES OF HYBRID TOPOLOGY

It is a type of network expensive.

The design of a hybrid network is very complex.

There is a change in the hardware to connect one topology with another topology.

Usually, hybrid architectures are larger in scale so they require a lot of cables in the installation process.

Hubs which are used to connect two distinct networks are very costly. And hubs are different from usual hubs as they need to be intelligent enough to work with different architectures.

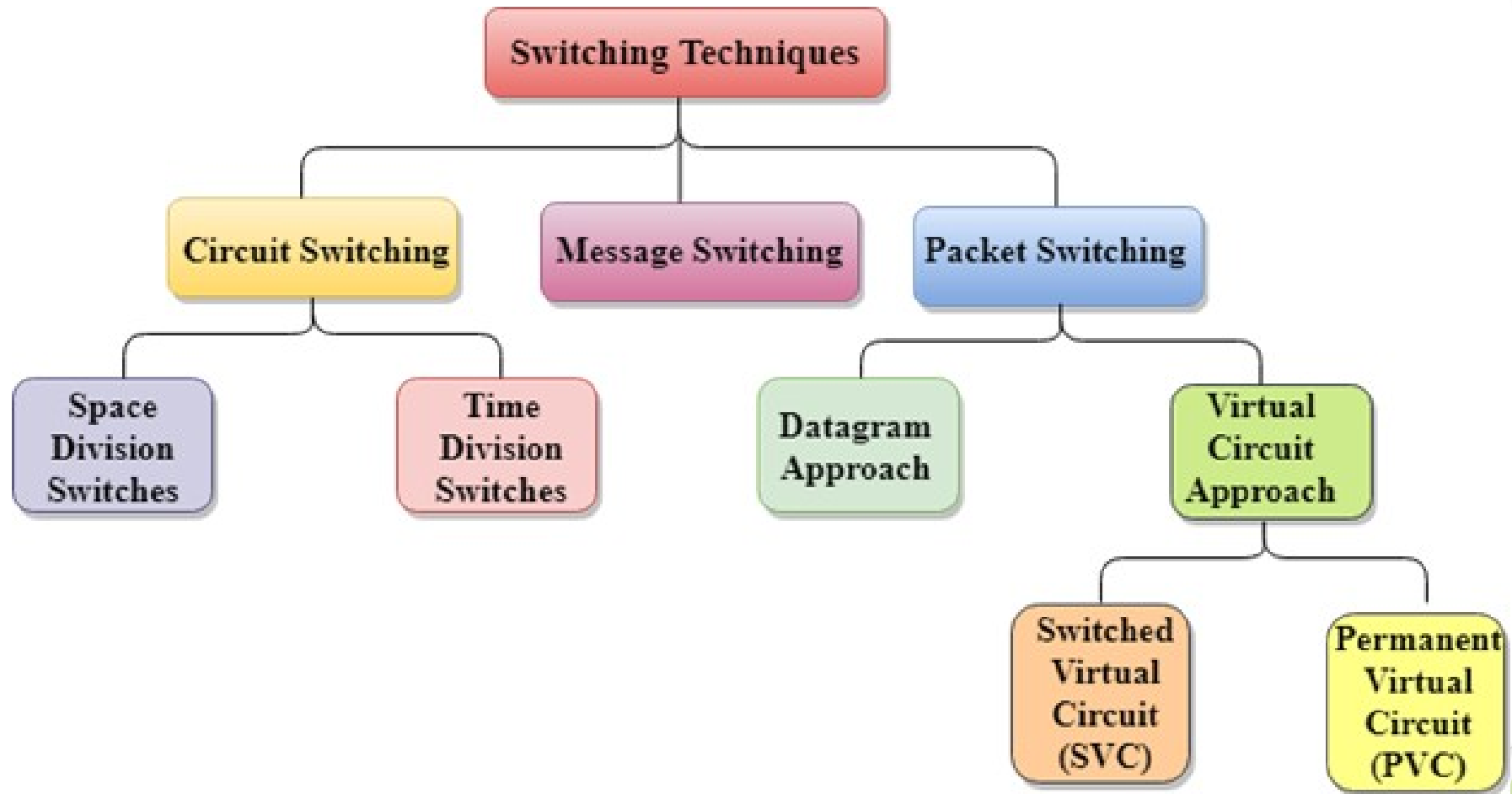Installation is a difficult process.

SWITCHING

In large networks, there can be multiple paths from sender to receiver.

The switching technique will decide the best route for data transmission.

Switching technique is used to connect the systems for making one-to-one communication.

TYPES OF SWITCHING

SWITCHING-CIRCUIT SWITCHING

Circuit switching is a switching technique that establishes a dedicated path between sender and receiver.

In the Circuit Switching Technique, once the connection is established then the dedicated path will remain to exist until the connection is terminated.

Circuit switching in a network operates in a similar way as the telephone works.

A complete end-to-end path must exist before the communication takes place.

In case of circuit switching technique, when any user wants to send the data, voice, video, a request signal is sent to the receiver then the receiver sends back the acknowledgment to ensure the availability of the dedicated path.

After receiving the acknowledgment, dedicated path transfers the data.

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SWITCHING-CIRCUIT SWITCHING

Advantages Of Circuit Switching:

In the case of Circuit Switching technique, the communication channel is dedicated.

It has fixed bandwidth.

SWITCHING-CIRCUIT SWITCHING

Disadvantages Of Circuit Switching:

Once the dedicated path is established, the only delay occurs in the speed of data transmission.

It takes a long time to establish a connection approx 10 seconds during which no data can be transmitted.

It is more expensive than other switching techniques as a dedicated path is required for each connection.

It is inefficient to use because once the path is established and no data is transferred, then the capacity of the path is wasted.

In this case, the connection is dedicated therefore no other data can be transferred even if the channel is free.

SWITCHING-MESSAGE SWITCHING

Message Switching:

Message Switching is a switching technique in which a message is transferred as a complete unit and routed through intermediate nodes at which it is stored and forwarded.

In Message Switching technique, there is no establishment of a dedicated path between the sender and receiver.

The destination address is appended to the message.

Message Switching provides a dynamic routing as the message is routed through the intermediate nodes based on the information available in the message.

Message switches are programmed in such a way so that they can provide the most efficient routes.

Each and every node stores the entire message and then forward it to the next node. This type of network is known as store and forward network.

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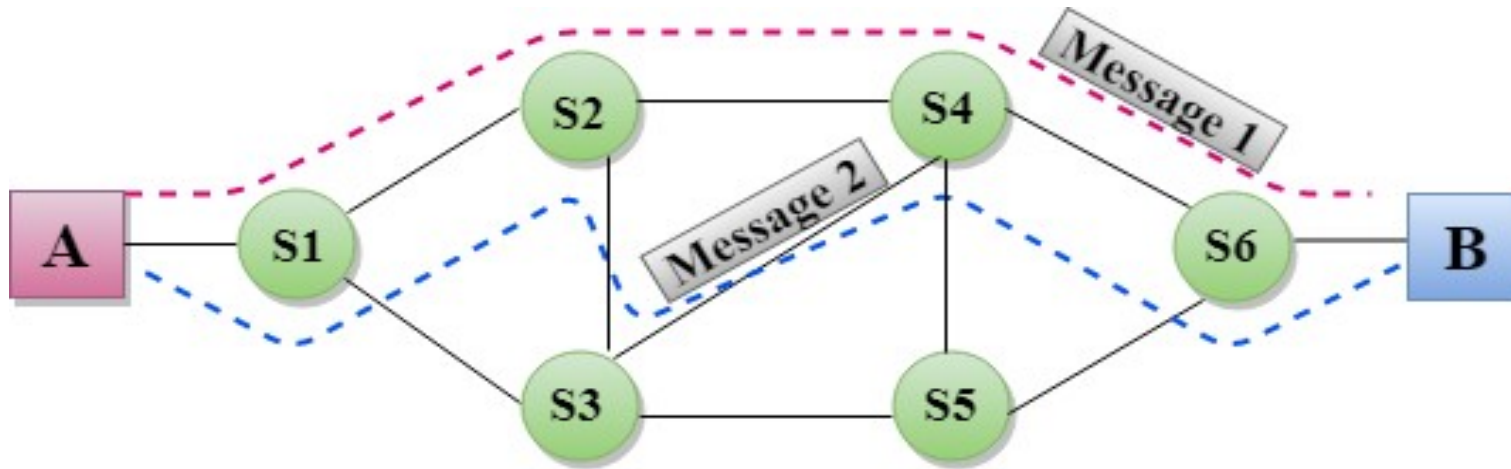The destination address is appended to the message.

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Message Switching:

SWITCHING-MESSAGE SWITCHING

Advantages Of Message Switching

Data channels are shared among the communicating devices that improve the efficiency of using available bandwidth.

Traffic congestion can be reduced because the message is temporarily stored in the nodes.

Message priority can be used to manage the network.

The size of the message which is sent over the network can be varied. Therefore, it supports the data of unlimited size.

SWITCHING-MESSAGE SWITCHING

Disadvantages Of Message Switching

The message switches must be equipped with sufficient storage to enable them to store the messages until the message is forwarded.

The Long delay can occur due to the storing and forwarding facility provided by the message switching technique.

SWITCHING-PACKET SWITCHING

 The packet switching is a switching technique in which the message is sent in one go, but it is divided into smaller pieces, and they are sent individually.

 The message splits into smaller pieces known as packets and packets are given a unique number to identify their order at the receiving end.

 Every packet contains some information in its headers such as source address, destination address and sequence number.
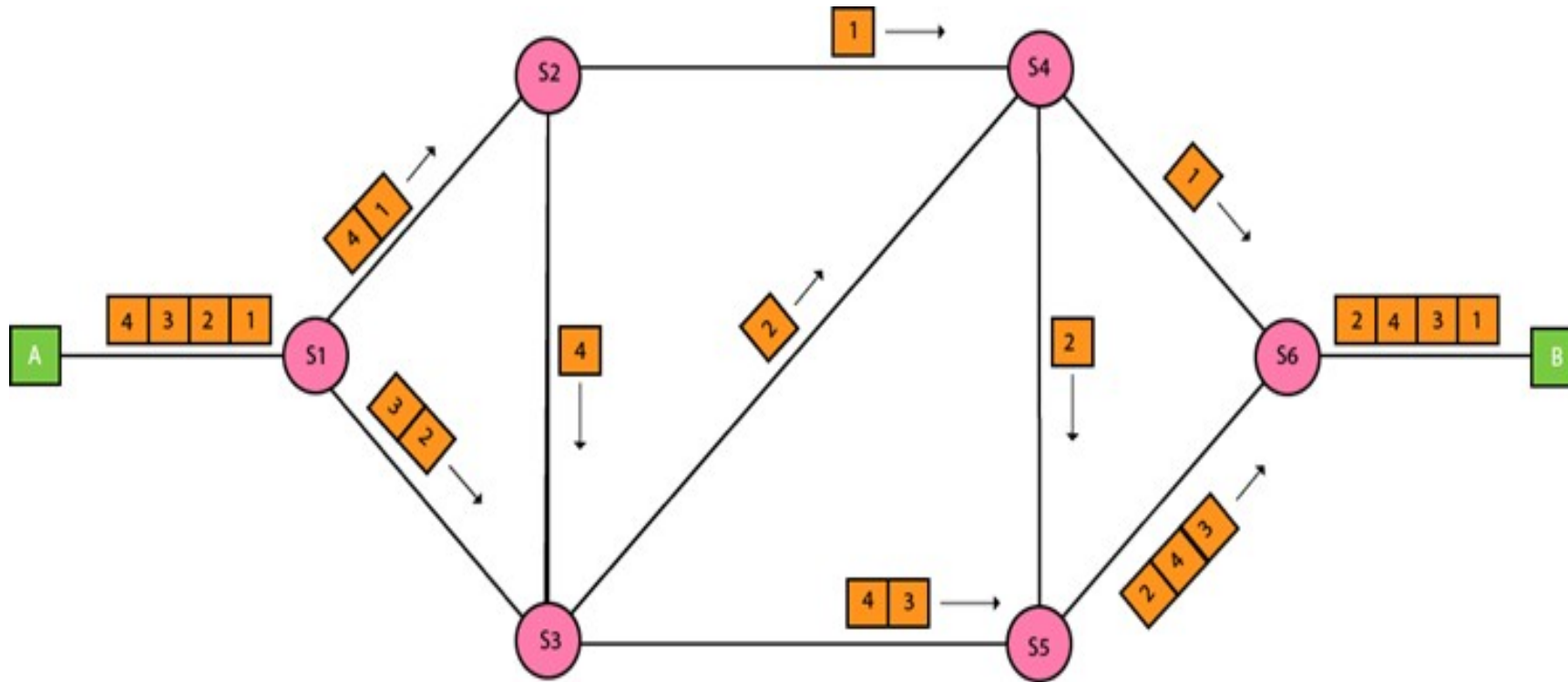
 Packets will travel across the network, taking the shortest path as possible.

 All the packets are reassembled at the receiving end in correct order.

 If any packet is missing or corrupted, then the message will be sent to resend the message.

 If the correct order of the packets is reached, then the acknowledgment message will be sent.

SWITCHING-PACKET SWITCHING

SWITCHING-PACKET SWITCHING

Advantages Of Packet Switching:

Cost-effective: In packet switching technique, switching devices do not require massive secondary storage to store the packets, so cost is minimized to some extent. Therefore, we can say that the packet switching technique is a cost-effective technique.

Reliable: If any node is busy, then the packets can be rerouted. This ensures that the Packet Switching technique provides reliable communication.

Efficient: Packet Switching is an efficient technique. It does not require any established path prior to the transmission, and many users can use the same communication channel simultaneously, hence makes use of available bandwidth very efficiently.

SWITCHING-PACKET SWITCHING

Disadvantages Of Packet Switching:

Packet Switching technique cannot be implemented in those applications that require low delay and high-quality services.

The protocols used in a packet switching technique are very complex and requires high implementation cost.

If the network is overloaded or corrupted, then it requires retransmission of lost packets. It can also lead to the loss of critical information if errors are nor recovered.
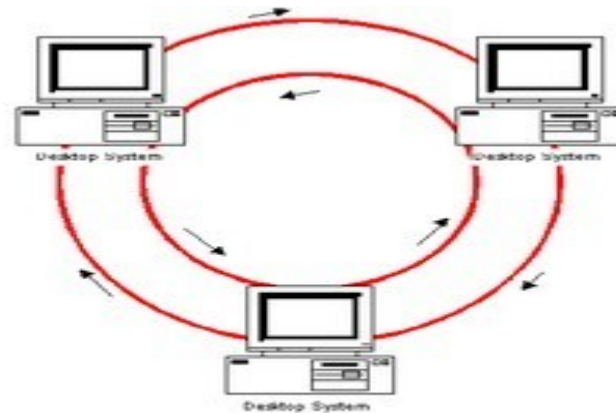
FDDI

The Fiber Distributed Data Interface(FDDI) network architecture is a LAN protocol standardized by ANSI and other organizations.

It supports data transmission rates upto 100mbps, and it is alternative to Ethernet and Token Ring.

FDDI was developed using optical fiber as the transmission medium because only optical fiber could support data rates upto 100 mbps.

But even copper wires can support such rates and such version is called Copper Distributed Data Interface (CDDI).

FDDI uses glass fibers for data transmission and encodes data in form of pulses of light.

FDDI - all stations functioning

FDDI

Properties of FDDI:

Token Passing for Media Access Control:

Like token ring, FDDI also uses the concept of a token frame.

FDDI also has a ring-like structure where network medium starts from a

computer passes through all hosts in the network and ends back at the original

host.

Self-healing mechanism:

The hardware in FDDI provides mechanism for detecting and problems on its own.

FDDI

Operations of FDDI:

FDDI hardware uses two independent rings to connect to every host.

Normally, FDDI uses only one ring for transmission.

The NIC(network interfacecard) of each host examines all the frames that circulate, compare the destination address.

It keeps copy of the frame only if the two addresses match, else it simply forwards.
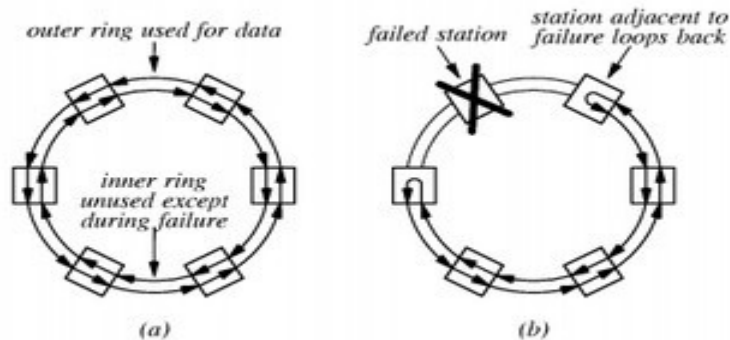
What is the need of second ring?

FDDI

Self-healing mechanism:

The self-healing mechanism of FDDI network is possible by the second ring. When a network error occurs or host is down, the NIC of a host realizes that it cannot communicate with its neighbouring host.

In such case, the NIC uses the second ring, which is used as a backup for such Failures. This is called **loopback**.

Whenever the first ring fails, or a host on the ring fails, the second ring is used to create another closed loop.

UNIT 3 COMPLETED