Transmission media and Network Devices

Transmission Media

Transmission medium is the means through which we send our data from one place to another.

OR

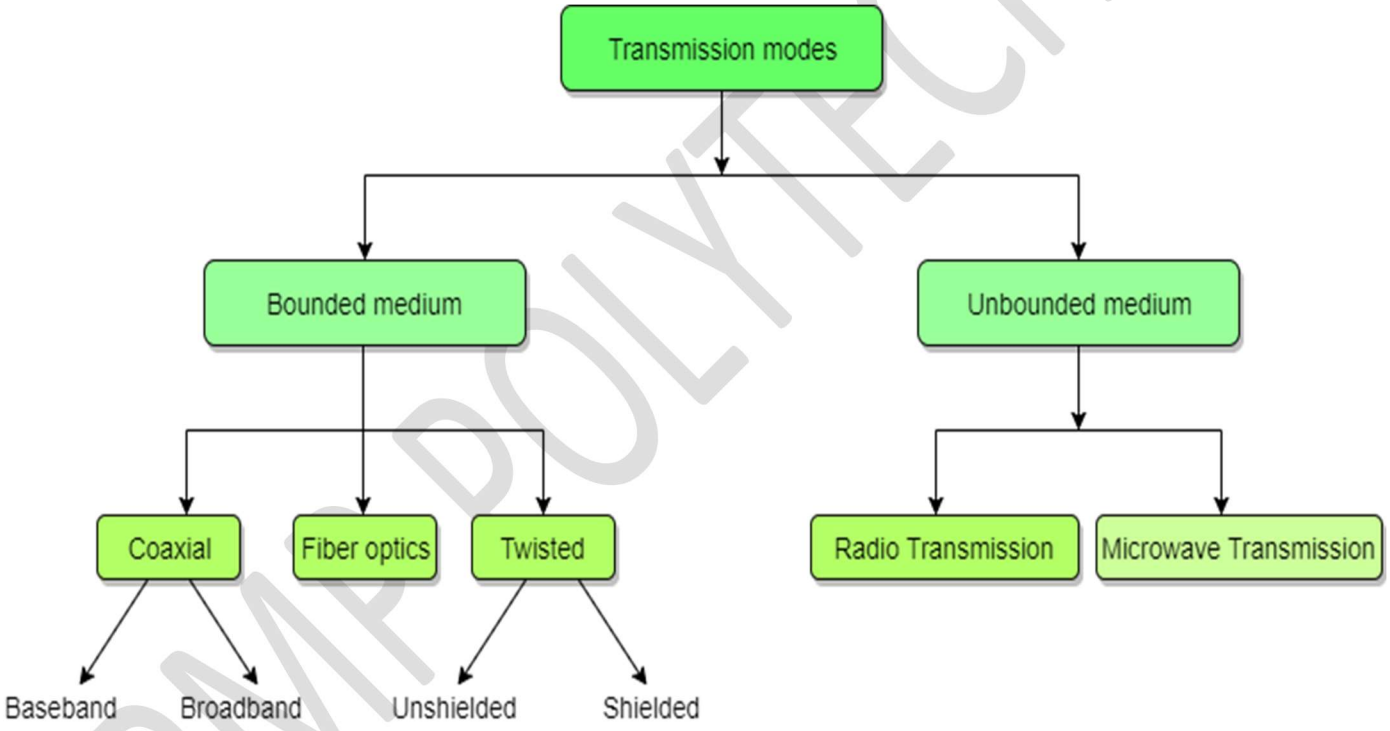
Transmission media is the physical link between two work station for transfer the message or information

Classification of Transmission media

It is divide mainly in two category

1.Guided Media(Bounded)

2. Un guided Media(Un bounded)



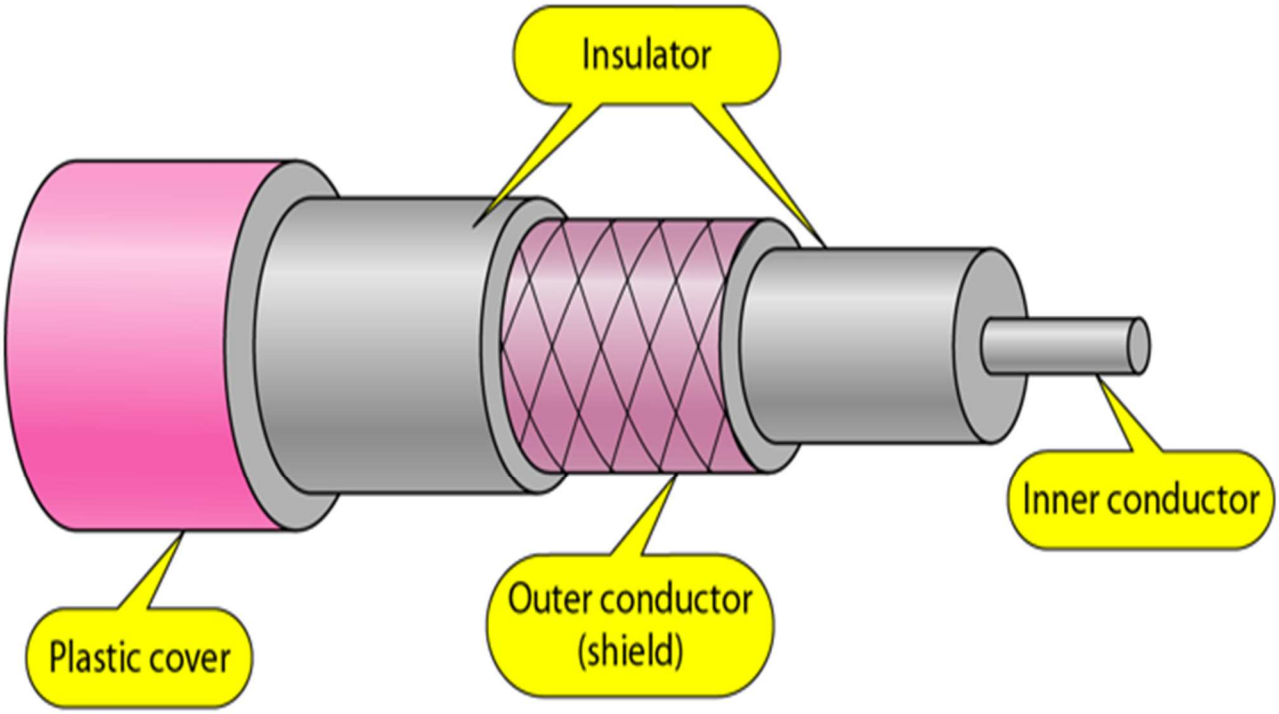
Bounded or Guided Transmission Media

Guided media, which are those that provide a conduit from one device to another, include **Twisted-Pair Cable**, **Coaxial Cable**, and **Fiber-Optic Cable**.

- Coaxial Cable
- Twisted pair cable
- Fiber optic cable

❖ Coaxial Cable:

- Coaxial is called by this name because it contains two conductors that are parallel to each other. Copper is used in this as Centre conductor which can be a solid wire or a standard one. It is surrounded by PVC installation, a sheath which is encased in an outer conductor of metal foil, barid or both.
- Outer metallic wrapping is used as a shield against noise and as the second conductor which completes the circuit. The outer conductor is also encased in an insulating sheath. The outermost part is the plastic cover which protects the whole cable.



❖ Advantages of Coaxial Cable

- Bandwidth is high
- Used in long distance telephone lines.
- Transmits digital signals at a very high rate of 10Mbps.
- Much higher noise immunity
- Data transmission without distortion.
- The can span to longer distance at higher speeds as they have better shielding when compared to twisted pair cable

❖ Disadvantages of Coaxial Cable

- Single cable failure can fail the entire network.
- Difficult to install and expensive when compared with twisted pair.
- If the shield is imperfect, it can lead to grounded loop.

❖ Applications of Coaxial Cable

- Coaxial cable was widely used in analog telephone networks, where a single coaxial network could carry 10,000 voice signals.
- Cable TV networks also use coaxial cables. In the traditional cable TV network, the entire network used coaxial cable. Cable TV uses RG-59 coaxial cable.
- In traditional Ethernet LANs. Because of it high bandwidth, and consequence high data rate, coaxial cable was chosen for digital transmission in early Ethernet LANs. The 10Base-2, or Thin Ethernet, uses RG-58 coaxial cable with BNC connectors to transmit data at 10Mbps with a range of 185 m.

❖ Twisted Pair Cable

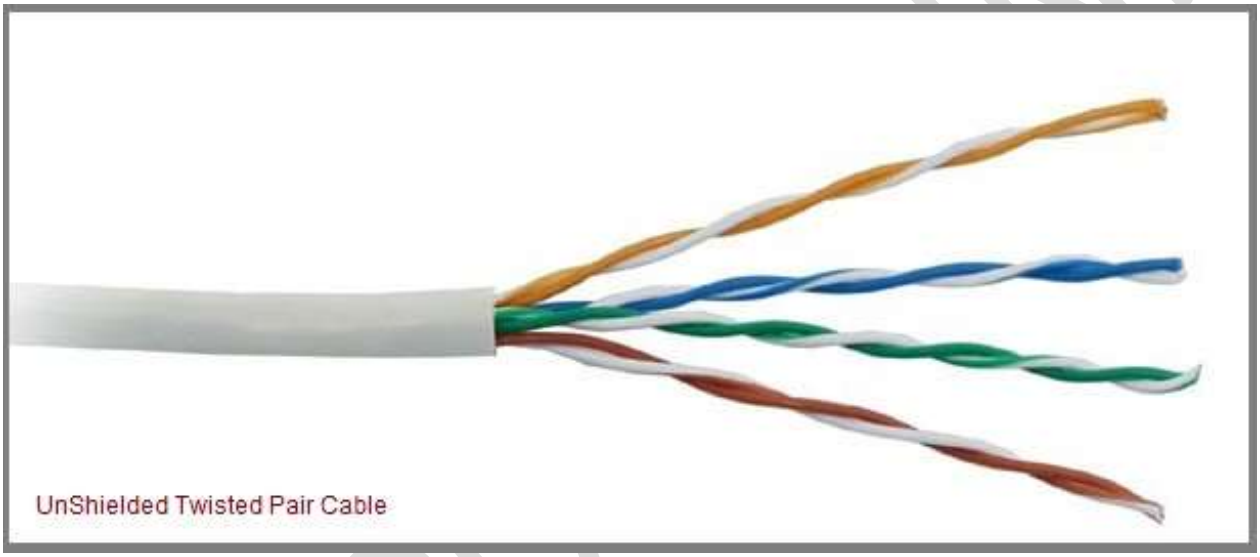
- A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together. One of these wires is used to carry signals to the receiver, and the other is used only as ground reference.

  Twisted Pair is of two types:

- **Unshielded Twisted Pair (UTP)**
- **Shielded Twisted Pair (STP)**

❖ Unshielded Twisted Pair Cable

- It is the most common type of telecommunication when compared with Shielded Twisted Pair Cable which consists of two conductors usually copper, each with its own colour plastic insulator. Identification is the reason behind colored plastic insulation.
- UTP cables consist of 2 or 4 pairs of twisted cable. Cable with 2 pair use **RJ-11** connector and 4 pair cable use **RJ-45** connector.



❖ Advantages of Unshielded Twisted Pair Cable

- Installation is easy
- Flexible
- Cheap
- It has high speed capacity,
- 100 meter limit
- Higher grades of UTP are used in LAN technologies like Ethernet.

❖ Disadvantages of Unshielded Twisted Pair Cable

- Bandwidth is low when compared with Coaxial Cable
- Provides less protection from interference.

❖ Shielded Twisted Pair Cable

- This cable has a metal foil or braided-mesh covering which encases each pair of insulated conductors. Electromagnetic noise penetration is prevented by metal casing. Shielding also eliminates crosstalk
- It has same attenuation as unshielded twisted pair. It is faster the unshielded and coaxial cable. It is more expensive than coaxial and unshielded twisted pair.

❖ Advantages of Shielded Twisted Pair Cable

- Easy to install
- Performance is adequate
- Can be used for Analog or Digital transmission
- Increases the signaling rate
- Higher capacity than unshielded twisted pair
- Eliminates crosstalk

❖ Disadvantages of Shielded Twisted Pair Cable

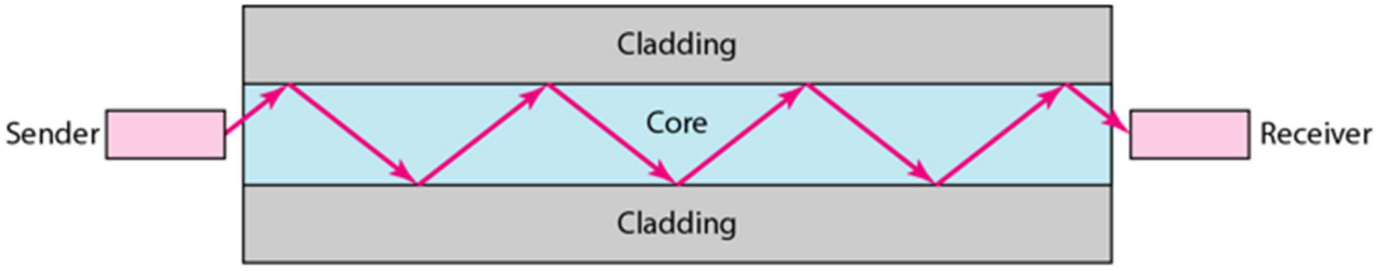
- Difficult to manufacture
- Heavy weight

❖ Applications of Shielded Twisted Pair Cable

- In telephone lines to provide voice and data channels. The DSL lines that are used by the telephone companies to provide high-data-rate connections also use the high-bandwidth capability of unshielded twisted-pair cables.

❖ Fiber Optic Cable

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



❖ Advantages of Fiber Optic Cable

- Fiber optic has several advantages over metallic cable:
- Higher bandwidth
- Less signal attenuation
- Immunity to electromagnetic interference
- Resistance to corrosive materials
- Light weight
- Greater immunity to tapping

❖ Disadvantages of Fiber Optic Cable

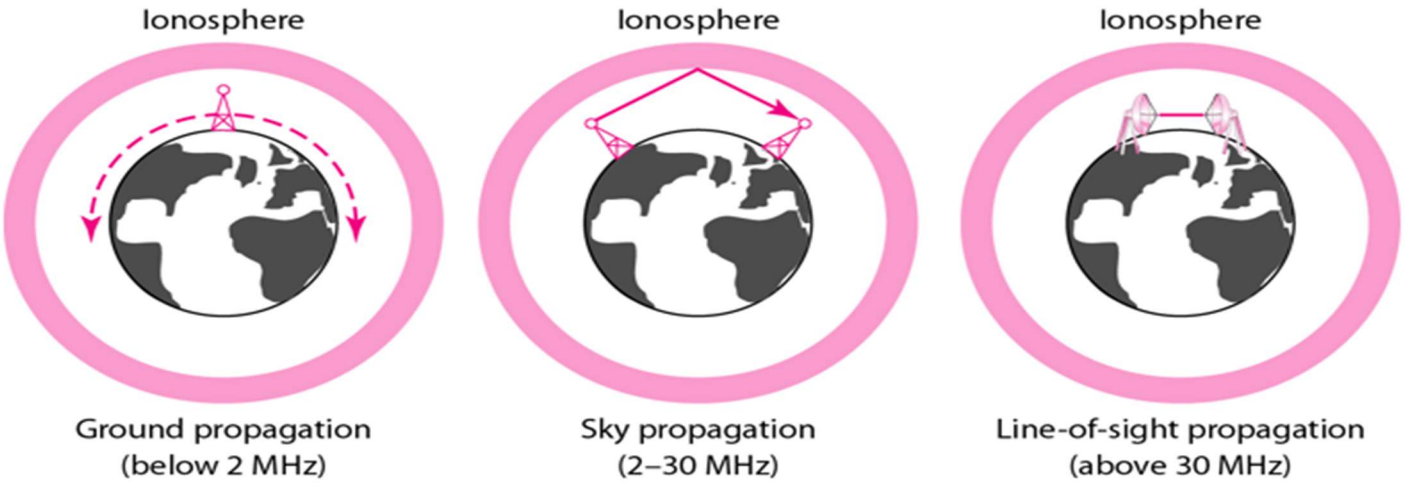
- Skill person required
- Installation and maintenance
- Unidirectional light propagation
- High Cost

❖ Applications of Fiber Optic Cable

- Often found in backbone networks because its wide bandwidth is cost-effective.
- Some cable TV companies use a combination of optical fiber and coaxial cable thus creating a hybrid network.
- Local-area Networks such as 100Base-FX network and 1000Base-X also use fiber-optic cable.

❖ Unbounded or Unguided Transmission Media

- Unguided medium transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.
- Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them
- Unguided signals can travel from the source to the destination in several ways: Ground propagation, Sky propagation and Line-of-sight propagation as shown in below figure.



Ground Propagation: In this, 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.

Sky Propagation: In this, higher-frequency radio waves radiate upward into the ionosphere where they are reflected to Earth. This type of transmission allows for greater distances with lower output power.

Line-of-sight Propagation: in this type, very high-frequency signals are transmitted in straight lines directly from antenna to antenna.

We can divide wireless transmission into three broad groups:

- Radio waves
- Micro waves
- Infrared waves

❖ Radio Waves

- Electromagnetic waves ranging in frequencies between 3 KHz and 1 GHz are normally called radio waves.
- Radio waves are omnidirectional. When an antenna transmits radio waves, they are propagated in all directions. This means that the sending and receiving antennas do not have to be aligned.
- A sending antenna send waves that can be received by any receiving antenna. The omnidirectional property has disadvantage, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signal suing the same frequency or band.
- Radio waves, particularly with those of low and medium frequencies, can penetrate walls. This characteristic can be both an advantage and a disadvantage. It is an advantage because, an AM radio can receive signals inside a building. It is a disadvantage because we cannot isolate a communication to just inside or outside a building.

❖ Applications of Radio Waves

- The omnidirectional characteristics of radio waves make them useful for multicasting in which there is one sender but many receivers.
- AM and FM radio, television, maritime radio, cordless phones, and paging are examples of multicasting.

❖ Micro Waves

Electromagnetic waves having frequencies between 1 to 300 GHz are called micro waves. Micro waves are unidirectional. When an antenna transmits microwaves, they can be narrowly focused. This means that the sending and receiving antennas need to be aligned. The unidirectional property has an obvious advantage. A pair of antennas can be aligned without interfering with another pair of aligned antennas.

❖ Applications of Micro Waves

- Microwaves, due to their unidirectional properties, are very useful when unicast(one-to-one) communication is needed between the sender and the receiver.
- They are used in cellular phones, satellite networks and wireless LANs.

❖ Advantages of Microwave Transmission

- Used for long distance telephone communication
- Carries 1000's of voice channels at the same time

❖ Disadvantages of Microwave Transmission

- It is very costly

❖ Infrared Waves

- Infrared waves, with frequencies from 300 GHz to 400 THz, can be used for short-range communication. Infrared waves, having high frequencies, cannot penetrate walls.
- This advantageous characteristic prevents interference between one system and another, a short-range communication system in on room cannot be affected by another system in the next room.
- we cannot use infrared waves outside a building because the sun's rays contain infrared waves that can interfere with the communication.

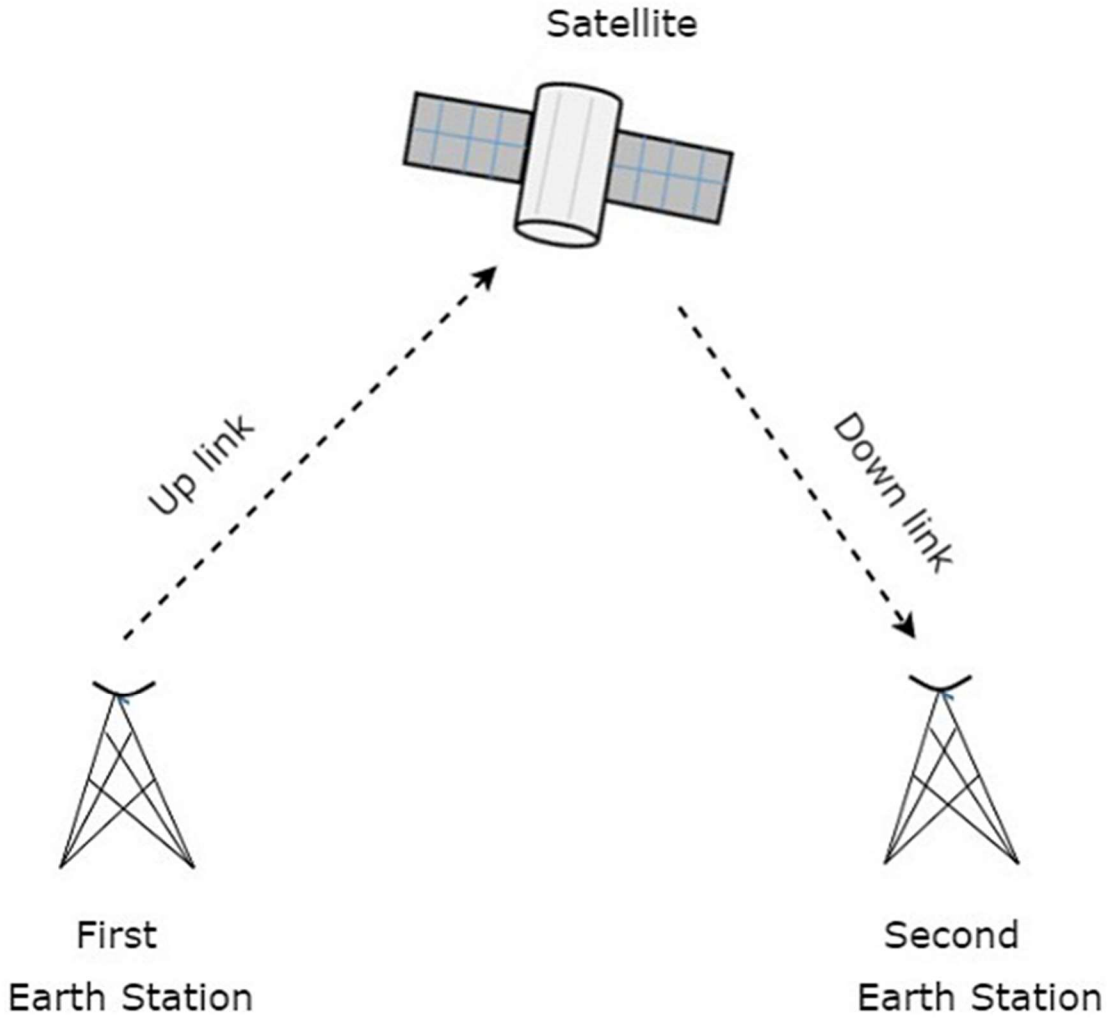
❖ Applications of Infrared Waves

- The infrared band, almost 400 THz, has an excellent potential for data transmission. Such a wide bandwidth can be used to transmit digital data with a very high data rate.
- The Infrared Data Association (IrDA), an association for sponsoring the use of infrared waves, has established standards for using these signals for communication between devices such as keyboards, mouse, PCs and printers.

- Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation

❖ Satellite Communication

- A **satellite** is a body that moves around another body in a particular path. A communication satellite is nothing but a microwave repeater station in space. It is helpful in telecommunications, radio and television along with internet applications.
- A **repeater** is a circuit, which increases the strength of the received signal and then transmits it. But, this repeater works as a **transponder**. That means, it changes the frequency band of the transmitted signal from the received one.
- The frequency with which, the signal is sent into the space is called as **Uplink frequency**. Similarly, the frequency with which, the signal is sent by the transponder is called as **Downlink frequency**. The following figure illustrates this concept clearly.



- The transmission of signal from first earth station to satellite through a channel is called as **uplink**. Similarly, the transmission of signal from satellite to second earth station through a channel is called as **downlink**.

❖ **Application of Satellite Communication**

- Radio broadcasting and voice communications
- TV broadcasting such as Direct To Home (DTH)
- Internet applications such as providing Internet connection for data transfer, GPS applications, Internet surfing, etc.
- Military applications and navigations
- Remote sensing applications
- Weather condition monitoring & Forecasting

❖ Give the difference between Base and and Board Band

Parameter	Base band	Board band
Definition	Baseband Transmission is a transmission technique that one signal requires the entire bandwidth of the channel to send data.,	Broadband Transmission is a transmission technique that many signals with multiple frequencies transmit data through a single channel simultaneously.
Types of Signals	Uses digital signals	Uses analog signals
Number of Signals	Sends one signal at a time	Sends multiple signals simultaneously
Signal Range	Signals travel a short distance	Signals travel a long distance without much attenuation

Transmission Type	Bidirectional	Unidirectional
Multiplexing	Uses Time Division Multiplexing	Uses Frequency Division Multiplexing
Examples	Ethernet is an example	Cable TV, Wi-Fi, and Power Line communication are some examples

- **Network:** Two or more **devices** connected with each other for sharing their data and resources is called a network.
- **Internetworking**: When two or more **networks** are connected for exchanging data or resources then it is called internetworking.

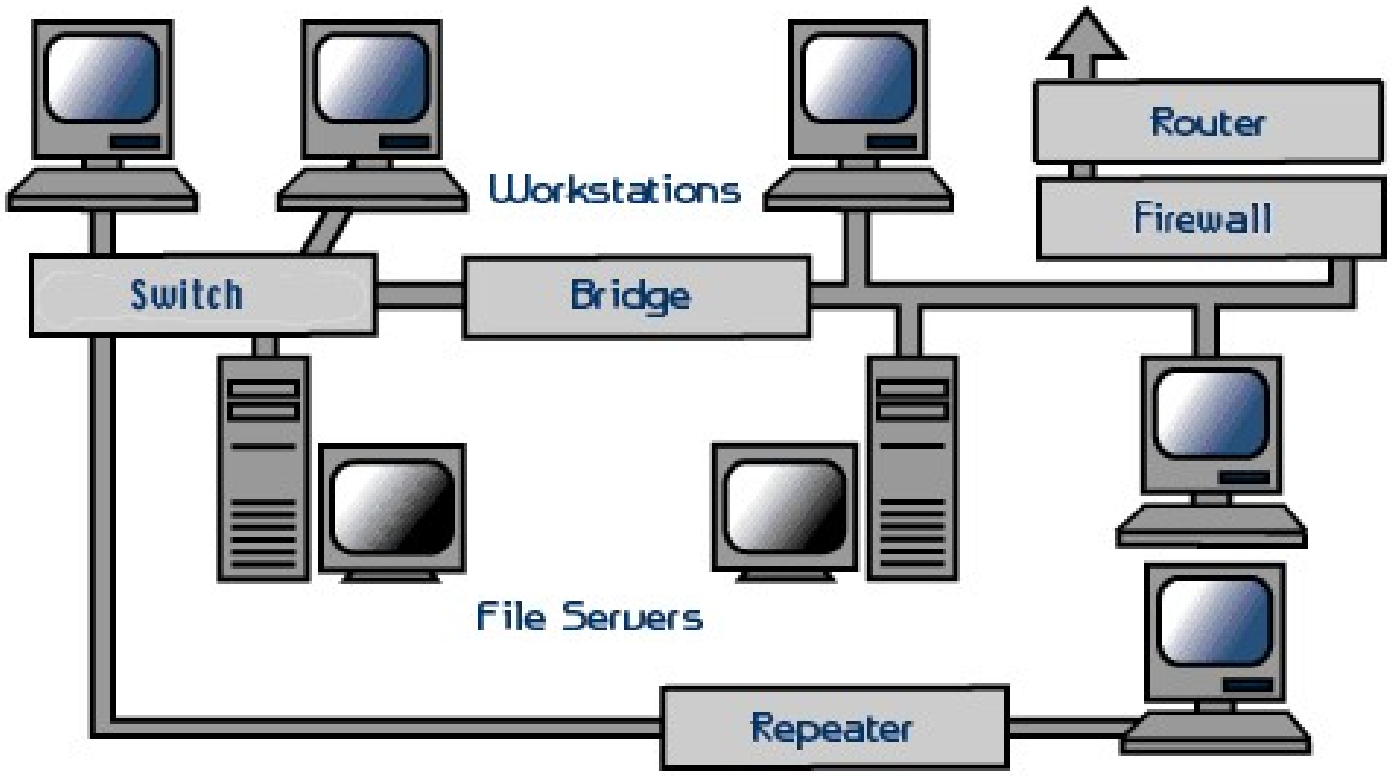
❖ Devices used in networking and intranetworking:

- Repeater
- Bridge
- Hub
- Switch
- Router
- Gateway
- Access point

❖ Devices and the layers at which they operate

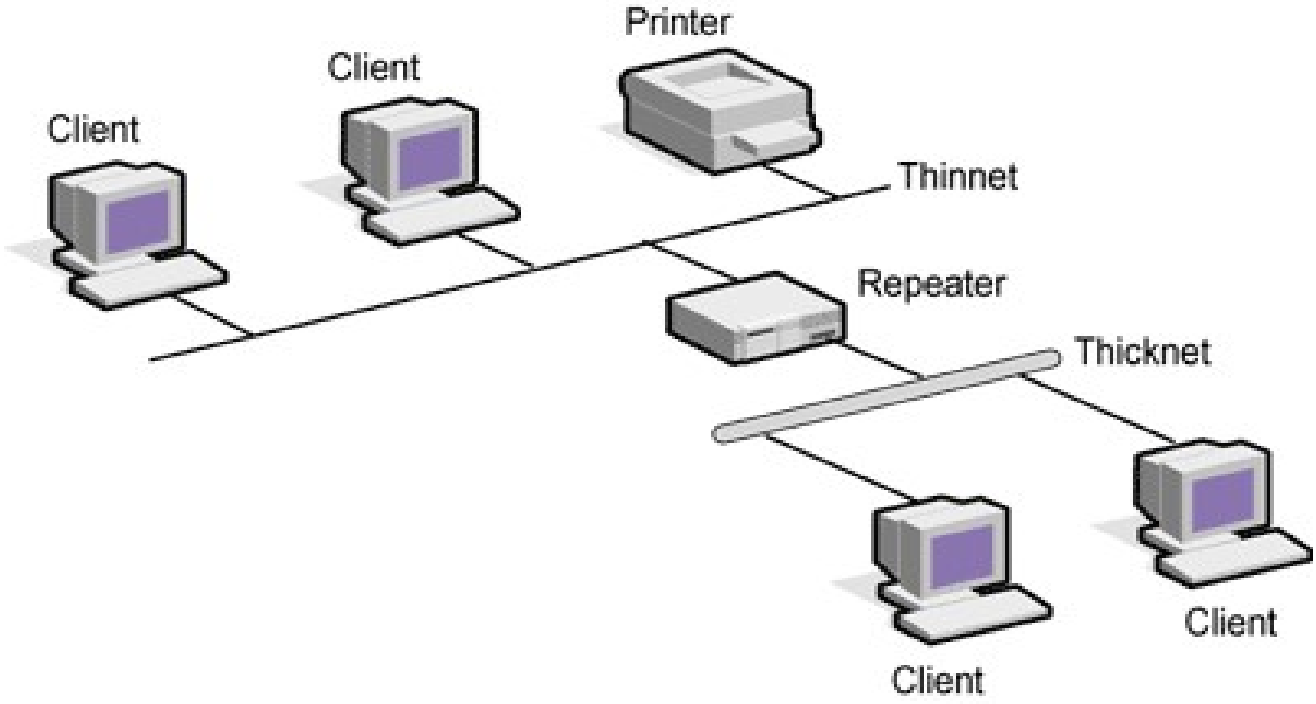
Layer	Name of Layer	Device
7	Application	Gateway
6	Presentation	Gateway
5	Session	Gateway
4	Transport	Gateway
2	Data Link	Layer-2 Switches, Bridges, NIC's, Gateway
1	Physical	Hubs, Repeaters, Bridges, Gateway

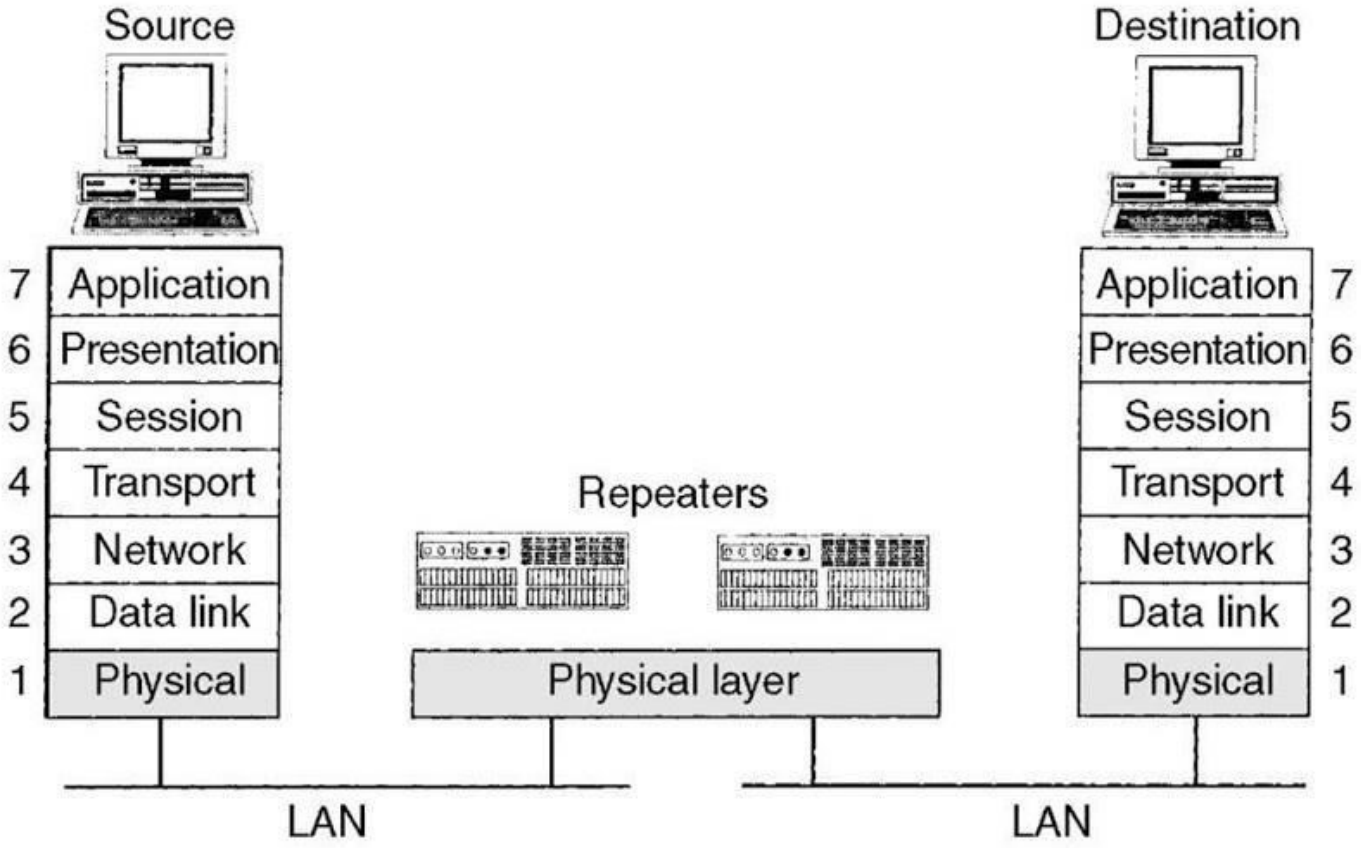
NETWORK DEVICES



❖ REPEATERS

- Repeater is a Electronics device It works on physical layer of OSI model.
- The signal that carries information with in network can travel a fixed distance
- Repeaters clean, amplify, and resend signals that are weakened by long cable length.
- Repeaters installed in a network, receives weak signals and regenerates it to original strength to forward refreshed copy on a link.
- They can Built-in to hubs or switches.

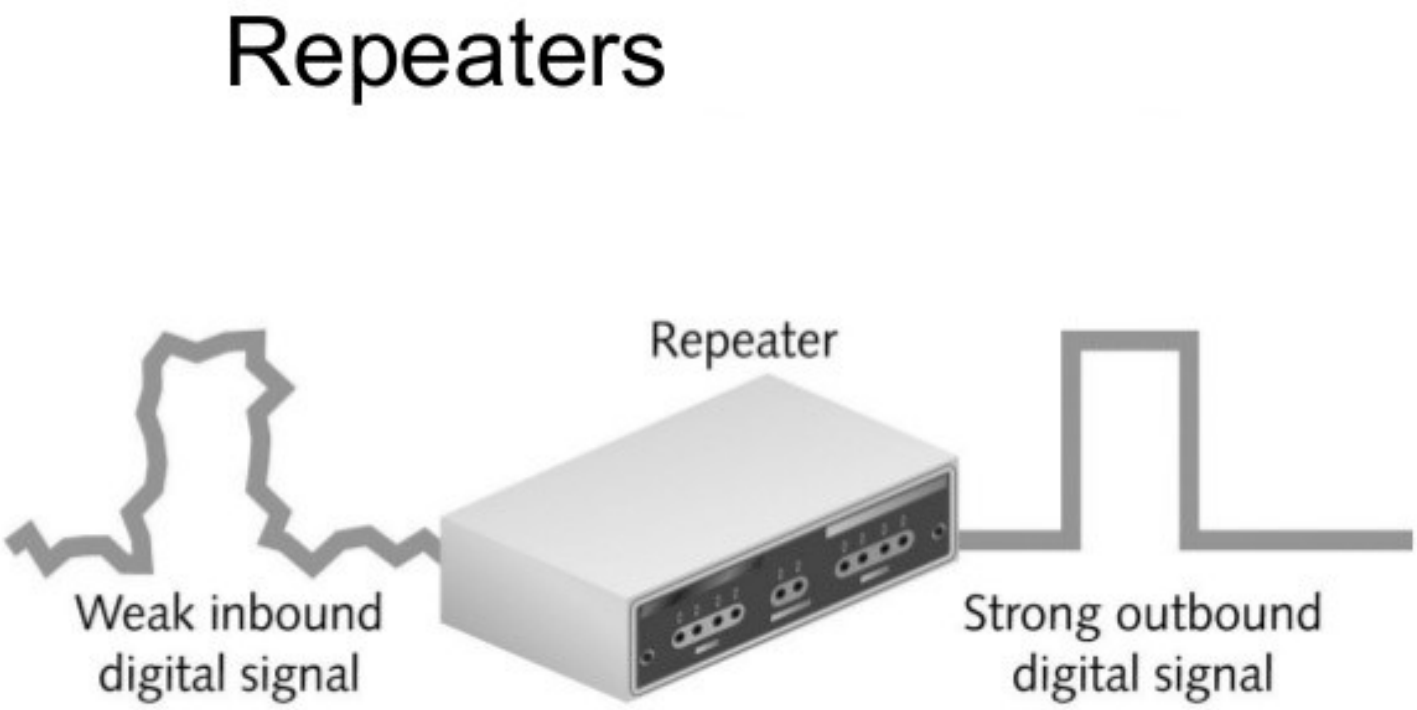

Printer
Client
Client
Thinnet
Repeater
Thicknet
Client
Client


Source
Destination
7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data link
1 Physical
Repeaters
Physical layer
LAN
LAN

Repeaters does not amplify"-Justify.

- An amplifier cannot differentiate between original signal and noise signal.

Repeaters does not amplify the signal, it regenerates it. When it receives a signal affected by noise signal, it creates a copy bit to its original strength



❖ Advantage of Repeaters

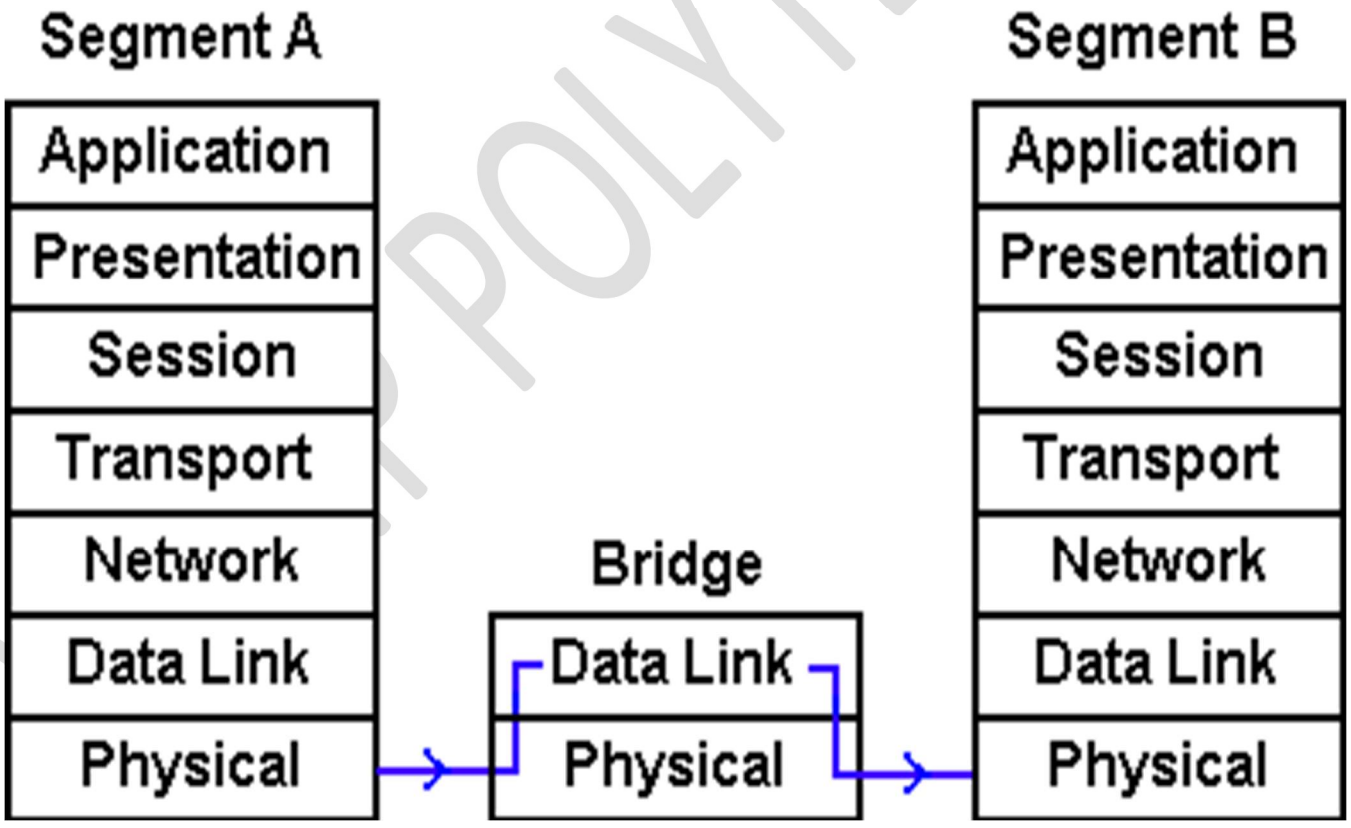
- Extend the network physical distance
- Do not seriously affect the performance of network

❖ Disadvantages Of Repeaters

- Cannot connect different network architectures
- Token Ring and Ethernet (Star)
- Cannot reduce network traffic
- Repeaters do not filter data
- Do not segment (divide) the network
- Repeat everything without discrimination
- Number of repeaters must be limited

❖ BRIDGES

- Bridges work at Datalink Layer of OSI model.
- It is designed to connect two or more LAN segments.
- At **layer 1**, it is used to **regenerate** a signal.
- At **layer 2**, it is used **to filter traffic** on a LAN and to keep local traffic local and also allow connectivity to other segments of the network.
- To provide **security**, it Filters traffic by looking at the
- MAC address and prevent unauthorized access.
- If the frame is addressed to a MAC address on the local side of the bridge, it is not forwarded to the other segment. Frames having MAC addresses on the other segment only are forwarded.
- Bridges maintain a MAC address table for both segments to which they are connected.



❖ Types of bridges:

1. **Simple bridge:**
    - It links two segments only.
    - It is having lowest cost among other types.
    - It require manual updating of bridging table.
    - Requires more time to maintain devices.
2. **Multiport bridges:**
    - It links more then two segments.
    - Three table are created , each stores physical address of stations reachable through corresponding port.
3. **Transparent Bridges:**

- It builds its tables of physical station address on its own.
- It performs bridge functions by its own.
- Table is automaticallybuilt byframe movement in a network.

❖ **Advantages of using a bridge**

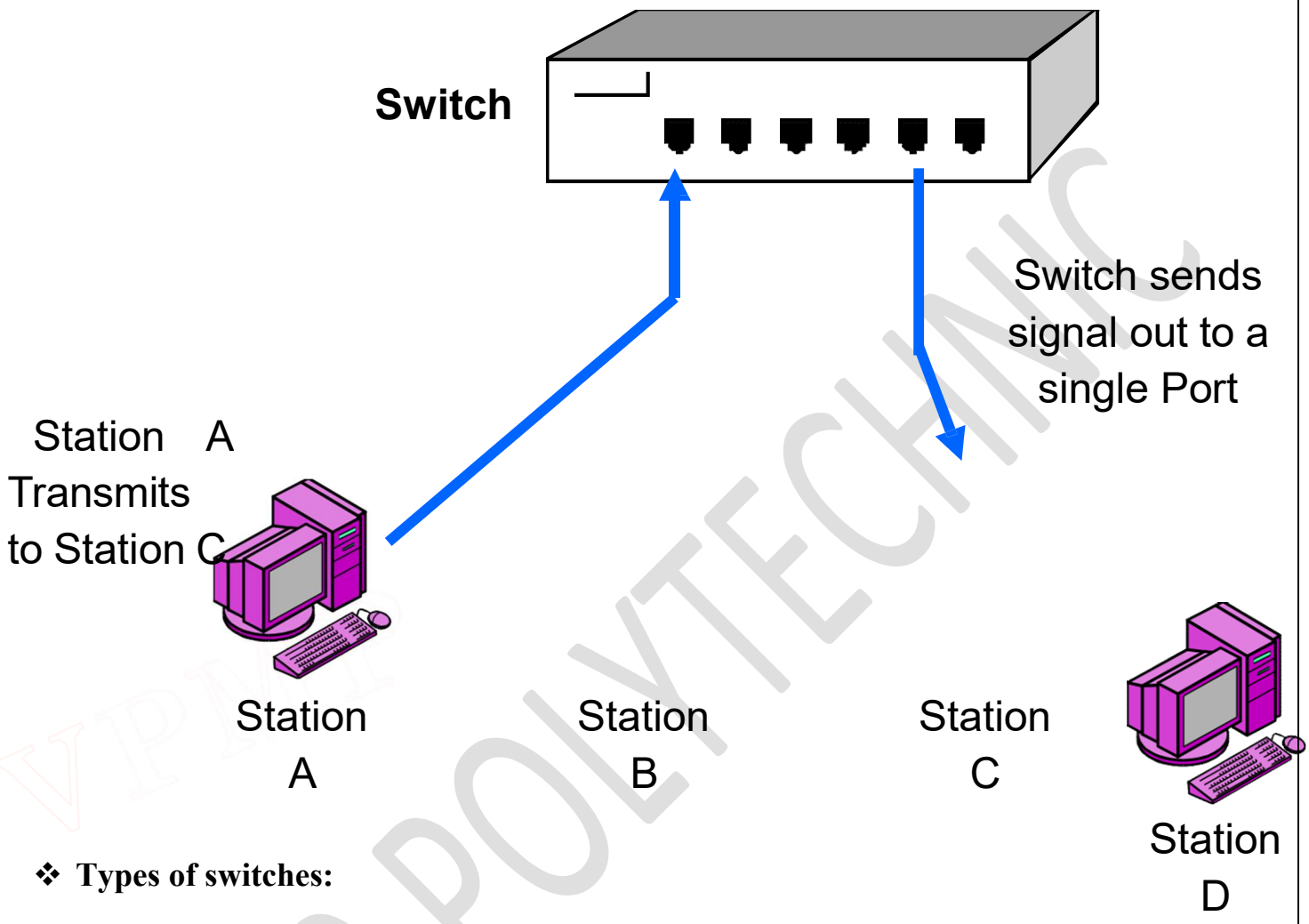
- Extend physical network
- Reduce network traffic with minor segmentation
- Creates separate collision domains
- Reduce collisions
- Connect different architecture

❖ **Disadvantages of using bridges**

- Slower than repeaters due to filtering
- Do not filter broadcasts
- Broadcast packages are passed across bridges.
- More expensive than repeaters

❖ SWITCHES

- It works on Datalink layer of OSI model.
- It provides bridging with greater efficiency.
- They have buffer for each link to which it is connected



❖ **Types of switches:**

1. Store and Forward Switches:

- Do error checking on each frame after the entire frame has arrived into the switch.
- It stores the frame into buffer until whole packet arrives.
- The switch looks in its MAC address table for the port to which to forward the destination device.
- Highly reliable because doesn't forward bad frames.
- Slower than other types of switches because it holds on to each frame until it is completely for errors before forwarding

2. Cut Through Switches:

- Faster than store and forward because does not
- perform error checking on frames.
- It Forwards bad frames too.
- Reads address information for each frame as the frames enter the switch.
- After looking up the port of the destination device, frame is forwarded without waiting for entire packet to arrive.

❖ Advantages of switches

- Increase available network bandwidth by reducing its workload, computers only receive packets intended for them specifically
- Increase network performance
- Smaller collision domains

❖ Disadvantages of switches

- More expensive than hubs and bridges
- Difficult to trace network connectivity problems through a switch
- Does not filter broadcast traffic

❖ LAYER 2 & 3 SWITCHES DIFFERENCES

Layer 2 switch	Layer 3 switch
Works on Datalink layer.	Works on network layer.
It uses MAC address for filtering and provide bridging	It uses MAC address to provide packet forwarding.
It behaves as a multiport transparent bridge.	It behaves as a router.
It is used to connect server and clients.	It is used to connect hosts in a large network like VLAN.
It is having buffer to store frames like cut-through switches.	it is having faster table lookup and forwarding capacity.

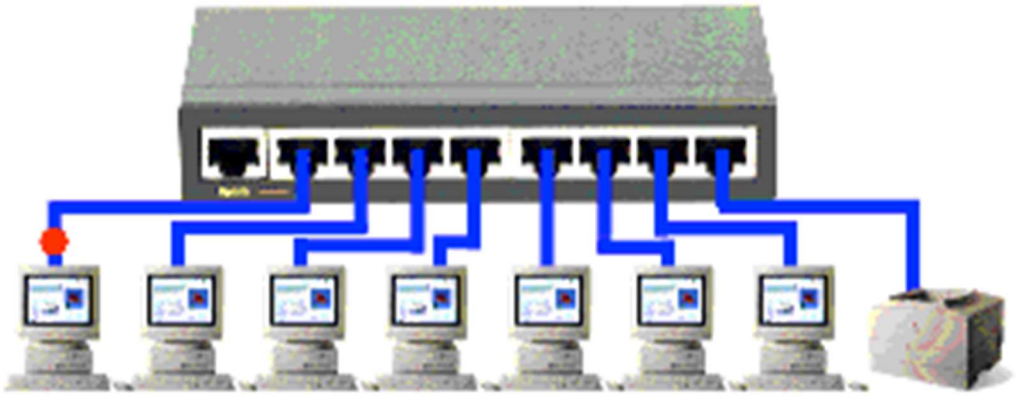
❖ **Difference between bridge and Switch**

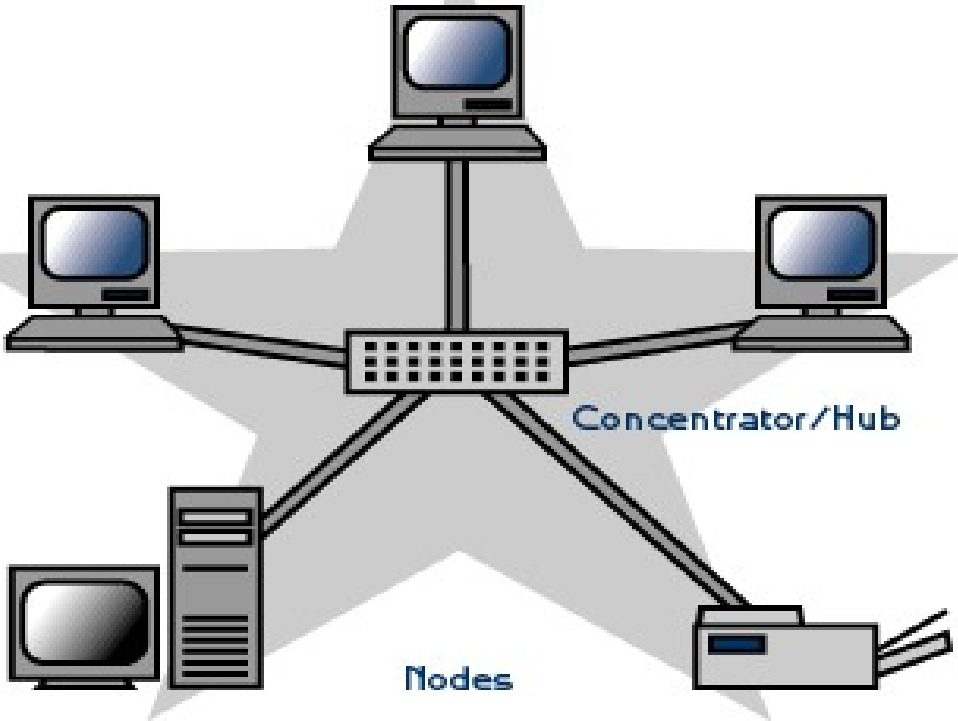
Bridge	Switches
Bridges is operate in Layer 2 devices	Switches is operated in Layer 2 devices
Packet forwarding in Bridges are performed using software	Packet forwarding in Switches are performed using ASICs (Application Specific Integrated Circuits).
Bridge operate comparatively lower speeds that switch.	Switches operate comparatively higher speeds that Bridges.
Method of switching of a Bridge is store and forward	Method of switching of a Switch can be store and forward, cut-through or fragment-free.
Normally a bridge has less ports than a switch.	Normally a Switch has more ports than a Bridge.

❖ **HUB**

- It works on physical layer of OSI model.
- Hubs is a central network device that network nodes and provide central management
- They connect devices centrally in a star topology.
- They cannot filter network traffic.
- They cannot determine best path.
- They are also known as network "**concentrators**".
- They have multiple inputs and outputs active at the same time.
- It provides connections for all guided media types.
- They provide high speed communication

Hub



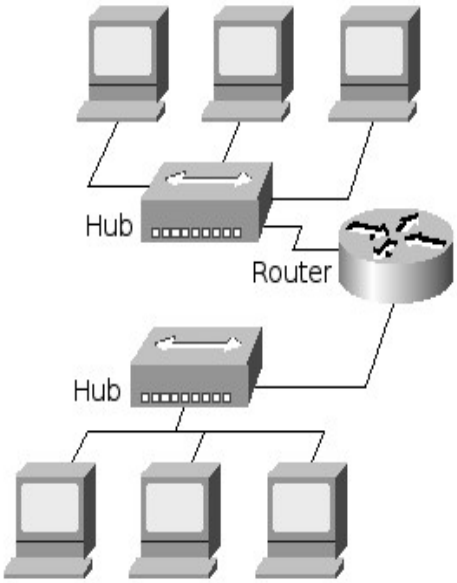


❖ **TYPES OF HUB:**

1. **Active hubs:**
   - Active hubs work similar to repeaters.
   - They need electrical power to run.
   - Also called multiport repeater.
2. **Passive hubs:**
   - A passive hub serves simply provides connection between devices, enabling data to go from one device (or segment) to another.
   - They don't need electrical power to run.
3. **Intelligent hubs:**
   - A third type of hub, called a intelligent hub, actually reads the destination addressof each packet and then forwards the packet to the correct port. Intelligent hubs are also called manageable hubs.

❖ **ROUTERS**

- It operates on Physical, Datalink and Network layer of OSI model.
- It is most active in Network layer of OSI model.
- Different networks can be connected via routers.
- It stores IP address of the devices of networks in a table called routing table.
- Function of router is to receive packets from one network and forward to another network based on information stored in routing table.



❖ Routing strategies:

❖ **Adaptive Routing**

- In adaptive routing, router may selectnew route for each packet.

❖ **Non-Adaptive Routing**

- In non-adaptive routing router choose same path for all the packets whose destination is same.

❖ **Routing table contains:**

- Network address of each device,
- Possible paths between routers,
- Cost of sending data over paths

❖ **Types of routers:**

1.Static router:

1. They use same path for all packets of same destination.
2. More secure.
3. Needs to maintain manually.
4. Cannot updated automatically.

2. **Dynamic router:**

1. It uses a routing protocol such as OSPF or BGP to select best paths for packets.
2. Each packet is sent via different path.
3. Less secure.
4. Can be updated and maintained automatically.

❖ Advantages of routers

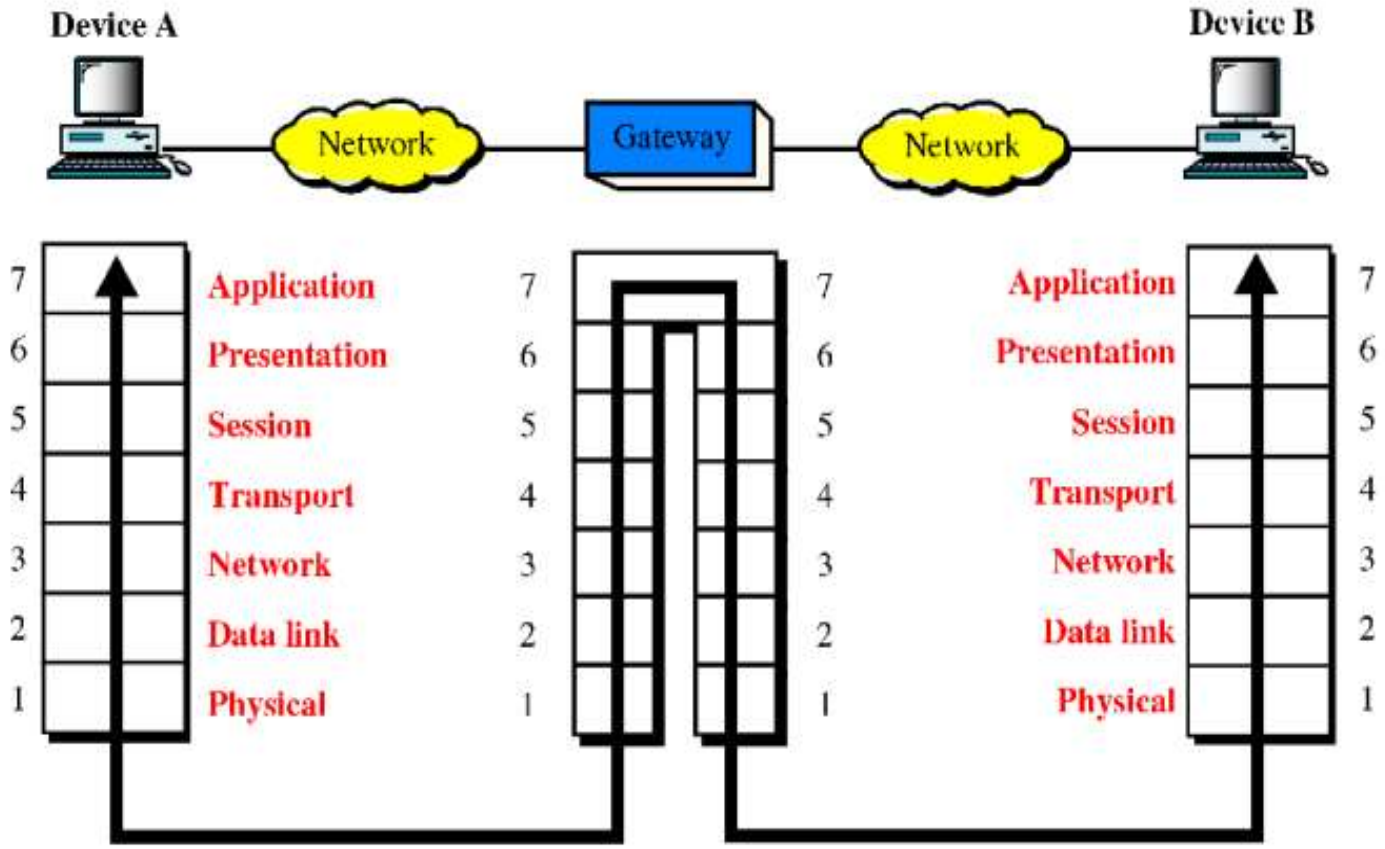
- Can connect networks of different architecture
- Token Ring to Ethernet
- Choose best path through or to a network
- Create smaller collision domains
- Create smaller broadcast domains

❖ **Disadvantages of routers**

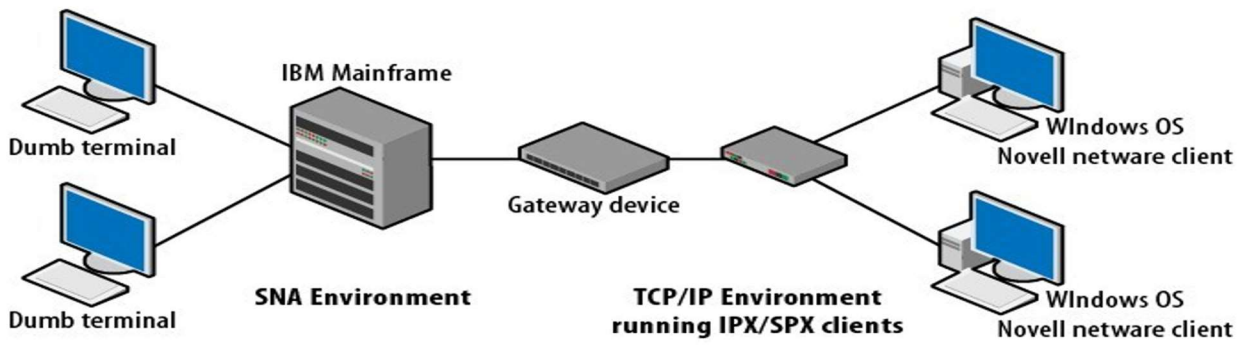
- Only work with routable protocols such as RIP, OSPF, or BGP
- More expensive than hubs, bridges, and switches
- Routing table updates consume bandwidth
- Increase delay due to a greater degree of packet filtering and/or analyzing

❖ GATEWAYS:

- It operates in all seven layers of OSI model.
- A gateway is a network point that acts as an entrance to another network.
- It is also called protocol converter.
- It is used to connect two different network types.

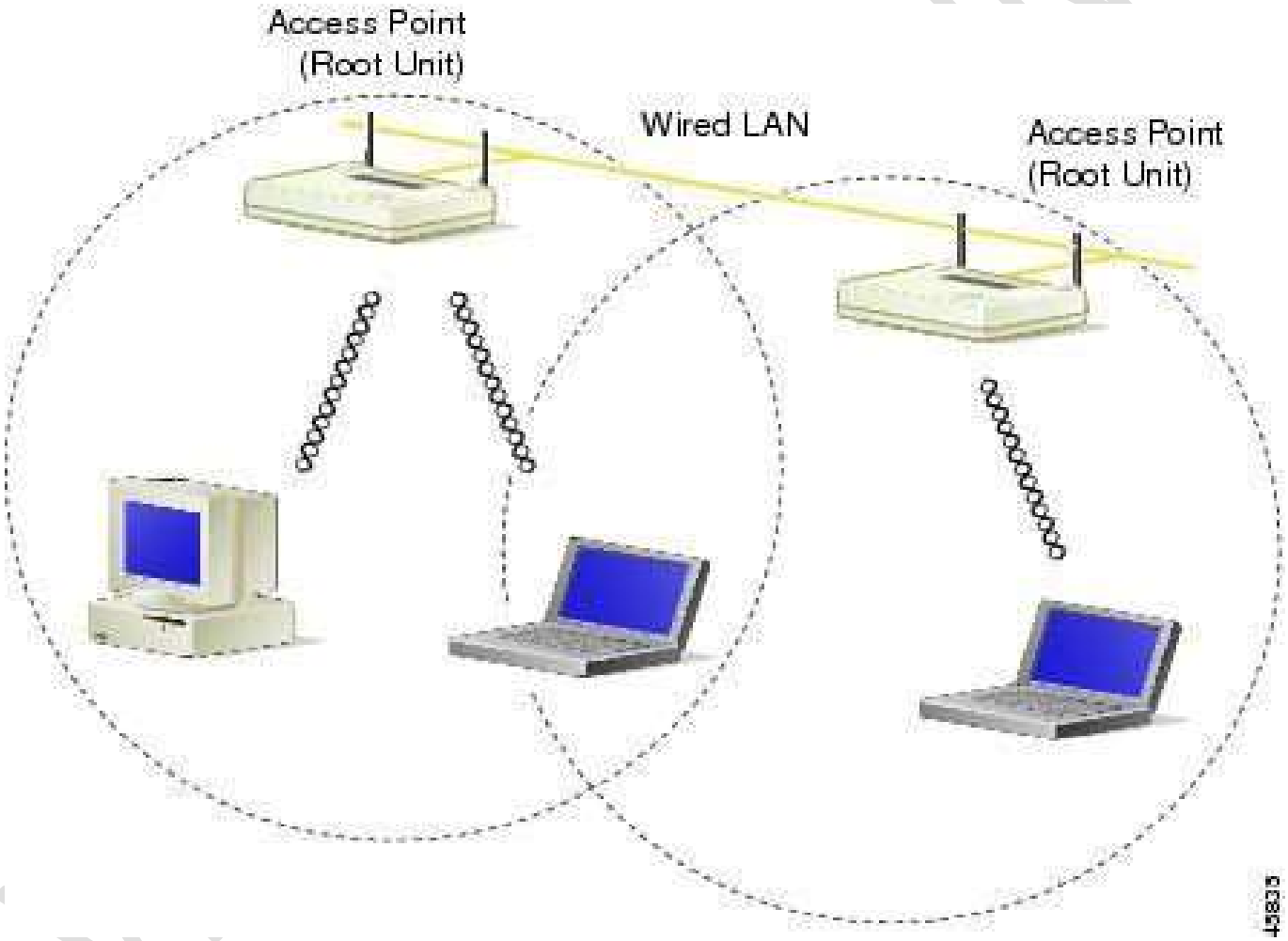


4.2.7 GATEWAYS CONTINUE...



❖ ACCESS POINT

- An Access Point connects directly to a wired LAN and then provides wireless connections using wireless LAN technology for other devices to utilize that wired connection.
- APs support the connection of multiple wireless devices through their one wired connection.
- It acts as a HUB between wired and wireless networks.
- It provides security and extend physical range of LAN



❖ **Difference between router and gateway:**

S.NO.	Router	Gateway
1.	It is a hardware device which is responsible for receiving, analyzing and forwarding the data packets to other networks.	It is a device that is used for the communication among the networks which have a different set of protocols.
2.	It supports the dynamic routing.	It does not support dynamic routing.
3.	The main function of a router is routing the traffic from one network to the other.	The main function of a gateway is to translate one protocol to the other.
4.	A router operates on layer 3 and layer 4 of the OSI model.	A gateway operates upto layer 5 of the OSI model.
5.	Working principle of a router is to install routing details for multiple networks and routing traffic based upon the destination address.	5. Working principle of a gateway is to differentiate what is inside the network and what is outside the network.
6.	It is hosted on only the dedicated applications.	It is hosted on dedicated applications, physical servers or virtual applications.
7.	The additional features provided by a router are Wireless networking, Static routing, NAT, DHCP server etc.	The additional features provided by a gateway are network access control, protocol conversion etc.