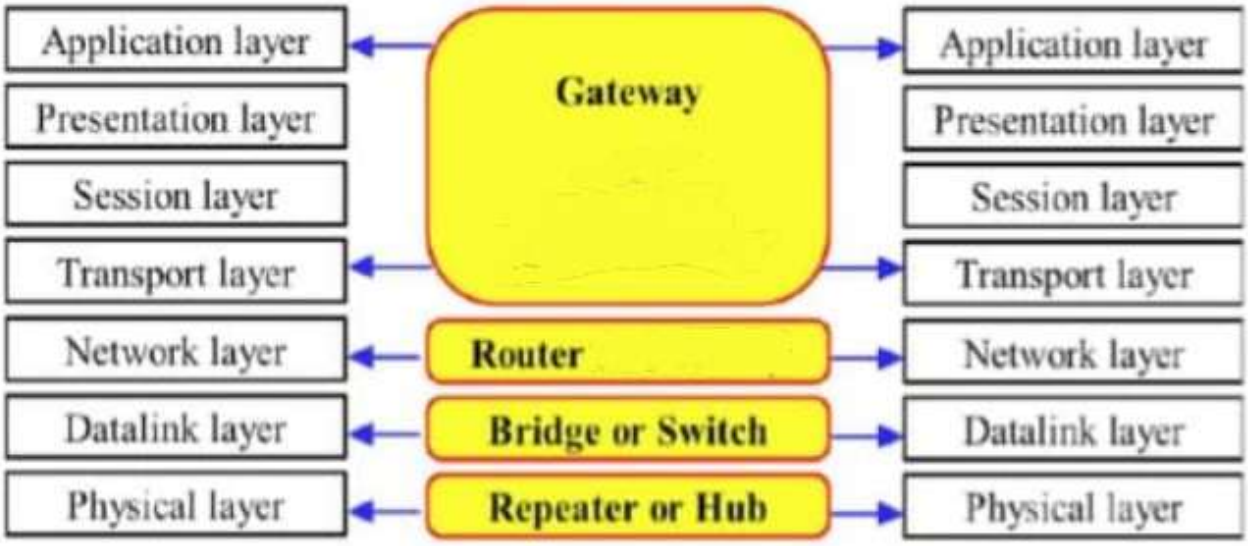
Networking Devices

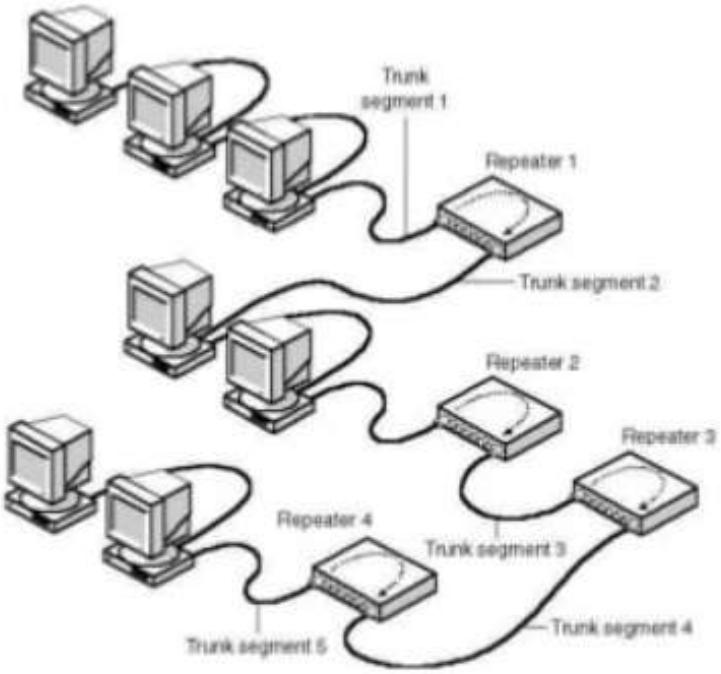
Network devices are components used to connect computers or other electronic devices together so that they can share files or resources like printers or fax machines.

Connecting devices and OSI model



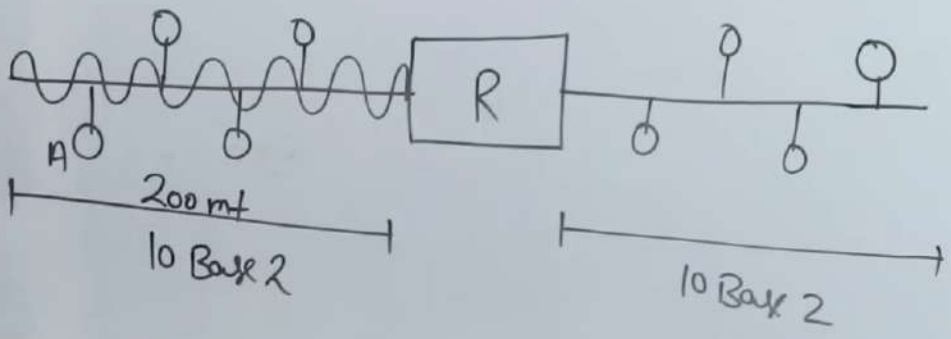
Repeater

- Repeater operates on physical layer.
- It receives the signal before it becomes corrupted and regerates the original bit pattern.
- It allows to extend the physical length of the network.
- It doesn't change the functionality of network.



Repeaters (Physical Layer)

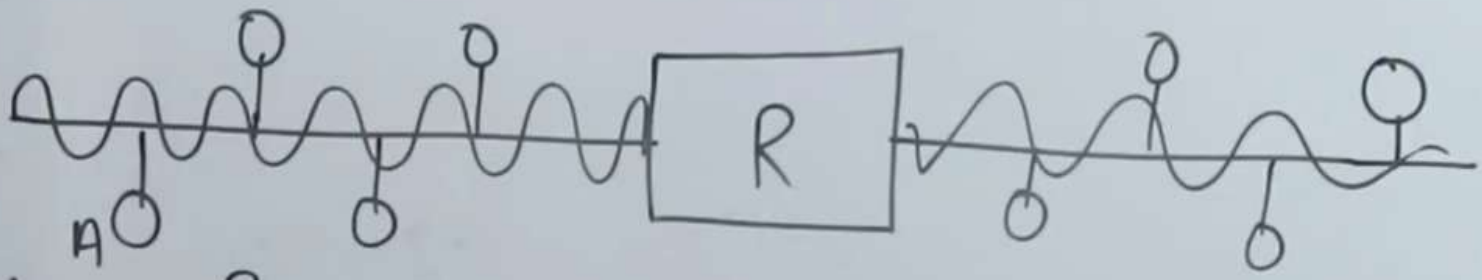
Regenerate the strength



1) 2 Port Device
2) Forwarding
3) No filtering
4) Collision Domain

Repeaters (Physical Layer)

Regenerate the strength



200 mt

10 Base 2

10 Base 2

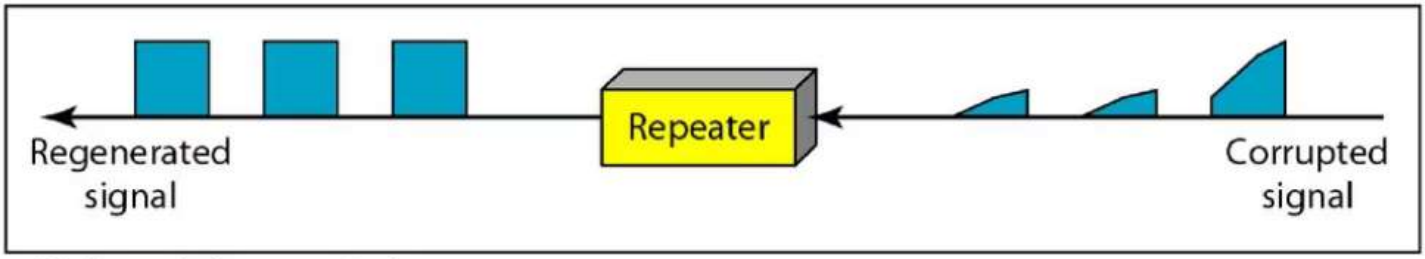
400 mt

Repeater

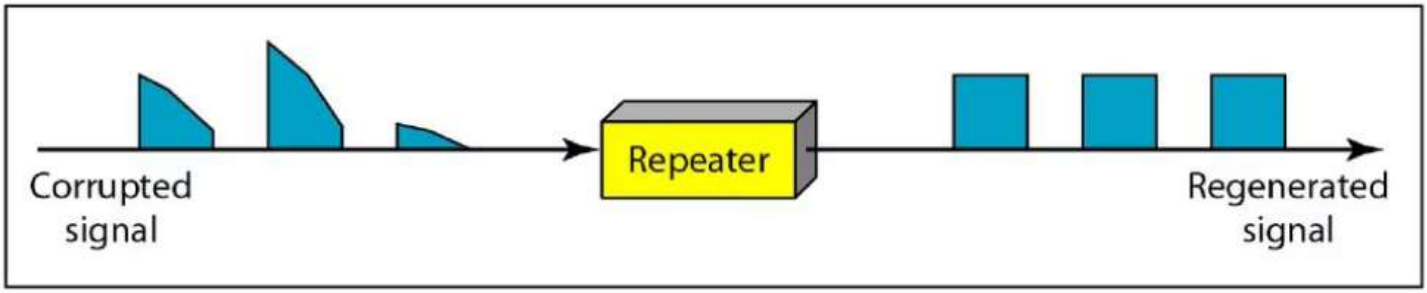
- A **physical layer** device the acts on **bits** not on **frames** or packets
- Can have two or more interfaces
- When a bit (0,1) arrives, the repeater receives it and **regenerates** it, the transmits it onto all other interfaces
- Used in LAN to **connect cable segments** and **extend** the **maximum cable length** ➔ extending the **geographical LAN range**
  - Ethernet 10base5 – Max. segment length 500m – 4 repeaters (5 segments) are used to extend the cable to **2500m**)
  - Ethernet 10Base2- Max. segment length 185m - 4 repeaters (5 segments) are used to extend the cable to **925m**
- Repeaters do not implement any **access method**
  - If any two nodes on any two connected segments transmit at the same time **collision** will happen

Repeaters are network devices operating at physical layer of the OSI model that amplify or regenerate an incoming signal before retransmitting it. They are incorporated in networks to expand its coverage area. They are also known as signal boosters.

Figure 15.3 *Function of a repeater*



a. Right-to-left transmission.



b. Left-to-right transmission.

Disadvantage associated with Repeater

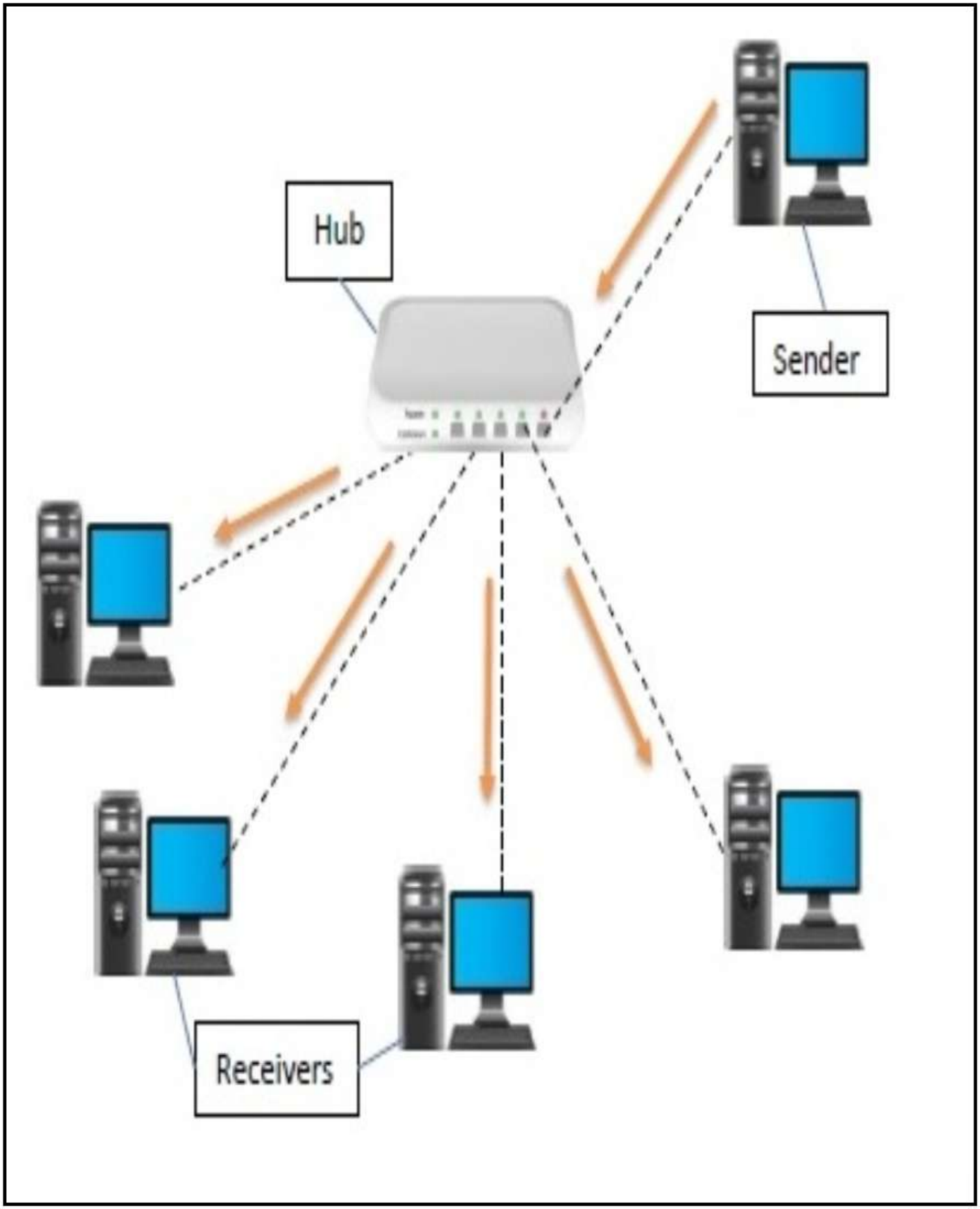
- It can't filter network traffic. Data, sometimes referred to as bits, arriving at one port of a repeater gets sent out on all other ports

- Data gets passed along by a repeater to all other LAN segments of a network regardless of whether it needs to go there or not.

Hubs

A hub is a physical layer networking device which is used to connect multiple devices in a network. They are generally used to connect computers in a LAN.

A hub has many ports in it. A computer which intends to be connected to the network is plugged in to one of these ports. When a data frame arrives at a port, it is broadcast to every other port, without considering whether it is destined for a particular destination or not.


Hub
Sender
Receivers

Network hubs are best suited for small, simple local area network (LAN) environments. Hubs cannot provide routing capabilities or other advanced network services. Because they operate by forwarding packets across all ports indiscriminately, network hubs are sometimes referred to as "dumb switches."

Types of Hub

1.PASSIVE HUB

2.ACTIVE HUB

3.INTELLIGENT HUB

1.PASSIVE HUB

- Passive hub don’t use power supply.
- It is just a connector that connects the wires coming from different branches.
- Passive hub do not regenerate or amplify incoming signals before rebroadcasting them to the network.

2.ACTIVE HUB

- Active hub requires power supply.
- The signal passing through an active hub regenerates or amplifies signals before they are retransmitted.
- They consists of repeating capabilities to strengthen the signals in a network.

3.INTELLIGENT HUB

- They are also known as **"smart hubs"** .
- The signal passing through an active hub regenerates signals and perform network management and intelligent path selection
- This hub do not have much importance in smaller networks with a few nodes, but as the network expands, its problems and management need also increase, and in those networks, such hubs are proved to be an asset.

- does not do **filtering** (forward a frame into a specific destination or drop it) just it copy the received frame onto **all other links**
- The entire hub forms **a single collision domain**, and **a single Broadcast domain**
  - **Collision domain**: is that part of the network when two or more nodes transmit at the same time collision will happen.

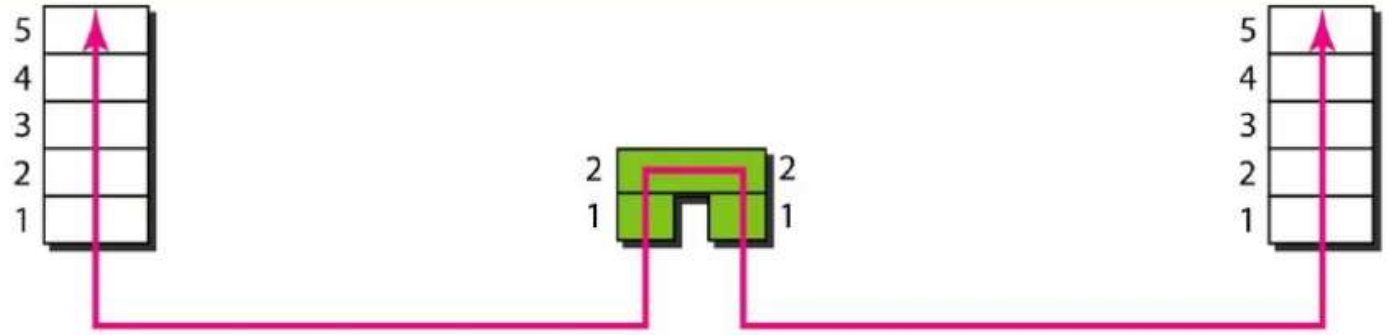
Bridge

- Acts on the **data link** layer (MAC address level)
- Used to **divide** (segment) the LAN into smaller LANs segments, or to **connect** LANs that use identical physical and data link layers
- Each LAN segment is a **separate collision domain**
- Bridge does not send the received frame to all other interfaces like hubs and repeaters, but it performs **filtering** which means:
  - Whether a frame should be **forwarded** to another interface that leads to the destination or **dropped**
- This is done by a bridge table (**forwarding table**) that contains entries for the nodes on the LAN
  - The bridge table is **initially empty** and **filled automatically** by **learning from frames movements** in the network
  - An entry in the bridge table consists of : Node LAN (**MAC**) **Address, Bridge Interface to which the node is connected to, the record creation time**

Address	Interface	Time
62-FE-F7-11-89-A3	1	9:32
7C-BA-B2-B4-91-10	3	9:36
...	...	...

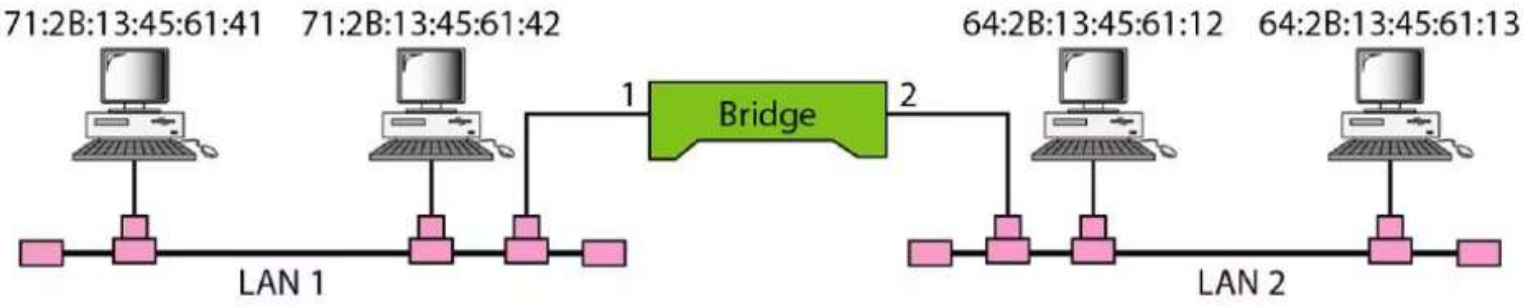
- A bridge runs **CSMA/CD before sending a frame** onto the link not like the hub or repeater
- Bridge frame handling is done in **software**

Figure 15.5 *A bridge connecting two LANs*



Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	1
64:2B:13:45:61:12	2
64:2B:13:45:61:13	2

Bridge Table



BRIDGE

- ★ Bridge = Repeater + Functionality of reading MAC address.
- ★ It is a layer 2 device.
- ★ It is also used for interconnecting two LANs on the same protocol.
- ★ It is also a two port device.

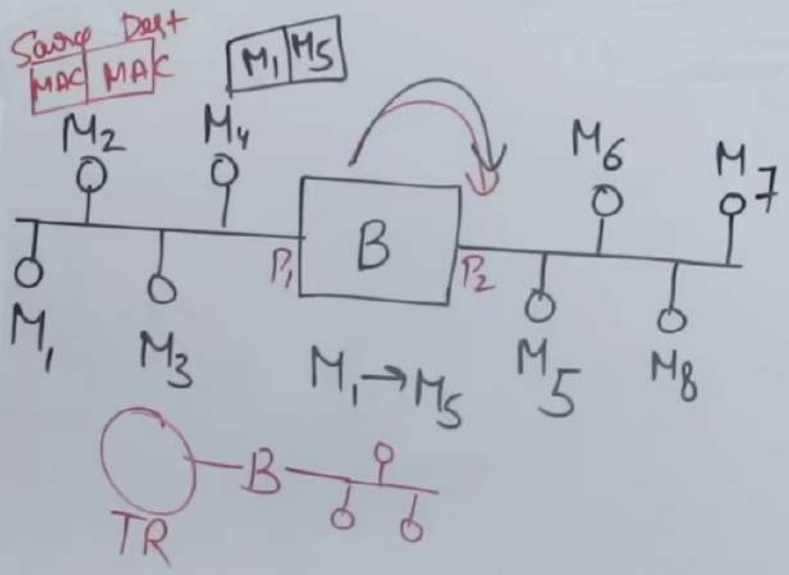
Token bus
Ring
etc.

Types of bridges

- Transparent Bridges.
- Source Routing Bridges

Types of bridges

- ★ Transparent Bridges.
  - ★ These are the bridge in which the stations are completely unaware of the bridge's existence.
  - ★ Reconfiguration of the stations is unnecessary even if bridge is added or removed from network.
- ★ Source Routing Bridges.
  - ★ In these bridges, routing operation is performed by source station and the frame specifies which route to follow.



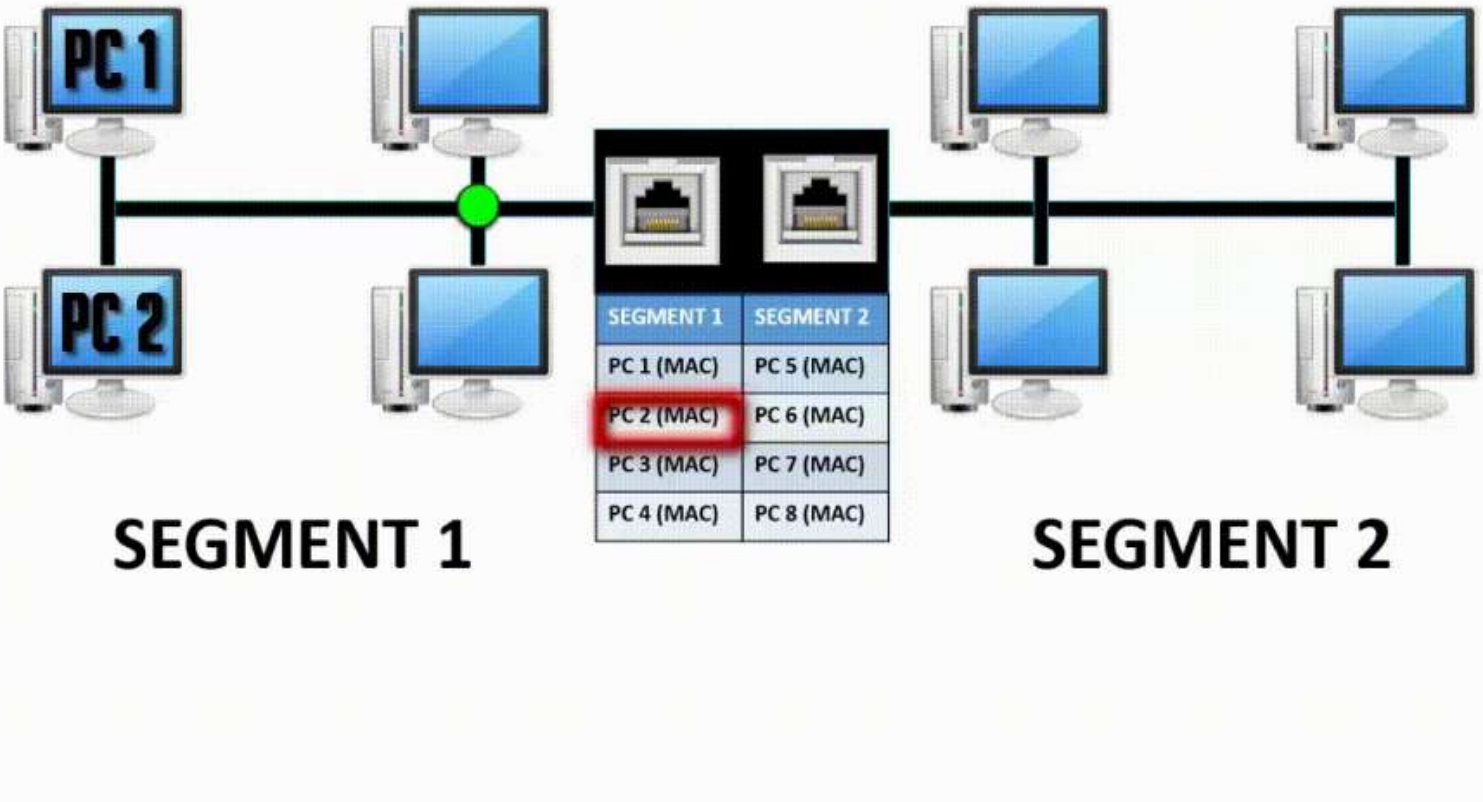
Types

- Static
- Dynamic OR (Transparent)

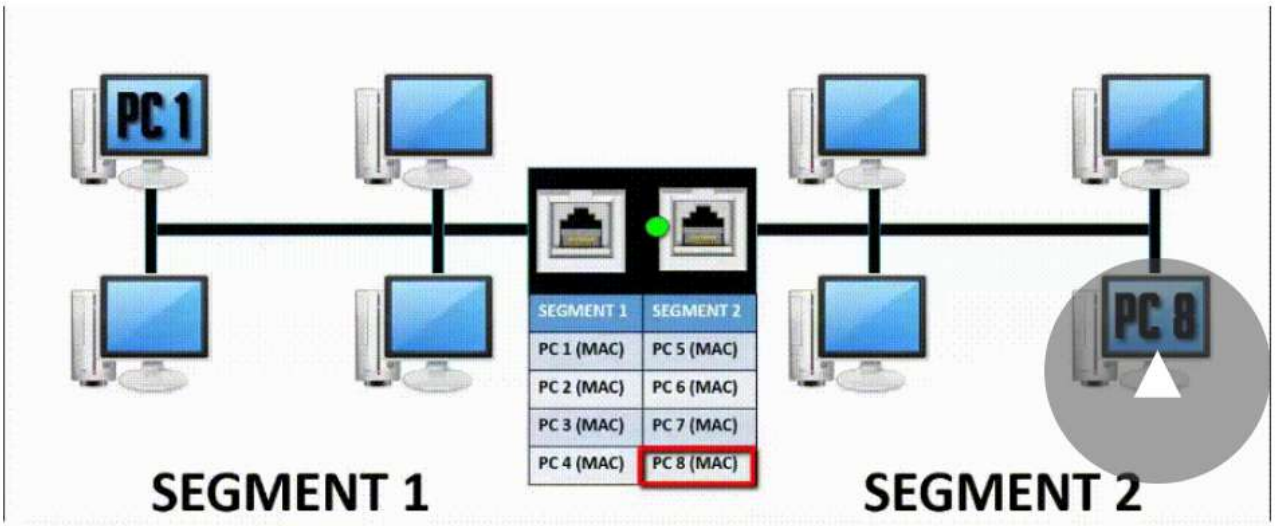
MAC	Port
M_1	P_1
M_2	P_1
M_3	P_1
M_4	P_1
M_5	P_2
M_6	P_2
M_7	P_2
M_8	P_2

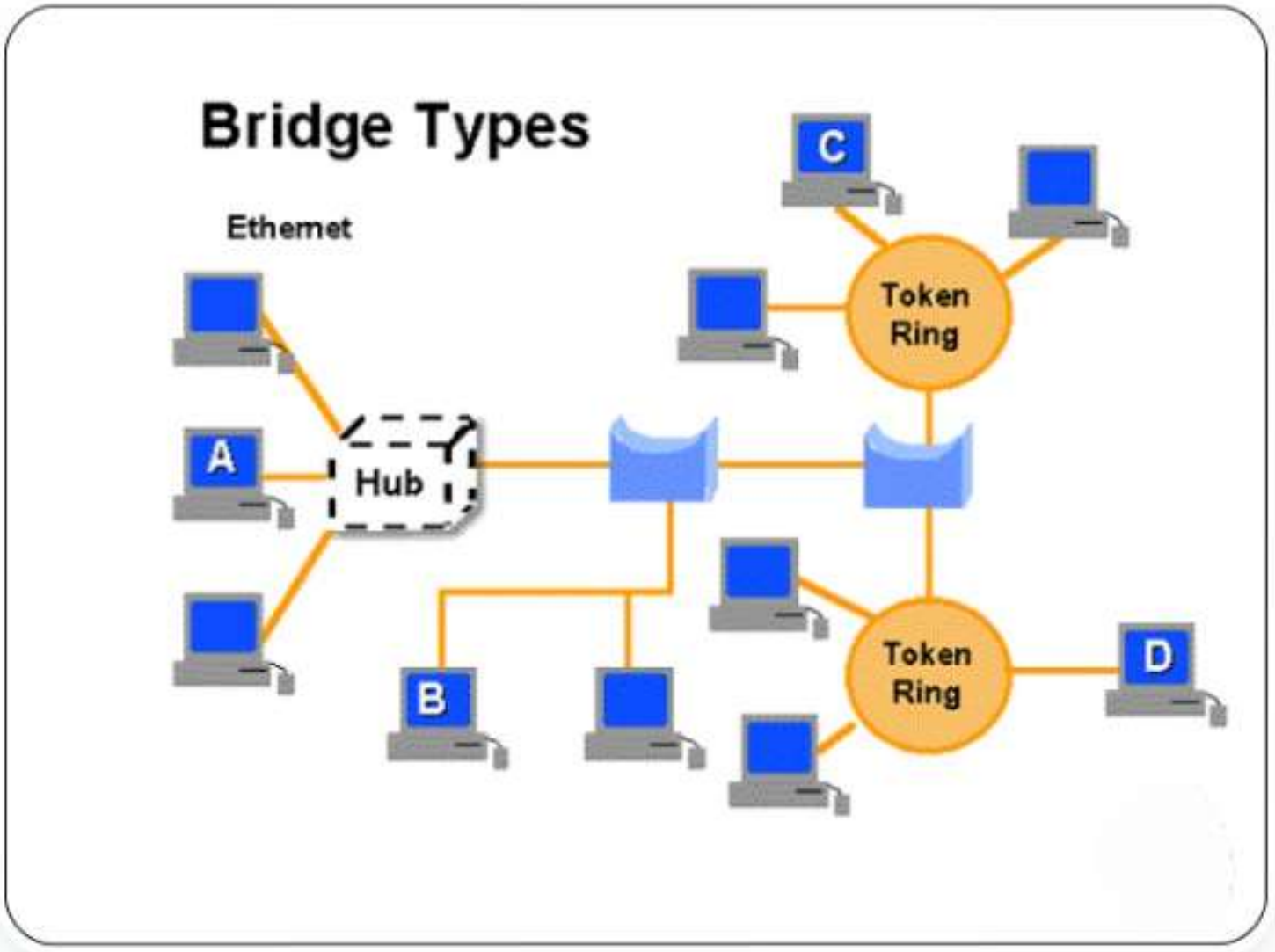
How Bridge works in Network

Bridge in networking divides a **LAN** into two segments (Segment 1 and Segment 2) and stores all the connected PC's MAC address into its table. Let's take an example, Here PC 1 tries to send data to PC 2. Data will first travel to the bridge. The bridge will read its **MAC address** and decide whether to send the data to segment 1 or segment 2. Hence, the PC 2 is available in segment 1 means bridge will broadcast the data only in segment 1 and excludes all the PCs connected in segment 2. Like this bridge reduce the traffic on a computer network.


PC 1
PC 2
SEGMENT 1
SEGMENT 2
PC 1 (MAC)
PC 2 (MAC)
PC 3 (MAC)
PC 4 (MAC)
PC 5 (MAC)
PC 6 (MAC)
PC 7 (MAC)
PC 8 (MAC)
SEGMENT 1
SEGMENT 2

Let’s take one more example. As mentioned in the below picture, PC 1 is trying to send data to PC 8. So, the data will first travel to the bridge. The bridge is going to read it’s MAC Address table and find whether PC 8 belongs to Segment 1 or Segment 2. Hence, the PC 8 is in segment 2 bridge will broadcast the data in segment 2 and excludes all the PCs connected to Segment 1. So, this is how the bridge works and reduce traffic in a computer network.




Bridge Types
Ethernet
C
Token
Ring
A
Hub
B
Token
Ring
D

What are Switches in Computer Network?

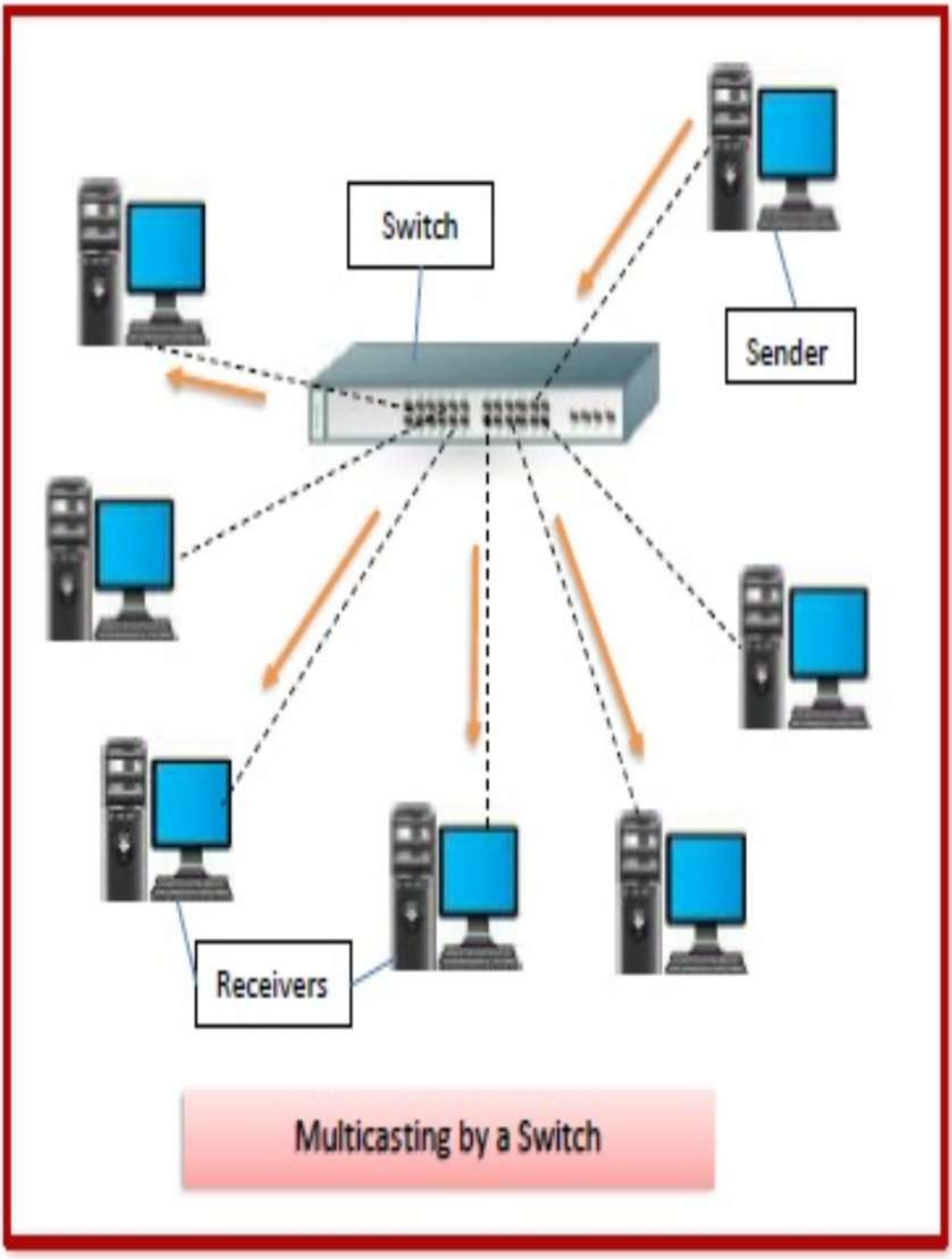
Switches are networking devices operating at layer 2 or a data link layer of the OSI model. They connect devices in a network and use packet switching to send, receive or forward data packets or data frames over the network.

A switch has many ports, to which computers are plugged in. When a data frame arrives at any port of a network switch, it examines the destination address, performs necessary checks and sends the frame to the corresponding device(s).It supports unicast, multicast as well as broadcast communications.

Switches

- Switches operate at the Data Link layer (layer 2) of the OSI model
- Can interpret address information
- Switches resemble bridges and can be considered as multiport bridges

- By having multiports, can better use limited bandwidth and prove more cost-effective than bridge

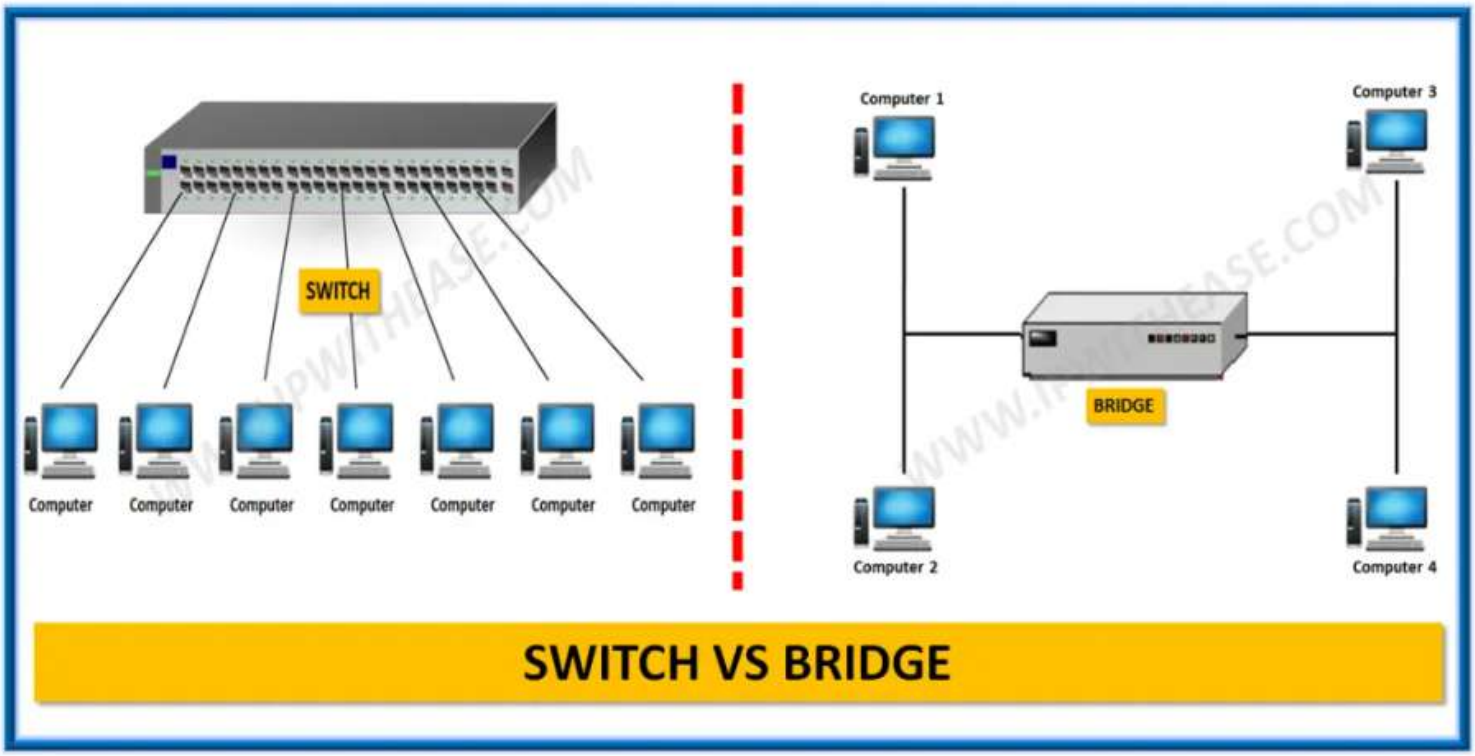


Multicasting by a Switch

Features of Switches

- A switch operates in the layer 2, i.e. data link layer of the OSI model.
- It is an intelligent network device that can be conceived as a multiport network bridge.
- It uses MAC addresses (addresses of medium access control sublayer) to send data packets to selected destination ports.
- It uses packet switching technique to receive and forward data packets from the source to the destination device.

- It is supports unicast (one-to-one), multicast (one-to-many) and broadcast (one-to-all) communications.
- Transmission mode is full duplex, i.e. communication in the channel occurs in both the directions at the same time. Due to this, collisions do not occur.

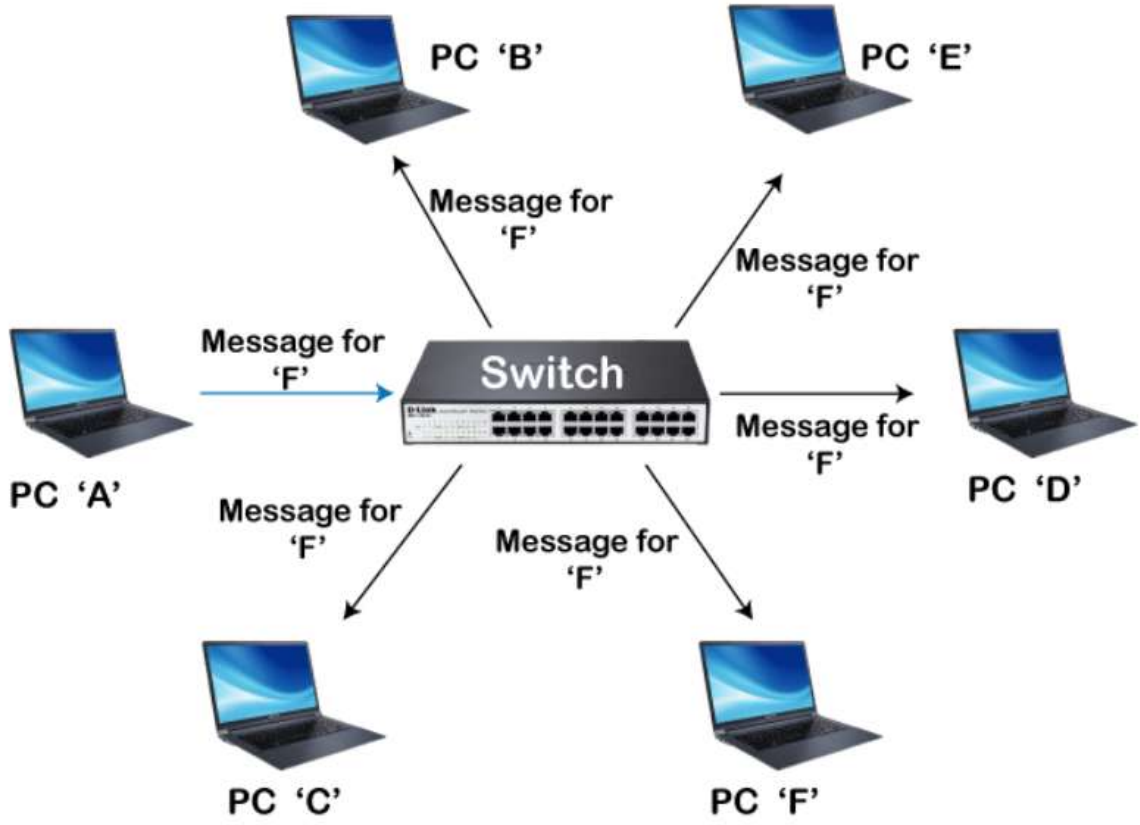

SWITCH
Computer
Computer
Computer
Computer
Computer
Computer
Computer
Computer 1
Computer 3
BRIDGE
Computer 2
Computer 4
SWITCH VS BRIDGE

What is a router?

Just as a switch connects multiple devices to create a network, a router connects multiple switches, and their respective networks, to form an even larger network. These networks may be in a single location or across multiple locations. When building a small business network, you will need one or more routers. In addition to connecting multiple networks together, the router also allows networked devices and multiple users to access the Internet.

A router works on the **third layer** of the OSI model, and it is based on the IP address of a computer. It uses protocols such as ICMP to communicate between two or more networks. *It is also known as an* ***intelligent device*** *as it can calculate the best route to pass the network packets from source to the destination automatically.*

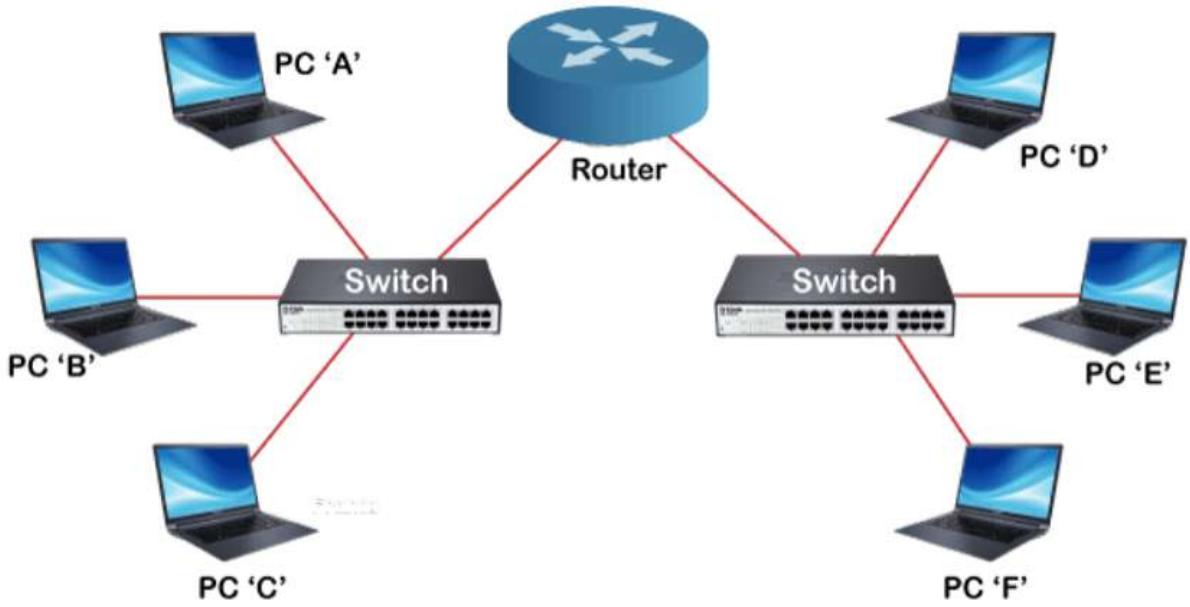
- With the help of a switch, the connected devices can share the data & information and communicate with each other.



- Without a switch, we cannot build a small business network and cannot connect devices within a building or campus.

Router

- Within a home or office, we have various networked devices such as PC, tablets, printers, etc., and with the router, these devices can be connected to the internet and form a network. A router first connects the modem to other devices to allow communication between these devices and the internet.



Connection of networks through Router

What Is a Gateway?

As is suggested by its name, a gateway is a network entity and also called the protocol converter. It can connect a computer of one network to another and define the boundaries of a network. If two networks of different protocols want to connect with each other, both networks need to have gateways which provide exist and entry points for computers from the two networks to communicate. In another word, a gateway can join dissimilar systems.

Gateways are the most intelligent and highly configurable network connecting devices. It operates in all the layers of the OSI(Open System Interconnection) model

- A **gateway** also forwards packets between networks, but where some conversion is required because the networks are running different, incompatible protocols

Gateway vs router: what is the difference

A router is a networking layer system used to manage and forward data packets to devices network while a gateway is simply a hardware that acts as a gate between the networks. Besides, routers and gateways are very different in their working principle.

Before arriving at the router, packets go to the gateway channel first, and the gateway checks the header information at once. After checking for any kind of error in the destination IP address and packet. According to the needs of the destination network, it carries out data conversion and protocol conversion on the packet, which is also the most critical step. Finally, the processed packet is forwarded to the router to establish intelligent communication between the two different networks.

The router extracts the destination address from the received packet, determines the network number in the address, and then looks up the routing table to find the entry matching the destination network. The routing table determines the next stop, destination, output interface, and other routing-related parameters that match the current packet. Finally, the packet is sent to the computer with the best route.