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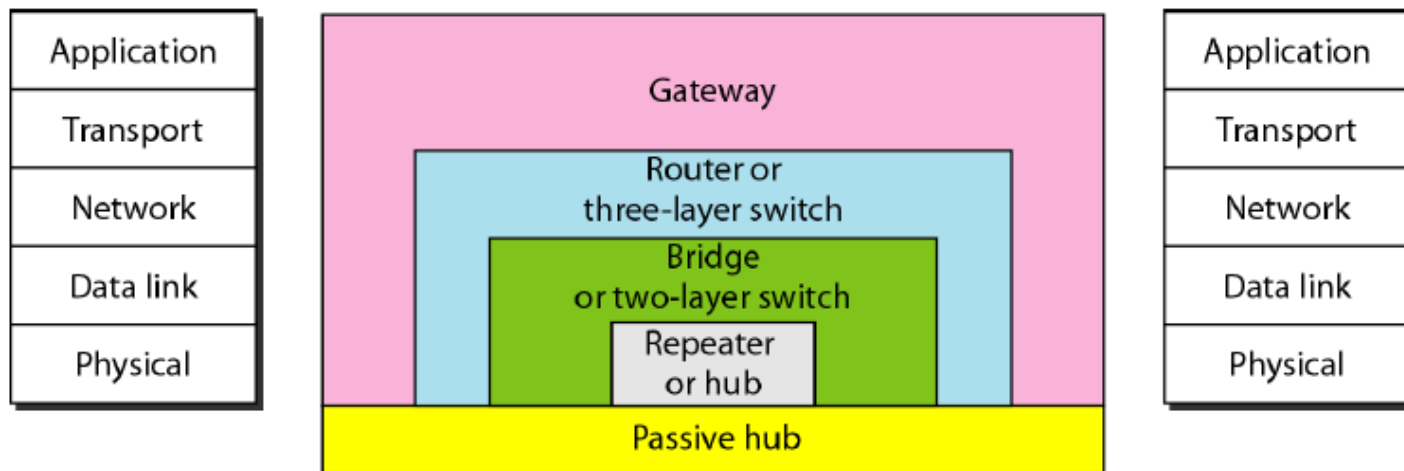
- LANs do not normally operate in isolation but they are connected to one another or to the Internet.
- To connect LANs, connecting devices are needed and various connecting devices are such as bridge, switch, router, hub, repeater.
- These connecting devices are Networking Devices

# What are Networking Devices?

- Network devices are the devices used for
  - organizing a network,
  - connecting to a network,
  - routing the packets,
  - strengthening the signals,
  - communicating with others,
  - surfing the web,
  - sharing files on the network and many more uses.

# CONNECTING DEVICES

- Connecting devices into five different categories based on the layer in which they operate in a network.



*Five categories of connecting devices*

# Types of network devices

- NIC
- Modem
- Hub
- Repeater
- Bridge
- Switch
- Router
- Gateway

# Network Interface Card (NIC)

A Network Interface Card (NIC) is circuit board or a card that allows computers to communicate over a network via cables or wirelessly.

## Description

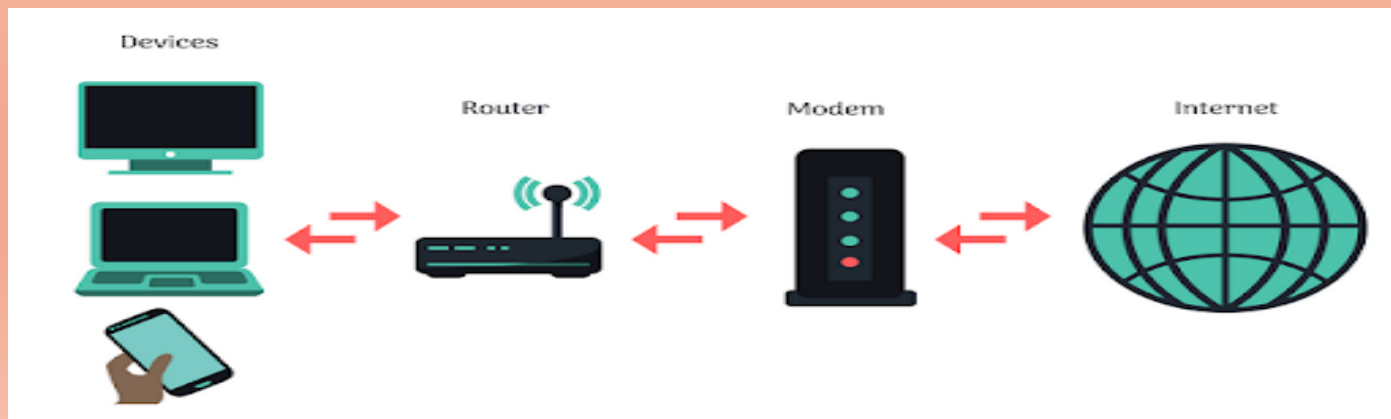
- It is also called as LAN adaptor, network adaptor or network card.
- Enable clients, servers, printers and other devices to transmit and receive data over the network.
- Operates on physical and data link layer of OSI model.
- Every network adaptor is assigned a unique 48-bit Media Access Control (MAC) address, which is stored in ROM to identify themselves in a network or a LAN.
- Available maximum data transfer rate is 10, 100 and 1000 MBPS.
- Typically network adaptor has RJ45 or BNC or both sockets for connecting and a LED to show up it is active and transmitting the data.
- Connects to a network via cables like CAT5, Co-axial, fiber-optics etc. and wirelessly by a small antenna.

# Modem

Modem is a device that converts digital signal to analog signal as a modulator and analog signal to digital signal as a demodulator.

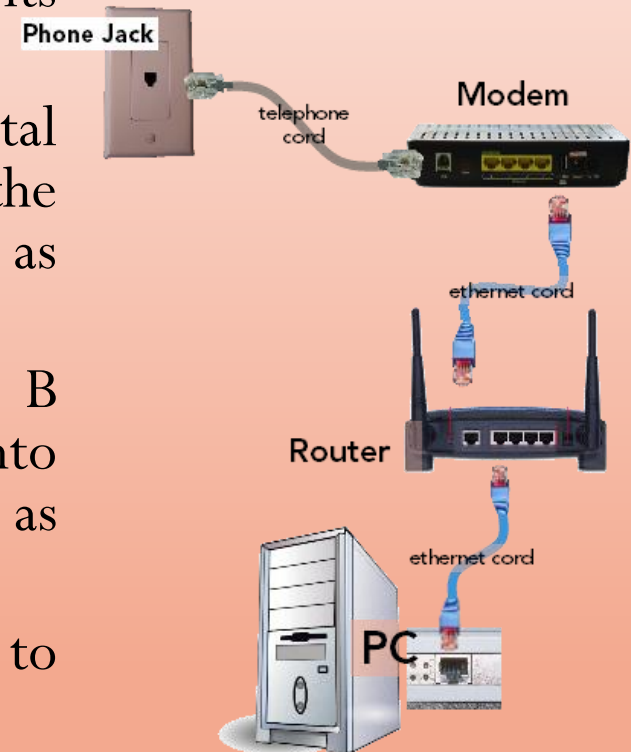
## Description

- Enable computers to communicate over telephone lines.
- Speed of modem is measured in bits per second and varies depending upon the type of modem. Higher the speed, the faster you can send and receive data over the network.
- Used to connect computer to the internet.



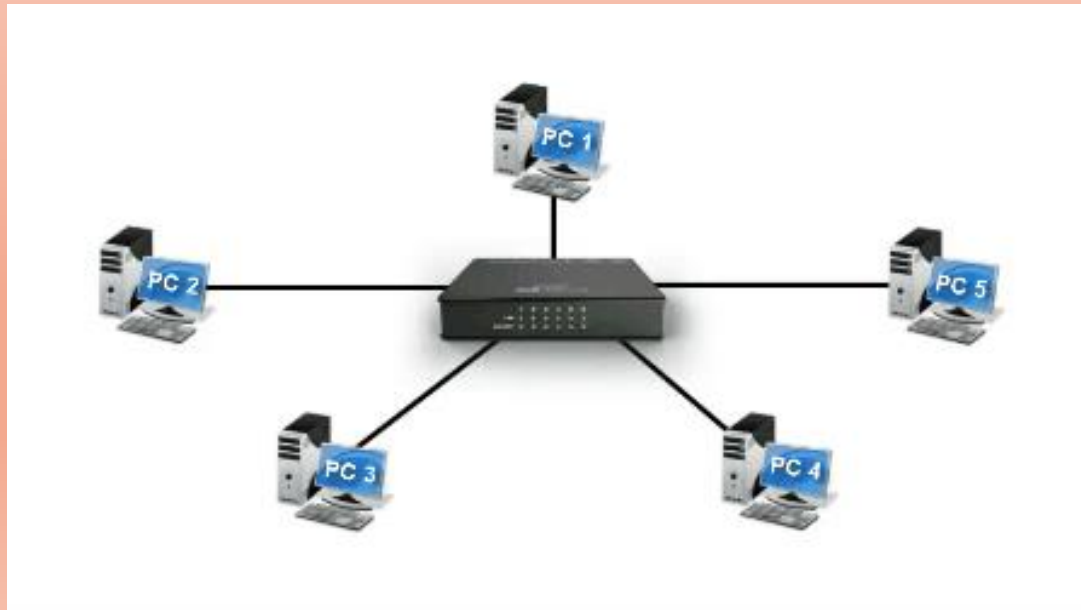
# Working

- Consider a communication between two computers A and B.
- Computer A transmits the digital signals to its modem in the form of binary 0's and 1's.
- Modem of computer A converts these digital signals into analog signals and sends over the telephone line. This process is called as **modulation**.
- While at the other end, modem of computer B receives the analog signals and converts back into digital signals. This process is called as **demodulation**.
- Converted digital signals by the modem are sent to the computer B for processing.
- In similar way computer B can communicate with computer A.



# Hub

- Hubs are devices commonly used to connect segments of 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.





# Types of Hubs

- **Passive Hub:** This type of does not amplify or boost the signal. It does not manipulate or view the traffic that crosses it. The passive hub does not require electrical power to work.
- **Active Hub:** It amplifies the incoming signal before passing it to the other ports. It requires AC power to do the task.
- **Intelligent Hub:** They are also called as smart hubs. Function as an active hub and also include diagnostic capabilities. Intelligent hubs include microprocessor chip and are very useful in troubleshooting conditions of the network.

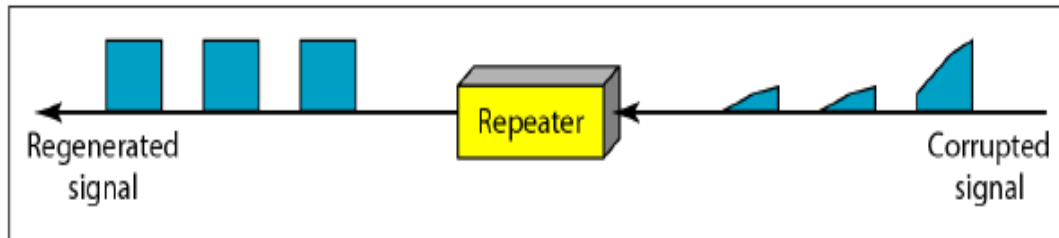
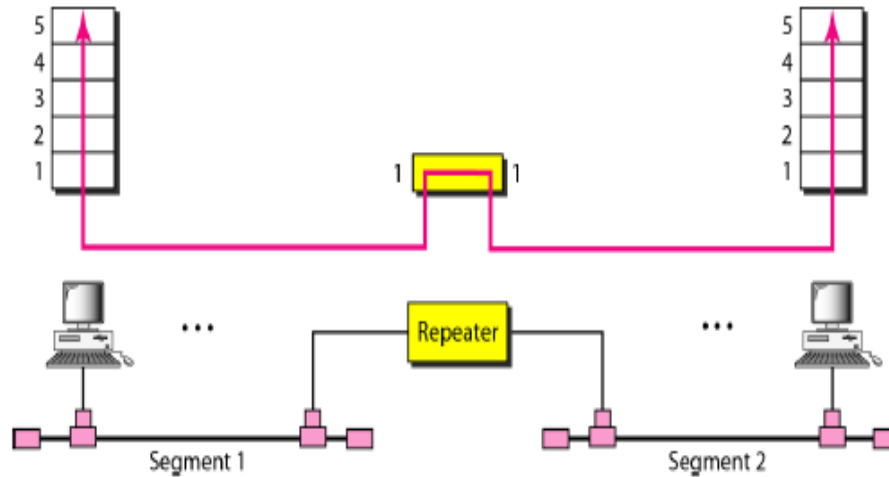
# Repeaters

- A repeater is a device that operates only at the PHYSICAL layer.
- A repeater can be used to increase the length of the network by eliminating the effect of attenuation on the signal.
- It connects two segments of the same network, overcoming the distance limitations of the transmission media.
- A repeater forwards every frame; it has no filtering capability.
- A repeater is a regenerator, not an amplifier.
- Repeaters can connect segments that have the same access method. (CSMA/CD, Token Passing, Polling, etc.)

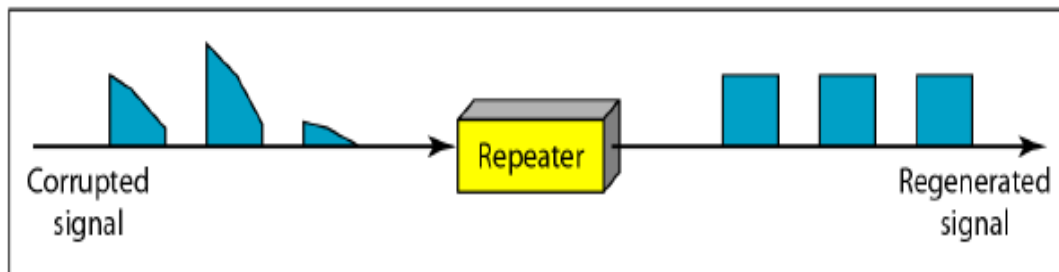


Optic fiber repeater

## Repeater connecting two segments of a LAN



a. Right-to-left transmission.



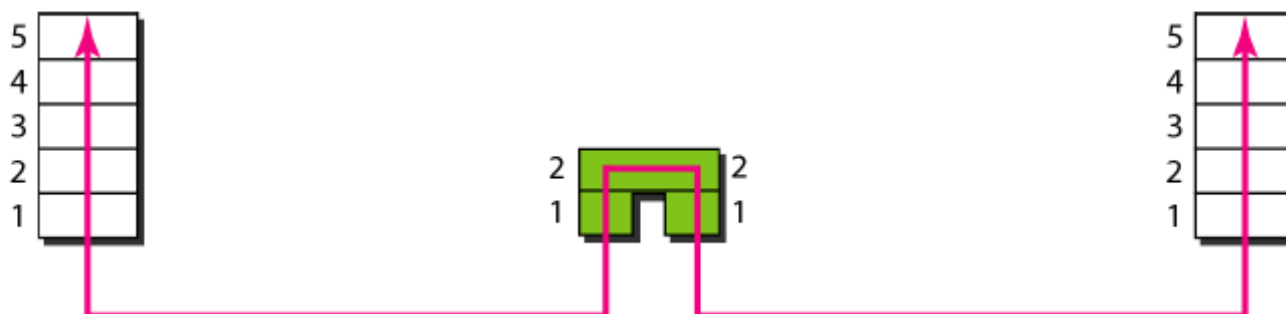
b. Left-to-right transmission.

*Function of a repeater*

## Bridges

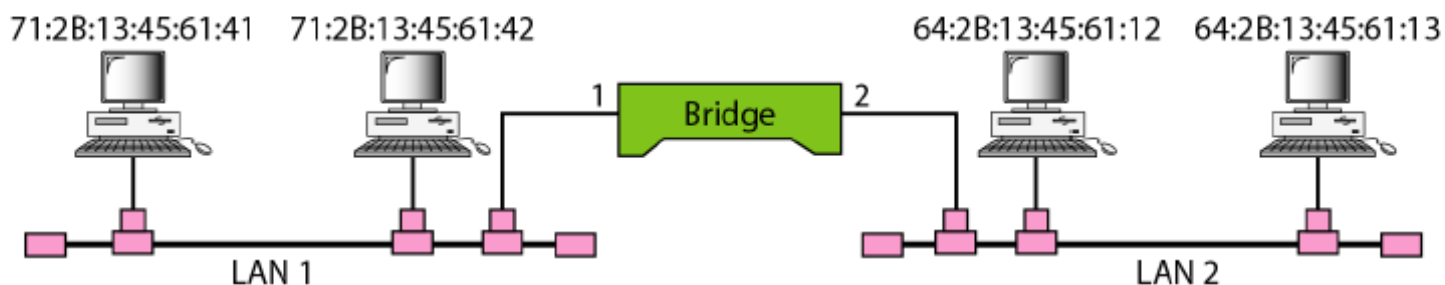
- Operates in both the PHYSICAL and the data link layer.
- As a PHYSICAL layer device, it regenerates the signal it receives.
- As a data link layer device, the bridge can check the PHYSICAL/MAC addresses (source and destination) contained in the frame.
- A bridge has a table used in filtering decisions.
- It can check the destination address of a frame and decide if the frame should be forwarded or dropped.
- If the frame is to be forwarded, the decision must specify the port.
- A bridge has a table that maps address to ports.
- Limit or filter traffic keeping local traffic local yet allow connectivity to other parts (segments).

## 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

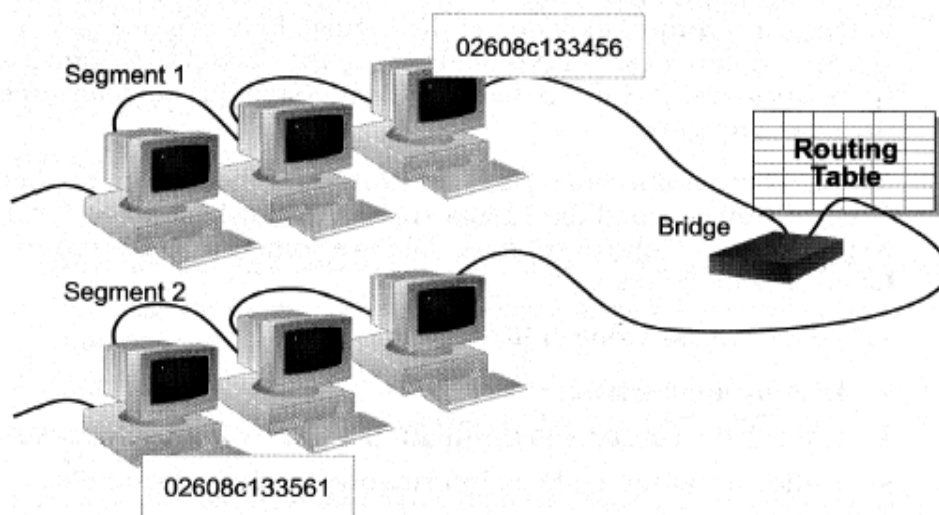
Bridge Table

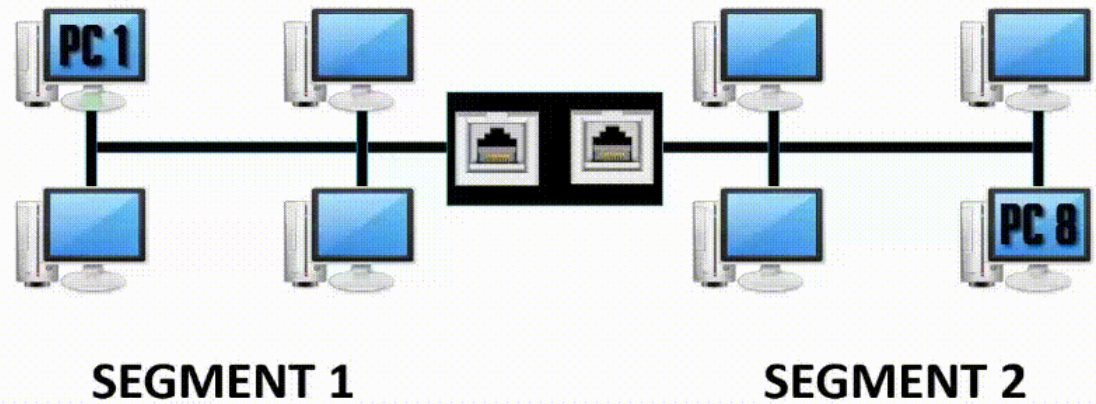
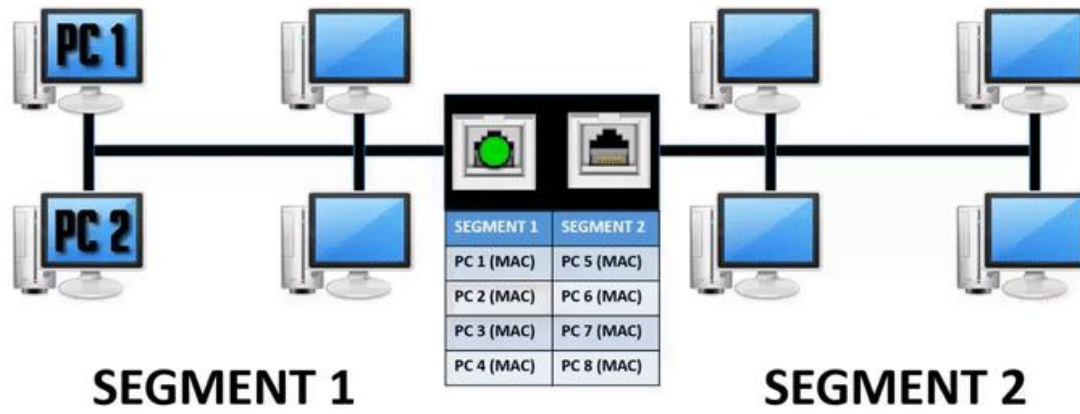


A bridge does not change the physical (MAC) addresses in a frame.

# How Bridges Work

- Bridges work at the Media Access Control Sub-layer of the OSI model
  - Routing table is built to record the segment no. of address
  - If destination address is in the same segment as the source address, stop transmit
  - Otherwise, forward to the other segment







# Characteristics of Bridges

- **Routing Tables**
  - Contains one entry per station of network to which bridge is connected.
  - Is used to determine the network of destination station of a received packet.
- **Filtering**
  - Is used by bridge to allow only those packets destined to the remote network.
  - Packets are filtered with respect to their destination and multicast addresses.
- **Forwarding**
  - the process of passing a packet from one network to another.
- **Learning Algorithm**
  - the process by which the bridge learns how to reach stations on the internetwork.



# Types of Bridges

- Transparent Bridge
  - Also called learning bridges
  - Build a table of MAC addresses as frames arrive
  - Ethernet networks use transparent bridge
  - Duties of transparent bridge are : Filtering frames, forwarding and blocking
- Source Routing Bridge
  - Used in Token Ring networks
  - Each station should determine the route to the destination when it wants to send a frame and therefore include the route information in the header of frame.
  - Addresses of these bridges are included in the frame.
  - Frame contains not only the source and destination address but also the bridge addresses.



# Advantages And Disadvantages Of Bridges

- 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
  - More expensive than repeaters

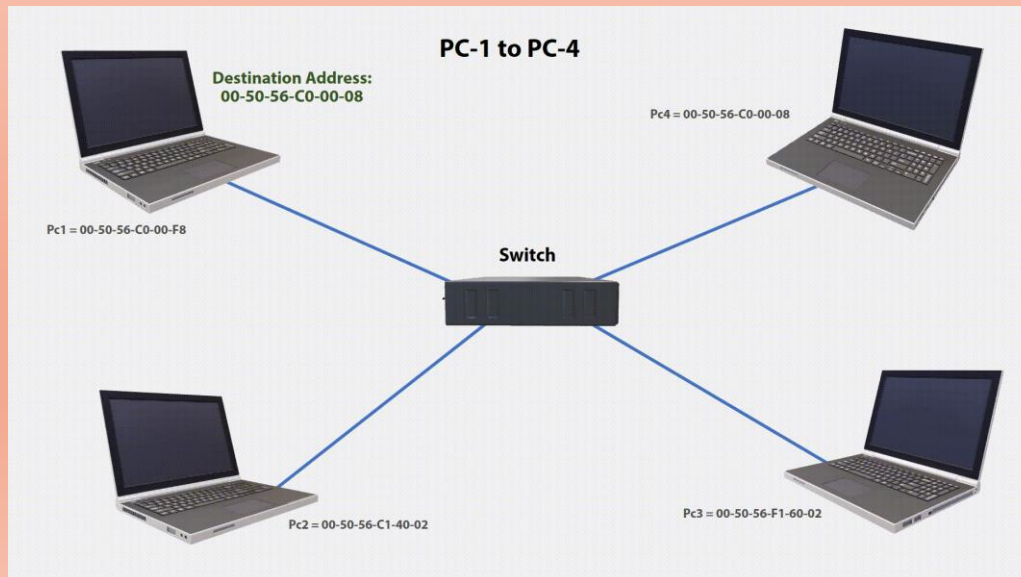
# SWITCH

- Switches allow different devices on a network to communicate.
- A Network Switch is a constituent of computer network that connects two network slices and/or two network devices (switches or routers) together.
- Switch can be termed as a network bridge with multiple ports which helps to process and route packets at data link layer of the OSI reference model.



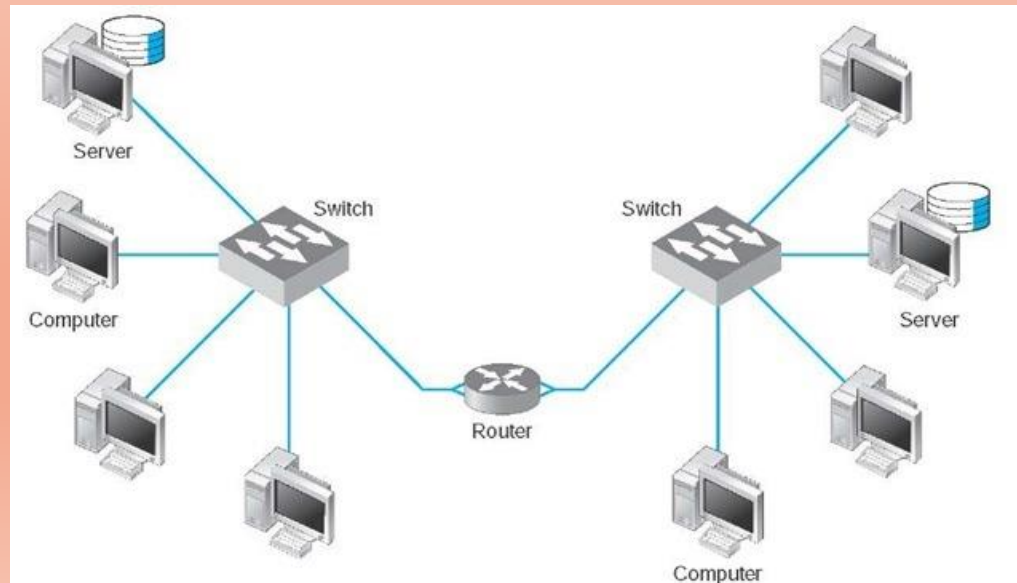
# Working

- Switch use two different methods for switching the packets:
  - In **cut-through** method switch examines the header of the packet and decides, where to pass the packet before it receives the whole packet. Increases the chances of errors without verifying the data integrity.
  - In **store and forward method** switch reads the entire packet in its memory and checks for error before transmitting the packet. This method is slower and time consuming but error free.



# Router

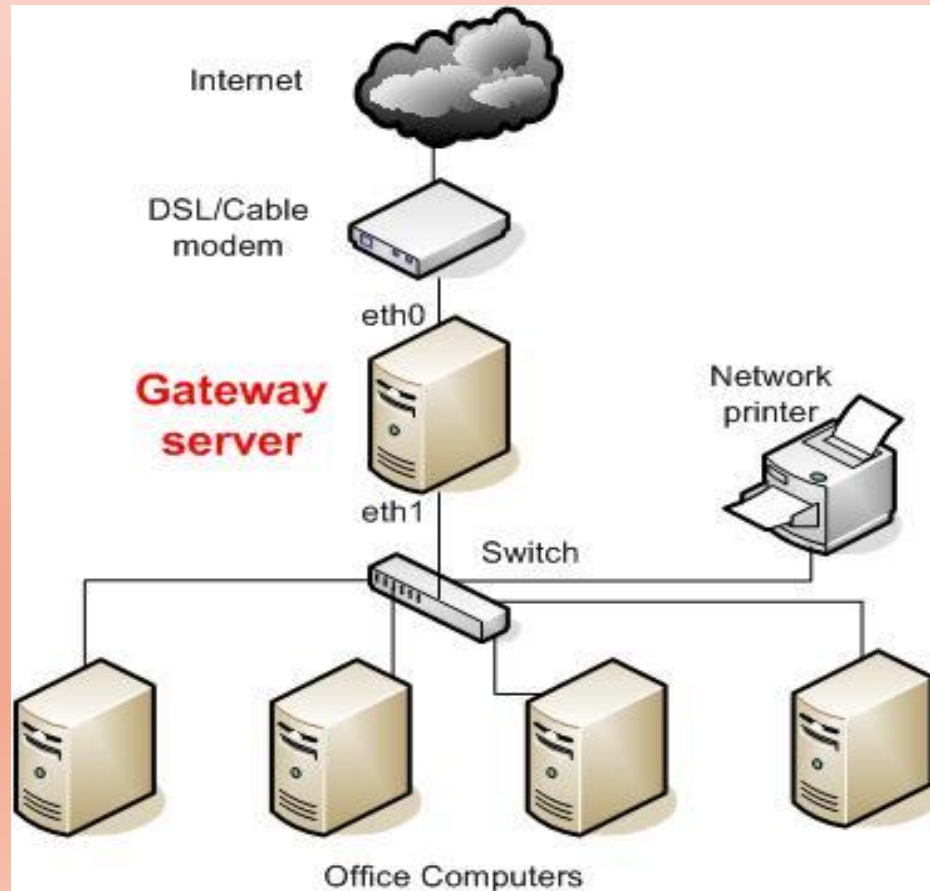
- A router is a network layer hardware device that transmits data from one LAN to another if both networks support the same set of protocols.
- So a router is typically connected to at least two LANs and the internet service provider (ISP). It receives its data in the form of packets, which are data frames with their destination address added.



- A router reads its routing table to decide the best available route the packet can take to reach its destination quickly and accurately. The routing table may be of these two types:
  - **Static Routing Table:** In a static routing table the routes are fed manually. So it is suitable only for very small networks that have maximum two to three routers.
  - **Dynamic Routing Table:** In a dynamic routing table, the router communicates with other routers through protocols to determine which routes are free. This is suited for larger networks where manual feeding may not be feasible due to large number of routers.

# Gateway

- Gateway is a network point that act as entry point to other network and translates one data format to another.





# Description

Following are some common functions of the gateway :

- Protocol translation : translates protocol format into required protocol format of the network, such as X.25 to TCP/IP.
- Network address translation : translates your public IP address to the private IP addresses on your network.
- DHCP service : automatically assigns IP address to a computer from a defined range of addresses for a given network.
- Monitoring and regulating each packet entering and leaving the network.