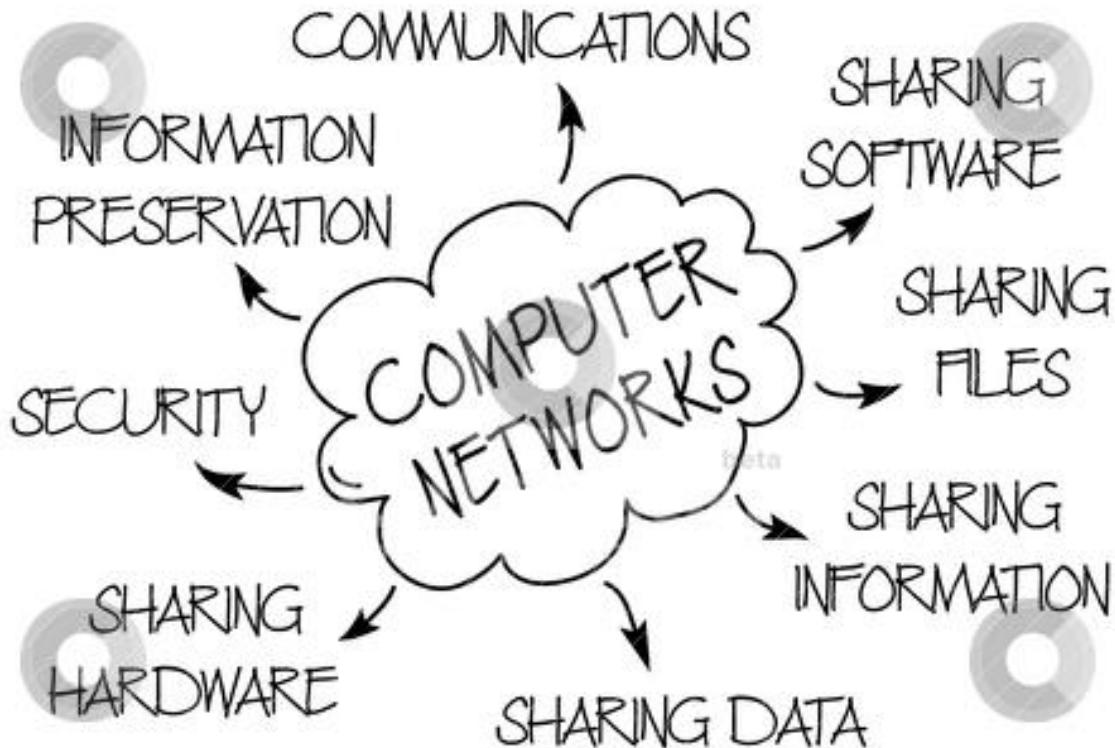


# **NETWORKING ESSENTIALS**

# Contents

- Network & Networking
- Topologies
- OSI Model
- Transmission Media
- Networking Devices
- Wireless Networking
- Network Threats
- Troubleshooting
- Remote Desktop Connection

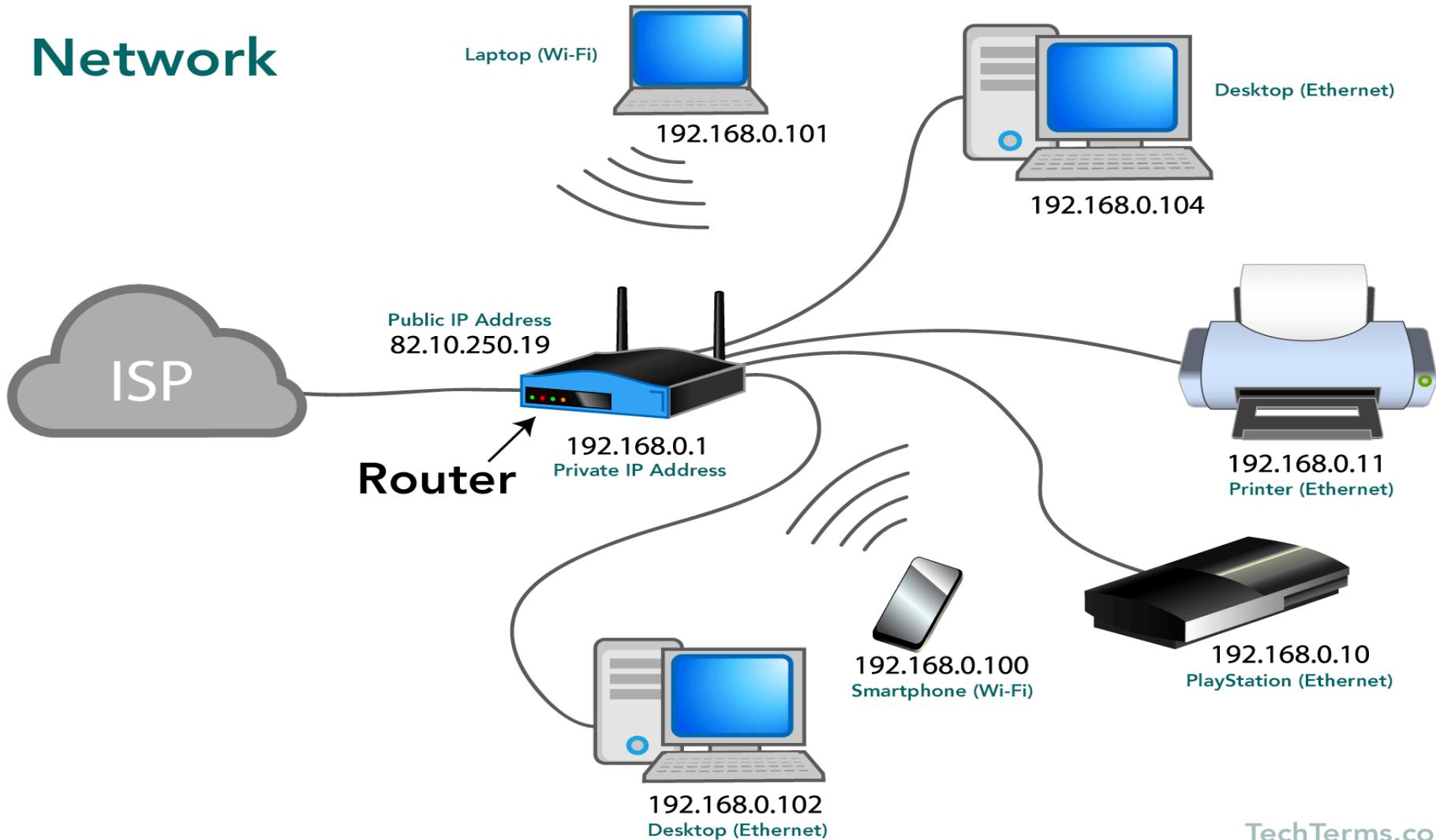


# What is Network ?

- A network consists of two or more computers that are linked in order to share resources (such as printers and CDs), exchange files, or allow electronic communications.
- The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

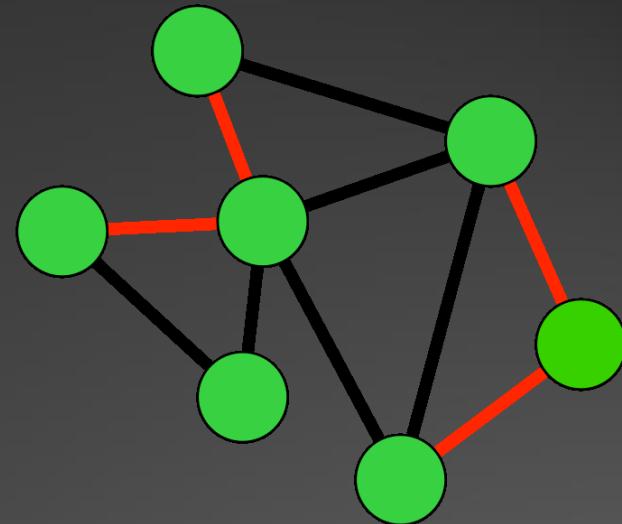


# Network



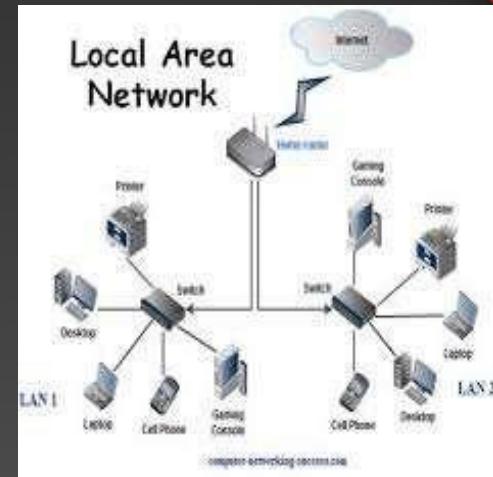
# Basic Types of Networks

1. Local Area Network (**LAN**)
2. Personal Area Network (**PAN**)
3. Metropolitan Area Network (**MAN**)
4. Wide Area Network (**WAN**)
5. Campus Area Network (**CAN**)
6. Storage Area Network (**SAN**)



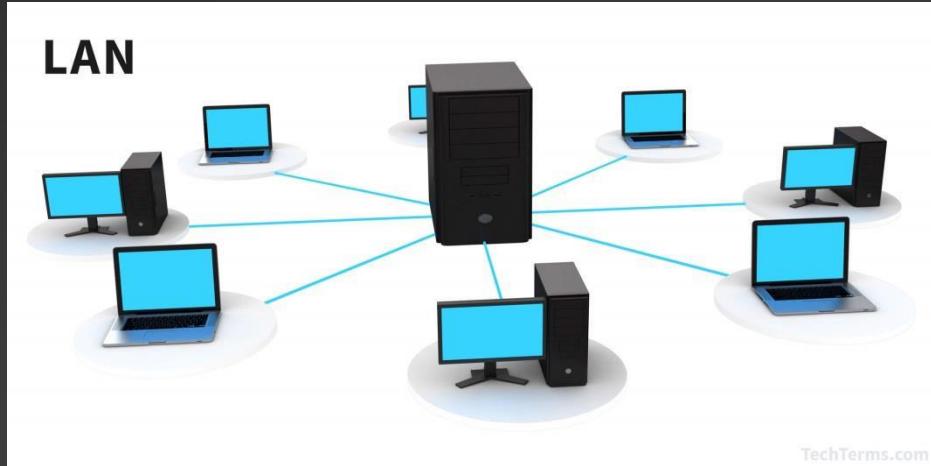
# Local Area Network (LAN)

- A LAN is a network that is used for communicating among computer devices, usually within an office building or home.
- LAN's enable the sharing of resources such as files or hardware devices that may be needed by multiple users
  - Is limited in size, typically spanning a few hundred meters, and no more than a mile
- Is fast, with speeds from 10 Mbps to 10 Gbps
- Requires little wiring, typically a single cable connecting to each device
- Has lower cost compared to MAN's or WAN's
- LAN's can be either wired or wireless. Twisted pair, coax or fibre optic cable can be used in wired LAN's.



# Advantages of LAN

- Speed
- Cost
- Security
- Resource Sharing



# Local Area Network (PAN)

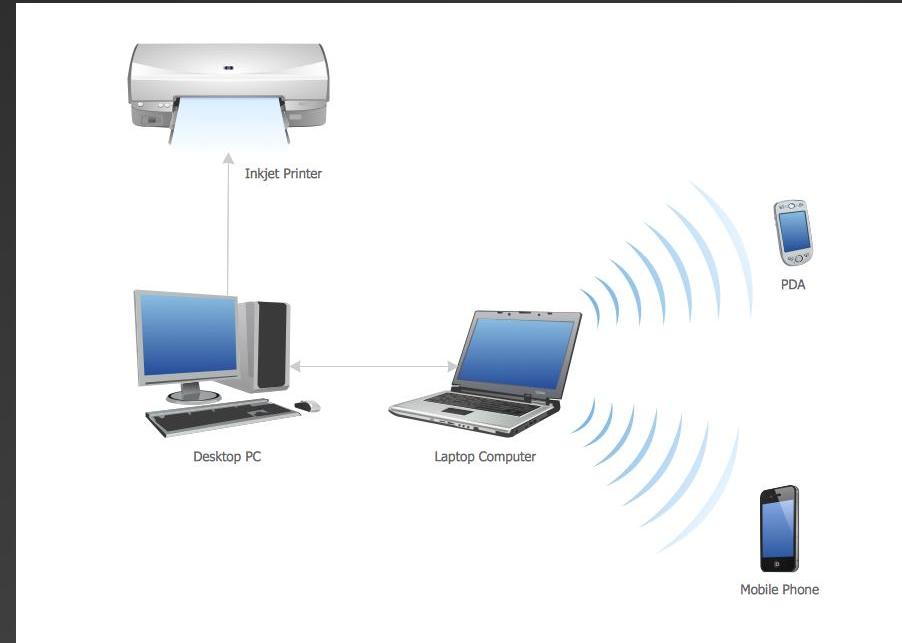
- A PAN is a network that is used for communicating among computer devices, usually home.
- PAN's enable the sharing of resources such as files or hardware devices that may be needed by multiple users
  - Is limited in size, typically spanning a few hundred meters
- Is fast, with speeds from 10 Mbps to 10 Gbps
- Requires little wiring, typically a single cable connecting to each device
- Has lower cost compared to MAN's or WAN's
- LAN's can be either wired or wireless. Twisted pair, coax or fibre optic cable can be used in wired LAN's.

PERSONAL AREA NETWORK(PAN)



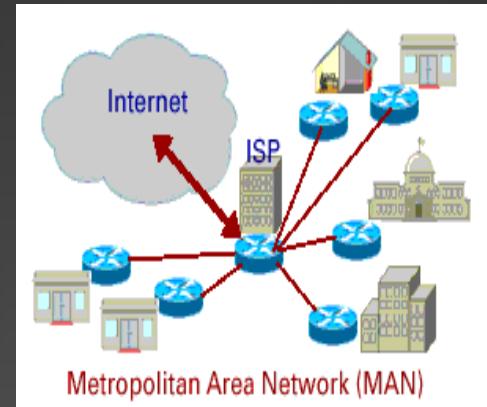
# Advantages of PAN

- Speed
- Cost
- Security
- Resource Sharing



# Metropolitan Area Network (MAN)

- A metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus.
- A MAN is optimized for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities.
- A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations.
- A MAN often acts as a high speed network to allow sharing of regional resources.
- A MAN typically covers an area of between 5 and 50 km diameter.
- Examples of MAN: Telephone company network that provides a high speed DSL to customers and cable TV network.



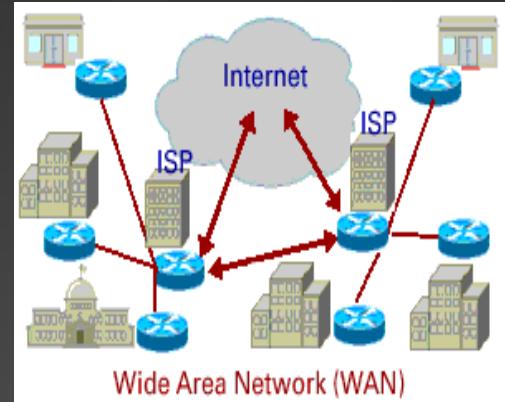
# Advantages of MAN

- Speed
- Cost
- Security
- Resource Sharing



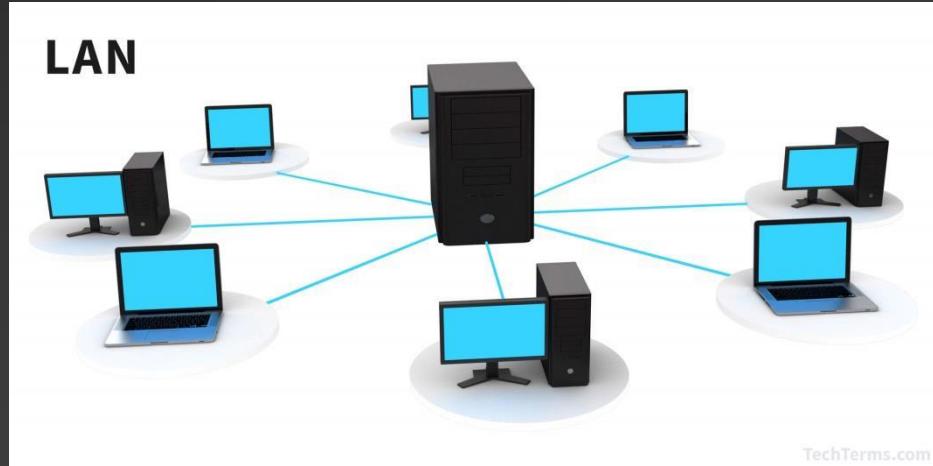
# Wide Area Network (WAN)

- WAN covers a large geographic area such as country, continent or even whole of the world.
- A WAN is two or more LANs connected together. The LANs can be many miles apart.
- To cover great distances, WANs may transmit data over leased high-speed phone lines or wireless links such as satellites.
- Multiple LANs can be connected together using devices such as bridges, routers, or gateways, which enable them to share data.
- The world's most popular WAN is the Internet.



# Advantages of WAN

- Speed
- Cost
- Security
- Resource Sharing



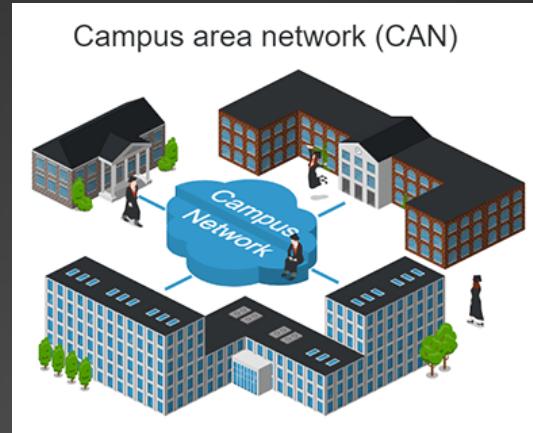
# Campus Area Network (CAN)

- ❑ A campus area network (CAN) is a network of multiple interconnected local area networks (LAN) in a limited geographical area. A CAN is smaller than a wide area network (WAN) or metropolitan area network (MAN).
- ❑ A CAN is also known as a corporate area network (CAN).
- ❑ CAN benefits are as follows:

Cost-effective

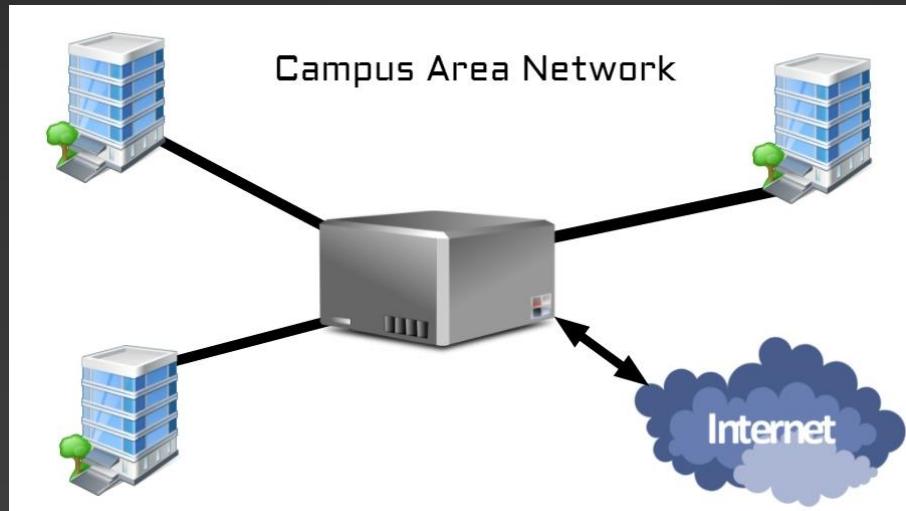
Wireless, versus cable

Multidepartmental network access



# Advantages of CAN

- Speed
- Reliability
- Campus Interconnection
- Better for Every Consumer



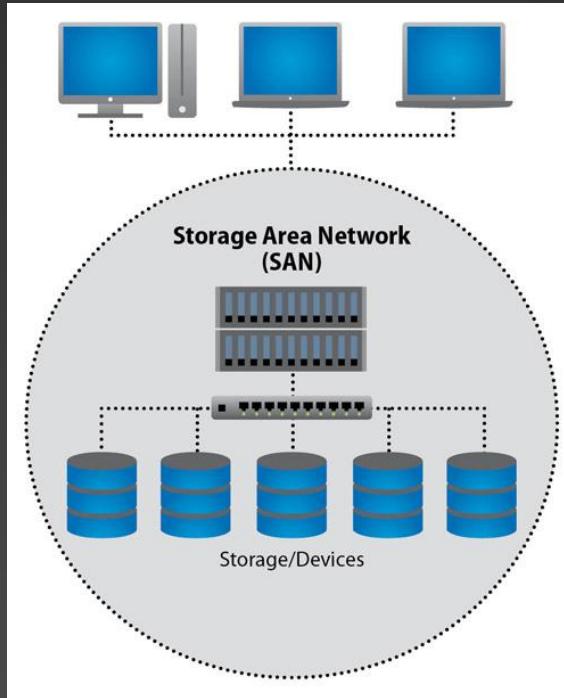
# Storage Area Network (SAN)

- ❑ A Storage Area Network (SAN) is a specialized, high-speed network that provides block-level network access to storage. SANs are typically composed of hosts, switches, storage elements, and storage devices that are interconnected using a variety of technologies, topologies, and protocols.
- ❑ This enables each server to access shared\_storage as if it were a drive directly attached to the server. When a host wants to access a storage device on the SAN, it sends out a block-based access request for the storage device.

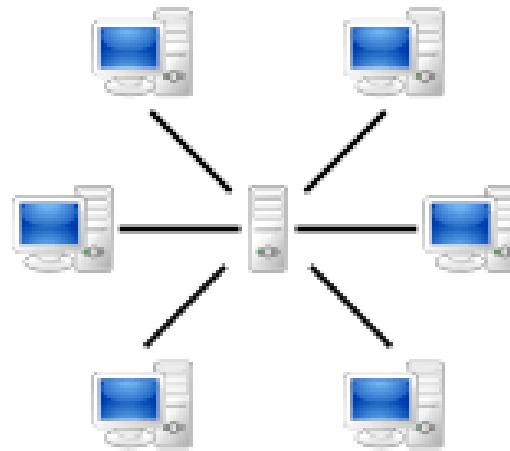


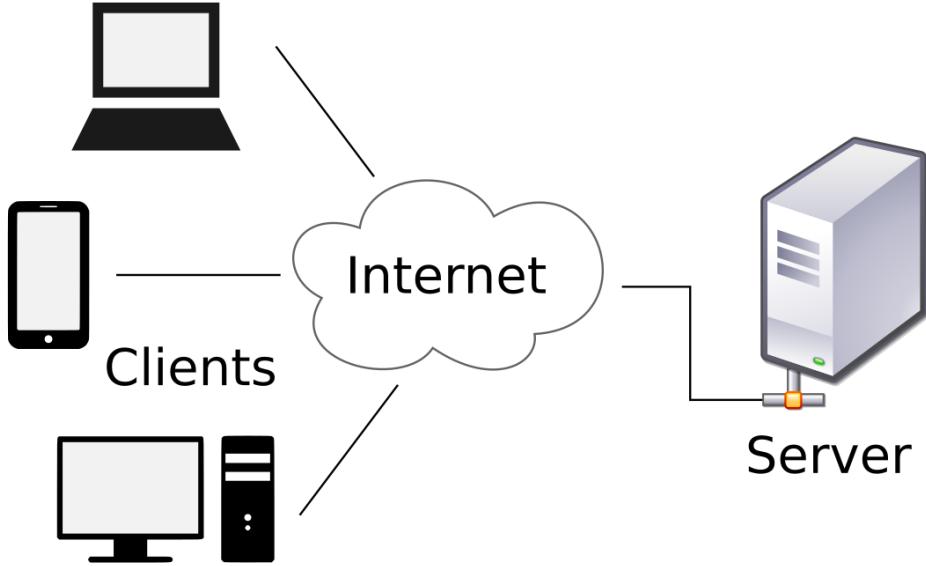
# Advantages of SAN

- Low Expense
- fault tolerance
- Disk Mirroring
- Real Time Update
- Administrator Control

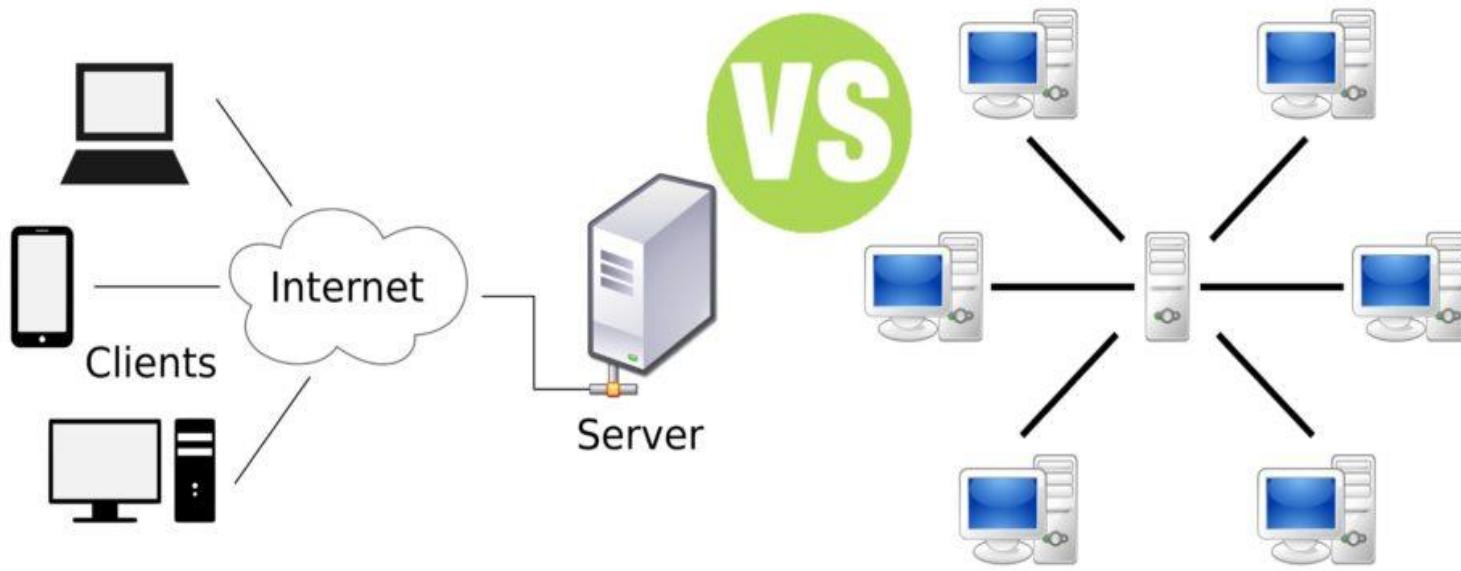


## Peer to Peer Model





## **Client-Server Model**



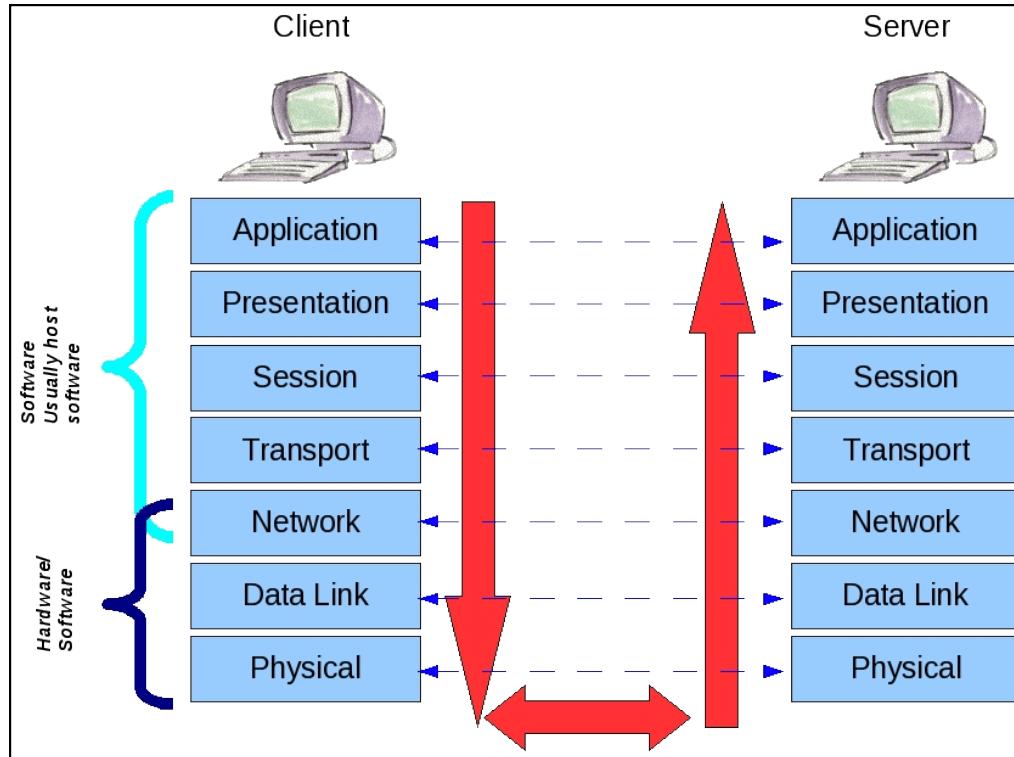
<b>Client/Server</b>	<b>Peer-To-Peer</b>
Server has the control ability while clients don't	All computers have equal ability
Higher cabling cost	Cheaper cabling cost
It is used in small and large networks	Normally used in small networks with less than 10 computers
Easy to manage	Hard to manage
Install software only in the server while the clients share the software	Install software to every computer
One powerful computer acting as server	No server is needed

# OSI MODEL

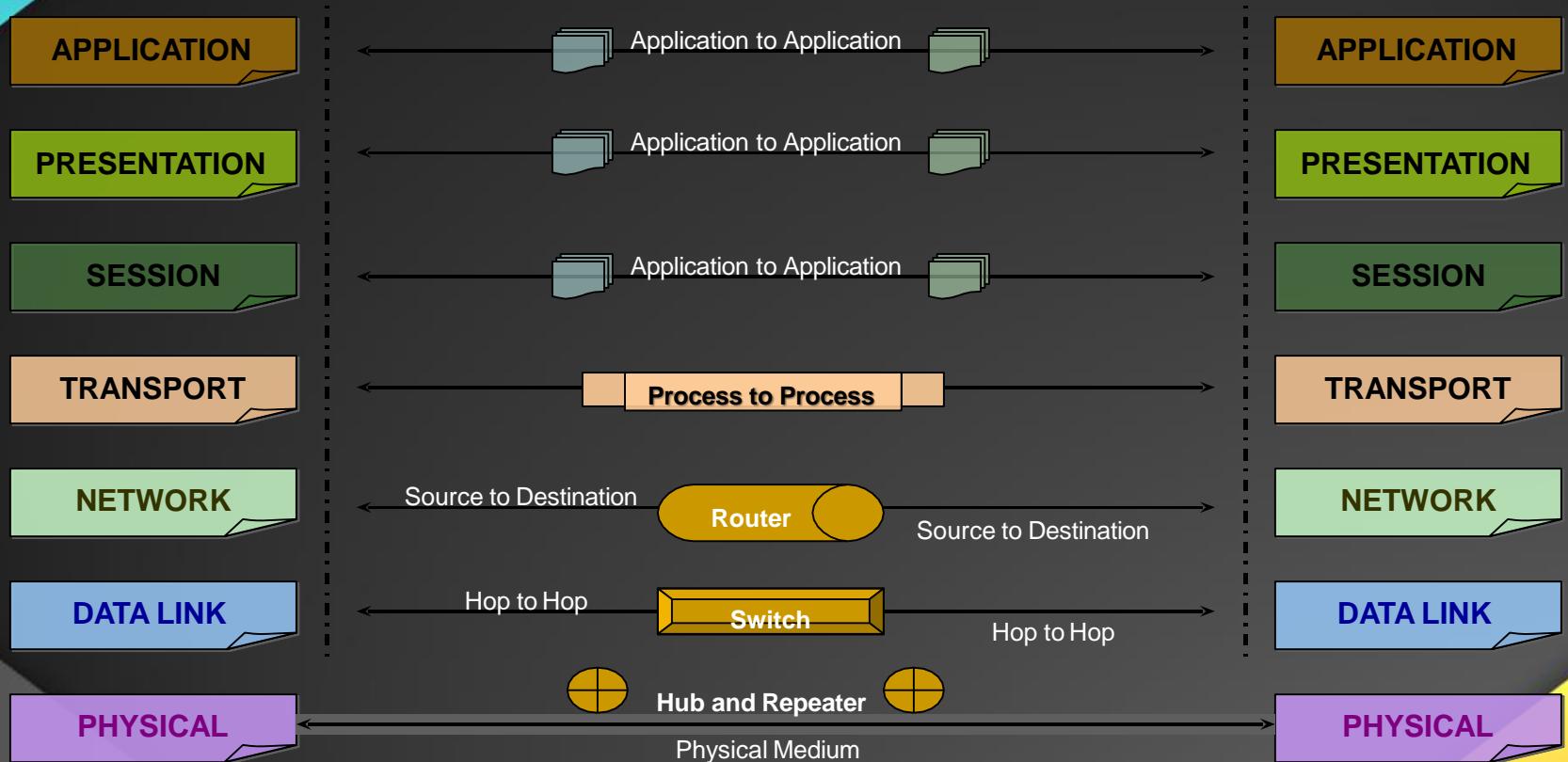
# INTRODUCTION

- Open systems interconnection basic reference model (OSI reference model or OSI model) is an abstract description for layered communications and computer network protocol design. It was developed as part of the open systems interconnection (OSI) initiative. In its most basic form, it divides network architecture into seven layers which, from top to bottom, are the application, presentation, session, transport, network, data-link, and physical layers. It is therefore often referred to as the OSI seven layer model.

# OSI MODEL



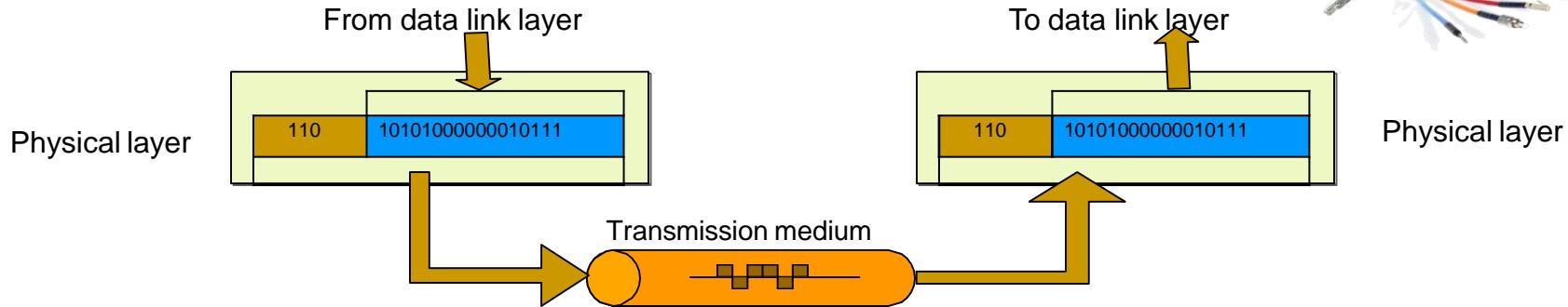
# OSI Model's 7 Layers



# Data, Protocol & Activities

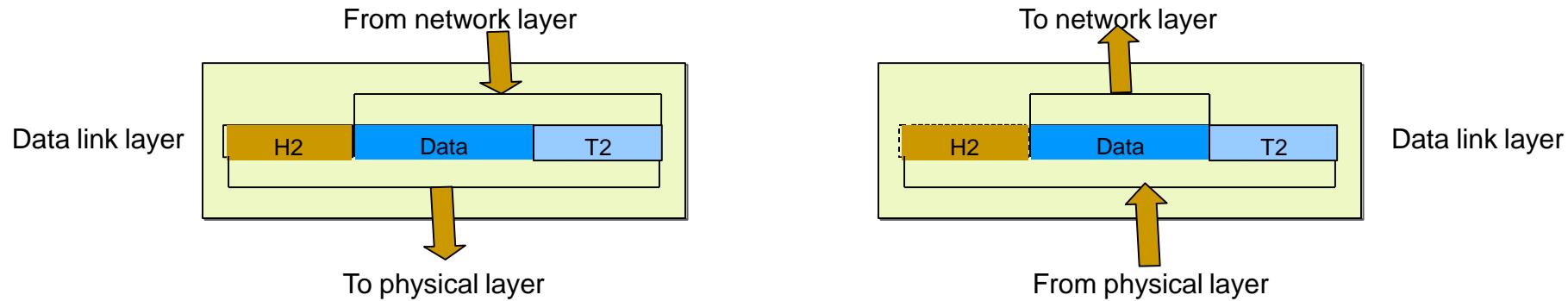
OSI Layers	TCP/IP Suit	Activities
Application	<b>Application</b> Telnet, FTP, SMTP, HTTP, DNS, SNMP, <i>Specific address etc...</i>	To allow access to network resources
Presentation	<b>Presentation</b>	To Translate, encrypt, and compress data
Session	<b>Session</b>	To establish, manage, and terminate session
Transport	<b>Transport</b> SCTP, TCP, UDP, Sockets and <i>Ports address</i>	To Provide reliable process-to-process Message delivery and error recovery
Network	<b>Network</b> IP, ARP/RARP, ICMP, IGMP, <i>Logical address</i>	To move packets from source to destination; to provide internetworking
Data Link	<b>Data Link</b> IEEE 802 Standards, TR, FDDI, PPP, <i>Physical address</i>	To organize bits into frames; to provide Hop-to-hop delivery
Physical	<b>Physical</b> Medium, Coax, Fiber, 10base, Wireless	To Transmit bits over a medium; to provide Mechanical and electrical specifications

# PHYSICAL LAYER



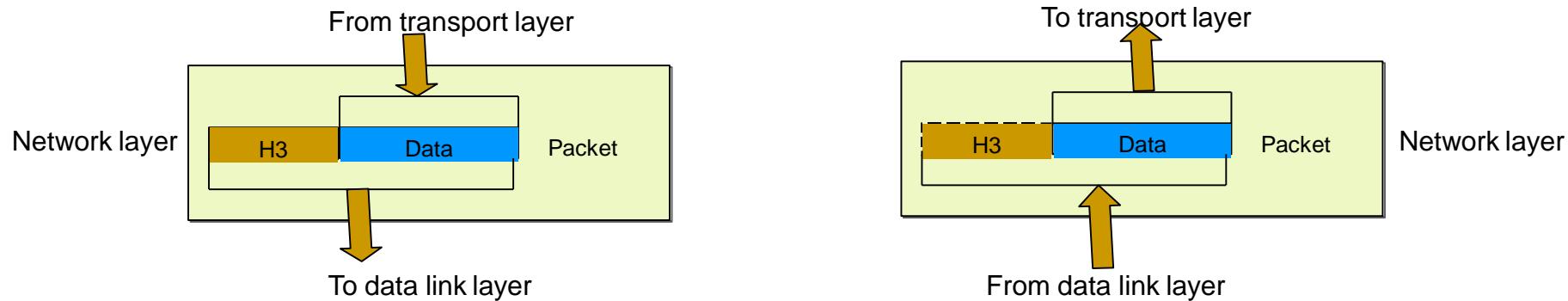
- One of the major function of the physical layer is to move data in the form of electromagnetic signals across a transmission medium.
- Its responsible for movements of individual bits from one hop (Node) to next.
- Both data and the signals can be either *analog* or *digital*.
- Transmission media work by conducting energy along a physical path which can be wired or wireless
  - Physical characteristics of interface and medium (Transmission medium)
  - Representation of bits (stream of bits (0s or 1s) with no interpretation and encoded into signals)
  - Data rate (duration of a bit, which is how long it last)
  - Synchronization of bits (sender and receivers clock must be synchronized)
  - Line configuration (Point-to-Point, Point-to-Multipoint)
  - Physical topology
  - Transmission mode (Simplex, half duplex, full duplex)

# DATALINK LAYER



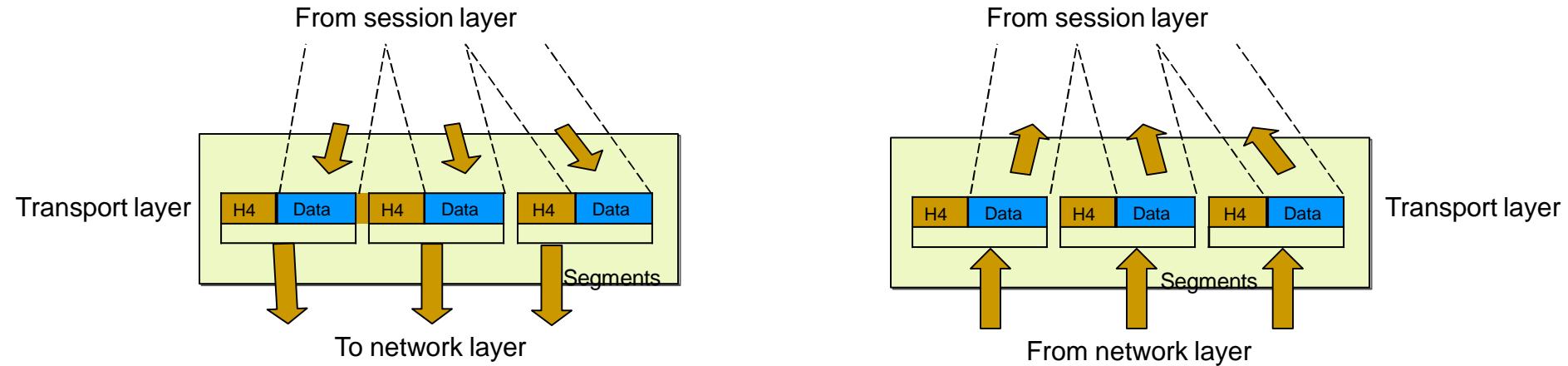
- Data link layer is responsible for moving frames from one hop (Node) to the next.
- Concerned:
  - ❑ Framing (stream of bits into manageable data units)
  - ❑ Physical addressing (MAC Address)
  - ❑ Flow Control (mechanism for overwhelming the receiver)
  - ❑ Error Control (trailer, retransmission)
  - ❑ Access Control (defining master device in the same link)

# NETWORK LAYER



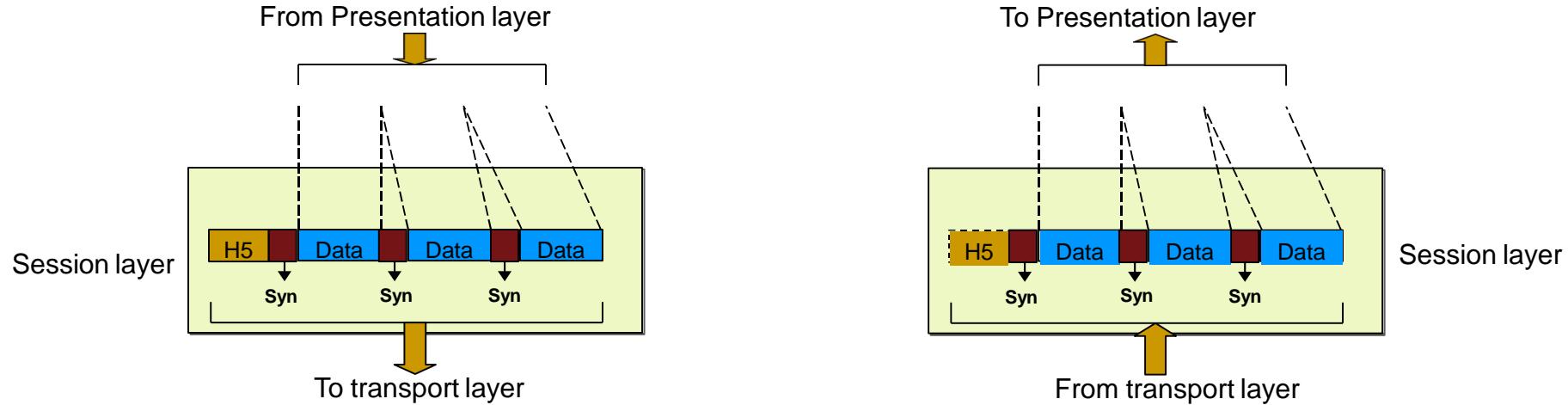
- The network layer is responsible for the delivery of individual packets from the source host to the destination host.
- Concerned:
  - Logical addressing (IP Address)
  - Routing (Source to destination transmission between networks)

# TRANSPORT LAYER



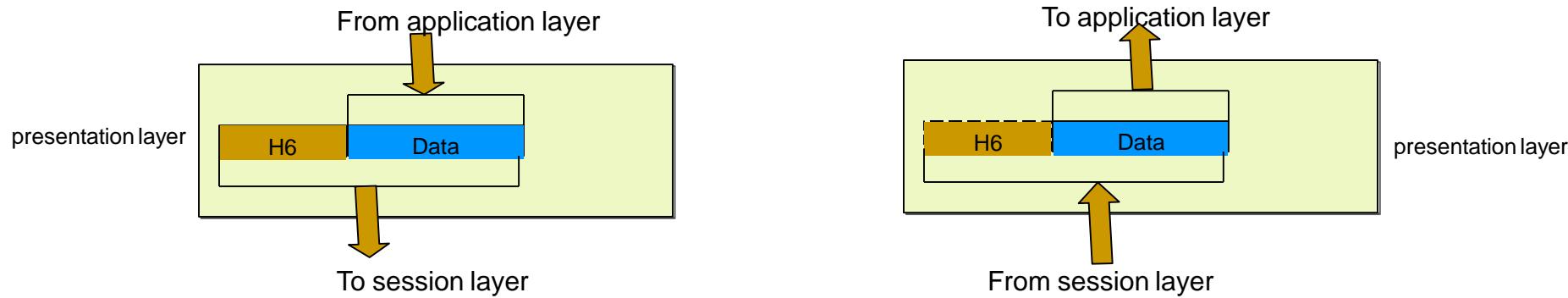
- The transport layer is responsible for the delivery of a message from one process to another
- Concerned:
  - Service-point addressing (Port address)
  - Segmentation and reassembly (Sequence number)
  - Connection control (Connectionless or connection oriented)
  - Flow control (end to end)
  - Error Control (Process to Process)

# SESSION LAYER



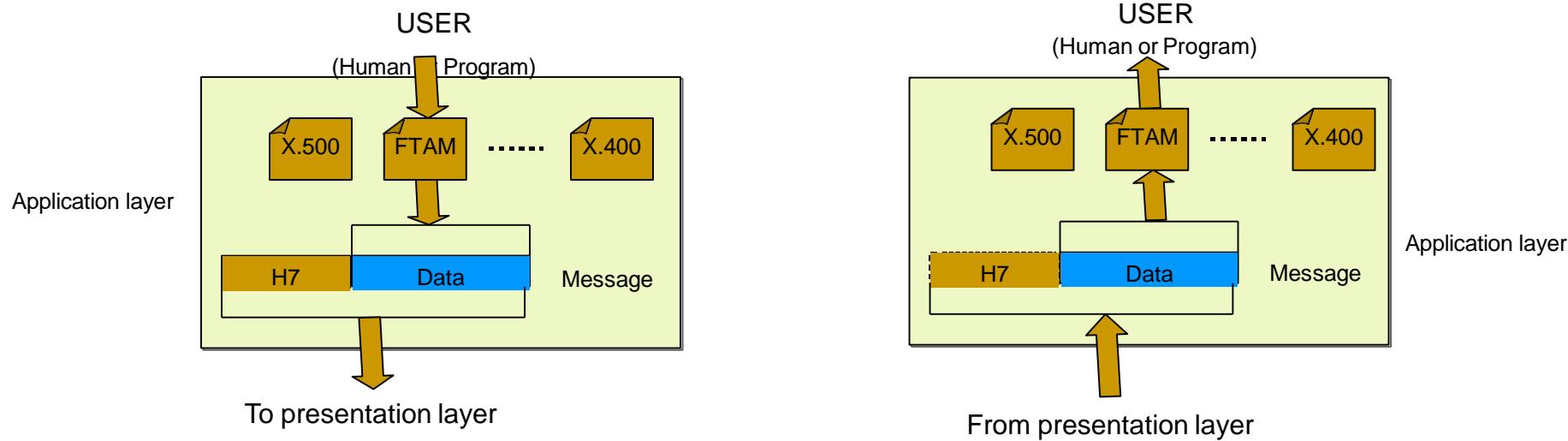
- The session layer is responsible for dialog control and synchronization
- Concerned:
  - Dialog Control (Half Duplex/Full duplex)
  - Synchronization (Synchronization points, process inline within same page)

# PRESENTATION LAYER



- The presentation layer is responsible for translation, compression and encryption
- Concerned:
  - ❑ Translation (interoperability between different encoding system)
  - ❑ Encryption (Privacy schemes)
  - ❑ Compression (data compression)

# APPLICATION LAYER



- The application layer is responsible for providing services to the user.
- Concerned:
  - Network virtual terminal (Software)
  - File transfer, access and management
  - Mail services
  - Directory services (access to distributed database sources for global information about various objects and services)

# TRANSMISSION MEDIA

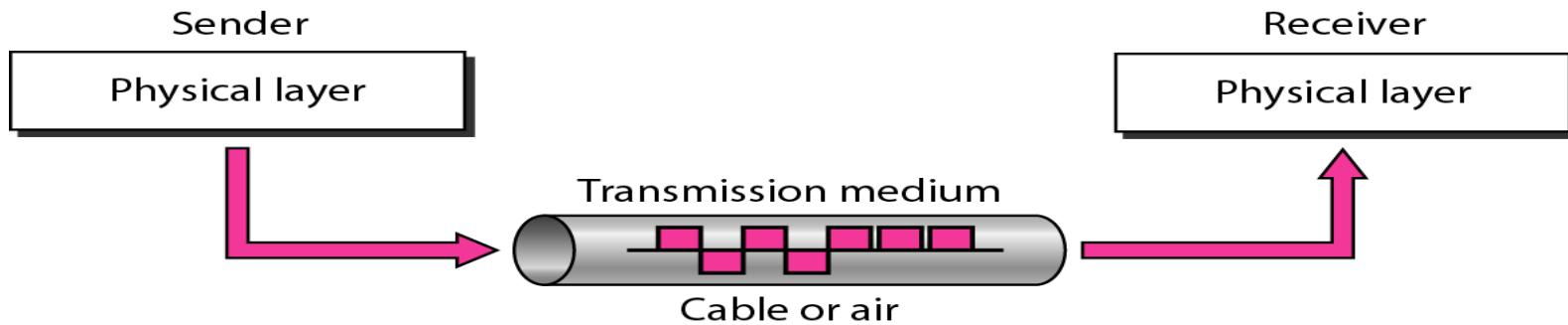
# What is Transmission Media ?

In data communication,

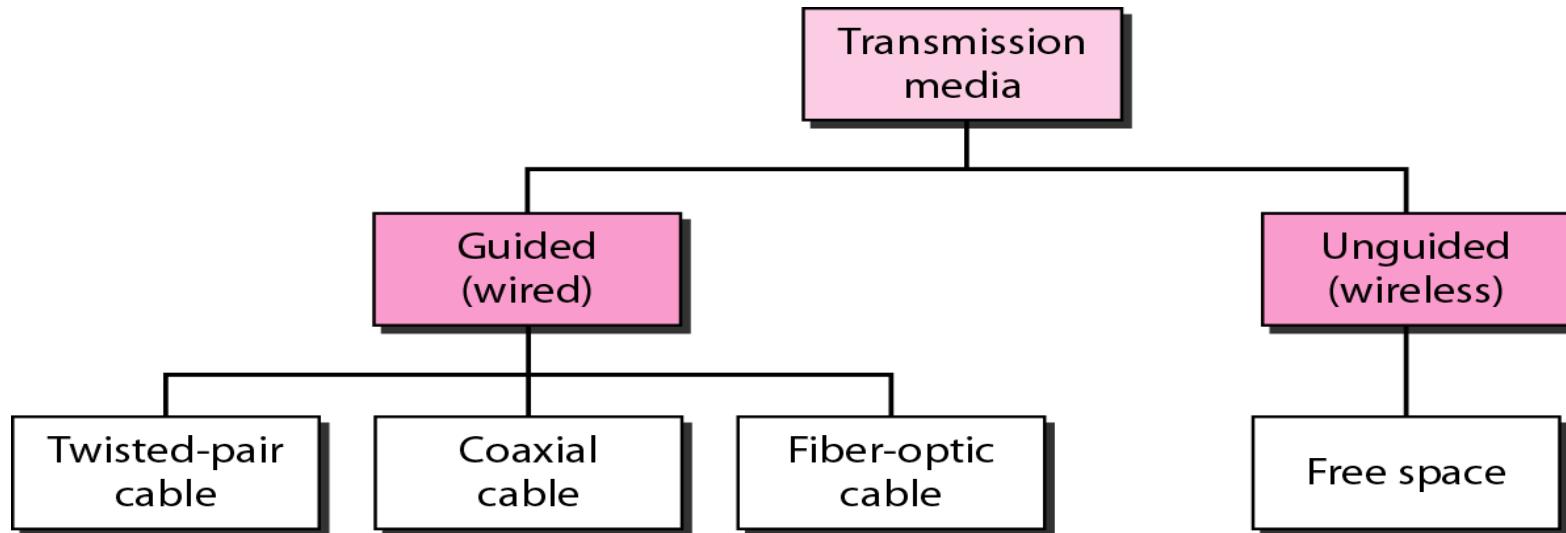
- **Transmission media** is a pathway that carries the information from sender to receiver.
- We use different types of cables or waves to transmit data.
- Data is transmitted normally through electrical or electromagnetic signals.

# DESCRIPTION

- Transmission media are located below the physical layer
- Computers use signals to represent data.
- Signals are transmitted in form of electromagnetic energy.

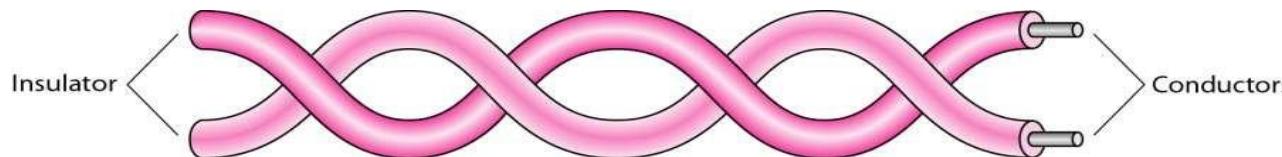
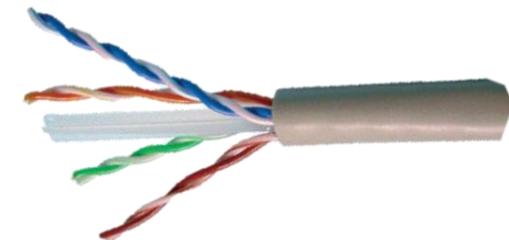


# CLASSIFICATION OF TRANSMISSION MEDIA



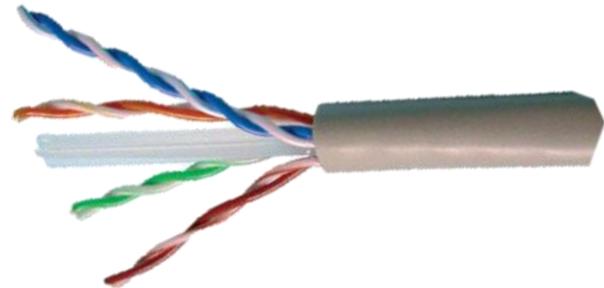
# TWISTED-PAIR CABLE

- A twisted pair consists of two conductors
- Basically copper based
- With its own plastic insulation, twisted together.



# TWISTED PAIR DESCRIPTION

- One wire use to carry signals to the receiver
- Second wire used as a ground reference
- Very common medium
- Can be use in telephone network
- Connection Within the buildings
- For local area networks (LAN)



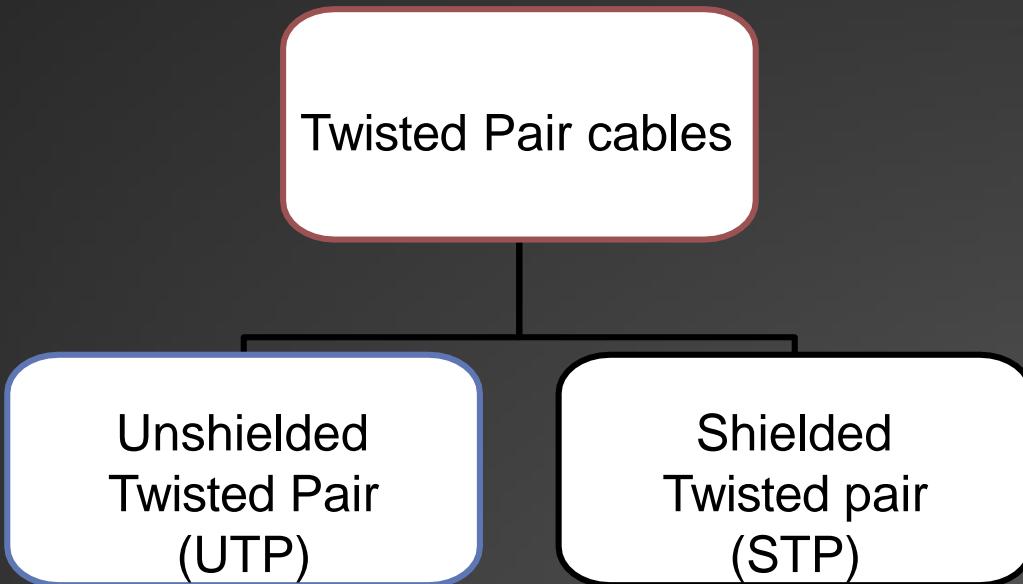
## **Advantages:**

- Cheap
- Easy to work with

## **Disadvantages:**

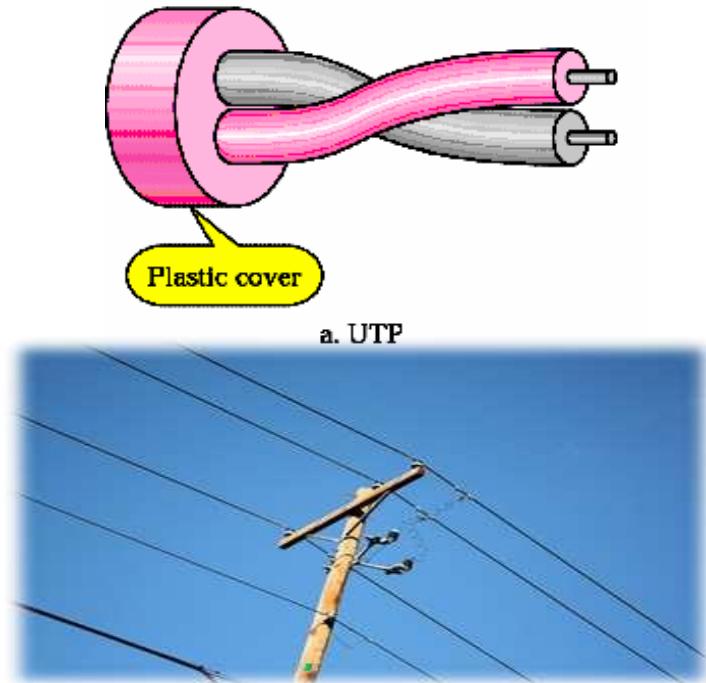
- Low data rate
- Short range

# Twisted Pair Cables



# UNSHIELDED TWISTED PAIR (UTP):

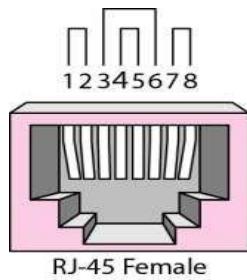
- Pair of unshielded wires wound around each other
- Easiest to install
- Telephone subscribers connect to the central telephone office
- DSL lines
- LAN – 10Mbps or 100Mbps



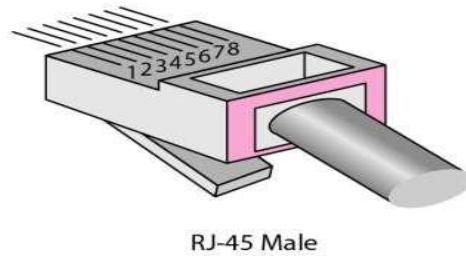
# UTP CABLE TYPES

UTP Categories - Copper Cable				
UTP Category	Data Rate	Max. Length	Cable Type	Application
CAT1	Up to 1Mbps	-	Twisted Pair	Old Telephone Cable
CAT2	Up to 4Mbps	-	Twisted Pair	Token Ring Networks
CAT3	Up to 10Mbps	100m	Twisted Pair	Token Ring & 10BASE-T Ethernet
CAT4	Up to 16Mbps	100m	Twisted Pair	Token Ring Networks
CAT5	Up to 100Mbps	100m	Twisted Pair	Ethernet, FastEthernet, Token Ring
CAT5e	Up to 1 Gbps	100m	Twisted Pair	Ethernet, FastEthernet, Gigabit Ethernet
CAT6	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT6a	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT7	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (100 meters)

# UTP CONNECTOR AND TOOLS



RJ-45 Female



RJ-45 Male

RJ45 (RJ stands for registered jack) is a keyed connector, it means that it can be inserted in only one way



Crimping Tool

## **ADVANTAGES OF UTP:**

- Affordable
- Most compatible cabling
- Major networking system

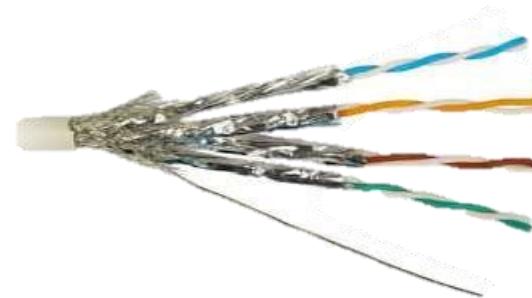
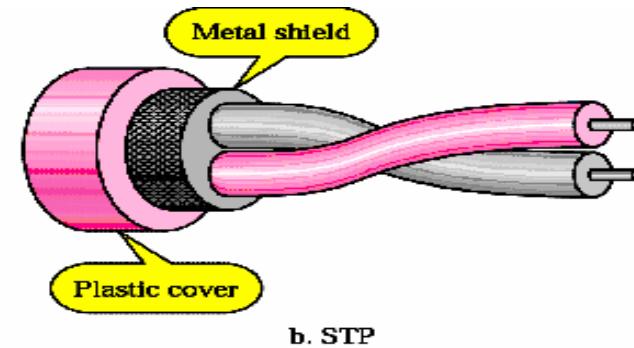


## **Disadvantages of UTP:**

- Suffers from external Electromagnetic interference

# SHIELDED TWISTED PAIR (STP)

- Pair of wires wound around each other placed inside a protective foil wrap
- Metal braid or sheath foil that reduces interference
- Harder to handle (thick, heavy)
- STP is used in IBM token ring networks.
- Higher transmission rates over longer distances.



## **ADVANTAGES OF STP:**

- Shielded
- Faster than UTP

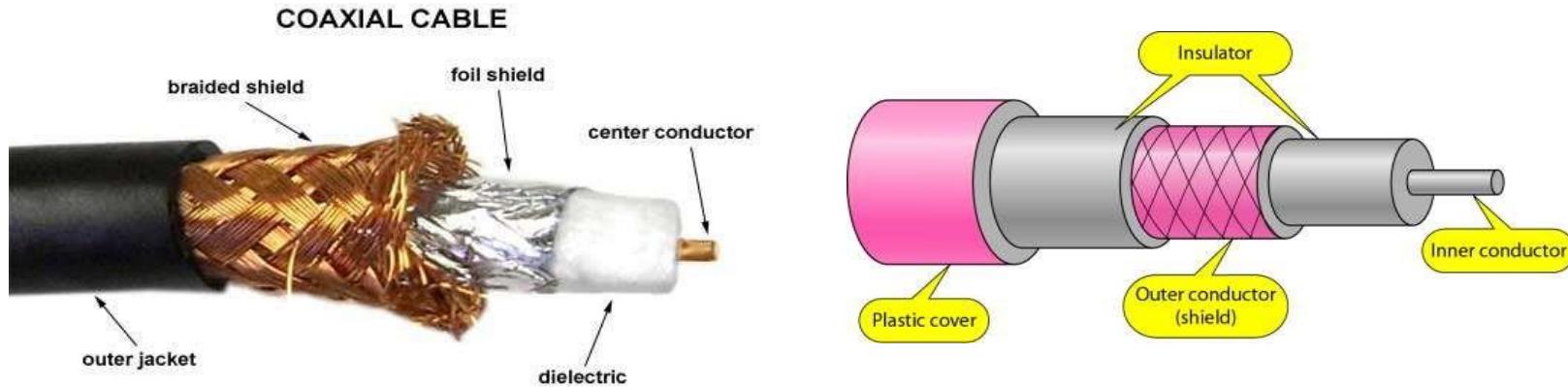
## **Disadvantages of STP:**

- More expensive than UTP
- High attenuation rate



# CO-AXIAL CABLE

Co-axial cable carries signal of higher frequency ranges than twisted pair cable



- Inner conductor is a solid wire
- Outer conductor serves as a shield against noise and a second conductor

# CATEGORIES OF COAXIAL CABLES

<i>Category</i>	<i>Impedance</i>	<i>Use</i>
RG-59	$75 \Omega$	Cable TV
RG-58	$50 \Omega$	Thin Ethernet
RG-11	$50 \Omega$	Thick Ethernet

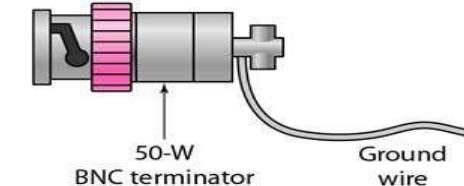
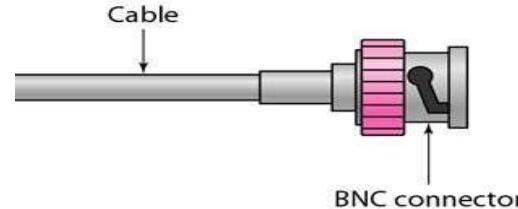
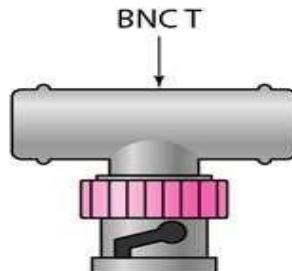
Coaxial cables are categorized by Radio Government (RG) ratings,  
RG is De Jure standards

# COAXIAL CABLE CONNECTORS

## BNC Connectors – Bayone Neil Concelman

To connect coaxial cable to devices we need coaxial connectors

- BNC Connector is used at the end of the cable to a device  
Example: TV set connection
- BNC T connector used to Ethernet networks to branch out connection to computer or other devices
- BNC terminator is used at the end of the cable to prevent the reflection of the signal



# COAXIAL CABLE APPLICATIONS

- Most versatile medium
- Television distribution
- Long distance telephone transmission
- Can carry 10,000 voice calls simultaneously
- Short distance computer systems links
- Local area networks



## ADVANTAGES

- Easy to wire
- Easy to expand

## DISADVANTAGE

- Single cable failure can take down an entire network

# FIBER-OPTIC CABLE

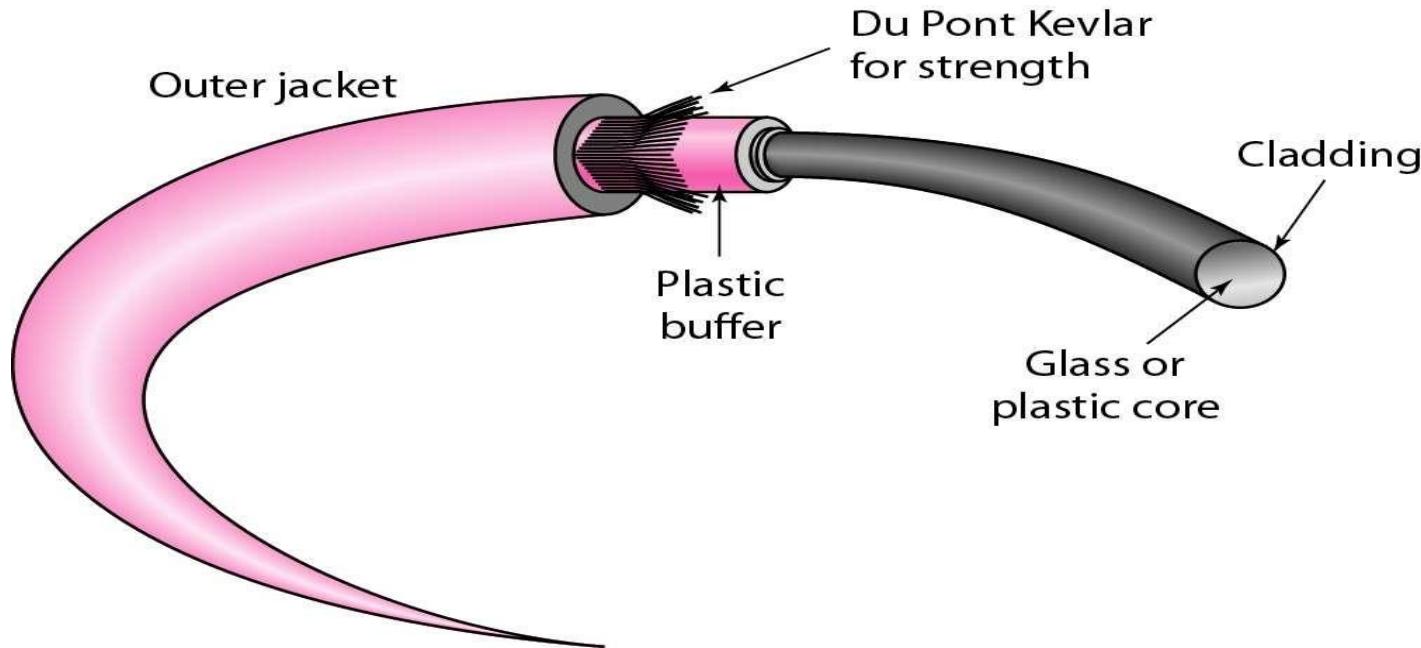
A fiber optic cable is made of glass or plastic and transmit signals in the form of light.

## Nature of light:

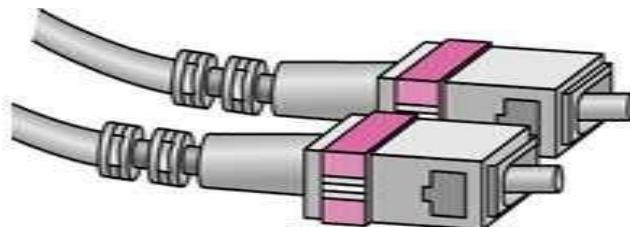
- Light travels in a straight line
- If light goes from one substance to another then the ray of light changes direction
- Ray of light changes direction when goes from more dense to a less dense substance



# FIBER CONSTRUCTION

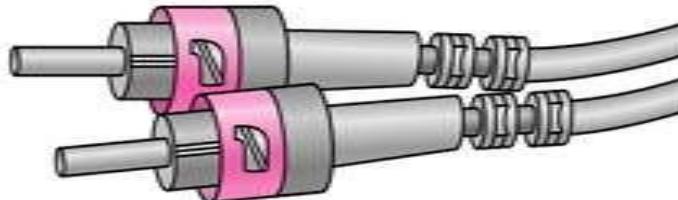


# FIBER – OPTIC CABLE CONNECTORS



SC connector

Subscriber Channel (SC) Connector



ST connector

Straight-Tip (ST) Connecter

# AREAS OF APPLICATION

- Telecommunications
- Local Area Networks
- Cable TV
- CCTV



## Advantage

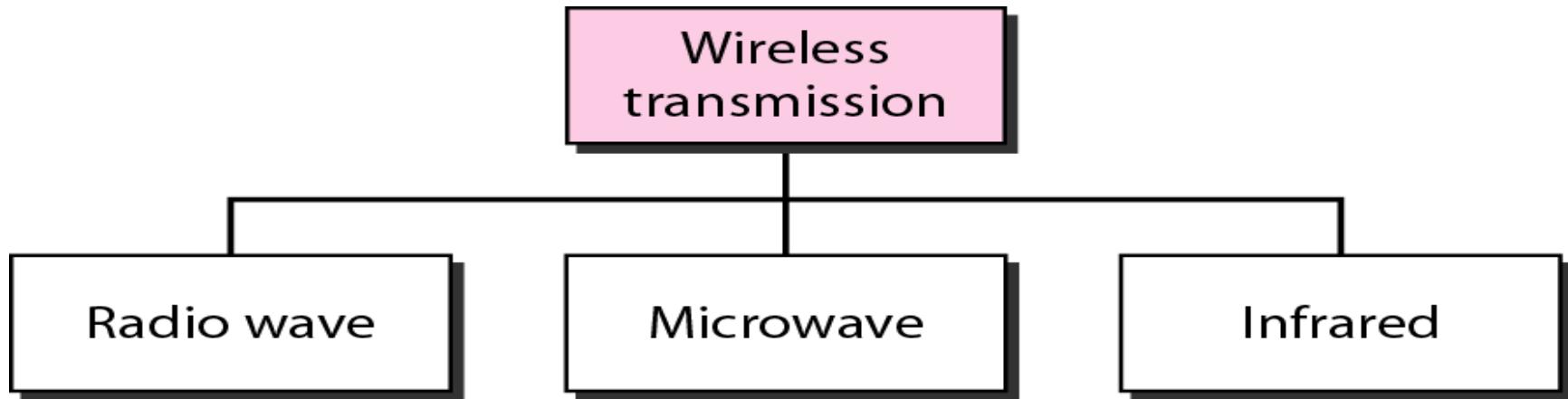
- Greater capacity Example: Data rates at 100 Gbps
- Smaller size & light weight
- Lower attenuation

## Disadvantage

- Installation and maintenance are Expensive
- Only Unidirectional light propagation

# Unguided Media

Wireless transmission waves



# UNGUIDED MEDIA – RADIO WAVES



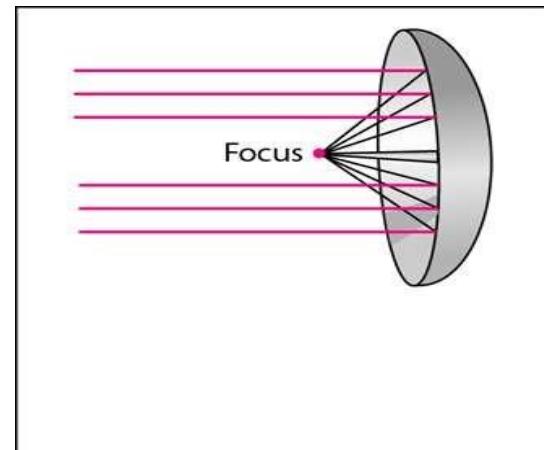
- Omnidirectional Antenna
- Frequencies between 3 KHz and 1 GHz.
- Used for multicasts(multiple way) communications, such as radio and television, and paging system.
- Radio waves can penetrate buildings easily, so that widely use for indoors & outdoors communication.

# ANTENNAS

An Antenna is a structure that is generally a metallic object may be a wire or group of wires, used to convert high frequency current into electromagnetic waves.

Antennas are two types:

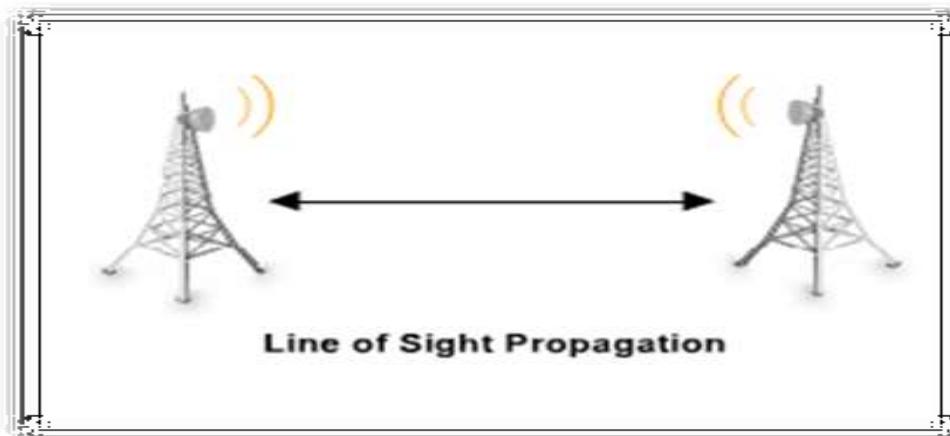
- **Transmission antenna**
  - Transmit radio frequency from transmitter
  - Radio frequency then Convert to electromagnetic energy by antenna
  - Then, radiate into surrounding environment



Dish antenna

# MICROWAVES

Microwaves are ideal when large areas need to be covered and there are no obstacles in the path



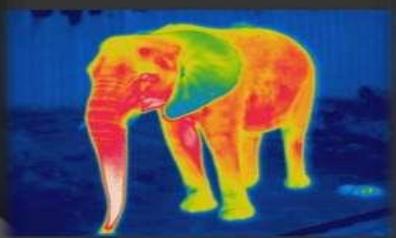
# MICRO WAVES TRANSMISSION

- Microwaves are unidirectional
- Micro waves electromagnetic waves having frequency between 1 GHZ and 300 GHZ.
- There are two types of micro waves data communication system : terrestrial and satellite
- Micro waves are widely used for one to one communication between sender and receiver,  
example: cellular phone, satellite networks and in wireless LANs(wifi), WiMAX,GPS



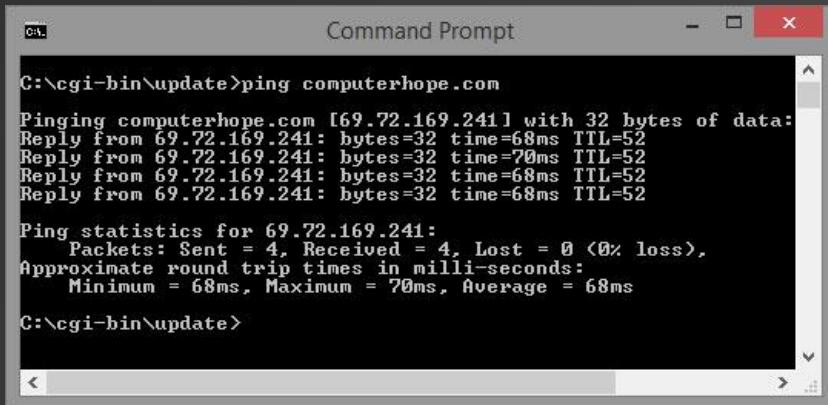
# Infrared

- Frequencies between 300 GHz to 400 THz.
- Used for short-range communication
- Example: Night Vision Camera, Remote control, File sharing between two phones, Communication between a PC and peripheral device



# What is PING?

- It stands for Packet Internet Groper. The ping command is usually used as a simple way to verify that a computer can communicate over the network with another computer or network device. The ping command operates by sending Internet Control Message Protocol (ICMP) **Echo Request** messages to the destination computer and waiting for a response.



```
Command Prompt
C:\cgi-bin\update>ping computerhope.com
Pinging computerhope.com [69.72.169.241] with 32 bytes of data:
Reply from 69.72.169.241: bytes=32 time=68ms TTL=52
Reply from 69.72.169.241: bytes=32 time=70ms TTL=52
Reply from 69.72.169.241: bytes=32 time=68ms TTL=52
Reply from 69.72.169.241: bytes=32 time=68ms TTL=52

Ping statistics for 69.72.169.241:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 68ms, Maximum = 70ms, Average = 68ms
C:\cgi-bin\update>
```

# **NETWORKING DEVICES**

# Introduction

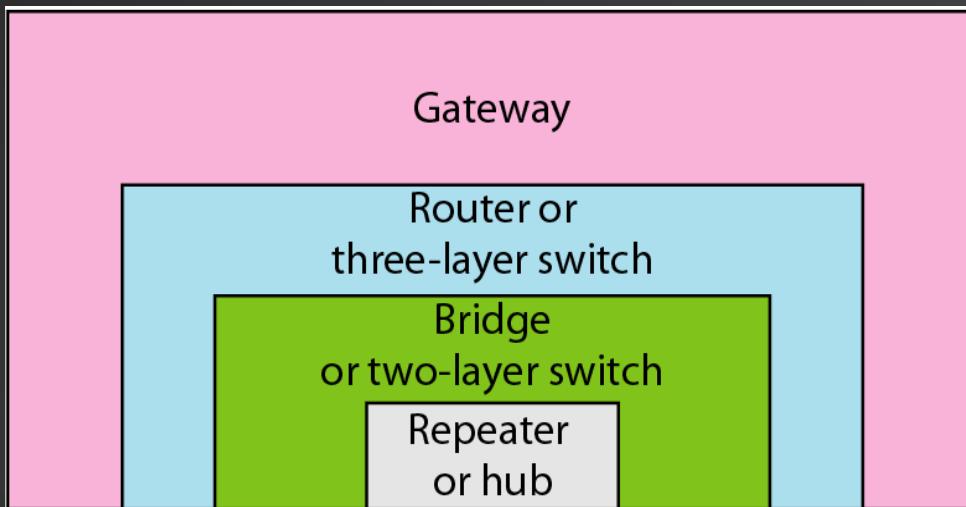
- To connect LANs, connecting devices are needed and various connecting devices are such as bridge, switch, router, hub, repeater.
- Types of Networking Devices:-

1. NIC Card
2. Repeater
3. Hub
4. Bridge
5. Switch
6. Gateway
7. Router
8. Modem



# CONNECTING DEVICES

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

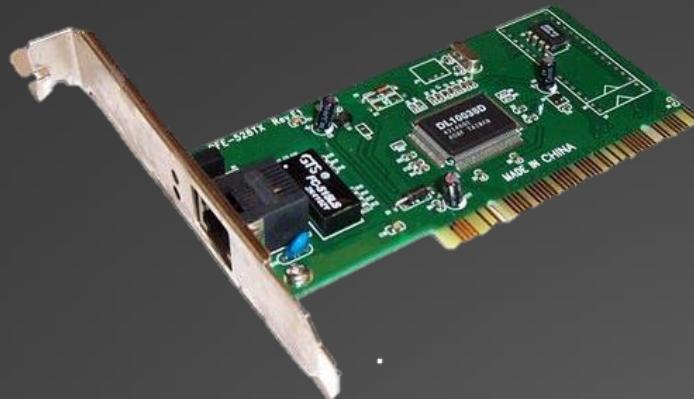


# NC or Network Card

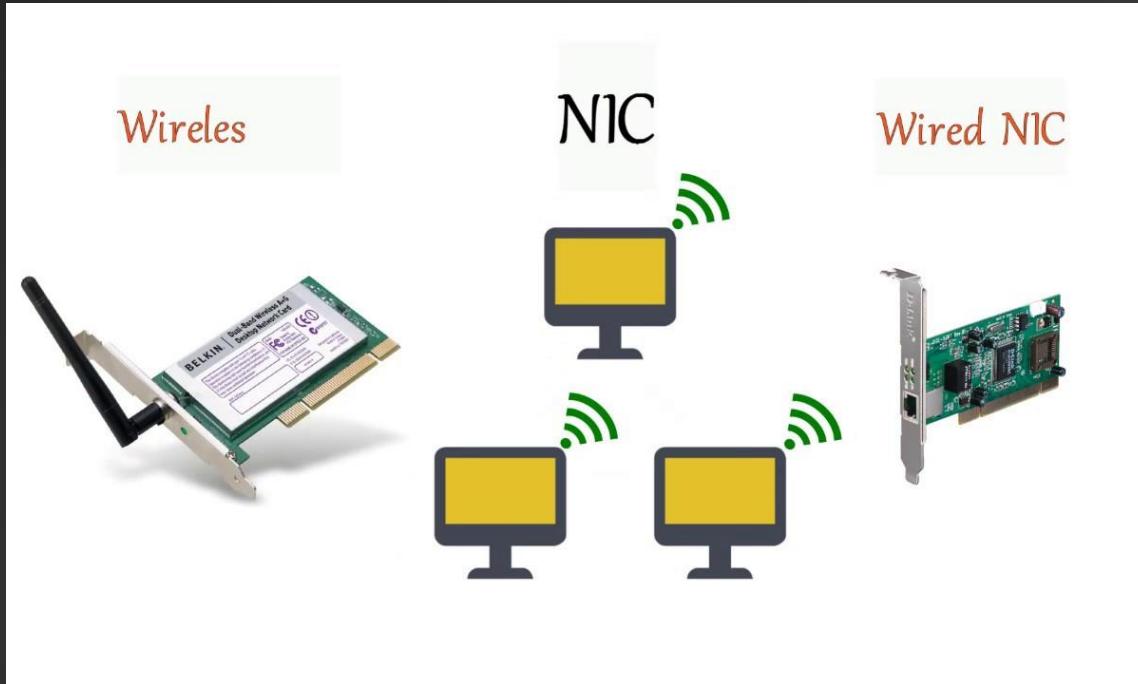
It stands for Network Interface Controller. NC used to connect the ethernet cable (RJ-45), (SC, ST Connector) with the PC. It is a Card which have Mac Address written on it.

Components of NC:-

1. Metal Expansion Card
2. Boot ROM Chip
3. 32 bit PCI Controller
4. Activity LED
5. RJ-45 LANPort



## *A NIC connecting a LAN*



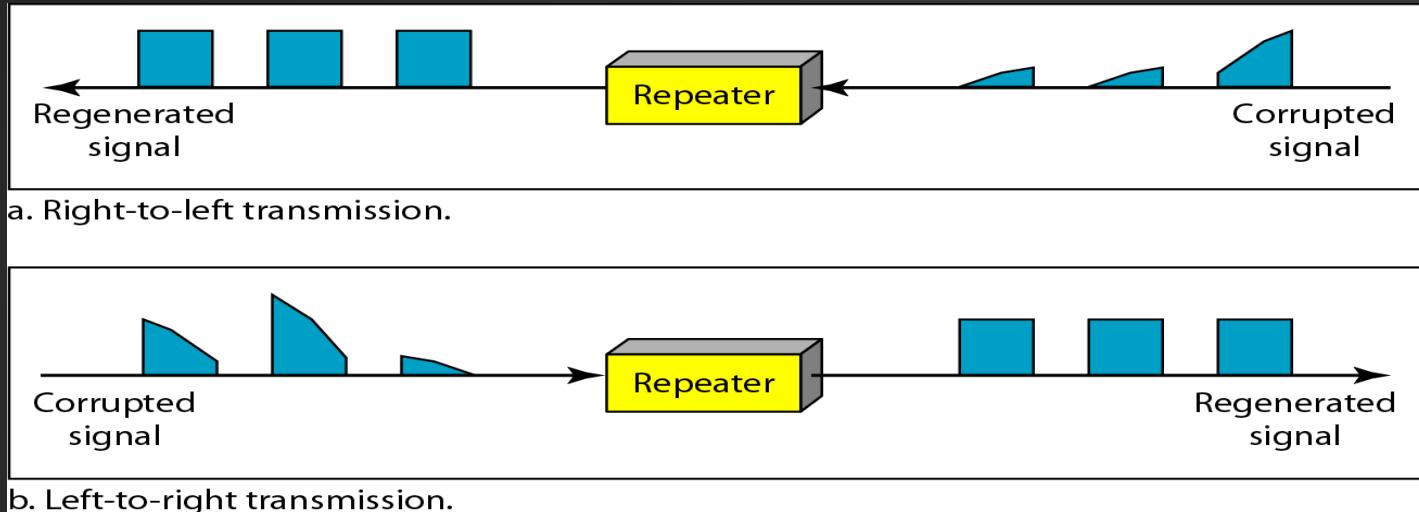
# Repeaters

Repeater used to regenerate or replicate a signal. It removes the unwanted noise in an incoming signal, it works on Layer 1 of OSI Model

It is used in some scaled area and it refine the signals and manage the proper speed of the network



# Repeater connecting two segments of a LAN



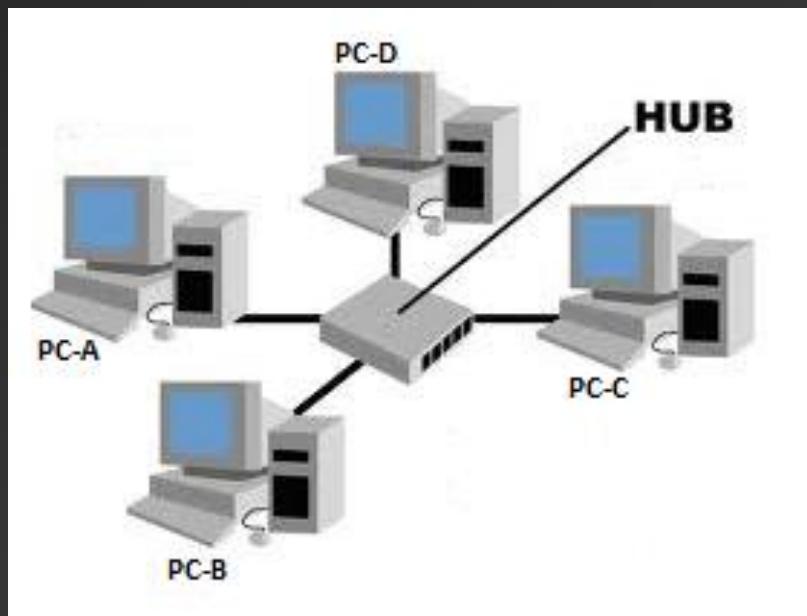
# HUB

It is a Networking Device which simply receive data from one port and transfer on all the other ports. HUBs are commonly used to connect segments of LAN. Hub Works on Physical layer of OSI Moodel

**It used in where you have to create multiple ethernet with the help of a networking device. It comes with different port segment like 6,12 & 24**



## *A HUB connecting LAN*



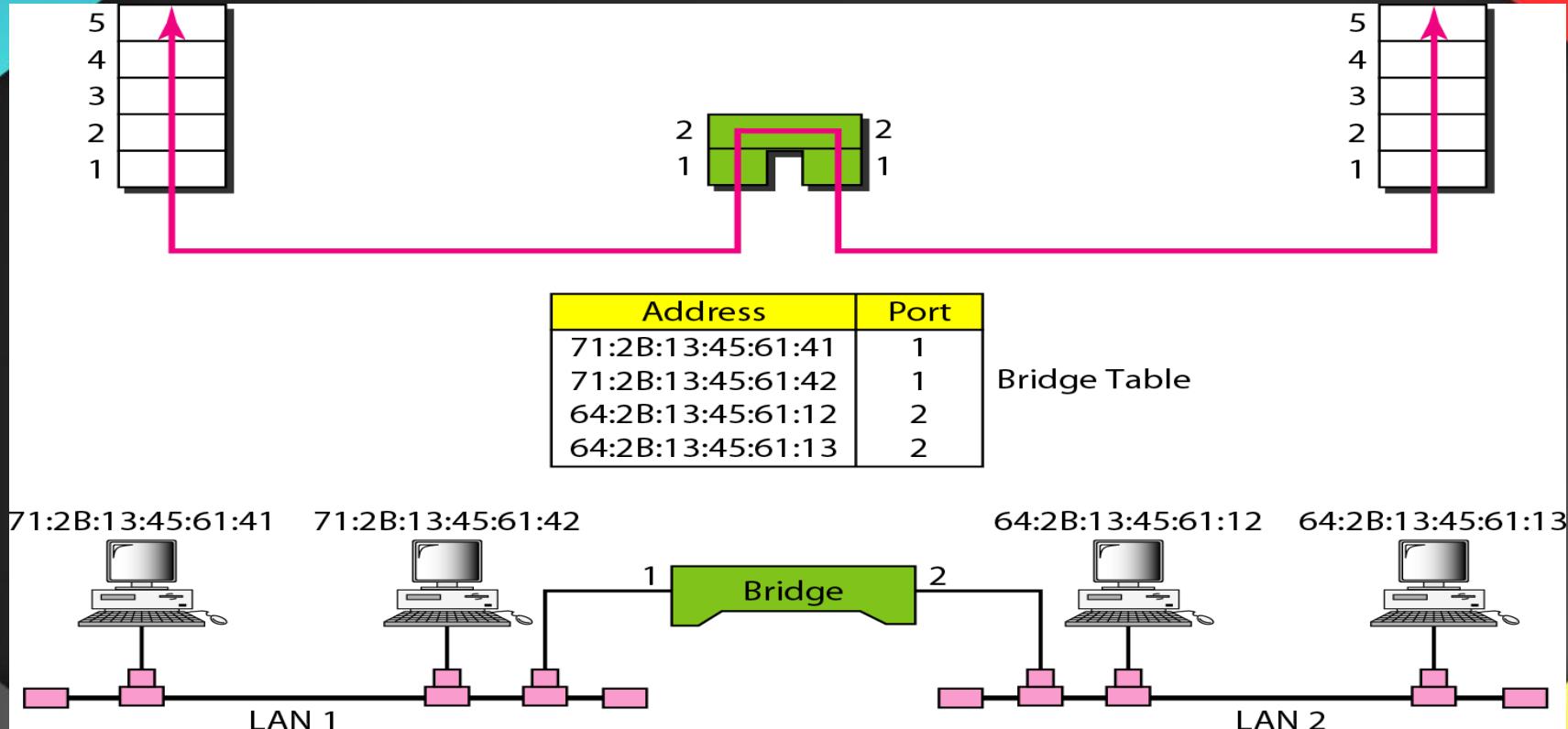
# Bridge

Bridge Devices inspect incoming network traffic and determine whether to forward or discard it according to its intended destination it operates on data link layer

A bridge is a type of computer network device that provides interconnection with other bridge networks that use the same protocol.

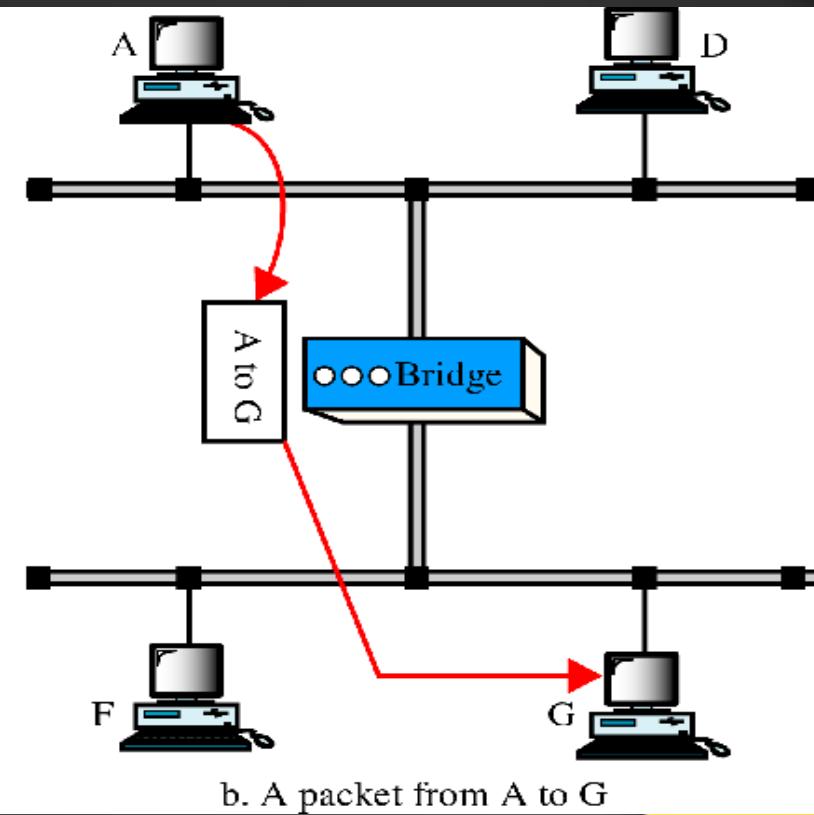
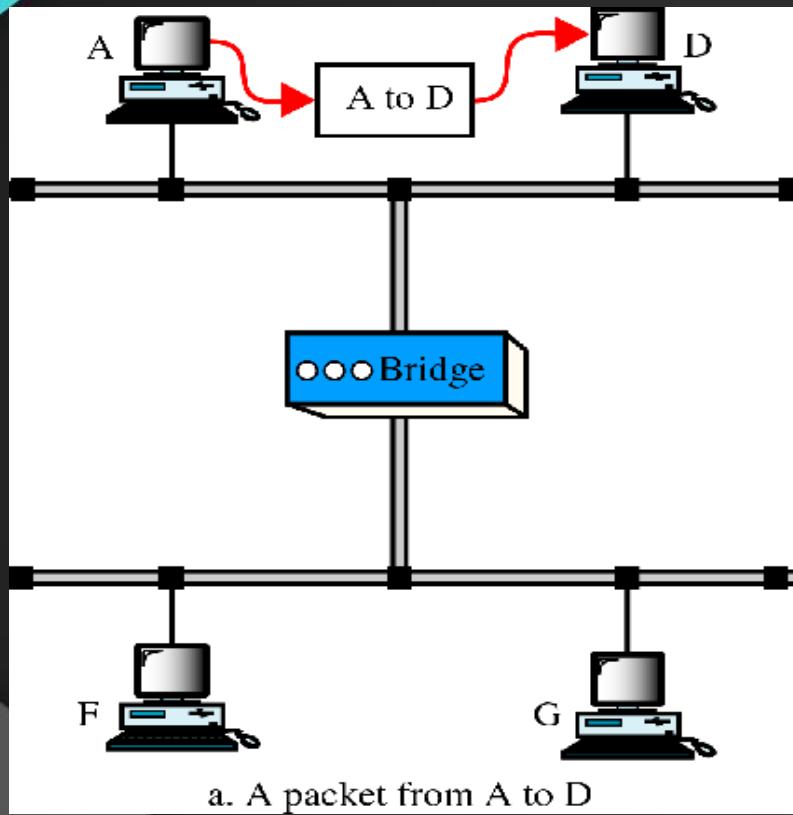


## *A bridge connecting two LANs*



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

# Function of Bridge



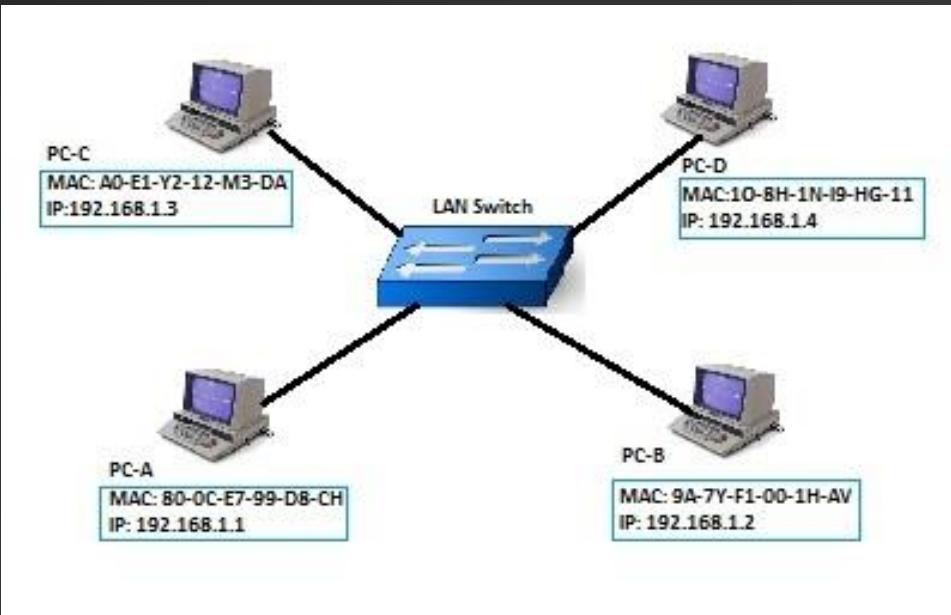
# Switch

A Switch can receive input or signal from any of one port and transmit it on all the ports. Ethernet LAN is used to connect to a switch that correct system. It works on Data link layer of OSI Model

It is a small device that transfers data packets between multiple network devices such as computers, routers, servers or other switches



## *A switch connecting a LAN*



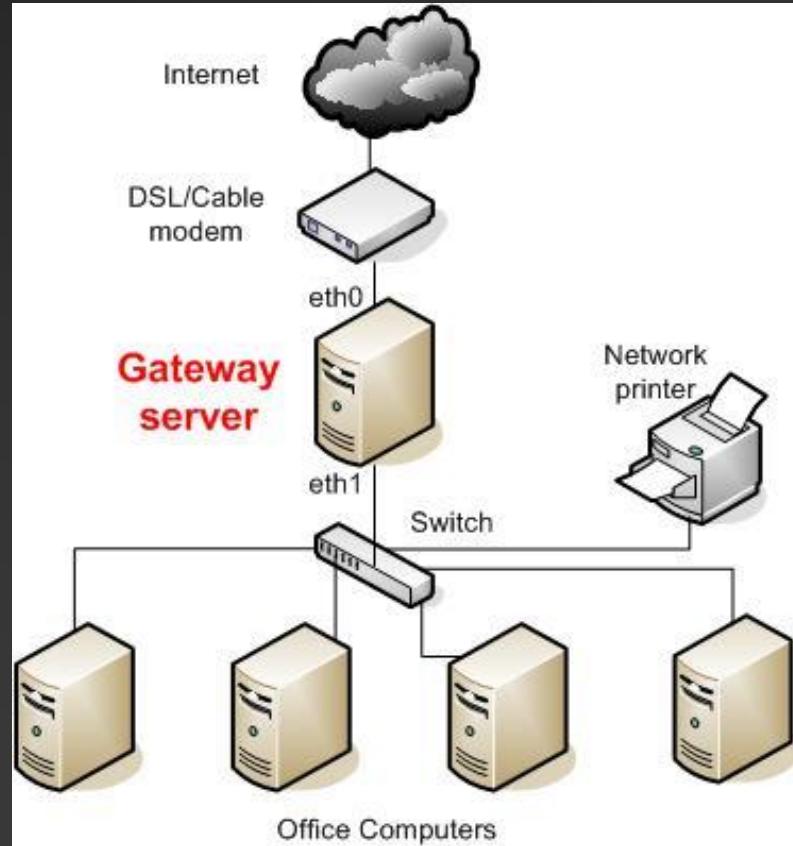
# Gateway

Gateway Connects two networks together with the help of gateway devices like firewire & router. It is a node between the public network and private network which makes some security with the help of identification

A gateway is a networking device that connects two networks using different protocols together. it also acts as a “gate” between two networks.



## *A Gateway connecting a LAN*



# Router

Router is a networking device which is used to provide interaction between two different networks. Router are also used for provide the routes to the data and devices that are connected in network. Router are used to establish internetwork communication

A router inspects a given data packet's destination Internet Protocol address (IP address), and provide connection to the nodes with the main network. It gives you wired and wireless both connectivities.



# *A Router connecting a LAN*

## Wireless Router Network Diagram



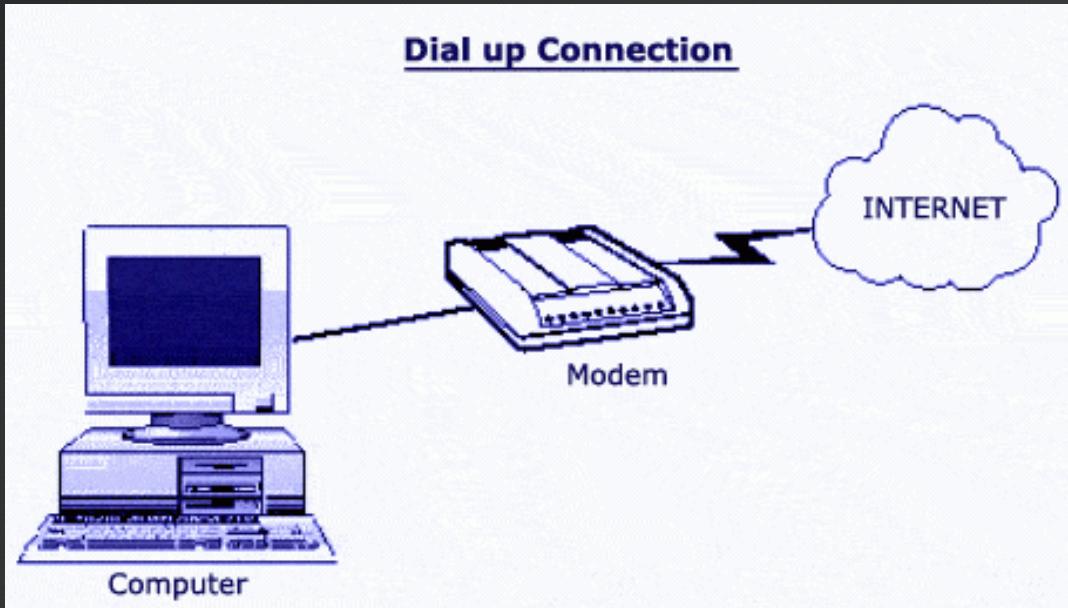
# MODEM

"Modulator-Demodulator" A modem or broadband modem is a hardware device that connects a computer or router to a broadband network. It converts or "modulates" an analog signal from a telephone or cable wire to digital data (1s and 0s) that a computer can recognize.

The main difference between the two devices is that a modem lets you connect to the internet, while a router distributes that connection to different devices. A modem is your gateway to the web, while a router is a central hub for your devices.



## *A Modem connecting a LAN*

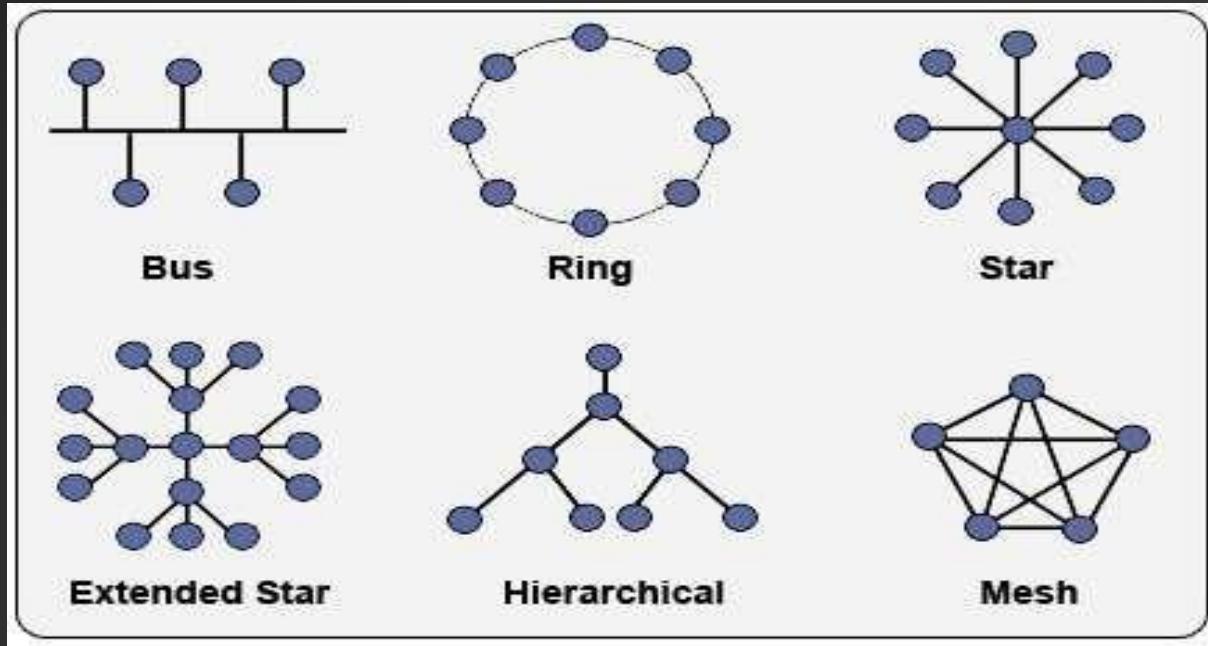


# NETWORK TOPOLOGIES

# Topology

- Topology refers to the layout of connected devices on a network.
- Here, some logical layout of topology.
  - Mesh
  - Star
  - Ring
  - Line
  - Bus
  - Tree
  - Hybrid

# Network Topology



# Mesh Topology

- Here every device has a point to point link to every other device.

## A d v a n t a g e s :

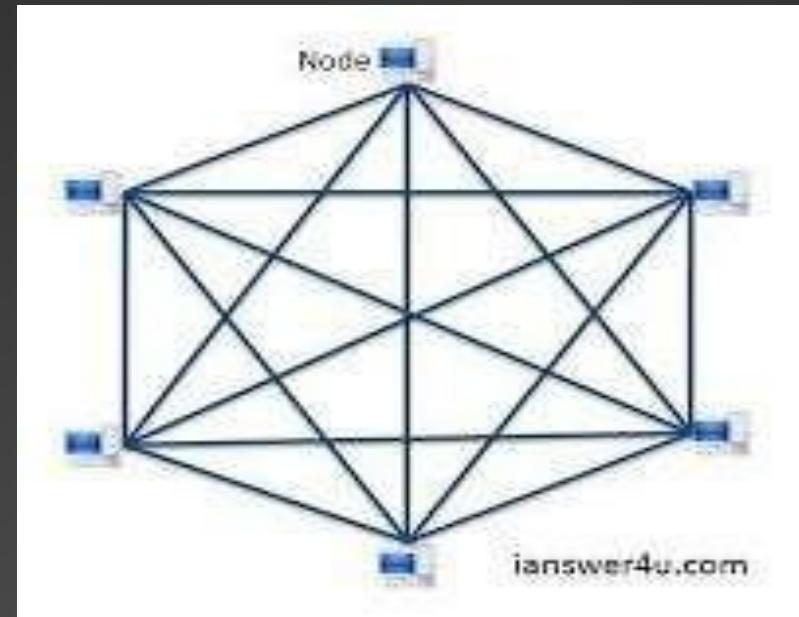
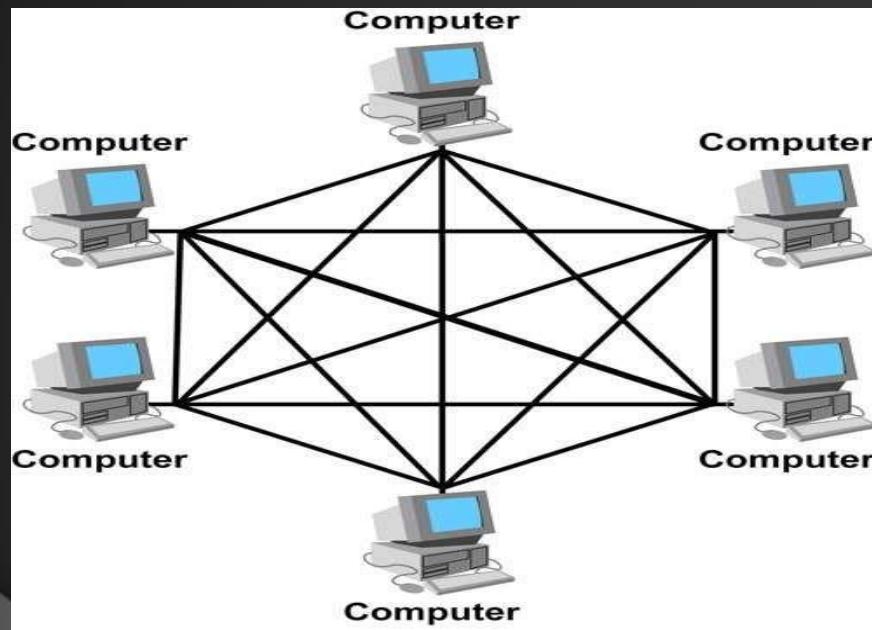
They use dedicated links so each link can only carry its own data load. So traffic problem can be avoided.

It is robust. If any one link get damaged it cannot affect others.

It gives privacy and security.

- Fault identification and fault isolation are easy.

# Mesh Topology



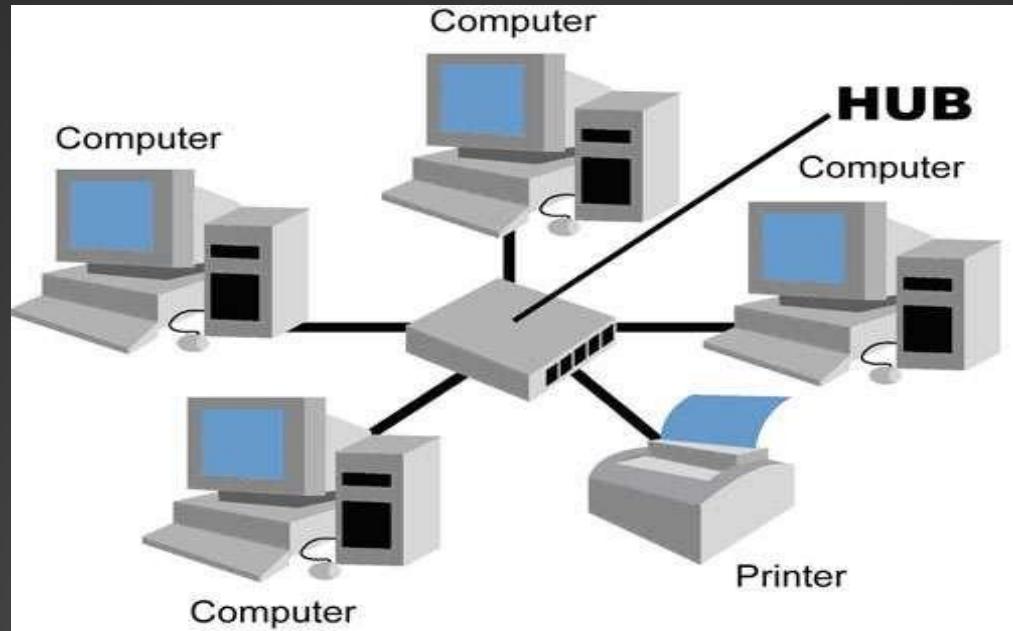
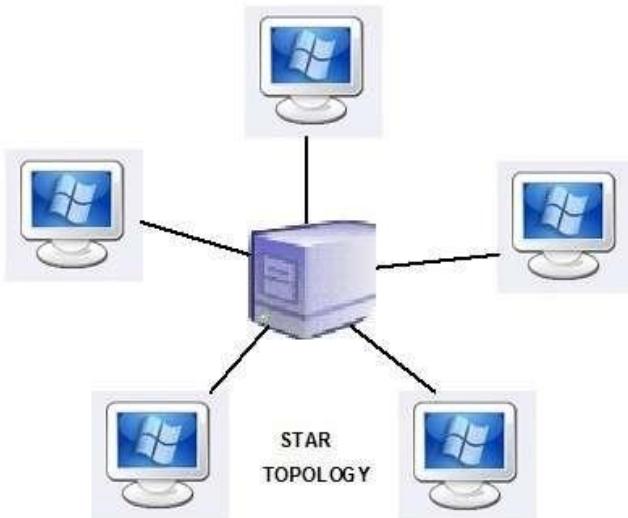
ianswer4u.com

# Star Topology

- Here each device has a dedicated point-to-point link to the central controller called “Hub”(Act as a Exchange).
- There is no direct traffic between devices.
- The transmission are occurred only through the central “hub”.
- When device 1 wants to send data to device 2; First sends the data to hub. Which then relays the data to the other connected device.

# Star Topology

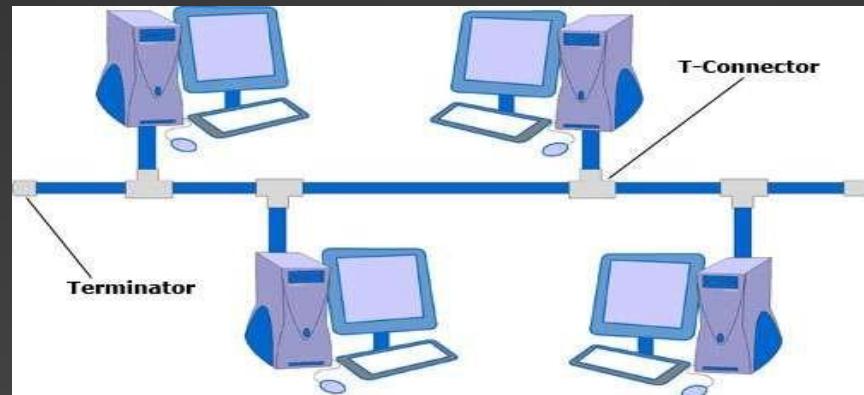
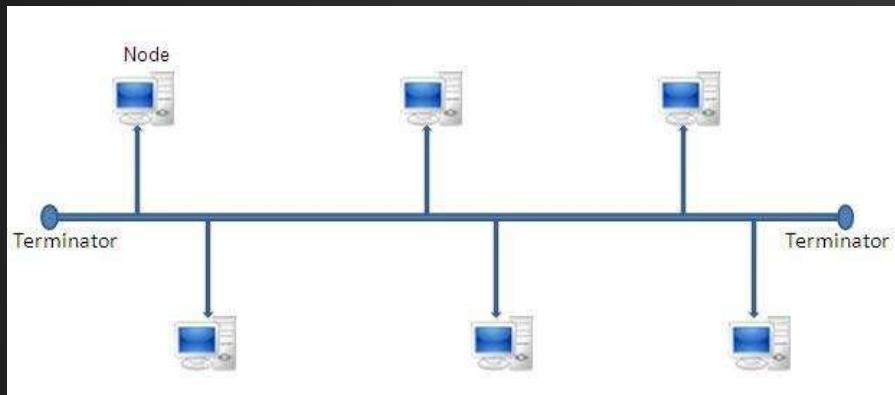
STAR TOPOLOGY:



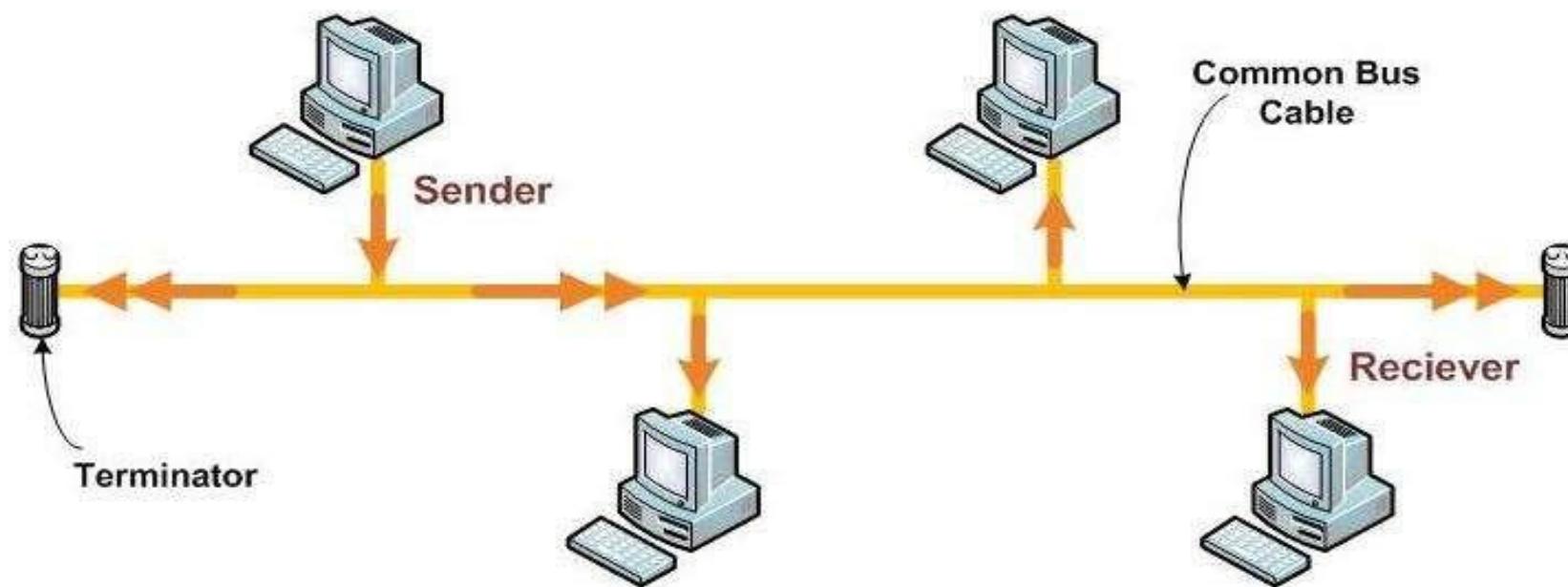
# Bus Topology

- A bus topology is multipoint.
- Here one long cable act as a backbone to link all the devices are connected to the backbone by drop lines and taps.
- Drop line- is the connection b/w the devices and the cable.
- Tap- is the splitter that cut the main link.
- This allows only one device to transmit at a time.

# Bus Topology



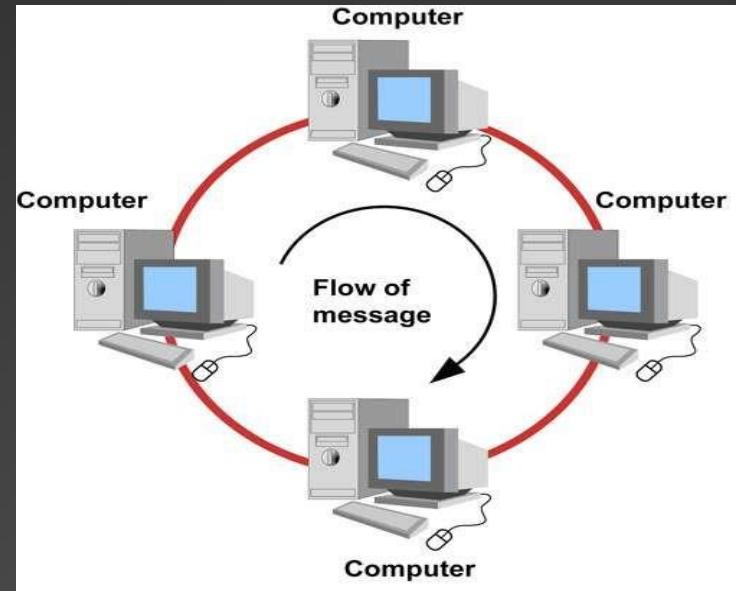
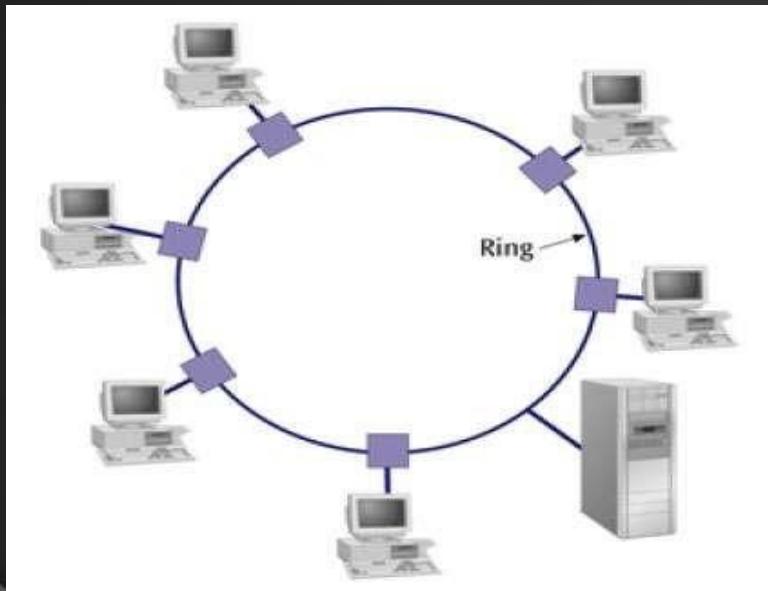
# Bus Topology



# Ring Topology

- Here each device has a dedicated connection with two devices on either side.
- The signal is passed in one direction from device to device until it reaches the destination and each device have repeater.
- When one device received signals instead of intended another device, its repeater then regenerates the data and passes them along.
- To add or delete a device requires changing only two connections.

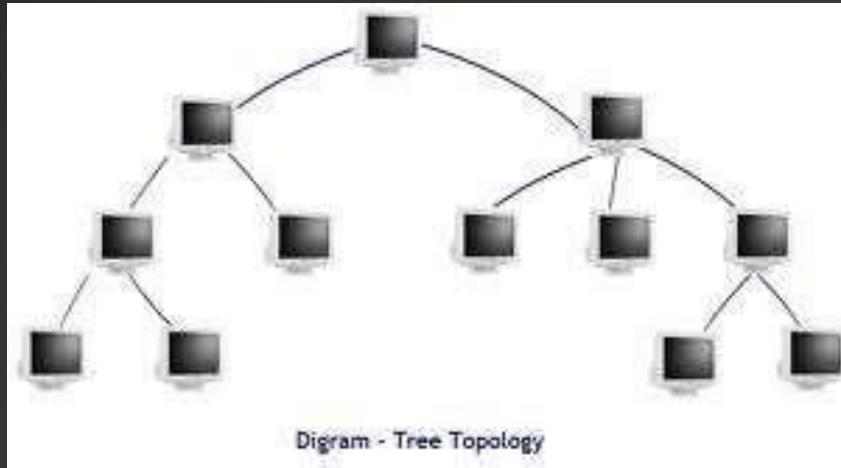
# Ring Topology



# Tree Topology

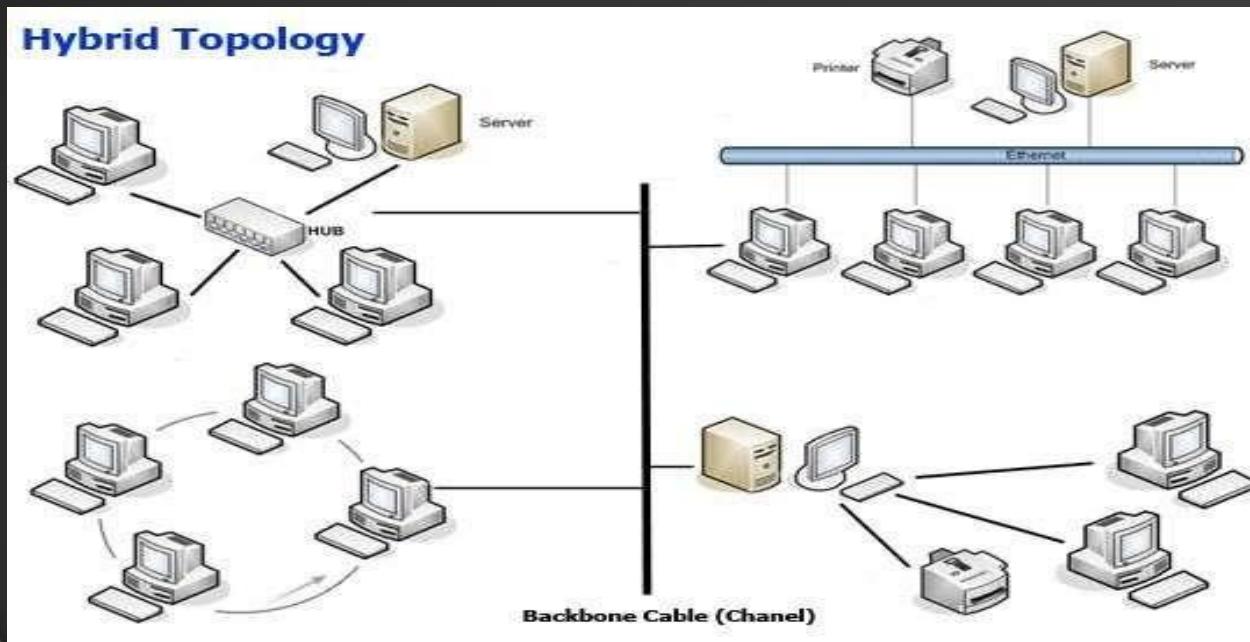
- Alternatively referred to as a star bus topology.
- Tree topology is one of the most common network setups that is similar to a bus topology and a star topology.
- A tree topology connects multiple star networks to other star networks. Below is a visual example of a simple computer setup on a network using the star topology.

# Tree Topology



# Hybrid Topology

- A network which contain all type of physical structure and connected under a single backbone channel.



# Considerations for choosing topology

- Money-Bus n/w may be the least expensive way to install a n/w.
- Length-of cable needed- the linear bus n/w uses shorter lengths of cable.
- Future growth-with star topology, expending is easily done by adding another
- Cable type-most common used cable in commercial organization is twisted pair. Which often used with star topologies.

# IP Addressing IPv4

- An IP address basically a 32-bit address that uniquely universally defines connection of host or a router to the Internet. IP address is unique.
- Introduced by IANA (Internet Assigned Numbers Authority).
- 32 bit is divided into 4 equal parts of 8-8 bits separated by dotted decimal notation. It is in the range of minimum 0.0.0.0 to 255.255.255.255.
- Each 8 bit group is known by OCTET.

# Various IP classes

IP has five different classes differentiated by characteristics.

- Class-A ranges from 0 to 127
- Class-B ranges from 128 to 191
- Class-C ranges from 192 to 223
- Class-D ranges from 224 to 239
- Class-E ranges from 240 to 255

First Octet is defines the class of particular IP e.g. - 128.11.3.31  
is follow in class –B

127.0.0.0 to 127.255.255.255 is a range of look back IP.

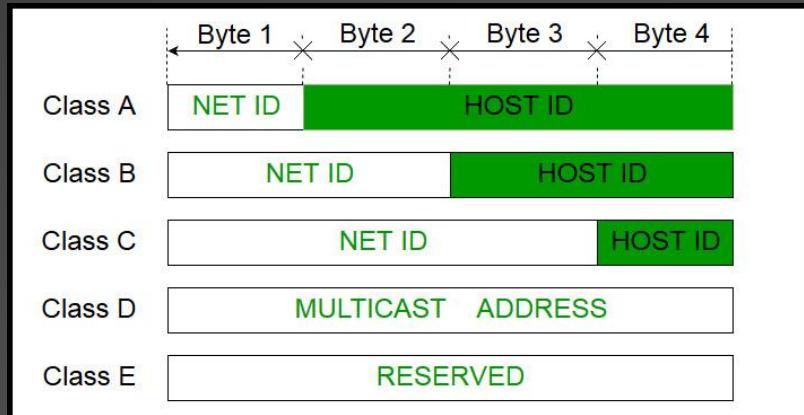
# Classes of IP addresses

## Class-A

This IP ranges from 0 to 126 Decimal value in first octet. And 1<sup>st</sup> octet defines network part and remaining three octet defines the Host part. It patterns like this NHHH (N-Network; H- Host).

First 8bits defines network and remaining 24 bits defines host parts. It has a highest nos. of address  $2^{31}$ .which is about 16,277,216.

Lie between 10.1.1.1 to 126.255.255.255

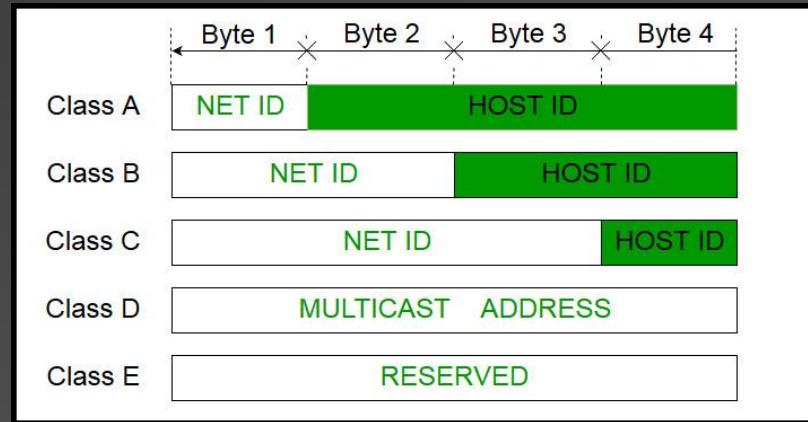


## Class B

This IP ranges from 128 to 191 Decimal value in first octet. And 1<sup>st</sup> two bit defines network part and remaining two octet defines the Host part. It patterns like this NNHH (N-Network; H-Host).

First 16 bits defines network and remaining 16 bits defines host parts. It has a highest nos. of address  $2^{30}$ . which is about 65,536.

IP ranges from 128.16.0.0 to 172.31.255.255.

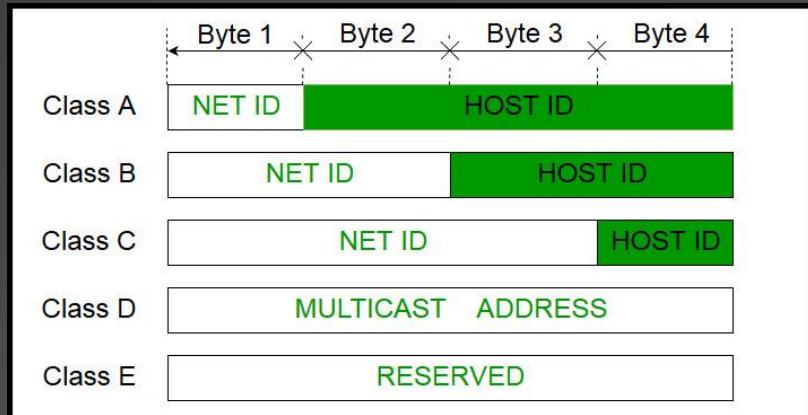


## Class C

This IP ranges from 192 to 223 Decimal value in first octet. And 1<sup>st</sup> three bit defines network part and remaining one octet defines the Host part. It patterns like this NNNH (N-Network; H-Host).

First 24 bits defines network and remaining 8 bits defines host parts. It has a highest nos. of address  $2^{29}$ .which is about 53,68,70,912

IP ranges from 192.168.0.0 to 223.255.255.0.

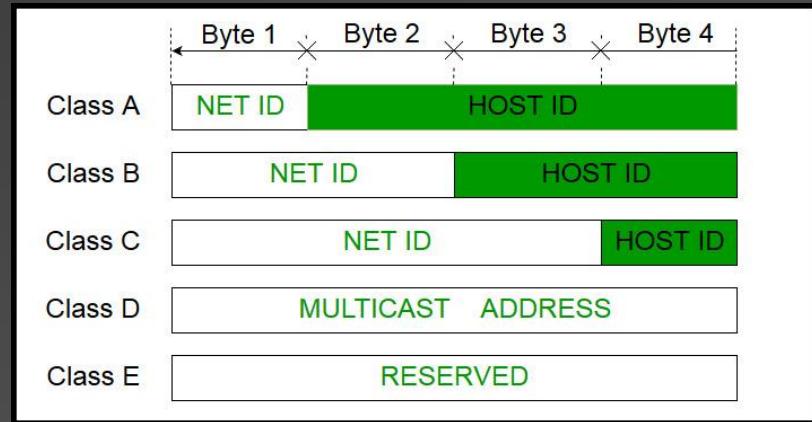


## Class-D

This IP ranges from 224 to 239 Decimal value in first octet.

It is not usually use in general applications.

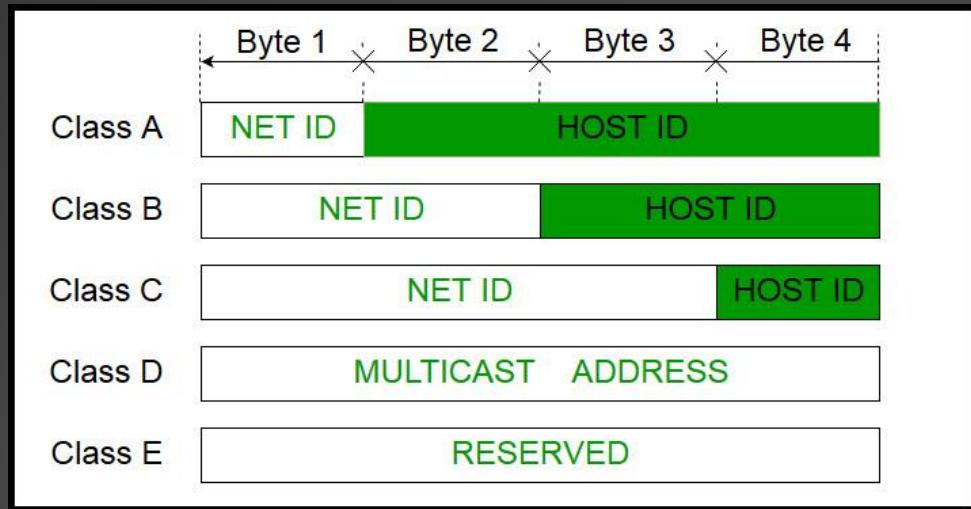
It is use in Special purpose applications known as Multicast.



## Class-E

This IP ranges from 240 to 255 Decimal value in first octet. It is not usually use in general applications.

It is reserved range of IP by R & D (Research and Development) department. Usually, Class-A to C is supported by PC and Class-D and E is not supported.



# IP Addressing IPv6

- An IP address basically a 128-bit address that uniquely universally defines connection of host or a router to the Internet. IP address is unique.
- Introduced by IANA (Internet Assigned Numbers Authority).
- total of 4,294,967,296 unique IP addresses can be assigned to hosts.
- IP is like 2001:db8:1234::f350:2256:f3dd/64
- It supports Unicast. Telecast & Multicast.
- It doesn't have Classes like ipv4

# What Is Subnet Mask?

A subnet mask is a 32- or 128-bit number that segments an existing IP address in a TCP/IP network. It is used by the TCP/IP protocol to determine whether a host is on the local subnet or on a remote network. Subnet mask divides the IP address into a network address and host address, hence to identify which part of IP address is reserved for the network and which part is available for host use.



**255.255.255.0**

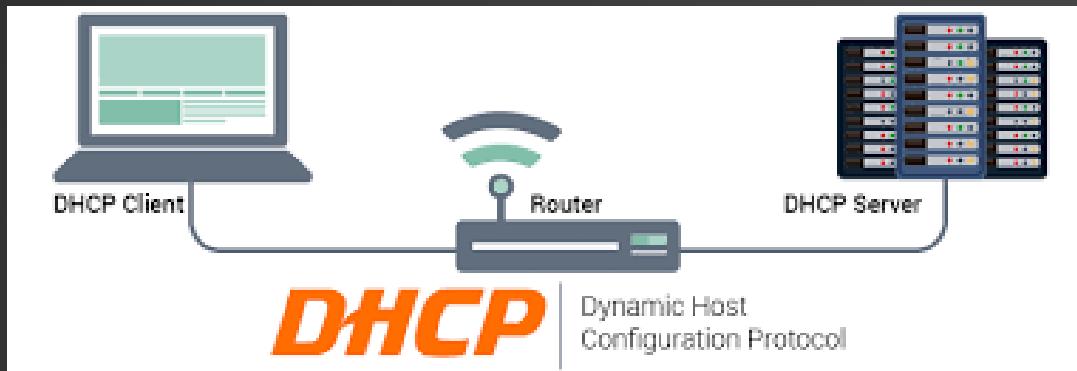


**IP:** 211. 139. 157. 9

**Subnet Mask:** 255. 255. 255. 0

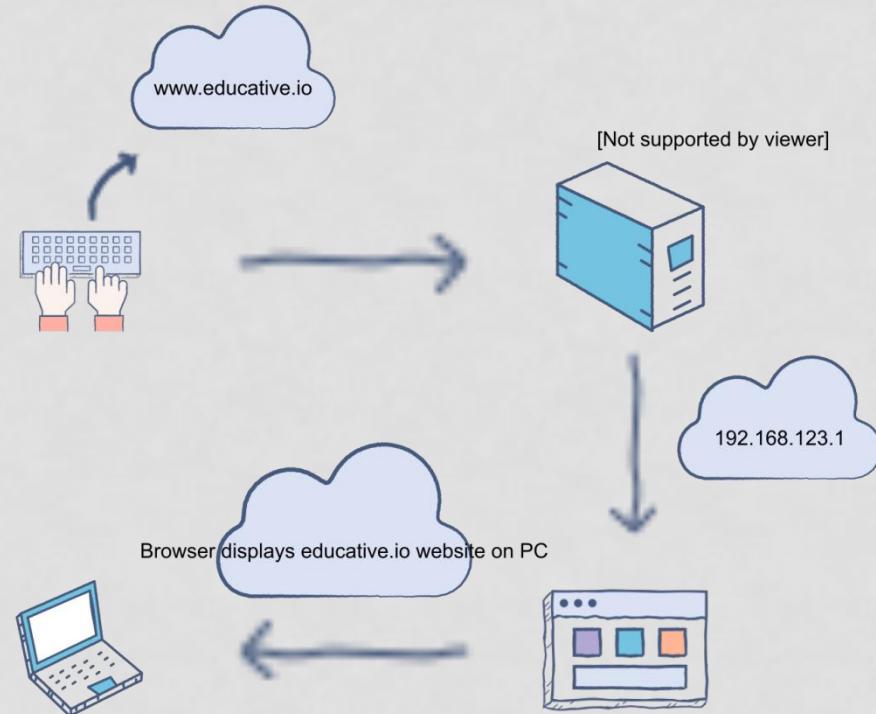
# What Is DHCP?

A **DHCP Server** is a network server that automatically provides and assigns IP addresses, default gateways and other network parameters to client devices. It relies on the standard protocol known as Dynamic Host Configuration Protocol or DHCP to respond to broadcast queries by clients. Its alternate is APIPA



# What Is DNS?

Domain Name System (**DNS**) are **the** Internet's equivalent of a phone book. They maintain a directory of domain names and translate them to Internet Protocol (IP) addresses. This is necessary because, although domain names are easy for people to remember, computers or machines access websites based on IP addresses.



# What Is MAC Address?

A media access control address is a unique identifier assigned to a network interface controller for use as a network address in communications within a network segment. This use is common in most IEEE 802 networking technologies, including Ethernet, Wi-Fi, and Bluetooth.

MAC address

D4-BE-D9-8D-46-9A

# TCP/IP model

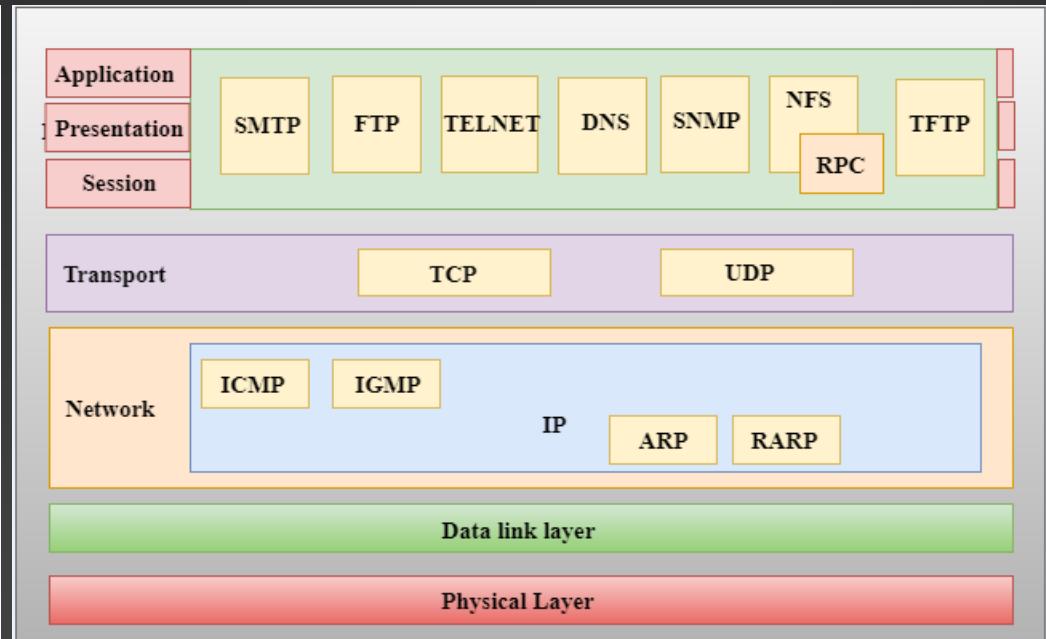
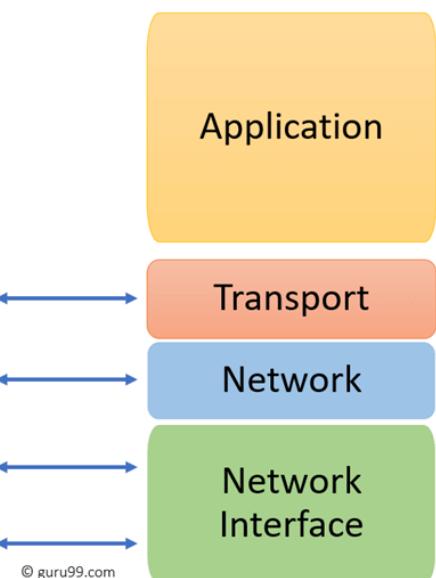
- The TCP/IP model was developed prior to the OSI model.
- The TCP/IP model is not exactly similar to the OSI model.
- The TCP/IP model consists of five layers: the application layer, transport layer, network layer, data link layer and physical layer.
- The first four layers provide physical standards, network interface, internetworking, and transport functions that correspond to the first four layers of the OSI model and these four layers are represented in TCP/IP model by a single layer called the application layer.
- TCP/IP is a hierarchical protocol made up of interactive modules, and each of them provides specific functionality.

# Model

OSI Reference Model



TCP/IP Conceptual Layers



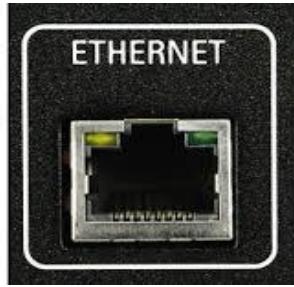
# Ethernet Cable



Also known as RJ-45 cable

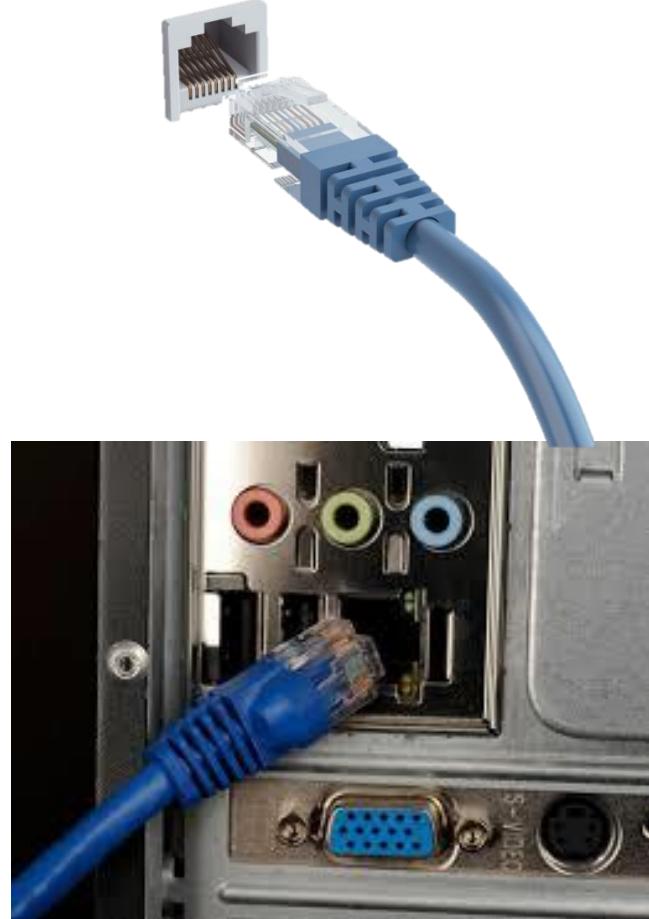
Connect one end to: router, network switch

Connect other end to: Ethernet port on computer (see image below)



## Ethernet Port

- Connects to a network and high speed Internet.
- Connects the network cable to a computer.
- This port resides on an Ethernet Card.
- Data travels at 10 megabits to 1000 megabits per seconds depending upon the network bandwidth.



# What are RJ connectors?

RJ Connectors are a family of push-and-click connectors for twisted-pair wiring in telephone and network wiring. RJ stands for Registered Jack. RJ types define both a jack or receptacle (female) and a plug (male) type of connector.

The most common types of RJ connectors are as follows:

**RJ-11 connector:** A 4-wire or 6-wire telephone-type connector



**RJ-45 connector:** An 8-wire telephone-type connector



**RJ-48 connector:** An 8-wire telephone-type connector TP





# What is BNC connector?

Bayonet Neill-Concelman BNC connector is a series of connectors used for connecting thinner coaxial cabling to various networking components. BNC connectors use a twist-and-lock mechanism that provides a secure connection between network cabling and components.

BNC connectors are typically used on 10Base2 Ethernet networks. The different types of BNC connectors include the following:

**BNC cable connector**

**BNC T-connector**

**BNC barrel connector**

**BNC terminator**





# What is SC and ST connectors?

Connector types that are generally used for connecting fiber-optic cabling to networking devices. Both are recognized by the Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA) 568A standard.

## Subscriber Connector SC

This Connector is for structural cabling it is used for high speed  
And for single mode fibre cabling



## Straight Tip ST

This Connector is for structural cabling it is used for high speed  
And for Multi mode fibre cabling

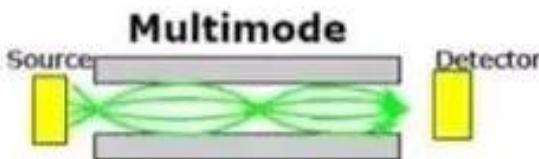


## Lucent Connector LC

LC connectors can be used with both single-mode and multi-mode cables.



# Multi-mode v/s Single mode



- + Low cost sources
  - + 850 nm and 1310 nm LEDs
  - + 850 nm lasers at 1 & 10 Gb/s
  - + Low precision packaging
- + Low cost connectors
- + Lower installation cost
- Higher fiber cost
- + Lower system cost
- Higher loss, lower bandwidth
- Distance up to 2 km
- Best for:**
  - LAN, SAN, Data Center, CO

- High cost sources
  - 1310+ nm lasers 1 and 10 Gb/s
  - 1 Gb/s + w/ DWDM
  - High precision packaging
- Higher cost connectors
- Higher installation cost
- + Lower fiber cost
- Higher system cost
- + Lower loss, higher bandwidth
- + Distance to 60 km+
- Best for:**
  - WAN, MAN, Access, Campus

# What is SC and ST connectors?

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## Straight Tip ST

This Connector is for structural cabling it is used for high speed  
And for Multi mode fibre cabling



## Lucent Connector LC

LC connectors can be used with both single-mode and multi-mode cables.





# Wireless Networking

# W-Fi & Bluetooth



Bluetoo**th**<sup>TM</sup>

# Wi-Fi

- What is Wi-Fi
  - Short for “*Wireless Fidelity*”
  - A trademark of the Wi-Fi Alliance
  - The brand name for products using the *IEEE 802.11* family of standards
  - Commonly used for “wireless local area network”(WLAN)



# Bluetooth



- Wireless Personal Area Networks (WPAN)
- Design goal
  - Cable replacement
  - Low cost
  - Low power
  - Small size
  - For mobile devices
- Standard: IEEE 802.15.1



**Bluetooth™**

# Wi-Fi Standards

IEEE Standard	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ax
Year Released	1999	1999	2003	2009	2014	2019
Frequency	5Ghz	2.4GHz	2.4GHz	2.4Ghz & 5GHz	2.4Ghz & 5GHz	2.4Ghz & 5GHz
Maximum Data Rate	54Mbps	11Mbps	54Mbps	600Mbps	1.3Gbps	10-12Gbps

# Bluetooth Evolution

Year Introduced	Bluetooth Version	Feature
2004	2.0	Enhanced Data Rate
2007	2.1	Secure Simple Pairing
2009	3.0	High Speed with 802.11 Wi-Fi Radio
2010	4.0	Low-energy protocol
2013	4.1	Indirect IoT device connection
2014	4.2	IPv6 protocol for direct internet connection
2016	5.0	4x range, 2x speed, 8x message capacity + IoT

# Wi-Fi vs. Bluetooth



## Vs.



	Bluetooth	Wifi
Specifications authority	Bluetooth SIG	IEEE, WECA
Year of development	1994	1991
Bandwidth	Low (800 Kbps)	High (11Mbps)
Hardware requirement	Bluetooth adaptor on all the devices connecting with each other	Wireless adaptors on all the devices of the network, a wireless router and/or access points
Cost	Low	High
Power Consumption	Low	High
Frequency	2.4 GHz	2.4 GHz
Security	It is less secure	It is more secure
Range	10 meters	100 meters
Primary Devices	Mobile phones, mouse, keyboards, office and industrial automation devices	Notebook computers, desktop computers, servers
Ease of Use	Fairly simple to use. Can be used to connect up to seven devices at a time. It is easy to switch between devices or find and connect to any device.	It is more complex and requires configuration of hardware and software.

# WIFI CARD

- Internal
- External



Internal



External

# Bluetooth CARD

- Internal
- External



Internal



External

# Network Threats

# Types of Viruses

- Macro Virus
- Executable Virus
- Backdoor Virus

# **Macro Viruses**

- Most common type of virus on campus Affect Microsoft Office documents Written in Visual Basic for Applications
- Generally harmless with a few destructive variants

# **Executable Viruses**

- Second most common type of virus on campus
- Written in programming languages and compiled into executable files

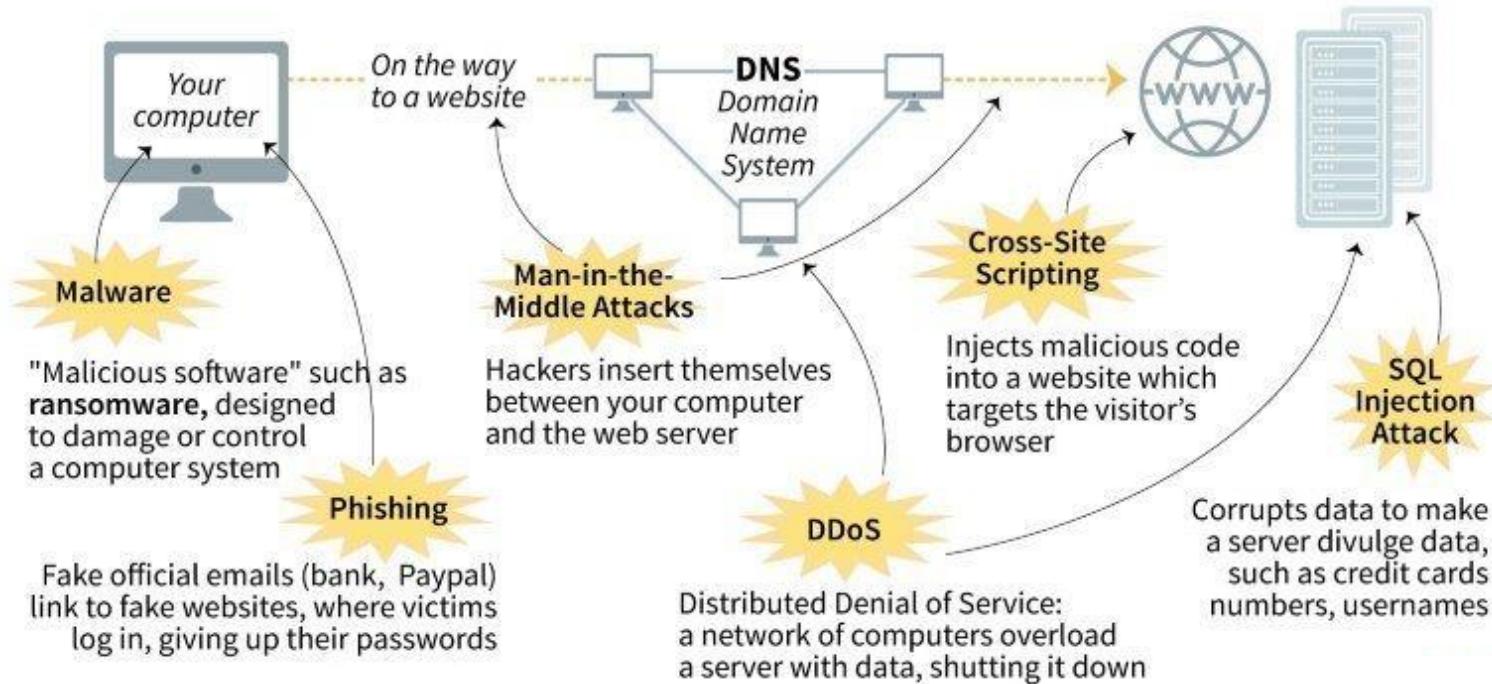
# **Backdoor Programs**

Allow anyone on the internet to remotely control the infected computer

- Send and receive files
- View the screen
- Monitor all keystrokes

# The different types of cyber attacks

Cyber crime worldwide cost \$400 billion in 2015 and is forecast to reach \$2 trillion in 2019\*



# Firewall

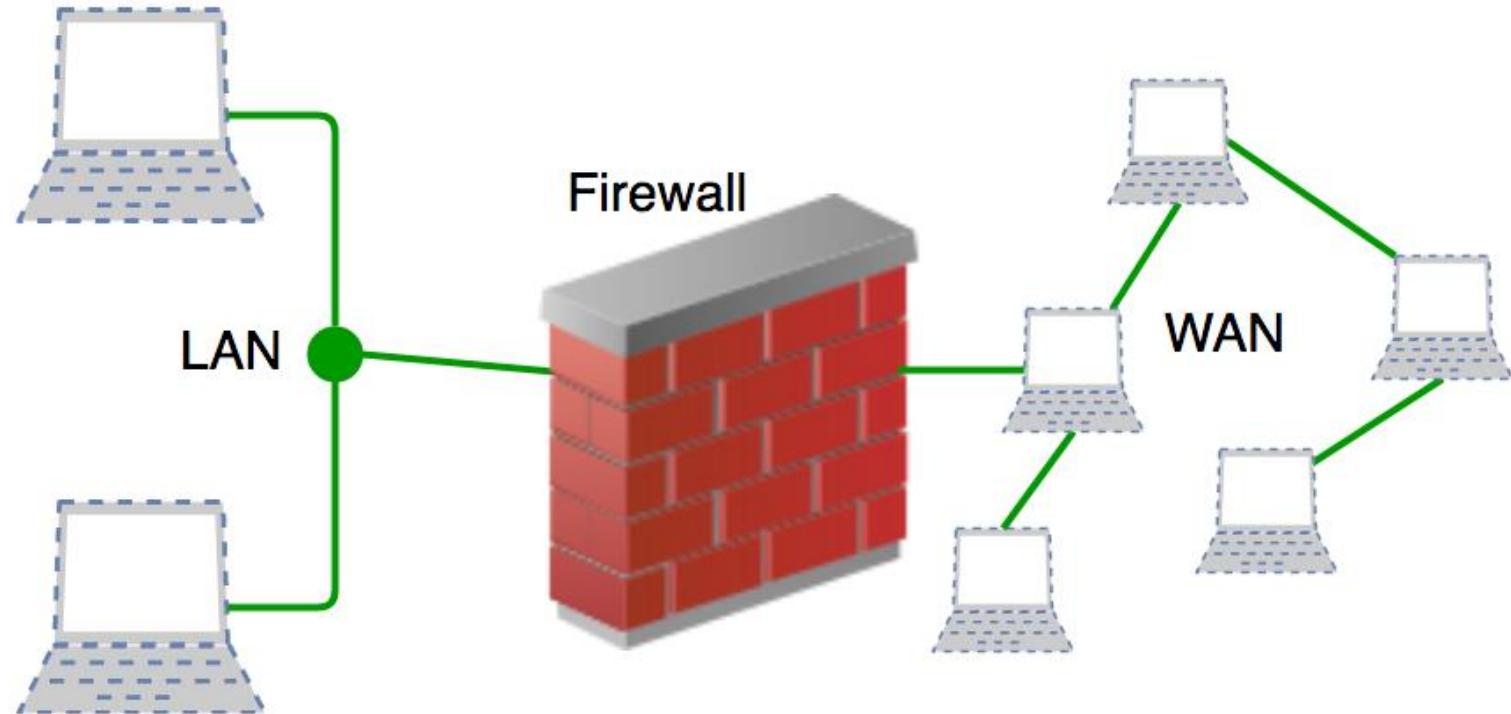
A firewall is a network security device, either hardware or software-based, which monitors all incoming and outgoing traffic and based on a defined set of security rules it accepts, rejects or drops that specific traffic.

**Accept** : allow the traffic

**Reject** : block the traffic but reply with an “unreachable error”

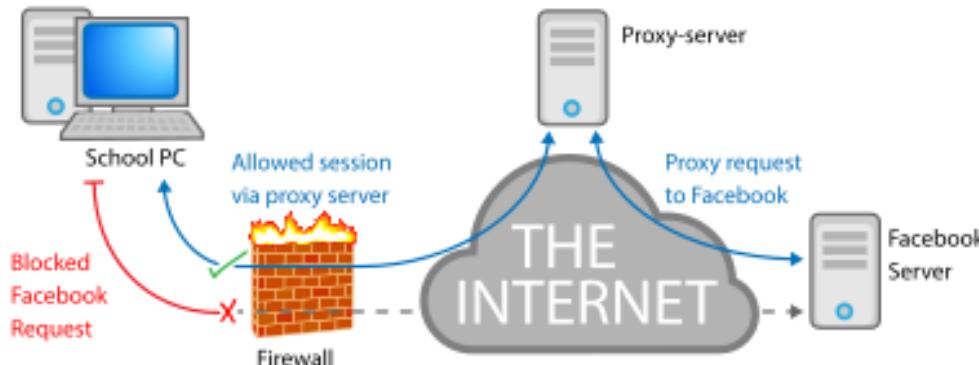
**Drop** : block the traffic with no reply

A firewall establishes a barrier between secured internal networks and outside untrusted network, such as the Internet.



# Proxy Server

A proxy server is a server that acts as an intermediary for requests from clients seeking resources from other servers. Today, most proxies are web proxies that facilitate access to content on the internet, while providing anonymity.



# TROUBLESHOOTING

# #1 Pinging Problem

Step-1 :- Check Discovery

Step-2 :- Check Firewall

Step-3 :- Check IP Address

Step-4 :- Check Host and Medium

# #2 No Printing

Step-1 :- Goto services.msc

Step-2 :- Check Printer Spooler Service

Step-3 :- Restart it

Step-4 :- Now give Printing Command

# #3 No Internet Access

Step-1 :- Check Adapters and Ports

Step-2 :- Check Physical Connectivity like wires, router & switch

Step-3 :- Restart your Network devices and System

Step-4 :- Try to Check Default in Cable Line

# #4 IP Conflict

Step-1 :- Check with Ping in another Device after Shutdown

Step-2 :- If it is Pinging Change your IP

Step-3 :- Goto ncpa.cpl and select adapter and ipv4 or ipv6

Step-4 :- Now give a new Unique Supported Static IP

# Practical

1. Folder Sharing in Network
2. Remote Desktop Connection

## BONUS

50 Computer Related Fullforms

All helping RUN Commands

CMD Commands for Networking link in Description

# Abbreviations

- LAN - Local Area Network
- MAN - Metropolitan Area Network
- WAN - Wide Area Network
- PAN - Personal Area Network
- NIU - Network Interface Unit
- NIC - Network Interface Card
- MAC - Media Access Control
- TCP - Transmission Control Protocol
- IP - Internet Protocol
- Bps - Bits Per Second
- gbps - Gigabyte Per Second
- KHz - kilohertz
- E-mail - Electronic Mail
- HTML - Hyper Text Markup Language
- STP - Shielded Twisted pair
- UTP - Unshielded Twisted pair
- URL - Uniform Resource Locator
- WWW - World Wide Web
- ISP - Internet Service Provider
- HTTP - Hyper Text Transfer Protocol
- PPP - Point to Point Protocol
- TCP - Transmission Control Protocol
- NTP - Network Time Protocol
- SMTP - Simple Mail Transfer Protocol
- POP - Post Office Protocol
- IMAP - Internet Mail Access Protocol

- Telnet - Terminal Network
- VoIP - Voice over Internet Protocol
- SIP - Session Initiation Protocol
- Wi-Fi - Wireless Fidelity
- GSM - Global system for mobile comm
- GPRS - General Packet Radio Service
- CDMA - Code Division Multiple Access
- WLL - Wireless in Local Loop
- 3G - Third Generation
- IRC - Internet Relay Chat
- SMS - Short Message Service
- TDMA - Time Division Multiple Access
- UMTS - Universal Mobile Telephone System
- NFS - Network File System
- RJ-45 - Registered Jack-45
- CD - Carrier Detect
- CTS - Clear – to-Send
- DTE - Data Terminal Equipment
- DCE - Data Communication Equipment
- DTR - Data Terminal Ready
- FAT - File Allocation Table
- DNS - Domain Name System
- PING - Packet InterNet Groper
- W3C - World Wide Web Consortium
- ARP - Address Resolution Protocol
- RARP - Rev. Address Resolution Prot.

# RUN Commands

- Ncpa.cpl - For Network Adapters
- Firewall.cpl - For Windows Firewall Settings
- Services.cpl - For Getting Windows Services
- Devmgmt.msc - For Device Management Settings
- Mstsc - For Remote Desktop Connection
- Msra - For Windows Remote Assistance
- gpedit.msc - For Windows Policies Settings

# Let's Practical