

# Introduction to Computer Networks



## Chapter 1

# Communication

- **Definition:** Communication means sending or receiving information.
- In ancient times, people used the beating of drums, smoke signals, mirror reflecting sunlight, homing pigeons and so on to send the message.



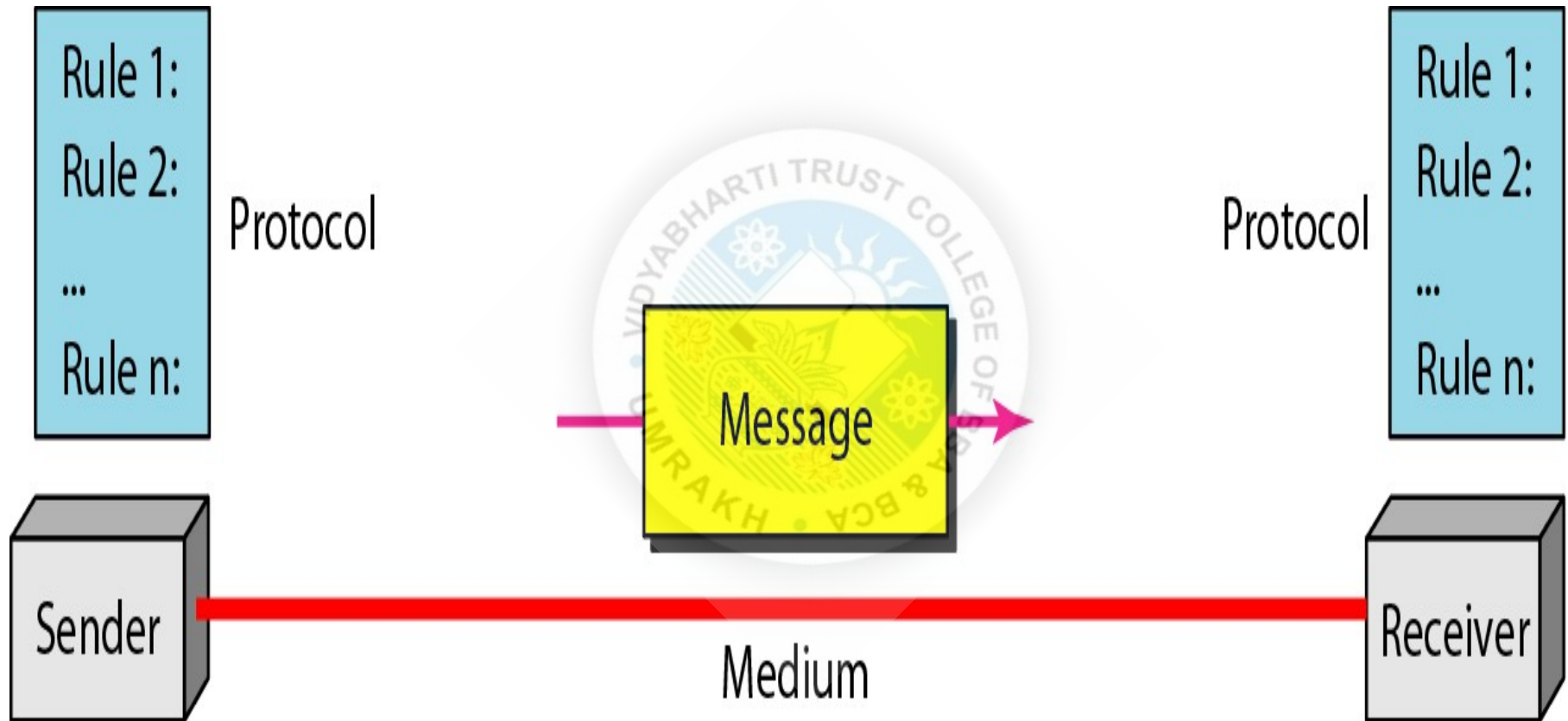
# Data Communication

- **Definition:** It is the exchange of data between two OR more devices using some form of wired or wireless transmission medium.
- It includes the transfer of data, the method of transfer and the preservation of the data using the transfer process.
- For data communication to be effective, the following three fundamental characteristics should be considered.

## Continue....

- **Delivery:** The system must deliver data to correct or the intended destination.
- **Accuracy:** The system must deliver data accurately (Error Free).
- **Timeliness:** The system must deliver data in a timely manner without enough time legs.

# Component of Data Communication



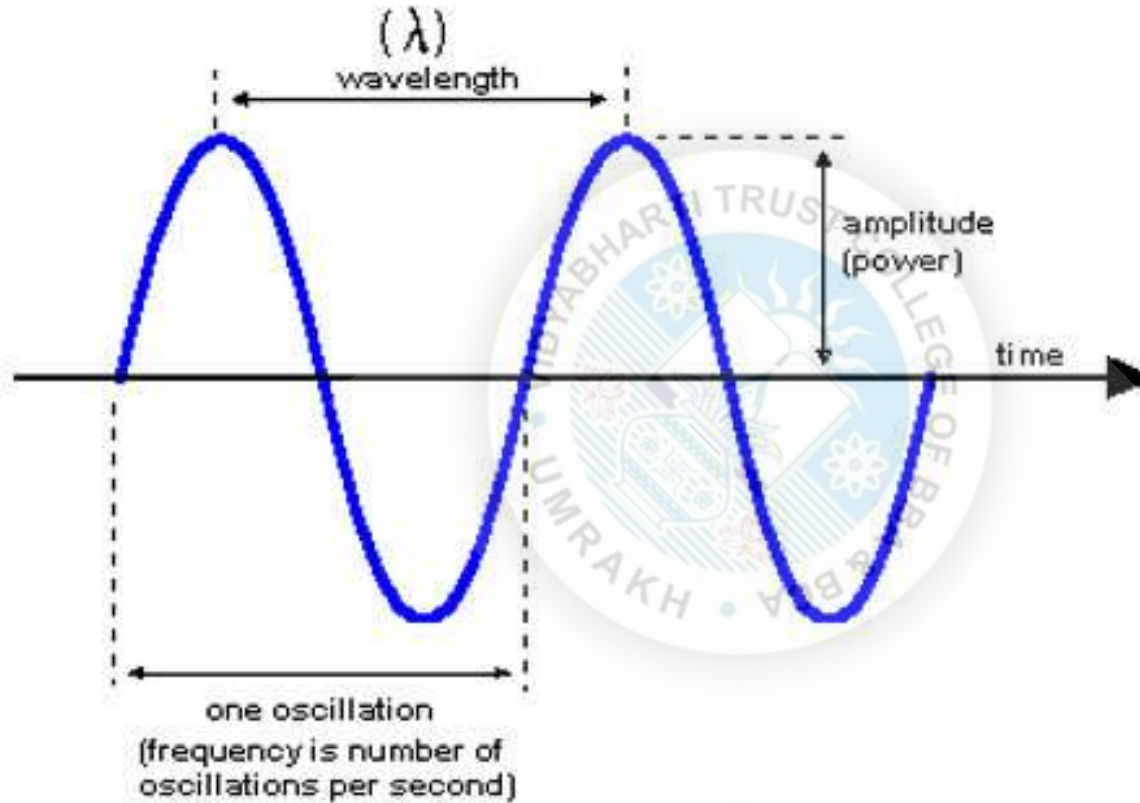
# Component of Data Communication

- There are five basic components in data communication system.
- **Message:** It is the information that is to be communicated.
- **Sender:** The sender is the device that send the message.
- **Receiver:** The receiver is the device that receive the message.
- **Medium:** The transmission medium is the physical path that communicates the message from sender to receiver.
- **Protocol:** It is refer to a **set of rules** that coordinates the exchange of information. Both sender and receiver follow the same protocol to communicate data.

# Analog Signal

- An analog signal is a continuous waveform that changes smoothly over time.
- It is perfect for carrying data such as voice or sound.
- However, these signals are prone to error or noise, which are caused from an outside source.
- Attenuation is another problem with analog signal because the amplitude of the wave naturally change over distance.
- The sine wave is the most fundamental form of an analog signal.

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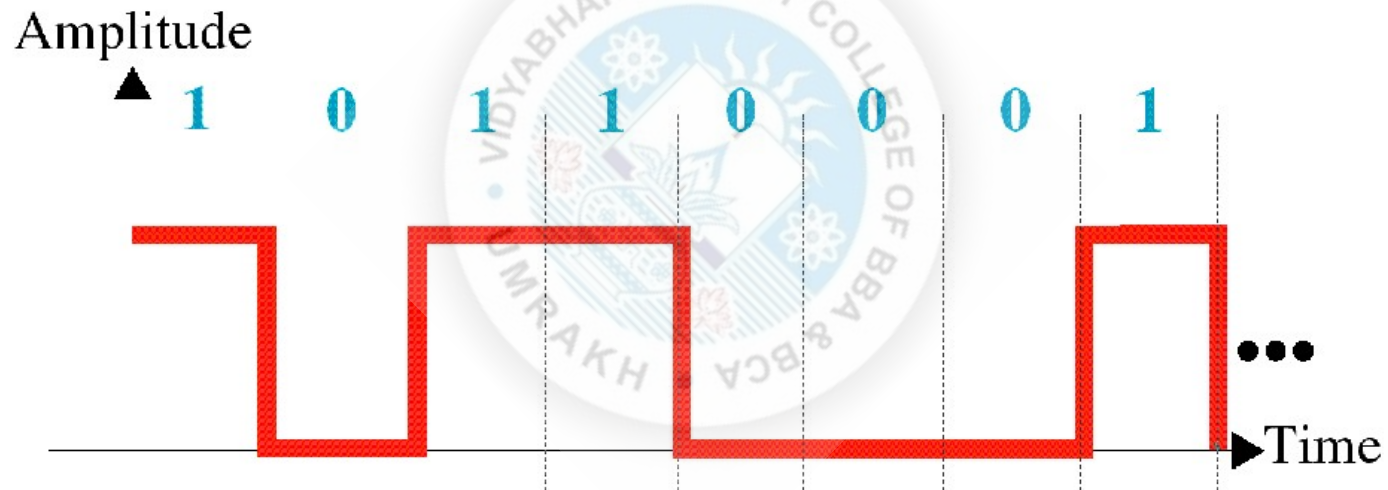




# Digital Signal

- It is data stored in the form of “0s” and “1s”.
- When the signal is at a high point, its value is 1” and when it is low, its value is “0”.
- It is not affected by noise or attenuation as compared to the analog signals.
- It can be represented by a graph similar to a bar graph.
- To transmit data, over analog phone lines, a modem is required to convert digital data signals to analog signals.
- When transmitted over long distances, analog signals require to be amplified which can possibly distort the value of the data transmitted.

Continue...



# Computer Network

- **Definition:** Interconnection of two or more computers and peripherals together via transmission media so that they can share information and resources.



# Advantages Of Network

- **File Sharing:** The major advantage of a computer network is that it allows file sharing and remote file access.
- A person sitting at one workstation that is connected to a network can easily see files present on another workstation.
- This saves him/her the hassle of carrying a storage device every time data needs to be transported from one system to another.
- Further, a central database means that anyone on that network can access a file and/or update it. If files are stored on a server and all of its clients share that storage capacity, then it becomes easier to make a file available to multiple users.

## Continue....

- **Resource Sharing:** If there are twelve employees in an organization, each having their own computer, they will require twelve modems and twelve printers if they want to use the resources at the same time.
- A computer network, on the other hand, provides a cheaper alternative by the provision of resource sharing. All the computers can be interconnected using a network, and just one modem and printer can efficiently provide the services to all twelve users.

## Continue...

- **Inexpensive Set-Up:** Shared resources mean reduction in hardware costs.
- Shared files mean reduction in memory requirement, which indirectly means reduction in file storage expenses.
- A particular software can be installed only once on the server and made available across all connected computers at once.
- This saves the expense of buying and installing the same software as many times for as many users.

## Continue...

- **Flexible Handling:** A user can log on to a computer anywhere on the network and access his files.
- This offers flexibility to the user as to where he should be during the course of his routine.
- A network also allows the network administrator to choose which user on the network has what specific permissions to handle a file. For example, the network administrator can allot different permissions to User A and User B for File XYZ. According to these permissions, User A can read and modify File XYZ, but User B cannot modify the file. The permission set for User B is read-only.

## Continue..

- **Increased Storage Capacity:** Since there is more than one computer on a network which can easily share files, the issue of storage capacity gets resolved to a great extent.
- A standalone computer might fall short of storage memory, but when many computers are on a network, the memory of different computers can be used in such a case.



## Continue..

- **Internet Access Sharing:** Small computer networks allow multiple users to share a single Internet connection.
- Special hardware devices allow the bandwidth of the connection to be easily allocated to various individuals as they need it, and permit an organization to purchase one high-speed connection instead of many slower ones.

## Continue...

- **Connectivity and Communication** : Networks connect computers and the users of those computers. Individuals within a building or work group can be connected into local area networks (LANs); LANs in distant locations can be interconnected into larger wide area networks (WANs).
- Once connected, it is possible for network users to communicate with each other using technologies such as electronic mail.
- This makes the transmission of business (or non-business) information easier, more efficient and less expensive than it would be without the network.

## Continue...

- **Data Security and Management:** In a business environment, a network allows the administrators to much better manage the company's critical data.
- Instead of having this data spread over hundreds of small computers data can be centralized on shared servers.
- This makes it easy for everyone to find the data, makes it possible for the administrators to ensure that the data is regularly backed up, and also allows for the implementation of security measures to control who can read or change various pieces of critical information.

## Disadvantages

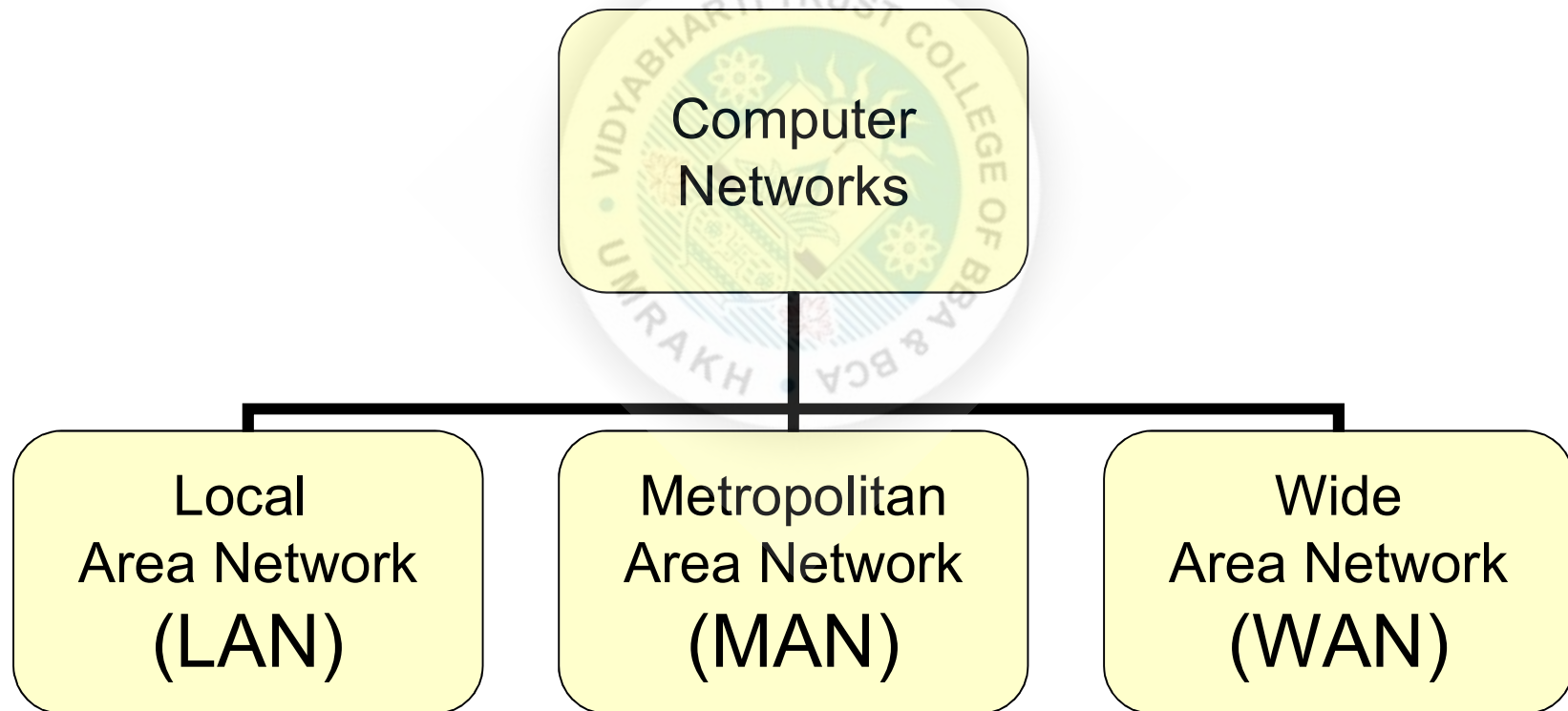
- **Security Concerns :** One of the major drawbacks of computer networks is the security issues that are involved. However, if a computer is on a network, a hacker can get unauthorized access by using different tools.
- In case of big organizations, various network security software need to be used to prevent theft of any confidential and classified data.
- **Virus and Malware:** If even one computer on a network gets affected by a virus, there is a possible threat for the other systems getting affected too. Viruses can spread on a network easily, because of the inter-connectivity of workstations.

## Continue...

- **Lack of Robustness:** If the main file server of a computer network breaks down, the entire system becomes useless. If there is a central linking server or a bridging device in the network, and it fails, the entire network will come to a standstill.
  - **Needs An Efficient Handler:** The technical skills and know-how required to operate and administer a computer network is considerably high. Any user with just the basic skills cannot do this job.
  - **Lack of Independence:** Since most networks have a centralized server and dependent clients, the client users lack any freedom whatsoever. Centralized decision making can sometimes hinder how a client user wants to use his own computer.
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# Types of Computer Networks

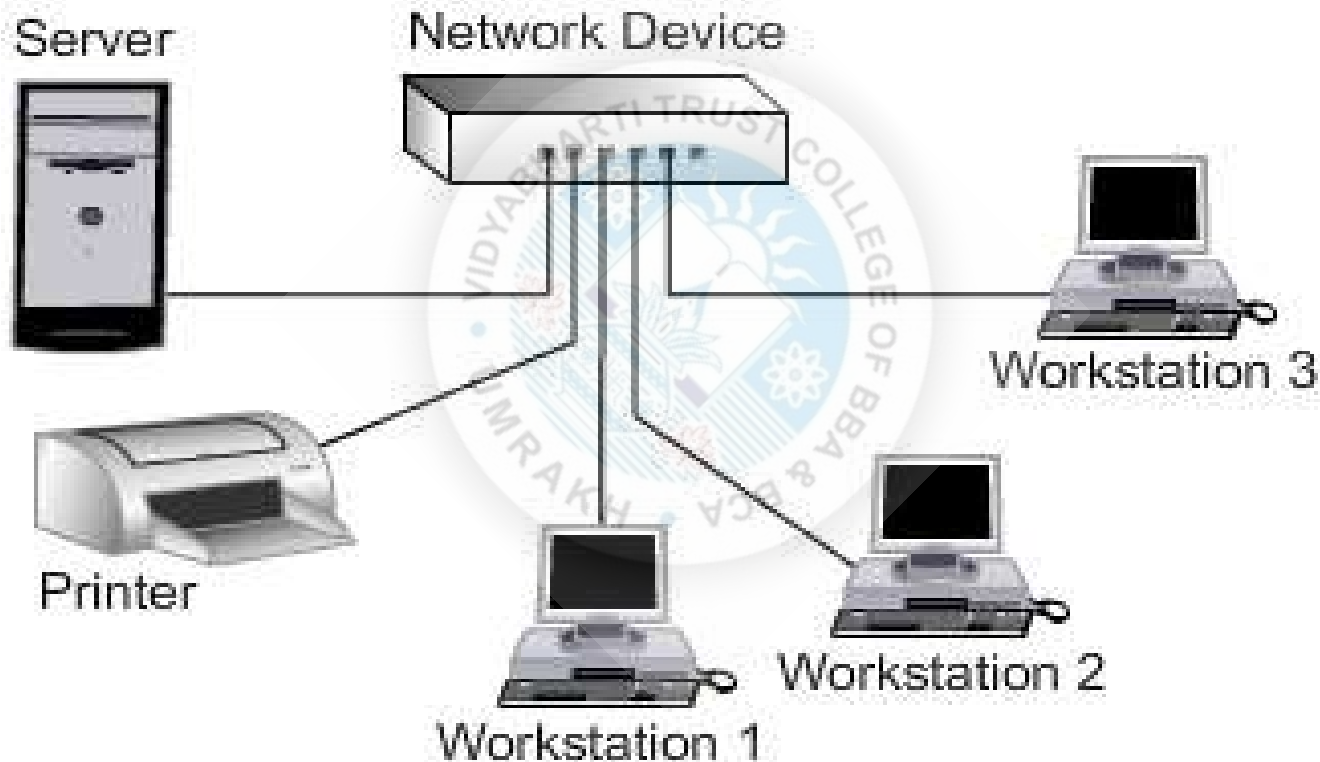
- Networks are **classified depending on the geographical area covered by the network**



# Local Area Network (LAN) - I

- It is a type of network which is privately owned and link computers and workstations **covering a Small local area like, office or home**
- Limited to **1.5 Km**
- Designed to share resources like file, printer, games and other applications.
- Each computers or device connected to the network is called **node**.
- Characteristics which differentiate LAN from other types of network are
  - ❑ Size of LAN
  - ❑ Transmission technologies Used by LAN
  - ❑ Network Topology

# Local Area Network (LAN) - I





## Continue...

- Depends upon application and cost, various topology used in LAN like star, bus, ring.
  - LAN use a transmission technology consisting of inexpensive hardware such as Ethernet Cable to which all other devices are attached.
  - It may be wired or wireless, or might employ both types of communication.
  - Since all the interconnected computers and devices are placed in a single location, LAN generally allows for faster and effective data connection.
  - Speed of LAN ranges from 10 to 100 Mbps.
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# LAN Properties

- Multiple system attached to shared medium
- Low error rate
- High total bandwidth upto 100 Mbps.
- Limited geography up to 1.5 km.
- Limited number of station.



# Local Area Network (LAN) - II

## ■ Advantages of LAN:

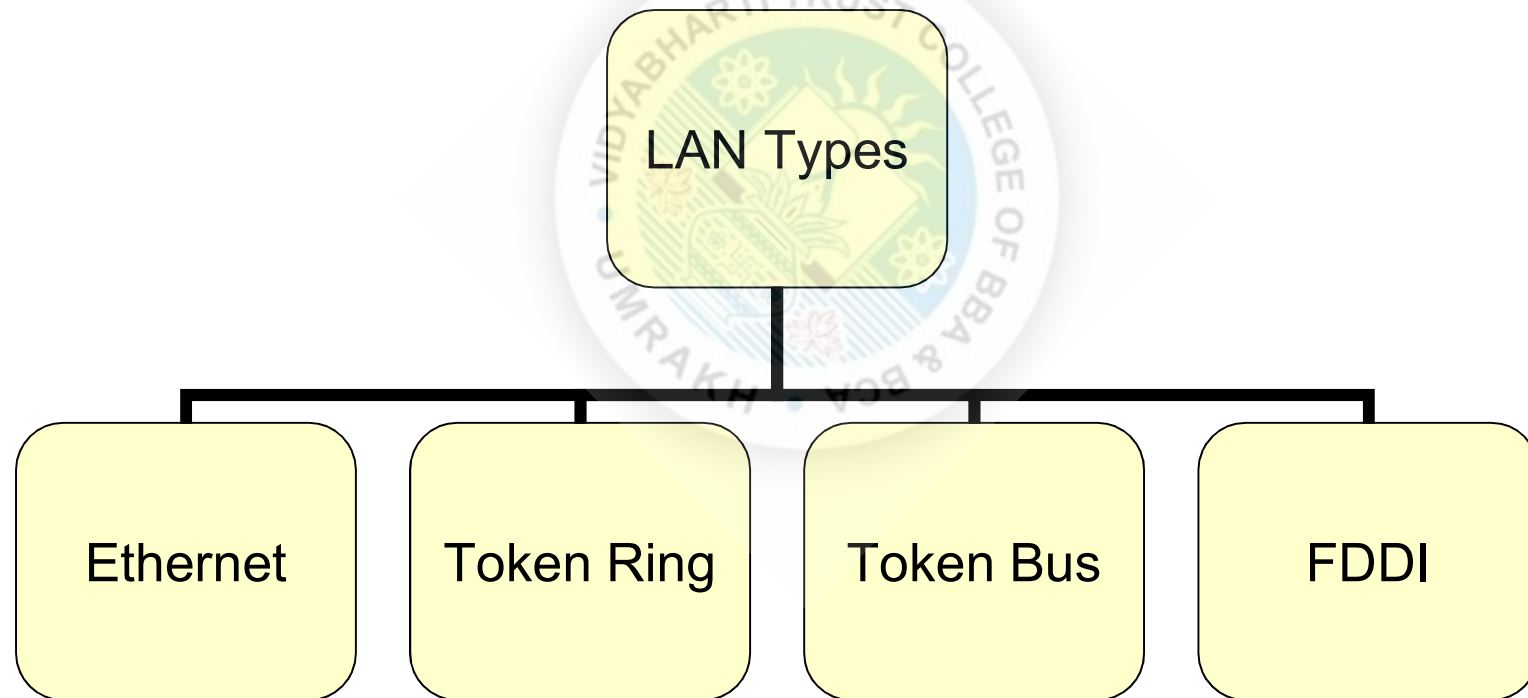
- ❑ Improves productivity due to faster work
- ❑ Provides easy maintenance
- ❑ New systems can be installed and configured easily

## ■ Disadvantages of LAN:

- ❑ Limited number of systems can only be connected
- ❑ Cannot cover large area
- ❑ Network performance degrades as number of users exceeds

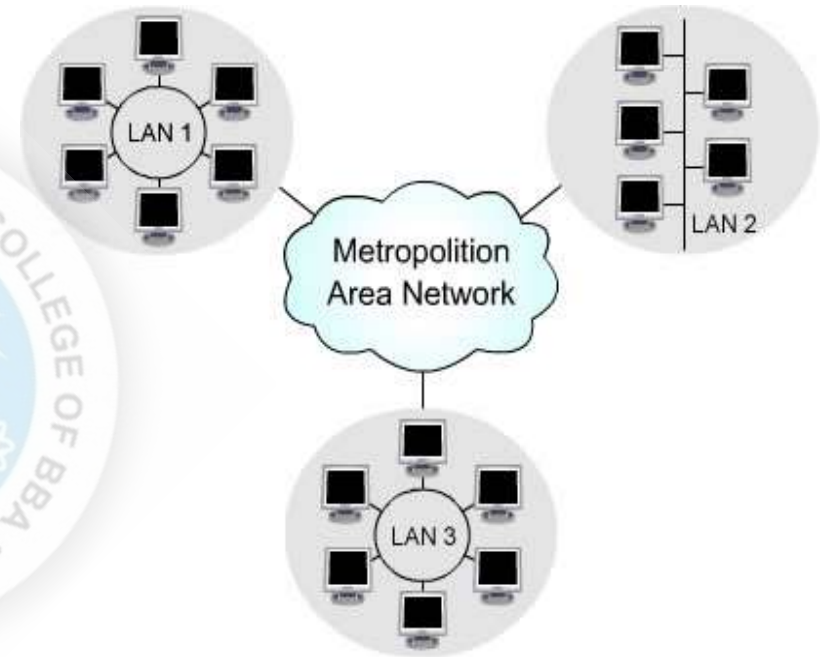
# LAN Technologies

- LANs are classified depending on the techniques used for data sharing



# Metropolitan Area Network

- This is a network which is larger than a LAN but smaller than a WAN.
- Usually span in to a city or large campus.
- A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations.



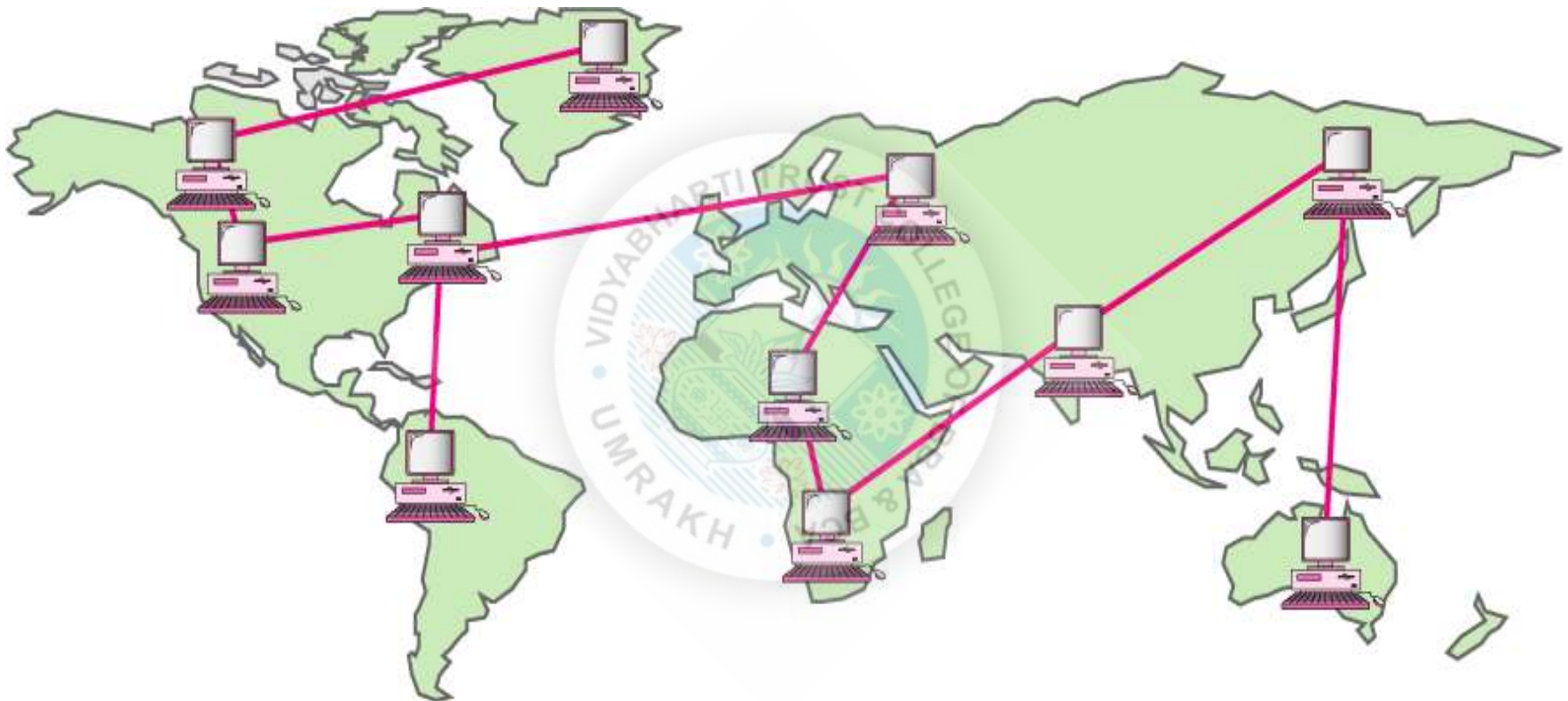
# Metropolitan Area Network

- A MAN often acts as a high speed network to allow sharing of regional resources.
- A MAN typically covers an area of between 1.5 and 50 km diameter.
- Metro Ethernet is a service which is provided by ISPs. This service enables its users to expand their Local Area Networks.
- For example, MAN can help an organization to connect all of its offices in a city.

# Wide Area Network

- Covers a wide geographical area that may comprise a country, continent or whole world.
- A WAN is two or more LANs connected together. The LANs can be many miles apart.
- Utilize public or private communication devices to span an unlimited number of miles.
- Connected by dedicated cabling or satellite links.
- LANs are interconnected using ROUTER to becomes WAN.

# Wide Area Network





# Wide Area Network

- WAN networks connect computers together over large physical distances and allowing them to communicate even when far apart.
- The Internet is a WAN, and connects computers all around the world together.
- WAN may use advanced technologies such as Asynchronous Transfer Mode (ATM), Frame Relay, and Synchronous Optical Network (SONET).
- WAN may be managed by multiple administration.

# Advantage And Disadvantages

- Provide long distance transmission
- Remotely Access data
- Costly
- Complex
- Slower than LAN



LAN	WAN
LANs cover less <b>distances</b>	WANs cover greater distances.
LAN <b>speeds</b> are more.	WAN speeds are slower.
LANs primarily use <b>private</b> network transports.	WANs can use public or private network transports
It is a group of computers in close proximity	The Internet is actually a specific type of WAN.
A LAN is always centralised	A WAN can be centralized or distributed. A centralized WAN consists of a central computer (at a central site) to which other computers and dumb terminals connect.
Easy to design and maintain	Difficult to design and maintain.
LAN is broadcasting in nature.	It is point to point in nature.
Transmission media is co-axial cable or UTP cable.	Communication media is satellite link or PSTN.

# PROF. AMIT PATEL

Parameter	LAN	MAN	WAN
Area Covered	Cover small area ie. Withing office or home.	Cover large geographical area than LAN but smaller than Wan	Cover large geographical area.
Error Rate	Lowest	Moderate	Highest
Transmission Speed	High	Moderate	Low
Media	Guided or Unguided	Guided or Unguided	Unguided
Equipment Cost	Low	Moderate	High

## Case Study - I

MoneyMaker is a bank having its registered office at Delhi. It has branches at Mumbai, Chennai, Hyderabad and Bangalore. The operating departments in the bank are Finance, Insurance, Loan, IT, Marketing, Customer Service and HR. MoneyMaker bank uses LAN as their computer network for each department. All the branches of the bank from different cities are connected through WAN. The bank is expanding and decided to open its branches at different locations in the city.

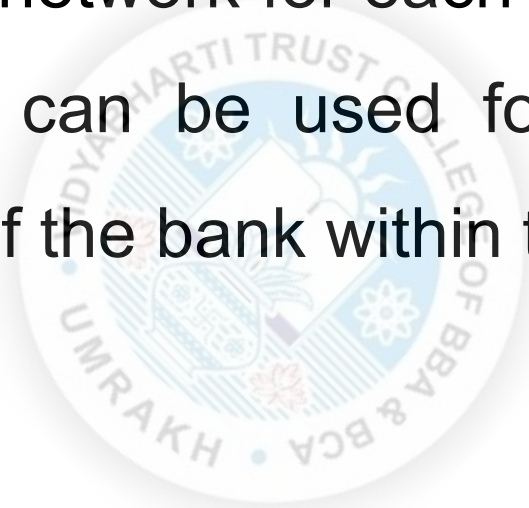
# Problem

Determine which type of network to be used within a city



## Suggested Solution

Use LAN computer network for each department in the new branch. MAN can be used for connecting the different branches of the bank within the city



## Internet Vs internet

- The Internet is a worldwide, publicly accessible series of interconnected computer networks transmit data using the standard Internet Protocol. It is a public network .
  - An internet is a private computer network that uses Internet protocols, network connectivity to securely share part of an organization's information or operations
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# Terminology Used In Network

- **Server** : A Server is a computer that provides services such as shared resources like data, software, peripherals to client computers.
- **Client** : Clients are the network computers which are used to access the shared resources of the network.
- **Node** : Node is a device like workstation, server or printer that can exchange information on the network.
- **Segment** : Segment is a part or group of large network that is linked by a connection devices like hub, switch.

## Continue....

- **Backbone** : Backbone is **link** between the different segments of the network.
- **Dedicated Server** : Dedicated server allow clients to access data, software and hardware resources. assigned to provide **specific application** or services for the network.
- **Bandwidth**: Describe **maximum** amount data can be sent over a specific connection in given amount of time.
- It is measured in the unit '**bits per second**' or bps. For example, bandwidth of Gigabit Ethernet is **1Gbps**.
- Used to describe speed of network.

## Continue....

- **Data Rate:** Data rate (or data transfer rate) is the amount of data being transferred through a connection within a second.
- Data rate cannot be higher than the bandwidth of the connection.
- Data rate is also measured in 'bits per second' or bps. Sometimes data rate is also called as bit rate
- Another term for data transfer rate is *throughput* or *Bit Rate*.

## Difference

- Bandwidth is the maximum amount of data that can travel through a 'channel'.
- Throughput is how much data actually does travel through the 'channel' successfully
- In communications, bandwidth is measured in Hz and it is measured in 'bps' (kbps, Mbps etc) for network connections. However data rate is only measured in 'bps'
- Data rate cannot be higher than the bandwidth of the network connection.

# Server Based Network

- Security and access permission to the client managed centrally.
- Allow network to centralize function.
- Consists of two elements, Client and Server
- Server:
  - ❑ A centralized computer which provides resources and peripherals to client.
  - ❑ Manages data, printers or network traffic

# Client

- **Definition:** A client is a piece of Computer Hardware or Software that accesses a service made available by a Server.
- Client **makes a request** or sending message to server.
- Client **must install a network interface card (NIC)** to talk on a network.
- Client may be laptop, desktop, smart cell phone, tablet, palmtop, or any software application etc.
- Rely on servers for Files, Devices, Processing power
- **Example:** E-mail client : An application that enables you to send and receive e-mail

# Server

- **Definition:** A server is a powerful computer that provides data or services to client computers.
- It may serve data to systems on a local area network (LAN) or a wide area network (WAN) over the Internet.
- Servers come in many shapes and sizes.
- They are a core component of the network, providing a link to resources necessary to perform any task.
- Clients rely on servers for
  - Resources, such as files, devices, and even processing power.

# Client-Server Network





## Continue....

- Network OS combine all components of the network and allow multiple user to share resources simultaneously.
- First server base solution
  - “NetWare” developed by Novell in 1985.
  - Novell Netware and Windows NT are Network OS.

# Hybrid Network

- A hybrid network is a network that contains two or more communications standards in one network design.
- An example of this is a network that combines wired and wireless technologies.
- A hybrid network can also refer to a network design that combines two or more types of basic physical topologies, such as multiple star topologies connected by a bus topology.

# Network Connection Type **OR** Transmission Technology

- The two different computer network connection types are
  - ❑ **Point-to-Point Connection**
  - ❑ **Multipoint Connection or Broadcasting**



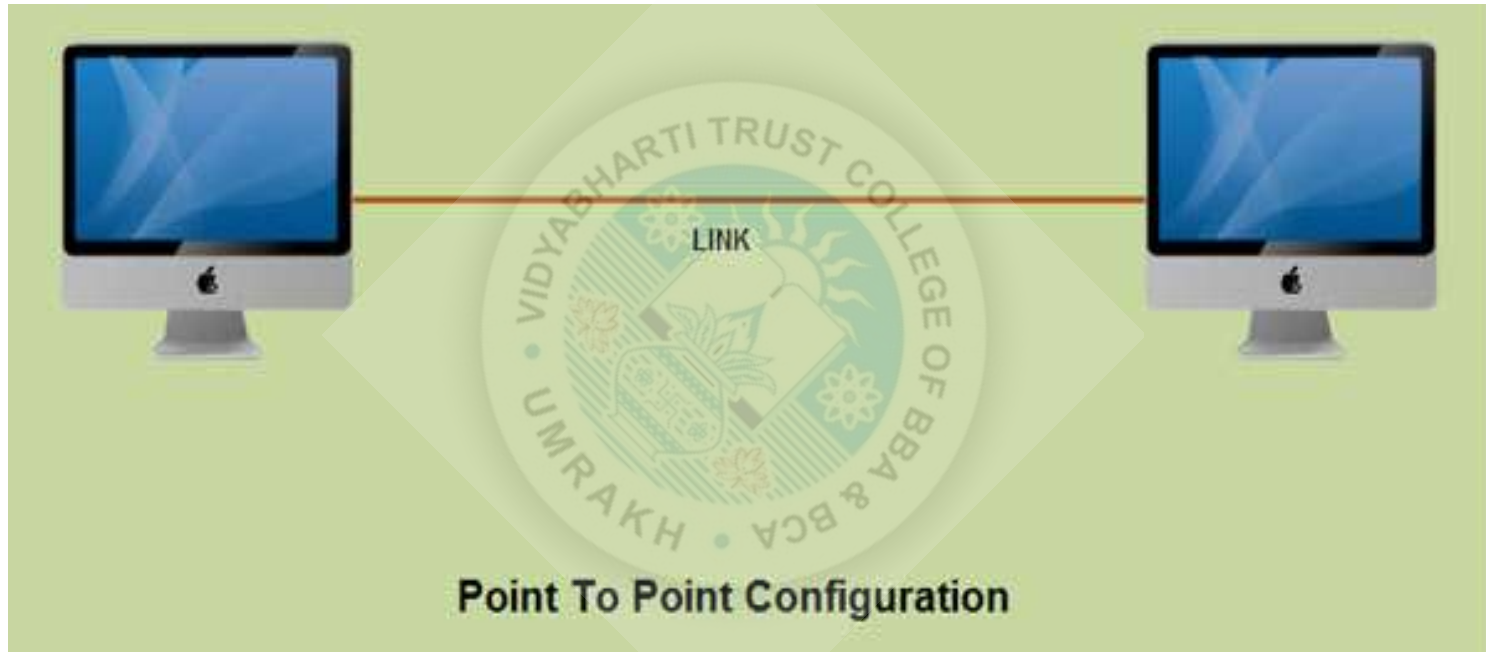
# Point To Point Connection

- A **point-to-point connection** is a direct link between two devices such as a computer and a printer.
- It uses dedicated link between the devices.
- The entire capacity of the link is used for the transmission between those two devices.
- It is store and forward network consist of several interconnected computers and networking devices.
- Most of today's point-to-point connections are associated with modems and PSTN (Public Switched Telephone Network) communications.

# Point To Point Connection

- Each packet has its own source and destination address.
- To go from source to destination, a packet on this type of network may first have to visit one or more intermediate devices or computer that are generally called “Router”
- Routing algorithm are used to find a path from the source to destination.
- Network located over wide geographical area (WAN) use point to point transmission.

## Continue..



# Multipoint OR Broadcast

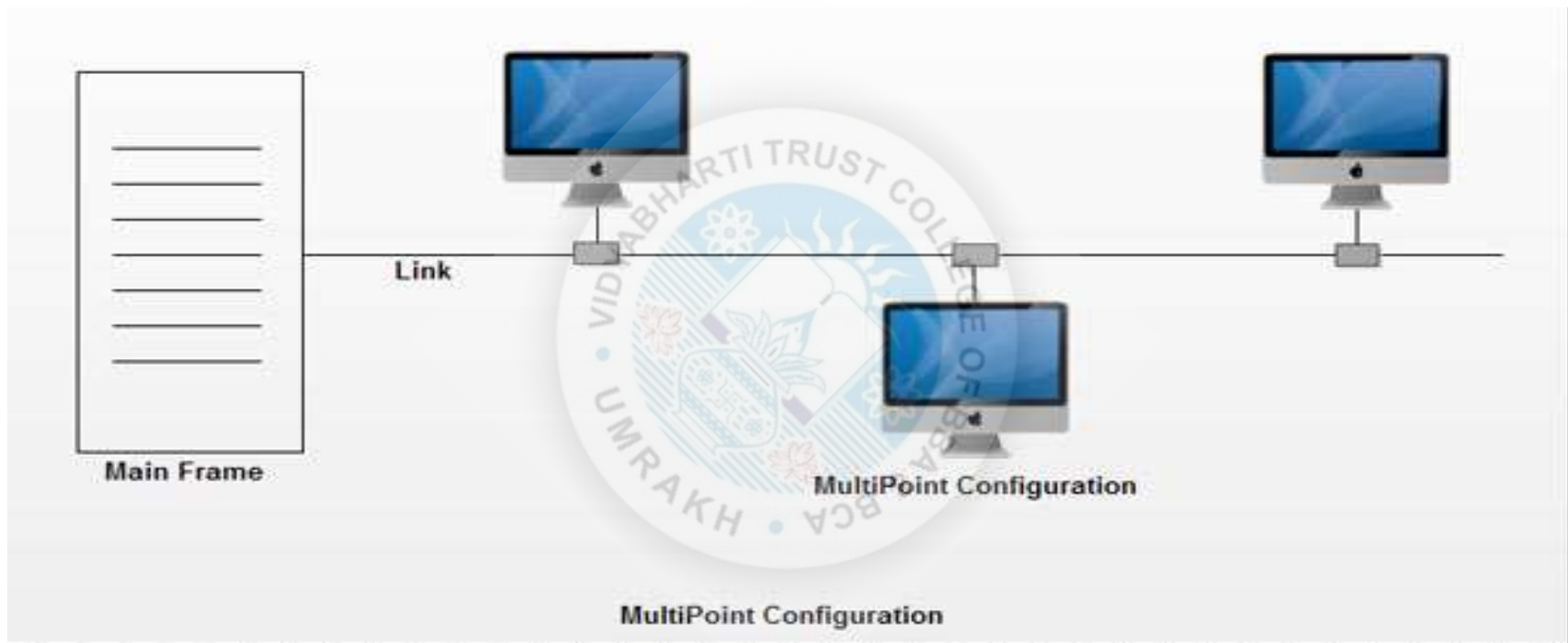
- It uses a single communication channel that is share by many station.
- It is also known as multipoint connection or multi drop configuration.
- The data is transmitted in small packed form.
- Each packet contain address field of the destination station.
- In broadcast network, a message or a packet sent by any machine is received by all other machines in a network.
- On receiving a packet, every computer check whether it is intended for it or not . If it is intended for it , it is proceed otherwise drop it.

# Multipoint OR Broadcast

- It is also possible to send same packet to all station within a network its known as broadcasting.
- Some broadcast systems also support transmission to a subset of the machines known as multicasting.
- Upon receiving a packet, a machine checks the address field. If the packet is addressed to it then the packet is processed, otherwise the packet is ignored.
- Small Localized Network (LAN) tend to use the broadcasting.

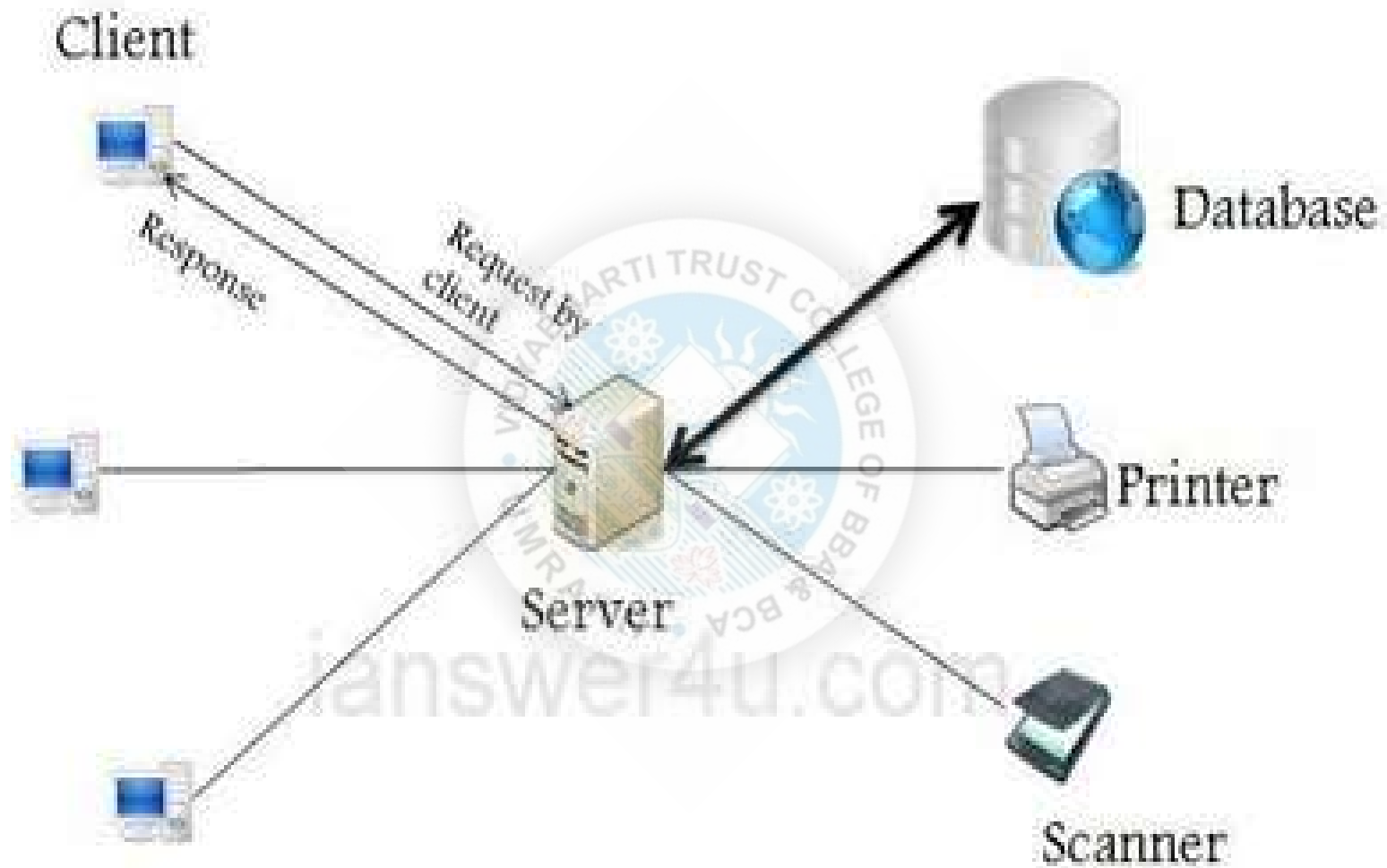


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## Client Server Architecture

- **Definition:** Client-server architecture can be considered as a **network environment** that exchanges information between a server machine and a client machine where server has some resources that can be shared by different clients.
- Architecture of a computer network in which many clients (remote processors) request and receive service from a centralized server (host computer).
- In a client server network divide processing tasks between clients and servers.



## Continue...

- In such networks, there exists a central controller called server. A server is a specialized computer that controls the network resources and provides services to other computers in the network.
  - All other computers in the network are called clients. A client computer receives the requested services from a server.
  - A server performs all the major operations like security and network management.
  - All the clients communicate with each other via centralized server
  - If client 1 wants to send data to client 2, it first sends request to server to seek permission for it. The server then sends a signal to client 1 allowing it to initiate the communication.
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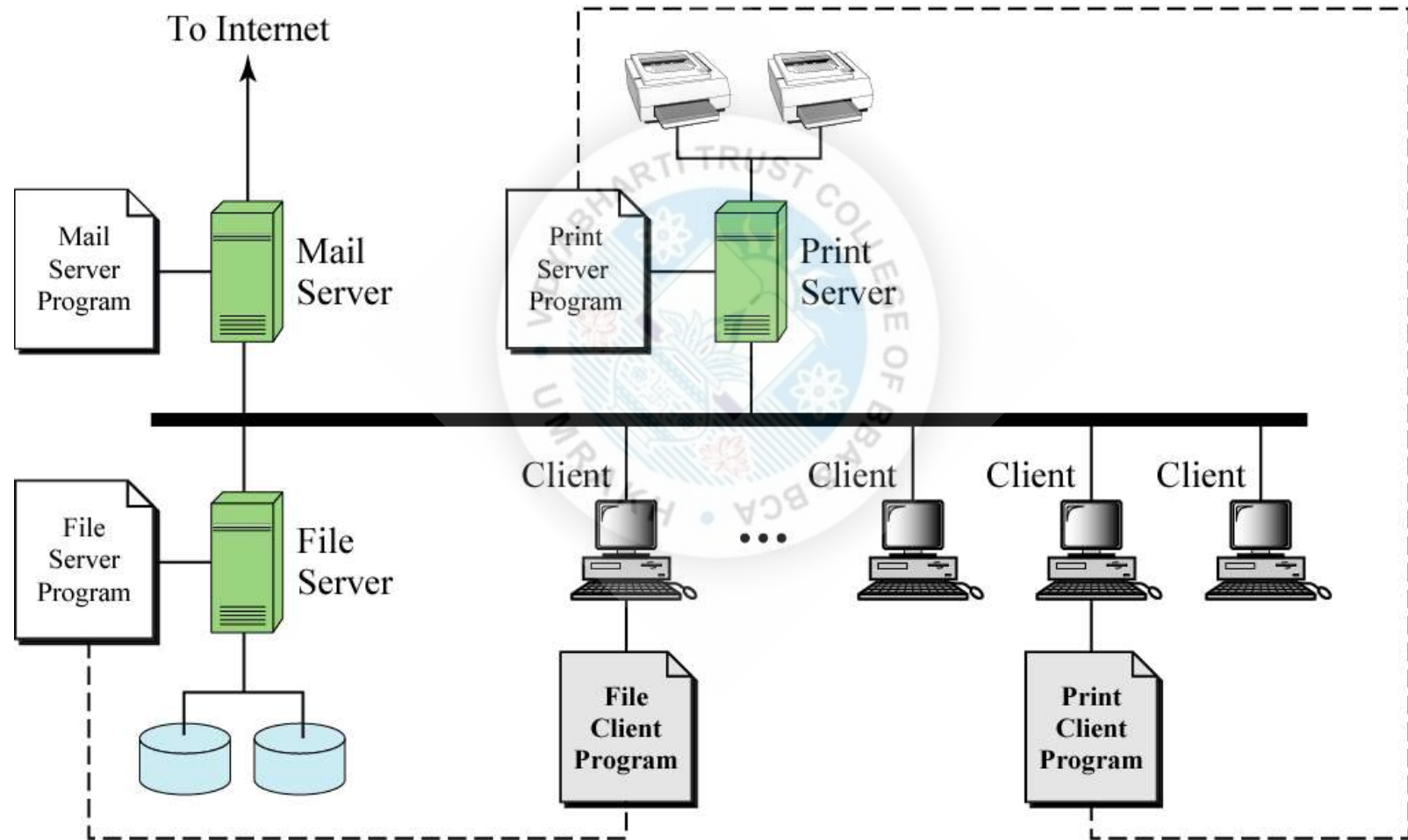
## Continue...

- A server is also responsible for managing all the network resources such as files, directories, applications & shared devices like printer etc.
- If any of the clients wants to access these services, it first seeks permission from the server by sending a request.
- Most Local Area Networks are based on client server relationship.
- Recommended for network requiring a high degree of reliability.

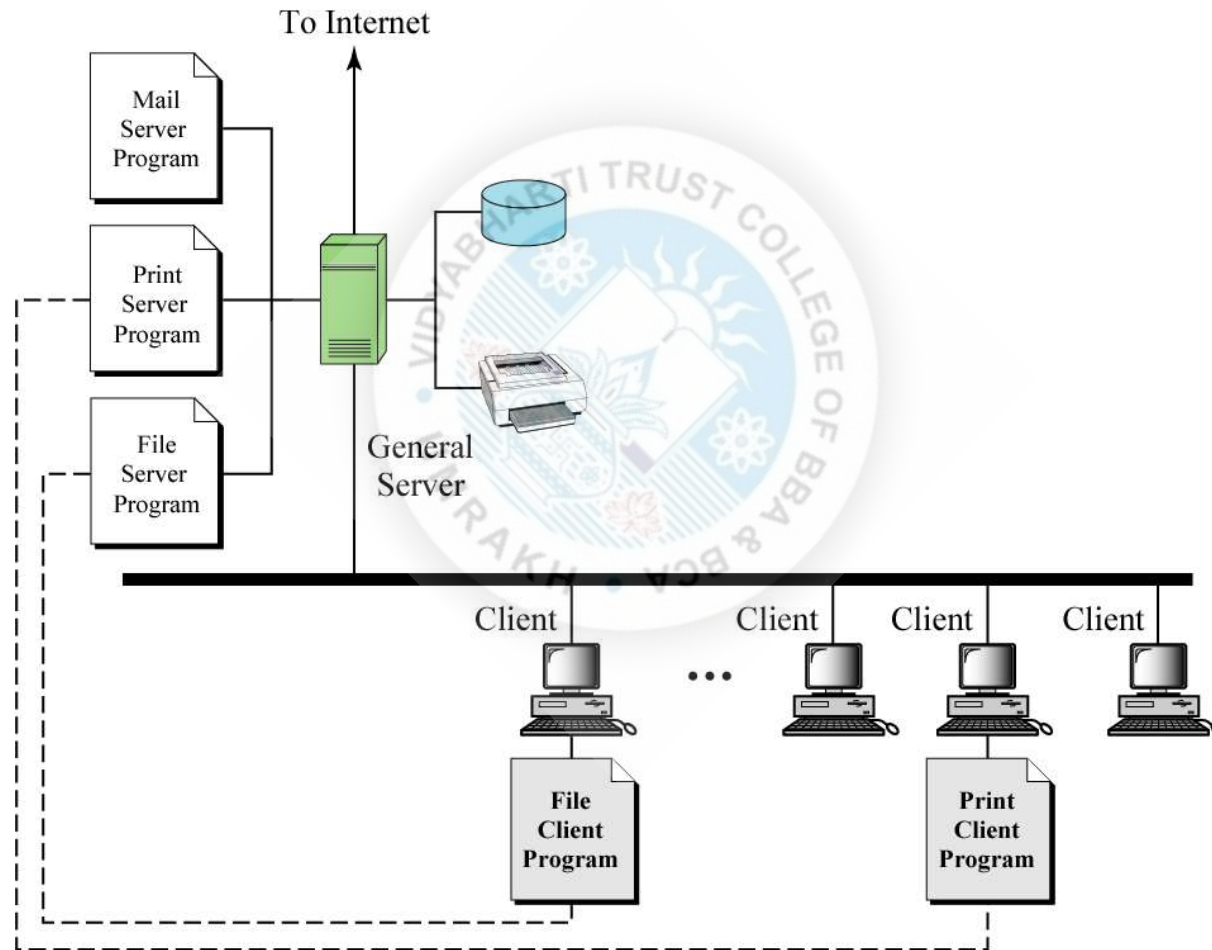
# Component Of Client Server Model

- Clients or Workstations.
- Servers.
- **Network Devices** :- They connect the clients and servers, and at the same time ensure proper collision free routing of information.
- Other components like scanner, printer,

# Client-Server Network With Dedicated Server



# Client Server Network With General Server





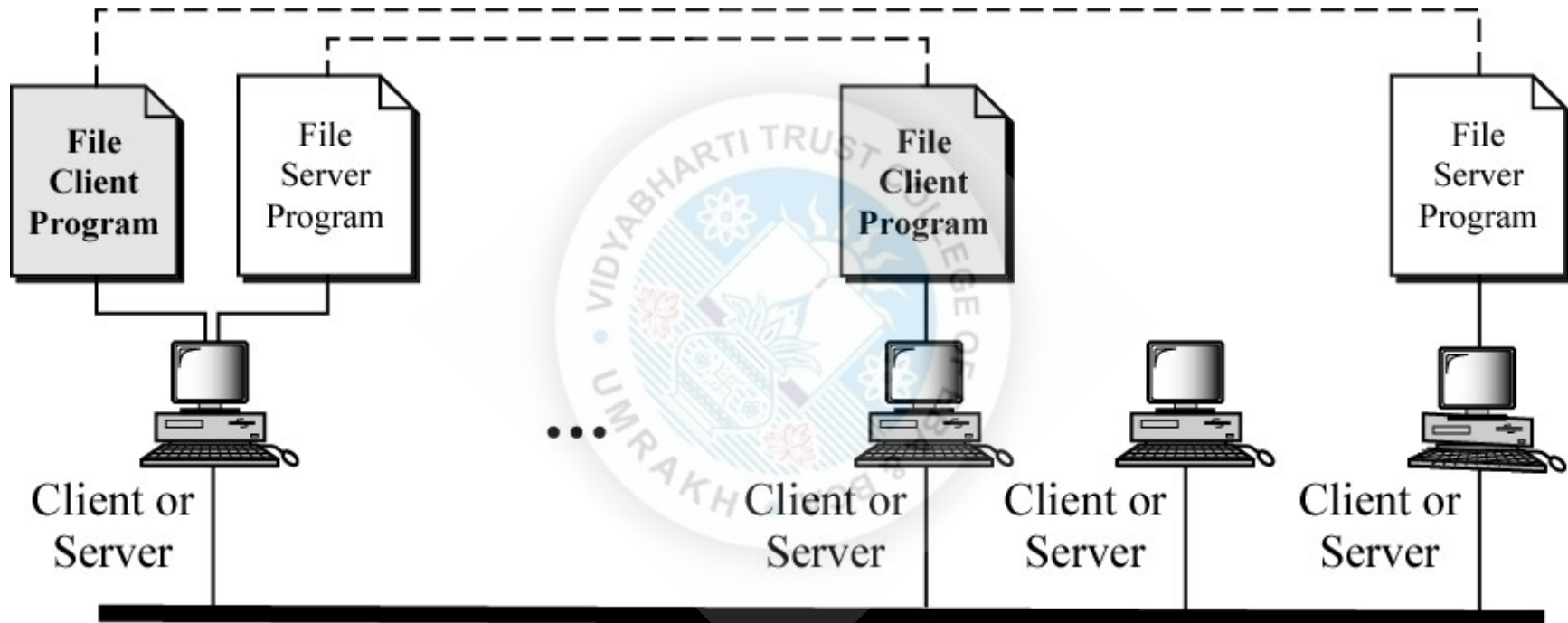
# Advantages

- **Performance:** Support multiple clients simultaneously and providing fast response.
- **Security :** Provide high level security to user's data.
- **Administration:** Resources and user can be centrally controlled.
- **Flexibility :** Easily integrate new technology.
- **Interpretability :** All component work together.
- **Scalability :** Resources should be added easily.

# Disadvantages

- **Cost** : System is expensive because of the higher system requirement.
- **Complexity** : Experience network administrator require to maintain and manage security and resources.
- **Dependence** : All operation cease when server goes down.

# PEER TO PEER NETWORK



## Continue...

- Each computer on network shares its hardware and software with all other computers on the network.
- No server, so costs are low and installation is simple
- All computers and users have equal authority and rights
- Little protection of one workstation against another
- Used at home or in small organisations with trusted users
- Allows sharing of files, internet connection, printer

# Advantages

- **Cost** : cheaper than server network. Provide cost effective way for networking upto 10 PC.
- **Small Network** : ideal for small network.



## Disadvantage

- **Performance** : Performance is affected as all of the machine are of lower configuration than dedicated server.
- **Security** : Security available in server based network is not available here.
- **Decentralized** : No central repository.
- **Scalability** : Can not be used for network that span long distance.

# Peer To Peer Vs Client-Server

Peer-to-Peer Networks	Client/Server Networks
Each PC is an equal participant on the network	One PC acts as the network controller
PCs are not reliant on one PC for resources such as the printer	One PC controls access to network resources
Access to the network is not centrally controlled	Network access and security are centrally controlled
Can operate on a basic PC operating system	Need a special operating system
Are generally simpler and lower cost	Are generally more complex but give the user more control

## Various Servers

- **Print Server** : accepts print jobs over the network faster than a printer; workstation gets on with other tasks while printing is done
- **Database Server** : hold d/bases and allows them to be used by many users
- **Web Server** : connected to internet and serve webpages to viewers
- **DHCP** : hand out the node number to each device



## Data Flow

- Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.
- Data flow between two devices can be

Simplex

Half Duplex

Full Duplex



# Simplex



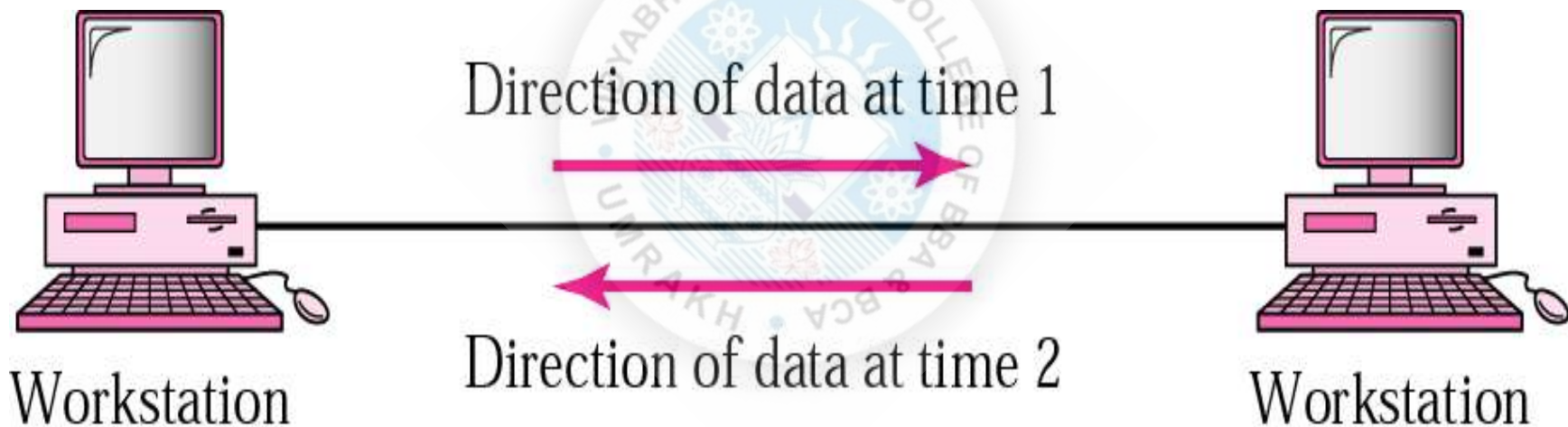
# Simplex

- The communication is unidirectional, as on a one-way street.
- Only one of the two devices on a link can transmit; the other can only receive.
- The simplex mode can use the entire capacity of the channel to send data in one direction.
- **Example:** TV, Keyboard, radio

# Half Duplex

**Each station can both transmit and receive, but not at the same time.**

**When one device is sending, the other can only receive, and vice versa**



# Half Duplex

- The half-duplex mode is like a one-lane road with traffic allowed in both directions.
- The half-duplex mode is used in cases where there is no need for communication in both directions at the same time.
- The entire capacity of the channel can be utilized for each direction
- **Example:** Walkie-talkies

# Full Duplex

**In full-duplex mode (also called duplex), both stations can transmit and receive simultaneously.**



## Full Duplex

- The full-duplex mode is like a Two-way street with traffic flowing in both directions at the same time.
- In full-duplex mode, signals going in one direction share the capacity of the link: with signals going in the other direction.
- **Example:** Telephone communication



# NETWORK COMPONENT

- Computers
- NIC ( Network Interface Card)
- Transmission Media
- Connecting Devices.
- Protocol.





# How Conventional Network Work?

1. Suppose **computer A wants to send** a message to **B**.
2. Computer A sends the message **to its NIC**.
3. The NIC **translates** the message into electrical **pulses** suitable for the computer network in use & **transmits it to the network connecting device** through the cable.

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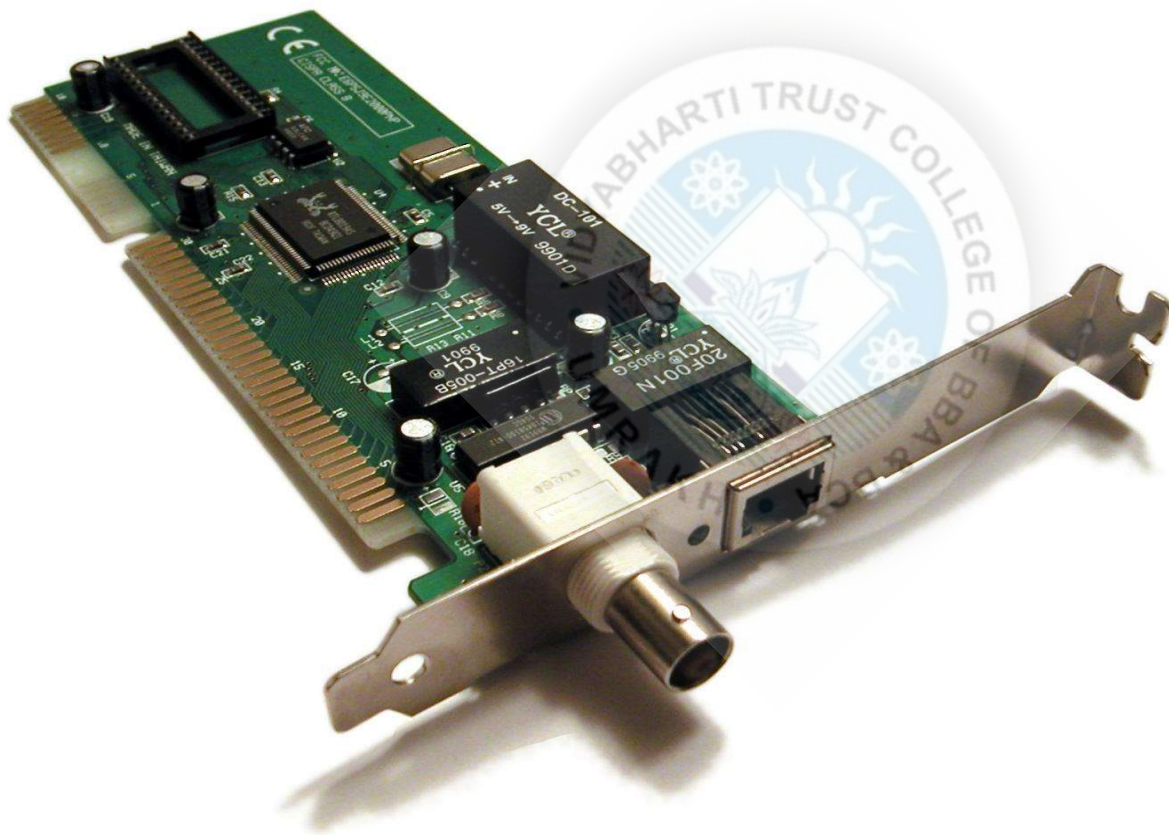
4. The **connecting device receives** them and **forwards** them to computer connected to it.
5. The **NICs of** computer **receive** the forwarded electrical pulses.
6. The **NIC of computer D decides** that the message is for it, & **translates** the pulses back to a form suitable for the computer.

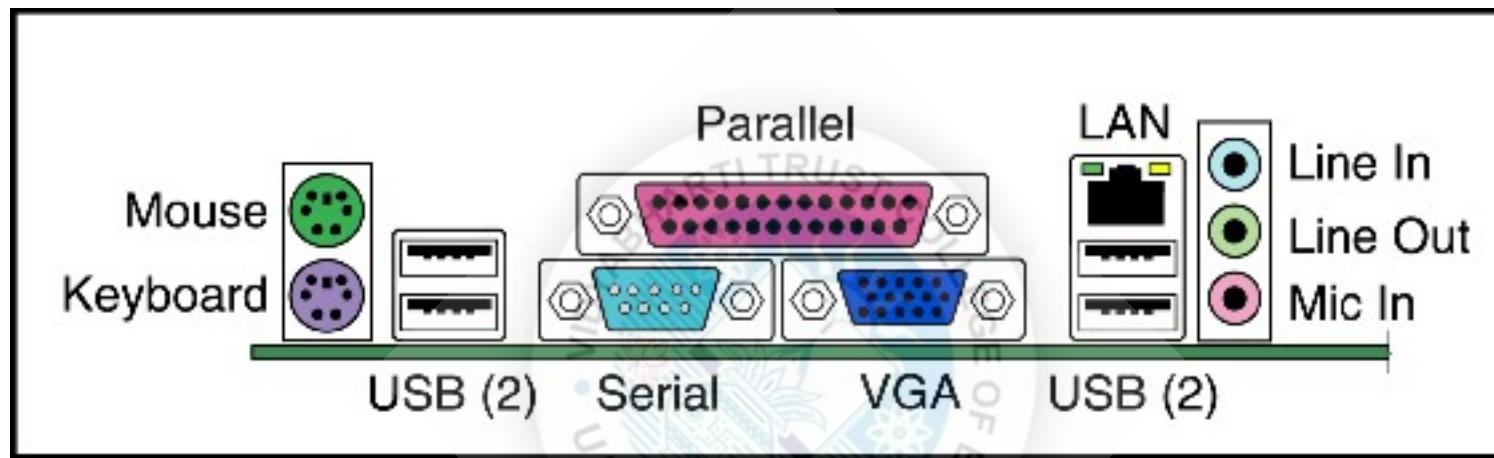
# NIC ( Network Interface Card)

- Component which is responsible for physically connecting the computer to the transmission media.
- Responsible for moving data from the computer to the network and vice versa.
- Manage the communication and network protocol for pc.
- Support Ethernet, token ring and FDDI
- Also Known as **Network card** or **Transceiver**.

## Continue...

**Combi Card :** NIC With number of different connectors





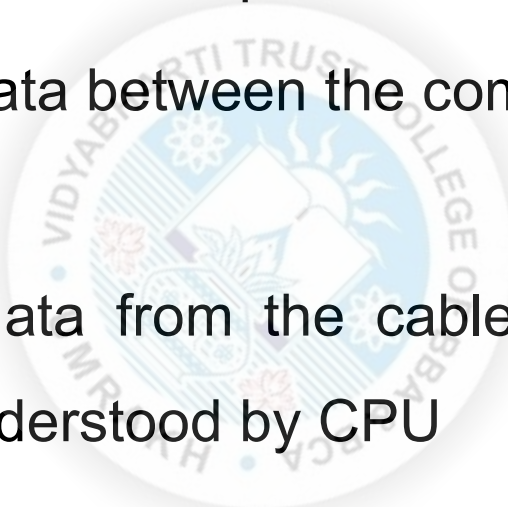
# NIC Components

- **Expansion bus connector** : Act as connection medium to system (mother) board
- **Media Connector** : Connection medium to transmission medium.
- **Buffer** : Used to store data before processing so that NIC can handle bottleneck on network.
- **Transceiver** : Responsible for converting the sent and received data

## Function of NIC

- To transmit and receive data to and from the network.
- Follow below step when it send data on network.
  - ❑ The system send data in parallel format to the NIC through system expansion bus.
  - ❑ NIC place data in buffer, where it can be stored if NIC cannot process data quickly.
  - ❑ Transceiver convert the format of the data signal from parallel format to serial format so that it can be sent over the network.
  - ❑ Media connector which physically join the network card to the transmission media, send the data on to the network.

## Role of NIC

- Prepare data from the computer for the network cable.
  - Send the data to another computer.
  - Control the flow of data between the computer and the cabling system.
  - Receive incoming data from the cable and translate it into bytes that can be understood by CPU
- 



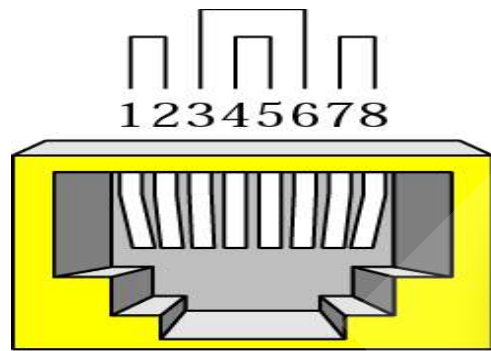
# Physical Connection

- Physical Connections
    - ❑ NIC either connected on a PCI slot
    - ❑ NIC cards can be connected to an USB port or can have a PC card connection
  - Depends on one of the cable connectors:
    - ❑ BNC connector
    - ❑ ST-fiber optic connector
    - ❑ RJ-45 connector
-

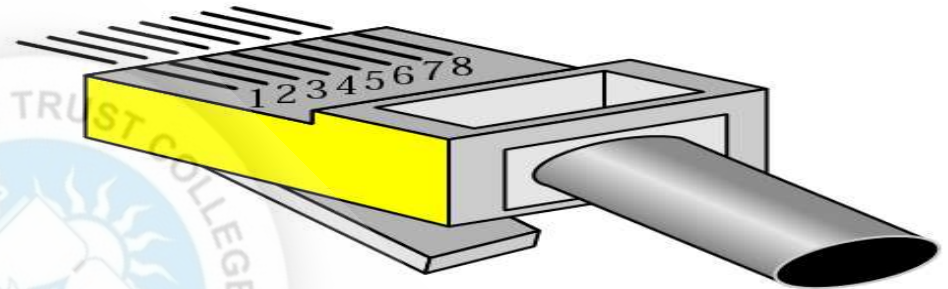
## Lights on NIC

- one green and one orange LED that indicate link status, activity, and link speed.

Name	Color	Description
LED 1	Green	<b>ON:</b> NIC Linked <b>Blinking :</b> Activity <b>Off:</b> No Linked
LED 2	Orange	<b>ON:</b> Speed 1 Gbps <b>Blinking :</b> Speed 100 Mbps <b>Off:</b> Speed 10 Mbps



RJ-45 Female



RJ-45 Male

# MAC (Media Access Control) Address

- NIC have **unique** hardware or physical address or Ethernet Address.
  - It is **48 bit address** display as 12 digit hexadecimal address.
  - Assigned by the **manufacturer of a NIC**.
  - **Stored in its hardware, such as the card's ROM** or some other firmware.
  - Used by NIC to address data to other NIC and recognize data sent for it.
-

# MAC Address

- Also known as hardware or physical address
  - Used to identify nodes at lower levels of the OSI model
  - ID assigned by IEEE
  - Hardware address hard-coded into NIC
  - Nodes on network identified by MAC address
  - Is a 12 digit hexadecimal number (48 bit address)
  - Work at **Data Link Layer**.
  - It is Fix, It can not be changed.
-

## MAC Address....

- For Example : 00:A0:C9:14:C8:29

First half of MAC Address contain the ID number of the adapter manufacturer. These IDs are regulated by an Internet standards body.

Here: **00:A0:C9** ----- indicate the manufacture is **intel corporation**.

Second half of MAC Address represents the serial number assigned to the adapter by the manufacturer.

<http://www.miniwebtool.com/mac-address-lookup/?s=90-fb-a6-36-2f-9c>

To select the appropriate NIC for your network, you first need to determine the type of cabling and cabling connectors it will have.

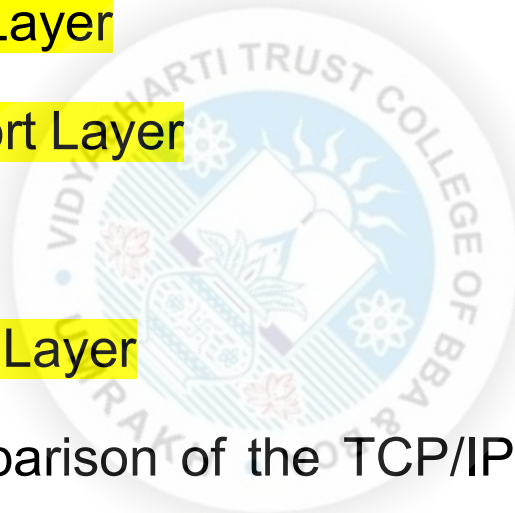
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## TCP / IP Model

- The OSI Model we just looked at is just a reference/logical model.
  - It was designed to describe the functions of the communication system by dividing the communication procedure into smaller and simpler components.
  - But when we talk about the TCP/IP model, it was designed and developed by Department of Defense (DoD) in 1960s and is based on standard protocols.
  - It stands for Transmission Control Protocol/Internet Protocol.
  - The TCP/IP model is a concise version of the OSI model.
-

# TCP / IP Model

- It contains four layers, unlike seven layers in the OSI model. The layers are:
  - ❑ Process/Application Layer
  - ❑ Host-to-Host/Transport Layer
  - ❑ Internet Layer
  - ❑ Network Access/Link Layer
- The diagrammatic comparison of the TCP/IP and OSI model is as follows :





# TCP / IP Model

TCP/IP MODEL
Application Layer
Transport Layer
Internet Layer
Network Access Layer

OSI MODEL
Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer

**TCP/IP**

**OSI**

TCP refers to Transmission Control Protocol/ internet protocol .

OSI refers to Open Systems Interconnection.

TCP/IP has 4 layers.

OSI has 7 layers.

TCP/IP is more reliable

OSI is less reliable

TCP/IP does not have very strict boundaries.

OSI has strict boundaries

TCP/IP follow a horizontal approach.

OSI follows a vertical approach.

TCP/IP uses both session and presentation layer in the application layer itself.

OSI uses different session and presentation layers.

**TCP/IP**

**OSI**

TCP/IP developed protocols then model.

OSI developed model then protocol.

Transport layer in TCP/IP does not provide assurance delivery of packets.

In OSI model, transport layer provides assurance delivery of packets.

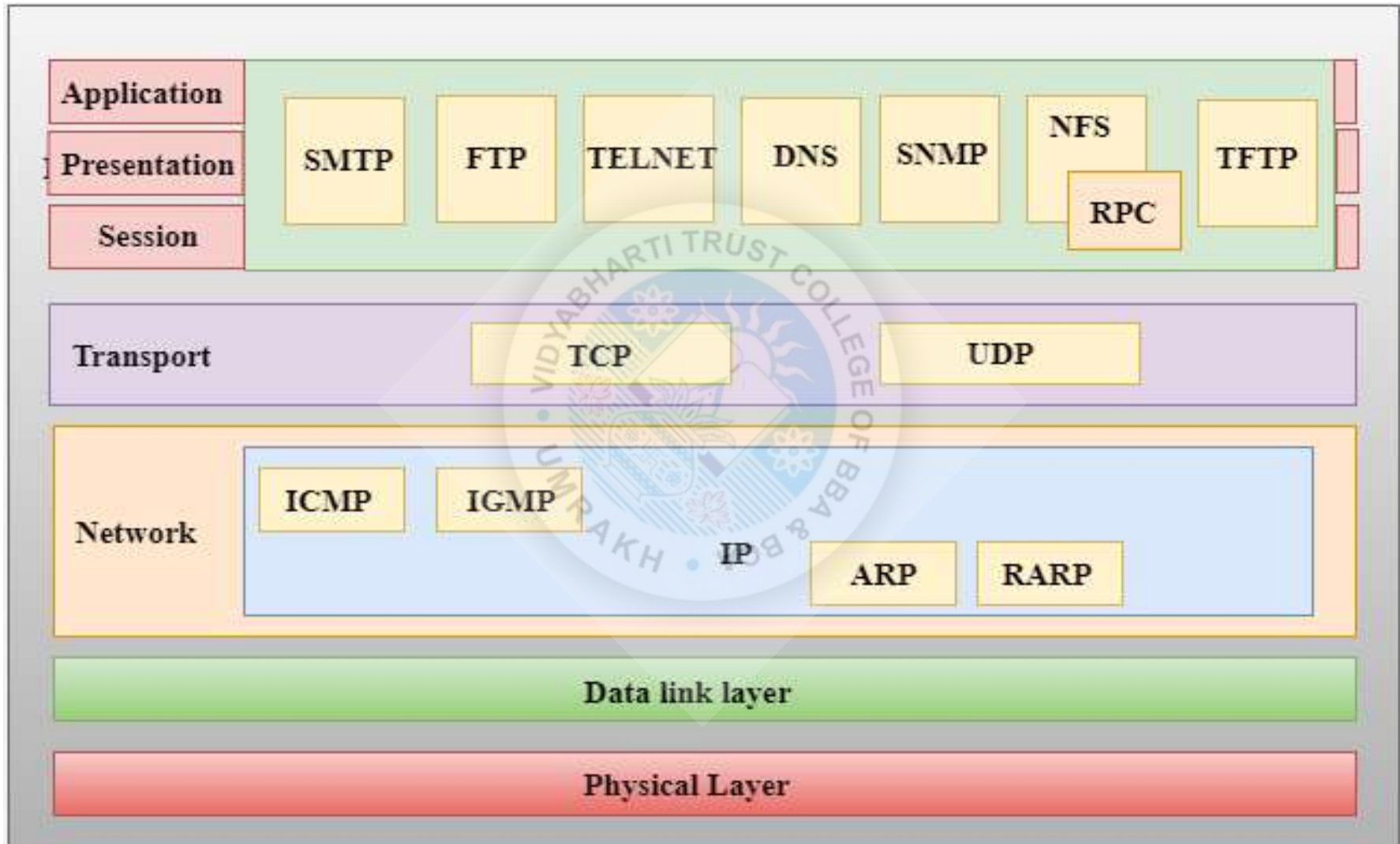
TCP/IP model network layer only provides connection less services.

Connection less and connection oriented both services are provided by network layer in OSI model.

Protocols cannot be replaced easily in TCP/IP model.

While in OSI model, Protocols are better covered and is easy to replace with the change in technology.

# Function of TCP / IP Model



## Network Access Layer

- A network layer is the lowest layer of the TCP/IP model.
  - A network layer is the combination of the Physical layer and Data Link layer defined in the OSI reference model.
  - It defines how the data should be sent physically through the network.
  - This layer is mainly responsible for the transmission of the data between two devices on the same network.
  - The functions carried out by this layer are encapsulating the IP datagram into frames transmitted by the network and mapping of IP addresses into physical addresses.
  - **Protocols used :** ethernet, token ring, FDDI, X.25, frame relay.
-

## Internet Layer

- An internet layer is a **second layer** of TCP/IP layers of the TCP/IP model.
  - It is also known as a **network layer**.
  - The main work of this layer is **to send the packets from any network, and any computer still they reach the destination** irrespective of the route they take.
  - **Message delivery at the network layer does not give any guaranteed** to be reliable network layer protocol.
  - Layer-management protocols that belong to the network layer are:
    - ❑ Routing protocols
    - ❑ Multicast group management
- 
- ❑ Network-layer address assignment.

## Internet Layer

- The main responsibility of the internet layer is to send the packets from any network, and they arrive at the destination irrespective of the route they take.

Following are the protocols used in this layer are:

- IP, ARP, RARP, ICMP, IGMP



## Internet Layer : IP Protocol Responsibility

- **IP Addressing:** This protocol implements logical host addresses known as IP addresses. The IP addresses are used by the internet and higher layers to identify the device and to provide internetwork routing.
- **Host-to-host communication:** It determines the path through which the data is to be transmitted.
- **Data Encapsulation and Formatting:** An IP protocol accepts the data from the transport layer protocol. An IP protocol ensures that the data is sent and received securely, it encapsulates the data into message known as IP datagram.



## Internet Layer : IP Protocol Responsibility

- **Fragmentation and Reassembly:** The limit imposed on the size of the IP datagram by data link layer protocol is known as Maximum Transmission unit (MTU). If the size of IP datagram is greater than the MTU unit, then the IP protocol splits the datagram into smaller units so that they can travel over the local network. Fragmentation can be done by the sender or intermediate router. At the receiver side, all the fragments are reassembled to form an original message.
- **Routing:** When IP datagram is sent over the same local network such as LAN, MAN, WAN, it is known as direct delivery. When source and destination are on the distant network, then the IP datagram is sent indirectly. This can be accomplished by routing the IP datagram through various devices such as routers.

## Internet Layer : ARP

- ARP stands for Address Resolution Protocol.
- Used to find the physical address from the IP address.

The two terms are mainly associated with the ARP Protocol:

- **ARP request:** When a sender wants to know the physical address of the device, it broadcasts the ARP request to the network.
  - **ARP reply:** Every device attached to the network will accept the ARP request and process the request, but only recipient recognize the IP address and sends back its physical address in the form of ARP reply. The recipient adds the physical address both to its cache memory and to the datagram header
-

## Transport Layer

- Transport layer builds on the network layer in order to provide data transport from a process on a source system machine to a process on a destination system.
  - It is hosted using single or multiple networks, and also maintains the quality of service functions.
  - It determines how much data should be sent where and at what rate.
  - This layer builds on the message which are received from the application layer.
  - It helps ensure that data units are delivered error-free and in sequence.
  - Transport layer helps you to control the reliability of a link through flow control, error control, and segmentation or de-segmentation.
-

## Transport Layer

- The transport layer also offers an acknowledgment of the successful data transmission and sends the next data in case no errors occurred.
- **Protocol Used :** TCP , UDP

### Important functions of Transport Layers:

- It divides the message received from the session layer into segments and numbers them to make a sequence.
  - Transport layer makes sure that the message is delivered to the correct process on the destination machine.
  - It also makes sure that the entire message arrives without any error else it should be retransmitted.
-

## Application Layer

- Application layer interacts with an application program, which is the highest level of OSI model.
  - The application layer is the OSI layer, which is closest to the end-user.
  - It means the OSI application layer allows users to interact with other software application.
  - Application layer interacts with software applications to implement a communicating component.
  - The interpretation of data by the application program is always outside the scope of the OSI model.
  - **Example of the application layer application:** file transfer, email, remote login, etc.
-

## Application Layer

Function of the Application Layers are:

- Application-layer helps you to identify communication partners, determining resource availability, and synchronizing communication.
  - It allows users to log on to a remote host
  - This layer provides various e-mail services
  - This application offers distributed database sources and access for global information about various objects and services.
-