

## Unit – 1 Introduction to Network

### 1.1 Basics of Network

#### 1.1.1 Types of networks

#### 1.1.2 Different Topologies [Bus, Star, Ring, Mesh, Tree]

### 1.2 Types of networks [LAN, MAN, WAN]

### 1.3 Terminologies [Intranet, Internet, Unicast, Broadcast, Multicast]

## 1.1 Basic of Network

### What is networking?

- In the world of computers, **networking** is the practice of linking two or more computing devices together for the purpose of sharing data/resources.
- Networks are built with a mix of computer hardware and computer software.

### The requirement of Networking / Advantages / Need of Networking

Most of the benefits of networking can be divided into two generic categories: **connectivity and sharing**. They also allow for the easy sharing of information and resources, and cooperation between the devices in other ways.

#### Connectivity and Communication

#### Data Sharing

#### Intranets and extranets

#### Hardware Sharing

#### Internet Access Sharing

#### Data Security and Management

#### Performance Enhancement and Balancing

#### Entertainment

## Disadvantages of Networking

- Purchasing the network cabling and file servers can be expensive.
- Managing a large network is complicated, requires training and a network manager usually needs to be employed.
- If the file server breaks down the files on the file server become inaccessible. Email might still work if it is on a separate server. The computers can still be used but are isolated.
- **Viruses** can spread to other computers throughout a computer network.
- There is a danger of **hacking**, particularly with wide area networks.

## Network Types based on their Role

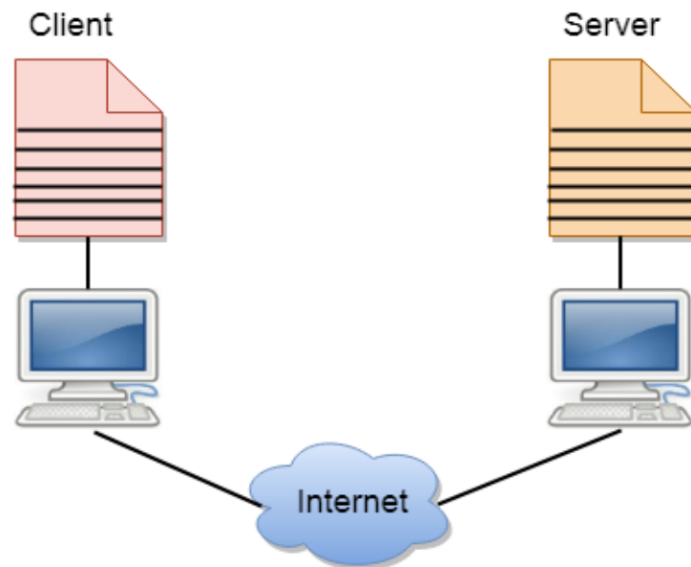
Based on the roles of the computers attached to them, networks are divided into three types:

- **Server-based** (also called client-server), containing clients and the servers that support them.
- **Peer** (also called-peer-to-peer), which have no servers and use the net-work to share resources among independent peers.
- **Hybrid network**, which is a client-server network that also has peers sharing resources. Most networks are actually hybrid networks.

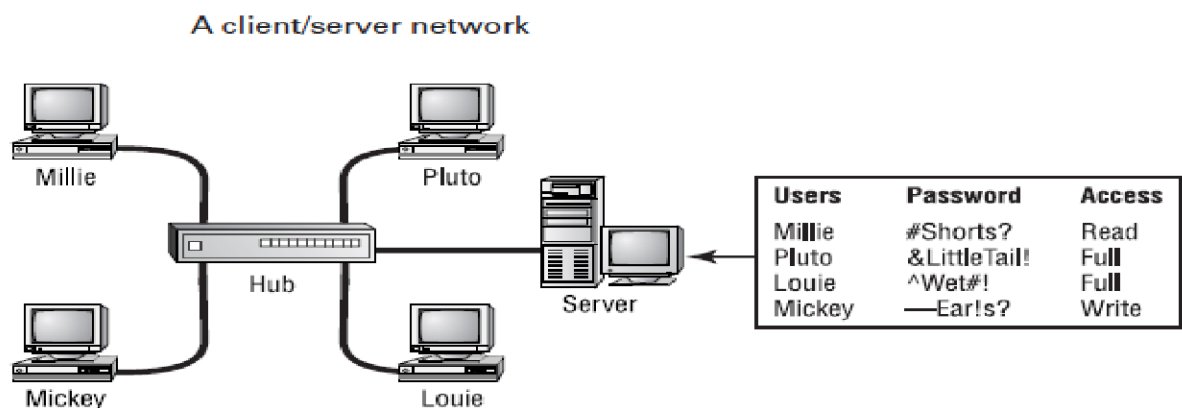
## Client – Server Network Model

- **Client**
  - A client is a program that runs on the local machine requesting service from the server.
  - A client program is a finite program means that the service started by the user and terminates when the service is completed.
- **Server**
  - A server is a program that runs on the remote machine providing services to the clients. When the client requests for a service, then the server opens the door for the incoming requests, but it never initiates the service.

- A server program is an infinite program means that when it starts, it runs infinitely unless the problem arises. The server waits for the incoming requests from the clients. When the request arrives at the server, then it responds to the request.



- A client and server networking model is a model in which computers such as servers provide the network services to the other computers such as clients to perform a user based tasks. This model is known as client-server networking model.
- The application programs using the client-server model should follow the given below strategies:



- An application program is known as a client program, running on the local machine that requests for a service from an application program known as a server program, running on the remote machine.
- A client program runs only when it requests for a service from the server while the server program runs all time as it does not know when its service is required.

- A server provides a service for many clients not just for a single client. Therefore, we can say that client-server follows the many-to-one relationship. Many clients can use the service of one server.
- Services are required frequently, and many users have a specific client-server application program.
- For example, the client-server application program allows the user to access the files, send e-mail, and so on. If the services are more customized, then we should have one generic application program that allows the user to access the services available on the remote computer.

### **Advantages of Client-server networks:**

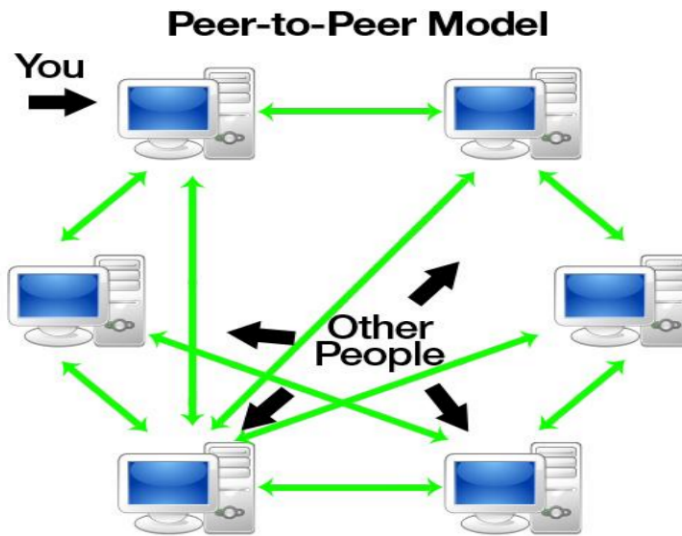
- **Centralized:** Centralized back-up is possible in client-server networks, i.e., all the data is stored in a server.
- **Security:** These networks are more secure as all the shared resources are centrally administered.
- **Performance:** The use of the dedicated server increases the speed of sharing resources. This increases the performance of the overall system.
- **Scalability:** We can increase the number of clients and servers separately, i.e., the new element can be added, or we can add a new node in a network at any time.

### **Disadvantages of Client-Server network:**

- **Traffic Congestion** is a big problem in Client/Server networks. When a large number of clients send requests to the same server may cause the problem of Traffic congestion.
- It does not have a robustness of a network, i.e., when the server is down, then the client requests cannot be met.

### **Peer-to-Peer Network**

- **The Peer-to-Peer network is also called P2P or computer-to-computer network.**
- 'Peers' are the nodes or computer system which is connected to each other. In this kind of network, each node is connected to each other node in the network.
- The nodes can share printers or CDROM drives, and allow other devices to read or write to its hard disk, allowing sharing of files, access to its internet connection, and other resources.
- Files or resources can be shared directly between the systems on the network, without the need of any central server.



- Such kind of network, where we allow nodes to become a server and share things in this manner, can be referred to as a peer-to-peer network.
- In a peer-to-peer network, each node can work as either a server as well as a client. This network does not distinguish between the client or server. Each of the nodes can act as both client/server depending on whether the node is requesting or providing the service. All the nodes are functionally equal and can send or receive data directly with one another.

### **Advantages of using a peer-to-peer network:**

- Easy to implement and manage.
- Nodes or workstations are independent of one another. Also, no access permissions are needed.
- The network is reliable in nature. If a peer fails, it will not affect the working of others.
- There is no need for any professional software in such kind of networks.
- The cost of implementation of such networks is very less.

### **Disadvantages of using a peer-to-peer network**

- Storage is decentralized, and also not so efficiently managed.
- No data backup options are available in peer-to-peer networks.
- These kinds of networks are not so secure.

## **Hybrid Network**

- Hybrid networks are the networks that are based on both peer-to-peer & client-server relationship.
- Hybrid networks incorporate the best features of workgroups in peer-to-peer networks with the performance, security and reliability of server-based networks.
- Hybrid networks still provide all of the centralized services of servers, but they also allow users to share and manage their own resources within the workgroup.

### **Advantages of Hybrid Network**

- Client Server application are still centrally located and managed.
- Users can assign local access to resources in their computers.

### **Disadvantages of Hybrid Network**

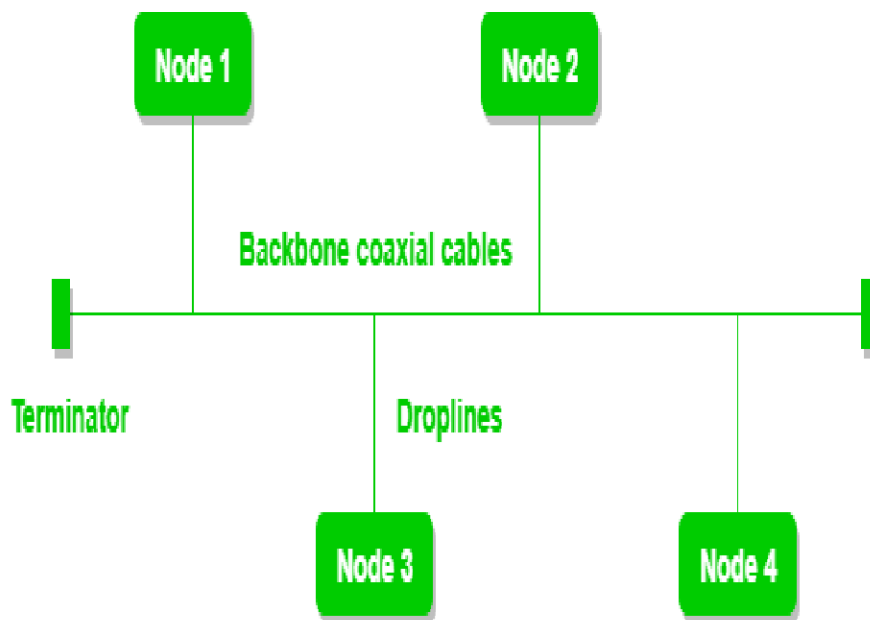
- Users may need to remember multiple passwords.
- Files can be duplicated and changes overwritten between the computers with the shared folder and the Server.
- Files saved on the workstation are not backed up.

### **1.1.1 Different Topologies**

- The arrangement of a network which comprises of nodes and connecting lines via sender and receiver is referred as network topology.
- A topology is basically a map of a network.
- The physical topology of a network describes the layout of the cables and workstations and the location of all network components.
- The various network topologies are :
  - **Bus Topology**
  - **Star Topology**
  - **Ring Topology**
  - **Mesh Topology**
  - **Tree Topology**

## Bus Topology

- In bus topology there is a main cable and all the devices are connected to this main cable through drop lines.
- There is a device called tap that connects the drop line to the main cable. Since all the data is transmitted over the main cable, there is a limit of drop lines and the distance a main cable can have.
- It transmits the data from one end to another in single direction.
- No bi-directional feature is in bus topology.
- A bus topology with shared backbone cable. The nodes are connected to the channel via drop lines.



### Advantages of bus topology

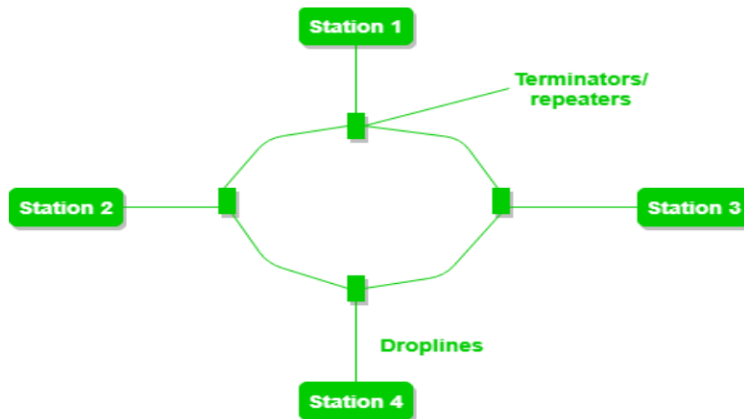
- Easy installation, each cable needs to be connected with backbone cable.
- Less cables required than Mesh and star topology

### Disadvantages of bus topology

- Difficulty in fault detection.
- Not scalable as there is a limit of how many nodes you can connect with backbone cable.

## Ring Topology

- In ring topology each device is connected with the two devices on either side of it.
- There are two dedicated point to point links a device has with the devices on the either side of it.
- This structure forms a ring thus it is known as ring topology. If a device wants to send data to another device then it sends the data in one direction, each device in ring topology has a repeater, if the received data is intended for other device then repeater forwards this data until the intended device receives it.



The following operations takes place in ring topology is:

- One station is known as **monitor** station which takes all the responsibility to perform the operations.
- To transmit the data, station has to hold the token. After the transmission is done, the token is to be released for other stations to use.
- When no station is transmitting the data, then the token will circulate in the ring.
- There are two types of token release techniques :
  - **Early token release** releases the token just after the transmitting the data.
  - **Delay token release** releases the token after the acknowledgement is received from the receiver.

## Advantages of Ring Topology

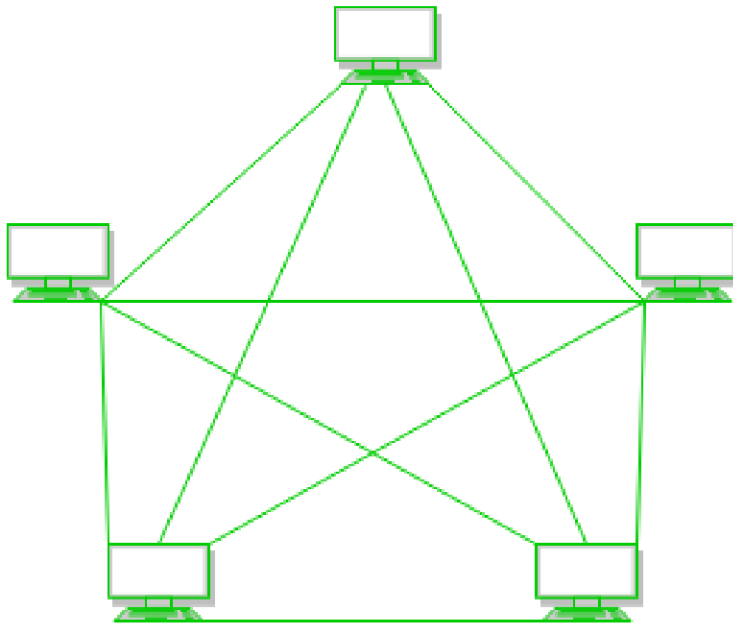
- Easy to install.
- Managing is easier as to add or remove a device from the topology only two links are required to be changed.

## Disadvantages of Ring Topology

- A link failure can fail the entire network as the signal will not travel forward due to failure.
- Data traffic issues, since all the data is circulating in a ring.

## Mesh Topology

- In mesh topology each device is connected to every other device on the network through a dedicated point-to-point link.
- When we say dedicated it means that the link only carries data for the two connected devices only. Let's say we have  $n$  devices in the network then each device must be connected with  $(n-1)$  devices of the network. Number of links in a mesh topology of  $n$  devices would be  $n(n-1)/2$ .



### Advantages of mesh topology

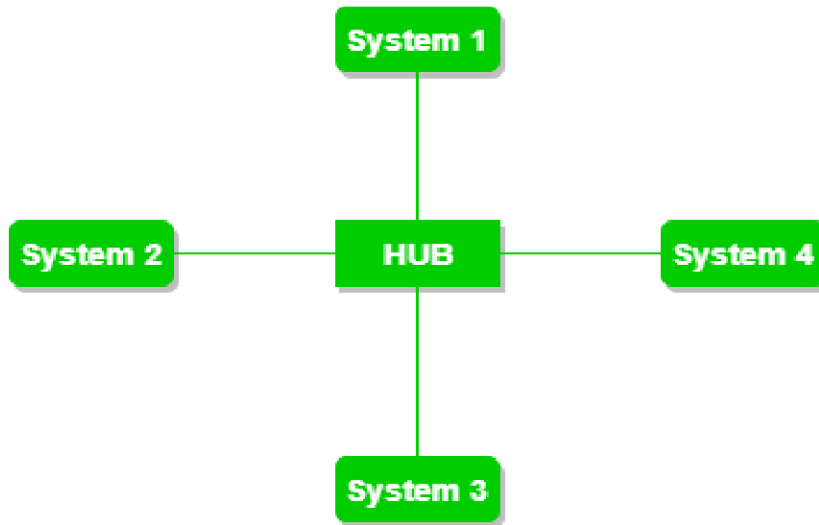
- It is robust.
- Fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links.
- Provides security and privacy.

### Disadvantages of mesh topology

- Installation and configuration is difficult.
- Cost of cables is high as bulk wiring is required, hence suitable for less number of devices.
- Cost of maintenance is high.

## Star Topology

- In star topology, all the devices are connected to a single hub through a cable.
- This hub is the central node and all others nodes are connected to the central node.
- The hub can be passive nature i.e. not intelligent hub such as broadcasting devices.
- The hub can be intelligent known as active.
- Active hubs have repeaters in them.
- A star topology having four systems connected to single point of connection i.e. hub.



### **Advantages of this topology:**

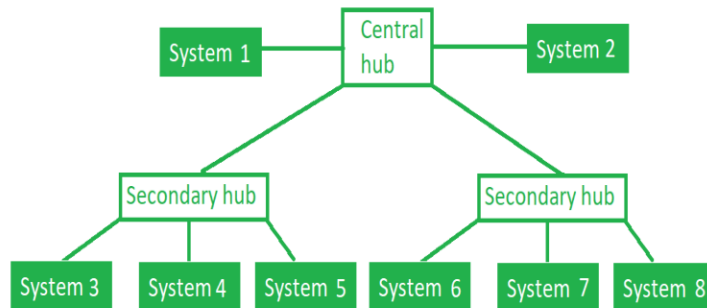
- If N devices are connected to each other in star topology, then the number of cables required to connect them is N. So, it is easy to set up.
- Each device requires only 1 port i.e. to connect to the hub.

### **Disadvantages of this topology:**

- If the concentrator (hub) on which the whole topology relies fails, the whole system will crash down.
- Cost of installation is high.
- Performance is based on the single concentrator i.e. hub.

## **Tree Topology**

- This topology is the variation of Star topology. This topology has hierarchical flow of data.
- In this the various secondary hubs are connected to the central hub which contains the repeater. In this data flow from top to bottom i.e. from the central hub to secondary and then to the devices or from bottom to top i.e. devices to secondary hub and then to the central hub.



#### **Advantages of tree topology:**

- It allows more devices to be attached to a single central hub thus it increases the distance that is travel by the signal to come to the devices.
- It allows the network to get isolate and also prioritize from different computers.

#### **Disadvantages of tree topology:**

- If the central hub gets fails the entire system fails.
- The cost is high because of cabling.

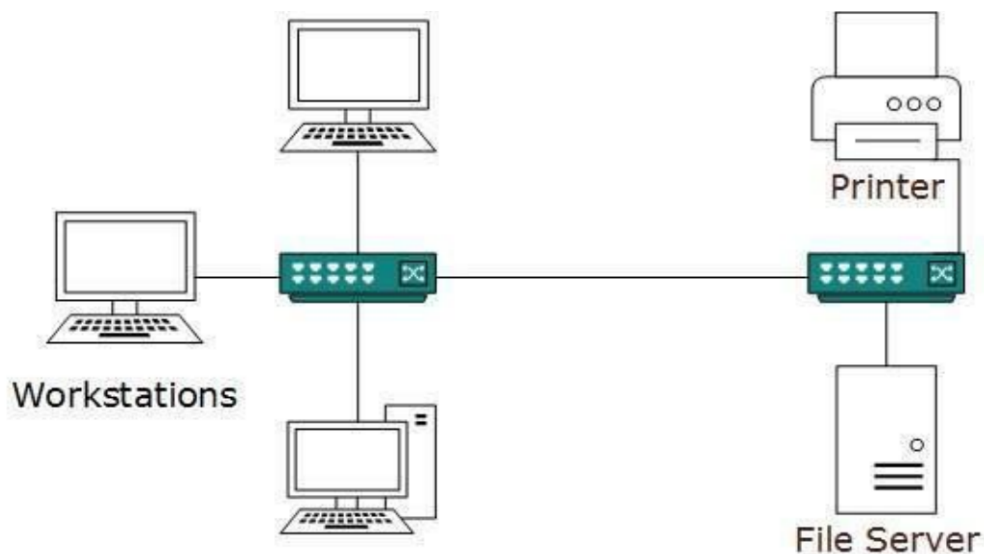
## **1.2 Network Types based on their Fundamental**

- **LAN (Local Area Network)**

- **MAN (Metropolitan Area Network)**
- **WAN (Wide Area Network)**

### **LAN (Local Area Network)**

- A computer network spanned inside a building and operated under single administrative system is generally termed as Local Area Network (LAN).
- Usually, LAN covers an organization's offices, schools, colleges or universities.
- LAN has a range up to 2km.
- LAN provides a useful way of sharing the resources between end users. The resources such as printers, file servers, scanners, and internet are easily sharable among computers.



- LANs are composed of inexpensive networking and routing equipment. It may contain local servers serving file storage and other locally shared applications. It mostly operates on private IP addresses and does not involve heavy routing. LAN works under its own local domain and controlled centrally.
- LAN uses either Ethernet or Token-ring technology.
- LAN can be wired, wireless, or in both forms at once.

#### **Advantages:**

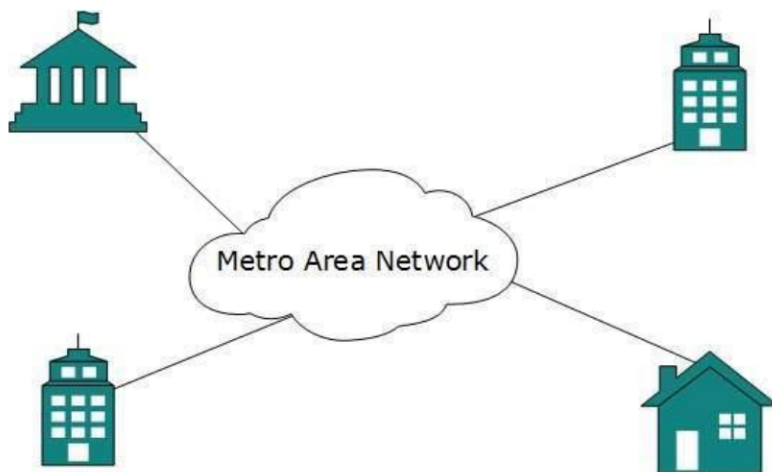
- Provides fast data transfer rates and high-speed communication.
- Easy to set up and manage.
- Can be used to share peripheral devices such as printers and scanners.

**Disadvantages:**

- Limited geographical coverage.
- Limited scalability and may require significant infrastructure upgrades to accommodate growth.

**MAN (Metropolitan Area Network)**

- The Metropolitan Area Network (MAN) generally expands throughout a city such as cable TV network. It can be in the form of Ethernet, Token-ring, ATM, or Fiber Distributed Data Interface (FDDI).
- 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.
- Backbone of MAN is high-capacity and high-speed fiber optics. MAN works in between Local Area Network and Wide Area Network. MAN provides uplink for LANs to WANs or internet.

**Advantages:**

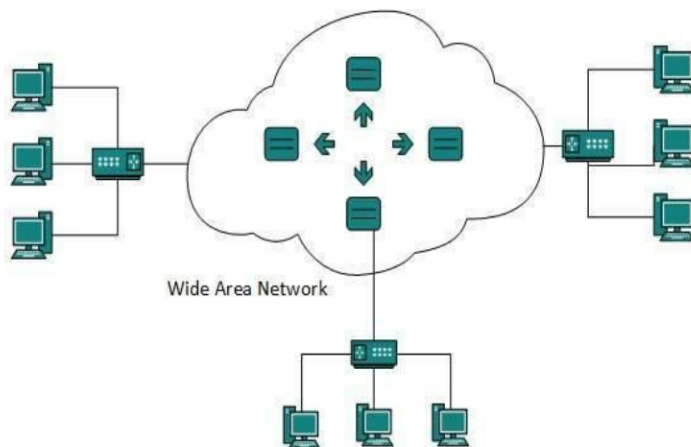
- Provides high-speed connectivity over a larger geographical area than LAN.
- Can be used as an ISP for multiple customers.

**Disadvantages:**

- Can be expensive to set up and maintain.
- May experience congestion and network performance issues with increased usage.

**WAN (Wide Area Network)**

- As the name suggests, the Wide Area Network (WAN) covers a wide area which may span across provinces and even a whole country.
- Generally, telecommunication networks are Wide Area Network. These networks provide connectivity to MANs and LANs. Since they are equipped with very high speed backbone, WANs use very expensive network equipment.
- WAN may use advanced technologies such as Asynchronous Transfer Mode (ATM), Frame Relay, and Synchronous Optical Network (SONET). WAN may be managed by multiple administrations.

**Advantages:**

- Covers large geographical areas and can connect remote locations.
- Provides connectivity to the internet.
- Offers remote access to resources and applications.

**Disadvantages:**

- Can be expensive to set up and maintain.
- Offers slower data transfer rates than LAN or MAN.

## 1.3 Terminologies[Intranet, Internet, Unicast, Broadcast, Multicast]

### Intranet

- An intranet is **a private network contained within an enterprise that is used to securely share company information and computing resources among employees.**
- An intranet can also be used for working in groups and teleconferences. Intranets encourage communication within an organization.

### Internet

- Internet is **a world-wide global system of interconnected computer networks.** Internet uses the standard Internet Protocol (TCP/IP).
- Every computer in internet is identified by a unique IP address. IP Address is a unique set of numbers (such as 110.22).

### Unicast

- In computer networking, unicast is **a one-to-one transmission from one point in the network to another point;** that is, one sender and one receiver, each identified by a network address.

### Broadcast

- Broadcasting in computer network is **a group communication, where a sender sends data to receivers simultaneously.**
- This is an all – to – all communication model where each sending device transmits data to all other devices in the network domain.

### Multicast

- In computer networking, multicast is group communication where data transmission is addressed to a group of destination computers simultaneously. Multicast can be one-to-many or many-to-many distribution.
- Multicast should not be confused with physical layer point-to-multipoint communication.