



# Introduction to Computer Network

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## Definition of a Computer Network

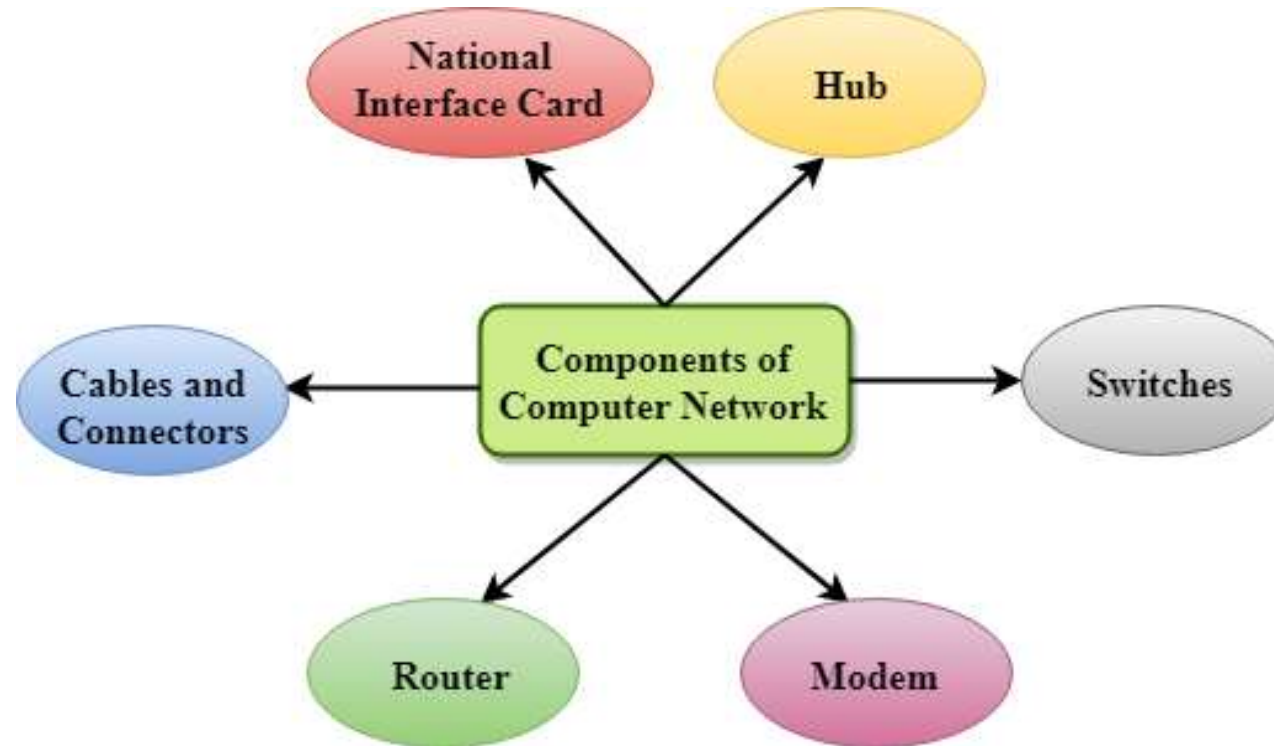
**“A computer network is a connected group of computers and computer hardware which are interconnected and can share resources from one machine to another.”**

## Concept of Network

A computer network is a set of devices connected through links. A node can be computer, printer, or any other device capable of sending or receiving the data. The links connecting the nodes are known as communication channels.

Computer Network uses distributed processing in which task is divided among several computers. Instead, a single computer handles an entire task, each separate computer handles a subset.

## Components Of Computer Network:



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**Major components of a computer network are:**  
**NIC(National interface card)**

NIC is a device that helps the computer to communicate with another device. The network interface card contains the hardware addresses, the data-link layer protocol use this address to identify the system on the network so that it transfers the data to the correct destination.

There are two types of NIC: wireless NIC and wired NIC.

**Wireless NIC:** All the modern laptops use the wireless NIC. In Wireless NIC, a connection is made using the antenna that employs the **radio wave technology**.

**Wired NIC:** Cables use the **wired NIC** to transfer the data over the medium.



## Hub

A Hub is a hardware device that divides the network connection among multiple devices. When a computer requests for some information from a network, it first sends the request to the Hub through cable. The Hub will broadcast this request to the entire network. All the devices will check whether the request belongs to them or not. If not, the request will be dropped.

The process used by the Hub consumes more bandwidth and limits the amount of communication. Nowadays, the use of hub is obsolete, and it is replaced by more advanced computer network components such as Switches, Routers.

## Switches

A switch is a hardware device that connects multiple devices on a computer network. A Switch contains more advanced features than Hub. The Switch contains the updated table that decides where the data is transmitted or not. The Switch delivers the message to the correct destination based on the physical address present in the incoming message. A Switch does not broadcast the message to the entire network like the Hub. It determines the device to whom the message is to be transmitted. Therefore, we can say that a switch provides a direct connection between the source and destination. It increases the speed of the network.

## Cables and connectors

Cable is a transmission media that transmits the communication signals. **There are three types of cables:**

**Twisted pair cable:** It is a high-speed cable that transmits the data over **1 Gbps** or more.

**Coaxial cable:** Coaxial cable resembles like a TV installation cable. Coaxial cable is more expensive than twisted pair cable, but it provides the high data transmission speed.

**Fibre optic cable:** Fibre optic cable is a high-speed cable that transmits the data using light beams. It provides high data transmission speed as compared to other cables. It is more expensive as compared to other cables, so it is installed at the government level.

## Router

A router is a hardware device which is used to connect a LAN with an internet connection. It is used to receive, analyze and forward the incoming packets to another network.

A router works in a **Layer 3 (Network layer)** of the OSI Reference model.

A router forwards the packet based on the information available in the routing table.

It determines the best path from the available paths for the transmission of the packet.



## **Modem**

A modem is a hardware device that allows the computer to connect to the internet over the existing telephone line. A modem is not integrated with the motherboard rather than it is installed on the PCI slot found on the motherboard.

It stands for Modulator/Demodulator. It converts the digital data into an analog signal over the telephone lines.

Based on the differences in speed and transmission rate, a modem can be classified in the following categories:

Standard PC modem or Dial-up modem

Cellular Modem

Cable modem

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## Uses Of Computer Network

**Resource sharing:** Resource sharing is the sharing of resources such as programs, printers, and data among the users on the network without the requirement of the physical location of the resource and user.

**Server-Client model:** Computer networking is used in the **server-client model**. A server is a central computer used to store the information and maintained by the system administrator. Clients are the machines used to access the information stored in the server remotely.

**Communication medium:** Computer network behaves as a communication medium among the users. For example, a company contains more than one computer has an email system which the employees use for daily communication.

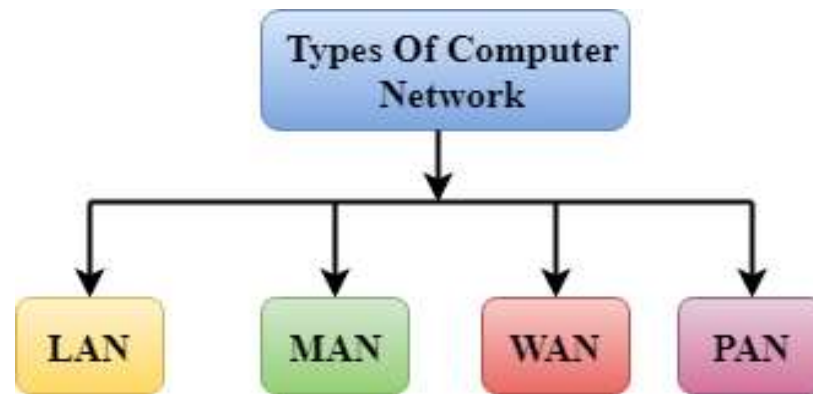
**E-commerce:** Computer network is also important in businesses. We can do the business over the internet. For example, amazon.com is doing their business over the internet, i.e., they are doing their business over the internet.



# Computer Network Types

A computer network is a group of computers linked to each other that enables the mputer to communicate with another computer and share their resources, data, and applications.

A computer network can be categorized by their size. A **computer network** is mainly of **four types**:



LAN(Local Area Network)

PAN(Personal Area Network)

MAN(Metropolitan Area Network)

WAN(Wide Area Network)

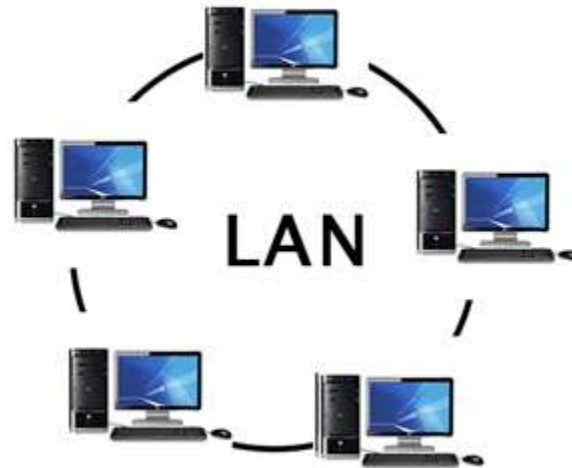
# LAN(Local Area Network)

Local Area Network is a group of computers connected to each other in a small area such as building, office. LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.

It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.

The data is transferred at an extremely faster rate in Local Area Network.

Local Area Network provides higher security.



## PAN(Personal Area Network)

Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters. Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.

**Thomas Zimmerman** was the first research scientist to bring the idea of the Personal Area Network.

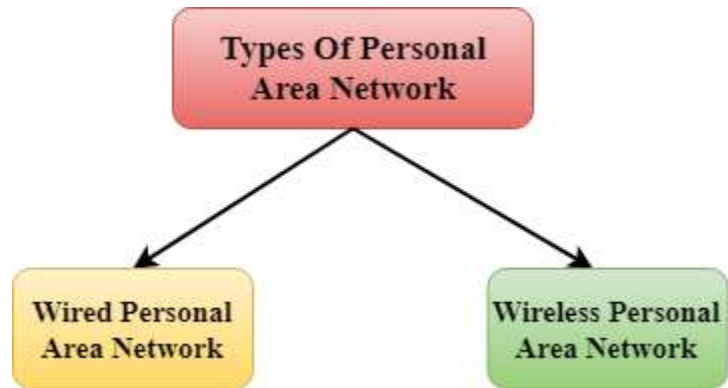
Personal Area Network covers an area of **30 feet**.

Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.



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There are two types of Personal Area Network:



Wired Personal Area Network

Wireless Personal Area Network

**Wireless Personal Area Network:** Wireless Personal Area Network is developed by simply using wireless technologies such as WiFi, Bluetooth. It is a low range network.

C++ vs Java

**Wired Personal Area Network:** Wired Personal Area Network is created by using the USB.

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## Examples Of Personal Area Network:

**Body Area Network:** Body Area Network is a network that moves with a person. **For example**, a mobile network moves with a person. Suppose a person establishes a network connection and then creates a connection with another device to share the information.

**Offline Network:** An offline network can be created inside the home, so it is also known as a **home network**. A home network is designed to integrate the devices such as printers, computer, television but they are not connected to the internet.

**Small Home Office:** It is used to connect a variety of devices to the internet and to a corporate network using a VPN

## MAN(Metropolitan Area Network)

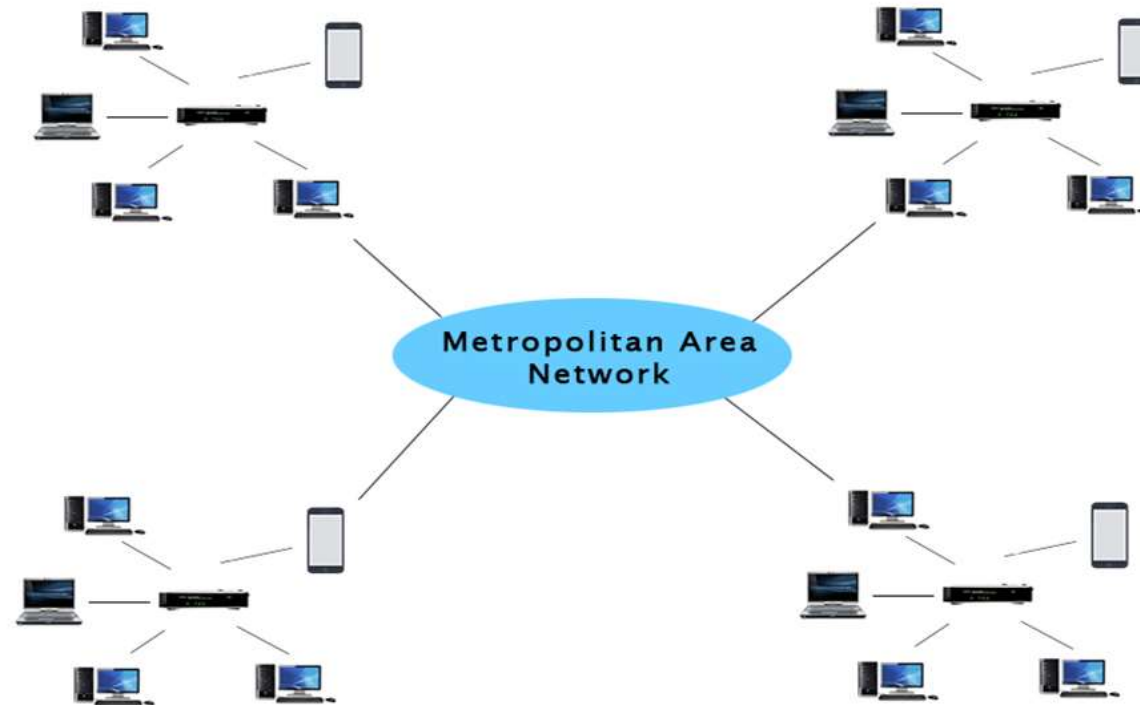
A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.

Government agencies use MAN to connect to the citizens and private industries.

In MAN, various LANs are connected to each other through a telephone exchange line.

The most widely used protocols in MAN are RS-232, Frame Relay, ATM, ISDN, OC-3, ADSL, etc.

It has a higher range than Local Area Network(LAN).



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## **Uses Of Metropolitan Area Network:**

MAN is used in communication between the banks in a city.

It can be used in an Airline Reservation.

It can be used in a college within a city.

It can also be used for communication in the military.

## WAN(Wide Area Network)

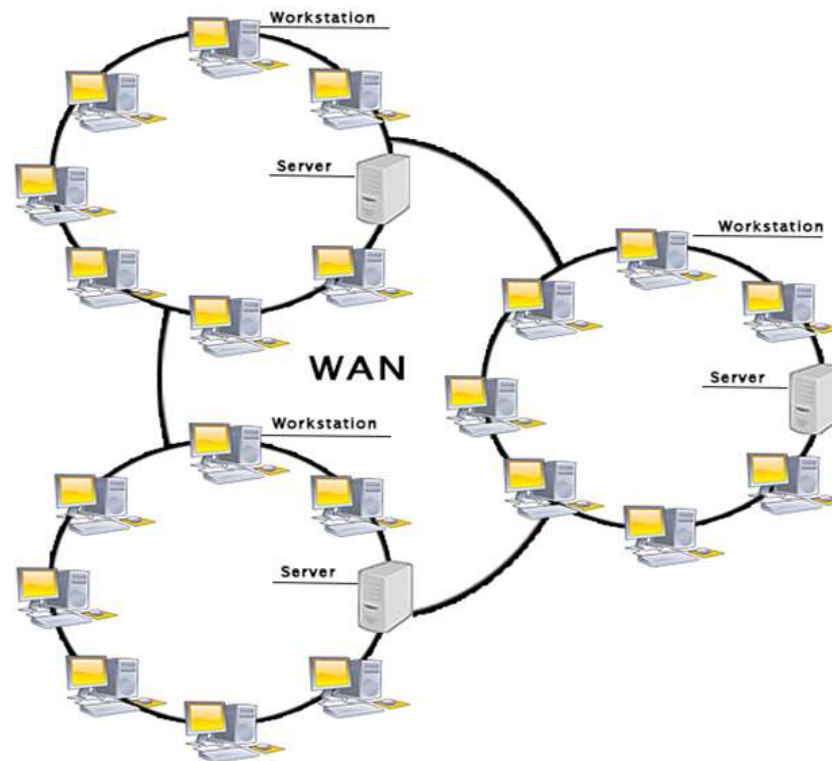
A Wide Area Network is a network that extends over a large geographical area such as states or countries.

A Wide Area Network is quite bigger network than the LAN.

A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.

The internet is one of the biggest WAN in the world.

A Wide Area Network is widely used in the field of Business, government, and education.





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## Examples Of Wide Area Network:

**Mobile Broadband:** A 4G network is widely used across a region or country.

**Last mile:** A telecom company is used to provide the internet services to the customers in hundreds of cities by connecting their home with fiber.

**Private network:** A bank provides a private network that connects the 44 offices. This network is made by using the telephone leased line provided by the telecom company.

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## Advantages Of Wide Area Network:

Following are the advantages of the Wide Area Network:

**Geographical area:** A Wide Area Network provides a large geographical area. Suppose if the branch of our office is in a different city then we can connect with them through WAN. The internet provides a leased line through which we can connect with another branch.

**Centralized data:** In case of WAN network, data is centralized. Therefore, we do not need to buy the emails, files or back up servers.

**Get updated files:** Software companies work on the live server. Therefore, the programmers get the updated files within seconds.

**Exchange messages:** In a WAN network, messages are transmitted fast. The web application like Facebook, Whatsapp, Skype allows you to communicate with friends.

**Sharing of software and resources:** In WAN network, we can share the software and other resources like a hard drive, RAM.

**Global business:** We can do the business over the internet globally.

**High bandwidth:** If we use the leased lines for our company then this gives the high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

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## Disadvantages of Wide Area Network:

The following are the disadvantages of the Wide Area Network:

**Security issue:** A WAN network has more security issues as compared to LAN and MAN network as all the technologies are combined together that creates the security problem.

**Needs Firewall & antivirus software:** The data is transferred on the internet which can be changed or hacked by the hackers, so the firewall needs to be used. Some people can inject the virus in our system so antivirus is needed to protect from such a virus.

**High Setup cost:** An installation cost of the WAN network is high as it involves the purchasing of routers, switches.

**Troubleshooting problems:** It covers a large area so fixing the problem is difficult.

## Transmission modes

The way in which data is transmitted from one device to another device is known as **transmission mode**.

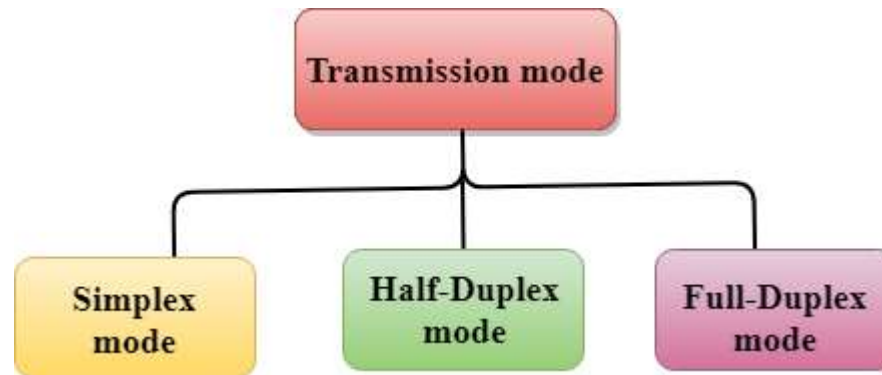
The transmission mode is also known as the communication mode.

Each communication channel has a direction associated with it, and transmission media provide the direction.

Therefore, the transmission mode is also known as a directional mode.

The transmission mode is defined in the physical layer.

The Transmission mode is divided into three categories:



Simplex mode

Half-duplex mode

Full-duplex mode

## **Simplex mode**

In Simplex mode, the communication is unidirectional, i.e., the data flow in one direction.

A device can only send the data but cannot receive it or it can receive the data but cannot send the data.

This transmission mode is not very popular as mainly communications require the two-way exchange of data. The simplex mode is used in the business field as in sales that do not require any corresponding reply.

The radio station is a simplex channel as it transmits the signal to the listeners but never allows them to transmit back.

Keyboard and Monitor are the examples of the simplex mode as a keyboard can only accept the data from the user and monitor can only be used to display the data on the screen.

The main advantage of the simplex mode is that the full capacity of the communication channel can be utilized during transmission.

### **Advantage of Simplex mode:**

In simplex mode, the station can utilize the entire bandwidth of the communication channel, so that more data can be transmitted at a time.

### **Disadvantage of Simplex mode:**

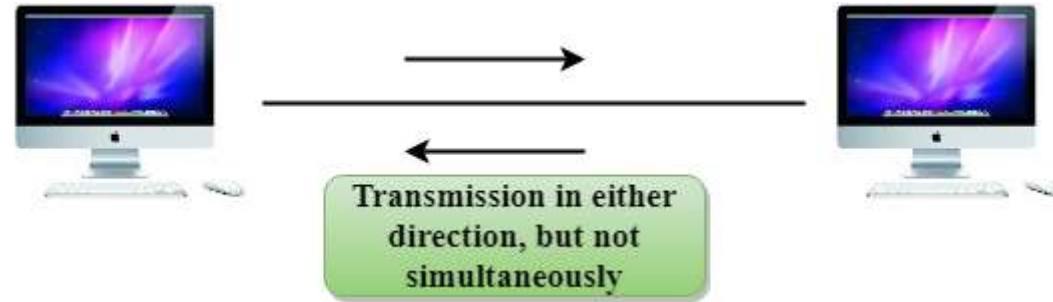
Communication is unidirectional, so it has no inter-communication between devices.



Transmission in only one direction



## Half-Duplex mode



In a Half-duplex channel, direction can be reversed, i.e., the station can transmit and receive the data as well. Messages flow in both the directions, but not at the same time.

The entire bandwidth of the communication channel is utilized in one direction at a time.

In half-duplex mode, it is possible to perform the error detection, and if any error occurs, then the receiver requests the sender to retransmit the data.

A **Walkie-talkie** is an example of the Half-duplex mode. In Walkie-talkie, one party speaks, and another party listens. After a pause, the other speaks and first party listens. Speaking simultaneously will create the distorted sound which cannot be understood.

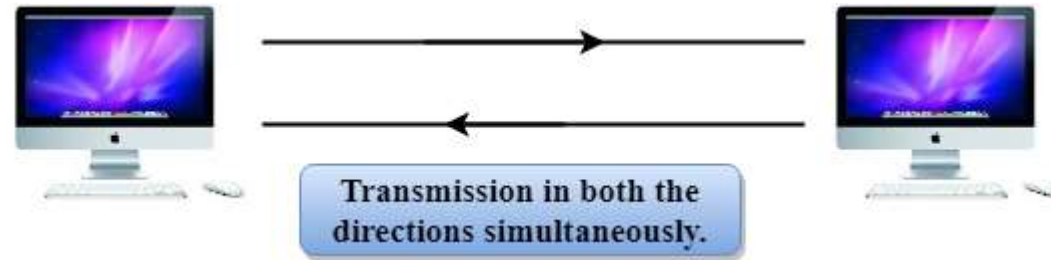
### **Advantage of Half-duplex mode:**

In half-duplex mode, both the devices can send and receive the data and also can utilize the entire bandwidth of the communication channel during the transmission of data.

### **Disadvantage of Half-Duplex mode:**

In half-duplex mode, when one device is sending the data, then another has to wait, this causes the delay in sending the data at the right time.

## Full-duplex mode



In Full duplex mode, the communication is bi-directional, i.e., the data flow in both the directions.

Both the stations can send and receive the message simultaneously.

Full-duplex mode has two simplex channels. One channel has traffic moving in one direction, and another channel has traffic flowing in the opposite direction.

The Full-duplex mode is the fastest mode of communication between devices.

The most common example of the full-duplex mode is a telephone network. When two people are communicating with each other by a telephone line, both can talk and listen at the same time.

### **Advantage of Full-duplex mode:**

Both the stations can send and receive the data at the same time.

### **Disadvantage of Full-duplex mode:**

If there is no dedicated path exists between the devices, then the capacity of the communication channel is divided into two parts.