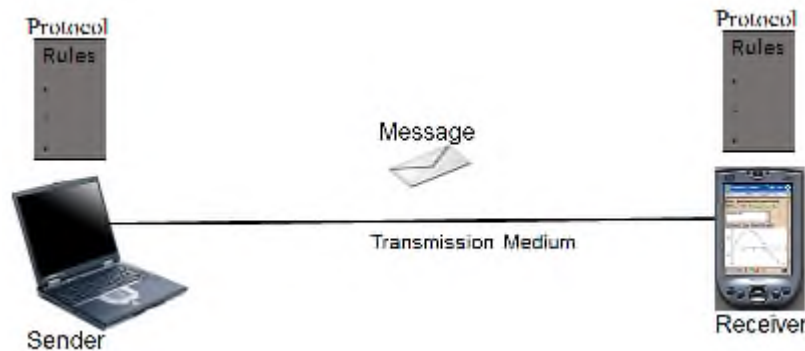


Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP

### 1.1 Data Communication

Data Communications are the exchange of data between two devices via some form of transmission.



#### Data Communication Characteristics

**1. Delivery:** The system must deliver data to the correct destination.

**2. Accuracy:**

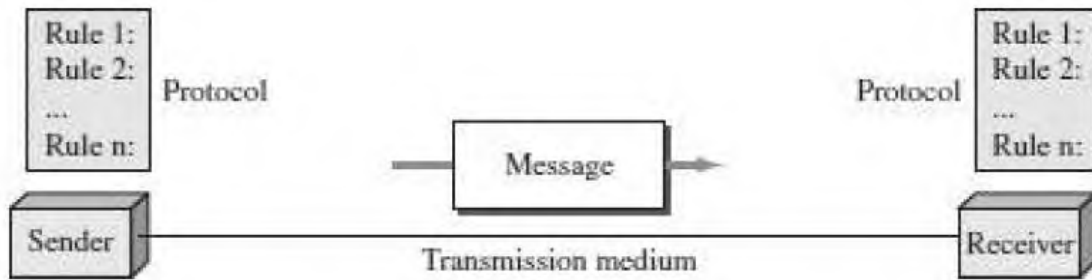
- Data delivered accurately.
- Altered data which left uncorrected are unusable.

**3. Timelines:**

The system must deliver data in timely manner without delay (real-time).

### 1.2 NETWORKS

- ✓ A network is a set of devices (often referred to as nodes) connected by communication links.
- ✓ A node can be a computer, printer, or any other device capable of sending or receiving data generated by other nodes on the network.
- ✓ When we communicate, we are sharing information. This sharing can be local or remote.



The five components are:

1. Message - It is the information to be communicated. Popular forms of information include text, pictures, audio, video etc.
2. Sender - It is the device which sends the data messages. It can be a computer, workstation, telephone handset etc.
3. Receiver - It is the device which receives the data messages. It can be a computer, workstation, telephone handset etc.
4. Transmission Medium - It is the physical path by which a message travels from sender to receiver. Some examples include twisted-pair wire, coaxial cable, radiowaves etc.
5. Protocol - It is a set of rules that governs the data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

## **TRANSMISSION MODES**

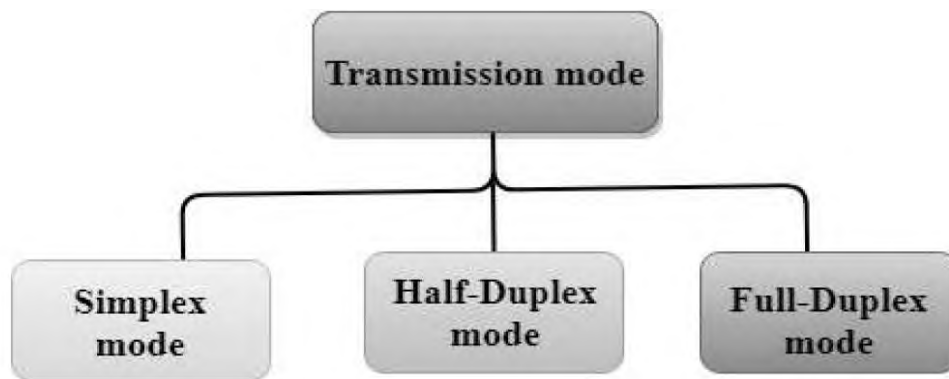
The way in which data is transmitted from one device to another device is known as transmission mode.

The transmission mode is also known as the communication mode

Types of Transmission mode

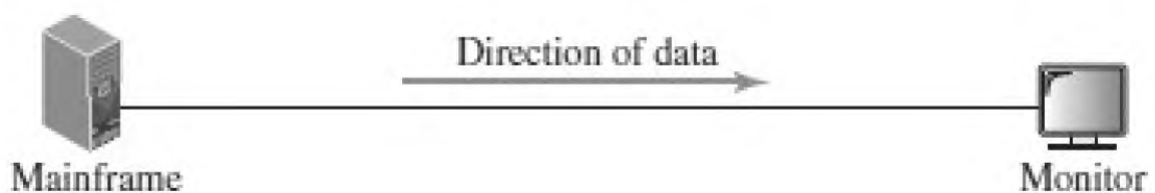
The Transmission mode is divided into three categories:

- o Simplex Mode
- o Half-duplex Mode
- o Full-duplex mode (Duplex Mode)



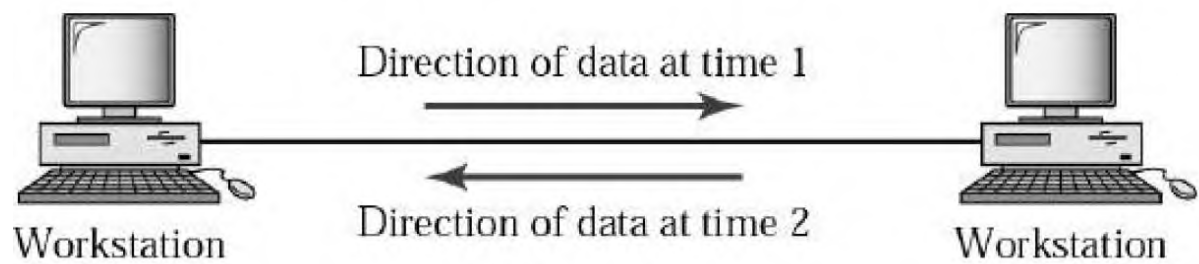
### **SIMPLEX MODE**

- o In Simplex mode, the communication is unidirectional, i.e., the data flow in one direction.
- o A device can only send the data but cannot receive it or it can receive the data but cannot send the data.
- o 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.
- o The radio station is a simplex channel as it transmits the signal to the listeners but never allows them to transmit back.
- o 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.



### **HALF-DUPLEX MODE**

- o In a Half-duplex channel, direction can be reversed, i.e., the station can transmit and receive the data as well.
- o Messages flow in both the directions, but not at the same time.
- o The entire bandwidth of the communication channel is utilized in one direction at a time.
- o 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.
- o A Walkie-talkie is an example of the Half-duplex mode.



### **FULL-DUPLEX MODE**

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

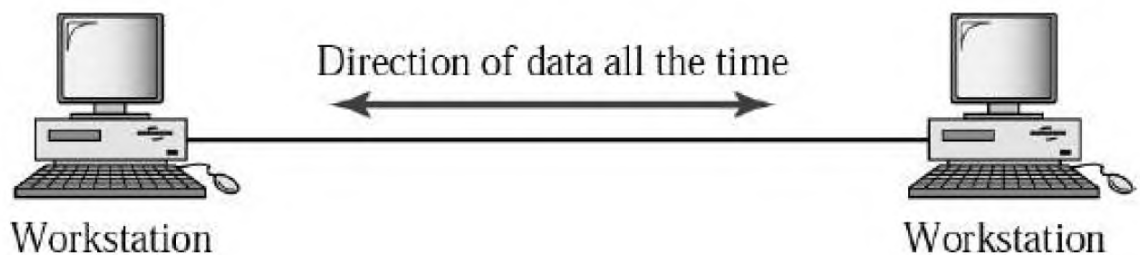
o Both the stations can send and receive the message simultaneously.

o 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.

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

o 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.



### **1.3 Network Types**

#### **Upon the scale (size):-**

- ✓ PAN (Personal Area Network).
- ✓ LAN (Local Area Network).
- ✓ CAN (Campus Area Network).
- ✓ MAN (Metropolitan Area Network).
- ✓ WAN (Wide Area Network).

### **PAN (Personal Area Network)**

- ✓ PAN is a short-distance network design to individual user (person).
- ✓ PAN may be contain:- printer, mobile, computer, wireless printers , PDA, etc.
- ✓ components of PAN connected together via Bluetooth , USB cable ,IrDA (infrared), etc.

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

- ✓ A LAN is a group of node connected together in a small specific area.
- ✓ LAN may be contain workstations, computers, scanner, printers, servers, etc.

### **CAN (Campus Area Network)**

- ✓ A CAN is a group of interconnection LAN within limited geographical area.
- ✓ A CAN using in school campus, military base, university campus ,etc.

### **MAN (Metropolitan Area Network)**

- ✓ A MAN is a large computer network uses to connect between LAN in different location (cities).
- ✓ A MAN is a group of node connect together over city.

### **WAN (Wide Area Network)**

- ✓ A WAN is a computer network that covers large geographical area.
- ✓ WANs are used to connect types of networks together.

## **1.4 PROTOCOL LAYERING**

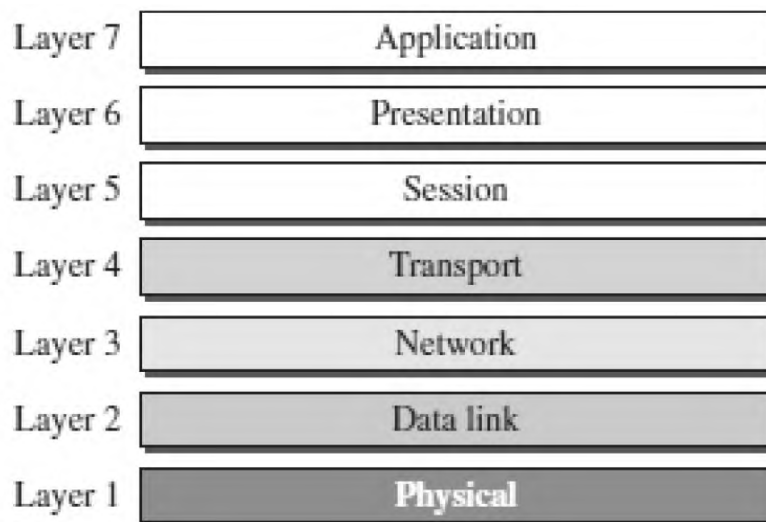
- In networking, a protocol defines the rules that both the sender and receiver and all intermediate devices need to follow to be able to communicate effectively.
- A protocol provides a communication service that the process use to exchange messages.
- When communication is simple, we may need only one simple protocol.
- When the communication is complex, we may need to divide the task between different layers, in which case we need a protocol at each layer, or protocol layering.
- Protocol layering is that it allows us to separate the services from the implementation.
- A layer needs to be able to receive a set of services from the lower layer and to give the services to the upper layer

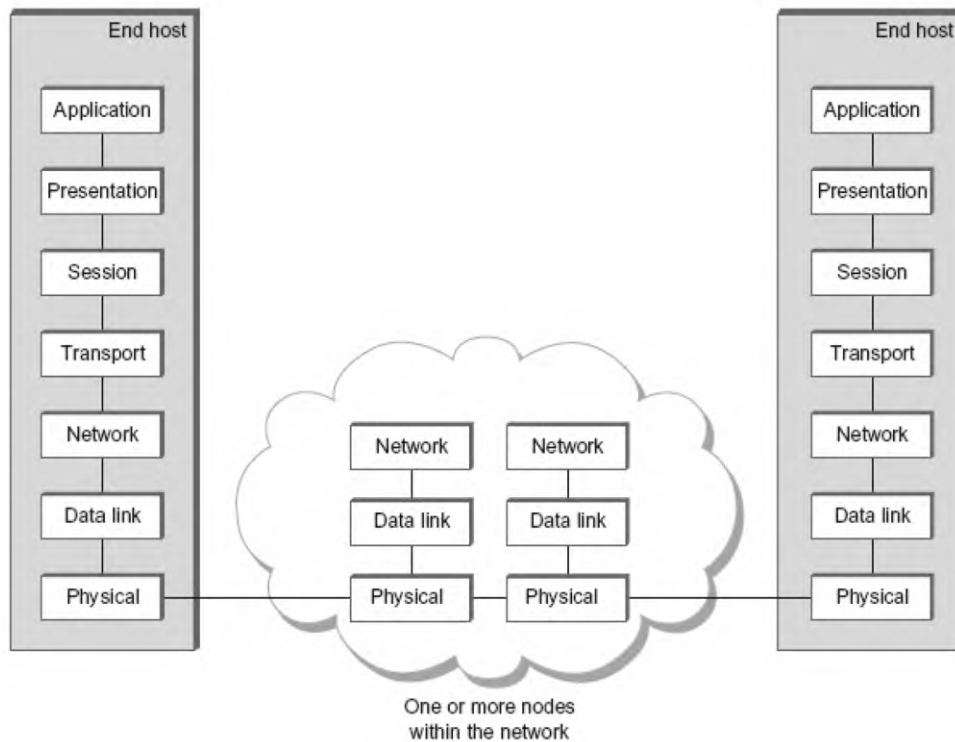
## Basic Elements of Layered Architecture

- **Service:** It is a set of actions that a layer provides to the higher layer.
- **Protocol:** It defines a set of rules that a layer uses to exchange the information with peer entity. These rules mainly concern about both the contents and order of the messages used.
- **Interface:** It is a way through which the message is transferred from one layer to another layer.

## 1.5 OSI MODEL

- OSI stands for Open System Interconnection.
- OSI consists of seven layers, and each layer performs a particular network function.
- OSI model divides the whole task into seven smaller and manageable tasks. Each layer is assigned a particular task.





## 1. PHYSICAL LAYER

The physical layer coordinates the functions required to transmit a bit stream over a physical medium.

The physical layer is concerned with the following functions:

- Physical characteristics of interfaces and media - The physical layer defines the characteristics of the interface between the devices and the transmission medium.
- Representation of bits - To transmit the stream of bits, it must be encoded to signals. The physical layer defines the type of encoding.
- Signals: It determines the type of the signal used for transmitting the information.
- Data Rate or Transmission rate - The number of bits sent each second –is also defined by the physical layer.
- Synchronization of bits - The sender and receiver must be synchronized at the bit level. Their clocks must be synchronized.

## 2. DATA LINK LAYER

It is responsible for transmitting frames from one node to the next node.

The other responsibilities of this layer are

- Framing - Divides the stream of bits received into data units called frames.

- Physical addressing – If frames are to be distributed to different systems on the network, data link layer adds a header to the frame to define the sender and receiver.
- Flow control- If the rate at which the data are absorbed by the receiver is less than the rate produced in the sender, the Data link layer imposes a flow ctrl mechanism.
- Error control- Used for detecting and retransmitting damaged or lost frames and to prevent duplication of frames. This is achieved through a trailer added at the end of the frame.

### 3. NETWORK LAYER

This layer is responsible for the delivery of packets from source to destination.

It determines the best path to move data from source to the destination based on the network conditions, the priority of service, and other factors.

The other responsibilities of this layer are

- Logical addressing - If a packet passes the network boundary, we need another addressing system for source and destination called logical address. This addressing is used to identify the device on the internet.
- Routing – Routing is the major component of the network layer, and it determines the best optimal path out of the multiple paths from source to the destination.

### 4. TRANSPORT LAYER

It is responsible for Process to Process delivery. That is responsible for source-to-destination (end-to-end) delivery of the entire message, It also ensures whether the message arrives in order or not.

The other responsibilities of this layer are

- Port addressing / Service Point addressing - The header includes an address called port address / service point address. This layer gets the entire message to the correct process on that computer.
- Segmentation and reassembly - The message is divided into segments and each segment is assigned a sequence number. These numbers are arranged correctly on the arrival side by this layer
- Connection control - This can either be connectionless or connection oriented. · The connectionless treats each segment as an individual packet and delivers to the destination. · The connection-oriented makes connection on the destination side before the delivery. After the delivery the termination will be terminated

### 5. SESSION LAYER

This layer establishes, manages and terminates connections between applications.



The other responsibilities of this layer are

- Dialog control - Session layer acts as a dialog controller that creates a dialog between two processes or we can say that it allows the communication between two processes which can be either half-duplex or full-duplex.
- Synchronization- Session layer adds some checkpoints when transmitting the data in a sequence. If some error occurs in the middle of the transmission of data, then the transmission will take place again from the checkpoint. This process is known as Synchronization and recovery.

## 6. PRESENTATION LAYER

It is concerned with the syntax and semantics of information exchanged between two systems.

The other responsibilities of this layer are

- Translation – Different computers use different encoding system, this layer is responsible for interoperability between these different encoding methods. It will change the message into some common format.
- Encryption and decryption-It means that sender transforms the original information to another form and sends the resulting message over the n/w. and vice versa.
- Compression and expansion-Compression reduces the number of bits contained in the information particularly in text, audio and video.

## 7. APPLICATION LAYER

This layer enables the user to access the network. It handles issues such as network transparency, resource allocation, etc. This allows the user to log on to remote user.

The other responsibilities of this layer are

- FTAM (File Transfer, Access, Management) - Allows user to access files in a remote host.
- Mail services - Provides email forwarding and storage.
- Directory services - Provides database sources to access information about various sources and objects.