

# **Fundamentals of Data Communications**

## **Data:**

- Data is the collection of raw facts.
- Data can be of two types analog and digital.

## **Information:**

- Information is referred to as the processed data that enables us to make decisions.

## **Data communication:**

- Data communication is a process of exchanging of data or information between two devices over a transmission medium.

## **Data representation:**

- Data can be represented in different forms such as text, numbers, images, audio, and video.

### **1. Text:**

- It is represented as a bit pattern, a sequence of bits (0s and 1s).

### **2. Numbers:**

- Numbers are represented by bit patterns. To simplify mathematical operations the number is directly converted to a binary number.

### **3. Images:**

- Images are represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels, where each pixel is a small dot. Resolution determines the size of the pixel.

### **4. Audio:**

- Audio refers to the recording or broadcasting of sound or music.
- It is a continuous entity.

### **5. Video:**

- Video refers to the recording or broadcasting of a picture or a movie.
- It can be either produced as a continuous entity or a discrete entity.

## **Data flow:**

### **1. Simplex:**

- In a simplex mode, the communication is unidirectional, i.e; sender can send the data but can't receive the data.
- The entire channel capacity of the channel is used to send the data in one direction.
- **Example:** The keyboard can only introduce input and the monitor can only accept output.

### **2. Half-duplex:**

- In a half-duplex mode, each station can both transmit and receive data, but not at the same time.
- The entire capacity of the channel can be utilized for each direction.

- **Example:** Walkie-talkies.

### 3. Full-duplex:

- In a full duplex mode, both stations can transmit and receive data simultaneously.
- Full duplex data flow is also called duplex data flow.
- The entire channel capacity of the channel is divided between the two directions.
- **Example:** Telephone network.

## Components of data communication:

### 1. Message:

- The message is the information to be communicated.
- Popular forms of information include text, numbers, images, audio, and video

### 2. Sender:

- The sender is a device that sends data messages.
- A sender can be a computer, workstation, telephone e.t.c.

### 3. Receiver

- The receiver is a device that receives data messages.
- A receiver can be a computer, workstation, telephone e.t.c.

### 4. Medium:

- The transmission medium is the physical path by which a message travels from sender to receiver.
- Some of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable e.t.c.

### 5. Protocol:

- A protocol is a set of rules that govern data communication.
- Without a protocol, two devices may be connected but not communicating.
- A protocol defines what is communicated, how it is communicated, and when it is communicated.
- The key elements of a protocol are syntax, semantics, and timing.
- **Syntax:** The term syntax refers to the structure or format of the data.
- **Semantics:** The word semantics refers to the meaning of each section of bits.
- **Timing:** The term timing refers to two characteristics: when the data should be sent and how fast they can be sent.

## Fundamental characteristics of a communication system:

### 1. Delivery:

- The system must deliver data to the correct destination.

### 2. Accuracy:

- The system must deliver the data accurately.

### 3. Timeliness:

- The system must deliver the data in a timely manner.

- **Timely delivery:** Delivering data as they are produced, in the same order that they are produced and without significant delay, this kind of transmission is called as **real time transmission**.

#### 4. Jitter

- It refers to the variation in the packet arrival time.

#### Networks and network criteria

- **Network:** A network is a set of devices or 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.
- A link is a communication pathway that transfers data from one device to another device. It can be a cable, air, optical fiber, or any other medium which can transport a signal carrying information.
- **Network criteria:**
  1. **Performance:**
    - The performance of a network depends on various factors like transmit time, response time, no of users, transmission medium, capability of connected hardware, and efficiency of the software, e.t.c.
    - **Transmit time** is the amount of time required for a message to travel from one device to another device.
    - **Response time** is the elapsed time between an inquiry and response.
    - Performance is often evaluated by two network metrics: throughput and delay. We often need more throughput and less delay.
  2. **Reliability:**
    - Network reliability is measured by **frequency of failure**, the time it takes a link to recover from failure, and the network's robustness in a catastrophe.
  3. **Security:**
    - Network security issues include protecting data from unauthorized access, protecting data from damage and development, and implementing policies and producers for recovery from breaches and data losses.