Data Communication

Data Communications and Networking, 5th Edition

By

Behrouz A. Forouzan

Overview

1. Data Communication

2. Components

3. Data Representation

4. Data Flow

1. Data Communication

- It is the exchange of data between two devices via a transmission medium.

- Communication system is a combination of hardware and software.

Data Communication cont..

- Effectiveness of data communication system is depends on four fundamental characteristics:

  1. Delivery
  2. Accuracy
  3. Timeliness
  4. Jitter

Data Communication cont..

1. **Delivery**
   - System must deliver data to the correct destination.
   - Data must be received only by the intended device or user.

2. **Accuracy**
   - System must deliver the data accurately.
   - Data that have been altered in transmission and left uncorrected are unusable.
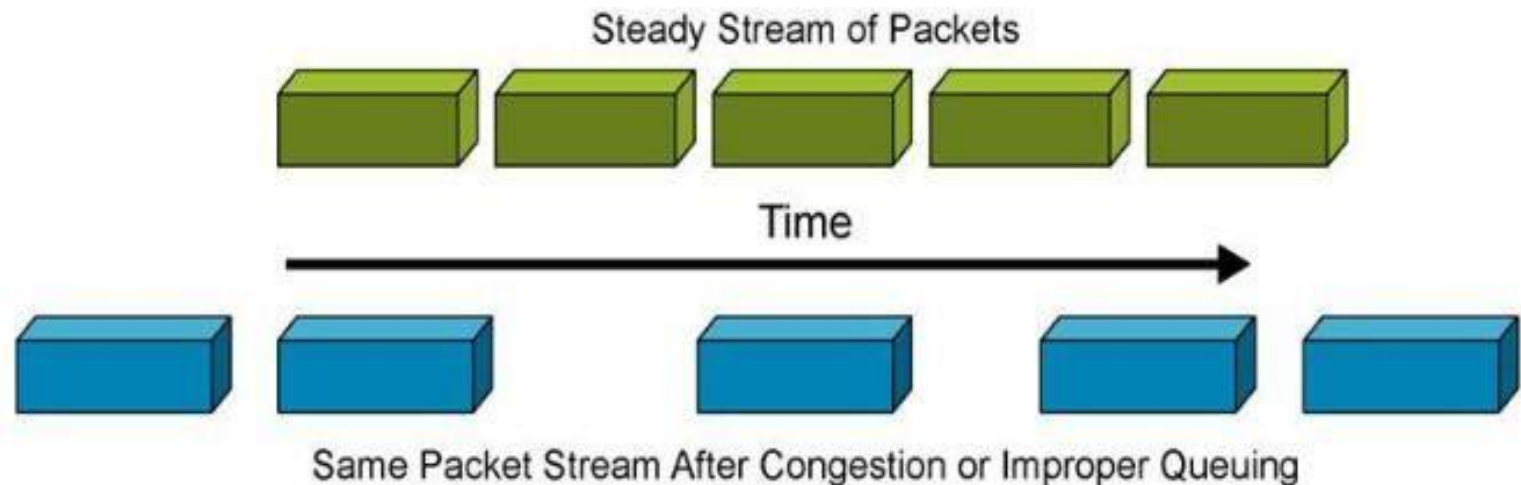
Data Communication cont..

3. **Timeliness**

   – System must deliver data in a timely manner.

   – Data delivered late are useless.

   – Ex: Real-time transmission

     • Video and audio – Deliver it in the same order that they are produced, and without significant delay.

Data Communication cont..

4. **Jitter**
   - It refers to the variation in the packet arrival time.
   - It is the uneven delay in the delivery of audio or video packets.
   - Caused by network congestion and packet loss.

Steady Stream of Packets

Time

Same Packet Stream After Congestion or Improper Queuing
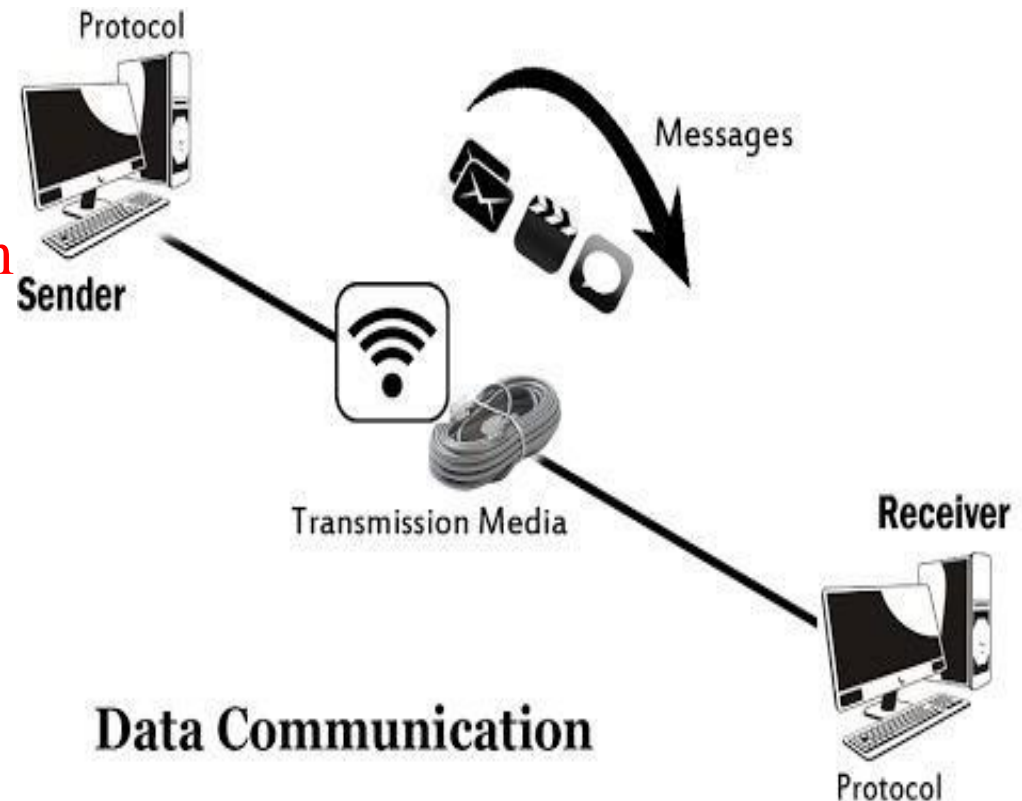
2. Components of Data Communication

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- A data communication system is made up of five components.
  1. Message
  2. Sender
  3. Receiver
  4. Transmission medium
  5. Protocol

Protocol

Messages

Sender

Transmission Media

Receiver

Data Communication

Protocol

2. Components of Data Communication

1. **Message**
   - Information (data) to be communicated.
   - **Ex:** text, numbers, pictures, audio and video.

2. **Sender**
   - Device that sends the data message.
   - **Ex:** computer, workstation, telephone handset, video camera and so on.

3. **Receiver**
   - Device that receives the message.
   - **Ex:** computer, workstation, telephone handset, television and so on.

2. Components of Data Communication

4. **Transmission medium**
   - Physical path by which a message travels from sender to receiver.
   - **Ex:** twisted-pair wire, coaxial cable, fiber-optic cable and radio waves.

5. **Protocol**
   - It is a set of rules that govern data communications.
   - It represents an agreement between the communicating devices.
   - **Ex:** A person speaking French cannot be understood by a person who speaks only Japanese.

3. Data Representation

3. Data Representation

- Information comes in different forms such as text, numbers, images, audio and video.

Text

Numbers

Images

Audio

Video

3. Data Representation cont..

1. **Text**
   – Represented as a bit pattern, a sequence of bits (0s or 1s).
   – Different sets of bit patterns have been designed to represent text symbols.
   – Each set is called a **code.**
   – Process of representing symbols is called coding.
   – **Unicode**
     - Common coding system.
     - It uses 32 bits to represent a symbol or character in any language.
   – **American Standard Code for Information Interchange (ASCII)**
     - Developed some decades ago in the United States.
     - Constitutes the first 127 characters in Unicode.
     - Also referred to as **Basic Latin.**

3. Data Representation cont..

2. **Numbers**
   - Represented by bit patterns.
   - It is directly converted to a binary number.

3. Data Representation cont..

3. **Images**
    - Represented by bit patterns.
    - Composed of a matrix of pixels.
    - Each pixel is a small dot.
    - Size of the pixel is depend on resolution.
    - Better representation (resolution): more memory is needed.
    - **Ex:** Image can be divided into 1000 pixels or 10,000 pixels.
    - Each pixel is assigned a bit pattern.

3. Data Representation cont..

3. **Images**
   - Size and value of the pattern depend on the image.
   - 1-bit pattern for image made of only black and white dots.
     - **Ex:** Chessboard
   - 2-bit pattern for image is not made of pure white and pure black pixels.
     - **Ex:** 4 levels of gray scale
       - A black pixel can be represented by 00
       - A dark gray pixel by 01
       - A light gray pixel by 10
       - A white pixel by 11.

3. Data Representation cont..

3. **Images**

   – Several methods to represent color images.

   - **RGB method**

     – Each color is made of a combination of three primary colors: *r*ed, *g*reen, and *b*lue.

   - **YCM method**

     – Each color is made of a combination of three other primary colors: *y*ellow, *c*yan, and *m*agenta.

3. Data Representation cont..

4. Audio

– Refers to recording or broadcasting of sound or music.

– It is continuous, not discrete.

5. Video

– Refers to recording or broadcasting of a picture or movie.

– It can either be

- Produced as a continuous entity (e.g., by a TV camera),
  – or it can be a

- Combination of images, each a discrete entity, arranged to convey the idea of motion.

4. Data Flow or Transmission Mode

4. Data Flow or Transmission Mode

- Defines the direction of signal flow between two connected devices.

- There are three modes of transmission, namely:

  1. Simplex
  2. Half-duplex
  3. Full-duplex
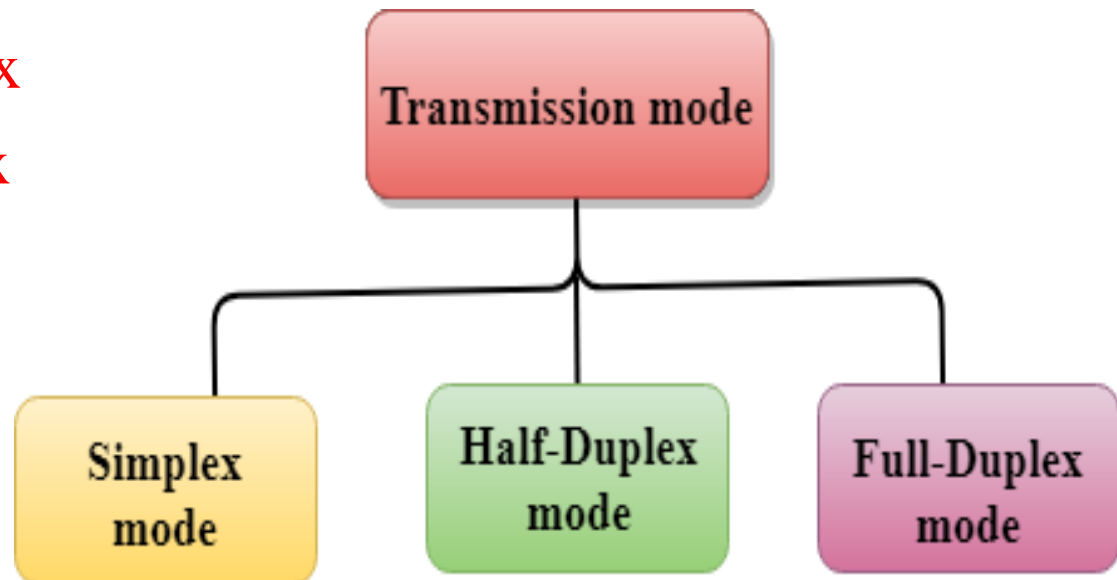
4.1 Simplex Mode

- Communication is unidirectional.
  - Communication between sender and receiver occurs in only one direction.
- Only sender can send the data and receiver can receive the data.
- Receiver cannot reply to the sender.
- Use the entire capacity of the channel to send data.

Transmission in only one direction
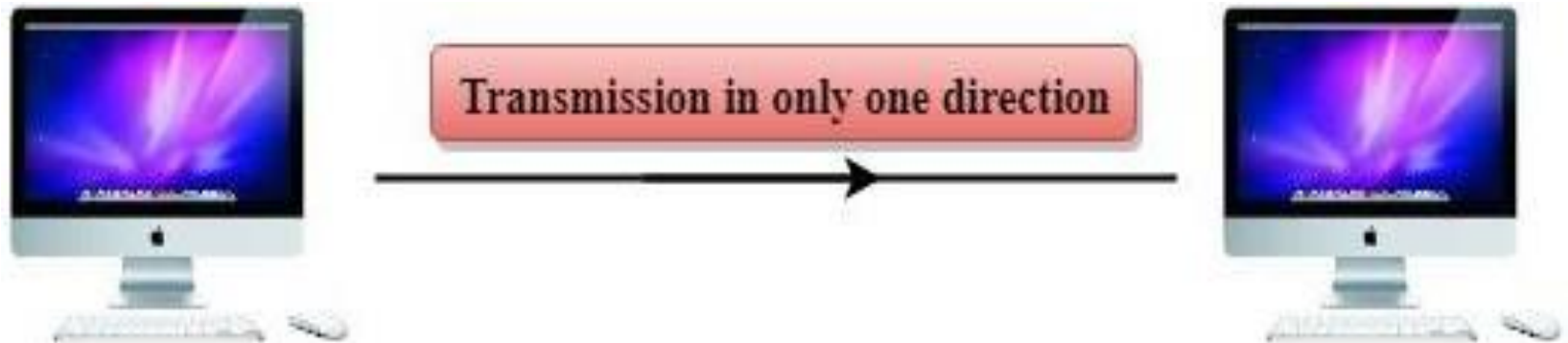
4.1 Simplex Mode cont..

- **Ex:** One-lane road

- **Ex:** Keyboards and Monitors
  - Only Keyboard can send input to monitor
  - Monitor can only receive the input and display it on the screen.
  - Monitor cannot reply to the keyboard.
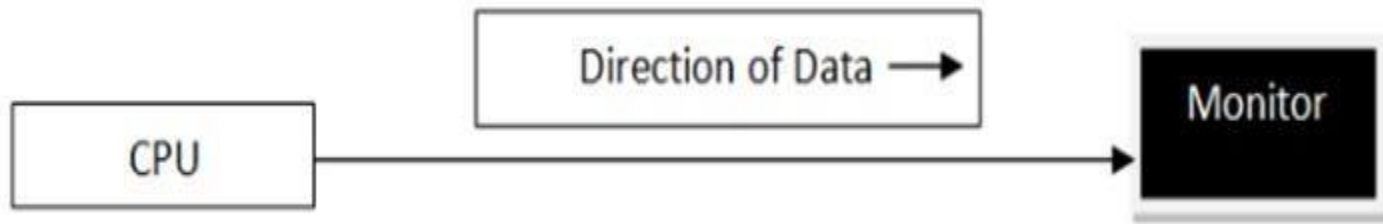
4.2 Half-Duplex Mode

- 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.
- Entire capacity of a channel is taken over by the transmitting device.


Transmission in either direction, but not simultaneously
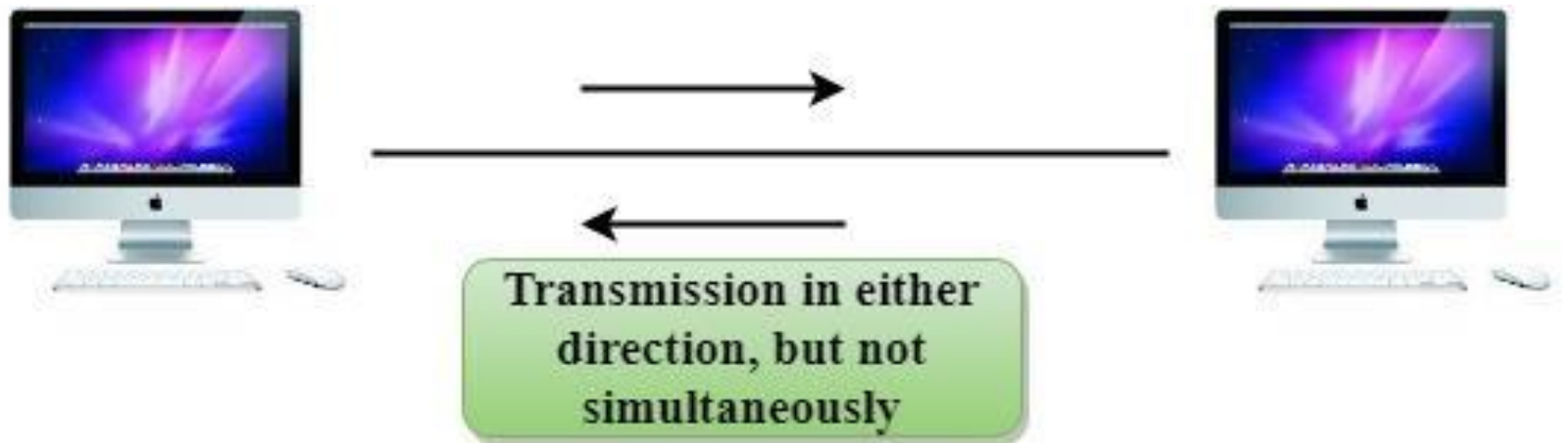
4.2 Half-Duplex Mode cont..

- **Ex:** Walkie-talkies
  - Speakers at both ends can speak, but they have to speak one by one.
  - They cannot speak simultaneously.

4.3 Full-Duplex Mode

- Also called *duplex*.

- Both stations can transmit and receive at same time.

- Signals going in either direction sharing the capacity of the link.

- Sharing can occur in two ways:
  - Link has two physically separate transmission paths
    - One for sending and other for receiving.
  - Capacity of the channel is divided between signals travelling in both directions.

Transmission in both the directions simultaneously.
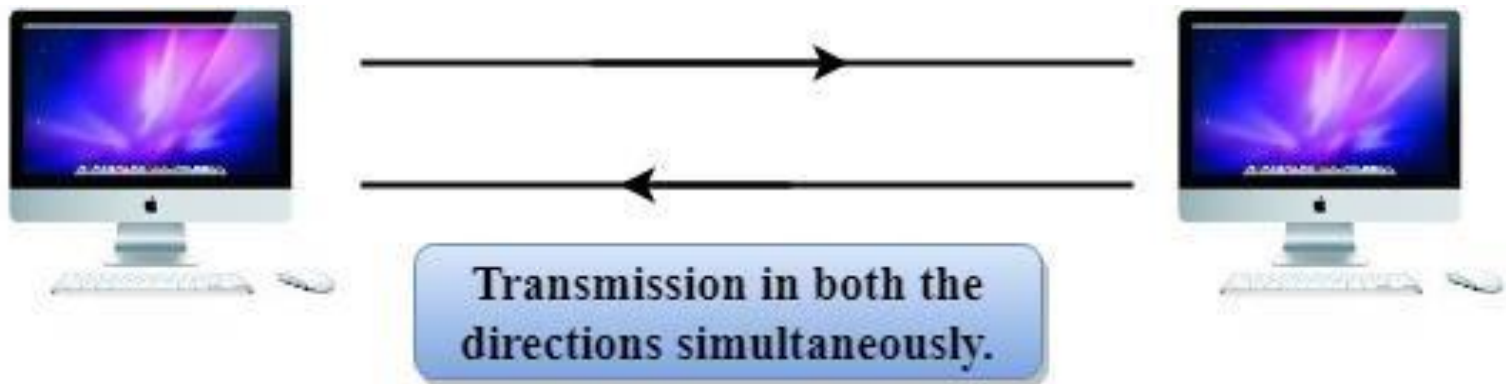
4.3 Full-Duplex Mode cont..

- **Ex:** Two-way road
  - Traffic flowing in both directions at the same time.
- **Ex:** Telephone network
  - Two people communicate
  - Both are free to speak and listen at the same time.

Comparison Chart

Basis for Comparison	Simplex	Half Duplex	Full Duplex
Direction of Communication	Unidirectional	Two-directional, one at a time	Two-directional, simultaneously
Send / Receive	Sender can only send data	Sender can send and receive data, but one at a time	Sender can send and receive data simultaneously
Performance	Worst performing mode of transmission	Better than Simplex	Best performing mode of transmission
Example	Keyboard and monitor	Walkie-talkie	Telephone