COMPUTER NETWORKS
BCS502

Data Communications

- The word **data** refers to information presented in whatever form is agreed upon by the parties creating and using the data.

- **Data communications** are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Characteristics of data communication system

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

- **Accuracy** :The system must deliver the data accurately.

- **Timeliness**: The system must deliver data in a timely manner. Data delivered late are useless.

- **Jitter**: Jitter refers to variation in the packet arrival time. For example, Video packets are sent every 30 ms . If some of the packets arrive with 30-ms delay and others with 40-ms delay, an uneven quality in the video is the result.
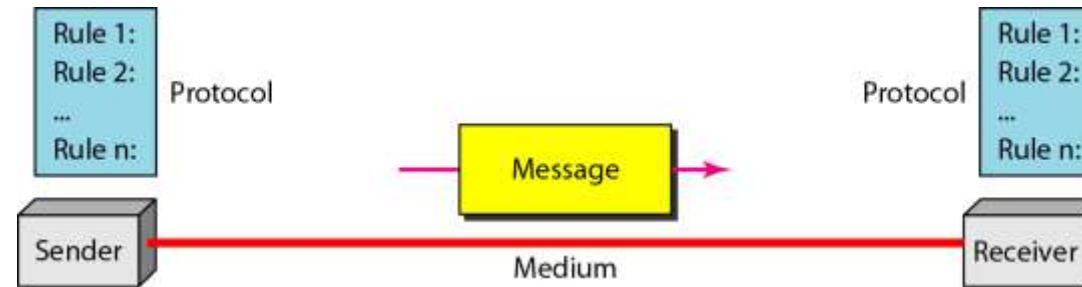
Components of a data communication system

Fig: Five components of data communication

- **Message :** The message is the information (data) to be communicated .

- **Sender:** The sender is the device that sends the data message.

- **Receiver :** The receiver is the device that receives the message.

- **Transmission medium :** The transmission medium is the physical path by which a message travels from sender to receiver.

- **Protocol :** A protocol is a set of rules that govern data communications

Data Representation

- Text
    ‣ Represented as bit pattern (sequence of bits 0s or 1s)
    ‣ Different set of bit pattern used to represent symbols or characters.
    ‣ Each set is called code
    ‣ Process of representing symbols is called encoding
    ‣ Ex: ASCII,UNICODE
- Numbers
    ‣ Represented as bit pattern
    ‣ Directly converted to binary form
- Audio
    ‣ Recording or broadcasting of sound or music.
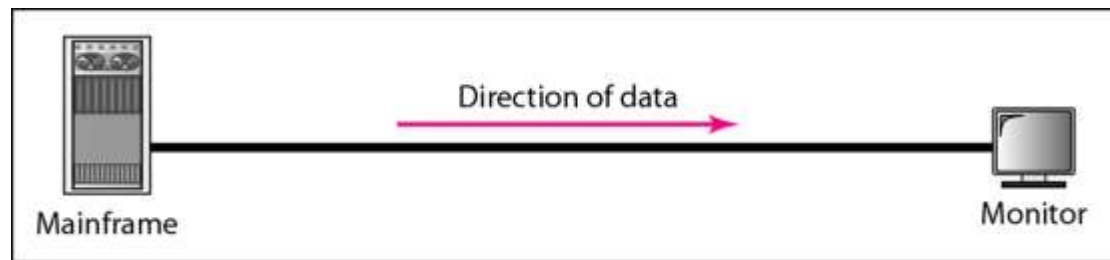   ‣ Continuous not discrete

- Video

  ‣ Recording or broadcasting of picture or a movie

  ‣ Produced as :

    - Continuous entity [TV camera]

    - Combination of images-discrete entity

- Images

  ‣ Represented as bit pattern

  ‣ Image is divided into matrix of pixels(smallest element of an image)

  ‣ Each pixel is assigned a bit pattern (size and value of pattern depend on image)

  ‣ Ex: black and white dots (chessboard) -1 bit pattern is enough to represent a
    pixel, gray scale- 2 bit pattern.

  ‣ Several methods to represent colour images : RGB,YCM

- Communication between two devices can be

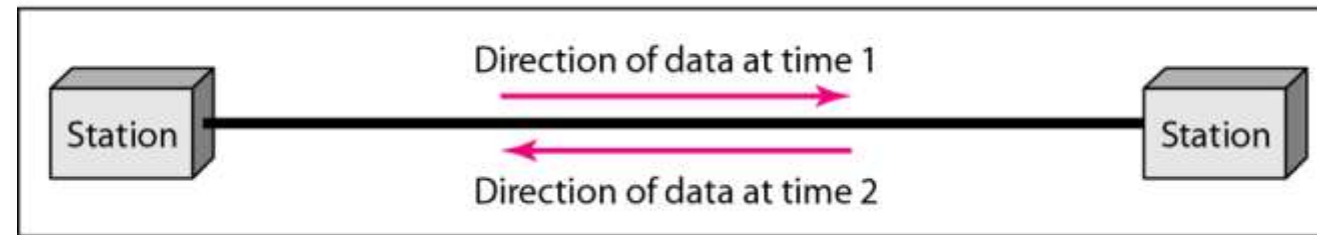 1. Simplex

  2. Half-duplex

  3. Full-duplex

1. Simplex

- Communication is unidirectional

- Only one of the two devices on a link can transmit; the other can only receive.

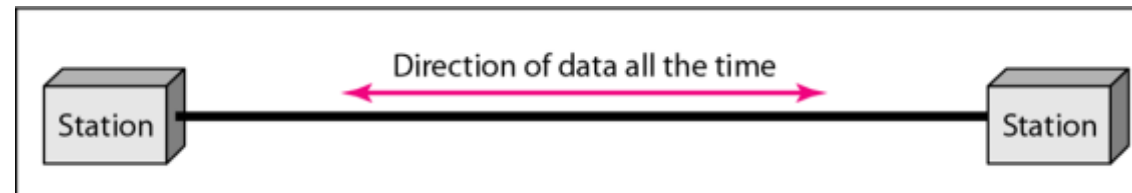- E.g. : One way street, Keyboard , Monitor.

2. Half duplex

- 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.

- E.g.: Walkie Talkie.

3. Full duplex

- Both stations can transmit and receive simultaneously.

- It is like a two way street with the traffic flowing in both the directions at the same time.

- E.g .: Telephone network

- 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 and/or receiving data generated by other nodes on the network.

- A link can be a cable, air, optical fiber, or any medium which can transport a signal carrying information.

1. Performance

- Measured in terms of:
  - ‣ Transit time: time taken to travel a message from one device to another.
  - ‣ Response time: time elapsed between enquiry and response.
- Depends on following factors:
  - ‣ Number of users
  - ‣ Type of transmission medium
  - ‣ Efficiency of software
- Evaluated by 2 networking metrics:
  - ‣ Throughput (high): how fast we can send the data through network?
  - ‣ Delay (small) : how long does it take for an entire message to completely arrive at the destination

2. Reliability

- Measured by

  ‣ Frequency of failure.

  ‣ Time taken to recover from a network failure.
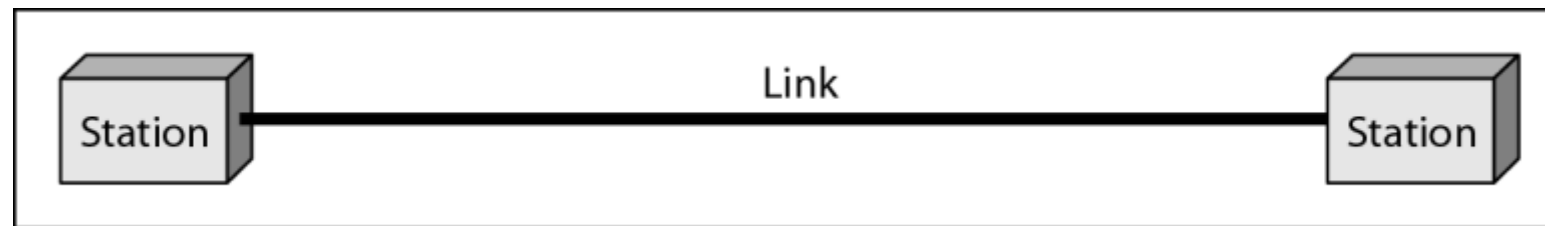
  ‣ Network robustness in a disaster.

3. **Security**

- Protecting data from unauthorized access, damage and development.

- Implementing policies and procedures for recovery from breaches and data losses.
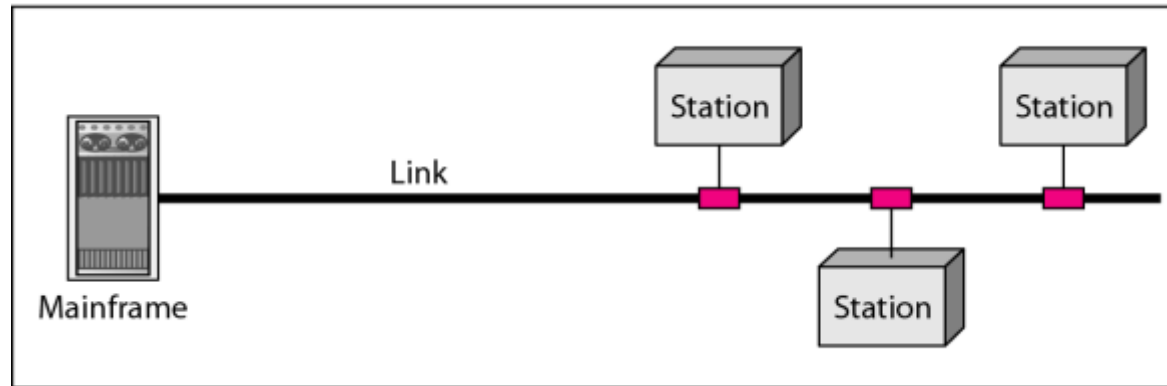
Type of Connection

1. Point to Point :

▪ It provides a dedicated link between two devices .

▪ The entire capacity of the link is reserved for transmission between those two devices.

▪ It uses an actual length of wire or cable to connect the two ends.

▪ When we change TV channels by infrared remote control, we are establishing a point-to-point connection between remote control and TV's control system
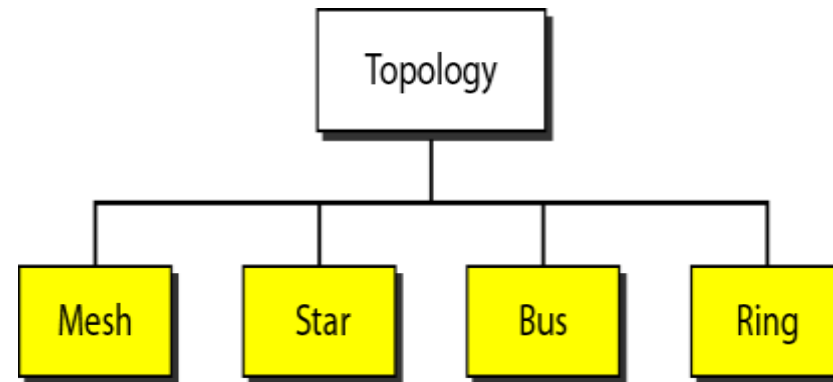
2. Multipoint

- It is the one in which more than two specific devices share a single link.

- Capacity of the channel is either spatially or temporally shared.

  ‣ Spatially shared : Several devices can use the link simultaneously.

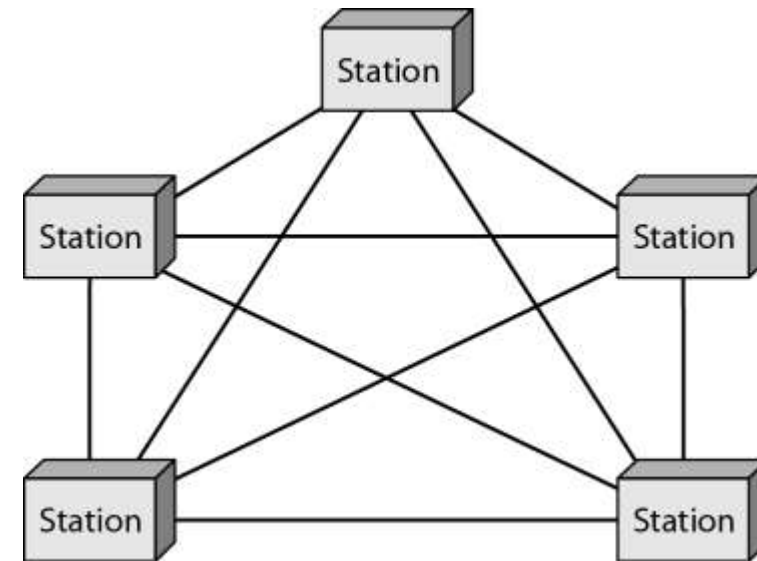 ‣ Temporally shared : Users take turns.

Physical Topology

- Topology of network is the geometric representation of all links and linking devices to one another

- Basic topologies:

  1. Mesh

  2. Star

  3. Bus and

  4. Ring

1. Mesh Topology

- Point to Point connection

- Every device has a dedicated point-to point link to every device.

- The term dedicated means that the link carries traffic only between the two devices it connects.

- For **n** nodes

  ‣ n(n-1) physical links

  ‣ n(n-1)/2 duplex mode links

- Every device have (n-1) I/O ports to be connected to other (n-1) devices.

- **Advantages:**

  ‣ A mesh topology is robust. If one link becomes unusable, it does not incapacitate the entire system.

  ‣ Point-to-point links make fault identification and fault isolation easy.

  ‣ Privacy or security : When every message travels along a dedicated line, only the intended recipient sees it.
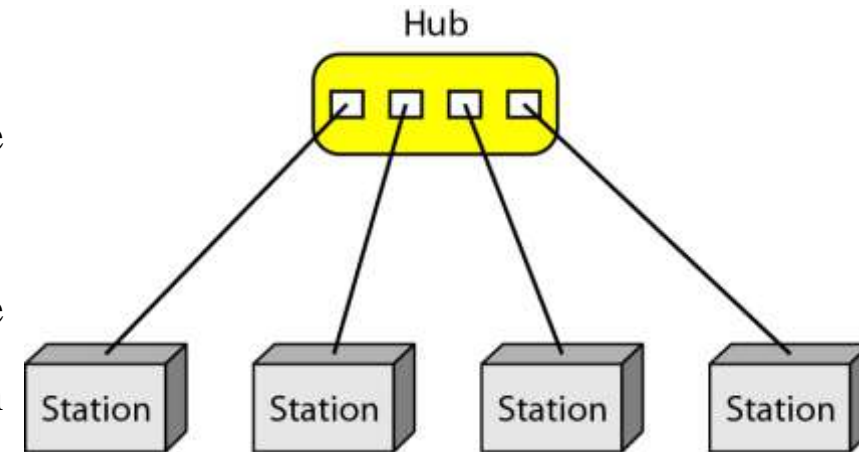
- **Disadvantages:**

  ‣ Difficult installation and reconfiguration.

  ‣ Bulk of wiring occupies more space than available space.

  ‣ Hardware required to connect each link is expensive.

- **Practical example:** connection of telephone regional offices in which each regional office needs to be connected to every other regional office.

2. Star Topology

- Point to Point connection

- All the devices are connected to a central controller called a hub

- Dedicated point-to-point link between a device & a hub.

- The devices are not directly linked to one another. Thus, there is no direct traffic between devices.

- The hub acts as a junction:
  - ‣ If device-1 wants to send data to device-2,
  - ‣ the device-1 sends the data to the hub, then the hub relays the data to the device-2.

- **Advantages:**

  ‣ A star topology is less expensive than a mesh topology. Each device needs only one link and one I/O port to connect it to any number of others.

  ‣ Easy to install and reconfigure.

  ‣ Requires less cabling, less expensive than mesh topology.

  ‣ Robustness: If one link fails, only that link is affected. All other links remain active. As a result fault identification and fault isolation becomes easy.

- **Disadvantages :**

  ‣ Dependency of whole topology on one single point, the hub.

- **Example** : Local area network

3. Bus Topology

- Multipoint connection

- All the devices are connected to the single cable called bus (backbone)

- Devices are connected to the bus by drop-lines and taps.

- A drop-line is a connection running between the device and the bus (main cable).

- A tap is a connector that links to the bus.