بسم الله الرحمن الرحيم

Fundamentals of Data Networks

Chapter 1: Introduction

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Chapter 1: Introduction

Introduction

- Data communications and networking
  - Change the way we do business and the way we live
  - Business decisions have to be made more quickly
  - Decision depends on immediate access to accurate information
  - Business today rely on computer networks and internetworks

  - Before get hooked up, we need to know:
    - How networks operate
    - What types of technologies are available
    - Which design best fills which set of needs

Introduction

○ Development of the PC changes a lot in business, industry, science and education.

○ Similar revolution is occurring in data communication and networking

- Technologies advances are making it possible for communications links to carry more and faster signals

- Services are evolving to allow the use of this expanded capacity

- For example telephone services extended to have:

  · Conference calling

  · Call waiting

  · Voice mail

  · Caller ID

1.1 Data Communications

Communication:

- Means sharing information
  - Local (face to face) or remote (over distance)
- Telecommunication
  - Telephone, telegraph and television
  - Means communication at a distance
  - Tele is Greek for far

Data Communications

Data:

- Refers to information
  - Presented in any form
  - Agreed upon by the parties (creating & using)

Data communication : is the exchange of data between two devices via some form of transmission medium (wire cable).

Data Communications

○ Communication system made up of a combination of hardware and software

○ Effectiveness of data communication system depends on:

1. Delivery : The system must deliver data to correct destination. Data received by the indented user only

2. Accuracy: The system must deliver data accurately (no change).

   • Data changed & uncorrected is unusable

Data Communications

3. Timeliness: The system must deliver data in timely manner
   - Data arrived late are useless
   - In the same order (video and audio) & without delay (Real time transmission)

4. Jitter: Variation in the packet arrival time (uneven quality in the video is the result)

Components

○ A data communication system is made up of five components
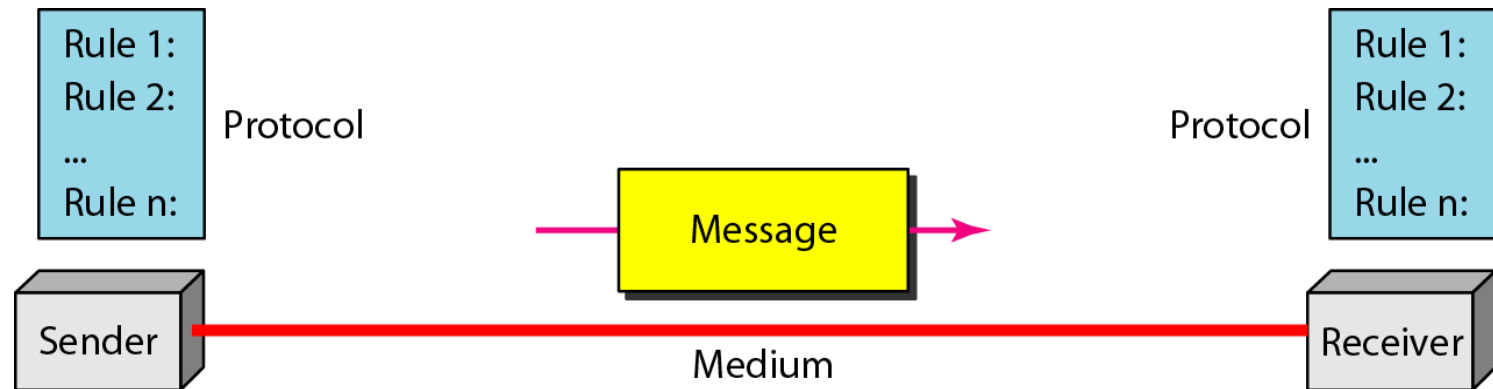
Components

1. Message: the information (data) to be communicated
   - Consist of text, numbers, pictures, audio, or video
2. Sender: the device that sends the data message
   - Computer, workstation, telephone handset, video camera, …
3. Receiver: the device that receives the message
   - Computer, workstation, telephone handset, television, ….

Components

4. Medium: The physical path by which a message travels from sender to receiver

    – twisted pair, coaxial cable, fiber-optic, radio waves
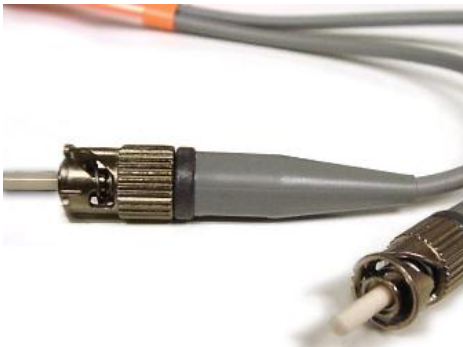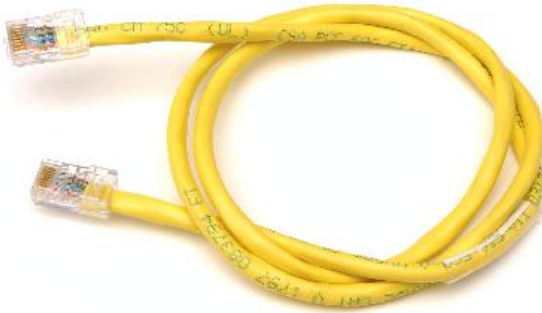
Components

5. Protocol: a set of rules that govern data communications

   – An agreement between the communicating devices

   – Devices may be connected but not communicating (no protocol)

   – Arabic speaker with Japanese speaker

Data Representation

Text

Numbers

Images

Audio

Video

Data Representation

- Text:
  - Sequence of bits (0s or 1s)
  - Different sets of patterns to represent text symbols (each set is called: *code*)
  - ASCII: 7 bits (128 symbols)
  - common coding system today is: **Unicode**
  - Unicode uses: 32 bits to represent a symbol or character in any language (4,294,967,296)

10101010 10101010 10101010 10101010 10101010 10101010 10101010

Data Representation

- Numbers:
  - Represented by bit patterns
  - The number is directly converted to a binary number

Data Representation

- Images:
  - Represented by bit patterns
  - A matrix of pixels
  - Resolution: size of the pixels
  - High resolution: more memory is needed
  - Each pixel is assigned a bit pattern
    - 1-bit pattern (black and white dots image)
    - 2-bit pattern (4 levels of gray)
    - RGB (color images)

Data Representation

- **Audio**:
  - Continuous not discrete
  - Change to digital signal
- **Video**:
  - Recording or broadcasting of a picture or movie
 - Change to digital signal

Data Flow

- Communication between two devices can be:
  - Simplex
  - Half-Duplex
  - Full-Duplex
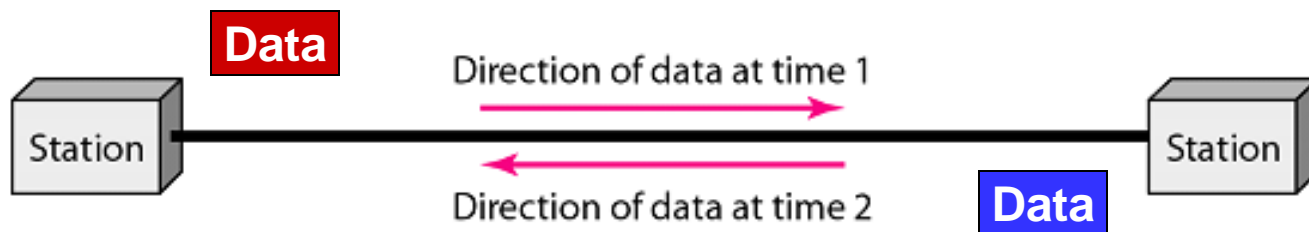
Data Flow

- Simplex (one way street)
  - The communication is unidirectional
  - Only one device on a link can transmit; the other can only receive
  - Use the entire capacity of the channel to send data
  - Example: Keyboards, Monitors

Mainframe — **Data** — Direction of data → — Monitor
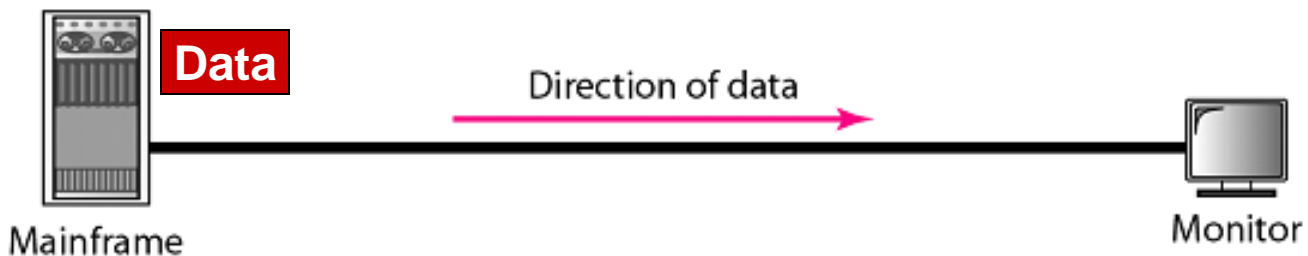
Data Flow

- Half-Duplex (one-lane with two-directional traffic)
  - 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
  - The entire capacity of a channel is taken over by the transmitting device
  - Example: Walkie-talkies

Data

Direction of data at time 1

Station

Direction of data at time 2

Data

Station

Data Flow

- **Full-Duplex (Duplex)** (two-way street)
  - 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 the other for receiving
    - The capacity of the channel is divided between signals travelling in both directions
  - Example: Telephone network
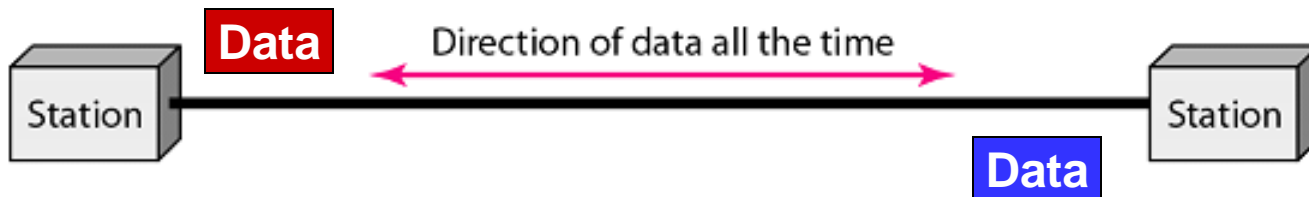
Exercise

- What mode of data flow the following exhibits shows?
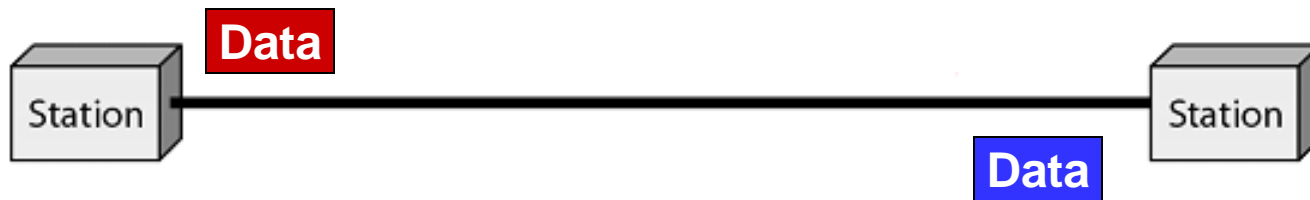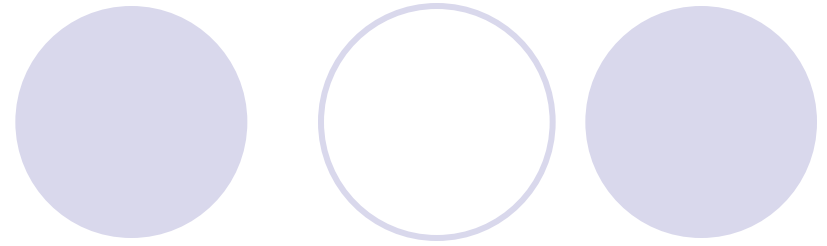

- Answer: Full-Duplex

Networks

○ Network : A set of devices (nodes) connected by communication links

   Node : computer, printer, …

   - Distributed Processing :

      - Most networks used it

      - Task is divided among multiple computers instead of one single large computer

Networks

- Network Criteria
  - Network must meet a certain number of criteria
  - The most important of the network criterions are:
    - Performance
    - Reliability
    - Security

Networks

- Performance
  - Transit time: A mount of time required for a message to travel from one device to another
  - Response time: Elapsed time between an inquiry and a response

Networks

- Performance
  - Performance depends on :

    1- Number of users: large number slow response time.

    2- Type of transmission medium: fiber-optic cabling faster than others cables.

    3- Capabilities of the connected hardware: affect both the speed and capacity of transmission.

    4- Efficiency of the software: process data at the sender and receiver and intermediate affects network performance.

Networks

- Performance
  - Performance is evaluated by two contradictory networking metrics:
    - Throughput (high): a measure of how fast we can actually send data through a network
    - Delay (low)

Networks

- Reliability
  - Reliability is measured by:
    1. Frequency of failure
    2. Recovery time of a network after a failure
    3. Network's robustness in a catastrophe: protect by good back up network system

Networks

- Security
  - Protecting data from unauthorized access
  - Protecting data from damage and development
  - Implementing policies and procedures for recovery from breaches and data losses (Recovery plan)
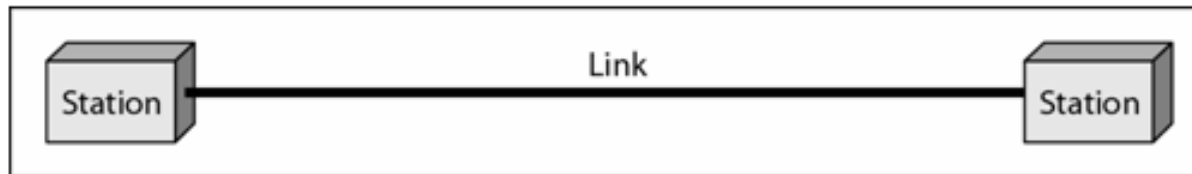
Networks

- Physical Structures:
  - Type of connection
    - Network: Two or more devices connected through links
    - Link: Communication pathway that transfers data from one device two another
    - Two devices must be connected in some way to the same link at the same time. Two possible types:
      - Point-to-Point
      - Multipoint

Networks

- Point-to-Point
  - Dedicated link between two devices
  - Entire capacity of the link is reserved for transmission between those two devices
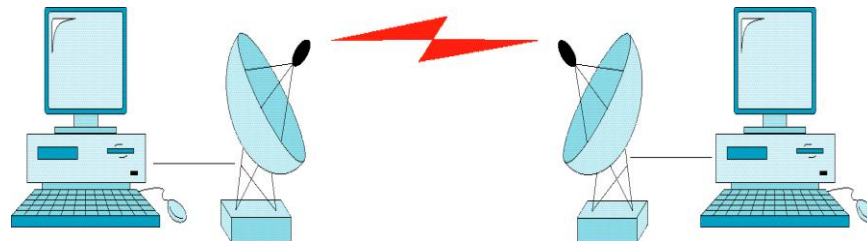 - Use an actual length of wire or cable

Link

Station — Station

a. Point-to-point
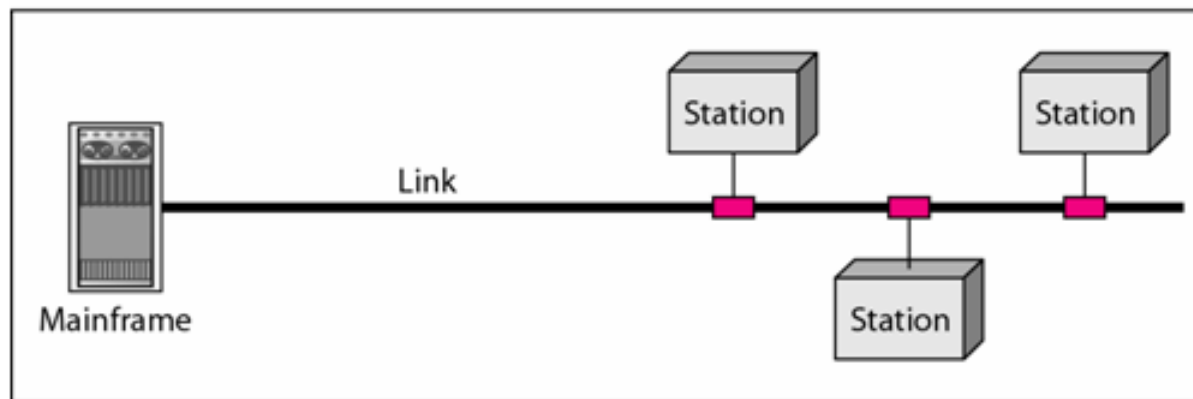
Networks

- Point-to-Point

  - Other options, such as microwave or satellite is possible
  - Example: Television remote control

Networks

- Multipoint (multidrop)
  - More than two devices share a single link
  - Capacity is shared
  - Channel is shared either spatially or temporally
    - Spatially shared: if devices use link at same time
    - Timeshare: if users must take turns

b. Multipoint