# DATA COMMUNICATIONS

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# INTRODUCTION

- When we communicate, we are sharing information. This sharing can be local or remote.
- The term **telecommunication**, which includes telephony, telegraphy, and television, means communication at a distance (tele is Greek for "far").
- 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.

# FUNDAMENTAL CHARACTERISTICS

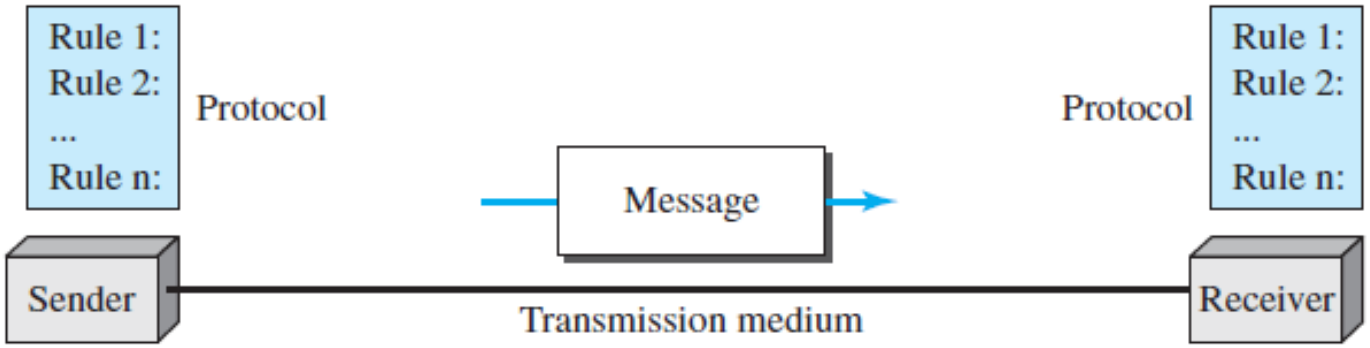
- The effectiveness of a data communications system depends on four fundamental characteristics:
  - **Delivery.** The system must deliver data to the correct destination.
  - **Accuracy.** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
  - **Timeliness.** The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called *real-time* transmission.
  - **Jitter.** Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that 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

- A data communications system has five components:
  - **Message:** The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
  - **Sender:** The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
  - **Receiver:** The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
  - **Transmission medium:** The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.
  - **Protocol:** A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

# COMPONENTS

**Figure 1.1** *Five components of data communication*



# DATA REPRESENTATION

- Information today comes in different forms such as text, numbers, images, audio, and video.
  - **Text**: text is 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, and the process of representing symbols is called coding. Ex: Unicode and American Standard Code for Information Interchange (ASCII)
  - **Numbers**: Numbers are also represented by bit patterns.
  - **Images**: Images are also represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels (picture elements), where each pixel is a small dot. The size of the pixel depends on the resolution.
  - **Audio**: Audio refers to the recording or broadcasting of sound or music. Audio is by nature different from text, numbers, or images. It is continuous, not discrete.
  - **Video**: Video refers to the recording or broadcasting of a picture or movie. Video 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.

# DATA FLOW

- Communication between two devices can be simplex, half-duplex, or full-duplex:
  - **Simplex**: In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive. Keyboards and traditional monitors are examples of simplex devices. The simplex mode can use the entire capacity of the channel to send data in one direction.
  - **Half-Duplex:** In half-duplex mode, each station can both transmit and receive, but not at the same time. In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time. Walkie-talkies and CB (citizens band) radios are both half-duplex systems.
  - **Full-Duplex:** In full-duplex mode (also called duplex), both stations can transmit and receive simultaneously. In full-duplex mode, signals going in one direction share the capacity of the link with signals going in the other direction. One common example of full-duplex communication is the telephone network.

# DATA FLOW

**Figure 1.2** *Data flow (simplex, half-duplex, and full-duplex)*