

## DATA COMMUNICATION AND NETWORKING

Data communications and networking are changing the way we do business and the way we live. Business decisions have to be made ever more quickly, and the decision makers require immediate access to accurate information. Why wait a week for that report from Germany to arrive by mail when it could appear almost instantaneously through computer networks? Businesses today rely on computer networks and internetworks. But before we ask how quickly we can get hooked up, we need to know how networks operate, what types of technologies are available, and which design best fills which set of needs.

When we communicate, we are sharing information. This sharing can be local or remote. Between individuals, local communication usually occurs face to face, while remote communication takes place over distance. 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.

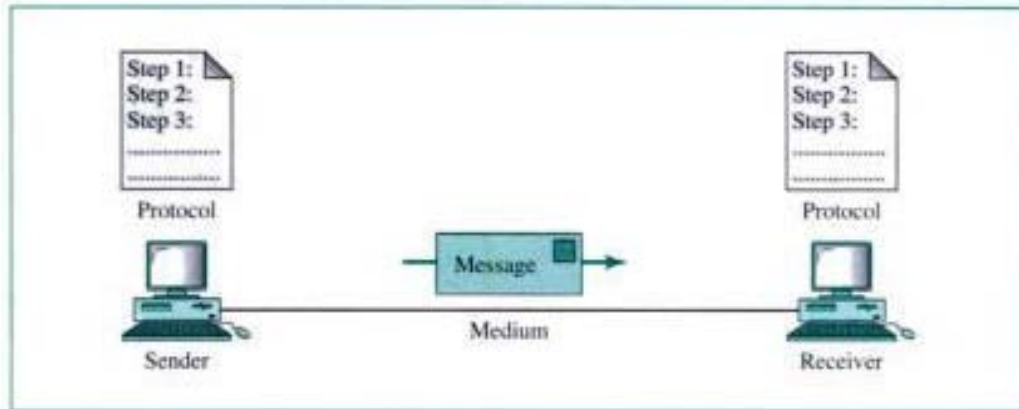
**Data communications** is the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs). The effectiveness of a data communications system depends on three fundamental characteristics: delivery, accuracy, and timeliness.

1. **Delivery.** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
2. **Accuracy.** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
3. **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.

## Components

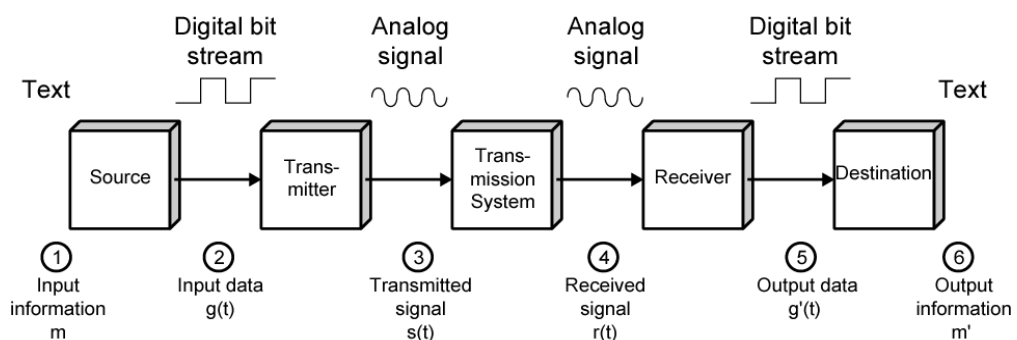
A data communications system has five components (see Fig. 1.1).

**Figure 1.1** Five components of data communication



1. **Message.** The **message** is the information (data) to be communicated. It can consist of text, numbers, pictures, sound, or video—or any combination of these.
2. **Sender.** The **sender** is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
3. **Receiver.** The **receiver** is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
4. **Medium.** The **transmission medium** is the physical path by which a message travels from sender to receiver. It could be a twisted-pair wire, coaxial cable, fiber-optic cable, or radio waves (terrestrial or satellite microwave).
5. **Protocol.** A **protocol** is a set of rules that governs 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.

## Data Communications Model



# NETWORKS

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.

## Distributed Processing

Most networks use **distributed processing**, in which a task is divided among multiple computers. Instead of a single large machine being responsible for all aspects of a process, separate computers (usually a personal computer or workstation) handle a subset.

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### Advantage

#### **1. Security/encapsulation**

A system designer can limit the kinds of interactions that a given user can have with the entire system, for example a bank can allow user access to their own accounts through an automated teller machine (ATM) without allowing them access the bank's entire database.

#### **2. Distributed databases**

No one system needs to provide storage capacity for the entire database. For example the World Wide Web (www) gives users access to the information that may be actually stored and manipulated anywhere on the internet.

#### **3. Faster problem solving**

Multiple computers working on parts of a problem concurrently can often solve the problem faster than a single machine working alone for example a network of PCs have broken encryption codes that were presumed to be unbreakable because the amount of time it would take a single computer to crack them.

#### **4. Security through redundancy**

Multiple computers running the same program at the same time can provide security through redundancy. For example a space shuttle, three computers run the same program so that if one has a hardware error, the other two can override it.

## 5. Collaborative processing

Both multiple computers and multiple users may interact on a task, for example in multi-user network game the actions of each player are visible to and affect all the others.

### Applications:

- 1- Marketing and sales
- 2- Financial services
- 3- Manufacturing
- 4- Electronic massaging
- 5- Directory services
- 6- Information services
- 7- Electronics data interchange (EDI)
- 8- Teleconferencing
- 9- Cellular telephone
- 10-Cable television

## Protocols

In computer networks, communication occurs between entities in different systems. An **entity** is anything capable of sending or receiving information. However, two entities cannot simply send bit streams to each other and expect to be understood. For communication to occur, the entities must agree on a protocol. A **protocol** is a set of rules that governs data communications. 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.** Syntax refers to the structure or format of the data, meaning the order in which they are presented. For example, a simple protocol might expect the first 8 bits of data to be the address of the sender, the second 8 bits to be the address of the receiver, and the rest of the stream to be the message itself.
- **Semantics.** Semantics refers to the meaning of each section of bits. How is a particular pattern to be interpreted, and what action is to be taken based on that interpretation? For example, does an address identify the route to be taken or the final destination of the message?
- **Timing.** Timing refers to two characteristics: when data should be sent and how fast they can be sent. For example, if a sender produces data at 100 Mbps but the receiver can process data at only 1 Mbps, the transmission will overload the receiver and data will be largely lost.

## **Standard Creation Committees**

### **1- ISO(The International Standard Organization)**

created in 1947

is an organization dedicated to worldwide agreement on international standards in a variety of fields(scientific, technological, economic activity)

OSI model

### **2- ITU-T(International Telecommunication Union Telecommunication Standards Sector)**

is an international standards organization related to the United Nations that develops standards for telecommunications.

### **3- ANSI(American National Standard Institute)**

is a nonprofit organization and is the U.S. voting representative to be both the ISO and the ITU-T

### **4- ETSI(European Telecommunications Standards Institute)**

### **5- IEEE(Institute of Electrical and Electronic Engineers)**

is the largest national professional group involved in developing standards for computing, communication, electrical engineering, and electronics)

### **6- EIA(Electronic Industries Association)**

is an association of electronics manufactures in the United States. (EIA-232-D, EIA-530 standards)