Communication and Computer Networks

Lesson 1... Introduction and physical level.

Abstract

In this lesson the aim is to give the students a general view about what the communication and computer networks actually means and also make them familiar with some new terms connected with this subject. The properties of the computer networks and the communication items will introduce in this lessons. They will be covered, in details, in next lessons.

Key points;

Introduction

A **computer network or data network** is a telecommunications network that allows computers to exchange data. In computer networks, networked computing devices pass data to each other along data connections. Data is transferred in the form of **packets**. The connections (network links) between nodes are established using either **cable media** or **wireless media**. The best-known computer network is the **Internet**.

Network computer devices that originate, route and terminate the data are called **network nodes**. Nodes can include **hosts** such as personal computers, phones, servers as well as networking hardware. Two such devices are said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other.

Computer networks support applications such as access to the World Wide Web, shared use of application and storage servers, printers, and fax machines, and use of email and instant messaging applications. Computer networks differ in the physical media used to transmit their signals, the communications protocols to organize network traffic, the network's size, topology and organizational intent.

A Communication Model

The fundamental purpose of a communications system is the exchange of data between two parties. Figure l.l presents one particular example, which is the communication between a workstation and a server over a public telephone network.

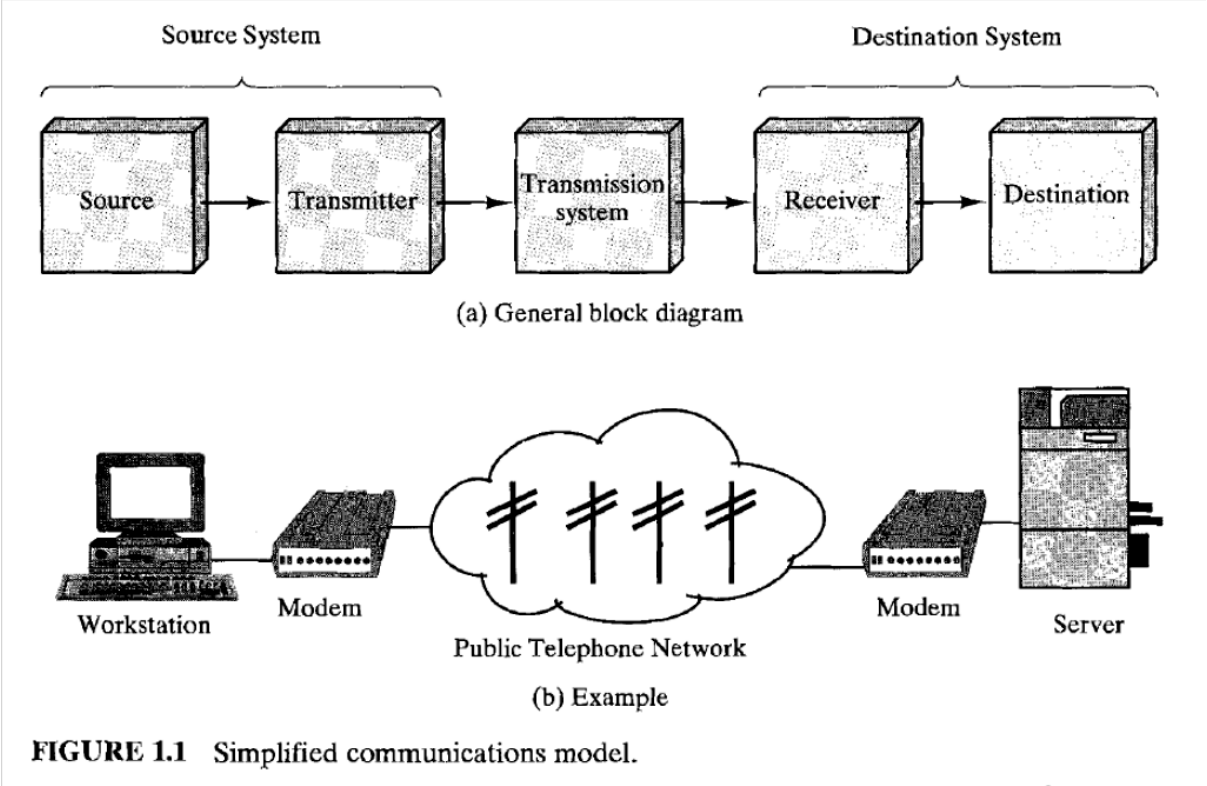

FIGURE 1.1 Simplified communications model.

Another example is the exchange of voice signals between two telephones over the same network. The key elements of the model are:

- **Source**. This device generates the data to be transmitted; examples are telephones and personal computers.
- **Transmitter**. Usually, the data generated by a source system are not transmitted directly in the form in which they were generated. Rather, a transmitter transforms and encodes the information in such a way as to produce electromagnetic signals that can be transmitted across some sort of transmission system. For example, a modem takes a digital bit stream from an attached device such as a personal computer and transforms that bit stream into an analog signal that can be handled by the telephone network.

- **Transmission System**. This can be a single transmission line or a complex network connecting source and destination.
- **Receiver**. The receiver accepts the signal from the transmission system and converts it into a form that can be handled by the destination device. For example, a modem will accept an analog signal coming from a network or transmission line and convert it into a digital bit stream.
- **Destination**. Takes the incoming data from the receiver.

The key tasks that must be performed in a data communications system.

- Transmission system utilization
- Interfacing
- Signal generation
- Synchronization
- Exchange management
- Error detection and correction
- Flow control
- Addressing
- Routing
- Recovery
- Message formatting
- Security
- Network management

Transmission system utilization, refers to the need to make efficient use of transmission facilities that are typically shared among a number of communicating devices. Various techniques (referred to as multiplexing) are used to allocate the total capacity of a transmission medium among a number of users. Congestion control techniques may be required to assure that the system is not overwhelmed by excessive demand for transmission services.

interface ; in order to communicate, a device must with the transmission system. All the forms of communication discussed in this book depend, at bottom, on the use of electromagnetic signals propagated over a transmission medium.

Signal generation is required for communication once an interface is established. The properties of the signal, such as form and intensity, must be such

that they are (1) capable of being propagated through the transmission system, and (2) interpretable as data at the receiver.

Synchronization; in the communication system, not only must the signals be generated to conform to the requirements of the transmission system and receiver, but there must be some form of synchronization between transmitter and receiver. The receiver must be able to determine when a signal begins to arrive and when it ends. It must also know the duration of each signal element.

Exchange management. If data are to be exchanged in both directions over a period of time, the two parties must cooperate. For example, for two parties to engage in a telephone conversation, one party must dial the number of the other, causing signals to be generated that result in the ringing of the called phone.

Error detection and correction are required in circumstances where errors cannot be tolerated; this is usually the case with data processing systems.

Flow control is required to assure that the source does not overwhelm the destination by sending data faster than they can be processed and absorbed.

Addressing and routing, when a transmission facility is shared by more than two devices, a source system must somehow indicate the identity of the intended destination. The transmission system must assure that the destination system, and only that system, receives the data.

Recovery is a concept distinct from that of error correction. Recovery techniques are needed in situations in which an information exchange, such as a data base transaction or file transfer, is interrupted due to a fault somewhere in the system.

Message formatting has to do with an agreement between two parties as to the form of the data to be exchanged or transmitted. For example, both sides must use the same binary code for characters.

Security, frequently, it is important to provide some measure of security in a data communications system. The sender of data may wish to be assured that only the intended party actually receives the data; and the receiver of data may wish to be assured that the received data have not been altered in transit and that the data have actually come from the purported sender.

Network management capabilities are needed to configure the system, monitor its status, react to failures and overloads, and plan intelligently for future growth.

Data Communication Networking

In its simplest form, data communication takes place between two devices that are directly connected by some form of point-to-point transmission medium. Often, however, it is impractical for two devices to be directly, point-to-point connected.

This is so for one (or both) of the following contingencies:

- The devices are very far apart. It would be inordinately expensive, for example, to string a dedicated link between two devices thousands of miles apart.
- There is a set of devices, each of which may require a link to many of the others at various times. Examples are all of the telephones in the world and all of the terminals and computers owned by a single organization. Except for the case of a very few devices, it is impractical to provide a dedicated wire between each pair of devices.

The solution to this problem is to attach each device to a communications network. Figure 1.2 relates this area to the communications model of Figure l.l and also suggests the two major categories into which communications networks are traditionally classified: wide-area networks (WANs) and local-area networks (LANs).

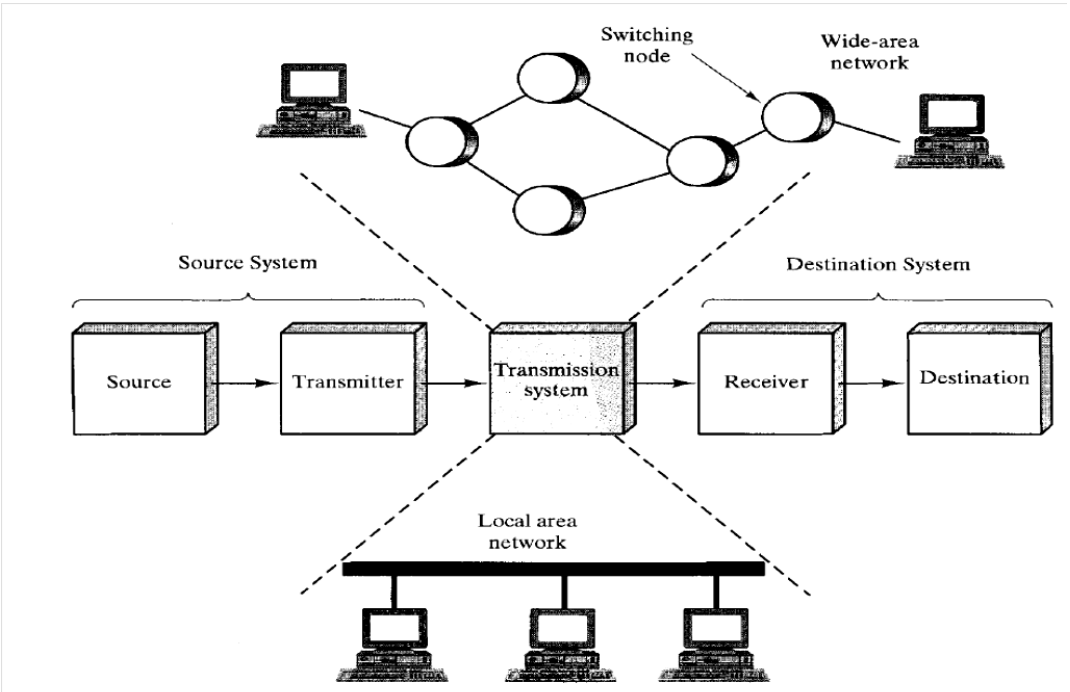

FIGURE 1.3 Simplified network models.

The distinction between the two, both in terms of technology and application, has become somewhat blurred in recent years, but it remains a useful way of organizing the discussion.

Wide-Area Networks

Wide-area networks have been traditionally been considered to be those that cover a large geographical area, require the crossing of public right-of-ways, and rely at least in part on circuits provided by a common carrier. Typically, a WAN consists of a number of interconnected switching nodes. A transmission from any one device is routed through these internal nodes to the specified destination device. These nodes (including the boundary nodes) are not concerned with the content of the data; rather, their purpose is to provide a switching facility that will move the data from node to node until they reach their destination.

Local Area Networks

As with wide-area networks, a local-area network is a communications network that interconnects a variety of devices and provides a means for information exchange among those devices. The scope of the LAN is small, typically a single building or a cluster of buildings. It is usually the case that the LAN is owned by the same organization that owns the attached devices. For WANs, this is less often the case, or at least a significant fraction of the network assets are not owned.

Ref.

1- **"**COMPUTER NETWORKS" FIFTH EDITION By TANENBAUM and WETHERALL 2011.

2- Data and Computer Communications - william stallings 1997.