

Fundamental of Computer Networks

By: Gajendra Nayal

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NEERAJ PUBLICATIONS

(Publishers of Educational Books)

Sales Office : 1507, 1st Floor,

Nai Sarak, Delhi-110 006

E-mail: info@neerajbooks.com

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Sample Preview of The Chapter

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FUNDAMENTAL OF COMPUTER NETWORKS

CONCEPTS OF COMMUNICATION AND NETWORKING

1

Basics of Data Communication

INTRODUCTION

Communication can be defined as the exchange of information of any kind by any means from one location to another location. Communication system is the system that is involved to achieve the goal of information exchange. For example, exchange of voice signals between two telephones over the same network. Communication between a workstation and a server over a public telephone network, so data communication is the transfer of digital or analog data using digital or analog signals over some form of network.

In this chapter, we will discuss about the basic concepts of data communication and their modes. How to transmits the data from one location to another location? We will also discuss the basic Network, protocols and standards, and their designing issues.

CHAPTER AT A GLANCE

CONCEPT OF COMMUNICATION SYSTEM

Data communication is the exchange of data (in the form of os and is) between two devices via some form of transmission medium (such as a network cables). Data communication is considered local if the communicating devices are in the same building or a similarly restricted geographical area, and is considered remote if the devices are farther apart.

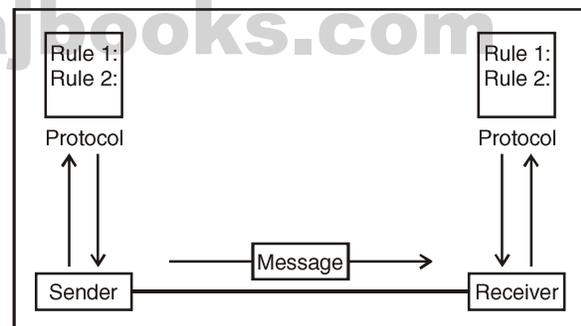
The effectiveness of a data communication system depends on three fundamental characteristics.

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 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 data timely deliver means delivering data as they are produced, in the same order that they are produced without significant delay. This kind of delivery is called real time transmission.

A data communication system is made up of five components:



1. Message: The message is the information to be communicated. It can consist of text, number, pictures, sound or video or any combination of these.

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

3. Receiver: The receiver is the device that receives the message.

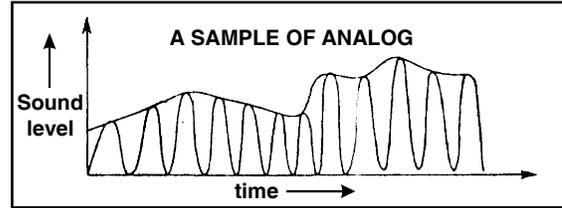
4. Medium: The transmission medium is the physical path by which a message travels from sender to receiver.

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5. Protocol: A Protocol is a set of rules that govern data communication.

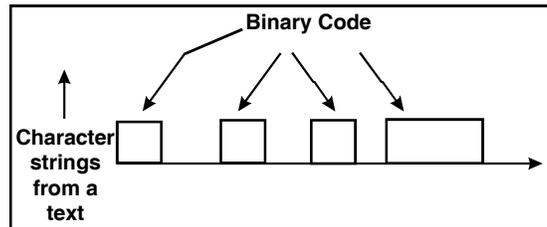
ANALOG AND DIGITAL COMMUNICATION

Analog Data Transmission: Sound coming out from an instrument is an analog data communication. Analog data is continuous over an interval. A representation of analog signal is shown in the Figure.



Another example of analog data is video.

Digital Data Transmission: Digital data is discrete. Examples are text and integers. They have to be represented by a sequence of bits for communication. A sample is shown below:



<i>Particulars</i>	<i>Analog</i>	<i>Digital Transmission</i>
1. Form	Continuous variable of physical quantities, such as electric current.	Discrete quantities with binary digits.
2. Cost of transmission	Low	High
3. Efficiency	Low	High
4. Maintenance cost	High	Low
5. Effect of noise	High	Low
6. Attenuation	High	Low
7. Examples	Radio transmission, TV channels	Data transmission of text and integers

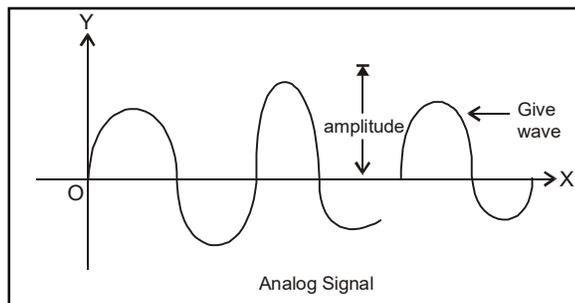
Comparison of Analog and Digital Data Communication: One drawback of analog communication is that it is very sensitive to disturbances. Digital data communication has no such problem.

Analog and digital are the two types of signals used in data transmission.

Analog Signal

Values of analog signals keep varying. The change in the values are used to represent data. The analog signal is continuous and can be represented as sine wave. Examples of analog signal are:

Human voice, Video, Audio and music etc.



The analog signals vary in amplitude (Volume) and frequency (pitch). These signals suffer from problem of attenuation on their way, and amplifiers have to be used to overcome it. The disadvantage is amplifiers also amplify noise along with the original signal. Therefore, if a signal is distorted, it cannot be reconstructed and becomes a permanent loss. Thus, analog transmission is not used when high level of accuracy of data transmission is required. It is used in the telephone system, where a small distortion of human communication does not matter.

Analog techniques have the unique capability to capture real world as it exists. But their perfect copying or reproduction is not possible. This is because analog signals cannot be copied perfectly.

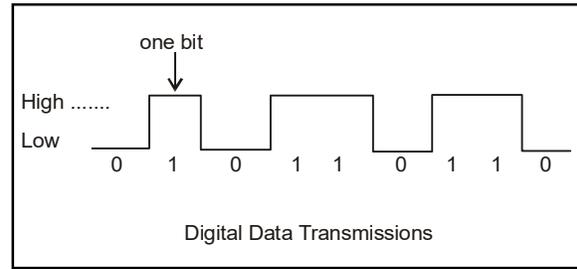
Therefore, the original analog signals are converted into digital signals to preserve audio/video in original for indefinite time or preservation.

In the digital form, the original analog signals can be stored and transmitted without loss of integrity due to accuracy inherent in digital signals.

Digital Data Transmission

Digital data is discontinuous and discrete. All computers are digital machines, which can work only at two levels of signals 0 and 1, or ON and OFF. All data for use in computer is digital encoded as a sequence of 0's and 1's in series.

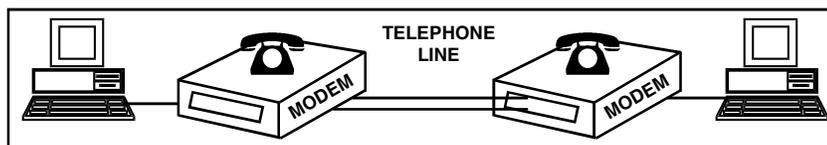
The output of computers is in the form of digital signals. The bandwidth of a digital signal is material compared to any medium, which has a limited bandwidth.



As the digital signal travels along a medium (with limited bandwidth) it gets distorted, and therefore, after a certain distance, the signal becomes unrecognizable. Before this happens, a hardware device called repeater is used to regenerate the digital signal. Exactly same signal is regenerated and there is no loss of information. The number of repeaters depend on the distance between the source and the destination. The line between the two is called digital line. When analog information, music, voice, and video are converted into binary digital form, they can be electronically manipulated, preserved and regenerated perfectly at very high speeds. Any number of copies can be made in exactly same quality. This is the greatest advantage of digital processing.

COMMUNICATION MODES

In sending and receiving messages of data from one place to another many elements work together. These elements put together called a system. The communication system passes data or information in the most effective manner. A communication system is shown in the Figure below:



Communication system is made up of hardware, software and data transfer links. It transfers data in a cost-effective manner across the links.

A communication system can be either analog or digital (or a combination of both). That is, the information can be transmitted in either analog or digital form within the communication networks. For example, computer generated data is digital, whereas the telephone lines are convenient to carry analog signals. Digital data are sent over analog telephone lines by converting digital signals to analog form. The technique

used is called modulation. The reverse process is conversion of analog signal to digital form at the destination is called demodulation. The process of modulation and demodulation is done by a special device called modem (short form for modulation/demodulation).

The analog form of message is sent via telephone line to the destination, where it is again converted into digital pulses by the modem at receiver computer. Thus the message or data is transmitted and received by the two computers.

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As the analog signal passes through the telephone lines, its quality decreases with distance. Amplifiers are used to boost the strength of the signal. But the amplifiers add noise to the signal and sometimes cause disruption of the message. But good quality of modems at both ends are able to minimize the effect of noise.

Advantages of Digital Transmission over Analog Transmission

- Voice data, music and images (e.g. television, fax and video) can be interspersed for more efficient use of the circuits and equipment.
- Much higher data rates are possible using existing telephone lines.
- Digital transmission is cheaper than analog transmission, since it is not necessary to accurately reproduce an analog waveform passing through several amplifiers on a long distance line. Being able to correctly distinguish 0 from 1 is enough.
- Maintenance of a digital system is easier than maintenance of analog system. A transmitted bit is either received correctly or not. It is simpler to track down the errors.
- A digital signal can pass through any number of regenerators (amplifiers in analog systems) with no loss in signal and, thus, long distances with no information loss. But analog signals always face some information loss when amplified, and this loss is accumulative. Digital transmission has error rate.

Data Communication Modes: In a digital communication system, there are two methods for data transfer: parallel and serial. Parallel connection have multiple wires running parallel to each other, and can transmit data on all the wires simultaneously. Serial, on the other hand uses a single wire to transfer the data bits one at a time.

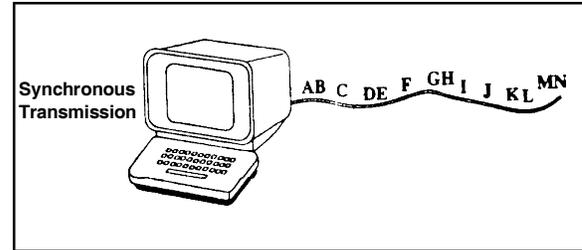
Parallel Data: The parallel port on modern computer systems is an example of a parallel communications connection. IDE hard-disk connection are another good example of parallel connections in a computer system.

Serial Data: The serial port on modern computers is a good example of serial communications. USB and fire wire are good examples of other serial communication standards.

ASYNCHRONOUS AND SYNCHRONOUS TRANSMISSION

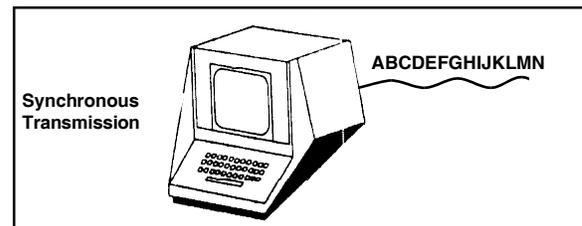
Asynchronous refers to a series of events that take place which are not synchronized one after the other.

Thus the time interval between events A and B in Figure below is not the same as B and C.



Asynchronous Transmission: Asynchronous transmission is often referred to as start-stop transmission because of the nature, that is, the sender can send a character at any time convenient and the receiver will accept it. Asynchronous communication lines remain in an idle state until the hardware on the line is ready to transmit. Since the line is idle, series of bits are sent to the receiving node to tell it about data coming. When data is finished, the node has to be told that the transmission is complete. Hence, the STOP bits are sent. This pattern continues for the duration of the time the link is operative. Thus, in asynchronous transmission data is transmitted character by character at irregular times.

Synchronous Transmission: Synchronous devices do not use Start and Stop bits. Coordination between the sender and the receiver is handled differently. There are two channels—one for data and other for link synchronization. The channel for synchronization uses the integral clock in the hardware for link synchronization between the two nodes when one of the nodes is ready to transmit data, a unique combination of bits called a synchronous character is sent to the receiver. Since the first character will probably get trashed, a second one usually follows to ensure that synchronization is complete.



Synchronous transmission means blocking a group of characters in way records are blocked on magnetic tape.