

MCA : MANAGEMENT : SEMESTER-II

ESSENTIALS OF NETWORKING

**A. V. DHAYGUDE A. V. DHUMANE
R. PATIL**



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PRAKASHAN**
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PREFACE

There has been significant development in recent years in the field of Computer Science. The book is a perfect blend of technology which has been a field of dramatic revolution; this subject focuses on different technologies of it.

It gives us great pleasure in presenting this book **“Essentials of Networking”** designed to serve as a textbook for students of the Second Semester of Master of Computer Application (M.C.A.). The book is organized in such a way that it mirrors the revised syllabus. The book will be found useful by a wide section of readers, teachers and students of Business, Technology and Computer Management courses in Indian Universities. The entire book is freshly written as per the revised syllabus.

The book has its own unique features. It brings out the subject in a very simple and lucid manner for easy and comprehensive understanding of the basic concepts, its intricacies, procedures and practices. This book will help the readers to have a broader view on Networking Concepts. The language used in this book is easy and will help students to improve their vocabulary of Technical terms and understand the matter in a better and happier way.

Particular attention has been paid to making this book stimulating and highly readable. The result is a text which is clear, focused and designed to capture student interest. This text is equally suitable for courses directed at undergraduates and postgraduates.

We have given our best inputs for this book. Any suggestions towards the improvement of this book and sincere comments are most welcome on niralipune@pragationline.com.

Authors

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We am also grateful to all the staff members of Nirali Prakashan, who were involved in the publication of this book.

Authors

SYLLABUS

1. Introduction (12 M, 5 Hrs.)

What is a Computer communication, communication system, Signal and Data, Channel Characteristics, Transmission Modes, Synchronous and asynchronous transmission. Transmission Media:

- a) Guided Media : Twisted Pair, Coaxial and Fiber-optic cables,
- b) Unguided Media: Radio, VHF, Micro Waves and Satellite

Multichannel Data Communication: Circuits, channels and multichanneling

Multiplexing: FDM, TDM, CDM and WDM

2. Common Network Architecture (13 M, 5 Hrs.)

Connection oriented N/Ws vs Connectionless N/Ws, Peer to peer networks, X.25 networks, Ethernet (Standard and Fast): frame format and specifications, Wireless LANs - 802.11(Architecture, issues, features etc.), 802.11x.

3. The OSI Reference Model (13 M, 5 Hrs.)

Protocol Layering, ISO/OSI reference Model, TCP/IP Model, OSI vs.TCP/IP

4. Local Area Networks (7 M, 3 Hrs.)

Components & Technology, Access Technique, Transmission Protocol & Media

5. Broad Band Networks (10 M, 4 Hrs.)

Integrated Service Digital Networks (ISDN), Broad Band ISDN, ATM and ATM Traffic Management, Very Small Aperture Terminal (VSAT)

6. IP Addressing & Routing (25 M, 10 Hrs.)

IP addresses – Network part and Host Part, Network Masks, Network addresses and

Broadcast addresses, Address Classes, Loopback address, IP routing concepts, Routing Tables, Stream & Packets, Sliding Windows, Role and Features of IP, TCP, TCP Connections, types and working. IPV6: The next generation Protocol

7. Application Layer (20 M, 8 Hrs.)

Domain Name System (DNS) and DNS servers, Electronic Mail: Architecture and services, Message Formats, MIME, message transfer, SMTP, Mail Gateways, Relays, Configuring Mail Servers, File Transfer Protocol, General Model, commands, World Wide Web: Introduction, Architectural overview, static and dynamic web pages, WWW pages and Browsing, HTTP.



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INTRODUCTION

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1.1 Introduction

Computer networks are now business critical in all modern organizations and business enterprises. They are important in everyday life. This subject introduces students to the fundamental issues in modern data communications and computer networks. This is essential knowledge for all users of IT, IT professionals and those who wish to specialize in computer networking.

1.1.1 What is a Computer Communication?

Communication is the conveyance of a message from one entity, called the source or transmitter, to another, called the destination or receiver, using a communication channel.

Communication is defined as transfer of information, such as thoughts and messages between two entities. The invention of telegraph, radio, telephone, and television made possible instantaneous communication over long distances.

To give a very basic example of such a communication system is conversation; people commonly exchange verbal messages, with the channel consisting of waves of compressed air molecules at frequencies, which are audible to the human ear. This is depicted in Fig. 1.1.

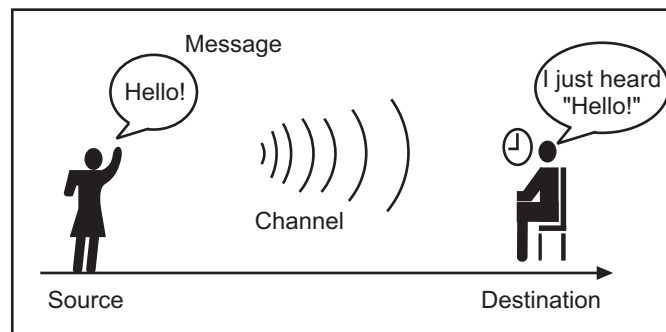


Fig. 1.1: Basic communication model

The conveyance of a message could be followed by a reciprocal response message from the original destination (now a source) to the original source (now a destination) to complete one cycle in a dialogue between corresponding entities. Depending on the application or need for the information exchange, either atomic one-way transactions or a two-way dialogue could be appropriate.

The only way that a message source can be certain that the destination properly received the message is by some kind of acknowledgment response from the destination.

Fig. 1.2 shows communication between one computer (sender/source) sending a message to another computer (receiver/destinations) over a wire.

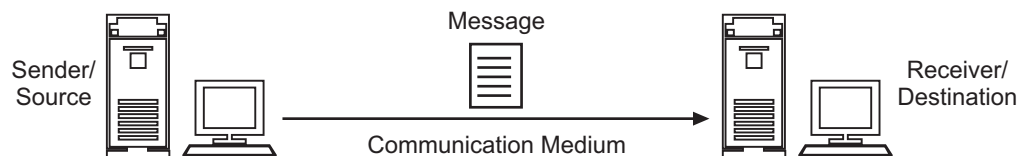


Fig. 1.2: Communication between two computers

1.1.2 Communication System

Data is a collection of facts in raw forms that become information after processing. This is the transfer of data or information between a source to a destination. The source transmits the data and the receiver receives it. In case of computer networks this exchange is done between two devices over a transmission medium.

The purpose of data communications is to provide the rules and regulations that allow computers with different disk operating systems, languages, cabling and locations to share resources. The rules and regulations are called protocols and standards in data communication.

The main objective of data communication and networking is to enable seamless exchange of data between any two points in the world. This exchange of data takes place over a computer network.

When we communicate, we are sharing information. This sharing can be local or remote. Data communications through the telephone network can reach any point in the world. The volume of overseas fax transmissions is increasing constantly, and computer networks that link thousands of businesses, governments and universities are pervasive.

In data communication, information comes in different forms such as text, images, audio, video and numbers.

1. **Text** is represented as a bit pattern. The sequence of bits is 0's or 1's. It consists of number of bit patterns. They represent text symbols. Each set of bit patterns is called as a code and process of representing symbols is called as coding.
2. **Images** are also represented by bit patterns. Image is composed of a matrix of pixels.
3. **Audio** refers to the recording or broadcasting of sound. Audio is continuous, not discrete. It is by nature different from text, numbers, images.
4. **Video** refers to recording or broadcasting of a picture or movie. Video can be combination of images, each a discrete entity arranged to convey the idea of the motion.
5. **Numbers** are represented by bit patterns.

A Computer Communication Network system containing any combination of computers, computer terminals, printers, audio or visual display devices, or telephones interconnected by telecommunications equipment or cables: used to transmit or receive information.

Components of Data Communication :

The main purpose of communication system is to exchange data between two points by electric means.

Fig. 1.3 shows exchange of the data between workstation and server on telephone lines.

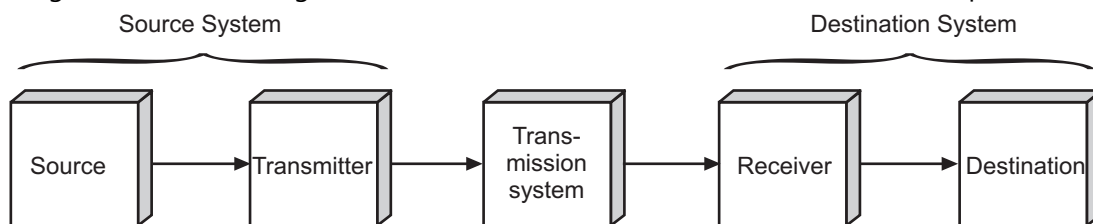


Fig. 1.3: Components of data communication

Following are the different blocks of communication system.

1. **Source:** Source generates the data which is to be transmitted. Examples of sources are telephone and personal computers.
Examples: (a) Terminal, (b) Computer, (c) Mainframe.
2. **Transmitter:** Data from the source are not transmitted in the same form which are generated by source, transmitter converts and encodes the data so as to produce electromagnetic signals. Modem is used to convert incoming data stream into analog signals that can be handled by telephone network.
3. **Transmission system:** It is a single transmission line or network connecting source and destination.
Examples: (a) Cabling, (b) Microwave, (c) Fiber optics.
4. **Receiver:** Function of the receiver is to accept the information from transmission line or network and converting it into digital data in the form of stream so that destination computer can handle the data.
Example: Printer terminal.
5. **Destination:** Destination is a device like computer that receives the data.

Characteristics of Data Communication System :

Characteristics of data communication system are listed below:

1. **Delivery:** The data or information should be delivered to correct destination.
2. **Timeliness:** For video and audio data the system should deliver the data or information in a timely manner i.e. without any time delay.
3. **Accuracy:** The communication system should be deliver data accurately i.e. without any error.
4. **Transmission system utilization:** It is a measure of use of transmission facilities that are shared among the number of communicating devices. Various multiplexing techniques are used to share total capacity of transmission medium with number of users.
5. **Synchronization:** Receiver must be able to detect when transmission begins and when it ends. Synchronization between receiver and transmitter should be achieved using handshaking signals.
6. **Error detection and Correction:** Transmitted signal may get distorted when it travels long distance through medium. For example, a file from one computer can be transmitted to other should be accompanied by error detection code.
7. **Exchange management:** Besides the nature and timing of signals, there are various requirement for communication between two parties that comes under the term exchange management.
8. **Message formatting:** Two parties should have some agreement about format of data to be exchanged or transmitted. Binary code for characters is to be adopted universally.

1.1.3 Signal and Data

Information that is stored within computer systems and transferred over a computer network can be divided into two categories: data and signals. Data are entities that convey meaning within a computer or computer system. If you want to transfer this data from one point to another, either by using a physical wire or by using radio waves, the data has to be converted into a signal. Signals are the electric or electromagnetic encoding of data and are used to transmit data.

Converting Data into Signals :

Like data, signals can be analog or digital. Typically, digital signals convey digital data, and analog signals convey analog data. However, you can use analog signals to convey digital data and digital signals to convey analog data. The choice of using either analog or digital signals often depends on the transmission equipment that is used and the environment in which the signals must travel. There are four combinations of data and signals: digital data transmitted using digital signals, digital data transmitted using analog signals, analog data transmitted using analog signals, and analog data transmitted using digital signals.

Table 1.1 : Four combinations of data and signals

Data	Signal	Encoding or Conversion Technique	Common Devices	Common Systems
Analog	Analog	Amplitude modulation Frequency modulation	TV tuner Radio tuner	Telephone AM and FM radio Broadcast TV Cable TV
Digital	Digital	NRZ-L NRZI Manchester Differential Manchester Bipolar-AMI 4B/5B	Digital encoder	Local area networks Telephone systems
Digital	(Discrete) Analog	Amplitude shift keying Frequency shift keying Phase shift keying	Modem	Dial-up Internet access DSL Cable modems Digital Broadcast TV
Analog	Digital	Pulse code modulation Delta modulation	Code	Telephone systems Music systems

1.1.4 Channel Characteristics

In computer networking, a communication channel or channel, refers either to a physical transmission medium such as a wire, or to a logical connection over a multiplexed medium such as a radio channel. A channel is used to convey an information signal, for example a digital bit stream, from one or several senders (or transmitters) to one or several receivers. A channel has a certain capacity for transmitting information, often measured by its bandwidth in Hz or its data rate in bits per second.

Communicating data from one location to another requires some form of r medium. These medium called communication channels, use two types of media: cable (twisted-pair wire, cable, and fiber-optic cable) and broadcast (microwave, satellite, radio, and infrared). Cable or wire line media use physical wires of cables to transmit data and information. Twisted-pair wire and coaxial cables are made of copper, and fiber-optic cable is made of glass.

Propagation time (channel latency): It is the amount of time required to propagate information from source to destination through the channel. It depends on media characteristics, signal propagation speed and transmission distance.

Throughput: It defined as the number of bits, characters or blocks passing through a data communication system over a period of time.

Throughput = Packet length in bits = Packet length in bits/(transmission time + propagation on time).

Bandwidth of a Signal:

Bandwidth of a signal is defined as the portion of the electromagnetic spectrum occupied by a signal. We can also define the bandwidth as "the frequency range over which an information signal is transmitted".

Bandwidth of analog and digital signals are calculated in separate ways; analog signal bandwidth is measured in terms of its frequency (Hz) but digital signal bandwidth is measured in terms of bit rate (bits per second, (bps)).

The bandwidth is the difference between the upper and lower frequency limits of the signal. Each of these signals (voice, music etc. signals) will have its own frequency range and this frequency range of a signal is known as its bandwidth.

The range of voice signal is 300 Hz to 3400 kHz as shown in Fig. 1.4.

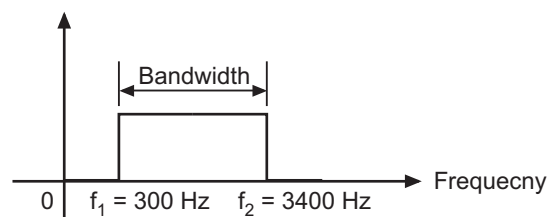


Fig. 1.4: Bandwidth of voice signal

$$\begin{aligned}
 \text{Therefore, BW (Bandwidth)} &= f_2 - f_1 \\
 &= 3400 - 300 \\
 &= 3100 \text{ Hz.}
 \end{aligned}$$

Table 1.2 shows bandwidth of different signals.

Table 1.2: Bandwidths of different signals

Sr. No.	Signal types	Frequency range	Bandwidth
1.	Voice signal for telephony	300 – 3400 Hz	3,100 Hz
2.	TV signals (picture)	0 – 5 MHz	5 MHz
3.	Digital data	* 300 – 3400	3,100
4.	Music signal	20 – 15000 Hz	14,980 Hz

1. Frequency Spectrum:

It is the representation of a signal in the frequency domain. Frequency spectrum can be obtained by using either Fourier series or Fourier transform.

Frequency spectrum consists of the amplitude and phase spectrum of the signal and indicates the amplitude and phase of various frequency components present in the given signal. It enables us to analyze and synthesize a signal.

2. Effect of Pulse Width of data on the Bandwidth:

When data is to be transmitted then the bandwidth depends on the pulse width of data. As the width of the data pulses which are to be transmitted reduces the bandwidth requirement increases according to the time scaling property of Fourier transform, (See, Fig. 1.5).

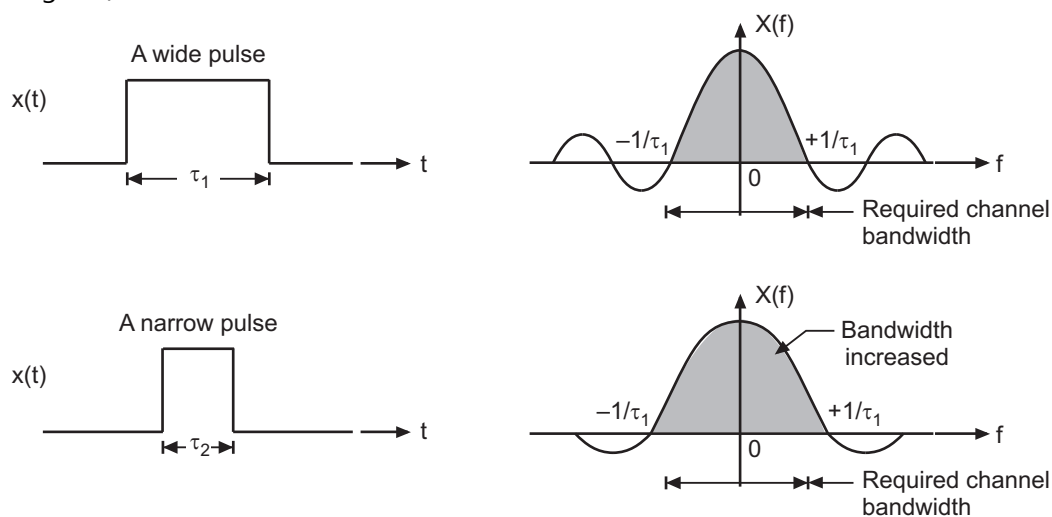


Fig. 1.5: Effect of data pulse width on bandwidth

Bandwidth of a Medium :

Bandwidth of a medium also known as channel bandwidth. A channel is the medium through which the signal carrying information will be passed. The channel bandwidth determines the type of signal to be transmitted i.e. analog or digital.

Bandwidth of a medium is defined as the maximum frequency it can allow to pass through it without attenuating it and without distorting the shape of the signal.

When the medium has less bandwidth than required, then signal distortion will take place as shown in Fig. 1.6. Channel or medium bandwidth is used to describe the range of frequencies required to transmit the desired information.

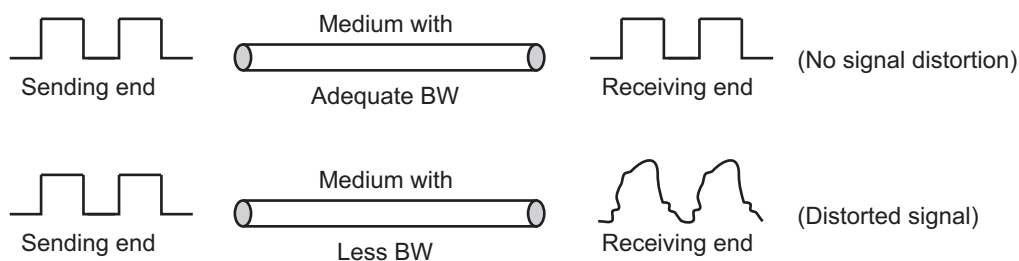


Fig. 1.6 : Distortion in signal

Terms related to Bandwidth:

1. **Amplitude:** The maximum value of an AC quantity is called as amplitude. It is measured in volts, amperes or watt depending on the type of signal.
2. **Frequency:** It is defined as the number of cycles completed by an AC quantity in one second. Its unit is Hz (Hertz).
3. **Phase:** Phase describes the position of the waveform with respect to time zero.
4. **Time period:** It is defined as the time taken in seconds by the waveforms of an AC quantity to complete one cycle.

Analog and Digital Signals :

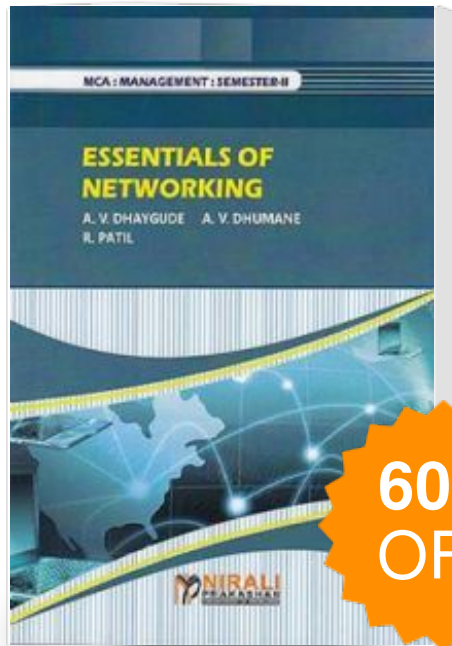
Data is transmitted from one point to another point by means of electrical signals that may be in digital and analog form.

- **Analog data** refers to information that is continuous; For example, sounds made by a human voice.
- **Digital data** refers to information that has discrete states. Digital data take on discrete values. For example, data are stored in computer memory in the form of 0's and 1's.

Signal Propagation:

Movement of signal through the channel wired or wireless is called as signal propagation. Fig. 1.7 shows a signal source, a communication channel and the destination of signal receiver.

Essentials Of Networking



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