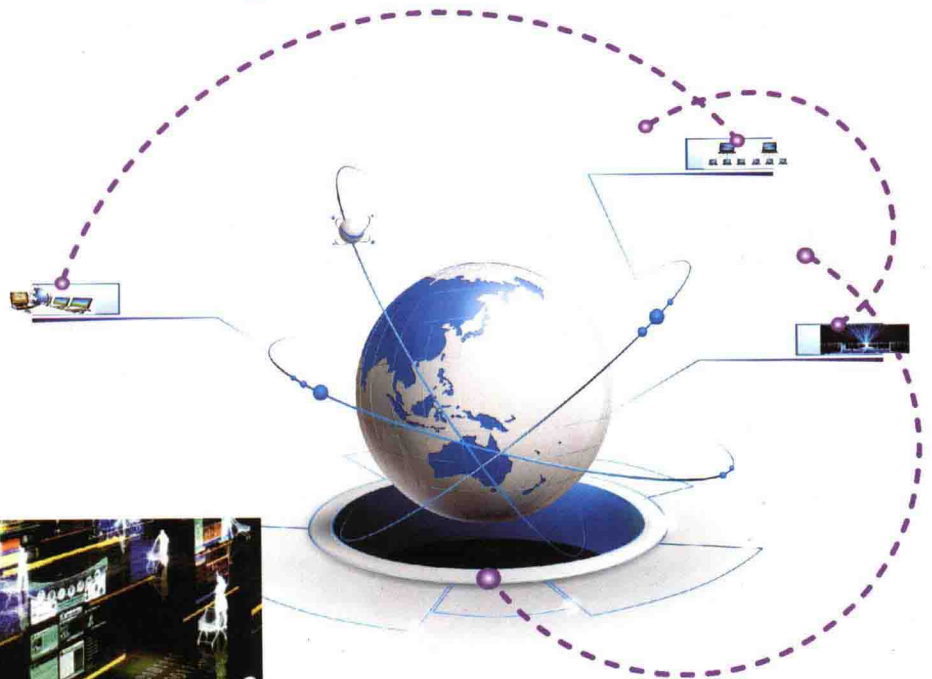
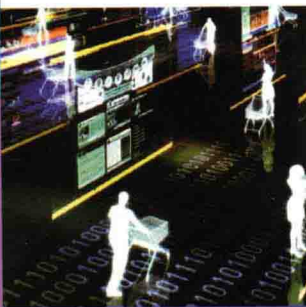


Computer Networks

A System Approach



K. K. Rastogi
Parma Nand



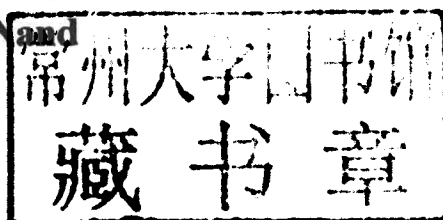
Computer Networks

A System Approach

K. K. Rastogi

&

Parma Nand



GLOBAL VISION PUBLISHING HOUSE

20, Ansari Road, Daryaganj, New Delhi-110002 (INDIA)

GLOBAL VISION PUBLISHING HOUSE

F-4, 1st Floor, 'Hari Sadan' 20, Ansari Road,

Daryaganj, New Delhi-110002 (INDIA)

Tel.: 011-23261581, 23276291

E-mail: globalgvph@gmail.com, info@globalvisionpub.com

Website: www.globalvisionpub.com

Computer Networks: A System Approach

© Authors

First Edition 2013

ISBN: 978-81-8220-596-3


[Responsibility for the facts stated, opinions expressed, conclusions reached and plagiarism, if any, in this title is entirely that of the authors. The publisher bear no responsibility for them whatsoever. All rights reserved. No part of this book may be reproduced in any manner without written permission.]

PRINTED IN INDIA

Published by Dr. N.K. Singh for Global Vision Publishing House, New Delhi-2 and *Printed at* G.S. Offset, Naveen Shahdara, Delhi-32

Computer Networks

A System Approach



*Dedicated
to
My Parents*

PREFACE

The Book "*Computer Network: A System Approach*" has been written in a well organised in systematic manner in seven chapters. Each chapter has explained under lying theory with diagrams and examples and adequate numbers of solved and unsolved problems for real application are given in each chapter. The very first chapter introduces concepts, Goal and application of networks, direction of data flow, transmission technology, classification of network, and networks topology. The second chapter deals with data communication system, time domain concept, digital signal, data rate, pulse code modulation, transmission media, switching connecting devices, and ISDN. Framing and synchronization of data link layer is discussed in the third chapter. The fourth chapter examines channel allocation, station model and multiple access protocol, IEEE 802 project, and ethernet cabling. Design issue of network layer, routing algorithm, broad casting and multicasting, congestion control, IP addressing, internet classes, sub netting and masking, and IPV6 is explained in the fifth chapter. The sixth chapter focuses on characteristic of UDP, transmission control protocol, duties of transport layer, QoS, socket structure, session layer, network security, and data compression and connection less iterative service, boot P, DHCP, NVT, telnet, DNS, FTP, simple mail transfer protocol, MIME, and virtual private network is described in the last chapter of this book.

With due respect I would like to thank God with whose grace and blessing I am able to write this book. I am thankful to Mr. Vihang Garg (Vice Chairman, Hi-Tech Institute of engineering and Technology Ghaziabad) and also Dr. S.N. Gupta (Director General, HIET), Dr. G.S. Sandhu (Director Academics, HIET), Dr. Harendra Singh (HOD CS, HIET), Dr. Sohan Garg (Director, IIMET Meerut), Dr. Pankaj Agarwal (HOD CS IMSEC), Dr.Prmanand (HOD CS Galgotia University) for their kind support. I would like to express my special gratitude to my wife Ms. Arunima Kaushal, Lovely daughter and dear Son. I would like to thanks Dr. N.K. Singh of Global Vision Publication for showing keen interest in publishing this book. The comments and suggestion from the readers will be greatly appreciated.

CONTENTS

PREFACE

(vii)

1. INTRODUCTION OF COMPUTER NETWORK

1

- 1.1. Introduction
- 1.2. Basic Components of Communication
- 1.3. Data Communication
- 1.4. Applications of Computer Network
- 1.5. Line Configuration
- 1.6. Direction of Data Flow
- 1.7. Network Technologies
- 1.8. Internet
- 1.9. Topology
- 1.10. Basic Concept of Layering
- 1.11. Open System Interconnection Reference Model
- 1.12. Functions of the OSI Layers
- 1.13. Architecture of Functioning OSI MODEL
- 1.14. TCP/IP Protocol
- 1.15. Difference between OSI and TCP/IP Model
- 1.16. Backbone Design

Summary

Questions Answers and Numericals

Exercise

2. PHYSICAL LAYER, TRANSMISSION MEDIA AND SWITCHING METHOD**35**

- 2.1. Introduction
- 2.2. Data Communication System Components
- 2.3. Data
- 2.4. Signal
- 2.5. Time-Domain Concepts
- 2.6. Bandwidth
- 2.7. Digital Signal
- 2.8. Baseband and Broadband Signals
- 2.9. Nyquist Bit Rate
- 2.10. Shannon Capacity (Noisy Channel)
- 2.11. Pulse Code Modulation
- 2.12. Transmission Media
- 2.13. Comparison Among Guided Media
- 2.14. Switching
- 2.15. Packet Switching
- 2.16. Message Switching
- 2.17. Comparison Among Circuit Switching, Datagram Packet, and Virtual Circuit Switching
- 2.18. Public Switched Telephone Networks
- 2.19. Connecting Device
- 2.20. Integrated Services Digital Network (ISDN)
- Summary
- Questions Answers and Numericals
- Exercise

3 DATA LINK LAYER**83**

- 3.1. Introduction
- 3.2. Framing and Synchronisation
- 3.3. Character Oriented Framing
- 3.4. Error Detection and Correction

- 3.5. Error Detecting Methods
- 3.6. Error Correcting Codes
- 3.7. Data Link Control
- 3.8. Data Link Layer in the Internet
 - Summary
 - Questions Answers and Numericals
 - Exercise

4 MEDIUM ACCESS LAYER

120

- 4.1. Introduction
- 4.2. Static Channel Allocation
- 4.3. Dynamic Channel Allocation in LANS and MANS
- 4.4. Multiple Access Protocol
- 4.5. Carrier Sense Multiple Access Protocol (CSMA)
- 4.6. IEEE 802 Project
- 4.7. FDDI (Fiber Distributed Data Interface)
- 4.8. Jacob Son's Algo
- 4.9. Ethernet Cabling 802.3
 - Summary
 - Questions Answers and Numericals
 - Exercise

5. NETWORK LAYER

139

- 5.1. Introduction
- 5.2. Design Issues for the Network layer
- 5.3. The Internal Organisation of the Network Layer
- 5.4. Routing
- 5.5. Shortest Path Algorithm
- 5.6. Flooding Algo
- 5.7. Hierarchical Routing
- 5.8. Distance Vector Routing

- 5.9. Link State Routing
- 5.10. Comparison of Distance Vector Routing and Link State Routing
- 5.11. Hop-Count Limit
- 5.12. Broad Casting
- 5.13. Multicast Routing
- 5.14. Congestion Control
- 5.15. IP Protocol
- 5.16. RARP (Reverse Address Resolution Protocol)
- 5.17. Addressing
- 5.18. Sub Netting
- 5.19. Masking
- 5.20. IPV6
- Summary
- Questions Answers and Numericals
- Exercise

6 TRANSPORT LAYER AND PRESENTATION LAYER

193

- 6.1. Introduction
- 6.2. User Datagram Protocol (UDP)
- 6.3. Port Numbers
- 6.4. UDP Datagram
- 6.5. Transmission Control Protocol (TCP)
- 6.6. Duties of Transport Layer
- 6.7. Quality of Services (QoS)
- 6.8. TPDU (Transport Protocol Data Unit)
- 6.9. Sockets
- 6.10. Purpose of UDP
- 6.11. Comparison of UDP and TCP
- 6.12. Session Layer
- 6.13. Connection-Oriented Service
- 6.14. Reliable Communication

- 6.15. Network Security
- 6.16. Symmetric Cipher Model or Conventional Model
- 6.17. Some Encryption Technique
- 6.18. DES (Data Encryption Standard)
- 6.19. RSA Algorithm
- 6.20. Digital Signature
- 6.21. Compression
 - Summary
 - Questions Answers and Numericals
 - Exercise

7. APPLICATION LAYER

225

- 7.1. Introduction
- 7.2. Connectionless Iterative Service
- 7.3. Connection Oriented Concurrent Server
- 7.4. Boot P
- 7.5. Dynamic Host Configuration Protocol (DHCP)
- 7.6. Network Virtual Terminal
- 7.7. Telnet
- 7.8. Domain Name System (DNS)
- 7.9. File Transfer Protocol
- 7.10. TFTP (Trivial File Transfer Protocol)
- 7.11. Comparison of FTP and TFTP
- 7.12. Simple Mail Transfer Protocol (SMTP)
- 7.13. Entire E-mail System
- 7.14. Multipurpose Internet Mail Extension (MIME)
- 7.15. Post Office Protocol (POP)
- 7.16. Simple Network Management Protocol (SNMP)
- 7.17. Hyper Text Transfer Protocol (HTTP)
- 7.18. Uniform Resource Locator (URL)
- 7.19. World Wide Web (WWW)

7.20. Common Gateway Interface (CGI)

7.21. Virtual Private Network (VPN)

Summary

Questions Answers

Exercise

MODEL QUESTION PAPERS

245

BIBLIOGRAPHY

293

INDEX

295

1

INTRODUCTION OF COMPUTER NETWORK

CHAPTER OVERVIEW

- 1.1. Introduction
- 1.2. Basic Components of Communication
- 1.3. Data Communication
- 1.4. Applications of Computer Network
- 1.5. Line Configuration
- 1.6. Direction of Data Flow
- 1.7. Network Technologies
- 1.8. Internet
- 1.9. Topology
- 1.10. Basic Concept of Layering
- 1.11. Open System Interconnection Reference Model
- 1.12. Functions of the OSI Layers
- 1.13. Architecture of Functioning OSI MODEL
- 1.14. TCP/IP Protocol
- 1.15. Difference between OSI and TCP/IP Model
- 1.16. Backbone Design
- Summary
- Questions Answers and Numericals
- Exercise

1.1. INTRODUCTION

The concept of Network is not new. In simple terms it means an interconnected set of some objects. For decades we are familiar with the Radio, Television, Railway, Highway, Bank and other types of networks. In recent years, the network that is making significant impact in our day-to-day life is the Computer network. By computer network we mean an interconnected set of autonomous computers. The term autonomous implies that the computers can function independent of others. However, these computers can exchange information with each other through the communication network system. Computer networks have emerged as a result of the convergence of two technologies of this century—computer and Communication as shown in Fig. 1.1. The consequence of this revolutionary merger is the emergence of an integrated system that transmit all types of data and information. There is no fundamental difference between data communications and data processing and there are no fundamental differences among data, voice and video communications.

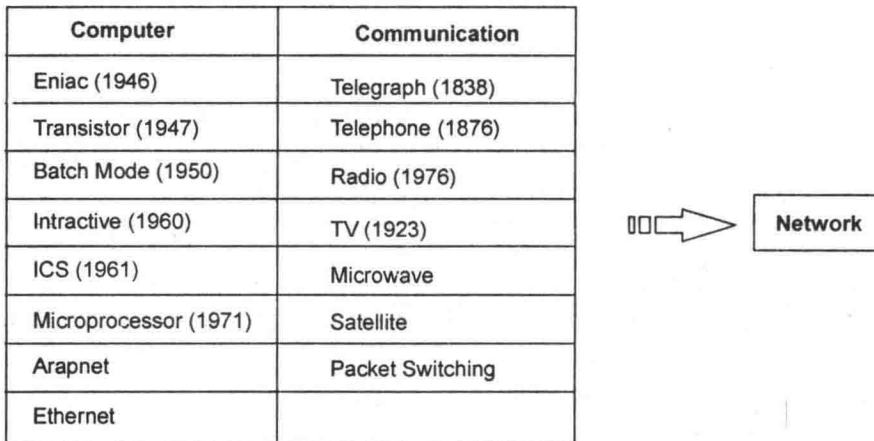


Fig. 1.1: Evolution of Computer Network

1.1.1. Definition

Two or more than two computers are connected to each other and share the information and recourses known computer network.

Advantage: Optimum utilisation, information sharing, security, reduced time, and reduced cost.

1.2. BASIC COMPONENTS OF COMMUNICATION

A data communication is made of five systems:

1. **Message:** The message is the information to be communicated eg: text, video, sound, and picture.
2. **Sender:** The sender is the device that sends the data message.
3. **Receiver:** The receiver is the device that receives the message.



Fig. 1.2: Basic Components of Communication

4. **Medium:** The Transmission medium is physical path by which a message travels from sender to receiver.
5. **Protocol:** A protocol is a set of rules that governs data communication. It represent agreement between two devices such as French can not be understood by a person who speaks only Japanese.

1.3. DATA COMMUNICATION

Data communication are an exchange of data (information of 0's and 1's) between two devices via some form of transmission medium. For data communication to occur, the communication device must be part of communication system made up by combination of hardware and software. The effectiveness of data communication system depends on three fundamental characteristics:

1. **Delivery:** The system must deliver data to the correct destination.
2. **Accuracy:** The system must deliver data accurately.
3. **Timeline:** The system must deliver data in timely manner.

1.3.1. Data Communication Network Criteria

1. **Performance:** performance can be measured in many ways—

Number of user: A large number of concurrent user response time can slow.

Type of transmission medium: The medium define the speed at which that can travel through a connection.

Hardware: It affects both speed and capacity of transmission.

Software: It also affects the network performance.

2. **Reliability:** It is measured by frequency of failure.
3. **Security:** Useful sensitive data must be protected from unauthorised access.

1.4. APPLICATIONS OF COMPUTER NETWORK

In a short period of time computer networks have become an indispensable part of business, industry, entertainment as well as common-man's life. These applications have changed tremendously from time and the motivation for building these networks are all essentially economic and technological.

And now after almost two decades, computer networks have entered a new dimension; they are now an integral part of the society and people. In 1990s, computer network started delivering services to private individuals at home. These services and motivation for using them are quite different. Some of the services are access to remote information, person to person communication, and interactive entertainment. So, some of the applications of computer networks that we can see around us today are as follows:

1. **Marketing and Sales:** Computer networks are used extensively in both marketing and sales organisations. Marketing professionals use them to collect, exchange, and analyse data related to customer needs and product development cycles. Sales application includes tele shopping, which uses order-entry computers or telephones connected to order processing network, and online reservation services for hotels, airlines and so on.

2. **Financial Services:** Today's financial services are totally dependent on computer networks. Application includes credit history searches, foreign exchange and investment services, and electronic fund transfer, which allow user to transfer money without going a bank (an automated teller machine is an example of electronic fund transfer, automatic pay-check is another).
3. **Manufacturing:** Computer networks are used in many aspects of manufacturing including manufacturing process itself. Two of them that use network to provide essential services are computer-aided design (CAD) and computer-assisted manufacturing (CAM), both of which allow multiple users to work on a project simultaneously.
4. **Directory Services:** Directory services allow list of files to be stored in central location to speed worldwide search operations.
5. **Information Services:** A Network information service includes bulletin boards and data banks. A World Wide Web site offering technical specification for a new product is an information service.
6. **Electronic Data Interchange (EDI):** EDI allows business information, including documents such as purchase orders and invoices, to be transferred without using paper.
7. **Electronic Mail:** Probably it's the most widely used computer network application.
8. **Teleconferencing:** Teleconferencing allows conference to occur without the participants being in the same place. Applications include simple text conferencing (where participants communicate through their normal keyboards and monitor) and video conferencing where participants can even see as well as talk to other fellow participants. Different types of equipments are used for video conferencing depending on what quality of the motion you want to capture (whether you want just to see the face of other fellow participants or do you want to see the exact facial expression).
9. **Voice Over IP:** Computer networks are also used to provide voice communication. This kind of voice communication is economical as compared to the normal telephonic conversation.
10. **Video on Demand:** Future services provided by the cable television networks may include video on request where a person can request for a particular movie or any clip at anytime he wish to see.

1.5. LINE CONFIGURATION

Line configuration refer to the way two or more communication devices attach to a link. Line Configuration are two type:

1. **Point to point Line configuration:** A point to point configuration provide dedicated link between two devices.



2. **Multipoint Line configuration:** A multipoint line configuration is one in which more than two specific device share a single link.

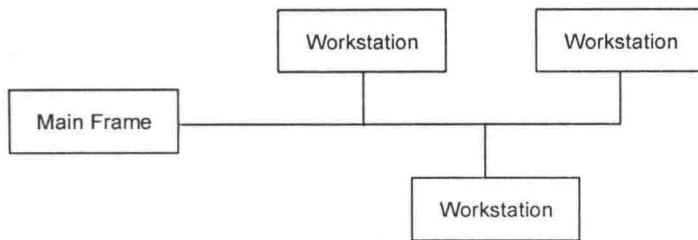


Fig. 1.3: Line Configuration

1.6. DIRECTION OF DATA FLOW

There are three possible modes in serial communication: simplex, full duplex and half duplex. In simplex mode, the communication is unidirectional, such as from a computer to a printer, as shown in Fig. 1.4.(a). In full-duplex mode both the sides can communicate simultaneously, as shown in Fig. 1.4.(b). On the other hand, in half-duplex mode of communication, each station can both send and receive data, as shown in Fig. 1.4.(c). But, when one is sending, the other one can only receive and vice versa.

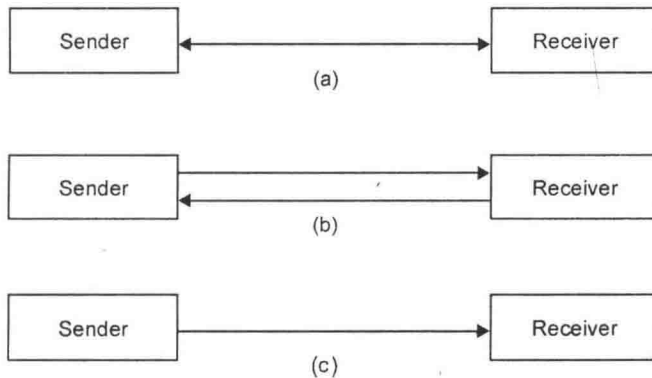


Fig. 1.4: Direction of Data Flow

1.7. NETWORK TECHNOLOGIES

There is no generally accepted taxonomy into which all computer networks fit, but two dimensions stand out as important: Transmission Technology and Scale. The classifications based on these two basic approaches are considered in this section.

1.7.1. Classification Based on Transmission Technology

Computer networks can be broadly categorised into two types based on transmission technologies— Broadcast networks and Point-to-point networks.