LOCAL AREA NETWORKS

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Dedicated to
my mother
SMT SUBHADHRA DEVI BASANDRA

ABOUT THE AUTHOR

Mr. Suresh K Basandra graduated in Electrical and Electronics Engineering from Delhi University in 1978 and obtained his M.Tech. in Computer Technology from I.I.T. Delhi in 1983. He is a Life Member of Computer Society of India (CSI), Institute of Electronics and Telecommunication Engineers of India (IETE), Indian Institute of Materials Management (IIMM), and Indian Science Congress Association.

He has more than forteen years research, development and teaching experience in hardware and software. He has worked as Research Engineer at I.I.T. Kanpur, as Senior Software Engineer at C-DOT, New Delhi, as Executive Officer (EDP) in Indian Ports Association, New Delhi, as Associate Professor and Incharge, Computer Centre in Management Development Institute, Gurgaon, as Project Manager, Computer Division, Howe (India) Pvt Ltd, New Delhi. Currently he is working as a Consultant with Digital Equipment (India) Ltd, New Delhi, an affiliate company of Digital Equipment Corporation (DEC), USA.

His research interests are in the area of networks, software engineering, data bases, information systems, application software and computer applications in management decision-making.

He has over fifty research papers and articles in the area of hardware and software to his credit. These have appeared in various reputed journals and magazines like Information Processing Letters (Netherlands), CSI Communications, DataQuest, Information Technology, Instruments and Electronics Developments, Indian Ports, and Electronics For You. He is contributing editor to Information Technology since June 1991.

Besides this book, he also has five more books to his credit: 'Computer Science Question Bank', 'Understanding Computers Through Common Sense', 'Computers Today', 'Software Engineering' and 'Computers for Managers', first four published by Galgotia Publications Pvt Ltd, New Delhi and the last published by Global Business Press, New Delhi.

His biographical details has been included in 'Reference Asia: Asia's Who's Who of Men and Women of Acievement', Vol V, published by Rifacimento International, Delhi and 'Biography International', Vol 3, published by Biography International, Delhi. He has been guest faculty to SBI Staff Training College, IIMM and IGNOU. He has guided B.Tech. students at I.I.T. Kanpur and M.B.A. students of IGNOU for their projects. He has been involved in the development of Computers Courses conducted by IGNOU and AIMA.

PREFACE

Evolution of Local Area Networks

In the early 1970s, a trend began in computing away from large centralized mainframes towards smaller departmental minicomputers. The first microcomputer was introduced around 1971 and since then cheaper and more powerful machines have appeared in the market. This trend gathered momentum and has developed into a definite movement towards single-user workstations.

One of the disadvantages of this is that facilities that were available on larger, centralized systems were lacking in the new workstation approach. These included the ability to share resources such as information, peripheral devices like printers, disks and so on, and send messages from one user to another.

While computing devices were getting smaller, cheaper and more powerful, simultaneously advances were also being made in communications technology. In particular a new generation of networks emerged which operated in a limited geographical area, but much more reliably and at higher data transmission rates than previous networks.

The introduction of these high speed local area networks (LANs) opened up the possibility of attaining the advantages of workstations without losing those of centralized mainframe systems. Information could flow between individual workstations at speeds which, to a large extent, hid the fact that they were not working on the same system. LANs are attractive for such features as high availability and the ability to support multiple vendor equipment.

Now that millions of homes and offices have personal computers (PCs), we are finding that it is important to be able to connect PCs together. In an office setting, one way to connect PCs is with a LAN. The benefits are many:

- Costly peripherals such as laser printers, hard disks, high capacity tape drives, and modems can be shared by all users of a LAN.
- Information too can be shared; for example, all members of an office can use their own PCs to access and update an important database.
- Another plus is electronic mail -- using PCs to send and receive inter-office memos or messages. Some LANs allow PCs to link up with minicomputers, mainframes, and even computer networks in other locations.
- For management, LANs represent a way to increase productivity with a modest outlay. Usually, PCs have already been purchased for the office; a LAN makes their use more efficient.
- In addition, an office with a LAN requires fewer hard disks and printers.
- For those using PCs, a LAN can make work less frustating -- fewer floppies to keep track of, easier access to files, and ready use of all the hardware on the system.

Work also becomes less solitary -- electronic mail makes it easier to work together with the people in your office.

The rate of development of LANs has been truly remarkable over the past few years, but the rapid appearance of new products, and equally rapid disappearance of some old products, has left many potential users and buyers confused and apprehensive about how to proceed. And, although the technology is rapidly evolving, the principal architectural forms and design approaches have emerged.

Objectives

It introduces the concepts behind the major LANs, bridging the gap between "full-blooded" textbooks of a highly technical and mathematical nature, and laymen's guides usually supplied by equipment manufacturers. Since LAN product offerings are rapidly changing, a delibrate attempt has been made to emphasize more on underlying fundamental technology, architecture, standards, operating characteristics, and management, rather than specific LAN products.

This book treats the subject of networks at the levels of potential purchaser, installer, manager, and end-user. It is also designed to give those who wish to buy LAN familiarity with the concepts involved. Here again, the aim is not to survey the current product offerings, but rather to assist the buyer in making an intelligent evaluation and selection.

In terms of the style, the book is primarily:

- Descriptive: Terms are defined and the key concepts and technologies are discussed in some detail.
- Comparative: Wherever possible, alternative or competing approaches are compared and their relative merits, based on suitable criteria, are discussed.

Intended Audience

This book is intended for a broad range of readers interested in LANs.

This book is intended for students, computer professionals, telecommunication managers, business managers, and others who want to become more familiar with the LANs. It is suitable for use as a higher level under-graduate and post-graduate textbook.

The book is intended to be self-contained. No prior knowledge of networks is assumed, but a basic understanding of the field of computer systems will be helpful. For the reader with little or no background in data communications, a brief primer is included. In fact, this book is for anyone who wants to have an edge on a technical field that promises to expand for atleast the next decade.

Plan of the Text

This book answers the questions most often asked about LANs. The remainder of this preface explains the layout of the book in little more detail.

Chapter 1 begins by defining what exactly we mean by the term network, and how a LAN is distinguished from other types. It gives a brief historical development of LANs, looks at some of the applications, advantages as well as disadvantages and why a business should install one.

Chapter 2 introduces most of the underlying communication concepts.

Chapter 3 covers the ways in which the machines are connected (topology) and the choices available in terms of communication media.

In Chapter 4, the concept of layered protocols is introduced.

In Chapter 5, we examine some of the standards that have been developed in this area. Important standards introduced by IEEE and IBM are explained in understandable terms.

In Chapter 6, the costs and benefits of a LAN are explored, to help you decide whether to purchase one.

Chapter 7 outlines the factors that should influence your evaluation and selection, should you decide that a PC network is appropriate for you.

Chapter 8 discusses the issues involved in evaluating and selecting the applications software for LAN.

Chapter 9 examines in detail the planning and installation of a network, and includes a discussion of how much hardware and software to buy. It covers proven techniques for successful LAN installation.

Chapter 10 tells you how to use a network to run both existing applications and new ones that take advantage of the special features a network offers.

Chapter 11 is an overview of mainframe connections. It reviews the IBM data communications, describes present products, and assesses the prospects for the future.

Chapter 12 discusses the broad aspects of network security.

Chapter 13 discusses the client/server concepts, architecture and different types of servers and services.

Chapter 14 examines the issues involved with LAN databases, uses of LAN databases, and different types of servers.

Chapter 15 provides an overview of a Novell Network.

Chapter 16 discusses the evolution of Ethernet, its features, formats, components and method of operation.

Chapter 17 discusses the historical development of Digital Network Architecture and its various phases.

Chapter 18 discusses the evolution of Systems Network Architecture, its components, layers and comparision with Digital Network Architecture.

Chapter 19 discusses the TCP/IP protocol, its structure, working, applications and how it is implemented.

Chapter 20 is concerned with extending LANs beyond their basic design limitations, and with the linking of LANs to other LANs and to wide area networks (WANs). The connection of LANs to existing networks is one of the main constraints to LAN market growth and is receiving considerable attention.

The next chapter, Chapter 21, is concerned with the often neglected subject of LAN management, from the nuts and bolts of installation to management systems which allow operations staff to control the network and investigate problems in an efficient manner.

Chapter 22 provides an overview of office automation. It discusses office activities, office system elements, office system functions, how an automated office is built, its benefits and communication infrastructure to support office automation activities.

Chapter 23 examines in detail what is E-Mail, its uses, advantages, drawbacks, how E-Mail is used and different types of mails.

Chapter 24 introduces the concepts involved with electronic data interchange, its advantages over a paper-based document system, how it works, different EDI standards and cost benefit analysis of EDI.

Chapter 25 provides an overview of CCITT X.25.

Chapter 26 discusses the evolution of ISDN, its standards and protocols, ISDN implementation, and ISDN chips.

Chapter 27 provides an overview of wide area networks, different types of networks, private and public networks, circuit switched and packet switched networks, WAN applications and design considerations.

Chapter 28, examines those developments in both hardware and software which will have a large impact in the next few years.

Chapter 29 discusses an overview of Wireless LANs, need of wireless LANs, components of wireless LANs, wireless receiving devices and Future evolution of Wireless LANs.

Chapter 30 focusses on the wireless LAN media components: Radio Wave LANs, Infrared LANs and Microwave LANs.

Chapter 31 discusses the One-to-One Operations, One-to-Many Operations, and Many-to-Many Operations. It also focussed on planning, setup and installation of wireless LANs. The Long Distance Wireless LAN Technologies, such as Cellular Connection, Low Earth Orbiting Satellites (LEOS), Medium Earth Orbit Satellites, and USAT Satellites are also explained in detail.

Chapter 32 discusses about Frame Relay, Cell Relay, B-ISDN, ATM, ATM LANs and SONET.

Chapter 33 is concern about the Physical and Datalink layers which covers Ethernet Technology, ProNET Token Ring Technology, SLIP, CSLIP, etc.

Chapter 34 provides an overview of Encapsulation, IP Address Structure, IP Datagram, IP Routing, ARP, RARP, ICMP and IGMP.

Chapter 35 discussed the Transport Layer and the protocol used for the concern layer.

Chapter 36 provides an overview of the Application Layer Services like Telnet, Rlogin, FTP, TFTP, BOOTP, SMTP, NetBIOS, etc.

Chapter 37 discusses the Session Layer, Presentation Layer and Application Layer.

Chapter 38 provides an overview on the Domain Name System.

Chapter 39 discusses the Network File System which include NFS Architecture, Remote Procedure Call (RPC), eXternal Data Representation(XDR), Port Mapper, and Mount protocol.

Chapter 40 outlines the Internet Naming Hierarchy, Management Information Base, SMI, SNMP, etc.

Chapter 41 discusses about the latest version of Internet Protocol.

In addition, the book includes Questions and Answers on LANs, Selecting Personal Computers, Computer Viruses, Encoding Schemes, Standards Organisations, ISO OSI Standards Documents, a list of frequently used Abbreviations and Acronyms, an extensive Glossary, list of Computer Journals and References.

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My thanks to all those of you who have purchased this book. I hope you will find it enlightening, entertaining and useful in your networking endeavours.

Finally my deepest thanks are to my wife, Karuna Basandra, for keying-in the complete manuscript and also because she had to endure the loss of my attention for far too long while I was producing the manuscript.

Good Networking

SURESH K BASANDRA