Linking LANs
A Micro Manager's Guide

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Introduction

I wrote this book for anyone who needs to understand how different networks can be linked together. In a very short time, an entirely new industry has developed with its own language—terms like *brouters, source routing, enterprise networking*, and *management network protocols*. Companies are beginning to look at their enormous investments in mainframe and LAN hardware and software and demanding that someone (perhaps you) come up with some answers on how these incompatible resources can be made to communicate effectively with each other. As if that were not a large enough assignment, corporate computing resources often include remote sites as well as LANs that use different network operating systems.

The first section of this book shows the hardware and software required for a local area network. I examine the different types of file servers and network interface cards now available as well as specific features to look for when selecting a network workstation. You also look at a number of operating systems including DOS, OS/2, and Unix as well as network operating systems including NetWare and LAN Manager. Finally, I show you the client-server model that is bound to play an increasingly important role in network design and system integration.

This book's second section focuses on network protocols, the software that must be understood in order to link together different networks. I discuss the OSI model, TCP/IP, and the problems associated with migrating from TCP/IP to OSI model protocols. In order to understand the problems associated with bridging and routing LANs, I show specific protocols associated with Ethernet and Token Bus as well as Token Ring and FDDI. I also examine the suite of protocols associated with AppleTalk and Arcnet.

This book's third section concentrates on internetwork operability by examining bridges, brouters, and routers. You will see how the incompatible routing schemes used by Ethernet and Token Ring can be reconciled as well as how a new class of brouters can solve problems that plague many large companies.

The book's fourth section provides a global perspective on linking together networks. It looks at the specific requirements for a metropolitan area network (MAN), how T-1 lines can be used as part of a wide area network (WAN), and how networks can be linked to packet switched networks (X.25).

It is becoming increasingly necessary for a network manager or systems integrator to understand telecommunications as well as data communications. I show the Integrated Services Digital Network (ISDN), which promises to integrate voice and data transmission over the public telephone network. You will see how gateways and LANs can be linked to host computers. This chapter will examine AppleTalk links to both IBM and DEC computers in addition to different methods of linking Token Ring networks to these computers.

Chapter 12 examines some key systems integration issues that are critical when networks are to be linked together. This section also covers the movement toward an international standard for electronic mail (X.400) and a global directory (X.500).

One area of growing importance is network management. I give you the different approaches taken by IBM, AT&T, and DEC, as well as the current battle of network management protocols between Simple Network Management Protocol (SNMP) and Common Information Network Management (CIMP). One of these protocols will probably play an important part in your network sometime in the future.

I have included an annotated list of books that belong on the shelf of the network manager as well as a discussion of seminars available on "cutting edge" topics such as network management and bridges, routers, and gateways. I have also included an extensive glossary that defines all the key terms that appear in the text.

I sincerely hope this book helps you understand the bewildering world of enterprise networking and the problems associated with integrating different network components. This book assumes no prior knowledge of networking or specific LANs. No book can answer all the questions you probably have about the very fast changing field, but I hope this book will help you formulate the questions you need to ask and the answers you need to find in order to solve your company's enterprise networking problems.

Contents

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CHAPTER

LAN hardware basics

In this chapter, you will explore the role of

- Local area network workstations.
- Network interface cards.
- File servers.
- Media.
- Network architecture.

Introduction

A *local area network* (LAN) is a group of computers that share hardware and software resources at the same physical location. This chapter examines a LAN's hardware building blocks. I describe the types of LAN workstations, the role of a disk server or file server, and the key functions performed by the network interface cards. Because LANs can be designed a variety of different ways to perform a wide range of different functions, you will explore some of the criteria network designers use when selecting the appropriate cabling or media as well as the network's architecture or topology.

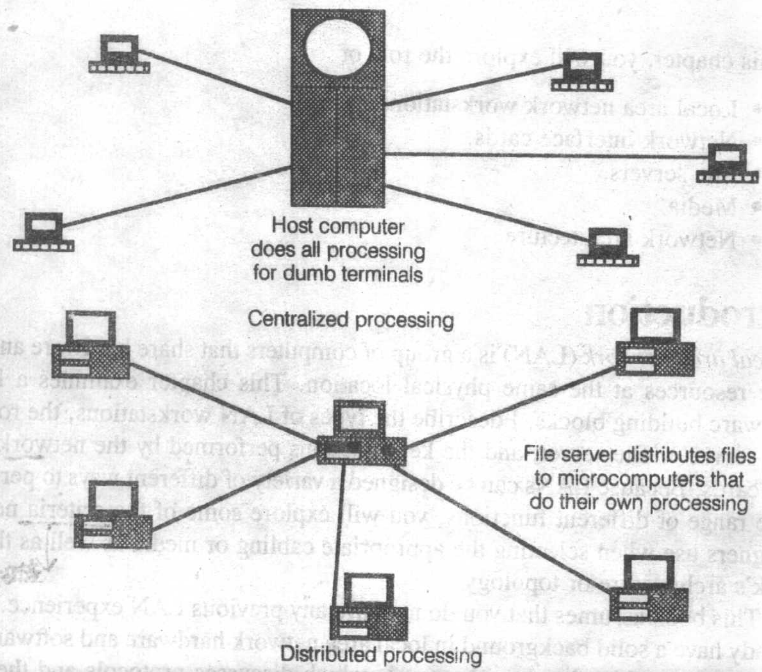
This book assumes that you do not have any previous LAN experience. If you already have a solid background in local area network hardware and software, you might want to skip ahead to chapter 3, which discusses protocols and the Open Systems Interconnect model for linking different computer networks.

Centralized and distributed processing

The first and second generations of computers developed during the 1950s and 1960s illustrate the principle of centralized processing. Mainframe computers and minicomputers used their powerful *central processing units* or *CPUs* to process all the work required by users connected by terminals. The number of users accessing the host computer has a direct correlation to the response time, so that more users resulted in slower computer response time.

The microcomputer revolution

The development of microcomputers in the 1970s and 1980s meant that processing could be distributed rather than centralized. It is true that local area networks permit users to share the cost of expensive resources such as laser printers. Equally important, though, is that a distributed processing environment can be inherently more efficient. Figure 1-1 illustrates the key difference between centralized and distributed processing. Each workstation is a microcomputer with its own processing power so that users need not wait for a host computer to share some of its valuable processing time. A LAN is often faster than a minicomputer with the same number of terminals because the processing workload is distributed among several workstations.



1-1 Distributed processing and centralized processing.

With powerful new software such as LAN Manager version 2.0 and NetWare 386 and powerful new hardware such as Intel 80486 based file servers, local area networks are beginning to approach mainframe-like performance.

The network workstation

Network workstations, also sometimes referred to as network *nodes*, provide each network user with a display, a keyboard, and a microprocessor capable of running network programs. Today some *diskless workstations* utilize a computer chip known as an autoboot ROM to load programs directly from the network's file server into its own *random access memory* (RAM), meaning that it holds information as long as the computer is turned on The lack of disk drives makes these nodes more secure because users cannot download network files to a floppy disk. Learning some of the terminology about workstation features will help you distinguish one workstation from another.

One of the problems a systems integrator faces is that with so many potential network workstations on the market it is necessary to establish a product matrix and do some careful comparisons and contrasts. In addition to raw processing speed, the type of workstation architecture and RAM can be very significant.

The workstation architecture

One major limitation of the original IBM PC was that while it contained a microprocessor capable of handling 16 bits at one time (a 16-bit word), it only utilized an 8-bit data bus, a data highway for moving the information from CPU to RAM or external devices. Perhaps an example will clarify this problem. Assume that during rush hour a Tokyo subway station utilizes sixteen turnstiles. In effect the station is processing sixteen people at a time. These sixteen people move to the train, which will carry them to their ultimate destinations. Unfortunately, though, these trains have only eight doors. A bottleneck probably will occur during rush hour as people have to wait their turns to enter through one of the eight doors.

The very same process occurred with the original IBM PC. The Intel 8088 microprocessor handled 16 bits of information while the data bus that was responsible for taking this information to the appropriate RAM or external location could not keep up with the flow of information from the microprocessor.

Network workstations also have an address bus and a control bus. The *address bus* serves as a highway of sorts through which travels the address (location in memory) of the next instruction to be executed or the next piece of data to be accessed. The *control bus* consists of a highway used for all timing and controlling function sent from the control unit to other parts of the computer system.

Micro Channel architecture

IBM's upper-range of PS/2 microcomputers feature a *Micro Channel Architecture* (MCA), an intelligent bus or data highway capable of handling high-speed traffic.