Brady

Mike Rogers and Virginia Bare

HANDS-ON APPLETALK

- *Network your office inexpensively and efficiently using the built-in capabilities of your Mac.*
- *Follow step-by-step instructions for designing, installing, and maintaining your network.*
- *Examine real world network case studies including the TOPS® installation.*

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Introduction

Why AppleTalk?

AppleTalk does for local area networking what the Macintosh did for personal computing. Focusing on what the LAN user needs out of the networking process, AppleTalk forms the basis of transparency into the world of communicating microcomputers and peripheral devices. Maintaining the same philosophy that gave the world transparent Macintosh technology, Apple implements AppleTalk so that how the networking happens does not need to concern the user. This is a significant departure from the historical approach to networking. This ease of use and transparent access to basic local area network functions is why AppleTalk has become the core of so many local area networks and the foundation technology for a wide host of third party products.

Hands-On AppleTalk is a practical book. It is about the process of choosing and using an AppleTalk network. It covers the basics of what AppleTalk is, providing a working definition of a local area network in AppleTalk terms. What does it mean to be "on a network?" What services are available? Who are the players?

Moving logically from initial orientation about what a local area network is in AppleTalk terms, *Hands-On AppleTalk* then covers LAN design basics. In order to decide how to establish a local area network, a basic understanding and working knowledge of topologies, cabling systems and internetworking is necessary. For those that are interested, Chapter Four talks about LAN communications from a technical perspective, discussing network protocols AppleTalk and the OSI model; and the network addressing, dynamic configuration; and name binding protocol unique to AppleTalk.

Once all the basics are established, Chapter 5 covers the practical process of designing a local area network. It starts with an obvious question "Do you need a network?" Although the question may be obvious, it is surprising how many people do not stop to consider it fully and thereby create problems for themselves. Out of the answer of why you need a network comes the basic facts needed to design the network. We emphasize the *process* of moving into local area networking, from thinking about why you need one and exactly what you're going to use it for, through designing it, implementing it, using it, and maintaining it.

It is important to consider all the steps. AppleTalk networking is simple, but it is more complicated than using a stand-alone computer. The only reason it is more complicated is because there are more elements to keep track of. As soon as one computer talks to another, thinking must extend to the group of computers and peripherals that will end up on the network and the people who will make use of them. Thinking logically and systematically about who will use the network and it is why absolutely essential to establishing a network that works, and will continue to work as needs change and the network grows.

In Chapter 5, the design process is taken apart step by step. How do you choose your network speed? Your topology? Does it matter what kind of cabling you choose? Do you need an internetwork? How do you create one? How will you accommodate the network peripherals your group needs, like different kinds of printers and modems that allow remote access? How do you think about the software that you will use on your LAN?

Chapter 6 includes five network design examples from the real-life stories of AppleTalk network "third-party vendors." What is a third party vendor? AppleTalk (from Apple) is only the centerpiece of a local area network. To make it do all the things people want it to do has taken a tremendous amount of development and cooperation by outside hardware and software developers. Companies like Farallon, Kinetics, TOPS, Shiva, and others provide significant functionality, extending AppleTalk into many places in the real world where it did not go on its own. Because these developers use AppleTalk as the basis for their development, we thought their own design stories would be useful. They address many of the same issues each company must face when they decide to bring a local area network into their workplace. Based on interviews with key personnel in each company, these stories give candid insight into the planning, problems, and potential of AppleTalk networks.

In Chapter 7 and 8, we cover the most practical aspects of the AppleTalk local area network. How do you install one? How do you maintain it? What should you expect and what should you definitely avoid?

Chapter 9 moves again into more examples, but this time they are taken from the community of AppleTalk customers: people who have bought and installed local area networks and use them to do a vast range of work. People have been infinitely creative with their AppleTalk networks. There are examples of small and large business installations of AppleTalk. AppleTalk in higher education, where educating the next generation of computer users is accomplished and a lot of experimentation is done, provides a different perspective from network use in private business.

The last part of Chapter 9 is about AppleTalk "futures," in this case specifically "groupware." Local area network use is changing the face and the functionality of the software people use. All software developers are aware of networks and most are attentive to making sure their products function responsibly in a networked environment. But network capability itself is suggesting a new genre of software: groupware. Groupware is in its infancy. But the possibilities it suggests, as well as the implications of its use are crucial for your own workplace.

Having walked network users from thinking about a network to having one in their workplace, Chapter 10 provides an exhaustive look at software and hardware products available for use in the AppleTalk local area network environment. The listing is extensive and gives, in specific terms, information about hardware and software functionality. For your convenience in thinking about your network and the functionality you are looking for, we have broken this product section down, distinguishing between network hardware and network services. Network hardware includes:

- Connectors/Cables
- Network Accelerators
- EtherTalk Cabling/Devices
- Repeaters
- Multiport Repeaters
- Local AppleTalk Bridges
- Half Bridges and Remote Access
- RS-232 Gateways
- Ethernet Gateways
- IBM 3270 Gateways
- PC LAN Gateways
- Mac SE Ethernet Interface Cards
- SCSI Ethernet Interfaces
- Mac II Ethernet Interface Cards
- PC LocalTalk Interface Cards
- Apple II LocalTalk Interface Cards
- Other Network Interface Cards

Network services includes:

- File/Disk Service
- Print Service
- Modem Service
- Terminal Service - TCP/IP
- Terminal Service - 3270
- Terminal Service - VMS
- Electronic Mail
- Conferencing

- Network Monitoring/Troubleshooting
- Network Utilities
- File Translations
- Backup Software
- Network Applications
- Mac/VMS Connectivity
- Mac/UNIX Connectivity

There is a tremendous amount of development work going on in the AppleTalk networking arena. We have been as diligent as possible to give you accurate and up-to-date information about these products. However, because of the lead time inherent in producing and printing a book, by the time this reaches your hands things will undoubtedly have changed. Use this section as a reference encyclopedia. When you get down to buying products, check with the manufacturer or your local authorized computer reseller for current information. The periodicals listed in Appendix B will belp your the most in keeping up with AppleTalk developments.

Hands-On AppleTalk is a practical guide for choosing, installing, and maintaining an AppleTalk local area network, or an AppleTalk LAN as part of other networked environments. Local area networking addresses a need that has grown out of people using microcomputers. Sharing information and resources and working together as a team is the way the world works. There is no need to make this more complicated than it already is. That is why people use AppleTalk.

Chapter One

What Is AppleTalk?

The Components

AppleTalk is the foundation for a LAN, a Local Area Network. At the lowest level, AppleTalk, like all networks, consists of cables, hardware, and software. The cables physically connect machines together. The hardware transmits and receives data to and from the cables and the attached devices. The software consists of two parts: an implementation of the protocols (AppleTalk in this case) and network applications chosen by the user. The protocols provide for basic, low-level message passing between network devices, while the applications build on top of these protocols to provide the actual network services, such as file service, print spooling, and electronic mail.

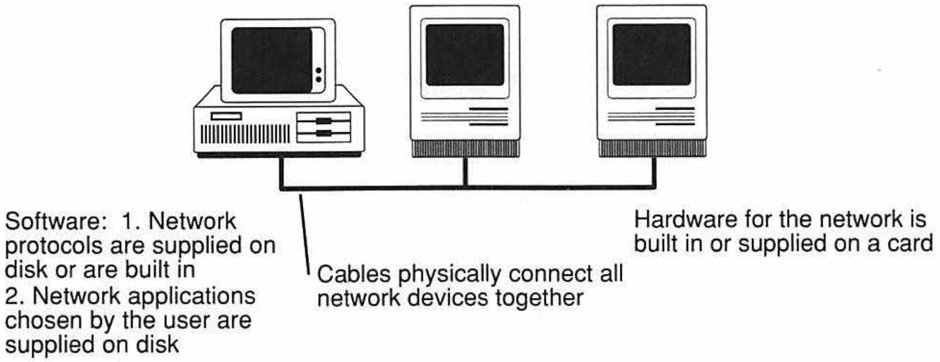

Figure 1-1 Three major components of a network.

In the literal sense, cables, network hardware, application software, and protocols comprise what AppleTalk is. However, a more useful description of an AppleTalk network is the answer to the question: "What can you do with it?"

What Can You Do with an AppleTalk Network?

AppleTalk is a straightforward way to network devices and people together. Why network devices and people together? What does connecting machines together allow that's not possible with a computer and its user alone? Sharing—sharing ideas, sharing information, sharing peripherals (like expensive laser printers or plotters). Networks connect people and devices together in a shared working environment.

Sharing

A network is designed to share one or several peripherals, distribute information among network members, and provide services—like centralizing all of a workgroup's shared data files on a single hard disk. A network provides access to information or devices in some way that isn't possible using stand alone computers.

Single-User Applications

For users of single-user applications and their associated data files, what does "being networked" mean? It means that applications and data can be stored on a central server or made available on a distributed basis. The network allows multiple users, one at a time, to open each file, read it, and make changes to it. The network makes the application itself available to multiple parties, allowing anyone to run it and generate files if it is not already in use by someone else.

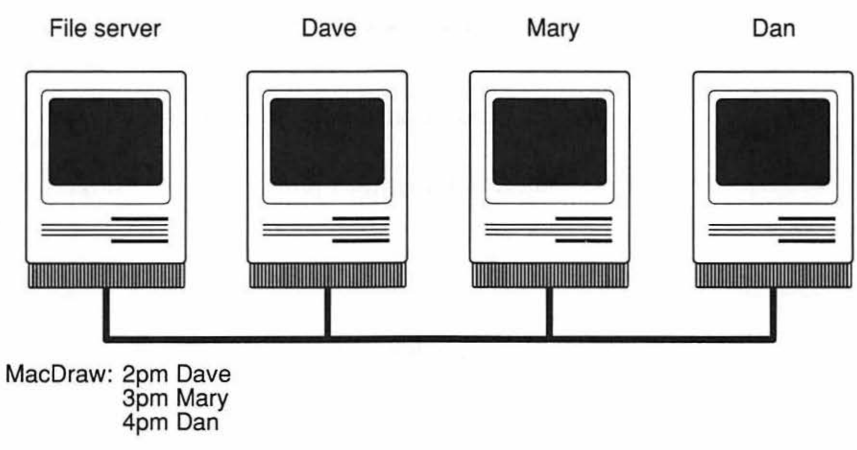

Figure 1-2 Sharing single-user applications.

A note of caution: Network use of single-user applications is often restricted by their license agreements. Be sure to read these agreements and adhere to their terms and conditions.

Multiuser Applications

The steadily increasing quantity of multiuser applications are, of course, designed to be shared. In this context, the network becomes the medium for a more sophisticated kind of sharing. Users are not borrowing resources and then returning them to the "library" for others to borrow. Instead, the technology enables many users to work on the same project at the same time. Instead of many individual users, workgroups are created. In workgroups, each user is permitted to contribute to a common project at the same time.

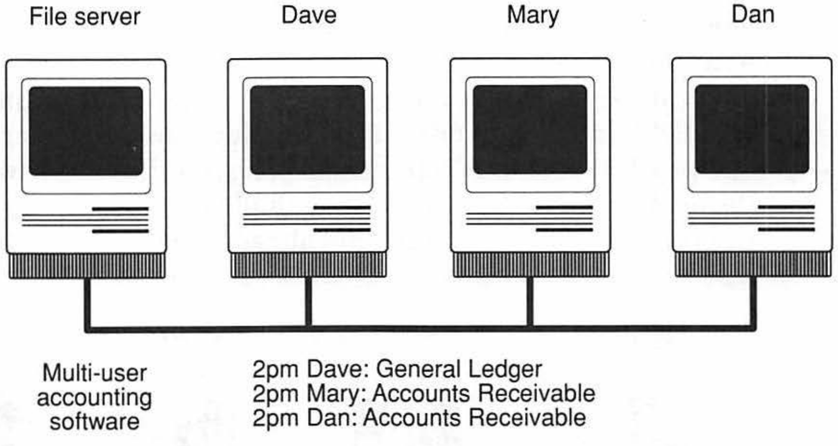

Figure 1-3 Sharing a multi-user application.

Utilization of a full-blown, network-ready application—such as a multiuser database or an accounting package—allows a workgroup *simultaneous usage* of one application and one set of data files. A network connects and contributes to the "workgroup" environment.

Groupware refers to an entirely new class of software. For the most part, Groupware is to date unreleased. Its design goes beyond simply allowing a group of people to simultaneously read and modify the same data. Groupware will mimic more closely the actual work of a group of people and perhaps even "learn" the work habits of group members. Multiuser or Groupware software applications allow a group to work together, in real-time, and eliminate the process of standing in line, one after another, to contribute.

A Typical Application

Electronic mail is a typical capability on a network. Electronic mail is a real-time process; it specifically depends on computers and connections. A postal carrier with the U.S. Postal Service delivering daily mail is not a real-time process. All letters go to a central place. They are sorted and routed by people and machines. Each piece eventually ends up in a letter carrier's bag. Once a day, at best, the carrier walks or drives his or her route and deposits messages and letters in one mail box and then the next. Although the functions are the

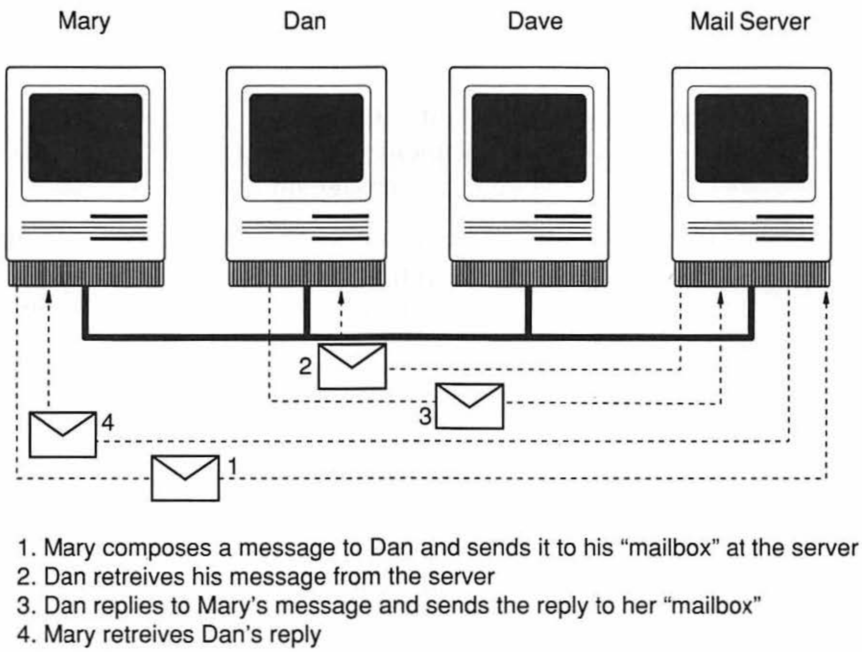

Figure 1-4 Electronic mail example.

same, the Postal Service and electronic mail differ greatly in the time it takes between sending a message and having it available to be read.

Electronic mail is built on this very familiar model, but electronic connections do the "walking." Instead of depositing a physical letter with a stamp in a mail box, the electronic letter or message needs no stamp and is sent via an electronic mailbox. That is, it is sent to an electronic holding box (a "mail server") addressed to someone else who is accessible through that mail server. Some electronic-mail systems even allow messages to be sent directly to the receiving computer without needing to be deposited in a central location. With a few keystrokes, the recipient retrieves the message and displays it on their computer. No pieces of paper have physically changed places. The intellectual "content" of the mail (message) has "travelled" from you to the recipient via electronically connected computers.

Electronic mail is very efficient. The network, not the letter carrier, is the "delivery" vehicle, so the delivery is not constrained by physical delivery considerations. Sending and receiving is handled by the computer at the request of the sender and the recipient. Since all activity is controlled by people, they can send, receive (read or print), and then send again (respond, redirect) when they wish.

Electronic mail is more immediate. Most systems even allow the sender to alert the recipient if the message is urgent by sounding a bell or displaying an alert message on the screen.

Electronic mail makes it simple to send a message to many people. One can very simply keep track of all the replies to a message, even if the message has gone back and forth many times among many people.

Through this simple electronic mail example, it is evident that effective networking can:

- increase productivity,
- eliminate arbitrary constraints and timing, and
- allow for more real-time communication to occur.

Networks Support Working Groups of People

Stand-alone computers do not easily support working groups. Physically connecting the computers is the first step in bringing the workgroup closer together. In the daily working process, the way you use that network defines how much the users work as an electronic "group" and how the devices—the physical resources—support individual and group needs. The added dimension of multiuser or Groupware application software can contribute further cohesion, capability, and power to the workgroup by enhancing each individual's level of contribution.

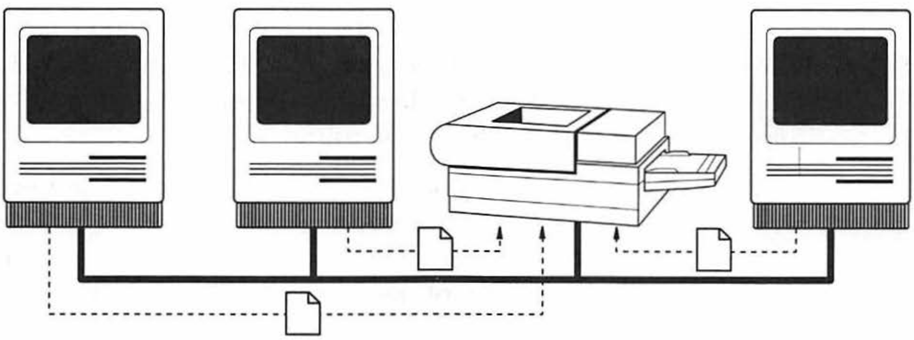

Figure 1-5 The simplest AppleTalk network.

The Simplest Network—Printer Sharing

Networking is most easily understood if you approach it from simple to more complex levels. On the first level, the simplest AppleTalk network involves cabling the computers together so that an expensive device like a LaserWriter can be shared. This is especially simple with an AppleTalk network because sharing that printer requires only cabling, nothing more. In fact, AppleTalk cabling did not exist until the LaserWriter was first released.

This primary connection is seemingly very primitive (simple) in that it only provides printer sharing. Although all network users can share the printer, only one person at a time can use the printer. Although primitive, it is functional, easy, and inexpensive. There is enough intelligence built into the standard system software to allow users to share that LaserWriter among themselves, simply by adding cables.

If the user is working from within the Macintosh Finder and wishes to print a file, the printer must be available and must complete the print job before the Macintosh becomes available again. If a 100-page manuscript is being printed, the user must wait without the use of the Macintosh or must cancel the Print request.

If, however, the user is working from within the MultiFinder, the Macintosh can be directed to "print" files to disk (to "spool," in network terminology) and free up the Macintosh for other tasks. While the user performs these other tasks, the Macintosh waits for its turn at the printer, takes the next file from the queue, and sends it to the printer for the user (in the "background").

This process is very simple. It is so simple that it is not even obvious. Many users don't even realize that with their Macintoshes and a LaserWriter hooked together, they have a LAN and a very sophisticated technology. This is one of the beauties of AppleTalk, of course. A great deal is hidden. Apple has hidden the sophisticated technological issues from the user—they've kept the details out of the way. They invite the user not to stand in awe and bewilderment before the technology, but to focus on their work. But simple as it is, it is the key to the rightful popularity and success of AppleTalk. For even more functionality, the network requires additional software and, possibly, additional hardware.

The Next Level—File Sharing

The next level of complexity, and the next most common capability of an AppleTalk network, is file sharing or file storage. This requires more software in addition to the printer-sharing capability built into the computer. The software connects the computers on another level, a functional level, by extending the file system (part of the Macintosh operating system) to look beyond the storage disks on a single user's computer.

For example, by using AppleShare or TOPS software, you can provide a central repository for files or applications. Keeping files in one location not only makes finding files simple for the users, but it can also simplify backup of those files. For sensitive files, it can enhance the security and confidentiality of the files. Adding file-sharing capabilities to a network also means that machines without hard disks can benefit from the hard disks on other machines. File-sharing solutions with today's technology allow files to be shared among "incompatible" computers, such as sharing files between Macintoshes and PCs.

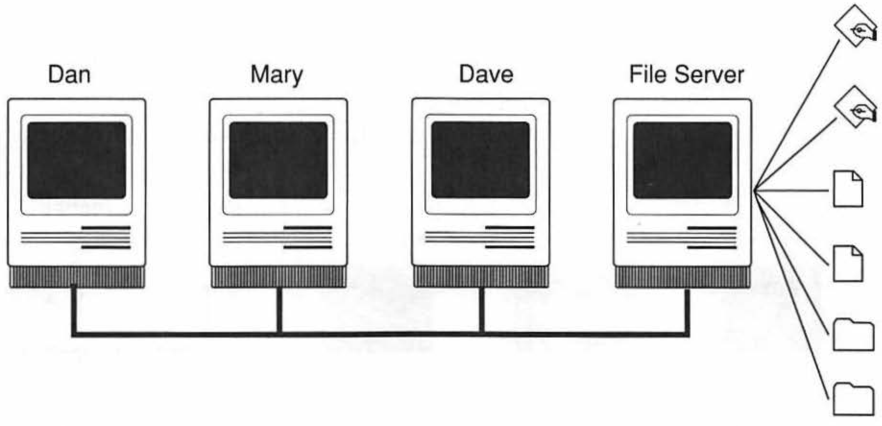

Figure 1-6 File sharing.

With single-user software, people share in the "lending library" sense: Only one person at a time can use the file or application.

Perhaps the most common use of file-sharing software, especially at smaller sites, is file transfer. The convenience of easy file transfers between machines, either directly from machine to machine with TOPS or via the central server with AppleShare, is critical for many sites.

The next level of complexity, in terms of a software application on a network, is the usage of a more sophisticated, multiuser application. Multiuser software allows numerous people to share the same data file, perhaps even the same application. The application can be distributed across the network, with machines requesting others to do processing for them. At this level of complexity, people can simultaneously read and write to the same file. This eliminates the one-at-a-time, lending library restrictions and allows people to work together in the same file at the same time. This type of software, as well as even more sophisticated Groupware, is now coming of age for AppleTalk.

More Peripheral Sharing

As previously mentioned, the simplest network is one in which users share LaserWriters by simply adding cables between devices. People share hard disks by adding file-sharing software. What about sharing other peripherals? By adding appropriate hardware to the network, people today can share devices that don't have built-in networking capability. Modems, plotters, and printers are all shared on AppleTalk networks with the help of additional hardware devices.

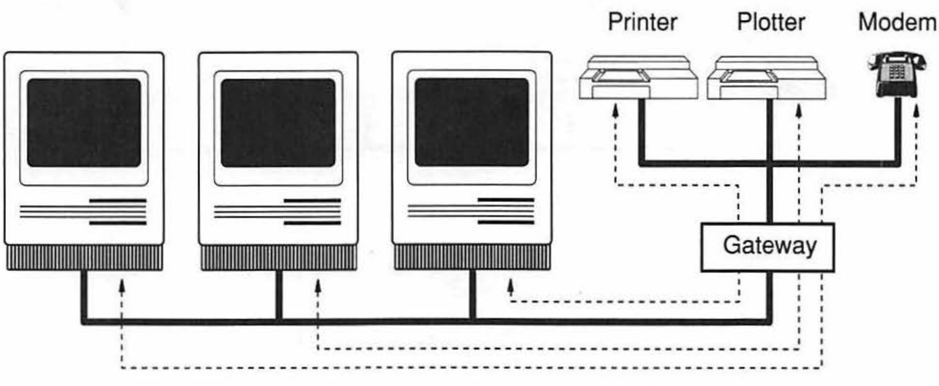

Figure 1-7 Peripheral sharing.

Networks Connect Networks?

Networks can sometimes become too large and need to be divided into smaller networks. Small networks may start off in different groups or departments and then need to be joined so the groups can communicate. And sometimes one group has an AppleTalk LAN while another group has a different LAN, such as those from Novell, 3Com, or others. In all these cases, there is appropriate software and hardware available to join these groups and networks to let them communicate and share resources.

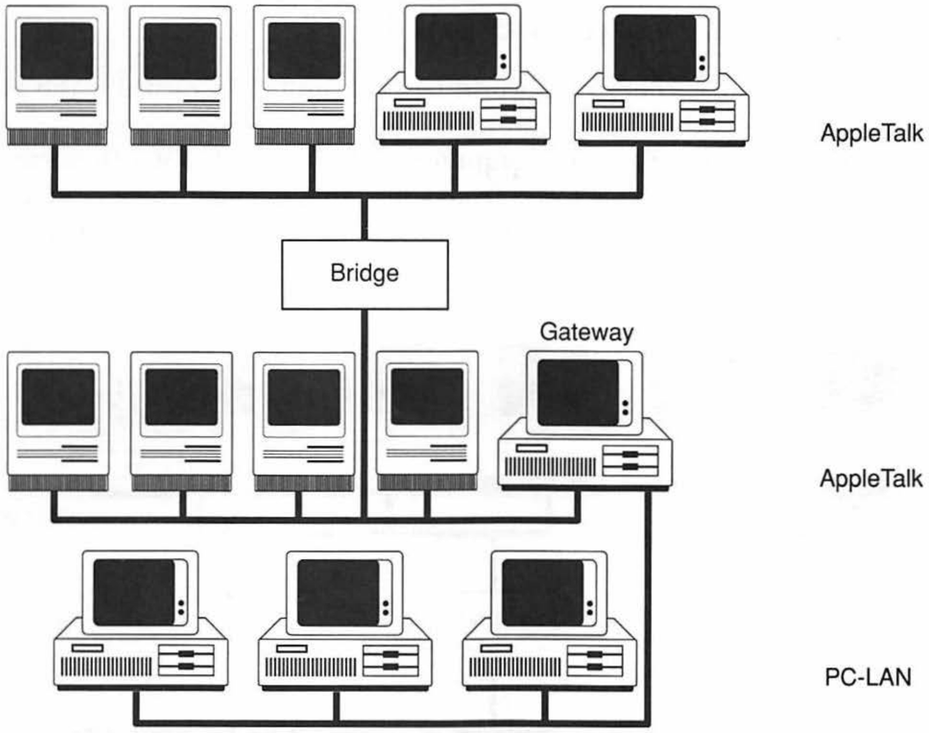

Figure 1-8 Networks connect networks.

The Endless Possibilities of a LAN

Continuing our discussion up through the levels of network possibilities, a fullblown network would combine a lot of these things. You might have LaserWriters and printer-spooling software to access those LaserWriters and allow people to continue to work. You might have file service available from one computer to another. You could certainly have multiuser applications running. If your focus is on effective and efficient use of "communications" time, you would undoubtedly want an electronic mail function to eliminate telephone tag, coordinate scheduling, and avoid the need for meetings. Larger networks might actually consist of many networks connected together.

The World Beyond the LAN

Of course, there's the world beyond the LAN—probably the highest level in the connection hierarchy. Just as you overcame the isolation of your stand-alone computers with a network, you can overcome the isolation of your LANs from your mini- or mainframe computers, and vice versa, with network connections to "hosts" or departmental-type computers.

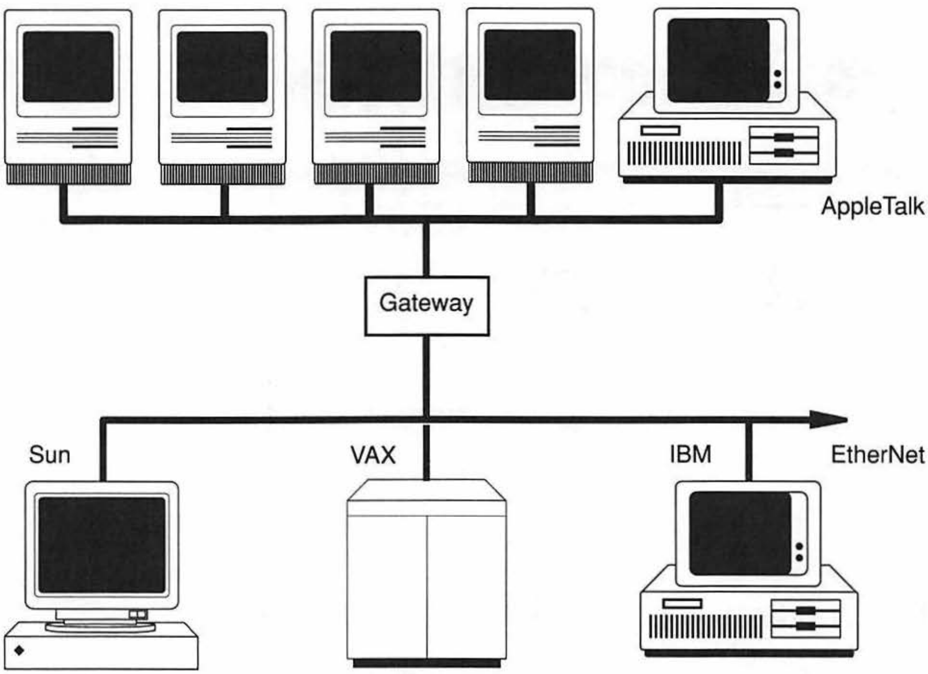

Figure 1-9 Connecting to other environments.

If your LAN is isolated by distance rather than by computer architecture or by communications protocol, this isolation can be overcome. With the appropriate hardware, AppleTalk LANs across town or across the country can be brought together with modems. Resources across the country look as if they're across the hall, though communications with them happen at slower speeds.

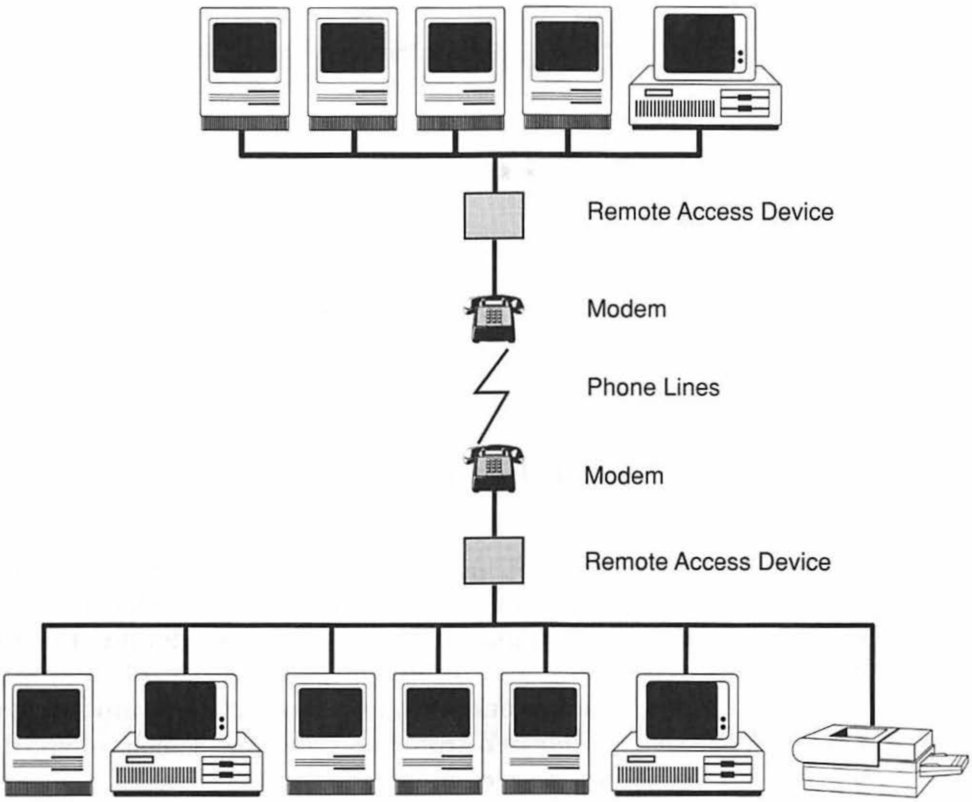

Figure 1-10 Networking with remote sites.

Simple to complex, level to level, we've described generically what networks entail—what people do with them and what they consist of. Throughout this book, we'll tell you how to take advantage of all this networking power.

An AppleTalk Focus

Out of all the networking possibilities, however, this book is concerned with a specific focus of networking—the AppleTalk network. What makes an AppleTalk network so popular?

The impetus to AppleTalk popularity stems from the same philosophy that guided the development of the Macintosh. *A complex task*

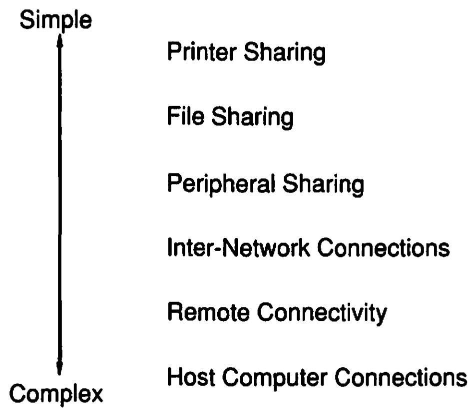

Figure 1-11 Levels of LAN complexity.

internal to the computer doesn't have to be presented as complex to the user. Even the layered complexities of networking can be made very simple. This principle was a guiding force in the development of the AppleTalk protocols and the various physical cabling schemes, software applications, and network peripherals introduced from Apple as well as third parties. Released from the esoterics of technology, the users are simply allowed to accomplish their work.

Another element, characteristic of the Macintosh and unusual for personal computer network solutions, is the fact that AppleTalk is standardized and built-in. Generically, AppleTalk is like other network solutions in that it provides for various network services, with this important exception. The fact that network hardware and a networking communications framework is built in is actually unique among network environments. It's not true in the DOS world or for any other microcomputer family. It is true in the minicomputer environment—Ethernet and TCP-IP support are built into most UNIX implementations, for example, and DECnet support comes with every VMS machine. But in the microcomputer world—predominated, of course, by the PC and its clones—that's unique. You cannot take a number of PCs, just add cables, and do anything with them. You must add some sort of networking hardware and software.

So from day one of the Macintosh, Apple built the networking hardware right into the computer. The serial ports can be used for the network because they have specialized hardware attached to them. Apple has provided networking hardware with every Macintosh delivered. The hardware performs the timing and access to the network, and the data encoding and decoding when it comes from or goes to another machine.

Apple also built network software functionality into the Macintosh. They put some essential pieces into memory in the machine and some elements are incorporated into the System and the Finder. The AppleTalk protocol stack is built into the Macintosh system software.

Apple and third-party developers (TOPS, Kinetics, and others) created network protocols with new ease-of-use features as their framework. That might have been notable in and of itself. To create a protocol and a hardware-cabling system that was easy to use was a big step for networking.

But in conjunction with that, most of these elements are delivered with the system. This "bundling" consists of network hardware built into the computer and protocol support and printer-sharing software built into the operating system. Literally, all a user has to do is add a number of cables between the systems and printers and that printer can be shared. And once this level of networking is in place, much of the other common network functionality can be added with software only and can be implemented and used easily.

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Chapter Two

A Short LAN Primer—In AppleTalk Terms

LANs

LAN stands for *Local Area Network*. LANs connect computers and other devices together so they can be shared. LANs connect computers in departments, floors, and offices that are relatively close together. A LAN is physically wired together. When data are transmitted over the air or telephone circuits to distant places from one LAN to another, the long-distance connections are called a WAN, or *Wide Area Network*. A LAN can be a part of a larger network, or "internetwork," that covers vast distances, but the LAN itself is *local*.

LANs are devices and people in combination. The "people" element is straightforward—people are the ones that use and benefit from the capability, services, and improved productivity the network makes possible. But what kinds of "nonpeople" elements are involved? Connectivity is several levels of complication beyond stand-alone computing, and in order to make decisions about network needs and implement your decisions, you need to understand LAN elements and how they relate to one another.

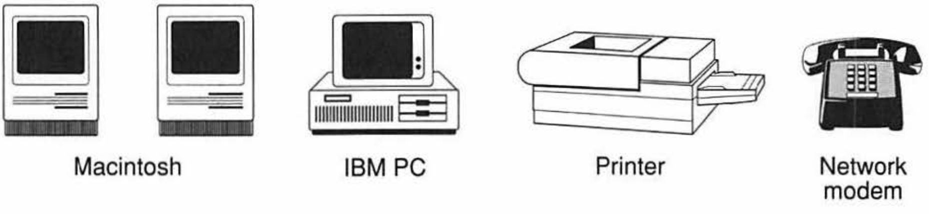

Figure 2-1 Typical network hardware elements.

LANs combine and connect hardware (of various kinds, sizes, shapes, and functions) via some kind of cabling scheme and employ software to add intelligent functions and increasing sophistication to what users can do with the network.

Being on a Network

Being on a network changes the internal process that occurs when a computer does work. For a stand-alone computer, all functioning is

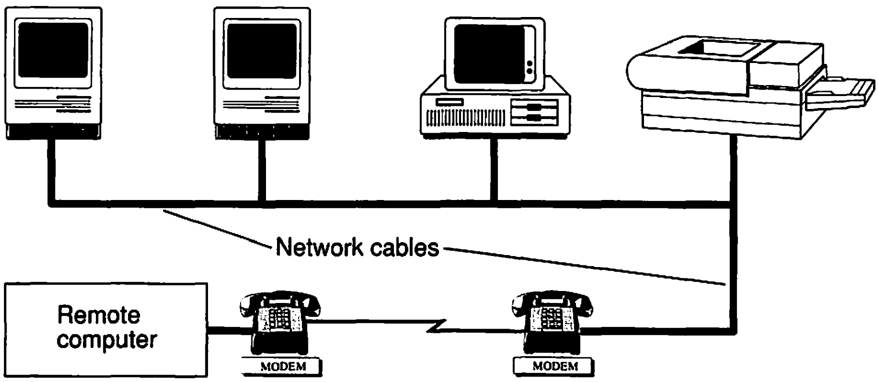

Figure 2-2 Connected via a cabling scheme.

self-contained. No decisions must be made about whether the user directing the activity wants information, processes or services from a device outside the stand-alone computer.

A computer that is part of a network, however, must be able to relate to processes and devices outside of itself. AppleTalk is very flexible and allows users to reach beyond their own machine to a wide variety of devices in many different types of environments. The open, layered protocol system that provides the architectural framework for AppleTalk is consistent with the Open Systems Interconnection (OSI) reference model. Apple and a growing network of developers, are constantly adding capability which extend and enhance AppleTalk's

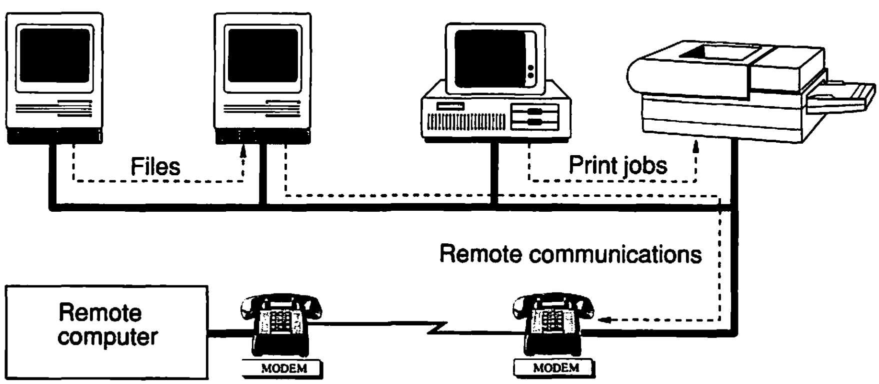

Figure 2-3 With software to control the network.

reach. Often services and protocols are specific to applications, user needs, or operating system environments (3270, VMS, VAX). Because AppleTalk as a network is independent of any particular machine's operating system, developers may begin from their own specific environment and construct avenues into AppleTalk. These avenues extend AppleTalk's reach, as well as make it more accessible.

Hardware—An Overview

Individual computers represent and work on behalf of individual users on the network. A computer may or may not have built-in networking hardware. With the Macintosh, it's built in. For a PC, network capability is not built in, but requires a network interface card, an add-in card that provides networkability and a port on the back of the machine to plug the physical connection into. The computer and the network interface card are the first two levels of networking hardware—you need both to have even the simplest network.

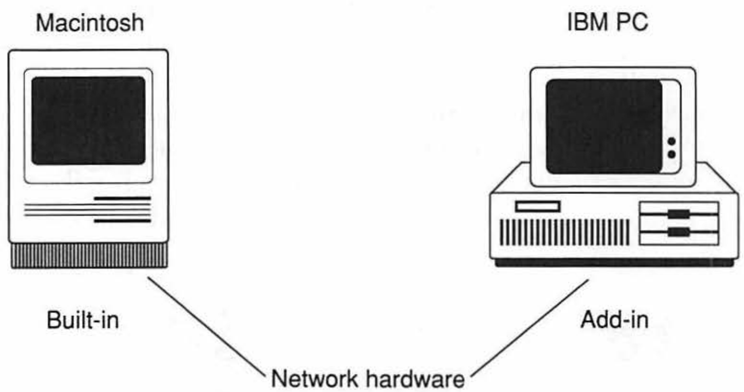

Figure 2-4 Networking hardware-1.

The next level of "hardware" is the elements of the physical connections between devices. In general, the physical scheme requires cabling and some sort of network connector boxes to hook up each device to the cables. These two components must be compatible with each other. For example, if you want to use LocalTalk cabling, you have to use LocalTalk connector boxes. If you want to use phone cabling, there are a number of choices for connector boxes. The combination you choose is a function of the characteristics of the physical environment and what the LAN will be used for.

The combination of cabling and connector boxes allows you to attach devices to the network. A computer is the most common device found on a network (e.g., Macintoshes, PCs, Sun Workstations). Additional hardware is dictated by a myriad of considerations specific to your needs, including the number of users, the physical environment, and usage of printers, modems, gateways, and many other devices.

Depending on the cabling, topology, length, and size of your network, you may also need to add devices that aid the distribution of data on the network. These devices can be repeaters and multiport repeaters, or devices which join networks together, such as bridges and gateways.

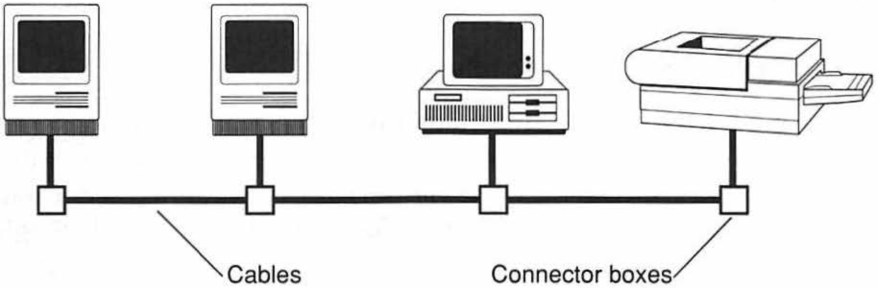

Figure 2-5 Networking hardware-2.

Hardware Terms

Computer

A computer consists of a central processing unit (CPU), and other electronic circuitry, including read-only memory (ROM) and random access memory (RAM). Also included are connections to devices that are necessary parts of "computing," such as input mechanisms, a hard disk, a printer, a network, a modem, or a variety of other devices. A computer has either a separate or an integrated display screen that displays the results of programs run on the computer. The user operates the computer by means of a keyboard, mouse, and/or other input mechanisms. On a network, there may also be connected "computers" that are not directly monitored by a user but function as dedicated servers.

Network Interface Hardware

Interface hardware consists of a specific set of electronic parts, either built in or assembled on a separate Network Interface Card, that give network capability to a computer. Network capability means that with the hardware the computer can communicate with other devices on the network. In the case of the Macintosh on LocalTalk, this is not a separate card, but is built into the electronics of the Mac. For IBM and compatible computers, network capability is not built in and must be placed inside on an "add-in" card.

Network Peripherals

File Servers

In the definition of computers, we stated that some general-purpose computers are used on LANs as dedicated network servers. Some are configured as file servers, functioning as central repositories for files and applications for users of the network. Single-purpose file servers are also available. They consist of a computer and hard disk, without a keyboard or monitor. They must be placed on the network and set up ("configured," in network terminology) by a system administrator.

Printers

Many printers, especially laser printers like the Apple LaserWriter, come with built-in network hardware. Others, such as the Apple ImageWriter II, can have this hardware added to the printer. Both options allow the printer to be added to the network and shared among users. Without this hardware, a printer communicates with a single computer via serial or parallel connection. These single-user printers can be shared on a network by connecting them to an RS-232 gateway or to a file server that also provides for printer sharing.

Modems

Network users often want to share modems to avoid purchasing one for every computer. Modems may be shared on a network in various ways. Some modems are now available with built-in network hardware for direct attachment to the network. Others are attached to RS-232 gateways on the network. Still others are attached serially to a computer just as for stand-alone use, but software in the computer allows others on the network to access the modem remotely.

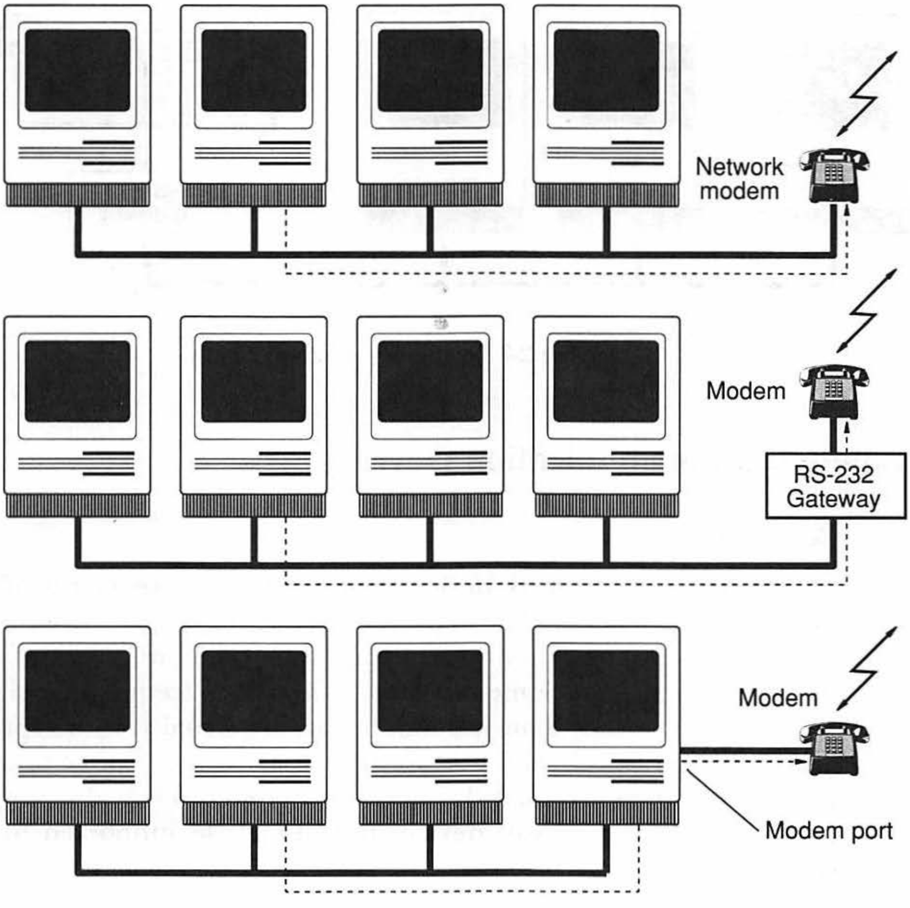

Figure 2-6 Network modem connections.

RS-232 Gateways

RS-232 gateways are network devices that allow other peripherals without built-in network hardware to be shared on the network. These devices connect printers, modems, plotters, and other RS-232 devices to the network. Data from network users are sent to and from the gateway. The gateway translates the data into the serial or parallel signals required by the peripheral.

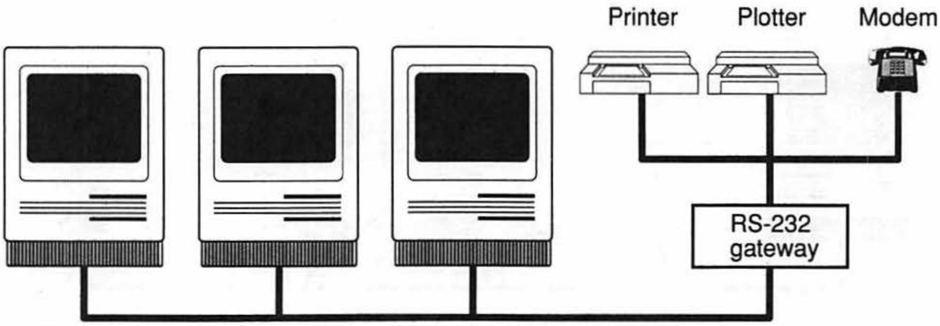

Figure 2-7 Peripheral sharing.

Intranetwork Communication Devices

Repeaters

Repeaters are network devices that connect two segments of network cabling together. The repeater "listens" for signals from other segments and sends them on to the other segment, regenerating them at full strength. Some repeaters also reclock (retime) the signal, meaning that rather than just amplifying the signal it is interpreted and reformed at full strength. Repeaters allow for greater network length and for more total devices on a network. They also support physical arrangements of devices not otherwise supported by the cabling scheme.

Multiport Repeaters

These devices essentially function the same a repeaters, except that more than two network segments are connected. AppleTalk multiport

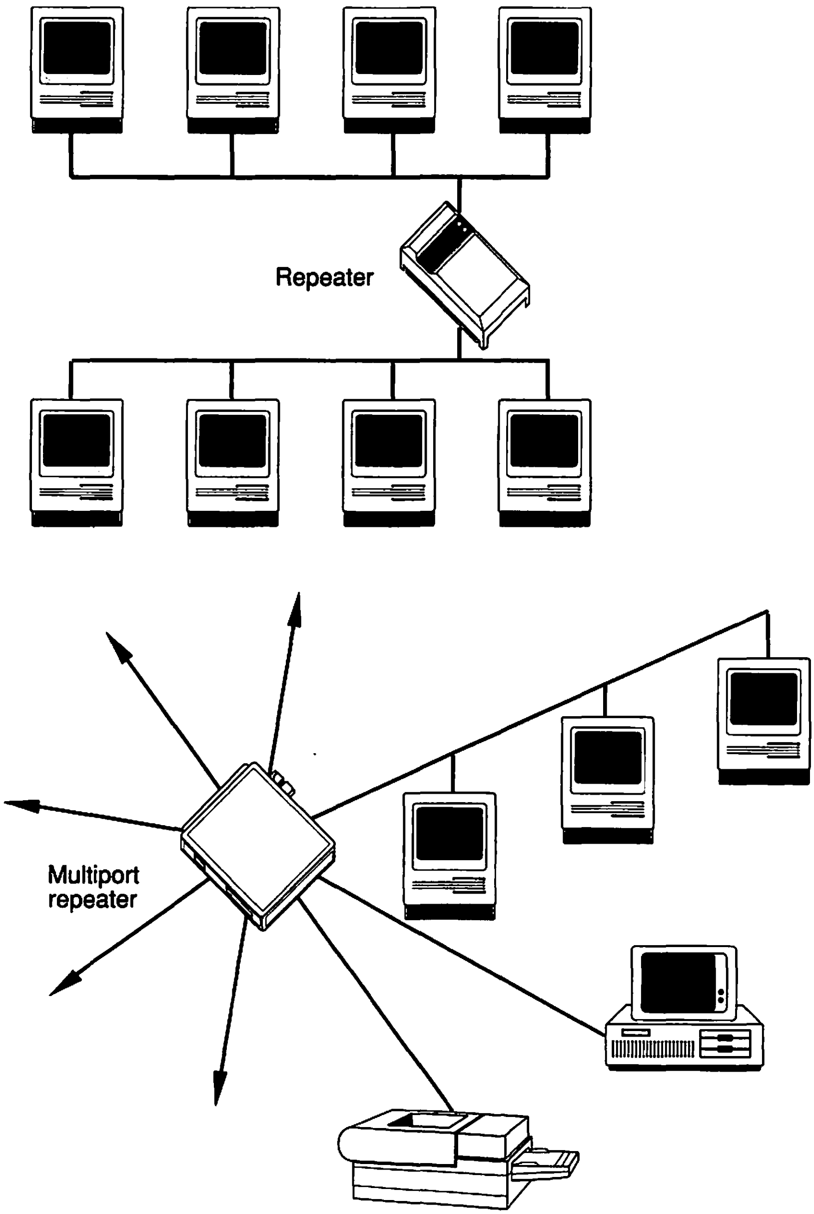

Figure 2-8 Intra-network communication devices.

repeaters connect as many as 12 segments. Multiport repeaters are required for proper configuration of a "star" topology (physical arrangement of devices on the LAN).

Internetwork Communication Devices

Bridge

A bridge provides an "intelligent" passageway for a signal. Bridges, like repeaters, join two segments of a network. When a bridge receives a signal, however, it has the capability to interpret the signal and then pass it on only if the signal is addressed to a node on the other side of the bridge. Thus, a bridge separates networks and minimizes traffic on each network, while allowing for communication between any two devices on either network. Networks on either side of the bridge must use the same network protocol.

Gateway

A gateway functions the same as a bridge, except that it connects two networks operated by different network protocols. The most common types of networks connected by a gateway are Ethernet and AppleTalk. Gateways are also "intelligent" devices. The gateway must interpret incoming signals and determine whether or not to pass the signal on. If so, the gateway adds, removes, or modifies the data in the signal and sends the signal on under the control of a different network protocol.

Media

Media are the physical pieces (cables and connectors) that connect the network devices together. The media must be compatible with the network hardware, whether built-in or on a network interface card. The media must also support the desired topology.

Cabling

Typically, cabling is made from wire, except with fiber optics, made from thin glass fibers. Commonly used types of cables are twisted pair, coaxial, and fiber optic. AppleTalk networks are usually designed with

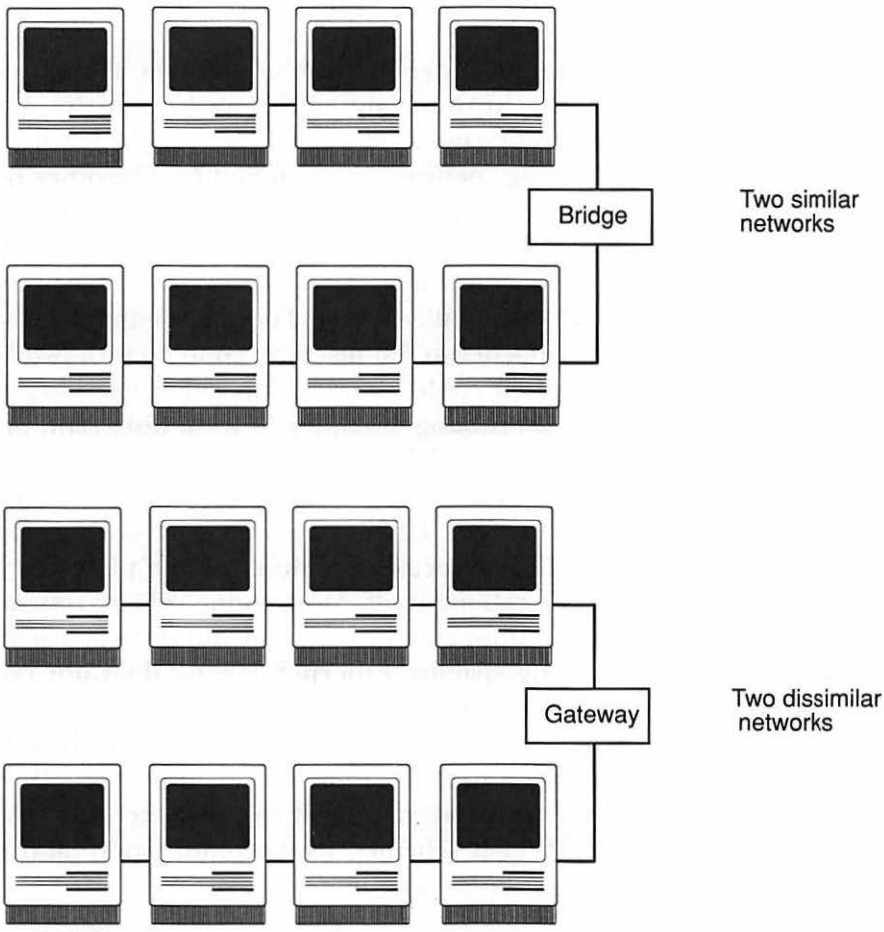

Figure 2-9 Inter-Network Communication Devices.

LocalTalk cabling (a proprietary Apple design) or phone cabling, both of which are based on twisted pair. Though similar, they both have different characteristics. AppleTalk users may now also use Ethernet cabling and network hardware for high-speed AppleTalk transmissions. Ethernet cabling comes in two forms ("thick" and "thin") and is based on a coaxial design. Refer to the design section on cabling (Chapter 5) for more detailed information.

Connector Boxes

Connector boxes join the network cables together at each device and electrically route network signals to and from the device. Connector boxes typically consist of a small box (2" by 3") with two female ports for "splicing" network cables together. The other side of the box is a 6–12 inch "pigtail," a small cable that runs between the connector box and the network device. Apple, Farallon, duPont, TOPS, and others produce connectors. Apple's LocalTalk connectors can only be used with LocalTalk cabling. They have either a DIN-8 or DB-9 connector that attaches to the machine coupled with two DIN-3 connectors to attach to the cables. LocalTalk is self-terminating. Refer to the design section on cabling (Chapter 5) for a discussion of "termination." Farallon's PhoneNET, TOPS' Teleconnectors, and other connectors of similar design are used with standard phone cabling. They have either a DIN-8 or DB-9 connector that attaches to the machine and two RJ-11 connectors (modular phone plugs) for connecting to the network cabling itself. Most phone cabling systems are not self-terminating. Connector boxes from duPont are used with their fiber optic cabling systems. Ethernet cabling does not require connector boxes per se. However, "thick" Ethernet requires a complex transceiver device attached to the main network bus, while "thin" Ethernet requires a simpler "T" connector to join together network cables together at the device itself to form the network bus. Twisted-pair-based Ethernet schemes are becoming more and more popular; some of these require a connector box.

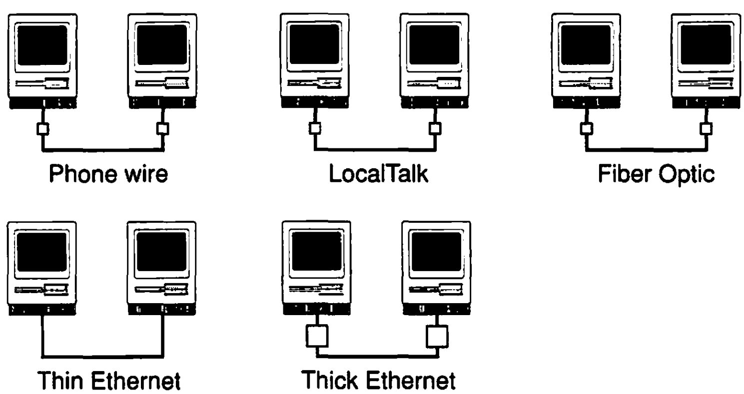

Figure 2-10 Cabling/connector box options.

Topology

Topology refers not to a piece of hardware, but to how the elements of the network are arranged in the actual physical space. The routing of cable and positioning of nodes in the network environment is called topology. A "bus" topology is the simplest and most common AppleTalk topology. Physically, machines on a network with a "bus" topology are daisy-chained together in a row, connecting one to another with network cables running only between connector boxes. AppleTalk was originally designed as a simple bus topology network. Other common AppleTalk topologies include:

- the trunk with drops, with all network devices connected to a single "trunk" cable running the length of the network, and
- the star, in which all devices and network segments connect together at a central point.

Some networks also use a ring topology with no distinct "end" to the network cabling; however, AppleTalk does not yet support this topology.

Backbone

A backbone is typically a separate network created solely to connect several other networks together and allow communications between them. Backbones normally function at a very high speed, thus allowing for rapid communications between networks.

Bandwidth

Bandwidth refers to how much data can travel over the network cable in a given timeframe. A higher bandwidth increases the capability for the network to transfer data. Due to errors, timing gaps, and network control and routing of information sent along with the actual "user" data, the bandwidth does not directly translate to exactly how much data are passed across the network. Refer to the design segment of this book (Chapter 5) for a discussion of these factors.

Baud Rate

Baud rate, which is similar to bandwidth, is a measurement of how fast data travel on the network. It measures the speed at which data travel across the network and yields the theoretical, unrealizable maximum number of data bits that may travel across the network in any given second. One baud is equivalent to one data bit per second.

Kilobaud

One Kilobaud equals 1,000 bits per second. Standard AppleTalk speed is 230.4 Kilobaud.

Bits Per Second

Bits per second is a measure of the frequency, or clock speed, on the network. It directly translates into the amount of data that can be sent over the network. Bits per second is also referred to as *baud rate.* The basic speed of AppleTalk is 230,400 bits per second.

Node

Node is commonly referred to in two senses. Generally, a node refers to anything attached to the network. Computers, printers, bridges, gateways, repeaters, multiport repeaters, and other peripherals all fall into this category. A stricter definition of a node is a device that is assigned an address on the network so that data may be sent directly to it. Repeaters and multiport repeaters are "invisible" to the network protocol and exist only to route information, without modification, on the network. They would not be referred to as nodes using this definition.

Software/Services—An Overview

Network software provides the capabilities—the services—available to the users. Network services are always built on top of network protocols, those rules that specify how all communications take place on a given network.

Network services come in many forms. File, print, mail, and terminal services are among the most common services. Many of these services are implemented in either a *centralized* or *distributed* fashion. It is important to understand the distinction between centralized and distributed services. In very simple terms, centralized services come from a central location, usually a network server. Sometimes this central server must also be *dedicated* to that task. Distributed services, on the other hand, are not in one place. They are distributed among the devices on the network and, by nature, do not require dedicated devices. To further explore this distinction, let's discuss centralized versus distributed file and print services.

Centralized File Service

Centralized file servers allow network users to share a common mass storage device. Many users can gain access to the same volume of files at the same time.

Figure 2-11 illustrates that each user on a file-server network can gain access to all files on the shared fixed disk. A security system allows assignment of passwords and definition of access modes (read only, write only, read/write, etc.) for each file or each volume of files. All files to be shared can be stored on this central mass-storage unit. Files can also be kept locally on floppy and hard disks attached to each computer but cannot be shared with others unless they are transferred to the file server. Simultaneous access to files is determined by the application software.

Centralized file storage allows for easier file backup and improved security. However, it does have potential drawbacks. Centralized servers often require dedicated hardware, which can be expensive. They also often imply a more formal system of network administration, perhaps including a formal system administrator. All files exist on one or several servers, which can increase network traffic and create traffic bottlenecks at the server. If a centralized server goes down,

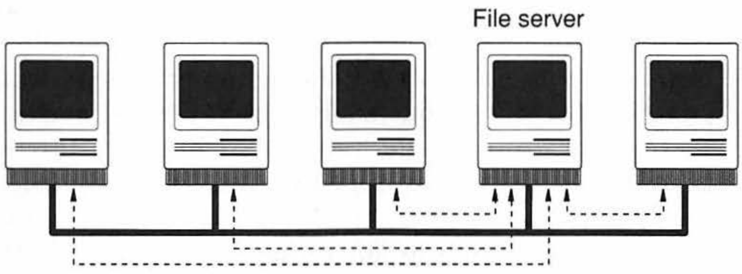

Figure 2-11 Centralized file service.

a great deal can be lost. Also, files cannot be transferred directly from one computer to another.

Distributed File Service

Distributed file servers allow network users to share *all* storage devices on the network. All disk volumes can be made available to all network users at the same time. Distributed file servers are the most flexible type of servers. Each computer on the LAN that has a fixed or floppy disk can become a server to the network. Simultaneous access to the same file is determined by the application program.

Because the file-service chores are distributed throughout the network and occur in the "background" of the computers, users are free to use the computers for their normal tasks. The file service does not require dedicated equipment, therefore lowering the installation cost of the network. Files can still be centralized simply by choosing to keep them on one or a few computers.

Administration of a distributed network is often handled on an ad hoc, unstructured basis. Users are able to individually decide which files and applications to make available. This can make file backup and file security much more difficult than on a centralized file service network. Another drawback is that a client performing a CPU intensive task can disturb the foreground user of the server.

On a distributed file server network, files can be easily transferred between any two machines on the network. Also, if a file server goes down, less will be lost because only a portion of the total file service is lost.

With print services, there are also centralized and distributed implementations. The AppleShare Print Server is a centralized print service that collects all print jobs for the network before sending them to the printer. It allows true queueing of print jobs but requires a dedicated server and doubles the amount of network traffic generated. Distributed print spoolers include TOPS Spool, LaserSpeed, SuperLaserSpool, and others. With a distributed print spooler, each individual user spools locally to his or her disk. The Macintosh then sends the file in the background to the printer. This is a simple solution that does not require dedicated hardware. But it also does not provide for any prioritization of print jobs or global management of print jobs.

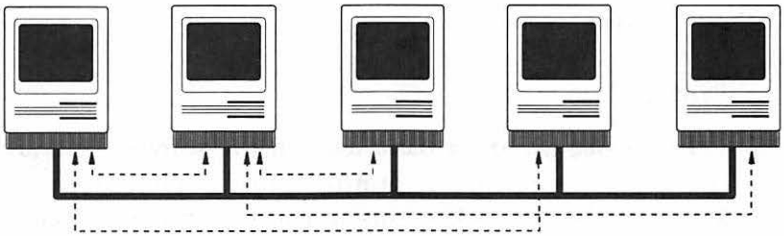

Figure 2-12 Distributed file service.

Distributed services must closely mimic the working habits of real people. Security issues and administrative constraints sometimes require files to be centralized. However, this can be accomplished with either implementation.

Centralized versus distributed service is an architectural issue decided upon by the user. With some network services, users will choose both distributed and centralized solutions. The arguments for and against each model have been presented above; the choice is left to you.

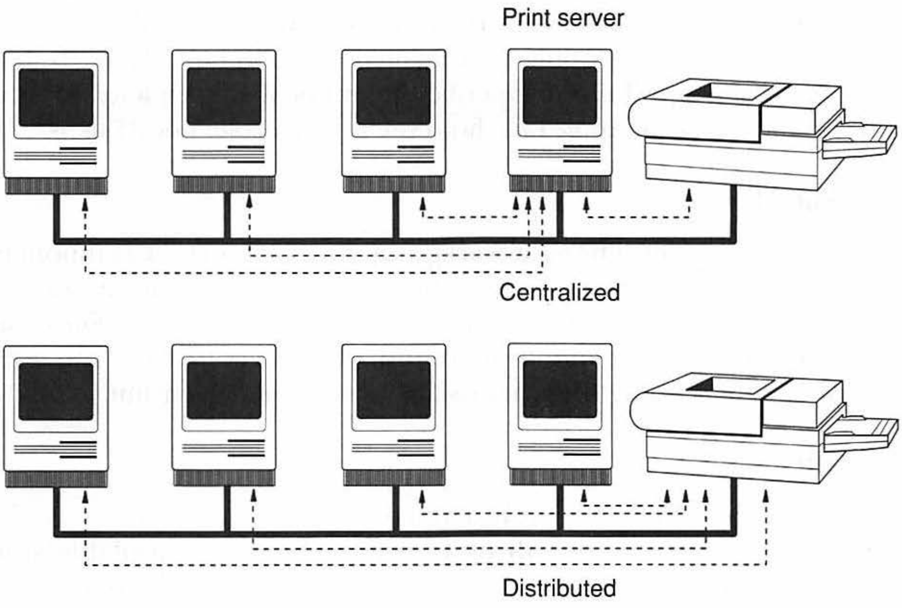

Figure 2-13 Print service.

Software Terms

Protocol

Protocols, the most basic level in the software hierarchy, form the basis for all network communications. They define the rules for accessing the network, communicating between devices, communicating between networks, ensuring accurate delivery of data, and communication between applications. Protocols control all LAN behavior. Different network types use different sets of communication rules that direct and control communications on the network. These communication rules are called *protocols.* AppleTalk networks use Apple's own *AppleTalk* protocol suite, which consists of many specific protocols and follows a standard called the Open Systems Interconnection Model.

Note: There is much confusion over whether AppleTalk refers to a network, a cable, a protocol, or all three. AppleTalk is commonly used to refer to a network in its entirety. AppleTalk is a networking system and the term, in this sense, is used throughout the book. Strictly speaking, AppleTalk refers to the network protocol alone. When first introduced, Apple's cables were referred to as AppleTalk cabling. To alleviate this confusion, Apple has renamed the cables LocalTalk. To be correct, use "AppleTalk" to describe the protocol or even a network based on the protocol. AppleTalk, however, is *not* a cable; LocalTalk is.

File Sharing

Sharing files among a workgroup is an important component of almost every network and can be accomplished in various ways. Files can also be transferred from one machine to another. Files can be made available on one or more disk or file servers. Files can even be shared by sending them across a network using electronic mail.

File Service

This has been previously defined as the sharing of a storage device on a network so that all users may make use of available storage space, files, and applications. Files can be shared by one user at a time with single-user applications, or an entire workgroup can share the same file with multiuser applications and groupware. Appropriate controls are built into file-service software to protect files via passwords and various access modes. File servers can be implemented in a distributed or centralized fashion. File service is the most common method for file sharing on a network.

Disk Service

Disk service is another form of file sharing, but is used much less frequently than file service. On the surface, they essentially perform the same functions. Both allow a hard disk to be shared among network users. However, this is accomplished by partitioning the disk into discrete areas for each user. Files are transferred among users by moving them from one partition to another. It is difficult to allow more than one user in a partition to share the same file, and it is extremely difficult to share files between dissimilar operating systems.

File Transfer

Disk and File Service products also allow the user to transfer files from one computer to another. Networks allow this to be done electronically and therefore eliminate the need to walk disks from computer to computer.

File Translation

File translation is the process of converting the contents of the file from the format specific to the application that created it to the format required by another application program. An example would be conversion of a MultiMate (word processing file) on an IBM PC to the format required for Microsoft Word on the Macintosh while preserving all necessary formatting (line breaks, character formatting, tabs, margins, etc.). File translations are written into many application programs (e.g., Microsoft Excel can read and translate files from Lotus' 1-2-3). File translations can also be performed via specific file-translation applications.

Print Service

Print servers allow printers to be shared among many users on a network. Printers may have built-in network hardware so they may be attached directly to the network. Others are attached via RS-232 cables either to file servers or to RS-232 gateways. Print-service software allows network users to print immediately to a disk somewhere on the network. Regardless of the printer status, this will print either at the local machine, a designated location on the network, or a device directly attached to the printer itself. The user is then free to perform other tasks with the computer. In the background, the print-service software ensures that the file is printed when the printer is available. Most software also allows the user to view and manipulate either their personal print queue or the global network print queue. It may also allow jobs from certain users to be prioritized within the queue.

Print Spooling

The act of sending your print job to the print server for processing. SPOOL is actually an acronym, which originated on mainframes, and stands for Simultaneous Peripheral Operations Off-Line.

Modem Service

Software enables modems attached to one computer on the network to be shared by anyone on the network.

Electronic Mail

E-mail is a software application that allows users to send messages and/or files across the network to one or more electronic "mailboxes" assigned to each network user. A central repository for messages is usually required to store and forward messages for users who are not "logged in" at the time a message is sent. Often, this repository stores all messages until they are deleted by the recipient. Users can generally reply to, forward, copy, delete, and store messages, and track electronic "conversations" on a given topic.

Mail Server

Name given to the central repository of electronic messages referred to above.

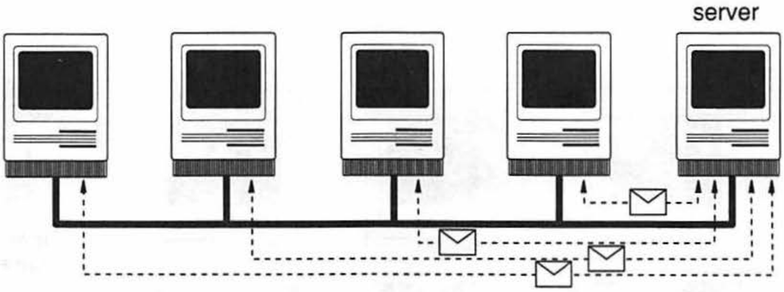

Figure 2-14 Mail service.

Conferencing

This is another form of messaging on a network. Rather than sending discrete messages to specific people at specific times, participants in an electronic conference are allowed to type messages at the same time and have all conference members view the participant's typing.

Terminal Service

This service is most commonly associated with communications to minicomputers and mainframes and allows users to "log in" over the network to another computer. The user's computer emulates a terminal (sometimes referred to as a "dumb terminal") attached to the remote or "host" computer. The user communicates via the local keyboard and/or mouse with the host computer, issuing commands and running applications whose output is directed back to the local computer screen. This service not only eliminates the need for a separate terminal for these communications and the additional wiring and communications hardware, but lets the user perform many tasks that cannot be done from a terminal. These activities include multiple sessions with different computers, transfer of files and/or screen data to and from the host computer, and saving of "transcripts" of the session with the host computer.

Backup Software

Backup software allows users to save ("archive") copies of files to a hard disk, floppy, or magnetic tape, to protect against the loss of the

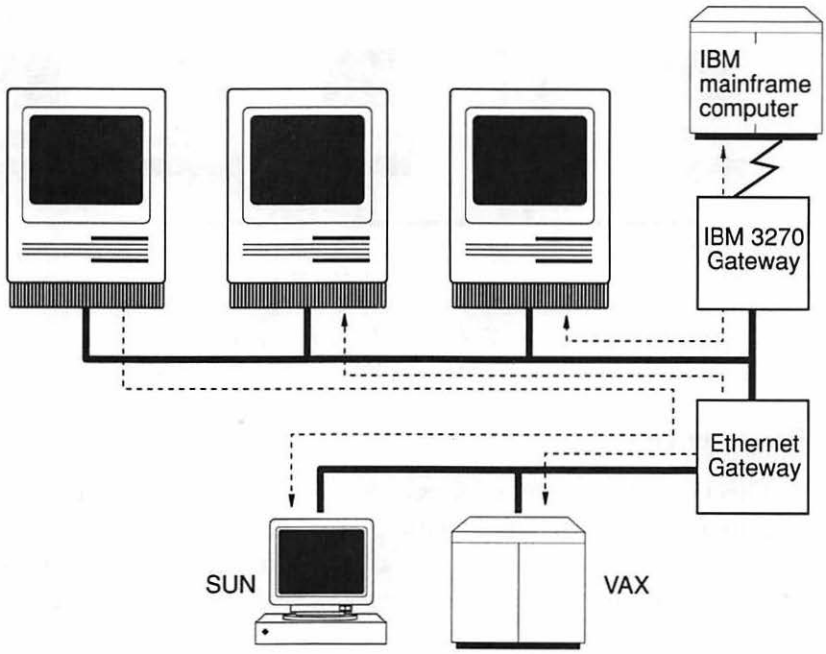

Figure 2-15 Terminal service.

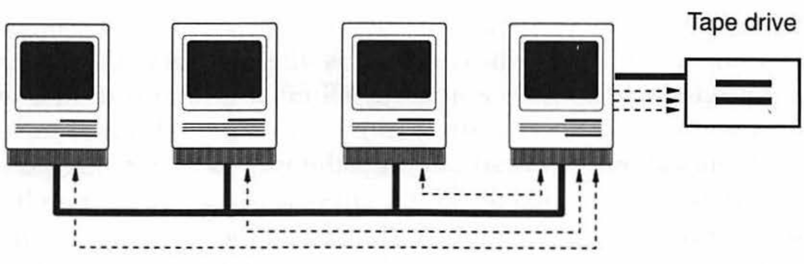

Figure 2-16 Backup software.

file. Network users want their backup software to backup files from all file servers on the network. This is difficult on a distributed file-server network.

Network Diagnostics

This category of software allows the network administrator to monitor the status of the network, find the cause of problems, and assist in optimizing performance and/or configuration of the network. These packages are just becoming available for AppleTalk networks and are critical for keeping large networks functioning smoothly.

Single-User Application

An application designed to be used by only one person at a time. Most software falls into this category. Simultaneous use of this software by more than one person

1. may not be allowed by the operating system,
2. may compromise the integrity of the data files, and
3. may violate the license agreement for the software.

Multilaunchable Application

An application designed with network file servers in mind. Multilaunchable applications allow one copy of the software to be used by many people over a network, but still requires that each user edit a separate file (it is *not* a multiuser application). License agreements normally limit the number of simultaneous users to the number of copies of the application purchased for the site. Please read these license agreements carefully.

Multiuser Application

An application that allows many people to use the software simultaneously, and to edit the same file. The most popular applications of such software are multiuser accounting systems and multiuser databases programmed for vertical applications, such as office automation and point-of-sale processing. Such multiuser systems require a network to operate and may also be dependent on file-service software.

Groupware

Applications that go beyond multiuser access to a file and closely mimic and facilitate the workings of a group. Applications that fall into this category are just beginning to emerge, as this is a relatively new genre of software.

A Note About Services and AppleTalk

There are quite a number of different services that can be put on a network. For AppleTalk, there aren't packages sold that contain all the possible services. It's more mix and match—you may be dealing with a variety of vendors. But all the options are there: print service, file service, disk service, mail service, terminal service, and others. This book will help you decide which you need and which of the available solutions will be best for you.

Network Players: Server, Client, and Network Administrator

When defining network services and contemplating what you can do with a network, you must ultimately consider the people involved: Who are the players on a network?

When you use a service—no matter where it comes from—you have a server/client relationship. The term "server" is used two different ways in networking. At first it may be a bit confusing to distinguish between the usages. The term "server" is often used as an abbreviated form of "file server." When network users refer to "the server" they are often referring to "the file server." The meaning is often clear from the context of the conversation.

A "server" more correctly refers to the user or device that makes available the resource sought by another user or computer (the client). A server makes available to others a resource or service, and a client makes use of that resource or service. Servers need not be dedicated and there may be many servers (and many clients) comprising a network service, especially for those implemented in a distributed scheme.

Network Administrator: By Design or Default?

There must be a person who acts as a network administrator, either by design or de facto (by default). This is rarely a full-time job, except at very complex and large AppleTalk installations. Someone, though, has to understand the overall scheme of things and has to be responsible for the network. These duties may include planning, monitoring, troubleshooting, security, and a host of other tasks, depending on the size and complexity of the network.

Chapter Three

LAN Design Basics

This chapter moves beyond primer material and goes deeper into the basic concepts critical to designing an AppleTalk network: cabling, topology, bandwidth options, and internetworking. Since the physical characteristics of the environment, as well as the network, predetermine topology and cabling choices, it is important to start with these concepts.

Topologies

Topology is largely determined by the physical areas where the network will exist. An understanding of topology is crucial to understanding and choosing correct cabling. Topology and cabling should be considered together. *It is important to carefully consider and choose topology and cabling before beginning the installation of a network.*

A bus network is laid out along a line of cables. The cables connect the various devices together, one to the next.

The line may curve around and go from floor to floor, but it is still a line. The ends of the bus may *never* be connected into a circle. Network devices like computers, printers, hard disks, etc. are attached along the bus.

Bus networks are easy to set up and maintain. Adding a device to the network is as simple as plugging it in. Devices can be added and removed from the network without having to restart anything. Extra connections can be installed ahead of time to accommodate future expansion. If one device on the network fails, the network remains operational. Bus networks, like AppleTalk, require very intelligent software to operate them.

For an AppleTalk network, there are three predominant topological schemes:

- the daisy chain
- the trunk with drops
- the star

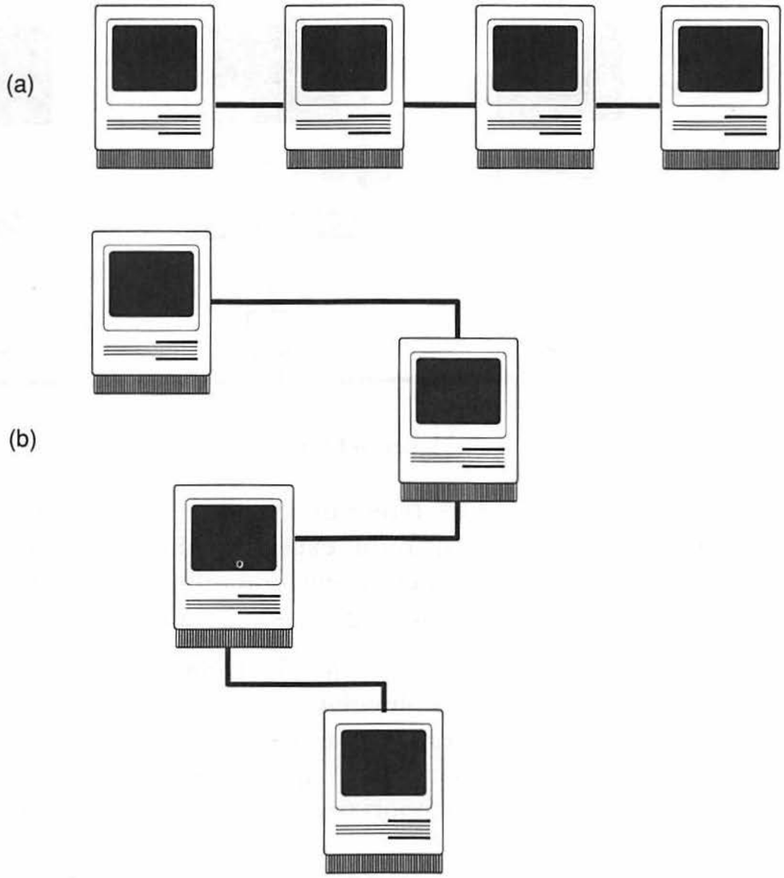

Figure 3-1 Bus networks.

Some topologies will work with all cabling options. The daisy chain (originally the intended method of connecting nodes on an AppleTalk network) is supported by all AppleTalk cabling schemes. Other topologies are possible only with particular cabling choices. The star topology, for example, is only possible at this point using phone wiring or fiber-optic cabling.

Daisy Chain

The daisy chain is a linear topology. It may never go in a loop or make a circle connecting back to itself. In a daisy-chain network con-

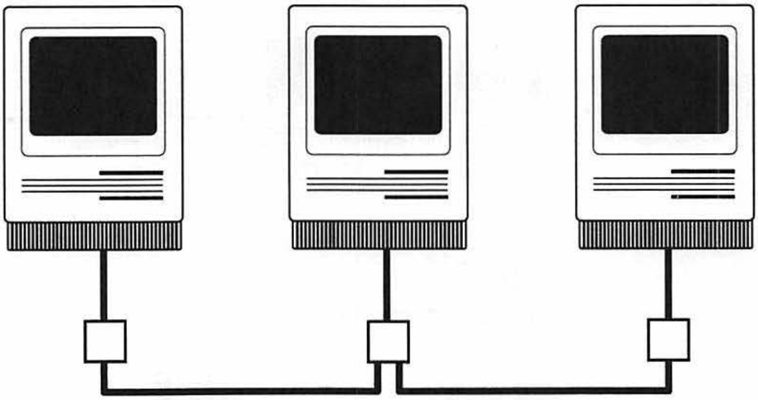

Figure 3-2 Daisy chain topology.

figuration, each device (computer, printer, etc.) is hooked to a device to its left and one to its right, except for the devices on either end of the chain, which connect to only one other device. "Ending" devices are like a caboose—or an engine—on a train.

Network cables join the devices by plugging into a network connector that accommodates plugging in two cables—one to go each direction along the network. A simple daisy-chain network of Apple's LocalTalk connectors can have up to 32 devices "on the chain." The same daisy chain can support up to 24 Farallon PhoneNET connectors.

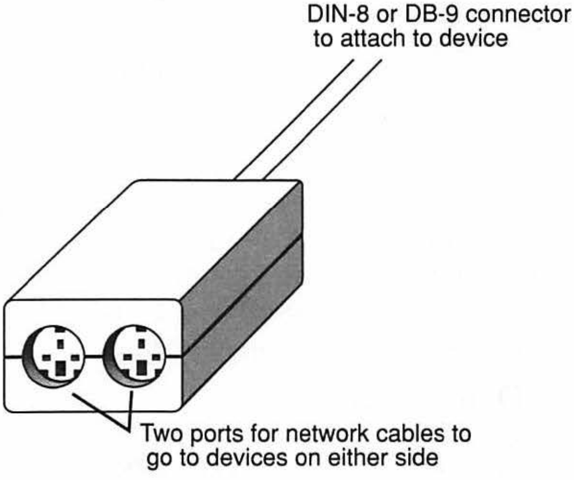

Figure 3-3 Network connectors.

Trunk with Drops

A trunk with drops topology uses a long network cable that runs the length of the entire network. Attached to this cable are modular jacks that allow shorter pieces of network cabling (the "drops") to be attached to the trunks. These drop cables then attach on the other end to one of the two ports of a network connector box. Extra modular jacks for drop cables may be installed to allow for expansion. This network topology works especially well for laying network cable around the perimeter of a large room or office.

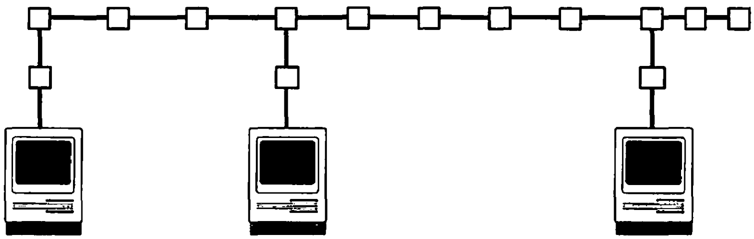

Figure 3-4 Trunk with drops.

The trunk with drops topology can only be used with telephone wire to form the network trunk. The modular jacks along the trunk for drop cables are wall boxes or wall plates, just like the ones used in offices to connect telephones into the telephone system. In the trunk network, a device can be attached off of each modular wall jack.

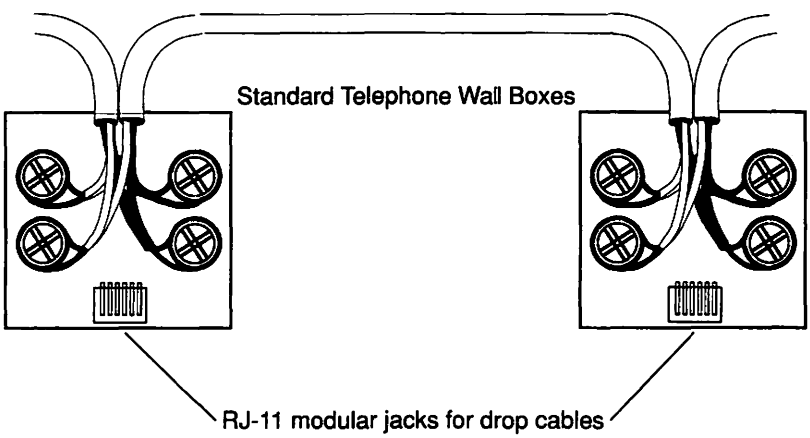

Figure 3-5 Phone wiring for trunk with drops.

Star

In a star configuration, many segments of network cable emanate from a single point, each segment supporting a device or even a daisy chain or trunk of devices.

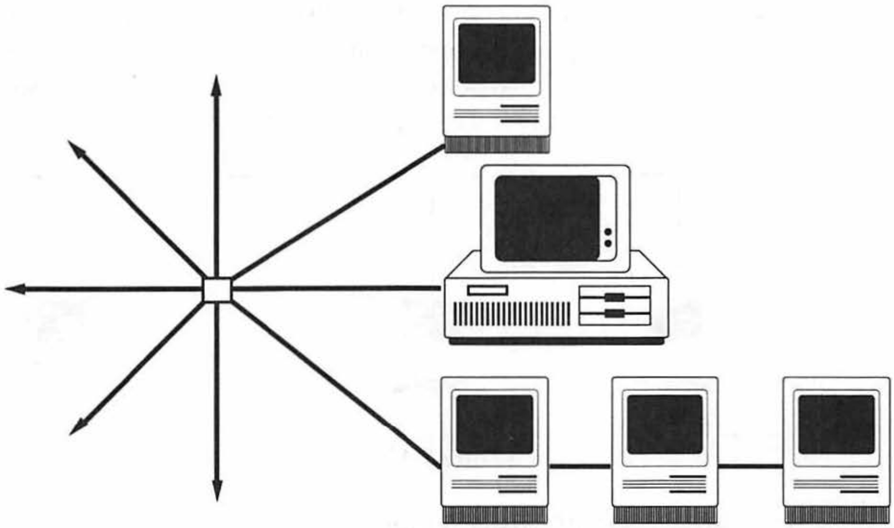

Figure 3-6 Star topology.

The star topology is similar to the wiring that forms the basis for telephone systems. There are active and passive star configurations. The active star network has a multiport repeater as the hub of the star configuration. The multiport repeater takes signals from any of the network segments and repeats them at full strength along all the other segments, ensuring good data communications. A passive star network connects several network segments to a single point, but there is no active device (multiport repeater) forming the hub. Passive stars are often connected in the phone closet, but difficulties terminating this configuration make them somewhat unreliable.

Hybrids

Hybrids of these topologies are also possible; for example, a trunk with a daisy chain at one or more of the modular jacks, or a multiport

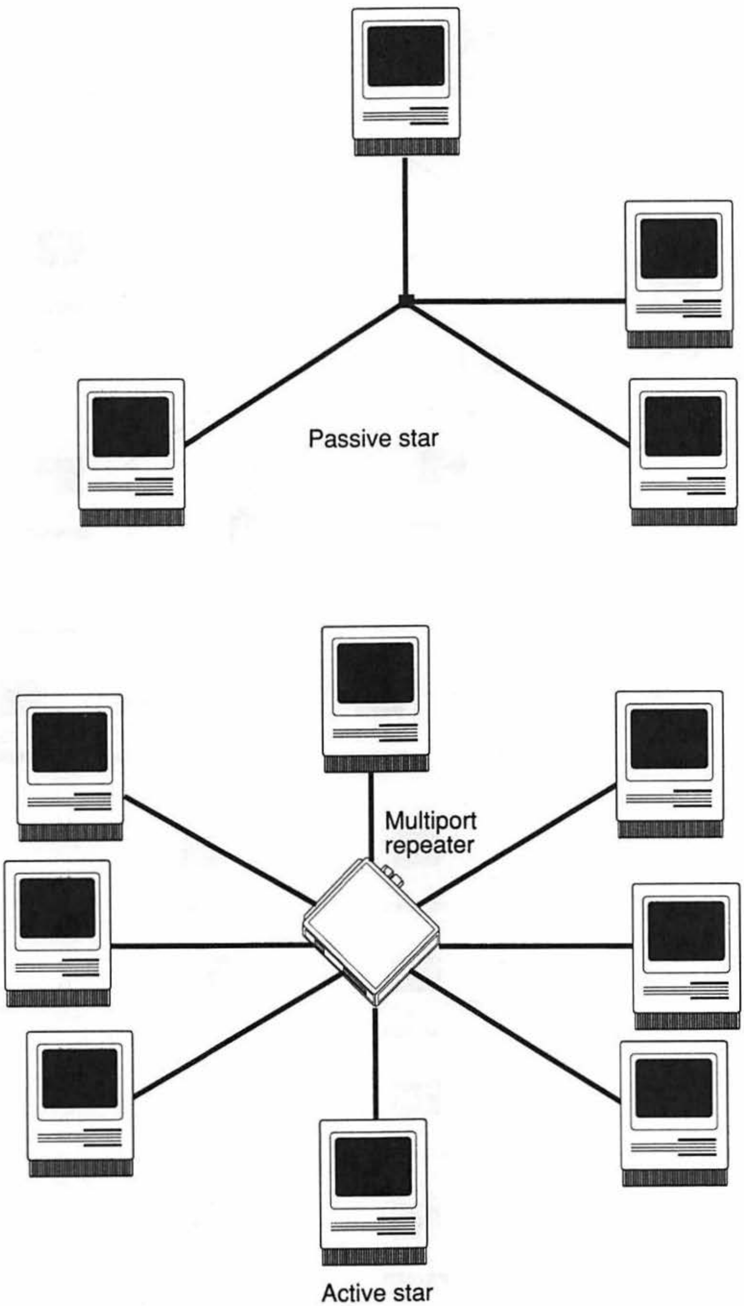

Figure 3-7 Passive and active stars.

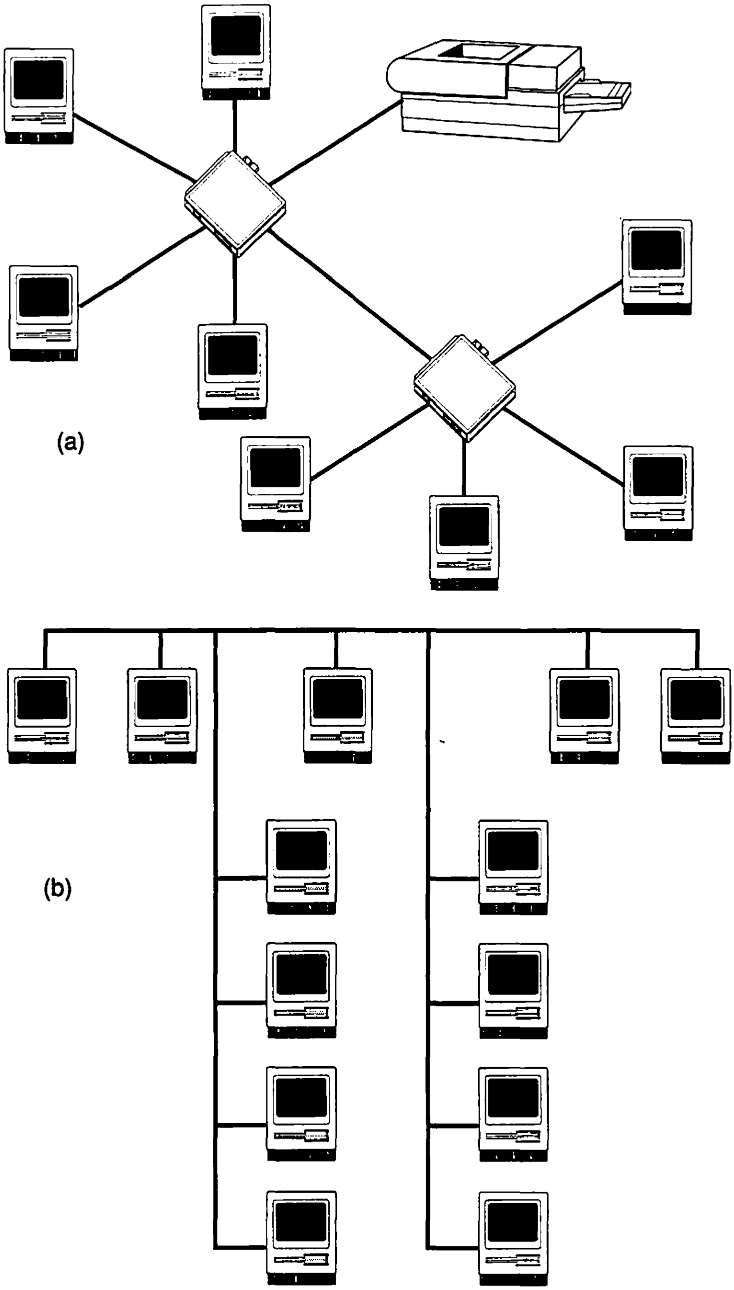

Figure 3-8 Hybrid Topologies.

repeater with another multiport repeater off one of its ports (two star topologies cascade to one another). Devices called *repeaters* allow branches to be added to daisy chains and trunks.

The design section of this book (Chapter 5) discusses the technical considerations including kind of wire, maximum distances, and termination of the network for daisy chain, trunk, star, and hybrid network topologies.

Cabling Systems

LocalTalk

There are a number of cabling schemes available for AppleTalk networks. The original cable, released by Apple, was called *AppleTalk* and was part of the AppleTalk Personal Network, or APN. It has been updated and the new Apple release is called *LocalTalk*. The cable itself is cylindrical, based on a two-wire, twisted-pair system of proprietary design, though cables and connectors are now available from third parties. At each end of a cable is a male three-pin DIN plug that plugs into one of the two female ports on the LocalTalk connector box. The connector boxes come with either a DB-9 or a DIN-8 plug for connection to all varieties of Macintoshes and AppleTalk peripherals.

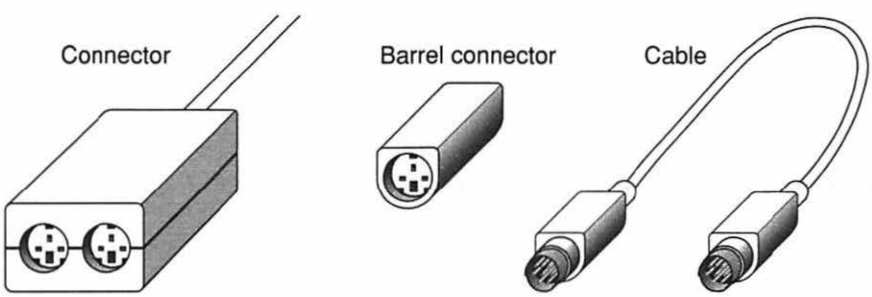

Figure 3-9 LocalTalk connectors and cables.

LocalTalk connector kits are sold by the node with one connector box, a three-meter cable, and a barrel connector for splicing together cables. Custom-wiring kits that allow assembly of custom-length cables are also available.

Phone Wiring

Twisted-pair telephone wiring is perhaps the most common way of cabling Macs and PCs and other AppleTalk devices. PhoneNET, from Farallon Computing in Berkeley, CA, was the original system to implement this—it's now referred to as PhoneNET Plus. In addition to PhoneNET Plus, the TOPS Teleconnector and a number of other clones offer similar systems. From the range of similar offerings, some are high quality and some are low quality. Those of lower quality will not support higher-speed AppleTalk implementations such as FlashTalk from TOPS and should be avoided.

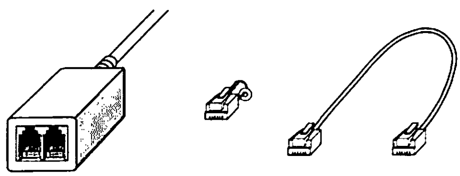

Figure 3-10 Phone wire connectors and cables.

These cabling systems use standard telephone cables and modular RJ-11 plugs for connecting cables and network connector boxes. Because the wiring is standard, custom-length cables are easily purchased or made by the user. Parts and supplies are available at Radio Shack or from other electronics and phone supply stores. Many offices are able to use existing, spare telephone wiring already installed in the building to set up their network. With twisted-pair cabling, all topologies are possible—daisy chains, trunks, stars, and hybrids of all three.

DuPont Fiber-Optic Cabling

Fiber-optic cabling is also available for AppleTalk networking. Fiber-optic cabling consists of a glass fiber, surrounded by a protective sheath, which transmits pulses of light that represent network data. Although expensive, fiber-optic cabling is preferred for networks where security is a vital concern since the glass fibers do not radiate network data. It is also preferred where EMI, electromagnetic interference, is a problem since EMI will not interfere with the light pulses.

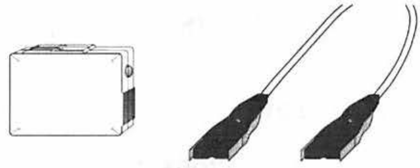

Figure 3-11 Fiber optic cabling and connectors.

DuPont sells such a system for AppleTalk networking. They manufacture the cables, connector boxes, and a device called a *concentrator.* For simple daisy-chain networks, only the cables and connector boxes are required. For a star topology, the concentrator is used as the active device at the hub. The concentrator also allows the optical signal to be connected to a more traditional electronic (LocalTalk or PhoneNET) signal network.

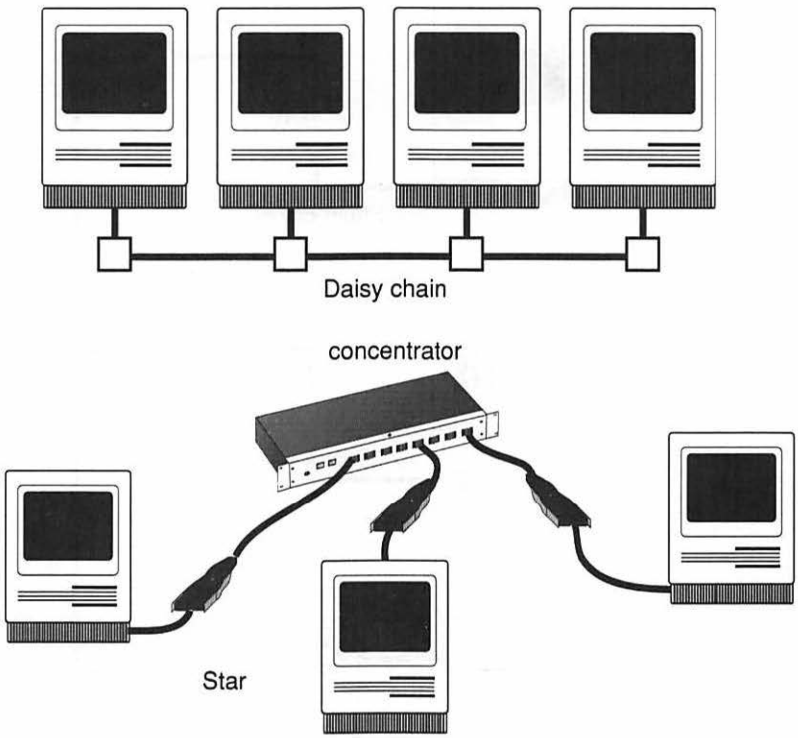

Figure 3-12 Fiber optic topologies.

Higher-Speed Options for AppleTalk Networks

FlashBox and DaynaTalk

All of the cabling options discussed so far use the printer port of the Macintosh as the conduit for all network communications. What happens if the standard 230.4 Kbaud data rate of AppleTalk is not sufficient for your tasks or when there are so many network users that the network bogs down? A product from TOPS called the *FlashBox* is now shipping and a product from Dayna Communications has been announced that allows higher-speed communications over existing LocalTalk or phone cabling.

The TOPS FlashBox is a hardware device that is inserted between the Macintosh and the existing network connector. It has a cable that

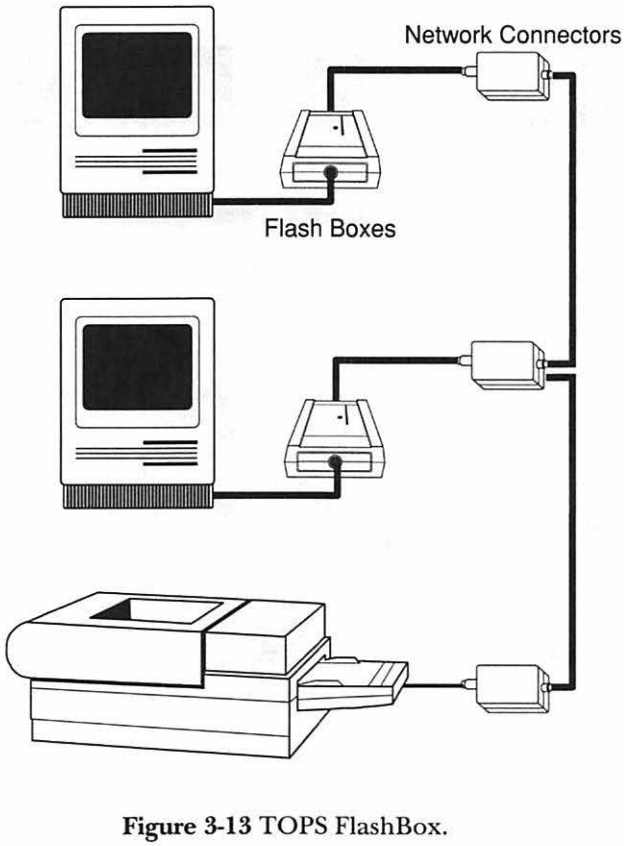

Figure 3-13 TOPS FlashBox.

plugs into the Macintosh printer port and a port for the network connector to attach to. The device then reclocks the Macintosh printer port at 768 Kbaud, 3 1/3 times as fast as standard AppleTalk speeds.

The TOPS FlashBox also comes with software that must be installed to implement FlashTalk, the TOPS implementation of higher-speed AppleTalk protocols. These protocols have been operating between PCs with the TOPS FlashCard for some time. The FlashBox extends this functionality to the Macintosh. FlashTalk not only allows for higher-speed communications among FlashTalk-capable devices, it also preserves standard speed capabilities for communicating to other devices.

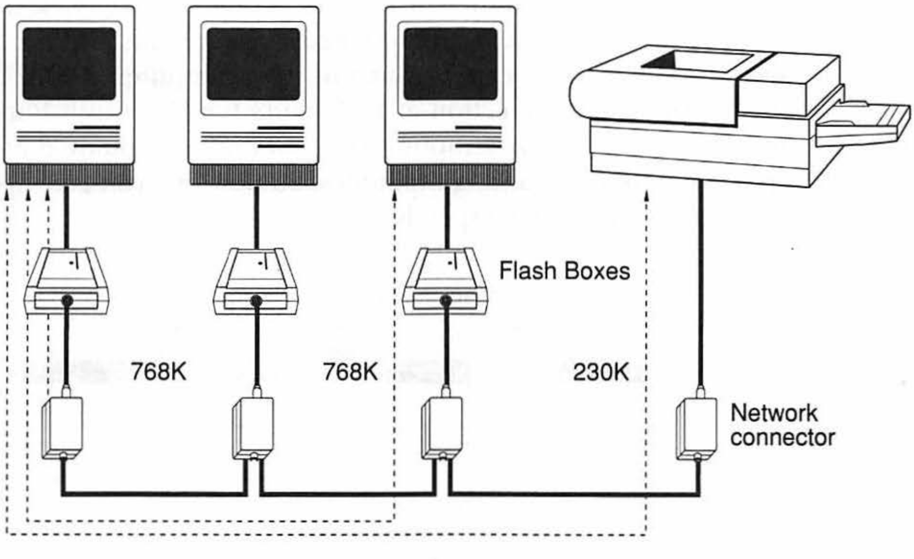

Figure 3-14 FlashTalk communication speeds.

DaynaTalk

Dayna's product appears to be of a similar design. It also is a hardware device that is inserted between the network connector box and the computer. Dayna claims Mac-to-Mac network data rates of as high as 850 Kbaud, slightly higher than the TOPS FlashBox. They also claim to get 1.7 Mbaud speeds between PCs using a proprietary new AppleTalk network-interface card and a data compression scheme.

EtherTalk

Following Apple's announcement of Ethernet support within the AppleTalk protocols, many companies have announced cabling and hardware schemes for Macintoshes in support of Ethernet. This allows for very high-speed implementations of AppleTalk networks. Note the distinction here—the cabling and network hardware are high-speed Ethernet hardware, but the data are still coming from AppleTalk applications. The data packets travelling across the Ethernet cables are referred to as "EtherTalk" packets.

The network hardware for this is, of course, different than for low-speed AppleTalk, so the printer port on the Macintosh cannot be used. There are a number of ways of adding the network hardware required to support Ethernet connections. For the Mac SE and the Mac II, add-in cards can be put into the computer. There are also SCSI devices for connection at each node for Macintosh Pluses, SEs, and IIs. And TOPS has announced that it has implemented EtherTalk drivers for IBM PCs and compatibles. So now PCs can run AppleTalk applications at Ethernet speeds.

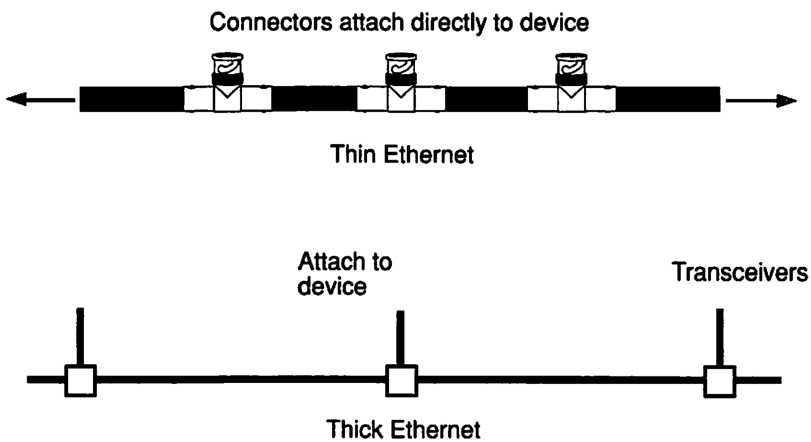

Figure 3-15 Ethernet cabling for AppleTalk Networks.

The most common method for taking advantage of the higher bandwidth of Ethernet is the connection of an entire AppleTalk network (not just one node) to an Ethernet network, using an

AppleTalk-Ethernet gateway. Two devices—the FastPath from Kinetics and the Gatorbox from Cayman Systems—accomplish this with dedicated hardware. A software-only solution called Liaison is available from Infosphere, and Apple has just announced a software-only solu-

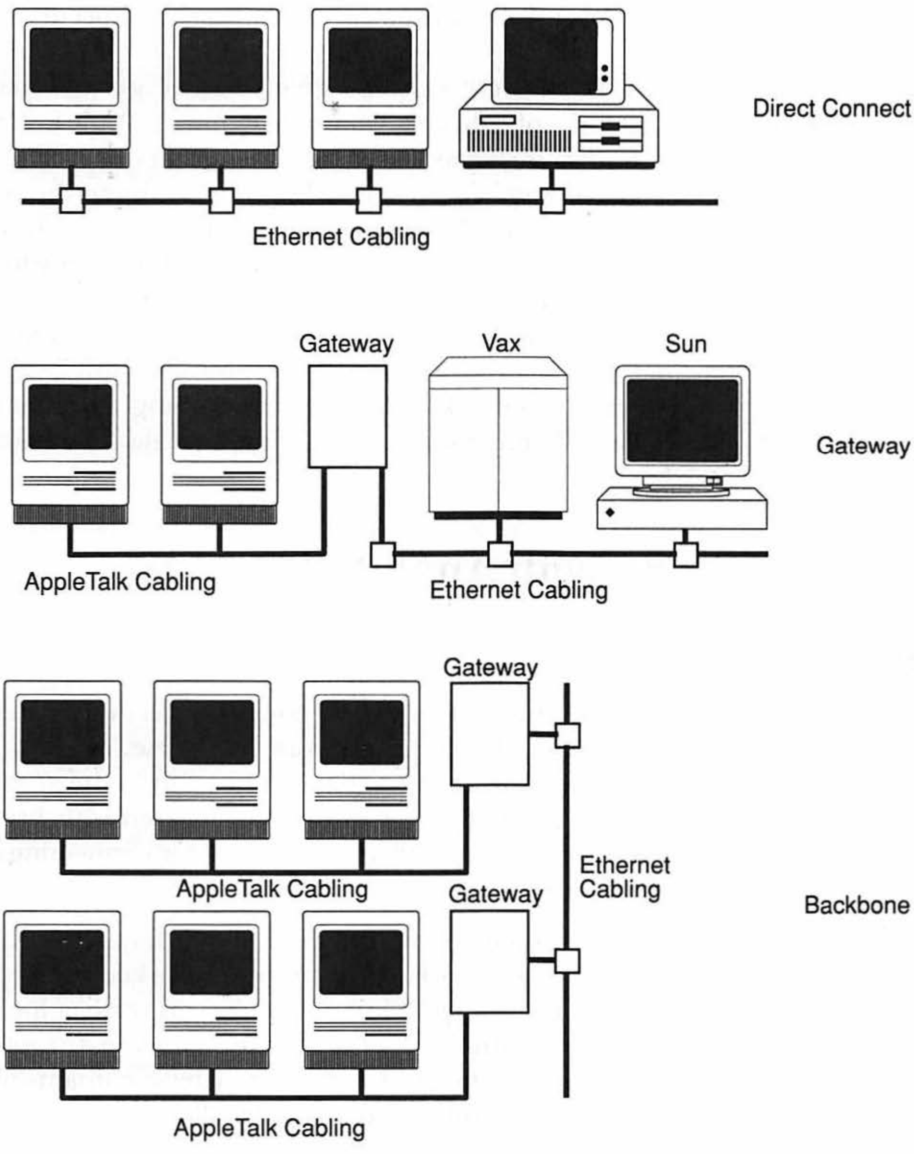

Figure 3-16 EtherTalk networking.

tion. This type of connection allows Macintoshes and PCs on AppleTalk to talk to devices on Ethernet, such as UNIX and VAX machines, or allows multiple AppleTalk networks to be bridged together by a high-speed Ethernet backbone. Because the high-speed Ethernet hardware is not installed at each node, however, communications along the AppleTalk portions of the network still occur at 230 Kbaud.

All of the direct-connect options give you the greater bandwidth—10 megabaud—of Ethernet while still running AppleTalk protocols, referred to in this case as EtherTalk. You preserve much of the ease of use on the software side of AppleTalk while gaining the transmission speed of Ethernet. The performance will increase with higher bandwidth options, but network operations over Ethernet will not be 40 times as fast as they are over LocalTalk (the ratio of the baud rates). In Chapter 5 we will discuss all the factors that determine network performance. This is a very expensive, but very high-performance solution for AppleTalk networking. Switching to EtherTalk from LocalTalk usually means all new cabling and always means all new network hardware.

Internetworking with AppleTalk

Networks

We have discussed some of the basic concepts needed to design your AppleTalk network. The term network, of course, refers to the sum total of everything that's connected together. But in the grandest sense, that might be a number of networks connected with bridges and gateways and, perhaps, remote access devices for connecting networks over long distances.

Logically you want to refer to that whole thing as the network, but the proper term is to call this large array of networked entities an *internetwork*. A "network," in AppleTalk vocabulary, is really a local or small entity. It can contain—according to the rules in the protocol—up to 254 devices. Practically, a network normally contains many less than 254 devices due to the speed of AppleTalk.

There are also physical limits to the number of devices you can attach to a network cable, and the total length of the network cables, regardless of whether the cable is LocalTalk, phone wire, fiber-optic line, or coaxial. Based solely on the electrical characteristics of Apple's LocalTalk cable and the network connectors, the limit is 32 devices and 1,000 feet of network cables. Farallon's PhoneNET has limits that vary depending on the topology, data rate, and wire gauge, and can go as high as 4,500 feet and 48 devices. But the protocol supports 254 devices. How does one get beyond 32 devices if the cabling won't allow it? By adding devices such as repeaters or multiport repeaters to your configuration, you can get around the limit imposed by the cabling.

Cabling Type	# of Devices*	Maximum Length, ft*
LocalTalk	32	1000
PhoneNET:		
26 gauge, daisy chain	24	1800
26 gauge, trunk	48	1800
22 gauge, trunk	48	4500
Fiber Optic	100+	4000ft. between nodes
Thick Ethernet	100	1640
Thin Ethernet	30	607

* The figures listed for # of devices and maximum length are for a single segment/electrical bus of network cabling. Much longer distances and greater number of nodes are possible using repeaters and bridges. AppleTalk network protocols limit the number of devices on a network to 254, but networks can be bridged together to go beyond this limit. Values listed for LocalTalk and PhoneNET cables are at standard AppleTalk speeds of 230.4 kbuad. At FlashTalk speeds of 768 kbaud, limit the number of nodes to 3/4 that listed above, and reduce the maximum length to 1/3rd of the listed value.

Figure 3-17 Limits of common cabling systems.

Electrical Buses

A network is a single entity where all data travel to all devices. It may consist of a number of "electrical buses." An electrical bus is a segment of network cable carrying a signal up to its maximum number of nodes without passing through any devices. A network may have a number of electrical buses. It is this electrical bus that has a limit on the total number of devices and total length (e.g., 32 devices and 1,000 feet for LocalTalk). Any time you use a repeater, you're joining two electrical buses. When you use a multiport repeater, you're combining as many as 12 electrical buses. By combining many electrical buses, each with many devices, one can approach the absolute protocol limit of 254 devices.

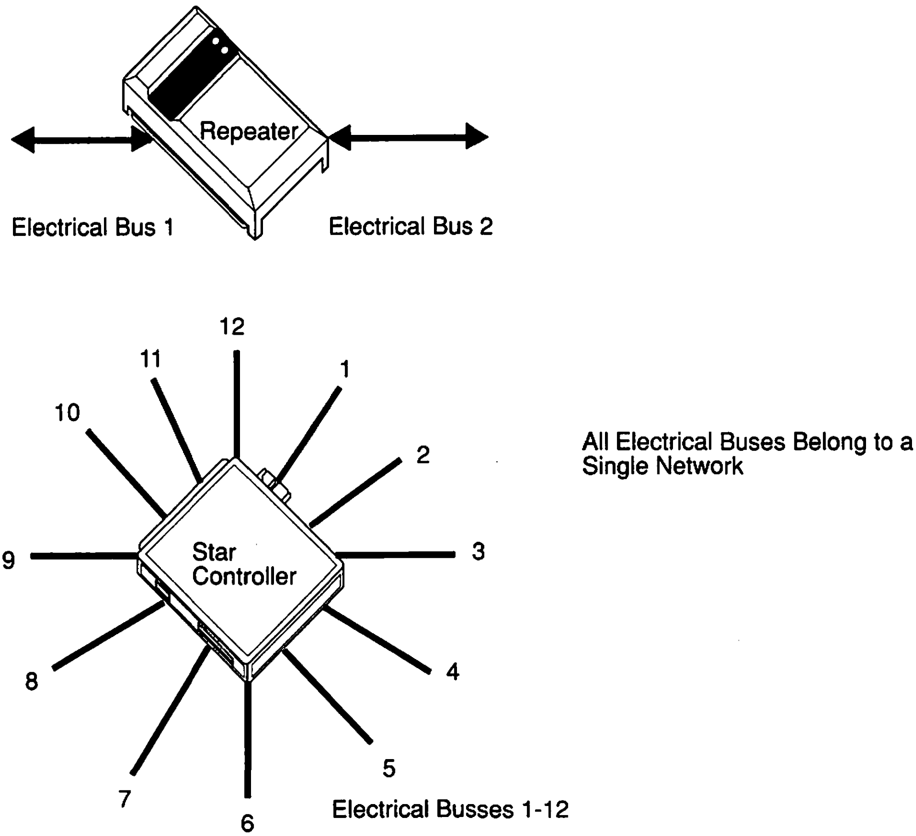

Figure 3-18 Repeater and star controller.

By joining electrical buses with repeaters and multiport repeaters, but not with a more intelligent device that filters data traffic, you have not created a new network. You have just joined two network segments into one, perhaps creating a hybrid topology. For this reason, we refer to multiport repeaters and repeaters as intranetwork communication devices. If you were to put a bridge in between two electrical buses, each of these buses would be on its own network.

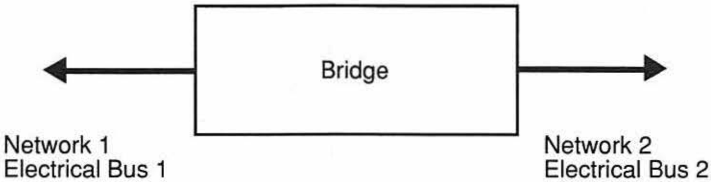

Figure 3-19 Bridging networks.

Internetworks

AppleTalk supports internetworking, or the passing of data between networks. This is done with bridges and gateways. If you take a single Hayes InterBridge to connect two groups of people each, working on an AppleTalk network, you really end up with two interconnected networks. The resulting pair is referred to as the internet, or internetwork. Creating an internetwork can be an alternative to increasing the bandwidth of the network while still supporting many users. Bridges and gateways are referred to as internetwork communication devices.

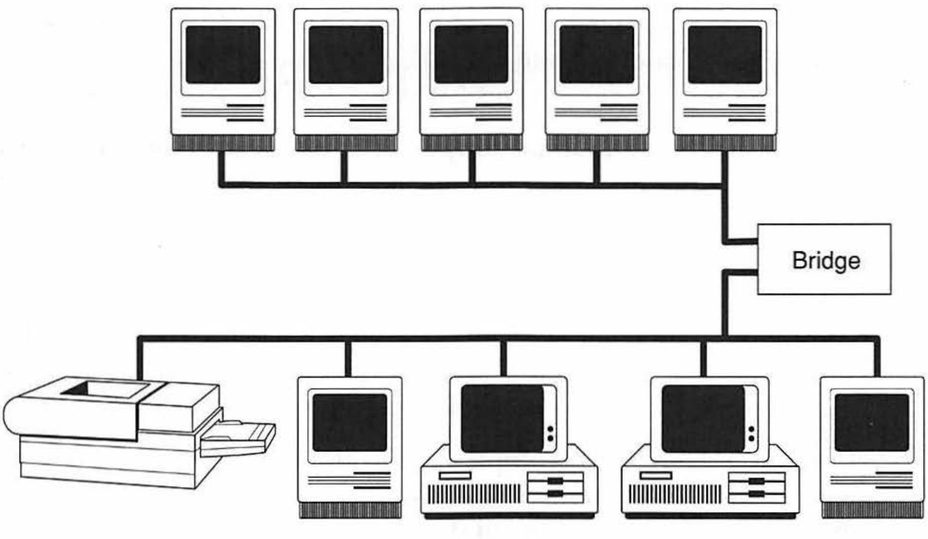

Figure 3-20 A simple internetwork.

We'll discuss some hypothetical configurations to make clear what a network is and what the distinction is between a network, an electrical bus, and an internetwork. The following scenario is also fairly typical of the growth of a network. Going, as usual, from simplest to more complex, we start with a single electrical bus, using LocalTalk cables.

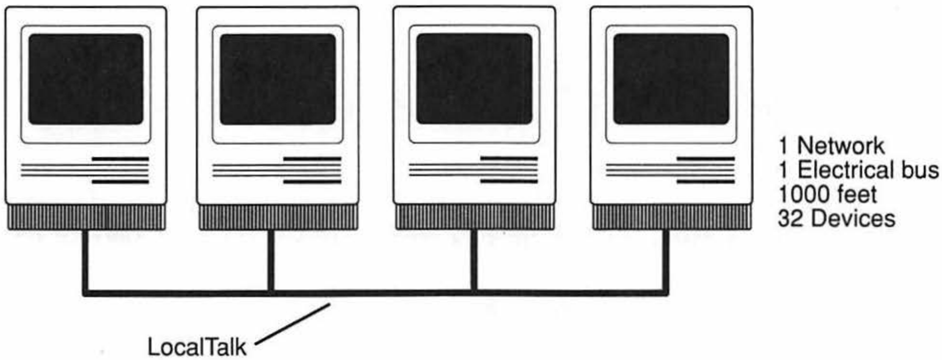

Figure 3-21 One electrical bus, one network, no Internet.

If this represents our network, there is no internetwork. This is a very simple configuration. If you have three or four machines, and you daisychain them together with LocalTalk cables, you have one electrical bus and just one network. This one electrical bus is subject to the limits of 32 devices and 1,000 feet (for LocalTalk cables).

Let's now add a multiport repeater or a repeater; these devices are used to extend the length of your network or support alternate topological schemes.

With the addition of a repeater or a multiport repeater, you still have just one network, but there are a number of electrical buses combining to make that one network. Each electrical bus individually is subject to the limitation of 32 devices and 1,000 feet (LocalTalk cables only). The entire network has a limit of 254 devices.

Getting even more complex, you might then take your network and connect it to another one, using a bridge or a gateway. Bridges and gateways act as intelligent data filters for network traffic.

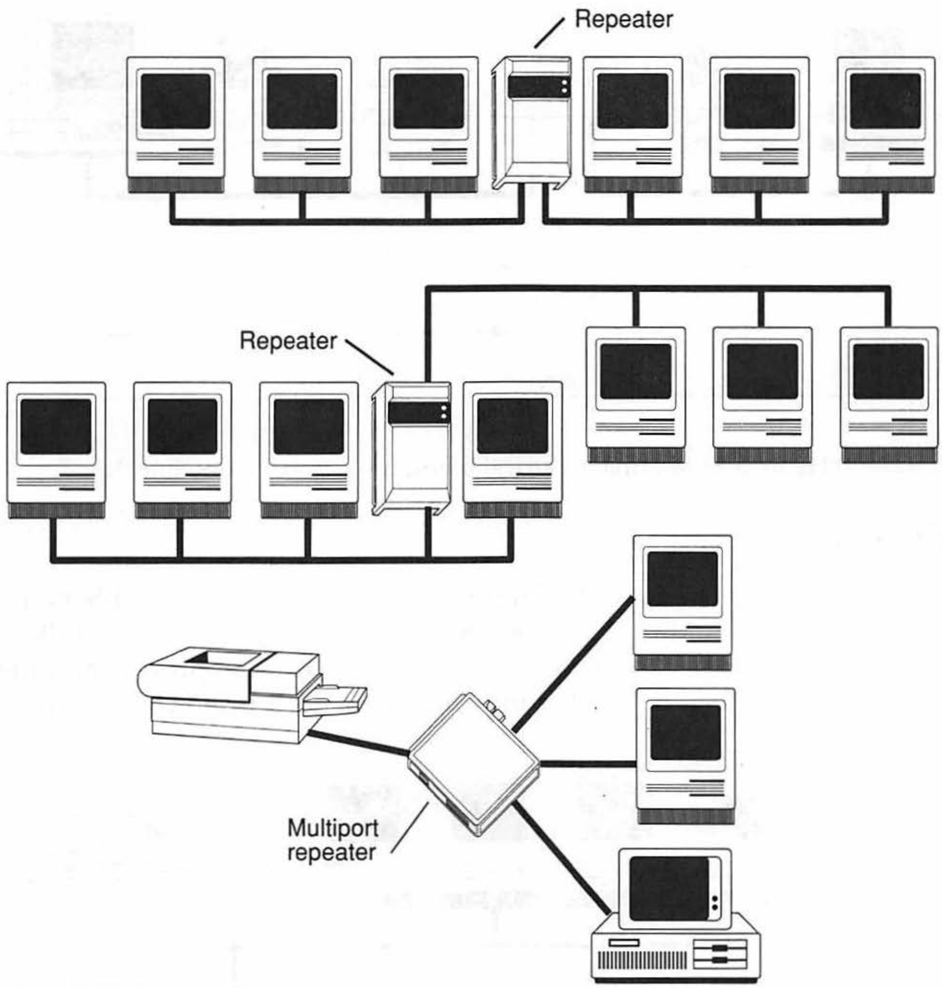

Figure 3-22 Multiple electrical busses, one network, no Internet.

This gives you one internet consisting of two networks. Each of the networks will consist of one or more electrical buses, which are subject to the limits (number of devices, total length) of the cabling you've chosen. However, now *each* network has a limit of 254 devices total.

NOTE: The limits given are absolute maximums. In actual practice, most networks do not approach these limits due to the low bandwidth of standard AppleTalk communications.

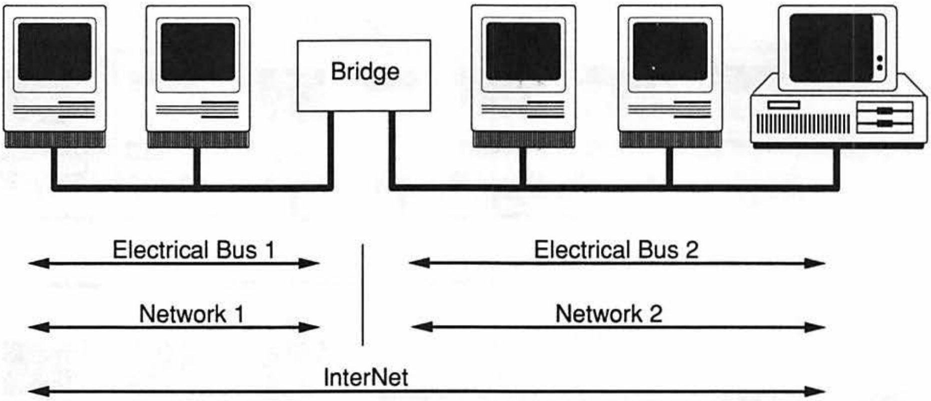

Figure 3-23 Multiple electrical buses, two networks, one InterNet

Bridges and Gateways

Bridges, such as the Hayes InterBridge, the Solana I-Server, or the Shiva NetBridge, allow local connection of two AppleTalk networks together to form an internetwork. Bridges provide an intelligent connection, so that only data that need to flow from one net-

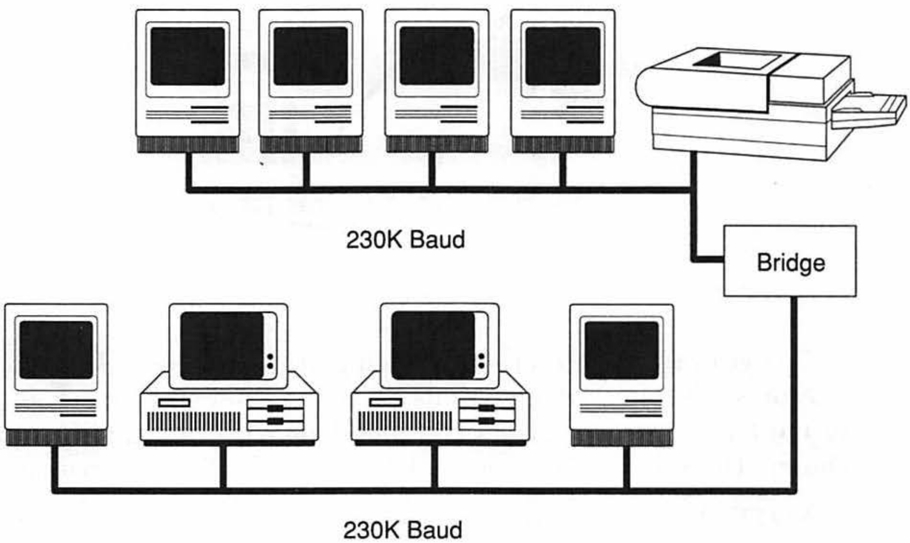

Figure 3-24 Local AppleTalk bridge.

work to another are transferred. The two connected networks act independently unless traffic needs to flow from one to the other. For instance, on one network a user may wish to print to a Laserwriter on the other; a bridge will let these communications go through.

A gateway is like a bridge in the sense that it is a data filter. Gateways, however, connect different networking schemes—the most common gateway being an AppleTalk to Ethernet gateway, like the Kinetics FastPath or the Cayman Gatorbox. There are a couple "conditions" that indicate the need for a gateway. You might be gatewaying from AppleTalk to Ethernet in order to communicate with a device that exists only on Ethernet. For example, to use TOPS for the Sun or PacerShare, an AppleShare implementation for the VAX family, you need a gateway.

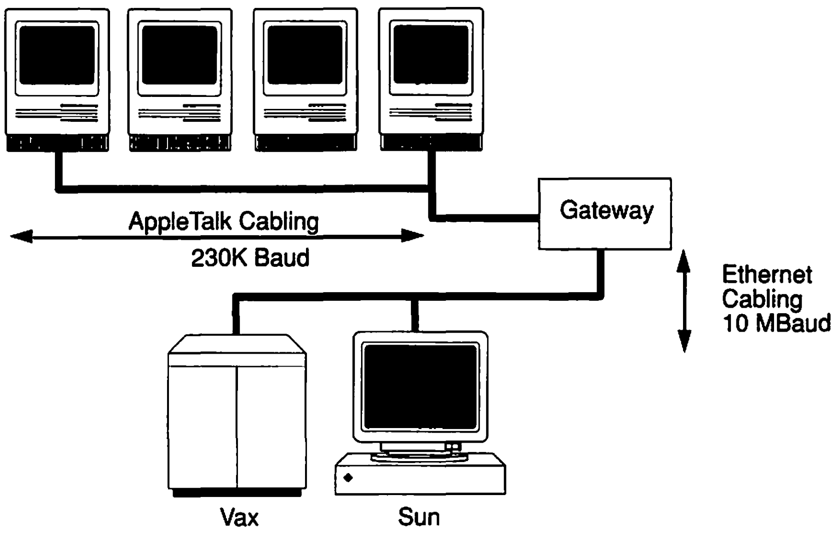

Figure 3-25 AppleTalk–EtherNet gateway.

The gateway allows AppleTalk devices—Macintoshes and PCs sitting on an AppleTalk network—to communicate with the Suns or VAXes, which, of necessity, sit on an Ethernet network.

You also might use a gateway or bridge in an alternative scheme to merely connect multiple AppleTalk networks together. You could, for example, connect together a number of AppleTalk networks with a LocalTalk backbone using Hayes InterBridges.

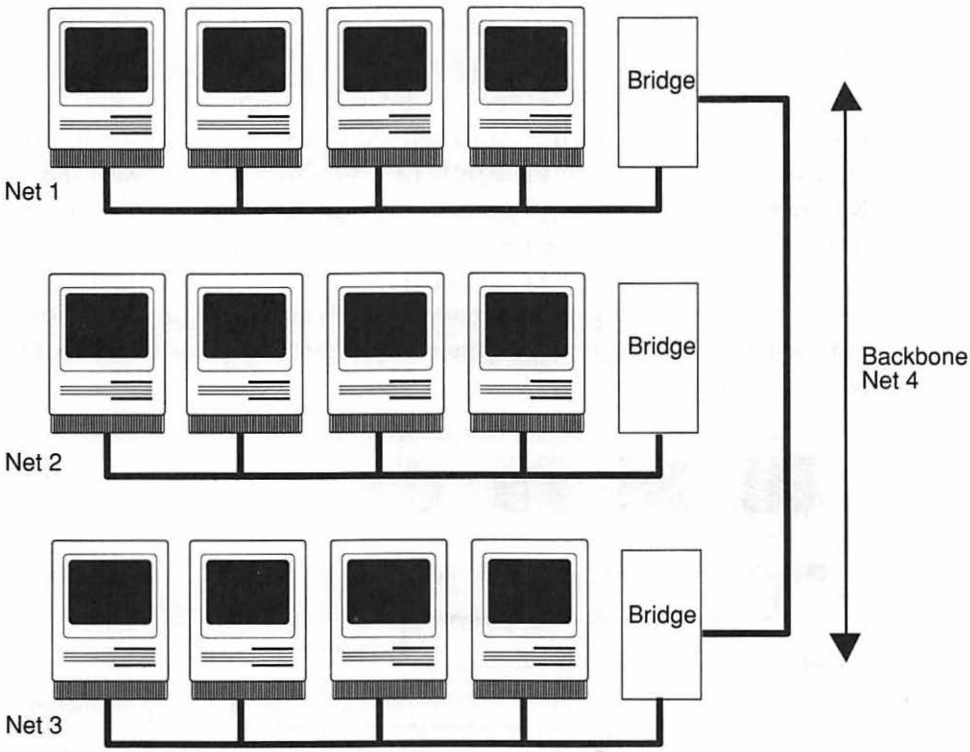

Figure 3-26 LocalTalk backbone.

You might have ten distinct networks representing ten workgroups. If you attach an InterBridge to each of those networks, you can then create an eleventh AppleTalk network that just routes information between the other ten and serves as a backbone. The backbone operation is limited to standard AppleTalk speed—230 Kbaud. As long as the amount of information travelling between networks is small compared to the total amount of information on the networks, this low-speed backbone will function quite well.

If, however, there's a large amount of internetwork communications, you might prefer a higher-speed backbone. If that is the case, you can take the same ten networks and, instead of connecting them with bridges, you could use a FastPath or a Gatorbox to provide access to an Ethernet backbone. This gives you a backbone speed capability of ten Mbps (megabits per second). This does not, of course, allow a Macintosh on one network to communicate with a Mac on another network at ten Mbps—you have to make direct connections to do that. But it would keep the backbone from slowing down.

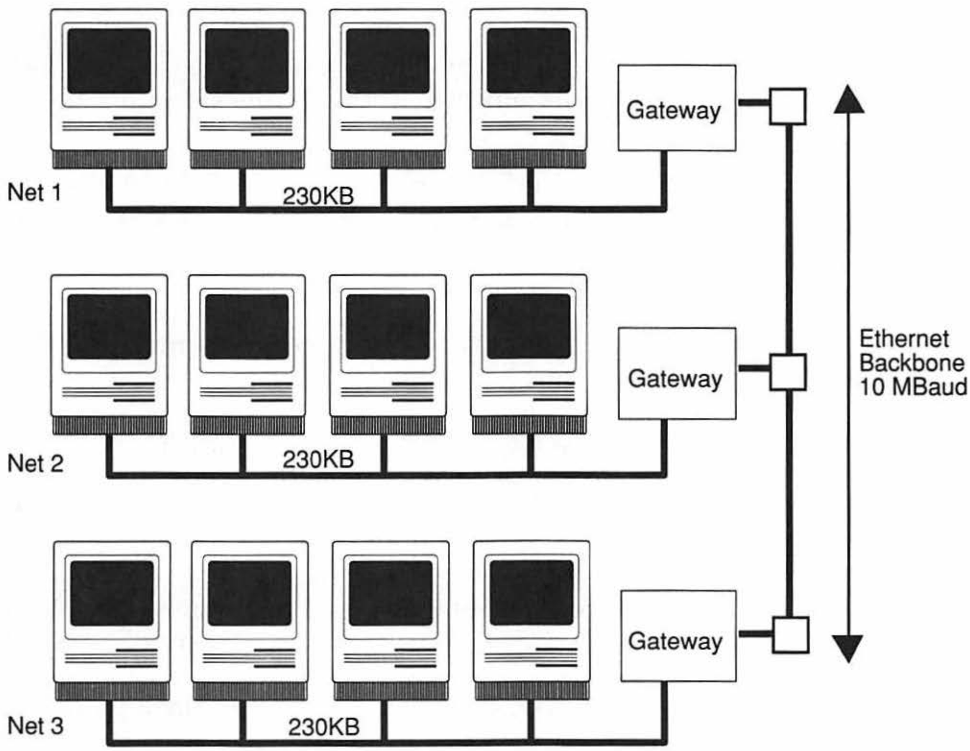

Figure 3-27 Ethernet backbone.

Both intra- and internetwork communications devices—repeaters, multiport repeaters, bridges, and gateways—are devices you can touch and see, but they tend to be hardware you may have to look pretty hard for. They get stuck in phone closets and off in corners. They're generally devices that require only infrequent human interaction.

Zones

One can imagine that a network can become very large and complex by combining many networks together. A large internetwork can be made to look less complex by dividing it into distinct "zones." An understanding of zones is important to understanding the configuration of AppleTalk internetworks.

Zones are applicable only in the case where you have a large AppleTalk internetwork. If you don't have any bridges or gateways connecting networks together, you don't have an internetwork and you don't need zones. In fact, you are not able to create zones without an internetwork. The only way to create zones is within the configuration software for bridges and gateways.

Zone names are used to distinguish—usually by function—different parts of an internetwork. If you have a single network, a zone is superfluous because there could only be one zone and it would be the same throughout the network.

Zones are in all cases optional, even on the largest networks. Zones are a way of organizing a large internetwork so that users look at manageable groups of network services. It is also a way to minimize somewhat the traffic that flows from network to network.

Zones help manage a large internetwork with many devices and many different services. Of all the devices and services, users will use some often and others will be used only occasionally. Some services will be centralized and others will be distributed. By placing bridges and gateways appropriately, and properly dividing the internetwork into zones, the network designer can make it easy for users to get to the resources they need, even on a very large internetwork.

By using bridges and gateways to combine networks, many users can share resources and communicate with each other. Without defining zones, however, all the bridges and gateways are invisible to the end user. If you had a large internet of 20 networks without zones, users would not be able to distinguish resources on the local network from those located on other networks. If each of the 20 networks had its own Laserwriter, and a user opened the Chooser from his/her Mac to select a Laserwriter, all 20 would be seen. It might be

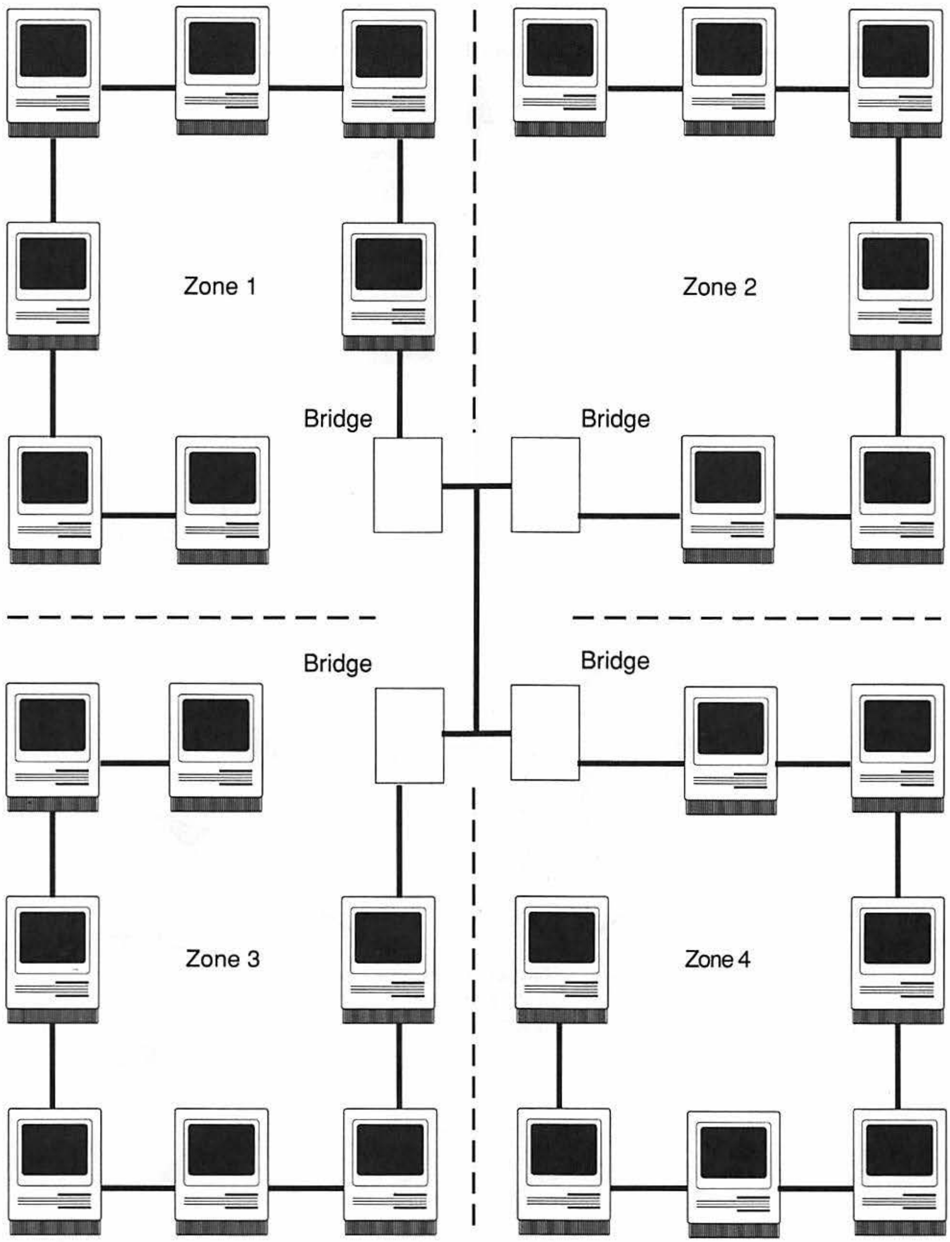

Figure 3-28 Internetwork with zones.

difficult to decide which one to choose unless he or she were familiar with the names and locations of all the printers.

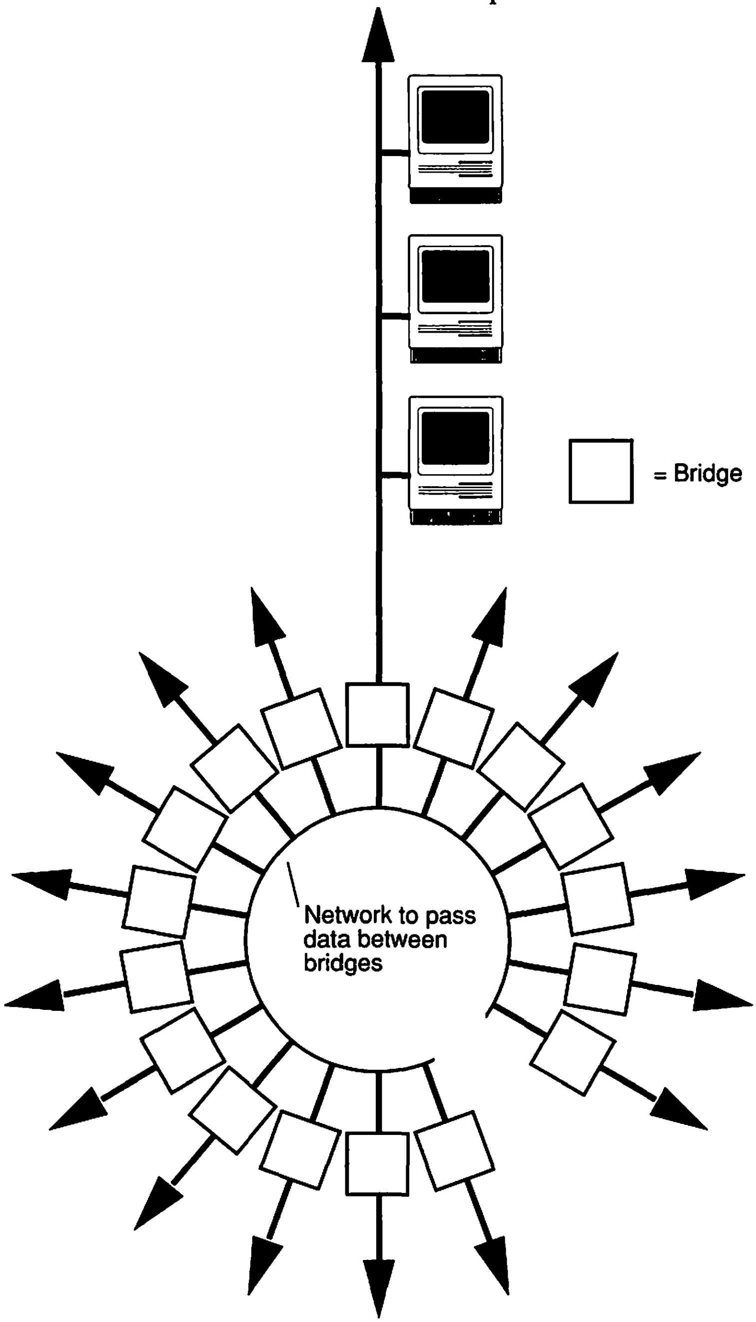

Figure 3-29 Internet of 18 networks.

Zones are a way of taking a large internetwork and dividing it up into logical subgroupings to make resource access more manageable to the user. Defining zones sensibly and assigning the networks to zones is a critical task for the network designer or administrator. Due to the layout of most work areas, people who work together tend to belong to the same local network. In our hypothetical case of 20 networks, perhaps five each belong to engineering, marketing, finance, and sales groups. By using some logical means of naming zones—grouping users by work function, product teams, geographic location, management structure, or whatever works for your organization—you can very effectively assign groups of people most likely to work together to the same zone. The resources they regularly use should be in their zone and resources they have only occasional need for may be in another. This simplifies traffic routing on the network and also organizes the resources on the internetwork into groupings that are simpler for users to relate to.

Zones can only be created at network boundaries, which is why only bridges and gateways can define zones. On one of the 20 networks in our example all of the devices must belong to the same zone, as defined in the bridge or gateway for the network. Although a network can belong to only one zone, each zone may consist of many networks.

If those five engineering groups were all located in one building and they tended to do a lot of work among themselves, but occasionally needed to send things back and forth to marketing, sales, and finance, you might take those five networks out of the 20 and place them all in a zone called Engineering. In our example, we might only create four zones for the 20 networks (Marketing, Sales, Finance, and Engineering). Each zone would consist of five networks.

Creating zones changes the way software interfaces allow you to view the network. For example, if you open the Chooser to select a Laserwriter or an AppleShare server, a zone list is now presented. Users now can select their local zone (the default) and any other zone. Only resources within the selected zone can be viewed at any given moment. In our example, an Engineering zone user would now see only five Laserwriters in any given zone. Bridges and gateways all send out special packets identifying the zone names and the networks that belong to those zones.

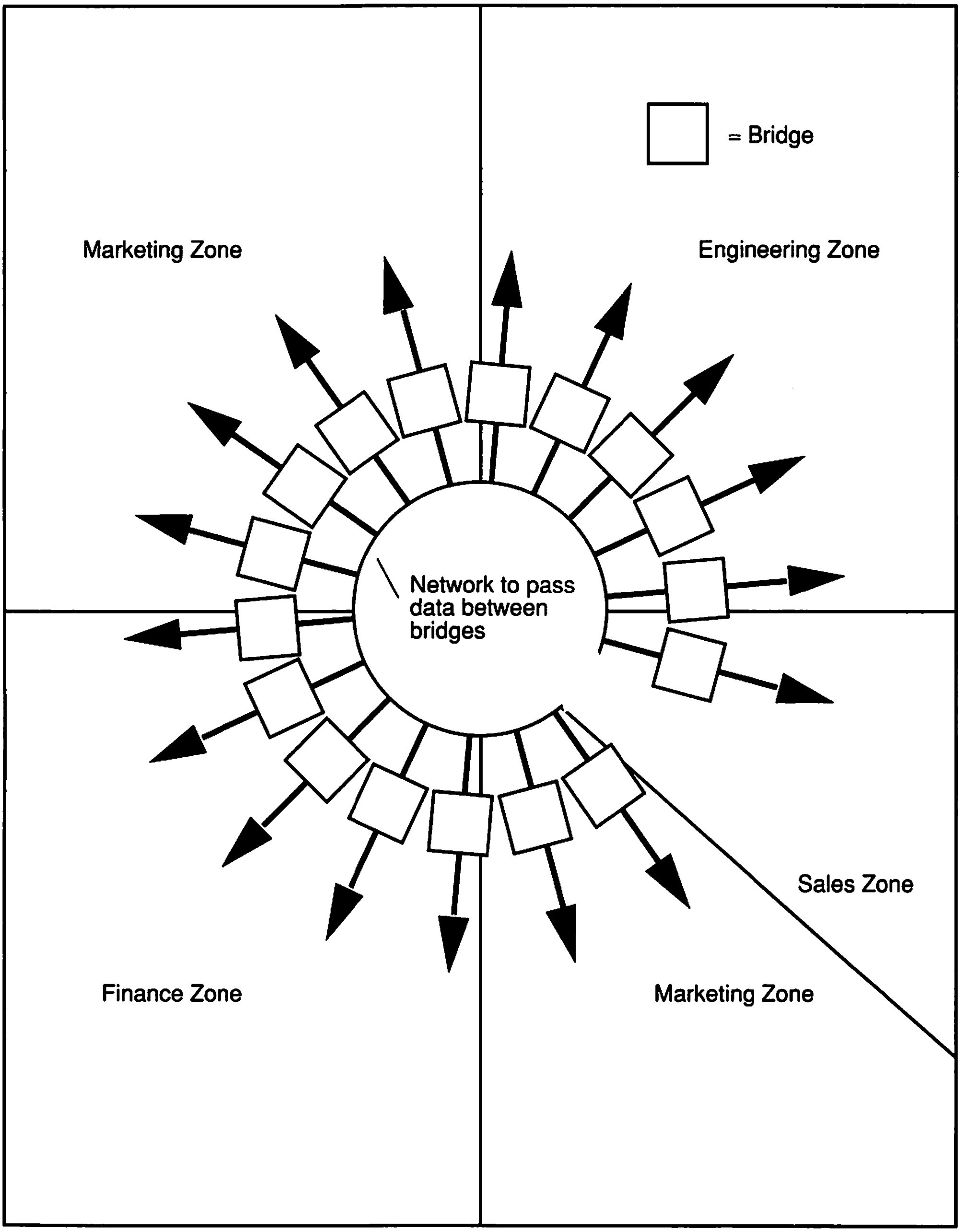

Figure 3-30 Internet split into four zones.

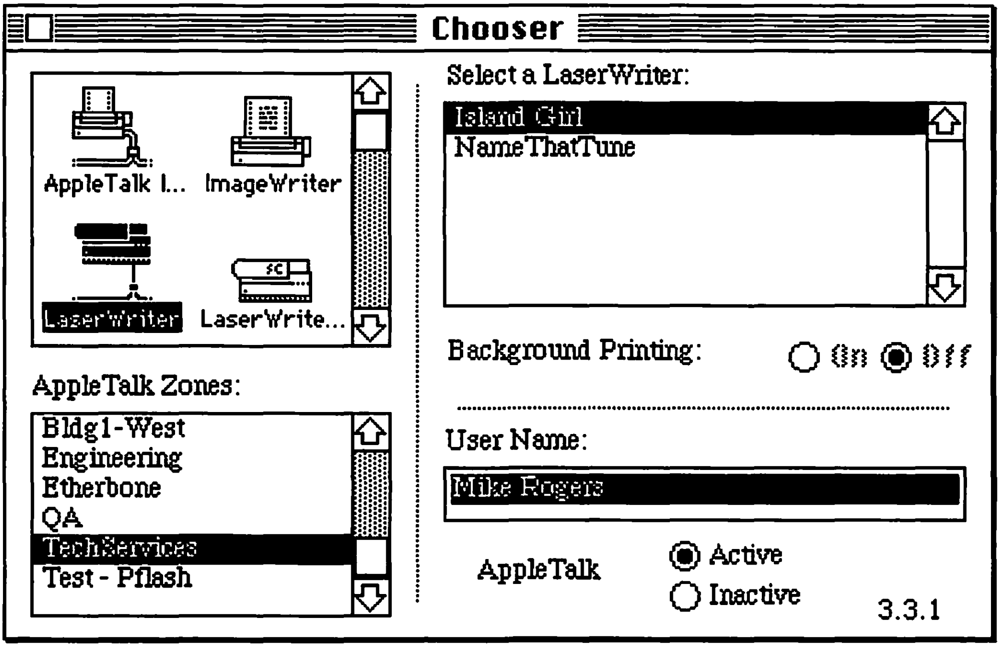

Figure 3-31 The Chooser with zones defined.

To summarize this explanation of zones, remember that:

- Zones can only be used on an internetwork.
- Zones are always optional.
- Zones are created at network boundaries by bridges and gateways.
- Since you can switch between zones, all resources can still be accessed.
- Zones divide resources into logical groupings according to some criteria (location, workgroup, etc.).
- If zones have been configured carefully, you work primarily in your local zone.
- If zones are used, all networks belong to only one zone, but a zone may consist of many networks.

Zones, however, have introduced another step in accessing network resources. You must explicitly choose a zone in addition to selecting the resource.

Now that may seem like a bad idea. Why introduce another step? The idea is to pare down the list of network resources you have to look at to find what you need. If you do most of your work with local resources, why should you be burdened with long lists of resources that you almost never choose for use? It is not efficient nor is it straightforward to have to look at what are, for the most part, extraneous services and devices. Zones make it easier to choose them on occasion when you need them.

Your zone, then, filters out the resources most useful to you—your local resources. This pares down the lists of available resources to a manageable size. Instead of seeing 20 Laserwriters in the Chooser, you see five. Those are the five you are most likely to use. You can still go choose another zone and use the other 15 Laserwriters, but you've got to choose the zone first. Some networks will use zones; some networks won't.

Zones are also—from a network administrator's point of view—an effective way of limiting some of the traffic on the network that has to flow between nets because of the addressing schemes.

So there are practical, logical reasons for creating zones to preserve the ease of use of the AppleTalk network, even though it does (in less frequent cases, if used properly) cause you to have to take another step in identifying a resource and choosing a zone. Zones preserve ease of use by presenting the user with manageable lists of resources, making it much easier to pick the resource you want.

Chapter Four

LAN Communications

In addition to the design basics discussed in the previous chapter, it is useful to understand some of the basics of communications on a LAN. To give a quick overview of this complex topic, we begin with a discussion of network protocols. We then compare this model for network communications to the AppleTalk protocols as they exist today. Finally, we discuss some of the specific addressing schemes used for AppleTalk communications and how they translate to ease of use for the user. This discussion will help you understand how these communications actually take place. It often seems that network communications happen as if by magic, but there are tangible things occurring.

Network Protocols

Network protocols specify the rules for communications on the LAN. All aspects of the communications, from the interface to the physical cabling, the data encoding and decoding, error detection, addressing, and the behavior of various network services (filing, printing, etc.) are specified by the network protocol.

A number of proposals have been made regarding standards for designing and implementing network protocols. Most of these are based on a "layered" approach, with each layer playing a role in successful communications. The lowest layers in the model correspond most closely with the hardware, while the upper layers are closest to the network applications built on top of the protocols.

OSI Reference Model

AppleTalk is based on a model called the Open Systems Interconnection reference model (OSI) proposed by the International Standards Organization (ISO). The model is a general description of the required layers of protocols and what function each layer performs. As such, the OSI model is not a protocol itself, but rather a model for the design of protocols. The model is hierarchical in nature; communications take place between adjacent layers as data pass up or down through the protocol "stack."

This layering of the protocol is critical to the network software vendor—it enhances network applications compatibility and portability.

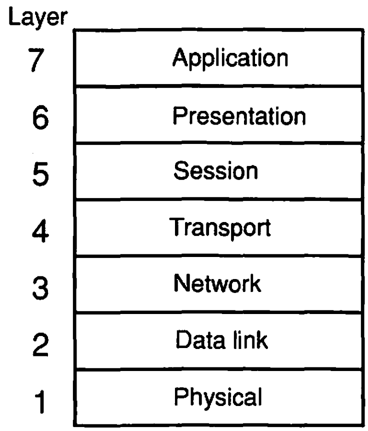

Figure 4-1 OSI reference model.

Because most network applications are written at the highest levels, changes to the lower levels should not affect the functionality of the application. Under the OSI Model, changes or replacements to low-level protocols can be handled by altering that protocol layer only, without affecting the application. Individual layers can be modified or replaced so long as the new protocols follow the specification. One should be able to remove a layer completely, and replace it with one of equivalent functionality without affecting the applications implemented at higher layers in the stack. The OSI model is merely a suggested means of designing network protocol stacks. Many protocol implementations do not follow the specification—communications may not always flow between adjacent layers, and the distinction between layers is not always clear.

For each layer in the model, there are well-defined tasks to perform. The topmost layer in the OSI Reference Model is the Application Layer. Network applications commonly sit at this layer. This is the level at which most users interact with their network software—the point at which information is requested and delivered. You would use your networking software, or functions built into the operating system, to interact with other devices on the network—request to see your new mail, launch an application from a file server, etc. At this level, the network application makes a request of the network—the lower level layers take this request and supplement it with additional information to ensure that the request is delivered and a response is gotten.

The Presentation Layer receives the requests from the Application layer and is responsible for ensuring seamless communications between devices. This layer deals to a large extent with the complexity of the request, handling communications regardless of whether the network itself or the requested task is simple or complex. The Presentation Layer typically is responsible for remote file access, code conversion, and data compression and decompression.

The next level down in the protocol stack is the Session Layer, which takes care of setting up, maintaining, and terminating the electronic "conversations" that occur between devices and users on the network. The Session Layer keeps the network applications from needing to worry about the many conversations that may be occurring between the same sets of devices/users. This layer must have explicit knowledge of the naming and addressing methods for differentiating between these sessions and users. At this level in the stack, the protocol is still not concerned about where on the network the other user/device is located or with the complexity of the network.

The quality of network communications is managed by the Transport Layer. The Transport Layer is charged with ensuring that error-free transmissions take place between any two devices/users. At this point in the protocol stack, the text-based names for devices and services used from within the network applications are translated into numeric addresses along the network or internetwork.

The last three layers of the OSI Model, the Network, Data Link, and Physical layers, are sometimes referred to as a *subnet.* These are the most basic protocols that must exist in a network architecture. Above the subnet, the layers are not aware of the underlying transport mechanism and topology of the network. This layered approach and independence of the layers from one another allows these transport mechanisms and topologies to change without needing to rewrite network applications software. For example, most AppleTalk software vendors did not need to change their applications at all when the EtherTalk protocols (AppleTalk running over 10-megabit Ethernet wiring) were released.

The Network Layer, based on knowledge of the actual network topology available at this layer in the stack and on the devices exchanging information, chooses a path for the data communications to occur and ensures that the data are exchanged between the proper two nodes. The Network Layer and the Transport Layer work together to avoid congestion along the chosen path. If the data must travel through other devices such as bridges or gateways before reaching their destination, the Network Layer ensures that these devices do nothing more than route the data correctly. Within these routing devices, the transmitted data only reach the Network Layer before they are sent on to the next device along the selected path.

The Data Link Layer, as the first layer above the actual physical medium of the network, deals with the requirements of interactions with the physical layer. Since all network communications occur as packets of information transmitted in frames, this layer assembles the packets of information for transmission and disassembles packets of information after receipt. At this point the packet consists of the original information prepared by the network software plus any additional information, commonly stored in headers, added at each protocol layer. Error detection and, in some cases, error correction are also handled at this layer.

The Physical Layer defines the actual physical interface between any network device and the network. This layer actually implements the transmission of all the bits of information within each network packet. The format of each bit on the physical medium, the specific voltage levels used to describe the "1s" and "0s" that make up a data packet, even the connector and pin specifications, may all be a part of the physical layer.

When a request for information is made from the network, the information travels through the protocol stack and gets supplemented with other information required for transmission, delivery, and error-free communications across the network. This supplemental information is typically kept in headers added by each layer. Figure 4-2 shows how a packet may grow in size as it moves through the protocol stack. This extra information is stripped off at the receiving end by the corresponding layer in the protocol stack. What reaches the application layer on the receiving end is the exact set of data prepared by the application layer of the sending machine. Notice that at the Data Link Level, where the actual packet of information is prepared, markers may be added to both the beginning and the end of the information to delineate the boundaries of the packet.

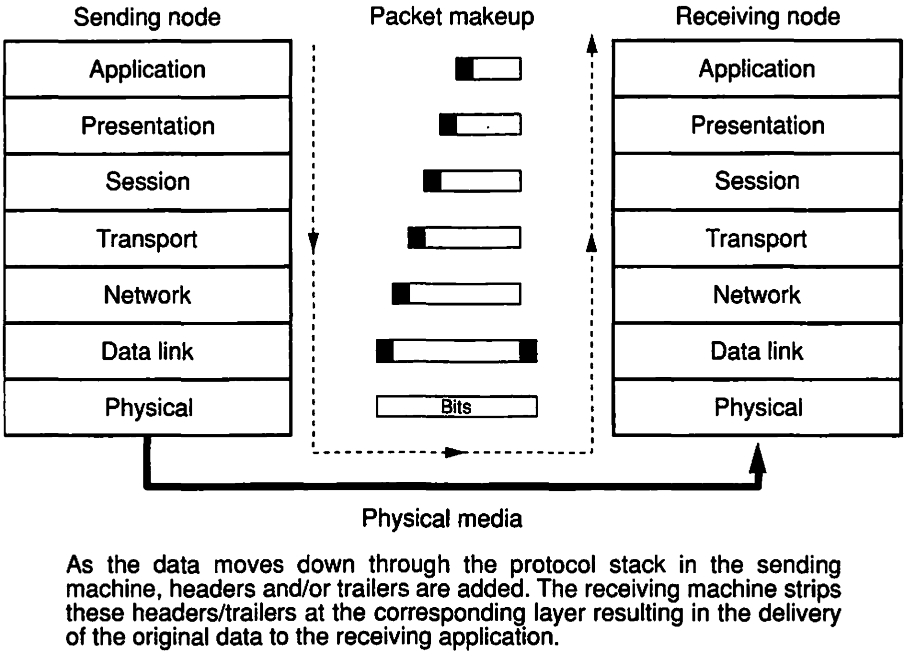

Figure 4-2 OSI model network communications.

AppleTalk and the OSI Model

AppleTalk is made up of a number of protocols corresponding to various layers of the OSI model. Figure 4-3 and the following descriptions show this relationship.

The Physical Layer, as mentioned earlier, takes care of signal reception and transmission, carrier sensing (listening to the network to sense when it is idle before transmitting), and signal encoding/decoding (translating between the bits in a packet and the voltage signals used to represent the bits on the network). The Serial Communications Control (SCC) chip in the Mac, connected to the

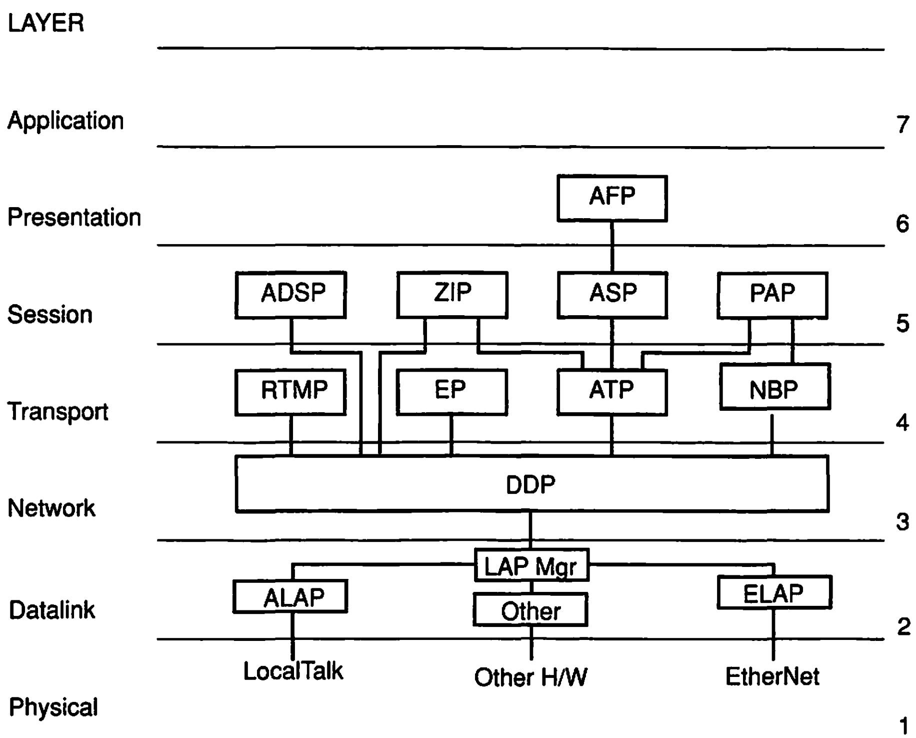

Figure 4-3 AppleTalk and the OSI model.

printer serial port used for AppleTalk communications, generates the network signals and listens to the network to detect incoming communications. The Physical Layer does not care what sort of connector and physical medium is attached to the Mac (PhoneNET, LocalTalk, duPont Fiber Optic, etc.), as long as it can relay the signals generated by the SCC chip to and from the Mac or other network device.

At the Data Link Layer, the AppleTalk Link Access Protocol (ALAP) is concerned with the communications between any pair of nodes on a single AppleTalk network. The data received from higher layers are directed towards a particular node on the local network, even if that node is a bridge or gateway responsible for routing the packet elsewhere. ALAP packages the data for transmission (encapsulating it in frames), watches for the network bus to be free (and waits a random amount of time to avoid collisions), and sends the data. Conversely, ALAP also recognizes when data should be received by monitoring the data captured by the SCC chip, watching the node number that transmissions are sent to in order to recognize packets meant for that node.

Node numbers, unique to each station on the network, are assigned by ALAP. When the Mac is booted, ALAP assigns a node number and keeps that number as long as it does not conflict with that of another station on the network. If it does conflict, it tries again with a new node number.

All protocols at the Data Link Layer must have a method for gaining access to the network and either avoiding or detecting collisions (garbage on the network that occurs when two devices transmit at the same time). ALAP uses a method called CSMA/CA, for carrier-sensing (CS), multiple access (MA), with collision avoidance (CA). Carrier sensing means that all nodes first "listen" to the network to see if it is in use (another node is transmitting), and if in use will wait until the network is idle. AppleTalk's CSMA/CA specifies that all nodes wait until the network is idle, then wait for a minimum time plus a random amount of time before attempting a transmission. This random amount of time minimizes the chance that two nodes waiting to send a packet will initiate a transmission at the same time. This is how AppleTalk implements Collision Avoidance. Multiple Access simply refers to the fact that many nodes will be vying for time on the same network.

The Link Access Protocol (LAP) Manager, a new protocol added with the introduction of EtherTalk, provides a switching function between LAPs. Note that, as we discussed in the section about the OSI model, only a lower level in the protocol stack is being modified as the user switches between protocols. All of the higher level layers, including most importantly the Application Layer, do not have to change. The user implements this change, from the Network option in the Control Panel, and can switch freely between LAPs (EtherTalk, LocalTalk [referred to as built-in], FlashTalk, and others).

When EtherTalk is selected, the LAP Layer uses the Ethernet Link Access Protocol (ELAP) to communicate with the add-in Ethernet hardware. Another protocol, the Apple Address Resolution Protocol, or AARP, handles translation between Ethernet addresses and AppleTalk addresses.

Remember that ALAP sends data between any pair of nodes on a single AppleTalk network. At the Network Layer in the protocol stack exists the Datagram Delivery Protocol (DDP), which allows data to be sent to any pair of nodes in an internetwork, a group of interconnected AppleTalk networks. DDP also allows a single AppleTalk device to maintain multiple AppleTalk connections simultaneously. This is critical, since you may want your Macintosh to be connected to a file server, network printer, and electronic mail system simultaneously. Within each data packet is a set of three numbers used to pinpoint the destination of the packet—the socket number, node number, and network number. A socket is used to identify an AppleTalk process within a node on the network. In the example above, the file service, mail service, and print service software might all open one or more sockets within your Macintosh. DDP maintains the sockets and is thus able to deliver information to the proper application within each device. To deliver packets to devices that are not on the local network, DDP adds a network number to the address information to specify which network the packet should be delivered to. Since each network in an internetwork may have a node 25, for example, this network number is critical to the proper routing of packets.

At the Transport Layer, one finds the Name Binding Protocol (NBP), the Routing Table Maintenance Protocol (RTMP), the AppleTalk Transaction Protocol (ATP), and the Echo Protocol (EP).

One of the keys to AppleTalk's relative simplicity for the user is the ability to browse the network and to choose network services by scanning text-based names. For example, to select a printer one merely opens the Chooser, scans a list of available printers, and clicks on the desired one. The user never sees the node number, socket number, and network number that were actually selected through that action. The glue between the text name and the numeric address is provided by the Name Binding Protocol (NBP), which translates the character string names into the internet address of the corresponding device or service.

The Routing Table Maintenance Protocol (RTMP) maintains a set of tables that describes the various networks in an AppleTalk internetwork and the different paths to the networks. Because networks can be connected by bridges and gateways in a variety of ways, there may be multiple paths from one network to another. RTMP allows the shortest path between two networks at any given time to be discovered. RTMP also keeps track of the node number of the local bridges and gateways that serve as routing devices to the other networks. The routing tables pair network numbers with the local node number of the bridge through which the shortest path to that net exists. Packets that are destined for another network are sent to these bridges and gateways by ALAP. RTMP allows bridges and internet routers to dynamically discover routes to the different AppleTalk networks in an internet.

Another Transport Layer protocol is the AppleTalk Transaction Protocol (ATP), which allows transaction services to be established between any two nodes. The protocol guarantees reliable, loss-free transactions between any two sockets. A transaction is any flow of data between two sockets where one requests information of the other and a reply is sent in return. ATP is commonly used to create connections between two nodes when a number of transactions are expected to take place.

The Echo Protocol (EP) allows any node to send a packet to any other node and receive back (echo) a copy of the packet. The Echo Protocol is only used by network troubleshooting and diagnostic programs.

At the Session Layer of the protocol stack, one again finds a number of protocols; the AppleTalk Data Stream Protocol (ADSP), the AppleTalk Session Protocol (ASP), the Zone Information Protocol (ZIP), and the Printer Access Protocol (PAP).

The specifications for the AppleTalk Data Stream Protocol (ADSP) have recently been released in preliminary form. ADSP is designed to provide byte-stream data transmission in a full duplex mode between any two sockets on an AppleTalk internet.

Zones are used to group a number of networks in an internetwork and split the network into logical sections. The Zone Information Protocol (ZIP) is used to maintain an internet-wide mapping of networks to zone names. Zones are actually created and configured from within the configuration software of bridges and gateways. Most of ZIP's services are transparent to the user. The Name Binding

Protocol uses information kept by ZIP to determine which networks belong to a given zone.

The AppleTalk Session Protocol (ASP) is used in conjunction with ATP to provide for establishing, maintaining, and closing sessions. A session is a series of communications between a client workstation (such as a Macintosh) and a server (a file server, printer, or mail server, for example). ASP sets up these sessions, assigns them a session identifier, and maintains the sessions. ASP is asymmetrical: The workstation initiates the session connection and issues sequences of commands, to which the server responds. The server does not send information directly to the workstation it merely responds to the workstation's requests for information.

The AppleTalk Filing Protocol (AFP) is a Presentation Layer protocol designed to control access to remote file systems. The overall objective is to allow access to files located on remote volumes throughout the network. AFP provides a number of services to applications and networking software. Most applications will use either the native Macintosh Filing System or a set of extensions to it referred to as the Shared Environment Traps, created specifically to provide services for multi-user access to files. AFP also provides services related to user authentication (logging in) to network services, and provides for directory privileges. As such, AFP is most heavily used directly by AppleShare client software and by the Finder.

We've looked at how network protocols are designed and how the AppleTalk protocol set fits into this design model. There is, of course, a lot of detail behind all of these protocols. For more information, see the Appendices of this book, which contain a reference list for more in-depth information.

For now, let's look at a practical example of the protocols in action and examine the internal addressing of data packets on an AppleTalk network.

AppleTalk Network Addressing

Take an example of a network that has three Macintoshes, and a Laserwriter.

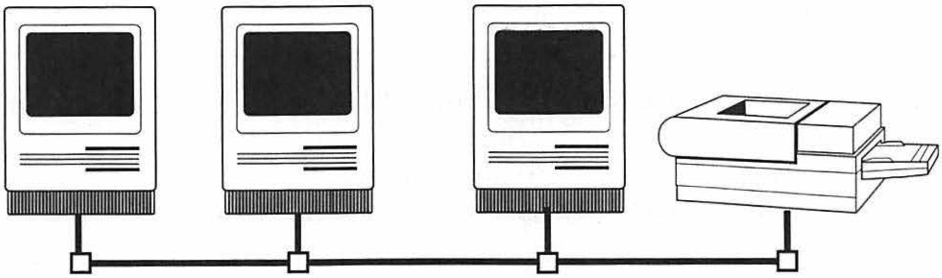

Figure 4-4 Simple AppleTalk network.

This is a simple configuration with just one network, but a number of nodes on the network. At each node (in this example, we'll use one of the Macintoshes) there are a number of AppleTalk software packages, all operating together—a file service application, a Laserwriter print spooler, and an electronic mail system. How does the traffic get directed properly from machine to machine and from application to application?

The traffic is directed in accordance with an addressing scheme inherent in the protocols. Traffic direction is one of the things the AppleTalk protocol dictates. The protocol specifies that you can have 254 nodes on any network, though the practical limit is often much less. It also specifies that you can have 65,534 interconnected networks. This huge number is the total number of AppleTalk networks that can actually be connected together at one time. 65,534 networks each with 254 nodes gives the largest internetwork size in excess of 16 million nodes, most likely suitable for your needs. But that is the limit as specified by the protocol.

Going back to our realistically sized example, however, how does this traffic get directed? How does the addressing scheme that routes traffic actually work? In our example, a Macintosh may need to talk to another computer on the net to make a request for, say, file service.

On AppleTalk, each node can maintain tables of the addresses of other machines or resources on the network. These addresses are the node numbers. Each node, as it turns itself on, picks for itself a unique node number. This node number represents a unique address on the network. And so, if one Mac talks to another and performs some file service, node 10 would "address" node 35 and request some information.

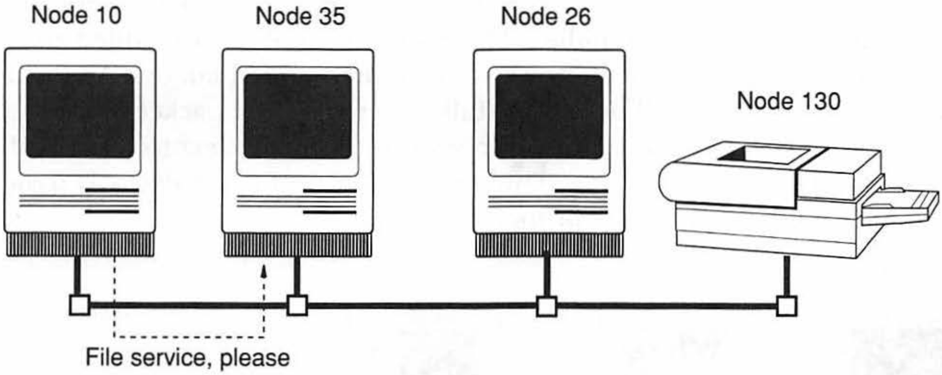

Figure 4-5 File service request.

But how does that information get directed within the computer if there are a number of AppleTalk processes active? Envision the packet of information coming from node 10 across the net and arriving at node 35. Let's say node 35 is a Macintosh functioning as a nondedicated file server and the user of node 35 also sends electronic mail and prints to a LaserWriter via a spooler.

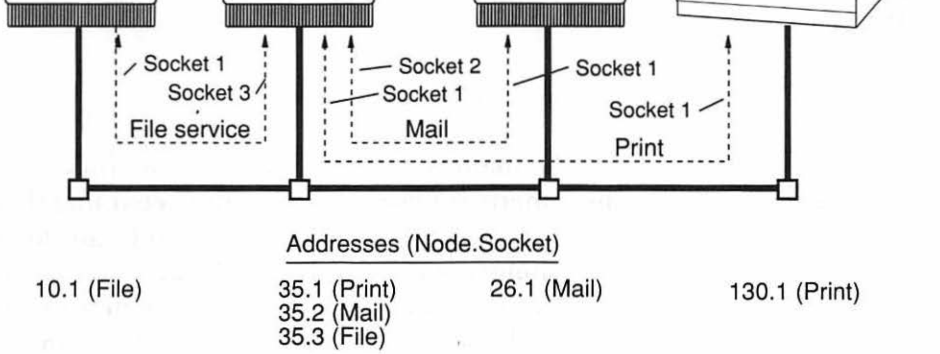

Figure 4-6 Multiple AppleTalk processes.

Each network application active within a particular computer is assigned a socket number. These socket numbers are added to the node number in the network address when more than one AppleTalk process is active. When AppleTalk "addresses" the packet of information to be sent, it will be addressed to the node, *and* to a particular socket within that node. This assures that traffic—or data—is passed within the node to the proper application.

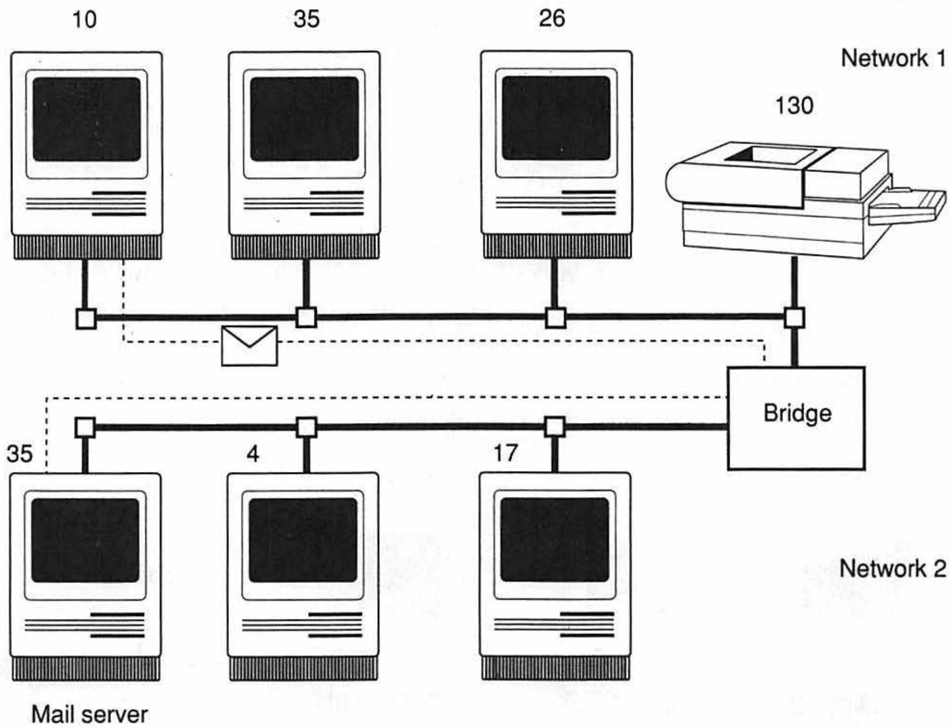

Figure 4-7 An internetwork example.

Now let's complicate matters by adding another network. We turn a bridge on and now there are two networks connected together. My mail server, for example, is on the other network and I want to go get my messages. It is no longer sufficient to route traffic to a particular node number, because the connection to the other network is the bridge, so the data must be sent to the bridge. To "address" this node, another element—a network number—is added to the addressing scheme. The complete address on an internetwork must include the elements shown in Figure 4-8.

Internetwork address

Network number; Node number; Socket number

Figure 4-8 Internetwork addresses.

So data are directed through the bridge towards a different net number, the node number on that net, and the socket number within that node. AppleTalk allows network applications to keep track of all these network numbers, node numbers, and socket numbers so that data can be directed correctly.

Dynamic Configuration and the Name Binding Protocol

Additional elements of this addressing scheme enable AppleTalk to sustain a networking environment that is

- easier to use,
- easier to setup,
- easier to maintain, and
- easier to administer than other networks.

A lot of other networks, in the PC environment, and particularly in the mini- and mainframe environments, require very strict rules for network administration and tables of information at each computer describing what's available on the network. Each computer must have a means of determining where a server is, or a printer, and what the address is and how to direct information to it. This is referred to as a *static configuration.* Static configurations change the functionality from a couple of points of view:

- Before the devices can communicate, an administrator is required to pick a unique node number, or address, for every device on the network and distribute that information around the network. To a laser printer, they might assign node number 28.
- At each and every PC on the LAN, some specific action must now be taken to let the network stations know that the printer exists. That this action must be done explicitly by someone at each station

before devices can be addressed, and that changes/additions must be propagated manually throughout the network, makes the configuration "static" as opposed to "dynamic." With AppleTalk networks, this kind of activity is automatic, or self-configuring.

The self-configuring, "automatic" nature of AppleTalk is referred to as a *dynamic configuration* and is made possible by two characteristics built into the protocols.

- First, each device has the ability to pick its own unique network address.
- Secondly, AppleTalk devices have the ability to look up across the network and identify, at any given time, what resources are available.

In addition to the dynamic addressing scheme for all network resources, which for many smaller networks eliminates the need for a system administrator, AppleTalk allows the resources to have logical names by which they are identified to the user. The *Name Binding Protocol* provides a piece of glue that binds a numeric address (net #, node #, socket #) for a particular service or device to a text-equivalent name. The name binding hides the numeric address from the user and allows applications to present only the name. The actual name binding occurs during the process of initializing each AppleTalk application.

The user does not have to know—in fact, he or she normally cannot see—the numeric addresses that exist deep within AppleTalk. Behind the scenes, the protocol keeps track of network numbers, node numbers, and socket numbers. The user sees only the equivalent names—a Laserwriter called "Rm. 216" or a file server called "Engineering Files."

Another important element of AppleTalk that supports logical identification of devices and services is *device typing*. Each new AppleTalk application or device is assigned a unique device type. For example, a Laserwriter and other laser printers has a device type called "laserwriter." A TOPS server has a device type of "TOPS 2 server," for TOPS Version 2. An InterBridge is simply referred to as "InterBridge."

Every different application or network peripheral has a unique device type. This device type becomes a part of the identifying name the user sees.

Device names, themselves, are generally chosen by the user—the InBox mail server is given a name by the administrator. Laser printers and networked Imagewriters can be named. The AppleShare servers are assigned names by the AppleShare administrator. Since TOPS is a distributed network, everyone on the network chooses their own name, which in turn shows up as the name of their server.

So what makes up the complete name for every AppleTalk service or device? Remember that there is a one-to-one relationship to each of the numeric addresses for a given node. This numeric address consists of net number, node number, and then socket number within that node. The textual equivalent also consists of three parts:

- a name for the device or service,
- the device type, and
- a zone name within which the device or service exists.

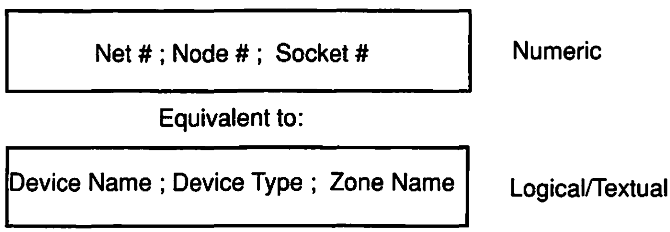

Figure 4-9 Textual and numeric network addresses.

How does the user identify all three textual elements to the application he or she is using? The Macintosh provides a standard interface, the Chooser, for browsing the network (and internetwork) and identifying resources. When the Chooser is opened, three distinct users come into view, corresponding to the three elements of the textual name. The top left gives a scrolling list of known device types. The bottom left shows all known zones (if any) in a scrolling list. The right side of the window lists device names as they are found. The user first selects a device type and a zone to look in, and all resources that match this criteria are displayed on the right for selection.

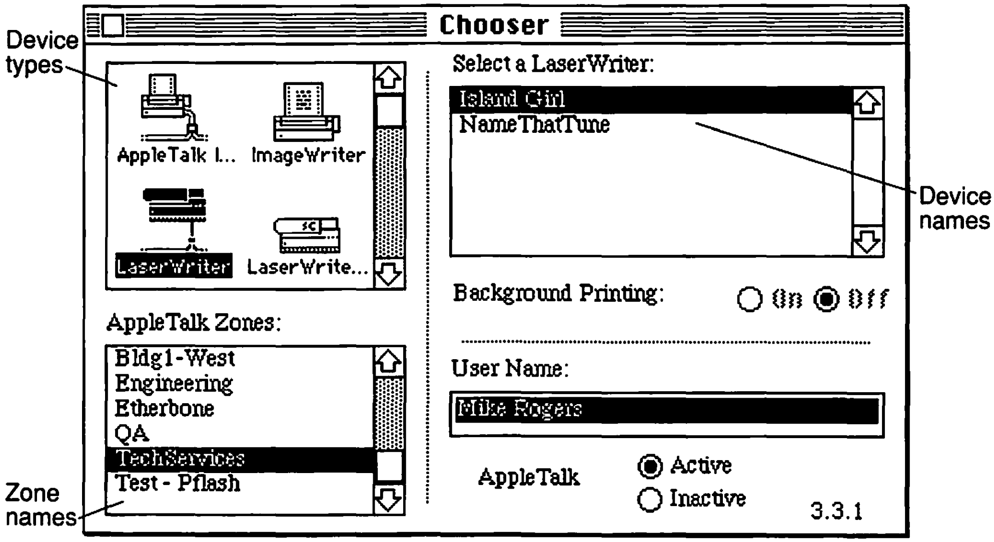

Figure 4-10 The Chooser.

What has the user just done? They've identified uniquely a device they wish to access. It exists in a zone (perhaps), it has a name, and it is a device of a particular type. Those names are translated internally by the protocol into the equivalent numeric address. The actual data packets sent over the network are directed to the proper net number, proper node number on that net, and specific socket number (if necessary). The identification corresponds exactly to the device type with that particular name in that particular zone.

Not all network applications use the Chooser interface to the network (TOPS, for example, has its own desk accessory). All applications that fully support the protocols, however, allow the user to choose the desired zone, device type, and device name.

As we use AppleTalk software and hardware for the first time, we are generally prompted for the logical names we would like to use. We are asked to name an AppleShare server, name a TOPS node, give a Laserwriter a name, etc. How do these numeric equivalents get assigned, though? This is really one of the beauties of AppleTalk. The numbers get assigned whenever a device is turned on or a particular software application within the CPU becomes active. One of the most critical processes is the selection of node numbers and net numbers.

Remember that if you have just one network you are not able to have, nor do you need, a zone name. Likewise, a network number would not be necessary. There is economy and intelligence in this approach. Why use node 10, net 1 as the address if there is only one net? Simply using node 10 as the address will do. Until a bridge or gateway is introduced, AppleTalk knows such information is unnecessary and does not attempt to maintain it.

Network numbers and zone names are established by an administrator during configuration of bridges and/or gateways. It is very critical that the administrator, when configuring bridges and gateways, makes sure that in a complex network the net numbers remain unique. Do not reuse a net number anywhere. Network numbers are somewhat arbitrary since no one but the administrator will need to know them. Most often, network numbers are assigned sequentially beginning with one (1). Once a network number is chosen, the administrator also chooses whether or not a network is associated with a zone name. Bridges and gateways, once configured, periodically broadcast packets of "routing information." This routing information informs network nodes (especially other bridges and gateways) what networks and zones have been defined and how to get to them.

Node numbers are set automatically. We discussed before that there may be up to 254 devices on any network in the internetwork. All devices are numbered, coincidentally, from 1 to 254.

In the actual packet of information sent across the network, space is reserved for the destination node number. AppleTalk packets have eight bits or one byte available for this node. That eight-bit number translates to the addresses 0 through 255, or 256 total addresses. Zero is defined as illegal and 255 is defined as a special type of packet called the *broadcast packet.* A broadcast packet doesn't travel to one particular node, but is sent to every node on the network. In turn, every node receives a broadcast packet and, if appropriate, responds to it.

Broadcast packets are used in browsing the network and identifying resources. When a user picks a zone in the Chooser and clicks on the Laserwriter device icon, a broadcast packet is sent to all networks in that zone asking all Laserwriters to identify themselves. All Laserwriters send back a packet giving their network address and their name. These names are presented to the user who can now select a printer. All of this happens without a system administrator assigning an address for the printer and distributing it to the network. In fact, the Laserwriter only had to be plugged in, attached to the net, and turned on! Any time you browse the network looking for resources, whether you're selecting a Laserwriter, looking for a TOPS server, selecting a network modem, or connecting to an AppleShare server, you are using broadcast packets to help you select your network resources.

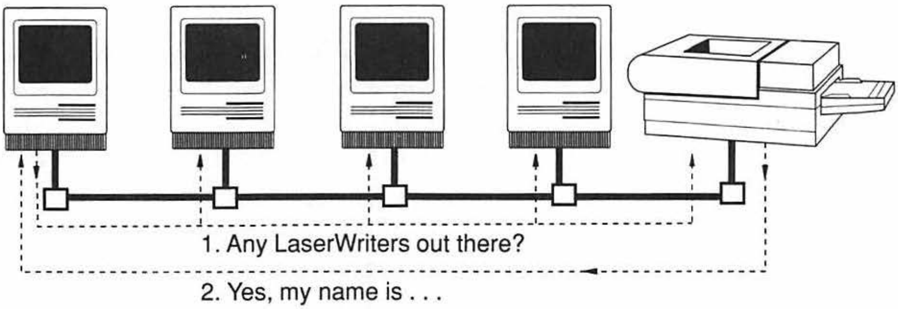

Figure 4-11 Use of broadcast packets.

The broadcast packet is critical to the ease-of-use of AppleTalk; it allows for simple configuration and reconfiguration of the network without complicated administration tasks. The other factor in simplifying network administration is the ability for a network device to pick for itself a unique address. How does this happen? Consider a simple event, like turning on your Macintosh. One of the first things that happens when you turn your Macintosh on is it looks up what node number it had last time it was turned on. Say that node number was 25. The first thing the Mac does, then, is send out a number of packets to node 25. The content of that packet essentially says, "Hey, I'm node number 25 and I'm about to come online. Is anybody else using node number 25?" If there is another machine that's using 25, then it responds back to say ". . .wait a minute, I'm already using that number."

If some other device responds to say node 25 is in use, the Mac then picks a random number within the valid range and sends out another packet. This time it says "I'll take, for example, node number

50—is anybody using that?" The Mac keeps doing that until it has a node number it knows is unique. This guarantees—*as long as the devices are connected to net when you turn them on*—a unique node number.

To summarize, the numeric addresses for each of the network services and devices named by the users are established as follows:

- Network numbers are chosen once by the network administrator and circulated throughout the network so all nodes are aware.
- Node numbers are established by each device as they power up and are guaranteed to be unique on each network.
- Socket numbers within each node, if necessary, are established as AppleTalk processes within the node are initialized.

The ease-of-use of AppleTalk extends from the fact that the user is hidden from the bits and the bytes and doesn't know about node numbers, socket numbers, and net numbers, even though they do exist. The user selects devices or applications with logical names. Devices pick their own unique address, so there are no conflicts on the network. Then AppleTalk's ever-present "look-up" function ensures those addresses are always current and can always be found, no matter how often they change.

This chapter started out with generic discussions of network theory and design. However, what was covered in these last two sections describes something very specific to an AppleTalk network. Since the elements of AppleTalk's dynamic configuration scheme greatly unburden user and network administrator alike, it is an important area to understand and leverage to the advantage of any organization needing network capability. Users, administrators, and managers alike will appreciate AppleTalk's sensitive treatment of the user, which successfully avoids burdening them unnecessarily with the intricacies of the technology.

Chapter Five

An AppleTalk Design Guide

As you consider the installation of a network in your workplace, there are a lot of questions and considerations that must be incorporated into the planning process up front. If you have never been involved in a network, it is difficult to know what questions must be asked and answered. Since networking changes the working lifestyle of the people who use it, these considerations must be given proper attention.

In this chapter, we anticipate those questions and considerations and try to put them in some order that will inform you and support you in your attempts to think through and design a network appropriate to your needs.

Do You Need a Network?

We begin with an obvious question. The answer, however, is not always straightforward. The Primer describes networking, but it doesn't ask the questions you need to ask in deciding to network or not. What are the benefits of having a network?

- Do you need to transfer files between people in your department, or your workgroup, your home, or wherever your network is going to be?
- Do you need to provide a convenient file storage system for all the members of your workgroup, one that could also store applications for use on the network?
- Do you need some sort of electronic mail for communicating back and forth in real time and distributing messages and files?
- Do you have expensive peripherals, such as hard disks or laser printers, that you'd like more people to use but don't want to purchase for each machine?
- Do you have a need to connect to different types of computers? Do you have different choices for microcomputers within the office—do your people use PCs or do all the people use Macs or even some other sort of microcomputer? And do you need to share work among those people?
- Do you have mainframes, departmental computers, or minicomputers at the site you need to connect to?

- Do you have an application package, an accounting system or some other multiuser office automation system that you would like to develop or like to buy? Would that sort of system running on a network enable you to work more efficiently or to do something you can't do today?

If the answer to all these questions is no, then you probably don't need a network. The first realistic step in designing a network is to decide whether or not you really need it. And if you do need one, the next step is to develop as much information about why you need it and what you're going to use it for. Once you've decided to network, you have to choose the topology, the cabling scheme, the network software, and the network hardware. All of these decisions must integrate into a design solution that suits your needs and functions well.

So not only do you ask those questions to determine whether or not you need a network, but you must be able to quantify, as much as possible, exactly what you will be doing with the network. A thorough understanding of your needs—current, as well as a realistic estimation of future needs—makes it much more likely that your system will be appropriately designed.

Upon clarifying what the network will be used for, you must think beyond generic uses to *specifics:*

- What software applications are going to be run on the network? Will you be sharing these applications over the network or just sharing data files?
- How many nodes will there be on the network?
- How many users will be on the network on the first day you implement it?
- How likely is that number to change over time? How quickly? Will it increase or decrease?
- How much confidence do you have in your estimate?
- What different sorts of computers do you think you need to link together? Macs? IBM PCs? UNIX? VMS? IBM Mainframe?
- Will you need a bridge or a gateway into an Ethernet network consisting of workstations, minis, superminis, or mainframes?

- What level of security do you need on the network?
- Will you have networks in different physical locations that need to communicate?
- Is there unused coax or twisted-pair wiring already installed in your offices that could be used for the network?

Another issue that needs to be considered up front is an estimation of the use of the network:

- How often will the network be used?
- How many people, on the average, will be using the network?
- How many people will be using the network at peak periods?
- Will the typical tasks be network intensive?
- How much disk storage will be needed?
- How many network printers will be needed?
- How many network modems will be needed?

The Design Process

In designing the network, there are a number of choices to make:

- You must choose the appropriate speed/data rate/bandwidth that you're both willing to pay for and that provides the performance you expect, based on:

  — the types of activities on the network,
  — the level of performance you expect to see from the network,
  — the number of people you expect to have on the network, and
  — the types of devices you expect to put on the network.

- You must choose a cabling scheme appropriate for the data rate chosen:

  — Apple's LocalTalk cable,
  — Twisted-pair phone wiring,
  — Fiber optic, or
  — Ethernet, thick or thin.

- You must design a topology consistent with the physical limitations of the environment where the network will be placed.
  - — Is it one big room, or a number of small rooms?
  - — How far apart are the rooms?
  - — What will the total network distance will be?

- Depending on the answers to these questions, you will select one of the following four different topologies:
  - — a daisy chain,
  - — a trunk with drops,
  - — a passive star,
  - — an active star, or
  - — or even some hybrid combination of these four.

There are any number of possibilities, but all these considerations must be taken into account up front in designing your net. The better you can evaluate your present needs and predict the future, the better your design decisions will be, which will provide for a smooth installation and manageable network maintenance.

The one thing you can almost *guarantee* with your network is that *you will have to make changes over time.* You may do it right the first time for the situation at hand, for that day, that time. But things change. Networks expand. Locations change. People move to different offices. Uses come up that were not anticipated. As much as possible, you must be able to anticipate the kinds of changes you expect in your network over time:

- A different building?
- More users?
- Different types of computers to be supported?
- More network traffic?
- New applications?

Whatever the case may be, try to anticipate as much change beforehand and build flexibility into your net to accommodate the inevitable. Thoroughly consider, in as much detail as is available, the use characteristics and needs of all the users. Detail current and future scenarios. Then choose the combination that will support the greatest number of those scenarios.

Choosing Your Network Speed

Bandwidth and Network Activities

Most local area networks are referred to as *baseband* rather than *broadband.* The differentiating factor is that a baseband network operates at a single frequency. Broadband schemes work at multiple frequencies and have multiple data paths flowing simultaneously over the same wire. *AppleTalk is a baseband network.* It has a frequency that, in comparison to other networks, is slow. The frequency, or clock speed, on the network translates directly into the amount of data that can theoretically be sent over the network in any given time period. The standard data rate of AppleTalk is 230,400 bits per second. Since bits per second is also referred to as baud rate, you'll commonly hear AppleTalk speeds referred to as 230,400 baud or 230.4 kilobaud. The speed is also sometimes referred to as "bandwidth." The higher the bandwidth, the more capability there is for the network to transfer data. The speed or bandwidth does not, however, translate directly to how much real data are passed across the network. Many factors contribute to the actual data rate; use the speed as a theoretical maximum.

First of all, of course, the actual speed depends on the activities on the network. If, for example, there is very low demand, you won't use the entire bandwidth. However, even in higher demand situations, only a portion of that bandwidth can actually be used. Your net data rate is some percentage of the total bandwidth. This is because there's competition for the wire—for the network.

In a typical situation, there may be a number of network applications running simultaneously. You may have file service between a server and a number of client computers, and there may be mail service between a number of clients and a mail server. People will be using the network LaserWriter on occasion. In this situation, various people are all sharing the same wire, taking their turn on the wire, passing data back and forth. Only one thing or another can be active at any one time in a baseband network. You can't achieve usage of the full bandwidth because there are periods of no network activity specified by the protocol. Devices that are waiting to talk on the network watch for an idle network, then wait a certain amount of time to make sure it's idle, and then start generating the actual data packets. Thus, there are small portions of each second when the network is designed to be idle.

When the network is actually transmitting data, the data are formulated into packets according to formats specified by the protocol. Of course what the user is really interested in is the actual data contained within the packets. For example, let's say I want to send a file to someone in the office three doors down and the file is 10K long. That 10K is going to be encapsulated into a number of data packets. It may be many packets, or it may be just a few large packets, depending on the network protocols and the network software performing the file transfer. The data from the file get divided up into packets, but address information must be added to the packet, as well as timing information, start and stop information, and who the packet was sent from.

In short, there is additional, necessary information encapsulated in the packet *beyond* the raw data the user is interested in. All of the extra pieces of information must also be transmitted across the network during any given moment, thereby reducing the amount of "real" data that can be transmitted. In addition, packets often need to be transmitted more than once because of an error or because of a receiving machine that wasn't ready and "missed" the packet. In addition, on internetworks, packets of routing information that contain no user data are periodically circulated around the network. Many network services also generate many packets of information that may seem extraneous to the user but are critical to the service provided. The bottom line is that there is a net data rate, which is somewhat less than the actual bandwidth of the network, that represents the actual amount of user data being transmitted. Realistically your actual data rate throughput is less than raw data speed—80 percent of this raw figure might be the most you can expect.

An understanding of what bandwidth is and what level of performance to expect from a given bandwidth is critical to the selection of a network cabling system. In addition, you must understand whether or not the selected bandwidth is going to be sufficient for your needs, which in turn depends on some projection of what the network will be used for.

Because estimating use is application dependent, projecting what the network demands will be is a very difficult thing to do. There are no real formulas for making this projection. It depends on the habits of the users, and is almost impossible to determine accurately.

But there are some general rules. More and more users will, of course, cause more and more network traffic and at some point they may need greater bandwidth because the network will begin to slow down.

Standard AppleTalk

First, however, what are the actual options for data rates? The standard AppleTalk, as we discussed, transmits at 230,400 bits per second, or 230 Kbaud (kilobaud). That is the data rate you get if you take LocalTalk or PhoneNET connectors, attach one to each device and install the cables, and perform any sort of AppleTalk communications—printing to a LaserWriter, transferring files with TOPS or AppleShare, or sending an InBox message. All those AppleTalk communications occur at 230KB, standard AppleTalk rates.

Besides the standard 230 Kbaud speed, you can choose either to increase the total throughput on your net, or to decrease the effective time it takes to do a task. If you can live with 230 Kbaud speeds on a network that isn't slowed down, the best option might be to create more than one network and bridge them together. Typical criteria for this kind of a solution might include:

- you're using low-intensity network applications like transferring files, electronic mail, and LaserWriter printing,
- but you think you've got too many people on your network,
- and the total amount of traffic on the network is so great that at 230 Kbaud network response seems to be getting slow.

If this is the case, the problem is not that any one task takes too long at 230 Kbaud, but just that so many tasks are occurring and causing the network to slow down. You may be able to solve the problem by merely breaking up the network into smaller ones and bridging them together. This solution is effective in most, but not all, cases of slow network response. If this is the case, refer to the section on creating internetworks later in this chapter.

Let's look at some different scenarios:

- You're trying to share applications from a file server among many people; for instance, launching Excel off a remote machine.
- You're trying to do some very intensive file service, such as sharing of a large database among a workgroup, and you desire fast response time.
- You have an application that requires that very large amounts of data be moved among devices on the network.

At the standard 230 Kbaud, the response time for launching an application across AppleTalk is roughly equivalent to running it locally on your Macintosh from a floppy disk. The response time is nowhere near what you could expect launching the file from a SCSI hard disk.

Many people purchase a network because they don't want to buy a hard disk for every machine. They then find that the network response is so slow at AppleTalk speeds that it is not sufficient for their use. Beware that with those uses listed above, network response time can be quite slow.

Large file transfers of 200K or more can be interminably slow at these data rates, depending on your patience and how often these transfers need to be made. The slow response time is *not* due to the number of people on the network, but is purely a limitation imposed by the slow speed of the network. These sorts of applications would be slow if you were the only user on the network. With this kind of use, even if you're not competing for the network, the network is just not that fast.

How fast is fast? Most PC LANs operate over Ethernet, with physical transmissions occurring at 10 megabaud—that's 10,000 kilobaud as opposed to 230 kilobaud. The bandwidth is about 40 times as large. But it is also true that most of those PC LANs never use anywhere near the whole ten megabaud. Applications do not launch 40 times faster on Ethernet. In fact, Ethernet transmission from a server to a client, even on an isolated network, probably can't happen at greater than 800 kilobaud to at most 1.5 megabaud, or 8–15 percent of the total bandwidth of the network. This is because the PCs on the network can't deliver the data fast enough to keep pace with the network hardware. So, yes, AppleTalk is very slow compared to most PC LANs in terms of raw data rates, but most PC LANs don't use nearly all the bandwidth either. So 1 or 2 megabaud might be all they ever really use.

Bandwidth has the greatest effect on very network-intense applications, like launching a program or transferring a very large file. You could do these in much less time if the data were transferred at a higher rate. So, what are the options?

NOTE: Remember if you're doing a lot of fairly low-intensity tasks, but you just have so many of those tasks that the network bogs down, you might choose a solution that effectively divides up the load of one large network into smaller, more manageable networks bridged together. In this case, you do not need to create one large network operating at a higher speed, but can divide the network into a number of smaller ones that can communicate to each other as necessary, and communicate sufficiently at the lower AppleTalk data rates.

There are two options for increasing the bandwidth of your AppleTalk network:

1. Use any of the available cabling options for standard 230 Kbaud transmissions, but add extra hardware to speed up network communications, or

2. Use Ethernet network hardware, cabling, and EtherTalk software instead of LocalTalk cables and AppleTalk speeds.

We will discuss each of these options in detail now.

FlashTalk and DaynaTalk

The first option, speeding up network transmissions over LocalTalk cables, is available from TOPS in a product called FlashBox and in a similar product, called DaynaTalk, which has been announced by Dayna.

- FlashTalk is a version of the AppleTalk protocols running at 3 1/3 times the standard data rate. Rather than operating at 230 Kbaud, they operate at 768 Kbaud.
- DaynaTalk is not as well defined at this point, but is said to have a number of speed "slots" between the standard 230 Kbaud and a maximum of 850 Kbaud on a Macintosh II. They are also claiming 1.7 MBaud between PCs using a new interface board and a data compression technique.

Let's discuss FlashTalk, the better known of the two solutions. Remember from the previous discussion that 800 Kbaud to 1.5 megabaud is the effective transfer rate of a 10 Mbaud Ethernet-based LAN. At 768 Kbaud we're getting up to a fairly high data transfer rate. At this point, the bottlenecks in the system are no longer the cable and the speed of the data along the cable, but the ability for a computer to process requests as network server and get data from a hard disk to the network. At 768 kbaud you're realizing a fairly significant improvement in the AppleTalk data rates.

What is the principle behind a product such as FlashTalk? The AppleTalk hardware that's built into the Macintosh works with a

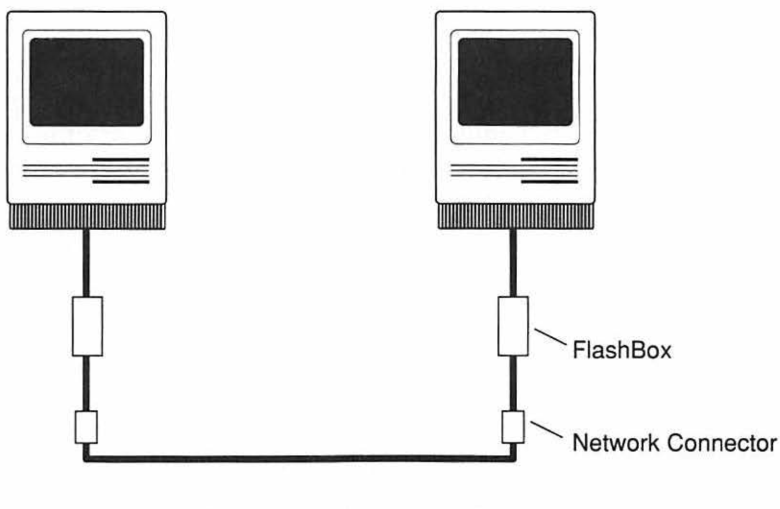

Figure 5-1 FlashTalk hardware scheme.

clocking mechanism at 230 Kbaud. There is, however, a connection to the external hardware (the printer port) that allows the networking chip in the Macintosh to be externally clocked. FlashTalk is simply an implementation of AppleTalk clocked at a higher frequency by an external hardware box. FlashTalk functions at 768 kbaud, 3 1/3 times the normal data rate. TOPS chose 768 Kbaud as the FlashTalk bandwidth because it is near the highest practical limit of the hardware that's built into the Macintosh.

TOPS designed the FlashTalk protocols so you don't have to choose between AppleTalk and FlashTalk; they both actually operate on the same cable, in conjunction with each other. Doing so adds overhead to FlashTalk communications, however, by requiring that certain portions of the high-speed communications take place at the lower speed. This lowers the effective data rate of FlashTalk to about twice regular AppleTalk. Supporting the lower-speed AppleTalk is very important since there are many network devices that are not FlashTalk capable. You cannot, for instance, take the FlashBox for the Macintosh and plug it into a LaserWriter and have that LaserWriter communicate with its clients at 768 Kbaud.

FlashTalk requires more than just externally clocking standard AppleTalk hardware. It requires changes in the LAP layer of the AppleTalk protocol structure as it exists in the Macintosh system software. Implementing FlashTalk on a Macintosh, then, requires some external hardware, but it also requires some software in the system. This software is, in fact, a new network driver accessed through the Control Panel. The software is required to support both AppleTalk and FlashTalk simultaneously. In our discussion of network protocols in Chapter 4, we mentioned that the layered design of protocols that adhere to the OSI reference model allows protocols to be substituted. FlashTalk software installs a new LAP-level layer in the place of the standard ALAP.

Because there's no way to load software and place network drivers on devices like LaserWriters, bridges, gateways, and remote access devices, FlashTalk would need to be built into the devices themselves. ROM-based software generally drives the devices. TOPS has a program to license the FlashTalk protocol so it can be built into other manufacturers' AppleTalk peripherals. TOPS is, in fact, trying to establish FlashTalk as the standard for higher-speed AppleTalk communications. So, given that networks will have a combination of devices, both FlashTalk capable and non-FlashTalk-capable, it is important that the FlashTalk protocol be able to switch speeds on the fly to accommodate whatever device the machine is communicating with. You certainly don't want to turn off FlashTalk and reboot your Macintosh just because a LaserWriter isn't able to communicate at FlashTalk speeds. You want the protocol to switch speeds for you, automatically. That's exactly what FlashTalk does.

FlashTalk devices keep a table internally of all the other devices they've spoken to on the network and whether or not they can communicate at FlashTalk data rates. If it's a FlashTalk-capable device, it communicates at FlashTalk speeds. If it's an AppleTalk device, then it communicates at AppleTalk data rates. So you can have any combination of both FlashTalk and non-FlashTalk devices on a network. You will realize the greatest gains, however, when most or all the devices on the network are communicating at FlashTalk rates.

An analogy should make this point clear. Imagine that the network is a freeway, one that is already crowded with cars going 55 miles per hour. If you get on the freeway with a car that can go 175 miles per hour (over three times as fast) you will only be able to travel at 175 miles per hour for very short periods of time because the freeway is so crowded. Now, if everyone could and would go 175 miles per hour, everyone on the freeway could get where they're going faster and, in fact, there would be room on the freeway for more cars. The analogy is not exact since on a network only one device can communicate at a time, but the general concept holds true.

One of the problems with non-FlashTalk devices comes from the fact that they can't sense the higher-speed packets on the network. Going back to the freeway, imagine what would happen if one of the 55-miles-per-hour cars drifted into the 175-mile-per-hour lane. A collision would be likely, and this is exactly what happens on networks. A non-FlashTalk device transmits in the middle of a FlashTalk transmission, thinking the network is idle. The packets get clobbered and the data must be sent again after the nodes back off for a significant amount of time. If this were to happen often, FlashTalk could be slower than AppleTalk. For this reason, TOPS recommends that all Macintoshes and PCs be FlashTalk equipped. Printers rarely interfere with FlashTalk communications because they do not transmit often, as they are usually receiving data.

So what about other non-FlashTalk devices, such as bridges, gateways, and network modems? Over time, many of these will incorporate the higher-speed protocols. In the meantime, if they had the capability to "sense" when there was FlashTalk activity they could avoid collisions with FlashTalk packets. The TOPS Repeater can do just that. By putting a TOPS Repeater between the network and the AppleTalk-only device, the Repeater becomes responsible for transmitting onto the main network. Since the Repeater is aware of FlashTalk transmissions, it will try to avoid transmitting and causing collisions.

Carrying the freeway example one step further should make clear why network accelerators, just like Ethernet, are not always the whole answer to speeding up network tasks. Imagine the process of getting up in the morning and getting to work as one network task. To complete the task you must wake up, shower, eat breakfast, change, get in your car, take slow surface streets to the freeway, drive on the freeway, take surface streets to your office, park your car, and make your way to your office. Whew! Now, if you could drive 175 miles per hour on the freeway rather than 55, you would get to work faster, but would it be three times as fast? No, because driving on the freeway at 175 miles per hour does nothing to speed up the surface streets or your shower.

The people who get the most benefit from the 175-mile-per-hour car are the ones who spend the greatest percentage of the total time to get to work on the freeway. Some network tasks are network bound, meaning that the speed of the network is the critical factor in determining how long the task will take. Others are CPU bound at the server; doing a complicated query of a database may take 25 seconds—20 seconds of which are the server churning away at the data. If the network portion of that task went from three seconds to only one second, a factor of three increase, the total task would still take 23 seconds.

The results you see with FlashTalk, DaynaTalk, and even EtherTalk will vary from task to task. Some will be sped up greatly, while others will not seem any different. Overall, you should see an average increase in performance, but sometimes the greatest benefit of accelerating your network is in the number of tasks that can be performed, and the number of users that can be supported before the network slows to a crawl, rather than the speed of any individual task increasing.

FlashTalk capability is also available for communicating between Macintoshes and IBM PCs on an AppleTalk network. If you are using TOPS and a TOPS FlashCard (their AppleTalk interface board for the PC), the FlashTalk circuitry and FlashTalk software is included. In this case, you can use FlashTalk to communicate between PCs, to communicate to Macintoshes that have an external FlashBox attached, or to any other network peripheral that will work at FlashTalk rates.

To summarize, one of the options to allow for large file transfers, intensive applications such as multiuser applications, and launching applications remotely, is to allow more network activity in a given time on your network by using a higher-speed version of AppleTalk, such as FlashTalk or DaynaTalk. As FlashTalk capability becomes available on other AppleTalk peripherals (Postscript laser printers, bridges, gateways, and network remote access devices), most of your network traffic may become FlashTalk-compatible.

The physical connection is very simple: The FlashBox sits between the Macintosh and the network connector, whether it's a LocalTalk connector, a Farallon PhoneNET, or a TOPS Teleconnector. The FlashBox externally clocks the AppleTalk chip on the Macintosh and passes data to the connectors at higher speeds.

A couple of cautions are in order here. Some network connector boxes don't support FlashTalk rates. If you choose to do a FlashTalk implementation, be very sure the connectors you choose support the FlashTalk data rates. PhoneNET Plus (not the older PhoneNET connectors), LocalTalk, Nuvotech, and TOPS Teleconnectors all support FlashTalk speeds.

The second caution involves applying FlashTalk to an existing network or designing a new net, and not exceeding the length restrictions of the network cables at FlashTalk speeds. Length restrictions are based on the rate at which signals dissipate over a given length of network cable. That rate is measured as signal loss per foot of network cable. The rate at which you lose signal strength is highly dependent on the frequency of the signal passing over the cable. In fact, it's roughly proportional to that frequency.

Since FlashTalk is 3 1/3 times faster than normal AppleTalk, one can only go approximately one third the distance at FlashTalk rates than you can at AppleTalk rates. If you're not pushing the length limits of your network cables, it won't be a problem. If you exceed the allowable distance and errors are generated at FlashTalk speeds, the protocol will back down to AppleTalk data rates. This speed "negotiation" happens on a per-node basis. If you plan to go long distances, you should plan on using network cables that support longer distances. Systems that are based on phone wiring generally support longer distances than LocalTalk cabling.

You can use intranetwork communication devices, such as repeaters and multiport repeaters, in conjunction with FlashTalk to connect different electrical buses together to get longer lengths. If you want the network to be 2,000 or 3,000 feet using FlashTalk, you'll almost certainly need to use a phone-wire-based system and you ought to be using 22-gauge wiring. You may even need a repeater to connect two sections of electrical bus together to reach that distance. The same is true with multiport repeaters. At FlashTalk rates, each arm from the multiport repeater will be able to support one third the maximum normal distance before the signal degrades to a point where the FlashTalk protocol automatically knocks itself down to standard AppleTalk rate.

EtherTalk

Another means to increase the bandwidth of the network and increase effective data transfer rates across that network is to use an Ethernet based network. Ethernet-based transmissions, as previously discussed, happen at ten megabaud, so each individual packet that's transferred gets transferred very quickly. However, this does not mean you're going to get a 40 times improvement in the speed at which you do transactions. Each particular node really can't transfer data all that quickly—800 megabaud to 1.5 kilobaud at the best.

You'll see great improvements, but not a 40-times improvement in speed. Recall the freeway analogy.

There are various options for connecting to Ethernet. Many users have taken existing AppleTalk networks and bridged them into Ethernet via a gateway. However, that does not give effective speed improvements—it merely allows you to create a high-speed backbone or to talk to devices that exist only on Ethernet.

The way to really effectively increase your data rates with Ethernet is to not use LocalTalk connections at all, but to connect each Macintosh on your network directly to Ethernet. Communications will then originate at 10 megabaud from the Macintosh.

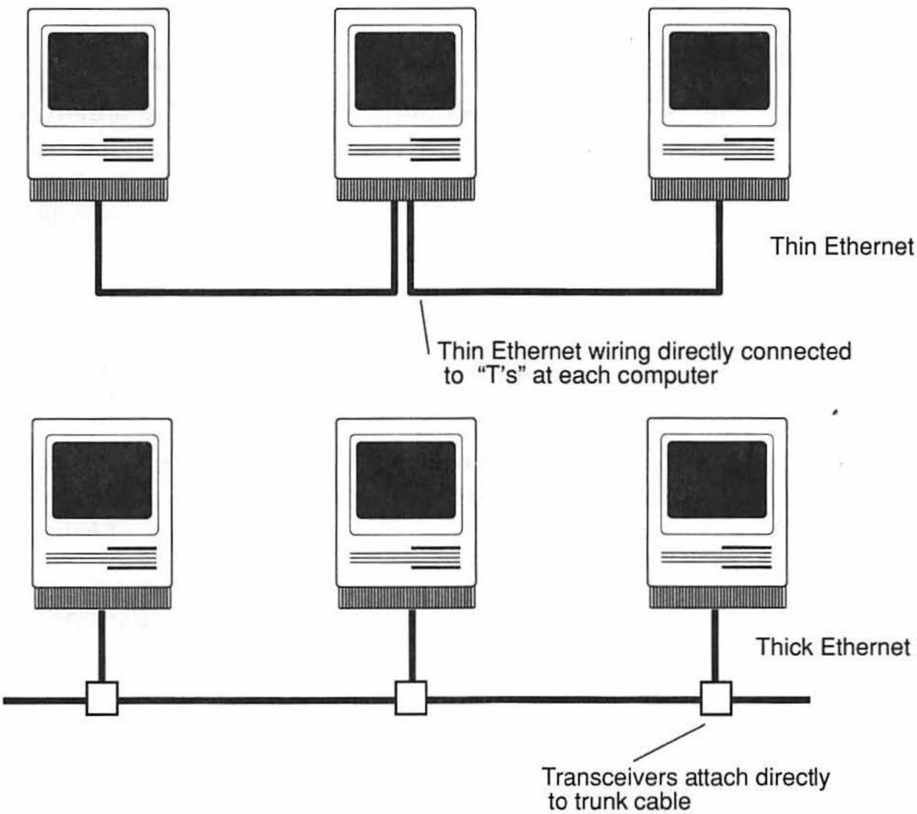

Figure 5-2 Ethernet hardware schemes.

There are a few different ways of making this Ethernet connection. Ethernet connectivity boards are available for both the Macintosh SE and the Macintosh II.

The board supplies the physical Ethernet connection. As with FlashTalk, software is installed that replaces the normal ALAP driver; in this case, it is an ELAP, or Ethernet Link Access Protocol, driver. From then on, communications no longer occur from the printer port, but occur at 10 megabaud from the add-in Ethernet interface board you installed. There are also options for adding direct-connect Ethernet hardware via the SCSI port on the Macintosh. These are good solutions when no slots are available or when connecting a Macintosh Plus to Ethernet, since it does not have slots. Because of the overhead of the SCSI port, this solution does not offer quite the performance advantages of the add-in boards. All of the available products are discussed in the Product Guide, (see Chapter 10).

Ethernet is a fairly expensive option. Prices for the add-in boards run from $600 to $1,000 or more per node for the card itself and the driver software, plus the cost of Ethernet cabling. If your building is already wired with Ethernet cabling, of course, that is not a factor. If you have to install it from scratch, you must install coaxial cable in your building, which is fairly expensive on a per-foot basis.

TOPS was the first company to come out with an EtherTalk driver for the PC that supports Ethernet interface cards for the PC, allowing Macintosh to PC communications at 10 megabaud as well.

Most network-interface cards for EtherTalk, which is the Ethernet version of AppleTalk, support both thick and thin Ethernet wiring schemes. Thick Ethernet is a more costly, older version of Ethernet.

To summarize, there really is a clear price/performance distinction here. The low data rate and the lowest cost is standard AppleTalk at $75 per node plus the cost of cabling. If you use phone wiring that's already installed in the building, the cost can be very low, even if repeaters or multiport repeaters are needed. The next step in performance is 3 1/3 times the data rate with FlashTalk. Here your cost would be $75 per node for Macs plus the cost of a FlashBox, which retails for $189. This solution affords a little higher price and better performance. Cabling costs should be approximately the same, but because of length restrictions, multiport repeaters and repeaters are more likely to be needed. The best performance comes with the ten megabaud solution with Ethernet. Now, however, for the network hardware the cost can be as much as $1,000 per node *plus* cabling and installation costs. The network accelerator solutions, such as FlashTalk, are likely to provide at least 60 percent of the performance improvement of Ethernet for less than 20 percent of the price, but again the actual performance increases are going to be highly variable depending on the task and where the bottleneck is located.

Option	Speed (Kbaud)	Cost/Node (Retail)
AppleTalk	230	75
FlashTalk	768	265
EtherTalk	10,000	1000+*

*Including cable installation.

Figure 5-3 Bandwidth options.

In addition to prohibitive cost, it may be a disadvantage that not all devices support EtherTalk connections. The most typical Macintosh LAN is a number of Macintoshes connected up to a LaserWriter. But LaserWriters and many other Apple peripherals can't be connected to Ethernet. If you want your network to operate at Ethernet speeds and also support a LaserWriter, the only solution today is to gateway back to a LocalTalk network and install the LaserWriter or other peripheral on the lower speed network. This gateway can be accomplished with either hardware or software. Both options are discussed in Chapter 9.

One other serious limitation to EtherTalk networking is support of no more than 254 devices. Remember that the AppleTalk protocols support up to 254 devices on a single network. At the low speed of standard AppleTalk, bandwidth prohibits getting even close to this limit. With the higher speed of Ethernet, supporting this many nodes is practical. However, going beyond 254 devices is not possible because there are no EtherTalk-compatible bridges available and no way to get around the protocol limit. The only currently used solution is a LocalTalk backbone between two EtherTalk networks. This solution, in which traffic is routed between 2 ten Megabaud networks via a 230 Kbaud backbone, is less than desirable for obvious reasons.

Some technical solutions to the 254-node problem have been discussed in the technical journals and on some of the commercial bul-

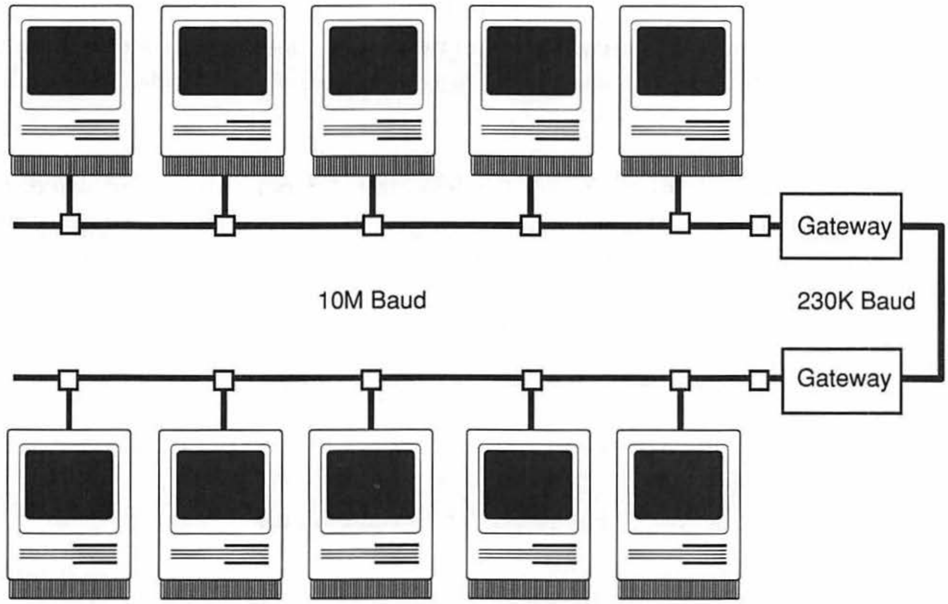

Figure 5-4 EtherTalk networks bridged with LocalTalk.

letin board services. The solutions are quite technical and won't be discussed here, but are available. See the Reference Guide at the end of the book for more information, including instruction for subscribing to *Connections,* a journal devoted to AppleTalk and Macintosh connectivity.

It does appear that a solution to the 254-node limit on Ethernet is underway. Apple is known to be readying a new release of the AppleTalk protocols, called AppleTalk 2.0, which should effectively solve the problem. AppleTalk 2.0, while it does not change the basic limit of 254 nodes per network, does allow for multiple "virtual" networks to coexist on the same physical network. Within a physical network, then, nodes will be addressed not just by node number but also by network number. The number of networks possible stays the same at 65,534. It will be possible to put over 16 million AppleTalk nodes on the same physical net. That ought to suffice. It is expected that AppleTalk 2.0 and the Apple Internetwork Router (discussed in Chapter 10) will be released together sometime in the second half of 1989.

Choosing Your Topology

One of the first steps in actually laying out the design of your network is choosing what sort of topology you will use.

Simple Topologies

There are a number of topologies available for AppleTalk networks. AppleTalk is designed to be a bus network with a daisy-chain topology. Each computer has a network connector box and a cable is strung between each of the nodes. There isn't one long cable; rather, there are many small cables between the connector boxes to form the network. The cable from one node goes to the connector box to the next and so on.

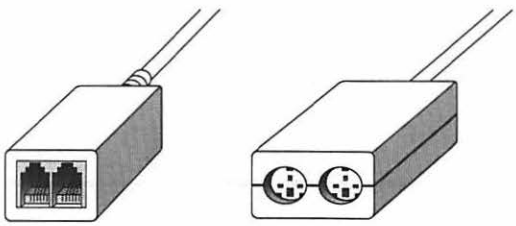

Figure 5-5 Network connector boxes.

This configuration is called a daisy chain. It's a very simple, linear type of topology. When AppleTalk was introduced, the only cabling system available was Apple's own proprietary cabling system, referred to then as AppleTalk on the AppleTalk Personal Network. This cabling scheme has since been renamed LocalTalk and a number of other options that have been introduced by third parties can form the physical link between computers.

Daisy chains are very simple to install and maintain. They are used almost universally on smaller networks of less than ten nodes. Because of the ease of installation, we recommend this topology for use on smaller networks contained completely within one room. Cables are simply strung from one machine to the next and the network is complete.

Another topology, popularized by the release of a phone-wire-based option for AppleTalk cables, is the backbone or trunk topology.

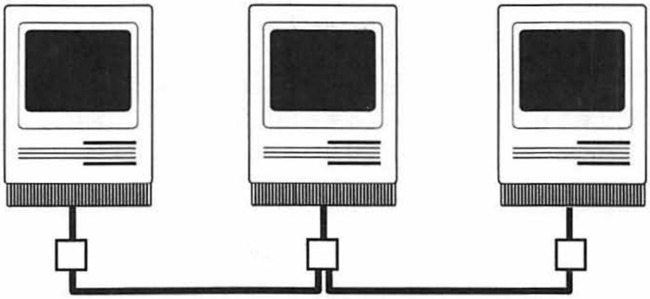

Figure 5-6 Daisy chain.

The "trunk" topology may have any number of "drops" or connections for devices. A solid piece of network cable extends the length of your network, with modular jacks installed along the trunk for connection of network cables between network devices and the modular jacks. Signals travel from the node generating the signal through the modular jack, along the backbone, and then are received by all other nodes.

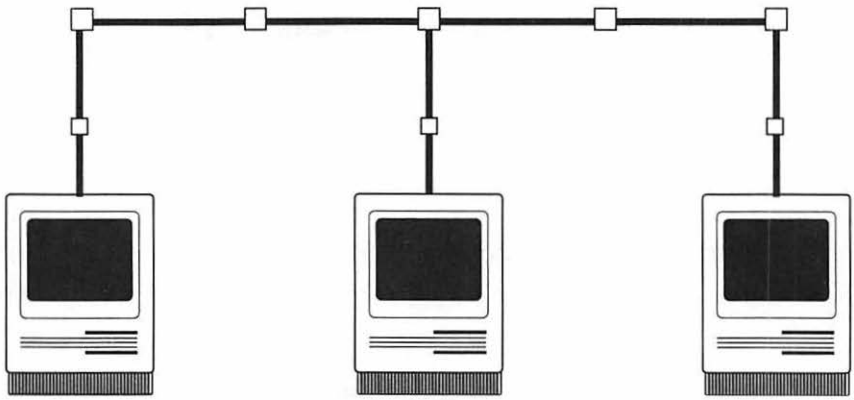

Figure 5-7 Trunk topology

The trunk is a popular topology when there is a good probability that expansion or reconfiguration will be necessary. The network can be installed throughout a physical space with modular jacks at regular spacing, whether or not a device will be installed at each location. When you wish to attach a device at the modular jack, just plug in a drop cable from that point to the network connector box and the device is installed. This does not disturb the network at all. You can freely plug and unplug devices into the network without disturbing it. The only precaution is to be sure that devices are powered on after they've been attached to the network.

Trunk topologies are possible for AppleTalk networks when phone wiring is used for network cabling. The availability of phone wire accessories makes bulk cabling, drop cables, and modular jacks easy to find. We recommend this type of topology especially for networks where lots of change or expansion is expected. When a long cable can be easily laid along the network to form the trunk (around the perimeter of a large room, between a limited number of rooms, etc.), this topology can be easily installed.

We mentioned that the trunk topology is ideal when a long backbone cable can be laid along the length of the network. If you have, for instance, one large room and you want to circle the room with network connections, you can begin by installing one solid piece of twisted-pair conductor all the way around the room. Then you can attach RJ-11 telephone modular wall boxes at intervals along this trunk. You can then use modular phone wire between this RJ-11 hook up and a Farallon PhoneNET connector to attach a device to the network. You can have any number of these wall boxes along the trunk ready for connection.

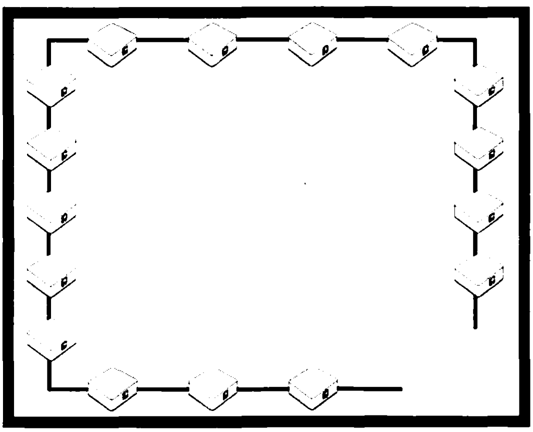

Figure 5-8 Trunk with drops around room.

You might take a large room and put 50 wall boxes around the room and then use perhaps only 20 of them for computers and peripherals. That leaves 30 spare "sites" for moving machines around or adding new machines whenever necessary. Nothing needs to be plugged into the unused RJ-11 wall boxes for the network to function.

Strictly speaking, AppleTalk is meant to be a daisy chain type of configuration. With the advent of phone-wire-based-cabling, the network wires were put in the hands of the users. Users can create many alternate topologies as long as a few rules are observed:

- There must be a continuous piece of conducting wire between all the nodes to provide a signal path.
- The signal path cannot be too long or too branched so as to cause the signal to degrade beyond usefulness.
- There cannot be any closed loops formed.
- The electrical bus must be terminated properly.

If these simple rules are observed, communications can proceed along that cable even though its topology is not a daisy chain. Branches off of a daisy-chain topology are referred to as passive topologies if they are formed merely by splicing wires together.

Network Termination

The predominant methods for wiring baseband LANs contain one pair of wires or one pair of conductors. Both telephone wire and the LocalTalk cables from Apple have one pair of wires for the network. Ethernet cabling also uses two separate conductors. All such wiring schemes require that the network cables be terminated. *Termination defines the electrical "ends" of the network.*

Termination helps ensure that signals will travel cleanly along the network. When a signal is generated on the wiring, a voltage differential travels along the two wires. This voltage differential proceeds out in both directions from the point at which it was generated. You "terminate" the network by placing resistors at the two ends of an electrical bus. The resistors, placed across the two conductors, absorb the signal and prevent it from bouncing back from the end of the wire.

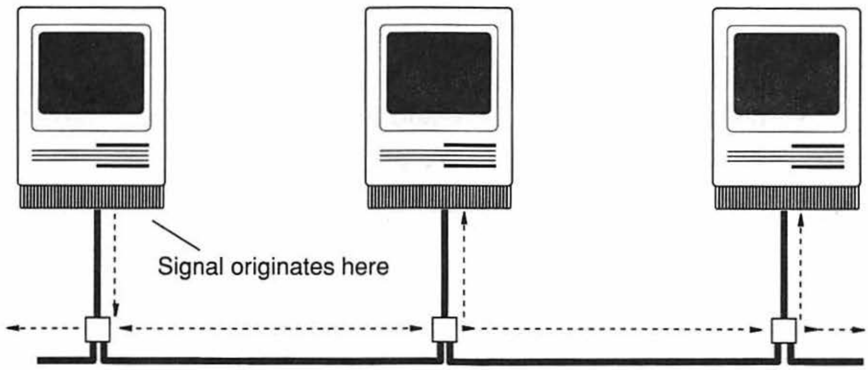

Figure 5-9 Signals along a daisy chain.

From an electrical point of view, terminating the network makes it appear as if the network cabling goes on forever, as if the network is of infinite length. None of the electrical signal gets passed back along the wire and therefore does not interfere with subsequent data being passed along the wire. This is important because, as mentioned previously, the "data" consist of a voltage differential between the two wires. Your computer, or any AppleTalk node, monitors the voltage differential along the wire and, depending on the rate of change of the differential, distinguishes between the "1" state and the "0" state, thereby forming the bits of the data packet. If this distinction is not clearly and consistently made, data corruption can occur and you may have problems with the reliability of your network.

Remember that an electrical bus consists of all the cables that network data pass across without going through an active device like a repeater or a multiport repeater. *It is critical that the network, and each electrical bus that makes up the network, is properly terminated.* Without this proper termination, you may observe poor performance or inconsistent, irregular behavior on your networks. Typical scenarios are as follows:

- You may not be able to see the devices on the network.
- There may be data corruption, resulting in the necessity for applications to retransmit packets.
- Your network may just not function at all.

Termination is an important part of setting up the electrical characteristics of the network. We've already traced the electrical signals along a daisy chain and found that the signals naturally travel to the two ends of the network and are absorbed by the terminators. Let's trace the signals along the other cabling scheme discussed so far—the trunk with drops.

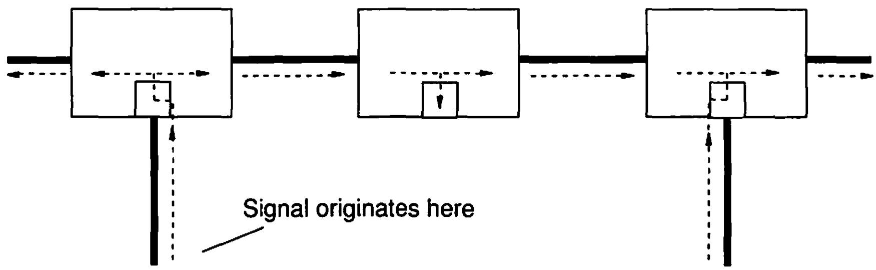

Figure 5-10 network signals along trunk with drops.

In a trunk with drops topology, a network signal is generated from one of the nodes and moves along the trunk in each direction. Each of the drops actually resembles a small T, or stub, coming off of the trunk. There is a path for the signal along this stub. Signals travel down the end of the stub or continue along the drop cable if one is attached. Now we have created a number of different data paths. If you have to terminate the ends of the trunk, do you have to terminate at each of these wall boxes if they're not used or at each network connector if a drop cable is installed?

The tendency for a signal to bounce back along a cable and cause interference with subsequent signals increases as the length of the stub, or T, of the trunk becomes longer. You must therefore keep those lengths to a minimum. If, for instance, there is no drop cable at a particular wall box, the length of the stub is only the length of the wire from the actual trunk cable through the wall box to the RJ-11 jack. It's very short—probably less than an inch. There is almost no possibility of significant reflection from that stub. When you add a drop cable to it and then a connector box at a node, you probably have six or eight feet of cable. As long as that length is small compared to the total length of the trunk, termination is unnecessary.

Now why not just put terminators everywhere? Every placement of a terminator absorbs a portion of the signal along the length of the trunk. Terminators everywhere would degrade the signal strength to the point where there is no longer much network length available to you.

Each of the cabling systems we will discuss has a recommended maximum network length. In general, the maximum length specified assumes a daisy chain with just two terminators. Keep the length of the drops off of a trunk to a minimum. In all cases make sure the drop cable length is short in comparison to the total length of the trunk; less than five percent of the length of the trunk is a good measure.

Maintaining short drop lengths prohibits you from attaching too many devices to one wall box along the trunk. You could, for example, attach a daisy chain from a wall box along the trunk. This side chain could continue on as long as you want, adding 15 or 20 computers, for example.

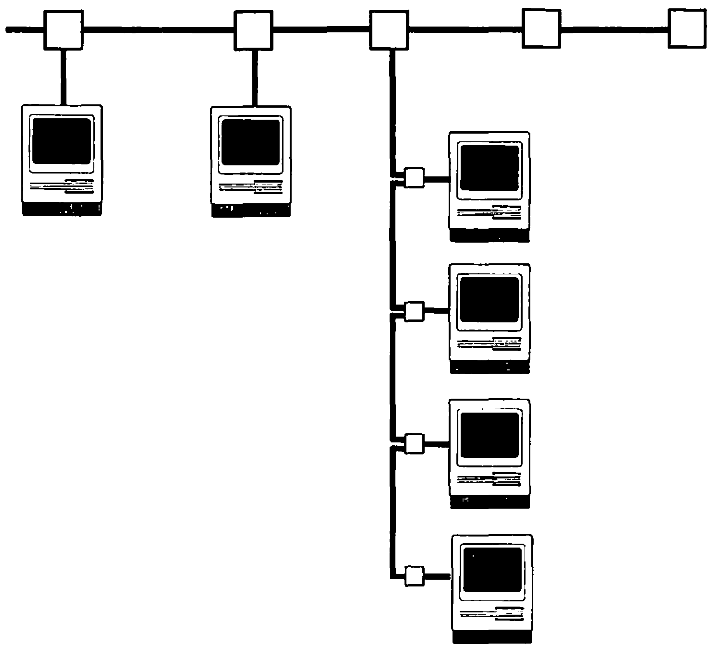

Figure 5-11 Passive side chains.

You really do not want to create passive side branches. When you do this you create a passive branch off of a trunk that is long—much longer than the wire within the wall box or the wire necessary to attach one node. As this side chain gets longer and longer, the tendency for the signal to reflect back along the side chain and trunk increases. This can cause a degradation of network performance.

You can usually get away with a couple of devices attached along a side chain. But, as the length of that side chain becomes long in comparison to the total length of the trunk, you invite problems. It is important to keep side chains short (less than 5 percent of the total network length).

There's nothing magical about having only two terminators along an electrical bus. The two ends of the trunk definitely need to be terminated. If you have an instance where you have 50 wall boxes, 20 computers attached, and then one long passive side chain, you could put a terminator along that side chain at the last node. What you don't want to do is create long side chains all over the trunk. *Never use more than four terminators per electrical bus.* Two terminators is preferable, but certainly no more than four.

One note of caution for network administrators considering a trunk with drops configuration. Unless there are a number of long side chains off of the trunk, termination is straightforward. However, at unused modular jacks and at the end of most side chains and attached devices, there are spare RJ-11 jacks. This can invite others in the workgroup to become network administrators and install their own RJ-11 terminators. A network can quickly become overterminated. When this happens, the only way to find the extra terminators is to "walk" the network, inspecting every connection.

Using Existing Telephone Wiring

With the advent of phone-wire-based networking schemes by Farallon, people have recognized that phone wiring is very common in existing buildings. The impetus to found Farallon actually came out of a hardware project of the Berkeley Macintosh Users Group. Twisted-pair wire is, of course, what telephone systems are based on.

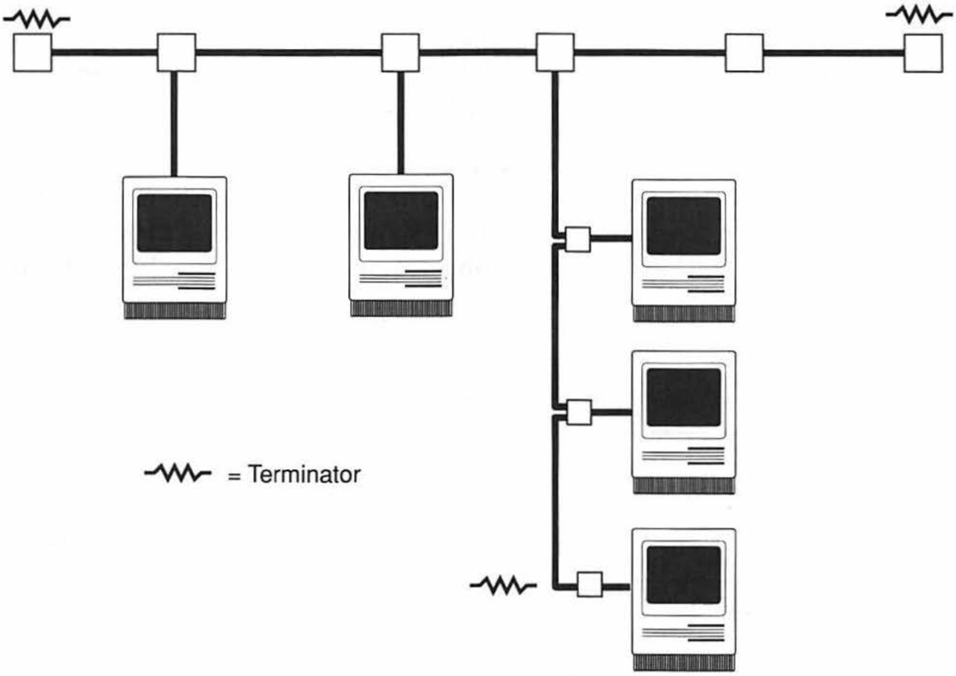

Figure 5-12 More than two terminators are sometimes allowable.

The typical situation in a building is a wall plate with an RJ-11 jack on it that you plug your phone into. It is highly likely that each wall plate has four wires hooked up to it originating from a central telephone closet. Typical analog telephones, and many digital telephones, use just one of those two pairs of wires, leaving one pair unused. There are telephone systems, however, that do use both pairs.

Recognizing the existence of unused wires and having a means by which AppleTalk signals could move along twisted-pair wiring, people of course wondered if the existing wiring in a building could be used to hook up all the offices without installing new wires. This could be a significant advantage for a large installation, for an entire building, or a single floor where you want an AppleTalk network among many offices.

We've already mentioned that when you have one very large room, or a small computer room where you want to concentrate a lot of computers, the *daisy chain* or the *trunk with drops* configurations (topologies) will work very well. This physical layout doesn't require that you do any special wiring. You simply circle the room with the appropriate wiring and network all the computers.

When you want to go between many rooms, however, the wiring is much more complex and expensive. Thus you will have a significant advantage if you can use the extra pair of wire already installed in many buildings. A typical phone system's wiring scheme is shown below.

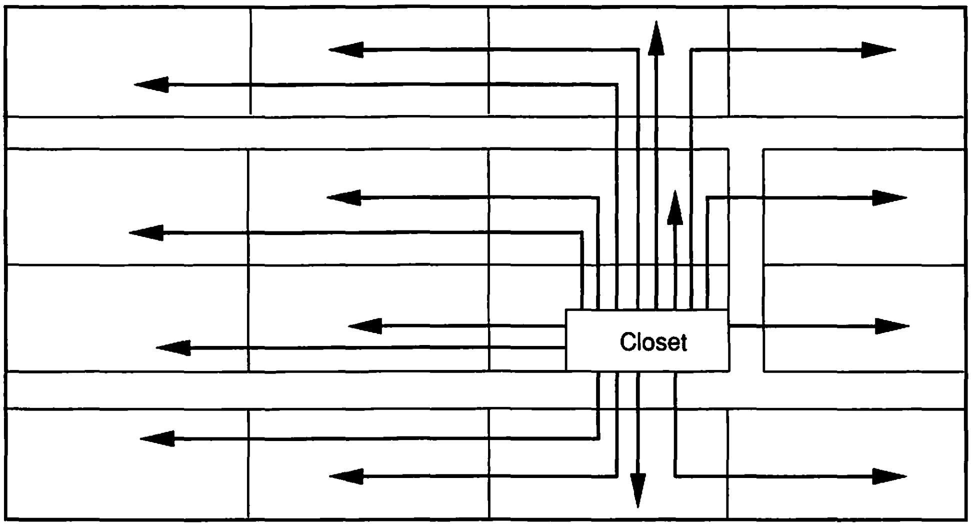

Figure 5-13 Typical phone system wiring.

The extra wires from the phone system do not support a daisy-chain topology with wires running from one office to the next. Instead you have a separate pair of wires running from each office to a central telephone closet. If you could use AppleTalk in a star topology, where all wires emanate from one point and each connection has its own dedicated pair, the topology would replicate exactly the sort of wiring that is the basis for telephone systems.

We mentioned earlier that a *trunk with drop* topology became possible only after the PhoneNET connectors were released. This topology became possible when the actual wires of the network were put into

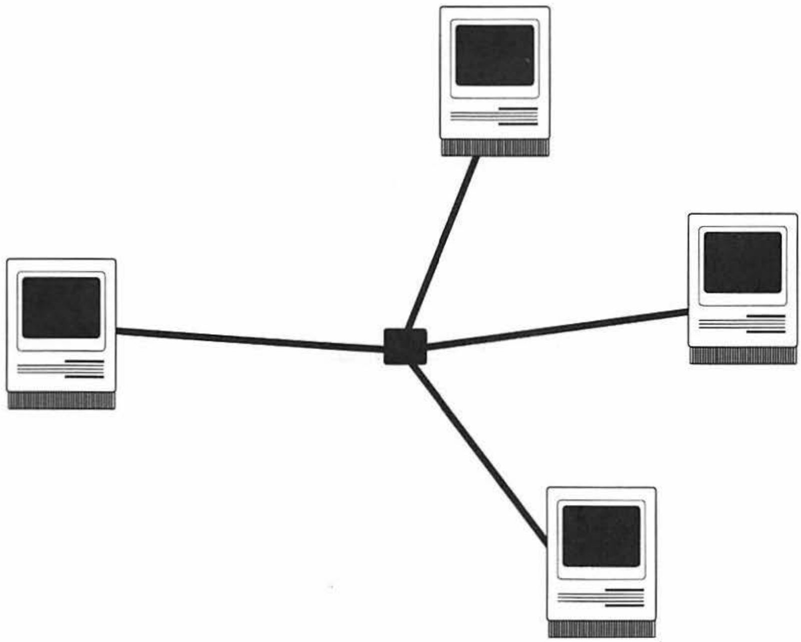

Figure 5-14 Star topology.

the hands of the users. The wiring itself is common, readily available, nonproprietary cabling.

This solution works because you can create a data path between all the nodes so the signals reach all nodes. By terminating the network properly and staying within length restrictions, the signal is strong enough to be recognized by each node. In the same way, you can create a star topology using your existing phone wires. Let's examine the wiring of a typical phone closet.

For every room you want to network, an individual pair of wires comes to the phone closet. The unused wires are not hooked to each other. By taking another two wires and joining all the pairs together, a topology very similar to a star is created. In actuality, a very short bus within the phone closet is created with a number of very long drops off of each, going to one of the rooms to be networked.

We have again created a signal path, a way of getting a signal from any one node to all of the other nodes. If you trace a signal now from

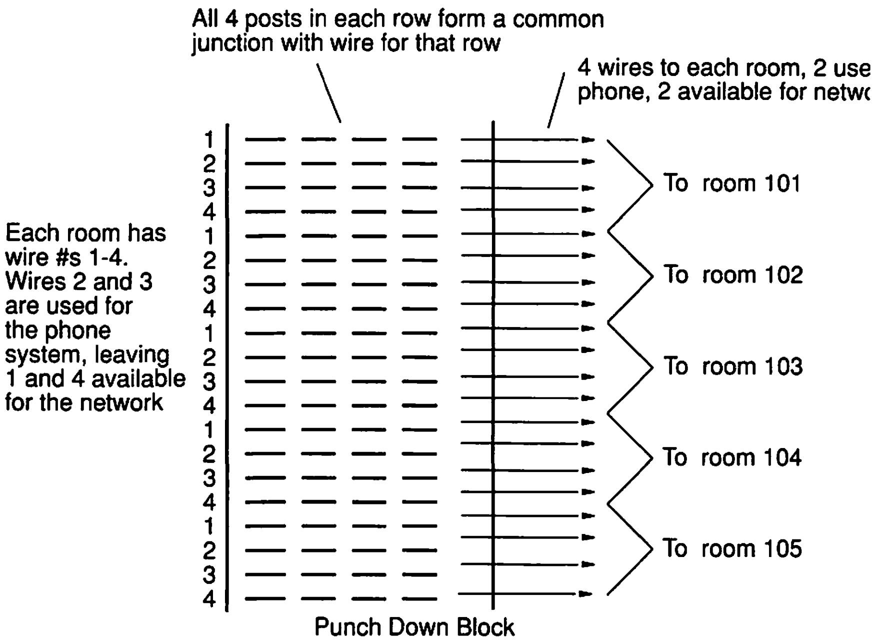

Figure 5-15 Wiring, typical phone closet.

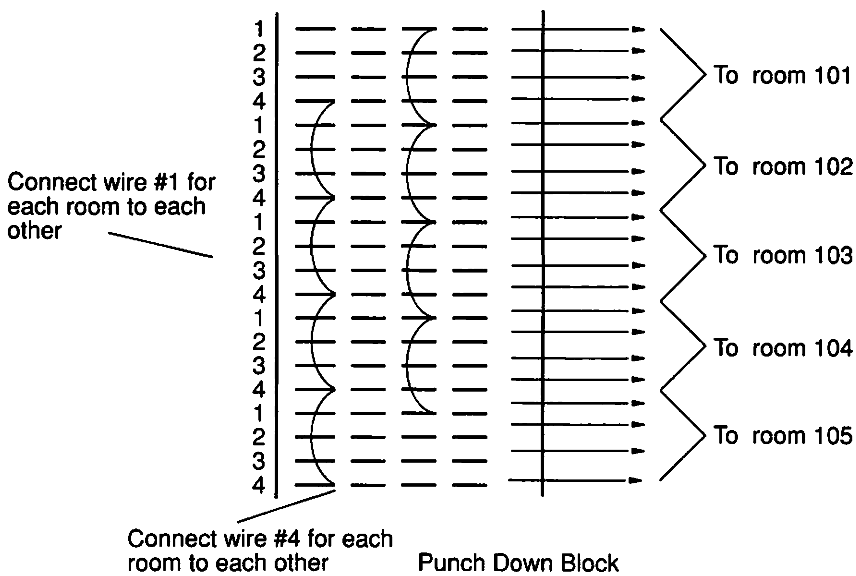

Figure 5-16 Network wiring using the phone system.

a Macintosh sitting in an office, it goes back along that office's pair of wires, to the phone closet, splits up in both directions along the short trunk and then goes out along each of the pairs of wires to each individual office.

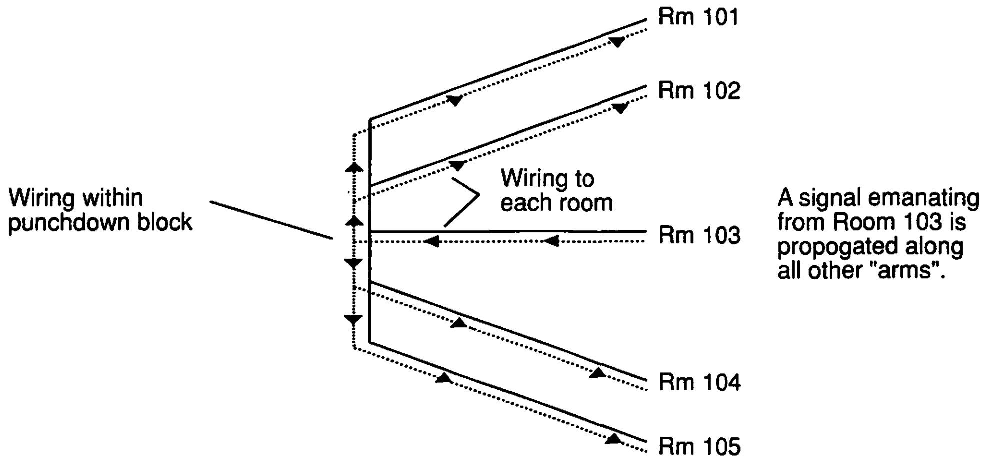

Figure 5-17 Network signals along a passive star.

This topology is exactly what we warned you to stay away from in configuring a *trunk with drops.* This topology has long drops, or arms, off a small trunk. This topology is similar to a star but it's not a true star because it doesn't emanate from a point. These drops are certainly of significant length in comparison to the trunk; the trunk may only be 12 inches long.

This scheme will only work if the number of arms is kept to a minimum. If, for instance, you had 30 arms off of this short trunk, it would be almost impossible to achieve good results. If you want to try this wiring scheme, follow the same rules we set up for terminating a trunk network. Keep the number of arms to a minimum and pick the longest arms and terminate them. Terminate no more than four arms. Keep the total length of all arms to less than the maximum length specified by the wiring. Farallon now recommends that passive stars not have any more than four arms; anything more complex needs a multiport repeater at the hub.

This topological configuration is referred to as a *passive star.* It is "passive" in that there is no active device generating clean signals along each of the arms. The signal is generated at one of the nodes, passes back to the phone closet, and from there is split up along all the arms. You must take care that your signal does not degrade to the point where it is unrecognizable at nodes along the other arms. *A passive star is not a recommended AppleTalk topology.*

There are situations where this passive star approach will work. If these rules are followed, this scheme will usually work when networking at most six or eight offices. The scheme does not lend itself well to expansion of the network. When it works you will be able to hook up six to eight offices using existing wiring, minimizing the cost of installing the network.

Using Repeaters and Multiport Repeaters

In summary, the preferred topologies for AppleTalk networks are either

1. A true daisy chain—daisy chains are simple to terminate, but can be difficult and expensive to implement across many rooms.
2. A trunk with drops—you can only create a trunk with drops using phone-wire-based cabling schemes. The drops must be kept to a minimum length, short in comparison to the length of the trunk, preferably with just one node each.

We have shown how to terminate each topology. We have also discussed topologies based on phone wiring and how to terminate these networks. The topology required is largely determined by the physical layout of the network.

What are the options, then, if your required topology isn't supported? There is a simple approach that can accommodate any physical layout if you are creative and responsible with its implementation. Hybrid topologies can be created by joining different electrical buses, not passively, but actively. To create such active electrical devices, you need devices like a repeater available from TOPS or Farallon, or a multiport repeater available from Farallon or Nuvotech. These devices allow you to pass signals from one electrical bus to another.

It is very important to recognize, as we discuss repeaters and multiport repeaters, that we're covering options *not for creating new networks, but for creating additional electrical buses, the sum of which is* *a single network.* It is crucial to understand that termination is not network-based—it's an electrical phenomenon. Termination must be applied to each electrical bus.

You can use a repeater for two reasons. First, you can connect two electrical buses together at their ends to overcome length restrictions on the network. Secondly, an electrical bus can be created within an existing bus, creating a branch.

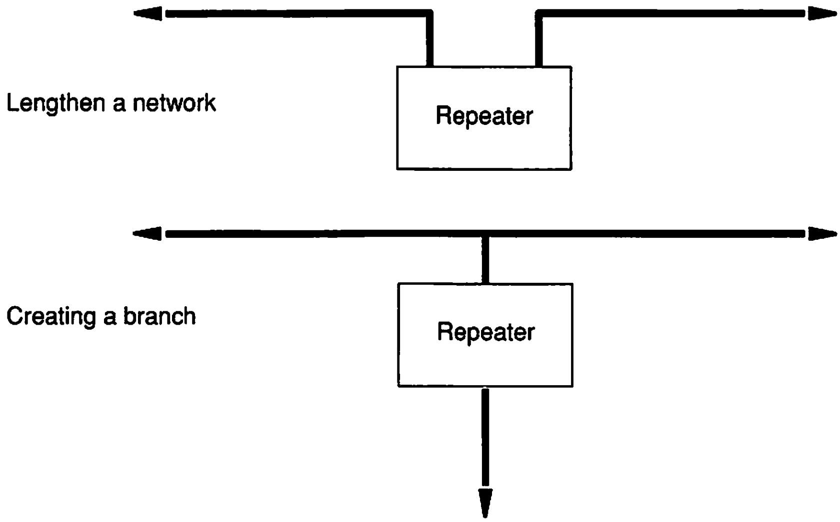

Figure 5-18 Uses of a repeater.

Let's consider how you might get around a length restriction. Perhaps you want 2,000 feet of LocalTalk cabling or you want to extend the length of your PhoneNET network. You may place a repeater at the end of the daisy chain of the trunk, use it as the end of one electrical bus, and hook it up to another electrical bus. The repeater will join two electrical buses together to form one network. Each of those electrical buses has its own electrical characteristics, its own length limitations, and will need to be terminated independently.

A similar approach may be used with a trunk topology. Perhaps you want to create a longer trunk than would normally be allowed. Use a repeater to join two trunks together. As long as each trunk is within the length restrictions, devices on either trunk will be able to communicate with each other.

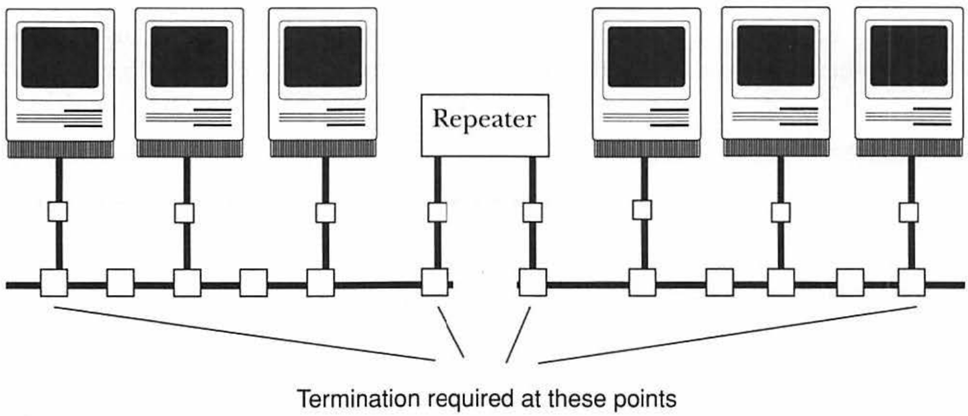

Figure 5-19 Extending the length of a network.

Using a repeater is a popular way of getting around the length restrictions of your chosen cabling system. You may also circumvent topological restrictions with a similar approach. But putting a repeater along a daisy chain causes regeneration of that same AppleTalk signal at the other side of the repeater. This allows you to create a branch off of the daisy chain even with LocalTalk connectors. Thus, a topology not inherently supported by the LocalTalk connectors is possible with the simple addition of a TOPS or Farallon repeater.

With trunk topologies, we discussed keeping the length of any side chains off the trunk to a minimum. If you must create a long side chain, you can do so safely with a repeater. You can simply plug a phone cable into a wall box and connect it to a repeater. From the other side of the repeater you can regenerate a full-strength AppleTalk signal and create a whole new electrical bus. This new bus can extend the full maximum network length without causing performance problems. Along that length you can place a number of devices (determined by type of cable and connector) and you must terminate the electrical bus. The repeater is the link allowing communication between the two buses. Also remember that you're not creating a new network here. You're simply connecting two different electrical buses and combining those to make *one* network.

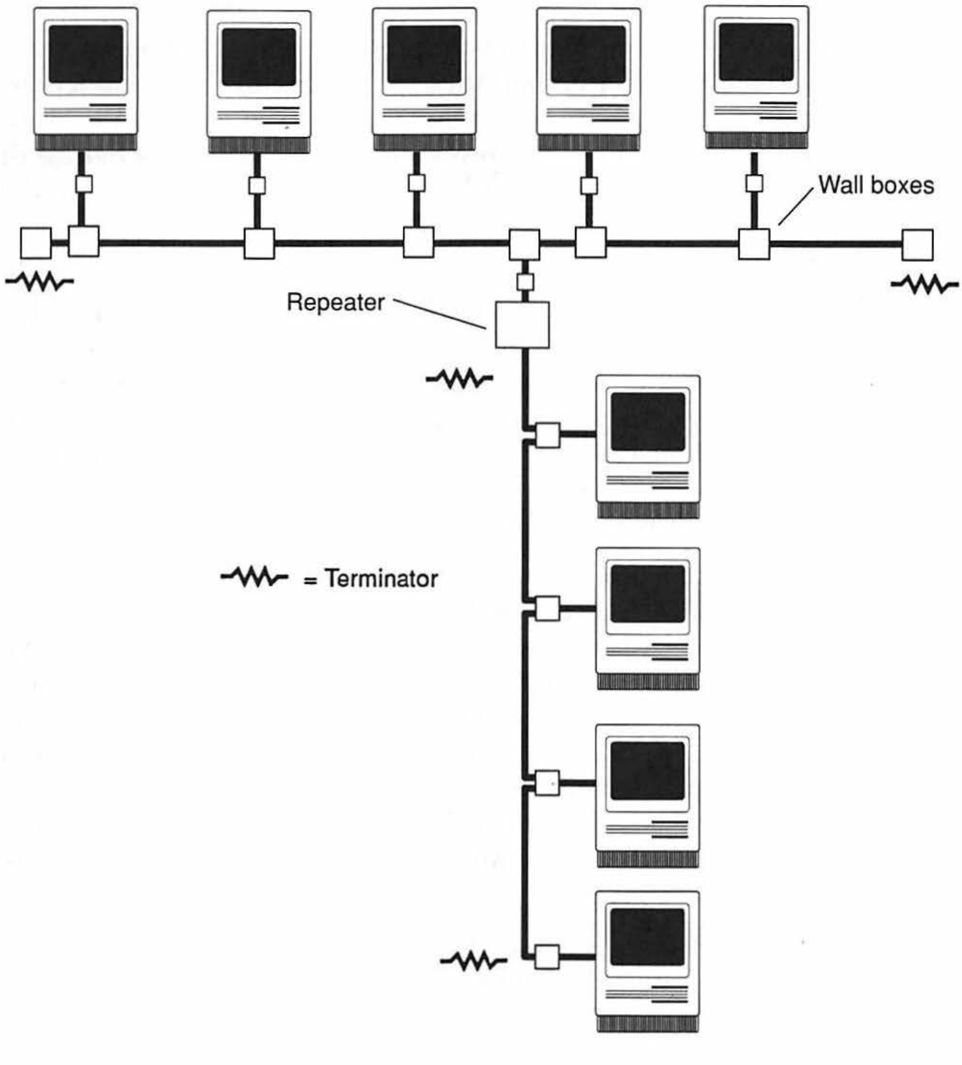

Figure 5-20 Creating hybrid topologies.

Repeaters can also be used to circumvent limits on the number of devices that can be supported. Apple's LocalTalk cabling scheme recommends no more than 32 devices per electrical bus. These restrictions are not imposed by the AppleTalk protocol; the protocol will support up to 254 devices per network. The limit of 32 is merely a function of the signal loss through the LocalTalk connector boxes and through the wiring between connector boxes. By using a repeater, you can join together separate LocalTalk electrical buses, each of which can support these 32 nodes and some length of wiring. This enables you to get closer to that true protocol limit of 254 devices. Remember, however, that due to the low bandwidth of AppleTalk, with any significant activity on the network, you're not going to be able to realize placement of 254 nodes without having poor performance.

Specifications for the maximum network length and number of supported devices are based on electrical characteristics of the wiring and the connector boxes. The maximum specifications represent approximations, and can vary greatly depending on the quality of the wiring and the topology used. Observing these limits minimizes signal degradation, assuring the signal will be understandable when it arrives at any node on the network.

The restrictions are determined by testing for signal loss both through the connectors and along the cable. The signal loss per foot of the cable is based on the resistance of the wire and is critical in determining maximum network length. With phone wiring, this signal loss is very much dependent on the gauge of the wiring. For example, 26-gauge telephone wire, the narrower gauge typical of the flat, modular telephone wiring, can only reach a much shorter length, probably only about 1,000 feet. For 22-gauge, round telco wire, which is the typical wiring installed in buildings, you can probably reach 4,000 feet.

Active devices, such as the repeater, afford ways to create many topologies safely, in an electrically sound manner. The other device used in this capacity to create many electrical buses and facilitate communication between them is called a *multiport repeater.* They are available from both Farallon and Nuvotech. It acts as a central point, a true star, and using all 12 ports will support 12 electrical buses.

Suppose you have 12 different offices you want to hook up in an office building and you want to use existing wiring in a star configuration. In our previous discussion of the passive star topology, we cautioned you about the reliability issues involved in networking 12 offices via a passive star. The star controller allows you better reliability. Placing a multiport repeater at the hub provides 12 electrically separate buses, each of which is then subject to the cabling restrictions based on the gauge of wire used.

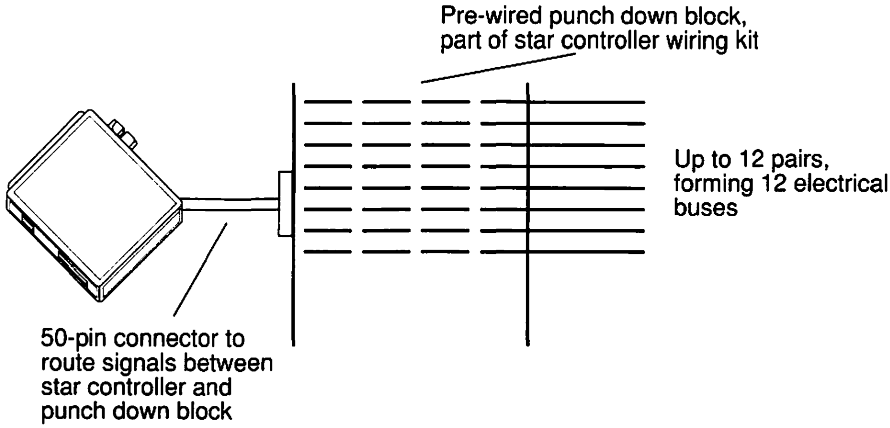

Figure 5-21 Star Controller.

This configuration allows, then, from 1,000 to 3,000 feet of network length along *each* of the 12 arms. Now you can connect offices very far away and you can safely support more than one device on each arm. Each arm could be a daisy chain of devices. This is the recommended method for networking in a building using the existing wiring. Rather than using a passive star topology, install a multiport repeater in the phone closet.

To summarize,

- Each of the 12 arms of a multiport repeater supports the maximum number of devices and the maximum length of cable based on the type and gauge of the wiring.
- Each of those 12 arms is a separate electrical bus connected at the multiport repeater and signals are regenerated at full strength coming from any one port and going to each of the other 11.
- Each of the 12 must be terminated separately.

The end of each electrical bus at the star controller is terminated within the star controller. Terminate each arm by placing a terminator at the last machine in the daisy chain on that arm. This is a very simple, safe way of guaranteeing good communications along a star configuration, while making use of existing wiring, and preserving the low-cost advantages of AppleTalk.

Choosing Your Cabling

Once you've chosen your bandwidth and topology for the network, you must choose from among the different cabling options available. Depending on the bandwidth and topology, you may have only one or a few choices for network cabling.

LocalTalk

These are the cables originally released as AppleTalk, now called LocalTalk, from Apple. It is a fairly expensive cable, at an average of $1.50/foot. It is a proprietary Apple design, though cloned cables and connectors are now available. The cable is sold in connection kits with the connector and one three-meter piece of cable. There are also 10-and 20-meter cables sold individually and Apple sells a custom-wiring kit with a couple hundred meters of cable and hardware for you to make your own custom cables. LocalTalk is self-terminating, which is very convenient. One of the reasons it can be self-terminating is because it's fairly restrictive in terms of topologies. The connector box of course has two ports on it, using a mini DIN 3 type of cabling. To make the physical connections, you simply attach a cable between every two nodes in a daisy chain fashion.

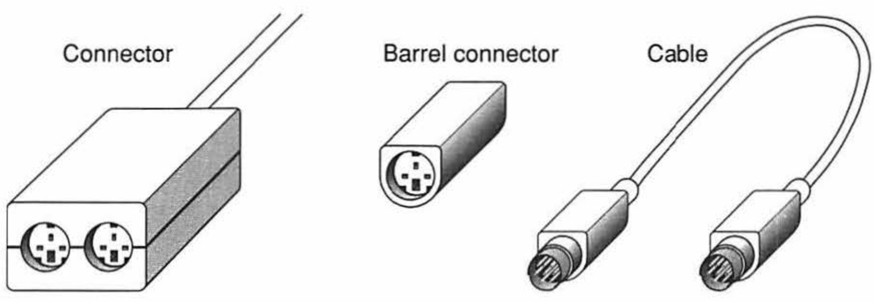

Figure 5-22 LocalTalk connectors and cable.

LocalTalk cables are self-terminating because there is, in fact, a resistor attached to each and every port within the connector. If you plug a cable into a port, the resistor is disabled.

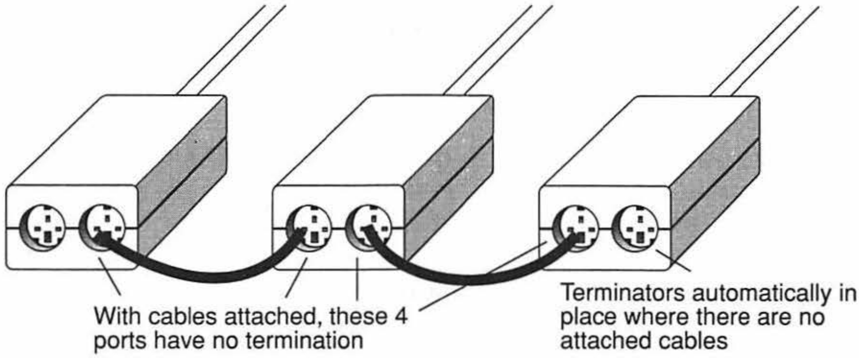

Figure 5-23 Self-termination with LocalTalk.

Suppose you have a small network of three computers hooked up in a daisy chain using LocalTalk cabling. The connector in the middle has a cable going in each direction to the connector on either side of it, filling both ports and hence disabling both resistors. At the two outside network connectors, however, only one of the ports is connected, leaving the second port unconnected and thus terminated. The network is thus terminated for you.

Even if you use a repeater to create a topology other than a daisy chain, the network is still automatically self-terminated. That's a significant advantage.

What are the disadvantages of LocalTalk?

- You are restricted to a fairly short network length: 300 meters at standard AppleTalk rates, less than that by a third at FlashTalk speeds.
- The cables tend to slip out of the connector box with the old cables that did not lock into place. They tend to slip apart, causing a break in the network. When Apple renamed the cabling LocalTalk, the new release of the connector box was changed to include a locking mechanism so that the cable locks into the connector.

- LocalTalk cabling also lacks topological flexibility: The only supported arrangements are daisy chains. By adding a repeater you can vary that topology slightly, but you are still dealing with a fairly restrictive topology and length specification.

LocalTalk is, however, very easy to use and install. Not being able to implement trunks with drops, passive stars, or even active stars keeps the network termination simple.

Another disadvantage of the LocalTalk cabling scheme is the proprietary nature of the cable. Besides the cable itself being expensive, it is also not found installed in buildings. To network a large workgroup, which usually means running network cables from room to room, you've got to bring in a professional network installer and run the cable up through the walls. The installation cost when any network cable needs to be run through existing buildings can be prohibitive.

Phone Wiring

The most popular cabling for AppleTalk networks is a phone-wire-based system originally introduced by Farallon as PhoneNET and then replicated many times over by various companies. The advantages of this twisted-pair cabling are that the cable is common. You find it already installed in buildings (albeit in a star configuration), and you can buy the cable and accessories like modular jacks in bulk very inexpensively. The cost is $0.10/foot or less at Radio Shack or a telephone store.

The PhoneNET-style approach allows you to easily access the wires. There are wall boxes and wall plugs and all sorts of other accessories commonly produced for telephones, that are readily available, for installing your network. You can easily assemble RJ-11 connections along a trunk or implement a trunk with drops configuration.

Phone-wire-based networks offer a number of advantages:

- You can get in and build your own custom-network topology (including stars) much more easily than with LocalTalk cabling.
- Unshielded phone wiring, especially lower gauges, has a lower resistance per foot of wire than LocalTalk, so you can go longer dis-

tances. With standard AppleTalk rates of 230 Kbaud, a backbone topology, and 22-gauge wire, you can go 4,500 feet. If you use all flat modular 26-gauge cabling and a daisy chain topology, the maximum is 1,800 feet.

- The total cost of installation is generally much less because the cost of the cable is less, and you may not have to run much cable because it may already be installed in the building.

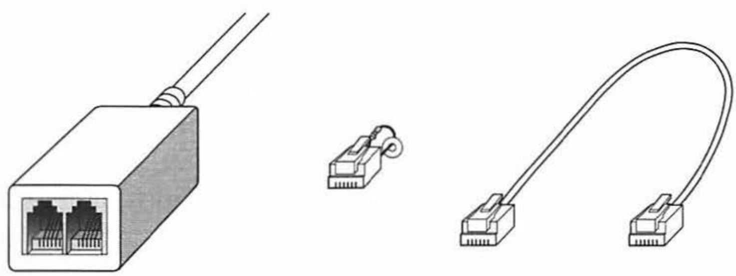

Figure 5-24 Phone wire based connectors.

It is important to note that the distances specified are at standard AppleTalk data rates of 230 Kbaud. With faster-speed networks like FlashTalk, your maximum distance is inversely proportional to the frequency at which you're operating. This means the higher the data rate, the lower the distance over which those signals can travel.

The disadvantage of twisted-pair cabling is that its not self-terminating. With PhoneNET, Farallon supplies the proper resistor mounted on an RJ-11 plug along with each PhoneNET connector. You take one of these resistors and you plug one into the connectors at the two ends of a daisy chain and you're terminated. But, when you get away from a simple daisy chain and go to almost any other topology, you're going to have any number of available places to terminate the network. Only some of these places, of course, are appropriate for termination.

Improper termination is by far the leading cause of network problems with phone-wire-based systems. If you don't put any terminators in at all (which you may expect is normal if you're familiar first with LocalTalk cables) you also run into problems because this leaves you with no termination whatsoever. It is very easy to over-terminate, or mis-terminate with PhoneNET topologies other than a daisy chain.

Nuvotech has released a connector based on phone wiring that is self-terminating, yet is still based on phone wiring and supports all topologies. This connector could eliminate the one major drawback of phone-wire-based networks. Another note of caution is in order with reference to PhoneNET systems. Farallon originally released a connector called PhoneNET. About a year later they replaced it with PhoneNET Plus. The difference is in the electrical circuitry within the connector itself. The older connectors contain transformers with somewhat inferior rise and fall times. The newer connectors provide a cleaner signal as it goes through the connector and also support higher-speed AppleTalk configurations, such as FlashTalk from TOPS. The older connectors do not support higher-speed AppleTalk configurations.

Nuvotech connectors, PhoneNET Plus connectors, and TOPS Teleconnectors all support high-speed AppleTalk. If you plan a high-speed AppleTalk installation and are considering another connector, be sure to check with the manufacturer first. There are many clones of the Farallon PhoneNET Plus; however, only some support the higher data rates.

Fiber Optics

In addition to LocalTalk and the many phone-wire options available, there is a system for fiber optic transmission of AppleTalk signals. duPont developed this system for in-house use and is now marketing it to the AppleTalk community. Fiber optic LANs rely on transmission of light pulses to represent the ones and zeroes that make up the bits in the data packets.

The Macintosh still generates electrical signals through the printer port or serial port on the back of Macintosh. The connector box for the duPont system consists of an electro-optical converter that attaches to the printer port of the Macintosh and generates a light signal equivalent to the electrical signal the Macintosh generates. These signals then pass through glass fibers to the next connection, or a concentrator. The concentrator is equivalent to a Farallon StarController

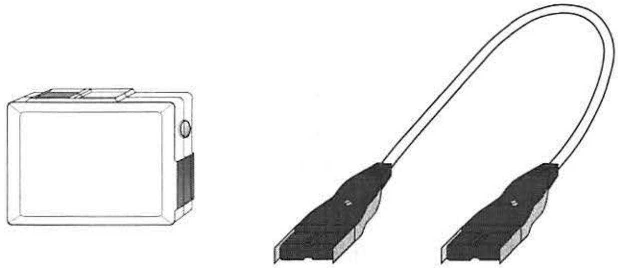

Figure 5-25 Fiber optic connectors and cables.

in that it supports a star topology, but it has only eight ports. The concentrator also has electrical output for connecting to an electrical-based LocalTalk or PhoneNET network.

The primary disadvantage of fiber-optic networking is the cost, at $250 per connection, compared to LocalTalk or PhoneNET connectors at about $75 each. Add the price of the cabling and installation, and fiber optics are well over $300 per node. It will, of course, have to be custom-installed because fiber optics are not found already placed in buildings. The cables have to be cut into specific lengths, or bought in specific lengths from duPont—you can't go splicing together glass fibers.

Why might you want to use such a fiber-optic AppleTalk implementation?

- It supports long distances, about 5,000 feet of wire between nodes.
- Termination is not a factor since the network transmissions are not electrical in nature.
- The fact that you can't readily splice it together is actually one of the advantages claimed by proponents of fiber optics. It is inherently more secure for data sensitive applications, since one cannot splice into the cable and capture data off of the network, though if the sheath is stripped away, enough of the light will emanate to capture and interpret signals.
- Being optical-based rather than electrical-based, the signals are not susceptible to interference from other electrical phenomenon such as FM transmissions, power cables, or other telephone-based sys-

tems. An optical-based system may avoid potential sources of interference inherent in your environment.

The following figure compares the advantages and disadvantages of the cabling options discussed in this section.

Cabling Type	Advantages	Disadvantages
LocalTalk	Inexpensive Connectors Easy to Install/Work with Self-Terminating Cables Shielded for noise immunity	Relatively expensive cabling 1000 ft length restriction Only support daisy chains Old connectors don't lock cables Non-standard cable—not found installed in buildings
Phone Wire Based	Inexpensive Connectors Inexpensive Cabling Flexible Topologies - Bus, Daisy Chain, Star Cables Lock into Connectors Cable, Tools, etc easy to find Easy to make custom cables Suppports longer distances Commonly found installed in buildings	Manual termination required for most implementations Relatively easy to configure unreliable installations
Fiber Optic	Expensive Connectors No need for termination No need for termination Long Distances allowed Supports Daisy Chains and Stars	Expensive cabling Immune to noise Requires custom installation

Figure 5-26 Comparison of common AppleTalk cabling schemes.

Creating an Internetwork

An internetwork is created when a number of networks are connected together, as opposed to extending a single network with repeaters and multiport repeaters, combining a number of electrical buses into one topologically complex network. Internetworking provides a means of communicating between networks.

It is important to understand the two key devices in creating an internetwork: a bridge and a gateway. Rather than define them in terms of layered protocols, as a network purist might, the definitions here reflect their function in the AppleTalk world.

Bridges

A bridge is a device that connects two like networks. Bridges available that connect two different AppleTalk networks together include the Hayes InterBridge, the Solana I-Server, and the Shiva NetBridge. A bridge allows a network on one side to communicate with another, but it prevents unnecessary duplication of information on the networks. A bridge monitors all network traffic on both networks and only when a device on one side of the bridge tries to communicate with a device on the other side of the bridge does the bridge pass the information from one network to the other. In this way, the bridge acts as a data filter between networks.

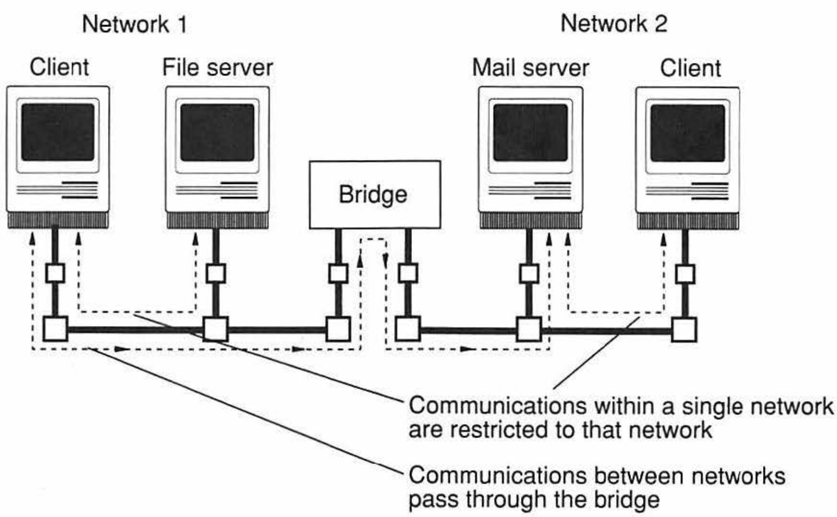

Figure 5-27 Network bridge.

When might you want to use a bridge? A bridge would be used for three reasons:

- To accommodate a large number of users on an internetwork or to take an existing network and break it into two connected networks to preserve or enhance network performance. This configuration was referred to in the section on choosing the speed for your network, as an alternative to higher bandwidth networks. This option works best when network traffic consists of too many small tasks rather than a few very intensive tasks. Breaking a network in two with a bridge will only enhance network performance if network resources (printers, file servers, etc.) can be provided for both networks.

- To join two existing networks together without degrading network performance.
- To create an AppleTalk backbone for routing data between AppleTalk networks.

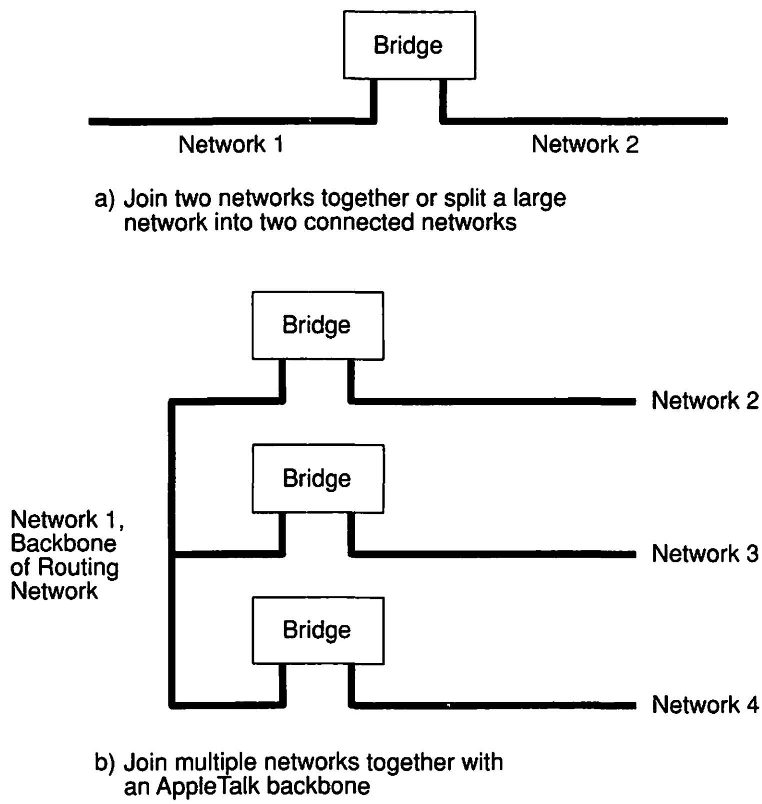

Figure 5-28 Use of a network bridge.

Gateways

While a bridge connects two like networks, a gateway connects two unlike networks, using two different protocols. The most common example of this for AppleTalk is the Kinetics FastPath, which is a gateway between AppleTalk and Ethernet. The FastPath takes AppleTalk packets and turns them into EtherTalk packets. EtherTalk is a protocol derivative of the AppleTalk protocol that defines packets containing AppleTalk information, which can travel on an Ethernet-based physical network. It enables AppleTalk applications to communicate over Ethernet physical schemes.

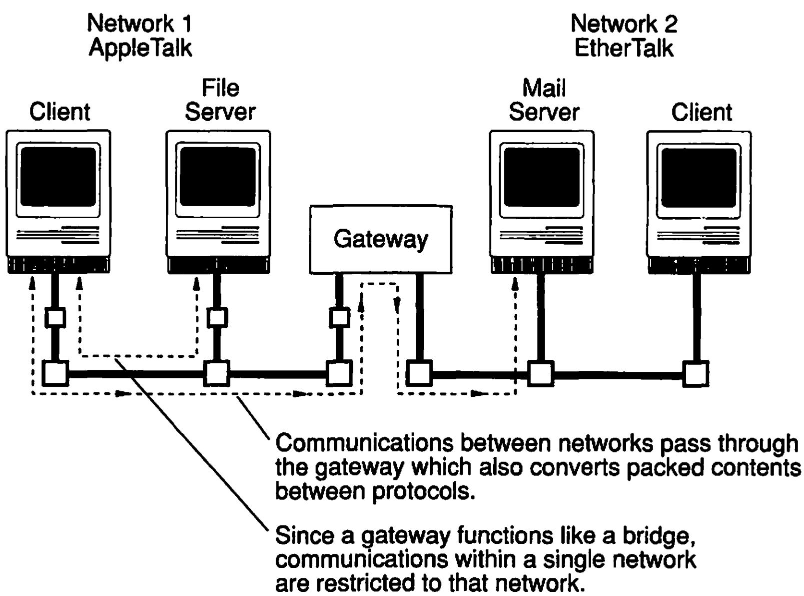

Figure 5-29 Network gateway.

This gateway is used for two reasons:

- To communicate to an EtherTalk device that is directly connected to the Ethernet network. For example,
  - — another Mac with an Ethernet card in it;
  - — a Sun workstation running with TOPS file-server software; or
  - — a VMS machine running AlisaTalk AppleShare software.

- To use the Ethernet as a backbone to route packets between AppleTalk networks. The Ethernet would then only be serving to route packets from one AppleTalk to another AppleTalk network.

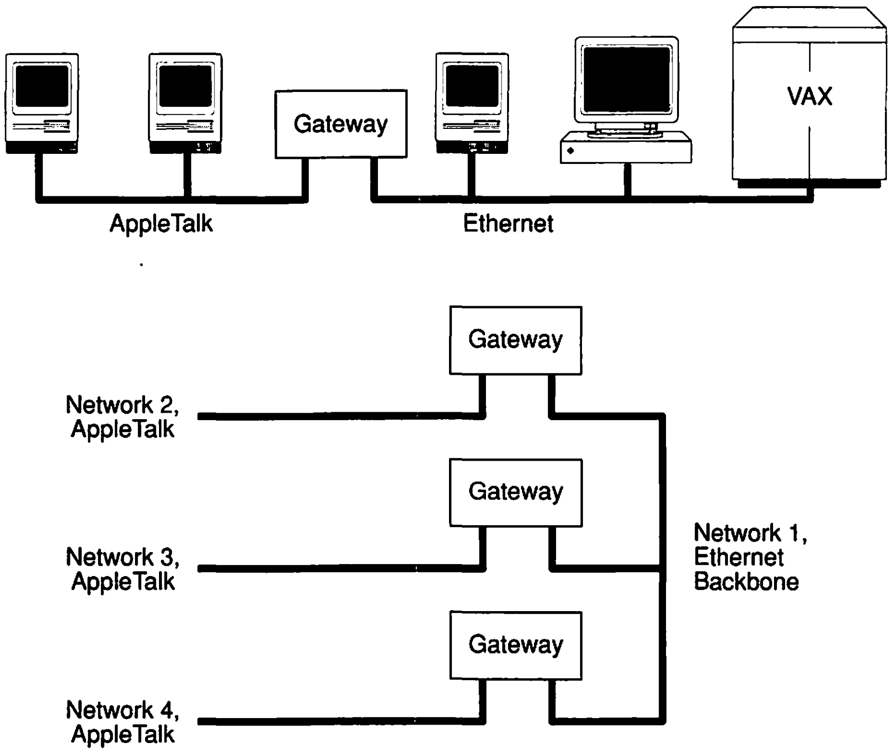

Figure 5-30 Uses of a network gateway.

Why would you want to create such a "backbone" arrangement? To virtually guarantee that you will not bog down the backbone with internetwork communications. Because that backbone operates at a much higher speed that AppleTalk, there is plenty of available bandwidth.

If you have an Ethernet network already installed at your facility and you want to connect two AppleTalk networks that are located remotely from each other, you could use existing Ethernet cable to form a backbone between the two.

When you use a bridge or a gateway, you're creating different networks in addition to separate electrical buses. This gives you the opportunity to define zones at the network boundaries. We talked about zones in a previous section. The zone feature of AppleTalk lets you go to larger and larger networks without making them seem more and more complex. The use of zones shields the user from the size and complexity of internetworks by taking what might be an unending number of network services and devices and managing their availability.

Choosing Network Peripherals and Software

Once you've selected the bandwidth, topology, and cabling for your network, adding network peripherals and network application software is normally quite simple. In Chapter 10, we compare and contrast the available choices for both network hardware and software.

Chapter Six

Network Design Examples

In this chapter, we will examine the topological and design evolutions of the in-house networks of some major vendors in the AppleTalk networking arena: TOPS, A division of Sun Microsystems, Shiva, Farallon, Kinetics, and, finally, the on-site topology and cabling of a MacWorld show. These are interesting case studies because they reveal much about how the "rules" are established in real time by the companies who originate the technology.

TOPS, A Division of Sun Microsystems

TOPS, A division of Sun Microsystems (formerly Centram Systems West), has occupied three different physical locations since 1986. Reflecting both the physical characteristics of the three different locations and the evolution of the company, its staff size, and its users' needs, the network has gone through three distinct development phases, with many subphases within the three major evolutions. The TOPS "pattern" is fairly typical of what a lot of companies go through. As the business grows and changes, their network needs range from small to large, and from relatively simple to fairly complex.

Ellsworth Street

In its original location, Centram Systems West was located on Ellsworth Street in Berkeley, California. The physical site was a series of four or five offices, open space, and a conference room. Centram employed less than than 15 people while at the Ellsworth location. Centram's first network used the only available cabling—AppleTalk. This meant the topology had to be a daisy chain. There was just one network at the Ellsworth site. Bridges were not available at the time.

In terms of network use, Centram was doing some fairly typical things: printing to a Laserwriter and using TOPS for file transfer and file service. The devices on the network included Macs, PCs and Laserwriters. This is typical of the way most things start out. The cable simply threaded through the walls, going from one computer to the next.

Parker Plaza Phase One

Having outgrown the Ellsworth location, Centram moved to Parker Plaza. The physical space in Parker Plaza consisted of one suite that had, basically, two large rooms and a handful of offices. The space occupied two different levels.

While the Ellsworth network was so small that it had not needed much design attention, Parker Plaza demanded some basic thinking about how the space would be used and where the users would be located. Although the staff size was still small when Centram moved to the new location, they anticipated substantial staff growth and planned accordingly. The network design chosen was based on a trunk. This trunk network used phone wire (which had become available in the interim) and PhoneNET connectors (from Farallon Computing).

Centram started this network by laying a long trunk. It started in one corner upstairs, went through the upstairs offices, and then traced along the perimeter of both large rooms. It was terminated at both ends, providing one long electrical bus with phone/wall jacks spaced about every ten feet along the network. This perimeter-style trunk was the backbone.

When Centram first moved in, the staff size didn't make many demands on the network design. People were basically stationed along the perimeter. Users would just drop a phone cord from the wall box over to their machine. Or, if they had two machines they would form a little side chain off the trunk. For the most part, experienced staff helped new staff get set up on the network. It was very straightforward and, as with the TOPS product itself, essentially democratic.

Within engineering, there was a second network terminated at both ends. It was installed specifically so that the engineers could test TOPS with bridges and internetworking, in anticipation of these additional network pieces becoming available.

In general, the network was terminated internally—the termination was built into the wiring in the wall boxes at the ends of each net. The intention was to keep the side chains short in comparison to the trunk so that terminators on the side chains would not be neces-

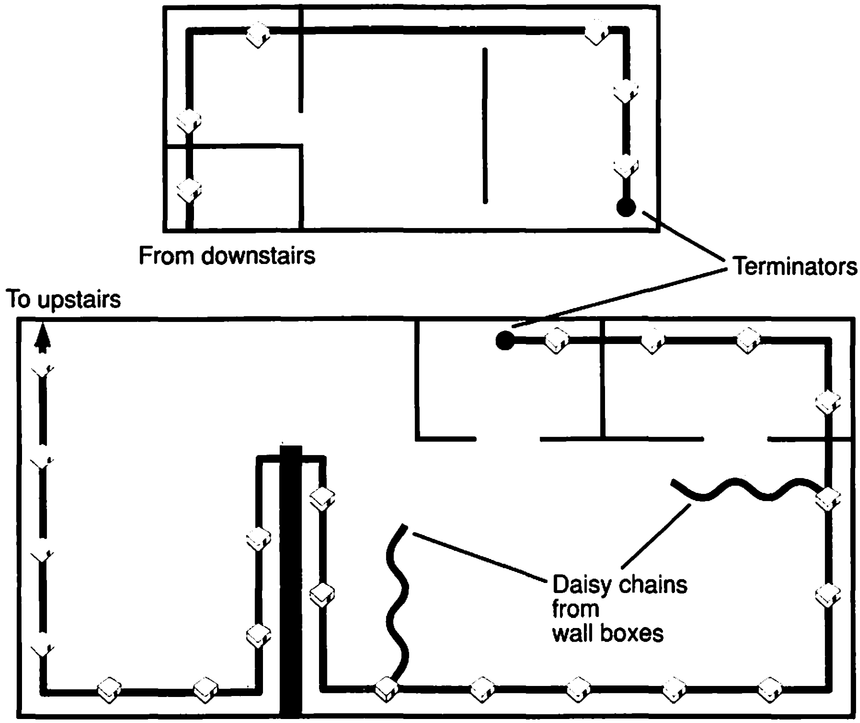

Figure 6-1 TOPS/Parker Plaza phase one.

sary. The idea was that people would take one or two machines at most and hook them together and into one of the wall boxes.

At this point in TOPS' development, they were doing file sharing, printer sharing, starting to experiment with VAX and UNIX machines, and experimenting with bridges from third party companies to test internetworking. At the same time, the Repeater and the FlashBox were under development.

As more and more people came into TOPS (the head count got to 40–50 people in this space), the side chains started to get longer and longer. Cubicles were built out from the walls, extending into the space, so the side chain became a long daisy chain through the cubicles. This led to some problems, mainly because of the length of the side chains. Another contributing factor was the quality of wiring installed for the trunk; an inferior gauge was mistakenly used.

At this point, terminator proliferation began and network administration became a real nightmare. People would try to fix the problems themselves by taking a terminator out of their drawer and putting it into an available slot on their network connector. One of the biggest problems with a network of this design is that, although it is convenient because you can put wall boxes anywhere and reconfigure the net by plugging devices in and out, administration can be very difficult. Troubleshooting is not straightfoward because network problems don't necessarily occur at the source of the misused terminator.

If a user at one end of the network put a terminator in the wrong place, their problem might go away, but someone on the other end of the network could develop a problem. Then they start looking in their area and are tempted to put their own terminator in. At that point in TOPS' evolution, isolating the problem required someone from technical support. TOPS didn't have a designated network administrator at the time. So someone from technical support would have to essentially walk the entire network looking at every connection to see if it was hooked up properly.

One of TOPS own products came out of development and quickly improved this rapidly deteriorating situation. The TOPS Repeater afforded a "legal," reliable way of hooking up long side chains to a trunk. The combination of proper termination and the Repeater allowed this topology and configuration to function very well. With the introduction of Repeaters, instead of having one large electrical bus, there were now a number of interconnected electrical buses, all of which require independent termination. So now the terminators weren't hidden—just placed in "mysterious" places that the nontechnical people couldn't really understand.

At about the same time, TOPS' continuing expansion pushed the need for physical space from one to three suites.

Parker Plaza Phase Two

Phase two began a new era for the TOPS network. They installed a "machine room" in one corner of the third suite. It contained VAXes, Suns, and other hardware, mostly related to development. In addition, the trunks that serviced the rest of the net all began and ended there. The internetwork across the three suites consisted of one network for each suite, and was divided into two zones. Suites 216/218 comprised one zone and Suite 220 the other zone.The original suite (Room. 220) was in its own zone, while the other two networks (Rooms 216 and 218) combined into a second zone. Conveniently, each network was designed so it began in the machine room, wound through the suite, and returned to the machine room.

To facilitate communications between the networks TOPS used Hayes Interbridges to communicate between the AppleTalk networks. A fourth network was configured to serve as a backbone, or routing network, between the other three. This routing network physically existed only in the machine room and only between Interbridges. The routing network also contained one FastPath as a gateway from AppleTalk to Ethernet. Ethernet existed only within the machine room, for the interconnection of Suns, VAXs, and Pyramid machines.

Within each network the topology was similar to that of the original suite—periodically spaced wall boxes, with either one machine or a very short daisy chain attached. Repeaters were used to connect long daisy chains. The Interbridges were eventually replaced with FastPaths to allow the higher speed Ethernet to be the backbone rather than the lower-speed AppleTalk backbone in use previously.

At this point, TOPS was making use of the full range of AppleTalk services: There were Laserwriters on each network, distributed file service with TOPS throughout the internetwork, and centralized, secure servers on the VAXes and the Suns. TOPS started with Intermail for e-mail service among Macintoshes and eventually moved to InBox for two reasons: better performance and the capability for MS-DOS connections. Net Modems were also in use on the network.

Two different testing lab areas existed, housing a wide variety of cabling, hardware, and software. These test areas were also connected into the main net. To accommodate development projects, Ethernet was extended throughout the engineering area. Development projects included EtherTalk for the PC, and people were getting Sun workstations (which require Ethernet) out in their cubicles. People were also starting to add Ethernet cards to their Macintoshes. Also under development was an implementation of TCP/IP on the Mac

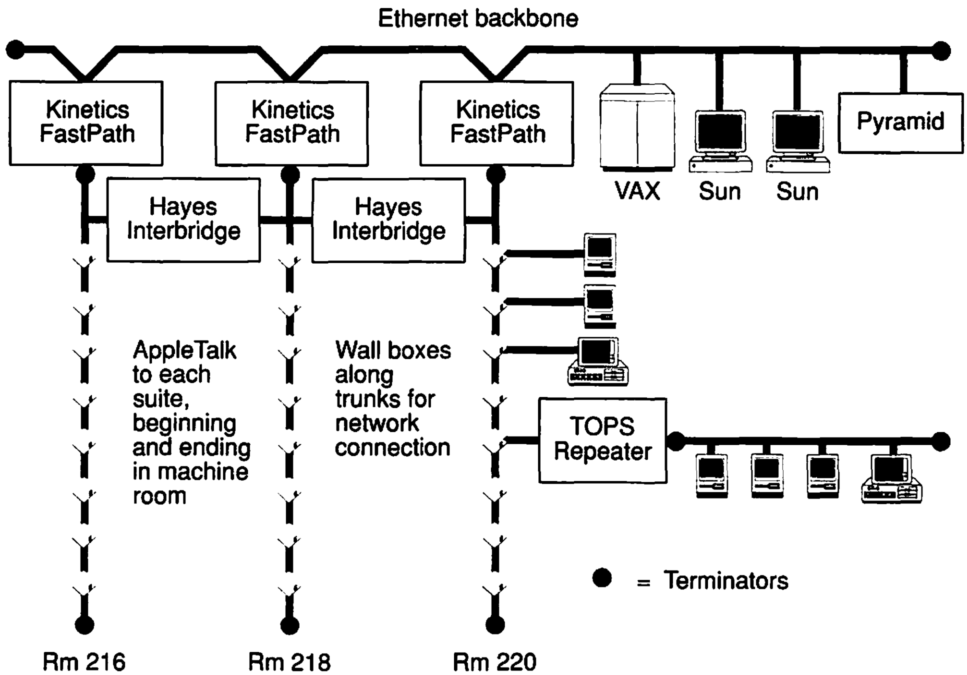

Figure 6-2 TOPS/Parker Plaza phase two.

with TOPS Terminal.

The development of TOPS Terminal meant the staff was establishing terminal sessions to the Suns and VAXes over AppleTalk through the FastPaths. That became another reason to replace Interbridges with FastPaths; network activity needed to get to the Ethernet, but the FastPath would not route TCP/IP packets that had already passed through an Interbridge. Thus evolved the necessity for a FastPath for each of the networks. When these FastPaths replaced the Interbridges, a couple of Interbridges were left on the net as an alternate route among AppleTalk networks.

Network administration was still ad hoc—it was handled catch as catch can by someone from technical support or an engineering person. It wasn't until TOPS reached a staff level of 75 people that they dedicated an internal support person (from the Technical Services group) to function as the network administrator.

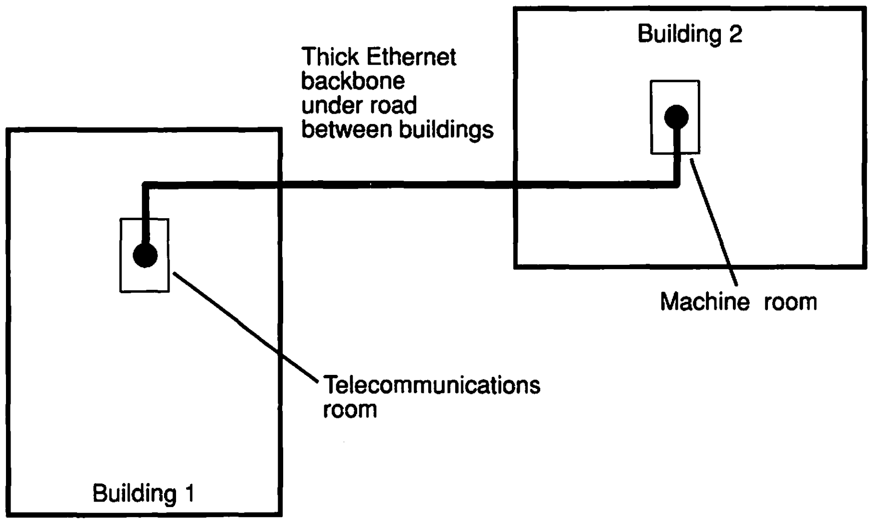

Figure 6-3 TOPS/Alameda, Ethernet backbone.

TOPS Moves to Alameda and Greatly Expanded Quarters

A great deal of network planning occurred before TOPS could move from Parker Plaza to Alameda. The resulting network design was based on two criteria:

1. The types of communication that had to take place.
2. The results of everything they had learned to date.

The design was complicated by the fact the new space spanned two separate buildings. There was now 65,000 square feet to network. Physically, the new facility was a combination of large spaces (demo rooms, test labs), cubicles, and hard-wall offices (one to two persons each).

The "network move planners" (Mike Rogers, Paul Sterngold, and Flash Pflaumer) made a couple of design decisions about the network up front. At this point both internetworking and EtherTalk were proven technologies for AppleTalk networking. The network planners couldn't predict where they would need Ethernet and where they would need AppleTalk connections, so they decided that every workspace had to have both. Even if the connections were not used, every workspace had to have the option.

It cost approximately $60,000 to 70,000 in hardware and labor to install just the cabling in Alameda. It is important to note that this move was into brand new buildings that were shells only. The network was designed before any walls went in, and before any of the phone wiring went in.

The other major decision made by the planners was to move away from the trunk with drops topology. They chose to use star controllers but insisted that each arm off the star controller would be a daisy chain, and not a trunk. This decision was made for ease of network administration. The advantage of the daisy chain, even though it's very easy for one person to break the network by disconnecting a wire, is that the problem is easily isolated. The network breaks *at the site of the problem.* Another factor was that they assured themselves that nobody would have to worry about a terminating resistor. In fact, every network connector with two ports on it would have two cables in it, of necessity. So there wouldn't be any opportunities for a person to misplace a terminator.

The resulting design is represented schematically in the accompanying Figures 6-3 — 6-5. The two TOPS buildings have an Ethernet backbone running between them—thick Ethernet cable runs under the street between the two buildings. A machine room was established in each building. In one building, the machine room is in fact the telecommunications room that also contains the phone switch. The other building houses the primary machine room for the facility with the large Sun servers, VAXes, Pyramids, all of the large equipment—in a computer room with controlled environment, raised floor, and Halon fire protection.

The machine room in each building also serves as the network hub for that building. The Ethernet backbone runs between the two machine rooms and from the machine room all network signals are distributed throughout the building. Within each building, the work areas are divided into logical, small (five to ten person) workgroups. A daisy chain attached to one arm of the Star Controller serves each workgroup. The typical daisy chain is a row of five hard wall offices, or a row of eight cubicles.

From the machine room, 22-gauge twisted-pair and thin Ethernet cable runs to each of these daisy chains. A wall plate was designed for each office or each cubicle, and contained two thin Ethernet jacks

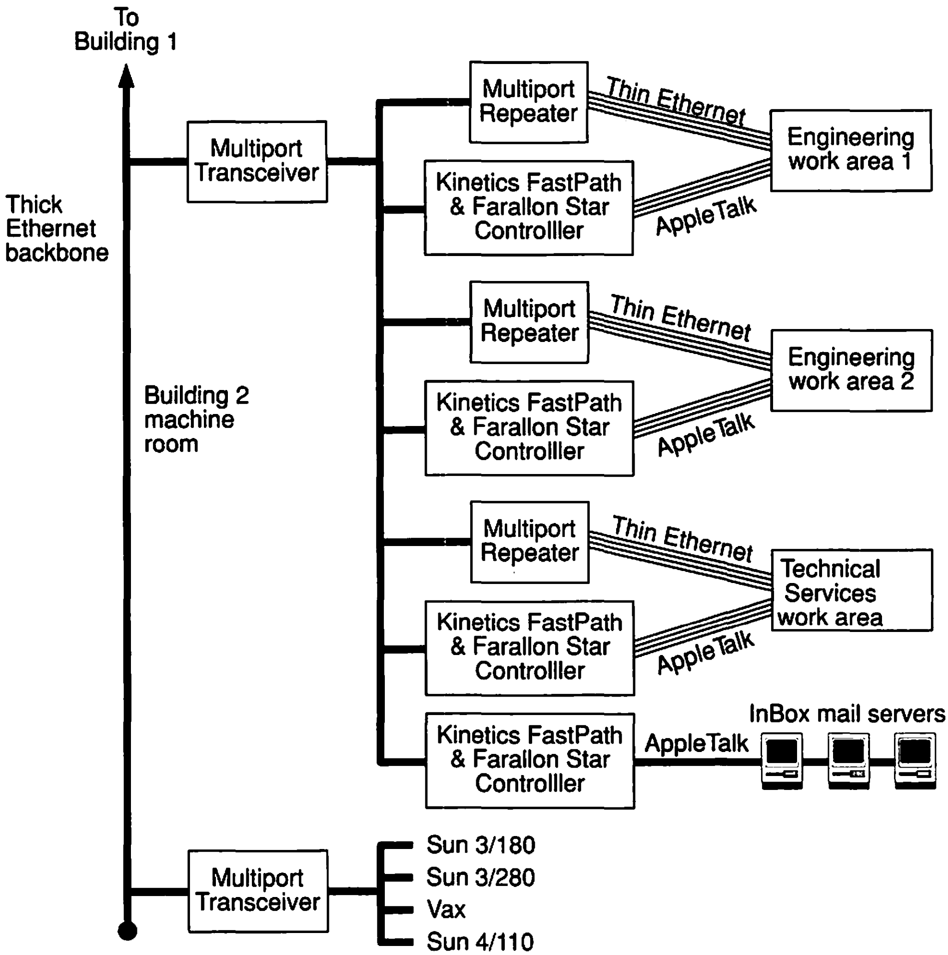

Figure 6-4 TOPS/Alameda, network routing.

and two RJ-11 jacks. Twisted-pair and thin Ethernet cable segments run from the machine room to the first connection, and then short segments run from office to office, or from cubicle to cubicle. If the office or cubicle is not in use or doesn't have a network device in it, a short jumper cable is installed between each thin Ethernet port and each RJ-11 jack to keep the daisy chain intact.

At the end of each daisy chain, terminators are installed *inside the wall, hidden from the users.* The users have been instructed that when adding a device to the network to ensure that cables extend from the wall plate to each device and a cable runs back to the other port on the wall plate. There is no reason to worry about terminators and no extra ports in any of the connectors in which to place terminators.

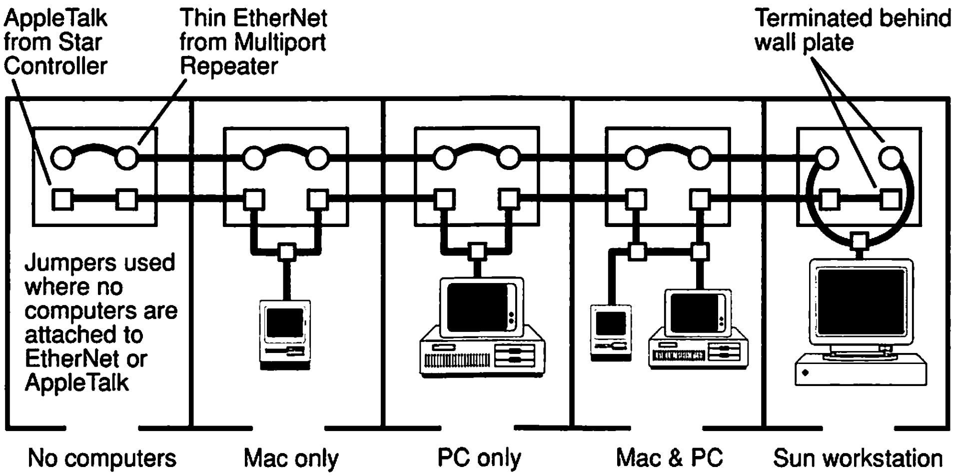

Figure 6-5 TOPS/Alameda, office wiring.

Each building has approximately 30 of these network segments. The AppleTalk segments are collected eight at a time and joined to Star Controllers, leaving four ports available on each Star Controller for expansion. Thin Ethernet segments from the same eight daisy chains are routed to an Ethernet multiport repeater, a device for Ethernet similar to the Star Controller for AppleTalk.

Segments are grouped together at Star Controllers or multiport repeaters, based on the workgroup the people on that network segment belong to. For instance, engineering requires two Star Controllers. Technical Services and Sales each require one. This grouping of people per Star Controller, based on their location in the building and thus their logical workgroup, formed the basis for network and zone boundaries.

The Ethernet backbone facilitates communication between these workgroups. The multiport repeaters are attached directly to the backbone via a multiport transceiver; the Star Controllers are connected to the backbone by taking one of the four available ports and routing one to a FastPath, which is connected to the backbone via the multiport transceiver. Workgroups are isolated to a single Star Controller defining a single AppleTalk network.

Zone boundaries are also chosen by workgroup. Technical Services has one network and is designated as one zone. Engineering consists of two networks, both of which are defined as being in the same zone. The Ethernet backbone is designated as an AppleTalk zone, independent of all the others. The backbone is used to route information between networks as well as for connection of Ethernet devices, such as Suns, VAXes, and PCs or Macs with Ethernet cards.

Because the multiport repeaters are not Ethernet bridges, there are no zone boundaries on the Ethernet. The Ethernet backbone plus all of the thin Ethernet segments running throughout both buildings are on one zone and one network. Unfortunately, this means that a user in technical services who adds an Ethernet card to their PC and connects themselves to the thin Ethernet in their cubicle becomes part of the backbone zone and is somewhat segregated from their workgroup on the network. If and when EtherTalk bridges become available, it will be possible to set up the thin Ethernet segments within a workgroup as part of that workgroup's logical zone.

As previously mentioned, one building contains a large computer room and the other building's machine room is in the telecommunications room, co-located with the phone switch. Within that room, off of the backbone, is a Sun workstation that functions as a network router and is connected to a T-1 (a special high-speed, dedicated phone) line that runs from Alameda to Sun's corporate offices in Mountaint View (about 40 miles). This provides for direct communications between Sun employees in Alameda and Sun employees in Mt. View, as well as for access to the worldwide internet.

Administration, although it takes more resources now because there are 250 people, is actually much simpler than it was back in phase two of Parker Plaza. The network administrator takes very few calls related to the physical network, but spends a fair amount of time with the more typical network administration problems of software version control and software propagation (getting a new version out to everybody), and in-house alpha testing. Because TOPS is a development environment as well, the network administrator deals with the additional functions of in-house alpha testing, training, and software-compatibility issues. The current network support staff consists of a systems administrator for Ethernet devices, a hardware repair specialist, one internal support person for AppleTalk, InBox, and training, and two systems analysts for mainframe-type applications. These staff positions all report to the MIS Director.

In terms of what TOPS is doing in their new location on this expanded net, it certainly includes all that was in process back at Parker Plaza, and more. There are Macs and PCs on AppleTalk and Ethernet running at three different speeds—Ethernet, AppleTalk, and FlashTalk. There are printers and network modems throughout the facility, with high-quality serial and parallel printers attached to PCs serving the network via TOPS DOS. Everyone in the company is on both InBox, for communications internal to TOPS, and on UNIX Mail, for communications within Sun and onto the worldwide internet. There are numerous database applications throughout the company that track orders, user registration, leads, etc. Most people in the company use TOPS Terminal or PCNFS for terminal service to Sun servers, database applications, and UNIX Mail. In addition, many people access the corporate MIS system, logging into terminal sessions from their Macintoshes to a Sun server across the T-1 line to Mt. View, routed to another T-1 line to Milpitas to a Sun running SunLink software connected to an IBM-compatible mainframe. From their Macintoshes, using TOPS Terminal, the users see a 3270 terminal-emulation window on their screen communicating with a mainframe 40 miles away.

Shiva

Shiva, incorporated in October of 1985, started out in the house of one of the founders. This house, located near Boston, looking out over Route 128, was a classic start-up location. With machines everywhere, the development of the technology was interspersed among the personal lives of entrepreneurs with a vision. Dan Schwinn, Shiva's hardware engineer, sat in a lawnchair in the backyard to wire wrap Shiva's first product prototype.

Shiva moved into its first formal offices in May of 1986. Occupying Suite 1200 of 222 Third Street in Cambridge first, and then adding a second suite (number 1250) of similar size in March 1987, these offices were the first home of Shiva's AppleTalk network. Shiva's network, like many AppleTalk networks, started humbly in a simple daisy-chain configuration around the perimeter of the office. The additional space acquired in Suite 1250, used for manufacturing and storage, was never networked.

Shiva manufactures internetworking products and shared peripheral devices. While their first products were in development, an interesting form of democracy/dictatorship governed their network. AppleTalk was the democratic element and the engineering department was the dictator. The engineering department, challenged by the demands of developing and debugging a sophisticated new piece of hardware, held the top network priority. Other Shiva personnel (Shiva's front desk, accounting, sales, and marketing staff) were basically at the mercy of what was going on in engineering. The network traffic made it difficult for the engineers to track problems. Since the Laserwriter was a major source of traffic, often the call would go out across the suite: "Don't use the LaserWriter for the next 10 minutes!"

In self-defense, engineering adopted a policy of secession from the network "union." Remaining a part of the network was unmanageable from their point of view (too much traffic to test and debug) and unacceptable to the rest of the staff. If engineering was testing and something went wrong, the whole network could come down. People expected to be able to get to other machines and to the Laserwriter. In the fast track race to produce a product winner, no one could afford to be down.

So it became the practice for engineering to secede from the network, as appropriate. During these periods, two separate and smaller daisy chain networks serviced Shiva employees. As the Shiva network, originally cabled with LocalTalk cables, grew in size, PhoneNet cabling replaced LocalTalk. The extra LocalTalk cables were then used only to facilitate engineering's periods of secession.

As Shiva's bridge products came into existence, the need for engineering's period of secession came to an end. Enginees simply put bridges between them and everyone else. Sometimes even individuals within engineering "bridged" themselves off from each other to isolate their hardware for development, testing, and debugging. That is an easy option for Shiva, since they make bridges and have lots around. It may not be an economical alternative for everyone.

Before Shiva moved from 222 Third Street, the network included about 15 Macintoshes, two IBM PCs, a Laserwriter, an AppleTalk ImageWriter, and Shiva's first two products, NetModem and NetSerial. NetModem shipped in May 1987 and NetSerial in October of '87 (see Chapter 10 for more information on Shiva's full line of network products).

Shiva tried originally to use MacServe and its print server as network software. At that time there were a couple Macintosh Pluses on the net, two 512K Macs, and an Imagewriter printer. The MacServe print-server software proved unworkable. The problem? When using MacServe on a Mac to print to the Imagewriter, the Mac became useless and the printing was *very* slow. Although the other machines on the network were unaffected, on that one Machintosh, nothing could stir, not even a mouse. . . .

Shiva eventually adopted TOPS for its network file and print service. However, before that was up and running, they used InBox. The day InBox came in, they dedicated a 512K Mac to be the InBox server. Engineering used it to "mail" new code files back and forth to each other. When TOPS came along, it proved to be a more suitable solution for moving new code among the developers.

With ten people on staff, Shiva needed a new physical space to continue development and expansion of their products. They moved to their current location at 155 Second Street in Cambridge in July 1987. This space covers two floors. Sales, marketing, manufacturing management, administration, and reception occupy the first floor. Engineering, technical support, and accounting are in the upstairs suite.

Shiva's Dan Schwinn and Mike McCormick designed and wired the new space. Thinking that they would install good-quality wiring, Dan chose twisted shielded pair. PhoneNET does not adapt well to shielded-pair wiring. There is too much capacitance in the wiring and it is difficult to establish much distance between nodes. When Dan first hooked the network up, it just sat there. He soon discovered the source of the problem. But the wiring was in. What to do? Well, it pays to be a bridge manufacturer. Shiva's NetBridge product was just beginning to be stable, so Dan put a lot of bridges in. This is the long way around circumventing the distance limitations of shielded twisted-pair wiring and PhoneNET.

The network at 155 Second Street is centralized off an AppleTalk backbone located in the first floor phone closet. Four bridges located in the wiring closet create five separate network zones: "Upstairs Zone," "Downstairs" (the whole first floor except for the QA island), "Accounting" (a secure, one-way link), "Engineering," and "Technical Support." There is an AppleShare server as well as several NetModems in the Technical Support zone. One NetModem gives the public access to support services. People accessing support through this NetModem can see only the Technical Support zone. Shiva is contemplating deviating slightly from its policy of using bridges for nearly everything and may soon install a StarController in the wiring closet. They continue, however, to put bridges in offices between the wall outlets (network node connections) and hardware equipment to isolate engineers from network traffic and to ensure engineering activities don't cause problems for other users on the net.

Shiva has a segment of Ethernet in the engineering lab for test purposes only. This network includes a 3COM 3Server, a FastPath 4, a GatorBox, and several Macintoshes. It is used solely for testing Shiva products over Ethernet.

On the occasion of the move to 155 Second Street, Shiva replaced InBox with Microsoft Mail. They found that InBox didn't support dial-in access and also proved to be a bit unstable over bridges. Microsoft Mail also has the advantage of not requiring a machine to be dedicated as the mail server.

Shiva uses TOPS in "autopublish" mode, so that all volumes are automatically available at all times. They use FileMaker's multiuser version for sales-order entry and to maintain their warranty database. At the time of this interview with Shiva's Dan Schwinn, he mentioned FileMaker doesn't work through zones. Why? Because Shiva didn't get them a bridge in time to test and debug the software to support zones. The situation is, of course, being remedied. We appreciate Dan's candor in sharing this anecdote with us. It is a good example of how much cooperation and coordination are required behind the scenes, among hardware manufacturers and software publishers, to bring the full range of functionality to network users. Shiva and Cayman Systems, Inc. (makers of the GatorBox) are linked directly by a Shiva TeleBridge. The link and the electronic mail system established between the two companies allows them the synergy of being able to work together more directly.

Dan's thoughts for the future of Shiva's net? In technical support, they may replace their AppleShare server with a Novell server. There are also plans to put a Macintosh II in the phone closet to act as a mail server. Networks in companies like Shiva grow and change dramatically, almost daily. A January 1989 *Inter•poll* report on devices on Shiva's net lists 92 types of activity in nine zones on Shiva's net. Shiva is a creative, living example of the vitality and adaptability of AppleTalk networks, and the entrepreneurship among AppleTalk developers that brings a full range of functionality to the user.

Kinetics

The Kinetics network discussed here was designed and installed in the Kinetics buildings at 2500 and 2540 Camino Diablo in Walnut Creek, California. Stephen Lewis, Director of Engineering at Kinetics, a division of Excelan, comments on the philosophy behind the network and its implementation.

The goal of the network was to provide everyone with state-of-the-art network services at their respective workstations. In Kinetics' case, the vast majority of users have Macintosh personal computers on their desks. These include 512s, Mac Pluses, Macintosh SEs, and IIs. The network design was driven by the desire that everyone should have uniform access to services, including printer service, mail service, and file sharing. The network is designed so that additional resources can be added to the network and provided to all users as their needs evolve.

The opportunity to design this network was occasioned by the move to a new building. Kinetics planners saw the potential to develop a complete network solution. They defined the placement and quantity of network outlets, and the interconnection method to be used while the building was still under construction.

AppleTalk internetworks have always had provisions for separating groups of nodes into networks and routing packet traffic accordingly. This is especially helpful on low-speed networks such as LocalTalk. The Kinetics FastPath is a bridge from one LocalTalk network to a high-speed EtherTalk network. Kinetics decided to feature their own products prominently in their network solution for good reasons: FastPaths are available, of course, at cost, and to use them prominently in the network provides an excellent product showcase for demonstrations.

The actual implementation involves an Ethernet backbone connected to eight FastPaths. Four of these drive the AppleTalk networks in the four major departments of the new building. Two FastPaths drive the two networks in the "old" building, and a pair of FastPaths are used with duPont fiber-optic cable to bridge between the two buildings. This is illustrated in the accompanying diagram.

Steven Lewis continues, describing the services provided on the Kinetics network. "I must digress a little for those of you who are not familiar with the Macintosh user interface. The Macintosh concept is that the user of services shall not require a manual and that there shall be no error messages. This is typically accomplished in the following manner. First, the user pulls down a menu of so-called "desk accessories" from which (s)he selects the Chooser. This is the universal access to network services. From there (s)he may choose services such as Laserwriter or AppleShare or Microsoft Mail server. The Chooser then does a broadcast lookup over the network for services by name. The ones that respond will be presented for the user to select. By this method, it is very difficult to choose a service that is down, and therefore one sees very few error messages. The services we have been able to provide uniformly at each desktop are as follows:

- **AppleLink.** AppleLink is administered by Apple Computer and is provided to Apple employees, VARs, dealers, developers, and consultants. It provides a bulletin board service, electronic mail and data libraries. The system is built upon GE Tymshare. AppleLink is accessed via an Abaton box known as MultiTalk. This permits anyone connected to our Internetwork to access a modem and run the AppleLink program.

- **AppleShare.** AppleShare is a file server that permits users to mount a remote volume and access the files as if they resided on a local hard disk drive. Password protection to the folder level in a hierarchical file system is provided.
- **Backup/Restore.** Running on a UNIX host is a backup and restore service that cooperates with a Macintosh program to provide full or incremental backup of Macintosh volumes over the internetwork. Thus, any user of the network can have automatic backup service for their local disks. This utility is a local adaptation of a program by Dan Tappan of Bolt Beranek and Newman.
- **4th Dimension.** 4th Dimension is a database server with substantial features and capability and will soon be used for sales lead tracking, customer logs, field service statistics, and repair logging.
- **Helix.** Helix is a database server that is used for order entry and sales tracking, and for generating shipping documents. This system is used by both Operations and Sales, even though they are not located in the same building.
- **K-Spool.** Kinetics host services include a print spooler for the Laserwriter. Known as K-Spool, it allows Macintosh users to print large files without waiting for the Laserwriter to actually output printed paper. The spooler acts like a Laserwriter for the Macintosh and then subsequently sends the file to the actual Laserwriter, which is serially connected to the UNIX host. K-Spool runs on all of our UNIX hosts and there are spoolers for each LaserWriter.
- **K-Term.** If anyone wishes to access UNIX directly, they need only launch K-Term on their Macintosh to obtain a four-window, VT1000-style terminal with scrollback that connects with a log-in server on any of the UNIX machines. This provides access to UNIX mail and all those tools for which UNIX is famous.
- **LaserWriter.** Apple Computer's 300 dot-per-inch laser printer. We have one in each department (five in all).

- **MultiTalk.** This is a network server that provides access to RS232 serial devices, such as modems, via the network from any Macintosh workstation. We use it to access external services such as CompuServe and to log in on remote machines at "Kinetics South."
- **TOPS.** The TOPS system is a symmetrical file server where anyone can publish a volume to the internetwork for use by any other node. There is no server; or, to put it another way, every node is both server and client. This is particularly useful in sharing files between offices or from one building to the other. Instead of making a copy of a file onto a server, one merely mounts someone else's disk for a few moments and writes a file onto it.

Lewis adds, "Now that the dust is settling after the move, we can ask 'Did we succeed in our goals?' Time will tell, but it seems that the network is up and stable and that we are already adding to its capability. It also seems clear that we could not survive without it. The most appropriate comment I've heard is: 'This is the way networks are supposed to work.'"

Farallon Computing, Inc.

Just as the computer extends the ability to use and process information, the computer network extends Farallon's ability to communicate that information to others. They use their network to communicate with words, pictures, and sound. Farallon designed and installed the network for their new 25,000 square foot headquarters facility using, quite naturally, their own PhoneNET System, an integrated cabling system for AppleTalk networks. The Farallon internetwork links a remote site in Lawrence, Kansas, and four other separate buildings located in Berkeley. Farallon founder Reese Jones has a vision of data networks someday as common and available as telephone networks. Farallon (with 800,000+ PhoneNET nodes installed) is actively developing products to that end, as well as Ethernet-based extensions of the PhoneNET system that will provide parallel choices for EtherTalk speeds on an AppleTalk network over twisted-pair telephone wiring.

Since Farallon's product focus is on the physical layer, it is appropriate that their tale examines in detail some of the nitty-gritty of the straightforward, yet crucial, laying down of the physical foundation of the net. Farallon recently moved to new headquarters, and the network was installed while the building was still empty. The network was designed by Farallon systems engineers and installed by professional in-house installers.

Farallon uses the network for file and print sharing, as well as electronic mail. Their network management software, PhoneNET CheckNET, TrafficWatch, and StarCommand keeps their net healthy, and up and running. TrafficWatch monitors network activity and tracks error rates and PhoneNET CheckNET displays the name, address and type of every device on the network. They use StarCommand to test wire quality, turn ports on or off, monitor network traffic loads, and perform other network-management functions necessary to run their active star network with maximum efficiency and minimum effort. Their network is a major asset to their business.

Farallon's network uses telephone wiring that was already installed in the building. Multiple StarControllers constitute the heart of this active star network. The StarControllers function much like a heart, pumping network signals down the arteries they service to all devices on the network. Telephone wire running out from these stars carries the network signals, as well as telephone voice signals.

In a typical building, the telephone wiring that runs out to office locations contains more wires than are actually needed by the telephone system. Wiring in the new Farallon space is typical: four pairs, or eight wires running out to each office location. Some buildings have only one or two pairs. Telephone systems normally require only one pair for the telephone. Because telephone wire is inexpensive compared to the cost of installing additional wire, the phone company routinely installs extra pairs to accommodate expanded future needs. PhoneNET only requires one extra pair of wires, normally already installed in the building.

Connecting these wires to create the physical layer of the network is a very straightforward process. Most buildings have central locations for telephone wiring configurations called wiring closets. In such a closet, you typically find a telephone punch-down block. Punch-down blocks are not a front for mysterious technology—they are just a simple way to connect wires together.

The wires that come out of the punch-down block are called distribution wires and run through the building to the various wall outlets. There are typically four pair, or eight wires in a building, and these wires form the basis for Farallon's net. There is a color pattern in the arrangement of wires that, in Farallon's case, is white/blue, white/green, white/orange, white/brown. The color pattern repeats itself and each group of eight wires in this color sequence goes out to a particular wall outlet. Colors vary from building to building.

To install both telephone and network capability in each workspace in their new building, Farallon installers ran these eight wires into a plate with an upper and lower RJ-11 jack. The first four wires were connected to the top jack and the second set of four wires run into the bottom jack. Using this scheme, people will connect their telephone into the upper jack and their network into the lower jack. The installer carefully labels all lower jacks with a PhoneNET insignia, so there is no confusion about what should be plugged in where.

At each office location, the installer connects the first pair of wires (line one) to the inner pair of pins on the upper jack. The second pair of wires (line two) is connected to the outer pins. The third pair of wires is connected to the inner pins on the lower jack and the fourth set of wires to the outer pins on the lower jack. Line four is the PhoneNET jack.

The installer is now ready to actually hook into the network and that's where theStarController comes into the picture. A punch down block is used to facilitate connections to the StarController. To hook someone to the network, the installer brings the last pair of their distribution wires (line four) over to one of the 12 ports on the StarController, accessed through the StarController punch-down block. That's all that is necessary at the phone closet end.

Out at the user's end, the installer plugs the PhoneNET connector into the computer and runs flat phone cabling between the bottom jack (labeled PhoneNET) and the PhoneNET connector. That's all there is to do. Not only is this convenient, but it is also a very reliable way of spreading the signal across the network. The StarController is like a very high-quality "public address system" for the network.

One of the criteria Farallon holds essential is the straightforward maintainability of the network. After the installer has the network set up, the network administrator should be shown how to make changes. It is not necessary to have the installer come back and change the wires around every time someone moves. Everything is marked clearly so follow-up modification and maintenance is fairly simple. Every wall jack in the building is numbered and its corresponding wires traced back to the distribution punch-down block and labeled with the same number.

The installer uses a tone test set, consisting of a tone generator and a tone receiver, to determine which wires that come in from the facility correspond to connections on the punch-down block in the phone closet. This is very simple. But there are two good reasons why customers shouldn't do this for themselves. It requires test equipment most people don't have. And, if you're doing any modification to the building—whether it's in the walls, the ceilings, or the crawl spaces—you should have a licensed contractor handle all wiring issues. This must be done by someone who knows local electrical code and, in most states, a licensed contractor is required by law.

We've described in some detail the connection of the physical layer of Farallon's network. But what about the larger picture, their network design?

As of this new building installation, there are about 80 users total on this network. Macintoshes account for most of the computers and there are a few IBM PCs. That's too many computers to have vying for network time, if the network is all one "continuous" net. Farallon's solution is to split the net into a series of smaller workgroups. The goal is to allow people in the workgroups to communicate with each other, but divide them so that most of the network traffic stays local to their workgroup area.

Workgroups are generally separated by department or by geographic location. In Farallon's case, the departments are already divided geographically. These workgroups are assigned to different zones. At Farallon, such workgroups include accounting, marketing, sales, technical support, engineering, product management, and administration, and are like building blocks for the larger network. On the Farallon network, a separate StarController distributes the signal for each zone. The zones are linked together using an Ethernet backbone, with a Kinetics FastPath providing the link between Ethernet and each AppleTalk network.

A Farallon systems engineer comments on the network design: "It is possible to have all the computers coming off the StarController, but that is not a very good solution. Every time someone uses the network, whether its for file transfer, e-mail, or printing, they create network traffic. If everyone is on the same network, it is like rush hour all day long. No one is able to get through. By creating separate workgroups, we separate out the network traffic." Besides traffic considerations, are there other advantages to this kind of network design? "Our goal is reliability. And this is the most reliable network I know of. Another goal is supportability. I want to be able to reconfigure the network quickly and easily. Say, for example, the company adds a new employee or someone moves to a new office. I want to be able to handle that quickly with absolutely no down time. That's very important because our network is an important part of our business operations."

To augment their electronic mail and print service, Farallon is set up with three AppleShare file servers in support of their particular zone configuration. All computers are equipped with what Farallon terms "collaborative software." Personal computers were originally designed to be used by one person at a time. But sometimes people need to work together and, if your work is on a computer, that can be very awkward.

Collaborative software allows people to work together across the network. To establish the ability to collaborate, Farallon installs Timbuktu, a desk accessory, on every Macintosh on the network. Timbuktu allows people to work together without leaving their desks. It simply connects people across the net. Say, for example, you have a group of people working on a report. With Timbuktu, it's possible for everyone to access the computer with the report running and see the document on their individual screen, all at the same time. Additions and changes can be made. You can also set up a conference call so people can talk about what's happening on the screen.

Farallon has warehouse space across the street and two other buildings in use in the Berkeley area. To accommodate order processing, they installed a network in the warehouse and tied it into the network in the main building. To accomplish this connection, Farallon ordered some special wires, called a "dry pair," from the phone company to use especially for the network. A "dry pair" is simply a pair of wires that runs from Farallon's main building to the telephone switching facility down the street. Within the telephone switching facility, these wires are directly connected to a pair of wires that runs to Farallon's warehouse.

Unlike normal telephone lines, a "dry pair" doesn't go through any telephone-switching equipment and it doesn't have any loading coils on it. If you try to run a network signal through telephone-switching equipment, the signal gets filtered out. Even though it is quite a distance from Farallon to the phone-switching facility and back to the warehouse (about 7,500 feet, almost a mile and a half), the connection is reliably accomplished by adding another member of the PhoneNET System product suite: the PhoneNET Repeater.

Farallon sets up a workgroup in their warehouse with a StarController that sends the signal out to all the Macs in the warehouse. Then off one port of that StarController a Repeater is installed. The Repeater boosts the signal and reclocks it, allowing it to be sent the mile and a half over to the other building where it will go into another Repeater. That Repeater is attached to a Kinetics FastPath that is, in turn, attached to the Ethernet backbone. This connection allows everyone in the two physically separate buildings to be on the same network together. Warehouse personnel have access to all the network services. In this case it's really a benefit because it means people taking orders in the main office can send them across the network to the warehouse and orders can go out the same day.

How is all this wiring managed in the phone closet? There are a lot of wires in the phone closet and it's a little confusing at first. That's why its important to have a professional installer around to help out. During network installation, once you come into the wiring closet, it is very important to do everything "by the book." Also, what is done here must take into account what you intend to do in the future. If you don't keep an eye on the future, you may not allow for compatibility issues that future expansion will raise.

It is worthwhile to have a network map noting the location of all the wall outlets in the building labeled with the corresponding number assigned to them. Using the map, you can easily identify which port in which StarController to connect the wires to. From this point, it is basically a processing of connecting the dots. For each network connection, the installer attaches a pair of wires to pair four of the appropriate distribution wire bundle and cross-connects them to the selected port on the StarController punch-down block.

The only thing left to do is install terminating resistors in all the network outlets. Signals coming from the StarController have a tendency to bounce back, like an echo. That echo coming back toward the StarController can cause interference on the network. The installer places a terminating resistor at the end of each wire to absorb any echo before it can bounce back and cause problems on the network.

In Farallon's case, the installer uses loose terminating resistors that can be installed directly on the terminal posts in the wall outlet. These resistors, as opposed to those that are RJ-11-mounted, are best because you don't have to worry about someone moving their computer and taking the terminating resistor with them. If the wall outlet does not have screws to secure the network wires, you must use the kind of terminating resistors that plug into the spare jack in the PhoneNET Connector. This method does not afford the reliability of those installed in the wall because people can take them out and put them somewhere they don't belong, or move their machine and take the terminator with them. This may leave a network segment unterminated and can potentially cause signal echo problems.

Cables between the wall jacks and the PhoneNET connectors are flat, modular cable, while the cables running through the walls from the StarControllers are round. Flat, modular cable is available at any hardware or electrical store. You can buy it in precut lengths or you can buy it on spools, and cut it to suit your needs. It is relatively easy to put the RJ-11 connectors on yourself. You just cut off as much wire as you need and use a crimping tool to strip the wire back. Then slide an RJ-11 blank on the wire as far as it will go and insert this assembly into the hole made for this on the crimping tool. Then just squeeze. After you have all the terminating resistors installed, the last thing to do is to go back to the phone closet and check all the electrical connections.

Farallon's installer uses a MultiMeter to check the resistance on all the network wires coming back from the wall outlets, from the Star Controller punch down block. The MultiMeter is placed on the wire and measures the resistance. By combining the resistance of the wire and the terminator, this reading should fall between 120 and 125 ohms. All the wire pairs are checked at the punch-down block and, if they are all fine, he connects the block is connected to the StarController and the StarController powered up. The final act will be to plug the computers in. The network is wired and ready to go.

Farallon also uses their Timbuktu software to administer a network file server. They use a Macintosh II chassis for the server, but it has no monitor or keyboard attached. To control the server, you simply bring up the Timbuktu desk accessory. A menu comes up listing all the possible hosts Timbuktu could connect to. Simply highlight the server you want to control and double click on it. Timbuktu asks for a password that will allow you through to the server machine. After typing in the password, Timbuktu connects us to the server. It's now as if the administrator's mouse and keyboard are directly connected to the server machine.

Timbuktu makes it possible to administer nearly everything on the network from your own machine. It greatly facilitates training and eliminates the need to run around and help everyone with their problems. When you have a new employee, you don't have to go and help them with their printing—you can take control of their machine and show them how to do it. You can talk to them on the phone about it at the same time. You don't have to leave your desk every time someone needs some help.

ShowNet/MacWorld Expo

The challenges of "live proof that Macintosh connects" were confronted by Kee Nethery of Kagi Engineering and Eric Gould of IDEAtion Strategies at MacWorld Expo, San Francisco, January 19–22, 1989. This year, they called the trade show network ShowNet™ and red balloons above participating company's booths marked their connection to the network. The network connected both halls, Moscone Hall and Brooks Hall, and featured wide-area network connections to remote sites in Canada, Oregon, Utah, and New Jersey. The network featured Macintosh to Macintosh, Macintosh to PC, Macintosh to VAX, Macintosh to Sun, and even Macintosh to IBM mainframes.

An AppleTalk network is not new to MacWorld shows. Ever since Kee organized the first AppleTalk trade show network at MacWorld Boston in August of 1986, makers of AppleTalk-related hardware and software products have been linking together at trade shows to demonstrate their network products. The ability to set up and manage a large network for a temporary event, in a temporary physical space, has its roots in the simple functionality of AppleTalk. But there is a lot of planning, fast work, cooperation, and vigilant troubleshooting put in by the team who puts it together and keeps it functioning. The end result gives show attendees a chance to see a real network in action.

An overview of ShowNet participation gives you a sense of how the many pieces of an AppleTalk network puzzle can fit and work together. Substantial material from the following descriptions is taken from the ShowNet information piece prepared by Kagi Engineering/IDEAtion Strategies for distribution at MacWorld.

Farallon, known for its PhoneNET System, and Kinetics, known for their FastPath Ethernet Gateways, were the original parties to link vendors together at trade shows. ShowNet organizer Kee Nethery was with Farallon when the first trade show AppleTalk network was implemented. Kee strung 500 feet of thick Ethernet coaxial cable (provided by Kinetics) into the ceiling at the Bayside Expo in Boston. He and Tim McCreary of Kinetics did all the troubleshooting.

- Farallon is the leading vendor of physical-layer components for a twisted-pair local area network installation. Working to make network nodes as omnipresent and trouble-free as telephone jacks, the PhoneNET System line of products is growing, with offerings that integrate voice, data, and graphic communications over AppleTalk networks on telephone wire.
- Kinetics is another original trade show net participant. Their product, the Kinetics FastPath, provides the ability to link AppleTalk networks to Ethernet. Kinetics FastPaths have leveraged AppleTalk around its speed limitations and made a place for it in higher-end

network environments. Kinetics, now a division of Excelan, Inc., a division of Novell, provides Ethernet connections for all Macintosh computers and, for this ShowNet, showcased Mac-to-VAX connections and applications.

- Hayes is another original participant. Hayes' Interbridge was the first LocalTalk-to-LocalTalk network bridge available. It is used to split AppleTalk networks for better performance, as well as segregate working groups of people in local networks to make access to network resources (printers, modems, etc.) more manageable for the users.
- Infosphere delivered the first AppleTalk solution with a product called MacServe. Liaison is their newest software product, providing dial-in access to AppleTalk networks allowing remote connection into electronic mail, AppleShare, MacServe, or TOPS. Liaison is a software-only bridge that runs in the background of a Macintosh. Noteworthy among its capabilities is its inexpensive solution for enabling LaserWriter printing from EtherTalk.
- TOPS, another original trade show network participant, was the first company to offer file service—distributed or centralized—that operated across operating system boundaries. Their ability to link Macintosh and MS-DOS machines first appeared in early AppleTalk networking days, when this "interoperability" brought a lot of attention to AppleTalk from those staunchly entrenched on the IBM PC side of the user arena. TOPS capability to link Macintoshes and PCs leveraged many a Mac through the back door into formal business computing environments where they, of course, began to proliferate like rabbits. It is the opinion of many who should know that TOPS did a lot more for Macintosh acceptance as a business computing tool than Apple will admit.
- Alisa Systems provides AlisaShare, a VAX/VMS-based file server for the Macintosh. They also showcased AlisaPrint, Alisa Terminal, and TSSnet (DECnet for the Macintosh).
- Apple, of course.
- AT&T's DataKit VCS is a data communication switching product capable of handling many protocols and interfaces at high speeds. DataKit VCS is being used by the telephone companies to provide

Central Office (CO-LAN) services, which provide simultaneous voice and synchronous/asynchronous data connections at speeds of 19.2 Kbps over existing telephone wires.

- Cayman Systems, Inc. showed GatorBox, the first application-level gateway from Macintosh to Ethernet. The GatorBox enables a network of Macintoshes (running under AppleTalk or EtherTalk) to share files with any computer supporting NFS, by allowing NFS servers to emulate AppleShare servers. All translation is handled within the GatorBox, allowing both server and client to run their native protocols and retain their standard user interface.
- CE Software featured QuickMail 2.0 with new features including Store and Forward messaging, Hot Keys, a large font option, and time-delayed mail. QuickMail 2.0 is a full-featured E-Mail and communications package for use with as few as three Macs.
- Microsoft products are omnipresent on AppleTalk networks because of Microsoft's track record in creating applications that behave well and work together from opposite sides of the Macintosh/PC operating system fence. This year Microsoft joined the net to show its powerful integrated communication program for AppleTalk networks that does Macintosh and PC electronic mail. Microsoft Mail delivers memos, documents, telephone messages, and files right to your machine. Integrated with Microsoft Word, Microsoft Mail can be used to send and receive documents directly from within Microsoft Word.
- cc:Mail Inc. was cited during 1988 by three major computing magazines as "Pick of the Litter," "Best in its Class," and "Editor's Choice." cc:Mail users can send almost anything they can create on their computers, including text and graphics, to any other cc:Mail user, regardless of network or workstation.
- DayStar Digital delivers a cost-effective total network solution for Mac to PS/2 or PC environments. Their products allow conversion of a PC or PS/2 into a high-performance AppleTalk file server and give Mac and DOS users transparent access to one another. This gives all computers access to PostScript printers and other shared devices.
- Miramar showed MACLAN Connect, an AppleShare server that runs on DOS-based machines. For Mac users, MACLAN appears

like AppleShare, accessing files and making DOS disks available, just as AppleShare does. In addition, MACLAN Connect bridges to PC-based LAN environments including 3Com, Banyan, and Novell.

- Novell linked up to the network, providing connectivity to the Macintosh and PC environments. Macintosh capability in Novell's NetWare product is in response to user demand for interoperability of Macintoshes and PCs. NetWare is the leading PC LAN, with over 300,000 server installations. NetWare for Macintosh is based on Novell's Universal NetWare architecture.
- 3COM is a computer networking systems company providing multivendor connectivity and information sharing for workgroups, departments, and corporate environments worldwide. The company designs, manufactures, markets, and supports a comprehensive range of local and wide-area network systems based on industry standards and open systems architecture.
- Tri-Data Systems, Inc. provides Macintosh and DOS machines with LAN-to-mainframe connectivity. Products showcased at MacWorld included the Netway 1000 LAN-based SNA Gateway family for Macs and DOS machines.
- White Pine Software, in conjunction with Alisa Systems, showed the multisession Mac241 product built on a unique communication architecture that allows different vendors' communication drivers to coexist in one product.

In late December, we talked with Kee Nethery about the challenges and rewards of orchestrating ShowNet. Kee was with Farallon back in the old days when he spearheaded an informal association of multiple vendors connected together on a trade show AppleTalk net. Why have a trade show net? "It's living proof that it all works together. It's real-time marketing for vendors because they can show their products in the context of other customary elements of a network. And, the network promotes goodwill and cooperation among all the AppleTalk vendors."

Every trade show is a new challenge. Trade shows are times when companies introduce new products and new versions of existing products. New products and new revisions make things interesting—they don't always work on the net the way everyone expected them to.

When there are problems, we have to figure out what is causing the fault. If the product that is the source of the problem can't be reconfigured or fixed, that product or it's booth has to be pulled off the net so that everyone else can survive. The show network provides a kind of product testing final exam—although a rather dangerously public one. This kind of test environment is just not available in all its variety and complexity at vendor or beta test sites.

The technical and organizational logistics of putting the net together are very complicated. There are a lot of pieces—physical and otherwise—to keep track of. All the cable has to be laid in a short time, and in unison with vendors setting up their own trade show booths. Figuring out how to connect it all and make it work in one and a half days is a huge challenge. The physical pieces required to connect everyone depend upon each vendor's location within the show floorplan. You have to know ahead of time what products people intend to show, what they interact with, what problems they know they have, what barriers they acknowledge, what works, and what doesn't work.

Typically, Farallon provides many of the LocalTalk components and connects the largest part of the physical layer together using its PhoneNET System. Kinetics typically runs Ethernet to Apple and other close by venders. Ethernet is run on or under the floor, or hung from the ceiling, depending on the characteristics of the exhibit hall. It's best to run it under the floor, because it can be done ahead of time and then the fork-lifts don't run over it a million times during show set up.

This time we used Farallon StarControllers located in phone closets, with vendors connected to the arms of the stars with existing phone cabling. Using existing cabling made the network easier to install and easier to troubleshoot if one booth needed to be disconnected from the network. In the past, we installed new wire to each booth and each vendor was responsible for running the wire in their booth. This time we did it right—the telephone installers connected the network wire when they installed the phone circuits. It cost a lot per booth for the installers to run the wire, but there were too many feet of cable for us to install new wire from booth to booth. This is the first show where vendors paid money to be on the net. Previously it was always a kind of grassroots cooperation effort. But just like all processes that mature and grow, it now requires coordination, administration, and a significant amount of materials. And as the environment gets more complicated and more sophisticated, we can't afford to show up a day or two before the show and hope that grassroots effort will bring it together.

In the past, the physical layer was much less stable than it is today. Bridges were very unpredictable in that kind of impromptu environment. But the physical layer has matured and its settling has made it predictable and reliable. Bridges are the keystone of the network, because they have to be able to speak to anything and everything on the net and be transparent as to whose bridge and router you're talking to. The bridge manufacturers have learned a lot from helping their customers solve problems and we have learned a lot from our experience of integrating them into the volatile show network environment. The bottom line is that the network must be designed so that any part of it can fail and not affect anything else that's going on.

There is a lot of cooperation necessary to make a show network a success. We have some volunteer assistance. These people help connect vendors to the net, configure their internal net, install proper system software, check bridges and wiring, correct anomalies internal to vendor booth sites and make sure, before the vendor is linked onto the net, that everything is operational within the confines of that booth. During the show, someone must be on call at all times so if something happens and a problem crops up, a vendor can get immediate assistance to solve the problem. You do a lot of running on the opening day. Volunteers that can do all this are very difficult to find. Most of these people have their own large networks and, for them, the show network is entertainment. This year, we'll have the suppport of the network administrator from Trans Canada Pipeline, two network technical writers from MacWeek, the network administrator from the University of San Francisco, and an Apple System Engineer from Cinncinatti, in addition to the Kagi Engineering/IDEAtion Strategies staff. (Writer's note: I recall well being in the middle of a TOPS demo back in the early days of the show net and having the machine refuse to function while I faced a crowd of 35 people intrigued with the concept of networking. This is, indeed, a very volatile situation. . . .)

And, of course, you must stage replaceable backups of all kinds of equipment to be immediately available if something fails. This doesn't happen a lot, but you must remember that this is a very unusual environment. Although it is planned and orchestrated to fit smoothly into a set of needs within a specific physical site, this network pushes the technology to the limits because of the diversity of products that have never been tested together.

There is another "failure-related" issue that is sometimes difficult because it is a human interface issue. It involves the inevitable necessity of helping people realize when a problem occurs that is not solvable. It may be caused by a new version of their software, while the old version worked fine. Now, for some reason, some piece of their system comes to a grinding halt. At this point, the logical step is to determine what the next best thing is to do to solve the problem. This is when cooperation among the vendors becomes paramount.

ShowNet did indeed provide "live proof that Macintosh connects." This effort of individuals and companies working together is a typical example of a relatively new, but very apparent trend in emerging software and hardware technologies. In researching the case studies for this book, we discovered that it's not only on the floor at trade shows that the network fosters cooperation among vendors. Company spokespeople and users note the same thing. Four companies—TOPS, Farallon, Shiva, and Kinetics—were mentioned consistently, which gave us the idea to include their own network implementation stories in this chapter because it made sense that their experience would be most useful to people involved in or contemplating *Hands-On AppleTalk.*

The AppleTalk networking solution is not a turnkey answer to networking from one source. It is a combination of offerings from a diverse set of vendors. In talking about their experiences with AppleTalk networks, users frequently mention that when they have a problem of indeterminate origin, that a technical support person for a vendor typically helps them troubleshoot the possibilities and solve the problem. It is interesting that these technical support people are often willing to help even when the problem isn't caused by their product, but is caused by some odd (or not-so-obvious) combination of use, circumstance, and configuration. This says two things: That network vendors realize that their responsibility extends beyond their product to the user's satisfaction and usefulness of *the network*, and that technical- support staffs know and understand companion network products well enough to be able to help a user separate the forest from the trees.

It is impossible to evaluate what this kind of support has meant to the acceptance of AppleTalk networking capability in the business world. One thing is certain—Apple has certainly leveraged a widespread range of talent and innovation to its advantage in storming the bastions of PCs lodged in the heart of Fortune 1000 businesses.

Chapter Seven

Installing Your AppleTalk LAN

Introduction

Once you've designed your network and chosen the hardware and software packages for the network, the installation process begins. You should put at least as much time and energy into the installation process as you did in the design process, as proper installation can do as much to prevent problems in the future as any other step. In this chapter we present a number of pitfalls to avoid and installation tips to help you in bringing your network up smoothly. These tips apply equally well to the initial installation as they do to the inevitable changes you will choose to make in the future. Most of the knowledge presented here has been learned the hard way—by making mistakes. Pay particular attention to the advice in this chapter; doing so could save you countless hours of frustration and rework and may even save you some dollars as well. We start off with some general tips that apply to any AppleTalk installation, followed by tips that apply specifically to each popular cabling scheme, and end up with some tips for checking your work along the way.

General Installation Tips

The following tips and hints should apply to all installations, regardless of the cabling type or topology. Some may seem obvious, others more subtle, but all should be taken seriously. An extra hour spent during an installation to avoid a shortcut or to check your work may save you five or ten hours later.

- *Don't begin the installation until the entire network has been planned, researched, and thought out.* Networks can get very complex and can have many interdependencies. Imagine designing a network to link 15 offices, purchasing 15 Local Talk connectors and a custom-wiring kit, only to discover the hard way that the total network cabling exceeds the 1,000 foot LocalTalk limit by 200 feet. Or imagine designing a large star topology network using the wiring already in your building, purchasing PhoneNET connectors and StarControllers, only to find that your phone system already uses all the available wiring. Doing your homework early may save you time, expense, and perhaps embarrassment down the road. Design the entire network first. Read this entire book. Consult with others who may have implemented a similar network—friends, vendors, and your local user group are all good places to go for help and advice. Use whatever advice you can find to assure yourself that the selected hardware and software packages are compatible with each other.

- *Don't take shortcuts.* Take the extra time and spend the extra money to do the job right. You aren't likely to be glad later unless you do. Using a lower grade, less expensive wire or twisting a pair of wires together rather than soldering them may come back to haunt you later and will almost certainly cost you many times the expense or time that you saved.
- *Get all the materials ahead of time.* Look at the purchasing process as part of the design. Actually putting together the "shopping list" and making the purchases may reveal design flaws and certainly helps you understand the total cost up front. For instance, purchasing the wire forces you to know how much you need. Better to discover before the purchase that the wire you are planning to use won't support the distance your network needs to run.
- *Don't skimp on quality.* Again you're not likely to save money in the long run. Many people who saved five to ten dollars per network connector are now having to go back and replace the connectors all together to support the higher speed AppleTalk devices now available. Using lower quality, cheaper cables may work at first, but as the network grows problems can develop.
- *Buy more supplies than you think you need.* Nothing is more frustrating than not having enough materials to do the job. Chances are you'll need more feet of cabling, more network connectors, more of everything than you anticipated. You may discover a faulty connector as you build your network or find a cable with a short in it. Having a few spares can save you time and frustration. Whatever is left over can be used as a spare or will get used when you expand your network (and you almost certainly will).
- *Develop a map of your network and keep it current !* This is one of the most important things you can do. Developing a map may help you identify design flaws before you start. Keeping a map as you install the network helps you keep all the wires and devices straight.

Keeping your map current helps others understand the net and allows someone else to decipher the wiring and administer or troubleshoot the network. A good map includes:

— The location of all devices on the network and their names or some other identifying information.

— A detailed description of all cables, their numbers, and the physical path they are routed along.

— The exact location of any terminators, if applicable.

— The locations of any cabling splices you had to make.

— The locations of any inter- and intranetwork devices (repeaters, multiport repeaters, bridges, gateways, etc.).

— On an internetwork, an indication of all network and zone boundaries, along with all network numbers and zone names clearly marked.

- *Install the network in logical segments.* Check your work as you go. Do a small piece of the network (one electrical bus or a few nodes along a daisy chain, for example) at a time. Before going on, make sure that the network works, especially in the beginning. If you are making an error, better to discover it early before the error is propagated throughout the entire network.

- *Don't push the restrictions of the network.* If possible, try not to push the network length restriction of the maximum number of devices allowed. These are often just estimates, anyway. If, for instance, your phone cabling is of poor quality, you may not be able to reach the 3,000-foot length offered by PhoneNET. Chances are, you may use more cable or connectors during the installation. Designing a network that approaches these restrictions may lead to troubles. Inevitably, you will also want to expand the network later as well. In general, it is a good idea to design the network so that these restrictions are not challenged.

- *Keep wire lengths to a minimum.* The longer the network, the more likely you are to have reliability problems. For a given design, the network will be most robust with the minimum length of network cabling possible. Networks do not typically just stop working as the

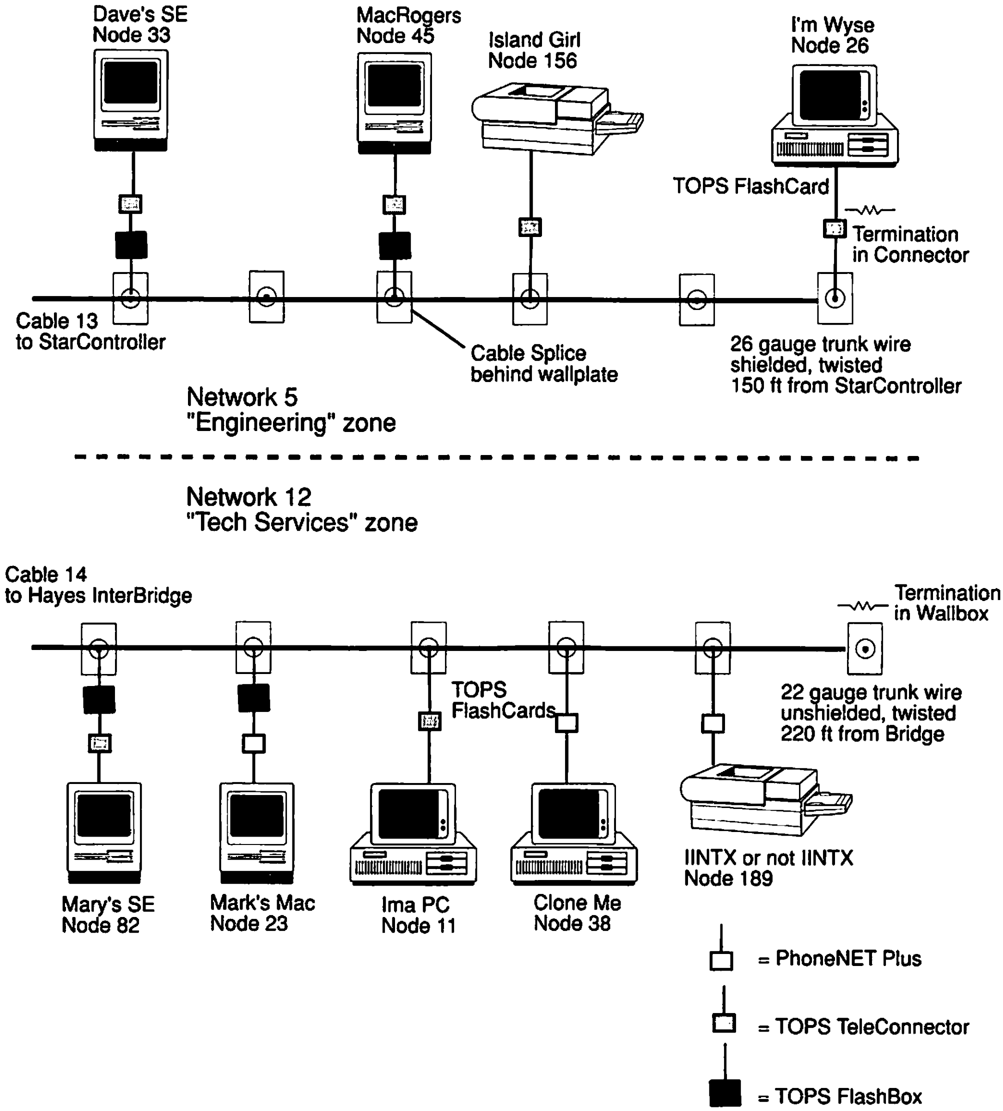

Figure 7-1 Portion of a network map.

cables get too long. Rather, they just get unreliable or slow due to the number of errors generated. As a rule, use just enough wire to go the required distance, leaving perhaps a couple of extra feet so that devices can be moved around slightly. It is better, though, to have to replace a cable that is too short than to build slack into every cable so that none need to be replaced. Also, in no case should you leave extra cabling, especially modular phone cable, coiled up or in a pile. Doing so can cause interference between network signals. If you must use extra cable, lay it out rather than coiling it up.

- *Minimize cable splices.* Whenever possible, make or buy the proper length cable between each pair of devices. Do not, for example, use four pieces of five-foot cable spliced together in place of one 20-foot cable. Each connection, splice, and even a solder joint can cause distortion of the signal or interference with network signals by causing reflections. It is tempting to use a network connector box to join two short cables into one long one, but this should be avoided.

- *Don't hide cable splices.* If you must splice two cables together, leave the splice accessible so it can be examined. Solder wires together rather than joining them with barrel connectors, but try not to hide the connection above ceiling tiles or behind walls. Over time, these connections might become faulty and if you have network problems you may get suspicious. By leaving them where they can be inspected, isolation of a network fault is much easier. Also, as other people take over support of the network, the splices are easier to locate.

- *Label all cables.* It won't take you long to label each cable in a large network, but it may take forever to sort out cables a year from now if you don't. In a simple daisy-chain network, of course, the cabling is very obvious and is rarely hidden between walls. For any cabling that is hidden behind walls and for a star topology or any other where a number of cables come together in one area, it is crucial that you label the cables. The labels may consist of a number cross-referenced on the network map, or they may actually indicate their location (e.g. "to Room 220" or "from Room 216"). In any case, just be sure to label the cables and to keep an accurate map of the network.

- *Make sure there are no loops.* Whether the network is a simple daisy chain or travels between many rooms, be sure to check that the network cables do not form a complete loop or circle. If you do create a loop, the effects should be immediately obvious, as network traffic and response will be very slow, if the network works at all. Educate the users about not creating loops (or changing the network wiring in any way).

- *Use consistent wiring throughout.* Do not switch cable types or switch quality of gauge of wire within the network. Adapter cables, for example, are available for mixing LocalTalk cables with PhoneNET. It is also common to link the wiring in a building (22 gauge) with flat modular phone cable (26 gauge) in a phone-wire-based network. Though the network will almost always function in these configurations, there may be hidden problems. Whenever you mix and match cables, or change quality or gauge of wire, there is an impedance mismatch at the junction that can interfere with the network signals. Wherever possible, use consistent type and quality of wiring throughout your entire network. If you must mix and match 22- and 26-gauge wiring, remember that every foot of 26-gauge wire should be counted as two feet of 22-gauge wiring in determining the total length of the network versus the recommended maximum for 22-gauge-wire networks.

- *Check for firm connections.* Throughout the network, check for and try to ensure firm, tight connections between the cables and the network connector boxes. Use locking connector systems if possible. Though it is fairly easy to diagnose a cable break or a cable that has come out of a connector altogether, it is very easy for a cable to lose its firm connection without coming out of the connector. Check all the connections as you install the network and check the connections when and if any problems arise. Be sure that there is a firm connection at the back of each Macintosh between the printer port and the network connector cable or pigtail.

- *Connect all devices to the network before powering up.* Since AppleTalk devices choose their own node number when they are powered up by communicating with all other devices on the network, it is critical that each and every device be connected to the network when it is turned on. Neglecting to do so may lead to duplicate node numbers and unpredictable results.

- *Ensure proper connections at each device.* Many network problems with Macintoshes can be traced back to a network connector plugged into the modem port rather than the printer port. Many PCs will have more than one DB-9 connector at the rear of the computer. If a particular user is having difficulty with their machine, check the connections at that machine first.

- *Enable AppleTalk at each device.* When a Macintosh is first connected to an AppleTalk network, AppleTalk needs to be enabled or turned on. You can do so by opening the Chooser and clicking on the appropriate button in the lower right hand corner.

LocalTalk Installations

The following tips apply to installations using Apple's LocalTalk cabling (formerly referred to as AppleTalk cabling). Various cable companies are now cloning this system as well. LocalTalk cabling is probably the simplest type of cabling for AppleTalk networks because it can only be used in daisy chains and is self-terminating. However, there are pitfalls to avoid and hints to follow:

- *Keep network lengths short.* LocalTalk cabling has severe length restrictions. Though the wiring is, in fact, twisted pair, the wire is shielded, which increases the signal loss per foot, limiting the maximum length of a network. If your network is much more than 600 feet in length and has a good chance of expanding, you may want to consider unshielded twisted pair (phone wiring) for your network cabling. Also, if you plan to use the higher-speed AppleTalk solutions (FlashTalk from TOPS or DaynaTalk from Dayna), don't forget that the maximum length will be reduced by about a factor of three.

- *Use locking connectors.* One of the most common complaints about the early versions of LocalTalk cabling was that the cables did not lock into place in the connector boxes. If you haven't yet purchased your connectors be sure to get the newer style with locking cables. If you already have the non-locking style, invest in some LocalTalk cable clips from Kensington Microware — they're inexpensive and will eliminate one of the most common causes of problems on a LocalTalk network. Use these clips wherever two cables are joined by a barrel connector as well.

- *Purchase connector boxes compatible with higher speed AppleTalk.* Even if you don't plan to use FlashTalk or DaynaTalk right away, you may need it later. Be sure that the network connectors you choose will support these data rates so that you don't need to replace all your connector boxes. The connectors from Apple support speeds up to one megabit/second.

- *Limit the use of barrel connectors.* Use as few cables as possible. Splicing together two short cables with a barrel connector to form a longer cable may seem to be a good use of materials, but may also invite problems later. Better to purchase longer cables or make them yourself with a custom wiring kit. If you must splice two cables together, be sure to use locking connectors of clips, don't hide the barrel connector behind a wall or above a ceiling, and don't use a network connector to splice together two cable segments.
- *Avoid using LocalTalk/PhoneNET adapters.* Adapter cables are available to join LocalTalk cables to PhoneNET cables. Though this is helpful in an emergency and is probably fine for smaller networks, it is an impedance mismatch between two different cables and should be avoided if possible. High-speed AppleTalk networks will be especially sensitive to the number of cable junctions and impedance mismatches.
- *Don't defeat the network termination.* Though termination is simple and automatic in a LocalTalk network, it can be defeated by leaving stray cables plugged into a connector box at the end of a daisy chain. Termination with LocalTalk connector boxes is achieved by means of a terminating resistor on each port of every connector box. The resistor is disabled when a cable is plugged into the port. A daisy chain has two open ports, one at each end of the daisy chain. If a cable is left in one of these ports without attachment to another connector box, the network will not be properly terminated.

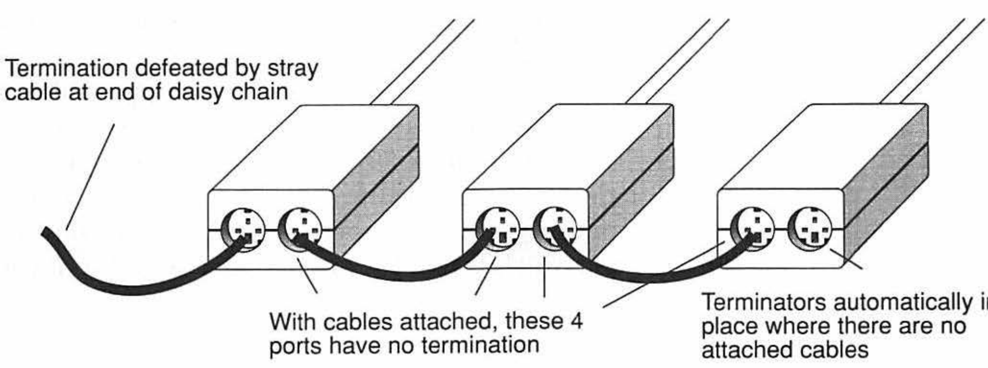

Figure 7-2 LocalTalk termination defeated.

Phone Wire Installations

Networks that use phone wire and connectors (PhoneNET, TOPS Teleconnectors, Nuvotech connectors) offer the most flexibility in terms of topology, network length, and the use of existing wiring. These networks, despite all these advantages, can be very difficult to install and maintain. The most common problems are poor wiring or passive topologies causing reliability and performance problems, improper termination or overtermination, or poor integration with existing phone wires. The following tips should help you avoid these problems:

- *Stay away from passive topologies where possible.* The ability to create topologies such as stars, branches, and trunks is one of the keys to the popularity of these cabling systems. If these topologies are created passively rather than actively with the use of repeaters and bridges, problems can result due to poor signal quality. Poor signals can result in networks that simply don't work, some devices not being able to see each other, inconsistent performance, or just slow performance due to data corruption and resulting retransmissions. Networks that appear to work may in fact have problems that don't become evident until the network grows or you add more branches to a trunk or star topology. Using repeaters and bridges, as explained in Chapter 5, can ensure clean transmission of the network signals despite the topology. Passive topologies are only appropriate for small networks with only a few electrical busses.
- *Use high quality, low gauge wiring.* This might be perhaps the single biggest factor in determining the performance and expandability of your network. Twisted pair wiring is typically either 22- or 26-gauge (sometimes indicated as 22 or 26 AWG), with a lower gauge indicating a thicker, higher-quality wire. The thicker the wire, the smaller the resistance per foot and hence the smaller the signal dissipation per foot. Lower-gauge wire, then, will allow you to reach longer distances with your network. Flat, modular phone cables as used with most phones today and, as supplied with network connectors, are typically 26 gauge. Round, "telco" wiring, as used for most phone systems for the wiring within the walls, is typically 22 gauge. If you use the flat modular cables, beware of what you are buying; most will be 26-gauge, which is fine for most applications, but if you

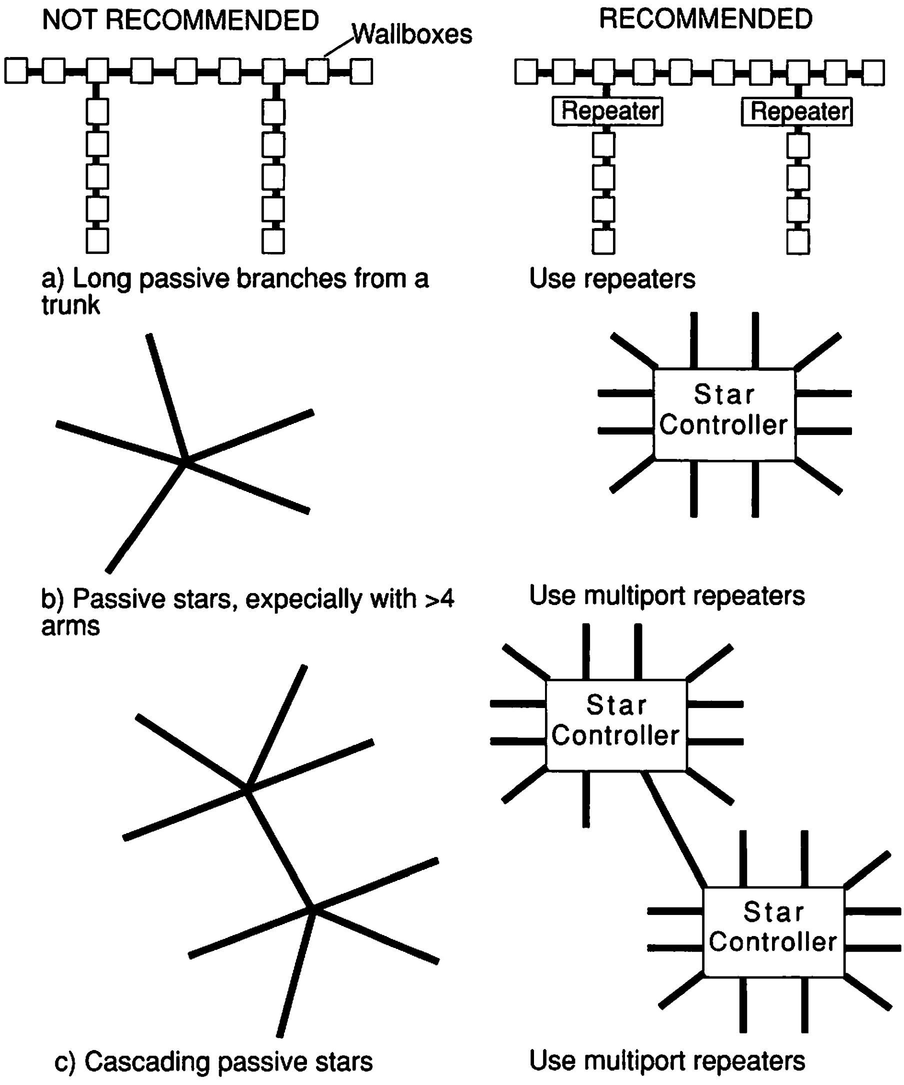

Figure 7-3 Use active devices to create alternate topologies.

can find 22-gauge modular wiring it is preferable. Beware of modular cables that have only two wires rather than four. These can be used only with phones, as the pair left out of these cheaper wires is the pair used for the network signals. Lastly, beware of cables that are not made from solid wires, but consist of twisted-foil braids as the conductor for network signals. These cables have a very high impedance and will not allow for network lengths of any significant distance.

If you plan to used a high-speed AppleTalk implementation (TOPS' FlashTalk or DaynaTalk), or think you might in the future, be careful of larger networks using 26-gauge wiring. The higher gauges (thinner cables) have higher signal loss per foot. As you increase the speed (frequency) of the network signals, the maximum length of the network decreases correspondingly. Since these high speed implementations speed up AppleTalk by a factor of between three and four, the maximum network length will be one fourth to one third of the maximum at the lower AppleTalk speeds. At these lower speeds, 22-gauge twisted pair allows a network length of at least 4,000 feet, while 26-gauge wiring may only allow 1,000 feet total. At accelerated speeds, the maximum for 22-gauge wiring will still be at least 1,000 feet, while 26-gauge wires may only support a network of 250 feet of cable.

Another factor that will increase the reliability of your network is minimizing or eliminating changes in cable impedance. A change in impedance can interfere with the network signals. The most common impedance switch in AppleTalk networks is changing between 22- and 26-gauge wiring, or switching between LocalTalk cables and phone wiring. Many networks start out with LocalTalk cables from Apple and, as the network grows or a topology other than a daisy chain is desired, PhoneNET or other phone-wire-based connectors are purchased along with an adapter to link the two cabling systems. It is often much better to just replace the LocalTalk cables for a consistent cabling type throughout the network. The PhoneNET-LocalTalk adapter causes an impedance switch and should only be used on smaller nets.

It is also quite common to switch between 22- and 26-gauge wiring within a phone wire-based network. Often 22-gauge telco wiring is used to form a backbone or trunk network, or is used because it is the predominant gauge used for telephone system wiring. From these 22-gauge segments, however, 26-gauge drop cables and extensions are attached using the modular phone cables that come with the connector kits. Each time the signal passes between the two gauges of wire, the signal quality may degrade slightly and a reflection may pass back along the wire interfering with other network signals. This does not usually present a problem on smaller networks but can become critical on larger networks, and can be especially critical if you are using a high-speed version of AppleTalk. Switching between 22- and 26-gauge might also cause problems with network length, as each foot of 26-gauge drop cable should be counted as two feet of 22-gauge wire in determining your total network length.

- *Consider making your own cables.* Making your own cables may present many advantages. If you have just a small network within a room, by all means use the modular cables that come with the connectors to form your daisy-chain network. For more complex networks, however, making your own cables can help. First, cable and RJ-11 connectors can be bought in bulk from telephone or electronics supply stores and are quite inexpensive. You can save yourself quite a bit of money versus buying premade cables in 10-, 20-, and 50-foot lengths. To make your own cables, you'll need a crimping tool. The crimping tool is used to crimp the RJ-11 connector onto the cable securely. It is critical that the teeth within the RJ-11 connector make a solid connection with the wire conductors. For this reason, it is recommended that you buy a high-quality crimping tool. Cheap plastic crimping tools are available from Radio Shack and other stores for about $20 but do not always provide a clean crimp. A heavy metal crimping tool that can sink the teeth of the RJ-11 connector cleanly into the wires may cost $75 or more but is well worth the investment.

  Making your own cables also negates the need to join two small cables together when a larger one is not available. It is tempting to purchase dual female RJ-11 connectors to make use of the many short phone wires you will receive with the connector boxes, or to use spare connector boxes to join two short cables together. *In general, however, you should keep the number of cable lengths to a minimum to eliminate unnecessary junctions for the signal to pass through.* Where possible, avoid the use of any dual female connectors or network connectors to splice cables together.

  As much as possible, make the network look like one solid piece of conducting wire to the network signal. If you are creating a trunk with drops or backbone topology, consider ways of using one long wire for the trunk rather than screwing down separate segments of wire between wall boxes. Wall boxes are available that allow you to punch down or crimp the wire onto the proper terminals without cutting or breaking the wire; with this type of wallbox, one solid conductor can be used for the trunk. If this is not possible, consider soldering the segments of wire together to reform a solid trunk.

- *Keep cable lengths to a minimum.* If you make your own cables, this is easy to do because all of your cables can be custom fit for the network. Leave only enough extra cable to move devices around slightly. If you find later that a cable is too short, you can make or buy a new one. Better to have to replace an occasional cable than to make all cables long enough to move devices around significantly. This could lead to problems later as your network expands or you try a higher speed AppleTalk implementation. Using a long cable where a short one will do can also mean piles of cables behind desks and along walls. *Since telephone wire is unshielded, coils of cables can lead to interference of network signals and should be avoided.* You can consider using shielded twisted pair cabling, but doing so provides very little advantage while reducing the maximum length of the network by about 30 percent. Just as with LocalTalk cabling, there should not be any cables that are only plugged in at only one end. Network cables should run only between connector boxes or between modular wall jacks and connector boxes. If you have a trunk network with modular wall boxes for connection to the trunk, don't attach a drop cable to the wall box unless it runs to a connector box. Doing so creates a needless side branch in a passive topology. Similarly, with a daisy-chain network, don't place a phone cable in the spare port at the ends of the network. Terminators belong in this port; placing a cable there prevents proper termination of the network.

- *Keep installations away from high voltage sources.* Although AppleTalk frequencies are outside the normal operating range of most radio, high-voltage power, and other electrical and electronic devices, it is best to keep the network wiring and devices away from such energy sources if possible. It is typical for multiport repeaters, bridges, repeaters, and other network devices to be located in telephone closets, computer rooms, and other machinery rooms. When this is the case, keep the network equipment together and as far away from potential sources of interference as possible.

- *Use a TDR to verify installation if possible.* Although Time Domain Reflectometers (TDRs) are a rare and complex piece of equipment, if you know someone who has one or who can set up an oscilloscope on your network, it may be very revealing to see how good your wiring is. Oscilloscopes can show you the signal waveform on the network and can reveal problems that are causing the signal to degrade in either strength or form. TDRs are like a radar for the network wiring, showing you a "picture" of a network pulse as it travels down the wire towards the terminator. A TDR can show whether or not you are terminated properly, whether there are any bad junctions causing reflections, and what the exact length of your networks are. These extreme means are by no means required to install a phone-wire network, but they can be very helpful in diagnosing problems or discovering them before they reveal themselves later. If you have access to these devices and to people who know how to use them, by all means take advantage of them. If you are having your network installed from scratch by a professional network installer, insist that these tests be performed before you sign off on the work.

Terminating Phone-Wire Networks

Proper termination of the network is possibly the most critical part of the installation process for insuring future reliability and performance of the network. It can also be one of the most difficult installation processes. Although phone-wire cabling/connector systems support complex topological configurations (often the reason for using phone wire systems), termination of these networks is not necessarily automatic or straightforward. Phone-wire networks that do not self-terminate are terminated by placing RJ-11-mounted resistors in appropriate ports on network connector boxes or by placing resistors across the network wires within wall boxes and wall plates, as necessary.

Termination of daisy-chain networks is easy: Resistors are placed in the only open ports of the connector boxes, one at each end of the network. For more complex networks with no passive branches (stars with multiport repeaters, daisy chains connected by repeaters, etc.), the many electrical buses are well-defined and termination is relatively simple—each end of each bus must be terminated. For networks with passive branches (passive stars, trunks with long side chains, etc.), the electrical buses can be quite complex topologically. In this case, termination of the bus is made in from two to four places along the longest segments of the electrical bus.

Topology	Termination
Daisy Chain	Use RJ-11 mounted terminating resistors. Place in available RJ-11 port at each end of the daisy chain.
Trunk	Use RJ-11 mounted terminating resistors in available RJ-11 port at each end of the trunk (either in the wallbox if unused, or in the network connector attached to the wallbox. Alternatively, install bare resistors across both network wires inside wall boxes at each end of the trunk.
Any using Repeaters	Treat the wiring on each side of the repeater as a separate electrical bus and terminate independently, according to guidelines in this table.
Active Star	Treat each arm from the multiport repeater as a separate electrical bus and terminate independently. Terminate at the far end of each arm using either RJ-11 mounted resistors or bare resistors as appropriate. Terminate at the near end using internal termination within the multiport repeater.
Passive Star	Do not configure with more than 4 arms from the center of the star. Terminate the longest 2–4 arms, using RJ-11 mounted resistors or bare resistors as appropriate.

Figure 7-4 Termination of phone-wire based networks.

The following guidelines should assist you in terminating your phone wire network properly:

- *Consider self-terminating connectors.* Nuvotech manufactures a self-terminating variety of network connector, while still allowing as much topological flexibility as other connectors. The Nuvotech TurboNet ST also has a network activity light, which assures you that the connector is functioning properly. They also claim that the self-terminating characteristic of the connector does not affect the maximum network achieveable with the connector. Farallon does not recommend using these self-terminating connectors with their StarControllers.

- *Be careful not to overterminate.* If you are using a simple daisy chain or have daisy chains connected with star controllers or repeaters, it is not possible to overterminate the network: Any open ports on connectors should have a terminating resistor in them. With passive arrangements, and especially with trunk and drop configurations, there will be many more open ports than resistors. Ideally, the network should have two terminating resistors, but in larger passive nets this may not be sufficient. Never use more than four terminating resistors on a single electrical bus. Doing so will drain so much of the signal strength that not all devices may be able to communicate with one another.

- *Consider permanent termination.* One of the problems with RJ-11 mounted terminators is that they tend to "grow legs" or "walk." Users unfamiliar with the subtleties of the network may remove a terminator (or add one) in the belief that one is unnecessary or that it will fix a problem. If your network uses the existing phone wire, terminators can be installed in the wall plates at the ends of electrical busses or long wire segments. If you have a trunk with drops configuration with RJ-11 wall boxes for connection to the trunk, terminators can be installed within the wall boxes at the end of the electrical bus. Doing so virtually eliminates the possibility of terminators being removed from proper locations, but also hides them from your view. Be sure to note on the wall plate or wall box that the resistor is installed behind or within it, and note the locations of terminators on the network map you have been faithfully creating. Regardless of how and where you terminate your network, you should plan on walking the network regularly to check for resistors that have been added or removed without your knowledge. In any case, you should not distribute your precious supply of terminators out to the public, as you will certainly find them to the net at improper places if you do.

Sharing Cabling With the Phone System

Here are a few tips to follow if you are considering using existing wiring from your phone system. Remember that phone system wiring is generally in a star configuration, sometimes referred to as "home-run" wiring because each office or phone outlet has its own dedicated pair of wires that runs directly from that location to the phone closet or wiring cabinet. Installed wiring thus lends itself to a star topology and thousands of locations have installed AppleTalk networks in star arrangements, both passively and actively, using the Farallon StarController. When using this existing wiring, however, here are a few tips to help you along:

- *Consult with your phone system installer/maintainer.* Phone systems can be quite complex and very different from one another. Although most buildings have at least two pairs of wires running to each location and most phone systems only use one, this is not always the case. You may not have a spare pair of wires for the network, either because the only pair installed is in use or because your phone system requires more than one pair for each location. Even if you are sure this is not the case, a phone system expert should be consulted for a couple of reasons: You may not be allowed to use the wires even if they are not in use, and you can help ensure that your network is not modified or disabled without your knowledge if everyone who may work with the wires is aware of the network.

- *Keep the phone wiring separate from the network wiring.* It is important to keep the two systems separate, not only so they don't interfere with each other but also to minimize the risk that someone working with one system affects the other system. Keep the jacks separate from each other and mark them clearly so devices are not plugged into the wrong wires. It is tempting to plug a splitter into an RJ-11 jack for the phone system and plug the phone into one side and the network into the other, but the proper method for isolating the two systems is to wire each pair of wires separately to its own RJ-11 jack.

Dual RJ-11 wall plates are commonly available and make for easy segragation of the systems.

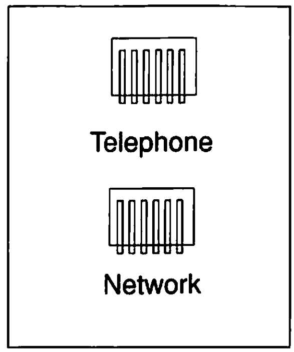

Figure 7-5 Dual phone/network wiring.

- *Use high quality phone wire accessories.* Make sure that all the wall plates, wall boxes, splitters (not recommended in any case), dual female connectors, and any other phone-wire accessory you purchase for the network is of high quality, and supports four wires.

Ethernet Installations

We will spend very little time discussing Ethernet installations. The predominant AppleTalk network cabling schemes are those for LocalTalk networks. Ethernet networks are not as simple to install as LocalTalk networks are, and are generally installed and certified by a professional network installer. The following general rules apply to Ethernet installations, however:

- Standard (thick) Ethernet, which consists of a long, continuous conductor with attached transceivers and drop cables from transceivers to attached devices, has the following restrictions: network cable maximum length of 500 meters (1,640 feet), network cables joined by repeaters for a maximum of 2,500 meters (8,200 feet), maximum transceiver drop cable length of 50 meters (165 feet), and 1,024 stations on the network.
- Thin Ethernet cabling, which consists of smaller diameter, more flexible coax cabling, uses network cables joined with a simple "T"

connector that attaches directly to the network device, has the following restrictions: maximum cable segment length of 185 meters (607 feet), maximum network length of 925 meters (3,035 feet), minimum distance between stations of 0.5 meters (1.6 feet), maximum number of attached devices of 30 per segment and 1,024 total.

- Twisted-pair Ethernet cabling, which must be connected in a star topology from a hub device, has the following restrictions: maximum cable segment length of 100 meters (328 feet), and only one attached device per segment (each node requires a dedicated port from the active hub).

Internetwork Installations

If your network is large enough to contain multiple networks joined by bridges and gateways, you have an internetwork and some special installation and configuration tips apply. AppleTalk networks can be quite simple to install and maintain, especially for smaller, less complex networks. One of the reasons they are easy to install is that they configure themselves to a large extent. This is not true in the case of an internetwork: Bridges and gateways must be configured by hand by the installer or network administrator. Generally, these bridges and gateways come with a management software tool that allows you to designate zone names and network numbers, along with other configuration data that might apply. In general, all the rules and tips mentioned so far will apply to each of the interconnected networks. Follow these carefully before configuring your internet. *Each individual network should be planned, installed, and checked independently before a bridge or gateway is installed to allow communications to another network.* Unless you convince yourself first that the individual networks are operating properly, problems that occur on the internetwork may be difficult to diagnose. The following steps will help ensure that your internetwork operates smoothly.

- *Plan all of the network numbers and zone names before configuring any bridges or gateways.* Be sure to plan the entire internet before beginning the configuration process. Read all of the manufacturer's manuals for the bridges and gateways you will be using, as some of these devices have very subtle configuration options that you may need to take note of. In the process of planning the internet configuration, you will need to choose zone names and network numbers carefully. Although zones are optional for internetworks, you are required to choose a network number for each connected network. Pick all of these before configuring any bridges or gateways, as you may notice a more logical set of names/numbers as you complete the planning process.

- *Locate shared devices logically.* Try to place devices that will be shared (LaserWriters, modems, file servers, etc.) where they will be most convenient and where network traffic will be minimized. If a particular group will be the primary users of a printer, consider locating it on their network to minimize traffic, and, potentially, to locate it most convenient to those who will use it. If you have a backbone or central network, consider locating devices shared equally by many networks on the backbone. If there is only one file server or network modem for an internetwork and no one group is the predominant user, it might make sense to locate it on the backbone network. Ultimately, the location of devices is a decision influenced by the network traffic generated to and from the device and the most logical physical location of the device.
- *Choose network numbers carefully.* A bridge or gateway is the communication link between devices on two distinct networks. The network on either side of this link must have a different network number. Single networks have no network number; devices are distinguished from each other on the basis of node numbers. When two networks are connected, a network number is added to the node number of each device to give each and every device on the internet a unique "address." The following tips apply to choosing network numbers:
    - Do not duplicate network numbers anywhere on the internetwork. If network number 1 is configured there cannot be another network 1 anywhere on the internet—even if the two are not directly connected. One of the ways this can happen is when two networks or internets are connected together via a remote link—duplicate network numbers can be inadvertently connected to each other. The other way this might happen is if you enable a new bridge or gateway on

your internet without first configuring it. The bridge or gateway's default settings may conflict with an existing network. In general, bridges and gateways should be configured on an isolated net before being enabled on the internet.

— Consider starting with network number 1 and continue sequentially. Network numbers can range from 1 through 65,534 (don't use 0, —it is invalid). Often, choosing small, simple numbers will help you remember which is which. If you have a backbone network with many networks attached to it, you might want to designate that as network number 1 and begin numbering the attached networks from 2 on.

— If a number of bridges are attached to a single net, as would be the case with a backbone network, be sure that all the individual bridges set the network number of the common network consistently (note Figure 1-6). Each bridge or gateway contains the network number of both nets it is attached to. In fact, the bridge is continually trying to "set" the network number of both nets by sending out special "routing" packets that identify the network number. These routing packets can come from many bridges and must be consistent on a single net in order for network software to function properly.

— If you are connecting AppleTalk networks to Ethernet networks and plan to route packets between devices on each net using the TCP/IP protocol (the predominant communication protocol on Ethernet), some special rules may apply. Some of the AppleTalk-EtherTalk bridges currently available can also be configured as a TCP/IP gateway as well. Doing so, may however require that the AppleTalk network look like a subnet of the Ethernet network. The KIP (Kinetics Internet Protocol) protocol prescribes how packets are routed in such configurations. The network number and node number of the AppleTalk device is embedded in its TCP/IP address. Because the Ethernet network administrator may have a narrow range of TCP/IP addresses available for your AppleTalk network, this address may dictate what the network number of the AppleTalk net must be. Configuring gateways for this sort of communication can be quite

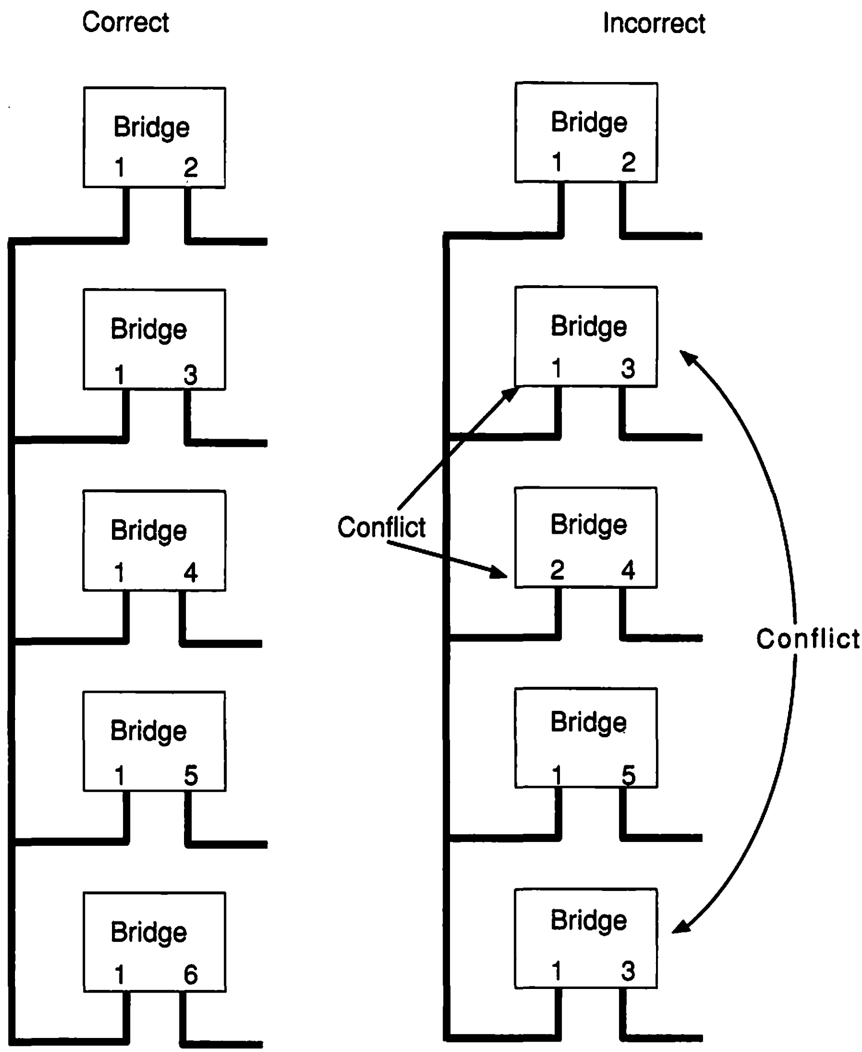

Figure 7-6 Unique network numbers required.

tricky—read the manufacturer's guidelines carefully to ensure proper configuration.

- *Choose zone names and boundaries carefully.* Before choosing zone names or boundaries, try to predict which groups will work most closely together and will need to communicate most often on the network. You will use this information to decide which groups to place in the same zone. Zones serve two purposes: to divide devices on an internetwork into logical groups, and to limit internetwork traffic. Zones are defined only at network boundaries, but do not need to be contiguous. A zone may consist of many networks, but all devices in a single network will belong to the same zone. Note that all the configurations shown below, dividing the same internetwork into zones, are legal.

Zone boundaries should be determined by the traffic study/speculation you perform. If possible, configure zones so that groups that work closely together are in the same zone and network resources used by that group are also located within that zone. When these network resources are accessed by the users through the Chooser or

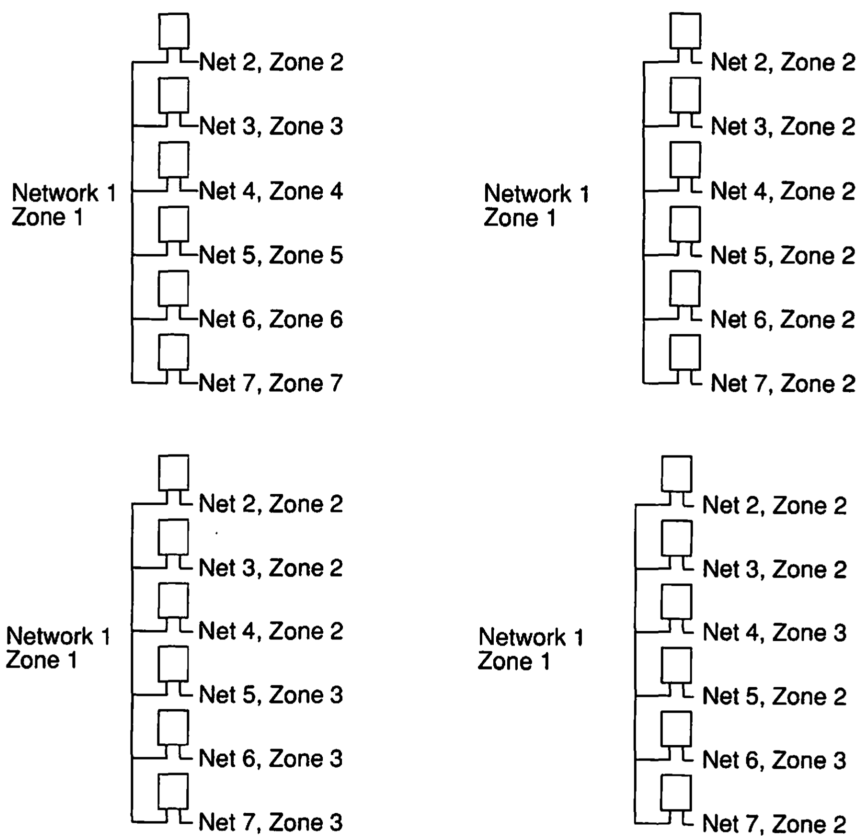

Figure 7-7 Configuring internetworks into zones.

other network access software, the default zone selected will be the local zone of that user. If the commonly used network services (printers, file servers, modems) are also located in the local zone, accessing them is simplified.

Zones are optional on internetworks and may not be needed on smaller internets of two or three networks. Beyond this level of complexity, however, zones are highly recommended because of the network traffic optimization they provide. Remember from our discussion of AppleTalk communications in Chapter 4 that broadcast packets are used to locate devices of a given type on a network. On a large internetwork, there may be many people at any given time who are searching or browsing the network for resources. The broadcast packets and their responses could flood the network if they traveled on each and every network in an internetwork. Conveniently, broadcast packets travel only to the networks within the zone for which they are intended. Thus, dividing an internet into zones, each containing only one or two networks, can help manage traffic on the network.

Once you've decided if and how to use zones on your internetwork, use the following guidelines in naming your zones and configuring the bridges and gateways:

- *Use logical names for your zones, clearly defining the devices and people in the zone by workgroup, geographic location, or whatever designation makes sense for your network.*
- *Be very careful of the spelling of the zone name.* If the same zone name is specified in more than one bridge, as would be the case in a backbone network or any time a zone contains more than one network, the spelling of the zone name in each bridge must be *exactly* the same. Capitalization, spacing, even leading and trailing spaces make all the difference. Many network problems end up being traced back to zone names that on the surface look similar but have subtle differences. If a particular net has more than one bridge or gateway on it, there will be more than one source for the zone name for that net (just as there was for the network number). If the two bridges are defining conflicting zone names for the same network, unpredictable results may occur.

- *Avoid using the symbols "=" and "*" in zone names.* This may seem odd, and there is nothing specified in the AppleTalk protocols that warns against the use of these characters, but nonetheless they can cause problems. In an AppleTalk packet these symbols in an address have special meaning. The "=" symbol is used as a wildcard for a device name. The "*" symbol is an abbreviation for the local zone name. For instance, the following address within an AppleTalk broadcast packet, =.*.LaserWriter, would specify that LaserWriters of any name in the local zone should respond to the packet. At any rate, some software interprets these symbols embedded into zone names incorrectly, and so their use is not recommended.
- *Enable bridges and gateways one at a time.* Once each individual network is configured and checked, and the bridges and gateways have been configured, the internetwork can be established by powering on or enabling the bridges. You should do this one bridge at a time, stopping to check your work and all internet communications before continuing. If you instead turn on all the bridges and gateways and a problem is found, you may have trouble knowing where to start looking.
- *Document configuration settings.* Some bridges and gateways have a number of configuration parameters other than network numbers and zone names that must be specified. It is a good idea to keep a record of every configuration setting for every bridge. Someone else may need to administer the network later and documentation always helps. Devices can fail or lose their configuration data and will need to be reconfigured. If the bridge manager software includes the ability to save configuration data to a file, do this and keep backups. If it does not, keep a log of all configuration settings. If you are the network-support person and a bridge fails, you will be very glad that the configurations can be recovered quickly while frustrated users breathe down your neck.

Checking Your Work

Although many of the steps listed in this chapter consisted of checks on your installation work, the following tips summarize some of the techniques to be used:

- *Proceed logically from smallest to largest entity as you check your network.* Start by checking each electrical bus in the network for continuity (signals will pass from one end of the bus to the other along each wire), check for shorts (signals do not pass from one wire to the other when the network is unterminated), and check for proper termination (install the terminators and check from each end of the bus for proper resistance across the pair of network wires). Do all of this with a handheld digital voltmeter before attaching any devices to the network. If possible, attach a TDR to each electrical bus and check for proper signal attentuation and termination. Finally, attach some devices to the network and check for communication across the network.

  Next, connect the electrical buses to each other with repeaters or multiport repeaters, as appropriate. Enable these devices and check that devices on any electrical bus can communicate with devices on other electrical buses. Finally, build the internetwork if you have one and configure and enable all bridges and gateways. Check for good communications between networks.

- *Use whatever methods you have available to verify proper communications on the network.* In Chapter 10 we list all known available network diagnostic tools. Use these to verify that your installation is working correctly. One of the best ways to verify the network's functionality is to move a few Macs around on the net to check for communications. Be sure that you power on the Mac after attaching it to the net, and be sure that AppleTalk is enabled in the Chooser. The following list describes some easy ways to verify that communications are indeed taking place:

  — Attach a network printer (Laserwriter, AppleTalk Imagewriter) to the net and see if it can be seen from all locations on the net.

  — Look for some other network resources from locations throughout the net. Devices you might use would be a network modem of a file server running AppleShare.

  — If you use TOPS, publish a volume from every station and then browse the network from each station and see if all other TOPS nodes can be seen. This is a nice test because communications between every pair of TOPS nodes is tested.

- If you have a program like Peek or TrafficWatch that directly measures network traffic and monitors packet errors, make use of it and more directly measure the performance of the network.
- Use any of the many other network troubleshooting aids mentioned in Chapter 10 to verify that the network is performing well.
- If you are using higher-speed AppleTalk implementations, be sure to check the network between nodes using the diagnostic software provided with the hardware. Testing at higher speeds will put more strain on the network and may reveal problems that go unnoticed at lower AppleTalk speeds.

Chapter Eight

Maintaining Your AppleTalk LAN

Introduction

Now that your network is installed and running, the maintenance of the network begins. Maintaining an AppleTalk network is not necessarily a big chore—after all, AppleTalk is known for its eas -of use and low maintenance. In fact, if your network is fairly small, say four to five computers and one LaserWriter used for simple file and print service, you may not need to worry at all about maintenance. Many large AppleTalk networks, with hundreds of nodes and very complex topologies and network hardware, have one or more people who work full time maintaining the network and helping the users of the network. Although the demands of maintenance for the network will vary with the size and complexity of your network, the principles are the same regardless of the size. In this chapter, we explore both preventive maintenance and troubleshooting techniques.

Preventive Maintenance

The following tips and suggestions all fall into the preventive maintenance category—they will aid you in preventing problems on your network and will help you solve problems more quickly when they do arise. Most of these suggestions are simple to implement and not very time consuming. Not following them can be very time consuming, as you try to solve a problem without the proper documentation or without backup files for device configurations. Network problems, of course, happen at the worst possible times—Murphy is a network user. If you are the administrator of a network, the users will be relying on you to keep their network running and to fix it quickly when problems occur.

- *Regularly check the termination of the network.* Probably the most frequent problem that occurs with a network is that the termination of the network is changed somehow. If you have a very small network, or one with self-terminating connectors (Apple or Nuvotech), this may not be an issue. Larger networks can have problems with the termination, though. Many users will tend to move network equipment around or add new equipment to the network, and will also tend to try to fix problems themselves. Either one of these situations can lead to people fiddling with the terminators. A terminating resistor will get removed from a location or one may be added where it is inappropriate. In a network topology other than the daisy chain, many of the network connectors will have an unused port where a terminating resistor could be added.

A couple of preventive measures can be taken to avoid problems with your termination. First, don't distribute terminators among network users. If you are the administrator, keep all the extra terminators in one safe place so others won't be tempted to add them to the network. Secondly, periodically check the termination of the network visually. Walk the network and see if all the resistors are where they should be and there are no extras. Look at the entire network to see if there are just as many terminators as you should have, no more, and if they are in the proper places. You'll be able to refer to the network map you've been keeping faithfully to refresh your memory on where they belong. The frequencies of the walk-throughs should be dependent on how complex the network is and how much of a tendency there is for the termination to change. The more often there are problems with the termination, the more often you should do your walk-throughs, at least until the problems are solved and the users are trained.

- *Keep your network map up to date.* The map of your network is your bible—and anyone else's who has to take over administering the net or who does so in your place. The network map will be continuously changing for most networks—new computers and peripherals are added to the network, people change jobs and offices, offices move, etc. For a number of reasons, networks tend to change. Keeping the map current with these changes will save you or someone else a lot of time down the road. Make it a habit to change the map every time you change the network and bring the map with you on your walk-throughs of the network to verify that it is up to date.

- *Backup, backup, backup.* We cannot overemphasize the importance of backing up critical network data. This is not as much a preventive measure as it is one that will lessen the impact of network problems or will allow you to solve them faster. All critical network data, whether it is the files and applications from a file server, the stored mail files on a mail server, or the configuration file for a network device like a bridge or gateway, needs to be backed up regularly so they can be restored easily in case of a problem. Some of the files are your direct responsibility, like the configuration files for bridges and gateways. No one else should be modifying them, so it should be fairly simple to keep current copies archived. Other, more general-use files like those on a file or mail server should be backed up at some appropriate interval. The importance of the data in the event of a catastrophe (however unlikely or infrequent) should determine this interval.

- *Follow the guidelines from Chapter 7.* As your network grows and changes, you will be modifying it. The guidelines from Chapter 7 apply equally well to the evolution of your network as they did to the initial installation. Continue to follow the guidelines for wiring, topology, termination, etc. to help ensure that network maintenance will continue to be a small chore.

- *Maintain consistent software versions throughout the network.* Keeping all network users standardized on one set of network software—System and Finder, LaserWriter drivers, TOPS software, print spoolers, serial device drivers, etc.—will help to minimize the number of problems your users experience. If possible, use consistent System and Finder software on all machines on the network. Older machines, such as 512K Macs, may not support the newest releases, but the other machines should be kept consistent to avoid interactions and incompatibilities between the machines and to simplify the network administration tasks. You also may not want to rush to install a new System/Finder just because Apple has released a new one. Give them some time to shake the bugs out on other people's networks. Evolving to a new System and Finder can be a lot of work for the network administrator—do it in a deliberate and planned fashion and don't do it needlessly.

  LaserWriter drivers can drive network users crazy. LaserWriter use requires two files: LaserWriter and Laser Prep. The LaserWriter file is used locally to generate the print files sent to the LaserWriter, whereas the Laser Prep file is sent across the network to the LaserWriter and is stored there. The Laser Prep file only needs to be sent to the printer once each time the printer is turned on. The Macintosh system software and most print spoolers will notify you when it needs to be downloaded and will either do it for you or explain how to do it. Many networks never turn off their LaserWriter so they don't need to worry about initializing it with Laser Prep. The LaserWriter and LaserWriter Prep files have been modified many times by Apple and must be consistent with each other for printing to work correctly. When the LaserWriter files are not the same on all machines, users will have problems printing and LaserWriter wars will ensue: Whoever needs to use the printer at the time will reinitialize it with the Laser Prep file appropriate for their LaserWriter driver, and users will be fighting each other. Sometimes the problem only manifests itself with arcane error messages returned from the LaserWriter. At any rate, keeping one, and only one, version of the LaserWriter and Laser Prep file installed on the network will avoid all of these problems.

Apple sells a network administration tools called Inter•Poll, which helps the network administrator manage this task. By installing a piece of software called the Responder in the System File of each Macintosh on the network, the administrator can run Inter•Poll from his or her machine and remotely check the System, Finder, LaserWriter, and Laser Prep file versions of all machines on the network. Running this sort of check regularly will help you track down problems that are brewing on the network.

You should also check that each Macintosh on the network has one and only one System Folder on the machine. Many times users installing applications will also copy the System folder from the floppy to their hard disk, leaving them over time with a number of these folders on a single machine. Some network software, and the Macintosh in general, can get confused by this and behave inconsistently. Check regularly to see if this is the case. Inter•Poll will not help you here (it only reports the version numbers of the active System and Finder), but you can run Find File on each system and search for "System" to see if there are duplicates.

It is just as important to keep other network software consistent across the network as well. File service, print service, electronic mail, and other network software should be kept consistent on all machines. Doing so will not only help prevent some problems, but will also make your job simpler by only requiring you to be familiar with one version of each piece of software.

- *Keep in contact with the vendors of your network software and hardware.* Staying in touch with the vendors of your network hardware and software can also keep you out of trouble. Make sure you are aware of the latest versions of their products by *REGISTERING YOUR SOFTWARE AND HARDWARE.* Very few people do, though without this information it is impossible for the vendor to notify you about problems that are found, or to let you know when a new version becomes available. If they have a technical journal or tech notes you can subscribe to, do so. Call up their electronic services to see if there are new files or announcements of interest. Keep up with them through the trade journals and at trade shows.

  Make use of their technical support groups, but do your homework first. Try to fix the problem yourself, make sure you know which product is causing the problem. Read through the troubleshooting portions of the manual first. If you do need to call, be sure you are familiar with your network, you have your up-to-date map handy, and you are at your computer.

- *Familiarize yourself with network diagnostics.* Some products you purchase will come with diagnostic software. While it may not seem necessary on the day you install the product, familiarize yourself with the diagnostic software. It may help you verify that the installation was done correctly. You may also save time later in diagnosing a problem if you are already familiar with the diagnostic utilities. You might discover a part of the diagnostic software that you want to use periodically as a preventive maintenance technique to catch subtle or early indicators of a problem on the network.

  In Chapter 10 we discuss some of the packages that are available strictly for network diagnosis and troubleshooting. Familiarize yourself with the tools available to help you and purchase the ones that sound most helpful for your network. The cost is generally minimal, especially compared to the cost of your time (and others) in tracking down network problems and lost productivity.

- *Periodically perform network traffic studies.* Regularly looking in some detail at the amount and quality of traffic on your network can alert you to problems and keep you aware of how much your network is being used. Using Traffic Watch from Farallon or other similar programs will allow you to track how much total traffic is on the network, track which nodes are speaking to which, and perhaps most importantly track how many errors and bad packets are on the network. Tracking total traffic will alert you to the use patterns of your network—if total traffic increases by 10 percent per month, for example, you should begin investigating higher bandwidth solutions or the use of bridges and gateways to keep network performance from degrading.

If you are already using bridges and gateways, familiarizing yourself with which nodes are talking to which, and how much internetwork traffic there is in general can help you decide how best to utilize network resources. If one user is talking to a bridge almost all the time, perhaps they are on the wrong network. If an entire network talks to a bridge constantly, perhaps there is a resource such as a LaserWriter or a file server that should be moved to their network. Knowing this sort of information will help you prevent degradation and perhaps optimize the performance of your network.

Looking at the error counts on your network will alert you to problems on the physical network. A change in error rates or abnormally high error rates can indicate a termination problem or an open or shorted pair of wires on your network. Be sure to check these error counts regularly, make sure they are acceptably low (no more than one to two percent bad packets), and that the error rates do not change appreciably with time.

Utilities like CheckNet from Farallon, or other utilities that let you "search" the net for all available devices and services, are also useful to run periodically. CheckNet will show a list of all devices and services found on the network. Familiarize yourself with what should be in the list and then run the search periodically to see that all is well. If something is missing or looks incorrect, investigate. This is also a good way of monitoring the network for additional devices and services that have been added without your knowledge. Finding these ahead of time will help you to ensure they are configured properly and may help you keep your network map up to date.

To help in analyzing the data presented by these diagnostic utilities, it is helpful to ensure that each device is named logically (and each

Mac has a logical name entered in its Chooser). It can also be helpful, especially with programs like Traffic Watch, which show node-by-node traffic counts, to "set" node numbers in some logical fashion. Although AppleTalk devices do not require you to pick a node number for them, there are a number of utilities listed in Chapter 10 that allow you to "set" node numbers for each Macintosh. You could number the Macintoshes sequentially along the network, for example, to aid in your analyses.

Network Troubleshooting

Despite all your best efforts in designing and installing your network and faithfully following the preventive maintenance tips discussed in the last section, you will have problems with your network. Careful design, installation, and maintenance will minimize the problems you experience, but will not eliminate problems altogether. In this section we identify common problems and offer suggestions as to how to troubleshoot and correct them.

There are some broad categories into which almost every problem will fall. These categories include:

- *User misunderstanding or error.* Quite often, users will report what they perceive to be a problem on the network when in fact they simply don't understand how a particular device or service works or how to access it. The network administrator should provide training classes, make documentation and quick reference material available, and try to pass on as much information as possible to minimize user confusion and frustration.

- *Problems or incompatibilities within a workstation.* Networks consist of the workstations (Macs, PCs, etc.) on the network along with network services. These network services are implemented through dedicated hardware devices attached to the network, centralized services running on a workstation, and distributed services running on many or all workstations. Since the software on any given workstation typically consists of a variety of packages from third-party vendors, only some of which are related to the network, incompatibilities can arise. When a problem occurs while attempting to access a network service, the natural tendency is to assume there is a problem with the network itself. Often, however, the problem has nothing to do with the network, but is an interaction between software packages within the machine. Often, upgrading to the latest version of software or reinstalling the system software on a Macintosh will clear up the problem. The solution, however, is trial and error since it will usually not be clear which two packages are interacting with each other.

- *Problems with the physical network*—the cabling, connectors, termination, internetwork devices, intranetwork devices, and other network devices. This is actually one of the most common sources of problems on AppleTalk network. Problems occur either because a mistake was made in the design or installation of the network, network use is different than anticipated, or something along the physical network has changed (someone unplugs a cable, adds an extra terminator, turns off the power to a routing device, etc.).
- *Problems with the network services themselves.* This is usually the first place fingers are pointed when problems occur but may in fact be the least likely place to find a problem. It is much more likely that a reported problem is not the result of a failure of that service, but is caused by user error, by an interaction between software packages within the user's workstation, or by a problem with the physical cabling and devices that make up the network.

The first challenge in troubleshooting a network problem is in isolating the source of the problem. Often this is the most challenging part of the correction process. Once the problem is isolated and identified, correcting the problem is often quite simple. The following steps will help you in isolating the source of your problem:

- *Check the local network connections.* You might be surprised how often a network problem is reported that is caused by a loose network connection or a network connector that is plugged into the modem port rather than the printer port. If you are using a network interface board or a SCSI network connection, be sure that the appropriate selection within the Network Control Panel is chosen.
- *Attempt to recreate the problem at another workstation on the network.* If you suspect that a problem exists with a particular service or device, try to use the service from another Mac or PC on the network. If

you are successful from that workstation, the problem is likely to be either within the original workstation or with the network cabling system. If you are unsuccessful from another machine, the problem is probably not within the original workstation, but a problem with the network or with the service itself.

If the problem does not appear to be local to a single workstation and you have an internetwork, try accessing the service from machines on different networks or zones. The results will often tell you whether or not the problem is with one of the internetwork devices. Accessing the services from one network but not another may indicate a problem with the bridge or gateway connecting the two networks. If you suspect a problem with your bridges and gateways, try accessing other services that require information to pass through the bridges and gateways. A problem with a bridge or gateway will normally prevent all traffic flow, so other services that depend on the bridge or gateway will be disabled as well. If the problem appears to be isolated to only one service, the problem is likely to be at the service itself and not on the network.

If you have intranetwork devices (multiport repeaters and repeaters), try accessing the service from another electrical bus. Success from some, but not all, electrical busses may indicate a problem with the repeating devices. Problems that do not appear to be local to a single workstation or to any particular electrical bus are more likely to be the result of a failure of an internetwork device or a failure of the network service itself.

- *Try another workstation at the same location.* If the problem appears to be local to a single workstation or if it is unclear where the problem is located, try another machine at the same location. Find another machine that is known to work with the desired service. Swap it in at the location where the problem was reported and attempt to use the service. If the network service is still unavailable, the problem is not likely within the workstation, but is a problem on the network, or at the network service itself.

  If you can use the network service by substituting a different machine, the problem is most likely within the original workstation. Check the configuration, if any, for the network service at the workstation or reinstall the software. Look in the user's guide for troubleshooting tips. If the problem does not appear to be with the network software itself, it may be a result of an interaction or incompatibility with another piece of software in the machine. Reboot the machine with another system (from floppy) and attempt to use the service. If you are still unsuccessful, you may have a basic incompatibility between the version of System/Finder and the version of the network software you are using. Call the vendor for more information. If, however, using a different system clears up the problem, the problem is most likely either an interaction with an INIT (software that loads itself whenever the Mac boots) or is the result of a corrupted system file.

To find out whether the problem is caused by an INIT or not, one must use a process of elimination. Perhaps the easiest way is to remove all of the INITs (labeled as start-up documents in the Finder) out of the system folder and into another folder. This will prevent any of them from loading when the Mac is rebooted. Retry the network application and see if the problem has gone away. If the problem does not go away, then it was not the result of an interaction with your INITs. You can put them all back in the system folder. If the problem does go away, then it was the result of an interaction with one of the INITs. Put them back one by one, rebooting the Mac each time and retesting for the interaction. When the problem reoccurs you have found the INIT that is conflicting with your network application.

If you still have not found the source of the problem, you may have a corrupted system file. Using an official, clean copy of the Apple System Tools disk of your choice, use the Apple Installer to update (even if you are already using the same version) the System you use to boot your Mac. Retest for the problem. If it still occurs you may need to replace the System and Finder together. Boot your Mac with the System Tools Disk, remove the System and Finder from your boot disk, and then install the System and Finder again with the Apple Installer. After doing this, you will have a clean copy of the System and Finder, but will have to customize it by adding any nonstandard fonts and desk accessories that you had in your old system. Hopefully your network application will now work correctly.

- *Attempt to recreate the problem on an isolated network.* One of the best ways to determine whether or not a problem is the result of your physical network is to attempt to duplicate the problem on another network. If, for instance, you are having difficulty getting a Mac and a PC to communicate to one another over a TOPS network and suspect that the network might be at fault, test away from the main net. Put the Mac and the PC next to each other in the same room, join them with a simple cable, two connectors, and two terminators if required. If the problem cannot be recreated on this isolated net, then the problem is not within the PC or the Mac but is a problem on the main network.

Once the problem has been isolated, most of the work may be done. You may find in many cases that the solution is obvious—a cable is disconnected from a Mac, power has inadvertently been turned off to a bridge or gateway, a cable has come loose from a network connector, a centralized server has bombed and must be restarted, etc. Some of the most common causes of network troubles, most of them having to do with failures or faults on the physical network itself, are listed in Figure 8-1.

If the source of your network problem is not listed above, follow the following general guidelines. Start by determining exactly what the problem is, including whether or not the problem is the result of user error or misunderstanding. Next, isolate the problem and check it against the list of common network problems inFigure 8-1. If you still have not found the cause of the problem, consult the troubleshooting sections in the manual for the network software or hardware you are troubleshooting and follow these tips:

- *Gather as much information as possible.* Determine the extent of the problem, isolate it, be sure you are familiar with the product in question. If you need to, call the technical support group at the product vendor's office.
- *Use your network map to help you and record any changes made.* Looking at a network map will often make the cause of a problem obvious to you. Solving a problem may involve changing the network design slightly. Be sure to record any changes you make on the map to keep it current.
- *Keep a problem log.* Keeping a log of all the reported problems and

Symptom	What to Check For
Can't see any devices/services	Properly connected to the network? Network connector in Printer port? AppleTalk Active in Chooser? Proper network driver selected in Control Panel?
Can't see one device/service	Device or Service active/turned on? Device isolated by a cable break? (Use CheckNET or Inter•Poll to verify and isolate) Device isolated by loss of intra-network device (repeater or multiport repeater) or inter-network device (bridge or gateway)?
Device/service found inconsistently	Network termination incorrect or over/under-terminated? Network designed with many passive branches (passive star with > branches)? Cabling recommended length exceeded? Cabling device maximum exceeded?
Network seems slow	Network unusually busy? Network termination incorrect or over/underterminated? High error rate on network? (Use CheckNET or Peek.) Bad cable in network (bad crimp, short, etc)? Network use may have grown to exceed capacity/bandwidth
Can't see any or all zones	Bridge or gateway device failed? Repeater or multiport repeater failed?
Errors using LaserWriter	Inconsistent LaserWriter drivers on networked Macintoshes? Insufficient memory in LaserWriter for applications?

Figure 8-1 Common network problems.

their resolution can help you in a couple of ways. By noting all problems and keeping track of them, you may be able to spot a trend and find the root cause of a number of less severe, annoying problems. Also you may have solved a particularly obscure problem some time ago that reoccurs. Being able to go back to a problem log will help in coming up with the solution again.

- *Keep your eyes open.* This may seem obvious, but until you isolate and narrow down the problem, don't rule any scenario out. Quite often, the root cause of a network problem is found in unusual places. With certain topologies, especially the trunk with drops, problems will occur at unusual places. An extra terminating resistor placed in a connector attached to a trunk may cause someone at the other end of the trunk to lose communications with their mail server, for example. In general, do not assume that the source of a problem must be located physically or logically "near" the effect of the problem.

- *Use available diagnostic tools.* The more information you have the more likely it is that you will be able to solve your problem quickly. Use the following diagnostic tools to help gather information and solve problems. Many of these tools are useful for preventive maintenance as well, and all are discussed in Chapter 10 under Network Monitoring and Troubleshooting. These and others are discussed in Chapter 10 under Network Monitoring and Troubleshooting.

  — Check Net. This utility from Farallon Computing will generate real-time lists of all devices on the network, including their node and socket numbers, network numbers, and zone names. Check Net can be especially useful in diagnosing cable breaks. Starting from either end of the network or electrical bus, running Check Net and seeing which devices are visible should point you directly to the source of a cable break.

  — Traffic Watch. Traffic Watch from Farallon can tell you which nodes are talking to which, and what the total traffic and error counts have been. Especially useful for diagnosing network designs, Traffic Watch can indicate how much certain network devices are being used and can point to problems in the design of internetworks.

  — Inter•Poll. Inter•Poll from Apple will also report active

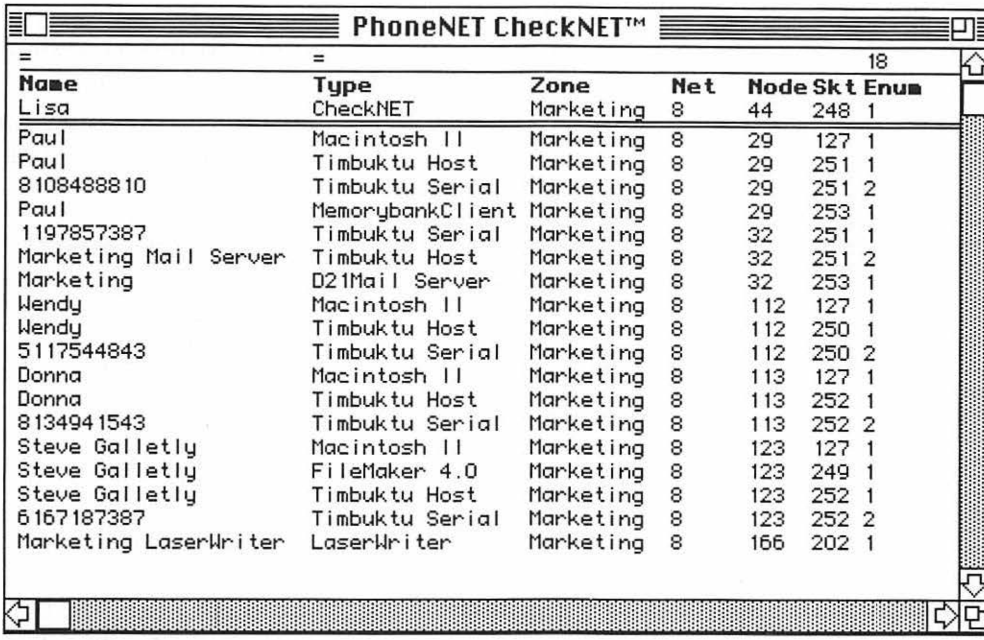

Figure 8-2 Farallon Check Net.

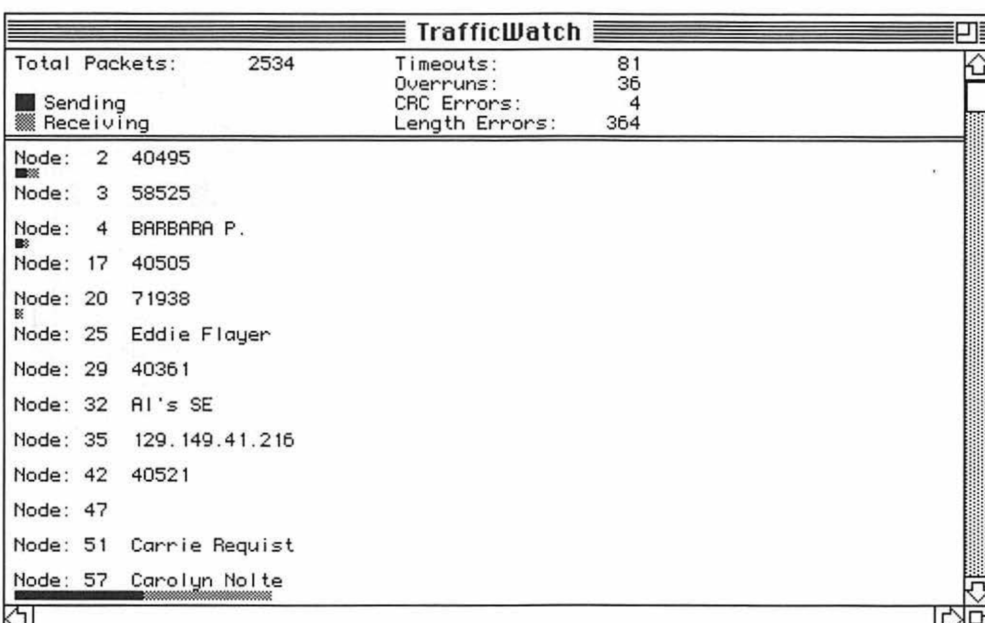

Figure 8-3 Farallon Traffic Watch.

devices and services similar to Check Net, but can also be used in conjuction with the Responder to report System, Finder, and LaserWriter software versions on any Macintosh on the network. This is especially useful for keeping the LaserWriter drivers on your network consistent, as they must be to access a common printer.

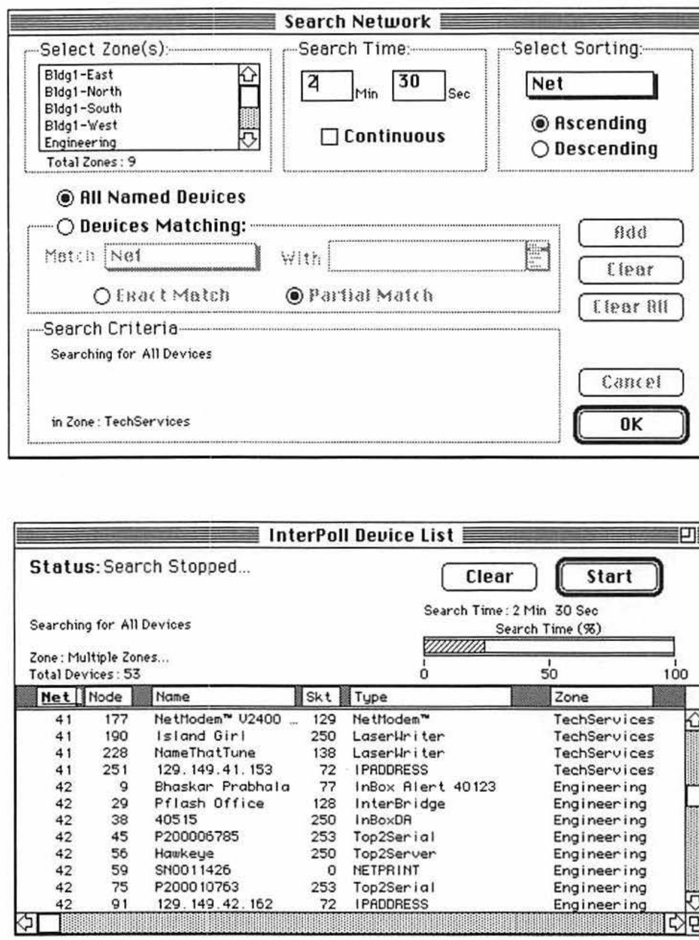

Figure 8-4 Apple Interpoll.

— Peek. Peek from Apple is a utility for capturing network traffic in its raw form. All packets can be captured from the net and displayed as either hex or ASCII, along with information about the sending node number, receiving node number, and time of transaction. Peek also reports statistics about total traffic and error rates.

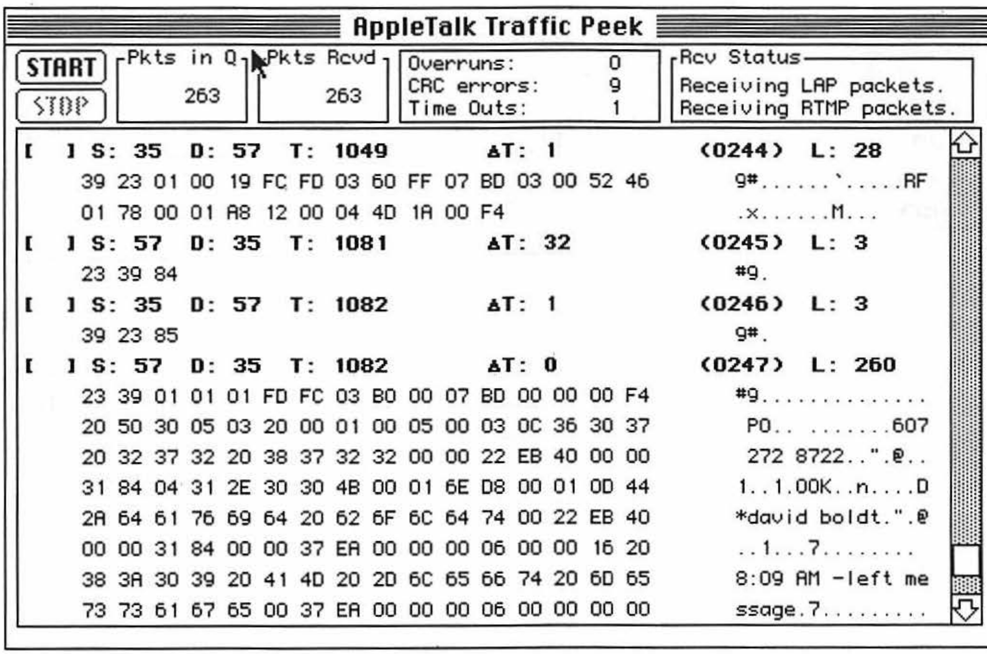

Figure 8-5 Apple Peek.

— Timbuktu. Timbuktu from Farallon can be used to troubleshoot network problems over the network. Timbuktu allows you to use your keyboard and mouse to control another Mac on the network while your screen shows the screen from the remote Mac. This can be especially useful when you have a user on the phone and want to troubleshoot a problem. You can "share" the screen, keyboard, and mouse of that system and talk through the resolution of the problem over the phone.

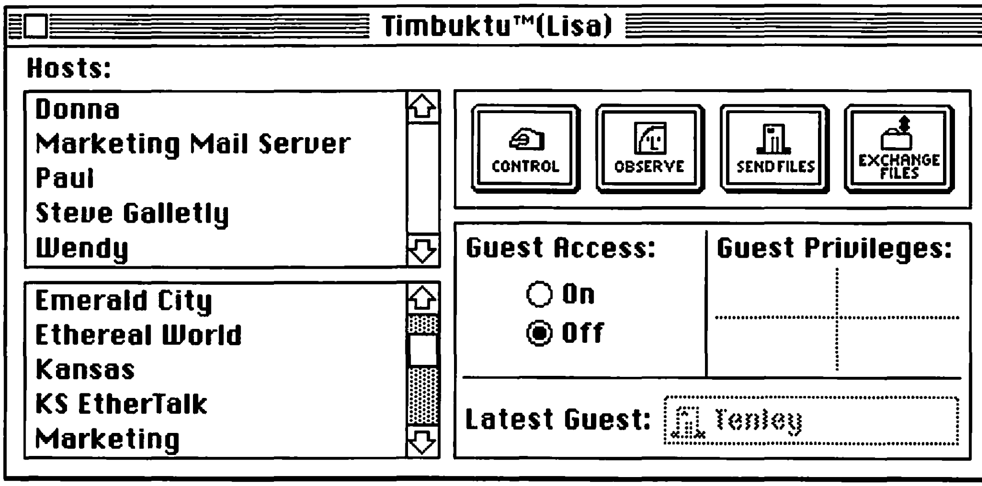

Figure 8-6 Farallon Timbuktu.

— TOPS ERR. TOPS ERR from TOPS is a part of TOPS/DOS and reports traffic and error statistics from the network. It is the only utility that allows PCs on AppleTalk networks to report these sort of statistics and can be used to infer network problems from the error rates.

```
Copyright (C) Sun Microsystems, Inc. 1987. All rights reserved.

TOPS: Network Address Information:

        OurNode:  222   (0xde)
        ABridge:  145   (0x91)
        Network:  8704  (0x2200)

      Driver Error Status Information:

        Total packets received:          2908
        Number of CRC errors:               0
        Number overruns detected:           0
        Number deferral errors:             0
        Number collisions errors:           0
        Number receive timeouts:            0
        Total send attempts:               16
        Total good receives:             2908
        DDP length errors:                  0
        IAP receive time-outs:              0
        IAP receives (bad data):            0
        IAP receive overflows:              0

C:\TOPS>
```

Figure 8-7 TOPS ERR.

Chapter Nine

Real-World Examples

This chapter includes a variety of actual examples of AppleTalk networks. Their range reflects the real AppleTalk world:

- A small Mac-PC net in a design and communications firm of three people.
- A typical AppleTalk departmental network.
- Networking in higher education environments.
- An extended assembly of Macintoshes in what may be the largest strictly AppleTalk network in the United States.
- AppleTalk Futures.
- Industry Watch.
- Groupware: Are people ready for networked workgroup software?

We include them as basic food for thought. Told somewhat in the tradition of the parable, within the details of these stories we hope everyone can find something that relates to their aspirations to begin networking, to expand the network they have, or to connect one kind of a net to another. We have been intentionally conversational and pretty informal in the telling of these tales because we find it is often the hints, the pieces of information discovered by accident, and the human networking among experienced and inexperienced users that is the glue in the technological solution.

The latter part of this chapter is a collection of product glimpses and musings about AppleTalk futures. It begins with *Industry Watch: Excerpts from an interview with Nat Goldhaber.* The section that follows is entitled *Groupware: Are people ready for networked workgroup software?*

So let's take a look at a few examples of real-world networks.

AppleTalk in Small Business

Stearns & Wheler Engineers & Scientists

Stearns & Wheler Engineers & Scientists was founded 40 years ago by partners Don Stearns and Gordon Wheler. Located near Syracuse, New York, this engineering partnership is run by eight partners. The firm's specialty is civil and environmental engineering. They employ more than 130 people, including professionals in surveying, electrical, mechanical, and structural engineering.

Five or six years ago, Don Schwinn, one of the partners, decided he had been computer illiterate long enough. A graduate of MIT in the late 1950s, Mr. Schwinn had no exposure to computers during his schooling. The only computers around when he was at MIT filled whole rooms of their own and were certainly not accessible to the casually interested individual. To begin his computer education, Don acquired a Commodore 64 and spent two years trying to learn BASIC. At the end of that period of time, he decided he would be more productive if he switched to a system for which he didn't have to write the software.

As is so often the case in many stories of the Macintosh, it was through his children that Don discovered this simple, ingenious computer. During Don's AC (after Commodore) search for a new computer, his son brought home a Macintosh equipped with an internal 10 MB HyperDrive hard disk. Over the next three or so years, Schwinn used MacDraw, MacDraft, MacWrite, and Excel on his Mac at home.

During the same period of time, Stearns & Wheler began their own computerization. They acquired a Prime computer and a sophisticated CAD system capable of producing their 24 x 36" drawings. The Prime crunched away on large engineering projects, running computer-intensive mathematical models and several business modules, in addition to the CAD software. To implement functionality that could take full advantage of the Prime's power, several outside consultants were hired to customize software in areas ranging from flood routing to structural engineering. At the same time, the office acquired a few PCs. The younger engineers made use of them—the ones that basically already knew FORTRAN and BASIC. The Prime, too, was loved by those already heavily into computers.

Meanwhile, Don Schwinn plugged along in his Macintosh "skunkworks" at home. He decided it was time to put a Mac in his office and then, not long after, he got his partners to agree to put one out on the floor where people interested in using it would have access to it; a few did use it. Don picked a graphics-oriented draftsman and encouraged him to become Macintosh literate. Together they arranged a little demonstration to show other people in the office how the Macintosh might affect their work.

One type of drawing commonly produced by such an engineering consultancy is 8 1/2" x 11" or 11" x 17", traditionally drawn in ink and lettered with Leroy letters. The demonstration Don and the draftsman presented involved producing such a drawing by two methods: one on the Mac, the other the traditional way. The same figure took 35 minutes to produce on the Mac and 4 1/2 hours to produce the traditional way. This generated a significant amount of interest, but still didn't produce the response Don thought appropriate to the Mac's capabilities.

At this point, Don was getting a little frustrated. He had made such gains in productivity using his Macintosh. He had found several dozen applications for proposals, schedules, job pricing, and graphics that would produce significant time savings and better quality. He had recently built a new house and done many necessary support drawings—site layout, floor layout, details, fixtures, schedules—on his Mac. The potential benefit to Stearns and Wheler was obvious to Don. The question: How does one make people aware of what is commonly possible on the Mac?

For years, Stearns & Wheler had an informal forum common to many organizations: the brown-bag lunch. People bring their lunch, eat it for the first half hour, and then have an informal presentation or discussion for the next half hour or 45 minutes. Although it was unusual for a senior partner to host such a brown bag forum, Don decided it would be a way to show people what the Mac could do. He began a six-week series of show and tell on the Mac. The first week was a general introduction on how to use it, and the following weeks focused on specific pieces of software. His "converted" draftsman, along with a young IBM PC-trained engineer who was willing to try the Mac, did many of the demos. Historically, these brown bag lunch forums drew 10–20 people. It wasn't long until Don's brown-bag Mac focus had 40–50 people trying to crowd into the room. He had their attention.

By the time the brown bag forum occurred, Don's own interests had turned toward networking. He and his partners agreed to buy a Laserwriter for the office. The acquisition of the Laserwriter made a huge difference. In a very short time, people from other buildings were clamoring for access to Laserwriter output, too. Stearns & Wheler quickly added a second and then a third Laserwriter. Then the network began to grow. They soon had eight Macs and five IBM compatibles using TOPS software on the net. They have continued to acquire Macs at a steady rate. They now have about 25 throughout the organization. The firm plans to have a Macintosh or a PC in every office.

As Don anticipated, the Macintoshes have changed the way Stearns & Wheler does business. Don is responsible for marketing Stearns & Wheler services and relates a lesson he learned based on the loss of a contract he felt they should have gotten. On the first contract, Stearns & Wheler's bid was about one half that of their nearest competitor. The client couldn't figure out why the discrepancy was so large. The client had worked with the competitor before, so chose them, even though the Stearns & Wheler proposal offered them substantial savings. Stearns & Wheler had based their proposal on a sophisticated Excel model that figured size and cost of the job. The mistake? They hadn't shown the client the model that would halve the engineering time. Don decided to take his Macintosh along to the presentation next time they did a proposal on a similar kind of contract. So he did and, as he expected, the client saw the rationale behind the proposal. Don attributes the award of two significant projects to the Macintosh-based presentation done as part of Stearns & Wheler's presentation.

In addition to the classic elements of an AppleTalk network (Macs, PCs, laser printers, and software), Stearns & Wheler have added Shiva's NetModems, which add valuable remote access capabilities. Schwinn continued his internal "education" program, this time playing a kind of "trick" on his staff through the NetModem. The trick involved accessing CompuServe via modem and sending himself a FAX. No one could figure out how he got a FAX from himself on his own FAX machine. The discussion around this mystifying event alerted other personnel to yet another capability inherent in the Stearns & Wheler set-up. From a modem, you can access CompuServe and send a FAX to whatever number(s) you wish. Dialog's information service is also available via NetModem to research technical papers on scientific and engineering problems.

In addition, NetModems provide access to the Stearns & Wheler Connecticut office, as well as a new office opened recently in Tampa. Each office has a Net Modem on their network. They used to send technical information back and forth to each other on paper; now they simply transfer files. The ability to funnel data files between offices has also greatly expedited the proposal process. At their central location, they make up a folder containing appropriate boilerplate information and the correct resumes, and send it through the NetModem to the network at the remote location. The remote office then integrates this information into the specifics they have prepared for the proposal and prints it out on a laser printer.

They also use another Shiva product, NetSerial, with terminal emulation software called FreeTerm. This combination turns the Macintosh into a terminal on the Prime system, providing access to all the engineering and project cost data stored on the Prime. Unfortunately, to date Schwinn knows of no way to transfer graphics from one environment to another. He said it would be of great use to them if they could do graphics on the Macintosh, like draw a detail, and then be able to transfer it over to the Prime and paste it onto the 24" x 36" drawing generated by the Prime's sophisticated CAD system. Called the Medusa System, this CAD software running on the Prime can produce any kind of drawing necessary, complete with the multilayering characteristic of engineering design drawings.

When Don first got the idea of using the Mac to access data from the Prime, he called Prime and they said there was no way it could be done. Don assumed he could make a dumb terminal out of a Macintosh. The object, however, wasn't simple terminal emulation, but how to get "live" data to the Mac, i.e., data that he could put into a Macintosh program like Excel and manipulate. The solution came from the combination of NetSerial and FreeTerm, a terminal-emulation package with a text capture mode. FreeTerm allows you to set defaults for the range of data you want, turn the "camera" on, take "pictures" of the data, and then paste it into Excel. Don took this one step further and produced graphs and charts of the job costing data he pulled from the Prime. And then, of course, he took what he'd done and showed it to Prime. Recently Don was invited to a Prime demo of a product called Prime Link that is said to provide similar capability.

In real time, Stearns & Wheler typically uses this transfer capability to take bond pay down schedules from a program on the Prime called Bond One (specifically designed for municipal projects), which creates a Table of Payments on principal and interest over the term of the bond, and transfer the data into Excel. They then use the charting part of Excel to graph dollars versus time. The ability to produce this visual is used often in feasibility reports for municipal projects.

Speaking again about presentations, Schwinn commented that Stearns and Wheler does their own overheads and prints them out on the Laserwriter. They also use Microsoft PowerPoint to create camera ready copy (words and art), which is then sent to Genigraphics for generation of a slide. Don notes that Genigraphics now provides direct access to PowerPoint via an incoming modem number. With this link comes the capability to generate a slide from your file sent by modem. Technology is again significantly changing the process of preparing a presentation. In the past the only way to produce a slide was to draw the elements, drive them to Syracuse, and have the slide produced by manual, photographic means.

Stearns & Wheler is in the process of constructing a new building to house their engineering consultancy. Schwinn has extricated himself from the network-planning process: A computer committee has researched the options for solutions to the present and future needs of the company in the new building. The committee's goal was to come up with a networking topology and cabling scheme that provides the maximum capability and flexibility for future growth and expansion. The new system features:

- Radial (star) wiring from a central location to all terminal locations (one in every office).
- Each terminal location has a telephone jack, PC jack, and AppleTalk jack. The network is a Novell system; PCs operate at Ethernet speed.
- Two central 300 MB hard drives serve both Macs and PCs. Tape backup is provided.

- Macs and PCs will all be able to access the mainframe, LaserWriters, HP plotter, and each other.

Host Broadcaster Group—Canadian Broadcasting Corporation

Juris Mazutis of the Canadian Broadcasting Corporation's Business Group states quite correctly that the Host Group's AppleTalk network is "one of the typical departmental nets everyone is talking about." He continues, "...it's really a simple net. I don't want anything complicated. I like it simple and intend to keep it that way."

The Group's network occupies one-half of a floor in an ordinary office building. It links a half dozen Macintosh SEs (20 MB internal hard disk and 4 MB of RAM), an Imagewriter LQ, a LaserWriter IINTX (with 5 MB of RAM), three Shiva V2400 NetModems using Farallon PhoneNET connectors and standard telephone wire, with jack outlets in every room so that equipment can be moved around. Mr. Mazutis himself has an additional Rodime 60 MB drive to accommodate development of a library of templates (in either a database program or Hypercard) to handle "boilerplate" materials integral to Proposals constantly prepared by the Group. As far as any thought of a network server, Mr. Mazutis documents his committment to simplicity in *The HostNet Book*, a guide he compiled to keep his network team up and running: "HostNet will have no dedicated 'network server,' i.e., one main computer that holds all the programs and 'smarts' that make things run. A 'server,' though powerful, is also expensive and represents one central point of failure. All HostNet stations will be equal, and each will still be able to function if the Net goes down."

The list of software available to Host network users includes HyperCard, Stella for Business, Acta, Smartcom II, MacPaint, MacWrite, MacProject II, CricketDraw, Cricket Presents, FileMaker 4, Excel, Quark XPress 2.0, FullWrite (Mazutis calls it his "hope unfulfilled..."), MacDraw II, TOPS, and FoxBase+/Mac. Mazutis calls XPress the "elegant man's PageMaker," praising its ability to handle word processing directly into the program and "output filters"—the capability to save text from XPress in ASCII, Word, and MacWrite formats.

The Host Group provides expertise, services, and consulting to a wide range of Canadian and international "events" organizers and institutional clients. For example, a recent project involved setting up the picture and sound coverage of all events for the Economic Summit in Toronto. This included provision of edit and "feed" facilities for domestic and foreign media, e.g., supporting a Japanese network in beaming news back home via satellite. In managing the logistics of such events, it is very important for Group staff to be able to communicate with the Ottawa home office. That is where the NetModems come in. Macintoshes "on the road" can "dial into" HostNet and retrieve information from files "posted" there. This capability also allows update reports from the field to be printed "at home."

Mazutis comments, "We have very real, practical, simple, everyday needs. Most departments have needs that are identical to ours in basic functionality. Connection to a mainframe would not meet those needs. IBM PCs or clones still do not come close to the Macintosh in ease of use across a variety of applications—which we consider to be a critical factor. We had to show precisely how the Macintosh would meet our needs to gain an exemption from the CBC's "MS-DOS only" policy. To me, success means being able to work 'smarter' tomorrow because of a simple but powerful solution. Macintoshes and AppleTalk help to make that happen."

The Host Group is constantly involved in preparing business proposals to prospective clients. Proposals follow a consistent format and often contain similar information: description of services, price quotes, personnel and equipment involved, expense breakdowns, and so on. Input from different people in the Group is required to pull together a complete proposal. Before TOPS, they had to exchange information on paper, revise, and repeat the process. Now contributions are "posted" to a common file via TOPS and proposals can be finalized with greater accuracy in less time. Soon the Group will combine this with a library of boilerplate and template pieces—and the network will serve as a proposal "assembly line."

Mazutis discovered the Macintosh through a set of what he describes as "fortunate circumstances." The local school board adopted Macintoshes—so his children were beginning to use them. He was looking for a personal computer so he could work at home. The notion that the family could be split along different operating system and program lines was mind-numbing. Earlier on, the CBC had managed an information systems project (OASIS—Office Automation Systems and Information Services) for the Canadian House of Commons (HOC), and out of that experience Mazutis concluded that (1) the last thing elected officials, or "ordinary users" of any kind, want or have time to do is "learn computers," or "command language"—they just need to get work done; and, (2) "elegant" and "snappy" are technical sales terms that do not mean much if the client says, "So what, I can't use it." There had to be a better way.

CBC responsibility for OASIS at HOC came to an end and, in a new phase, IBM PCs began to replace the original networked Micom word processors. Mazutis muses that perhaps "computer people" influenced this decision. He comments: "Computer people automatically like IBM. If you challenge them with outside research that questions their assumptions (the Peat, Marwick, Gartner Group and D/R Fortune 1,000 studies), they tend to get angry. They influence a lot of people who are not well informed and don't understand this natural bias. But we have to keep showing them what the Macintosh can do until they listen."

Mazutis returned from the OASIS Project to the Business Group and began to organize computer support for the Host Group. "I tried a Mac 512 out on myself at home first." Based on that and the OASIS, he wanted a Macintosh Plus and a serial 20 MB hard disk (there were no SCSI hard disks then) at the office. He did not want an IBM or a clone. The first "nonstandard" machine was approved and slowly interest in it began to build. Passers-by would ask, "Is that a spreadsheet?" Mazutis: "Yes, it's Excel. Want to see the graph I can produce from these numbers?" "Sure....Gee, I can't do that in 1-2-3...." "No, you certainly can't..."

Mazutis continues the tale. "Two more Mac Pluses were added to our resources. With those three, critical mass developed among the users—we decided to buy more Macs, converting to the SE model. Why the 4 MB RAM? If you're serious about HyperCard, MultiFinder, and even Excel, the standard 1 MB isn't enough RAM. We bought the IINTX for its SCSI connection. The plan is to attach a hard disk to store fonts, corporate logos, and other commonly used graphic elements for access over the network. Then I'll be able to clean up my 12 MB System Folder..."

"Planning all this?" muses Mazutis. "You cross your fingers. You read furiously. Join your local Macintosh club. Go to as many trade shows as you can. Stay in touch with software vendors for upgrades.... We did some informal planning, mostly on the blackboard. We asked questions like

- How are we going to work?
- What would we like to be able to do?
- How do we do it now?
- What will it take to get to the place where we can do it differently, better?

Someone in the Group must assume a 'planner' role. Not everyone can gather information and sift through all the options effectively. I do it by default, because I'm personally interested. This isn't my job...I'm really a 'fireman'...."

He continues: "I recently did an interesting experiment. I audited my work-week. I listed tasks and how I did them five years ago. Then I took a similar cut at how I work now. At the end, I found myself thinking, 'You mean, you used to dictate memos? Write one-paragraph notes and physically send them to people?' The changes! Electronic mail. Today, I very rarely give things to a secretary to type. Something is happening to job content. Technology is changing not only how we work, but what we do. The functional description of a manager's job has changed dramatically—he or she must handle more situations, quickly, with great accuracy. There is a pressing need to work 'smarter.' I awoke to this at 8:30 one morning at a conference where the lead speaker said: 'Everyone in this room is threatened. You all know that Chrysler down-sized and cut 10,000 jobs. Do you know what kinds of jobs they cut? All middle-management, all information-handling jobs. They brought in computers'."

Mazutis has definite opinions on the solution to this kind of crisis in the workplace. "There's pressure on middle-aged management to perform. The easiest way to deal with it—give them all Macintoshes. No more 'what to do' studies, please, for a half million dollars a pop. Just give them Macs. The days of the dedicated secretary are gone. Middle managers can't rely on this kind of staff support any longer—it slows them down too much, keeps them distant from what's going on. Before they know it, they're out of a job. For the secretaries, it's good. It gives them the opportunity to acquire more portable skills, enhances their ability to become departmental support persons.

"Sometimes I think even Apple has lost sight of what they have. They should herd a bunch of us into a room and ask, 'Where did you meet this (Macintosh) truth on the road to Jerusalem?' Their strength lies in helping ordinary people do ordinary things—in an extraordinary way, yes. But it seems like they've kind of forgotten that. Do we really want to talk about using ResEdit to modify desktop icons? Or, multimedia?

"But to get back to planning...how do you look ahead? You must be consumed by your search for solutions. If you buy out of a catalogue, you are assured of getting one-year-old technology. Why didn't I buy AppleTalk cabling to hook up HostNet? Because I read about PhoneNET somewhere. It is more flexible, less expensive. Why buy the Apple solution as a matter of course—don't we criticize 'IBM people' for the same thing? Support is another important consideration. There's an incredible range of dealers selling this technology. The meaning of support is changing, and some of them haven't figured that out. Support is not machines anymore. It's systems. That's because people aren't buying machines, they're buying solutions. Dealers must learn support in the context of small systems problems. They have to be able to relate to what people do every day on small networks; that involves everything—hardware, software, users—working together."

Mazutis understands the layers of complexity added when you install even a simple scheme to link computers together. He says one of the best ways he's found to make people successful system users is to keep a running document of "...rules of the road, do's and don'ts." This history is recorded in *The HostNet Book.* A few words from the first page explain the concept:

> A book—because manuals don't cover everything. Some things we learn only from experience—they never really get written down anywhere. Commandments, you can call them, rules of the road, do's and don'ts. Why plow the same ground again, especially if the experience is likely to be a painful one? The other way also—why not use a time-tested knife or two? So, once in a while, we'll collect and immortalize those—including your own discoveries. Remember: Working on a network will be a new show for everyone involved!

The HostNet Book includes comments on "Why a network?"; contains a list of available programs; explains the PhoneNET scheme for hooking into the net (complete with cautions: "Under no circumstances make a move without checking whether your colleagues have 'traffic' under way); includes a schematic of the HostNet layout; a HostNet Functional Diagram (both are reproduced here for your interest); as well as over 50 pages (currently) of "commandments, rules of the road, do's and don'ts."

Mazutis heartily recommends that someone keep a record, from day one, detailing "difficult" experiences on the net. Include what went wrong, what you were doing, how you got out of it, what you think the problem is, and what the path of resolution should be.

Substantial detail from the interview with Juris Mazutis is included here because it represents the thinking and learning process of an ordinary person out to do ordinary things with an AppleTalk network. To those not yet online with an AppleTalk network, perhaps it characterizes a frame of mind and an approach to implementation that will be useful. Networking technology is changing the world. It has given the Host Group new capabilities, no doubt. And it has given at least one computer user food for thought concerning the future of the world workplace as we know it. In closing, Mazutis has one more tale to tell.

Canada is officially a bilingual country. Apple markets system software in 25 languages. They obviously have awareness of, and expect to do business in, the international marketplace. For the past nine months Mr. Mazutis has been trying to sort an international list of names—some of which have accented first characters (e.g., É, Ç) in alphabetical order. Not possible! It turns out that some of the names come out in the right place, but most don't. Why? From what he can determine, it has something to do with the fact that, for sorting purposes, the Macintosh operating system is set up to recognize only the first 128 characters of the ASCII table; it ignores the second 128 characters, which is where most "diacritics" happen to fall. Mazutis pressured a local dealer to help, then to ask Apple the question. He combed through volumes of *Inside Macintosh* at bookstores. There's apparently a way to do it, maybe, with a modification to the "international resources" in the System file. An "interrim fix" is promised, a permanent one in a future System release. Mazutis comments: "When I talk to support people, they say—this is trivial. That's typical of the 'wizard' point of view. I just want to be able to sort my list. If it's so trivial—fix it now."

Creekmore Behasa

Creekmore Behasa (CB) is a design and communications firm located in Mill Valley, California. Microcomputer technology companies have accounted for a major portion of their client base over the last seven years. They provided crucial support to Ashton-Tate in the "early days," a fast track period characterized by frenetic activity in support of overnight success and phenomenal growth. Other major CB clients have included TOPS, a division of Sun Microsystems, SBT Corporation, Broderbund Software, and Autodesk, Inc.

The CB staff is small. Though small, the combined microcomputer industry experience of the core team is substantial. From the basis of this highly varied experience they are able to provide a wide range of planning and project support to their clients. The work is extremely diverse. Each client requires a different level and kind of design and communications support. The physical environment to support this wide range of activity must likewise be flexible and comprehensive. Computers and the AppleTalk network that links them together form a key physical core in support of diverse clients and many different kinds of project work.

How big is the Creekmore Behasa network? It depends on which day you ask. Two IBMs with hard disks, four Macs (three with hard disks), and a Laserwriter is the most frequent configuration. Principal

Wayne Creekmore comments: "We have only three people in the office but we bring in freelance people for projects as well. We also do software development work, design software interfaces, and write documentation. Often these activities overlap, so the demands on our equipment and the way it's configured can vary quite a bit. In the case of documentation, for example, one computer may be running the software while the writer works at another computer to write the words that describe the software's operation. A similar scenario applies to our interface work. We design software program interfaces for both Macintosh and PC environments. We also design and develop software for both environments. Our mixed network of Macintoshes and PCs is always in use. Often, when software development is in progress, the computers will have no covers and wires will be running everywhere. The configuration of our network can change several times in one day."

How has having a network changed the way Creekmore Behasa works? Wayne Creekmore talked about the use and evolution of CB's network. "In the beginning, the network was simply a means to share peripherals—hard disks and the Laserwriter. At that time, the major problem we had was organizing the disk so everybody could work on it effectively and not run into each others files in the organization. At the time, only the IBMs had hard disks so the Mac we had used one of their hard disks. We saved a lot of time disk swapping on the Mac, but were frustrated at how slow the network operations were and how much the host computer with the hard disk slowed down when one or two other people were using it."

"Eventually, we bought more computers and put hard disks on each of them. Then we could keep files on projects we were managing on our own computer and hard disk. The network then turned into a convenient way of moving files between computers. Often, when one of us has a crash deadline, they will take over all our computers—editing files stored in a central place and even dedicating one of them to printing. The network is essential in these cases. However, this gave rise to another problem—keeping track of multiple files and multiple versions on different hard disks.

"We use TOPS because our client base has both Macintosh and PC machines. It works pretty well. The network's biggest advantage today is that we can bring in files from virtually any PC or Macintosh source and readily convert formats among them. This is essential to servicing our client base.

"Early on, we were very PC oriented. We had a Mac because one of our clients was thinking of developing software in that area and they ordered one for us, but there was very little software for the Mac at the time we could use. It sat around for a couple of years waiting for the software to develop. With the advent of desktop publishing (DTP) software, we converted to a Macintosh-centered office.

"Because we have such a variety of software clients, we have shelves and shelves full of software. We actually use only three of four programs on a regular basis. The rest are there simply to be able to convert files back and forth between our formats and those of our clients. The program that we use most is Ready-Set-Go. We've used quite a few different DTP products.

"Ready-Set-Go serves us the best at the moment, but the DTP program of the future—that we could use right now—hasn't been written yet. One of the biggest problems in this type of software is trying to bridge the use by professionals with their set of nomenclature and laypeople who know nothing about those terms. In most cases, software designers have misinterpreted the historical basis of typesetting, design, and production and implemented this slightly distorted bias in the technical aspects of their desktop publishing applications. Professional designers have some difficulty adjusting to terms in the software that don't mean what they expect them to mean or do what they expect them to do.

"In considering networking, there is another area of acute need in the software—especially in offices like ours. That is the need for well-designed groupware that allows for multiple layers of editing and tracking of those edits. We track that process now with substantial difficulty. Using databases, hand-marked copies of subsequent drafts, and constant checking and rechecking, we do get complicated documents produced. But software technology should be able to provide a better solution. Such an application could save a tremendous amount of time and headache.

"One of the things networks have created is a huge demand for standardization among file formats, both graphic and text. The interim solutions are translation utilities, many of which don't work very well, or only convert well between certain formats. This is a big problem for us at the moment. We spend a lot of time dealing with it.

"In smaller professional offices like ours that work on a project basis with multiple clients, there is a tremendous need for a simple means to schedule resources. There is a fair amount of scheduling and project management software on the market today, but it requires a tremendous amount of initial organization, accuracy and completeness of input, and constant maintenance. If I were to use one of those programs with my projects, that's all I would be doing.

"There is an eminent need for a scheduling and organizational program that is much more freeform, one that doesn't get in the way of a person's style of organization. It would combine projects, scheduling, and billing. It would be a network product that allows everyone in my office to know what everyone else is doing. Our lives aren't as structured as a computer program. Sometimes in the middle of the afternoon, we get a call to go rescue a seal and we do it. (Authors note: The principals of Creekmore Behasa, Wayne Creekmore and Stephanie Behasa, volunteer every Monday at the California Marine Mammal Center at the mouth of the Golden Gate. The Center rescues sick, wounded, and distressed marine mammals. They're treated, made well again, and released back to their sea.) I don't have time to sit around and revise my schedule to see if I have time. Or to enter new dates and times for those hours I missed.

"Maybe someday artificial intelligence will allow such a program to learn my priorities and work habits through experience. Maybe that's the way it could be more supportive. Or maybe it's just a program that allows me to set priorities and build in things like taking a break when I need it.

"The other issue is that in an office this size, you wear so many different hats. You don't have the luxury of always being a manager or at one level in the hierarchy. All the levels typically change daily, all at once, and in different directions. The new workgroup concept within corporate structures both large and small is very similar to this. People are taking more responsibility for different aspects of project management. The common denominator in all these group situations is a "project" that has financial elements, time elements, personnel elements, and content elements. These should all be handled by a single multiuser program that supports these efforts as an integrated whole."

How has the incorporation of microcomputer and network technology changed the way Creekmore Behasa works? Wayne comments on his own style of contribution: "I used to spend all my time at the drafting table with pencils and erasers, T-squares and triangles. I hardly ever wrote anything, because I was a terrible typist and typewriters aren't forgiving. Now I spend 90 percent or more of my time writing and designing on my Mac. I'm hardly ever on the drafting board. The whole nature of my activity in my business has changed. And that's primarily due to computers. And I love it. It's still design, but it's designing more now with concepts, people, budgets, and the like. Its hard to predict the way that computers, software, and networks will change the way that you (the readers of this book) do business, but it will change it! If I had any advice to give to other professionals like myself, it's buy the best equipment and software that you can afford and be prepared for changes in yourself and your business."

Stephanie Behasa had some additional comments concerning computer technology and the use of the network. She uses desktop publishing and the network extensively in support of client projects. Her perspective provides an interesting counterpoint to Wayne's comments and experience with the technology.

Stephanie began using the technology because of the service it afforded her clients. "I could take their files and format them. This eliminated the need for me or the typesetter to rekey the text. It saved me time and it saved my clients money.

"Computers have really changed the way I work. Although I don't consider myself particulary technical, I feel very comfortable on the Macintosh. Considering how long microcomputers have been around and how much maturation I've seen in ease of use, I'm really amazed at how many people I find who work for computer companies who aren't very computer literate. So often I have to spell out for them exactly what I need and then hold their hand while they try to get it for me. This situation doesn't make very much sense to me."

Stephanie Behasa makes extensive use of the network to produce some very involved desktop publishing projects. While she agrees with Wayne that the applications and the network have streamlined the work, she has had some significant problems with big projects that she believes push the technology to the limits of its capacity. What are the problems and what is their impact? Stephanie's comments: "Bombs! I've had some drastic ones lately. And of course they happen when I'm scrambling to get something out the door. One of our Macs is a 512K with new ROMS. We use it as a backup machine when we have overflow work and an extra person working. It bombs a lot, especially when the application in use is loaded from a remote machine. It's hard to say what's at fault when the crash occurs. Was it the network? The application? The computer? It's just really frustrating and I don't trust the network very much.

"Another thing that bothers me—it's more of an irritation than a problem—occurs when someone else is using my computer as a server. My work really slows down, especially when they're saving to disk. That's really frustrating when I'm trying like crazy to get something out. I know, it's only a few seconds, but it breaks my pace and when I'm rushed and a deadline is haunting me, every second of delay is irritating."

As most users discover, however, there is a lot of good that comes to counterbalance the unexpected and unexplained events that can make a day in the life of a desktop publisher into a minor nightmare. Stephanie appreciates the added dimension and flexibility DTP brings to the design phase of a project: "I enjoy having more control over page layout and type specs. I can experiment more with the layouts and type. The desktop publishing programs also allow me to do really tight comps. "Comps" are mock-ups that approximate the way a page will look when it is produced. This gets a quicker and more specific response from clients and helps cut down the overall time required for projects. The physical process of doing pasteups and separations used to take forever. Few clients realized just how long this process took."

"Computers have speeded up this process tremendously. In the process, however, they've created another problem. Many people don't understand how 'desktop publishing' programs really work.

Since the marketers have made them seem like the panacea for all production problems, users believe that you just have to press a key and all the edits are entered and a whole new page layout is instantly created. From this point of view, they assume they can keep making changes right up to the last minute. Not true. I've formatted large documents of several hundred pages where one page being deleted caused 24 hours of repagination, reformatting, and reindexing."

Stephanie has come in close contact with how this technology is changing the way people work and the expectations they have about what can and can't be done. And, in integrating DTP into her daily design and production life, she has at least one "wish" that could make her job easier: "I would like an application that combines the features of a relational database with the features of a desktop publishing program. In such an application, you could take data from the database and relate it to the content of a DTP document. This would be a tremendous help in preparing catalogs and creating indexes for them. I'd like to be able to place the fields directly into the document.

"Now I have to do it using two separate programs. It's a real problem keeping both programs up-to-date. Usually, the data are gathered in the database and then run into the DTP document. Sounds smooth but there are always edits at the last minute and they have to be made in the desktop-published document. Then they have to be re-entered into the database. You can get lost in this process and not know if you have the latest information or not. Having the database linked to the document would solve all this. Edits made in one place would be reflected in the other."

AppleTalk in Larger Businesses

Chevron's Richmond Refinery

The Chevron story is remarkable in many regards. It is a grassroots tale. AppleTalk networking at Chevron was introduced by our own Mike Rogers, the coauthor of this book. At the time, Mike was a Process Engineer in Chevron's Richmond, California refinery. Mike brought his own Mac to work—he needed computing power and was accustomed to the ease of use and friendliness of his own personal computer.

At the time, computers were not very accessible to Chevron's potential users. The Process Engineering and Design groups, responsible for a majority of the company's computing activity, were serviced by two Ethernets that networked a total of 18 Xerox Star computers. The engineers also used a few isolated PCs scattered among them. Mostly chemical engineers, the computing activity from this group controls the intricate processes of several refining plants on the huge Chevron site.

The Xerox Stars were easy to use, but extremely expensive to maintain; their maintenance contract alone was about $120,000 a year. Most engineers used these computers when possible, but it was often hard to find one available. In their work, the engineers need access to common bases of information. The isolated PCs among them did not solve this access problem. But PCs did add word processing, spreadsheet, and drafting capability, which some engineers took advantage of in the course of their daily responsibilities.

Mike's familiarity with Macintosh flexibility, power, and ease-of-use, coupled with his working understanding of process engineering, led him to believe that personal computers could offer valuable support to the engineering staff if there was a way for Macintoshes to share information with the PCs. That would give each engineer the choice of working on their system of preference. Connecting the Macs and PCs together could potentially give engineers access to each other and to the common base of information they all used in their work.

The catalyst in the evolution of this AppleTalk network was TOPS. The TOPS board for the PC gave it AppleTalk capability, allowing PCs to connect to an AppleTalk network. TOPS software made it possible for Macs and PCs to share information and files. Meanwhile, the visibility of the Macintosh had increased at Chevron, and more and more users were interested in access to friendly computing resources.

Mike started a small Macintosh to PC network within the process engineering group. This small net was instructional, but was only a prototype. In reality, Chevron had a lot of users who needed to be linked together. And cost was an issue. This AppleTalk network project was not funded from the top down; it grew out of its users and the timely appearance of user-manageable technologies. Because of his personal interest in the Macintosh and networking technologies, Mike managed the initial Chevron AppleTalk installation. Computer use increased dramatically. A new level of communication became available, and with it, a new, more informed and efficient way of working.

Sharing information and experience gained on the network became more and more common. This sharing increased the computer literacy of everyone involved. They began to do projects "in common." One of the first was a Monthly Highlight Summary that required contributions from numerous personnel. They worked on it together by putting the report file in a published area where each user could contribute his or her input to the report. 1-2-3 spreadsheet users began to share information with Excel users. The technology actually made working together easier. More information was available to more people, and people became better informed.

From a physical design perspective, the network was low budget and ingenious. Using PhoneNET connectors and existing spare pairs from their telephone wiring system, they basically had wire "in place" to just about everywhere they wanted connections. AppleTalk has restrictions on length of cable between nodes as well as number of nodes on a network, so Chevron used Hayes Interbridges to create separate networks of manageable size and length. The Interbridges also helped minimize the traffic on any one network.

They implemented a configuration that is not highly recommended—a passive star. Grouping 17 Hayes Interbridges on a LAN of their own, inside the central Chevron phone "closet" (actually occupying most of a basement), Mike and Bill Silva managed to construct 17 working networks along the arms that ran out from each Hayes Interbridge. These 17 "arms" connected users in 13 buildings.

The Chevron AppleTalk network continues to grow. Today they still rely on some of the basic design decisions made when the net was first put in place. The number of users and the intensity and kind of activity on the net has grown to a point where they must implement some significant changes in the near future to maintain the functionality to all users on the net. New projects are growing out of the woodwork and Greg Flosi, who manages the network, notes that orders for new machines are up. He is looking at a near-term implementation of 16 additional LANs, ten of which will be connected via modems. The new reach is going to have a phenomenal impact on this truly amazing AppleTalk LAN. Flosi said, "At the end of this upcoming iteration, we will probably have the largest AppleTalk network in the continental United States...running at AppleTalk speeds."

Currently they have 31 individual networks—23 running off the phone closet "backbone" and seven remote LANs. Arms from the network backbone extend out from 30 Hayes Interbridges. The network administrators are connected to the backbone network because some network-administration software will not function properly from the other side of a bridge. The entire AppleTalk network covers a five-square-mile area.

The remote LANs are connected by some expensive Limited Distance Direct Connect Nondialing Modems (LDMs) Chevron had that weren't being used. This isn't a common solution to remote access; but it works and the LDMs were already Chevron property. Due to both the size, increased user traffic, and the modem traffic from the remote LANs, some areas along the net are suffering signal degradation and/or noticeably slowed response times.

The AppleTalk network administrators have been working closely with Farallon to implement a near-term solution to these problems. They plan to soon add three Farallon star controllers at points where heavy traffic loads or too many nodes are affecting the quality and speed of the signal. Once installed, points beyond these stars will become LANs of their own. Flosi comments: "We will be able to connect star to star through their managerial (12th) ports, in essence daisy-chaining their capability together. 11 of the 12 star ports will support separate network arms. Because of the daisy chain link off the 12th port, we will be able to remotely control the separate network arms from one central Mac in our network administration area. That allows us to do certain crucial administrative tasks, like turn things on and off and change configurations, without physically going to these remote locations."

Another barrier administrators have struggled with, which they are now in the process of alleviating, relates to the limitation in TOPS

Version 2.0 of 22 definable active zones. While still operating under Version 2.0 of TOPS, Chevron effectively hit the upper limit of this capability and ran out of zones. TOPS Version 2.1 allows definition of 44 active zones. This will allow Chevron to zone, or isolate, remote modem-linked nets. Until now, incorporating remote LANs into existing zones has been painful because any time there is heavy modem traffic, other net activity slows to a crawl. The addition of more definable zones makes it possible to go back to constructing zones more logically.

The network administrators evaluated FlashTalk from TOPS, a product that effectively boosts the speed of information travelling over an AppleTalk net. At $200+ per node, the cost for Chevron does not match the benefit. The Chevron user base doesn't complain about speed. And, with so many nodes, if speed is a real issue, it is probably best to look for a more fundamental solution (like Ethernet).

The Chevron site pushes the use of these technologies to their limits. To our knowledge, no other five-mile-square, 200-node networks exist based on this topology. Because Chevron has mounted this project with limited funding, they have fully optimized AppleTalk on its own and now are building on that.

The AppleTalk networkers may be able to take advantage of another networking project in the future.The object of the plan is to link six DEC computers with Ethernet. There is a tentative plan to install an Ethernet backbone to link the DECs. Once Ethernet is laid (and extended to the phone room), it affords an opportunity for AppleTalk administrators to use the Kinetics Fast Path to link into the higher-speed, Ethernet backbone. It would also provide the path for AppleTalk machines to use terminal emulation software to link directly to the six DEC minicomputers within the refinery.

They are also contemplating the use of Teltone modems to integrate a new Chevron Telecommunications Network (CTN) phone system into the AppleTalk communications scheme. Teltone is an easy link and might in the future offer the capability to download information from remote Chevron sites in such places as Houston and London.

With over 500 people using 170 Macintoshes, computer use has continued to grow among computer-familiar users and expand to encompass users who might not be such obvious candidates for computer use. For example, the refinery process operators—the people who actually monitor and control the 24-hour a day process of "boiling" the oil—are a unique breed. Daily reality for process operators can include extremely stressful situations where decisions must be made quickly based on the most up-to-date regulations and safety procedures. The procedural and safety codes that direct refinery processing are subject to constant updating and revision. A "trainer" is part of each crew shift, taking note of circumstances and situations in real time, and then initiating the written process of informing all other involved personnel of changes and modifications to this crucial set of procedures.

Before the Macintosh, this process was accomplished essentially "by hand." The trainer would make written notes during the shift, give them to a secretary to type, circulate the draft for comment and discussion, finalize the document for approval, and give it back to the secretary to produce final copy. Using this process, it was often two months from initiation to finished document. With Macintoshes in the hands of trainers and online to the rest of the Chevron AppleTalk network, the process of initiating, revising, and finalizing a new procedure has been greatly streamlined. Comments are gathered quickly, the document is finalized for management approval, and the procedure incorporated into the refining process in much less time. To expedite this process, Macintoshes were first put into the hands of the trainers.

Macs were then put into the control rooms themselves. This effectively involved a lot more people whose input is vital to processing operations. The way "knowledge" is passed among the processing operators is interesting. During a shift, when all systems are quiet, the operators continually discuss the process and what has gone on and goes on among themselves. These informal sessions are vital to the building of an in-depth understanding of the intricacies of this complicated and constantly changing occupation. The problem before the Macs was that it was difficult to share this information beyond the shift staff. With the Macs on-site, the results of these informal dialogues are often written and left in a folder on the net for other interested parties to access. This effectively extends the conversation to all interested parties, supporting the training of operators and the building of in-depth understanding across all crew shifts.

What has happened at Chevron since Mike Rogers carried the first Mac into his workspace is unique in terms of the work done at Chevron, but very generic in terms of the way AppleTalk networking is changing the way people work in the world. AppleTalk's transparent usability enfolds users into the networking learning curve with no conscious effort. Like the Macintosh, AppleTalk provides the primary platform for learning to work in a networked environment.

Chiat Day

Chiat Day has one of the oldest Macintosh installed bases in the country. Chiat Day was the advertising agency of record when Apple introduced the Macintosh. They got a lot of Macintoshes into the office and the Mac capability fit well with Chiat Day's management style—creative. Putting Macs on many desks created a momentum of its own at Chiat Day and their use has grown tremendously. Currently they have around 200 Macs in New York, spread over six floors housing Chiat Day and its subsidiaries. The New York office is a "prototype" for solutions that will be implemented across the country at other Chiat Day locations.

As in any growing environment, the AppleTalk network is changing. In the beginning, Chiat Day had a whole bunch of Macs with an occasional Imagewriter printer scattered through the organization. When the capability for laser printing was introduced, the Laserwriter became the core of small networks of three or four Macs. Standard software supported the creative needs of the users: MacWrite, Excel, MacDraw, and MacPaint.

As the number of connected Macs increased, Chiat Day encountered problems with certain elements of their network. Their biggest headache was the cabling scheme. Since they started to network early on in the evolution of AppleTalk, they had what is probably "one of the oldest, clunkiest installations of AppleTalk around." In fact, theirs may have been one of the largest installed networks using Apple's own cabling scheme, at that time called AppleTalk rather than LocalTalk. As their network grew, Chiat Day discovered the AppleTalk connectors themselves were very hard to wire and it was sometimes difficult to find someone who could do it. In addition, the connections didn't stay together and pieces of the network kept getting disconnected. (Note: As mentioned above, Chiat Day had installed "original" AppleTalk cabling. The "disconnection" problem has since been corrected by a new plug design from Apple. This revised design in their cabling solution coincided with Apple's naming of the cabling "LocalTalk.")

To cut down on cabling maintenance, Chiat Day began to substitute PhoneNET connectors where they had previously used AppleTalk connectors. Additionally, PhoneNet was able to accommodate the inevitable new topological needs in this growing installation. What were originally small workgroups networked to Laserprinters became larger groups moving into newly renovated spaces. With PhoneNet, Chiat Day was able to use the spare pairs of wire already in the new physical spaces (see Chapter 3 section on "Phone Wiring").

Continual expansion is standard operating procedure. To accommodate this, Farallon star controllers are the hub of each office installation. This "direct home-run system" allows up to 44–48 users per star controller. It also allows the placement of terminating resistors in each office, making the system truly "plug and play." Users make their own network connections and disconnections themselves. Due to the topology implemented, network administration has been drastically reduced.

Chiat Day's Macintosh network has become a crucial extension of their Wang system, which houses a custom advertising database and an accounting package. The decision to acquire the Wang system was made several years ago, based on Chiat Day's need for this sophisticated software. In time, it became feasible to link the Macs to the Wang and use them as "terminals" for the Wang system. In addition, of course, these Macs still have all their substantial Macintosh computing capabilities. Looking for a way to use the Macs as Wang terminals was a matter of functionality and economy. Since 75–80 percent of employees already had Macs on their desk, why keep buying Wang terminals in addition?

Terminal emulation is accomplished with VS-Term, a software package from MacSoft of Bakersfield, California. In addition, customizations of Wang software, Wang Office and Wang Term, make it possible for the Macs to participate on the Wang E-Mail system, as well as transfer Wang files through to the Macs. In addition, people are able to log directly onto the Wang system using NetSerial, a product of Shiva Corporation. Each network has seven or eight NetSerials—Chiat Day's goal is to maintain a ratio of four or five people to every NetSerial, to ensure access to the Wang whenever necessary. Chiat Day is working closely with Shiva Corporation to enhance the functionality of the NetSerial product for their particular needs. Chiat Day's Richard Esterbrook appreciates Shiva's receptivity and their willingness to work closely with a client to optimize their product. Esterbrook comments that this kind of responsiveness from a vendor is crucial to the success of both parties. It is an opportunity for a dialogue that will ultimately optimize the product on both sides of the vendor-client relationship. "Wang has also been very helpful," Esterbrook said.

This makes the wealth of information housed on the Wang accessible from the Macintosh. All Chiat Day offices, and several of its subsidiaries, have some kind of Wang system. Until recently, the Wang system provided the mechanism for one office to talk to another, across remote distances. Now they are beginning to install NetModems, another Shiva product, to give users access to networks in remote locations. Just as the NetSerial product presented a cost-effective solution to providing Macintosh users with access to the Wang, NetModems are the most cost-effective solution to Chiat Day's growing need for communication among their physically separate locations.

For example, ease of communication among offices optimizes the substantial research done by media departments at each location. Coming from an era when on-line databases were researched by a single research person in each location, Chiat Day now encourages people to do the research themselves using their reach into resources previously unavailable to individuals. This relieves the bottleneck of entire offices relying on one person and one database for research. It also allows individuals to develop expertise and "library" files in their own areas of interest, and share those with other Chiat Day personnel on an as-needed basis. Personnel are encouraged to make creative use of raw research data. For example, research numbers may be read into Excel and various kinds of "sorts" run on the data. Sort results, in turn, can be graphed to make a clearer presentation for a client.

The question, of course, that comes to mind is what kind of planning goes into implementing and maintaining an installation like this? Esterbrook says that to date he has followed no formal planning process. He doesn't try to put it down on paper. AppleTalk is mature, but evolving quickly. It's hard to sit down and write it up and do it. He comments: "The networks assume lives of their own. I try to be vigilant in expanding my knowledge so I can keep pace with our needs and what solutions are appearing to meet those needs. I go to as many trade shows as I possibly can. I read constantly. I follow-up on what sounds like it might fit us. Say I read about something, but it's not quite there yet. I keep in touch on developments about it. When it gets close, if it looks good and optimizes our forward direction, I slant what we're doing toward it. If you really want to do a lot of things, you have to be creative, you have to be well-informed, you have to lobby the vendors and form close alliances with them. I try to make decisions that maintain my flexibility. You can't be sedentary and expect to take advantage of the expanding capabilities of this technology." In closing, Esterbrook continued, "...and you have to remember that, as much maligned as the AppleTalk network has been in some circles, it is the first real network available at an "appliance" level. That is significant in so many respects. It allows users to network without having to climb over the technology to get there. It certainly started something at Chiat Day that has been of tremendous value to us."

LANs and Higher Education

The following section addresses a different sector of AppleTalk network users—those in higher education. The process of how campus-located networks evolve and how they are maintained is similar to the business environment, but there are some significant differences. The most obvious difference is the duality of their purpose on campus: The administration of a college uses technology to support the business of higher education; students and professors use technology to support and further education. And, of course, learning to use the technology is now a discrete discipline as well.

In researching the material for this section, we talked with many people, among them Janet Perry, Education Accounts Manager and a member of the Business Development Group at Kinetics, Inc., a division of Excelan. Janet provided us with a thoughtful perspective on the higher-education marketplace. I include, as an introduction, some of her observations about computers and higher education. Our thanks to her, as well, for basic information, shared with us from her personal files, on several of the schools discussed later in this section.

The Kinetics FastPath is a frequent component of higher-education networks. Janet enjoys a close view of evolving networks on many campuses and she is aware of the planning parameters and functional diversities that drive technology in higher-education. She comments about her role: "In higher education, a vendor's account representative is more an advisor than a sales person. Product adoption occurs 75—90 percent of the time on a referral basis. The educational community is often 'networked' (in the human sense) by discipline, beyond school boundaries. Students, professors, researchers, administrators, and computer-science people all talk to one another about what works. People call us because they've heard about us from someone else. These people use technology in the name of education and tend to be open to sharing information about what works and doesn't work. That makes them very good reference resources for education and business alike."

Higher education is the arena where tomorrow's professionals are trained. Computers on campus not only support the obvious function of providing a support tool to accomplish work, they also form an increasingly vital part of the actual process of education. The kinds of technology available often reflect the ideals of the governing board of the institution, e.g., its President and Board of Trustees. Attitudes originating at this level profoundly influence computer visibility and accessibility. A good example is the level of dedication to computers at Reed College, a liberal arts school in Portland, Oregon. It is interesting to note that Reed has no computer-science department, per se, and that their intense interest in a totally networked campus arises out of technology's place at the core of their educational perspective.

Within the educational process, typical computer use extends beyond the standard uses in the business world. The availability of increasingly sophisticated programs that can model complex phenomenon from the real world transform computers into experimental labs. Within the interior reaches of this sophisticated modeled environment, the constraints of the physical world are no longer a physically limiting factor. Experimentation is easily made complex and simulation possibilities "shrink" time, allowing more experiments to be accomplished more quickly.

Computers also offer superb support for remedial learning. They are patient, diligent teachers in all manner of necessary drill and practice. Networked computers increase the opportunities to work "at a distance" with students who have special project interests or need additional tutoring. The existence of a network makes it possible for a teacher to make materials available, for a student to accomplish the task or exercise, for the teacher to correct and comment on the work, and for the student to receive this feedback, all without the logistics of time and physical space scheduling. Both teacher and student work in their own time frame.

The availability of computers in libraries, lecture halls, laboratories, dorm rooms, and computer resource centers often expands interaction beyond walls, to include many people interested in a growing group dialogue. Separate computer resources in such a learning environment literally beg to be networked. Networks afford many economies and advantages. Central sources of information can be made much more accessible; limited numbers of computers can be shared among many who need them; communication can be facilitated among large groups of people who needn't occupy the same time or space to share ideas and information.

One of the most difficult issues that arises in network planning on a college campus often stems from the fact that very few campuses have central control of computer use. Typically, administrative resources are quite separate from the academic resources. Historically, academicians and administrators have not come together to plan or implement technology. It has, in fact, been more common to find them working at cross purposes. In addition, academic departments may be quite separate from each other. Until recently, it has been difficult to identify a central source of information or an umbrella perspective on campus-wide use of technology.

The issue of networking, however, is adding fire to something stand-alone computers had already begun to foster: collaboration. Networked computing resources foster collaboration and a kind of synergy that is bringing the planning process across departmental lines. In some cases, it is even managing to bridge the long-standing gap between administrators and academics. In the process of physically linking buildings, departments, diverse interests, and functions, people are having ideas together about what is good for the institution as a whole. The existence of a network has people sharing information, capabilities, and physical resources.

Just as networking has immense implications in the business world for the way people work, higher education is a fertile and changing real-time experiment in the way people learn. What is fostered there, and what is learned there will be taken by the next generation out into business.

It will be interesting to observe network technology in higher education as it moves beyond pioneering sites into more and more institutions. The stories that follow of the Oregon State College of Oceanography, Vassar, Swarthmore, Brown, Rutgers, and Reed College networks are just a few instances of what is in the process of being accomplished by these early adapters of network technology.

College of Oceanography—Oregon State University

Oregon State's College of Oceanography is literally room after room, workspace after workspace where Macintoshes and SUN Workstations live side by side. The ever-present Mac/SUN combination is what strikes you as you walk around, but that certainly isn't all the technology housed by the College of Oceanography. There are SUN compute-servers, DEC PDPs, VAX clusters, HP 9000s, IBM PCs and PC clones, Ethernet drops, PhoneNET drops, LocalTalk cabling, laser printers, Kinetics FastPaths, MultiPorts, TOPS and AppleShare File Servers, exotic image processing equipment, laboratories full of test apparatus, etc. The place is a truly remarkable combination of high technologies. And most of these things are networked together.

The College of Oceanography network provides a flexible working environment for its 79 faculty members and 60 graduate students. The Oceanography net, connected by an Ethernet backbone, also extends beyond the College to Oregon State's broadband network. The broadband, served by the OSU satellite link, is connected to the Ethernet via a Chipcom Ethernet Modem. From OSU's Ethernet, there is also access to the ARPA Network and three Cray superminis located at various remote locations. This is not your typical departmental net.

Chuck Sears, Manager of the Computer Services Lab (Communications Network Specialist) for the College of Oceanography, was first approached about the College's need for "distributed computing tools." At the time, Sears was managing OSU's Library Microcomputer Software Information Center and Fitts, from the College of Oceanography, was out in search of solutions. The overall goal: to allow any researcher to bring their own tools, drop into an environment, and work without worrying about the environment. Another critical element: The environment must be reliable. "You cannot be down. You cannot disrupt the critical day-to-day functioning of this group. This is science, it is research, it is key to many things larger than us—like support of NASA, the Defense Department, the Navy—reliability is absolutely necessary."

What does it mean when a researcher wants to bring their own tools and drop into an environment? The College of Oceanography supports five disciplines that each have their own research and technical staffs. College personnel are responsible for over 300 published articles a year. Researchers must be able to share information on site. They must be able to call from remote locations and access the net. They must be able to send information via microwave signals to the local satellite link. Collectively, researchers from the five disciplines are specialists whose combined input often has to end up in one presentation or one published report. The challenge to the network is to give them a vehicle to get information, exchange information, and ultimately assemble their findings into one cohesive presentation or document.

The College asked Chuck to help devise a technological platform to accommodate the present and allow for the future. Chuck began planning with a survey of all the equipment they had, the current needs of individual users and their projected needs for the future. He went to trade shows and looked at everything he could find. He followed up on likely products. He began working closely with key vendors. What emerged is a diverse multiproduct, multivendor installation. There was no other way to do it and still meet the very individualized needs of College personnel.

Chuck's relationship with vendors has become a key to success both for the College and for the vendors. The vendors have provided a tremendous amount of support. The College also serves the vendors as a beta site for many emerging versions and new products. Chuck notes that one of the most important elements of the evolving plan for the College is understanding where the vendors are going. He spoke of Sun's commitment to the scientific community, very important to the College. He mentioned the emerging NeXT environment, something he following closely. He wondered aloud (as did many other people interviewed in the course of documenting these case studies) if Apple would abandon their roots. He talked about HP's depth of understanding in engineering and their increasingly visible commitment to a scientific workstation division.

The Ethernet backbone running through the building connects 80 microcomputers, both PCs and Macs, and 40 UNIX and VMS-based workstations. Two Sun 3/280's act as data servers for network management, while a Sun 3/60 with a 330 MB drive handles the TOPS gateway for UNIX. Currently the College has 121 copies of TOPS running throughout the school.

While researchers are still at sea, they send in data from the ship so they can be run on the SUN compute servers and the graduate students can begin massaging them. "Data are processed on the large, number-crunching systems," says Sears, "then sent through the Sun workstations to Macs and PCs for translation into published research material. In many ways, we operate like a newsroom." The flexibility to send files to the College and, if you are in the field or on the sea, get files from College computers, is crucial to the working style of these professional researchers. Working quarters at the College are cramped, so it is also an advantage to be able to work from home when an excess of researchers on campus makes workspace even more limited. At the upper end of this remote processing spectrum, researchers can work on a Cray supermini computer in San Diego or Chicago, then link the information back to the Oregon installation via satellite.

Dale Pilsbury, a Research Faculty Member in Physical Oceanography, uses terminal emulation to examine data. After this "discovery" process using a wide variety of tools to manipulate and sift through the data, Pilsbury extracts the data and, with a Macintosh, creates words and pictures to describe the results of his discovery process. Before learning to use a Mac, he was completely dependent on programmers for the routine analysis of data. Now he does it himself, more quickly and more easily. He comments on his improved productivity: "What the Macintosh has done for me in terms of scientific analysis is the equivalent of what word processors have done for writing." And, because of the network, he has joined the ranks of students, researchers, and professors doing cooperative work with other universities via the far reaches of this technological web.

Staff members use popular microcomputer software, along with customized software for the Sun, written by College staff members. Chuck and the professional and technical College staff are particularly fond of TOPS, the distributed file-service system from TOPS, a Sun Microsystems Company. Chuck has been very vocal about its success and mentions numerous calls from parties interested in connecting their UNIX systems to microcomputers. Sears comments from the point-of-view of the College staff: "Everyone likes the flexibility of TOPS' distributed file server architecture. And they enjoy having control. They like to have the ability to query the net and make their own choices about where to go."

Researchers also often change the way they do things. Their de facto standards change and along with those changes, the support installation must adapt. To handle their ongoing computing needs, a computer committee was established. Each discipline has a representative who sits on the computer committee. This group is the bridge between what the researchers need and what Chuck and his staff must implement and maintain.

Reed College

Reed College, a liberal arts school in Portland, Oregon, is in the process of completing a campus-wide network that will provide access to the network from nearly every building on campus, including individual dorm rooms. Targeted for completion in 1989, the net already provides general computer resources for both students and faculty, allowing them to share access to mainframes, file servers, and other computer resources.

Each building on the net to date contains one or more AppleTalk networks connected to Ethernet through FastPath gateways. Fiber-optic cabling is used for connections between buildings. The standard protocol is TCP/IP. SuMac IP from Stanford University provides access to VAX and other UNIX systems.

Information Resource Centers located throughout the campus provide access to the network. Students make extensive use of the net that provides popular software programs stored on AppleShare. Many students prepare papers and other class assignments, while others use the network resource to complete classwork in subjects ranging from Pascal programming to statistics.

Reed has instituted what they call the Public Policy Workshop. Open to any student or faculty member, the "Workshop" functions as a computer lab/classroom, as well as a conference area and lounge, encouraging community research. Stefan Kapsch, Professor of Political Science, feels the different functions are integral to the Workshop's objective of developing inter- and intradepartmental approaches to the subject of public policy analysis. Thus far, Workshop use realizes Dr. Kapsch's vision of providing a more "human" and community-oriented approach to computer centers.

Reed's Software Development Lab develops new applications for the network, making use of the college's membership in Apple's University Consortium. Programs include Modern Artist, a graphics application sold commercially by the Portland-based company Computer Friends; TALK, a conferencing program enabling several people to engage in an electronic conference call through the network in real-time; and a terminal emulation program. Under current development at the Lab is a mail system that will be available to every node on the Reed network. The mail system may include automatic printing of unread messages for delivery to a campus mailbox.

The Reed network contributes to the development of new software and provides a focal point for the development of a strong academic community, giving students and faculty vital computer tools that enrich their teaching and learning experiences.

Rutgers University

Rutgers, the State University of New Jersey, has been using microcomputers to teach undergraduate computer science for eight years. Since 1985, the Macintosh has become a standard for both faculty and students in Computer Science. In 1988, Computer Science used Kinetics FastPaths to join several AppleTalk networks together. Plans are afoot in Chemistry, Physics, and the School of Business to follow Computer Science's lead.

Three AppleTalk networks are currently in place in Computer Science. Joined with FastPaths, the AppleTalk networks are then joined to an intercampus network. The campuses of Rutgers and New Brunswick offer five Mac labs for computer science students. Each lab, or zone, consists of three to five AppleTalk networks connected with Hayes Interbridges to a shared-trunk AppleTalk network. Each shared trunk is linked to the Ethernet with a FastPath. Remote Ethernets are assembled into the intercampus network with TCP/IP routing devices and T-1 links.

Computer-science instructors have chosen the Macintosh as their standard computer/workstation. The intercampus network allows instructors to answer questions and administer class assignments online to students. In 1988, 1,500–2,000 students will use the Macintoshes in four undergraduate courses.

Through the Rutgers wide-area network, Macintoshes can provide terminal emulation, file transfer, and automatic backup. Automatic backup is accomplished with Dumper, a ShareWare program available to universities. Future plans for the network include mail services, conferencing, and connections to Sun workstations used in advanced courses.

Brown University

For universities using IBM mainframes for computing, providing connections for PCs has always been a problem. At Brown University, an Ivy League college in Providence, Rhode Island, Macintoshes are connected to mainframes using Kinetics gateways and tn3270, a terminal emulator written by Peter DiCamillo of Brown. Hiding under the cover of campus Macintoshes are powerful mainframe workstations, created using multiprotocol gateways and tn3270.

Brown's campus-wide network uses broadband communications to provide access to computer services throughout the campus. Individual buildings may have Ethernet, AppleTalk, or a combination running through them. AppleTalk networks are connected to the campus network either through Kinetics FastPaths or BroadPath gateways from Cactus Computer. Most of the existing networks are located in the science and engineering departments with one public access lab of 40 Macintosh IIs used for classes.

tn3270 is a multifeatured terminal emulator for IBM 3270-type mainframes. Users of the program can access any IBM mainframe that understands TCP/IP protocols. In addition to terminal emulation and file transfer, tn3270 lets users mount IBM volumes as AppleShare volumes and provides remote printing facilities. These features and its transparent access to the mainframes, make tn3270 popular at Brown and other campuses.

"By using tn3270, users can access campus-wide services as well as services in other departments," explains Brown's Anthony Torti. "The combination of Kinetics FastPaths, Cactus BroadPath boxes, and tn3270 provides a complete solution for departments here. The transparent access is very important to our users. As more connections are made to the broadband network, we expect tn3270 to become even more popular."

tn3270 users are equally enthusiastic. Elli Mylonas, a doctoral student at Brown, uses the program daily. She lives in Cambridge, Massachusetts and does her work at Brown. Her Macintosh is hooked to the campus mainframes via modem. "It's faster for me to send electronic mail directly to Brown through tn3270 than to try to connect to them through the Internet. I use it to print drafts of my work on the IBM system printers. It makes my work much easier."

Cactus Computer uses the basic Kinetics FastPath and adds an internal broadband connection. W. N. Smith, President of Cactus, describes his work at Brown: "Brown is one of the first universities to do campus-wide Macintosh connectivity to broadband. They began planning in 1987; they required the broadband support TCP/IP, AppleTalk, or any Ethernet structure packet." Cactus set out to meet those criteria and selected Kinetics as the basis for their AppleTalk to BroadTalk gateway.

Swarthmore College

The network story at Swarthmore, a liberal arts college in eastern Pennsylvania, is distinctly different from other network installations in one important aspect: planning. This is not a network that evolved from stand-alones to connectivity. Swarthmore's approach was intentional and very well organized. The elements? Because the Swarthmore staff is small, they believed the key to the whole solution was "the relationship with one vendor to handle design, sales, and installation." Swarthmore decided what they needed and then worked with DEC to create a conceptual plan to network the whole campus.

The DEC staff from their field office in Blue Bell, Pennsylvania helped design Swarthmore's networking plan and implement it. June Davey, Senior Account Representative for Digital, comments: "The success of the network at Swarthmore testifies to the success of planning and partnership between users and vendors when creating a network. The system was done on time and on budget. It was finished before school started."

Early in the planning process, Swarthmore made some decisions about their network and what it should support. They decided to support only four protocols on the network: TCP/IP, DECnet, AppleTalk, and EtherTalk. Transparent access was also of paramount importance. Networking solutions had to be able to operate in this multiprotocol environment.

Swarthmore's network provides transparent access to a variety of programs and computers used for general computing. The transparency is provided by Macintosh computers that gain access to the Ethernet through Kinetics products. The current network is the first stage of the networking plan and includes approximately 120 Macintoshes, 17 FastPaths, and five Etherport boards. It provides transparent services from Macintoshes in academic buildings all over campus.

The connection of eight academic buildings is accomplished with a combination of Ethernet and AppleTalk. Ethernet cables run through the buildings with AppleTalk networks based on Farallon's PhoneNet cabling system branching off of the Ethernet. Fiber-optic cabling connects the buildings. Ultimately, this net will link over 400 Macintoshes, DigitalVAX's, Apollos, and Sun workstations.

Students and faculty use Alisa System's AlisaShare to access AppleShare servers residing on Digital VAX computers. Electronic mail has become a big success on campus through access to BITnet and campus mail from the desktop. Kinetics FastPaths provide access to laser printers located throughout campus. Access to important specialized programs, like the statistical applications SAS and SPSS, is no longer limited to specialized terminals; these programs can be used from Macs anywhere on campus. This central administration makes it easier to deal with software licensing.

"The original plan was to have one vendor do everything from start to finish," says Swarthmore's William Conner. "It has worked out very well. The users have the pleasure of the end results. They are able to do things easily now that were rather difficult before."

Vassar College

Vassar College, a private liberal arts college outside New York, has a campus-wide network that connects 14 buildings. Ethernet backbones are used in each building, with fiber optic connections between the 14 buildings on campus. Within each building, as many as 20 AppleTalk networks may be run off each Ethernet backbone. The campus currently has a total of about 55 AppleTalk networks supporting both Macintosh and IBM PC-style computers. Three AppleShare servers form the core of their AppleTalk service.

Most applications—including word processing, spreadsheets, and programming—are kept centrally on the AppleShare servers. Students have access to these programs. Each faculty member automatically receives Mac240 and WriteNow when they get their computer. In addition, many faculty members use mainframe programs to provide drill and practice programs to their students. Students access these practice programs through terminal-emulation software running on the Macintosh.

Vassar's Office of Instructional Computing is a hub for computer exploration and learning. Students and faculty members are encouraged to find new ways for computers to be used. One group interested in creating advanced front ends and simulation for scientific research. Another group, this time in the humanities, is exploring the intricacies and potential of Hypercard. Dr. Mark Andrews, Assistant Professor of French, is developing a Hypercard application that simulates the Paris Metro system. The program features a game interface. The game? Taking a trip across Paris by subway. In the course of their subway ride, students encounter French exercises and drills. They practice vocabulary and grammar and are exposed, in French, to basic cultural information. Dr. Andrews also avails himself of the ability to construct drill and practice programs on the DEC machines. His students run the practices from their Macs via terminal emulation software.

Galen Work, Assistant Director for Microcomputer Services, believes Vassar's computer capabilities improve Vassar's ability to attract and retain students. Today's students are, in many cases, already computer literate. They can't imagine learning without computer support. The College provides them with a broad library of applications. Through the Office of Instructional Computing, they are also encouraged to create new applications on their own. According to David Dailey, Director of Instructional Computing, some students are using MacRecorder from Farallon to create interactive language tutorials.

The Vassar net connects Macintosh, IBM PC, and DEC computers. The Kinetics FastPath provides the TCP/IP and EtherTalk capabilities that link these disparate operating systems onto one common network. This extends the capability of the Macintosh and PC computers beyond their already substantial stand-alone value, giving them a dual role as terminals for the DEC system. Running software from Alisa Systems, Vassar provides printer spooling for LaserWriters located throughout campus, giving campus users access to distributed printing capabilities.

AppleTalk Futures: Industry Watch

During these case-study interviews, we uncovered universal concern for where AppleTalk networking is headed. The concern with "AppleTalk futures" falls into two main categories:

- Where do networking companies stand today and where are they going?
- How is application software changing to accommodate the new networked environment? Neither of these questions has a definitive answer. Much remains to be seen and done by the players that are making technological history.

The remaining portion of this chapter contains the fruits of some informal interviewing done with these two issues in mind. The first excerpt from an interview with Nat Goldhaber comments briefly on major network vendors. Nat has worked in the mainstream of AppleTalk development since the early days. As one of the founders of TOPS, he is well-known for his opinions on what's going on in local area networking.

The second area of interest—software application development—led us to something called groupware. Groupware appears to be an emerging genre of software developed specifically for the network environment. According to background information provided by the makers of a groupware product called Syzygy, the term "groupware" was first used in 1980 by Peter and Trudy Johnson-Lenz at a World Future Society conference in Toronto. It first appeared in print in New Jersey Institute of Technology Report Number 16 in 1981.

Most recently, groupware has become a common phrase tossed around among people discussing workgroup computing on local area networks. Nat Goldhaber, a founder of TOPS and a vocal thinker on the technological and human implications of peer-to-peer human and technological sharing, provides a working definition for "groupware" on a local area network: software just beginning to emerge that will be designed to "...enable computers to make a bona fide qualitative difference in the way people work together on a network."

Groupware is indeed just emerging. To familiarize current or potential network users with this concept and provide a basis for considering groupware issues, we include some interview excerpts, product summaries, and stories about workgroup computing. There is no doubt that local area networks are changing the way we work. The questions raised and comments volunteered when users and technologists are asked about workgroup computing range from functional issues to some rather profound philosophical concerns. It reminds us of the clamour at the beginning of the PC revolution amid the proud promises of "improved productivity."

There is a flurry of activity and many opinions about workgroup computing. What is really going on? What kind of software is appropriate for groups working together on a network? What can it be expected to do and what should it not even try to do? Network users are faced with these issues as they appear while they do their jobs. These users are thinking about what is happening and trying to make some sort of sense out of it. Vendors are trying to read all the signs and put the right products in the right places to catch the wave and fulfill workgroup computing dreams. Users don't necessarily believe everything they hear or read, especially if it comes from the vendors. We found ourselves wondering if they're not clamoring, again, about a phenomenon distinctly ahead of its time.

We hope our attention to this phenomenon provides an inkling of issues to come in an area sure to be hot on the software development side in the next few years. To start, then, here are some excerpts from an interview with Nat Goldhaber that provide a kind of "industry watch" framework.

Excerpts from an Interview with Nat Goldhaber

Virginia Bare: Because of your long and intimate association with AppleTalk, I am curious about your impressions of the major players in the networking environment as they relate to AppleTalk connectivity. Let's start with the most obvious one, Apple. What is your impression of their current direction?

Nat Goldhaber: Apple has recently brought in some big guns and developed new strategic alliances. The Apple Dec alliance has gotten a lot of press play and suggests important AppleTalk-to-DecNet connectivity. In addition, Apple has recently appointed Don Casey as head of networking. He is a former IBMer from their networking group.

It appears that they were dissatisfied with their progress in penetrating corporate computing. I think this kind of activity is an indication of their desire to make AppleTalk mainstream. Further, their networking engineering staff is growing tremendously.

My gut says that in the medium term Apple is going to try to establish an Apple-branded solution to a large variety of connectivity problems, particularly with respect to interoperability. This might include gateways, AFP ports, AFP file service running on other operating systems, and simple hardware solutions using add-in cards for their expandable machines.

They want to argue that Apple offers solutions for every environment–SNA, DECNet, TCP/IP. The point they want to make is that the Mac works as a terminal, as an individual workstation, for file sharing, for whatever: The Mac is fully and actively integrated with everything.

However, for Apple, interoperability is a sales tool. Its value is in marketing more than in function. It provides the opportunity to go into a Fortune 1000 company, listen to the customers' needs and say, "Yes, we can do that. Here are four different solutions to your connectivity problems from which you can choose."

VB: I hear the comment quite often that people are afraid Apple is forgetting its roots—forgetting the ordinary people doing ordinary things that gave them their start into the marketplace. What is your impression of the situation?

NG: Just like every company that becomes successful, there is change and growth of great magnitude. Apple is both enjoying and suffering from the inevitable fruits of its own success. It is becoming a big company, factionalized and with often competing directions and goals. No longer is it a group knit tightly together by a common goal. By necessity, it has become much more loosely bound. This is just the reality of growth. There's really no blame involved.

The kind of people Apple hires is changing, too. They're hiring more business types where they used to hire more computer types. This will change the general Apple character, and yes, I think it has made Apple less oriented toward the computer enthusiast. At the same time, it is just the kind of changes that will interest the corporate world in the Apple product line and that will satisfy the Wall Street analysts.

VB: What about 3COM?

NG: I think they've largely lost their initiative in the networking software arena. I know very few people who have any kind words about their Apple networking solution. It's only adequate technology and it's too expensive. In a few instances where there is already a large 3COM installation some may choose the 3COM solution because of their 3COM investment. But in new Apple only sites, 3COM is a weak player.

And I suspect the "alliance" they announced with Microsoft was more of a public relations hype than a real alliance. It was good for the image of both 3COM and Microsoft at the time. But it seems to amount to no more than 3COM's right as a licensee to the LAN Manager technology from Microsoft. I have no doubt Microsoft has independent development and a strategy of their own.

However, 3COM is very strong on the hardware side. They make the best Ethernet hardware for the PC and the Mac. They should concentrate there and get out of the software business....

VB: And what about Novell, now that its Macintosh capability has been incorporated into Netware?

NG: Novell is such a success story in the networking arena, that they are without a doubt a large force to be reckoned with. I saw a beta version of their AFP/Netware capabilities and it looked good, a little slow, but it was still in beta. Because of Novell's ubiquity and well-earned respect, it would be hard for any company to catch up. Also, Novell has a large dedicated VAR organization around the world.

VB: What about TOPS and Sun. Have TOPS environments sold any Sun capability or has TOPS been incorporated into any SUN environments?

NG: The TOPS/Sun gatewaying capabilities have been expedient in instances where both Macs and Suns live in the same environment. The two most obvious examples are university and engineering environments. TOPS has been a means of more tightly integrating organizations that have both style machines. TOPS for the SUN provides an effective solution to file sharing.

As far as sales go, I would say that neither has leveraged the other across environments. But that's probably more a function of lack of advertising of the capability, or lack of priority for the sales organization to focus on that capability.

And then, of course, TOPS has been such a catalyst in bringing the Macintosh into the IBM environment. TOPS did more for Apple in getting Macs into the IBM environment that Apple will ever admit. TOPS is just that kind of product. And TOPS is doing very well.

Groupware: Are People Ready for Networked Workgroup Software?

Excerpts from an Interview with Nat Goldhaber

Virginia Bare: What is your current definition of groupware?

Nat Goldhaber: Well, it really hasn't changed from the old days. To fit into the groupware genre, a product must provide more than just efficiency to the end-user. It must enable a new style of cooperative computing. Groupware has very important sociological consequences because of the way it modifies the way people work. And in an even broader social context, groupware implies increased human creativity.

Groupware parallels networking itself. It parallels the needs we identified before we made TOPS for distributed, democratic, peer-to-peer communications. Groupware running on a network is the chance for application software to reinforce what the physical network has begun to provide. This added application functionality must be reinforced by a groupware solution for it to qualify as groupware.

I can best illustrate the desirable qualities for a groupware application through the following example. Imagine a groupware Star Trek game. Each person fulfills a different and distinct function although they are all bound by coordination, interaction, and commitment to work toward a common goal. For the Star Trek crew, that may be reaching Planet X or destroying some invader craft. The characters of the game each fulfill their own function: The captain tells people what to do, others execute his commands, Uhura handles all communications, opens channels, establishes relays. Sulu functions at the helm: He steers the ship.

Although this might represent only a game, it is a perfect instance of the kind of functionality groupware will one day accommodate. It will support the working together of distinct individuals within a common context toward some final purpose. That final purpose could be the publishing of a magazine or newspaper or development of software.

Computer-aided software engineering (CASE) is a complicated set of tasks all aimed at the completion of a software application. The function of groupware in this context would be to coordinate and integrate the efforts of all individuals involved. To do this, the system must understand how the thing fits together and have the tools to coordinate all the pieces.

The step further, though, and this is perhaps the ultimate groupware step, is to allow multiple individuals to work together on the same thing in the same module, on the same floor, within the same design at the same time. In this instance, the application software would function in real time as the conceptual white board. The computer would provide the communications to intelligently tie all of these individuals working together simultaneously in real-time, and make the fruits of their labors into the end product. The groupware would mesh all the elements together and add the cohesion to a design as it progresses. This would allow people to work together intimately through their technologies in support of the real synergies of human intelligence. This kind of groupware, when it is real, will truly fulfill the promise of groupware.

VB: Can you comment on the current stage of groupware development?

NG: It's really still pretty much in its beginnings. As you know, I am a principal in the Cole Gilburne Fund, an investment firm that specializes in emerging information and communications technologies. In August we announced an agreement with Imagine Software, a northern California developer of Macintosh computer utilities. I'm currently sitting on their board of directors. Imagine has a product called Perfect Timing that essentially puts its toe in the ocean of groupware. It provides a calendaring function that people could not do conveniently before. (See discussion of Perfect Timing that follows this interview.)

There's another company with a product called Syzygy, that is a step in a similar direction to that taken by Imagine's Perfect Timing. Syzygy allows group coordination in the context of project scheduling. I guess, after calendaring, the next-most-likely step in groupware evolution is related to group coordination of projects. Whether a full-blown application in this arena would include a PERT or GANTT metaphor or some other metaphor for describing this coordination is unknown today, at least by me. But that genre of groupware is the next likely step. After that, the next logical step would probably be the support of desktop publishing.

VB: Where are network users in terms of embracing a "groupware"? When Framework was introduced by Ashton-Tate as an "integrated" product, it became evident that the positioning was ahead of its time, that users didn't want their generic functions integrated. In a similar sense, is the market ready for groupware?

NG: That's an excellent question, one that shows you have a real understanding of groupware issues. Well, that is precisely the marketing question vendors will have to ask themselves when contemplating the launch of a groupware application. It's a very difficult question to answer. Do you present the attributes of the groupware product in single-user terms, and then mention they also apply to working as a group? Or do you present the market with the product as groupware, a new generation of networking software, the leading edge of networking applications? I don't know. I think it might be better, at this point, to sell benefits and not worry about marketing the underlying groupware concept. For example, sell "superb group coordination" as a feature and when they have it and have used it, then perhaps they will have the context to understand they are using the beginnings of groupware.

Excerpts from an Interview with Michael P. Masterson, Arthur Young Co.

Virginia Bare: Are you familiar with the new genre of software, termed "groupware," which is designed specifically to take advantage of a network environment?

Michael Masterson: Yes. Electronic mail is the most important "groupware" function we have. In the strictest sense, electronic mail doesn't necessarily meet the criteria for inclusion in this new genre of software. Groupware as title of a new software genre is a bit of a problem. I don't think it is well-defined, and the functions appropriate to such a term don't yet exist. And, perhaps more importantly, the question is what is the significance of groupware in terms of the people who would use it on the network? We're presently testing a custom document-revision control and storage system that may become an important tool for us in a year or so.

The technology itself isn't significant. What is important is how and when it will support the way people work. There are some very real questions that come in establishing a true groupware function in a network environment. Who is going to be the ruler of its hierarchy? For any electronic system to provide realistic functionality, it has to adhere to the social rules that exist in the office culture. There is an accountability loop. There are people's expectations. There is the disruption of established work patterns and their replacement with a new process. The implications of groupware use go far beyond user's occupied with stand-alone applications. Work style changes are inevitable. I'm not convinced that just because the technology of groupware exists that it is necessarily an advancement in support of people's work.

VB: Your concerns are shared by many potential end users. They are perhaps rightfully wary of the promises of new technology and the realities of its everyday use. You mentioned initially that electronic mail is crucial to the way people work at Arthur Young. How so?

MM: Electronic mail is a very powerful facilitating application. In our office it has become an infrastructure like the telephone. Its existence and use is assumed, like the telephone's. Electronic mail is an integral part of daily work process. Its use has inherent advantages over telephone communications for certain kinds of interchanges. Those advantages make it easier for our people to communicate and to accomplish the work they must do.

It also fits nicely into the sociological requirements of our working culture. Big Eight accounting firms have a recognizable social protocol that is an integral part of the working process. Electronic mail is able to support crucial social protocols with acceptable patterns of communication. There is the accountability element, too, in communication and response. Partners in charge of a client engagement, for example, get quick responses from their team. E-mail works because it is every bit as flexible as your dynamic reporting structures, and it's just as informal as the telephone.

The Beginning of Groupware: Perfect Timing

Perfect Timing is a multiuser calendaring and scheduling system for the Macintosh. Accessed as a desk accessory, Perfect Timing provides each user with a password protected, shareable personal calendar and an intelligent "To-Do List" that can hide entries until their appointed dates and then schedule them on the user's calendar. Perfect Timing allows everyone in an office to share a calendar and reserve resources such as conference rooms and slide projectors.

According to networking guru Nat Goldhaber, "Perfect Timing is the first Macintosh application that truly fits the definition of groupware—that is, a program enabling computers to make a bona fide qualitative difference in the way people work together."

The program enables any user on the network to schedule and confirm group meetings. A visual "composite" of the calendars of all invited people quickly identifies common slots of available time. In the course of scheduling a meeting, Perfect Timing sends a Meeting Request message out over the net to invited users. The Meeting Request advises recipients of who is requesting the meeting, who else is invited, and displays the meeting time on the recipients' own calendar. The person invited may respond immediately, delay the decision, or decline to attend.

An "Agenda" may be attached to Meeting Requests as they are sent out. Each recipient may respond and add items under his/her own byline. The originator of the meeting can then incorporate agenda amendments and additions into the master agenda. According to Goldhaber, the agenda function is a disguised bulletin board/e-mail system.

In addition to its network functionality, Perfect Timing provides a sophisticated on-screen calendar and datebook functions for individual users. Appointments may be created or edited over a half-dozen ways, according to the user's preference, and displayed or printed in one of several formats. The personal "To-Do List" automatically carries forward unfinished items. Passwords may be used to protect private on-screen reminders and calendar notes.

Shep Tamler, President of Imagine Software, is sensitive to what he calls "reasonable criteria" for a groupware application. He believes, first, that there must be a full-function, single-user application at each node—a user should have individual functionality within the application as well as multiuser functionality. His second criteria relates to the politics of multiuser applications: The individual must be able to retain control of the function. The program should not be able to take control of the user. He cites some examples of PC-based calendaring programs that reminded users that perhaps Big Brother was on their desk. There is a very sensitive line between providing functionality and overdoing it. Particularly with a calendaring application, the user must retain control of when and where (s)he is scheduled for meetings.

Another Step for Groupware? SYZYGY

SYZYGY (SIZ-ih-gee), the word, means the alignment of the sun, moon, and earth. SYZYGY, the product, allows alignment of activities, resources, schedules, and budgets with management objectives. Published by the Information Research Corporation of Charlottesville, Virginia, SYZYGY is part of a strategy and vision of the future of workgroup computing that will put into user's hands practical, real-world tools for more effective management, systems for enhancing work life, and technology that frees the mind to create.

According to IRC, "SYZYGY is the first workgroup product for managers, an information management tool designed to improve the flow of information between members of a workgroup. It helps manage activities, resources, projects, and tasks, keeping track of such information as schedules, budgets, and notes. The keys to its usefulness are its ability to track multiple projects simultaneously, tailor the information to the level of the person using it, and provide information from a number of different perspectives."

IRC is aware of key issues concerning groupware computing resources. "Groupware (also known as 'workgroup computing' and 'computer-supported cooperative work') refers to processes and tools to facilitate a group's work and enhance productivity. The term 'groupware' has generated a great deal of hype, confusion, and, to some, disappointment. Just as spreadsheets like VisiCalc and Lotus 1-2-3 forever changed the way people crunch numbers, groupware promises to revolutionize the way people work in groups and make networks into the communication-enhancing tools they were designed to be."

IRC's backgrounder on Workgroup Computing Today continues. "The key questions are: Does the software give people more control over their work or take it away? Does it eliminate unnecessary work or does it create extra work (such as more meetings)—especially work that's irrelevant to a group's objectives? And does it improve communication in the corporation, help meet strategic goals, and integrate seamlessly with corporate information systems—or further isolate workgroups (and management) from reality?"

The benefits of workgroup computing are said to be increased communication, increased coordination, new paths to knowledge, group memory, time savings, more equal participation, internalization of management values, better teamwork, and increased creativity. Phew! Can a mere software phenomenon possibly deliver all that? The issue may actually be an educational one. Even if the software can do all this, can people comprehend it's doing it? Is there an understandable metaphor available that people can refer to when trying to incorporate this power-software concept into their everyday lives? IRC says the "lack of an appropriate metaphor is currently holding groupware products back."

What are the problems? Groupware is just beginning to emerge and, as such, doesn't exhibit the maturity to be taken seriously at any major level in the business process. People also feel that workgroup products are aimed at controlling people, that they give managers more power over workers and allow them to electronically look over everyone's shoulder. IRC comments: "The products themselves are not authoritarian or dictatorial (just as matches don't start forest fires). The social implications of using groupware products are enormous."

In addition, the same things that happened to the first promises of the personal computer "productivity" revolution are happening with groupware. There is publicity, advertising, and hype that goes along with new product introductions, but just how much of this in the groupware arena is just smoke and mirrors? In the same publicity breaths, marketers claim ease-of-use for this new software genre. Ease-of-use is relative and if there really isn't a working metaphor for this little technological jewel, even if it has pull-down menus and padded-cell help, of what use will it be and to whom?

SYZYGY claims to take on these pitfalls by a clear, well-organized definition of the problem it seeks to solve and the work-process area it seeks to support. "SYZYGY does not try to be all things to all people. It gives managers the tools to direct, monitor, and control workgroup activities. SYZYGY gets managers involved in the workgroup and gets workers involved in managing. It enables you to quickly reallocate resources and budgets. It helps automate repetitive activities. SYZYGY is easy enough for executives to learn and use without staff assistance. It ties into existing corporate information systems. SYZYGY can be customized for different groups."

As of this writing, SYZYGY is available for the IBM personal computer or compatible and works with Novell Netware, 3COM 3+, Banyan Vines, DCA 10Net, DECnet, and TOPS 2.1 (for the PC). Future enhancements will be interoperability (Macintosh, OS/2, UNIX), and template libraries. This promises to be an interesting piece of groupware to watch.

BellSouth Media Technologies: Groupware on a Larger Scale

BellSouth Media Technologies develops and markets sophisticated groupware applications for directory and corporate publishing environments. The technology emerged from a group called TechSouth who was responsible for producing the Yellow Pages directories for the nine-state area served by Southern Bell and South Central Bell. BellSouth Media Technologies is now a division of TechSouth, Inc.

Prior to the emergence of electronic information management, directory publishing was paper-based, labor intensive, and costly. TechSouth automation of this process resulted in lower personnel requirements, greater efficiency, and higher profits. TechSouth's Dewey Anderson comments on the directory publishing business: "Our business has many peculiar needs. What works for one publishing segment, for instance newspapers, does not meet all the needs of directory publishing. Our business is very graphic and text-oriented. We use all kinds of art, from line art to continuous tone, artwork borders, and logos, and produce it all in both color and black and white. Many fonts, in point sizes ranging from six to 72, are required to handle the textual aspects of listings and ads.

"The volumes associated with directory publishing separate us more than any other factor from other publishing segments. Our contracts require us to handle over 250,000 pieces of display advertising per year, with as many as one million cuts of art in over 350,000 in-column ads with 300,000 different logos. All of these elements must stay online throughout the directory canvas-and-close cycle. This process can last as long as nine months. The final culmination of the process is the directory page. We produce over 50,000 pages annually in over 500 directories."

TechSouth's challenge to coordinate and effectively produce such volume led to their development of special groupware software that runs on a distributed network of VAX and Macintosh computers. The extension of their initial effort to solve their own problem has produced a series of modular publishing products designed to integrate text and graphics and bring electronic publishing power to the directory publishing industry. These products operate in networked Macintosh and Macintosh-DEC environments.

SAMSON is a fully integrated system including modules for the development of display ads, in-column ads, a telemarketing and sales support system, a production tracking system, and an expert technology-based page make-up system. For the corporate environment that produces highly structured, lengthy documents that integrate text and graphics, the Intelligent Document Processor provides the capability for a workgroup to produce centrally defined, automatically formatted documents. This allows content experts to focus on content rather than form.

SAMSON was designed with the directory publisher in mind, and can be configured to support unique user needs. It supports display ad production, allowing complete text and artwork generation, proofing, and final output capability at each workstation on the network. Artwork can be incorporated into the system through flatbed desktop scanners, popular Macintosh drawing packages like Adobe Illustrator 88, or CD-ROM resident clip art files. Art may be retouched, stored for future use, then selected from a pull-down menu when building an ad on-screen. Text and art can be rotated and interactively resized.

SAMSON display ad makeup software operates on stand-alone Macintosh II workstations, on Apple-only networks, and in a Macintosh-DEC environment for high-volume production shops. It supports low-cost desktop scanning at 300 to 800 DPI in the stand-alone workstation version and high-resolution scanning up to 2,000 DPI in its production configuration. Scanners and CD-ROM players may be incorporated into the LAN. Laser printer output at 300 DPI is typically used for proofing and higher resolution output on RC paper is possible on a wide range of PostScript-compatible image setters.

The Intelligent Document Processor (IDP) seems to exhibit the desirable qualities for a groupware application as described by Nat Goldhaber. His analogy is to a Star Trek game. "Each person fulfills a different and distinct function, although they are all bound by coordination, interaction, and commitment to work toward a common goal." IDP permits central definition and control of format to ensure document consistency. Once the format is created, the system guides the writer from one document element to the next—from heading to subheading—in the correct order and properly positioned on the page. As text is entered by the writer, format is applied automatically by the program, provided continuous WYSIWYG display of complete pages. This gives a writer freedom to concentrate on content, but within the context of the way what is written will actually appear on the page to the reader.

Musings from a Personal Perspective: If I Had Groupware...

From my own experience as a writer, being able to think of the format of my writing with heads and graphics integrated is a very desirable way to work. I much prefer to write that way. To make it an option in my world, however, requires a coherent combination of separate electronic and human functions, much like the old cut-and-paste routine in the production world.

I quite often work with a group of design-oriented professionals. We have worked together a long time and how we complete a project has evolved substantially in parallel with developments in application software, hardware, and networks. Each associate has his or her own area of expertise, so the process of combining all of our work into a finished document is a constant source of experimentation and refinement.

In a recent project where I contributed as a writer, the designers produced for my use a layout template with attributes that could be applied to blocks of text. They have taught me the remedial use of Ready Set Go that allowed me to write, as well as apply page layout/formatting attributes and move things around. I was able to produce an approximation on the screen of what the reader would eventually see.

Since our functions are not integrated under one application umbrella, it was then up to the desktop publishing professionals to take my file, clean up all my mistakes, and tweak it so it's right. I'm told working with my files was not exactly a straightforward process for them!

It was, however, an instructive experience that whets my appetite for an application like SAMSON from BellSouth Technologies. I found that writing to the exact layout and visual context of a page improves the clarity of preliminary drafts. It seemed to reduce editing because I knew what space I was trying to fill and what it looked like, so I could custom-fit the words to the presentation. It also helped me to integrate visuals into my communication process. Instead of dropping visual elements in after the narrative is written, they were suggested by the flow of communication.

The only significance of this, my less than state-of-the-art experience, is to suggest that there are many possibilities for groupware in the future. Preliminary observations, however, suggest that the issues around integration of groupware into the workplace are profound. We would be interested in your comments, experiences, and musings on the issues of groupware. Write to Virginia Bare and Michael Rogers, c/o Brady Publishing, 15 Columbus Circle, New York, N.Y. 10023.

Chapter Ten

AppleTalk Solutions: A Product Guide

Introduction

In this chapter we introduce all the available products for your AppleTalk network. The products are divided up into logical groups—network connectors, interface cards, file servers, print spoolers, etc. For each product category, we describe all known products and provide some information about the vendor.

For each product in this guide, a general description of the product is given along with the product's distinguishing features and limitations. Rather than attempt to discuss each product in detail, a short description is provided so that a complete list of products can be included. Some of the more popular products are given more complete reviews. Each product is accompanied by a table giving some vital statistics about the product and its vendor. The template for this table is as follows:

Mac File Server

Description:	Dedicated file server for Macintoshes only.
Price:	$5000 per server
Vendor:	Ima Vendor, Inc.

Network Hardware

Connectors/Cables

Network connectors and cables are essential for any networking project. This section describes many of the cables available for creating LocalTalk networks, those that use the built-in networking hardware of the Macintosh or similar hardware found in network peripherals and on LocalTalk interface cards for other computers. Because of the proliferation of connectors by many vendors (as you will see in this section), there is a tendency to think of the network connectors as commodity items, one as good as the next. Unfortunately, this is not always the case. What looks like a great buy may come back to haunt you. The most important thing to watch out for is the data rate the connector will sustain. Many of the more inexpensive connectors on the market will not support any speeds other than the normal 230 Kbaud generated by the built-in hardware of the Mac and most peripherals. It is best to purchase connectors that support speeds of up to 1 Mbaud (1,000 Kbaud) to protect your investment in case of future network upgrades. Be sure to check the packaging or to contact the manufacturer before you standardize on any particular brand.

Beyond the data rates sustainable by the connector, the other differences between connectors have to do with the type of cabling employed, and whether or not the connectors feature automatic termination. As discussed earlier in this book, three cabling types dominate: shielded twisted-pair with DIN-3 connectors (as used in Apple's LocalTalk and others), phone cabling with RJ-11 connectors (as used in Farallon PhoneNET, TOPS Teleconnectors, Nuvotech TurboNet, and others), and fiber-optic cabling by duPont. Fiber-optic cabling does not require termination since the signals are not electronic; both phone-wire and shielded twisted-pair cabling implementations are available in self-terminating varieties.

All available cables come in both DB-9 and DIN-8 varieties for connection to network devices; some come in a DB-25 style for the Mac XL (Lisa). A short list of the devices that require each style is provided below:

DIN-8	DB-9	DB-25
Mac Plus	Mac 512K, 512KE	Mac XL (Lisa)
Mac SE, SE/30	LaserWriter, LaserWriter Plus	
Mac II, IIX, IICX	Hayes InterBridge	
LaserWriter IINT, IINTX	Kinetics FastPath	
Apple IIE, IIGS	PC AppleTalk Interface Cards	
Imagewriter II, IILQ	TOPS Repeater	
Other AppleTalk Devices	Other AppleTalk Devices	

LocalTalk

Description: LocalTalk Cabling System for linking computers and peripheral devices in an AppleTalk Network System. Connectors come with a three-meter cable and a barrel connector for joining cables. LocalTalk cables are self-terminating, but can only be used in daisy-chain configurations.

Price: $75—Connector kit (DIN-8 or DB-9)

$75—Ten-meter cables

$125—25-meter cables

$849—Custom wiring kits—100 meters cable, 20 plugs

Vendor: Apple Computer, Inc.

PhoneNET Plus

Description: PhoneNET Plus connectors for connecting each device on an AppleTalk network over new or existing telephone wire. Farallon was the first to offer network connectors that utilized phone wire and RJ-11 connections for AppleTalk networking. Kits for creating custom cables and for creating passive star topologies are available. Farallon also offers a wide variety of other cables and connectors for combining PhoneNET systems with LocalTalk cables, and for adapting to a number of common phone systems and wiring standards. Call Farallon for details on these specialized PhoneNET products.

Price: $59.95 retail (DIN-8 or DB-9)

$75 retail (DB-25)

Vendor: Farallon Computing, Inc.

TOPS Teleconnectors

Description: TOPS Teleconnector is an AppleTalK and FlashTalk-compatible connector for connecting each device on an AppleTalk Network System; DIN-8 and DB-9 connectors. Each connector comes with an eight-foot cable and an RJ-11-mounted terminating resistor.

Price: $59 retail

Vendor: TOPS Division, Sun Microsystems, Inc.

TurboNet, TurboNet ST

Description:	TurboNet is an AppleTalk-compatible networking system similar to the PhoneNET products. TurboNet ST is a self-terminated AppleTalk connector that runs on RJ-11 telephone cabling. TurboNet Adapter Cable allows the combining of TurboNet connectors with existing LocalTalk network connectors.
Price:	$49.95 retail (TurboNet)
	$59.95 retail (TurboNet ST)
Vendor:	Nuvotech, Inc.

CompuNet

Description:	CompuNet Connectors to connect each device on an AppleTalk Network System; DIN-8 and DB-9. Not compatible with higher-speed AppleTalk implementations.
Price:	$29.95 retail
Vendor:	Trimar USA, Inc.

NetTalk, AppNet

Description:	NetTalk connectors are similar to Apple's LocalTalk connectors or mini-DIN-3 wiring connections; AppNet connectors are twisted-pair connectors or RJ-11, similar to PhoneNET.
Price:	$24 each, DIN-8 or DB-9
Vendor:	Allied Technology Corp.

ModuNet

Description:	AppleTalk-compatible, local-area network connectors. Not compatible with higher-speed AppleTalk implementations.
Price:	$37.97 retail (MDT-M8)
	$43.95 retail (MDT-D9)

	$47.95 retail (MDT-D25)
Vendor:	DataSpec

QuikNet, BelTalk

Description:	Unshielded twisted-pair LocalTalk cabling; QuikNet cabling system comes with either DB-9 or eight-pin mini DIN connector with six feet of RJ-11 modular cable and terminator. BelTalk cabling and connectors are LocalTalk-compatible connector kits with standard mini-DIN-3 connectors.
Price:	$59 per kit retail
Vendor:	Belkin Components

QuickNet, DualNet, TriNet

Description:	QuickNet— AppleTalk-compatible networking system.
	DualNet—Permits 64 devices to work from one wall jack.
	TriNet—Connects up to 96 devices on QuickNet.
Price:	$45 per node retail (Quicknet)
	$59 retail (DualNet)
	$54 per node retail (TriNet)
Vendor:	Infotek, Inc.

MagicNet

Description:	MagicNet connectors to connect each device to an AppleTalk Network System.
Price:	$24.95
Vendor:	MacProducts USA

AP Net

Description: AppleTalk-compatible, local area network connectors

Price: $59 per node, DIN-8 or DB-9

Vendor: Lynn Products, Inc.

Q-Talk

Description: AppleTalk-compatible, local-area network connectors

Price: $59 per node, DIN-8 or DB-9

Vendor: Laser Connection

CompuTalk, PhoneTalk, CompuTalk AT Plus

Description: AESP offers a wide variety of innovative network connection devices for both LocalTalk and phone-wire network installations. In addition to standard LocalTalk and phone-wire-network connectors, AESP offers LocalTalk and phone-wire wall plates so that network connectors can be hidden inside the wall, wall plates with bypass switches so the connector can be removed altogether, and various other network-cabling accessories. The CompuTalk AT Plus is a line of LocalTalk concentrators with either three, four, or five ports plus a connection to the main network. This allows a single, compact device to serve as a passive hub for up to five AppleTalk devices, eliminating the need for connectors at each device.

Price: $59–75 Network Connectors

$11–140 Wall plates

$185–275 AT-Plus with three to five LocalTalk ports

Vendor: AESP Inc.

IntelliNet

Description: IntelliNet cable and software, phone-wire-based LocalTalk connector kits, compatible with FlashTalk,

	bundled with Net Auditor network utilities for device and system file lookup, font downloading, printer reset, and printer font listing.
Price:	$50 for either DIN-8 or DB-9 version
Vendor:	Nexsys

Fiber-Optic AppleTalk LAN

Description:	Fiber-optic local-area network; compatible with the AppleTalk copper twisted-pair system.
Price:	$250 retail (Converter)
	$950 retail (Concentrator)
	$4.55 per meter (Fiber)
	$350 retail (Extender from copper twisted-pair to fiber optics)
	$400 retail (Communications card for Mac II)
Vendor:	duPont Electronics

Network Accelerators

Network accelerators are devices that allow you to operate your LocalTalk networks at higher-than-standards speeds without bypassing the built-in hardware of your Macintosh by adding a card to the system. The Macintosh printer port, used for AppleTalk communications, is connected to a chip called the Serial Communications Chip (SCC). This chip is clocked on the Macintosh motherboard for the normal 230.4 Kbaud speed of LocalTalk. This chip, however, can be clocked externally to speed up communications. Both of the products reviewed in this section do exactly that, providing network data transmission speeds in excess of three times the normal speed.

Because use of these accelerator devices require changes to the AppleTalk protocols (provided as software drivers on disk with the product), neither of the products reviewed can be used with any devices but Macintoshes. Other network devices, especially bridges and gateways, should begin appearing with support for these protocols.

These products are useful for networks requiring higher bandwidth but will not be upgraded to Ethernet cabling due to cost or other considerations. A solution involving network accelerators will often cost only 10–20 percent of the cost of buying and installing Ethernet hardware and cabling. As discussed in Chapter 5, the higher speeds of these solutions will require more conservative design rules—at these speeds maximum network lengths will be much shorter and passive junctions may not be tolerable.

It cannot be emphasized enough that you should not relate the network data transmission speeds to the speed of network tasks. Moving from LocalTalk speeds to FlashTalk may not provide three times the speed, just as Ethernet will not provide 40 times the speed of LocalTalk. The time it takes for any given network task to take place depends on the application involved, the number of network transactions required, other network activity at the time, other activity at either the server or the client station, CPU time required at both the server and the client, and may involve disk activity at both the server and the client. Network accelerators will only decrease the time it takes for actual data interchanges along the network—the total time required may actually consist mostly of disk and CPU activity and, perhaps, waiting for the network to be available.

Using network accelerators is quite simple. The accelerator device is merely placed between the Macintosh and the network connector, and a software installation program is run to install and select the driver.

TOPS FlashBox

Description:	Macintosh network accessory allowing network transmissions at 770 Kbaud rather than the standard 230 Kbaud speed. FlashBox supports both the higher speed and standard speeds so that FlashTalk-capable machines can coexist with AppleTalk devices.
Price:	$189 retail—DIN-8 version
	$239 retail—DB-9 version
Vendor:	TOPS Division, Sun Microsystems, Inc.

DaynaTalk

Description:	DaynaTalk connector box for Macintosh that boosts data transmission rates over LocalTalk and compatible cabling systems. Maximum of 850,000 bits per second, depending on type of Macintosh used.
Price:	$189 retail
Vendor:	Dayna Communications

EtherTalk Cabling/Devices

The term "Ethernet" refers to a published standard for the physical and data link layers of a network. "Ethernet" is also referred to as a cabling system for Ethernet LANs. When Ethernet physical cabling is used for an AppleTalk LAN, it is often referred to as an EtherTalk LAN. Standard Ethernet cabling is used with EtherTalk. The cabling types are Coaxial Cable—Standard (Thick) Ethernet; Coaxial Cable—Thin Ethernet; and Twisted Pair. The Ethernet vendors listed below typically manufacture various types of Ethernet equipment, including: Ethernet cables, tranceivers, terminators, and repeaters. Ethernet cabling is quite common and can be obtained from many sources other than those mentioned here.

Vendors:	3Com Corporation
	Cabletron
	SynOptics
	Western Digital
	David Systems, Inc.

Repeaters

Repeaters allow for topological flexibility in designing your LocalTalk network, giving you longer maximum distances between nodes or support for topologies not otherwise possible without passive junctions. Repeaters are not intelligent devices; they merely amplify and/or regenerat signals on the network, so that data can be sent longer distances or along branches. As such, they are invisible to the machines on the network and do not interact with the contents of data packets at all. They count as nodes towards the electrical limits of your chosen cabling system, but do not have an explicit address or count towards the AppleTalk limit of 254 nodes per network.

TOPS Repeater

Description:	The TOPS Repeater extends the maximum length of an AppleTalk network by joining separate electrical buses, each of which can support the full length and number of devices specified by the vendor. The TOPS Repeater also allows alternate topologies to the standard daisy chain.
Price:	$189 retail
Vendor:	TOPS division, Sun Microsystems, Inc.

PhoneNET Repeater

Description:	PhoneNET Repeater receives, reclocks, and resends network signals. Because the PhoneNET Repeater fully reclocks the signal it can extend the range of your network to much longer distances. The Repeater can be used in eitwher a two-wire or a four-wire configuration. In the two-wire configuration, each side of the repeater is an active AppleTalk bus that can support AppleTalk devices. The four-wire configuration is used for reaching even longer distances between Repeaters. In this configuration, the four-wire side of each repeater cannot support AppleTalk devices. With 22-gauge wire and the four-wire configuration, two Repeaters can be as far as 9,000 feet apart.
Price:	$495
Vendor:	Farallon Computing, Inc.

Multiport Repeaters

Multiport repeaters are just like repeaters, except that they join more than two electrical buses and are used as active hubs for star topologies. Each "arm" of a multiport repeater is an independent electrical bus with the limits associated with the chosen cabling system. Like the repeater, multiport repeaters do not interact with the contents of the data packets and are invisible to the protocol and to devices on the network. Without the addition of bridges or gateways, all arms of the star controller and the attached devices belong to the same AppleTalk network.

PhoneNET StarController

Description: The PhoneNET StarController was the first device to bring reliable star topology communications to AppleTalk networks. The StarController is a 12-port AppleTalk repeater, which significantly increases the size and topological flexibility of your networks. Each of the 12 ports is a separate electrical bus, with restrictions based on the quality of wires and type of connectors used. The StarController includes StarCommand software, which allows you to control each port's status. In addition, each port has antijamming circuitry built in to keep a failure along one port from affecting the entire network. A 50-pin connector attaches directly to the StarController and to a special punch-down block, allowing easy connection of network wires to the StarController without hard-wiring them to the device.

Price: $1,695 retail

Vendor: Farallon Computing, Inc.

TurboStar

Description: The TurboStar is a 12-port AppleTalk packet repeater, significantly increasing the size and topological flexibility of your networks. The product was- expected to be released in the first half of 1989. Similar in design to the Farallon StarController, the Turbo Star connects 12 distinct electrical buses, each limited by the type of wire and connectors used on the bus. The TurboStar is an active AppleTalk device and comes with administration software that can be used from any Macintosh on the network. This software can be used to turn any port on or off, or to check a statistical log of network traffic that is kept in the TurboStar. Each port is connected to antijamming circuitry that will shut down any port that appears to be jammed, preventing degradation of the entire network.

Price: Unannounced

Vendor: Nuvotech

Local AppleTalk Bridges

A local AppleTalk bridge allows two local networks to be joined together to enhance communications and share peripherals while acting as a traffic filter, passing information between networks only when necessary. A bridge is thus differentiated from a device like a repeater, which only serves to build larger or more diverse networks. Bridges are used both to connect two previously isolated networks and to split an existing network into two connected networks to enhance performance on the network. Because a bridge does not inhibit communication between the devices on either side of it, no functionality is lost when a bridge is added. In fact, as explained in Chapter 4, bridges are invisible to the user unless zones have been configured across the bridge.

Using bridges brings a new element of network administration to AppleTalk networks. Installing a bridge requires not only attaching it to the physical network, but configuring the bridge, usually from one of the Macintoshes on the network. Typically, you must specify the network number for each of the two networks attached to the bridge and must decide which zones each network belongs to if you are using zones. Some bridges offer additional capabilities, such as allowing only one of the two networks to "see" the other.

The products listed in this section all offer local networking—attaching two local networks to form an internetwork. There are differences among the bridges, however. Most are hardware products, though one of the bridges is a software-only implementation. Some offer a combination of both local and remote bridging, joining remote networks using phone lines and modems. The figure below illustrates some of these key differences in the products listed.

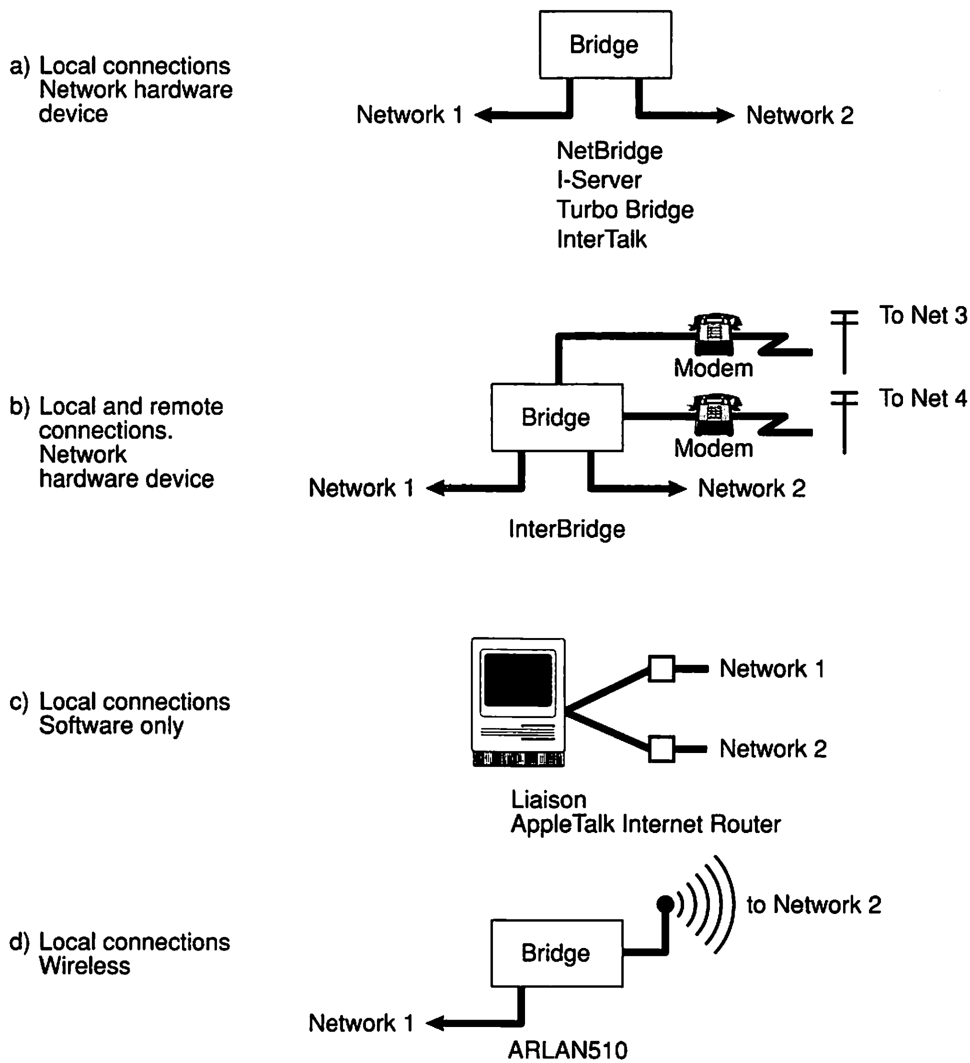

Figure 10-1 Local AppleTalk bridges.

InterBridge

Description: The InterBridge from Hayes was the first available bridge for AppleTalk LANs. InterBridge combines both local bridging and remote bridging from the same device. Two local networks and two remote networks may all be connected with one InterBridge. The InterBridge is a stand-alone network device and is configured from another Macintosh on the network using the InterBridge Manager software. The Manager must be used to set up zones, network numbers, and remote port parameters. The Manager can also be used to interrogate the bridge and report statistics such as total traffic, total number of good and bad packets, etc.

Price: $799 retail

Vendor: Hayes Microcomputer Products, Inc.

NetBridge

Description: The NetBridge is a local AppleTalk Bridge for connecting two networks or splitting an existing network into two. The NetBridge acts as a filter for network traffic, only passing packets between networks when necessary. It allows networks to expand well beyond the single-network limits by creating internetworks of connected networks. The NetBridge comes with configuration software that allows the administrator to specify the network numbers and zones on either side of the bridge. The configuration software also allows the administrator to look at the entire internetwork and reconfigure the zones and networks and to specify zone access privileges.

Price: $499 retail

Vendor: Shiva Corporation

I-Server

Description: The I-Server is a local AppleTalk bridge, allowing you to join two AppleTalk networks or to split an existing network into two to maintain or improve network performance. The I-Server is a stand-alone network device that is connected directly to both networks being bridged. I-Servers must be configured prior to use with the I-Server Manager. The Manager allows you to specify network numbers and zone names for the two networks.

Price: $695 retail

Vendor: Solana Electronics

Liaison

Description: Liaison is unique because it is a software-only implementation of a network bridge. Liaison can provide network bridging services in any of four ways—single users can dial into a network using Liaison and modems, two entire networks can be bridged over phone lines, two LocalTalk networks can be bridged locally, and a LocalTalk network can be bridged to an EtherTalk network. Once the connection is made, remote users use the network as if it were local. Network users on either side of a local Liaison bridge cannot tell there is a bridge unless each network is configured in a different zone. The configuration software can be told to configure the local bridge automatically, avoiding duplicate network numbers. Many people use the LocalTalk-EtherTalk bridge capability for attaching LaserWriters onto their otherwise all-EtherTalk networks and negate the need for a Kinetics FastPath or other LocalTalk-EtherTalk bridge.

Price: $295 retail

Vendor: Infosphere, Inc.

TurboBridge

Description:	The TurboBridge is a local AppleTalk Bridge for connecting two networks or splitting an existing network into two. The TurboBridge acts as a filter for network traffic, only passing packets between networks when necessary. The TurboBridge has two TurboNet ST connectors, Nuvotech's self-terminating RJ-11 connectors, built into the bridge. The TurboBridge comes with configuration software that allows the administrator to set up the network numbers and zone names on either side of the bridge. The software also allows invisible zones to be set up to provide limited access to various networks on the internetwork.
Price:	$499
Vendor:	Nuvotech

AppleTalk Internet Router

Description:	Apple is preparing a release of an AppleTalk internet router that will run in the background of a Macintosh. Though the machine does not need to be dedicated, the product does take extensive amounts of memory and can severely impact performance of the Macintosh. Apple's router differs from other bridges in that it can support multiple network connections within a single machine. With a Mac II, you could have LocalTalk network attached to both the printer and modem ports, and up to five Ethernet networks, all bridged together. The router is not expected to be released until AppleTalk 2.0 is released.
Price:	Unannounced
Vendor:	Apple Computer

InterTalk

Description: InterTalk is a stand-alone AppleTalk network device that bridges two networks together. The InterTalk acts as a node on each network. Configuration software is provided, but only needs to be used to define zones. Selection of network number is automatic so as to avoid duplicates.

Price: Unannounced

Vendor: P-Ingenierie

InterTalk IIi

Description: The InterTalk IIi provides all the same features as the previously described InterTalk, except that rather than being a stand-alone network device, the InterTalk IIi is a NuBus card for use in a Macintosh II.

Price: Unannounced

Vendor: P-Ingenierie

ARLAN 510

Description: ARLAN is a wireless device for bridging two AppleTalk networks over long distances (up to 6 miles) or where direct wiring is impossible. Using Spread Spectrum radio frequency technology, an ARLAN unit is required at each network. The bridge operates at the full 230 Kbaud speed of AppleTalk. Although this solution is ideal for long distances or where wiring is impossible or very expensive, the devices themselves are quite expensive.

Price: $3,000, approximately; shipping Fall 1989

Vendor: Telesystems SLW, Inc.

LANSTAR AppleTalk Bridge

Description: The LANSTAR AppleTalk Bridge is software that enables you to link AppleTalk networks that use the

	LocalTalk cabling system with LANSTAR AppleTalk networks. Runs on a Macintosh II equipped with the LANSTAR AppleTalk interface card.
Price:	$295
Vendor:	Apple Computer, Inc.
	Northern Telecom, Inc.

Half Bridges and Remote Access

AppleTalk Bridges can also operate between networks that are nowhere near each other, through the use of phone lines and modems. All of the following products allow networks across the street or across the world from each other to be connected and to appear as if they were local networks. Just as with internetworks that are completely local, printers and file servers can be shared, electronic mail can be exchanged, and files can be transferred. In this case, however, the speeds are limited by the quality of the phone lines and the capabilities of the modems used. Modem speeds are generally from one to ten percent of the speed of AppleTalk networks.

Also included in this section are products that do not form a remote bridge between two networks but allow a single user to "dial in" to an existing network and become one of the nodes on the network. Once this is done, the user has the full capabilities of one on the local network, except again that the speeds are limited to modem speeds. Making a single connection to a network requires a remote connection device and a modem at the network, and requires a modem and (in some cases) additional hardware at the remote site.

Remote bridging requires both a remote bridge and a modem at each end of the connection. Such connections may be made on an as-needed basis or can be set up permanently over leased telephone lines. Figure 10-2 shows typical set-ups for the products listed.

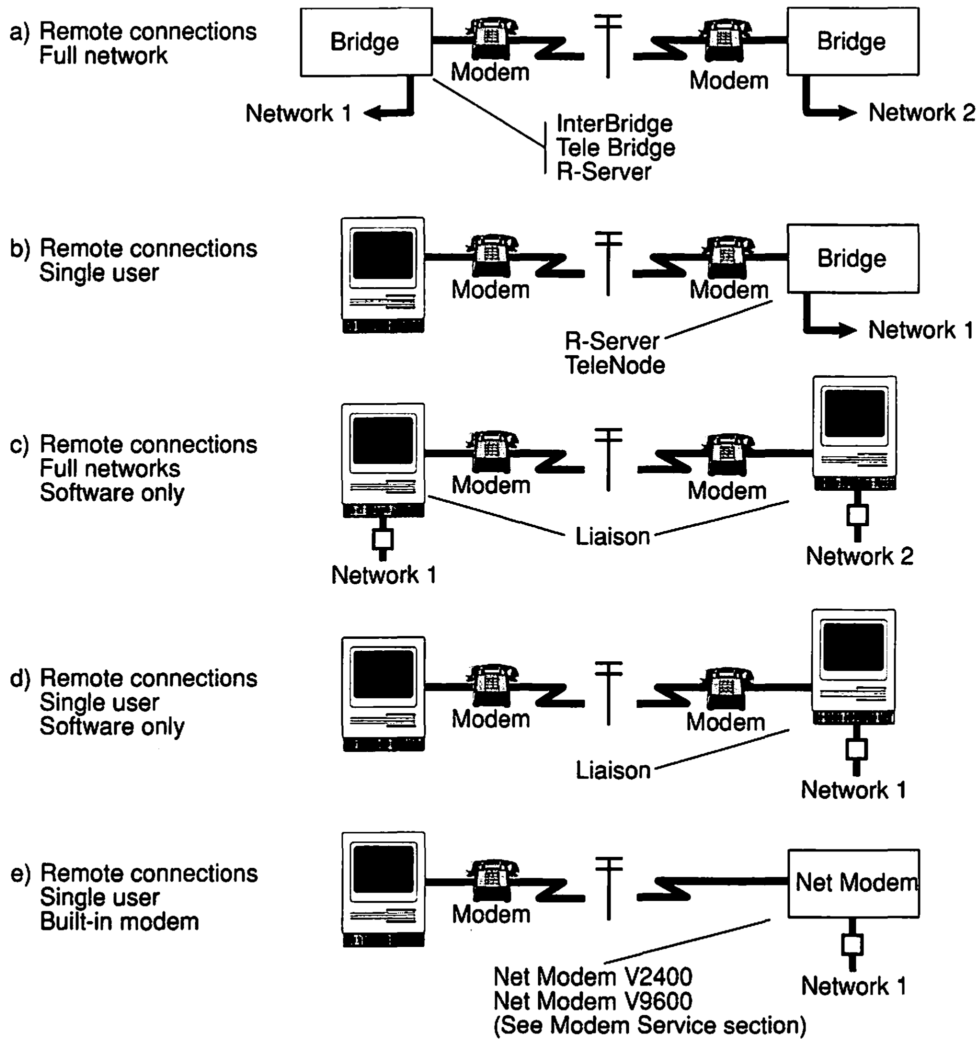

Figure 10-2 Remote network connectivity.

TeleBridge

Description: The TeleBridge is used when you are connecting a network over phone lines due to the distances involved. With a TeleBridge at each network connected via a phone line and modems at each end, the two networks can be made into an internetwork or wide-area network (WAN). Once connected, the users on either network can use network services and devices as if they were local. Single remote users with a modem and Shiva's remote dial-in software for the Mac or the PC can also dial in to a TeleBridge. Tasks will generally take longer across TeleBridges than they would locally since the communications occur at modem speeds rather than at full AppleTalk speeds, though the TeleBridge supports modems at speeds up to 57.6 Kbaud.

Price: $499

Vendor: Shiva Corporation

TeleNode

Description: The TeleNode is a device that allows remote access to an AppleTalk network. The TeleNode is a stand-alone network device that, when combined with a modem, allows users to dial in from remote sites with just a modem and remote dial-in software provided with the TeleNode. The TeleNode works with most popular modems and accepts speeds of from 1,200 to 19,200 baud. Once connected, the remote Macintosh has full access to AppleTalk services as if it were local to the network. Password protection prevents unauthorized access to the network.

Price: $695 retail

Vendor: Dataspace Corporation

R-Server

Description: The Solana R-Server functions as a gateway for remote user access or as a bridge for linking remotely located networks. A stand-alone device on the network, the R-Server combined with a modem is ready to accept a connection. A Macintosh along with a modem and the Remote AppleTalk desk accessory that comes with the R-Server allow one remote user to dial in to the network (passwords can be required for security). Two networks, each with an R-Server and a modem, can be connected to form an internetwork, providing all users on either network access to all network services. R-Servers can be used with modems at up to 19.2 Kbaud.

Price: $595 retail

Vendor: Solana Electronics

InterBridge

Description: The InterBridge from Hayes was the first available bridge for AppleTalk LANs. InterBridge combines both local bridging and remote bridging from the same device. Two local networks and two remote networks may all be connected with one InterBridge. The InterBridge is a stand-alone network device and is configured from another Macintosh on the network using the InterBridge Manager software. The Manager must be used to set up zones, network numbers, and remote port parameters. The Manager can also be used to interrogate the bridge and report statistics, such as total traffic, total number of good and bad packets, etc.

Price: $799 retail

Vendor: Hayes Microcomputer Products, Inc.

Liaison

Description: Liaison is unique because it is a software-only implementation of a network bridge. Liaison can provide network bridging services in any of four ways—single users can dial into a network using Liaison and modems, two entire networks can be bridged over phone lines, two LocalTalk networks can be bridged locally, and a LocalTalk network can be bridged to an

EtherTalk network. Once the connection is made, remote users use the network as if it were local. The server protects access to the network by requiring a name and a password to validate the user. Upon validation, remote users can be restricted to services on a particular node, zone, or given access to the entire internet. For Liaison dial-up clients, personal "address books" can be configured to store commonly dialed numbers and Liaison can be instructed to make a particular connection each time the Macintosh is booted. Connections that have not shown any activity for a specified period of time can be terminated automatically. Liaison even lets users dial out without disconnecting their machine from the main network.

Price: $295 retail

Vendor: Infosphere, Inc.

DOS Dial-in

Description: DOS Dial-in is a software package for the PC that allows PC users to use AppleTalk software from their PCs over phone lines. Users of TOPS/DOS, InBox for DOS, NetPrint, and PC AppleShare can dial in using a modem to AppleTalk networks equipped with NetModems and TeleBridges. This capability should be extremely useful to those who travel with laptops or who work from their home.

Price: $99 retail—three users

Vendor: Shiva Corporation

RS-232 Gateways

There are many devices that do not have AppleTalk networking capabilities built in to them, which you might like to share on a network; popular examples include printers, plotters, and modem. Through the use of an RS-232 gateway, such as those discussed in this section, any hardware device with either serial or parallel communications capabilities can be shared on your network. The combination of an RS-232 gateway with a number of serial or parallel ports and software for your Macintosh allows you to "connect" to a particular port and share the attached device.

C-Server

Description: The C-Server from Solana Electronics is a standalone network device that allows up to three RS-232 devices to be shared over an AppleTalk network. The C-Server attaches directly to the network and has three DIN-8 ports for connections of serial devices. Common devices to be attached are serial lines running to host computers so network users can connect as terminals, and higher-cost devices such as printers and modems. Access to any device can be restricted by password.

Price: $645 retail

Vendor: Solana Electronics

MultiTalk II

Description: MultiTalk II is a serial port server that enhances your AppleTalk network by allowing any Macintosh computer on the network to share three asynchronous serial peripheral devices. The MultiTalk II is a standalone network device into which you connect up to three RS-232 devices through DIN-8 ports on the MultiTalk II. A Chooser device driver allows any Macintosh user to "connect" to one of the ports to use the attached device. If the port is already in use, the user may switch to another port or wait for the selected port to become free. Any RS-232 device can be attached to the MultiTalk II; some of the more common devices to attach are printers and modems. Devices can be optionally password-protected before access is granted.

Price: Unannounced

Vendor: P-Ingenierie

MultiTalk IIi

Description: MultiTalk IIi is a NuBus interface card and serial port server that enhances your AppleTalk network by allowing any Macintosh computer on the network to share three asynchronous serial peripheral devices. Rather than being a stand-alone network device like the MultiTalk II, the IIi is installed in one of the slots of a Macintosh II into which you connect up to three RS-232 devices through DIN-8 ports on the card. A Chooser device driver allows any Macintosh user to "connect" to one of the ports to use the attached device. If the port is already in use, the user may switch to another port or wait for the selected port to become free. Any RS-232 device can be attached to the MultiTalk IIi; some of the more common devices to attach are printers and modems. Devices can be optionally password-protected before access is granted.

Price: Unannounced

Vendor: P-Ingenierie

NetSerial X232

Description: The NetSerial X232 is a stand-alone network device that allows one RS-232 device to be shared among network users. Printers, plotters, and modems are common devices to be shared. The NetSerial X232 can also be used as a serial gateway to other computers so that Macintosh users can log in as terminals without having lines dedicated to each user. The NetSerial has been used successfully in conjunction with products like the Avatar MacMainframe DX, a serial 3270 connectivity device, to provide shared network access to mainframes. In conjunction with Shiva's Dial-In Network Access software for the Macintosh, a modem connected to a NetSerial X232 can be used to support remote dial-ins to the AppleTalk network. Such remote dial-ins can be password-protected.

Price:	$399 retail
Vendor:	Shiva Corporation

Silverplatter

Description:	Silverplatter is La Cie's software offering that allows any serial device to be shared across a local network. One copy of Silverplatter lets an unlimited number of users access the serial device at that server. Any serial device, such as a modem, ImageWriter, or other printer, plotter, or FAX modem can be shared by simply attaching it to the modem port of a Macintosh and installing the Silverplatter software. Users anywhere on the local network can then "connect" to these serial devices through Chooser software provided with the Silverplatter. No additional hardware, other than the serial device itself, is required.
Price:	$99.95 $149.95 with SilverServer Bundled with Cirrus drives from La Cie.
Vendor:	La Cie, Ltd.

Ethernet Gateways

An Ethernet gateway allows a LocalTalk network to be connected to an Ethernet network. You might need a gateway to enable communications with other devices that exist on Ethernet or to use Ethernet as a high-speed backbone network for routing information between LocalTalk networks. The diagram below shows the typical uses of Ethernet gateways. The gateways discussed in this section all allow the connection of the two physical networks for the interchange of AppleTalk and EtherTalk packets. The actual implementations and the other options available differ from one gateway to the next, however. The Kinetics FastPath allows for AppleTalk—EtherTalk routing, but also allows connection to DECnet networks and can translate AppleTalk packets into TCP/IP packets and serve as a TCP/IP internet address server. The Cayman GatorBox allows NFS (Network File

System, a standard for file-sharing among UNIX machines) servers on Ethernet to be seen to the AppleTalk users as AppleShare servers. Liaison from Infosphere allows only basic AppleTalk EtherTalk communications, but does it in software only in the background of a nondedicated Macintosh.

FastPath 4

Description: The FastPath 4 gateway joins a LocalTalk and Ethernet network together, allowing the Ethernet to serve as a high-speed backbone for LocalTalk networks, allowing AppleTalk-based machines on either network to communicate, and facilitating communications between LocalTalk devices and Ethernet-based host machines. The gateway can support both AppleTalk and EtherTalk, TCP/IP, and DECnet communications protocols. Physical connections are made through either a thick or thin Ethernet port (both provided) and a DB-9 port for LocalTalk. The FastPath is bundled with LAN Ranger to help the administrator manage the internetwork.

Price: $2,795 retail

Vendor: Kinetics, Inc.

GatorBox

Description: The Cayman GatorBox is a LocalTalk-to-Ethernet gateway that allows users on LocalTalk to communicate across Ethernet backbones to other LocalTalk networks, to communicate with other AppleTalk-based machines (Macs, PCs with EtherTalk cards) directly connected to Ethernet, and to communicate with Ethernet-based minicomputers that understand the EtherTalk protocols (a Sun workstation with TOPS for Sun). In addition to these connectivity options, the GatorBox allows translation between AppleShare calls and NFS (Network File System) calls so that any computer on Ethernet that supports NFS can be seen as an AppleShare server. The GatorBox also allows Macintosh users to communicate as terminals to TCP/IP hosts. Printing can be centralized as well, with all users printing to a designated AppleTalk printer.

Price: $3,495 retail

Vendor: Cayman Systems, Inc.

Liaison

Description: Liaison is unique because it is a software-only implementation of a network bridge. Liaison can provide network bridging services in any of four ways—single users can dial into a network using Liaison and modems, two entire networks can be bridged over phone lines, two LocalTalk networks can be bridged locally, and a LocalTalk network can be bridged to an EtherTalk network. Once the connection is made, remote users use the network as if it were local. Network users on either side of a local Liaison bridge cannot tell there is a bridge unless each network is configured in a different zone. The configuration software can be told to configure the local bridge automatically, avoiding duplicate network numbers. Many people use the LocalTalk-EtherTalk bridge capability for attaching LaserWriters onto their otherwise all-EtherTalk networks and negate the need for a Kinetics FastPath or other LocalTalk-EtherTalk bridge.

Price: $295 retail

Vendor: Infosphere, Inc.

IBM 3270 Gateways

Communicating with an IBM mainframe by emulating an IBM 3270 terminal traditionally requires specialized hardware and software for each computer. This class of product puts that hardware into a network device, allowing it to be shared among all network users without requiring any additional hardware at each computer.

Another solution for shared mainframe connectivity is to attach serial mainframe communication products to RS-232 gateways. The Shiva NetSerial X232 and the Avatar MacMainframe DX have been used together successfully to provide this sort of connectivity.

Netway 1000AE

Description: The Netway 1000AE is a multisession AppleTalk 3274 gateway providing shared access to an SNA gateway and to 3270 environments. The Netway is a standalone network device shared by network users. Rather than purchase the necessary hardware for each machine on the network, the Netway 1000 allows up to 16 simultaneous sessions from any machines on the network. The Netway is purchased with a 16-user license for either PC or Macintosh software and additional licenses can be purchased to provide access to a workgroup of PCs and Macs. The Netway SNA protocol-support software is downloaded to the Netway 1000 at installation from a Macintosh on the network. Client software includes 3270 terminal emulation, file transfer utilities, and 3287 printer emulation to support host printing directly to network printers. A single client can be logged in to as many as eight sessions from any one Macintosh and as many as six session from any PC. Optional MacMover software provides a desk accessory for file transfers in the SNA environment and requires installation of software on the host (mag tapes available for TSO, CMS, CICS).

Price: $3,995—Netway 1000AE with Mac or PC access software

$895—MacMover file transfer software.

Vendor: Tri-Data Systems, Inc.

Netway 2000

Description: The Netway 2000 is a more powerful version of the

Netway 1000AE multisession AppleTalk 3274 gateway, which provides shared access to an SNA gateway and to 3270 environments. See the previous description for the Netway 1000AE; the functions of the Netway 2000 are identical. The Netway 2000 is based on a very powerful SPARC processor and so can support up to 64 users from two AppleTalk LANs. The Netway 2000 also has two VME expansion slots, and Tri-Data has promised both Ethernet and Token Ring interface cards so that the Netway 2000 will support mixed LANs and protocols for both IBM PCs and Macintoshes.

Price: $9,995—Netway 2000

$200 56KB V35 Serial Adapter

$2,795 Ethernet Adapter

$3,695 Token Ring Adapter

Vendor: Tri-Data Systems, Inc.

PC LAN Gateways

The following products allow AppleTalk networks to be integrated into other PC-based LAN products. Long before AppleTalk file sharing became popular, companies such as Novell and 3Com were producing network products for networks of IBM PCs and compatibles. With entrenched installations of these networks, AppleTalk users often wonder if their AppleTalk networks can be integrated into these networks to allow file sharing between all members of the networks. Such integration is accomplished in two ways: either by integrating support for Macintoshes and AppleTalk protocols into the products from these vendors as Novell and 3Com have done, or by using TOPS for DOS as a nondedicated gateway between TOPS on the AppleTalk side and the PC LAN running in the same PC. Figure 10-3 below shows the difference between the two configurations.

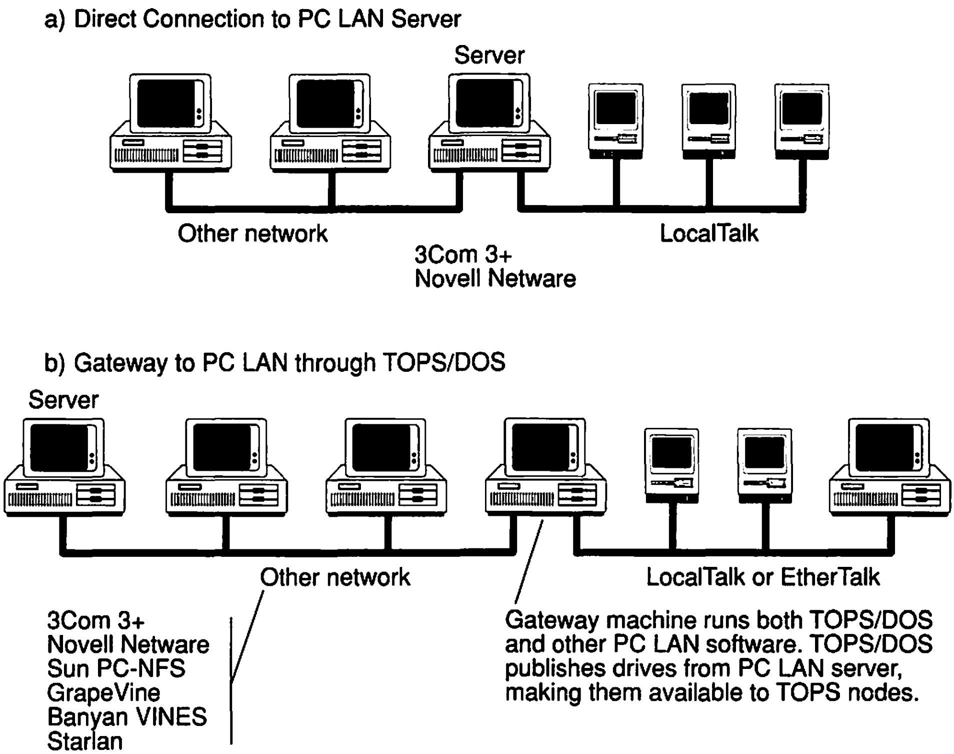

Figure 10-3 PC LAN gateways.

TOPS/DOS

Description: AppleTalk network users can gateway from AppleTalk into many of the popular PC LANs using TOPS/DOS software. Using one of the PCs that has TOPS/DOS installed, install the client software and hardware for the PC LAN into the same PC. With both LAN software packages installed, make the client connection to the PC LAN server. The virtual drives that represent directories on the PC LAN server can now be "published" using TOPS/DOS. Once this is accomplished, other TOPS nodes (Mac or PC) can access the PC LAN server by mounting the volume on their machine. This type of gateway has been

	successfully used with Novell, 3Com, Banyan, PC-NFS, Grapevine, and Starlan networks, among others.
Price:	$189
Vendor:	Tops Division, Sun Microsystems, Inc.

3+ Share

Description:	3+ Share is a popular choice of LAN for PCs and compatibles. The latest release of 3+ supports direct LocalTalk connections to the server, providing a gateway and a common network environment for both PC and Macintosh users.
Price:	$8,495 retail; 3S/200
	$10,495 retail; with 150 MB tape backup
	$12,495 retail; 3S/401
	$14,495 retail; with 150 MB tape backup
Vendor:	3Com Corporation

Netware for Macintosh

Description:	Novell Netware is the best-selling network for PC-only networks. With the latest release, Netware 2.15, direct Macintosh connections to the server are supported. Netware thus offers a gateway and common computing environment for both Macs and PCs.
Price:	$4,695—Netware Version 2.15
	$200—Netware for Mac/site
Vendor:	Novell Inc.

Mac SE Ethernet Interface Cards

The hardware cards described in this section are for attaching the Macintosh SE directly to an Ethernet physical network. The cards occupy the one internal expansion slot of a Macintosh SE. Using

Ethernet rather than a LocalTalk physical networking scheme is desirable when high-speed networking is required or when Ethernet is already installed in your work environment.

EtherPort SE

Description: Internal Macintosh SE Ethernet controller board for either thick or thin Ethernet networks. Allows a Macintosh SE to connect directly to high-speed Ethernet networks for communication with host computers or other EtherTalk-capable machines. The EtherPort SE also supports TCP/IP, DECnet, and OSI protocols in addition to EtherTalk.

Price: $695 retail

Vendor: Kinetics, Inc.

EtherPort SEL

Description: Internal Macintosh SE Ethernet controller board for LattisNet networks. Allows a Macintosh SE to connect directly to high-speed Ethernet networks for communication with host computers or other EtherTalk-capable machines. The EtherPort SEL also supports TCP/IP, DECnet, and OSI protocols in addition to EtherTalk.

Price: $695 retail

Vendor: Kinetics, Inc.

EtherPort SE/30

Description: Internal Macintosh SE/30 Ethernet controller board for either thick or thin Ethernet networks. Allows a Macintosh SE/30 to connect directly to high-speed Ethernet networks for communication with hosts computers or other EtherTalk-capable machines. The EtherPort SE/30 also supports TCP/IP, DECnet, and OSI protocols in addition to EtherTalk.

Price: $695 retail

Vendor: Kinetics, Inc.

FastNet SE

Description:	The FastNet SE is an internal interface card for the Macintosh SE that adds a direct Ethernet connection to the Macintosh. The FastNet SE offers both thin and thick Ethernet connections.
Price:	$599
Vendor:	Dove Computer Corporation

FastNet SE/30

Description:	The FastNet SE/30 is an internal interface card for the Macintosh SE/30 that adds a direct Ethernet connection to the Macintosh. The FastNet SE/30 offers both thin and thick Ethernet connections.
Price:	$599
Vendor:	Dove Computer Corporation

Marathon LAN 020

Description:	The Marathon LAN 020 combines an Ethernet Interface and a 68020 accelerator for Macintosh SEs. Since there is only one slot in the Macintosh SE, a multifunction card such as this is very attractive. The Marathon LAN 020 offers both thin and thick Ethernet connections.
Price:	$1,499—16MHz 68020
	$2,199—16MHz 68020 + 1 Meg memory
	$1,799—16MHz 68020 + 68881
	$2,499—16MHz 68020 + 68881 + 1 Meg memory
	$149—Thick Ethernet transceiver plus cable
Vendor:	Dove Computer Corporation

IPT 1000

Description:	Ethernet interface card for the Mac SE. Includes a thin Ethernet transceiver only. Supports both EtherTalk and TCP/IP communications.

Price: $495

Vendor: Information Presentation Technologies

EtherLink/SE

Description: An interface card for the Macintosh SE that allows the computer to be directly connected to Ethernet. Includes both standard (thick) and thin Ethernet connection and attaches to twisted-pair Ethernet using 3Com MultiConnect hardware. Supports TCP/IP and DECnet in addition to EtherTalk protocols.

Price: $595 retail

Vendor: 3Com Corp.

NAE 1000

Description: The NAE 1000 is an internal interface card for the Macintosh SE that adds a direct Ethernet connection to the Macintosh. The NAE 1000 offers both thin and thick Ethernet connections.

Price: $495

Vendor: Novell, Inc.

SCSI Ethernet Interfaces

The hardware devices described in this section are for attaching a Macintosh directly to an Ethernet physical network. The devices attach to the SCSI port of the Macintosh in place of a LocalTalk connection through the printer port. These devices are often used for connecting a Macintosh Plus to Ethernet or for a Macintosh SE that does not have the internal slot available. It is generally better to use an internal Ethernet card, if possible, to gain the best performance. Using Ethernet rather than a LocalTalk physical networking scheme is desirable when high-speed networking is required or when Ethernet is already installed in your work environment.

EtherSC

Description:	The EtherSC provides a direct Ethernet connection for any Macintosh Plus, SE, or II. The EtherSC is most useful for Pluses, which do not have expansion slots, and for SEs and IIs, which do not have an available slot for an EtherPort card. Using available slots in SEs and IIs is preferable as you will have better network performance. The EtherSC supports AppleTalk, TCP/IP, and DECnet protocols.
Price:	$1,250 retail
Vendor:	Kinetics, Inc.

FastNet SCSI

Description:	Intelligent SCSI gateway to a variety of local area networks, including Ethernet and DECnet. FastNet SCSI allows a Macintosh Plus or a Macintosh SE with no available slots a direct connection to Ethernet. Includes software driver required to redirect AppleTalk communications to the SCSI port.
Price:	$1,249 retail
Vendor:	Dove Computer Corporation

Nodem

Description:	SCSI Ethernet Interface units for connection of a single Macintosh to an Ethernet network. There are three models: NodemE for standard Ethernet installations; NodemC for thin Ethernet installations; and NodemT for twisted-pair Ethernet installations.
Price:	$595
Vendor:	Adaptec

Ether+

Description:	SCSI Ethernet Interface units for connection of a single Macintosh to an Ethernet network. SCSI Ethernet

devices are important for Mac Pluses and for Mac SEs and IIs that do not have an available slot. The Ether+ has connections for both thick and thin Ethernet and comes with both the required network driver and network performance software.

Price: $495

Vendor: Compatible Systems Corp.

Mac II Ethernet Interface Cards

The hardware cards described in this section are for attaching the Macintosh II directly to an Ethernet physical network. The cards occupy one of the NuBus internal expansion slots of the Macintosh II. Using Ethernet, rather than a LocalTalk physical networking scheme, is desirable when high-speed networking is required or when Ethernet is already installed in your work environment.

EtherPort II

Description: Internal Ethernet interface board for the Mac II for either thick or thin Ethernet networks. Allows a Macintosh II to connect directly to high-speed Ethernet networks for communication with host computers or other EtherTalk-capable machines. The EtherPort II also supports TCP/IP, DECnet, and OSI protocols in addition to EtherTalk.

Price: $695 retail

Vendor: Kinetics, Inc.

EtherPort IIL

Description: Internal Macintosh II Ethernet controller board for LattisNet networks. Allows a Macintosh II to connect directly to high-speed Ethernet networks for communication with host computers or other EtherTalk-capable machines. The EtherPort IIL also supports TCP/IP, DECnet, and OSI protocols in addition to EtherTalk.

Price: $695 retail

Vendor: Kinetics, Inc.

FastNet II

Description: Intelligent communications controller for DECnet and Ethernet connectivity. The FastNet II is a standard Ethernet controller board but includes intelligent hardware that supports downloadable code and processing, as well as diagnostic features. The FastNet II includes both thin and thick Ethernet connectors.

Price: $899 retail

Vendor: Dove Computer Corporation

FastNet III

Description: A Mac II Ethernet interface board similar to the FastNet II, but without the support for downloadable code modules and diagnostics. The FastNet III includes both thin and thick Ethernet connectors.

Price: $599 retail

Vendor: Dove Computer Corporation

EtherTalk Interface Card

Description: Internal Ethernet interface board for the Mac II for either thick or thin Ethernet networks. Allows a Macintosh II to connect directly to high-speed Ethernet networks for communication with host computers or other EtherTalk-capable machines.

Price: $699 retail

Vendor: Apple Computer, Inc.

EtherLink/NB

Description: A NuBus interface card for the Macintosh II that allows the computer to be directly connected to Ethernet. Includes both standard (thick) and thin

Ethernet connection and attaches to twisted-pair Ethernet using 3Com MultiConnect hardware. Supports TCP/IP and DECnet in addition to EtherTalk protocols.

Price: $595 retail

Vendor: 3Com Corporation

NAE 2000

Description: Internal Ethernet interface board for the Mac II for either thick or thin Ethernet networks. Allows a Macintosh II to connect directly to high-speed Ethernet networks for communication with host computers or other EtherTalk-capable machines.

Price: $595

Vendor: Novell, Inc.

SpeedLink

Description: Connects a Macintosh II directly to Ethernet with this NuBus interface card. SpeedLink offers both standard (thick) and thin Ethernet connections and supports EtherTalk, TCP/IP, and DECnet protocols.

Price: $549

Vendor: EMAC, A Division of Everex Systems, Inc.

MacCon II/E

Description: Connects a Macintosh II directly to Ethernet with this NuBus interface card. MacCon II/E offers both standard (thick) and thin Ethernet connections and supports 32-bit transfer capabilities.

Price: $595

Vendor: Asante Technologies, Inc.

PC LocalTalk Interface Cards

The hardware cards described in this section are for attaching an IBM PC, XT, AT, PS/2, or compatible directly to a LocalTalk physical network. The cards occupy one of the Classic PC or MicroChannel internal expansion slots of the machine. PCs and PS/2s are becoming commonplace on AppleTalk networks as these machines are integrated with Macintoshes in today's office environments. IBM users are also attracted to the ease of use and low cost of AppleTalk LANs relative to PC LANs.

Not all of the products described in this section perform identical functions. All of the cards come with software that implements the AppleTalk protocols within the machine the card is installed in. Only some of the cards (those from TOPS, Hercules, and Everex) have incorporated the FlashTalk protocol into the drivers for high-speed AppleTalk communications. Only the DaynaTalk card implements the Dayna protocol for higher-speed communications. Other cards, such as the TOPS FlashCard, may not have implemented all of the necessary calls for running the PC AppleShare software.

TOPS FlashCard

Description: AppleTalk network card for PCs using the classic PC bus architecture, providing support for both LocalTalk and FlashTalk data rates. The FlashCard requires a DB-9 connector for attachment to the network.

Price: $239 retail

Vendor: TOPS Division, Sun Microsystems, Inc.

TandyLink

Description: AppleTalk interface card for Tandy computers and other PCs using the classic PC bus architecture. Requires a DIN-8 connector for physical connection to AppleTalk networks.

Price: $120

Vendor: Tandy Computers

LocalTalk PC Card

Description: LocalTalk interface board for PCs using the classic PC bus architecture. LocalTalk cards do not support higher-speed implementations of AppleTalk. Requires a DB-9 connector for attachment to the network.

Price: $249

Vendor: Apple Computer

Network Card Plus

Description: Combination video card/network interface board for PCs with the classic PC bus architecture. Hercules has taken the Graphics Card Plus and replaced the parallel port with an AppleTalk port. The Hercules card supports the FlashTalk protocol.

Price: $369

Vendor: Hercules Products

LT200-PC

Description: AppleTalk interface card for IBM PCs or compatibles that have the classic PC Bus architecture. Allows users access to popular PC-based AppleTalk software packages, including TOPS for DOS, InBox for DOS, and PC Microsoft Mail. This board does not support the higher-speed FlashTalk or DaynaTalk protocols.

Price: $249 retail

Vendor: DayStar Digital, Inc.

LT200-MC

Description: AppleTalk interface card for IBM PS/2 and other MicroChannel architecture machines. Allows users access to popular PC-based AppleTalk software packages, including TOPS for DOS, InBox for DOS, and PC Microsoft Mail. This board does not support the higher-speed FlashTalk or DaynaTalk protocols. TOPS does not recommend using this card in a file server machine, though as a client it seems to work fine.

Price: $395 retail

Vendor: DayStar Digital, Inc.

NL/1000

Description: LocalTalk interface card for PCs and compatibles using the Classic PC Bus architecture. Allows users access to popular PC-based AppleTalk software packages, including TOPS for DOS, InBox for DOS, and PC AppleShare. Does not support the FlashTalk or DaynaTalk protocols for higher-speed AppleTalk networking.

Price: $250

Vendor: Novell, Inc.

NL/2

Description: LocalTalk interface card for PS/2s and compatibles using the MicroChannel architecture. Allows users access to popular PC-based AppleTalk software packages, including TOPS for DOS, InBox for DOS, and PC AppleShare. Does not support the FlashTalk or DaynaTalk protocols for higher speed AppleTalk networking.

Price: $350

Vendor: Novell, Inc.

Dayna Talk PC Card

Description: Interface board for PCs using the classic PC bus architecture. Supports DaynaTalk-accelerated AppleTalk

	network speeds. Boosts transmission speeds to up to 1.7 MBits/second for PC—PC communications using an encryption scheme, while supporting PC—Mac communications at a maximum of 850 Kbaud/second.
Price:	$289 retail; IBM PCs or compatibles
Vendor:	Dayna Communications

SpeedTalk

Description:	Interface board for PCs using the classic PC bus architecture. Supports FlashTalk-accelerated AppleTalk network speeds and designed for use with TOPS networks. The SpeedTalk card includes both DIN-8 and DB-9 ports for physical connection to the network. Allows users access to popular PC-based AppleTalk software packages, including TOPS for DOS, and InBox for DOS.
Price:	$199 retail; IBM PCs or compatibles
Vendor:	EMAC, A Division of Everex Systems

Apple II LocalTalk Interface Cards

The hardware cards described in this section are for attaching an Apple II directly to a LocalTalk physical network. The cards occupy one of the internal expansion slots of the Apple II.

Apple II Workstation Card

Description:	An interface card for the Apple II that allows it to become part of the AppleTalk network. Apple II Workstation software allows the Apple II to connect to an AppleShare server.
Price:	$249—Apple II Workstation Card
	$99—Apple II Workstation Software
Vendor:	Apple Computer, Inc.

Other Network Interface Cards

The hardware cards described in this section cover a variety of interface cards for attaching printers and minicomputers directly to a LocalTalk physical network or for connecting Macintoshes to networks other than AppleTalk. The cards occupy an internal expansion slot of the Macintosh, printer, or minicomputer.

ImageWriter II/LQ LocalTalk Option

Description:	Interface card for connecting an ImageWriter II or ImageWriter LQ printer to a LocalTalk network.
Price:	$139
Vendor:	Apple Computer, Inc.

Actinet II, Actinet SE

Description:	Interface cards for the Macintosh SE and II that allow you to integrate Macintoshes into existing Arcnet networks. Transmission speeds are 2.5 MBits/second. The board comes with the necessary driver software.
Price:	$695—Mac II
	$495—Mac SE
Vendor:	Actinet Systems

BroadTalk LAN

Description:	A line of interface cards for the Macintosh II that allows you to integrate Mac IIs into existing broadband networks. The BroadTalk boards use the standard EtherTalk driver software.
Prices:	$895—BroadTalk LAN board with Broadband module
	$745—BroadTalk LAN board with Ethernet module
	$3,550—Broadband—Ethernet gateway.
Vendor:	Cactus Computer

TokenTalk Interface Cards

Description:	Apple, Kinetics, and Asante Technologies are all known to be working on Token Ring Interface Boards for the Macintosh II and Mac SE, but have not yet formally announced or introduced the products.
Price:	Unannounced
Vendor:	Apple Computer, Kinetics, Asante Technologies

LANSTAR Interface Card

Description:	LANSTAR AppleTalk Interface Card for the Macintosh II for LANSTAR AppleTalk Network, which is an integration of Macintoshes into Northern Telecom Meridian LANSTAR System phone switches. The system supports a shared bandwidth of 40 MBits/second. Individual transmission speeds are 2.56 MBits/second.
Price:	$295—Macintosh II interface card
	$5,400—LANSTAR AppleTalk software.
Vendor:	Apple Computer, Inc.
	Northern Telecom, Inc.

Network Services

File/Disk Service

The products described in this section all implement some form of file sharing on AppleTalk networks. File-sharing products allow network users to share a hard disk or file server. Doing so allows the hard disk to serve as a repository for many peoples' files, either to centralize file storage or to negate the need for a hard disk for every user. Applications can also be stored on the network to be used at network workstations (subject to software license restrictions) or to be shared for multiuser applications such as accounting systems. The products fall into one of four categories:

- Disk Servers, which allow a disk to be partitioned into segments for different users.
- Centralized File Servers, which utilize a Macintosh, PC, or a specialized network device as a dedicated file server.
- Distributed File Servers, which allow any or all Macintoshes and PCs to be used as nondedicated file servers.
- PC LAN file-server products that have integrated support for AppleTalk protocols and Macintoshes.

File service products for AppleTalk networks come in many flavors and prices. Some are sold on a per-node basis, while others charge for the server software and/or hardware. Some are sold as file-service products only, while some products are bundled with other network products such as print spooling, electronic mail, and file translation utilities. Some products support Macintoshes only, while others provide support for heterogenous environments consisting of PCs, Macs, UNIX, and VAX machines. Some of the typical file-service configurations are noted in Figure 10-4.

TOPS/Macintosh 2.1

Description: Distributed file-server software for AppleTalk LANs including LaserWriter spooler and file translation program. TOPS is the most popular file-service option for AppleTalk LANs. TOPS is well known for its ease of use, low cost, and its ability to integrate heterogenous computing environments. TOPS differs from many file-server implementations in that it follows a distributed server model—no hardware needs to be dedicated. Each machine on the network can be a nondedicated server, making files and folders available as necessary. TOPS file services are accessed through a TOPS desk accessory, making it available at any time.

The TOPS Desk Accessory consists of two scrolling lists and a row of command buttons. The two lists represent the local file system, while the other shows the rest of the network. Folders and entire disk vol-

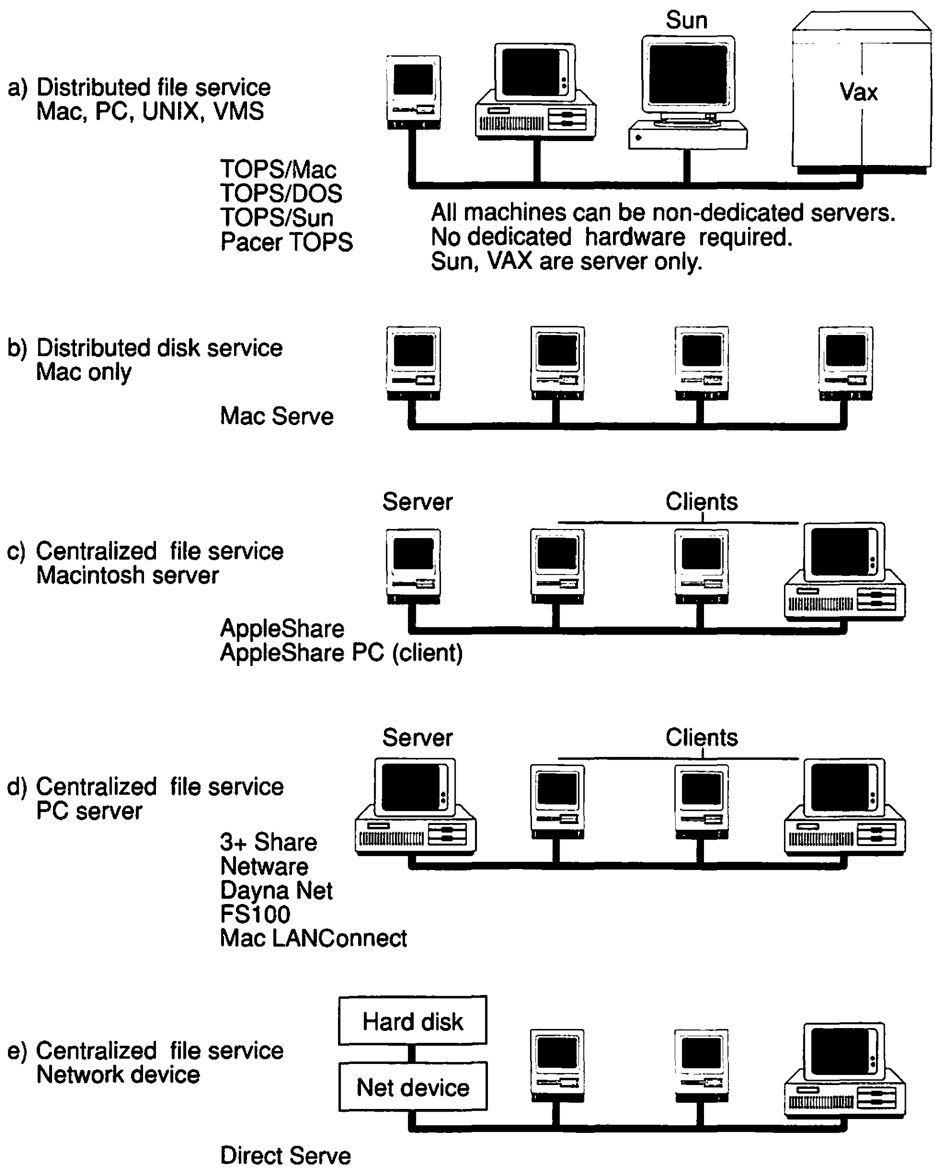

Figure 10-4 File service configurations.

umes are shared by selecting them and choosing "publish." When publishing, the folder can be made read only and can be copy protected. The second scrolling list shows the other file servers on the network, the other machines that have made files available by publishing. The other servers can be browsed with the Desk Accessory and files transferred in either direction. Published volumes can also be "mounted," which makes them available locally as if they were attached to the machine. The volume shows up in the Finder, and all Finder operations work on the remote volume. Applications can also access the mounted volume through the Open and Save dialog boxes. PC volumes that are mounted are accessed like any other Mac volume through the Finder and through applications.

TOPS is bundled with utilities for print spooling and file translation. TOPS Spool provides distributed print spooling to networked PostScript printers, allowing you to work while you print job is processed. TOPS Translator is a utility which converts files between popular PC and Macintosh file formats.

Price: $249 retail; per Macintosh

Vendor: TOPS Division, Sun Microsystems, Inc.

TOPS/DOS 2.1

Description: TOPS/DOS follows the same distributed file-service model as TOPS/Macintosh. Any PC can be used as a nondedicated file server; in fact, Macs can be used as servers for PCs and vice versa. TOPS has a number of software modules—client only and full client/server modules, NetBIOS support, TOPS PRTR for sharing of local printers between PCs, and TPRINT for access to networked printers. TOPS' features can be accessed either through an easy-to-use menuing system or from the command line (which facilitates the creation of batch files for common network functions). Just as with TOPS/Mac, resources are "published" to make them available to others, and are "mounted" to make remote resources available locally. Mac resources are accessed through the familiar DOS interface.

TOPS/DOS requires an AppleTalk card for the PC, like the TOPS FlashCard, or can operate over common Ethernet cards. TOPS/DOS thus provides the first EtherTalk driver for PCs, with drivers available for 3Com and Western Digital Ethernet cards.

Price: $189; requires TOPS FlashCard, Ethernet Card, or equivalent.

Vendor: TOPS Division, Sun Microsystems, Inc.

AppleShare 2.0

Description: AppleShare 2.0 is the current offering of file server software from Apple. Operating on a dedicated Macintosh, AppleShare is thus centralized in design—all users communicate directly with the server, not with each other. Users connect to the file server using the Chooser, being asked to specify the correct server and a name and password for the "account." Once the user has been properly authenticated, the file volume accessed shows up on the user's desktop as if it were a locally attached disk driver. AppleShare, however, introduces the concept of access control for security and privacy. The first level of security is the password protection on the accounts themselves. As folders/directories are created, they are assigned a set of access privileges. These privileges are extended at the owner's option to the owner, a group of users, or to all users (the "world"). For each of these classes of users, the following privileges may be extended: the ability to see documents and applications stored in the folder, the ability to see folders within the folder, and the ability to make changes to documents and applications in the folder.

Once these privileges have been set up, each user will see folders from their Macintosh as falling into one of four categories, each with its own unique type of folder icon in the Finder: private folders only available to the owner, shared folders with and without change privileges, and drop folders that can be written to but not opened or examined.

The AppleShare server must be administered by a designated network administrator. The administrator maintains the list of authorized users and creates the user "groups." The administrator should also arrange for the server to be periodically shut down for backup of the files. AppleShare servers can be used concurrently by up to 25 users (50 if the server is a Mac II). Client software for AppleShare is bundled with the Macintosh system software and can be used to access AppleShare and AppleShare-compatible servers such as those listed in this section. Client software for both IBM PCs and Apple IIs is available from Apple. Dedicated AppleShare servers also allow one other concurrent network service such as the AppleShare Print Server or an electronic mail server.

Price: $799 retail; requires dedicated Macintosh plus hard disk

Vendor: Apple Computer, Inc.

AppleShare PC

Description: Bridges gap between MS-DOS operating system and AppleShare File Server. AppleShare PC allows the MS-DOS user to access AppleShare servers: storing files, and launching applications with full implementation of the AppleShare access privilege scheme. Also includes printing utilities that give MS-DOS users access to networked PostScript printers.

Price: $149 retail; AppleShare PC

	$249 retail; LocalTalk PC Card
Vendor:	Apple Computer, Inc.

MacServe 2.4

Description:	MacServe is an AppleTalk disk-server software that runs in the background of a Macintosh. As a disk server rather than a file server, MacServe offers both advantages and disadvantages. MacServe has implemented a very secure network environment—even crashes can be recovered from. Unfortunately, however, multiuser access to files is difficult and MacServe operates in Macintosh-only environments. To share a disk with MacServe, it must first be partitioned into volumes for each user. These fixed-size partitions can limit the effective use of disk space and can become easily fragmented. MacServe also offers print-spooling features to the network, using disk space on the host for the spooled print files.
Price:	$250 per server retail
Vendor:	Infosphere, Inc.

3+ Share 1.3.1

Description:	3+ is 3Com's current network offering for its popular PC LAN networking product. 3+ can run either on 3Com's dedicated file servers (the 3S/200 and the 3S/400) or can be purchased separately and installed on a dedicated PC of your choice. 3+ can be upgraded to support Macintoshes as well as PCs by adding 3+Share for Macintosh. 3+ does not support Macintoshes by emulating AppleShare servers, thus it comes with its own client software for accessing the file server, print server, and the mail functions.
Price:	$2495 retail; 3+ Share 1.3.1
	$495 retail; 3+ for Macintosh in addition to 3+ Share
	$595 retail; 3+ Mail, 1–5 users

	$1,190 retail; 3+ Mail, unlimited users
	$8,495 retail; 3S/200 (including3+ Share)
	$10,495 retail; 3S/200 with 150 MB tape backup (includes 3+ Share)
	$12,495 retail; 3S/401 (including 3+ Share)
	$14,495 retail; with 150 MB tape backup (includes 3+ Share)
Vendor:	3Com Corporation

Netware For Macintosh

Description:	Netware for Macintosh is an add-on for Netware that allows Netware servers to support Macintoshes as well as PCs by emulating an AppleShare server. Netware for the Mac thus allows integration of Macintoshes into networks from the leading vendor of PC LANs. In addition to providing Macintosh users access to powerful AppleShare servers, it also provides services as part of Netware that are not standard services under AppleShare. These services include enhanced security, system fault tolerance, and resource accounting and auditing. Novell and TOPS have announced that future versions of Netware will offer support for TOPS protocols as well, allowing TOPS users to tap into the power and services of Novell servers.
Price:	$4695—Netware 2.15; requires dedicated PC
	$200—Netware for Mac, requires Netware + LocalTalk card
Vendor:	Novell, Inc.

DirectServe

Description:	The Jasmine DirectServe is a dedicated AppleShare file server that replaces a dedicated Macintosh as the server. Rather than dedicate a Macintosh and a SCSI

hard disk as an AppleShare server, Direct Serve attaches directly to the network to function as the server. The user attaches the choice of SCSI hard disk(s) directly to the Direct Serve. The Direct Serve is 100 percent compatible with AppleShare 1.2, but does not support other concurrent applications as does AppleShare. Because AppleShare requires central administration, software is included that allows the administrator to set up and maintain the server across the network.

Price: $1,299

Vendor: Jasmine

HyperNet 2000

Description: A product originally sold by General Computer to provide file service to AppleTalk networks. The only reason to mention it here is to point current users to TOPS, as recommended by General Computer, which has special upgrade offers for HyperNet users.

Price: No longer sold; upgrades to TOPS available through TOPS

Vendor: General Computer

Silverserver

Description: Silverserver is La Cie's software offering that allows hard disks to be shared across a local network or across phone lines. One copy of Silverserver lets an unlimited number of users access the hard disk at that server. These users can be located on a local AppleTalk LAN or across phone lines with just a modem at each end. Hard disk volumes that are accessed show up on the Macintosh desktop as Finder volumes as if they were local disks. In addition to the file-serving capabilities, Silverserver also offers a "chatterbox" mode that users can utilize to communicate in real-time over the network with each other.

	The chatterbox mode also works either locally across an AppleTalk network or across phone lines.
Price:	$99.95
	$149.95 with Silverplatter
	Bundled with Cirrus drives from La Cie.
Vendor:	La Cie, Ltd.

DaynaNet

Description:	DaynaNet is a version of Netware sold by Dayna Communications. DaynaNet runs on a dedicated PC server and can support up to 100 users. The package includes the server software and an interface card for the server. Clients use either the AppleShare client software, which comes with every Mac, or the PC Client software for Netware. DaynaNet includes the same file security and print-service features that Netware for the Mac does. DaynaNet is sold in either a LocalTalk or an EtherTalk version, and the server can be upgraded from LocalTalk to EtherTalk, if necessary. Upgrades may also be offered to upgrade the server to the full versions of SFT Netware and Advanced Netware
Price:	$1249—LocalTalk version; requires dedicated PC
	$1799—EtherTalk & LocalTalk version; requires dedicated PC
	$650—Upgrade from Local Talk to EtherTalk/LocalTalk version.
Vendor:	Dayna Communications

FS100

Description:	Turns any IBM PC, PS/2, or compatible into an AppleShare compatible file server. Prices include server software, workstation software, and the appropriate LocalTalk interface card for the server. For

	sites which desire AppleShare services, this is an attractive solution because of the relatively low price of PC clones as compared to Macintoshes. Allows both PC and Macintosh clients.
Price:	\$595—FS100 for Classic PC Bus; requires dedicated PC
	\$695—FS100 for MicroChannel Bus; requires dedicated PS/2
Vendor:	DayStar Digital, Inc.

Mac Lan Connect

Description:	Turns any IBM PC XT, AT, 386, or compatible into an AppleShare compatible file server. For sites that desire AppleShare services, this is an attractive solution because of the relatively low price of PC clones as compared to Macintoshes. The product includes all the software necessary to turn the PC into a nondedicated server. The PC needs to be equipped with a LocalTalk interface card for physical connection to the network. Because the server is nondedicated, the user of the server machine can run other applications and can access the Mac files stored there. The server can also act as a gateway to other PC LAN networks. It allows both PC and Macintosh clients, using the AppleShare client software for each machine. Full AFP and access privileges are implemented on the server.
Price:	\$995—requires dedicated PC XT, AT, or 386
Vendor:	Miramar Systems

Waterloo MacJanet 2.0

Description:	Local-area network and LaserWriter/ImageWriter print spooler designed to meet the special requirements of academic institutions. Offers special security in the form of an audit trail of all network activity.

Price:	$1,450, U.S. retail
	$995, U.S. retail; introductory educational price (site licensing available)
Vendor:	Watcom Products, Inc.

Print Service

Print Service products allow many users to share network printers. High end printers are much too expensive to purchase for each user and can take quite a long time to process each print job. The solutions to these problems are described below—products that allow many users to share printers and allow them to "spool" their print jobs, sending them to a temporary repository until the printer is free, thus allowing users to continue working while their print jobs wait to be printed.

The products described in this section fall into four categories:

- Print spoolers that store your print jobs at your local workstation while waiting to be printed.
- Print spoolers that store your print jobs at a central print server on the network while waiting to be printed.
- Hardware print servers that sit directly on the network, emulating the printer (which is attached to the server) and sending jobs to the printer in order.
- Software that allows printers to be shared between users on AppleTalk networks and users on VAX and UNIX machines.

Examples of each of these types of print service are shown in the diagram below. In addition to the products described in this section, the RS-232 gateways described in a previous section can also be used to provide access to serial and parallel printers attached to the gateway.

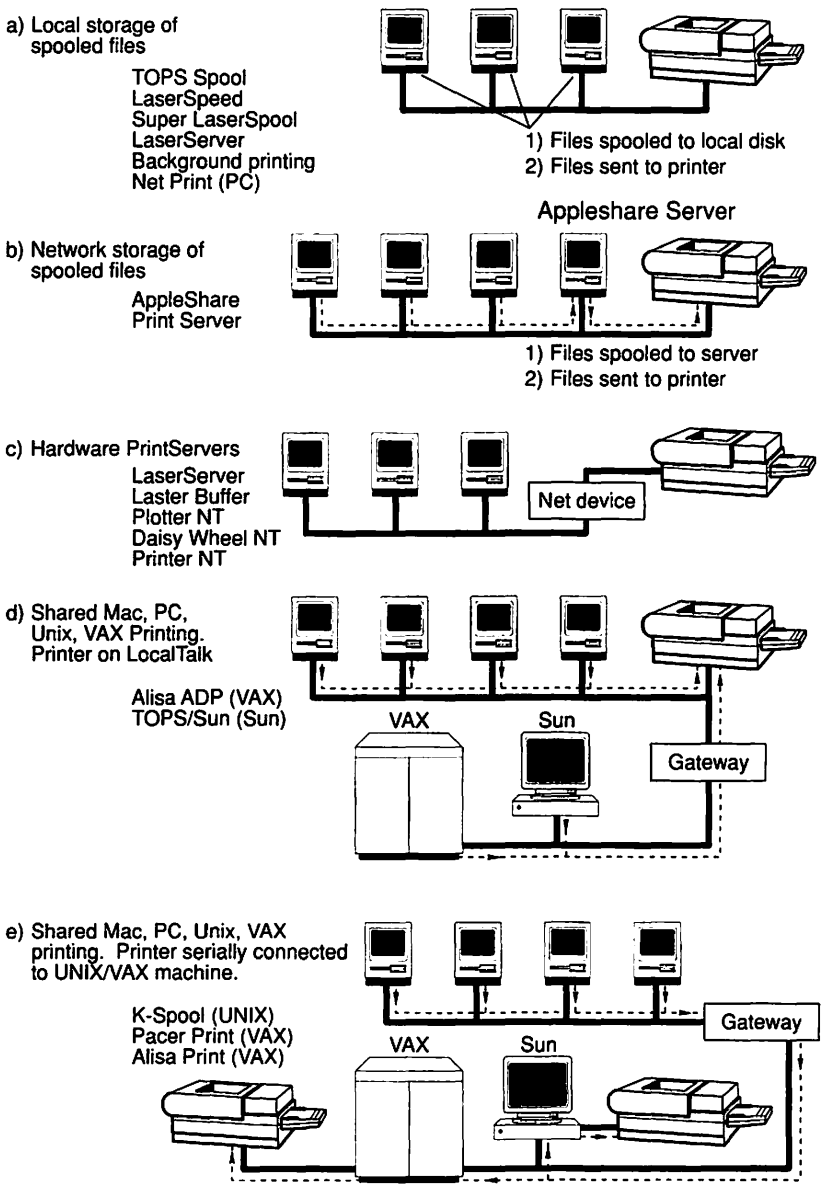

Figure 10-5 Print service configurations.

AppleShare Print Server

Description:	The AppleShare Print Server is sold as an option for networks with AppleShare servers that need centralized print service. Print files from workstations across the net are spooled to the AppleShare server, which then monitors the LaserWriter and sends files to the printer as it is available.
Price:	$299 retail
Vendor:	Apple Computer, Inc.

LaserSpeed 1.7

Description:	LaserSpeed is a distributed print server product. With LaserSpeed installed, print files from a workstation are spooled to a local disk, freeing up the Macintosh for other work. In the background, LaserSpeed watches for the LaserWriter to become available and processes the print files. A desk accessory allows the user to monitor and reorder the queue, cancel print jobs, temporarily turn off the spooler, and control notification options.
Price:	$99 retail; program
	$499 retail; Office Pack (includes five disk sets and manuals)
Vendor:	Symantec Corporation

TOPS Spool

Description:	LaserWriter print spooler for AppleTalk networks, bundled with TOPS/Macintosh. TOPS Spool is based on LaserSpeed and has all the same features.
Price:	Included with TOPS/Mac
Vendor:	TOPS Division, Sun Microsystems, Inc.

SuperLaserSpool 2.0

Description: SuperLaserSpool is a local background print spooler for both LaserWriters and AppleTalk ImageWriters. Print files are intercepted by SuperLaserSpool while printing and saved to disk. Your application is then free to proceed with other tasks. In the background, SuperLaserSpool waits for the selected printer to become available and sends it the print file. Users interact with the spooled files using a desk accessory called Laser Queue, which can be used to changed the order of spooled jobs, change the designated printer, and to preview the files in the queue. SuperLaserSpool also supports downloading of font files to the printers.

Price: $149.95, single-user retail

$395, multiuser five pack retail

Vendor: SuperMac Technology

LaserServe

Description: LaserServe is a LaserWriter print spooler that also supports AppleTalk ImageWriter. The spooler is a distributed one, spooling files locally so the workstations can be used for other tasks while the spooler watches the selected printer in the background.

Price: $95 retail; per workstation

$295 retail; Network Pack

Vendor: Infosphere, Inc.

Background Printing-System

Description: Laserwriter print spooler that operates in the background of the MultiFinder. Similar in design to other distributed print spoolers, files are stored locally to free up the Macintosh for other tasks. Background Printing is a standard part of the Macintosh system

	software, but requires MultiFinder to be active; usually only practical with Macs with at least two megabytes of RAM.
Price:	Included in standard Macintosh system software
Vendor:	Apple Computer, Inc.

NetPrint

Description:	NetPrint is an application for IBM PCs and compatibles that gives the PC a broad range of printing capabilities to network-based PostScript printers. As a spooler, NetPrint allows PC users to print from within their applications and continue working as soon as the file is finished spooling to the designated directory. For applications that support PostScript printing, NetPrint merely processes the file in the background, handling all communications to the printer. For those applications that cannot create PostScript print files, the applications should be configured for printing to an Epson FX-80 or an IBM Proprinter. NetPrint handles the conversion to PostScript. NetPrint come with a CONFIGUR program that functions as a Chooser for the PC and controls all of the options within NetPrint. NetPrint works with any AppleTalk interface card for the PC.
Price:	$189 retail
Vendor:	TOPS Division, Sun Microsystems, Inc.

TOPS PRTR

Description:	Software that allows TOPS/DOS PCs to share locally attached serial and parallel printers over an AppleTalk network. A part of TOPS/DOS, TOPS PRTR allows local printers to be "published" and "mounted" between PCs just like file volumes are shared over TOPS.
Price:	Included with TOPS/DOS

Vendor: TOPS Division, Sun Microsystems, Inc.

AppleShare PC Printing Utilities

Description: The AppleShare PC printing utilities are a part of the AppleShare PC software package. The printer software allows PC users to access networked PostScript printers from within their applications. The printer utilities include a conversion routine for translating Epson print files to PostScript.

Price: $149 retail; AppleShare PC

Vendor: Apple Computer, Inc.

K-Spool

Description: Kinetics offers K-Spool for networks of Macs, PCs, and UNIX machines who wish to all share the same printer. K-Spool is loaded into a UNIX machine that has a serially connected PostScript printer attached to it. The UNIX machine then emulates a Laserwriter on the network so that users can select it in the Chooser just as they would any LaserWriter. Print files are sent to the UNIX machine where they are first spooled and then printed.

Price: $495 retail

Vendor: Kinetics, Inc.

TOPS for SUN

Description: Software for Sun Microsystems workstations and servers that allows TOPS clients (Macintosh and PC) to use the Sun system as a file server. Bundled with software allowing Suns to share LaserWriter printers on the AppleTalk network.

Price: $895—One to four users

$1,595—Unlimited users

Vendor: TOPS Division, Sun Microsystems, Inc.

PacerPrint

Description: PacerPrint provides PostScript printing capabilities to VAX/VMS uses. VAX users can print to PostScript printers using standard VMS print commands. Conversions can be made to PostScript from many common VMS file and print formats. Macintosh and PC users on AppleTalk can take advantage of PacerPrint's printing functionality and print to the same serially connected PostScript printer by routing their print files to the VAX via any means, including PacerLink, PacerShare, and PacerTOPS.

Price: $1,000; MicroVAX

$2,000; VAX

$4,000; VAX Cluster

Vendor: Pacer Software, Inc.

AlisaPrint System

Description: AlisaTalk includes the AlisaPrint System (APS). AlisaPrint allows both Mac and VAX users to share the same AppleTalk-based PostScript printers. Mac users continue to use their network-based printers while VAX users can redirect their print jobs to AppleTalk to use the same printer.

Price: Bundled with AlisaTalk

Vendor: Alisa Systems, Inc.

Alisa Digital Printing Support System (ADP)

Description: The Alisa Digital Printing System allows Mac users access to DEC PostScript printers, including the LN03R ScriptPrinter and the LPS-40 PrintServer. ADP allows the VAX to emulate a LaserWriter on the network so that Macintoshes send their print jobs to the VAX, which then sends the print jobs into the standard VMS print queue for processing by the DEC printer.

Price: $750 to $3,450 retail; based on VAX CPU size

Vendor: Alisa Systems, Inc.

LaserServer

Description: The Dataspace LaserServer is a stand-alone network device for centralized spooling of LaserWriter print jobs. The LaserServer replaces the LaserWriter on the network, with the LaserWriter being serially connected to the LaserServer. The LaserServer emulates the printer on the network and appears to be a printer that is always available. Network users print directly from their applications across the net to the LaserServer, which stores all the print jobs and prints them sequentially or in priority order. A software desk accessory at each client allows examination and manipulation of the queue.

Price: $1,995 retail, with 512K RAM

Vendor: Dataspace Corporation

LaserBuffer

Description: The Nuvotech LaserBuffer is a stand-alone network device for centralized spooling of LaserWriter print jobs. The LaserBuffer replaces the LaserWriter on the network, with the LaserWriter being serially connected to the LaserBuffer. The LaserBuffer emulates the printer on the network and appears to be a printer that is always available. Network users then print directly from their applications across the net to the LaserBuffer, which stores all the print jobs and prints them sequentially or in priority order.

Price: Unannounced

Vendor: Nuvotech

Plotter NT

Description: The Plotter NT is an AppleTalk device that allows almost any popular plotter to be shared and buffered on the network. The Plotter NT is attached directly to the network, with the plotter attached to the Plotter NT. The Plotter NT, which is chosen using a driver in the Chooser of a client Macintosh, then accepts jobs from any network user and spools them in its memory, which can be configured from 256 KB (standard) to 1 MB. The Plotter NT driver allows selection of more than 15 different plotters and the communications settings for the printer. The Plotter NT also holds jobs which are printed using the manual feed option until the user sets up the printer and selects manual feed on the Plotter NT.

Price: $1,495 Standard for A & B size plotters

$2,595 Professional, up to E size plotters

Vendor: Dataspace

Daisy Wheel NT

Description: The Daisy Wheel NT is an AppleTalk device that allows Daisy Wheel printers to be shared and buffered on the network. The Daisy Wheel NT is attached directly to the network, with the printer attached to the Daisy Wheel NT. The Daisy Wheel NT, which is chosen using a driver in the Chooser of a client Macintosh, then accepts jobs from any network user and spools them in its memory, which can be configured from 256 KB (standard) to 1 MB. The Daisy Wheel NT driver allows selection of more than eight popular printers and can be customized for the appropriate printer control settings. The Daisy Wheel NT also holds jobs that are printed using the manual-feed option until the user sets up the printer and selects manual feed on the Daisy Wheel NT.

Price: $745

Vendor: Dataspace

Printer NT

Description: The Printer NT is an AppleTalk device that allows Imagewriter printers to be shared and buffered on the network. The Printer NT is attached directly to the network, with the Imagewriter attached to the Printer NT. The Printer NT, which is chosen using a driver in the Chooser of a client Macintosh, then accepts jobs from any network user and spools them in its memory, that can be configured from 256 KB (standard) to 1 MB. The Printer NT also holds jobs that are printed using the manual-feed option until the user sets up the printer and selects manual feed on the Printer NT.

Price: $855

Vendor: Dataspace

Cricket Presents Office

Description: Cricket Presents Office is an integrated set of applications that ties together Cricket Presents users on networked workstations into a centralized print production environment. Any number of Cricket Presents users can be networked to Cricket Central, a network file server (TOPS, AppleShare, Novell, 3Com) that collects and controls the production of presentations. Each user creates a device-independent image file for their presentation that is sent to Cricket Central along with a Job Request Form. The operator at Cricket Central then controls the printing of the jobs, which are sent to output devices (thermal printers, ink jet printers, film recorders, etc.) directly connected to Cricket Central, to other workstations on the network, or via modem. Cricket Central also provides Job Management Software, which allows the operator to schedule and sort jobs, track job history, prepare billing information and price structures, and define individual user accounts.

Price: Variable, dependent on size and complexity of installation

Vendor: Cricket Software

Modem Service

Modems allow communications over phone lines for accessing remote computers and commercial services. Although most users have occasional need for modems, it is rare that a modem is provided for every user. The products described in this section allow modems to be shared by many users on the network. Some operate as standalone network modems, attached directly to the network, and come with software allowing Macs and PCs to make connections through the modem (one user at a time). Others allow modems attached inside to a Macintosh or to one of the Macintosh serial ports to be shared by others on the network. In addition to these examples and the products in this section, the RS-232 gateways described in a preceding section can be used in conjunction with standard modems to provide access to anyone on the network.

ComServe

Description: ComServe allows a modem attached serially to a Macintosh to be accessed by other users on the same network as the Macintosh. ComServe is a software-only product consisting of server software to make the modem available to the network and client software to access it.

Price: $195

Vendor: Infosphere

ModemShare

Description: ModemShare allows a modem attached serially to a Macintosh to be accessed by other users on the same network as the Macintosh. ModemShare is a software-only product consisting of server software to

	make the modem available to the network and client software to access it.
Price:	$195
Vendor:	Mirror Technologies

Hayes Smartmodem 2400M

Description:	The Smartmodem 2400M is an internal modem for the Macintosh II, bundled with software (Hayes Connect) that allows the modem to be shared by other Macs on the network. The Mac II, with up to five Smartmodem 2400Ms installed, becomes a Hayes Connect Server. Individual users use the Hayes Connect Software from the Macintosh Control Panel to select a Smartmodem for use. Users then choose their favorite telecommunications program to dial out through the 2400M. When their session is complete, they can deselect the modem by going back to the Control Panel software, or the Mac II can be set to automatically disconnect after a specified period of inactivity.
Price:	$549
Vendor:	Hayes Microcomputer Products, Inc.

NetModem V2400

Description:	The Shiva NetModem allows shared access to a 2,400 baud modem and allows remote users to dial in to an AppleTalk network. The NetModem is attached directly to the network as a stand-alone device. Using the NetModem software from the Chooser, users can "connect" themselves with the modem for making outbound connections. Although only one user at a time can use the NetModem, users can choose to be notified when the NetModem becomes available or when an incoming call comes in. Remote users who have the Shiva Dial-In Network Access software and a modem can call in to the network and use network services as if they were local.

Price: $599 retail

Vendor: Shiva Corporation

NetModem V9600

Description: A 9,600-baud version of the NetModem, described in the preceding section. This product is scheduled to be released in the second half of 1989.

Price: Unannounced

Vendor: Shiva Corporation

Terminal Service—TCP/IP

AppleTalk network users often have other computer systems in addition to the ones on their local network. Common companion systems are departmental minicomputers, often UNIX or VAX machines. These machines typically support multiple users logged in as terminals. The most common protocol for logging in across a network is TCP/IP. The products listed in this section provide TCP/IP services to Macintoshes on AppleTalk networks, allowing a Macintosh to act as a terminal to a TCP/IP-based host computer. Since most TCP/IP hosts have Ethernet support built in to them, most of these products also require an AppleTalk-Ethernet gateway, such as those described in a preceding section, or require that the Macintosh be directly connected to Ethernet.

TCP-Mac

Description: Released as a part of the Net/One product line, Ungermann Bass offers TCP-Mac, providing Telnet, FTP, and mail support based on either the POP or SMTP protocols. TCP-Mac is based on Apple's MacTCP software driver for TCP/IP.

Price: $250 per workstation

Vendor: Ungermann Bass

TCP/Connect

Description: TCP/Connect is a TCP/IP connectivity package for the Macintosh that offers TELNET terminal emulation, file transfer via FTP, and IBM 3270 connectivity. TCP/Connect can offer these services to any host computer running the TCP/IP protocol suite, including Suns, VAXes, IBM Mainframes, and most UNIX systems. The TELNET implementation emulates a VT240 terminal and offers the VT240's text and graphics capabilities, including multiple character sets, function keys, Regis and Tektronix 4010/4014 graphics, graphics primitives, and color/gray scale support. Terminal emulations for VT100, VT102, VT125, and VT220 are also supported. The file-transfer capabilities of TCP/Connect are offered through an implementation of FTP, the File Transfer Protocol. TCP/Connect offers both FTP client and server functionality, and allows file transfers and remote directory browsing through a simple-to-use Macintosh interface.

TCP/Connect also implements TN3270, which allows 3,270 sessions to be carried over TCP/IP. Mainframes with TCP/IP capability can communicate with Macintosh users through TCP/Connect. Terminals emulated include 3278-2, 3278-3, 3278-4, and 3278-5. TCP/Connect can support multiple simultaneous sessions with multiple hosts. File transfer during 3270 sessions is accomplished with the same FTP implementation.

InterCon has promised versions of TCP/Connect based on both MacTCP and TCPort, and a version for the IBM PC.

Price: $495—standard version

$295—without VT240 emulation

$295—without IBM 3270 emulation

Vendor: InterCon

NCSA Telnet

Description: An implementation of the TCP/IP protocols over AppleTalk providing terminal emulation via the Telnet protocol and file transfer via the FTP protocol. NCSA Telnet supports a number of terminals in its emulation and supports multiple sessions with multiple hosts.

Price: Public Domain

Vendor: Bulletin Boards

Mac IP

Description: A public-domain software package that allows users to initiate a single terminal session (emulating a VT100 and utilizing the Telnet protocol) with a TCP/IP host. File transfers can also be accomplished with TFTP, the Trivial File Transfer Protocol.

Price: Public Domain

Vendor: Bulletin Boards

TOPS Terminal

Description: TOPS Terminal is a public domain utility written by TOPS that provides TCP/IP connectivity from Macintoshes to TCP/IP hosts. The program will run on Macs connected directly on Ethernet or on LocalTalk through a gateway. Users can establish multiple sessions simultaneously and can act as a terminal to the host and perform file transfers. TOPS Terminal was designed to shield the user from the complexities of the remote system. If the remote operating system is well known, the user can interact with it through the terminal emulator. Novices and newcomers to the remote system can use simple menu commands to manipulate files and directories on the remote system. TOPS Terminal issues the appropriate commands to the remote system.

	Macros can also be created for repetitive tasks. For users who need to edit text documents on the remote system but don't have a text editor, the product has a built-in Mac-like text editor that can operate on remote files.
Price:	Public domain
Vendor:	Bulletin Boards; maintained by Oregon State University.

MacTCP

Description:	A development tool for creating TCP/IP network applications that coexist with AppleTalk. MacTCP allows developers to take advantage of TCP/IP addressing schemes and services. MacTCP simplifies network administration by supplying TCP/IP network addresses dynamically, and includes a Control Panel module that allows the administrator to configure addresses when necessary. MacTCP is a full implementation of the TCP/IP protocol suite, including IP, TCP, UDP, ICMP, ARP, P, TIP, and BootP.
Price:	$2,500—internal use site license
	$5,000—commercial license including distribution rights
Vendor:	Apple Computer, Inc.

TCPort HostAccess

Description:	Macintosh access to Ethernet hosts. Provides VT100 emulations using the Telnet protocol and supports file transfer using FTP. Multiple sessions with one or more hosts can be established.
Price:	$149 retail
Vendor:	Kinetics, Inc.

TCPort Toolkit

Description: A developer's kit providing tools for creating TCP/IP applications on the Macintosh. Support for the TCP, IP, UDP, and BSD4.3 socket protocols are provided.

Price: $595

Vendor: Kinetics

MacNIX/A

Description: Gives Macintoshes running the Macintosh OS a Finder-like interface to a Macintosh II running A/UX.

Price: $995 retail; two-user package

Vendor: List

Terminal Service—3270

AppleTalk network users often have other computer systems in addition to the ones on their local network. Many companies have IBM mainframes that need to be accessed from time to time. These machines support multiple users logged in as terminals, but require specialized hardware and software to do so. The products listed in this section provide terminal emulation services to Macintoshes on AppleTalk networks, allowing a Macintosh to act as a terminal to an IBM mainframe computer.

Netway 1000AE

Description: The Netway 1000AE is a multisession AppleTalk 3274 Gateway providing shared access to an SNA gateway and to 3270 environments. The Netway is a stand-alone network device shared by network users. Rather than purchase the necessary hardware for each machine on the network, the Netway 1000 allows up to 16 simultaneous sessions from any machines on the network. The Netway is purchased with a 16-user license for either PC or Macintosh software and additional licenses can be purchased to provide access to a workgroup of PCs and Macs. The Netway SNA protocol support software is downloaded to the Netway 1000 at installation from a Macintosh on the network. Client software includes 3270 terminal emulation, file transfer utilities, and 3287 printer emulation to support host printing directly to network printers. A single client can be logged in to as many as eight sessions from any one Macintosh and as many as six sessions from any PC. Optional MacMover software provides a desk accessory for file transfers in the SNA environment and requires installation of software on the host (mag tapes available for TSO, CMS, CICS).

Price: $3,995—Netway 1000AE with Mac or PC access software

$895—MacMover file-transfer software.

Vendor: Tri-Data Systems, Inc.

Netway 2000

Description: The Netway 2000 is a more powerful version of the Netway 1000AE multisession AppleTalk 3274 Gateway, which provides shared access to an SNA gateway and to 3270 environments. See the previous description for the Netway 1000AE; the functions of the Netway 2000 are identical. The Netway 2000 is based on a very powerful SPARC processor and so can support up to 64 users from two AppleTalk LANs. The Netway 2000 also has two VME expansion slots and Tri-Data has promised both Ethernet and Token Ring interface cards so that the Netway 2000 will support mixed LANs and protocols for both IBM PCs and Macintoshes.

Price: $9,995—Netway 2000

$200 56KB V35 Serial Adapter

$2,795 Ethernet adapter

$3,695 TokenRing Adapter

Vendor: Tri-Data Systems, Inc.

Terminal Service—VMS

AppleTalk network users often have other computer systems in addition to the ones on their local network. Many companies use VAX machines for departmental computing. These machines support multiple users logged in as terminals. The products listed in this section provide terminal emulation services to Macintoshes on AppleTalk networks, allowing a Macintosh to act as a VT100 terminal to a VAX host computer. Some products also support other, more specialized features such as a Mac-like interface to popular productivity tools on the VAX. Since most VAX hosts support Ethernet, most of these products also require an AppleTalk-Ethernet gateway such as those described in a preceding section or require that the Macintosh be directly connected to Ethernet.

PacerLink 5.2

Description: PacerLink is a connectivity package that provides communications services between microcomputers and minicomputers. PacerLink is available for VAXes and offers Macintosh and IBM PC users on AppleTalk access to multiple terminal emulation windows, file transfer, print spooling, and virtual disk services. The terminal-emulation software allows sessions with multiple hosts using VT100 and VT220 emulation. User-defined softkeys and function keys allow common actions to be performed easily, and information can be cut and pasted between windows. File transfers of text, binary, and application files can be accomplished for single files or groups of files.

PacerLink also allows the host to emulate a LaserWriter on the network so that Macintoshes can select it in the

Chooser. Print files are then gathered by the VAX and sent to DEC PostScript printers so that a single printer can be shared by all network users. PacerLink also allows disk space on the host to be used as virtual disk space for the client for storage of file and applications. PacerLink can be used from Macintoshes and PCs connected directly to Ethernet or from Macs and PCs on LocalTalk through a gateway.

Price: $2,000 to $37,500, based on number of concurrent sessions.

Vendor: Pacer Software, Inc.

PacerGraph

Description: PacerGraph adds additional terminal-emulation capabilities to PacerLink. With PacerGraph, Macintosh users can also emulate VT240 and VT241 monochrome and color-graphics terminals, Tektronix 4010 and 4014 terminals, and can display Regis graphics. Editing capabilities and transfer of graphics to the Macintosh clipboard are supported.

Price: $150 per Macintosh retail; quantity discounts available

Vendor: Pacer Software, Inc.

AlisaTerminal

Description: AlisaTerminal is included with AlisaTalk. AlisaTerminal allows you to log in to the VAX over AppleTalk and establish terminal sessions. AlisaTerminal uses the DECnet remote terminal service to allow you to log in to any terminal on the DEC internet. Once logged in, AlisaTerminal provides you with VT100 emulation so you can act as a VMS user and even run VAX-based applications with your Mac as the terminal.

Price:	Included with AlisaTalk
Vendor:	Alisa Systems, Inc.

CommUnity-Mac 1.2

Description:	Connects Macintosh systems with VMS, Ultrix, and RSX-11M computers on a DECnet Phase IV Ethernet or asynchronous network.
Price:	$260 to $350 retail; CommUnity-Mac license
	$200 retail; media and documentation
	$1,195 to $1,495 retail; Total Solution packages include CommUnity-Mac license, media, documentation, Kinetics or Dove Computer Ethernet controllers and transceiver
Vendor:	Technology Concepts, Inc.

MacNOW

Description:	General-purpose VT100 terminal emulator for the VAX plus a Macintosh interface to DEC's All-in-1 office automation system. Mac-like interface offers simple interface to All-in-1 Electronic Mail, Text Processing, File Cabinet Management, User Scripts, and File Transfer.
Price:	$3,000 per VAX CPU
	$200 per Macintosh: call for volume pricing
Vendor:	Telos Corporation

Electronic Mail

Electronic mail allows users of a network to emulate a postal system in a real time instant delivery environment. You can carry on conversations and exchange files (enclosures) with others on the network. Electronic mail systems require a central mail server for storage of new and saved messages and enclosures. Individual users interact with the server to read, reply, and forward mail, to send mail to individual users or to entire distribution lists, and to manage pieces of mail.

The three dominant packages for electronic mail on AppleTalk networks are InBox, Microsoft Mail, and QuickMail. A major upgrade of the InBox package is expected to be released in the fall of 1989.

InBox 2.2

Description: Desktop communications package that delivers electronic mail and file-transfer capabilities to AppleTalk users. InBox was the first electronic mail package available for AppleTalk networks and the first to offer both Macintosh and PC connectivity. InBox requires a Macintosh as the message center, which can either be dedicated or operate in the background. Multiple message centers can be accessed over the network from any client. Options at the client include message retrieval, reply, storage, printing, and routing, message creation, addressing, and delivery. Files can be standard text or phone messages and can include a single enclosure.

Price: $249 retail; Starter Kit—Message Center plus three Mac connections

$69 retail; one Macintosh connection

$99 retail; one PC connection

Vendor: TOPS division, Sun Microsystems, Inc.

Microsoft Mail 1.37D

Description: Microsoft Mail allows for both PC and Macintosh users, handles message creation, addressing, delivery, and routing all from the same window. Mail includes standard text, phone messages, and graphics file message formats. Also included are an on-line tutorial and built-in administration routines for configuring your private mail account.

Price:	$299.95 retail; up to four users
	$499.95 retail; up to ten users
	$749.95 retail; up to 20 users
	$949.95 retail; 21 to 32 users
Vendor:	Microsoft Corporation

QuickMail 2.0

Description:	QuickMail is an electronic mail system for Macintoshes on AppleTalk networks, though they have promised a PC version as well. In addition to the features noted in the table, QuickMail is noted for its on-line conferencing options, and the ability to custom-generate the electronic "forms" used to send messages between users. QuickMail also allows e-mail servers to be connected across phone lines. Remote users can send and receive mail using QM Remote.
Price:	$399.95 retail; ten users
	$269.95 retail; five users
	$49.95 retail; QM Remote
	$199.95 Quick Mail PC—not yet shipping.
Vendor:	CE Software

3+ Mail

Description:	3+ Mail brings electronic-mail capabilities to the 3+ network user. Both Macintoshes and PCs can be integrated into a single mail system running over either LocalTalk or EtherTalk. 3+ Mail supports message routing, filing, printing, distribution lists, enclosures, and gateways to other popular e-mail systems. 3+ Mail alerts the network user when new mail has arrived and is waiting for the user at the network server.

Price:	$495 retail; 3+ for Macintosh in addition to server, 3+ software $595 retail; 3+ Mail for up to five users $1,190 retail; 3+ Mail for unlimited users
Vendor:	3Com Corporation

DaynaMail

Description:	Dayna Communications is expected to soon release an electronic mail package that supports both Macs and PCs over AppleTalk networks. The product is based on MHS (Message Handling Service) and thus should have connectivity through gateways to other popular mail systems. Users can choose from multiple message formats, multiple delivery priorities, and can include enclosures along with the messages.
Price:	$295 retail; per five-user pack of Mac or PC connections
Vendor:	Dayna Communications

MacAccess

Description:	MacAccess provides a link to the Coordinator for Mac users. The Coordinator is an electronic mail and work-management package for PC LANs, often sold with Netware. While MacAccess is not a full version of the Coordinator for Macintoshes and AppleTalk, it does allow Mac users access to many of the features of the Coordinator. Action Technologies is planning the release of a full Coordinator package on the Macintosh sometime in 1990.
Price:	$345—five users
Vendor:	Action Technology

Retix Mail

Description:	An X.400-compatible e-mail system expected to be released for many popular LANs, including AppleTalk.
Price:	Unannounced
Vendor:	Retix

VINES Mac Mail Gateway

Description:	A server-based gateway between QuickMail on AppleTalk and VINES Network Mail on a VINES network.
Price:	$795 per server
Vendor:	Banyan Systems Inc.

Mail*Link

Description:	Mail*Link is a gateway between QuickMail and UNIX Mail systems running on A/UX Macintoshes or Sun workstations. By installing Mail*Link on one of the A/UX or Sun systems on your network, you can exchange mail transparently with UNIX mail users to anyone on the world-wide internet (ARPAnet, USENET, etc.) transparently. QuickMail's notification feature alerts you when you have new UNIX mail.
Price:	$695 for A/UX—30 user license $895 for Sun workstations—30 users license
Vendor:	StarNine Technologies, Inc.

cc:Mail

Description:	cc:Mail is a popular electronic mail package for the IBM PC and compatibles. cc:Mail has announced that they will soon support Macintoshes integrated into cc:Mail networks. cc:Mail uses the concept of

	"envelopes" of mail that can contain up to 20 text messages, graphics images, and files. The extension of cc:Mail to the Macintosh environment allows any AFP or DOS 3.1 file server to act as the cc:Mail "post office." It also provides Gateways to TeleMail, EasyLink, and PROFS.
Price:	$69.95 per Mac user
	$695—one post office plus 25 DOS users
	$595—upgrade to unlimited DOS users
Vendor:	cc:Mail Inc.

Conferencing

The products listed in this section allow a number of users to participate in a real time conference, in which each user sees an identical screen and can enter messages for all to see. In some cases this capability is built into electronic mail packages.

AppleJam

Description:	Apple Jam is a network chat/conferencing program that lets up to 20 users type and send messages to each other in real time.
Price:	Public Domain
Vendor:	Bulletin Boards, written by Brian Sutter & Hari Wagener

QuickMail

Description:	QuickMail, described in some detail in the preceding section, is an electronic-mail system for Macintoshes on AppleTalk networks, though they have promised a PC version as well. In addition to the features noted in the table, QuickMail is noted for its on-line conferencing options, and the ability to custom-generate the electronic "forms" used to send messages between users. QuickMail also allows e-mail servers

	to be connected across phone lines. Remote users can send and receive mail using QM Remote.
Price:	$399.95 retail; ten users
	$269.95 retail; five users
	$49.95 retail; QM Remote
	$199.95 Quick Mail PC—not yet shipping.
Vendor:	CE Software

AS&M Phone

Description:	Provides communications between users on AppleTalk or EtherTalk networks. Allows users to chat between stations and transfer files.
Price:	$60 retail
	$900 retail; zone pack
Vendor:	Analytical Services and Materials, Inc.

RealTalk

Description:	Provides communications between users on AppleTalk or EtherTalk networks. Allows users to chat between stations and transfer files. It also contains a "real time" feature that allows one computer screen to be viewed and modified by another workstation.
Price:	$79.95 retail
	$219.95 retail; three pack
Vendor:	InterCon Corporation

Network Monitoring/Troubleshooting

As outlined in Chapters 7 and 8, there are many tools available to help a network administrator verify installations, find network problems, and correct them. The tools described in this section cover a wide variety of tasks helpful to the network administrator. Many of these utilities allow you to "look" at the network and list all the devices that can be seen from the machine running the utility. Others can capture all network traffic, let you either examine the packets in detail or can present higher level information about the total amount and quality of network traffic, and statistics about which devices are talking to which. An interesting troubleshooting utility allows you to control another machine across the network from yours. Two such products allow you to see another Macintosh's screen at your machine and control that machine using your keyboard and mouse. Another useful utility is one that assists you in configuring your internetwork—naming and renaming zones and assigning networks to zones.

BridgeManager

Description: The Shiva BridgeManager is bundled with the Net Bridge, as it is the configuration software for the Bridge. The product is useful for general configuration and testing as well, though. The BridgeManager lets you examine the internetwork in some detail. Starting at the highest level, zones, the product lists all network zones. Opening a particular zone shows all of the network numbers assigned to it. Opening a network shows all the registered AppleTalk devices and services it can find.

One of the most useful features of BridgeManager is the ability to look at two different zones side-by-side and actually "move" networks from one zone to another. The BridgeManager takes care of reconfiguring the bridges once you save the changes. To accomplish this for bridges other than the Net Bridge, the software must understand how to reconfigure other bridges. Shiva intends to produce bridge "descriptions" for all major bridges and gateways, but the current product ships with descriptions for the NetBridge and the Hayes InterBridge.

Price: Included with the Shiva NetBridge

Vendor: Shiva Corporation

Inter•Poll

Description: Inter•Poll is Apple's first release of a network administrator's utility for AppleTalk. Inter•Poll allows you to search the network for active devices, which helps in diagnosing network wiring faults. Inter•Poll can also interrogate any Macintosh on the network (which has the Responder in its system folder) as to its System file, Finder file, and LaserWriter file versions.

Price: $129 retail

Vendor: Apple Computer, Inc.

Timbuktu Version 2.0

Description: Timbuktu is a desk accessory that allows sharing of Macintosh screens across a network. A Timbuktu user can choose to "allow" guests—who may be allowed to see the screen only or to see the screen and control the machine from the remote mouse and keyboard. While Timbuktu allows for some level of collaborative work across a network, such as two people both in a graphics program simultaneously, the users can tend to "fight" each other across the network. Perhaps the best use of Timbuktu is for network administration and troubleshooting. Administrators can now "see" someone else's machine and can work on it remotely or can run a user through a sequence of steps, perhaps explaining them over the phone simultaneously, so that the user will understand the solution. With the release of Timbuktu 2.0, the product now includes file transfer capabilities. Users can select files for transfer across the net without need of additional file service or electronic mail software. Files are transferred in the background and end up in a "received files" folder on the destination machine. Administrators also use Timbuktu to configure file servers on the net without need of a monitor of keyboard. Farallon has also released

	Timbuktu/Remote, which offers the same capabilities across phone lines rather than across AppleTalk.
Price:	\$99—Timbuktu
	\$295—Timbuktu/Remote
	\$1,995—Timbuktu 30-packs
Vendor:	Farallon Computing, Inc.

Sideband

Description:	Sideband is a desk accessory that allows sharing of windows between Macintoshes on a network or remotely connected via modem. With Sideband, users can both look at a single screen and either user's mouse and keyboard can be used to control the Macintosh. Sideband does not have any file-transfer capabilities like Timbuktu, however. The guest of the remote user can put the remote screen into a smaller window, allowing work on local applications.
Price:	\$149—Two node pack
Vendor:	Nexus Development

CheckNet

Description:	Farallon's CheckNet is a handy desk accessory that lets you search the net for all active devices and services. Broadcast requests are issued from the machine running CheckNet asking all network devices and services to identify themselves. CheckNet can look for all AppleTalk entities or it can search based on criteria that you set. You will get a list, updated periodically, of all the entities along with their name, network number, node number, socket number, device or service name, and zone name.
Price:	\$95
Vendor:	Farallon Computing

TrafficWatch

Description: TrafficWatch is a network traffic analysis program. TrafficWatch monitors the network, capturing essential information about each packet, including who the packet was from, who the packet was going to, the type of packet, and whether or not the transmission was successful. This monitoring can be set to happen over a period of time to generate meaningful statistics regarding overall traffic volumes, total error rates, and to look deeper into who's talking to whom (by node number).

The overall traffic volumes and error rates will tell you something about the utilization and performance of the net as a whole. The traffic patterns by node will help you analyze which services are being utilized most heavily and whether or not the internet is configured properly. A traffic analysis might show that a particular node sends 90 percent of the packets it generates to a bridge because the packets are destined for another network. You might move this particular node to the other network to improve performance. You might also discover shared resources on the network (printers, modems, etc.) that appear to be over or underutilized.

Traffic data can be saved from TrafficWatch in Excel format for further analysis. TrafficWatch includes some Excel macros, in fact, to aid in analysis of the data. Since the traffic can be saved to a file, it is common to run similar studies at different times of the day or week, or on a periodic basis, to watch for changes in network utilization and performance.

Price: $195

Vendor: Farallon Computing

LAN Ranger

Description: LAN Ranger is a diagnostic utility bundled with the Kinetics FastPath that helps a network administrator manage the internetwork. LAN Ranger searches for all FastPaths and graphically displays a network map of all networks and of all nodes on each network, showing the topological relationship of all FastPaths on the network. Network traffic is also tracked and can be sampled and graphed in real-time, along with logging of errors and events. The administrator can click on a single node, which is given an icon specific to the platform type, and list all of the active network services on that node. Requires the Apple Responder at each Macintosh to be able to recognize Macintoshes.

Price: Bundled with FastPath

Vendor: Kinetics

Node Check

Description: Node Check is a public-domain program similar to CheckNet in that it collects and displays information about all known entities on the network. Broadcast requests are issued from the machine running Node Check asking all network devices and services to identify themselves. Once this is complete, a list is displayed showing the name, type, zone, node number, socket number, and network number of all the entities found.

Price: Public Domain

Vendor: User Groups/Apple Computer

FlashCheck

Description: FlashCheck is a diagnostic utility bundled with the TOPS FlashBox. FlashCheck was designed to test for three things: first, that the FlashBox hardware and software is installed and running correctly; second, to search for all devices on the network and report whether or not they are FlashTalk capable; and third, for a given pair of nodes, to check FlashTalk communications integrity. When a pair of nodes that are FlashTalk capable are tested, the network is flooded with FlashTalk packets that are intended to be echoed back to the sending machine. FlashCheck looks at how often this operation is successful and provides feedback as to the ability of the physical network to sustain FlashTalk communications between the two selected devices.

Price: Bundled with TOPS FlashBox

Vendor: TOPS Division, Sun Microsystems Inc.

Peek/Poke

Description: Peek and Poke are low-level utilities for creating and/or monitoring network traffic. Intended as debugging tools for network programmers, they can generate useful information, though. Poke allows you to generate network packets and "push" them onto the network. Peek monitors network traffic and captures entire packets according to criteria you set. Statistics are kept regarding total network traffic and error rates, and when capture of the packets is complete the actual data that flowed across the network can be analyzed. Peek shows all packets in the order received, giving the sending and destination node numbers, the length of time the packet occupied the wire, and the length of time the network was idle between packets. For each packet, the content can also be viewed in both ASCII and hexidecimal formats. There is a security issue here, as you might not want people randomly collecting packets from your network. The content of packets generated by common utilities like electronic mail are often not encrypted at all, giving the person with Peek access to perhaps too much information.

Price: Variable

Vendor: User Groups/Apple Computer

PCMacTerm/Network; PC Anywhere III

Description: PC Anywhere III allows a PC's screen and keyboard to be controlled from another machine, similar to Timbuktu. PC MacTerm/Network allows the PC to be controlled from a Macintosh over an AppleTalk network. You use your Macintosh mouse and keyboard to control DOS programs running on the PC. Many familiar Macintosh features are active, even when controlling the PC. Data can be transferred between DOS applications or between Mac and DOS applications using the clipboard. Files can be transferred to and from the Macintosh and printed to the LaserWriter.

Price: $395 for PC MacTerm/Network, including PC Anywhere III

Vendor: Dynamic MicroProcessor Associates

MacChuck 1.5

Description: MacChuck is similar to PC MacTerm in that it allows a Mac to control a PC across serial lines. Version 1.5 of MacChuck extends this capability to AppleTalk users. Consisting of a driver and utility programs for the PC and an application for the Mac, data can be shared between the two machines via file transfer functions and the Mac clipboard. Users of MacChuck can install the software on a single PC and access it from any number of Macs.

Price: $99.95

Vendor: Vano Associates

ATView

Description: A public-domain program that gives a current listing of all registered devices/services within a given zone on the AppleTalk net. Included in the listing are node number, name, device type, network number, and socket number.

Price: Public Domain

Vendor: Bulletin Boards

NodeHint

Description: A utility file that allows one to "set" the node number of any given Macintosh. Setting node numbers can help analyze node-by-node traffic statistics such as those collected with TrafficWatch. When you set the node number for a Macintosh, it only guarantees that will be the first node number attempted when the machine is next restarted; if the node number is already in use, a new, randomly chosen node number will be tried.

Price: Bundled with TrafficWatch

Vendor: Farallon

Register Name

Description: An INIT file that allows one to ensure that a valid AppleTalk name is registered for every Macintosh node. Useful in conjunction with network device lookup programs so that nodes may be distinguished from one another.

Price: Bundled with CheckNet and TrafficWatch

Vendor: Farallon

Set Node

Description: Set Node is Control Panel software that allows one to "set" the node number of any given Macintosh. Setting node numbers can help analyze node-by-node traffic statistics such as those collected with TrafficWatch. When you set the node number for a Macintosh, it only guarantees that will be the first node number attempted when the machine is next restarted; if the node number is already in use, a new, randomly chosen node number will be tried.

Price: Public Domain

Vendor: Bulletin Boards

Sniffer

Description: The Sniffer is a hardware/software combination used to analyze network performance and isolate faults. The Sniffer is sold along with the computer to run the analysis or as an add-on hardware/software combination that can be added to a Compaq 386. Using the Sniffer, a network administrator or LAN specialist can test the integrity of your cables; can produce statistics about LAN activity, utilization, and errors; and can capture all packets or only those meeting a certain set of criteria (errors only, only those to/from a particular node, etc.). Once data have been captured, the Sniffer can help decode packets to understand their contents. In some cases, the Sniffer can interpret the contents of data packets all the way through Layer 7 of the ISO protocol. The Sniffer will operate over Ethernet, Twisted-Pair, Starlan, Sytek, Token Ring, and Arcnet hardware. Protocol-interpretation software is sold separately from the hardware—an AppleTalk support package is available.

Price: $15,750—$24,000, depending on hardware selected, options

$12,500 for add-ons to customer-supplied Compaq 386.

$995—PA1310 AppleTalk Protocol Suite

Vendor: Network General

LANalyzer

Description: The LANalyzer is a hardware/software combination used to analyze network performance and isolate faults. The LANalyzer is sold along with the computer to run the analysis or as an add-on hardware/software combination to a customer=supplied computer. A network administrator or LAN specialist can test the integrity of your cables; can produce statistics about LAN activity, utilization, and errors; and can capture all packets or only those meeting a certain set of criteria (errors only, only those to/from a particular node, etc.). Once data have been captured, packets can be decoded to understand their contents. The LANalyzer can interpret the contents of data packets through Layer four of the ISO protocol. The LANalyzer can operate over Ethernet, Twisted Pair, and Starlan cabling, and understands the AppleTalk, XNS, DECnet, TCP/IP, NetBIOS, SMB, ISO, and MS Net protocols.

Price: Ranges from $5,200 for EX5100 (interface board + software) to $15,755 for the EX5500, which includes a portable computer.

Vendor: Excelan

Network Utilities

In addition to the utilities discussed in the previous section on troubleshooting, many other useful utilities exist to add convenience and functionality to your AppleTalk network. The utilities discussed in this section provide a wide variety of services to the AppleTalk user: the sharing of downloadable PostScript fonts from one central location on the network; sharing clipboards between Macintoshes on the network; the ability to send a message to any or all Macs on the network; tracking network use of files and applications; synchronizing the clocks of all Macintoshes on the network; providing an electronic "bulletin board" on the network; and even checking the status of LaserWriters before attempting to print to one. Also discusses are a number of utilities that are of interest to AppleShare file server users.

FontShare

Description: Downloadable PostScript font printing utility that allows fonts to be stored centrally on the network

	rather than needing to take up disk space at every machine that might make use of them.
Price:	$295 retail; per network
Vendor:	Olduvai Corporation

Suitcase II

Description:	Suitcase II is a utility that allows any number of fonts and desk accessories to be used on a workstation simply by dropping the font and DA files into appropriate folders and to temporarily load fonts and DAs for short-term use. This allows the user to "install" fonts and desk accessories without having to use the Font/DA mover and create large system files. Suitcase also allows fonts to be stored centrally on a network for downloading to a LaserWriter, freeing up valuable disk space at each machine.
Price:	$59.95
Vendor:	Fifth Generation Systems

Master Juggler

Description:	Allows users unlimited access to fonts, DAs, Fkeys, and sounds without having to install them into the system file. Up to 255 fonts can be handled by Master Juggler with automatic resolution of font-numbering conflicts. For the network user, allows just one copy of the fonts, DAs, and Fkeys to be kept on a network server for all to use without requiring the disk space (which can be quite large, especially for fonts) at each user's machine. Requires a network filing system such as TOPS, AppleShare, or MacServe to share these resources.
Price:	$79.95
Vendor:	ALSoft, Inc.

Font/DA Juggler Plus 1.1

Description: Allows users unlimited access to fonts, DAs, Fkeys, and sounds without having to install them into the system file. Up to 255 fonts can be handled by Font/DA Juggler Plus with automatic resolution of font-numbering conflicts. For the network user, allows just one copy of the fonts, DAs, and Fkeys to be kept on a network server for all to use without requiring the disk space (which can be quite large, especially for fonts) at each user's machine. Requires a network filing system such as TOPS, AppleShare, or MacServe to share these resources.

Price: $59.95

Vendor: ALSoft, Inc.

ClipShare

Description: Allows users on a network to instantly share Clipboard contents among each other. Individual clipboards are still maintained at each machine, but you can choose to "send" your clipboard to another person's. Olduvai also makes MultiClip, which allows you to maintain multiple clipboard selections at the same time. With MultiClip, a clipboard received from across the network will not overwrite the contents of the clipboard, but will simply add another selection.

Price: $149 retail; three users

$249 retail; six users

$395 retail; full network license

Vendor: Olduvai Corporation

Network Notes

Description: A "polite alternative to electronic junk mail," a public notes area accessible over the network. The public notes area includes both a bulletin board and a calendar. Users who search the notes can browse and post messages, which can include both text and pictures.

Price: $200 per network

$25 per workstation.

90-day package for 32 users for $35.

Vendor: Eastgate Systems Inc.

GOfer

Description: GOfer is a desk accessory that performs free-form text searches in a single file, multiple files, or entire folders and subfolders. Many networks with file service create folders or directories where many general-user files are located. Quite often, however, the user of the folder is unfamiliar with what is in each file. GOfer lets you search through files looking for a text string you specify or even a complex logical formula for text strings (search for TOPS and printing, but not Excel, for example). Once the string is found, GOfer will display each occurrence of the string.

Price: $79.95

Vendor: Microlytics Inc.

In/Out Board

Description: In/Out Board is a utility under development by CE Software that allows members of a workgroup to sign in and out of the office and indicate their whereabouts. Similar to physical in/out boards mounted on walls, In/Out Board will allow users to update their status over the network. CE Software plans versions for both the Macintosh and the IBM PC.

Price: Unannounced

Vendor: CE Software

Broadcast

Description: A utility that allows a message to be sent to any set or all users on a network. Users receiving the message are presented with a dialog box with the specified message. Useful for broadcasting shutdown messages or as simple e-mail on a small network.

Price: Public Domain

Vendor: Bulletin Boards

LW Status

Description: A utility CDEV that allows a user to "look" at the status of any LaserWriter on the network. Useful for troubleshooting printer problems or in choosing an available printer.

Price: Bundled with CheckNet and TrafficWatch

Vendor: Farallon

MacInUse

Description: MacInUse is a utility that allows you to track the use of various applications and files—when they were used, how long, etc. The network version allows the user's name as well as the application name to be logged.

Price: $79

Vendor: SoftView Inc.

ClockSynch

Description: A utility that allows the clocks of all Macintoshes on a network to be synchronized with one another. The clock of one machine is designated as the source of time and all others are set according to this one Macintosh.

Price: Public Domain

Vendor: Bulletin Boards

FolderShare

Description: A utility from CE software designed to help create new folders on an AppleShare server. FolderShare lets a user create a default set of access privileges for any new folder created, including extending access privileges to a particular group or to the world.

Price: Public Domain

Vendor: Bulletin Boards

AppleShare Kill

Description: AppleShare Kill is an INIT that will remove all AppleShare log-in instructions from a Mac. This is useful if you need to get into a Mac that has an AppleShare log-in requesting an unknown password before allowing a user into the system.

Price: Public Domain

Vendor: Bulletin Boards

DoppelMaker

Description: Allows users to create "doppelgangers" on a file server. Doppelgangers allow an application on a server to be made invisible while creating an icon that represents it so it can be launched. Since the actual application is invisible, it cannot be copied from the server. DoppelMaker will also keep track of access to the file or application.

Price: Public Domain

Vendor: Bulletin Boards

File Translations

All of the utilities discussed in this section provide translations between the file formats of popular applications. Because networks promote the notion of sharing among users on the network, each of whom may have different choices for applications, providing for file translations is often critical in the networked environment. Among Macintosh applications, files can often be shared without the use of an additional application. By saving the original file in a common format (such as MacWrite for word processor files, or MacPaint for bit mapped images), or by taking advantage of the destination application's ability to read files in other formats than its own, files can often be moved directly between applications. When this is not possible, however, many applications exist purely to translate between the many possible combinations of file formats. Many of these were designed for translating between common Macintosh and PC file formats but can be used equally well between two PC or two Macintosh applications.

TOPS Translator

Description:	A special version of MacLink Plus written for use over AppleTalk networks with TOPS. TOPS Translator converts file formats between popular applications on both the Mac and the PC.
Price:	Bundled with TOPS/Macintosh
Vendor:	TOPS Division, Sun Microsystems, Inc.

MacLink Plus 4.0

Description:	MacLink Plus is a utility for converting files between the formats of common PC and Mac applications. MacLink allow conversion of files across network drives or between Macs and PCs connected serially. Once a physical or network connection is made, MacLink allows any file to be selected for conversion. Conversions can be made from Mac format to PC format and vice versa. To be able to convert a file, MacLink must understand the format of both the original file and the format required by the converted file it will create. MacLink offers over 50 conversion combinations, between popular applications such as Word Perfect, WordStar, Multimate, Xywrite, MacWrite, MSWord, dBase, Lotus, MultiPlan, Symphony, and Excel. MacLink also recognizes vari-

ous "standard" file formats such as DCA, DIF, Text, Tab Values, Tab Text, and Comma Values. Version 4 of MacLink adds graphics file formats including Lotus, PCPaintbrush, TIFF, PICT, and PICT II. MacLink Plus comes as both a stand-alone application for file conversion and as a set of translators to be used with the Apple File Exchange.

Price: $195 retail—MacLink Plus

$159 retail—MacLink Plus/Translators (for use with AFE)

Vendor: DataViz, Inc.

The Graphics Link Plus

Description: IBM PC to Macintosh file conversion. File formats supported are PCPaintbrush, MS Windows Paint, GEMPaint, Ventura Publisher, TIFF, EGA Paint 2005, MacPaint, Dr. Halo DPE, BLoad, and PCPaint Plus.

Price: $149 retail

Vendor: PC Quik-Art, Inc.

Apple File Exchange

Description: The Apple File Exchange (AFE) is a utility that allows for conversion of files between different formats. AFE is a "shell" that will accept translators written according to a specification published by Apple. AFE is distributed by Apple as part of the standard System Software bundled with every Mac and includes two simple word-processing format translators. Additional translation files are available both commercially and as part of public domain software available through user groups and on-line services. MacLink Plus from DataViz offers the most extensive set of translation modules, with over 50 conversions between popular Macintosh and PC application formats.

Price: Included in standard System Software.

Vendor: Apple Computer

HiJaak

Description: A file-conversion utility that handles graphic file conversions between Amiga, CompuServe RLE, HP LaserJet, Lotus .PIC, MacPaint, PCPaintbrush, PostScript, TIFF, and Text formats.

Price: $99

Vendor: Inset Systems

CADMove

Description: A graphics file translation utility that supports IGES, DXF, Minicad, MacDraw, PICT, MSC/pal, SNAP!, Super 3D, and Space Edit.

Price: $495 retail

Vendor: Kandu Software

GIFConverter

Description: A file-conversion program for translation of graphics file formats, including GIF, MacPaint, Thunderscan, PICT, and EPSF.

Price: Public Domain

Vendor: Bulletin Boards

Optiks

Description: A PC-based file conversion program for translation of MacPaint files into PC graphics file formats. A public domain version of Optiks allows the user to save MacPaint files into BASICA. Registered users of the program can save MacPaint files into BASICA as well as PC Paintbrush, TIF, and EPSF file formats. Optiks also allow some manipulation of the images as well as the editing of existing bit maps.

Price:	Public Domain version, or $79.95 for full version
Vendor:	Keith Graham
	Bulletin Boards

Iconvert

Description:	A PC-based file conversion program for translation of graphics file formats, including RLE, PrintMaster, Print Shop, PC Paintbrush, Windows Paint, MacPaint, BASICA, NewsMaster, and Fontasy. Iconvert also allows the bit-map images to be viewed and manipulated.
Price:	ShareWare, $35
Vendor:	J. Michalski
	Bulletin Boards: CompuServe, Genie

Vision Lab

Description:	A Mac-based file-conversion program for translation of graphics file formats, including GIF, MacPaint, PixelPaint, PICT2, and EPSF. Files can be displayed in color or in dithered gray scale.
Price:	ShareWare
Vendor:	John Raymond/Koala Technologies
	Bulletin Boards: CompuServe, Genie, Delphi

Built-in Translators

The following pairs of applications on the PC and the Macintosh have translators built into them to allow exchange of files without the use of another utility. Many application vendors are recognizing the need for such translators and are building them directly into their products. This list contains the most well-known applications that can translate "foreign" file formats. Most can import the foreign files to allow for editing of the file. When the file is again saved, the user is presented with the choice of saving back to the foreign format or to save the file to the application's own format.

- WordPerfect PC <> WordPerfect Macintosh
- Excel PC <> Excel Mac
- Excel Mac <> Lotus 1-2-3
- Pagemaker PC <> Pagemaker Mac
- More (Mac) <> Ready (PC)
- MicroPlanner Mac <> MicroPlanner PC
- MS Word Mac <> MS Word PC
- dBASEMac <> dBase III
- McMax <> dBase III
- FoxBase Mac <> dBase III
- FoxBase Mac <> FoxBase PC
- MS Works Mac <> MS Works PC

Backup Software

The applications described in this section facilitate backing up file and applications to a central disk or tape drive unit. When files are stored in a central location, as they often are on a network, keeping a backup copy of them becomes critical. In addition, if the storage device is a tape unit, it is unlikely that each person on the network will have their own tape unit locally. Both of these facts point out the need for software that makes backing up files on a network, whether backing up a centralized file server to a disk or tape unit, or backing up files distributed throughout a network to a centralized tape unit, a critical operation. The software products listed in this section all provide these sorts of services. In addition to the software products listed in this section, all tape backup units sold come with software for backing up and restoring files to and from the unit. Also, every Mac is shipped with two backup utilities: the Finder and a program called HDBackup. The Finder is probably the most common backup software used. If you have a need to keep certain key files backed up or, better yet, all your files backed up, you can always use the Finder to create backup diskettes of your work.

Network DiskFit 1.5

Description: SuperMac produces a backup utility specifically tailored to network users of AppleShare and TOPS. Network DiskFit allows entire disk or network volumes to be backed up and a Smart Set created that remembers all files backed up and their location. As incremental backups are made, DiskFit uses the Smart Set to determine which disks need updating and how best to use available space. DiskFit stores backed up files in standard Macintosh format so that they may be retrieved through the Finder. All files are verified as they are backed up. Options for backing up include entire disks, individual files and folders, or just applications and system files. AppleShare volumes that are backed up retain full access privilege information. Users with MultiFinder can work in other applications while backups are being performed.

Price: $395 retail; for up to 31 users

Vendor: SuperMac Technology

HFS Backup 3.0

Description: HFS Backup is a versatile backup and restore utility for Macintosh users. Files to be backed up can be selected by name, date, or type, and the selection criteria can be saved for future use. Files can be archived to any media, including floppies, hard drives, tape backups, and WORM drives. Incremental backups are supported, with changed or deleted files being updated or removed as appropriate from the backup copies. When used with AppleShare volumes, the access privileges associated with each folder are preserved. HFS Backup can be multilaunched so that one copy of the program can be kept on a network server for all to use (be sure to pay attention to restrictions in the software license).

Price: $99 retail, bundled with PCPC MacBottom hard drives

Vendor: Personal Computer Peripherals Corporation

FastBack Mac

Description: Fifth Generation Systems has long had a backup software product on the market for PCs and compatibles. With FastBack Mac, they bring the same capabilities to Macintosh users. Powerful selection features allow users to back up entire volumes or just selected files and folders. Incremental backups and partial backups by date are also possible. FastBack also prints disk labels for the floppy backup disks.

Price: $59.95 retail

Vendor: Fifth Generation Systems, Inc.

Irwin EzTape

Description: Irwin's 40 MB and 80 MB tape backups come bundled with backup software called EzTape for selecting, backing up, and restoring file to and from the tape drive. EzTape provides powerful file selection, unattended backups, and is compatible with both TOPS and AppleShare. The format used by the EzTape software makes the tapes interchangeable with tape backup units for Macs, PCs, and PS/2s.

Price: $1,395 retail; 40 MB

$1,695 retail; 80 MB

Vendor: Irwin Magnetic Systems, Inc.

Redux 1.5

Description: Redux is a very powerful file backup utility for the Macintosh. Entire volumes can be backed up to any disk volume, including network volumes. Allows you to verify your backups as they are made. Extensive

	control over files to be backed up is allowed: single folders, individual files, files of a specified type or age, files only (no applications), individual file/folder restore, and incremental backups. Redux even has a scripting language that allows you to specify backup criteria in plain English.
Price:	Version 1.01, bundled with Jasmine hard drives
	$99 retail
Vendor:	Microseeds Publishing, Inc.

Soft Backup

Description:	Soft Backup is a software-only backup utility that can be utilized for backups to floppies, hard drives, or tape units. Selection criteria are versatile and incremental backups are supported.
Price:	$69.95 retail; singer-user version
	$139.95 retail; network version
Vendor:	Diversified I/O

Network Applications

Databases/Accounting Packages

The software packages described in this section are not network products per se, but are common productivity packages for the Macintosh with some level of networking capabilities built in—either the ability to share files among multiple users or to exchange files with other systems across a network. Many of the packages described in this section are some form of database package, from configurable databases that could be used for any database application, to vertical packages programmed for a specific database application, such as accounting or professional billing. Some of these applications rely on an underlying network file system; they depend on a product like TOPS or AppleShare for access to database files on the network, while others have this functionality built-in and need not be used in conjunction with other network products.

Omnis 3 Plus Express 3.3

Description: Single or multiuser, customizable, relational database manager. Offers Mac-like interface features and powerful relational database programming. Requires an underlying network file service such as TOPS or AppleShare.

Price: $795 retail

Vendor: Blyth Software

4th Dimension

Description: 4th Dimension is an extremely powerful relational database for creating single multiuser applications with simple-to-use interfaces. 4th Dimension is multiuser and does rely on an underlying network transport such as TOPS or AppleShare.

Price: $695 retail; 4th Dimension

$295 retail; 4D Runtime

Vendor: Acius, Inc.

dBase Mac

Description: dBase Mac is a relational database management system for creating sophisticated applications. dBase Mac is inherently single-user, however, limiting its usefulness on a network. dBase Mac can import data from dBase III, though it cannot import the program routines.

Price: $495 retail; dBase Mac

$795 retail; dBase Mac Runtime version

Vendor: Ashton-Tate

FoxBase+/Mac 1.1

Description: Relational database system compatible with dBase III Plus and FoxBase+/PC. FoxBase is a powerful database system for Macintoshes that also allows importation of existing databases from FoxBase on the PC or from dBase III Plus. FoxBase+/Mac adds familiar Macintosh interface features and integrated graphics. Offered in both single-user and multiuser versions (which require a file server that supports the full Macintosh file system for network file access). FoxBase is the first database application to offer full multiuser support for both Macintoshes and PCs simultaneously.

Price: $395 retail; single-user

$595 retail; multiuser

$300 retail; royalty-free run-time single-user

$500 retail; royalty-free run-time multiuser

Vendor: Fox Software, Inc.

FileMaker II

Description: FileMaker II is a very easy-to-use, easy-to-program file system. FileMaker is not a relational database, but is multiuser and does not require an underlying file-server system for multiuser access to the database.

Price: $299 retail

Vendor: Claris

Double Helix II; Helix VMX

Description: Double Helix is a high-end, multiuser, relational database for use on Macintosh networks. Helix can use servers located either on Macintoshes or on VAXes. Helix does not require an underlying file-server system to provide multiuser access to the database.

Price: $595 retail; Double Helix II

$395 retail; Double Helix II Multiuser Kit

$4,500 starting price; Helix VMX

Vendor: Odesta Corporation

Oracle for Macintosh

Description:	Brings Oracle's SQL database functionality to the Macintosh. As a client to an Oracle or other SQL database located on the network or via asynch connections, Oracle for Macintosh operates in one of three ways. First, Hypercard can be used along with the bundled Application Generator to quickly generate Hypercard applications for adding, editing, or deleting information from the database. Secondly, more advanced Hypercard applications can be created by incorporating SQL commands directly into Hypercard scripts using the bundled Hyper*SQL additions to the HyperTalk language. Lastly, Oracle for Macintosh includes tools for imbedding SQL commands directly into your C-language programs for generating custom SQL applications.
Price:	$199 retail; developer version
	$999 retail; networking version
Vendor:	Oracle Corporation

SequeLink

Description:	A package to allow a number of different methods of access from the Macintosh to SQL databases on a VAX. The SequeLink package for the Mac consists of a number of components—a SequeLink driver for communications with the SQL host; a 4th Dimension run-time package, as well as 4th Dimension language extensions for creating custom applications; and Hypercard XCMDs for creating Hypercard links to SQL databases. Using SequeLink from a Macintosh requires SequeLink server software on the VAX as well.
Price:	$395—SequeLink for the Mac, per Mac
	$2,950–9,950—SequeLink server software (VAX)
Vendor:	Alisa Systems, Inc.

SQL/Expert

Description: Generates Structured Query Language (SQL) statements for use in accessing SQL databases on host computers.

Price: $99.95 retail

Vendor: HyperPress Publishing Corporation

CL/1

Description: CL/1 is a connectivity language for linking personal computer applications to host-based databases transparently. Links between Macintoshes and A/UX and VAX-based databases and files are available. CL/1 for Hypercard allows transparent access through Hypercard to the databases stored on these hosts. CL/1 supports Ingres, SyBase, Rdb, and Oracle databases, as well as flat RMS files on the VAX.

Price: $35,000—Developers Toolkit

$3,000—24,000—CL/1 Server for VAX, depending on VAX

Vendor: Network Innovations/Apple Computer

Insight Expert Accounting Series

Description: General Ledger, Accounts Receivable and Billing, Accounts Payable, Inventory Control, and Time Billing modules for building a full-featured accounting system. Insight is multiuser capable, but requires an underlying file system such as TOPS or AppleShare.

Price: $695 each retail; General Ledger, Accounts Receivable and Billing, Accounts Payable, Inventory Control, Time Billing

$995 each; multiuser Accounts Receivable, Accounts Payable

$299 retail; Insight OneWrite

Vendor: Layered, Inc.

Great Plains Accounting Series

Description:	General Ledger, Accounts Receivable, Accounts Payable, Payroll, Inventory, Order Entry with Point of Sales, Purchase Order, Job Cost, Network Manager, and Executive Advisor modules for building a complete accounting system for your business. Great Plains is also available for the IBM PC. The modules are multiuser capable but do require a file system such as TOPS or AppleShare to provide these capabilities.
Price:	$795 retail; per module
	$595 retail; Executive Advisor
Vendor:	Great Plains Software

Flexware

Description:	Multiuser accounting package with the following modules available: Accounts Payable, Accounts Receivable, General Ledger, Payroll, Inventory, Order Entry, Purchasing, Job Costing. Requires an underlying file-service mechanism such as TOPS or AppleShare.
Price:	$795 retail per module
Vendor:	Flexware, Inc.

McMax 2.0

Description:	dBase III-compatible relational database system. Currently only available in single-user versions. Able to share existing dBase applications and data with PCs on an AppleTalk network. McMax 2.0 allows you to run dBaseIII programs on your Macintosh without modification. File systems that offer both Mac and PC versions will allow running dBase III programs across the network, utilizing the dBase code located on a PC. McMax allows you to add Macintosh fea-

tures like pull-down and pop-up menus within your dBase III applications for ease of use. Includes a royalty-free, unlimited use run-time version called McMax Run.

Price: $295

Vendor: Nantucket Corp.

Mac/Series Six Plus

Description: The Mac/Series Six Plus is a full database accounting library built on top of FoxBase+/Mac or Multiuser FoxBase+/Mac. Modules include General Ledger, Accounts Receivable, Accounts Payable, Sales Order Processing, Purchase Order Processing, Payroll and Labor Accounting, Fixed Assets Management, Manufacturing Planning, Job Cost Accounting, Time and Billing, Property Management, and Service and Equipment Maintenance. SBT also produces the Series Six Plus line that provides a PC-like user interface and works with either FoxBase+/Mac or McMax.

Price: Varies with modules selected

Vendor: SBT Corporation

Project Billing

Description: A network package that allows professionals to keep accurate time billing statistics. Requires a network file system, such as TOPS or AppleShare, to operate in a multiuser mode.

Price: $695 retail; Project Billing

$1,095 retail; Project Billing+ (remote entry version)

Vendor: Satori Software

Legal Billing

Description: A network package that allows legal professionals to keep accurate Time Billing statistics. Requires a network file system, such as TOPS or AppleShare, to operate in a multiuser mode.

Price: $595 retail; Legal Billing

$895 retail; Legal Billing II (ABA approved)

$1,295 retail; Legal Billing II+ (remote entry version)

Vendor: Satori Software

Picture Base Network Version

Description: Picture Base is a utility that provides a database, accessible from the DA menu, of graphic symbols and pictures. Each symbol or picture can be accompanied by keywords so that symbols may be searched for. The network version lets the files be loaded onto a file server for access across the network by multiple users but only allows changes to the graphics by the owner of the file.

Price: $150 for three users

Vendor: Symmetry Corp.

Groupware

Groupware is the name of a category of software that goes beyond the extension of database capabilities to multiple users on a network. Rather, it describes software that really facilitates the workings of a group of people, providing them with capabilities far beyond automating or computerizing what they already do. Groupware is a common buzzword in the industry and unfortunately describes a class of software that is largely undeveloped as of yet. Some products for AppleTalk networks are approaching Groupware status; these products are described in this section.

Markup

Description: Markup from Mainstay is a group-editing and commenting program. Users who wish to solicit comments on a document put the document on a machine designated as a server (nondedicated). The user puts an image of the document, rather than the original source file, on the server so it can be viewed by anyone, whether or not they have the application that originally created the document. Reviewers can then view the document and can use a variety of drawing and text tools to "mark up" the document without actually editing it. The originator of the document can then review each of the markups individually, treating them as overlays, or can overlay many at once. It is then up to the author to go back to the original document and applications to incorporate the edits.

Price: $245—single user

$495—two users

$995—five users

Vendor: Mainstay

Annotator

Description: Farallon's Annotator is also a group editing and commenting program for AppleTalk networks. Although it does not require a central server for storage of the documents and edits, it does allow a workgroup to collaborate on the review of a document. Annotator gives the reviewer many tools—graphics, proofreading symbols, text, and color highlighting—with which to annotate the image of the original document. The reviewer cannot directly edit the document. Farallon also supports integration of their MacRecorder into the group-editing process. Reviewers can attach voice comments to their edits, which the author hears when an object is selected.

Price: Unannounced

Vendor: Farallon

Smart Alarm, Multiuser Appointment Diaries

Description:	Personal reminder system; up to 21 users (networkable on AppleShare, MacServe, or TOPS)
Price:	$99 to $299 retail, depending on number of users
Vendor:	Jam Technologies

Front Desk Multiuser 6.0

Description:	Front Desk allows multiuser access to a group-wide time- and resource-scheduling facility. Appointments can be made by anyone on the network with access to the file (TOPS, AppleShare, or other network filing system required).
Price:	$99 per user node retail
Vendor:	Layered, Inc.

Perfect Timing

Description:	Perfect Timing is a network-based group-calendaring and schedule-management system for AppleTalk networks. Each user keeps their own personal calendar/appointment diary, which can be password-protected, in one of a number of formats. In addition to scheduling appointments and meetings, each user can maintain personal "to do" lists and can send reminder alerts to themselves at scheduled times. Appointments can be added to the calendar at any time, and recurring meetings can be scheduled once and automatically added to the schedule thereafter. The real beauty of Perfect Timing comes in the server component of the software. As appointments are made, a single node designated as a nondedicated server tracks appointments for the entire workgroup, tracking for each time slot who has appointments scheduled. This allows someone setting up a meeting to select the attendees from a list and be shown all the times when those people are available. Once

a time is proposed, meeting requests are sent to all attendees asking them to confirm attendance at the meeting. When all are confirmed, appointments are written to each person's calendar. Perfect Timing does not require a network file system such as TOPS or AppleShare to operate.

Price: $295 retail; starter kit (includes server and three nodes)

$150 retail; additional three-workstation node kits

Vendor: Imagine Software

Syzygy

Description: Syzygy is a workgroup-based project- and time-management tool for IBM PCs and compatibles. Syzygy goes beyond traditional project-management software that allows resources and tasks to be tracked for individual projects and extends this capability to the resources and tasks of an entire workgroup. Information Research has announced that they will extend Syzygy's capabilities to the heterogenous workgroup that includes Macintoshes and PCs. Though they have not announced a release date for the product, it is not expected before the end of 1989.

Price: Unannounced

Vendor: Information Research Corp.

Multilaunchable Products

Some personal productivity applications do not have multiuser capabilities at the file level, but do allow for sharing of the application. This allows for one copy of the application to be kept on a network file server for many people to use simultaneously. While many users could launch the same application from the server, attempting to open an already opened file from that application would either be prevented or would restrict the user to a read-only copy of the file. This is one step away from true multiuser capability, but is generally suitable for applications where multiuser capability is rarely necessary, such as word processing and spreadsheeting. It should be noted that while more and more applications are being developed with this sort of capability, this is distinctly different from a site license. Most manufacturers require those using multilaunch applications to purchase a copy of the application for all users on the network or as many copies as there are simultaneous users of the application.

Microsoft Excel, Word

Most Microsoft products for the Macintosh, including both Excel and Word, are multilaunchable. Any number of users can launch the same application file from a server, but once a document is opened with that application, subsequent requests to open the file from other machines will give the user a read-only copy. Changes made to the copy cannot be saved to the same file, although the edited file can be saved to a different name, creating a second file.

Glue

Description:	A multilaunchable version of a popular utility that allows images of files to be saved so that the document can be viewed, but not edited, without needing to have a copy of the application used to create the document.
Price:	$250
Vendor:	Solutions, Inc.

Mac/VMS Connectivity

The minicomputer most likely to be found in an office along with Macintoshes is the VAX from Digital Equipment. Consequently, many products have become available that facilitate communication and resource-sharing between users of both systems. Apple and DEC themselves have announced plans for development projects to allow and promote this sort of connectivity. Products listed in this section are all from third parties and all offer various levels of connectivity between Macintoshes and VAXes.

PacerLink 5.2

Description: PacerLink is a connectivity package that provides communications services between microcomputers and minicomputers. PacerLink is available for VAXes and offers Macintosh and IBM PC users on AppleTalk access to multiple terminal-emulation windows, file transfer, print spooling, and virtual-disk services. The terminal-emulation software allows sessions with multiple hosts using VT100 and VT220 emulation. User-defined softkeys and function keys allow common actions to be performed easily, and information can be cut and pasted between windows. File transfers of text, binary, and application files can be accomplished for single files or groups of files.

PacerLink also allows the host to emulate a LaserWriter on the network so that Macintoshes can select it in the Chooser. Print files are then gathered by the VAX and sent to DEC PostScript printers so that a single printer can be shared by all network users. PacerLink also allows disk space on the host to be used as virtual disk space for the client for storage of file and applications. Pacer Link can be used from Macintoshes and PCs connected directly to Ethernet, or from Macs and PCs on LocalTalk through a gateway.

Price: $2,000 to $37,500, based on number of concurrent sessions.

Vendor: Pacer Software, Inc.

PacerGraph

Description: PacerGraph adds additional terminal-emulation capabilities to PacerLink. With PacerGraph, Macintosh users can also emulate VT240 and VT241 monochrome and color graphics terminals, Tektronix 4010 and 4014 terminals, and can display Regis graphics. Editing capabilities and transfer of graphics to the Macintosh clipboard are supported.

Price:	$150 per Macintosh retail; quantity discounts available
Vendor:	Pacer Software, Inc.

PacerPrint

Description:	PacerPrint provides PostScript printing capabilities to VAX/VMS uses. VAX users can print to PostScript printers using standard VMS print commands. Conversions can be made to PostScript from many common VMS file and print formats. Macintosh and PC users on AppleTalk can take advantage of PacerPrint's printing functionality and print to the same serially connected PostScript printer by routing their print files to the VAX via any means, including PacerLink, PacerShare, and PacerTOPS.
Price:	$1,000; MicroVAX $2,000; VAX $4,000; VAX Cluster
Vendor:	Pacer Software, Inc.

PacerShare

Description:	PacerShare is an add-on package to PacerLink that allows the VAX to emulate an AppleShare server. Macintosh and PC AppleShare client software can be used in conjunction with PacerShare to provide file-service capabilities. Clients use the VAX just as they would a dedicated Macintosh AppleShare server, and all of the VMS user and file securities are preserved. PacerShare supports clients directly on Ethernet or from LocalTalk through a gateway such as the Kinetics PastPath.
Price:	$400 to $7,500 per VAX, depending on number of concurrent users allowed; requires PacerLink
Vendor:	Pacer Software, Inc.

PacerTOPS

Description: PacerTOPS is an add-on package to PacerLink that allows the VAX to emulate a TOPS server. Macintosh and PC TOPS client software can be used in conjunction with PacerTOPS to provide file-service capabilities. Clients use the VAX just as they would any TOPS server, and all of the VMS user and file securities are preserved. VMS users also have access to the Mac and PC files stored on the VAX, subject to the file-security protections within VMS. PacerTOPS supports clients directly on Ethernet or from LocalTalk through a gateway such as the Kinetics PastPath.

Price: Unannounced; requires PacerLink

Vendor: Pacer Software, Inc.

AlisaTalk: AlisaShare, AlisaPrint, AlisaTerminal

Description: The AlisaTalk system is a complete connectivity package for Macintosh-to-VAX communications. AlisaTalk adds the AppleTalk protocol suite to the VAX's communications capabilities. AlisaTalk includes AlisaShare, an implementation of AppleShare on the VAX. Mac users can use the VAX as a file server using the standard AppleShare client software included with every Macintosh. Files and applications may be stored on the VAX and the full access privileges scheme of AppleShare is implemented. The server is maintained through the AlisaShare Utility (ASU), a VAX application. Alisa is now shipping a HyperCard version of ASU with AlisaTalk.

AlisaTalk also includes the AlisaPrint System (APS). AlisaPrint allows both Mac and VAX users to share the same AppleTalk-based PostScript printers. Mac users continue to use their network-based printers while VAX users can redirect their print jobs to AppleTalk to use the same printer.

AlisaTerminal is also included with AlisaTalk. AlisaTerminal allows you to log in to the VAX over

AppleTalk and establish terminal sessions. AlisaTerminal uses the DECnet remote terminal service to allow you to log in to any terminal on the DEC internet. Once logged in, AlisaTerminal provides you with VT100 emulation so you can act as a VMS user and even run VAX-based applications with your Mac as the terminal.

Price: $4,700–21,500 depending on VAX CPU

Vendor: Alisa Systems, Inc.

CommUnity-Mac 1.2

Description: Connects Macintosh systems with VMS, Ultrix, and RSX-11M computers on a DECnet Phase IV Ethernet or asynchronous network

Price: $260 to $350 retail; CommUnity-Mac license

$200 retail; media and documentation

$1,195 to $1,495 retail; Total Solution packages include CommUnity-Mac license, media, documentation, Kinetics or Dove Computer Ethernet controllers and transceiver

Vendor: Technology Concepts, Inc.

AppleTalk for VMS

Description: A developer's toolkit that provides AppleTalk protocols on VMS-based machines. Allows developers to create AppleTalk software packages for VAXes.

Price: $5000, site-license

Vendor: Apple Computer

MacNOW

Description: General-purpose VT-100 terminal emulator for the VAX plus a Macintosh interface to DEC's All-in-1 office automation system. Mac-like interface offers simple interface to All-in-1 Electronic Mail, Text

	Processing, File Cabinet Management, User Scripts, and File Transfer.
Price:	$3,000 per VAX CPU
	$200 per Macintosh; call for volume pricing
Vendor:	Telos Corporation

AsynchServer

Description:	AsynchServer is a VMS software package that allows Macintosh users to make asynchronous links to VAX-based AppleTalk services such as PacerLink and AlisaTalk. Such a service allows users to dial in to VAXes and still make use of AppleTalk services, such as file service and print spooling.
Price:	$595–$1895
Vendor:	Computer Methods

Mac/UNIX Connectivity

The products in this section all provide connectivity solutions for Macintoshes and UNIX-based computers. More and more computer vendors, including Apple, offer UNIX exclusively or as an option. As this trend continues, AppleTalk connectivity between Macintoshes and UNIX-based machines will become more and more important.

TOPS for Sun

Description:	File-server software for Sun Microsystem's workstations and servers that allows the Sun machines to act as file servers to Macs and PCs running TOPS software. Also provides for sharing of a single AppleTalk PostScript printer by Sun, Macintosh, and PC users.
Price:	$895 for one to four users
	$1,595 unlimited
Vendor:	TOPS Division, Sun Microsystems Inc.

TOPS for A/UX

Description: Software that allows a Mac II running A/UX system software to act as a TOPS server. A/UX volumes can be published using a simple-to-use Mac interface for use by others on the TOPS network. NFS volumes mounted on the A/UX machine may also be published, making the A/UX machine a TOPS/NFS gateway. Full UNIX security implemented for access to published A/UX volumes.

Price: $895—1 to 4 user license

$1,595—5+ user license

Vendor: StarNine Technologies, Inc.

Xinet

Description: File Service software for UNIX-based minicomputers providing connectivity to Macs and PCs using TOPS software. Xinet is available for Mt. Xinu's MORE BSD operating system, and Ultrix running on VMS systems. Mt. Xinu also acts as a porting house for the TOPS UNIX server software. Check with Mt. Xinu for a list of available ports.

Price: Dependent on operating system; call Mt. Xinu

Vendor: Mt. Xinu

U-Share

Description: Software and hardware that allows Apollo 3000 and 4000 series computers or Sun workstations as file servers for Macintoshes. The complete package includes software for the Apollo/Sun, an AppleTalk interface card for the Apollo, and software for the Mac that provides file service, virtual disk service, terminal emulation, print spooling, and electronic mail.

Prices: $295—AppleTalk adapter for Apollo 3000 or 4000

$1,195—U-Share for Apollo or Sun

	$149—Macintosh software, per workstation.
Vendor:	Apollo Computer—for Apollo Version Information Presentation Technologies—Sun Version

K-Talk

Description:	Development libraries for various minicomputer and workstations products allowing developers to create AppleTalk applications on these systems. K-Talk is available for Ultrix, Integrated Solutions, Sun Workstations and Servers, Pyramid, and Cadmus. These packages allow these machines to recognize EtherTalk packets as valid Ethernet packets and provide AppleTalk protocol support for applications to be built on.
Price:	Varies by machine type: Ultrix prices vary from $750–1,000.
Vendor:	Kinetics

CAP (Columbia AppleTalk Package)

Description:	A developer's toolkit for creating AppleTalk applications on systems running 4.2BSD versions of UNIX or derivatives thereof. The majority of the AppleTalk protocol suite is implemented in the provided libraries.
Price:	Public Domain
Vendor:	Columbia University User Services

Appendix A

Vendors and Products

Acius, Inc.

Products:	4th Dimension
Address:	20300 Stevens Creek Boulevard, Suite 495 Cupertino, CA 95014
Phone:	408-252-4444

Action Technologies

Products:	MacAccess
Address:	2200 Powell Avenue, 11th Floor Emeryville, CA 94608
Phone:	415-654-4444

Actinet Systems

Products:	Actinet II Actinet SE
Address:	360 Cowper Avenue, Suite 11 Palo Alto, CA 94301
Phone:	415-326-1321

Adaptec

Products:	Nodem
Address:	691 S. Milpitas Boulevard Milpitas, CA 95035
Phone:	408-945-8600

AESP, Inc.

Products:	CompuTalk AT Plus CompuTalk PhoneTalk
Address:	1680 NE 205 Terrace North Miami Beach, FL 33179
Phone:	800-446-2377

Alisa Systems, Inc.

Products:	Alisa Digital Printing Support System (ADP) AlisaTalk: AlisaShare, AlisaPrint, AlisaTerminal SequeLink Mac SequeLink Server
Address:	221 E. Walnut, Suite 175 Pasadena, CA 91101
Phone:	818-792-9474

Allied Technology Corp.

Products: Net Talk
AppNet
Address: 211 N. 13th Street, Suite L-1
Philadelphia, PA 19107
Phone: 215-557-8181

ALSoft, Inc.

Products: Master Juggler
Address: P.O. Box 927
Spring, TX 77383-0927
Phone: 713-353-4090

Analytical Services and Materials, Inc.

Products: AS&M Phone
Address: 107 Research Drive
Hampton, VA 23666
Phone: 804-865-7093

Apollo Computer

Products: UShare
Address: 330 Billerica Road
Chelmsford, MA 01824
Phone: 617-256-6600

Apple Computer, Inc.

Products: LocalTalk connectors
LocalTalk cables (10-and 25-meter kits; custom-wiring Kit)
LocalTalk PC Card
Apple II WorkstationCard
ImageWriter II/LQ LocalTalk Option
LANSTAR AppleTalk Bridge
LANSTAR Interface Card
EtherTalk Interface Card
TokenTalk Interface Card
AppleShare 2.0
AppleShare PC
AppleShare Print Server
AppleTalk for VMS
Mac TCP

	Peek/Poke
	Apple File Exchange
	CL/1
	Inter•Poll
	AppleTalk Internet Router
Address:	20525 Mariani Avenue
	Cupertino, CA 95014
Phone:	408-996-1010

Asante Technologies, Inc.

Products:	MacCon II/E
Address:	1050 E. Duane Avenue, Suite G
	Sunnyvale, CA 94086
Phone:	408-736-3360

Ashton-Tate

Products:	dBase Mac
Address:	20101 Hamilton Avenue
	Torrance, CA 90502
Phone:	213-329-8000

Banyan Systems Inc.

Products:	VINES Mac Mail Gateway
Address:	115 Flanders Road
	Westborough, MA 01581
Phone:	508-898-1000.

Belkin Components

Products:	QuikNet
	BelTalk
Address:	14550 S. Main Street
	Gardena, CA 90248
Phone:	213-515-7585 or 800-223-5546

Blyth Software

Products:	Omnis 3 Plus
	Express 3.3
Address:	1065 East Hillsdale Boulevard, Suite 300
	Foster City, CA 94404
Phone:	415-571-0222

Cabletron

Products: Ethernet cabling/devices
Address: P.O.Box 6257
Rochester, NH 03867
Phone: 603-332-9400

Cactus Computer

Products: BroadTalk LAN
BroadTalk-Ethernet Gateway
Address: 1120 Metrocrest Drive
Carrollton, TX 75006
Phone: 214-416-0525

Cayman Systems, Inc.

Products: GatorBox
Address: 26 Landsdowne Street
Cambridge, MA 02139
Phone: 617-494-1999

cc:Mail, Inc.

Products: cc:Mail
Address: 385 Sherman Avenue
Palo Alto, CA 94306
Phone: 415-321-0430

CE Software

Products: QuickMail
In/Out Board
Address: P. O. Box 65580
W. Des Moines, IA 50265
Phone: 515-224-1995

Claris Corp.

Products: FileMaker II
Address: 440 Clyde Avenue
Mountain View, CA 94043
Phone: 415-962-8946

Columbia University User Services

Products: CAP (Columbia AppleTalk Package)
Address: Download CAP over ARPAnet using FTP
FTP: CU20B.COLUMBIA.EDU [128.59.32.128]
File is CAP.TAR in directory US:<US.CCK.CAP.D3>

Compatible Systems Corp.

Products: Ether+
Address: P.O. Drawer 17220
Boulder, CO 80308
Phone: 303-444-9532

Computer Methods

Products: AsynchServer
Address: 525 Route 73 South, Suite 300
Marlton, NJ 08053
Phone: 609-596-4360

Cricket Software

Products: Cricket Presents Office
Address: 40 Valley Stream Parkway
Malvern, PA 19355
Phone: 215-251-9890

DataSpace Corporation

Products: TeleNode
LaserServer
Plotter NT
Daisy Wheel NT
Printer NT
Address: 185 Riviera Drive, Unit 9
Markham, Ontario, Canada L3R5J6
Phone: 416-474-0113

DataSpec

Products: ModuNet
Address: 20120 Plummer Street; P.O. Box 4029
Chatsworth, CA 91313
Phone: 818-993-1202

DataViz, Inc.

Products: MacLink Plus 4.0
Address: 35 Corporate Drive
Tumbull, CT 06611
Phone: 203-268-0030

David Systems, Inc.

Products: Ethernet cabling/devices

Address: 701 E. Evelyn Avenue
Sunnyvale, CA 94086
Phone: 408-720-8000

Dayna Communications
Products: DaynaTalk
DaynaTalk PC Interface Card
DaynaMail
DaynaNet
Address: 50 South Main Street, Fifth Floor
Salt Lake City, UT 84144
Phone: 801-531-0600

DayStar Digital, Inc.
Products: LT200-PC
LT200-MC
FS100
Address: 5556 Atlanta Highway
Flowery Branch, GA 30542
Phone: 404-967-2077 or 800-962-2077

Diversified I/O
Products: Soft Backup
Address: 766 San Aleso
Sunnyvale, CA 94086
Phone: 408-745-0344

Dove Computer Corporation
Products: FastNet SCSI
FastNet SE
FastNet SE/30
FastNet II
FastNet III
Marathan LAN 020
Address: 1200 North 23rd Street
Wilmington, NC 28405
Phone: 919-763-7918 or 800-622-7627

DuPont Electronics
Products: du Pont Fiber-optic AppleTalk LAN
Address: 515 Fishing Creek Road.
New Cumberland, PA 17070
Phone: 717-938-6711 or 800-237-2374

Dynamic Microprocessor Associates

Products:	PC MacTerm/Network
	PC Anywhere III
Address:	60 E. 42nd Street
	New York, NY 10017
Phone:	212-687-7115

Eastgate Systems Inc.

Products:	Network Notes
Address:	P.O. Box 1307
	Cambridge, MA 02238
Phone:	617-924-9044

EMAC, A Division of Everex Systems, Inc.

Products:	SpeedLink
	SpeedTalk
Address:	48431 Milmont Dr.
	Fremont, CA 94538
Phone:	800-821-0806, ext. 2222

Excelan

Products:	LANalyzer
Address:	2180 Fortune Drive
	San Jose, CA 95131
Phone:	408-434-2300

Farallon Computing, Inc.

Products:	PhoneNET Connectors
	PhoneNET Plus Repeater
	PhoneNET StarController
	Timbuktu 2.0
	Timbuktu/Remote
	Check Net
	Traffic Watch
	Node Hint
	Register Name
	LW Status
Address:	2201 Dwight Way
	Berkeley, CA 94704
Phone:	415-849-2331

Fifth Generation Systems

Products:	Suitcase II
	Fastback Mac
Address:	1322 Bell Avenue, Suite 1A
	Tustin, CA 92680
Phone:	800-225-2755

Flexware, Inc.

Products:	Flexware
Address:	15404 E. Valley Boulevard
	Industry, CA 91746
Phone:	800-527-6587

Fox Software, Inc.

Products:	FoxBase+/Mac
Address:	118 W. South Boundary
	Perrysburg, OH 43551
Phone:	419-874-0162

General Computer

Products:	HyperNet
Address:	580 Winter Street
	Waltham, MA 02154
Phone:	617-890-0880

Graham, Keith

Products:	Optiks
Address:	32 Smith Avenue
	Nyack, NY 10960

Great Plains Software

Products:	Great Plains Accounting Series
Address:	1701 38th Street, S.W.
	Fargo, ND 58103
Phone:	701-281-0550 or 1-800-645-1007

Hayes Microcomputer Products, Inc.

Products:	InterBridge
	SmartModem 2400M
	Hayes Connect
Address:	P.O. Box 105203
	Atlanta, GA 30348
Phone:	404-449-8791
	404-441-1617 (Customer Service)

Hercules Computer Technology

Products: Network Card Plus
Address: 92 Parker Street
Berkeley, CA 94710
Phone: 415-540-6000

HyperPress Publishing Corporation

Products: SQL/Expert
Address: P. O. Box 8243
Foster City, CA 94404
Phone: 415-345-4620

Imagine Software

Products: Perfect Timing
Address: 19 Bolinas Road
Fairfax, CA 94930
Phone: 415-453-3944

Information Presentation Technologies

Products: IPT 1000
U-Share
Address: 23801 Calabasas Road, Suite 2011
Calabasas, CA 91302
Phone: 818-347-7791

Information Research Corp.

Products: Syzygy
Address: 2421 Ivy Road
Charlottesville, VA 22901
Phone: 800-368-3542

Infosphere, Inc.

Products: Liaison
MacServe 2.4
LaserServe
ComServe
Address: 4730 SW Macadam Avenue
Portland, OR 97201
Phone: 503-226-3620 or 800-445-7085

Infotek, Inc.

Products: QuickNet
DualNet

TriNet
Address: 56 Camille
East Patchogue, NY 11772
Phone: 516-289-9682

Inset Systems
Products: HiJaak
Address: 71 Commerce Drive
Brookfield, CT 06804
Phone: 203-775-5866

InterCon Corporation
Products: Real Talk
TCP/Connect
Address: 11732 Bowman Green Drive
Reston, VA 22090
Phone: 703-435-8170

Irwin Magnetic Systems, Inc.
Products: Irwin EzTape, Tape Drives
Address: 2101 Commonwealth Boulevard
Ann Arbor, MI 48105
Phone: 313-930-9000

Jam Technologies
Products: Smart Alarms And Multiuser Appointment Diaries
Address: 685 Market Street, Suite 860
San Francisco, CA 94105
Phone: 415-442-0795 or Int'l +612-799-1888 (Australia)
Jasmine

Products: DirectServe
Address: 1740 Army Street
San Francisco, CA 94124
Phone: 415-282-1111

Kandu Software
Products: CADMover
Address: P.O. Box 10102
Arlington, VA 22210-1102
Phone: 703-532-0213

Kinetics, Inc., A Division of Excelan

Products: FastPath 4
EtherPort SE
EtherPort SEL
EtherPort SE/30
EtherPort II
EtherPort IIL
Ether SC
K-Spool
K-Talk
LAN Ranger
TCPort Host Access
TCPort Toolkit
Address: 2540 Camino Diablo
Walnut Creek,CA 94596
Phone: 415-947-0998

La Cie, Ltd.

Products: SilverServer
SilverPlatter
Address: 16285 SW 85th, #306
Tigard, OR 97224
Phone: 503-684-0143 or 800-999-0143

Laser Connection

Products: Q-Talk
Address: P.O. Box 850296
Mobile, AL 36685
Phone: 205-633-7223 or 800-523-2696

Layered, Inc.

Product: Insight Expert Accounting Series
Front Desk Multiuser 6.0
Address: 529 Main Street
Boston, MA 02129
Phone: 617-242-7700

List

Products MacNIX/A
Address: P. O. Box 271
Stinson Beach, CA 94970
Phone: 415-868-1828

Lynn Products, Inc

Products: AP-Net
Address: 1601 Lockness Place
Torrance, CA 90501
Phone: 213-530-5966

MacProducts USA

Products: Magic Net
Address: 8303 Mopac Expressway, Suite 218
Austin, TX 78759
Phone: 1-800-MAC-DISK

Mainstay

Products: Markup
Address: 5311-B Derry Avenue
Agoura Hills, CA 91301
Phone: 818-911-6540

Microlytics

Products: GOfer
Address: One Tobey Village Office Park
Pittsford, NY 15437
Phone: 716-248-9150

Microseeds Publishing, Inc.

Products: Redux 1.5
Address: 7030-B West Hillsborough Avenue
Tampa, FL 33615
Phone: 813-882-8635

Microsoft Corporation

Products: Microsoft Mail 1.36
Microsoft Excel 1.5
Microsoft Word 3.02
Address: 16011 NE 36th Way, Box 97017
Redmond, WA 98073
Phone: 206-882-8080

Miramar Systems

Products: Mac Lan Connect
Address: 201 N. Salsipuedes, Suite 205
Santa Barbara, CA 93103
Phone: 805-965-5161

Mirror Technologies

Products:	Modem Share
Address:	2644 Patton Road Roseville, MN 55113
Phone:	612-633-4450

Mt.Xinu

Products:	Xinet
Address:	2560 Ninth Street, Suite 312 Berkeley, CA 94710
Phone:	415-644-0146

Nantucket Corporation

Products:	McMax '89
Address:	12555 W. Jefferson Boulevard, Suite 300 Los Angeles, CA 90066
Phone:	213-390-7923

Network General

Products:	Sniffer
Address:	1945A Charleston Road Mountain View, CA 94043
Phone:	415-965-1800 or 800-423-4440

Network Innovations

Products:	CL/1
Address:	20863 Stevens Creek Boulevard Cupertino, CA 95014
Phone:	408-257-6800

Nexsys

Product:	IntelliNet
Address:	296 Elizabeth Street New York, NY 10012
Phone:	212-995-2224

Nexus Development

Product:	Sideband
Address:	19 Staple Street Seventeen Mile Rocks, Queensland, Australia 4073

Northern Telecom, Inc.

Products:	LANSTAR AppleTalk Bridge LANSTAR AppleTalk Software

LANSTAR Interface Card
Address: P.O. Box 202048
Dallas, TX 75220
Phone: 800-328-8800

Novell, Inc.
Products: NAE 1000
NAE 2000
NL/1000
NL/2
NetWare For Macintosh
Address: 122 East 1700 South
Provo, UT 84601
Phone: 801-379-5900 or 800-453-1267

Nuvotech, Inc.
Products: TurboNet
TurboNet ST
TurboBridge
TurboStar
LaserBuffer
Address: 2015 Bridgeway, Suite 204
Sausalito, CA 94965
Phone: 415-331-7815

Odesta Corporation
Products: Double Helix II
Double Helix II Multiuser Kit
Helix VMX
Address: 4084 Commercial Avenue
Northbrook, IL 60062
Phone: 312-498-5615

Olduvai Corporation
Products: ClipShare
FontShare
Address: 7520 Red Road, Suite A
South Miami, FL 33143
Phone: 305-665-4665

Oracle Corporation

Products:	Oracle For Macintosh
Address:	20 Davis Drive Belmont, CA 94002
Phone:	415-598-8000

P-Enginierie

Products:	MultiTalk MultiTalk IIi InterTalk InterTalk IIi
Address:	500 Sutter Street, Suite 222 San Francisco, CA 94102
Phone:	415-397-4666

Pacer Software, Inc.

Products:	PacerPrint PacerGraph PacerLink 5.2 PacerShare
Address:	1900 W. Park Drive, Suite 280 Westborough, MA 01581
Phone:	617-898-3300

PC Quik-Art, Inc.

Products:	The Graphics Link Plus
Address:	394 S. Milledge Avenue, Suite 252 Athens, GA 30606
Phone:	404-543-1779

Personal Computer Peripherals Corp.

Products:	HFS Backup 3.0
Address:	4710 Eisenhower Boulevard, Building A4 Tampa, FL 33634
Phone:	813-884-3092 or 1-800-622-2888

Retix, Inc.

Products:	Retix Mail
Address:	2644 30th Street Santa Monica, CA 90405
Phone:	213-399-2200

Satori Software

Products:	Project Billing Legal Billing Legal Billing II Legal Billing II+
Address:	2815 2nd Avenue, Suite 560 Seattle, WA 98121
Phone:	206-443-0765

SBT Corporation

Products:	Mac/Series Six Plus
Address:	One Harbor Drive Sausalito, CA 94965
Phone:	415-331-9900

Shiva Corporation

Products:	NetBridge NetModem V2400 NetModem V9600 NetSerial X232 TeleBridge Bridge Manager DOS Dial-in
Address:	155 Second St. Cambridge, MA 02141
Phone:	617-864-8500

Softview Inc.

Products:	MacInUse Network Version
Address:	4820 Adohr Lane, Suite F Camarillo, CA 93010
Phone:	800-622-6829

Solana Electronics

Products:	I-Server R-Server C-Server
Address:	7887 Dunbrook Road, Suite A San Diego, CA 92126
Phone:	619-566-1701

Solutions International

Products: Glue
Address: P.O. Box 989, 29 Main Street
Montpelier, VT 05602
Phone: 802-229-9146

StarNine Technologies, Inc.

Products: TOPS for A/UX
Mail*Link
Address: 2126 Sixth Street
Berkeley, CA 94710
Phone: 415-451-9789

SuperMac Technology

Products: SuperLaser Spool 2.0
Network DiskFit 1.5
Address: 295 N. Bernardo Avenue
Mountain View, CA 94043
Phone: 415-964-8884

Symantec Corporation

Products: LaserSpeed 1.7
Address: 10201 Torre Avenue
Cupertino, CA 95014
Phone: 800-441-7234 or 800-626-8847 in California

Symmetry Corporation

Products: Picture Base Network Version
Address: 761 East University Drive
Mesa, AZ 85203
Phone: 602-844-2199

SynOptics

Products: LattisNet
Ethernet cabling/devices
Address: 501 E. Middlefield Road
Mountain View, CA 94043-4015
Phone: 415-960-1100

Tandy Computers

Products: TandyLink
Address: 1800 One Tandy Center

Fort Worth, TX 76102
Phone: 817-390-3700

Technology Concepts, Inc.; A Bell Atlantic Co.
Products: CommUnity-Mac 1.2
Address: 40 Tall Pine Drive
Sudbury, MA 01776
Phone: 617-443-7311 Ext. 221 or 800-777-2323 Ext. 221

Telesystems SLW, Inc.
Products: ARLAN 510
Address: 85 Scarsdale Road, Suite 201
Don Mills, Ontario, Canada M3B 2R2
Phone: 416-441-9966

Telos Corporation
Products: MacNOW
Address: 3420 Ocean Park Boulevard
Santa Monica, CA 90405
Phone: 213-450-2424

TOPS, A Division of Sun Microsystems, Inc.
Products: TOPS Teleconnectors
TOPS FlashBox
TOPS Repeater
TOPS/DOS 2.1
TOPS FlashCard
TOPS/Macintosh 2.1
TOPS/Sun 2.1 & 2.2
TOPS Terminal (public domain software)
TOPS PRTR (bundled with TOPS/DOS)
FlashCheck (bundled with FlashBox)
TOPS Spool (bundled with TOPS/Macintosh)
TOPS Translator (bundled with TOPS/Macintosh)
InBox Mac 2.2
InBox for DOS 2.2
TOPS NetPrint 2.0
Address: 950 Marina Village Parkway
Alameda, CA 94501
Phone: 415-769-8700 or 800-445-8677

Tri-Data Systems, Inc.

Products:	Netway 1000AE Netway 2000 Mac Mover
Address:	1450 Kifer Road Sunnyvale, CA 94086
Phone:	408-746-2900

Trimar USA, Inc.

Products:	CompuNet Connectors
Address:	236 West 15th Street New York, NY 10014
Phone:	1-800-872-4454; in New York 212-645-7008

Ungermann-Bass

Products:	TCP-Mac
Address:	3900 Freedom Circle; P.O. Box 58030 Santa Clara, CA 95052-8030
Phone:	408-496-0111

Vano Associates Inc.

Products:	MacChuck 1.5
Address:	P.O. Box 12730 New Brighton, MN 55112
Phone:	612-788-9547

Watcom Products, Inc.

Products:	Waterloo MacJanet 2.0
Address:	415 Phillip Street Waterloo, Ontario, Canada N2L 3X5
Phone:	419-886-3700

WordPerfect Corporation

Products:	WordPerfect Macintosh
Address:	1555 N. Technology Way Orem, UT 84057
Phone:	801-225-5000

Western Digital

Products:	Ethernet cabling/devices
Address:	2445 McCabe Way Irvine, CA 92714
Phone:	714-863-0102

Subject Index

Product Index

About the Authors

Virginia Bare began her career in the microcomputer industry in 1981 as the 17th Ashton-Tate employee. As Director of Marketing Communications, she guided and built their marketing communications support, including public relations, trade shows, advertising, sales support and, in the early days, documentation and publishing. Virginia edited and produced the first Ashton-Tate book ever published, *Everyman's Database Primer* by Robert A. Byers. After 18 months as Director of Marketing Communications, she assumed responsibility at Ashton-Tate for certain special projects. As Special Projects Manager, she researched and implemented the first phase of Ashton-Tate's field sales force, establishing offices in eight major metropolitan areas.

Virginia has done extensive writing and consulting in the microcomputer field. In late 1986, she became Marketing Services Manager for TOPS, gaining her grounding and familiarity with local area networking on the front lines during those fast track growth days at TOPS. She functioned as Acting Vice President of Marketing for TOPS prior to leaving that organization. Since her departure from TOPS, she has functioned as Vice President of Marketing for the start-up Lightgate and done extensive research, writing, and marketing consulting for a variety of high technology companies. Continuing a long-term association with the design and communications firm of Creekmore Behasa of Mill Valley, California, her recent projects include work with CB for Broderbund, SuperMac Technology, SBT, and Autodesk, Inc.

Mike Rogers is the Director of Technical Services at TOPS, a division of Sun Microsystems. Mike oversees all of the functions of the Technical Services Department, including technical support, customer service, developer support, and beta and compatibility testing. Mike also has project management responsibilities for many of TOPS' current software and hardware development projects. As a member of the TOPS Senior Staff, Mike participates in setting the business and strategic direction for TOPS. Mike joined TOPS (then Centram Systems West) in 1987 prior to the acquisition of Centram by Sun. Mike has been a frequent contributor to *Connections* and to various user group publications. Mike enjoys backpacking, sailing, whitewater rafting, racquetball, and tennis when he can break away from TOPS.

Networking/Macintosh

Explore the Real Potential of Your "Hidden" Network

If your Macintosh is connected to a LaserWriter, you're already using an AppleTalk network. But running this "hidden" network effectively takes more than just cabling and connector boxes. *Hands-On AppleTalk* gives you step-by-step instructions for designing, installing, and maintaining an AppleTalk network, from simple to complex. It then shows you the productivity potential of networking with several on-site examples and delves into the dozens of AppleTalk-compatible hardware and software network options.

This invaluable networker's reference includes:

- AppleTalk versus LocalTalk and other LAN (Local Area Network) terminology
- File sharing and multiuser applications
- A LAN primer
- A complete design guide for AppleTalk LANs
- Installation and maintenance tips
- Case studies of AppleTalk LANs in real-world situations including TOPS and MacWorld installations
- A survey of specific hardware and software options

Whether you're installing a fiber optic network with shared peripherals, multiuser applications, and a mainframe gateway, or you just want to connect your MacPlus and SE to your LaserWriter, *Hands-On AppleTalk* will guide you to higher levels of productivity and convenience.

A Brady Book ▪ Distributed by Prentice Hall Trade ▪ New York

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