

An Overview of Macintosh Connectivity Products, Part 1

In this report:

LocalTalk -102

Network Operating
Systems -109

EtherTalk -110

TokenTalk -114

ARCnet -114

Broadband
Networks -115

Telephone Systems
as Networks -115

Connectivity
to IBM -116

Connectivity
to Digital -120

Mac-to-UNIX
Connectivity -122

Connecting to
Other Mainframes
and Minis -124

For More
Information -125

Editor's Note

This is the first part of a two-part overview of major Macintosh connectivity options and the vendors that provide them. Part One concentrates on the implementation of Macintosh communications. Part Two will focus on communication applications and cover electronic mail, remote software, general terminal emulation, network management, and access to mainframe databases. No attempt has been made to offer in-depth coverage of any of these products, but readers can use the vendor list provided at the end of the report to obtain more information. More detailed information on several of the vendors covered in this report are provided in Datapro product reports.

Report Highlights

Over the past few years a quiet explosion has been occurring in Macintosh communications. Macs can now interact with PCs on Ethernet, token-ring, or ARCnet networks; with UNIX-based workstations; Digital Equipment Corporation VAX minicomputers; and the entire range of IBM systems from the AS/400 to the largest System/370 mainframes. File translation utilities allow Macintosh users to access documents and

applications from any of these systems, and electronic mail software keeps them in touch.

Characterizing the proliferation of Macintosh connectivity solutions as an explosion could be inaccurate in one sense—an explosion has a center. The products that have become available recently have erupted from several centers. Apple, until the June 1989 announcement of AppleTalk Phase 2, was not exactly at ground zero, either. Dozens of vendors have developed products that integrate the Mac into industry-standard networks and communications systems. Apple, however late it may have arrived on the scene, has quickly caught up with the pack in terms of communications products and has provided systems hardware and software that has kept the interest level among developers high. At this writing, an Apple Developer's Conference is under way addressing the issues arising from Apple's latest operating system release, System 7.0, expected to be delivered in late 1990. Some System 7.0 features that are sure to benefit both vendors and users of Macintosh communications products include new file sharing capabilities, support for virtual memory in Macintosh II models, and new interapplication communication facilities.

LocalTalk

One of the most important features that Apple included in the original 128K Macintosh was the LocalTalk network interface. From the beginning every Macintosh had the capacity, on-board, to connect to a shielded twisted-pair network for communication with other Macs. Most computers still do not include such a capability as a standard feature.

The original LocalTalk network software had few of the capabilities we now expect from a network operating system, however. Essentially, it allowed users only to share peripheral devices such as printers. Third-party disk server software soon appeared, which allowed a centralized hard disk to be divided into volumes. In this approach to mass storage sharing, only one user at a time could have write access to a volume.

AppleShare

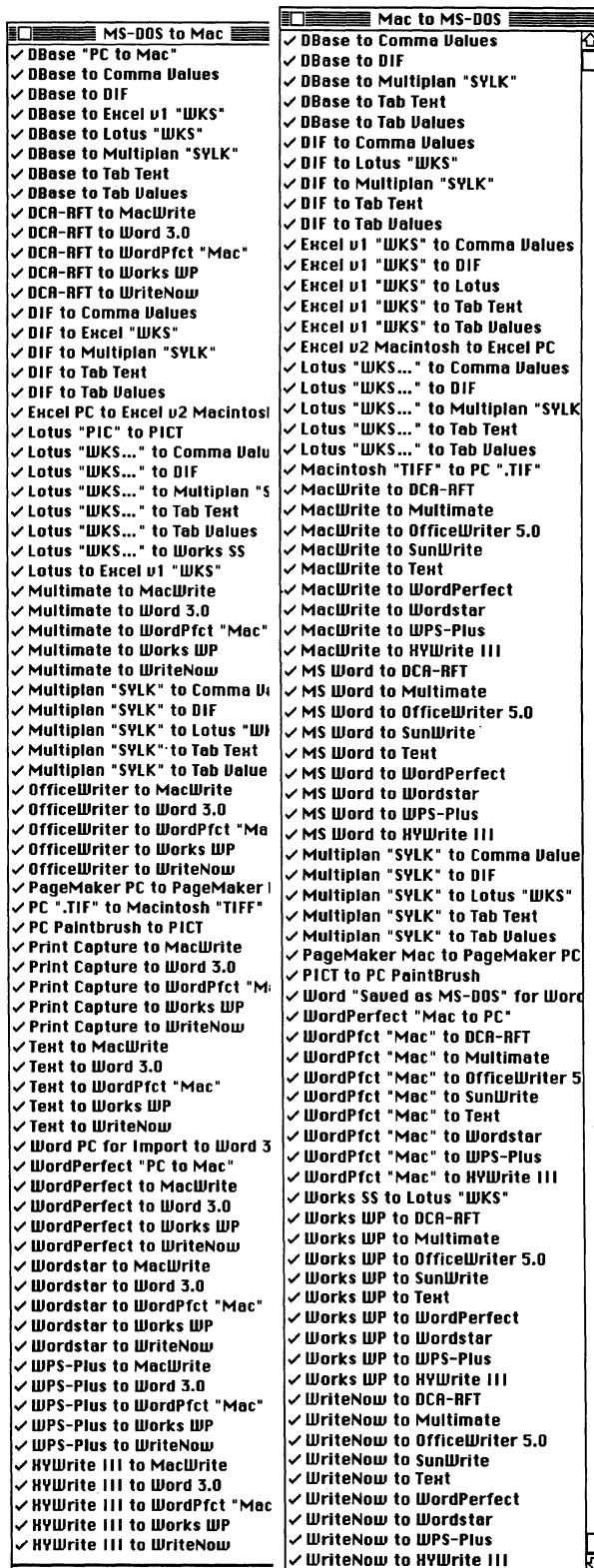
All this changed in early 1987 with the announcement of *AppleShare*, a true network file server for the Macintosh. Users select AppleShare servers from the Chooser desk accessory in the same way they would select a printer. The server then appears on the right side of the user's screen as if it were a local disk. Clicking on the AppleShare icon opens a window in which files, applications, and folders reside just as in any other disk window. The only difference is that the server disk is located across the network. AppleShare must run on a dedicated Macintosh. AppleShare client software is included with the system software of every Macintosh.

TOPS

Throughout most of LocalTalk's history, it had only one real competitor—TOPS. Conceived from the ground up as a LAN that could link IBM PCs and Macs, TOPS did just that and also provided connectivity to UNIX-based Sun workstations. That connectivity attracted the attention of Sun Microsystems, and in April 1987 Sun acquired Centram, the company that developed TOPS. Recently, Sun reorganized TOPS as a separate division.

TOPS, in contrast to LocalTalk, is a distributed network system. This means that no centralized server is used—files and other resources on any machine on the network can be accessed by any other machine. For Mac-to-Mac connectivity,

Figure 1.
Menus



Two of the menus from *DataViz MacLinkPlus/Translators* illustrate some of the many file formats handled by this versatile translation package.

TOPS originally ran at the LocalTalk speed of 230.4K bps. A PC, using TOPS' *FlashCard* network interface card, could run at 770K bps. Later, TOPS introduced the *FlashBox*, a transceiver that converted LocalTalk's 230K bps to the 770K bps used by FlashCard. Today, these options are still available, but TOPS software will also run on Ethernet or token-ring networks as well, at this much higher speed. The latest version of TOPS is 3.0, which provides Apple Filing Protocol compatibility so that all AFP-compatible applications will run under the TOPS Filing Protocol (TFP).

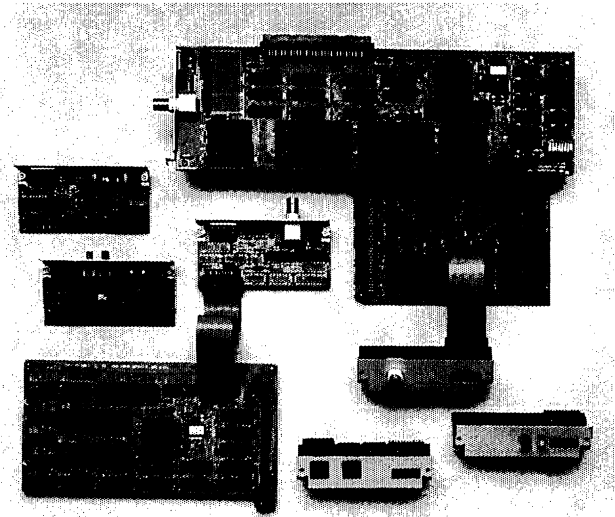
TOPS supplies its networking software in packages called "Network Bundles" that include the TOPS electronic mail software *InBox*, for up to 20 users. Also included is the DataViz MacLinkPlus/TOPS file translation software, which allows the exchange of files between many popular Macintosh and DOS applications.

A *Network Bundle for Macintosh* or a *Network Bundle for DOS* is required for each machine to be networked.

Dayna Communications

Dayna Communications provides a LocalTalk enhancement that offers even greater performance than TOPS FlashTalk. *DaynaTalk* allows Macintoshes to transmit and receive network data at 850K bps. IBM PCs and compatibles attached to LocalTalk networks can transmit at 1.7M bps. Best of all, these machines can coexist on the same network with standard LocalTalk and TOPS FlashTalk connected computers. File servers and other stations that most need the higher speeds offered by DaynaTalk can be upgraded to it while other stations continue to operate at the lower speeds. The *SpeedGuard Collision Filter* box, attached to any computer that does not have DaynaTalk capability, prevents slow transmissions from preempting high-speed links between DaynaTalk machines. DaynaTalk for the Macintosh is a box that is inserted between the Mac's LocalTalk connector and whatever cabling is employed, either standard LocalTalk cable or a PhoneNet or similar connector. PCs require the *DaynaTalk PC* card for PC XT or AT machines or the *DaynaTalk MC* card for Micro Channel-based PS/2 machines.

Recently Dayna acquired Novell's LocalTalk adapters, the NL1000 for the PC and PC/AT and the NL/2 for PS/2 Micro Channel Architecture machines. Dayna renamed them *DL2000* and *DL/2*.



The Thomas-Conrad line of ARCnet adapters illustrates the differences between the Macintosh II NuBus card (top), the SE (left), and SE/30 (right) cards. Both the SE and SE/30 cards are shown with daughterboards for various types of connections—unshielded twisted pair, fiber optic, and thin coaxial cable.

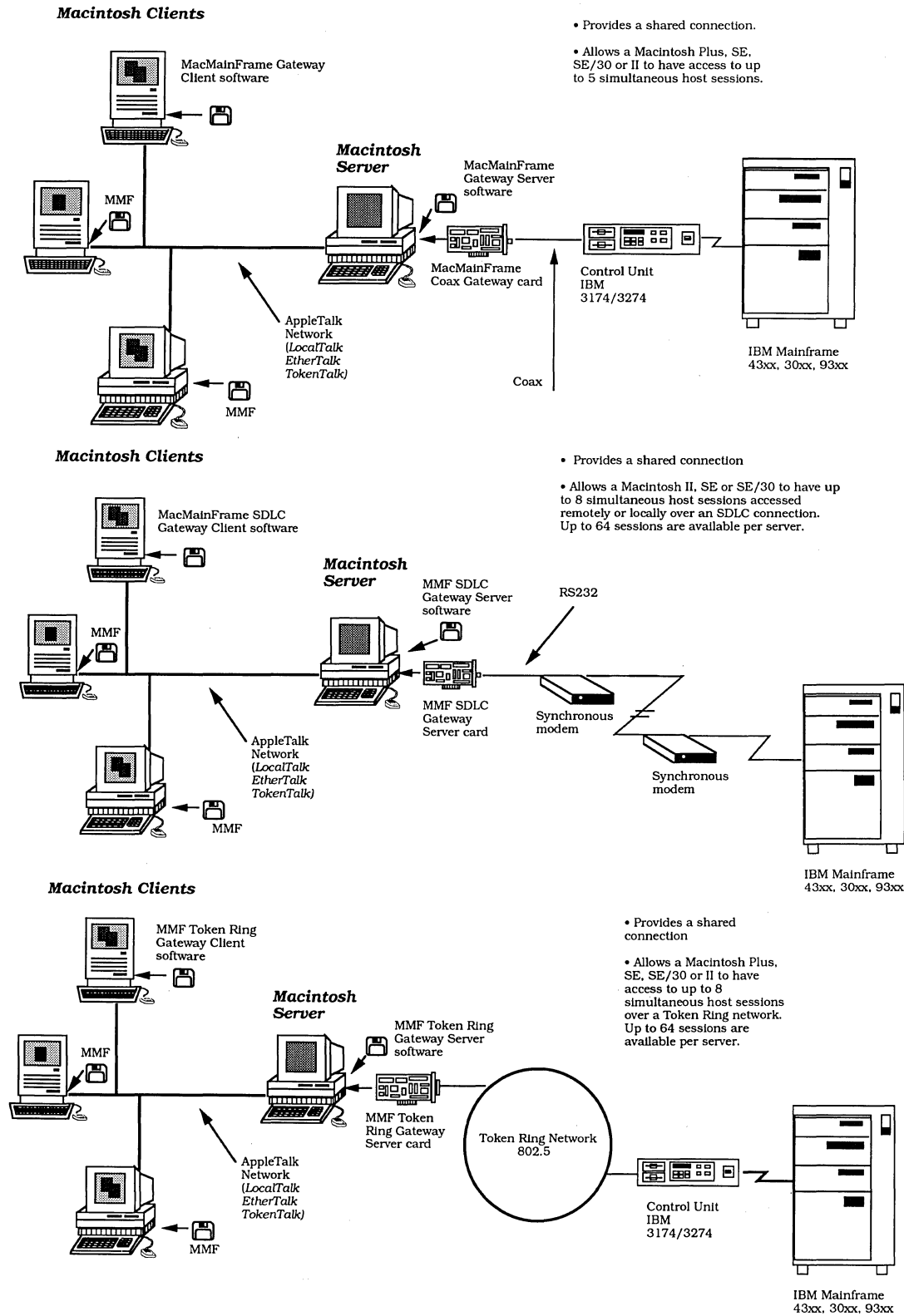
Unlike the DaynaTalk cards, these adapters cannot take advantage of the higher speeds offered by DaynaTalk. They can only run at the standard LocalTalk speed of 230.4K bps.

Distributed Networks

Apple's 7.0 operating system will include a distributed network operating system called *Macintosh File Sharing*, which will allow any networked Macintosh to act as a nondedicated server. Users will be able to declare any file or an entire disk volume a public resource for access by any other user. TOPS has always been a distributed network of this type.

Several vendors have announced similar distributed networks recently. All these networks run in the background on a networked Mac and provide distributed file sharing. Information Presentation Technologies has announced its *Personal Server Network (PSN)*. EveryWare, Inc. offers its *allShare* network. ShirtPocket Software provides *EasyShare*. International Business Software offers its *DataClub* network. DataClub is somewhat unique among these, in that all public files appear as part of a single disk volume, no matter where on the network they physically reside.

Figure 2.
Connecting Macintoshes to IBM Mainframes



These diagrams illustrate three common methods of connecting a Macintosh network to an IBM host. At the top, a direct coaxial connection to an IBM Control Unit. Center, a remote SDLC connection over public or leased lines. At the bottom, a gateway connection to an IBM Token-Ring Network containing a networked control unit.

Source: Diagrams courtesy of Avatar Corporation.

LocalTalk Enhancements

Farallon

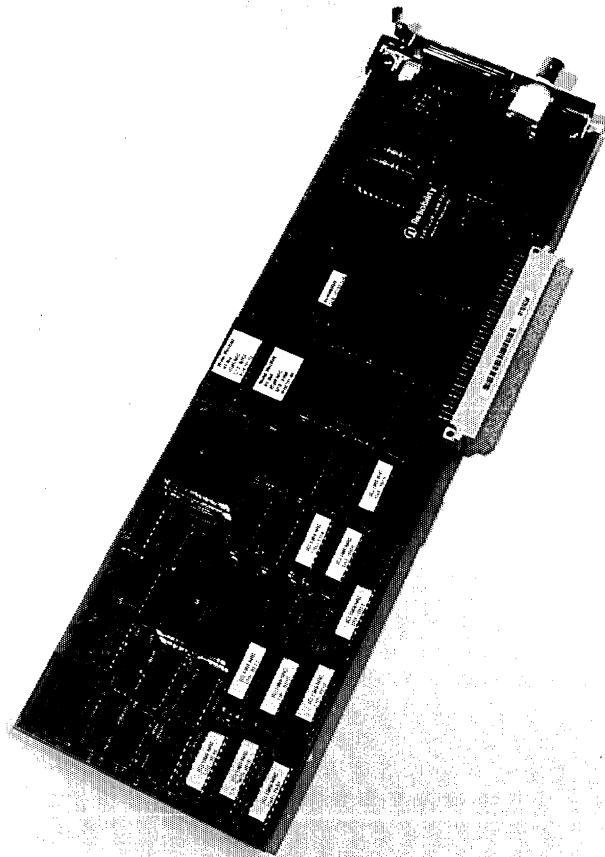
Farallon offers an enhancement to LocalTalk that allows it to run on inexpensive unshielded twisted-pair wire, the same wire used for telephone connections. This product has been very successful: over half of all AppleTalk nodes are PhoneNET nodes. The *PhoneNET Connector*, which plugs into the back of the Macintosh, can be wired in a simple daisychain or in active or passive star topologies. The PhoneNET Connector is available in two configurations, to fit early Macs (128K, 512K, and 512KE) that had a DB-9 LocalTalk connector, or the newer models with the DIN-8 connector. Dual RJ-11 jacks permit daisychained networks. An improved and more compact connector, the *PhoneNET StarConnector* is also offered. The StarConnector is only available in the DIN-8 configuration and has only one RJ-11 jack.

Farallon also offers the *PhoneNET StarController*, a repeating hub used as a central connection point in active star topologies. The StarController has 12 ports which each support up to four network branches. Each supports up to 3,000 feet of cable. The StarController supports the LocalTalk transmission speed of 230.4K bps as well as the faster speeds possible with such LocalTalk enhancements as TOPS FlashTalk and DaynaTalk. The StarController can automatically shut down malfunctioning ports and comes with a network management tool called *StarCommand* which displays traffic statistics in bar graph form, allows monitoring of the status of any port, and provides the capability to disable any port for troubleshooting purposes.

The *PhoneNET Repeater* amplifies and re-times network signals, allowing maximum cabling distances to be extended to form internets. Using multiple repeaters, up to seven miles of cabling can be run between buildings in a campus-wide network.

Nuvotech

Nuvotech TurboNet and *TurboNet ST* LocalTalk connectors are unshielded twisted-pair devices similar to the Farallon PhoneNet connectors. The TurboNet ST is an enhanced connector and features built-in termination, a pair of diagnostic LEDs that aid troubleshooting, and damping circuitry that enhances signal quality. The TurboNet



This Network Resources Mac2000 adapter illustrates the typical NuBus card, but the card itself is anything but typical. It is based on its own 68000 processor and supports connection to Ethernet, broadband, or fiber optic networks.

ST's surge damping capability will absorb spikes of up to 2,500 volts without damage to the connector, and larger surges will be stopped before they can damage the Macintosh or peripherals. Nuvotech offers the TurboNet and TurboNet ST connectors individually and in 12-packs called *NetPack 12*.

The Nuvotech *TurboStar* is a LocalTalk network management hub like the Farallon StarController, but it offers more ports (16 as opposed to Farallon's 12) and a pair of status LEDs for each port. Based on the Motorola 68008 processor, the TurboStar hub has 10K bytes of RAM on-board and is shipped with management and diagnostic software that can be run from any Macintosh on the network. The TurboStar hub not only disables jammed ports, it continues to sample them once a minute and restores them to active status when the jamming stops. A recent upgrade to the TurboStar

User Profile: Jefferson University

We recently had the opportunity to interview George Kuetemeyer, senior information systems analyst at Thomas Jefferson University. A medical school with its associated hospital, Jefferson occupies a large campus in downtown Philadelphia. Kuetemeyer and his associates in the Department of Information Services (DIS) support nearly 30 token-ring LANs running Novell NetWare and about 20 LocalTalk networks. All these more or less isolated networks have been

installed over the last five years. Several departments, such as the Clinical Labs and the Library, have Digital Equipment Corporation VAX mini-computers which use Ethernet connections for their terminals. The central data center has two IBM 3090 mainframes. Jefferson is now in the process of designing and installing a 16M bps fiber optic token-ring backbone to connect all of these

systems into a campus-wide internetwork. "We're kind of always in the middle of building things," Kuetemeyer notes.

The wiring for all the networks is the IBM Cabling System using Type 1 shielded twisted pair running to wiring closets where multistation access units (MAUs), patch panels, and the various network servers reside. At the user's end of the cable, wall sockets are provided which accept the IBM connectors. Adapters that plug into these connectors permit the connection of unshielded twisted-pair wire used with Macintoshes to connect to the Type 1 cabling in the walls. Farallon

PhoneNET connectors link the Mac LocalTalk ports to the unshielded twisted pair.

A typical LocalTalk network has a dedicated SE/30 with an 80M-byte hard disk as an AppleShare server. The network is also connected to a Tri-data Netway 1000 SDLC gateway to provide one path to the data center's IBM 3090 mainframes.

An IBM PC AT equipped with a Novell NL1000 LocalTalk PC card provides a Service Protocol Gateway to the NetWare system. An additional path to the Novell NetWare PC networks is provided by

management software added MultiFinder compatibility and multiple window capability so that several TurboStar hubs can be monitored simultaneously.

Cactus Computer

Cactus Computer offers a 16-port LocalTalk hub for unshielded twisted-pair cabling called the *StarBurst-16*. Up to four StarBurst-16 hubs may be mounted together in Cactus' *StarBurst Panel* rack to provide up to 64 ports. The StarBurst-16 acts as a repeater and amplifier, allowing each port to connect up to 1,000 feet of cable.

Telesystems

An unusual LocalTalk interconnectivity device is offered by *Telesystems* of Ontario, Canada. The *Arlan 510 AppleTalk Router* is a wireless device which can be used to link a single wireless device to a conventional LocalTalk network, bridge two

networks without cabling, or construct an all-wireless network with no cabling between workstations at all. The standard LocalTalk speed of 230.4K bps and AppleTalk 2.0 routing protocols are supported. Each Arlan 510 has a single LocalTalk port connected to a spread spectrum radio transceiver and three-inch monopole antenna. Optional omnidirectional or directional high-gain antennas are available to tailor performance for indoor or building-to-building communications. Line-of-sight range with directional antennas is up to six miles, while indoor ranges of up to several hundred feet are typical.

Photonics

Perhaps even more unusual than radio networking is infrared networking. Photonics Corp. offers this option to LocalTalk users in the form of its *Photolink* which uses infrared projectors to connect LocalTalk network clusters. Photolink comes with four projectors that bounce invisible infrared beams off ceiling or wall-mounted "focal points"

Miramar MacLAN Connect running on an IBM PC XT. Kuetemeyer likes this solution because it puts to use an XT that might otherwise be sitting idle. "The Novell gateway requires an AT-class machine, because it has to run in protected mode," he noted.

At his Macintosh II, Kuetemeyer points out the icons that represent the AppleShare server, a hand offering a serving tray, and the NetWare server, a file cabinet, open and spilling out papers. Clicking on the filing cabinet icon opens a window that reveals several icons, including some marked "DOS" to indicate

that they are DOS applications that cannot be run from the Macintosh.

As a demonstration of the multitasking capability of MultiFinder, as well as the multiplicity of paths to the IBM mainframes, Kuetemeyer first opened a PROFS session through the Netway 1000. A single point-and-click movement operation on the Netway icon established this connection. Opening MacTerminal, Kuetemeyer then dialed into a second PROFS session using the latest addition to his suite of mainframe access tools, the Shiva NetModem. The NetModem's software produces an icon-like representation of

the modem at the top of the Mac's display that features operating status lights like those on the front panel of a modem. Kutemeyer sent himself a brief message which appeared in the Netway session's window. A third session was begun under Apple's MacDFT software running on the Apple TokenTalk card. The token-ring LAN to which Kuetemeyer's Mac II is connected is bridged to another ring on which a 3745 front-end processor with a token-ring interface coupler (TIC) resides. Kuetemeyer had high praise for the features of the MacDFT software, especially its easy-to-use configuration options. Finally, he accessed the

MacLRMA card to open a fourth session via coaxial cable to a 3174 controller. With four mainframe sessions now running, Kuetemeyer noted, "It gives IBM mainframe-oriented people fits, but I really think the best way to access an IBM mainframe is through the Macintosh. It's the easiest from a support point of view and from the user's point of view."

to connect networks separated by up to 35 feet. Photolink has four RJ11 connectors for unshielded twisted-pair (UTP) wiring and come with adapters for LocalTalk connections to UTP. Surprisingly competitive in price with twisted-pair wiring, Photolink could prove very cost effective in environments that are rearranged often.

IBM PCs on LocalTalk

An IBM PC can be connected to a LocalTalk network using Apple's *AppleShare for the PC* software and a LocalTalk PC adapter card. Several manufacturers offer such cards. Apple provides the *LocalTalk PC card*; TOPS offers its *FlashTalk* card; Dayna supplies both the *DaynaTalk* cards for the PC and the Micro Channel Architectures and the former Novell/Kinetics adapters, the DL/2000 and the DL/2. DayStar Digital also offers cards for both IBM buses—its *LT200PC* for the IBM PC or AT bus and the *LT200MC* for the PS/2 Model 50 or higher with Micro Channel Architecture.

Miramar

Miramar *MacLAN Connect* turns an IBM PC or compatible into an AppleShare-compatible file server. A PC with an AppleShare PC card, a TOPS FlashTalk card, or any similar LocalTalk adapter can be used as a very economical replacement for a dedicated Macintosh in the file server role. MacLAN Connect can also act as a bridge between AppleTalk networks of any topology and PC-based networks. It is compatible with most popular PC network operating systems, including 3Com, Banyan VINES, and all versions of Novell Netware. Files from DOS machines appear as folders on the Macintosh, and Macintosh folders are shown as DOS directories on the PC.

DataViz

DataViz provides what is perhaps the most complete set of file translation utilities for the Macintosh in its *MacLinkPlus/PC*. MacLinkPlus/PC allows transfer and translation of files from dozens of popular IBM PC applications. Macintosh files

can be translated to PC formats as well. Transfer and translation of files from Sun workstations and the NeXT computer are also supported. Some vendors of Macintosh communication products, such as TOPS, have chosen to bundle the DataViz product with their own. MacLinkPlus/PC includes cables to connect the Macintosh to a PC. DataViz also offers the translation files separately as *MacLinkPlus/Translators*.

LocalTalk Peripheral Sharing

Shiva

Shiva makes several devices for shared usage on a LocalTalk network. *NetSerial* is a LocalTalk shared serial port that connects a LocalTalk network to a serial device so that all users can access printers, plotters, or modems. *NetModem V2400*, a 2400 bps modem, can be connected to a LocalTalk network for shared use among all Macs on the network. *NetModem V.32*, a high speed modem for shared use on a LocalTalk network, features Hayes compatibility and rates up to 9600 bps.

Shiva's *DOS Connect* allows PCs networked over AppleTalk to access the NetModem using popular communications packages such as DCA's Crosstalk Mk.4. *DOS Connect* also allows the PC to share printers or other serial devices connected via the NetSerial. *DOS Dial-In* allows remote IBM PCs or compatibles, including laptops, to dial into a TOPS network equipped with a Shiva NetModem or TeleBridge.

Solana Electronics

Solana also offers a device for sharing serial ports among LocalTalk network users. *C-Server* has three serial ports with mini DIN-8 connectors and a mini DIN-8 LocalTalk connection. The first of the three serial ports can run at up to 19.2K bps, while the remaining two ports have a maximum speed of 9600 bps.

LocalTalk Bridges

Apple

Apple's *AppleTalk Internet Router* is a software-based router that can connect LocalTalk, EtherTalk, and TokenTalk networks to form a single internetwork. Depending on the number of expansion slots available in the Macintosh, up to six network adapter cards can be connected through the

Internet Router software, in addition to two LocalTalk connections through the serial ports. The Internet Router can operate in the background on a server, or it can use a dedicated Macintosh.

Hayes

Hayes, which has become almost a synonym for modem, offers the InterBridge, a device for connecting two LocalTalk networks to form a larger internetwork. The InterBridge is based on the Motorola 68008 CPU and has 256K bytes of RAM. Two DB-9 LocalTalk connectors and two DB-25 RS-232 connectors are provided on the back panel. InterBridge units can be linked via modems to connect remote networks via synchronous or asynchronous communications at speeds up to 19.2K bps. InterBridge Manager software included with each InterBridge allows traffic monitoring of bridges so that internetwork loads can be best distributed. InterBridge Manager also provides configuration information on ports, network names and numbers, and data transmission characteristics.

Infosphere

Infosphere's *Liaison* is a software-based router. Running on any Macintosh from 512KE up, Liaison can connect two networks of any AppleTalk variety. LocalTalk, EtherTalk, TokenTalk, and ArcTalk are all supported. Liaison runs in the background on a workstation or a server. Liaison can be used to connect remote networks with modems. A Macintosh connected to a modem and running Liaison can also be accessed by individual users at remote locations. Liaison supports two LocalTalk connections and one other interface card, of any variety.

Nuvotech

The Nuvotech *TurboBridge* is a LocalTalk bridge that allows the interconnection of LocalTalk networks to form larger internet configurations. The TurboBridge acts as repeater and amplifier to maintain signal strength across interconnected networks. It is supplied with RJ11 jacks to support TurboNet and similar unshielded twisted-pair wiring devices. An adapter cable is available to connect standard LocalTalk shielded cabling.

Shiva

Shiva's *NetBridge* is a similar LocalTalk local bridge. NetBridge includes Internet Manager software that allows the creation of zones, control of access rights, and monitoring of the status of peripherals from any Macintosh on the network. Shiva's *TeleBridge* is a LocalTalk remote bridge, which, in conjunction with a modem, connects geographically separate LocalTalk networks at speeds up to 57.6K bps.

Solana Electronics

Solana Electronics offers several devices to interconnect LocalTalk networks. *I-Server* is a LocalTalk bridge capable of connecting two LocalTalk networks. It has two mini-DIN 8 connectors.

R-Server is a remote asynchronous bridge which can run at speeds up to 57.6K bps. It can connect two remote LocalTalk networks or provide dial-up access to a LocalTalk network from a standalone Macintosh or PC. It provides user passwords and a method of controlling access to sensitive areas of the network referred to as zone cloaking.

H-Server, a synchronous remote bridge for LocalTalk, supports synchronous speeds up to 64K bps and asynchronous speeds up to 19.2K bps. The H-Server has a DB-25 connector for synchronous or asynchronous RS-232 connections and a V.35 synchronous serial connector.

The most recent addition to the Solana product line is a version of the H-Server with a built-in ISDN terminal adapter. Called the *ISDN H-Server*, it features the same performance figures as the H-Server but has an RJ45 connector for the telephone line, a DB25 connector for RS-232 serial connection, and a mini DIN-8 for connection to the LocalTalk network.

Network Operating Systems

AppleTalk

The decision to model *AppleTalk*, the Macintosh network operating system, on the Open Systems Interconnection (OSI) reference model was forward looking in 1984. Each layer of AppleTalk, containing separate protocols for addressing the

various functions needed to communicate over a network, corresponds to a layer of the OSI model. Since the OSI standard was designed to support a modularity that would ease the task of upgrading the protocols, AppleTalk, too, is easily upgraded. Apple made a major upgrade in July 1989, when it announced AppleTalk Phase 2. Where Phase 1 AppleTalk permitted a maximum of 254 nodes on a single network, an AppleTalk Phase 2 internetwork can have as many as 16 million nodes.

The capability to have so many nodes creates a potential for new problems—how can all these nodes be logically grouped to provide users with fast access to any of their resources? AppleTalk provides an answer to the problem of network complexity through the concept of zones. Several nodes can be grouped together on a conceptual basis of any kind—by department, geographically, or around a shared project. Zones are set up using Apple's Internet Router software. Each network connected via an internet router must be assigned one or more zone names when the router is configured.

Novell

Each copy of Novell NetWare, the most popular network operating system in the IBM PC networking world, includes *NetWare for the Macintosh*. A NetWare server uses a Novell value-added process called a Service Protocol Gateway to convert incoming Apple Filing Protocol requests to NetWare Core Protocol requests, which are then serviced in the usual NetWare manner before being reconverted to AFP for transmission back to the Macintosh client. The result is that PCs and Macs networked over NetWare can share files and peripherals. Some applications available in versions for both the PC and the Mac, such as Microsoft Word and Excel and Aldus PageMaker, require no format translation for file sharing. Microsoft Excel can also import files directly from Lotus 1-2-3. Applications that do not provide any commonality between the PC and the Mac can undergo translation with a third-party conversion utility such as DataViz MacLink Plus/Translators.

NetWare connects PCs on any popular network topology—Ethernet, token-ring, or ARCnet. LocalTalk LANs can be bridged to these networks by the inclusion of an Apple LocalTalk PC card or a similar card from a third party in a server. Conversely, a Macintosh server with an Ethernet,

ARCnet, or token-ring card and appropriate gateway software can also form the bridge. Standalone LocalTalk-to-Ethernet bridges, discussed later, are also available from many manufacturers.

Novell's latest networking software, NetWare 386, does not feature integrated support for the Macintosh. NetWare for the Macintosh Version 2.15, however, can be bridged to a NetWare 386 server via software. Novell plans to add Macintosh support to NetWare 386 before the end of 1990.

Dayna and Novell

Dayna, which developed the Macintosh Value Added Processes included in NetWare for the Macintosh, has developed its own version of NetWare called *DaynaNet*. DaynaNet simplifies NetWare administration and installation by using the standard features of the Macintosh user interface such as icons, requesters, and dialog boxes. DaynaNet also includes several Macintosh-oriented utilities.

3Com

3Com has been the main supporter of Microsoft's OS/2 LAN Manager and has recently begun shipping *3+ Open for Macintosh*. 3+ Open for the Macintosh allows Macs to join OS/2 LAN Manager networks and be integrated with both OS/2 and DOS machines for file and print sharing. 3+ Open for Macintosh uses standard AppleShare and the AppleTalk Filing Protocol to connect to the network, which means that all applications written to conform to Apple standards will run on 3+ Open LAN Manager.

3Com has a long history of support for the Macintosh beginning with its EtherMac network which shipped in late 1985. It provided a number of "firsts" in the Mac networking world including integration with Ethernet systems and IBM PCs. Later 3Com continued its Macintosh support with its 3+ network operating system. Based on the Microsoft MS-Net standard, 3+ is widely installed and is still supported by 3Com.

EtherTalk

Ethernet is by far the most widely used networking scheme today. Originally developed by Xerox, Ethernet is supported by nearly every manufacturer of PC networking equipment. It is the standard network in the world of UNIX workstations, and it is the primary method used by Digital

Equipment Corporation to link its VAX minicomputers to terminals, PCs, and other VAXes. EtherTalk, Apple's implementation of Ethernet, was released in 1988 and represented Apple's first attempt to embrace industry networking standards.

Ethernet workstations gain access to the central Ethernet bus cable by "listening" for the presence of other traffic on the line. If no traffic is present, transmission of data takes place. If traffic is detected, the station waits for a short period before trying again. Occasionally, two stations may try to transmit at the same time, in which case a "collision" occurs. After such an event, both stations wait for a random interval before trying to transmit again. This access scheme is known as Carrier Sense Multiple Access (CSMA).

Ethernet can run on various cabling types, including thick coaxial cable, thin coaxial cable, and unshielded twisted-pair telephone wire. The latest development in Ethernet standards, 10BASE-T, is a subsection of the IEEE 802.3 standard and allows 10M bps Ethernet on unshielded twisted-pair wire, using a star topology with central hubs.

Macintoshes can gain access to the Ethernet media, whatever it may be, in several ways. Macs without expansion slots can connect to external devices through the SCSI port, higher end Macs can house internal Ethernet interface cards, and finally, whole LocalTalk networks can be bridged to Ethernet networks.

LocalTalk-to-Ethernet Gateways

There are many reasons to consider connecting a LocalTalk network to an Ethernet network. Users may wish to connect existing networks in different departments. There could be a requirement to employ the very economical LocalTalk where possible while providing access to large-scale computing resources that must be networked using Ethernet, such as the Digital VAX or any of the several types of UNIX workstations. Whatever the reason, such a connection requires a gateway, a device that translates from one network's protocols to another's.

Cayman

The Cayman *GatorBox* is a LocalTalk-to-Ethernet gateway based on a Motorola 68000 and 1M byte of RAM. It includes interfaces for LocalTalk, Ethernet, and thin Ethernet and allows LocalTalk

to Ethernet bridging. *GatorShare* is file sharing software for the GatorBox that allows Macs to access files and applications on UNIX-based workstations and minicomputers that support the industry-standard Sun Network File System (NFS). To the Macintosh user, NFS disks appear on-screen as Mac disk icons, and files and folders contained in them can be manipulated in the familiar manner.

Compatible Systems

Compatible Systems' *EtherRoute* is one of the latest releases in the LocalTalk-to-Ethernet market. *EtherRoute* includes two LocalTalk connectors and AUI or BNC connections for its single Ethernet port, so that it can be used with either thick or thin Ethernet coaxial cable. The router comes with network management and administration software, and Compatible Systems has promised to deliver TCP/IP support later this year.

Shiva

Shiva recently acquired the former Novell/Kinetics FastPath 4 gateway, which connects LocalTalk and Ethernet networks. Based on the Motorola 68000 processor, the FastPath comes with 256K bytes of RAM that can be expanded to 512K bytes. The FastPath is supplied with BNC and AUI connectors for thin or thick Ethernet coaxial cable and a DB-9 LocalTalk connector. The FastPath includes K-Star gateway software. K-Star can route Ethernet and LocalTalk messages between LocalTalk Phase 1 and Phase 2, TCP/IP, and DECnet, and it supports the Simple Network Management Protocol (SNMP).

Shiva *EtherGate* connects two LocalTalk networks to an Ethernet network or allows stations on an Ethernet network to share serial devices such as printers or modems. *EtherGate* uses a 10MHz Motorola 68000 and comes with 128K bytes of RAM, expandable to 192K bytes. Data in RAM is protected by battery backup. *EtherGate* provides an Ethernet AUI connector for thick coax, a BNC connector for thin coax, and two DIN-8 connectors used as either LocalTalk or serial ports.

Network Resources

The Network Resources (NRC) *MultiGate 2000* is a high-performance router that connects LocalTalk to Ethernet, broadband, or fiber optic networks. Based on the Motorola 68000 and an Intel 82590

LAN controller, it comes with 512K bytes of RAM and can be configured with a variety of connectors for the cabling it supports. It can run NRC's *IP-Gate* TCP/IP internetworking software to allow integration of LocalTalk networks as TCP/IP subnets on a TCP/IP network. *IPGate* includes NRC's *MultiGate Access* software, a set of applications which use the Macintosh interface to provide access to UNIX and Digital VMS-based computers. *MultiGate Access* applications include *MacEdit*, which brings the functionality and user friendliness of the Mac's cut-and-paste editing capabilities to host-based document preparation. *MacFTP*, a point-and-click file transfer tool that enables access to host directory systems without using VMS or UNIX commands, is also included.

NRC's *MultiGate Mac* is a software-based router that runs on any Macintosh II. Like the *MultiGate 2000*, it can route between LocalTalk and Ethernet, broadband, fiber optic, and TCP/IP networks. It can be used to segment EtherTalk and TCP/IP Ethernet networks for enhancement of performance, manageability, or security.

NRC's *MultiGate Manager* is a network management application employing an Oracle database system to provide powerful and comprehensive management capabilities on the Macintosh II. It gathers network statistical data and configuration information and provides control of internetworking devices such as routers and gateways from a single workstation.

TriData Systems

TriData recently announced *MaxWay* routers which can connect LocalTalk to token-ring networks, as well as to Ethernet. Equipped with four LocalTalk ports, the *MaxWay* routers come in three configurations. The *MaxWay 500E* supports Ethernet, the *MaxWay 500TR-4* connects to 4M bps token-ring networks, and the *MaxWay 500TR-16/4* can work with both 16M and 4M bps token-rings. The *MaxWay* routers provide two VMEbus expansion slots, giving the option of adding additional cards for either type of network, or routing between Ethernet and token-ring.

The SCSI-to-Ethernet Solution

Several manufacturers produce external interfaces that allow Macintoshes without expansion ports to connect to Ethernet networks through their SCSI (Small Computer System Interface) connector.

These devices provide a good solution to the problem of attaching the early, less expandable Macs to Ethernet networks. They can also provide a means to connect an SE or SE/30 which must use its single expansion slot for other purposes. Several SCSI devices, which could include hard disks and tape drives, can be daisy-chained to a single port. A single SCSI device or the last device in a chain requires a terminator plug.

Adaptec

Adaptec calls its offering in this category the *Nodem*. This box allows Mac Plus and 512K machines, as well as the new Portable Mac, to share in Ethernet connectivity at the full 10M bps speed. The Nodem is offered in three models, depending on the Ethernet interface required. The *Nodem-30* attaches to thin Ethernet and features an on-board media attachment unit (MAU); the *Nodem-31* for thick Ethernet attaches to an external attachment unit interface (AUI) through its DB-15 connector; the *Nodem-32* has an on-board MAU and RJ-45 connector for unshielded twisted-pair cabling. A newly released model, the *Nodem-33*, supports the IEEE 10BASE-T standard for 10M bps unshielded twisted-pair networks. The Nodem has two 50-pin SCSI connectors and an external terminator plug.

Compatible Systems

Compatible Systems' *Ether+* is a SCSI-to-Ethernet box that provides both thin (BNC) and thick (AUI) Ethernet connections and a single DB-25 SCSI connector identical to the Mac's connector. Typically installed at the end of a chain of SCSI devices, the *Ether+* requires an adapter cable if it must be installed in the center of a chain. The terminator plug that must be removed for use in the center of a chain is internal.

Dove Computer

Dove Computer's *FastNet SCSI* is based on a 10MHz Motorola 68000 and has 512K bytes of memory on-board. *FastNet SCSI* also includes an additional 25-pin SCSI port so that other SCSI devices can be attached to the Macintosh. Dove also manufactures the *MacSnap SCSI*, a kit that adds a SCSI port to a 512K Macintosh. A hard drive or a SCSI-to-Ethernet device, or both, can then be connected to a 512K Mac.

Nuvotech

Nuvotech's *NuvoLink SC* is essentially the same as the Compatible Systems' SCSI box, since Compatible Systems manufactures the Nuvotech device. It includes both a BNC connector for thin Ethernet and a DA-15 connector for attachment to either a thick coaxial AUI or to unshielded twisted-pair wire through a transceiver. Internal jumper settings are provided to make one or the other of these ports active, and the *NuvoLink SC* is available factory configured in either mode. The *NuvoLink SC* also provides a removable internal terminator so that the device can be placed in the middle of a chain of SCSI devices.

Ethernet NuBus and SE Interface Cards

Adaptec

Adaptec recently introduced a pair of Macintosh II NuBus cards, the *EtherMac II* for thick or thin coaxial cable and the *EtherMac II/10T* for unshielded twisted pair.

Apple

The Apple *EtherTalk NB* card for the Macintosh II NuBus is actually OEM'ed from 3Com. It features support for thick or thin coaxial cable in the form of AUI and BNC connectors. The *EtherTalk NB* card has 64K bytes of RAM on-board, in contrast to the 3Com version, which only has 16K bytes.

Asanté Technologies

Asanté Technologies manufactures three Ethernet cards: the *MacCon+IIE*, the *MacCon+SE30E*, and the *MacCon+SEE* for thick or thin Ethernet connections and three cards for 10BASE-T unshielded twisted pair: the *MacCon+IJET*, the *MacCon+SE30ET*, and the *MacCon+SEET*. The 10BASE-T cards feature an AUI connector for connection to thick coaxial backbone cable, as well as an RJ45 connector for twisted pair.

Cabletron

Cabletron offers Ethernet cards for each of the top-of-the-line Macs: the *E6000* for the Mac II series, the *E5000* for the SE/30, and the *E4000* for the SE. These cards are also available in variants for twisted-pair and fiber optic cabling. The twisted pair cards are called the *E6020*, *E5020*, and

E4020. The fiber optic cards are the *E6030SNA/40ST*, the *E5030SNA/40ST*, and the *E4030SNA/40ST*.

Cayman

Cayman has OEM'ed the Racal InterLan MacConnect 10 NuBus Card, calling it the *GatorCard E/II*. It includes 16K bytes of on-board RAM and BNC and AUI connectors.

Compatible Systems

Compatible Systems' Ether2 is a NuBus Ethernet card with BNC and DB-15 connectors, for thin or thick Ethernet. One or the other port can be configured though jumper settings on the board. The card is shipped with *Manager2* network management software that provides statistical information on Ethernet performance and permits loopback testing of the Ether2 card.

Dove Computer

FastNet III (NB EtherNet card) is a NuBus Ethernet adapter with an on-board transceiver for thin Ethernet cabling. Dove also offers the *FastNet SE* and *FastNet SE/30* cards. The Dove cards feature 64K bytes of on-board memory.

Dove's *FastNet LAN 020* for the Macintosh SE packs a lot of functionality into a small area. It is a multifunction card that is a combination network interface/accelerator/memory expansion card with a 16MHz Motorola 68020 processor (32 bits) and optional 68881 math co-processor. The card can be configured with up to 4M bytes of RAM. The Ethernet portion of the card features a built-in thin Ethernet transceiver. Dove also offers other accelerator and memory expansion products for the Macintosh.

EMAC

EMAC, a division of Everex Systems, offers Ethernet Cards for each of the three expandable Macs: *SpeedLink II*, *SpeedLink SE/30*, and *SpeedLink SE*. All these boards provide AUI and BNC connectors and are driven by an Intel 82586 processor.

Novell/Kinetics

Kinetics, which was acquired by Excelan and then by Novell, offers Ethernet cards called the *EtherPort* series. *EtherPort II*, *EtherPort SE/30*, and *EtherPort SE* all come configured with both BNC and DB-15 connectors. Kinetics also offers cards

configured for Lattisnet unshielded twisted-pair networks, and these cards are known as the *EtherPort IIL*, *SE/30L*, and *SEL*. The L-series cards are provided with RJ45 jacks for unshielded twisted pair and standard Ethernet DB-15 AUI connectors.

Network Resources

Network Resources' *Mac2000* is a NuBus network interface card with several unique features. It is based on the Macintosh Coprocessor Platform, which means that its on-board 10MHz 68000 can handle all communications processing including concurrent processing of multiple network protocols. The *Mac2000* is sold in three different configurations. As an Ethernet card it has an AUI connector for standard Ethernet and a BNC connector and on-board transceiver for thin Ethernet. A broadband version is offered with an F connector for broadband coaxial cabling. It complies with the IEEE 802.7 broadband network standard. A fiber optic version is also available with an AMP Optimate Duplex connector for fiber optic cabling.

NetWorth

NetWorth *EtherNext* for the Macintosh II is a NuBus 10BASE-T card. Networth offers *EtherNext Hubs* for unshielded twisted-pair wire, fiber optic cabling, and unshielded twisted pair-to-fiber optic cable. The NetWorth *EtherNext AUI Adapter* (AUI to UTP connector) allows any Ethernet card to connect to unshielded twisted pair.

Nuvotech

The Nuvotech *NuvoLink II* is a NuBus Ethernet card that provides BNC and AUI connectors for attachment to thin or thick Ethernet cabling, respectively. With the addition of a transceiver, it will also work with unshielded twisted-pair cabling.

Racal InterLan

Racal InterLan makes three cards for coaxial Ethernet applications: *MacConnect 10*, *MacConnect SE/30*, and *MacConnect SE*. Racal has also introduced a 10BASE-T version of its Macintosh II card, the *MacConnect 10BT*.

3Com

3Com currently makes only two Macintosh Ethernet interfaces, the *EtherLink/NB* for the Mac II NuBus and the *EtherLink/SE* for the Mac SE. Each card has BNC and AUI interfaces for attachment

to thin or thick Ethernet, respectively. Each card also has 16K bytes of on-board RAM. 3Com warrants these cards for three years.

TokenTalk

Token-ring is IBM's strategic solution to the problem of LAN connectivity. Recently, IBM has moved to extend token-ring functionality to all levels of its products. For the Macintosh user, access to token-ring can provide a path to IBM mainframes as well as a fast and dependable network connection between PCs and Macs.

Token-ring's name is derived from its access method and its topology. The access method, the manner in which a workstation gains the right to transmit data over the shared network path, involves a special data structure called a token. Stations may only transmit data while in possession of the token, which passes from one station to the next around the ring. If a station has no data to transmit, it simply passes the token on to the next station in line. If it does have a transmission, it attaches the token to the data along with the address of the receiving station. The receiving station then puts the token back on the ring after it has completed the reception of the data. Token-ring workstations are attached to a central hub called a medium access unit (MAU). The ring is formed by the electrical connections within a single MAU or by a series of MAUs connected in a ring.

Apple

Apple announced TokenTalk in July 1989 as part of the AppleTalk Phase 2 announcement. The *TokenTalk NuBus Card* has its own 68000 microprocessor and memory and operates independently of the system CPU to execute multiple networking protocols. It is a 4M bps card and uses the industry-standard Texas Instruments TMS380 chip set for token-ring access.

Asanté Technologies

Asanté has entered the token-ring market with two cards, the *MacCon II/TR* and the *MacCon+IITR*. The first supports only IBM Type 1 and Type 2 shielded twisted pair, while the *MacCon+IITR* allows connection via Type 3 unshielded twisted-pair wire. Optional ROM-based support for IEEE 802.2 Logical Link Control is available for either

card, and the names change to *MacConII/TRLLC* or *MacCon+IITRLLC*.

h-Three Systems

h-Three Systems offers the 4M bps *MacRing SE*, *MacRing SE/30*, and *MacRing NB* for the Macintosh II NuBus. Avatar has OEM'ed the h-Three token-ring cards and is offering them as part of its token-ring gateway to IBM mainframes.

TriData Systems

Tridata Systems has announced the first 16M bps token-ring cards for the Macintosh. The *LanWay 16/4* cards, which will also operate at the more common 4M bps speed, will be available in versions for the SE/30 and the Macintosh II.

ARCnet

ARCnet is a popular and inexpensive networking scheme developed by Texas-based Datapoint in the late 1970s. Based on a token-passing access method and operating at 2.5M bps, ARCnet networks are usually arranged in a star topology, though a bus is also supported. At the center of ARCnet's star topology is a hub which can be a passive connection point or an active repeater. Most popular network operating systems, including Novell NetWare, will run on ARCnet networks.

Only three firms currently support ARCnet for the Macintosh: Actinet, Standard Microsystems, and Thomas-Conrad.

Actinet

Actinet offers one card each for the Macintosh II (*ARCTalk II*), the SE/30 (*ARCTalk SE/30*), and the SE (*ARCTalk SE*). These cards have a BNC connector for attachment to coaxial cable. One unique feature of the Actinet ARCTalk drivers is the simple LocalTalk bridge included which allows ARCTalk-connected Macs to print to LaserWriter printers attached to the Mac's LocalTalk port without the addition of any other hardware or software. This bridge will also support the connection of other shared devices such as modems.

Standard Microsystems

Standard Microsystems Corporation (SMC) is one of the chief ARCnet standard-bearers. SMC offers ARCnet cards for the Macintosh II and the SE in unshielded twisted-pair and thin coaxial versions.

The *SE250* and *NB250* boards, for the SE and the Mac II NuBus, respectively, feature two RJ45 connectors so that a small ARCnet network can be wired in a daisychain topology as well as the more common hub-based star. The *SE100* and *NB100* each have a single BNC connector for thin coaxial cable.

Thomas-Conrad

Thomas-Conrad's line of Macintosh ARCnet products is a very complete one, including cards and hubs for coaxial and fiber optic cabling and for unshielded twisted-pair wire. The cards are available for Macintosh II NuBus machines (*ARC-CARD/NB*), for the SE (*ARC-CARD/SE*), and for the SE30 (*ARC-CARD/SE30*). Each card is available in five versions—for coaxial star topologies, coaxial bus topologies, unshielded twisted-pair star or bus topologies, fiber optic with an SMA connector, and fiber optic with an ST connector.

Broadband Networks

Broadband networks can carry a variety of signals at the same time, including voice and video, in addition to data. Broadband networks are often found where a requirement for network connections between buildings on a large campus dictates the necessity for a backbone network. Broadband signals are analog, as opposed to the digital signals carried by other networking schemes, and thus require a modem to interface the network adapter to the broadband cable. Broadband networks use heavy coaxial cable, the same cable used for cable television.

Only two vendors currently offer broadband solutions for the Macintosh—Network Resources and Cactus Computer.

Cactus Computer

Cactus Computer provides a comprehensive line of broadband networking hardware and software, offering many options to Macintosh users who require broadband connectivity. Its *BroadTalk* cards are available in versions for the Macintosh II, the SE/30, and the SE. The broadband modem for these cards is a plug-in module which can be interchanged with an Ethernet plug-in so that the cards may also be used to connect to Ethernet networks. Cactus also offers a *BroadTalk* card for the IBM PC and compatibles.

Cactus has two products for broadband network interconnectivity—the *BroadTalk to Ethernet Gateway* and the *BroadTalk to LocalTalk Gateway*. The Ethernet gateway can also be used to connect two Ethernet networks, either of the same or different media types. Likewise, the LocalTalk gateway can connect LocalTalk to Ethernet networks as well as broadband.

AppleTalk Phase 1 allowed only 255 nodes to attach to a network. Since broadband backbones are typically found in environments requiring many more nodes than that, Cactus developed its *Logical Zone* software, which allows up to 65,025 Macintosh or gateway nodes to connect to a broadband backbone. Logical zones can be interconnected using the *Logical Zone Bridge*, and LocalTalk networks can be attached to Logical Zone backbones using the *Logical Zone Gateway*. The Logical Zone Gateway, like the *BroadTalk to LocalTalk Gateway*, is based on the popular Kinetics (now Shiva) FastPath 4 and is functionally equivalent to it.

Cactus also offers the *LANLook Network Packet Monitor*, a network management device which allows users to view packets on Ethernet and broadband networks. Based on the FTP Software LANWatch package for Ethernet, LANLook is sold as a system, including the software and a Western Digital Ethernet card, or as separate components.

Telephone Systems as Networks

Northern Telecom

Most businesses have a powerful networking device already installed on their premises in the form of their telephone PBX switching equipment. While most telephone switching equipment vendors have made some provisions for attaching computers to their switches, no manufacturer has pursued this avenue of connectivity as completely as Northern Telecom, especially with regard to the Macintosh. Through development agreements with Apple and several third party vendors, Northern Telecom has managed to assemble a broad line of connectivity solutions based on its *Meridian* series of PBXs and central office switching equipment. Meridian PBXs require an Interface Line Card to connect a Macintosh, and appropriate file transfer software. Computers connected to a Northern

Telecom PBX communicate at 19.2K bps. A Macintosh connected to a Meridian system can easily connect to other Macs, IBM PCs, and any sort of mini or mainframe computer, and expensive communications devices such as high speed modems, multiplexers, protocol converters, and X.25 PADs can be shared among many users.

Northern Telecom also offers a local area networking system that does not depend on its PBX equipment. *Meridian LANStar* is based on Northern Telecom's Meridian LANStar hub, which sits at the center of a star topology of unshielded twisted-pair cable. Up to 1,344 Macintoshes can be connected to the LANStar hub, which allows transmission speeds of 2.5M bps. The LANStar can be connected to the Northern Telecom Meridian PBX as well, allowing access to other networks, host computers, and shared resources attached to the Meridian.

Connectivity to IBM

Connecting to IBM Mainframes

Connections to IBM's SNA network architecture take many forms. SNA has traditionally been a hierarchical network scheme in which the System/370 mainframe communicated with "dumb" terminals through intermediary devices called cluster controllers. In recent years, SNA has been evolving toward a less rigidly defined scheme in which peer-to-peer communications between PCs, midrange systems, and mainframes are supported.

Briefly, an individual Macintosh can connect to an S/370 mainframe through a 3174 or 327X cluster controller, or a 372X or 3745 communications controller either locally via a direct coaxial connection, or remotely through a synchronous or asynchronous modem connected to a serial communications card. Networks of Macintoshes can be connected through some form of gateway, that is, a computer on the network that contains a coaxial card for local connection or a serial card for remote connection.

Apple

Included in the July 1989 AppleTalk Phase 2 release were several products for connecting the Macintosh to the IBM world. On the hardware side, the *Apple Coax/Twinax Card* and the *Apple Serial NB Card* can connect the Macintosh II to

IBM's SNA network. Both cards are based on the Macintosh Coprocessor Platform, which means they operate independently of the rest of the system, including main memory. Each card has a 10MHz 68000 and 512K bytes of RAM, expandable to 1M byte. The Coax/Twinax Card has a BNC connector for coaxial cable connections to IBM's 3270 communications systems and a 15-pin D-type connector for future support of 5250-style twinax connections. The Serial NB Card has a single DB-62 connector which provides four RS-232 serial ports. Two ports can be configured for up to 64K bps full duplex and two can support 230.4K bps half duplex.

MacDFT software included with the Coax/Twinax Card allows single-session Control Unit Terminal (CUT) emulation or Distributed Function Terminal (DFT) emulation with support for up to five concurrent sessions. Whether DFT mode can be used depends on the configuration of the control unit and the host. MacDFT requires no additional software on the host. File transfer is accomplished using the IBM standard IND\$FILE software with hosts running either the MVS/TSO or VM/CMS operating system. Text and tabular information can be copied between Macintosh and host applications in the standard Macintosh cut-and-paste manner.

MacAPPC software, a development tool, allows the creation of IBM Logical Unit (LU) 6.2/Node Type (NT) 2.1 server software so that Macintoshes can communicate with IBM mainframes and other intelligent devices on an SNA network on a peer-to-peer basis, rather than in the standard, strictly hierarchical host-to-terminal fashion.

Both MacDFT and MacAPPC can also run on a TokenTalk NB card, allowing access to an IBM host for token-ring-attached Macs.

Avatar

The Avatar *MacMainFrame* Series provides several avenues to the IBM mainframe—direct coaxial connections, LocalTalk-to-coax gateway connections, token-ring gateways, and SDLC connections.

Direct coaxial connections can be implemented with the *MacMainFrame II* for the Macintosh II family, the *MacMainFrame SE/30*, or the *MacMainFrame SE*. These packages include the internal cards and software necessary to establish a

Control Unit Terminal (CUT) mode session with an IBM mainframe. Also available is the *MacMainFrame DX*, an external device that supports Macs without expansion slots including the new Macintosh portable.

Avatar also offers *MacMainFrame/DFT (Distributed Function Terminal)* software, which permits a single terminal to run five 3270 sessions at a time. *MacMainFrame/DFT* includes *MacMainFrame 3287*, which allows mainframe users to print to the Apple LaserWriter as if it were an IBM printer.

The *MacMainFrame Coax Gateway* uses a Macintosh server equipped with one of the three *MacMainFrame Coax Gateway* cards—the Macintosh II, SE/30, or SE models. The server is connected via LocalTalk, EtherTalk, or TokenTalk to Macintosh client stations. Up to five sessions can be distributed to these clients. Specific users can be designated for each of the sessions, or users can access pooled sessions as needed on a contention basis. The coax gateway software is based on *MacMainFrame DFT* software.

MacMainFrame SDLC is offered in two versions—a *Workstation* version and *Gateway* version. They allow a single Macintosh, or an AppleTalk-attached gateway Mac, to access a remote mainframe using IBM's Synchronous Data Link Control (SDLC) protocol. The *Workstation* version supports up to eight 3270 sessions. The *Gateway* version supports up to 8 sessions per user and is available in 8-, 32-, or 64-session versions for the Macintosh II or SE/30 servers, while only 8 sessions are supported on SE servers. The *MacMainFrame SDLC Gateway* server card attaches to a synchronous modem through a DB-25 connector and supports transmission speeds up to 56K bps.

MacMainFrame Token Ring is also offered in *Workstation* and *Gateway* versions. The *Workstation* version allows a single Macintosh to connect to a token-ring network to access a mainframe connected through a 3174 Control Unit. Up to eight host sessions can be run simultaneously. The *Gateway* version connects any AppleTalk network to a token-ring and supports up to 8 sessions per user and up to 64 total sessions on the server. Like the *SDLC Gateway*, versions are available for 8, 32 and 64 clients, and an SE server can only handle 8 sessions maximum. The *MacMainFrame Token*

Ring Gateway has both client and server components. The client software is installed on each connected Macintosh client. The server portion consists of the server software and a token-ring card for the Macintosh II, SE/30, or SE.

MacPROFF is a HyperCard interface to IBM PROFS (Professional Office System). *MacPROFF* comes with over a hundred predefined cards that correspond to the most used PROFS screens. HyperCard developer tools are also included so that custom screens can be easily created. Macintosh text files can be saved as PROFS notes and vice versa. *MacPROFF* supports the PROFS scheduling and calendar functions in a Macintosh-like manner using HyperCard buttons and point-and-click operations.

MacMainFrame Graphics allows Macintosh II and SE/30 users to access mainframe graphics packages by emulating IBM 3179G and 3192G color graphics terminals. Based on IBM's protocol for graphics display and printing, the *Graphics Data Display Manager (GDDM)* and *Distributed Function Terminal (DFT)*, *MacMainFrame Graphics* allows multiple host sessions, including concurrent graphics, terminal, and print sessions.

DCA

Digital Communication Associates (DCA) manufactures and markets the well-known coaxial attachment board for the IBM PC, the IRMA board. DCA's *MacIRMA* board extends IRMA functionality to the Macintosh world. Three models are available, for the Macintosh II NuBus, the SE/30, and the SE. *MacIrma EE (Entry Emulator)* software is bundled with every *MacIRMA* card.

MacIRMA EE supports all features of the IBM 3278/3279 Display Terminal, including extended attributes (blink, reverse video, underline, and seven colors) and status line symbols. It also supports Multiple Logical Terminal (MLT) which allows five CUT sessions on 3174 controllers with MLT support. Light pen applications are also supported, using the mouse. *MacIRMA* supports the IBM standard IND\$FILE file transfer, as well as two DCA file transfer products, *IRMALink FT/TSO* and *FT/CMS*, and *ForteNet TSO* and *CMS*.

MacIrma WorkStation (WS) software allows a Macintosh equipped with a *MacIRMA* board to emulate an IBM Distributed Function Terminal (DFT), which can provide up to five simultaneous 3270 sessions. *MacIRMA WS* also supports the

MacIRMALAN SDLC Gateway 2 and *MacIRMA-LAN 802.2 Gateway*, which allow IBM host access from LAN stations.

MacIRMA WS also features IBM 3287 printer emulation, so that mainframe jobs can be sent to local printers such as the Apple LaserWriter. Both the MacIRMA EE and the MacIRMA WS share features which bring Macintosh user friendliness to the 3270 application world. Standard features include cut and paste; menu-driven configuration of 3270 session information; and MacIRMA's QuickPad feature, which allows the use of the mouse to execute hard-to-remember key combinations for host commands.

The newest additions to DCA's MacIRMA line are two Macintosh LAN gateways, *MacIRMA-LAN SDLC Gateway 2* and *MacIRMALAN 802.2 Gateway*. Both require an IBM PC or PS/2 to act as the gateway. The MacIRMALAN SDLC version includes an SDLC adapter card that allows a LAN-connected IBM PC or PS/2 to emulate an IBM 3274 or 3276 control unit. Two versions are offered, an IBM PC architecture version with a card that fits in any PC, PC/AT, or compatible slot, and a Micro Channel Architecture version for the PS/2 Model 50 or greater.

The MacIRMALAN 802.2 gateway connects a token-ring LAN to an IBM host through a 37XX communications controller or 3174 control unit attached to the token-ring. This gateway must also run on a PC, PC compatible, or PS/2. Up to two LAN adapters are supported, one for token-ring and another that can connect a LocalTalk or Ethernet LAN.

Either gateway supports up to 128 host sessions, which can be distributed over the network. Both gateways include MacIRMA WorkStation software. Versions are available to support 16 or 64 users.

MacIrma Graphics, a software upgrade, turns the Macintosh into an All Points Addressable (APA) graphics workstation allowing the use of such mainframe graphics applications as SAS/GRAPH, TELLAGRAF, and IBM Interactive Chart Utility. Mainframe graphics can be pasted into Macintosh graphics applications such as MacPaint, stored locally as Macintosh PICT files, and output to AppleTalk and PostScript devices such as the LaserWriter.

TriData Systems

TriData Systems *Netway 1000* and *Netway 2000* gateways take a different approach to connecting networks to IBM mainframes. The Netway boxes are LAN-to-mainframe gateways that replace an IBM 3174 controller. They attach to the S/370 channel remotely via modem or locally with a modem eliminator.

The Netway 1000 supports only LocalTalk networks and connects to a synchronous port, either directly or through a modem, for speeds up to 19.2K bps. It supports 16 simultaneous host sessions.

The Netway 2000 can connect LocalTalk, Ethernet, or token-ring networks to the host and supports 64 host sessions at up to 19.2K bps or, with an optional V.35 Serial adapter, 56K bps. LocalTalk connections are provided with the base unit, and Ethernet and token-ring adapters are offered. The optional Ethernet and token-ring cards are inserted in two VME bus expansion slots.

Either Netway model will support networks containing both Macs and IBM PCs and compatibles.

Simware

Simware offers *SimMac*, formerly known as Mac3270. SimMac is a software package that, combined with some form of IBM connection, provides a user interface that makes the maximum use of the Macintosh's various tools such as buttons, dialog boxes, and pull-down menus. SimMac can operate over coaxial connections, such as DCA's MacIrma or Avatar's MacMainFrame, with hardware protocol converters, or with remote connections such as SDLC or X.25.

Microcom

Microcom *RELAY Mac* file transfer software for the Macintosh works with one of Microcom's mainframe file transfer packages, Relay/TSO or Relay/VM. Asynchronous connections to the mainframe are supported, and no additional hardware is required at either end. Relay Mac can run on any Mac from a Macintosh Plus to a Mac II.

Packet/PC

Packet/PC, Inc. offers *Packet/3270 Mac*, a software package which provides a Macintosh SE or larger machine asynchronous access to IBM mainframes.

Since Packet/3270 Mac requires no protocol converter or synchronous modem, it provides an inexpensive method of connecting Macs to the IBM mainframe world. Packet/3270 Mac requires one of two software packages on the mainframe—Packet/Main, which operates under VTAM, or Packet/74, a software and hardware package that functions as an SNA controller and HPAD.

Performance Software

Performance Software's *MacMasterLink* file transfer software allows Macintoshes and IBM PCs to access IBM mainframes running DOS/VSE or MVS. It provides automatic reformatting of mainframe data files transferred to the Mac and access to the mainframe's large-scale disk storage and print spooling facilities.

Connecting to IBM Midrange

Connecting to IBM's midrange systems, the AS/400 and the System/34, System/36, and System/38 (S/3X), is somewhat different from the System/370 attachment schemes. These computers and their associated terminal systems, the 5250 series, are attached by means of a twinaxial cable. Similar in construction to coaxial cable, twinax has a twisted pair of conductors within its plastic and metal sheathing. The various methods of connecting Macs to the midrange systems are similar to those in the mainframe world, however. Direct twinaxial connections, remote connections via telecommunications, and gateway connection of local area networks are all supported.

Several vendors compete in the midrange connectivity market. KMW Systems and Emerald Technology (which were both recently acquired by Andrew Corporation), IDEAssociates, and Telematics all offer Macintosh-to-midrange solutions.

Andrew/KMW Systems

The first vendor to venture into this market was KMW, which cooperated with Apple to develop an external protocol converter box that would allow Apple to connect Macintoshes to its own System/38 and AS/400 machines used in its national distribution network. These devices are sold as the *KMW TwinAccess Series II* and *Series III Protocol Converters*. The Series II model features expansion slots that allow the use of up to seven asynchronous ports. The Series III is a single-port model.

KMW's *NetAccess* is a Macintosh-to-midrange gateway which allows several networked Macintoshes to share a midrange connection. Compatible with LocalTalk, EtherTalk, and TokenTalk, NetAccess consists of a Macintosh II NuBus card and terminal emulation software including a HyperCard interface.

TwinAccess for the Macintosh II is a NuBus card which performs the same functions as the TwinAccess protocol converters. The TwinAccess card only allows direct connection to a 5250 channel.

Andrew/Emerald Technology

Emerald Technology is another company recently acquired by Andrew Corporation in what seems like a drive to dominate the Macintosh-to-midrange market. Emerald offers a midrange connection package called *MacTwin* that includes a twinaxial board and 5250 terminal emulator software. MacTwin is capable of up to seven concurrent sessions with one session for Apple printers. Emerald also offers the *Emulator Transfer Utility*, which runs on the midrange system to allow file transfer between Macintosh and AS/400 or System/3X applications. MacTwin versions are available for the SE, the SE/30, and the Macintosh II.

IDEAssociates

IDEAssociates supports connection to the IBM midrange with its *IDEAcomm Mac for Macintosh II* and *IDEAcomm Mac for Macintosh SE*. These products offer four concurrent host sessions, each with its own window, emulating the IBM 3180 and 3196 terminals. IDEAcomm Mac operates in both the Finder and MultiFinder modes. IDEALink, IDEA's bidirectional file transfer software, is included with IDEAcomm Mac. IDEALink features a HyperCard file transfer front end that turns host file transfer commands into simple point and click operations. Custom Macintosh front ends for all IBM applications can be constructed using the IDEA HyperCard API (Application Programming Interface). Users can choose to print to IBM host printers or to locally attached Apple printers using the 5224, 5225, and 5256 printer emulation included with IDEAcomm Mac.

Telematics

Telematics' *SmartNet 5250/T* protocol converter allows up to seven asynchronous devices to attach to an IBM System/3X or AS/400 or a 5251-12/5294 cluster controller. The SmartNet 5250/T can be attached locally with twinax cable or remotely over an SDLC connection. *MacCOM/5250* Macintosh workstation software works with the SmartNet device to provide Mac users with terminal emulation and file transfer capabilities. MacCOM is available in versions for the Mac and for the IBM PC and features a common user interface whether running on a Macintosh or a PC. PC users will find that Telematics has designed a menu-driven user interface that resembles the Macintosh interface as closely as possible. Interfaces to the various computers in the IBM midrange are also as similar as possible.

Connectivity to Digital

In early 1988 Apple and Digital Equipment Corporation formed an alliance to develop enterprise-wide client-server computing based on the Digital VAX as server and the Macintosh as client. The culmination of this two-year development cycle came in early May 1990 with the joint announcement of 14 products designed to integrate the VAX and Macintosh environments. The centerpiece, *DEC LanWORKS for the Macintosh*, includes server software for the VAX and client software for the Mac. LanWORKS allows file sharing through VAXshare, which transforms the VAX into an AppleShare file server. Users can share both Apple LaserWriters and Digital PostScript printers using AppleTalk's Printer Access Protocol (PAP) and the VAX VMS operating system's print queues.

Digital's *DECnet for the Macintosh* allows Mac users to connect to Digital's Ethernet networking scheme from individual Macintoshes. DECnet for the Macintosh does not require that the VAX be turned into an AppleShare device; it integrates the Macintosh into an existing DECnet network. The *AppleTalk-to-DECnet transport gateway* is software for VMS that allows AppleTalk networks to connect to DECnet networks through a Chooser document and access DECnet-based applications and services.

It should be pointed out that Digital's offerings for the Macintosh are not simply aimed at those users with a giant VAX cluster already on

their premises. For users who do not have a VMS-based system, Digital offers both VMS- and OS/2-based servers for multivendor networks. The *DEC LanWORKS Server 316* and *333* are OS/2-based servers, and the *DEC LanWORKS Server 3100* is a VMS-based box. These compact systems, approximately the size of a PC, can form the basis of new networks that integrate Macintoshes, DOS, OS/2, and UNIX-based machines and can provide links to SNA and X.25 services, in addition to linking to Digital Equipment's larger systems.

Linking to VAX

Connecting to the Digital VAX product line is a somewhat simpler affair, conceptually, than an IBM connection. Macs can connect directly to a VAX by an asynchronous link either through a modem or a direct cable connection. Asynchronous links can also be made to a terminal server, a device with multiple asynchronous ports that is attached via an Ethernet link to the VAX host. Macs can also be attached directly to the VAX Ethernet cable using internal Ethernet adapter cards or Ethernet-to-SCSI links. Finally, LocalTalk networks can be connected to the VAX Ethernet by means of gateways, so that all Macs on a network may share in VAX connectivity.

VAX and Macintosh computers can be integrated two ways at the software level. VAXes can join AppleTalk networks as servers, or Macintoshes can join DECnet networks as DECnet nodes. The latter solution is addressed by products from two vendors—Alisa Systems and Everex.

Alisa

Alisa's *TSSnet*, originally developed by Thursby Software Systems, provides a Macintosh with access to all DECnet services. TSSnet includes file transfer and E-Mail applications and DECnet protocols for Ethernet and asynchronous connections.

Everex

Everex supplies *CommUnity-Mac*, originally developed by Technology Concepts, a Bell Atlantic subsidiary. Like TSSnet, CommUnity-Mac works with both Ethernet and asynchronous connections and provides file transfer and E-Mail services. CommUnity-Mac is also available for MS-DOS and UNIX-based systems and is compatible with Digital's VMS services for MS-DOS.

AppleTalk for VMS

AppleTalk for VMS, originally developed for Apple by Alisa Systems, is AppleTalk software that runs on the Digital VAX microcomputer family under the VMS operating system. As offered by Apple, AppleTalk for VMS is purely a development tool for creating networked environments that take advantage of the strengths of both the Macintosh and the VAX.

AppleTalk for VMS appears as a virtual AppleTalk network within an AppleTalk internet. VMS processes are nodes in this virtual network, and three processes form the core of it—the network process itself, a protocol support library, and a bridge between the VAX processes and AppleTalk.

One potential use of the VAX' capabilities is as an AppleTalk router. Used as such, a VAX can connect widely separated AppleTalk networks over a DECnet wide area link. The VAX' large-scale disk storage and multitasking operating system also makes the VAX an ideal file and print server.

Alisa Systems

Alisa Systems' *AlisaTalk* is Alisa's value-added version of AppleTalk for VMS and includes three major components—*AlisaShare*, *AlisaPrint*, and *AlisaTerminal*. *AlisaShare* is a VAX-based server for Macintosh and PC systems on an AppleTalk network. The *AlisaPrint* System allows both Macintosh and VAX users to print to PostScript-compatible printers on the AppleTalk network. *AlisaTerminal* provides network virtual terminal service to a terminal emulator on the Mac. Alisa resells White Pine's Mac240 and Mac241 and Synergy's VersaTerm Pro emulators for high-end emulation and Versaterm for simple VT100 emulation. *Alisa ADP* (Alisa Digital Printer), a print server, lets Macintosh users print to Digital PostScript printers such as the LN03R ScriptWriter and the LPS-40 PrintServer.

Pacer Software

Pacer Software's *PacerLink* allows Macintoshes and IBM PCs to reside on a network with a VAX running under VMS or ULTRIX, the Digital implementation of UNIX. With *PacerLink*, Macintosh and PC users can access the large storage facilities of the typical VAX host as virtual disks. The Macintosh or PC user can easily access Digital office automation environments such as ALL-IN-1.

Host print queues and spooling are also available to networked Macintoshes and PCs.

PacerShare software lets a VAX running under VMS or ULTRIX act as an AppleShare file server. *PacerShare* requires *PacerLink* on the host, but only the standard AppleShare client software on the Macintosh. IBM PCs and compatibles running AppleShare for the PC can also access *PacerShare*.

PacerTOPS allows a VAX to act as a file server in TOPS Macintosh networks, bringing the advantages of large-scale storage, print services, and application sharing to this popular networking software. Like *PacerShare*, *PacerTOPS* requires *PacerLink* running on the host. Pacer has also promised integration of *PacerShare* and *PacerTOPS* in a forthcoming release, so that networks using the two different network operating systems may share the same VAX server and access the same disk volumes.

PacerPrint translates common VAX file formats, such as Tektronix 4014 and Diablo 630, into PostScript for printing on an Apple LaserWriter or similar PostScript-based printer. Printers may be attached by asynchronous connections to the VAX or to a terminal server, or they may reside on any AppleTalk network that is bridged to the VAX Ethernet.

PacerGraph, an optional emulation package, allows VT240 monochrome and VT241 color graphics on the Macintosh. Graphics in VAX ReGIS or Tektronix 4010/4014 formats can be viewed and manipulated on the Mac and copied into Macintosh graphics and desktop publishing applications.

Datability

Datability *MacRAF* is a Macintosh version of Datability's popular Remote Access Facility (RAF) software for the IBM PC. *MacRAF* allows a VAX to act as a file server for networked Macintoshes and also permits Mac users to execute VAX applications. Up to 16 VAX disk volumes can be designated as servers, and a Macintosh can also access up to four of the VAX' printers. *MacRAF* allows users to interact with the VAX through the familiar Macintosh graphical interface without learning VMS commands. *MacRAF* runs on the Macintosh II, the SE/30, and the SE and requires an Ethernet

interface card to connect to the VAX network. Software components are supplied for both the Mac and the VAX.

White Pine Software

White Pine *Mac220*, *Mac240*, and *Mac241* are terminal emulator programs that reproduce the VT220 text-only terminal, the VT240 text and graphics terminal, and the VT241 color graphics terminal, respectively.

White Pine's *VMacS* is a Mac-to-VAX file transfer and conversion program that converts Macintosh data file formats to VAX formats. Word processing documents from MacWrite or Microsoft Word, Excel spreadsheets, and MacDraw or MacPaint graphics files, among others, can be used in VAX applications, while files from many VAX applications can be transferred to similar Macintosh programs.

White Pine's *Reggie* converts Macintosh PICT, PICT2, MacDraw, MacPaint, and any other Mac graphics file that can be copied to the clipboard, into Digital formats such as ReGIS or SIXEL. TIFF or Encapsulated PostScript graphics files can be converted in a two-step process using a Macintosh utility first to transform them to a format that Reggie can accept. Reggie can import these files into any VAX application that supports ReGIS or SIXEL files.

Walker, Richer, and Quinn

Walker, Richer, and Quinn provides *Reflection 2 Plus*, which emulates the Digital VT320 terminal on the Macintosh. Reflection 2 Plus allows connection to both VAX/VMS and UNIX hosts and file transfer software that can be uploaded to the host. Reflection 2 Plus runs under MultiFinder, so host sessions can run in the background, and a Basic-like command language lets users automate frequently performed tasks. Walker, Richer, and Quinn also offers *Direct-To-1*, which allows Macintosh and PC users to access the applications and services available under Digital's ALL-IN-1 office automation environment.

Integrated Solutions

Integrated Solutions provides a unique software package which, while not really for the Macintosh, allows the control of networked VAX systems using the Macintosh. *Central System Manager* (CSM) runs under AppleTalk for VMS and supports both

direct Ethernet connections or LocalTalk connections with a hardware or software bridge. CSM also can use Alisa's TSSNet for connection to DECnet, if the VAX site has no requirement for AppleShare. Central System Manager can treat groups of clustered or unclustered VAXes as a single management domain. All features of the Macintosh user interface are employed to simplify the task of VAX management. Users can open 16 simultaneous windows that can be updated at set intervals or at the user's request. Windows can be turned into icons and reopened by clicking on them. When reopened, windows contain current, updated information. All window attributes can be customized, and dialog boxes can be designed by the user to yield the most efficient control of a particular VAX installation.

Mac-to-UNIX Connectivity

UNIX is a popular multitasking operating system developed in the early 1970s at AT&T Bell Labs. AT&T allowed universities to license UNIX for an almost nominal fee in its early days, and this led to its widespread acceptance as the operating system of choice for scientific and technical computing. UNIX was ported to many minicomputers, and users developed a rich set of applications and utilities. Engineering workstations such as those offered by Sun, Apollo, and other vendors are exclusively UNIX-based machines.

The government-funded nature of much academic research led to the use of UNIX and UNIX-based computer systems as the foundation of the Defense Department's Advanced Research Projects Agency's ARPAnet. ARPAnet and other wide area networks spawned TCP/IP, an internet-working protocol in wide use today as a de facto standard for wide area connectivity.

Apple offers its own UNIX implementation, called A/UX, as an option for Macintosh II users. A/UX is based on AT&T UNIX System V, Version 2, Release 2, and it includes enhancements from the other major version of UNIX in wide use, the University of California at Berkeley BSD 4.2 release.

Apple offers two important additions to A/UX—*MacTCP* and *MacX*. MacTCP, a development package, allows the creation of TCP/IP-based terminal emulation and other applications programs for accessing host systems over TCP/IP

links. MacX is an Apple implementation of the MIT X-Windows graphical user interface. X-Windows provides a mouse-driven windowed user interface, similar in some respects to the Macintosh user interface, for UNIX-based systems of all sizes. MacX, and the X-Windows system in general, are also supported by Digital Equipment Corporation under VMS for the VAX. Both MacTCP and MacX are available only to developers registered with the Apple Programmers and Developers Association (APDA).

White Pine Software

White Pine *eXodus* is the first X-Windows server for the Macintosh Finder or MultiFinder operating systems. Any Macintosh with 1M byte or more of memory can run eXodus, which can access X-Windows applications on UNIX machines or on Digital's VAX minicomputers running the VMS operating system. White Pine has worked closely with Digital to ensure compatibility with DECwindows, Digital's own implementation of the X-Windows standard. The eXodus software requires a network driver specific to the environment it runs in—for the VAX/VMS version, a DECnet driver such as Alisa's TSSnet or EMAC's CommUnity Mac; for TCP/IP, MacTCP or Novell/Kinetics TCPort.

Mt. Xinu

Mt. Xinu, which, in case you have not noticed, is UNIX spelled backwards, offers several products that integrate the Macintosh with UNIX environments.

Mt. Xinu has acquired the rights to the former Kinetics products, *K-Talk*, *K-Spool*, and *K-Share*, from Novell. *K-Talk*, a development system, allows the connection of AppleTalk networks, on LocalTalk or Ethernet, to the UNIX environment. It is currently supported on Sun workstations and the Digital VAX running ULTRIX. *K-Spool* allows both Macintoshes and UNIX systems to share PostScript printers and acts as a print server for Macintosh users. *K-Spool* includes a *ditroff*-to-PostScript translation utility that converts files from the UNIX typesetting program device-independent *troff* to PostScript format. *K-AShare*, formerly *K-Share*, is file server software that turns a UNIX host into an AppleShare file server. Compatible with the industry-standard Sun NFS file system, *K-AShare* allows users to mount

NFS volumes. *K-AShare* requires only the standard AppleShare client software on the Macintosh. *K-AShare* runs on the Sun 3, Sun 4, and SunSPARCstation 1; on the Hewlett-Packard HP 9000/300 or HP 9000/800; and on the Digital Equipment VAX with ULTRIX.

T-Serve, formerly referred to as Xinet, allows a Hewlett-Packard HP 9000/300, HP 9000/800, or a Digital VAX running ULTRIX or MORE/bsd, Mt. Xinu's implementation of UNIX, to act as a server for TOPS networks.

Information Presentation Technologies

Information Presentation Technologies offers *uShare*, an AppleShare file server that runs on UNIX-based machines. *uShare* is available for The Santa Cruz Operation's SCO UNIX and SCO Xenix, which are UNIX implementations for Intel 286/386-based machines. *uShare* is compatible with AppleTalk Phase 1 and Phase 2 and TCP/IP. *uShare* is also offered in versions for MIPS superminicomputers and Data General's Aviion workstations.

Novell

Novell offers *LAN WorkPlace* for the Macintosh. *LAN WorkPlace* provides TCP/IP connections to mainframes, minicomputers, and PCs and access to Novell NetWare servers. *LAN WorkPlace* includes Telnet terminal emulation and File Transfer Protocol (FTP) file transfer. Macintoshes connected to an Ethernet network or to a LocalTalk network bridged to Ethernet can connect to TCP/IP hosts. *LAN WorkPlace* includes TCPort and HostAccess development tools which allow the creation of TCP/IP connectivity solutions.

InterCon Systems

InterCon Systems provides *TCP/Connect II*, which allows a Macintosh to connect with a wide variety of computers over TCP/IP local and wide area networks. *TCP/Connect* features Digital VT240/241 and IBM 3278 emulation, File Transfer Protocol (FTP) file transfer, support for Internet-standard electronic mail, and a Simple Network Management Protocol (SNMP) agent. Intercon also offers *Telnet Driver*, an addition to Synergy Software's *VersaTerm Pro* or Software Ventures' *MicroPhone II* that allows these terminal emulation packages to communicate over a TCP/IP connection to a host computer.

Connecting to Other Mainframes and Minis

The world of large-scale computing is not exclusively made up of IBM and Digital products, and several firms have addressed the need for Macintosh connectivity to other machines. Most of these solutions are software based, that is, terminal emulator programs that copy the particular look and functionality of a terminal from one of the smaller mainframe or minicomputer manufacturers, and some feature mainframe-based file transfer utilities that add to their functionality. Most of these programs also use the features of the Macintosh user interface to emulate the unique keyboards of each system. On-screen buttons take the place of complex key combinations to make emulation easier.

Hewlett-Packard

International Computer Consultants

International Computer Consultants' *Mac3000* connects the Macintosh to the HP 3000 minicomputer series by emulation of the HP 2622A, HP 2624B, HP 2645, or HP 2392A terminals, as well as the Digital VT102 or IBM 3278 terminals.

Walker, Richer, and Quinn

Walker, Richer, and Quinn offers two HP emulation programs for the Macintosh. *Reflection 1 Plus* provides HP 2392A alphanumeric terminal emulation, while *Reflection 3 Plus* adds HP 2393A graphics capability. Host-generated graphics can be copied to Macintosh applications using cut-and-paste. *DeskDirect* allows Mac users to access HP's *DeskManager* office automation software.

Tymlabs

Tymlabs Session is a family of emulation products. *Business Session*, the basic software, emulates the HP 2392 block mode terminal in a standard Macintosh interface with support for MultiFinder. *Graphic Session* adds the graphics capability of the HP 2393 terminal, and *Color Session* completes the picture by including the color graphics support of the HP 2397 terminal.

Prime

Prime Computer offers *PrimeLink* software which allows file transfer between Prime minicomputer systems and Macintosh workstations, Macintosh

emulation of the Prime PT200 terminal, sharing of large-scale disk resources, and remote printing to any printer on the system. Both a Macintosh and a host component are required.

Data General

Pacer

Data General Eclipse MV/Family systems can run Pacer Software's *PacerLink* software for Macintosh and IBM PC connectivity. *PacerLink* is described in the Digital Equipment portion of this report.

Kaz Business Systems

Kaz offers *FrontEnd*, a Macintosh-to-Data General terminal emulation and file transfer package, which allows emulation of DG's D210, D211, D214, D215, and D216 terminals.

Tandem

Tandem Computers offers a pair of Macintosh programs, *Lighthouse* and *Lighthouse Keeper*. *Lighthouse Keeper* allows the development of HyperCard-based front ends for Tandem applications. No changes to host code are required. HyperCard stacks developed with *Lighthouse Keeper* run under *Lighthouse*, which provides translation between the Macintosh and Tandem computers.

Menlo Business Systems

Menlo offers a suite of Macintosh-to-Tandem connectivity products. *Mac Menlo* software emulates a Tandem 653X terminal using conversational and block mode applications such as *Pathway*, *VS-Editor*, and *PS Text Edit*. *Mac Menlo* supports cut-and-paste copying of data between Tandem and Macintosh applications. *MenloCOM* provides Macintosh graphic user interface front ends for standard Tandem applications. Menlo's *Foundation Graphics ToolBox* allows the addition of graphics originated on the Macintosh to standard Tandem applications. Menlo's file transfer software, *MAX*, allows files from a database on a Tandem host to be transferred to a Macintosh or PC. *MAX* also allows files created on the Mac or PC to be transferred to host applications. *Spool AT*, which runs in two parts on the host and on a dedicated Macintosh, allows Tandem users and Macintosh users to share a LaserWriter printer.

Unisys

Core Technology Corporation

CTCBridge-Mac from Core Technology connects an individual Macintosh, including 512K machines, to both Sperry and Burroughs hosts. Sperry terminals supported are the UTS 20, 30, 40, and SVT1120. Burroughs emulators are provided for the TD830, MT983, ET1100, and T27 terminals.

CTCBridge-Mac Gateway connects an AppleTalk network to both Sperry and Burroughs hosts, supporting up to 100 sessions per gateway. The *CTCBridge-Mac Gateway* software can run in the background on a file server.

Performance Software

Performance Software's *MacMasterLink* file transfer software is available in a version for the Unisys 1100/2200 mainframe. It allows the Macintosh to access mainframe files and applications and use the storage and print spooling facilities of the host.

Wang

DataViz

DataViz provides two Wang emulators, for the Wang VS and the Wang OIS systems. Called *MacLinkPlus/Wang VS* and *MacLinkPlus/Wang OIS*, they provide terminal emulation and file transfer for Wang word and data processing applications and electronic mail. Both programs also allow file conversion to and from MS-DOS formats. Over 45 translators are included in each program to allow file translation to many of the most popular Macintosh and MS-DOS applications.

M/H Group

M/H Group provides *VsCom/Macintosh*, a Wang VS 2110/2110A terminal emulator that allows document and file transfer and conversion between the Macintosh and Wang VS. Wang Standard WP and WP Plus document formats are supported.

Bull

Cambridge Computer

Cambridge Computer offers *Mac73/78* that allows the Macintosh to emulate the Bull VIP7200, VIP7300, VIP7700, VIP7800, and HDS asynchronous and synchronous terminals.

NCR

Rasmussen Software

Rasmussen Software offers its *MacQT* emulator for NCR host systems. *MacQT* supports connection to the IMOS V, IRX, ITX, RMCOS, and UNIX operating systems running on an NCR computer. Rasmussen also offers a file query program called *QuickSend*, as an add-on to *MacQT*. *QuickSend* can extract, format, and transfer to the Macintosh selected fields in one step.

PICK Operating System

Carnation Software

Carnation Software provides *MactoPic*, a terminal emulation program for Macintosh communications with any computer running the popular PICK operating system. Three emulators are provided—Digital VT101, ADDS Viewpoint, and Prism.

For More Information

Apple provides two publications that were especially helpful in the preparation of this report. The *Apple Multivendor Solutions Guide* is a 268-page compendium of networking products from all vendors and contains product descriptions and user profiles in all the areas of Macintosh connectivity covered in this report. Although this publication is dated June 1989 and thus does not cover many of the latest developments in Macintosh communications or as many vendors as our own report, it is still an invaluable resource. We hope Apple will see fit to update and expand this book very soon.

A Guide to Apple Networking and Communication Products, a catalog of all Apple's own products for Macintosh communications, presents a concise picture of the Macintosh connectivity environment, particularly in regard to AppleShare and the Apple Filing Protocol. For those with no previous exposure to Macintosh communications, this publication provides the best starting point.

At a more detailed technical level, *Inside AppleTalk*, by Gursharan S. Sidhu, Richard F. Andrews, and Alan B. Oppenheimer, is the definitive reference. Available from Addison-Wesley, an updated second edition, which covers the AppleTalk Phase 2 enhancements, was published in June 1990.

Vendors

Actinet Systems, Inc.

360 Cowper Avenue, Suite 11
Palo Alto, CA 94301 (415) 326-1321

Adaptec Inc.

691 S. Milpitas Boulevard
Milpitas, CA 95035 (408) 945-8600

Alisa Systems Inc.

221 E. Walnut Street, #175
Pasadena, CA 91101 (818) 792-9474

Andrew/Emerald Technology, Inc.

18912 N. Creek Parkway, Suite 102
Bothell, WA 98011 (206) 485-8200, (800) 222-6174

Andrew/KMW Systems Corp.

6034 W. Courtyard Drive
Austin, TX 78730 (512) 338-3000, (800) 531-5167

Apple Computer Inc.

20525 Mariani Avenue
Cupertino, CA 95014 (408) 996-1010

Asanté Technologies Inc.

405 Tasman Drive
Sunnyvale, CA 94809 (408) 734-4844

Avatar Technologies Inc.

65 South Street
Hopkinton, MA 01748 (508) 435-3000

Cabletron Systems Inc.

10 Main Street, Box 6257
East Rochester, NH 03867 (603) 332-9400

Cactus Computer Inc.

1120 Metrocrest Drive, #103
Carrollton, TX 75006 (214) 416-0525

Cambridge Computer Corp.

80 Mt. Sanford Road
Mt. Carmel, CT 06518 (203) 288-6004

Carnation Software

P.O. Box 608
Carnation, WA 98014 (206) 333-4902

Cayman Systems Inc.

26 Lansdowne Street
Cambridge, MA 02139 (617) 494-1999

Compatible Systems Inc.

P.O. Drawer 17220
Boulder, CO 80308 (303) 444-9532, (800) 356-0283

Core Technology Corp.

7335 Westshire Drive
Lansing, MI 48917 (517) 627-1521

Datability Software Systems Inc.

322 Eighth Avenue
New York, NY 10001 (212) 807-7800

DataViz

35 Corporate Drive
Trumbull, CT 06611 (203) 268-0030

Dayna Communications

50 S. Main Street, Fifth Floor
Salt Lake City, UT 84444 (801) 531-0600

DayStar Digital, Inc.

5556 Atlanta Highway
Flowery Branch, GA 30542 (404) 967-2077, (800) 962-2077

Digital Communications Associates Inc.

1000 Alderman Drive
Alpharetta, GA 30201 (404) 442-4000

Digital Equipment Corp. (DEC)

146 Main Street
Maynard, MA 01754-2571 (508) 493-5111

Dove Computer Corp.

1200 N. 23rd Street
Wilmington, NC 28405 (919) 763-7918, (800) 622-7627

EMAC

A Division of Everex Systems Inc.
48431 Milmont Drive
Fremont, CA 94538 (415) 498-1111, (800) 821-0806 ext. 2222

EveryWare, Inc.

2176 Torquay Mews
Mississauga, ON, Canada L5N 5M0 (416) 821-9222

Farallon Computing

2201 Dwight Way
Berkeley, CA 94704 (415) 596-9100

h-Three Systems Corp.

P.O. Box 12557
Research Triangle Park, NC 27709 (919) 549-8334,
(800) 622-7464

Hayes Microcomputer Products Inc.

P.O. Box 105203
Atlanta, GA 30348 (404) 449-8791

IDEAssociates Inc.

29 Dunham Road
Billerica, MA 01821 (508) 663-6878

Information Presentation Technologies, Inc.

5000 N. Parkway Calabasas
Calabasas, CA 91302 (818) 347-7791

Infosphere Inc.

4730 SW Macadam Avenue
Portland, OR 97201 (503) 226-3620, (800) 622-7464,
(800) 445-7085

Integrated Solutions, Inc.

1020 Eighth Avenue
King of Prussia, PA 19406 (215) 337-2282

InterCon Systems Corp.

950 Herndon Parkway, Suite 390
Herndon, VA 22070 (703) 709-9890

International Business Software

1230 Oakmead Parkway, Suite 310
Sunnyvale, CA 94088 (800) 733-2822

International Computer Consultants

1311 Clegg Street
Petaluma, CA 94952 (707) 765-9200

Kaz Business Systems

10 Columbus Circle, Suite 1620
New York, NY 10019 (212) 757-9566

M/H Group

300 W. Adams Street
Chicago, IL 60606 (312) 443-1222

Menlo Business Systems Inc.

201 Main Street
Los Altos, CA 94022 (415) 948-7920

Microcom Software Div.

55 Federal Road
Danbury, CT 06810 (203) 798-3800

Miramar Systems Inc.

201 N. Salsipuedes, #205
Santa Barbara, CA 93103 (805) 965-5161

Mt. Xinu

2560 9th Street, Suite 312
Berkeley, CA 94710 (415) 644-0146

Network Resources Corp.

2450 Autumnedale Drive
San Jose, CA 95131 (408) 263-8100

NetWorth Inc.

8101 Ridge Point Drive
Irving, TX 75063 (214) 869-1331

Northern Telecom

Public Relations, Meridian Communications Systems Div.
2305 Mission College Boulevard
Santa Clara, CA 95054 (408) 988-5550

Novell Inc.

122 E. 1700 S.
Provo, UT 84606 (801) 379-5900, (800) 453-1267

Nuvotech Inc.

2015 Bridgeway, #204
Sausalito, CA 94965 (415) 331-7815, (800) 232-9922

Pacer Software Inc.

7911 Herschel Avenue, #402
La Jolla, CA 92037 (619) 454-0565

Packet/PC Inc.

270 Farmington Avenue
Farmington, CT 06032 (203) 678-1961

Performance Software Inc.

575 Southlake Boulevard
Richmond, VA 23236 (804) 794-1012

Photonics Corp.

200 E. Hacienda Avenue
Campbell, CA 95008 (408) 370-3033

Prime Computer

Prime Park
Natick, MA 01760 (508) 655-8000

Racal-Interlan Inc.

155 Swanson Road
Boxborough, MA 01719 (508) 263-9929

Rasmussen Software Inc.

10260 SW Nimbus Avenue, Suite M2A
Portland, OR 97223 (503) 624-0360

ShirtPocket Software

P.O. Box 40666
Mesa, AZ 85274-0666 (602) 966-7667

Shiva Corp.

155 Second Street
Cambridge, MA 02141 (617) 864-8500, (800) 458-3550

Simware Inc.

20 Colonnade Road
Ottawa, ON, Canada K2E 7M6 (613) 727-1779

Solana Electronics

4907 Morena Boulevard, Ste. 1404
San Diego, CA 92117 (619) 573-0801

Standard Microsystems Inc.

35 Marcus Boulevard
Hauppauge, NY 11788 (516) 273-3100

Tandem Computers

19191 Vallco Parkway
Cupertino, CA 95014 (408) 725-6000

Telematics International, Inc.

26630 Agoura Road
Calabasas, CA 91302 (818) 880-4900

Telesystems SLW Inc.

85 Scarsdale Road, #201
Don Mills, ON, Canada M3B 2R2 (416) 441-9966

Thomas-Conrad Corp.

1908-R Kramer Lane
Austin, TX 78758 (512) 836-1935, (800) 332-8683

3Com Corp.

3165 Kifer Road
Santa Clara, CA 95052 (408) 562-6400

TOPS

950 Marina Village Parkway
Alameda, CA 94507 (415) 769-9669

TriData Systems, Inc.

1450 Kifer Road
Sunnyvale, CA 94086 (408) 746-2900

Tymlabs Corp.

811 Barton Springs Road
Austin, TX 78704 (512) 478-0611

Walker Richer & Quinn Inc.

2825 Eastlake Avenue E.
Seattle, WA 98102 (206) 324-0350

White Pine Software Inc.

94 Route 101A
Amherst, NH 03031 (603) 886-9050 ■

