Multiuser DOS Systems: Overview

In this report:

Synopsis

Editor's Note

In what might seem like an indication that we have come full circle, there are some new multiuser systems on the market. But these are not the multiuser systems of the past with 32 terminals attached to a box the size of a refrigerator, running some sort of user-unfriendly proprietary operating system. No, these are multiuser systems for the 1990s—cheap, compact, easy to install, connected by fiber optic cables, DOS based, and hosted by a PC.

What? DOS based? PC host? That is right. Granted, the PC host must be a 386 or better, and the DOS user interface runs on top of a powerful multitasking operating system you may never have heard of, but these setups can be faster than most LANs and, perhaps best of all, they can cost as little as half as much.

Report Highlights

In this report we examine some of the products available from the members of the Multiuser DOS Federation—multiuser operating systems, multiple serial port adapter cards, and graphics adapters, that allow users to build a multitasking, multiuser system based on a single 80386 microcomputer.

Not Just an Entry-Level Solution

Touted by the vendors as an alternative to a LAN, it might seem that these systems are aimed strictly at the entry-level, small business environment, but a closer look will reveal that many offer interconnectivity to local area networks as an option. These systems could be extremely cost-effective if used to supplement an existing LAN in departmental settings where only occasional access to companywide data is required. Remote sites could realize cost benefits from such an installation as well.

While multiuser systems for microcomputers have been around almost since the beginning—some may recall Digital Research's MP/M, the multiuser version of the early CP/M operating system—the advent of 386-based PCs made multiuser computing on a PC platform a much more serious option. For the first time, a microcomputer was available that offered hardware support for the kinds of operating system features that are a must for true multitasking, multiuser operation. The 80386's 32-bit bus, its capability to address memory up to 4 gigabytes, its "virtual machine" mode, paging, and virtual memory, were all features that users had come to expect in minicomputer operating systems by the mid-1970s.

Several companies banded together in the summer of 1990 to form the Multiuser DOS Federation. Some of the firms had, for some years, been producing multiuser operating systems that delivered acceptable performance for a small number of users attached to an 80286-based PC. Others manufactured serial cards and graphics adapters that allowed multiple stations to connect to a single PC.

Some of these companies offer full turnkey systems, while others provide only software or hardware components that allow users to build their own systems. One of the advantages of these multiuser systems is that they allow existing standalone PCs to be used as terminals on the multiuser system, as well as supporting inexpensive "dumb" terminals. In particular, they can

—By John Krick
Associate Editor

breathe new life into older, 8088-based machines that might otherwise be gathering dust in a storeroom.

Some of the operating system vendors, most notably Theos Software and Bluebird Systems, provide the kind of software development systems that one might expect to be bundled with a full-size minicomputer. Basic, Pascal, Cobol, and C language packages are available.

A software developer can create a multiuser DOS operating system in several ways:

- An existing multitasking, multiuser operating system not originally intended to emulate DOS can be modified to support DOS emulation, usually through an add-on software module. This is the path taken by Bluebird Systems with its SuperDOS with PC-Connect, and by Theos Software, in its THEO+DOS product.
- An entirely new multiuser operating system kernel that behaves like DOS and provides DOS emulation at each workstation can be written. Alloy 386/MultiWare, Digital Research DR Multiuser DOS, and S & H Computer Systems' TSX-32 are examples of this approach.
- A standalone multitasking addition to standard MS-DOS can be turned into the basis of a multiuser system. This is how IGC VM/386 MultiUser and StarPath Systems' Vmos/MultiUser were created.

All of these strategies for creating a multiuser DOS system use the features of the 80386 and higher processors in similar ways. The virtual 8086 mode that divides the processor clock among several virtual 8086 systems, and provides each of those systems with their own memory, is fundamental to the operation of these systems. The capabilities of individual systems vary widely, however, especially in the number of users supported. Some systems support as few as 8, others as many as 64. Users can build text-only, monochrome systems with terminals connected to standard serial ports over copper wire, or, under some of these systems, they can opt for VGA graphics systems with each workstation linked to the host by fiber optic connections.

It should also be pointed out that multiuser DOS systems are not the only way to attach multiple users to a 386 or larger Intel-based system. Many vendors, including some of those described here, offer or support UNIX systems that provide color X-terminal operation.

Multiuser DOS Operating Systems

Alloy Computer Products, Inc.

Alloy Computer Products' 386/MultiWare allows up to 21 users, including the host, to attach terminals or PCs to a 386 or 386SX computer. 386/MultiWare uses the virtual machine mode of the 386 processor and allows each virtual 8086 created to have up to 4M bytes dedicated to its own use. Each user may have up to eight DOS tasks running simultaneously. The Alloy multiuser operating system is available in three versions—MW386E, an entry-level version that supports up to 5 users; the standard version, MW386, that supports up to 21 users; and the third, and newest, version, 386/MultiWare EZ. 386/MultiWare EZ supports three users without adding additional hardware to the host PC. The standard COM1 and COM2 ports are used to support the second and third workstations.

386/MultiWare includes LINK-PC, terminal emulation software that allows an existing PC to act as a terminal attached to the host system. Alloy also offers MAC-ATTACH terminal emulation software that allows Apple Macintosh computers to connect to a 386/MultiWare host.

Two important software options set 386/MultiWare apart from the pack in connectivity. Alloy's NetWare Connectivity software module allows a 386/MultiWare system to connect to a node on a Novell NetWare local area network. This means that users with NetWare LANs already installed can economically expand the number of users attached to the LAN and are able to share LAN resources. Only a single Ethernet or Arcnet adapter card in the 386/MultiWare host is required to add the full complement of 21 MultiWare users to the LAN. MultiWare users become fully privileged NetWare users, able to access NetWare's electronic mail and any gateways attached to the network. Up to eight NetWare and DOS tasks can run simultaneously.

The second important connectivity option offered for 386/MultiWare is Sangoma Technologies' ClusterComm MultiWare, which allows users of a MultiWare system to perform 3270 or 5250 terminal emulation for attachment to IBM mainframes and midrange computers. ClusterComm supports both SDLC (for leased-line and dial-up connections) and X.25 packet-switching networks.

Alloy also sells what it refers to as IMPs, Intelligent MultiPort cards, in two-user and eight-user versions. Each IMP card is available in models for the ISA bus and for the Micro Channel Architecture (MCA) bus used in the PS/2 product line. The IMP2 and IMP2/PS two-user cards support monochrome Hercules Graphics or CGA text. The IMP8 and IMP8/PS can attach eight text terminals or four text and four Hercules Graphics. Users with PCs can run in CGA emulation mode with Alloy's Link-PC terminal emulation software.

Bluebird Systems

Bluebird has offered a non-MS-DOS multiuser system, called SuperDOS, for some time, and has only added DOS connectivity comparatively recently. SuperDOS has had a wide variety of applications written for it, many aimed at vertical markets and sold through VARs that specialize in particular vertical market application categories. SuperDOS on a 286-based IBM PS/2 Model 30 can support 18 users. On the PS/2 Model 80, it allows up to 66 users to share resources. SuperDOS can also run on all types of IBM PC compatibles from 8086- to 80486-based machines.

PC-Connect, based on Microsoft Windows, allows the attachment of an IBM PC or compatible to a SuperDOS host machine over a serial connection. In this configuration, the PC can run as many as six SuperDOS tasks, each in its own window, and as many DOS applications as the PC's memory will allow. While the PC with its DOS applications and the SuperDOS host remain two separate environments, the PC-Connect Windows interface does allow users to cut and paste between the two. Data from a SuperDOS application can be easily transferred to a DOS application in this way, and vice versa.

Bluebird offers a rich set of application development tools including compilers for C, RM-COBOL-85, Data General- and Wang-compatible BASICs, and Pascal. A Basic-to-80x86 assembler cross-compiler is also offered that allows applications developed for SuperDOS to be ported to MS-DOS-based microcomputers.

Bluebird also offers a LAN interconnection option for SuperDOS host systems called SuperLAN. It allows 255 SuperDOS microcomputers to be connected over 2.5M

bps Arcnet hardware. Applications, peripherals, and other resources residing on any SuperDOS system can be accessed by users attached to any of the network nodes. Each node can support the full complement of 66 users each, and up to 80 disk drives can be distributed over the network.

Concurrent Controls, Inc. (CCI)

Concurrent Controls' 386-DOS is based on Digital Research's DR Multiuser DOS. It can connect up to 67 workstations to an 80386 or 80486 host and uses the virtual machine mode of the processor. Any workstation can run up to 16 programs concurrently. 386-DOS implements disk caching to speed I/O operations. 386-DOS includes Smartscreen, a 386-DOS extension that supports graphics workstations with multiuser graphics display adapters. Running on top of 386-DOS, it allows monochrome Hercules graphics-capable monitors and color EGA monitors to be used as terminals. Up to 256 of these host systems can be connected using CCI-Net, allowing any user on any host to share files, disk storage, and printers attached to any host. Remote workstation support is included with CCI multiuser systems so that users off-site can dial into the host system.

Digital Research

DR Multiuser DOS replaces DR's earlier Concurrent DOS 386 product and shares features with DR DOS 6.0, DR's standalone operating system. DR Multiuser DOS was designed to be DOS compatible from the ground up, and does not build on an existing multitasking operating system and add DOS support on top. DR Multiuser DOS supports a maximum of 64 users. Three users can be supported just by attaching serial terminals to the COM1 and COM2 ports.

DR Multiuser DOS includes PCTERM terminal emulation software that allows PCs to act as DR Multiuser DOS terminals. DR Multiuser DOS supports color text, CGA graphics, and the Microsoft Windows 3.0 environment. Each user station can have as many as eight DOS sessions running at one time. Users can hot key between DOS sessions, but only the foreground session will accept keyboard input. Applications that do not require keyboard input, such as spreadsheet recalculation, database sort, or file transfer via telecommunications, can run in the background. All sessions can run in graphics mode.

DR Multiuser DOS supports applications that use the Lotus-Intel-Microsoft Expanded Memory Specification (LIM EMS). DR Multiuser DOS allocates conventional memory and LIM EMS memory dynamically. Rather then having a certain amount of memory preallocated to it, a session is not allocated memory until an application is started.

IGC, Inc.

IGC takes a unique approach to achieving multiuser connectivity. The company's initial product, VM/386, is an add-on to DOS. VM/386 uses the virtual machine mode of the 80386 microprocessor to create a multitasking environment on top of a standard copy of DOS. VM/386 requires DOS 3.0 or later, allows data sharing among running tasks, provides file locking, and makes use of the DOS command.com file to allow use of traditional DOS commands.

VM/386 MultiUser runs on top of VM/386, creating a multiuser, multitasking operating system that can support up to 32 users. VM/386 allows a user to restart an individual virtual machine without affecting the operation of any of the other users' virtual machines. VM/386 Multiuser supports graphics when used with Advanced Micro Research, SunRiver, and Viewport International graphics adapters.

VM/386 MultiUser Starter allows a single 386 or 386SX computer to host two monochrome text-only terminals as well as supporting the monitor attached to the host machine. It includes a print spooler, and local printers are supported at the terminals. VM/386 Multiuser requires 4M bytes for a three-user system.

VM/386 and VM/386 MultiUser allow network access with an add-on option called NetPak. NetPak runs in one of the virtual machines, giving that machine access to the network server, all of the files stored on it, electronic mail, and the network-attached printers and other peripherals. The other virtual machines can access the network's resources through a NetPak utility called the Network Distributor. NetPak requires a network interface card and driver software. VM/386 supports most PC networks, including Novell NetWare.

S & H Computer Systems

S & H Computer Systems' TSX-32 is a multitasking, multiuser operating system for use on 386- and 486-based computers. TSX-32 executes programs in the 80X86's protected mode using 32-bit addressing and demand paging. TSX-32 also uses a proprietary job scheduling algorithm S & H calls Adaptive Scheduling, which allows flexible response to external factors such as I/O activity and completion, and each individual job's execution time. Jobs can be assigned higher priorities by administrators to override the normal interactive scheduling priorities. Each user connection to the host uses the virtual 8086 mode so that each terminal emulates a dedicated PC. DOS support in TSX-32 is not a program that rides on top of the multitasking OS. Instead, it is an integrated part of the TSX-32 kernel. Each user can have up to 10 programs running at one time.

TSX-TERM is a terminal emulator that allows a PC to connect directly to a TSX-32 system and retain its local processing capability, while acting as a TSX system terminal as well.

MessageNet is electronic mail for the TSX-32 system. It includes browse screens, forwarding and reply functions, reminder messages, distribution lists, and folders for message storage.

TSX-Net is an option that allows Ethernet networking between TSX host systems. A serial networking scheme is a standard feature of TSX-32. The TSX-32 network server software works with either attachment scheme to allow users on one system to access files and resources that reside on a different TSX-32 system.

The Software Link (TSL)

PC-MOS is a multitasking, multiuser operating system that lets users run multiple DOS tasks simultaneously, switching between programs with a "hot key." PC-MOS is available in 5-, 9-, and 25-user versions. It can address up to 4G bytes of RAM and can allocate up to 676K to each task, depending on configuration.

PC EmuLink is terminal emulation software that allows a PC to connect to a PC-MOS host. It requires 64K of RAM in the PC and connects either directly to the host with a null modem cable for speeds up to 38.4K bps, or

remotely over a dial-up connection. PC EmuLink's 25-line display supports either monochrome or CGA color text and graphics.

PC-MOS Gateway to Novell NetWare allows the PC-MOS multiuser system to communicate with a Novell NetWare LAN. It allows up to 16 users to share a single network adapter card connection, reducing the hardware expense usually involved with adding new users to the LAN.

TSL distributes the MaXtation SH-4 manufactured by Maxpeed Corp. of Foster City, CA. The MaXtation SH-4 is component set that includes a four-port Intelligent Workstation Controller, and a Maxpeed Hercules Workstation Unit that is attached to the controller by an eight-conductor phone cord with RJ-45 connectors. The MaXtation SH-4 Workstation unit includes a mouse interface, a parallel printer port, a beeper, and an activity LED. Up to four MaXtation Intelligent Workstation Controllers can be installed in a PC, to support up to 16 workstations.

StarPath Systems

StarPath Systems developed the Vmos/3 operating system to provide a DOS-compatible multitasking operating system for PC use. Vmos/3 implements demand paging to allocate RAM to programs only as needed, and virtual paging to allow hard disk storage space to simulate RAM storage. The Lotus-Intel-Microsoft/Expanded Memory Specification (LIM/EMS) is used to provide up to 32M bytes for each program.

Vmos/MultiUser (Vmos/MU) runs under Vmos/3 and allows as many workstations, each with its own DOS prompt, as the hardware is capable of supporting. Users may run multiple DOS sessions at one time. Individual sessions can be rebooted without affecting any other session. Up to 768K bytes are available for each session depending on the type of video in use. Vmos/MU requires at least 2M bytes of memory in the host, and the vendor recommends 4M bytes for optimum performance.

Theos Software Corp.

THEO+DOS runs on top of THEOS 386, the THEO multiuser system, which, like Bluebird's SuperDOS, is a proprietary multiuser operating system. THEO+DOS requires a licensed copy of DOS 3.1 or higher for each DOS user, and network versions of DOS applications are recommended by the manufacturer to ensure proper file sharing and file locking capabilities. THEO+DOS supports up to 256 simultaneous tasks and up to 30 users. 952K of RAM is allocated to each DOS user from up to 128M bytes of total memory. THEO+DOS can support up to 26 hard disks, each with a capacity of up to 4.29G bytes, for a total storage capacity of up to 111.6G bytes.

Users of THEOS 386 or THEO+DOS require another product, THEO+TERM, in order to have multiple sessions at their terminal. THEO+TERM allows up to eight active sessions per terminal that the user can "hot key" between.

ScanTerm is Theos' product that allows existing PCs to act as THEO+DOS or THEOS 386 terminals, while retaining their standalone computing capability.

THEO+GRAFX provides up to 16 users with VGA, EGA, or CGA graphics. It works with the Theos' TG-4 multiuser graphics adapter and controller box that Theos has OEM'ed from DigiBoard. The TG-4 is similar to the DigiBoard MV/4 described below. THEO+GRAFX also works with the SunRiver Fiber Optic Workstation.

Multiuser Serial Port Boards

Arnet

Arnet's newest product, the ClusterPort/S, is a workgroup concentrator that can support up to 128 ports. Available in versions for PC AT, Micro Channel, and EISA machines, the ClusterPort/S system includes a single host adapter card; an external power supply; and an RS-422 interface that can attach up to eight 16-port concentrator boxes, for the full complement of 128 ports. The concentrator boxes are available with DB-25 or RJ-45 connectors. A host PC can be equipped with as many as four ClusterPort/S systems giving it the capability to support up to 512 users.

Arnet's SmartPort Plus line of intelligent serial port boards is available in models with 8, 16, 24, and 32 ports. Based on a 10MHz 80C186 processor, the SmartPort Plus boards feature 64K of RAM onboard. Onboard RAM can be upgraded to a total of 512K. Port expansion kits for each board are available as well, in 8-, 16-, and 24-port increments, so any SmartPort Plus board can be upgraded to the full complement of 32 ports. Arnet also offers the SmartPort Plus Micro Channel for the IBM PS/2 Models 50 and above. The SmartPort Plus Micro Channel is available in 8-, 16-, 24-, and 32-port versions.

Arnet also makes the SmartPort board, originally known, in its eight-port version, as OctaPort. The SmartPort board is available in four- and eight-port versions. It can be attached to terminals or PCs using Arnet's four-line Quadracable or eight-line Octacable or an optional external box which is available with either DB-25 connectors or RJ-45 modular plugs.

MultiPort is Arnet's name for its line of standard serial port expansion cards, available in four- and eight-port models. As with the SmartPort board, the MultiPort can be ordered with the Octacable, or with an RJ-45 modular, or DB-25 equipped connection box. A Micro Channel Architecture model of the MultiPort 8 is also available, with the same three connection options.

Finally, Arnet offers a low-priced, two-port board called TwinPort.

Comtrol Corp.

Comtrol offers its Hostess four- and eight-port models for the IBM PC AT bus. They feature one 16450 UART chip per port. Four-port models are field upgradable to eight ports. Hostess/MC four- and eight-port models for the Micro Channel Architecture bus are similar to the AT bus models.

Hostess 550 buffered 4-, 8-, and 16-port models use 16550 UARTs. The four-port model is a half-slot card that can be upgraded to support eight ports with the addition of a plug-in daughter board. The Hostess 550 16-port model is a full-slot card. The Hostess 550/MC for the Micro Channel Architecture also supports 16 devices. Up to four Hostess 550 controllers can be installed in a single system.

Smart Hostess cards feature an onboard 80186 processor and up to 512K of RAM. The Smart Hostess cards are available in four-port and eight-port models, and the four-port version can be upgraded to eight ports with the addition of a plug-in module. All ports on either the four- or eight-port version can support synchronous communications.

The Hostess i Series cards are Comtrol's top-of-the-line models. Available in models for the PC AT bus (Hostess i), the PS/2 Micro Channel Architecture (Hostess i/MC), and the EISA bus (Hostess i/E), these boards use a 10MHz 80286 processor (i/MC), or a 12MHz NEC V53 processor

(i, i/E). All three cards are available in 8- and 16-user models, and any 8-user model can be upgraded to 16 users with an add-on card. All of the cards feature 128K of dual-ported RAM. The Hostess i/MC can be upgraded to 512K of onboard RAM, the Hostess i and the Hostess i/E to 2M bytes.

DigiBoard

DigiBoard offers a unique product in its top-of-the-line DigiCHANNEL C/CON-16. The C/CON-16 is a cluster controller capable of supporting up to 128 users. The C/CON-16 consists of two components—the C/X Adapter card that occupies a single host slot and is available in PC AT, Micro Channel Architecture (MCA), and EISA models; and an external concentrator box to which the terminals are attached. The adapter card is based on a 10MHz 80186 and has 128K of dual-ported RAM onboard. It has two full-duplex RS-422 synchronous ports that provide a data transmission rate of up to 1.2M bps. The concentrator box is also based on an 80186, but this processor is running at 16MHz. The concentrator also has 128K of RAM and sixteen 16C550 UART chips. An LED diagnostic display and a row of LEDs that indicate handshaking and transmission status like those found on a modem are provided. Transmission speeds of up to 38.4K bps are supported.

The DigiCHANNEL C/CON-16e is a less expensive version of the concentrator box, without the LED diagnostic display. It uses sixteen 16C450 UARTs and supports transmission speeds up to 19.2K bps.

DigiBoard makes several intelligent serial port boards. The DigiCHANNEL PC/Xi, which comes in 8- or 16-port models, is based on a 12.5MHz 80186 processor and the processor can be upgraded to 16MHz. It has 128K of onboard RAM standard, and can be upgraded to 256K or 512K. In addition to up to 16 asynchronous serial ports, the PC/Xi card can also be equipped with an optional synchronous port.

The DigiCHANNEL MC/Xi is for the IBM PS/2 Micro Channel Architecture. It comes in 4-, 8-, or 16-port models, is based on the 12.5MHz 80186, and has 256K of RAM onboard.

The DigiCHANNEL PC/Xe is available in 4-, 8-, and 16-port models. The 4- and 8-port versions are based on an 8MHz 80186; the 16-port model has a 10MHz 80186. It has 64K of onboard RAM.

The DigiCHANNEL COM/Xi, available in four- or eight-port models, is based on a 10MHz 80188 processor and has 256K of RAM onboard.

DigiBoard also makes a line of standard serial port boards. The DigiCHANNEL PC/X for the PC AT bus, and the DigiCHANNEL MC/X for the Micro Channel Architecture, are both available in 4-, 8-, and 16-port models.

DigiBoard also makes a multiuser graphics adapter. The DigiCHANNEL MV/4 provides four 640 x 480 color VGA channels for multiuser systems. Up to four of these cards can be installed in the same system for a total of 16 VGA graphics channels. Terminals can be located up to 200 feet from the host. An adapter box at the terminal allows the connection of a monitor, a keyboard, and a mouse to a single cable attached to the MV/4 card in the host.

Star Gate Technologies

Star Gate offers the Advanced Communication Link (ACL) series of intelligent serial port expansion cards. The ACL II+ is an eight-port board based on a 16MHz 80188 and is available with 16K or 64K of dual-ported RAM onboard. The ACL IIR+ is a 16MHz, 80188-based board with eight RJ-12 connectors that support low-cost telephone wire connections.

The ACL 16+ is a 16-port card for the AT bus that features two 80C186 processors. Each processor supports eight ports, and each has its own 64K of onboard RAM. The ACL MC and ACL MC16 fit the IBM Micro Channel Architecture bus and are built around 10MHz 80C186 microprocessor.

The PLUS 8 is an eight-port serial expansion board for the IBM PC XT and AT buses. A four-port version of the card is also offered, and it is upgradable to eight ports. The PLUS 8MC is an eight-port serial board for the IBM PS/2 Micro Channel bus.

Multiuser Graphics Adapters

Advance Micro Research, Inc.

The UnTerminal VNA (Video Network Adapter) is a full-size card for the IBM PC AT bus that supports monochrome text and Hercules-compatible graphics. Used in an 80386 host running in virtual processor mode, the VNA board provides a dedicated video display memory buffer and PC keyboard interface for each virtual terminal. The basic VNA card supports one workstation. Up to three additional VNA User Modules can be added to support a total of four workstations per card. VNA User Modules are piggyback cards that plug into connectors on the VNA card. Up to four VNA cards may reside in a single system, for a total of 16 workstations.

The VNA system also requires a Translation Unit and an Interface Unit. Since the video and keyboard signals are multiplexed over the cable, the Translation Unit is required to demultiplex the two at the host end. The Interface Unit splits video, keyboard, and I/O signals at the workstation end. The Translation Unit provides a 37-pin female adapter for parallel or serial I/O support for each workstation. The Interface Unit can be optionally equipped with a 25-pin female connector to attach a local parallel printer.

The UnTerminal VNA Plus (Video Network Adapter Plus) is similar in most respects to the original VNA adapter, but supports up to eight workstations. The base VNA Plus card supports four workstations, and four VNA Plus User Modules that each support a single workstation can be added.

The UnTerminal EGNA (Enhanced Graphics Network Adapter) provides up to four users with CGA or EGA graphics. An EGNA user module is added to the basic EGNA card to support each individual workstation. The EGNA card supports 640 x 350 alphanumeric color text and all-point addressable graphics. Like the other AMR cards, the EGNA card requires the external Translation Unit and Interface Unit at the host and workstation end, respectively.

The UnTerminal VGNA Plus (Video Graphics Network Adapter) connects four standalone VGA monitors and AT keyboards to an 80386 host PC. The VGNA Plus card supports a single monitor and keyboard, and additional stations are accommodated by adding up to three VGNA Plus User Modules. The User Modules are piggyback boards that attach to the VGNA Plus card. The VGNA Plus card and each User Module connect to a VGNA Plus Interface Unit that demultiplexes video, keyboard, and I/O signals. The Interface Unit also supports the attachment of a mouse and a printer. In contrast to the other AMR cards, only a single external box, the Interface Unit, is required with the VGNA system.

The Unterminal Connect Card (UCC) replaces the Interface Unit when a PC XT or PC AT, instead of a terminal, is connected to an 80386 host PC equipped with a Video Network Adapter (VNA).

SunRiver Corp.

SunRiver offers a broad line of products that enable text terminal and graphics workstation attachment to multiuser DOS systems via both fiber optic and shielded twisted-pair cabling.

SunRiver's Fiber Optic Station attaches to a 32M bps duplex fiber optic link. The Fiber Optic Station is offered in versions that support Hercules, EGA, or VGA graphics, and each version includes a 101-key IBM PC AT-compatible keyboard. The Fiber Optic Station supports Digital Research DR Multiuser DOS, Virtual Systems Quick Connect 386, IGC VM/386 MultiUser, TSL PC-MOS386, Alloy 386/MultiWare, and Theos THEO+DOS.

LightAdapter is the name SunRiver gives to its fiber optic card designed for use in 80386 or 80486 host systems. AT, EISA, and Micro Channel models of the LightAdapter card are available. Each card supports four workstation attachments.

The PC LightCard allows a PC to act as graphics workstation when connected to a multiuser host. The card fits the IBM PC XT or AT bus and is connected to the host's LightAdapter card via fiber optic cables, and data is transmitted at 32M bps in full duplex. The PC LightCard comes in two versions—one works with EGA, CGA, and MGA monochrome; the other supports VGA. Both versions include a file transfer utility and are equipped with a serial port.

Viewport International, Inc.

The VPT System 1000 is a four-user monochrome text and Hercules graphics system that consists of a host controller card that plugs into an IBM PC AT bus slot, and a station controller for each monitor. The host and station controller modules are connected by a single twisted-pair cable at distances of up to 250 feet. The station controller module features a serial port that can be used to attach a mouse, a modem, or a local printer. Resolution is 720 x 350.

VPT System 2000 is similar to the VPT 1000 described above but supports two EGA or EGA+ users. EGA resolution of 640 x 480 is supported in both digital and analog modes. The station controller module has two serial ports available.

ViewPort's VGA product, the System 3000, is available in two versions—the VPT System 3000-2 card is a two-user VGA system, and the VPT System 3000-4, a four-user VGA system.

Turnkey Multiuser Systems

Star Gate Technologies

Star Gate offers the Star Light Graphics Display System based on IGC's VM/386 software and Star Gate's fiber interface board and workstation module. The system can support up to 32 workstations featuring VGA graphics. Each workstation module is connected by a ring of fiber optic cabling to an interface card in the host PC. Running at a transmission speed of 125M bps, the fiber optic connection provides performance that contributes greatly to the user's illusion of a dedicated machine of his or her own. The system's VGA display capability supports Microsoft Windows 3.0 with a mouse. Putting a network interface card in the PC host will allow users to access the resources of a LAN, providing a low-cost way to increase the number of users on a network without adding a network node for each workstation.

A typical PC LAN using 386 PCs with VGA graphics can cost at least $3,000 per workstation. A multiuser graphics system can cost from $1,800 to $5,400 per station. The Star Light system costs under $1,500 per workstation.

Vendors

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