All About Integrating Micros in the Mainframe Environment

The microcomputer has arrived in the business environment and it is here to stay. The micro can no longer be viewed strictly as a toy for running games; it is being used as a valuable tool to perform various management functions. According to a survey done by International Data Corporation (IDC) in June 1982, only half of the large corporations had a plan for acquiring microcomputers. One year later, more than 90 percent of all large companies had developed a plan for microcomputer usage. This growing popularity has probably come as a result of the communications software presently available to link micros with mainframes or minicomputers; the micro is now capable of accessing information that is stored in data bases on large computer systems.

Until recently, there were relatively few micros being used in large corporations and MIS (Management Information Systems) was able to ignore the two or three personal computers that had crept in. The influx of micros into the corporate environment can no longer be ignored and it is especially important for MIS to get involved early in their implementation.

MIS is the one group within the organization which has all of the attributes necessary to ensure successful microcomputer implementation. MIS has a knowledge of the future plans of the corporation and the direction in which it is going. This knowledge will be very important in choosing micros which are versatile enough to adapt to changes in the organization. MIS has an in-depth knowledge of both hardware and software which comes from years of experience with large computer systems. Even though the capabilities of microcomputer hardware and software are quite different from those of mainframes, the expertise MIS has gained in the development of applications for larger systems will prove to be very valuable in the microcomputer evaluation process. MIS also has a very detailed knowledge of data base systems and how they function; this knowledge is necessary in order to guarantee the most efficient use of information. MIS can help the microcomputer user to access the appropriate information in corporate data bases. The knowledge MIS has in the area of communications cannot be overlooked when implementing a large number of microcomputers in an organization. The microcomputer user may want to communicate with the corporate mainframe and with other microcomputers; MIS's knowledge of compatibility among systems will be essential in making this connection possible. Dealing with vendors can sometimes be a very frustrating experience for the prospective buyer. MIS has had plenty of experience in negotiating with vendors before purchasing large computer systems. This experience will be extremely valuable in choosing the right microcomputer application software package and hardware. There will be many more vendors to look at when evaluating microcomputer hardware and software than there were in the mainframe evaluation process; however, in the long run, the time invested in this evaluation process will be well spent.

The influx of microcomputers in the mainframe world has led to many different vendors scurrying around to put together the perfect product to "link" the two. This report discusses the position MIS should take in corporate micro implementation and the various products on the market today which provide support for micro/mainframe communications. Handy comparison charts on the communications capabilities of popular microcomputers are also provided.

MIS should look at the use of micros as an opportunity to increase their value to the corporation. The use of technology in the corporation must be controlled and the MIS director is the ideal person to establish this control. MIS has the expertise to choose the most cost-effective equipment and to make sure that the software functions optimally. We cannot emphasize strongly enough the importance of early MIS involvement in the implementation of micros in the corporate environment.

The Evaluation Process

The first step in the microcomputer evaluation process is identifying the microcomputer user within the corporation. MIS can circulate surveys and conduct interviews with the prospective end-users; or, under the direction of MIS, a key individual from each of the end-user departments can be appointed to a task force to do this. A survey will be the first step in determining the overall need for microcomputers. The interviews will help MIS to determine whether the applications of interest are best-suited on a microcomputer or a mainframe.

If a micro is operating as a standalone unit, it is functioning totally independently of any other computer system. Many less complex functions can be performed on a micro to avoid tying up system resources on the mainframe. A microcomputer application, however, might require complex calculations that could be more efficiently performed by the mainframe; this can be done by passing the information up to the mainframe for processing and then having the results sent back to the micro. When the micro is communicating with a mainframe or with another micro, it is operating as part of a distributed network. This communication among the members of the network can allow a user to access information stored in data bases on the mainframe or on other microcomputers, thereby avoiding the need to re-key data that is already there.

Typical potential users of micros exist in the accounting, sales/marketing, engineering, production, shipping/receiving and research departments. Listed below are some of the application software packages commonly used by these departments. ▷

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▷ • Spreadsheet analysis—This type of package enables non-technical users to program financial forecasts and budgets. Interfaces are frequently provided to graphics processors to produce pie and bar charts. It can be very useful in doing small modeling tasks.

• Financial Modeling—These packages are used for complex models with large data files; access to a mainframe data base may be required. They are usually more expensive than the spreadsheet packages.

• Word Processing—This package usually includes most of the features available on word processing systems. Report preparation and text editing can be valuable features.

• Data Base Systems—This software provides the user with a relational view of the data. This sort of file management allows the user to concentrate on the application rather than on managing the data.

• Graphics Systems—These packages offer colorful data presentation capabilities.

• Communications Software—This software provides communications protocol support allowing connection to public data bases, a corporate host mainframe or other micros.

Software Evaluation

It is not usually application software that sells hardware; however, in the microcomputer industry, it does. When acquiring a large number of microcomputers for a corporation, the MIS director should consider those packages that are easy to use by non–technical personnel; this software should not require a programmer/analyst to operate it.

Application software should be purchased from a vendor with a proven track record. An end–user within the corporation might buy a software package from a vendor who promises that an enhancement to his application package will be available in the future. MIS professionals have experience in investigating promises such as these and, through contract negotiations, are able to guarantee what function will actually be delivered and when. A reputable vendor will stand behind his product if problems are encountered in running the software. Occasionally a user will experience problems in running a package that are a result of bad software released from the vendor. MIS is experienced in obtaining agreements from the vendor in the area of software support.

One of the most significant weaknesses of microcomputer application packages is the lack of adequate documentation. During the process of identifying the micro user, MIS should have established the average level of experience of this user. This will be important to know in choosing a package which will provide the appropriate amount of instructional detail necessary for the typical user. A high degree of user–friendliness in the software package, however, will lessen the need for in–depth documentation.

Hardware Evaluation

An important factor in the evaluation of microcomputer hardware and software is that of compatibility. Incompatible hardware increases the potential for waste and duplication.

The type of operating software used on a micro can be the key element in determining the usefulness of that kind of hardware in an organization. There are basically two types of operating systems: proprietary and generic. Proprietary operating systems will function on only one vendor's equipment while generic operating systems will function on a number of different vendors' equipment. Therefore, hardware that supports generic operating systems like CP/M, MS/DOS and Unix, which will allow the same application software to run on different vendors' products, should be considered very seriously before a large volume microcomputer purchase.

When acquiring a large number of microcomputers for a corporation, the number of different vendors' machines purchased should be kept to a maximum of three. This may not seem important until the corporation becomes interested in connecting micros with the corporate minicomputer or mainframe. Protocols used on micros can vary; the use of standard protocols will facilitate the connection of micros and other computers. Detailed information on the products available to link micros and mainframes is provided later in this report.
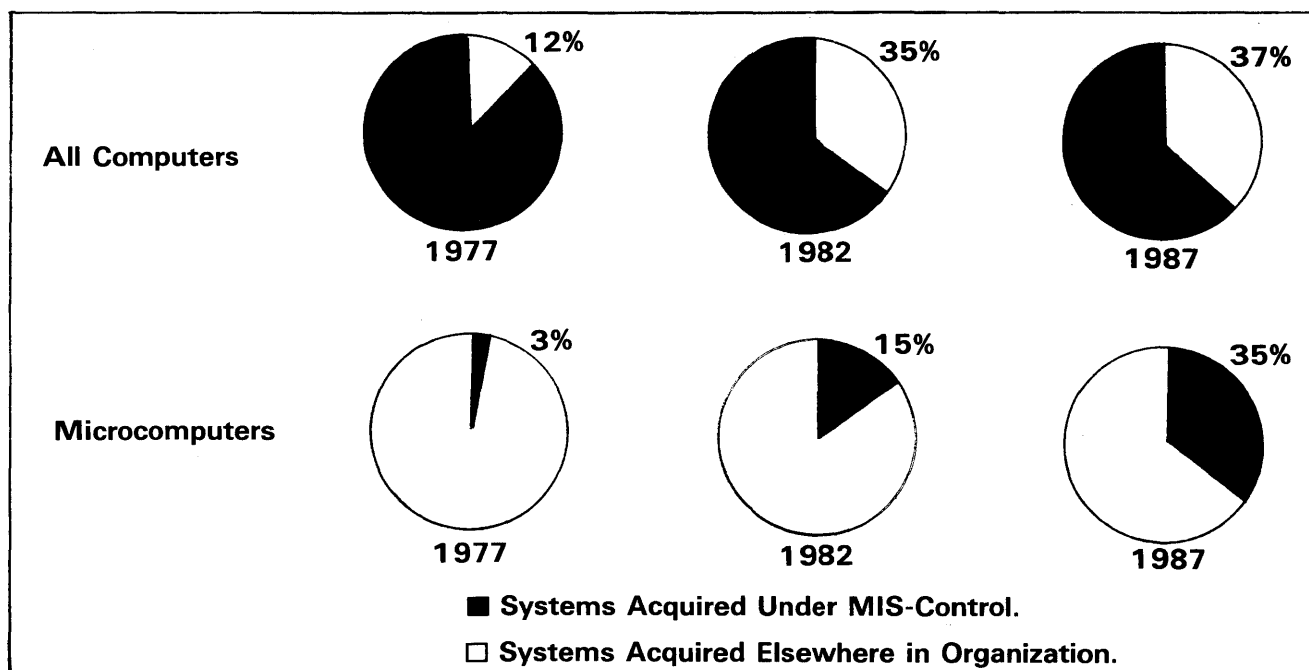
In addition, large corporate purchases will be far less expensive than ad hoc purchases on a per–system basis. When one vendor is being considered for a large microcomputer purchase, volume discounts should be negotiated for. Another reason for choosing micros from just a few vendors is to provide backup from micro to micro. If one micro is inoperable, the user can easily take data stored, for instance, on a floppy disk, move to another micro and continue to process.

An area that should be agreed upon before purchasing any microcomputer is vendor support for hardware maintenance. MIS is accustomed to dealing with vendors who sell or give support and service along with the mainframes they install. Support and service of micros should be negotiated for at the time of the purchase of the equipment. Vendors or distributors will probably be more inclined to provide on–site service for a large installation of their equipment. The vendor should provide a "loaner" machine in the case that the equipment has failed and must be taken elsewhere for repair. MIS has the expertise in negotiating in areas such as support and service and should use this expertise in obtaining a clear commitment from the vendor as to exactly what type of microcomputer hardware maintenance will be provided.

Setting Up An Information Center

The information center is a department that must be set up under the direction of MIS whose purpose is to provide ▷

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All Computers

12% — 1977
35% — 1982
37% — 1987

Microcomputers

3% — 1977
15% — 1982
35% — 1987

■ **Systems Acquired Under MIS-Control.**

□ **Systems Acquired Elsewhere in Organization.**

This is an example of how computer acquisition outside of MIS is slowing down yet microcomputer acquisition under the direction of MIS is rapidly increasing. The data for these pie charts was gathered by International Data Corporation.

▷ education, training and support to end-user personnel. End-users are trained by the information center staff to access data and generate reports. Almost half of the large IBM installations have implemented the information center concept.

Typically, the documentation provided with the purchase of microcomputer software will be in the form of selfpaced instruction. The information center staff should be knowledgeable about the different application packages purchased, after having been involved in their selection; they should be supportive of end-users in using these instructional materials. The information center staff should serve as internal consultants to the corporation.

Traditionally MIS has been faced with a huge applications backlog. The information center can provide an effective method of getting rid of this backlog by making the end-user more self-sufficient; a fourth-generation language can be used by the end-user as a tool for general problem solving and a financial analysis package can be used for budgeting and financial planning.

The information center staff is responsible for providing the user with access to information stored in the corporate data base. The micro user may need to obtain a subset of the data stored on the mainframe; the information center personnel should be able to determine which fields are to be contained in that subset. The micro user may use the information to produce management reports; on the other hand, the user might actually change data in the subset and send it back to the mainframe which updates the corporate data base. Systems security must be handled by the information center staff when linking micros and mainframes. Some of the products which provide this communications link on the market today have this security built in.

It is also the responsibility of the information center to ensure that the proper communications facilities are installed and that there is a sufficient amount of storage resident on the micro. If files are going to be downloaded from a host computer, there must be enough storage space to accommodate them. File standardization should also be set up to ease file transfers from one program to another.

If technical software support has been obtained from the vendor, it may not always be the kind of support that a less experienced micro user would require; the end-user might not even know what questions to ask. To avoid the frustration that would be caused by the end-user receiving technical jargon from the vendor, the information center staff should act as a liaison between the two. For these reasons, it is very important to establish an open line of communication between the information center staff and the end-user.

The Micro/Mainframe Connection

The mainframe computer with its processing power and ability to accommodate large data bases is a very important resource to the microcomputer user today. The micro user is finding out the value of tying micro work into existing data processing resources.

Software to link micros and mainframes is being offered by software suppliers, service bureaus, and hardware vendors. Their products have been described as being "quick" and "sophisticated," but the competition is getting stiffer every day. The integration of micros in the corporate environment has become so popular that these "link" suppliers realize that their product might very well determine their future place in the industry. ▷

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▷ Distributed data processing was implemented in the past to reallocate a set amount of applications programs and usually resulted in the off-loading of mainframe tasks. With the connection of micros and mainframes, the total amount of applications processing will be expanded and should provide some relief for current applications backlogs.

To present a clearer picture of how the micro/mainframe link fits into the corporate environment, the following is a list of the major needs of the end-user:

• Data Base Access—To access information which is stored in a corporate data base.

• Distributed Files—Data base extracts which the user maintains in private storage on a microcomputer for personal computations; optimally, these extracts will periodically be updated as changes are made to the corporate data base.

• Corporate Consolidation—To feed their data into a corporate pool of data for consolidation.

• Backups—To ensure backup of important data; optimally, these backups are done automatically along with mainframe corporate data.

• Access to Mainframe Peripherals—The ability to use line printers, laser printers, tape drives, and the mainframe hard disks.

• Distributed Processing—Simultaneous mainframe processing of some of the micro functions that cannot physically fit on the micro.

Product Descriptions

TERMINAL EMULATION: A wide variety of tools is available for linking microcomputers and mainframes and they come in many different forms. The very basic type of communication between the two is that of terminal emulation. The following list of products and their descriptions focuses on the terminal emulators which are currently available.

IBM

IBM provides its Personal Computer with the ability to serve as a terminal in all of IBM's major systems from the System/34 to the 308X. This connectivity consists of binary synchronous 3270 emulation which allows the PC to appear to the host system as one of the following IBM 3270 BSC devices: 3271 Model 2/3277 Model 2; 3274 Model 51C/3278 Model 2; 3275 Model 2; and 3276 Model 2. The communications interface supports the IBM BSC Communications Adapter and both switched and leased lines. Modem support includes an EIA RS–232–C interface, half duplex, external clocking, and up to 9600 bps. Non-3270 functions provided with the PC include: a command to route printer directed data to a file; a command to allow ASCII file data to be written to the unprotected fields on

the display for modification and/or transmission to the host; a command to format and print (or display) the communications line trace; and a command to display communications statistics. The cost of the emulation software is $700.

IE Systems

For the asynchronous world, ACCULINK communications software permits binary or ASCII file transfers between CP/M- or MS–DOS-based microcomputers and DECsystem-10 and DECSYSTEM-20 hosts. The micro can act as an intelligent terminal attached to the host machine, or it can transfer ASCII files over full-duplex links at speeds up to 9.6K bps. Screen contents can be stored on disk or sent to a printer. ACCULINK microcomputer communications software is priced at $245 per micro and the host communications software costs $2,445 per host machine.

For the bisynchronous world, IE Systems offers software which allows the micro to communicate with mainframes using industry standard synchronous protocols. BIS-3270 turns the micro into a bisync IBM 3270 terminal for screen-based transaction processing. Devices supported include the 3271/3277, 3274/3278, 3275 and 3276. BIS-3780 provides emulation of a Remote Job Entry terminal "talking" to a mainframe using 3780, 3741, 2780, or 2770 bisynchronous communications. BIS-HASP allows the micro to interact with HASP, POWER, JES, and RES as a multileaving workstation. BIS- software pricing starts at $695.

Intelligent Technologies

PC Express is an integrated communications package which consists of software on diskettes, tutorials, and a printed circuit board which plugs into an IBM Personal Computer. The package allows the IBM PC to emulate the DEC VT100 and VT52 terminals providing full file transfer capability between the PC and a DEC mainframe. PC Express also allows communication between the IBM PC and IBM mainframes through the Systems Network Architecture software providing access to any software product running in the SNA, VTAM/TCAM environment such as IMS, CICS, TSO and SPF. The mainframe recognizes the IBM PC as a 3274 Model 51C cluster controller with the PC console and keyboard acting as the 327X display station and performing 3770 Remote Job Entry emulation. The PC Express software package is priced as $1,295.

Intercomputer Communications Corporation

INTERCOM 100 is a software package which allows a microcomputer to emulate a Burroughs MT983/TD830 terminal. The software is compatible with the Corona, Columbia, Eagle, COMPAQ, and the IBM PC microcomputers. The package simultaneously supports up to five addresses: four addresses for concurrent operator dialogues and/or bi-directional file transfers, and one for background printing. The INTERCOM 100 is available on a 5¼" diskette and costs $99. ▷

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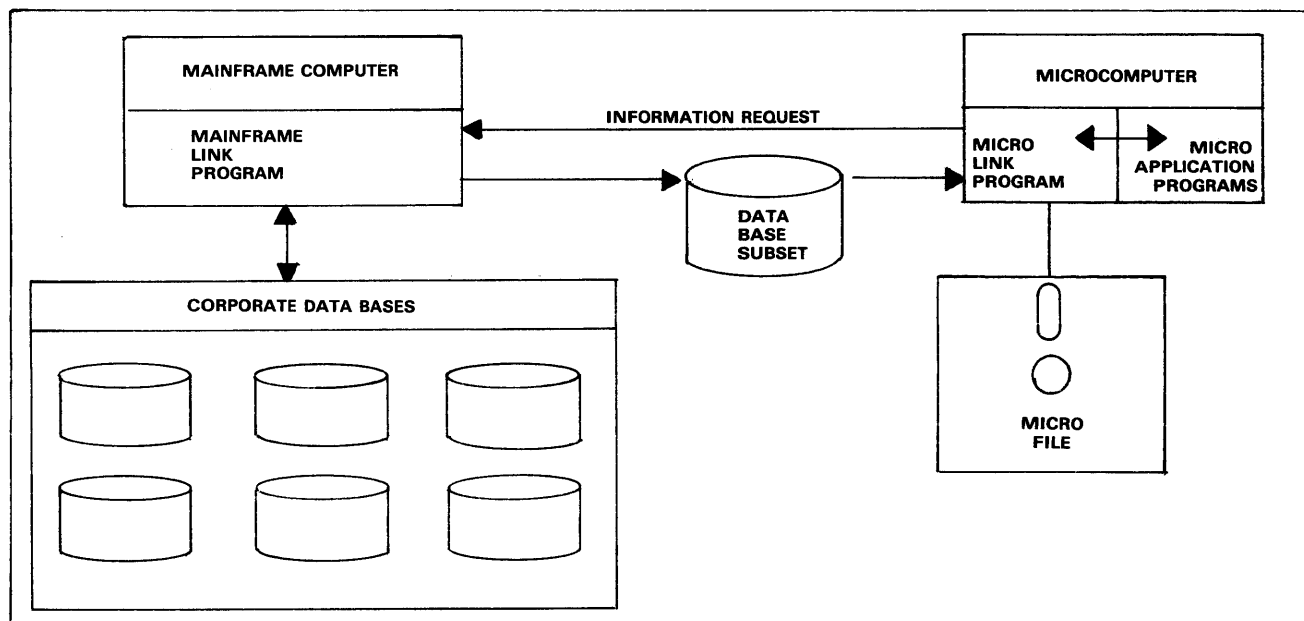
This is an illustration of one method of micro/mainframe interaction.

▷ **Micro Tempus Incorporated**

Tempus Link, an intelligent file–sharing software package for IBM mainframes, was designed to allow IBM Personal Computers to access virtual floppy disks on mainframes running CICS, TSO and VM/CMS. The package includes three major modules: A mainframe program which manages an unlimited number of micro–compatible "Virtual Disks" of variable size from 32K bytes to 15 megabytes, arranged in boxes of up to 255 disks; a communications module which makes the entire system independent of the teleprocessing monitor and the communications media used; and a micro portion which provides the micro with up to four mainframe "Virtual Disks" in addition to its physical disks. Major features of the package include: upload/download; operation in PC-DOS without affecting micro application software being run; binary data transfers without conversion; automatic backups; table lookup and data validation capabilities on the mainframe; and full-screen 3278 emulation and IBM 3101 emulation. Pricing for Tempus Link starts at $995.

OBS Software

FTP (File Transfer Protocol) is a utility program that allows file transfer between microcomputers and IBM mainframes running TSO or VM/CMS. Micros supported include the IBM Personal Computer running PC-DOS, Apple II running DOS or CP/M, and machines based on 8080 or Z80 microprocessors. The package provides two–way, high–speed, asynchronous text or binary file transfer through the use of a program resident on the mainframe and one that is resident on the micro. The purchase price of either the TSO or the VM/CMS Interface Program is $3,500. Both programs may be purchased together as a package for $4,500. A single version of the microcomputer program costs $500 and the price increases to $800 for four versions.

Software Module Marketing

PC-TRACS is a software product that performs batch teleprocessing functions for the IBM Personal Computer. The package supports the following application types: IBM 3780 terminal emulation; IBM 3780 host functions; send only functions; and receive only functions. Information can be downloaded from any mainframe bisynchronous device to the IBM PC for processing; the updated information can then be sent back to the mainframe. The method of diskette retrieval and transmission makes it compatible with mainframes. This involves extracting the variable length PC records and expands them to fixed length, allowing a programmer to develop a mainframe program using the line editor on the PC and transmit the program to the mainframe for compilation or assembly. PC-TRACS uses an RS–232 communications board and software diskette and supports leased or switched lines, including manual dial and/or auto answer. The communications board supports both bisynchronous and SDLC protocols. Pricing for PC-TRACS starts at $950.

TAB Products Company

The 8–bit and 16–bit multifunction workstations follow four IBM mainframe protocols: Async, Bisync 3780, Bisync 3270, and Bisync HASP. Async mode offers a store-forward capability which transfers files to mainframes such as IBM, CDC, DEC, and Honeywell. While looking like a terminal to the host, the interface allows recording of time–sharing sessions, forces the creation of backup files, and sends and receives multiple files. In Bisync 3780 mode, the system allows emulation of an IBM 2770, 2780, 3741, 3780 or a CPU. In Bisync 3270 mode, the interface communicates with any IBM network as if it were a 3270–type terminal. The microcomputer emulates a HASP multileaving workstation when operating in Bisync HASP mode making it functionally equivalent to an IBM 3777 program- ▷

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▷ mable terminal or System/360 Model 20 CPU. Additional communications capabilities for the TAB Workstation are included in the comparison columns later in this report. Pricing for the TAB Workstation starts at $6,995.

VM Personal Computing

PLEASE is an intelligent communications program that runs on VM/CMS-based mainframes and works in conjunction with IBM Personal Computers running the company's RELAY communications software package to allow uploading and downloading of any type of file from either computer. Some features of the PLEASE software package include: automatic translation between EBCDIC and AS-CII; option to suppress translation for binary files; and definition of user default options to facilitate uploading and downloading. Data being transferred does not tie up the PC's screen, and there is no need to clean up the transferred file. Two versions of the package are currently available. Personal PLEASE which supports a single copy of RELAY costs $99 and Corporate PLEASE which supports multiple copies of RELAY costs $1,495.

SOFTWARE DEVELOPMENT TOOLS: Another feature available in the micro/mainframe connection is a tool for use in developing software. Some of the packages currently available which provide code compatibility between a micro and mainframe are listed below.

Ryan-McFarland Corporation

A version of the RM/Cobol compiler enables users to download Cobol programs from IBM mainframes to microcomputers running the microcomputer version of the compiler. The portable software package was designed for use on the IBM 370, 4300 and 30XX series mainframes running under the VM/CMS operating system. Microcomputers that support RM/Cobol include those that are based on the the following microprocessors: Motorola 68000 and 6809; Zilog Z80 and Z8000; Intel 8086; and Texas Instruments 9900. For added security, the source code which is developed on the mainframe can remain there and only the object code may be downloaded to the micro. On the other hand, the same source code can be developed on the micro. An RM/Cobol program, no matter where it is developed, requires an average of only seven bytes of memory per source code line which greatly reduces storage requirements making program development on a micro more feasible. The software package allows for Level 2 sequential, relative and indexed file access methods which enables the user to set up data bases that can fulfill several applications. The product is available on a lease basis at a cost of $5,000 per year.

SoloSystems Incorporated

The SoloSystems 1116 Workstation is a single-user microcomputer system designed for programmers to write, edit, compile, test, document and maintain OS/VS Cobol programs for use on an IBM mainframe computer, completely independently of the mainframe. Programming tools include: a viewer to allow programmers to scan through a file without altering its contents; a compiler to check syntax and semantics; a verifier to test programs; a comparator for line-by-line comparison of two files; a diagrammer for graphic representation of a program's logic; a profiler to show how often a phrase or routine is executed; and a cross-referencer to show where paragraph names or variables are referenced in the source code. The 1116 Workstation comes equipped with a communicator which transfers data to and from the IBM mainframe. Communications capabilities for the 1116 Workstation are included in the comparison columns later in this report. Pricing for the 1116 Workstation starts at $35,000.

INTEGRATED APPLICATIONS PACKAGES: Some vendors who offer products in the area of linking micros and mainframes also offer integrated microcomputer software applications packages. Some of these packages provide for both uploading and downloading of data in the linking process. Others, however, only provide for downloading of data from the mainframe to the microcomputer; these packages are covered in the following product descriptions.

GRiD Systems Corporation

Three products support micro/mainframe connection within the GRiD product line: GRiDTERM, GRiD3101, and GRiDREFORMAT. When GRiDTERM is resident in bubble memory, the Compass microcomputer can be used as a standard asynchronous terminal; when GRiD3101 is resident in bubble memory, the Compass microcomputer can be used as a portable IBM 3101 or an IBM 3270 terminal. Both GRiDTERM and GRiD3101 will operate at 1200 or 300 bps using an integrated modem. Connections can be made with ordinary dial-up telephone lines. Through the use of an Access form which appears on the screen, the user specifies connection parameters, such as phone number, transmission rate, modem type, etc. All of this information can be saved in a file which causes GRiD-TERM or GRiD3101 to be initiated. The connection and terminal specifications are set up in a file according to the data retrieved from the mainframe; the number of mainframes with which the user will communicate will determine how many of these pre-defined files are needed. GRid3101 gives the user access to: IMS and CICS applications and files for processing and data manipulation; development systems such as VM/370 or TSO/SPF for text processing, file manipulation, job submission, program development, and all the other capabilities of these systems; and IBM's PROF System. GRiD3101 can also appear as an IBM 3270 terminal to those mainframe applications or systems which support IBM 3270 terminals, if: third party IBM 3101-to-3270 protocol conversion hardware is installed at either the mainframe site or the Compass site; or, the mainframe is running under VM/370 with the IBM 3101 Pass Through VM/370 Support Installed User Program is present. When suitable conversion hardware is installed, the Compass microcomputer appears as an IBM 3276 cluster control unit with either binary synchronous communications (BSC) or with Synchronous ▷

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▷ Data Link Control (SDLC). GRiDREFORMAT puts data received from the mainframe, which is usually in the form of a printed report, into a format suitable for use in one of the GRiD Management Tools (microcomputer application software packages). It strips away needless information and it converts certain characters into a format required by the micro application. GRiDTERM and GRiDREFORMAT are sold together as a package for $200; GRiD3101 and GRiDREFORMAT together cost $250.

Informatics General Corporation/VisiCorp

VisiAnswer is designed to link IBM Personal Computers with data bases on IBM mainframe computers and works in conjunction with the Informatics Answer/DB on-line retrieval and reporting system. Informatics has designed VisiAnswer to be application-independent, providing access to a variety of mainframe files and data bases. The package allows the user to formulate requests for specific mainframe data. The Answer/DB product selects and extracts this data from the data base (such as IMS, IDMS, and TOTAL), summarizes the data, and downloads it to a micro running the VisiAnswer software. The summarized data is stored on the micro's floppy diskette in a format immediately usable with the VisiCalc, VisiTrend/Plot, and other VisiSeries software packages. The initial versions of Answer/DB and VisiAnswer communicate with each other using an asynchronous link protocol. Later versions are expected to support IBM's bisynchronous (BSC) and Systems Network Architecture (SNA/SDLC) communications protocols. A typical configuration, consisting of an Answer/DB module on a single mainframe and VisiAnswer for 50 microcomputers costs $45,000.

University Computing Company

UCC MBA is an integrated applications software package which includes support for communications between a corporate mainframe with an asynchronous port and the IBM Personal Computer or Hewlett-Packard HP-9816 Personal Computer. The terminal communications environment is established by specifying mainframe specific information such as baud rate, bits per character, parity, stop bits, type of buffering, duplex operating (half or full), and character set (ASCII or EBCDIC). Using a modem to establish communications, the micro acts as a 30 character-per-second non-intelligent TTY-type terminal. Any disk file that can be accessed in a dial-up asynchronous mode can be downloaded to the micro running MBA. This data can be edited to delete the unnecessary lines and then expanded into the MBA spreadsheet for subsequent manipulation. Pricing for UCC MBA starts at $900.

The following describes those products which provide integrated microcomputer applications software packages and allow both uploading and downloading of data in linking micros and mainframes. The upload feature can be quite valuable because it eliminates the need to re-key micro-based information into the mainframe.

Applied Data Research Incorporated

The basic design approach ADR has taken for its micro/mainframe communications capability is called the Information Distribution Architecture (IDA). IDA is a mechanism for accessing, sharing, and moving information between mainframes and micros and it is modeled after IBM's Document Interchange Architecture syntax. Implementation of the IDA architecture consists of a connection layer and a function layer of software. The connection layer supports connection protocols and data transfer between nodes in a distributed network; the function layer supports a full range of software capabilities that allow a user at one node to manage information stored at another node. Protocols supported include asynchronous, bisynchronous, and SNA/SDLC. ADR/LINK is the primary software component of IDA and supports micro/mainframe connections via a telecommunications line.

In addition to IDA, three other products enhance the capabilities of the micro. ADR/PC Datacom provides the ability to obtain data from mainframe Datacom/DB data bases using full relational capabilities. Data received by the micro is stored in the Visi On Data Structure format, allowing information to be shared by all Visi On applications. ADR/PC EMail allows users to create and edit correspondence on the micro and then upload it to the mainframe for distribution. ADR/PC Empire allows the results of the mainframe's decision support system ADR/Empire to be downloaded for processing on the micro under Visi On. Results of Visi On Calc can be uploaded to the mainframe also. ADR/PC Roscoe and ADR/PC Vollie serve as local programmer workstations for the mainframe-based on-line programming products ADR/Roscoe and ADR/Vollie. Editing and browsing capabilities are provided for files stored locally or on the mainframe. Currently, ADR supports micro/mainframe communications for the IBM PC and IBM mainframes. The ADR/PC products are priced from $500.

Comshare Incorporated

Distributed W is a micro-based version of Comshare's mainframe W software. It provides asynchronous communications capabilities for linking the IBM Personal Computer and mainframes operating under VM/CMS or MVS/TSO environments. The product provides integrated communications and syntax compatibility. Features of Distributed W allow users to: extract data from the mainframe and transmit it to the micro; maintain libraries of applications on the mainframe and electronically transmit a whole application to the microcomputer; and develop financial models on the micro and send certain functions to be processed on the mainframe. Building a model on the micro is done through a series of menus displaying System W commands, much the same way as a model is built on the mainframe. Distributed W includes two-dimensional financial modeling and color graphics capabilities. Pricing for Distributed W starts at $80,000. ▷

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▷ **Cullinet Software**

The Cullinet Information Database facility is a series of files of summarized management information which may be created from either production data or external sources. These files reside on the mainframe and may be accessed by the IBM Personal Computer and Apple's Lisa microcomputer. The data can then be manipulated using spreadsheet, modeling and graphics products from Apple Computer or Cullinet's Integrated Personal Computer Software. Files created on the micro can be stored in the Information Database and later retrieved for use on the micro; these files can also be used to update the production data base on the mainframe. The hardware connection of microcomputers to the mainframe may be made using 3270 emulation or asynchronous protocols. The Information Database facility is designed to run on an IBM 360/370, 43XX, 30XX, or compatible system and costs $75,000.

Honeywell Information Systems

The Microsystem 6/10 includes communications capabilities to connect the user with both IBM and Honeywell mainframes. The micro is compatible with IBM's Systems Network Architecture and bisynchronous communications protocols, as well as Honeywell's Distributed Systems Architecture and Remote Network Processor. In linking microcomputers and mainframes, the Honeywell system has achieved four levels of sophistication: IBM 3270 and X.25 communications; high-level language compatibility; file compatibility; and application subset compatibility. Management tools supported by the Microsystem 6/10 are InfoCalc, Multiplan and various word processing tools and other office automation products. Users can take advantage of the wide range of microcomputer applications software developed for MS–DOS and CP/M 86–based systems by using an optional board in one of the expansion slots available with the Microsystem 6/10. Additional information on the communications capabilities of the Microsystem 6/10 is included in the comparison charts later in this report. Pricing for the product, which includes both hardware and software, starts at $3,995.

Intel Corporation

The Data Pipeline is designed to link SYSTEM 2000 data bases on Control Data, IBM, and Sperry mainframes with microcomputers. The product, which consists of both hardware and software, is built around Intel's iDIS 86/735 Database Information System, a microcomputer–based traffic manager which interprets, stores, and distributes mainframe data to and from microcomputers. The Data Pipeline uses the SYSTEM 2000 data base management system for data storage and retrieval; it has been enhanced to include a relational capability, graphics, and a fourth generation architecture called SYSTEM 2000 On-Line Operation. The microcomputer used in the Data Pipeline product is based on the 16–bit 8086 microprocessor and it communicates with all mainframe processors that run SYSTEM 2000 via a configurable communications subsystem. Synchronous mainframe communications support is

handled by an iSBC 88/45 Advanced Communications Processor Board. On–board firmware supports bisynchronous HASP multileaving protocol. Asynchronous communication is controlled by an iSBC 544 Intelligent Communications Controller board. Pricing for the Data Pipeline starts at $35,000.

Management Science America Incorporated

PeachLink is microcomputer software which provides selection and data capture from MSA data bases resident on an IBM mainframe. Micros supported by PeachLink include the IBM Personal Computer, and the Epson QX10. In the initial sign–on procedure, the mainframe recognizes the micro as a terminal. The user then displays the information from the mainframe data base on the micro screen. By depressing a special key, the screen freezes, mainframe access is disconnected, and control is passed to the microcomputer processor. The user may save the entire screen, save only a portion of it by selected rows or columns, or define certain data selection criteria known as a template. This template is stored in a file on the micro which can be used with the MSA's Executive Peachpak II, Lotus Development Corporation's 1–2–3, VisiCorp's VisiCalc, and Data Interchange Format microcomputer applications software packages. Summary information can then be transmitted back to the mainframe. PeachLink, which is included in Executive Peachpak II, costs $6,000.

McCormack & Dodge Corporation

The bisynchronous Interactive PC Link allows the IBM Personal Computer to communicate with McCormack & Dodge mainframe application files resident on an IBM ▷

Supplier	Electronic Spread-sheet	Text Editing	Word Processing	Business Graphics	Data Base Mgmt.
ADR	X		X	X	X
Comshare	X			X	
Cullinet	X			X	
Grid	X	X	X	X	X
Honeywell	X		X		
Intel	X		X	X	
McCormack & Dodge	X			X	X
MSA	X	X	X	X	X
On–Line Software	X		X	X	
UCC	X		X	X	X
VisiCorp	X		X	X	X

This table shows which integrated applications packages are offered by each vendor.

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> mainframe. The software package provides downloading of data either in the form of a complete file, a record, or a piece of a record. The Link works in conjunction with McCormack & Dodge's Advanced Financial Systems (AFS), a system which reuses code and routines; applications using AFS draw on a common base of information. HiLite, an on-line query facility, is used to search for data and select appropriate items from different mainframe applications; this data is then condensed into a form suitable for use on the micro. The package also includes a customized version of Lotus Development Corporation's 1–2–3 spreadsheet, data base management and graphics package. By using the real-time uploading feature, mainframe files can be updated. The purchase price of $25,000 per mainframe plus $2,500 per PC Link includes Lotus 1–2–3, customized McCormack & Dodge software on Lotus 1–2–3 and all required hardware to interface the micro with the mainframe via the 3270 protocols.

On–Line Software International Incorporated

OmniLink, an integrated software package, was designed to provide intelligent communication between an IBM Personal Computer and an IBM mainframe. Selected fields and records can be extracted and transferred from the mainframe to the micro for use in electronic spreadsheets, business graphics and word processing applications. An identical query language exists on both the micro and the mainframe which facilitates obtaining data from either device. The application generator will allow the user to write a custom program and upload it to the mainframe. Omnigard will allow MIS to control access to information in the mainframe, deciding which levels of data the user will have access to and when. A monitoring capability is also included which allows MIS to track mainframe use. Pricing for OmniLink starts at $24,000.

Micros and Information Retrieval and Remote Computing Services

It can be said that both the information retrieval services and time–sharing segments of the remote computing services industry have experienced both positive and negative effects since the acceptance of the microcomputer in the corporate environment. In conjunction with information retrieval services, the microcomputer has evolved from a "dumb" terminal to a local storage/data manipulation processing tool. In the time–sharing environment, microcomputers have become effective communications nodes in the time–sharing vendors' telecommunications network; however, the capabilities of the micro have caused problems for vendors ranging from unauthorized downloading of information from public data bases to the replacement of simple applications processing offered by time–sharing companies.

The key to the success of information retrieval services lies with the microcomputer's ability to access and locally store information that is available in the public data bases. This enables users to manipulate the stored information off-line,

whether it be for financial analysis, market research, or a number of other strategic calculations. It is how the information retrieval service vendors handle this capability that will either "make or break" the industry.

Communications Capabilities

Most microcomputer hardware today contains some communications capability. The most prevalent of these capabilities is basic asynchronous, or teletype, terminal emulation. This capability enables the micro to function as a basic conversational terminal. Other communication packages enable the micro to emulate a Telex or TWX terminal. Bisynchronous or SNA/SDLC communications are enabled through IBM 3270 emulation packages, enabling the micro to appear to the host as a 3277 or 3278 terminal. In an effort to bring PC capabilities to its large 3270 user base, IBM's 3270 PC Attachment option lends personal computing capabilities to the 3278 display.

Communications software is usually available directly from the microcomputer vendor, who may have developed it in-house or licensed it from a third party. Communications software for most popular microcomputer systems may also be purchased directly from a software vendor or distributor.

THE COMPARISON CHARTS

The comparison charts presented in this report summarize the key characteristics of the data communications functions of some of the popular microcomputers on the market today. This information was supplied by the vendors, whose cooperation is gratefully acknowledged.

A description of the comparison chart entries follows.

Main Storage

Processor Type indicates the manufacturer and model of the microprocessor used as the system's central processing unit (CPU).

Capacity of basic system, bytes specifies the amount of memory included in the basic system. The amount of internal storage is one of the most significant characteristics in appraising the power of any computer. The amount of productive processing that a computer can perform during any one run is largely determined by the number of instructions and/or operands it can hold.

Maximum capacity, bytes shows the largest memory size available for this model; *increment size, bytes* indicates the size of the memory modules that can be added to expand the basic system.

Communications

Maximum number of lines indicates how many communications lines can be physically connected to a particular system. The types of lines are specified in the next two ▷

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▷ entries. The entries in these three categories represent the raw outer limits of line number, type, and speed provided by each system.

To utilize this information properly, the reader must take into consideration two important factors. First, the line mix (the number of lines of each type and speed) and the resource mix (the number and type of workstations, peripherals, and other facilities) determine the actual practical limits of the system. For example, the number of high-speed communications lines that are physically attachable to a processor is generally much less than the number of low- or medium-speed lines. Secondly, the throughput capabilities of the system vary radically, depending not only on the physical configuration of the hardware but also on the system's software requirements. Even if the system is configured within recommended physical bounds, a heavy processing load can reduce throughput to below an acceptable level.

Synchronous and *asynchronous* have entries of standard, optional, or no, indicating their availability, and also a notation as to the speed of each line in bits per second (bps). Most entries are of the type "to 4800 bps," indicating one or more lines supporting transmission up to a maximum of 4800 bps.

Protocols supported indicates the type of communication protocols accommodated by hardware and software for the model.

Network architecture supported indicates the communications network architecture support by this model. Entries may include, for example, Xerox's Ethernet, Datapoint ARCnet, Apollo Domain, Corvus Omninet, Zilog Z-net, IBM SNA, or CCITT X.25.

RJE terminals emulated indicates whether there is software available from the vendor for this system to enable it to function as a "look-alike" for remote job entry terminals. The terminals for which support is provided are indicated.

IBM 3270 emulation is listed as a separate entry as a result of an increasing amount of interest from our users concerning the emulation of the IBM 3270 Information Display System.

Pricing

Purchase price of basic system shows the minimum purchase price of the system. In the case of a system in which each component is sold as a separate item, the comparison chart shows the price of the CPU, power supply, front panel, and minimum memory in the chassis. In the case of a packaged system, the price includes all standard components and facilities of the entry-level model.

Comments

This final entry on the comparison charts is used to explain or amplify the preceding entries and to provide other pertinent information about each system's hardware, software, pricing, or applications.

Dashes (—) will occasionally appear in the chart. This indicates that Datapro lacks the information needed to provide the required answer, or that the system being summarized does not possess those capabilities.

In Conclusion

A successful implementation of micros in a mainframe installation depends on thorough planning. It is essential that MIS get involved early in the evaluation and selection phases of micro implementation because this is the only group in an organization that has the necessary data processing background along with a knowledge of the direction in which the corporation is going.

Suppliers

Listed below, for your convenience in obtaining additional information, are the full names, addresses and telephone numbers of the vendors whose products are included in this report. ▷

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▷ **Apollo Computer Corporation,** 19 Alpha Road, Chelmsford, MA 01824. Telephone (617) 256-6600.

Applied Data Research, Inc., Route 206 & Orchard Road, CN-8, Princeton, N.J. 08540. Telephone (201) 874-9000.

Burroughs Corporation, Burroughs Place, Detroit, MI 48232. Telephone (313) 972-7000.

Comshare, Inc., 3001 South State Street, Ann Arbor, MI 48104. Telephone (313) 994-4800.

Convergent Technologies, 2500 Augustine Drive, Santa Clara, CA 95051. Telephone (408) 727-8830.

Cullinet, Inc., 400 Blue Hill Drive, Westwood, MA 02090. Telephone (617) 329-7700.

Datapoint Corporation, 9725 Datapoint Drive, San Antonio, TX 78284. Telephone (512) 699-7059.

Digital Equipment Corporation (DEC), 146 Main Street, Maynard, MA 01754. Telephone (617) 897-5111.

Fortune Systems Corporation, 1501 Industrial Road, San Carlos, CA 94070. Telephone (415) 595-8444.

GRiD Systems Corporation, 2535 Garcia Avenue, Mountain View, CA 94043. Telephone (415) 961-4800.

Hewlett-Packard, General Systems Division, 19447 Pruneridge Avenue, Cupertino, CA 95014. Telephone (408) 725-8111.

Hewlett-Packard, Personal Office Computer Division, P.O. Box 572, 978 East Arques Avenue, Sunnyvale, CA 94086. Telephone (408) 735-1550.

Honeywell Information Systems, Inc., 200 Smith Street, Walthan, MA 02154. Telephone (617) 895-6000.

IBM Corporation, Information Systems Division, Entry Business Systems, P.O. Box 1328, Boca Raton, FL 33432. Telephone (305) 998-6007.

IE Systems, 112 Main Street, Box 359, Newmarket, NH 03857. Telephone (603) 659-5891.

Informatics General Corp., 21031 Ventura Boulevard, Woodland Hills, CA 91364. Telephone (213) 887-9040.

Intel Corp., P.O. Box 9968, 12675 Research Boulevard, Austin, TX 78766. Telephone (512) 258-5171.

Intelligent Technologies, 151 University Avenue, Palo Alto, CA 94301. Telephone (415) 328-2411.

Intercomputer Communications Corp., 3195 Linwood Avenue, Suite 2A, Cincinnati, OH 45208. Telephone (513) 321-3199.

Lanier Business Products, Inc., 1700 Chantilly Drive N.E., Atlanta, GA 30324. Telephone (404) 329-8000.

Management Science America, Inc., 3445 Peachtree Road N.E., Atlanta, GA 30326. Telephone (404) 239-2000.

McCormack & Dodge Corp., 560 Hillside Avenue, Needham Heights, MA 02194. Telephone (617) 449-4012.

Micro Tempus, Inc., 4 Farnham Place Bonaventure, P.O. Box 1339, Montreal, Quebec H5A 1H1. Telephone (514) 861-3335.

NCR Corporation, 1700 South Patterson Boulevard, Dayton, OH 45479. Telephone (513) 445-5000.

Northern Telecom, Inc., Electronic Office Systems, Data Park, P.O. Box 1222, Minneapolis, MN 55440. Telephone (612) 932-8000.

OBS Software, 115 Sansome Street, San Francisco, CA 94104. Telephone (415) 391-9555.

On-Line Software International, Fort Lee Executive Park, 2 Executive Drive, Fort Lee, N.J. 07024. Telephone (201) 592-0009.

Onyx Systems, Inc., 25 East Trimble Road, San Jose, CA 95131. Telephone (408) 946-6330.

Radio Shack, a Tandy Corporation, 1800 One Tandy Center, Fort Worth, TX 76102. Telephone (817) 390-3300.

Ryan-McFarland Corp., 609 Deep Valley Drive, Rolling Hills Estates, CA 90274. Telephone (213) 541-4828.

Software Module Marketing, Crocker Bank Building/Penthouse, 1007 Seventh Street, Sacramento, CA 95814. Telephone (916)441-7234.

SoloSystems, Inc., 482 Oak Mead Parkway, Sunnyvale, CA 94086. Telephone (408) 945-1700.

Tab Products Company, 2680 Hanover Street, Palo Alto, CA 94304. Telephone (415) 493-5790.

TeleVideo Systems, Inc., 1170 Morse Avenue, Sunnyvale, CA 94086. Telephone (408) 745-7760.

University Computing Company, UCC Tower, Exchange Park, Dallas, TX 75235. Telephone (214) 353-7100.

Vector Graphic, Inc., 500 North Ventu Park Road, Thousand Oaks, CA 91320. Telephone (805) 499-5831.

VisiCorp, Inc., 2895 Zanker Road, San Jose, CA 95134. Telephone (408) 946-9000.

VM Personal Computing, Inc., 60 E. 42nd Street, New York, N.Y. 10165. Telephone (212) 697-4747.

Wang Laboratories, Inc., 1 Industrial Avenue, Lowell, MA 01851. Telephone (617) 459-5000.

Wicat Systems, Inc., P.O. Box 539, 1875 South State Street, Orem, VT. Telephone (801) 224-6400.□

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MANUFACTURER & MODEL	Apollo Domain	Burroughs B20	Convergent Technologies AWS-215	Convergent Technologies AWS-225	Convergent Technologies AWS-235
MAIN STORAGE					
Processor Type	32-bit	Intel 8086/8088	Intel 8086	Intel 8086	Intel 8086
Capacity of basic system, bytes	3.5M per CPU	128K	256K	256K	256K
Maximum capacity, bytes	3.5M per CPU	512K/640K	512K	512K	512K
Increment size, bytes	—	—	128K	128K	128K
COMMUNICATIONS					
Maximum number of lines	3 per CPU	—	—	3	3
Synchronous	Up to 19,200 bps	—	—	Up to 9600 bps (opt.)	Up to 9600 bps (opt.)
Asynchronous	Up to 19,200 bps	Standard	—	Up to 19,200 bps	Up to 19,200 bps
Protocols supported	IBM, DEC, Hewlett-Packard	IBM BSC	—	Async., BSC, SDLC	Async., BSC, SDLC
Network architecture supported	Domain;X.25 Level 3; Ethernet	X.25	CT-Net, X.25	CT-Net, X.25, SNA	CT-Net, X.25, SNA
RJE terminals emulated	IBM HASP	IBM 2780/3780	IBM 2780/3780	IBM 2780/3780	IBM 2780/3780
IBM 3270 emulation	Yes-BSC/SDLC; also IBM 3101	Yes	Yes	Yes	Yes
PRICING					
Purchase price of basic system, $	24,900	Contact vendor	4,790	6,900	7,790
COMMENTS					

MANUFACTURER & MODEL	Convergent Tech. AWS-245/-255/-265	Datapoint 1560	Digital Equipment (DEC) Rainbow 100	Digital Equipment (DEC) Professional 300	Fortune 32:16
MAIN STORAGE					
Processor Type	Intel 8086	Zilog Z80A	Zilog Z80/Intel 8088	PDP-11/23	Motorola MC68000
Capacity of basic system, bytes	256K	64K	64K	256K	256K
Maximum capacity, bytes	512K	128K	256K	256K	1MB
Increment size, bytes	128K	64K	64K	—	128K-256K
COMMUNICATIONS					
Maximum number of lines	3	7	1	1	16
Synchronous	Up to 9600 bps (opt.)	Up to 9600 bps	Up to 19,200 bps	Up to 19,200 bps	Up to 19,200
Asynchronous	Up to 19,200 bps	Up to 9600 bps	Up to 19,200 bps	Up to 19,200 bps	—
Protocols supported	Async., BSC, SNA	TTY, TWX, TELEX, IBM, BSC/SDLC, Burroughs, Honeywell	—	—	IBM BSC
Network architecture supported	CT-Net, X.25, SNA	Datapoint ARC	—	—	X.25
RJE terminals emulated	IBM 2780/3780	IBM 2780/3780	—	—	2770
IBM 3270 emulation	Yes	Yes, BSC and SDLC	—	—	Yes, also 2968 and 3741
PRICING					
Purchase price of basic system, $	9,990	3,195	3,495	3,995-4,995	4,995
COMMENTS					

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MANUFACTURER & MODEL	GRiD Systems Compass	Hewlett-Packard HP 250/30 & 250/35	Honeywell MicroSystem 6/10	IBM Personal Computer	Lanier Computereze II
MAIN STORAGE					
Processor Type	16-bit	Multiple	LSI–6; 8086	Intel 8088	L-200
Capacity of basic system, bytes	256K	160K(sys.), 32K(us.)	128K	16K	128K
Maximum capacity, bytes	256K	192K(sys.), 384(us.)	512K	256K	256K
Increment size, bytes	—	64K, 128K	384K	—	64K
COMMUNICATIONS					
Maximum number of lines	1	—	3	1	—
Synchronous	—	110-9600 bps	Up to 9600	50-9600 bps	Up to 9600 bps (opt.)
Asynchronous	Up to 9600	110-9600 bps	Up to 9600	50-9600 bps	Up to 9600 bps (opt.)
Protocols supported	TTY	BSC	BSC,HASP, 2780, 3270,SNA/SDLC, VIP,STD,RNP,LHDLC	TTY, IBM BSC	IBM BSC
Network architecture supported	GRiDlink	—	SNA, RNP, DSA	—	Yes
RJE terminals emulated	—	IBM 2780/3780	IBM 2780,3780, 3777-3,HASP	—	IBM 2780/3780
IBM 3270 emulation	No, but IBM 3101 and DEC VT 100	—	BSC, SDLC	Yes	Yes
PRICING					
Purchase price of basic system, $	8,150	22,500-25,600	3,995-12,000	Yes	6,595
COMMENTS	Additional communications features planned	IEEE 488 Bus channels standard; operating system in resident RAM	All protocols selectable under software control.	1,565	

MANUFACTURER & MODEL	Lanier Computereze IV	Northern Telecom 503	NCR I-9010	Onyx Systems Sundance-16	Onyx Systems C5002
MAIN STORAGE					
Processor Type	L-400	Intel 8085A	Intel 8085	Zilog Z8001	Zilog Z8001
Capacity of basic system, bytes	128K	64K	48K	256K	256K
Maximum capacity, bytes	256K	256K	128K	512K	1024K
Increment size, bytes	64K	64K	32K	256K	256K
COMMUNICATIONS					
Maximum number of lines	—	1	1	2	2
Synchronous	Up to 9600 bps (opt.)	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps	Up to 9600 bps
Asynchronous	Up to 9600 bps (opt.)	Up to 9600 bps	No	Up to 9600 bps	Up to 9600 bps
Protocols supported	IBM BSC	TTY, IBM, BSC/ SDLC, Burr., CDC	BSC	IBM BSC (opt.)	IBM BSC
Network architecture supported	Yes	—	—	—	Omninet
RJE terminals emulated	IBM 2780/3780	IBM2780/3780, 3774,SDLC,2770; B.	IBM 2780/3780	IBM 2780/3780 (opt.)	IBM 2780/3780
IBM 3270 emulation	Yes	Yes, BSC/SDLC;	—	—	—
PRICING					
Purchase price of basic system, $	9,595	7,090	Contact vendor	12,990	10,990
COMMENTS					

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MANUFACTURER & MODEL	Radio Shack TRS-80 Model 16	SoloSystems 1116 Workstation	TAB Multifunction Workstation	TeleVideo Systems TS 1602/1603	Vector Graphic 5005
MAIN STORAGE					
Processor Type	M68000, Zilog Z80A	Motorola 68000	8088	Intel 8088	Zilog Z80B
Capacity of basic system, bytes	128K	1024	256K	128K	128K
Maximum capacity, bytes	512K	1024	768K	256K	384K
Increment size, bytes	128K	1024	256K	128K	64K
COMMUNICATIONS					
Maximum number of lines	2	15	8	1	1
Synchronous	Standard	Up to 9600	Up to 19,200	Up to 19,200 bps	1200 bps (opt.)
Asynchronous	—	Up to 9600	Up to 19,200	Up to 19,200 bps	1200 bps (opt.)
Protocols supported	IBM BSC	SDLC, BSC	ANSI,3270,3780, 2780,2770,3741, HASP,SNA SDLC 3270	TTY, TWX, Telex, IBM BSC/SDLC, Tele-Video TeleAsync	IBM BSC
Network architecture supported	Arcnet	SNA	—	Mmmost	—
RJE terminals emulated	IBM 2780/3780	—	3780,2780,2770, 3741	IBM 2780/3780, 2770	IBM 2780/3780
IBM 3270 emulation	—	Yes—BSC, SDLC	Yes—BSC, SDLC	Yes—BSC and SDLC	—
PRICING					
Purchase price of basic system, $	6,998 (floopy disk-based); 11,453 (hard disk-based)	35,000	6,995	2,995-4,495	7,990
COMMENTS				TeleAsync utilizes the Blast protocol by Communications Research Group, allowing for transfer of files to sys. using Blast, e.g. IBM PC, Apple II, Data General, DEC, HP	

MANUFACTURER & MODEL	Vector Graphic 5032	Wang Professional	Wicat Systems Systems 100	Wicat Systems System 150	
MAIN STORAGE					
Processor Type	Zilog Z80B	Intel 8086	Motorola MC68000	Motorola MC68000	
Capacity of basic system, bytes	128K	128K	512K	256K	
Maximum capacity, bytes	384K	640K	5M	1.5M	
Increment size, bytes	64K	128K	1M	512K	
COMMUNICATIONS					
Maximum number of lines	1	1	32	6-14	
Synchronous	1200 bps (opt.)	Up to 19,2000 bps	1M bps (opt.)	1M bps (opt)	
Asynchronous	1200 bps (opt.)	Up to 19,2000 bps	19,200 bps	19,200 bps	
Protocols supported	IBM BSC	IBM BSC	IBM BSC, SDLC	IBM BSC, SDLC	
Network architecture supported	—	WangNet (future)	OSI, SNA, .25	OSI, SNA, X.25	
RJE terminals emulated	IBM 2780/3780	IBM 2780/3780	IBM 2780/3780	IBM 2780/3780	
IBM 3270 emulation	—	No	Yes-SDLC	Yes-SDLC	
PRICING					
Purchase price of basic system, $	11,490	2,695-8,495	27,835	10,850	
COMMENTS		WangNet capabilities planned for future			