Trends in Microcomputer Operating Systems

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TRENDS IN MICROCOMPUTER OPERATING SYSTEMS

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CONTENTS

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EXHIBITS

I INTRODUCTION

- This study was produced by INPUT as part of the Microcomputer Software Program in the 1985 Market Analysis and Planning Service (MAPS) for the information services industry.

A. PURPOSE AND SCOPE

- The purpose of this report is to examine market issues, trends, and developments in microcomputer operating systems as they relate to the major trends in the information services industry.

- Although IBM PC-DOS was the hands-down leader in the business personal computer system marketplace in 1984 (over 70% of micro shipments were IBM or compatibles), new technological and industry trends will alter the market drastically.

- Information service vendors as well as users will need to be attuned to these changes. Software vendors with finite resources will need to know for which operating system to design application software. Users will want to know which products and hardware suppliers will survive in the marketplace to service present equipment as well as provide an upgrade path to the next generation of more sophisticated products.

- Operating systems are the major type of systems software for microcomputers. They manage all the computer's resources and supervise the processing of the end user's programs (application software). An operating system is normally included (bundled) in the user's initial cost of a microcomputer. It is developed by the hardware vendor or an independent software house and purchased by the hardware vendor to incorporate in the machine. Growth and changes in the operating systems industry therefore parallel and affect the hardware market.

- The scope of this report includes business microcomputers as well as operating systems since there exists such a high degree of interdependence between the products.

- The study examines several key issues:

  - What operating systems will IBM incorporate in future products?

  - How will technological changes affect operating system functions?

  - Will current operating system vendors remain leaders?

B. METHODOLOGY

- The research for this study included 20 telephone interviews, other INPUT programs and reports, secondary sources, our files, review of trade press literature, and previous INPUT research.

- The interviews were used to gather data, opinions, and plans for the purpose of performing the analysis for this study. The interview technique included the use of many open-ended questions in an effort to provide INPUT clients with maximum feedback on the current thinking of involved participants.

- Those interviewed included:
  - Independent operating system vendors.
  - Local area network (LAN) vendors.
  - Major microprocessor manufacturers.
  - Microcomputer hardware suppliers.
  - Microcomputer hardware application software vendors.
- A copy of the questionnaire is included in Appendix A. Definitions and the scope of inclusion for forecasts are included in Appendix B.

II EXECUTIVE SUMMARY

- This chapter summarizes key forecasts, issues, and trends that are discussed in more detail in the remainder of the report.

- This Executive Summary is prepared in a presentation format; i.e., the exhibits are set in larger type for use with an overhead projector, and the text is in script form. The script for each exhibit is contained on the left-hand page opposite the exhibit.

A. TRANSITION IN THE BUSINESS MICROCOMPUTER MARKET

- The business microcomputer marketplace is about to undergo a fundamental transition that will offer growth opportunities to current hardware and software vendors--and to newcomers. The transition affects the competitive scope of the business micro market (i.e., the products and services that the micro will challenge), the functional spectrum that the micro will cover, and the distribution channels that will funnel the product to end users.

- The fundamental shift from individual purchaser to corporate buyer greatly increased in 1984. Especially in large businesses (revenue over $10 million), a major product deficiency is becoming increasingly apparent: the inability to share a working file between users. This capability, as well as multitasking, is being realized, primarily due to microprocessor changes.

- It is becoming critical that control of corporate data be recaptured by the management information systems (MIS) department. This does not interfere with the business PC role as individual productivity tool (which will continue), but focuses on the necessity of linking individual work units so that a measure of uniformity (file structures, data formats, security, access control) can be established. File sharing and networking are the logical (and economically justifiable) answers to this need.

- Early 8-bit microcomputers would have had great difficulty exploiting multitasking even if it had been available--the processors were too slow and the memory overhead needed too onerous. Now, however, with memory capacities easily reaching beyond 1 MB and CPU processor speeds four times greater multitasking is easily justified, particularly in light of the impending shift from standalone (off-line) to linked (on-line) operation, with the need for many PCs to act as file servers for local area networks as well. Exhibit II-1 provides INPUT's forecast for both of these trends.

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TRANSITION IN THE BUSINESS MICROCOMPUTER MARKETPLACE

- **Standalone → Linked**
- **Single { User / Task → Multi { User / Task**

	Single User		
	Single-Task	Multitask	Multiuser/Multitask
1984	94%	1%	5%
1990	10%	65%	25%

B. TECHNOLOGY—A DRIVING FORCE IN THE MICROCOMPUTER INDUSTRY

- As with the initial development of the personal computer, today's and tomorrow's market stimulant will be technology: processor power, memory (and storage) size, and, as a result of cheaper technology, system cost. As processor power and memory size grow, the functional capabilities increase, providing wider market potential, increased sales and higher unit volume--which in turn allows cheaper prices, which in turn accelerate market penetration and increase product competitiveness. Each technological step therefore results in a new wave of products, markets, and applications.

- But raw processing power alone is insufficient to exploit the potential market; packaged software is the indispensable complement. In order for the applications software market to develop, an operating system (OS) standard must be available to serve as the foundation for families of software products with compatible files and command structures. Knowing which operating system will emerge as the dominant standard is therefore crucial, since it conditions the ultimate success of the hardware it drives and the applications it supports.

- Exhibit II-2 analyzes processor technology shipment trends over the past two (hectic) years and provides a forecast. In terms of installed base, there will be a dramatic decrease in the share of 8-bit processors (from 81% in 1983 to barely 5% by 1990). At the same time, however, the seeds of the replacement of the 16-bit processor were sown with the first volume shipments of 32-bit processors in 1984. The real significance of the 16-bit and (particularly 32-bit) processor is the new applicational vistas that are opened up, PROVIDING the required operating system's functional needs are met. Multiuser, multitasking, shared-file, and interconnected personal processing are the new markets that await development, and those needs must be supported by high-performance operating systems that integrate all of the supporting functions needed by these very different components.

TECHNOLOGY - A DRIVING FORCE IN THE MICROCOMPUTER INDUSTRY

	ACTUAL		FORECAST	
	1983	1984	1985	1990
Shipments (Million Units)	1.5	2.8	3.5	3.5
	Percent		Percent	
CPU Bit Size				
8	70%	27%	11%	-
16	30	66	72	74%
32	-	7	17	26

C. IBM'S OFFICE SYSTEM STRATEGY DEFINES THE OPERATING SYSTEM MARKET

- IBM's decision in 1981 to enter the microcomputer industry has affected the entire small system market immensely. The company offered a microcomputer product (the IBM PC, with an 8088-8/16 bit chip) more capable than competitors with an open operating system, to encourage development by third-party vendors of a large applications software base. In 1983-1984 IBM took over the business microcomputer marketplace.

- IBM's goal is to structure the office environment around the systems network architecture (SNA) and to assure the increasing demand for mainframe mips. Networked microcomputers as intelligent workstations linked to mainframes are a significant part of this strategy. Consequently, an operating system for microcomputers that provides these capabilities is a mandatory step for the company to take.

  - INPUT believes IBM will port a version of its mainframe operating system (VM) down to the microcomputer level for its high-end PC products. This proprietary operating system will help the company achieve absolute market dominance and reinforce the dependence on SNA. INPUT believes this proprietary microcomputer operating system, targeted for general business microcomputers, could be introduced as early as 1986.

  - Most IBM PC AT-type products and above are expected to have multiple operating systems running as guests under VM. This would include an enhanced version of PC-DOS (multiuser, multitasking) and perhaps a third choice, such as UNIX. The PC-DOS operating system would allow the usage of PC-DOS application software from the large installed base. The inclusion of other operating systems would depend upon uniqueness of application packages for that environment as well as the tools for program modification or development available under that specfic operating system.

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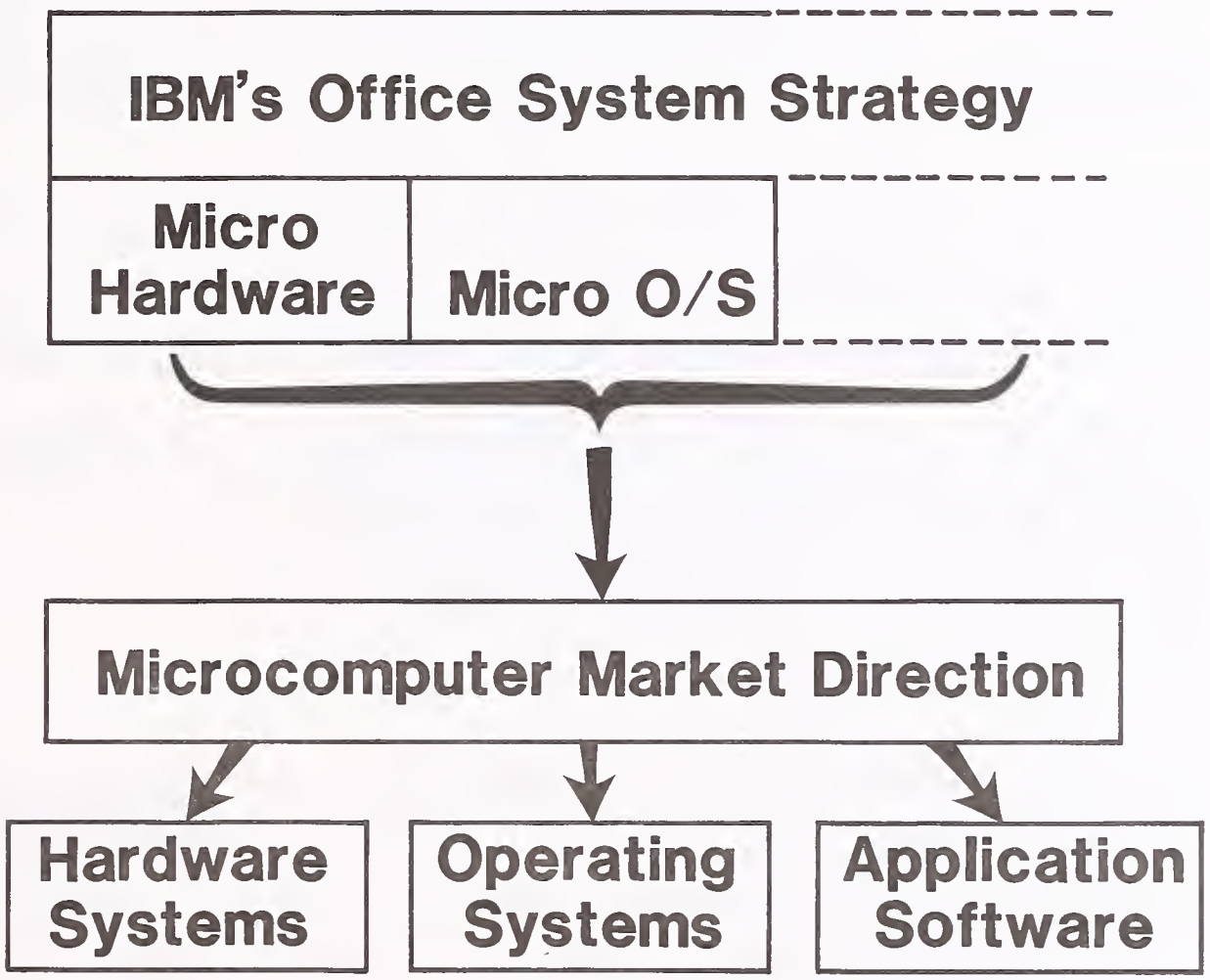
IBM's OFFICE SYSTEM STRATEGY DEFINES THE OPERATING SYSTEM MARKET



D. FATE OF THE OPERATING SYSTEM MARKET

- IBM's microcomputer products, based on IBM's operating system (PC-DOS and proprietary), will continue to have healthy growth rates.

- As the decade continues, both large and small businesses will consider their computers more as necessities than as luxuries. Consequently they will continue to turn to established companies for microcomputers--companies that can provide quality service and support and will remain in business to provide future compatible product upgrades and enhancements. The overwhelming choice for vendor will be IBM.

- Exhibit II-4 shows there will be secondary growth market opportunities for MS-DOS IBM compatibles, as well as for products based on major vendors' (i.e., Apple, Commodore) proprietary operating systems.

- Small businesses will be the main segment for these products since they are more price conscious than are large businesses, and the products will be lower in price than IBM products. "IBM consciousness" is not as well entrenched in small business as in large.

- UNIX, due primarily to ATT marketing thrust, will become a significant operating systems market player in 1986-1987 in multiuser environments; however, its market share will decrease significantly by decade's end as UNIX's major selling points (multiuser, multitasking, programming utilities) will be incorporated in one of IBM's new operating systems. UNIX will remain a market alternative, but, as with proprietary vendors, will be more successful in small business markets than in large.

THE FATE OF THE OPERATING SYSTEM MARKET

GROWTH MARKET	SECONDARY MARKET	DIMINISHING
PC-DOS and Upgrades	MS-DOS, IBM-Compatible OS, Proprietary OS,* UNIX/XENIX	MS-DOS, CP/M, Other Non-Proprietary O/S

*Excludes IBM

E. MICROCOMPUTER OPERATING SYSTEM FORECAST, 1985-1990

- The installed base of microcomputers, when viewed from an operating system perspective, will change dramatically through the decade's end. Technological trends, IBM's overall business strategy, and business needs are all stimulating that change.

- IBM will standardize the operating systems market. In 1983 the leaders in the micromarket were early innovators such as Apple, Tandy, and H-P, all with proprietary 8-bit operating systems. By 1989, IBM and compatibles will have the overwhelming market share.

- Application software developers will be writing in C for IBM products and networks, as well as for perhaps one alternative operating system--Apple DOS or UNIX. The most innovative and largest installed base of computerized "solutions" will be available on IBM products.

BUSINESS MICROCOMPUTER OPERATING SYSTEM FORECAST, 1985-1990

	ACTUAL		FORECAST	
	1983	1984	1985	1990
Installed Base (Million Units)	3.1	5.7	8.5	19.9
	Percent		Percent	
Proprietary and Other	62%	47%	35%	25%
CP/M	20	13	11	1
PC-DOS/MS-DOS Compatibles	18	33	48	74
MS-DOS	-	7	6	

III MARKET ANALYSIS

A. CHARACTERISTICS OF PERSONAL COMPUTER OPERATING SYSTEMS

- The function of an operating system is to decouple the user and the application software from the hardware. This requires at least three facilities:

  - Control and management of the computer's resources, including:

    . Memory allocation.

    . Disk file allocation.

    . Command processing.

    . Job stream management.

    . Internal timing requirements (priorities).

    . Management of the user (operator) interface.

    . Recognition and management of hardware error conditions.

  - Residence and operation of primitive programs that interact with and control the unique hardware components. For example:

  - . Getting a character from the keyboard.

  - . Putting a character on the CRT.

  - . Converting data from one code representation to another.

  - . Handling timing and access sequences of individual peripheral devices (device drives).

- Support and operation of the system utilities, employed to:

  - . Copy, catalog, recognize, or delete data and/or program files.

  - . Credit and edit programs and data.

  - . Display the status of various system capacities, e.g., disk file space available.

  - . Customize the operating system to various device and size configurations.

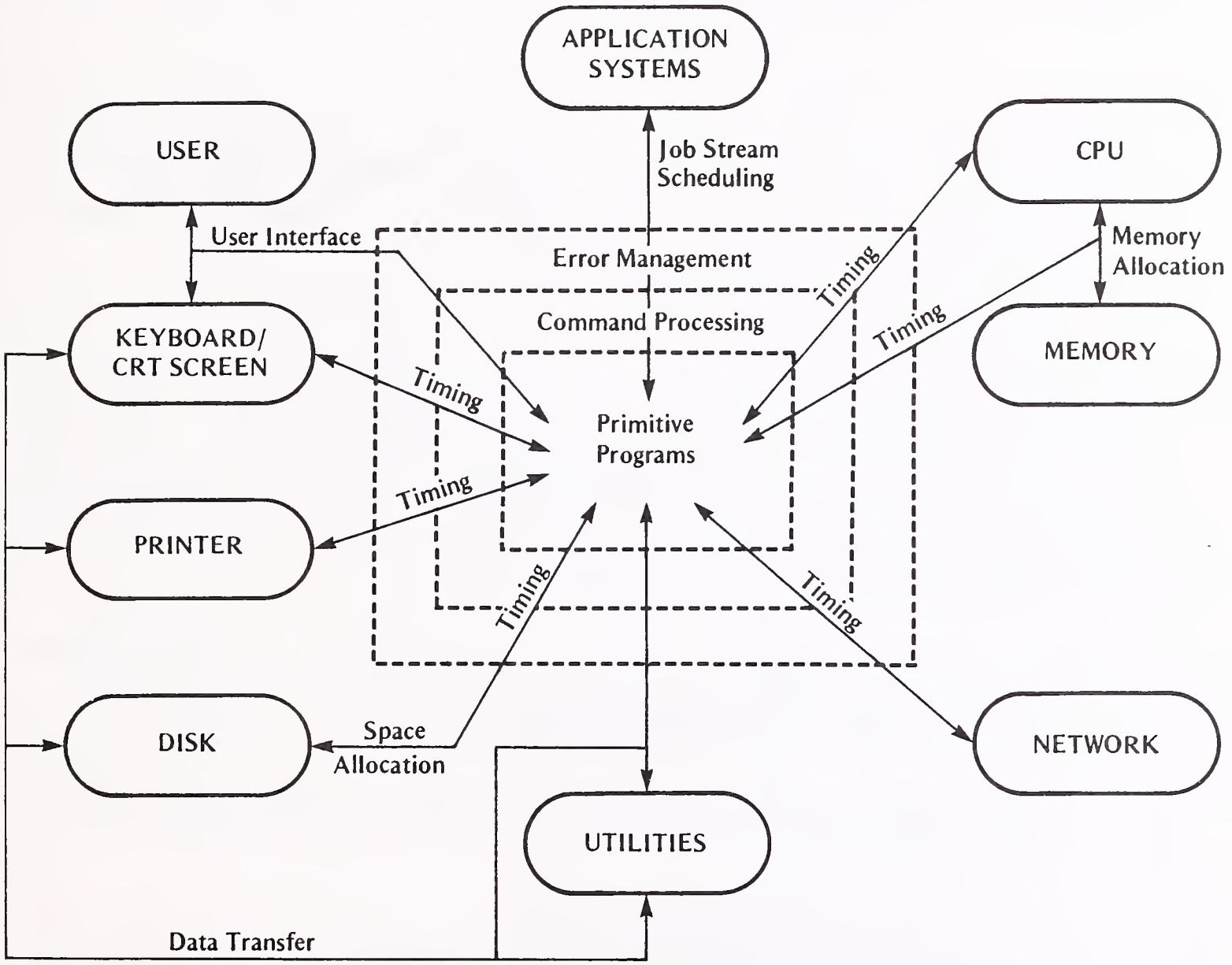
  - . Optionally, interface with one or more program development assemblers, compilers, and debugging facilities.

- Exhibit III-1 graphically portrays the relationship of the operating system and the entities with which it interacts.

- By itself, however, an operating system is not worth much. The high-level application languages it supports, the migration path it provides, and the portability, size, speed, and stability of applications developed under it deserve at least as much attention as the operating system itself.

EXHIBIT III-1

INTERACTION BETWEEN OPERATING SYSTEM AND OTHER ENTITIES



- It is also important to keep in mind that features of certain operating systems can make it easier for application developers to develop more effective software. For example, virtual memory management helps developers create more user-friendly programs.

B. 1984 INSTALLED BASE OF MICROCOMPUTERS IN BUSINESS

- Besides an understanding of operating system competitors and products, an overview of the business microcomputer market is necessary before analyzing future operating system trends and direction due to the intimate relationship of hardware products and operating systems.

- In 1984, 55% of the installed base of 5.7 million business microcomputers were 8-bit, 41% were 16-bit, and 4% were 32-bit (see Exhibit III-2). In 1983 the installed base by chip size looked amazingly different. The large number of sales of IBM PCs and compatibles (16-bit) in 1984 as well as the retirement of older 8-bit models accounted for the major change.

- In 1984, a larger percentage of the 16-bit market share of the installed base of microcomputers was in large business (see Exhibt III-3). This was due to:

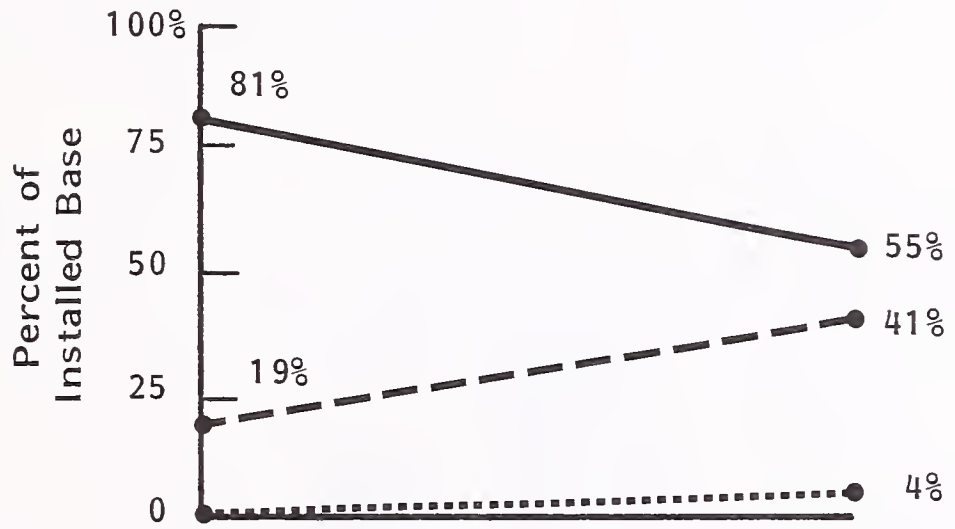
  - Large business's ability to spend more money on newer, more sophisticated computers.

  - A larger number of "power users" in large business influencing purchasing decisions.

  - Due primarily to cost constraints, small businesses tend to "make do" where computers are concerned and would therefore keep an older computer system rather than acquiring a new model.

EXHIBIT III-2

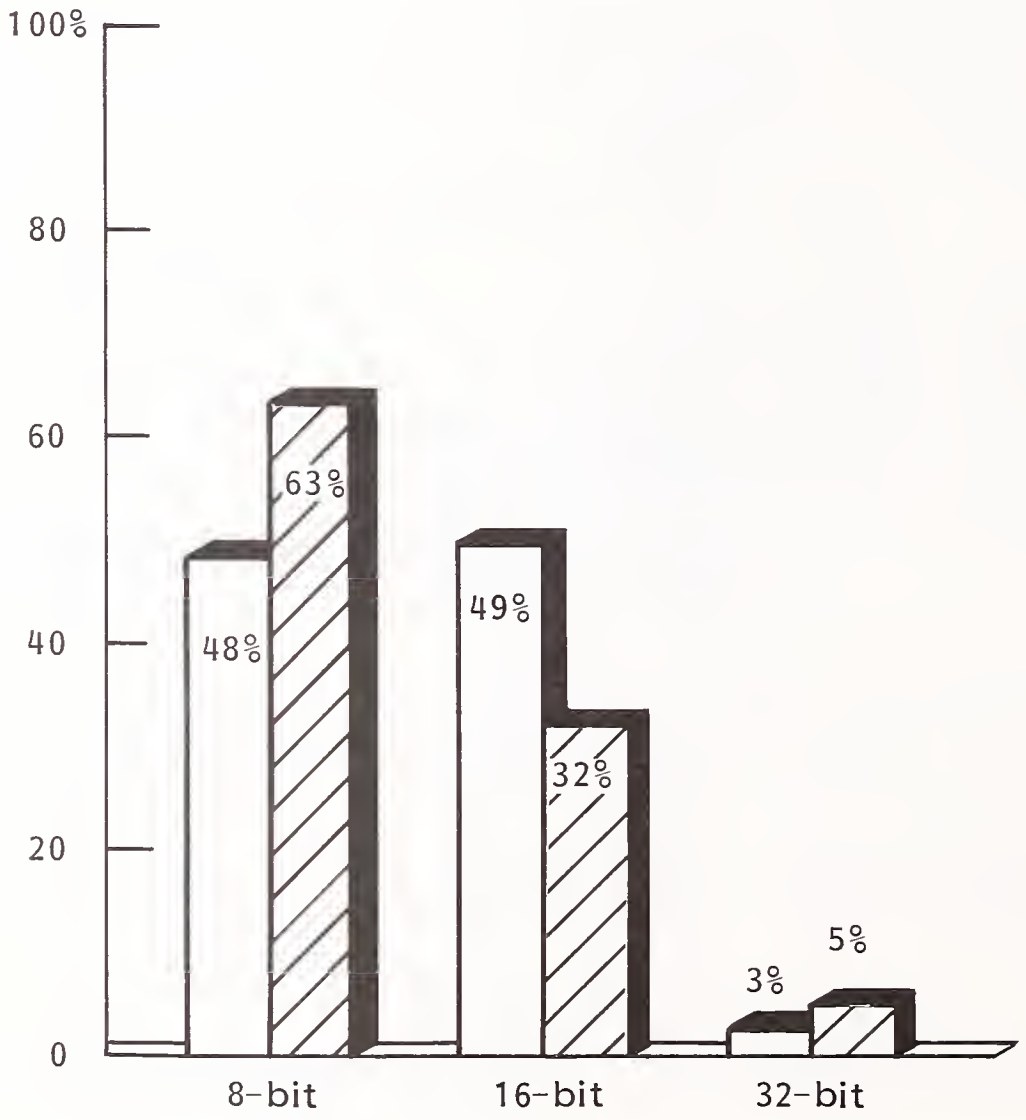
CHANGE IN MICROCOMPUTER INSTALLED BASE
1983-1984
BY MICROPROCESSOR SIZE



	1983	1984
8 Bit	2.5	3.1
16 Bit	0.6	2.3
32 Bit	-	0.3
Total (Units in Millions)	3.1	5.7

EXHIBIT III-3

LARGE AND SMALL BUSINESS MICROCOMPUTER
MARKET SEGMENTS' PERCENTAGE OF INSTALLED BASE BY
MICROPROCESSOR SIZE
1984



- Comparable pie charts showing the business installed base by operating system show proprietary operating systems accounting for the major portion of business units in 1983 and 1984 (see Exhibit III-4). A noticeable increase in PC/MS-DOS systems occur in 1984, again due to IBM PC shipments--over one million units in 1984.

- Large and small businesses reflect the same pattern as in the preceding charts by microprocessor type (see Exhibit III-5).

C. IBM'S OFFICE SYSTEM STRATEGY

- IBM is the driving force affecting the operating system market. Since 1981 when IBM entered the PC marketplace, they have quickly achieved over 30% of the 1984 installed base. In 1985 INPUT expects IBM to account for almost half of business microcomputer shipments.

  - As in the other segments of the information services industry that IBM dominates, their future strategies and products determine the overall market direction.

  - There has been much speculation about IBM's microcomputer operating system strategy. Several schools of thought have evolved:

    . IBM will port their mainframe operating system VM down to the microcomputer level.

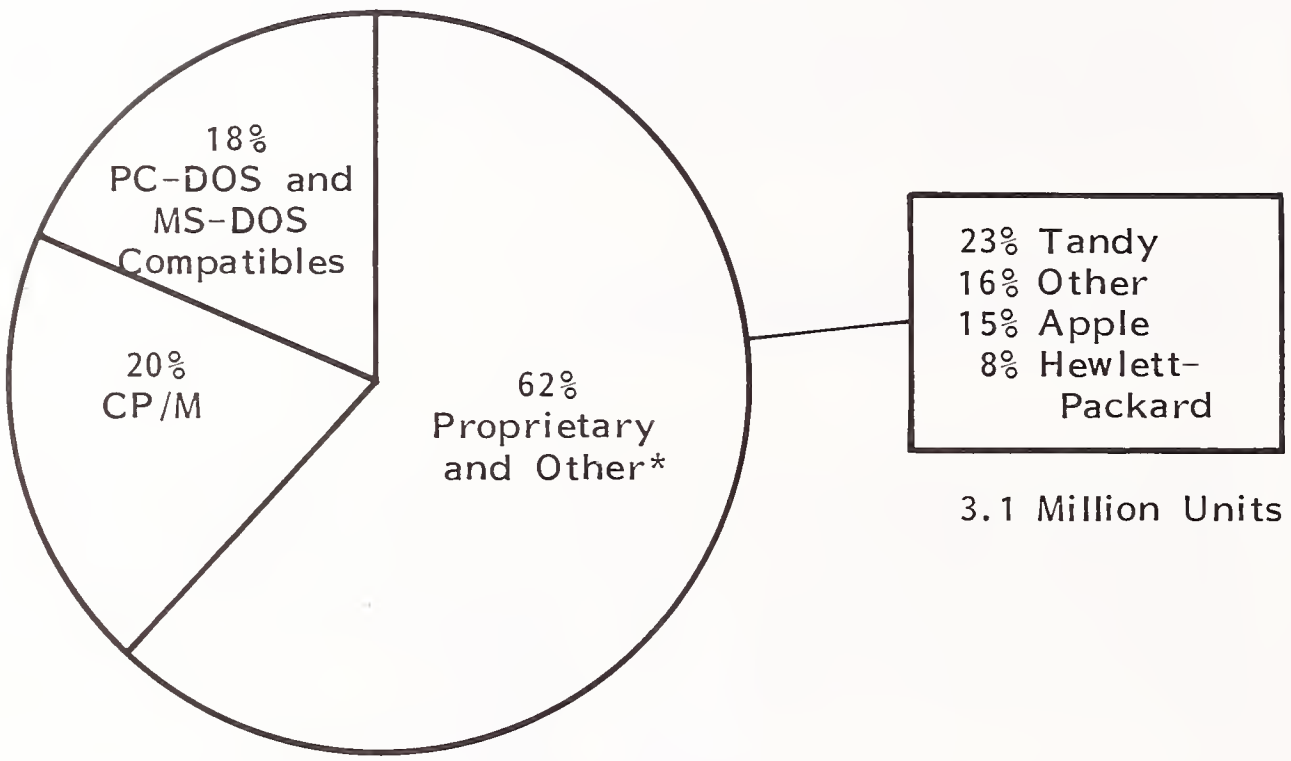
    . IBM will support UNIX on present and future microcomputer product offerings.

    . IBM will abandon PC-DOS or adapt it slightly to lock out "PC clones" and close the PC market.

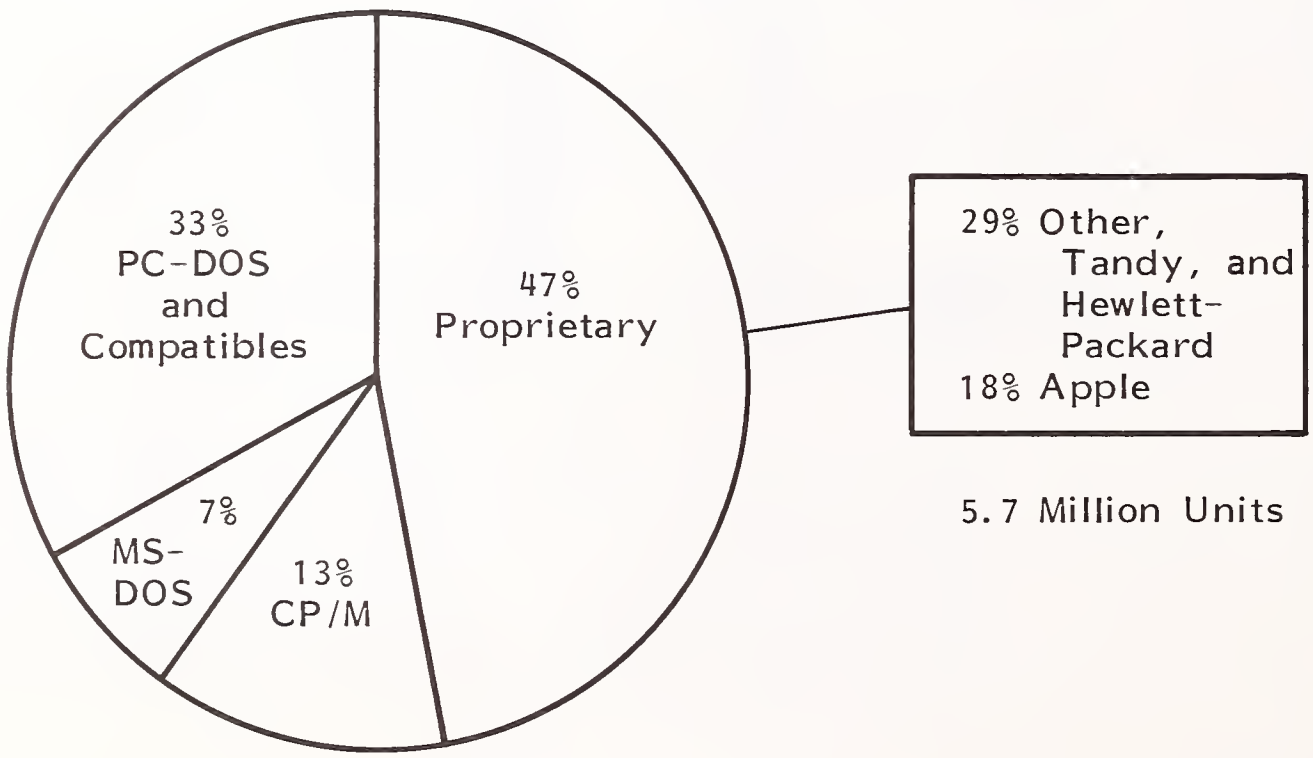
EXHIBIT III-4

TOTAL INSTALLED BASE OF BUSINESS
MICROCOMPUTERS BY OPERATING SYSTEM

1983



1984



*Other includes products such as UNIX, PICK and Oasis, as well as proprietary operating systems like Commodore and Atari DOS.

EXHIBIT III-5

LARGE AND SMALL BUSINESS MICROCOMPUTER INSTALLED BASE BY OPERATING SYSTEM, 1984

	LARGE BUSINESS (Percent)	SMALL BUSINESS (Percent)
Proprietary:	40%:	55%:
Apple	14	23
Other	26	32
CP/M	10	15
PC-DOS and MS-DOS Compatibles	47	18
MS-DOS	3	12
Total	100%	100%
Total Units (Millions)	3	2.7

. IBM will continue to support an upgrade of PC-DOS.

- IBM's microcomputer operating system strategy must be viewed as part of the company's overall office strategy. Exhibit III-6 shows IBM's idea of centralization and differentiation of functions within the office. Microcomputers are part of the overall configuration linked to the SNA architecture. In Exhibit III-7 they fit within the category of intelligent terminals display and the control of office products with fewer capabilities.

  - IBM's response to the proliferation of standalone personal computers in the corporate environment has been based on two perceived threats: true off-loading of processing from mainframes, and the potential of personal computers to be used as cheap, intelligent terminals. Over a year ago, Don Estridge of IBM stated: "The PC is communications-oriented. The day of the standalone is over." The primary impetus for micro-mainframe links from IBM's point of view is integration. Intelligent workstations are going to become more dependent upon other parts of the system--specifically, mainframe hardware, software, and data.

  - Over a year ago, IBM announced that there were more installed mips in PCs than there were in mainframes--and this trend has obviously accelerated since that time. IBM's direction in resource allocation will be to assure that those mips are not employed to diminish the ever-increasing demand for mainframe mips. Since a high percentage of mainframe mips are used to execute IBM operating systems software, maintaining central control of resource allocation is not only necessary, but self-fulfilling. This will result in the following:

    . As intelligent workstations are added, requirements for mainframe power will increase sharply.

EXHIBIT III-6

IBM CENTRALIZATION AND DIFFERENTIATION
OF FUNCTIONS

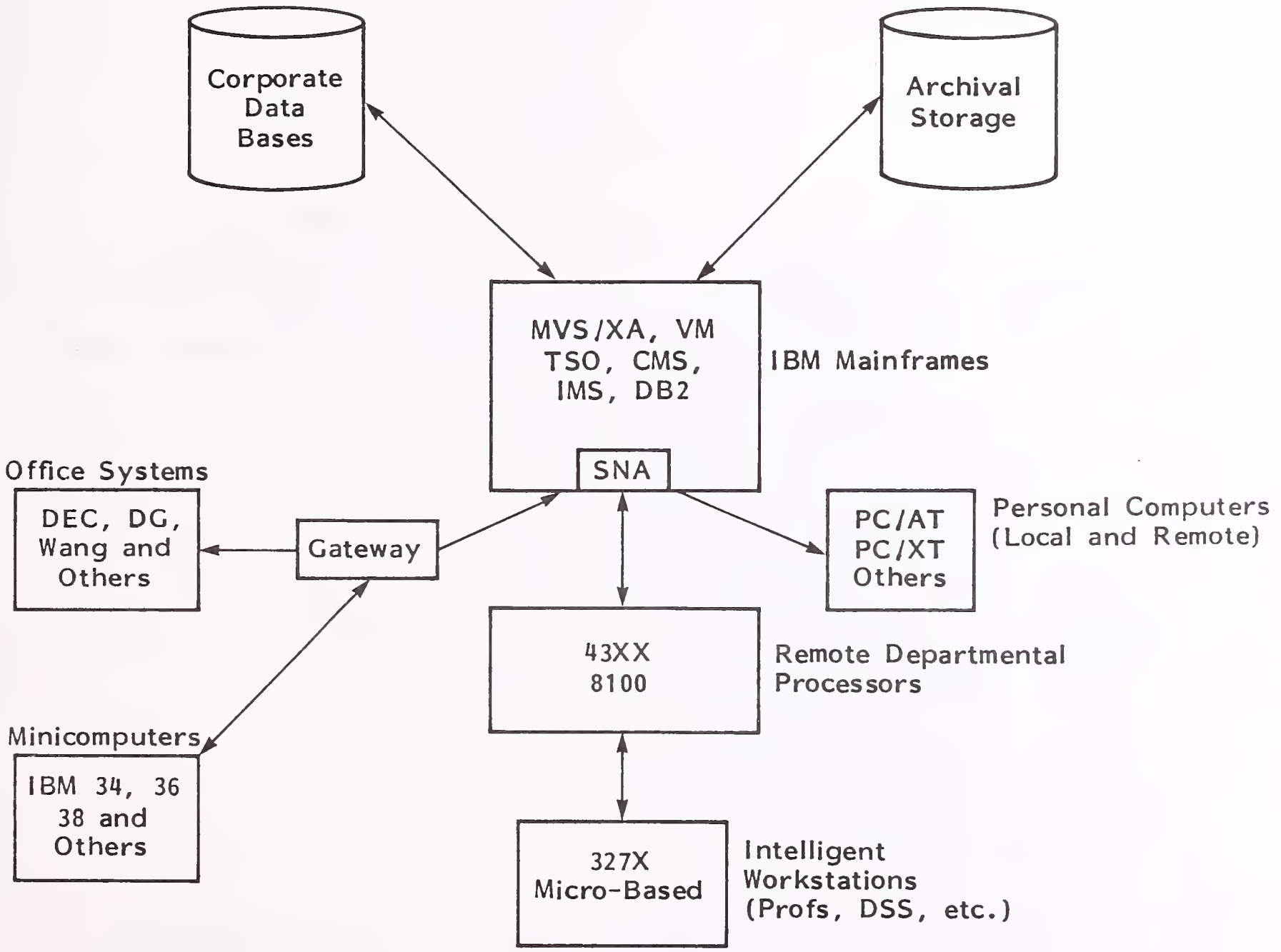
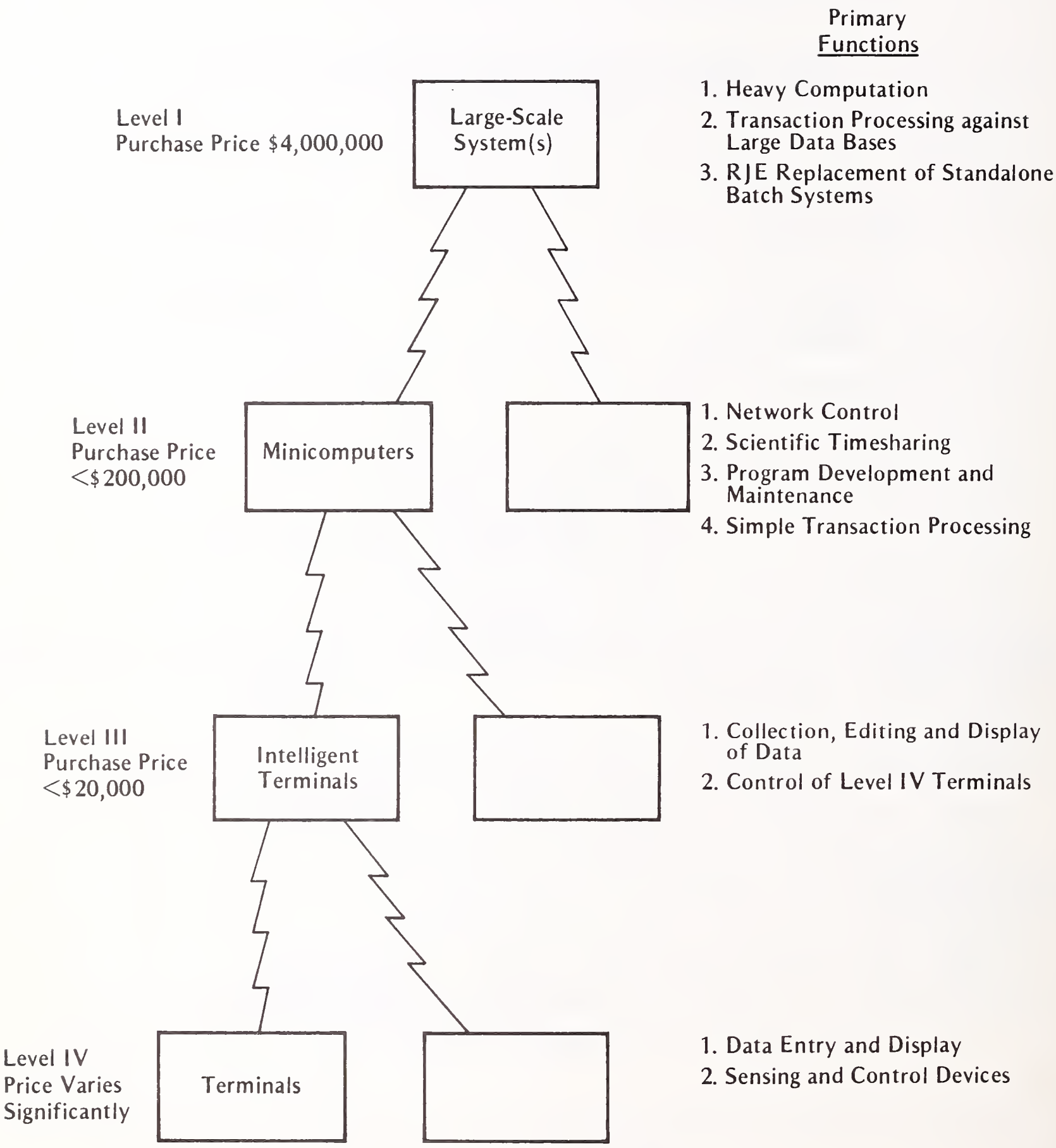


EXHIBIT III-7

HIERARCHICAL NETWORK



- For every dollar spent on workstations, substantially more will be spent (over the life cycle) on host services (processing and storage).

- Host processing will be extended to the workstation only when it receives its "fair share" of the host operating system burden. (The XT/370 is a good example of how to burn microprocessor mips without substantially off-loading mainframes.)

- Considering IBM's overall strategy of centralization, what are its microcomputer operating system options for the future?

  - VM.

    - VM was designed in the early 1960s as a development and testing environment--not as a production environment. Many changes have taken place since then and today the major use of VM is for highly interactive applications. With VM there are multiple operating systems running on the host and a large number of simultaneous users. It is the only IBM operating system that runs on machines ranging from IBM PC XT/370 to 3084.

    - IBM has said "VM is a highly strategic operating system."

    - VM is already available at the PC level on the XT/370 and AT/370. The PC version is called VM/E (VM/Entry) and is a limited-function version of VM priced at $40,000. Its primary use has been in a programming environment to off-load programs from the host, alter them, and then upload them. This saves mainframe processing power for other projects.

    - One major drawback of VM is its large overhead, i.e., its processing speed is quite slow.

- IBM is driven by market demands; therefore, needs of VM clients today influence the use of VM in the future.

- UNIX.

  - Several years ago IBM began offering a UNIX mainframe product VM/IX in the form of a programming request for price quotation (PRPQ). This product was appropriate for engineering, scientific, and university environments. The product was offered as a trial to gauge the demand for UNIX on a mainframe.

  - In 1985 IBM announced UNIX V for its Sierra mainframes, which runs as a guest under VM. It replaces VM/IX as IBM's UNIX product offering. Called Interactive Executive for System/370 (IX/370), the product was developed largely by IBM with some components of Interactive Systems Corporation IS/3.

    - IX/370 allows the host to be more easily used as a shared resource in distributed processing networks.

    - IX/370 supports full-duplex ASCII terminals but not IBM 3270 terminals. The product is therefore intended for use with IBM PCs running PC/IX or a "new unannounced" IBM terminal that translates ASCII.

    - The product both accommodates the user community demand for UNIX and keeps them with IBM, and it validates the UNIX market with a single UNIX standard.

  - IBM offers a version for its IBM PC XT called PC/IX. The product is developed by Interactive Systems Corporation, Santa

Monica (CA) and costs $900. IBM's decision to have Interactive Systems rather than Microsoft develop their product could indicate their desire not to be locked into a single third-party vendor for microcomputer operating system products.

  - Microsoft, however, offers XENIX for the IBM PC and IBM has announced XENIX for the PC AT as well as an upgraded UNIX PC/IX. INPUT believes this shows IBM's overall ambivalence toward the UNIX marketplace.

- PC-DOS.

  - IBM chose Microsoft's PC-DOS for the operating system of its first personal computer product. It has since stayed with the basic DOS operating system for other PC products, adding enhancements and adaptions where necessary.

  - IBM, however, feels the latest PC-DOS release 3.1 is performance-poor, and will use only the redirector in its PC Net--IBM's first PC networking product. The company is also instructing third-party software developers to write programs in line with the basic IBM input/output system (Netbios) and for Topview; therefore utilities written into application software will bypass the operating system. This is perhaps the first major sign of IBM's moving away from an absolute endorsement of PC-DOS for future microcomputer products.

- INPUT sees IBM's microcomputer operating system strategy as a combination of products.

  - The company will continue to want to capitalize on the large installed base of PC-DOS software. IBM can't abandon the 370 architecture for the same reason.

- IBM also has a history of reacting to market pressures. An example is in the mainframe business. When companies started undercutting IBM disk drive prices, IBM made a few proprietary enhancements to the disk controller while also moving it within the mainframe. The plug-compatible disk drive business was over. IBM will soon perceive too much competition from PC-compatible vendors, especially large mainframe and mini vendors who now or will have available IBM PC-compatible microcomputers as part of their office solutions. A proprietary operating system would lock out this competition.

- INPUT believes that IBM will port VM down to its high-end PC products for the reason of market dominance as well as office centralization around SNA. PC AT-type and as yet unannounced 32-bit products will have the availability of a VM PC host as early as the end of 1986. PC-DOS software could be run under VM, as well as UNIX, but IBM by 1990 will have its own offerings of new software applications taking advantage of Topview as well as VM. Third-party packages will be available for VM but to a lesser degree. The high-end VM products will be used primarily as minis:

  . Linking to mainframes.

  . Running office automation systems.

  . Used in smaller companies as hosts.

- In the mid- and lower-range PC products, whose function is to be primarily intelligent workstations, there will be some type of concurrent PC-DOS provided, perhaps version 7.0, providing multiuser capability, multitasking, friendly user interface, windowing, and high speed. Small businesses would also be key purchasers of this product since many units will be sold through VARs (value-added resellers) with vertical packages.

- UNIX will be offered by IBM, but not aggressively. Why support a competitor (AT&T) by licensing and reselling its products? By 1990, other operating systems, especially IBM's own operating system, will have the two major selling characteristics of UNIX--multiuser and multitasking.

- IBM will therefore lock out PC hardware competition on the mid to high end, be able to choose which software developers write for its products, and with the addition of its PC networks, more or less "lock up" the corporate marketplace.

- Another significant trend that affects the transition from single user-single tasking to multiuser-multitasking is technology. The availability of more powerful 16- and 32-bit microprocessors such as the Motorola 68000, National 16032, and Intel 80286 have stimulated the growth of operating systems from collections of programs to products as powerful as operating systems in mainframes and minicomputers were a few years ago. The new chips provide the ability to address more memory than earlier 8- or 16-bit processors, with increased speed. These chip characteristics greatly influence the operating system's ability to solve or at least contribute to solving the user needs which will be elaborated upon in Chapter IV.

D. FORECAST FOR 1985

- In 1985 the market is just beginning to sense the transition from single user-single tasking to multiuser-multitasking.

  - IBM introduced its multiuser PC AT incorporating the very sophisticated Intel 80286 chip.

- The company is beginning to ship its Topview operating environment. Interestingly enough, users aren't flocking to purchase it and software developers aren't flocking to develop packages for it. Some reasons given include:

  . It uses too much memory.

  . It's too difficult to use.

  . It still has "bugs" that cause data to be lost.

- INPUT expects the product to succeed with a large advertising campaign and some product enhancement that will make it easier to use.

- The low cost, easy-to-install Apple Macintosh LAN has been announced by Apple, and major application software vendors are writing network software for it. The large business market targeted by Apple for significant sales, however, is not where the products will succeed. INPUT feels that the Mac will sell primarily to home, schools, and small businesses; to small businesses because of:

  . Ease of use.

  . Less of a small business need to "go IBM."

  . Low cost LAN.

- The Atari ST line, low-cost 68000 processor-based, with GEM interface, as well as the similar Commodore Amiga will begin shipping in late 1985. They will garner some small business market share since their cost will be low and significant application developers are already writing software for the products.

- In 1985 INPUT expects over 3.4 million microcomputers to be shipped to businesses. (Projection assumptions are included in Appendix B.) Of this number, 11% will be 8-bit, 72 % 16-bit, and 17% 32-bit (see Exhibit III-8). The 16- and 32-bit markets increase yearly due to:

  - Market acceptance of more capable, brand-name (i.e., IBM) machines.

  - Decreased cost.

  - Increased application software.

  - Increased computer acceptance and/or ease of use with operating environment.

- Of the 8-bit shipment segment, 1985 products primarily will consist of lap tops.

- Comparable large and small business exhibits show the 32-bit market for large and small business as more similar than expected. This is due to shipments of ATT 7300 and MAC XL to large business and low-end MACS to small business--products with the same microprocessor size but far different system price and capabilities.

- The same 1985 shipments, when viewed from the specific operating system perspective, show IBM PC-DOS and MS-DOS compatibles the undisputed leaders, with a 60% market share (see Exhibit III-9). The installed base for PC compatibles also increases from 33% in 1984 to 47% in 1985--a significant increase. At the same time, shipments and installed base of other vendors (as a percentage of the whole) continue to decrease.

- Large business will have a large share of the PC-DOS shipments--while small business will purchase a larger percentage of microcomputers with proprietary

EXHIBIT III-8

MICROCOMPUTER SHIPMENTS TO BUSINESS
1985
BY MICROPROCESSOR SIZE

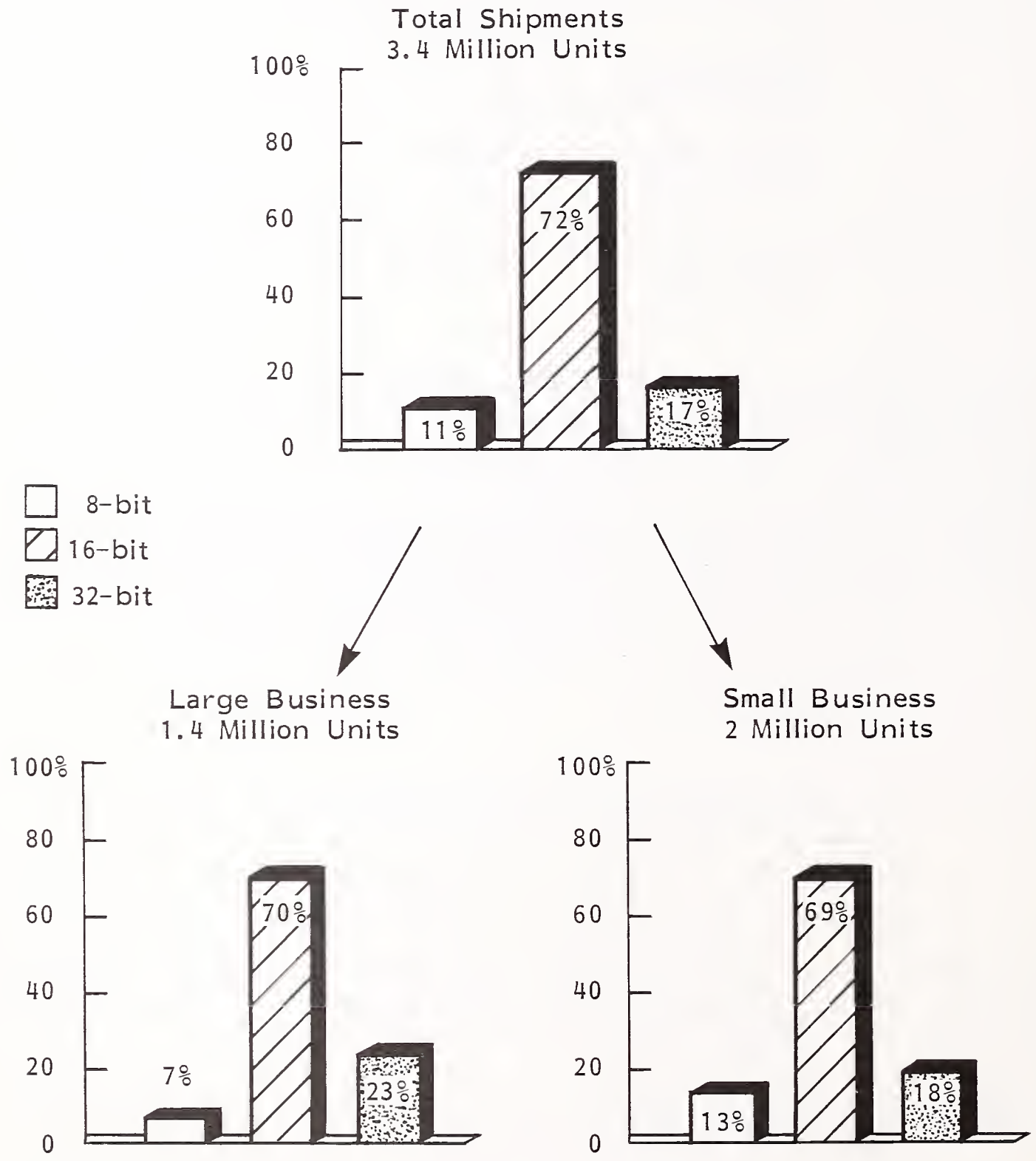


EXHIBIT III-9

BUSINESS MICROCOMPUTER MARKET FORECAST, 1985

	SHIPMENTS (Percent)	INSTALLED BASE (Percent)
Pc-DOS and MS-DOS Compatibles	60%	48%
Proprietary and Other Operating Systems*	17	17
Apple DOS	15	18
MS-DOS	6	6
CP/M	2	11
Total	100%	100%
Total Units (Millions)	3.4	8.5

*Includes lap top products, UNIX, Oasis, Pick, Atari TOS, and others.

operating systems (see Exhibit III-10). The assumptions behind these projections are the same as those mentioned in Section B--large versus small business purchasing decisions.

E. FORECAST FOR 1990

- Considering industry and user influences, INPUT envisions the 1990 microcomputer market to be divided as follows:

  - Of the 3.2 million microcomputers to be shipped in the U.S., about 1.4 million will be shipped to large business, and about 1.8 million to small business. Large business--because quicker to adapt, more skilled, technologically innovative, with higher computer budgets--will be close to saturation by then, with most units being replacements. Small business, on the other hand, will still have several years to go before saturation is reached. See Exhibits III-11 and III-12 for overall shipments and installed base in the microcomputer market 1984-1990.

  - Of the total business microcomputer shipments in 1990, 74% are expected to have 16-bit microcomputer processors, and 26% 32-bit (see Exhibit III-13). Large business has a slightly lower percentage of 32-bit microcomputers. This may be deceiving until specific product type is analyzed. It is then noted that large business 32-bit shipments consist primarily of high-end multiuser systems, while small business shipments consist of lower end 32-bit "MAC" type products.

- INPUT expects that in 1990 70% of microcomputers will be linked--primarily in CBX, LAN, and mainframe connections in large business; and in small business as multiuser systems or in a LAN (see Exhibit III-14).

EXHIBIT III-10

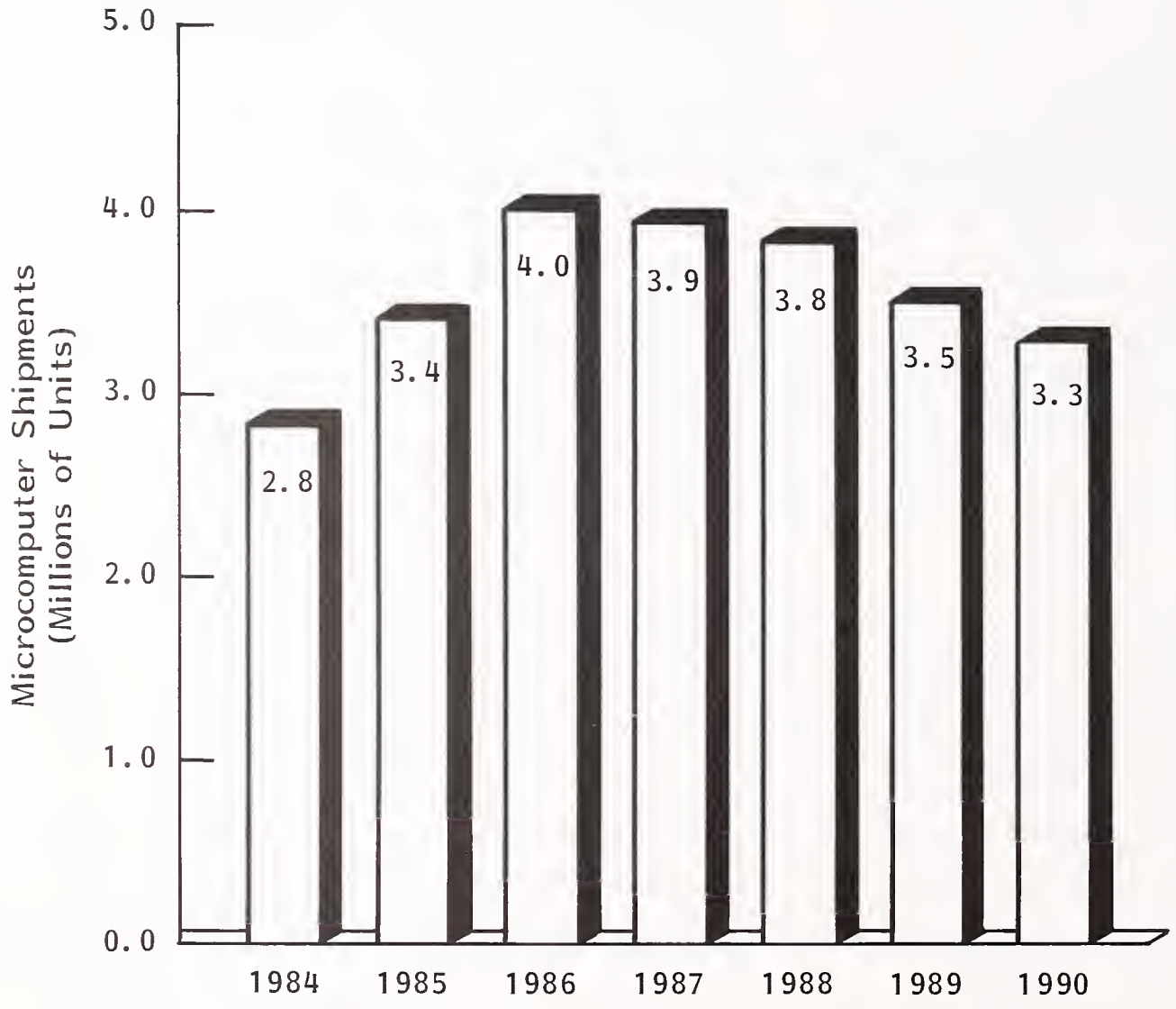
BUSINESS MICROCOMPUTER SHIPMENTS, 1985, BY OPERATING SYSTEM

	LARGE BUSINESS (Percent)	SMALL BUSINESS (Percent)	TOTAL BUSINESS (Percent)
PC-DOS and MS-DOS Compatibles	73%	51%	60%
Proprietary and Other Operating Systems*	11	22	17
Apple DOS	8	19	15
MS-DOS	8	5	6
CP/M	–	3	2
Total	100%	100%	100%
Total Units (Millions)	1.4	2.0	3.4

*Includes lap top products, UNIX, Oasis, Pick, Atari TOS, and others.

EXHIBIT III-11

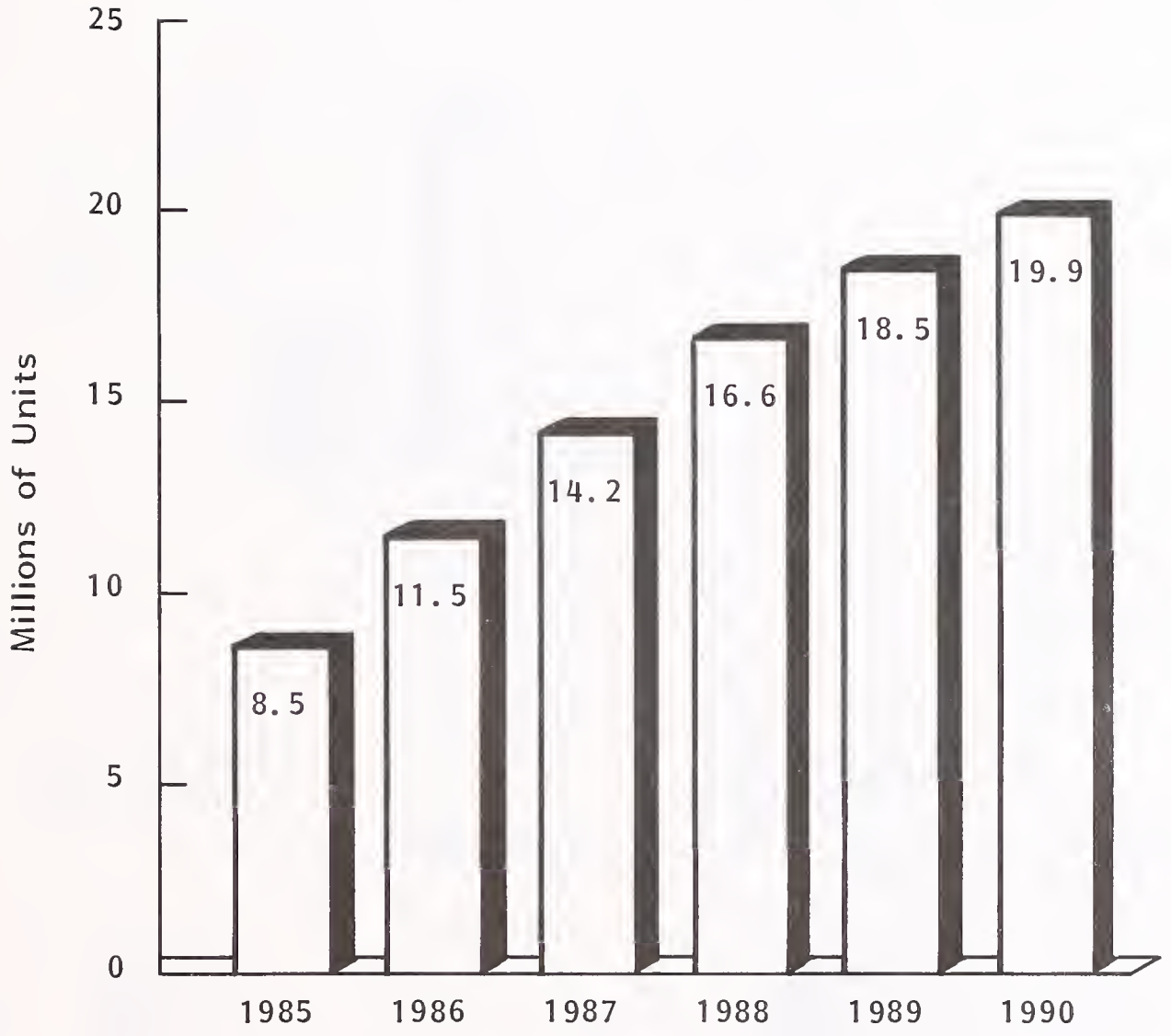
ANNUAL SHIPMENTS OF MICROCOMPUTERS*,
1984-1990



* U.S. sales of microcomputers selling for less than $15,000 that are used for business.

EXHIBIT III-12

NET INSTALLED BASE OF MICROCOMPUTERS*,
1985-1990



* U.S. sales of microcomputers selling for less than $15,000 that are used for business.

EXHIBIT III-13

MICROCOMPUTER SHIPMENTS TO BUSINESS
1989
BY MICROPROCESSOR SIZE

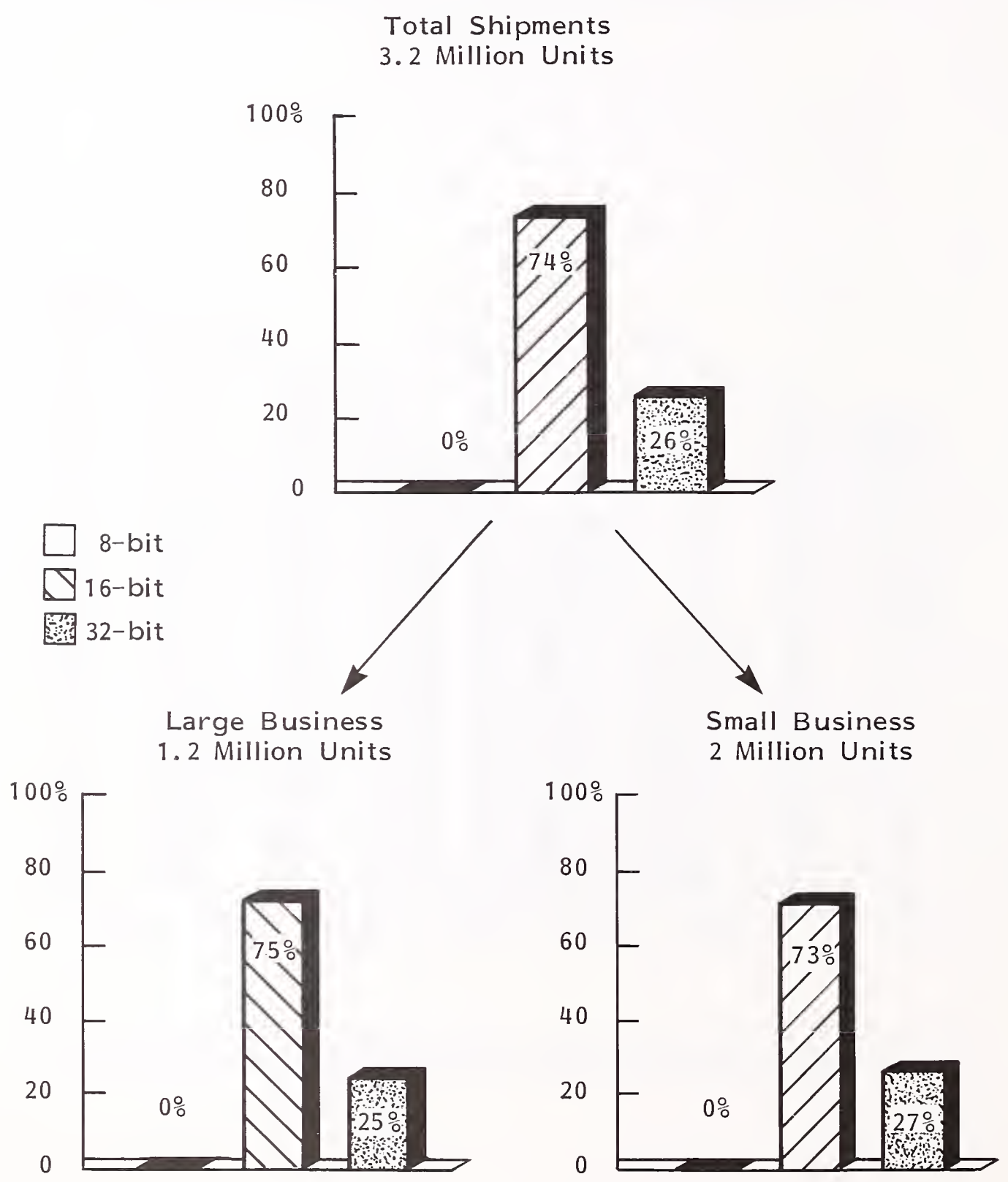
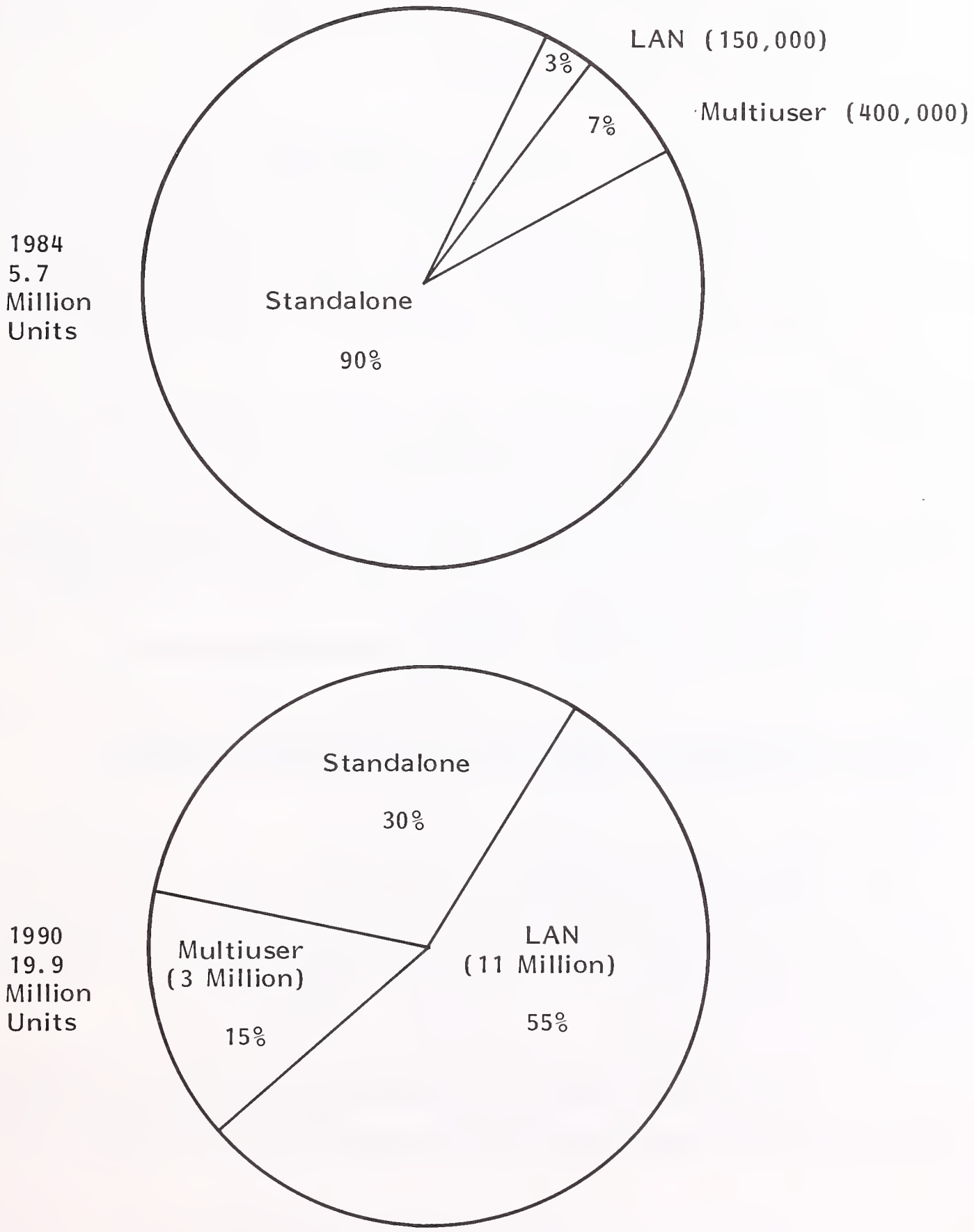


EXHIBIT III-14

MICRO INSTALLED BASE IN BUSINESS



- In 1990 is where IBM's operating strategy as projected by INPUT can be clearly seen. Of the total units shipped, INPUT believes about 15% will have proprietary operating systems and the remainder (85%) some type of IBM proprietary and/or a PC-DOS-enhanced version (see Exhibit III-15).

- PC AT-type products and above are expected to have the multiple operating system while PC-XT, PC two drive, and some lap tops are expected to have the enhanced PC-DOS product.

- In 1989 large business, 43% of shipped units are expected to have multiple operating systems, in small business 41%, as shown in Exhibit III-15. As in 1985 projections, the product type between large and small business differs--large business units will be very sophisticated 32-bit systems, while small business will have IBM AT-type multiuser, multitasking systems.

- Exhibit III-16 shows the large increase in IBM operating system products as part of the overall microcomputer installed base. Proprietary operating systems will still remain viable--but only from a few large vendors with large installed bases of quality generic application software packages, or specialized quality vertical systems. Apple presently is aggressively soliciting VAR support for the latter approach.

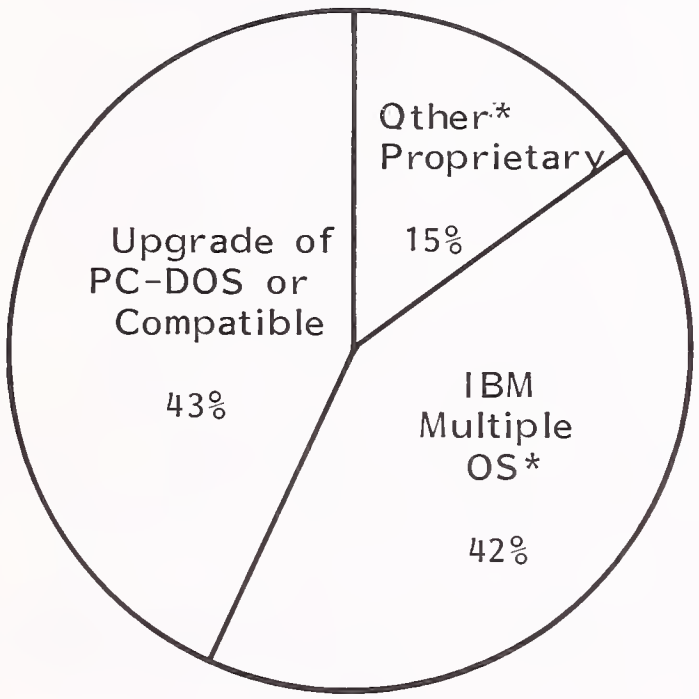
F. HARDWARE CONFIGURATION CHANGE, 1985-1990

- As seen in Exhibit III-17 microcomputer configuration is expected to change drastically between 1985 and 1990. Much of this change is due to microprocessor design, affecting operating system design, which affects system design.

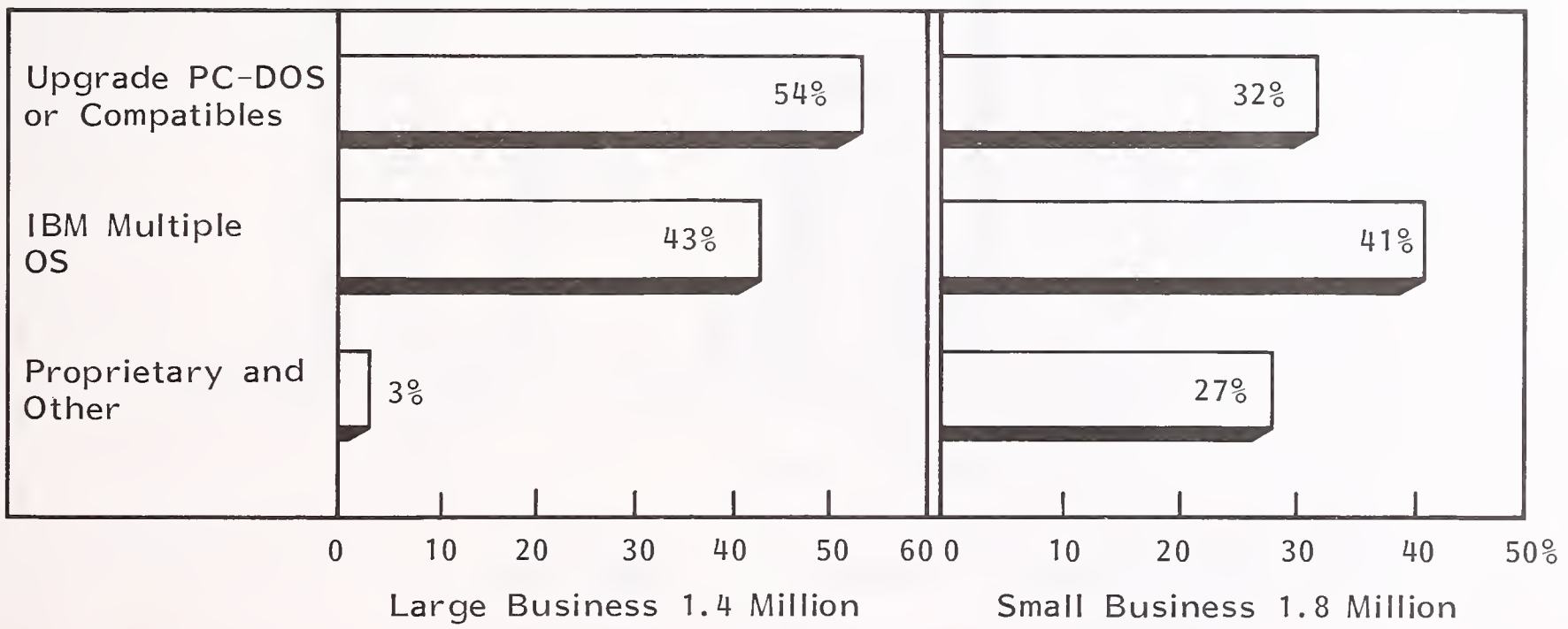
- The configuration changes influence the decrease in system prices, which aids in increasing demand for microcomputers--but not as significantly in business, which is not as price-sensitive as general consumer goods.

EXHIBIT III-15

BUSINESS MICROCOMPUTER SHIPMENTS, 1990, BY OPERATING SYSTEM



3.2 Million Units



*Excludes IBM Proprietary "Other," e.g., Oasis, Pick; "Proprietary", e.g., Apple, Commodore, Atari

** Includes: IBM Proprietary OS as host; PC-DOS as guest on all units; Unix or "Other", as guest on 50% of units.

EXHIBIT III-16

TOTAL BUSINESS MICROCOMPUTER INSTALLED BASE
BY OPERATING SYSTEM
1984-1990

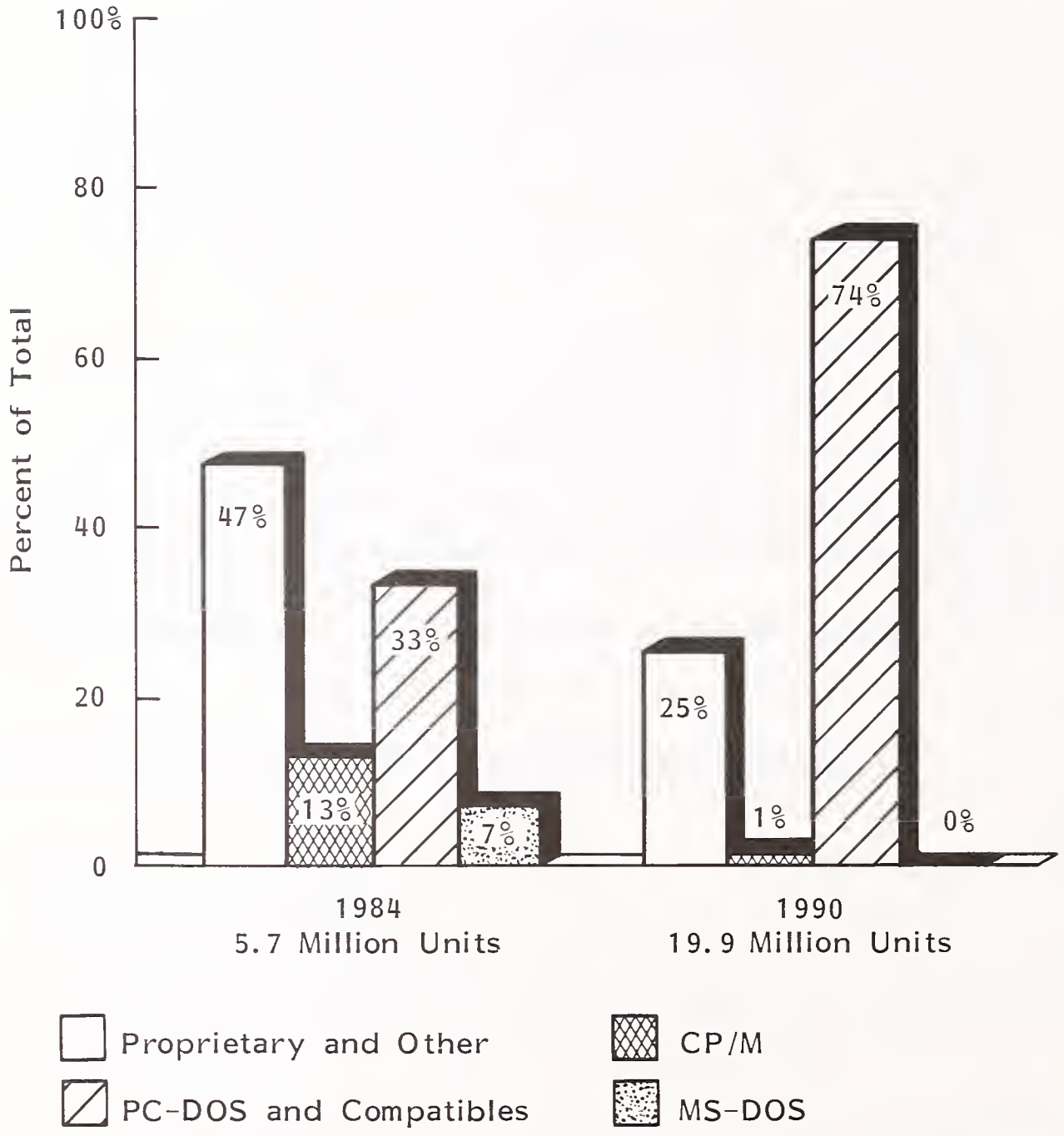


EXHIBIT III-17

CHANGE IN MICROCOMPUTER CONFIGURATION

PRODUCT TYPE	1985	1986-1987	1988-1990
PC, PC Compatible			
Processor	8/16	16/16	16/16
OS	PC-DOS	PC-DOS	Concurrent PC-DOS with Operating Environment
Memory	256K	512K	512K
Storage	2-5¼" Floppies	2-3½" Floppies	2-3½" Floppies
Price	$2,000	$1,500	$1,000
Monitor/Graphics	Black and White Monitor	Same	Bit Mapped Graphics
Comments	-	-	-
PC-XT Compatible			
Processor	8/16	16/16	16/16
OS	PC-DOS	Concurrent PC-DOS	Concurrent PC-DOS with Operating Environment
Memory	256K	512K	640K
Storage	10MB Hard Drive	20MB Hard Drive	Optical Disk
Price	$3,500	$3,000	$2,500
Monitor/Graphics	Black and White Monitor	Same	Bit Mapped Graphics
Comments:	-	-	-

Continued

EXHIBIT III-17 (Cont.)

CHANGE IN MICROCOMPUTER CONFIGURATION

PRODUCT TYPE	1985	1986-1987	1988-1990
PC-AT Compatibles			
Processor	16/24	16/24	16/24
OS	PC-DOS 3.1	Topview with Concurrent PC-DOS	Topview with Concurrent PC-DOS plus VM AS Host
Memory	512K	640	1 MB
Storage	20MB Hard Drive	40MB Hard Drive	(Huge) Optical Read/ Write Drive
Price	$5,500	$5,000	$3,500
Monitor/Graphics	Black-White Monitor	Same	Color Monitor
Comments:	Multiuser Capability, 3 Users	Multiuser Capability Support More than 3 Users	Multiuser Capability Support More than 3 Users
32-bit (High End)			
Processor		32/32	
OS		Concurrent PC-DOS, Topview VM	
Memory		IMB	
Storage		Optical Drive	
Price		$7,000	
Monitor/Graphics			
Comments:		- Multiuser - Multitasking 10 Users - Integrated Software Built in - Communication	- Multiuser - Multitasking (20 Users) - Integrated Software Built in - Communication

Continued

EXHIBIT III-17 (Cont.)

CHANGE IN MICROCOMPUTER CONFIGURATION

PRODUCT TYPE	1985	1986-1987	1988-1990
Low End Mac (Apple, Amiga, Atari)			
Processor	16/32	16/32	16/32
OS	Proprietary	Proprietary	Proprietary
Memory	128	512K	512K
Storage	1 Floppy Drive	10 MB Hard Drive	20 MB Hard Drive
Price	$2,000	$1,000-1,500	$1,000
Monitor/Graphics		Color Monitor	Color Monitor
Comments:			Integrated Software Built in
Hi-End MAC and Imitators			
Processor	16/32	16/32	32/32
OS	Proprietary	Proprietary	Proprietary also Runs PC-DOS
Memory	512K	640K	1 MB
Storage	2 Drives	20 MB Hard Drive	Optical Storage
Price	$3,000	$3,000	$3,000
Monitor/Graphics		Color Monitor	
Comments:		- Multiuser - Multitasking - Built-in Integrated Software	- Multiuser - Multitasking - Built-in Integrated Software

Continued

EXHIBIT III-17 (Cont.)

CHANGE IN MICROCOMPUTER CONFIGURATION

PRODUCT TYPE	1985	1986-1987	1988-1990
LAP TOP			
Processor	8/8 or 8/16	8/16	16/16
OS	Proprietary or MS-DOS IBM Compatible	MS-DOS Compatible	MS-DOS Compatible with Operating Environment
Memory	64K	128K	256K or Bubble Memory with ROM Expander
Storage	1-3½" Disk or None	2-3½" Disk	2-3½" Disk
Price	$2,500	$2,500	$1,500
Monitor/Graphics	16 Line LCD	16 Line LCD Graphics Electroluminescent Screen	16 Line LCD Graphics Electroluminescent Screen
Comments:	Built in Software Memo Calendar Basic	Plus Integrated Software Built in	Plus Software on Pop-out ROM Chips

IV USER NEEDS

- A major factor stimulating the market changes that will occur from 1985 to 1990 is user needs.

  - Corporations and small businesses are finding increasing need for better communication and more effective utilization of company resources. This significantly increases productivity and efficiency, which lead to increasing company profit. Especially in large business, these efficiency needs are coupled with the need for centralized control of data and resources as well as data security.

  - Programmers of third-party applications software or within large corporations require more efficient tools and methods of changing a software package from one format or operating system to another, or to custom program "solutions" to specific users' problems and requirements.

  - End users ask for:

    . Easier to use hardware and software.

    . The capability to use mainframe data (access host).

    . The ability to share information with their co-workers.

. Solution software packages adapted for their individual or departmental uses.

- The operating system can provide either partial or total solutions to the aforementioned users' needs (see Exhibit IV-1).

  - Business user and purchaser needs are satisfied by:

    . Virtual operating system that can run application software written for other operating systems; this tends to make hardware more of a commodity item and therefore more price sensitive.

    . Mainframe communication capability with data security.

    . CBX, LAN, and multiuser system capability to link PCs.

    . Multiple operating system on one computer again extending the available installed base of application software.

    . Transparent operating system, in that if the user needs data from a data base at a remote host or elsewhere, the operating system knows where and how to get it without user command.

  - Programmer and developer needs are satisfied by:

    . Modularity--writing operating system in modules for easy modification and upgrades.

    . Operating system portability for developing or adapting operating system quickly and simply.

EXHIBIT IV-1

OS RESPONSE TO INDUSTRY TRENDS AND USER NEEDS OS CONFIGURATION IN 1990

- Virtual OS
- Mainframe Communications and Data Security
- Linking Capabilities
- OS Modularity
- OS Portability
- Self-Contained Device Drivers
- Windows, Icons, Operating Environments, Shells, Pointing Devices
- Multitasking

  - Self contained device drivers or modularity with regard to sets of code written for communicating with peripherals as printers, disks, etc.; routines can be rewritten for devices without altering the BIOs.

- User needs are satisfied by:

  - Fulfillment of business needs mentioned above.

  - Ease of use evolving from use of windows, icons, operating environments, shells, and pointing devices.

  - Increased productivity by multitasking capabilities.

V PRESENT MAJOR MICROCOMPUTER OPERATING SYSTEM VENDORS AND PRODUCTS

- Before microcomputers were invented, operating systems (as well as application software) used by customers of mainframes and minicomputers were proprietary. With the introduction of microcomputers, many microcomputer vendors offered a limited number of common operating systems. This helped to create large markets of applications software available for various operating systems that in turn stimulated hardware sales.

  - Apple, Radio Shack, and Commodore were three vendors that primarily provided proprietary operating systems with their products. However, since they all were early entrants to the market, large installed bases of software were written by hobbyists and small companies.

  - In 1984 Apple DOS (Apple II product line) is still one of the operating systems with the largest available base of application software (second only to PC-DOS). Since the operating system is not available to other hardware vendors for competitive products, it will be excluded from this discussion.

- Major operating system vendors and products highlighted are listed in Exhibit V-1.

EXHIBIT V-1

OPERATING SYSTEM VENDORS AND PRODUCTS

VENDOR	OS PRODUCTS
Digital Research Inc. 160 Central, P.O. Box 579 Pacific Grove, CA 93950 (408) 649-3896	- CP/M, MP/M - CP/M-86, MP/M-86 - Concurrent CP/M - Concurrent DOS - GEM
Microsoft 10700 Northrup Way Box 97200 Bellevue, WA 98009 (206) 828-8080	- MS-DOS, PC-DOS - XENIX - Windows (not shipping yet)
AT&T Information Systems 1 Speedwell Avenue Morristown, NJ 07960	- UNIX - Model 6300 Microcomputer with MS-DOS IBM-Compatible OS
Apple Computers 20525 Mariani Avenue Cupertino, CA 95014 (408) 996-1010	- Apple DOS - MAC Finder Operating Environment
Tandy Corporation 1700 One Tandy Fort Worth, TX 76102 (817) 390-3700	- TRS DOS - MS-DOS on Model 2000 Microcomputer - MS-DOS IBM-Compatible on Model 1000 and 1200 Microcomputers
Phase One Systems 7700 Edgewater Dr. Oakland, CA 94621 (415) 562-8085	- Oasis - Oasis-16
Pick Systems 17911-D Skypark Circle Irvine, CA 92714 (714) 261-7425	- Pick
Interactive Systems Corp. 1212 Seventh St. Santa Monica, CA 90401 (213) 450-8363	- PC-IX (UNIX for IBM PCs)
Softech Microsystems Inc. 16885 W. Bernardo San Diego, CA 92127 (619) 451-1230	- UCSD p-System

A. DIGITAL RESEARCH

- Digital Research was founded by Gary Kildall, who was also the developer of the company's first operating system product CP/M.

  - Kildall developed the product while working for Intel on a programming language for the 8008 microprocessor. The language developed was called PL/M, a compact version of PL/I. Using this language, Kildall's "control program for microcomputers"--CP/M--came to be.

  - CP/M is a general control program that is designed to be independent of specific microcomputers. It has two parts: an invariant disk operating system and a small variant portion which allows various computer manufacturers to adapt CP/M around their specific products.

  - Next, a multiuser version of CP/M was added to DRI's product offerings--MP/M. It is a real time, multiuser, multitasking operating system for Intel 8080 and 8085 (and Zilog Z-80 chips) which supports 16 users, is upward compatible of CP/M, and offers record and file locking to insure data integrity as well as a password option for data security. MP/M is regarded as a minimal multiuser operating system partially because it attempts to incorporate multiuser capabilities on only an 8-bit chip.

  - In the early 1980s two similar operating systems were developed by DRI for implementation on the Intel 8086 and 8088 16-bit microprocessors--CP/M-86 and MP/M-86. Both were faster operating systems able to take advantage of the 8086/8088s' 1-megabyte direct memory addressing range. CP/M-86 was considered by IBM for the operating system on their PC product in 1981. The companies (DRI-IBM) could not come to terms, so IBM chose Microsoft's MS-DOS.

- DRI's product line evolved to concurrent CP/M--an operating system that allows a 16-bit microcomputer to execute several programs that appear to occur simultaneously. Although this product was before its time, it was the predecessor to concurrent DOS and concurrent DOS 286 (for PC AT and for IBM PCs), to be released in later 1985 compatibles. The company is placing its hopes for near-future success in these two products, as well as in its new operating environment--GEM.

- GEM (Graphics Environment Manager) is an operating system extension that uses little memory and creates a "Macintosh-like" screen on an IBM PC. The result is a much easier to use microcomputer with pull down menus, icons, and the use of a mouse pointing device. It was introduced in late 1984 and distributed initially on an OEM basis, but a low cost retail product will be available in 1985 and major hardware vendors (Atari, perhaps IBM and AT&T) are bundling the product on ROM with new 1985 products.

- Digital Research's strategy is one of support--support of major hardware vendors with add-on operating systems and extensions; support of application software vendors with developmental tools and training on rewriting packages to take advantage of DRI's product capabilities; and support of end users with ease of use--a sound future strategy.

B. MICROSOFT

- Microsoft was founded by a young lobbyist turned entrepreneur, Bill Galts, to market his BASIC microcomputer language.

- In 1980 Microsoft was approached by IBM, which at that time was searching for a company that could provide both an operating system and high-level languages for its planned personal computer. Microsoft purchased the 86-DOS operating system from Seattle Computer Products and included it as the heart of MS/PC-DOS. PC-DOS in turn was licensed by IBM for thier IBM PC operating systems. It is doubtful that Microsoft would have been interested in 86-DOS if IBM had not been involved. Microsoft had been working on XENIX for the 68000, targeted at the high end of the 16-bit scale. IBM's interest, however, suggested a low-end mass market that would be hard to pass up.

  - MS/DOS evolved neither upward from 8-bit microcomputer nor downward from minicomputers. It is actually a low-level version of UNIX.

  - PC-DOS 1.0, the original IBM version, was difficult to use, and was replaced by versions 1.1, then 2.0 to support the PC XT hard disk drives.

  - PC-DOS 2.1 was introduced in early 1984 to run on the IBM PC jr. It differed from 2.0 in that it supported half-height floppy drives found in the PC jr. rather than full size drives found in most PC products.

  - PC-DOS 3.0 is the operating system found on IBM's most recent PC product--the AT. Its enhancements include: optional file sharing, block locking, background print, optional function calls for better file management, and error recovery.

  - IBM's network support is, however, in PC-DOS version 3.1.

- Microsoft's XENIX, a version of ATT UNIX III, is the most widely used UNIX product in the microcomputer multiuser marketplace.

  - It differs from other UNIX products in that it offers a more "friendly" interface for end users, and simplier commands.

- XENIX will also be available in 1985 as the primary multiuser operating system option on the IBM PC AT.

- Microsoft's Multiplan and Word application packages will be available for XENIX on the AT, but the products will have no multiuser features. This casts doubt on Microsoft's real commitment to multi-user products.

- Since ATT's announced support of UNIX V as the UNIX standard, Microsoft has stated that it is working on a new version of XENIX that will be compatible with System V. The product will be able to run both XENIX III and UNIX V applications; however, the complete System V programs may not be able to be executed.

- Intel is presently working on porting XENIX to its 80286 chip.

- Microsoft has also completed work on MS-NET, a LAN that has the support of many LAN hardware and software suppliers.

- Microsoft's operating system strategy is also one of support--but it seems its support is for IBM. Should IBM abandon its commitment to PC-DOS as its primary PC operating system--where will that leave Microsoft?

- Fortunately Microsoft has diversified enough with applications software, windows operating environment, and MS-NET, so that even without IBM they could remain a significant force in the computer industry.

C. AT&T (UNIX)

- Bill Labs developed the UNIX operating system in 1969. Original versions ran on DEC minicomputers PDP-7, PDP-9, and PDP-11. It is a multiuser, multitasking operating system that can be configured with all types of computer systems from large hosts to microcomputers.

- UNIX is written in a general purpose language called C. With C it is easy to write programs on one computer and move them to another; thus UNIX can be adapted to other microcomputer systems rather quickly.

- Because of upgrading by Bill Labs and modifications by educational and other institutions, there exists no overall standard of UNIX today. AT&T however, after diversifying, announced its support of UNIX System V as the standard UNIX operating system. The company's 3B series of minicomputers, new 7300 UNIX-PC, and planned future products all evolve around a strategy of office automation with UNIX as the core.

- In 1984 Motorola received certification from AT&T of its implementation of UNIX System V on the Motorola 68000 microprocessor. (More than 75% of all UNIX based hardware products use the 68000 chip.) Intel, Zilog, and National Semiconductor have all done the same with their 32-bit chip and are actively soliciting support from third party application vendors. DRI has agreed to work with Intel on implementing UNIX on its 80286 16/24 bit chip which is the microprocessor used in the IBM PC AT.

- In 1984, IBM announced a version of UNIX for the IBM PC--PC XT. The product was provided by IBM not as a sign of market thrust but as a stopgap measure--"if a user wants UNIX we will have a UNIX product available."

- UNIX has some very positive characteristics:

  - It ports easily from one computer to another.

  - It provides multiuser, multitasking.

  - It has the possibility of setting an industry operating system standard that would take the control of the microcomputer industry from hardware vendors, thereby increasing competition, which would stimulate a decrease in hardware prices and better quality for end users.

  - This standard would also help Japan to enter the U.S. software market, which could stimulate better quality software products at lower prices.

- UNIX however, has many disadvantages attached to it.

  - Lack of user friendly interface.

  - Consumption of large amount of disk storage space (1.5 M-byte).

  - Writing in C makes programs run slower.

  - Data Security problem; expert programmers can break into the best protected UNIX files.

  - The best-selling application software for PCs is superior in function and lower in cost than UNIX software.

  - Buyers can't locate available UNIX products since there is no clear distribution path.

  - On a microcomputer, UNIX requires at least nine disks--a problem for retailers and users.

- There are so many versions of UNIX, it's unclear which ones to incorporate in a hardware product, to develop software for, or to purchase as part of a system configuration.

- Technology trends coupled with innovation have led or are leading to solutions in many of these problem areas:

  - UNIX's cryptic interface is being alleviated by Unicon, a product by Infologic, Inc. in Eatontown, New Jersey. The product is an icon driven interface that employs Graphics Kernel System (GKS) standard interfaces and presently is running on DEC VAX 11/750. DRI's GEM is another option--AT&T has licensed the product from DRI.

  - As more powerful chips are employed in microcomputers, the capacity for storage increases; thus in the near future, UNIX's memory consumption will not be an issue.

  - To alleviate the UNIX application software package issue several companies have developed "bridge products". In 1984 AT&T Locus of Santa Monica (CA) introduced PC Interface. It is a program that runs under a UNIX multiuser system and another on a PC DOS microcomputer linked as an intelligent workstation. Through this product DOS and UNIX applications can be used concurrently. Similar products have been introduced by Computerized Office Systems Inc., Ann Arbor (MI); and by Uniform Software Systems, Inc., Santa Barbara (CA). Consequently, a user can purchase a UNIX machine and continue to run DOS until sufficient UNIX application software is available.

- Although there are many versions of UNIX in the marketplace today, AT&T's announcement of their support of UNIX V as standard will have a great impact on narrowing UNIX versions. The company is also providing training and support of hardware and software vendors.

VI CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

- Operating systems will greatly influence the trend from single-user, single-tasking microcomputers to multiuser, multitasking microcomputers.

- IBM's overall office systems strategy will be the single most significant factor in determining the operating system market in 1990.

- Technology changes will make operating systems easier to use and more functional, resulting in more beneficial hardware and software products for users.

- UNIX, due primarily to AT&T market thrust, will become a significant operating system market player in 1986-1987 in multiuser environments, but will decrease in significance by the decade's end as IBM has an equally, if not more, capable product.

- IBM will standardize the operating system market. In 1983 the leaders in the micromarket were early innovators like Apple, Tandy, and HP, all with proprietary 8-bit operating systems (see Exhibit II-5). By 1990 IBM and compatibles will have the overwhelming market share.

- There will be secondary growth market opportunities for MS-DOS IBM compatibles, as well as products based on major vendors' proprietary operating systems. Small businesses will be the main segment for these products since small business is more price conscious than large, and these products will be lower in price than IBM products. "IBM consciousness is not as well entrenched in small business as in large."

- Application software developers will be writing in C for IBM products and networks, as well as for perhaps one alterntive operating system--Apple DOS or UNIX. The most innovative and largest installed base of computerized "solutions" will be available on IBM products.

B. RECOMMENDATIONS

- Large business: Buy IBM! The company has a tradition of support and quality, and they will provide an overall office solution with operating systems that link from low end through hosts.

- Small business: IBM would be a safe buy, and VAR will have vertical solution business packages available on IBM systems. If cost is a significant issue and excessive software sophistication is not necessary, low end products such as Apple and Atari will suit your needs.

- Operating system vendors: If you don't have IBM's blessing, business users will have a hard time perceiving any added benefit your operating system may have. Support of AT&T and IBM (as DRI with Gem) is a possibility for a select few, but to quote Jack Scanlon, vice president of computer systems, AT&T Technology Systems Group: "An operating system is not something a lot of companies ought to go to work on. First, they are very tough to do, there are a million more failures than successes. If you've got a good one, then you ought to standardize on it and you ought to concentrate on anybody who has

something unique to contribute, like an applications package for a vertical market."

- Hardware vendors: IBM will lock up the high-end compatible market by year's end, but the low end will still be available. IBM compatible or not, turnkey approaches to small business will be the only viable hardware strategy. Lower cost hardware (Atari and Commodore) with solutions to specific market segments, plus service and support, will all be necessary for success.

- Application software developers: Take advantage of new chips and operating system capabilities to write easier-to-use, more concise solutions to users' problems. Established successful software vendors should write multiuser packages for Apple Net and IBM's new network. Write software compatible with IBM as long as possible.

QUESTIONNAIRE

1. Where is the operating system market going?

   a. Multiuser? _____

   _____

   b. Micro-mainframe? _____

   _____

   c. Operating environment? _____

   _____

   d. Operating system on ROM? _____

   _____

   e. Operating system as secondary purchase? _____

   _____

   f. LAN? _____

   _____

   g. Any other technological trends? _____

   _____

   h. What functionality will be added to OS? _____

   _____

2. What are your feelings on VM as the PC main operating system of the future with UNIX, PC-DOS, Apple DOS, etc. running as guests?

3. What do you see as the future of PC-DOS?

4. Where is the application software market going in relation to operating systems?

5. What do you think will be the future strategies of:

   a. IBM?

   b. AT&T?

   c. Others?

6. What would be a viable market and/or product strategy for an OS vendor to take to counter these strategies?

7. Will current OS vendors remain leaders? Why or why not?

_____

_____

_____

8. In what year do you expect these hardware configurations to be commonplace?

_____

a. Multiuser with terminals? _____

b. LAN _____

c. PC-AT with terminals linked to PC-AT with terminals _____

_____

9. Any new products your company is working on that will impact the OS marketplace?

_____

_____

_____

10. If you were an application software developer, for which OS or hardware product(s) would you be designing software? Why or why not?

11. If you were a corporate micro user, which system(s) would you purchase? Why?

12. Any other comments?

APPENDIX B: SCOPE OF INCLUSION FOR MICROCOMPUTER HARDWARE FORECASTS

- The forecast is for U.S. sales only.

- The forecast includes computers bought for business use; computers bought for home and classroom use are excluded. Computers used for administrative purposes in educational institutions are included.

- The definition of the computers counted in the forecast is as follows:

  - Price range: Less than $15,000 (in current dollars) for a complete system, including monitor, memory, and storage.

  - Typical configuraion: Monochrome monitor, 256K RAM, two floppy disk drives, and a 16-bit processor that sell as a system for $3,000.

- The forecast counts machines that can serve as standalone computers and are sold for general purpose use. Consequently, the following products are not included: dedicated word processors, graphics workstations, dedicated CAD/CAM systems, terminals, and intelligent terminals with memory but no CPU.

- Machines that are included are:
  - Personal computers, intelligent workstations, executive workstations, and intelligent terminals that are capable of local processing on a standalone basis.
  - Multiuser systems sold for less than $15,000 are included; however, only the CPU is counted--the terminals are not counted.
  - A personal computer connected to a host or to a network is counted, but the computer must have some form of local storage.
  - For the installed base forecast, a retirement rate of 12% for 1985 and 1986, and 10% per year for 1987-1990 was assumed.
- Portables, luggables, and lap top computers are included.

About INPUT

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

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