

Hewlett-Packard HP 3000 Series

MANAGEMENT SUMMARY

UPDATE: Hewlett-Packard realizes that it can no longer rely on the fine reputation it earned within the commercial and manufacturing data processing community, and is expanding and enhancing its products to compete more effectively against IBM and Digital Equipment Corporation. As part of its strategy, Hewlett-Packard recently announced HP 3000 Series 955, 935, 925, and 925LX superminicomputers and the Micro3000LX and Micro3000GX supermicrocomputers. Combined with revamped marketing and sales strategies and HP's existing high-rated service and support programs, these products are designed to capture market share lost to the competition.

Hewlett-Packard introduced the HP 3000 Series in 1970 and has approximately 30,000 systems installed today. According to International Data Corporation (IDC)—a market research firm in Framingham, Massachusetts—Hewlett-Packard holds *fifth place in market share for business computers*. The company has maintained this position for a number of years. Hewlett-Packard's marketing and product development programs have kept it from gaining any substantial market share within the commercial and manufacturing data processing environments. For several years, Hewlett-Packard pursued less intensive marketing efforts than other successful vendors, such as IBM and Digital Equipment Corporation, and offered no new innovative technologies.

Since Hewlett-Packard does not wish to remain in fifth place within the commercial and manufacturing data processing marketplace, the company has been making some ➤

The Hewlett-Packard 3000 Series is a compatible family of commercial data processing systems that spans a broad performance range. Known for their reliability and ease of use, the HP 3000s are ideally suited for online transaction processing and distributed processing. With an installation base of over 30,000 systems, they appear in a wide range of manufacturing and service industries in addition to government and public service infrastructures.

MODELS: Micro 3000LX, Micro 3000GX, Micro 3000XE, Series 52, Series 58, Series 70, Series 925LX, Series 925, Series 935, Series 950, Series 955.

MEMORY: 2M to 128M bytes.

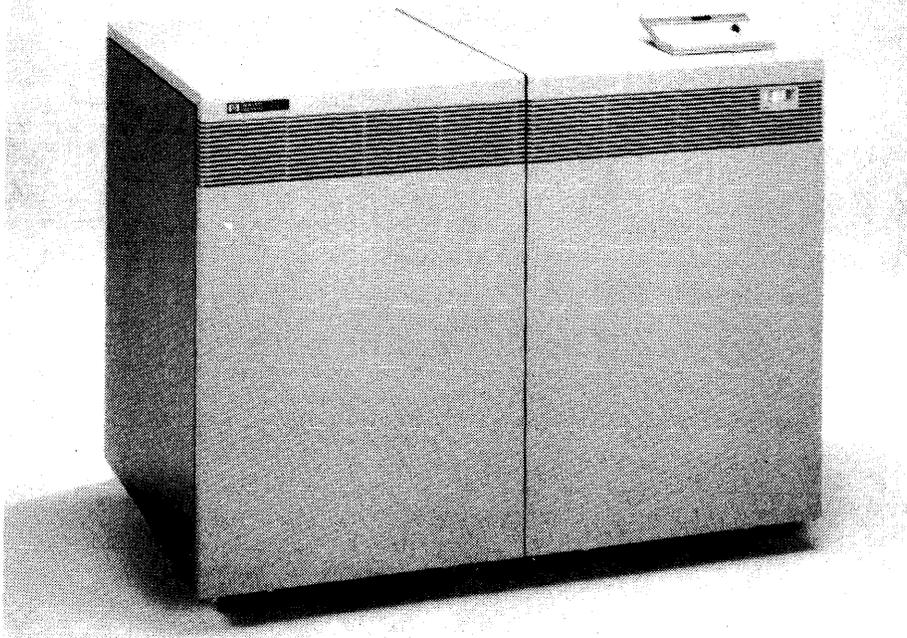
DISK CAPACITY: 81M to 24.1G bytes.

WORKSTATIONS: Up to 400 (via point-to-point connections).

PRICE: \$10,950 to \$390,000 (basic entry system prices).

CHARACTERISTICS

MANUFACTURER: Hewlett-Packard Company, 1820 Embarcadero Road, Palo Alto, California 94303. Contact your local sales office. ➤



Pictured here is the HP 3000 Series 955, a 11-MIPS system that accommodates up to 400 terminal I/O devices.

Hewlett-Packard HP 3000 Series

CHART A. SYSTEM COMPARISON

MODEL	Micro 3000LX	Micro 3000GX	Micro 3000XE	HP 3000 Series 52	HP 3000 Series 58	HP 3000 Series 70
SYSTEM CHARACTERISTICS						
Date of introduction	April 1988	April 1988	November 1986	August 1988	August 1985	April 1988
Operating system	MPE V					
Upgradable to	Field upgrade options are not available.					
MIPS	—	—	—	—	—	1.6
MEMORY						
Minimum capacity, bytes	2M	2M	2M	4M	4M	8M
Maximum capacity, bytes	4M	4M	8M	8M	8M	16M
Cache memory, bytes	None	None	128K	32K	32K	128K
MINIMUM DISK STORAGE (bytes)	81M	152M	81M	—	—	—
MAXIMUM DISK STORAGE (bytes)	304M	2G	4.5G	4.5G	4.5G	13.7G
NUMBER OF WORKSTATIONS	2 to 8 (typical)	6 to 16 (typical)	12 to 30 (typical)	20 to 50 (typical)	20 to 50 (typical)	50 to 120 (typical)
COMMUNICATIONS PROTOCOLS						
	HP ThinLAN/ ThickLAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25 \$10,950	HP ThinLAN/ ThickLAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25 \$15,950	HP ThinLAN/ ThickLAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25 \$27,000	HP ThinLAN/ ThickLAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25 \$45,890	HP ThinLAN/ ThickLAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25 \$76,490	HP ThinLAN/ ThickLAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25 \$160,000
PURCHASE PRICE (basic entry system)						
COMMENTS	A supermicro-computer based on conventional designs. Maintains compatibility with other HP 3000 computers.	A supermicro-computer based on conventional designs. Maintains compatibility with other HP 3000 computers.	A supermicro-computer based on conventional designs. Maintains compatibility with other HP 3000 computers.	A 16-bit mini-computer with a conventional design. Maintains compatibility with other HP 3000 computers.	A 16-bit mini-computer with a conventional design. Maintains compatibility with other HP 3000 computers.	A 16-bit mini-computer with a conventional design. Maintains compatibility with other HP 3000 computers.

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

positive moves with the HP 3000 Series product line. Hewlett-Packard is pursuing new technologies as replacements for its older ones and is using a more aggressive marketing strategy to sell systems.

The new design technology for the HP 3000 computers is the Hewlett-Packard Precision Architecture (HPPA). It is to be Hewlett-Packard's computer architecture up through the 1990s.

HPPA is a Hewlett-Packard computer design technology based on reduced instruction set computing (RISC) concepts and extensions. Hewlett-Packard is the *only major superminicomputer vendor* to use RISC-based technology as a foundation for superminicomputer computing. Most RISC-based systems are found mostly among technical workstations and engineering/scientific and realtime superminicomputers. Even though Pyramid Technology uses RISC for its general-purpose systems, those systems do not compete directly with Hewlett-Packard HP 3000s. Moreover, competitors such as IBM, Digital Equipment Corporation, Data General, Wang, Honeywell Bull, and Prime do not yet have RISC-based superminicomputers.

RISC-based systems offer benefits in price/performance and reliability over conventional or complex instruction set computing (CISC). Furthermore, RISC allows the vendor to develop less expensive systems more quickly since the complex designs of the CISC systems are avoided. Such attributes help Hewlett-Packard to deliver a more competitive system.

▶ **CANADIAN ADDRESS:** Hewlett-Packard Canada Ltd., 6877 Goreway Drive, Mississauga, Ontario L4V 1M8. Telephone (416) 678-9430.

DATA FORMATS

BASIC UNIT: 16-bit word for the conventional HP 3000 computers—i.e., the Micro 3000 supermicros and Series 52, 58, and 70 minicomputers. A 32-bit word for the Hewlett-Packard HP Precision Architecture (HPPA)-based HP 3000 superminicomputers—i.e., the Series 925LX, 925, 935, 950, and 955.

FIXED-POINT OPERAND: For the conventional HP 3000 computers, 16-bit operands can be used by logical or fixed-point arithmetic instructions to represent 16-bit integers. Double-integer, fixed-point formats provide 32 bits of value representation. Packed decimal instructions can be extended to 28 digits of precision. Logical operands are represented in positive integer format, while fixed-point operands are represented in twos complement format.

The Series 900 superminicomputers, implementing the HP Precision Architecture, support 16-bit and 32-bit integers, either signed or unsigned. Signed integers are in twos complement form. Both packed and unpacked decimal data representations are supported. To help minimize processor complexity, halfword (16-bit) integers must be aligned at even byte addresses, and 32-bit integers must be aligned on a word boundary.

FLOATING-POINT OPERAND: The conventional HP 3000 systems include single-precision, 32-bit operands and extended-precision, 64-bit operands.

▶ The Series 900 supports binary floating-point representation that conforms to the ANSI/IEEE 754-1985 standard. ▶

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CHART A. SYSTEM COMPARISON (Continued)

MODEL	HP 3000 Series 925LX	HP 3000 Series 925	HP 3000 Series 935	HP 3000 Series 950	HP 3000 Series 955
SYSTEM CHARACTERISTICS					
Date of introduction	April 1988	April 1988	April 1988	February 1986	April 1988
Operating system	MPE XL				
Upgradable to	Series 925	Series 935	Field upgrade options are not available. 6.0 to 6.4	Series 955	Does not apply.
MIPS	3.2	3.2		7.0	11.0
MEMORY					
Minimum capacity, bytes	24M	32M	32M	48M	48M
Maximum capacity, bytes	48M	48M	96M	128M	128M
Cache memory, bytes	16K	16K	128K	128K	256K
MAXIMUM DISK STORAGE (bytes)	4.5G	9.1G	13.7G	17.1G	27.1G
NUMBER OF WORKSTATIONS	16 to 32 (typical)	32 to 75 (typical)	60 to 150 (typical)	75 to 200 (typical)	120 to 300 (typical)
COMMUNICATIONS PROTOCOLS	HP ThinLAN/Thick-LAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25	HP ThinLAN/Thick-LAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25	HP ThinLAN/Thick-LAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25	HP ThinLAN/Thick-LAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25	HP ThinLAN/Thick-LAN (IEEE 802.3 Ethernet), HP StarLAN, HP ASNL, NS/3000, APRA Services, SNA, BSC, OSI/X.25
PURCHASE PRICE (basic entry system)	\$50,000	\$80,000	\$150,000	\$270,000	\$390,000
COMMENTS	A (32-bit) supermini-computer implementing the RISC-based HP Precision Architecture design. It maintains compatibility with all HP 3000 models.	A (32-bit) supermini-computer implementing the RISC-based HP Precision Architecture design. It maintains compatibility with all HP 3000 models.	A (32-bit) supermini-computer implementing the RISC-based HP Precision Architecture design. It maintains compatibility with all HP 3000 models.	A (32-bit) supermini-computer implementing the RISC-based HP Precision Architecture design. It maintains compatibility with all HP 3000 models.	A (32-bit) supermini-computer implementing the RISC-based HP Precision Architecture design. It maintains compatibility with all HP 3000 models.

➤ Hewlett-Packard first placed HPPA within the HP 3000 product line in 1986 to provide the HP 3000 systems with the power needed to effectively compete with Digital Equipment Corporation systems, its toughest rivals. Before the advent of the HPPA-based HP 3000 models, Hewlett-Packard had watched its market share shrink year after year as competitors produced conventional computers that could easily outperform the HP 3000 systems. Project after project failed to provide a conventional design that yielded the power needed to match that of rival machines. Hewlett-Packard finally hit pay dirt with the Series 930 and 950, the first of a new breed of HP 3000s that upgraded computing power without sacrificing compatibility with the line's conventional predecessors.

In order to expand upon the capabilities offered by the first-generation HPPA superminicomputers—the Series 930 and 950—and to offer better cost-effectiveness for large, medium, and small configurations, Hewlett-Packard added the HP 3000 Series 955, 935, 925, and 925LX superminicomputers to the HP 3000 product line. The Series 955 represents Hewlett-Packard's attempt to improve the economics and processing of the large-scale Series 950. The Series 935 represents an attempt to better the economics and resources of the midrange Series 930. The Series 925 and 925LX represent affordable HPPA technology for the smaller environment; the Series 925 and 925LX offer attractive price/performance and cost-per-seat relative to a Series 930 configured for a small environment.

The Series 955 is the new top-of-the-line HP 3000 model. Running at up to 11 MIPS, it offers 50 percent more ➤

➤ The computers perform floating-point arithmetic operations using single-precision (32-bit), double-precision (64-bit), and quadruple-precision (128-bit) floating-point formats.

On the Series 900, the floating-point instructions can either be executed directly in hardware by a co-processor, or can be emulated in software. With a floating-point co-processor, floating-point calculations are performed while the CPU continues to execute in parallel.

INSTRUCTIONS: Conventional HP 3000 instructions are either 8, 16, or 32 bits in length. With the exception of the stack instructions, all conventional HP 3000 instructions are one-word types with 23 distinct formats for 13 different instruction groups. The 65 stack instructions, which are 8-bits long, can be packed two per word.

To enable the machine to be cycled as quickly as possible, the HPPA-based computers—Series 900—support a reduced number of instructions relative to conventional computers. For example, typical complex architectures utilize over 300 instructions, compared to 140 instructions provided with Series 900 computers. The reduced complexity allows instruction decoding and control circuitry to be simplified, resulting in higher performance.

All of HPPA instructions of the HPPA architecture are fixed-length, 32-bit instructions. A fixed-length instruction helps facilitate the simultaneous execution of multiple instructions, a capability known as instruction pipelining.

All HPPA instructions are fixed format, which means that the instruction opcode and operand registers are always specified in the same place in the instruction. Having fixed-format instructions allows for instruction decoding and fetching of required operands to occur in parallel, thus increasing processing efficiency and performance.

Furthermore, the HPPA instruction set directly implements only simple functions to minimize processor complexity. The more complex functions, which are often ➤

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CHART B. MASS STORAGE

MODEL	HP 7933H and HP 7933XP	HP 7935H and HP 7935XP	HP 7936FL	HP 7936H	HP 7937FL	HP 7937H
Type	Fixed	Removable	Fixed	Fixed	Fixed	Fixed
Controller model	Integrated	Integrated	Integrated	Integrated	Integrated	Integrated
Drives per subsystem/controller	1/controller	1/controller	1/controller	1/controller	—	—
Formatted capacity per drive, megabytes	404	404	307	307	571	571
Average seek time	24.0 ms	24.0 ms	20.5 ms	20.5 ms	20.5 ms	20.5 ms
Average rotational/relay time	11.1 ms	11.1 ms	8.3 ms	8.3 ms	8.3 ms	8.3 ms
Average access time	35.1 ms	35.1 ms	28.8 ms	28.8 ms	28.8 ms	28.8 ms
Data transfer rate	1.06M bytes/second	1.06M bytes/second	2.35M bytes/second	2.35M bytes/second	2.35M bytes/second	2.35M bytes/second
Supported by system models	All models except Micro 3000LX and Micro 3000GX	All models except Micro 3000LX and Micro 3000GX	All models except Micro 3000LX	All models except Micro 3000LX	All models except Micro 3000LX	All models except Micro 3000LX
Purchase price (basic)	—	\$24,000 for HP 7935H; 25,500 for HP 7935XP	\$15,500	\$14,250	\$16,950	\$15,700
Comments	Requires the HP-IB interface to communicate with the host. Up to 4 drives, each with their own controller, can reside on the HP-IB.	Attaches to the host via HP-IB. The HP 7935XP features a read/write cache; the HP 7935H does not.	Requires the HP-FL interface to communicate with the host. Up to 8 drives, each with their own controller, can reside on the HP-FL.	Attaches to the host via HP-IB.	Requires the HP-FL for connectivity and operability.	Communicates with the host via the HP-IB interface.

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▷ performance than the previous high-end system—the Series 950 (which remains in the product family). Furthermore, it supports 1.5 times more online mass storage and can effectively accommodate 1.5 to 1.6 more workstation devices.

The Series 955 allows installations to grow with no need to reinvest in another vendor's computer architecture. Peripheral, communications, and software compatibility throughout the HP 3000 product line allows easy migration to the Series 955. Furthermore, the Series 955 has a longer life expectancy than the other Series 950—it can address a broad range of work loads during the installation's growth.

The Series 935, 925, and 925LX superminicomputers bring a new level of midrange performance to the HP 3000 product line and dramatically improve price/performance. The Series 935, which runs applications at up to 6.4 MIPS, offers 1.7 times more price/performance than the Series 930—a 4.5-MIPS computer—and up to 4.0 times more price/performance than the Series 70. The 3.2-MIPS Series 925 and 925LX offer approximately three to four times more performance than the Series 52 and Series 58 at price levels that are equal to that of the Series 52 or Series 58 or one third lower.

Since the Series 935, 925, and 925LX outperform the Series 52, 58, and 70 and effectively replace the Series 930, these HPPA systems represent Hewlett-Packard's new solution for computing at the midrange of the HP 3000 product line. The Series 935, 925, and 925LX are intended for processing that falls between the Series 950 supermini and the Micro3000 supermicrocomputers (the entry-level points into the HP 3000 family).

▷ directly supported in the instruction sets of the conventional systems, are performed by a sequence of simple instructions generated by high-level language compilers.

With the HPPA architecture, data stored in memory is referenced via only Load and Store instructions. Accessing memory with only Load and Store instructions, coupled with support for a relatively large number of central processor registers, allows for frequently required operands to be held in the central processor. A performance increase is thus realized, as the number of accesses to cache and main memory is minimized.

The arithmetic and logical functions are limited to relatively simple functions with appropriate primitives provided for common operations. More complicated arithmetic and logical functions are implemented by executing a sequence of simple instructions.

INTERNAL CODE: ASCII.

MAIN STORAGE

GENERAL: The HP 3000 computers are virtual memory machines. Under virtual memory allocation scheme of the conventional HP 3000 systems, each program is partitioned into as many as 63 segments. Each code segment can be up to 32K bytes in length, and each data segment up to 64K bytes. A program cannot be larger than 2M bytes.

Using 48-bit virtual addresses, the HP Precision Architecture-based computers provide virtual address spaces of significant size. The virtual memory is organized as a set of 65,536 linear spaces. Each space is 4G bytes long. Spaces are further divided into fixed-length, 2K-byte pages, each of which can hold either code, data, or both. A single data structure can be up to 4G bytes long.

Main storage holds the virtual memory segments and pages. The segments and pages are moved to and from main storage on an as-needed basis. Virtual memory segments and pages are brought into and out of main storage

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CHART B. MASS STORAGE (Continued)

MODEL	HP 7957A/B	HP 7958A	HP 7958B and HP 7962B	HP 7959B	HP 7963B
Type	Fixed	Fixed	Fixed	Fixed	Fixed
Controller model	Integrated	Integrated	Integrated	Integrated	Integrated
Drives per subsystem/controller	1/controller	1/controller	1/controller	1/controller	1/controller
Formatted capacity per drive, megabytes	81	130	152	304	304
Average seek time	29.0 ms	29.0 ms	—	17.0 ms	17.0 ms
Average rotational/relay time	8.3 ms	8.3 ms	—	8.9 ms	8.9 ms
Average access time	37.3 ms	37.3 ms	—	25.9 ms	25.9 ms
Data transfer rate	1.25M bytes/second	1.25M bytes/second	—	1.25M bytes/second	1.25M bytes/second
Supported by system models	All models	All models	Micro 3000LX, Micro 3000GX, and Micro 3000XE	All models	All models
Purchase price (basic)	\$4,250	\$6,450	\$5,475 for HP 7958B; \$6,300 for HP 7962B	\$9,350	\$10,750
Comments	Has a 5.25-inch form factor. Can be rack-mounted. Requires the HP-IB to communicate with the host.	The HP 7958B is packaged in a small desktop package. The HP 7962B is housed in a cabinet that can hold three HP 7962B units.	Has a 5.25-inch form factor. Requires the HP-IB for connectivity.	Has a 5.25-inch form factor. Requires the HP-IB for connectivity.	Has a 5.25-inch form factor. Up to three HP 7963Bs can reside in one disk drive packaging. The HP-IB interface is required for connectivity.

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Even though the Series 935, 925, and 925LX offer better price/performance than the 0.5-MIPS Series 52, 0.6-MIPS Series 58, and the 1.6-MIPS Series 70, they are not meant to replace the CICS-based systems. The Series 52, 58, and 70 models are marketed to those installations looking for cost-effective data processing solutions that will participate in a multivendor or multiple-communications scheme network. The CICS-based systems offer more communications and networking functions than the Series 900 computers. For instance, the Series 52, 58, and 70 provide integral X.25 support whereas the Series 900 cannot directly accommodate X.25 communications or networking. The only way the Series 900 computers can communicate within X.25 communications infrastructure-based computers is through a gateway maintained by a CICS-based computer—an expensive way to achieve X.25 communications relative to the direct connections used on the Series 52, 58, and 70.

Although Hewlett-Packard has not added HPPA computing to the low end of the HP 3000 product spectrum, it continues to improve the price/performance and capabilities of its low-end, CICS-based HP 3000 products. Two years ago, Hewlett-Packard replaced its low-end, CICS-based HP 3000 minicomputer—e.g., the Series 37—within supermicrocomputer products—computers that delivered minicomputer performance at reduced costs—to offer more cost-effective computing. As a further commitment to enhance performance and cost-effectiveness at the low end of the HP 3000 product spectrum, Hewlett-Packard recently enhanced its Micro 3000 series by adding the Micro 3000LX and Micro 3000 supermicrocomputers.

The Micro 3000LX and Micro 3000GX provide a new entry point to entry-level and small-scale HP 3000 computing. The new supermicrocomputers are positioned below the Micro3000XE, a high-performance supermicrocomputer, and effectively replace the Micro3000, the previous entry-level HP 3000 supermicro.

under the control of the virtual memory manager within the MPE V and MPE XL operating systems.

CAPACITY: The Micro 3000GX and Micro 3000LX supermicros accommodate either 2M or 4M bytes of main storage. The main storage resides on the system processor board along with the central processor and input/output (I/O) channel.

The Micro 3000XE comes with a 2M-byte main memory which can be expanded to 8M bytes in increments of 2M or 4M bytes.

The Series 52 and 58 accommodate from 4M to 8M bytes of main storage. Main storage is expanded in increments of 2M or 4M bytes.

The Series 70 comes with an 8M-byte memory which can be expanded to 16M bytes in increments of 4M or 8M bytes.

From 24M to 128M bytes of main storage is supported on the Series 900 computers. Chart A provides the main storage capacities of specific models.

CHECKING: Error detection and correction circuitry detects and corrects single-bit errors. Multibit errors are detected and a high-priority interrupt is sent to the system software for appropriate action.

STORAGE PROTECTION: The conventional HP 3000 Series systems have upper and lower address boundaries provided by certain registers that define the limits of authorized program access in main storage. The microprogram routinely checks for bounds violations during execution (overlapped with operand fetch) and generates an interrupt if an unauthorized memory access attempt is made. Bounds violations may be classified under program transfer or reference, data reference, and stack overflow or underflow.

On the Series 900 computers, virtual memory access is protected by the translation lookaside buffer hardware in the central processor. The translation lookaside buffer supports protection mechanisms to assure that the currently executing process can perform only the code, data, or I/O accesses for which it is authorized. Included in the access checking mechanisms are four privilege levels. Protection

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CHART C. WORKSTATIONS

MODEL	HP 700/92	HP 700/94	HP 700/41	HP 700/22	HP 700/43
DISPLAY PARAMETERS					
Screen size	14 inches	14 inches	14 inches	14 inches	14 inches
Screen format	80 or 132 columns per line	80 or 132 columns per line	80 columns per line	80 or 132 columns per line	80 or 132 columns per line
Screen type	Monochrome with green, amber, or soft white character phosphor	Monochrome with green, amber, or soft white character phosphor	Monochrome with green or amber character phosphor	Monochrome with green, amber, or soft white character phosphor	Monochrome with green, amber, or soft white character phosphor
KEYBOARD PARAMETERS					
Style	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY
TERMINAL INTERFACE	RS-232-C	RS-232-C	RS-232-C	RS-232-C	RS-232-C
PURCHASE PRICE (basic)	\$895	\$1,095	\$375	\$575	\$475
COMMENTS	A block-mode alphanumeric display terminal. Has an 8-page display memory.	A high-performance block-mode alphanumeric display terminal.	Features 9 ASCII alphanumeric display terminal compatibility modes.	An alphanumeric display terminal. Features a 4-page display memory.	An alphanumeric display terminal with 12 compatibility modes.

CHART C. WORKSTATIONS (Continued)

MODEL	HP 2392A	HP 2393A	HP 2394A	HP 2397A	HP 3081A
DISPLAY PARAMETERS					
Screen size	12 inches	—	—	12 inches	—
Screen format	24 lines, 80 columns per line	80 or 132 columns per line	160 columns per line	—	—
Screen type	Monochrome	Monochrome	—	Color	—
KEYBOARD PARAMETERS					
Style	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY
TERMINAL INTERFACE	RS-232-C	RS-232-C or RS-422	RS-232-C	RS-232-C or RS-422	RS-232-C
PURCHASE PRICE (basic)	\$1,400	\$2,295	\$1,910	\$3,595	\$935
COMMENTS	An alphanumeric display terminal with an 8-page display memory. Offers a character resolution of 7 x 11 in a 9 x 14 dot matrix cell.	A graphics terminal with bit-mapped and line-drawing graphics. Graphics resolution is 512 x 390 or 640 x 400 pixels.	A terminal with extensive data entry functions.	A graphics terminal with bit-mapped and line drawing graphics.	A data entry terminal packaged for the factory floor environment.

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ The Micro3000LX and Micro3000GX operate at the same performance level as the Micro 3000 but are priced lower.

By replacing the Micro 3000 with the Micro 3000LX and Micro 3000GX, Hewlett-Packard offers more cost-effective computers for small businesses, departmental, and branch office computing. The Micro 3000GX is priced 25 percent lower and the Micro 3000LX costs 49 percent less than the Micro 3000. This increased cost-effectiveness enables Hewlett-Packard to compete more effectively at the low end of the computing spectrum.

To convince customers to invest in the HP 3000 product line, Hewlett-Packard has made a very large investment to ensure that the Series 900 models remain program, file, and data compatible with the rest of the HP 3000 family despite their RISC-based HPPA design. The Series 900 computers' MPE XL operating system provides protection for software investments in system migrations and provides a measure of bottom-to-top software development and execution. Applications developed on one conventional HP 3000 multiuser computer can be moved to an HPPA-based HP 3000 without undergoing modification or recompiling.

All HP 3000 computers implement an "open network computing" philosophy to attract customers with a multi-vendor or multiple-architecture computer infrastructure. ➤

➤ parameters are associated with each page, and these parameters define what privilege level is required to access that page, as well as what types of accesses are permitted. For each requested access, these privilege parameters are checked against the privilege level of the currently executing process, to ensure that the privilege has sufficient authorization to perform that access.

CACHE MEMORY: The Micro 3000XE supermicro, the Series 52, 58, and 70 minicomputers, and the Series 900 superminicomputers each have a cache. By using a cache, the central processors have high-speed access to frequently used data and instructions. This improves system performance since fetching instructions and data in cache memory is faster than accessing instructions and data within memory. The utilization of cache memory overcomes the discrepancy between the memory cycle speed and the faster data-access rate of the central processor.

CENTRAL PROCESSOR

GENERAL: The conventional HP 3000 computers use central processors that include a firmware-implemented instruction set; firmware-implemented, repetitive functions such as subroutine linkage, string processing, and buffer transfers; firmware-assisted software; bus control clock; and crystal clock dedicated to process execution measurements.

➤ The Micro 3000LX, Micro 3000GX, and Micro 3000XE central processor is mostly contained on a single microprocessor chip. The processor chip comprises the central processor unit (CPU); a control store containing the most

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CHART C. WORKSTATIONS (Continued)

MODEL	Touchscreen II Terminal	Portable Plus	HP Vectra CS and HP Portable Vectra CS	HP Vectra ES and HP Vectra ES/12	HP Vectra RS/16 and HP Vectra RS/20
DISPLAY PARAMETERS					
Screen format	24 lines, 80 columns per line	24 lines, 80 columns per line	24 lines, 80 columns per line	24 lines, 80 columns per line	24 lines, 80 columns per line
Screen type	—	—	Monochrome or color	Monochrome or color	Monochrome or color
KEYBOARD PARAMETERS					
Style	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY
TERMINAL INTERFACE	RS-232-C	RS-232-C, HP StarLAN, or IEEE 802.3-compatible LAN	RS-232-C, HP StarLAN, or IEEE 802.3-compatible LAN	RS-232-C, HP StarLAN, or IEEE 802.3-compatible LAN	RS-232-C, HP StarLAN, or IEEE 802.3-compatible LAN
PURCHASE PRICE (basic)	\$2,730	—	\$3,199	—	—
COMMENTS	An intelligent workstation with advanced touchscreen technology.	A portable microcomputer that runs MS-DOS operating system.	The HP Vectra CS is an MS-DOS-based PC with an 8086 chip. The HP Portable Vectra CS is a portable version of the HP Vectra CS.	The HP Vectra ES and HP Vectra ES/12 are IBM PC AT-compatible microcomputers.	The HP Vectra RS/16 features a 16MHz Intel 80286 chip and the HP Vectra RS/20 microcomputer has a 20MHz Intel 80386.

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ The HP 3000's communications and networking scheme provides the openness required in a departmental and distributed processing environment. Tools are available to:

- Communicate with Hewlett-Packard HP 1000 technical computing and realtime processing systems and HP 9000 workstations and multiuser computers; and
- Communicate with non-Hewlett-Packard computers with proprietary and industry-standard architectures that are connected to IEEE 802.3-recommended Ethernet or X.25 communications lines and implement the Department of Defense Advanced Research Projects Agency (ARPA) networking standards—i.e., the TCP/IP, FTP, Telenet, and SMTP protocols for file transfer, terminal login access, electronic mail, and remote command execution.

The HP 3000 systems also can communicate with IBM System/370-architecture mainframe and supermini host systems and can directly interface with DECnet-connected Digital Equipment Corporation computers.

To further highlight the HP 3000 as a "true" departmental system, Hewlett-Packard touts the HP 3000's capabilities of supporting MS-DOS-based and IBM PC and compatible microcomputers. PC integration tools like AdvanceLink, Resource Sharing, and Information Access allow the microcomputers to access HP 3000 programs and data, and to use the HP 3000 as a resource server and a gateway to other systems within the network.

Hewlett-Packard maintains its award-winning customer and product support programs in an effort to convince customers to invest in HP 3000 computing or to remain with HP 3000 computers. According to Datapro's 1987 U.S. Computer Users Survey, Hewlett-Packard was rated above Digital Equipment Corporation, IBM, Data General, Prime, and Wang in overall support satisfaction. ➤

➤ frequently used microcode routines and boot code; a register file; a power supply monitor; and a miscellaneous maintenance block. The external support circuitry consists of the system clock generation circuitry, a maintenance panel interface, a power supply for the processor chip, and the additional control stores.

A cache memory is contained on the central processor board of the Micro 3000XE. The cache stores 128K bytes of frequently referenced instructions and data.

The Series 52 and 58 each feature a 16-bit central processor that contains a CPU with a single arithmetic and logic unit (ALU), a shifter, a register file, and control logic; a writable control store; and a 32K-byte cache for instructions and data. Each central processor also has a console and a maintenance processor.

The Series 70 central processor contains a CPU featuring two ALUs, two shifters, and related data manipulation and testing logic. It also features a 128K-byte cache for instructions and data and a console and diagnostic control unit. With the dual ALU and shifter design, the Series 70 central processor can execute two 16-bit or one 32-bit operation in one CPU cycle.

The Series 900 computers feature central processors that implement the HP Precision Architecture (HPPA). Each processor embodies the basic principles of reduced instruction set computers (RISC). The Series 900 processors are hardwired controlled and are pipelined at the instruction level such that up to five instructions can be operational at the same time. Instructions are executed directly in hardware and typically will execute in only one clock cycle. Branch instructions and Load/Store instructions may require more than one cycle to execute, but are implemented and scheduled such that effective execution rates approaching one cycle per instruction are achieved.

➤ The Series 925LX, 925, and 935 central processor contains a CPU comprised of an instruction unit for instruction fetching and decoding and an execution unit for arithmetic, logic, system control instruction execution; a floating-point co-processor which performs floating-point arithmetic operations; a cache controller and cache; the translation lookaside buffer which performs virtual-to-physical address translations; and a console and diagnostic control processor.

Hewlett-Packard HP 3000 Series

CHART D. PRINTERS

MODEL	HP 2563B	HP 2564B	HP 2566B	HP 2567B	HP 2932
Type	Matrix line	Matrix line	Matrix line	Matrix line	Matrix serial
Speed	300 lpm	600 lpm	900 lpm	1,200 lpm	200 cps
Character formation	7 of 19 x 18 and 14 of 38 x 18 dot matrix	7 of 19 x 18 and 14 of 38 x 18 dot matrix	7 of 19 x 18 and 14 of 38 x 18 dot matrix	7 of 19 x 18 and 14 of 38 x 18 dot matrix	9 x 12 dot matrix
Horizontal character spacing (char./inch)	5.0, 10.0, 12.0, 13.3, 15.0, 16.7	5.0, 10.0, 12.0, 13.3, 15.0, 16.7	5.0, 10.0, 12.0, 13.3, 15.0, 16.7	5.0, 10.0, 12.0, 13.3, 15.0, 16.7	5.0, 10.0, 6.3
Controller/Interface	RS-232-C, RS-422, or HP-IB interface	RS-232-C, RS-422, or HP-IB interface	RS-232-C, RS-422, or HP-IB interface	RS-232-C, RS-422, or HP-IB interface	RS-232-C, RS-422, or HP-IB interface
Graphics capability	Yes	Yes	Yes	Yes	Yes; at 90 x 90 dpi
Purchase price (basic)	\$7,790	\$12,950	\$22,641	\$29,170	\$2,595
Comments	Prints text and alphanumerics in draft or NLQ mode. Can do OCR and bar code printing. Supports 22 sets of typestyles and fonts and 4 types of graphics.	Used as a data center or departmental printer. It prints draft- and NLQ-mode alphanumerics, OCR, bar code, and 4 types of graphics printing.	Used to accommodate high-volume printing at the data center or within the department. Features bar code and OCR printing capabilities.	A heavy-duty printer for high-volume printing. Has OCR and bar code printing capabilities.	Used as a departmental or workstation printer. Does text and alphanumerics in draft mode only.

CHART D. PRINTERS (Continued)

MODEL	HP 2934	HP 2235	HP 2225	HP 2227	HP 2228
Type	Matrix serial	Matrix serial	Inkjet	Inkjet	Inkjet
Speed	200 cps	480 cps	150 cps	192 cps	192 cps
Character formation	9 x 12 and 36 x 24 dot matrix	9 x 12 and 36 x 24 dot matrix	11 x 12 dot matrix	19 x 12 and 19 x 24 dot matrix	19 x 12 and 19 x 24 dot matrix
Horizontal character spacing (char./inch)	5.0, 10.0, 16.3	—	6.0, 10.7, 12.0, 21.3	5.0, 6.0, 10.0, 10.6, 12.0, 21.3	5.0, 6.0, 10.0, 10.6, 12.0, 21.3
Controller/Interface	RS-232-C, RS-422, or HP-IB interface	RS-232-C	RS-232-C or HP-IB interface	RS-232-C or HP-IB interface	RS-232-C interface
Graphics capability	Yes; at 90 x 90 dpi	Yes	Yes; at 96 or 192 x 96 or 192 dpi	Yes; at 96 or 192 x 96 or 192 dpi	Yes; at 96 or 192 x 96 or 192 dpi
Purchase price (basic)	\$2,995	\$1,695	\$495	\$799	\$599
Comments	Used as either a departmental or workstation printer. Features a draft and NLQ mode. Also can do bar coding.	Used as either a departmental or workstation printer. Has a draft and NLQ mode for text and alphanumeric printing.	Used as a workstation printer. Features a draft and NLQ mode.	Used as a workstation printer. Features a draft and NLQ mode.	Used as a workstation printer. Features a draft and NLQ mode.

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ Hewlett-Packard is expanding the role of its HP 3000 computers within the business data processing marketplace in an attempt to gather more market share. By focusing on such a wide range of target markets, Hewlett-Packard is guaranteed sales income from market segments that are automating faster than the marketplace as a whole and revenues from those traditional marketplaces that still offer significant sales opportunities.

The company is trying to place more HP 3000s within the service industry and government. Although Hewlett-Packard has HP 3000s installed in a variety of service sector industries (i.e., banking, wholesale/distribution, and health care) and government offices (e.g., state government agencies and school district administrative offices), the company has never focused heavily on selling into such sectors. Current marketing plans direct the sales force to call on a greater number of service-oriented businesses and government and public service agencies while maintaining and expanding sales within the manufacturing environment—Hewlett-Packard's traditional stronghold.

Hewlett-Packard also plans to grow the installed base of HP 3000s within the manufacturing sector by placing ➤

➤ The Series 925LX, 925, and 935 central processor has an instruction execution cycle time of 80 nanoseconds (ns.). Instructions are executed using a three-stage pipeline architecture.

The Series 950 central processor has an instruction execution cycle time of 73 ns. and features a three-stage pipeline architecture for instruction processing. Included within the central processor are a CPU with an instruction unit and an execution unit; a floating-point co-processor; a cache controller; a 64K-byte cache for instructions and a 64K-byte cache for data; and the translation lookaside buffer. A console and diagnostic control processor are also included within the central processor.

The Series 955 central processor has an instruction execution cycle time of 40 ns. and features a five-stage instruction pipeline. Included within the central processor are a CPU with an instruction unit and an execution unit; a floating-point co-processor; a cache controller; a 128K-byte cache for instructions and a 128K-byte cache for data; a translation lookaside buffer; and the console and diagnostic control processor.

➤ **CONTROL STORAGE:** The conventional HP 3000 computers are microcoded. This means the instructions within the instruction set are broken down into a series of microinstructions. The microinstructions perform the elementary

Hewlett-Packard HP 3000 Series

CHART D. PRINTERS (Continued)

MODEL	HP 3630	HP 33440	HP 2686D	HP 2684	HP 2680
Type	Inkjet	Laser	Laser	Laser	Laser
Speed	167 cps	8 ppm	8 ppm	20 ppm	45 ppm
Character formation	—	300 x 300 dpi	300 x 300 dpi	300 x 300 dpi	180 x 180 dpi
Horizontal character spacing (char./inch)	—	10.0, 16.7	10.0, 16.7	10.0, 16.7	—
Controller/Interface	RS-232-C or HP-IB interface	RS-232-C or RS-422 interface	RS-232-C or RS-422 interface	RS-232-C or RS-422 interface	HP-IB interface
Graphics capability	Yes; at 180 x 180 dpi	Yes; at 300 x 300 dpi	Yes; at 300 x 300 dpi	Yes; at 300 x 300 dpi	Yes
Purchase price (basic)	\$1,395	\$2,595	\$2,995	\$19,995	\$87,750
Comments	Used as a workstation printer.	Used as a departmental printer.	Used for departmental printing. Features extensive paper-handling capabilities.	Used for departmental printing. Has 34 built-in fonts, 3 font cartridge slots, and font downloading capabilities.	A heavy-duty printer for high-volume printing. Supports up to 60 print styles. Can do multicopy, continuous form, single-sheet, and label printing.

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more emphasis on sales within the process manufacturing arena. Hewlett-Packard's stronghold within the manufacturing sector is with the discrete manufacturing arena; sales of HP 3000 for process manufacturing are relatively weak. Thus, in an effort to capitalize on a market opportunity, Hewlett-Packard directed its marketing and sales forces to find more customers within the process manufacturing sector—which basically is an untapped resource for Hewlett-Packard with its HP 3000s.

Also, Hewlett-Packard is expanding the role of the HP 3000 within the business organization. Besides targeting the HP 3000 as a departmental data processing system, Hewlett-Packard is directing the HP 3000s towards "niches" or specific application tasks within an application environment. The HP 3000 off-loads a single task or a group of tasks from the departmental processor. For example, an HP 3000 could be used to run a field sales system or a customer support system while the remainder of the marketing system applications run on the central marketing system.

To compete in its target markets, Hewlett-Packard ensures that applications software for the HP 3000 systems are readily available. The major source of applications software is alliances with independent software developers. To attract and retain independent software providers, Hewlett-Packard maintains the marketing, technical, and business aspects of these alliances. The alliances give Series 800 customers access to the services of the independent software vendors (ISVs). Upon discovering a customer's application need, Hewlett-Packard helps the customer establish contact with the appropriate data system suppliers. In some cases, Hewlett-Packard will provide the customer with third-party package directly.

Hewlett-Packard increased its direct and indirect sales channel size to increase its HP 3000 computers' market visibility. By adding more distributors, dealers, and value-added resellers to its network of existing resellers, Hewlett-Packard increases sales potential. The resellers give the company access to those customers it cannot reach through a direct sales force.

operations of a machine instruction. One instruction consists of several microinstructions. The machine instruction cannot be executed until it has been transformed into a sequence of basic operations.

In addition to the instruction set, many system operations that were in the past programmed in software have been microcoded. These operations are requested by machine instructions that, in turn, execute multiple microinstructions. Some of the standard system functions which have been microprogrammed include the interrupt handler, the saving of critical information upon power failure, automatic restart upon restoration of power, and a set of microdiagnostic routines.

The microinstructions and microprograms are contained in the central processor's control store. This control store is implemented in either a read-only memory, a writable memory, or a memory that is both read-only and writable. A writable control store permits system programmers to change or build microcode functions. The control store is not directly accessible to the application and cannot be modified during the operation of the machine.

Unlike the conventional HP 3000s, the RISC-based HPPA systems do not rely on microcode to execute the instruction set. RISC designs eliminate microcode by implementing the instruction set directly in hardware. This means there is no intermediate translation step from machine instructions to primitive, microcoded operations. The hardwired instructions drive the processor directly, without having to be decoded. By eliminating the steps for translating machine instructions into primitive, microcoded operations, instructions are executed faster. Fewer machine cycles are required to execute an instruction when interpretive overhead is removed.

REGISTERS: There are 256 registers on the Micro 3000s; 18 of these registers are addressable by the programmer. There are 72 hardware registers on the Series 52, 58, and 70 models. Of the 72 registers, 21 are available to the programmer. Those dedicated to system use are mostly 16-bit registers. These include current and next instruction registers, scratch pad, flag, and interrupt registers; I/O registers; memory address and data registers; and firmware address registers. The Series 70 adds four cache operand registers, a performance register, and four ALU registers to those provided on the other systems.

Registers accessible to the programmer include the four code segment pointers, seven stack pointers, four top-of-stack registers, and the index and status registers.

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CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	HP 7974A	HP 7978B	HP 7979A	HP 7980A	HP 9144A	HP 35401A
TYPE	0.5 inch reel-to-reel	0.5 inch reel-to-reel	0.5 inch reel-to-reel	0.5 inch reel-to-reel	0.25 inch cartridge	0.25 inch cartridge auto-changer
FORMAT						
Number of tracks	9	9	—	—	16	16
Recording density, bits per inch	800/1600	1600/6250	1600	1600/6250	—	—
Recording mode	NRZI/PE	PE/GCR	PE	PE/GCR	DC 600 HC	DC 600 HC
CHARACTERISTICS						
Controller model	Integrated	Integrated	Integrated	Integrated	Integrated	Integrated
Storage capacity, bytes	20M/40M	40M/140M	40M	40M/140M	67.1M	67.1M (on each cartridge)
Tape speed, inches per second	100	75	125	125	60	60
Data transfer rate, units per second	—	—	200K bytes/second	781K bytes/second	35K bits/second	35K bytes/second
Streaming technology	Yes	Yes	Yes	Yes	Yes	Yes
Start/stop mode speed, inches per second	50	—	—	—	—	—
Supported by system models	All models except Micro 3000LX	All models except Micro 3000LX	All models except Micro 3000LX	All models except Micro 3000LX	All models	All models
PURCHASE PRICE (basic)	\$16,500	\$27,000	\$13,400	\$23,200	\$2,550	\$8,000
COMMENTS	Requires an HP-IB interface to communicate with the host.	Requires an HP-IB for connectivity.	Has an auto-changer that accesses up to 8 cartridges from a removable magazine. An HP-IB interface is required to communicate with the host.			

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➤ Hewlett-Packard also intends to exploit the strength of its new products with aggressive sales programs. Several tools have recently been added to assist in finding and winning sales and keeping present customers. First, Hewlett-Packard is providing more market-specific and technical training to better prepare its sales representatives. Second, Hewlett-Packard is now performing competitive benchmarking; Hewlett-Packard salespeople were previously instructed to avoid competitive benchmarks and analyses. Third, Hewlett-Packard has instituted new sales force compensation plans which honor sales representatives for head-to-head wins against IBM and Digital Equipment and for wins in key accounts. Fourth, Hewlett-Packard's Customer Information Center helps generate U.S. customer inquiries and provides "one-stop" shopping for all presales inquiries. Fifth, the direct sales force has been given portable microcomputers that link to corporate data bases to obtain up-to-date information of software applications, price, availability, order status, and competitive offerings; this helps them offer better service to customers seeking a purchase.

COMPETITIVE POSITION

Although the HP 3000 product line faces a multitude of competitors, its toughest competition comes from Digital Equipment Corporation and IBM. Digital Equipment Corporation and IBM hold the largest percentage of systems within the HP 3000's primary target markets—online transaction processing and professional support within manufacturing and service industries and government/public service organizations.

The modified HP 3000 product line enables Hewlett-Packard to compete more effectively with Digital's VAX ➤

➤ The Series 900 HPPA specifies register-intensive operation. Calculations are performed only between high-speed registers or between a register and a constant held in the instruction. There are 32 available 32-bit-wide, general-purpose registers for holding operands and results. There also are 32 control and status registers used for interrupt processing, virtual memory access protection, and other system functions. Eight space registers are used to specify up to eight possibly different 4G-byte virtual spaces that can be utilized for a given operation; these registers can hold 16-bit or 32-bit space identifiers. Five of these space registers can be used directly by application programs. Two registers are used to point to the next instruction to be executed.

Register-intensive operation allows for increased processor performance. Since data is not processed in memory, the number of references to memory is reduced. Memory references require machine cycles. By reducing the number of memory references, the time to execute an instruction is reduced. Furthermore, because the circuitry within the register file is faster than the circuitry in memory, data within a register can be processed quicker than that in memory, thus promoting for faster processor speed.

ADDRESSING: On the HP 3000 conventional systems, only privileged instructions may use absolute addressing. All other addressing is performed using one of the six allowable, relative techniques. Two techniques apply to code, while four apply to data. Except for privileged instructions (including I/O), all word addressing is direct, direct-indexed, indirect, or indirect-indexed.

As stated previously, under the virtual memory architecture of the conventional HP 3000 computers, each program is partitioned into as many as 63 segments. Each code segment can be up to 32K bytes in length, and each data segment up to 64K bytes. A program cannot be larger than 2M bytes. ➤

Hewlett-Packard HP 3000 Series

➤ and IBM's Application System/400 (AS/400), 9370, and 4381 computers on a price/performance basis. For example, the Series 955 provides mainframe-class performance comparable to the large VAX 8000 systems and IBM 4381 systems at up to one half the price. The Series 925 offers approximately the same performance as a comparably configured AS/400 Model 60 at one third the price and the Series 935 provides 2.5 times more MIPS than a comparably configured IBM 9370 Model 90.

The HP 3000 computers, however, are at a disadvantage in configurability and system expandability. Generally, the Digital Equipment VAX 6200 systems offer greater mass storage and terminal input/output (I/O) device connectivity than the HP 3000 computers. For instance, the Series 925 accommodates up to 9.1G bytes of mass storage and 152 hardwired terminal I/O devices. In contrast, the VAX 6210 accommodates up to 20M bytes of mass storage and 128 hardwired terminal I/O devices. As further evidence, the Series 955 supports up to 27.1G bytes of mass storage and up to 400 hardwired terminal I/O devices while the IBM 4381 Model 21, its competitor, supports over 50G bytes of mass storage and over 400 hardwired terminal I/O devices.

The HP 3000 computer is also at a disadvantage when its online transaction processing solution is compared to Digital's newly announced DECTp software package, an online transaction processing system for the VAX computers. Previously, the HP 3000 had an advantage over the Digital VAX in online transaction processing because it supported a full set of online transaction processing tools; the Digital VAX lacked the sophisticated software tools for online transaction processing. With the introduction of the DECTp, however, the HP 3000 loses its advantage.

DECTp provides the VAX computer with a complete set of online transaction processing tools plus price/performance advantages. DECTp features a high-powered transaction processing monitor that facilitates transaction speeds associated with mainframes. The Hewlett-Packard HP 3000s do not yet have a transaction processing monitor that offers this very high-speed transaction processing. Furthermore, the HP 3000s do not yet have the multiprocessing or processor clustering capabilities and disk shadowing needed to provide the high system availability required in "mission-critical" applications such as online manufacturing monitoring and control and customer service support.

The other primary competition for the HP 3000 Series comes from Data General with its Eclipse MV series; Wang Laboratories with its VS Systems series; Prime Computer with its Prime 50 Series; and NCR with its Tower and 10000 Series computers. These vendors and their respective products are very active in attempting to displace HP 3000 online transaction processing, management information, professional automation, and office automation systems. Generally, when compared to the

➤ The HPPA provides for support of 48-bit virtual addressing. This 48-bit addressing offers 4G bytes of virtual memory for each of the 65,536 linear spaces. The virtual-to-physical address translation is performed by the translation lookaside buffer. The translation lookaside buffer is used to convert the 48-bit virtual address into a 28-bit physical address; to cache recently accessed virtual page translations; and to implement page-level access protection.

In addition to virtual addressing, HPPA provides direct access to physical memory locations. Low-cost systems have the option of providing only physical addressing if appropriate. The smallest addressable quantity is a byte.

INTERRUPTS: The HP 3000 conventional systems' interrupt system provides for up to 105 external interrupts. There are 16 levels of interrupt masking, and each device is initially assigned to one of the 16 levels to fix priorities and permit masking under software control. Under microprogram control, context switching for an interrupt is performed in an average time of 21 microseconds. The interrupt routines operate on a common interrupt control stack to permit nesting of interrupt routines for multiple interrupts. Twenty internal interrupts for user errors, system violations, hardware faults, and power fail/restart are also provided, plus 14 traps for arithmetic errors and illegal use of instructions or privileged mode.

The Series 900 systems define 25 interruptions, which are categorized in four groups based on their priorities. Central processor control registers provide information for vectoring to appropriate software interrupt handler routines, for saving the current machine state when handling an interrupt, and for restoring machine state after the interruption is handled.

OPERATING ENVIRONMENT: The central processor of both the Micro 3000LX and Micro 3000GX is contained on the system processor board, which also holds main storage and the I/O channel. This board resides in the system cabinet along with disk drives, a cartridge tape, workstation controllers, communications/networking interfaces, and power equipment. The cabinet measures 24.0 inches high, 8.4 inches wide, and 21.2 inches deep. It weighs 93 pounds.

The components within the system cabinet of the Micro 3000GX and Micro 3000LX are fully operational in an environment where the temperature ranges between 40 to 104 degrees Fahrenheit and relative humidity falls between 20 to 80 percent. Heat dissipation is 1,450 Btu per hour. An input current of 4.0 Amp at 100 to 120 V AC and 50 to 60 Hz or 2.5 Amp at 200 to 240 V AC and 50 to 60 Hz is required to power the system cabinet. The line voltage frequency is 100 to 120 V AC at 47 to 63 Hz or 200 to 240 V AC at 47 to 63 Hz.

The Micro 3000's central processor, main storage, and I/O control modules are packaged in the system processor. The system processor resides in the system cabinet. The system cabinet measures 29.0 inches high, 15.0 inches wide, and 28.5 inches deep; it weighs 73 pounds.

The components within the system cabinet of the Micro 3000XE are fully operational when the temperature ranges between 50 to 104 degrees Fahrenheit and relative humidity is 20 to 80 percent. Heat dissipation is 3,278 Btu per hour. An input current of 6 Amp at 100 to 120 V AC and 50 to 60 Hz or 4 Amp at 200 to 240 V AC and 50 to 60 Hz is required to power the units within the system cabinet. The line voltage frequency is 100 to 120 V AC at 47 to 63 Hz or 200 to 240 V AC at 47 to 63 Hz.

Hewlett-Packard HP 3000 Series

▷ offerings from vendors such as Data General, Wang Laboratories, Prime, and NCR, the new HP 3000s provide greater price/performance and stay competitive in configurability and functionality.

Although the HP 3000 product line offers competitive price/performance and capacities, it is highly unlikely that users will replace a comparative system from a competitor with a HP 3000. Customers rarely change vendors or computer architectures, because of the high cost of the migration. The modified HP 3000 product line does, however, give Hewlett-Packard a better chance to compete with Digital Equipment, IBM, and others for new corporate accounts or for the first-time automation sale.

ADVANTAGES AND RESTRICTIONS

One of the HP 3000 Series' primary advantages is the compatibility provided throughout the product line. The HP 3000 supermicrocomputers and minicomputers are object-code compatible with one another. Because the MPE V operating environment runs on the Micro 3000 supermicros and HP 3000 Series minicomputers, applications developed on one conventional HP 3000 multiuser computer can be moved to another conventionally designed HP 3000 without undergoing modification or recompiling. Such compatibility preserves the software investments, thus prompting system migration and bottom-to-top and top-to-bottom application development.

Hewlett-Packard has made a very large investment to ensure that the Series 900 models remain program, file, and data compatible with the rest of the HP 3000 family despite their RISC-based HP Precision Architecture. The Series 900 computers' MPE XL operating system provides protection for software investments in system migrations and provides a measure of bottom-to-top software development and execution.

MPE V-based applications and data can be moved to the Series 900 systems without modifications or recompilations. Customers can move MPE V-based applications and data to the MPE XL environment with just a backup procedure—by storing the application and data on tape and restoring them on the Series 900 without modifications. The applications will run on the Series 900 in the MPE V-compatibility mode. To achieve maximum performance for the applications, customers must recompile applications with optimizing compilers.

Customers have ample flexibility in moving to the Series 900 systems. Native mode applications can communicate with applications running in the compatibility mode and vice versa. Furthermore, the MPE V-compatibility mode of MPE XL permits customers to develop applications that will run on the MPE V-based systems.

MPE XL is a functional superset of MPE V. The two versions are nearly identical in terms of user interface, ▷

▶ The Series 52 system processor, which contains the central processor, main storage, and I/O control modules, is packaged in a cabinet that measures 40.0 inches high, 24.0 inches wide, and 22.4 inches deep and weighs 190 pounds. The Series 58 system processor is packaged in a cabinet that measures 28.5 inches high, 72.25 inches wide, and 31.25 inches deep and weighs 240 pounds.

The system cabinet components within both the Series 52 and 58 are fully operational when the temperature ranges between 68 to 78 degrees Fahrenheit and relative humidity is 40 to 60 percent. Heat dissipation on the Series 52 is 3,000 Btu per hour; 7,350 Btu per hour on the Series 58. An input current of 8.3 Amp at 120 V AC and 50 to 60 Hz or 8.1 Amp at 220 to 240 V AC and 50 to 60 Hz is required to power the units within the system cabinet.

The Series 70 system processor is contained in one of two cabinets. The standard system cabinet measures 48 inches high, 69 inches wide, and 26 inches deep or and weighs 1,200 pounds. The cabinet that contains an I/O option expansion bay measures 48 inches high, 105 inches wide, and 26 inches deep and weighs 1,500 pounds.

The system cabinet components within both the Series 70 are fully operational when the temperature ranges between 68 to 78 degrees Fahrenheit and relative humidity is 40 to 60 percent. Heat dissipation is 72,000 Btu per hour. An input current of 24 Amp at 208 V AC and 60 Hz, 13 Amp at 380 V AC and 60 Hz, or 12 Amp at 408 V AC and 60 Hz is required to power the units within the system cabinet.

INPUT/OUTPUT (I/O) CONTROL

The Micro 3000LX and the Micro 3000GX use the Synchronous Inter-Module Bus (SIMB) to carry communications between the central processor, main storage, and I/O channel controller. This SMID resides on the processor board along with the central processor, main storage, and I/O channel controller. The on-board (central system) bus operates at 113 nanoseconds (ns.).

The Micro 3000LX and Micro 3000GX use a backplane SMIB to interface peripherals and network interfaces with main storage and the central processor. This backplane bus operates at 226 nanoseconds. An SMIB interface on the processor board buffers data between the high-speed and low-speed SMIBs.

The Micro 3000XE uses a single SIMB to interconnect central processor, main storage, mass storage and data communications controller interfaces, terminal controllers, and local area network (LAN) interfaces. This single SMIB is the backplane of the computer into which all boards are plugged and is the main communication vehicle for transferring data between processor components.

The Series 52 and Series 58 utilize an Intermodule Bus (IMB) to handle communications among the central processor, memory, and I/O modules. The Series 52 and Series 58 central processor generates over 90 percent of the bus activity and has continuous access to the bus. The central processor relinquishes control to the I/O channels only on request.

The Central System Bus (CSB) is used on the Series 70 to carry communications among the central processor, main storage, and I/O bus adapters. The 32-bit CSB has a 53M byte-per-second overall bandwidth to allow support of multiple I/O bus adapters. No module has implied control of the CSB; each operates independently except when it is ▶

Hewlett-Packard HP 3000 Series

➤ system management, accounting, and security. Investments in MPE V training are protected.

Because of common I/O mechanisms, the Series 900 computers support many of the same peripherals as the other HP 3000 systems. This protects investments in mass storage devices, terminals, PC workstations, and printers when upgrading to the Series 900.

In some cases, there are in-place upgrade options for moving from one HP 3000 model to another. By simply swapping processing boards or adding or replacing hardware options:

- A customer with an obsolete Series 37 minicomputer or aging Micro 3000 can move to a Micro 3000XE.
- A Micro 3000LX can be transformed into a Micro 3000GX.
- An installation with an old Series 68 can upgrade to the Series 70.
- The Series 925LX can be transformed into a Series 925 or a Series 935.
- The Series 925 can be made into a Series 935.
- A Series 950 can be transposed into a Series 955.

In other cases, there are no cost-effective features for migrating to a high-performance model from a smaller scale system. The following migrations require reinvestments in the system's main unit; i.e., the system processing unit boxes must be exchanged when:

- Moving from a Micro 3000LX or Micro 3000GX supermicro to a Micro 3000XE supermicrocomputer.
- Moving from a Micro 3000 supermicrocomputer model to a Series 52, 58, 70, or Series 900 model.
- Moving to a Series 52 or 58 from a predecessor which has been obsoleted.
- Moving from a Series 52 to a Series 58.
- Moving from a Series 52 or 58 to a Series 70.
- Moving from a Series 935 to a Series 950 or 955.

Such migrations are costly, since the entire investment in the main unit is lost. Having to replace the entire main unit requires more effort and more expense than performing an upgrade by simply replacing or adding a few circuit boards, as in a field upgrade.

Application availability is not a problem with the HP 3000 Series. Through HP Plus, Hewlett-Packard's third-party vendor program, customers have access to an abundance of packaged software programs written for ➤

➤ necessary to transfer data or send commands. The initiating module asks for and receives control of the CSB. All transfers to and from memory are in eight-word blocks.

The I/O bus adapter interfaces an I/O bus to the CSB. The I/O adapter allows communications between the I/O subsystem and the main storage and central processor. The I/O adapters control direct memory access (DMA) and direct I/O transfers between the I/O device controllers and the central processor and main storage. To devices on the I/O bus, the I/O adapter appears as memory responding to bus requests generated by I/O controllers. A cache memory on each I/O adapter buffers communications between the slower I/O bus and the faster CSB.

Up to three I/O adapters can be placed on the CSB. Each I/O adapter attaches one Intermodule Bus (IMB). The 16-bit IMB serves as the I/O connection for disk drives, magnetic tape equipment, terminals, printers, data communications controllers, and LAN interfaces.

The Series 925LX, 925, and 935 use the Central Bus (CTB) to interconnect the central processor, main storage, the I/O bus adapters, and a programmable serial interface card. The CTB is 32 bits wide. On the Series 925LX and 925, the CTB runs synchronously with an 8MHz clock, supporting data transfer rates up to 20M bytes per second. The Series 935 CTB runs synchronously with a 10MHz clock and supports a data transfer rate of over 22M bytes per second.

The Series 925LX, 925, and 935 Channel I/O Bus Adapters provide the interface between the CTB and the Channel I/O Buses (CIBs)—the I/O bus. The Series 925LX has one adapter while the Series 925 and 935 both support two Channel I/O Adapters. Each adapter accommodates one CIB.

Each CIB supports up to seven cards for interfacing peripheral devices and local area networks. Each CIB provides a 16-bit-wide, bidirectional data path that runs synchronously with a 4MHz clock rate and has a data transfer rate of up to 5M bytes per second.

The Series 950 and 955 employ a three-tier bus structure for I/O throughput. The System Memory Bus (SMB) carries communications between the central processor, main storage, and I/O bus adapters. The SMD provides a 64-bit-wide data path and runs asynchronously with a 27.5MHz clock. It supports an average transfer rate of 100M bytes per second.

The Series 950 and 955 Central Bus Adapters (CTB Adapters) provide the interface between the SMB and the Central Buses (CTBs). The CTB Adapters act as agents for DMAs and direct I/O transfers between the Channel I/O Adapters and the central processor and main storage.

Both the Series 950 and 955 accommodate two CTB Adapters, which are standard. Each CTB Adapter supports one Series 950 and 955 CTB.

The 32-bit CTB is the communication path between the CTB Adapters and the Channel I/O Adapters. In addition, the Series 950 and 955 CTB directly support a programmable serial interface card which interfaces data communications controllers to the central processor and main storage. Each CTB runs synchronously with a 9.2MHz clock and supports a sustained data transfer rate of up to 20M bytes per second. ➤

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➤ HP 3000 computers. The program provides users with a wide range of solutions for a diverse set of commercial computing disciplines. Customers have direct access to the application solutions through Hewlett-Packard's cooperative marketing efforts with third-party vendors.

Furthermore, for those customers developing their own application systems, the application development and maintenance tasks are reduced when programmers employ products such as the Virtuoso Code Generator programmer productivity tool, the Toolset program development tool set, the Transact transaction-based application programming language, the Forms/V and Vplus/V screen management facilities, and the Business Report Writer (BRW) report writing system. These tools provide programming professionals with automated systems analysis, design, development, and installation tools for reducing the complexities and costs associated with traditional programming and systems development. With these tools, programs are developed, installed, and serviced at a quicker pace than with traditional programming and system development methods.

The communications and networking scheme of the HP 3000s provides an advantage. Because the HP 3000s are designed for distributed data processing environments, their communications and networking capabilities are of particular importance. The data communications tools used on the computers provide flexibility in creating networking and distributed processing environments and provide the open connectivity required in departmental processing.

The HP 3000's PC integration support products enable Hewlett-Packard MS-DOS-based microcomputers and IBM PCs or compatibles located throughout a department or organization to access HP 3000 applications and files and to use the HP 3000 as a peripheral server and gateway to other computer systems. The Network Services 3000 (NS3000) software package interlinks HP 3000 systems so they can perform to virtual terminal, file transfer, remote file and peripheral access, remote database access, and interprocess communication amongst each other. The Network File Transfer (NFT) protocol enables HP 3000s to perform directional file transfer with HP 9000 and HP 1000 Series computers. ARPA Services provides communication among professional workstations and multiuser computers that implement the Department of Defense Advanced Research Projects Agency (ARPA) networking standards—i.e., the TCP/IP communications model for data transportation and system interfacing and the FTP, Telenet, and SMTP protocols for file transfer, terminal login access, electronic mail, and remote command execution. The SNA communications tools permit HP 3000 computers to communicate with IBM System/370-architecture mainframe and supermini host systems. The BSC communications utilities permit the HP 3000 computers to participate in a bisynchronous (BSC) IBM network. The DECnet communications facilities permit

➤ The Series 950 and 955 Channel I/O Bus Adapters provide the interface between the CTB and the CIBs. Each Channel I/O Bus Adapter serves as a high-performance channel multiplexer, providing full DMA for all CTB-attached peripheral and communications channels.

The Series 950 and 955 include two Channel I/O Bus Adapters as standard. A third or fourth Channel I/O Bus Adapter may be optionally added.

Each Channel I/O Bus Adapter supports one CIB. The CIB supports up to seven cards for interfacing peripheral devices and local area networks. Each CIB transfers data at up to 5M bytes per second.

Disk drive, magnetic tape, system printer, and data communications options for the Micro 3000 series computers communicate with central processor and main storage via the *Peripheral Interface Controller (PIC)*. One PIC is used on the Micro 3000LX and Micro 3000GX while up to three PICs are featured on the Micro 3000XE.

The PIC is the hardware I/O channel that provides the interface necessary to control and communicate with mass storage, printers, and data communications devices. It interfaces with the SMID and is controlled by standard I/O instructions or by the execution of channel programs. It consists of SMID interface logic, PIC control logic, and a peripheral bus. Up to six devices can be connected to the PIC.

PIC interfaces with peripheral and communications devices via the *Hewlett-Packard Interface Bus (HP-IB)* peripheral bus. The HP-IB peripheral bus is Hewlett-Packard's implementation of the IEEE standard 488-1975 peripheral interface. HP-IB is an eight-bit-wide asynchronous bus that supports a sustained data transfer rate of 1M bytes per second.

The Series 52, 58, and 70 computers use the *General I/O Channel (GIC)* to connect disk drives, magnetic tape devices, system printers, and data communications options to the system. Each GIC supports up to eight devices. Each GIC contains the interfaces to send data across and receive data from the IMB; the logic to direct I/O commands and transfers between peripherals and the central processor and main storage; and the HP-IB peripheral bus. The HP-IB carries I/O commands and transfers to and from the GIC. Data is transferred up to 1M bytes per second.

The 900 Series computers use the *HP-IB Channel* to interface disk drives, magnetic tape devices, and system printers to the system. The HP-IB Channel consists of the HP-IB Interface Card and the HP-IB peripheral bus. The HP-IB Interface Card connects the HP-IB peripheral bus to the CIB and performs protocol translation so the HP-IB-based devices can communicate with the central processor and main storage. The HP-IB peripheral bus, as stated previously, transports commands and data transfers to and from the peripherals. Up to six devices can be connected to the peripheral bus.

As an option, the Series 900 computers can be configured with the *Hewlett-Packard Fiber Link (HP-FL) Channel*. The channel connects up to eight 307M- and 571M-disk drives to the Series 900 computer. It consists of an HP-FL interface controller and the HP-FL bus. The HP-FL interface controller connects the HP-FL bus to a CIB. The HP-FL bus—a fiber optic link—carries I/O commands

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➤ the HP 3000 computers to interact with DECnet-connected Digital Equipment systems with the VAX/VMS operating system.

The most important component of the HP 3000 Series open system approach to networking and distributed processing is the IEEE 802.3 Ethernet-based local area network (LAN). IEEE 802.3 Ethernet is one of the most popular for interconnecting information systems and workstations—especially at the departmental level. By employing IEEE 802.3 Ethernet, the HP 3000 computers have a common communications channel for interacting with other Hewlett-Packard multiuser computers and workstations and other vendors' supermini-class systems and professional workstations. With IEEE 802.3 Ethernet, costs for system interconnection are reduced and data transfer speeds are increased relative to those afforded by hardwired communications schemes.

The SNA and DECnet emulators are also very important. Such facilities are needed in those departmental or distributed processing environments where departmental systems are frequently called upon to access data, files, and application services residing in IBM mainframe or Digital Equipment VAX/VMS environments.

A significant component for HP 3000-to-IBM mainframe communications is the HP LU6.2 Applications Programming Interface (LU6.2 API), an Advanced Peer-to-Peer Communications/LU6.2 (APPC/LU6.2) support facility. This facility enables HP 3000 computers to establish sessions with applications on IBM mainframes without running the multiple layers of emulation that are usually required to communicate with these systems. This reduces the complications and performance degradations caused by file format limitations and emulation overhead. Moreover, this facility offers a transparent interface between HP 3000 and IBM System/370 computers for distributed processing tasks.

The microcomputer integration tools provided by the HP 3000s are essential within today's information system arena. Once attached to the host, the MS-DOS and IBM-compatible microcomputers reduce peripheral cost, provide access to both host microcomputer applications, broaden information access capabilities, and improve host performance and throughput by conducting specialized or localized processing.

One requirement which a departmental processor or end-user-oriented system should meet is that of simplified operator/end-user interaction. The HP 3000 meets the requirement by offering system operator, system administrator, programmer, and application view ports; command interpreters with syntax editors and command validation entry; English-like commands; a customizable command set; online help and reference material; and native-language support. In addition, the Micro 3000 computers are equipped with a menu-driven interface for system management functions, thus easing system management operations.

➤ and transfers to and from the peripherals. Up to eight disk drives can be connected to the link. The link has a 5M byte-per-second bandwidth.

Workstations are connected to the Micro 3000 computers via the *Advanced Terminal Processor Model M (ATP/M)*. The ATP/M workstation controller provides connectivity for up to eight (asynchronous) workstations (terminals, printers, and personal computers [PCs]) in a point-to-point local or remote configuration. The ATP/M allows workstations to transmit and receive in either character or block mode at speeds ranging up to 19.2K bits per second (bps). Local workstations are connected to the system via RS-232-C direct-connect ports, modem ports, or RS-422 direct-connect ports. Remote workstations can be connected via RS-232-C modem ports with full-duplex asynchronous modems or with HP 2334A statistical multiplexers and full-duplex synchronous modems.

ATP/M communicates with the central processor and main storage of the Micro 3000 computers via the SMID bus.

The *Advanced Terminal Processor (ATP)* interfaces workstations to the Series 52, 58, and 70 systems in a point-to-point configuration. Interfaces are available to allow workstations to be connected either directly or through full-duplex modems. An intelligent workstation controller off-loads character processing from the central processor by transferring data to and from main storage. Workstations can transmit and receive in either character or block mode at up to 19.2K bytes per second.

Several products are included in the ATP subsystem: the System Interface Board (SIB); Direct Connect Port Controller; Modem Port Controller; Direct Connect Expansion Package; and Modem Expansion Package. The ATP uses a separate microprocessor chip for each workstation port. Each chip contains an asynchronous receiver/transmitter to handle data transmission and reception. An additional microcomputer for every 12 modem ports handles the modem control signals. Each additional port controller supports 12 additional workstations. A single HP 3000 computer may have multiple ATP subsystems installed.

The SIB provides the hardware interface to the IMB and performs the byte packing and unpacking necessary for optimum use of the IMB. The SIB also controls the DMA data transfer.

The Direct Connect and Modem Port Controllers provide the physical interfaces for connecting local and remote workstations. Each port controller supports up to 12 workstations. They also handle handshaking between the system and the workstations, and provide data buffering control speed sensing, special character detection, and character echoing functions.

Local workstations are connected to the system via the Direct Connect Port Controller. Using the RS-422 interface, workstations can be connected to the Direct Connect Port Controller with cables up to 4,000 feet long. The RS-232-C interface allows workstations to be connected to the Direct Connect Port Controller with cables up to 50 feet long.

The Modem Port Controller has one interface for connecting remote workstations to the system. If needed, local workstations may also be connected to the modem-connect port. Workstations connect to the Modem Port Controller via the RS-232-C interface and asynchronous, full-duplex modems.

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➤ Hewlett-Packard is committed to enhancing its HP 3000 product line to accommodate the customer's growing power, functionality, and system expansion requirements. For example, Hewlett-Packard is working on placing X.25 communications capabilities directly on the Series 900 computers. At the present, an MPE V-based data comm server is used to provide the X.25 support. Furthermore, Hewlett-Packard is planning to introduce multiprocessor versions of its Series 900 superminicomputers. Currently, each Series 900 model is configured with only one central processor but has internal bus structures and control schemes that can accommodate multiple central processors. Multiprocessor versions of the Series 900 computers can be expected sometime in 1989.

As indicated earlier, Hewlett-Packard offers an extensive set of customer and product support programs. Included are several levels of maintenance support for computer processors and peripherals; several levels of software support; standardized and tailorable consulting services for all stages of technology and applications acquisition; and a full set of educational training courses. According to Datapro's 1987 U.S. Computer Users Survey, Hewlett-Packard was rated above Digital Equipment Corporation, IBM, Data General, Prime, and Wang in overall support satisfaction.

USER REACTION

Datapro's 1987 Computer Users Survey included responses from 505 HP 3000 system users. Many respondents were operating with models that were no longer actively marketed. *The responses of those with obsolete or passively marketed systems are still valid since their systems are compatible with and similar in functionality to newer models and other actively marketed models.*

The respondents reported that their systems had an average installed life of 34 months. Of the respondents, 70 percent purchased their systems from Hewlett-Packard; 20 percent rented or leased from Hewlett-Packard; and 10 percent leased from a third party.

The respondents stated that their HP 3000s functioned within small- and medium-sized environments. Of those respondents that provided descriptions of their installations, 56 percent said they have from 1 to 5 local workstations connected to a HP 3000; 28 percent stated that their computers support from 16 to 30 local workstations; and 25 percent said that their HP 3000s accommodate over 60 workstations. Furthermore, 28 percent reported that their systems support up to 5 remote workstations; 22 percent said their computers accommodate from 5 to 15 remote workstations; 14 percent stated that their systems offer connectivity for 16 to 30 remote workstations; 8 percent stated that their systems offer connectivity for 31 to 60 remote workstations; and another 8 percent said that their system supports over 60 remote workstations.

Only a small percentage (9 percent) of the respondents indicated that the systems were being used in a distributed ➤

➤ The Direct Connect Expansion Package adds a Direct Connect Port Controller to the ATP subsystem. The Modem Expansion Package adds one Modem Port Controller to the workstation controller subsystem. Up to four direct-connect port controllers or two direct-connect port controllers and one or two modem-connect port controllers comprise the ATP subsystem.

The *Asynchronous Data Communications Controller (ADCC)* is used in the Series 52 and 58. The ADCC attaches to the IMB and provides direct-connect and modem connections for workstations. From four to eight full-duplex ports are provided on each ADCC. Each port addresses on workstation.

The *MTS Cluster Controller*, featured on Series 52, 58, and 70 computers, connects a group of terminal I/O devices to a communication link.

The *Distributed Terminal Controller (DTC)* for the Series 900 computers is an intelligent controller with microprocessors to handle workstation connection preprocessing and communications with the system. The DTC is compatible with the ATP.

The DTC supports up to 48 workstations in point-to-point local configuration, up to 36 workstations in a point-to-point remote configuration, or a combination of both. Workstations can perform data transfers in either a character or block mode at up to 19.2K bps. Furthermore, the DTP includes online diagnostics and a comprehensive configuration program.

The DTP connects local workstations via an interface board which contains eight ports that either support a RS-232-C or RS-422 cable. Remote workstations connect to the DTP via an interface board that contains six modem ports that support full-duplex modems. Up to six interface boards can be configured within the DTC.

The DTC attaches to the Series 900 superminicomputers using HP ThinLAN or HP ThickLAN networking cable. A LAN link residing on the CBI connects the Series 900 central processing complex to the cable where the DTC resides.

The *Terminal Server 8-Port (TS8)* connects a maximum of eight, asynchronous terminal I/O devices to one or more computer systems via an IEEE 802.3-specified Ethernet network. On the computer side, the TS8 allows the ATP, DTC, or asynchronous multiplexer to transmit data to and receive data from workstations connected to an IEEE 802.3-based TS8. The TS8s are controlled by a LAN manager running in an HP Vectra microcomputer.

Remote terminal I/O device connections can be made using the *HP 2334A Plus X.25 Multiplexer*. The multiplexer can be connected to a maximum of 16 devices. A second multiplexer is connected to the ATP, DTC, or TS8 ports. A X.25 link connects the two multiplexers.

The *HP Asynchronous Serial Network Link (HP ASNL)* provides a remote asynchronous connection for MPE V-based computers and HP Vectra, MS-DOS-based, and IBM PC and compatible microcomputers. The communication link is made through a standard ATP.

Besides using workstation controllers and hardwired communications links, PCs can also connect to the HP 3000 computers via the *HP Starlan* and *HP Starlan-10* PC-based local area networks (LANs). Furthermore, Hewlett-Packard's IEEE 802.3-compatible *HP ThinLAN* or ➤

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➤ departmental computing scheme—communicating with a host or another network of computer systems. The remainder (89 percent) said their systems were used in a standalone mode of operation. Responses indicated that the HP 3000s are used within a variety of industries as multipurpose business systems as well as dedicated systems, thus validating Hewlett-Packard's attempt to meet a wide range of application processing needs.

According to our survey, the HP 3000s appear most frequently within discrete and process manufacturing companies, retail and wholesale/distribution establishments, health care organizations, educational institutions, and government agencies. In line with Hewlett-Packard's marketing and product strategy, the HP 3000s are used for business data processing tasks such as accounting, payroll, and sales management; professional support tasks such as office automation, decision support, and software development; and operational support tasks such as manufacturing resource planning, records administration, and customer billing. Only rarely are they used to support technically complex applications such as process control, scientific research, or engineering analysis.

Identifying sources of application programs, respondents used a variety of methods. Of those responding, nearly 80 percent said they acquired some or all of their applications via an in-house programming staff. Contract programming was employed by approximately 33 percent. Independent software suppliers were used by almost 64 percent. Packaged applications from the vendor were used by nearly 40 percent. Hewlett-Packard's contract programming services were used by only 5 percent. The other seven used only one method; five used in-house personnel and two used the services of independent application suppliers to acquire application systems.

When asked about system operability and functionality, the respondents rated the HP 3000 systems as follows:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	308	182	10	1	3.59
Reliability of system	430	65	4	2	3.84
Reliability of peripherals	324	160	12	1	3.62
Maintenance service:					
Responsiveness	333	153	14	3	3.62
Effectiveness	317	156	11	4	3.61
Technical support:					
Troubleshooting	227	243	29	4	3.38
Education	141	295	61	4	3.14
Documentation	110	283	92	16	2.97
Manufacturers software:					
Operating system	271	210	16	1	3.51
Compiler & assemblers	198	263	25	19	3.36
Application programs	108	250	82	4	3.04
Ease of programming	206	247	36	3	3.33
Ease of conversion	189	230	48	6	3.27
Overall satisfaction	292	200	10	1	3.56

*Weighted Average on a scale of 4.0 for Excellent.

Overall, the respondents are totally committed to their systems. Almost 67 percent plan to expand their present ➤

➤ *ThickLAN* can be used for attaching personal computers to the HP 3000 computers. *Discussions of these LANs can be found in the COMMUNICATIONS CONTROL section of this report.*

The system-to-system communications on the Micro 3000 and conventional HP 3000 minicomputers are handled through *HP ThinLAN*, the *HP ASNL*, and the *Intelligent Network Processor (INP)*. The system-to-system communications on the HPPA-based HP 3000 superminicomputers are handled through *HP ThinLAN* and the *Programmable Serial Interface (PSI)*. Via an HP ThinLAN hub, nodes on HP ThinLAN can communicate within systems on Hewlett-Packard's *HP ThickLAN*—an IEEE 802.3 Ethernet which features thick coaxial cabling instead of thin coaxial cabling. *Detailed descriptions of these system-to-system communications products are found in the COMMUNICATIONS CONTROL section of this report.*

CONFIGURATION RULES

GENERAL: The Micro 3000LX, Micro 3000GX, and Micro 3000XE supermicrocomputers addresses entry-level information system requirements. The standard Micro 3000LX contains 2M bytes of main storage, one 81M-byte fixed disk drive, one cartridge tape drive, five terminal ports, a system cabinet, and one terminal. The MPE V operating system, fundamental operating system utilities, the HP Easytime user interface, and the TurboImage/V database management system are also included as part of the standard Micro 3000LX.

The Micro 3000LX configurations can be expanded to include the following:

- A maximum of 4M bytes of main storage: The 2M-byte memory can be replaced with a 4M-byte memory array.
- A maximum of 304M bytes of fixed disk storage.
- One cartridge tape drive.
- A maximum of eight ports for workstation/terminal I/O device attachment.
- Up to eight hardwired (point-to-point) display stations.
- One serial printer.
- One local area network interface.
- One communications line for system-to-system communications.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

The standard Micro 3000GX comes in a preconfigured, fully functional format. Included in the base platform are 2M bytes of main storage, one 152M-byte fixed disk drive, one cartridge tape drive, eight terminal ports, a system cabinet, one terminal, MPE V, fundamental operating software, HP Easytime, and TurboImage/V.

A Micro 3000GX accommodates the following:

- A maximum of 4M bytes of main storage: The 2M-byte main storage can be replaced by a 4M-byte memory array. ➤

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▷ configurations with additional hardware. In addition, approximately 30 percent said they plan to acquire more software from Hewlett-Packard and almost 49 percent said they plan to purchase more products from third-party software suppliers.

When asked if the system did what it was expected to do, nearly 97 percent of the users stated that it did while the remainder said it did not or refused to comment. To the question, "Would you recommend this system to another user?", 94 percent said they would, 3 percent said they would not, and the remainder said they were undecided.

To supplement our survey findings, we telephoned four companies that have HP 3000 computers. Some of these respondents have computers that are no longer actively marketed. The responses, however, are still valid since the newer models implement similar architectures and services and feature similar advantages and weaknesses.

The first company we contacted was a furniture manufacturing firm. The manufacturer uses an HP 3000 Series 70 to run a comprehensive set of applications for business administration and operations automation. Included in the application set are accounting, payroll and personnel management, order processing, customer billing, inventory control, purchasing, manufacturing planning and control, and data collection applications.

The manufacturer upgraded to the Series 70 from an HP 3000 Series 68. The move was made to process transactions faster and to improve response times. The manufacturer experienced a 25 percent increase in system performance by moving to the Series 70. Furthermore, the upgrade caused minimal disruption since the migration was a field upgrade—the Series 68 was transformed into a Series 70 by simply swapping processor boards.

Before acquiring the HP 3000 Series 68, the manufacturer owned an IBM System/370. The manufacturer decided to move to the HP 3000 product line for several reasons. First, the manufacturer said HP 3000 computers were lower in operational cost—long-term overhead was lower and the personnel cost alone was cut in half since the HP 3000 was much easier to use than the IBM computer. Second, the manufacturer switched from an IBM environment to an HP 3000 environment because the manufacturing software offered the type of functions the company required. Even though this meant purchasing new software (to replace the System/370 third-party manufacturing management programs and accounting system), the company was willing to do so to obtain the functions.

The manufacturer also selected the HP 3000 based on the product line's reputation for reliability. While searching for an alternative to the IBM shop, the manufacturer conducted surveys and interviews with users of Data General MV/Eclipse, Prime 50 Series, and Hewlett-Packard HP 3000 computers. Based on its findings, the manufacturer concluded that the HP 3000 family offered the best uptime. Furthermore, the manufacturer invested in the

- ▶ • Up to 2G bytes of online mass storage.
- Up to four magnetic tape drives.
- A maximum of 16 workstation/terminal I/O device ports.
- Up to 16 hardwired display workstations.
- Two line and three serial printers.
- One local area network interface.
- One communications line for system-to-system communications.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

Unlike the other Micro 3000 supermicros, the standard Micro 3000XE does not come in full-size system configuration. The standard Micro 3000XE comes with a system cabinet housing the central processor and 2M bytes of main storage and with MPE V, fundamental operating system utilities, and TurboImage/V. Mass storage and terminal I/O device connectivity must be ordered separately; they are not provided by the base platform. Furthermore, programming languages, information management software tools, communications and networking software, office system software, and business automation software must be added.

A Micro 3000XE can contain the following:

- A maximum of 8M bytes of main storage: The standard 2M-byte main storage is expanded in 2M-byte increments.
- Up to 4.5G bytes of online mass storage.
- Up to four magnetic tape drives.
- A maximum of 56 workstation/terminal I/O device ports.
- Up to 56 hardwired display workstations.
- Four line and eight serial printers.
- One local area network interface.
- Three communications lines for system-to-system communications.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

The Series 52 and Series 58 are medium-sized minicomputers. The standard Series 52 and 58 both come with a system unit containing the central processor and basic memory. Furthermore, the standard Series 52 or 58 both have MPE V, fundamental operating software, and TurboImage/V. Mass storage and terminal I/O device connectivity options are not included with the base platform. In addition, the base system does not feature programming languages, information management software tools, communications and networking software, office system software, or business automation software.

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➤ HP 3000 product line because it was pleased with Hewlett-Packard's type (quantity and quality) of customer support and product servicing.

Currently, the manufacturer has not had any major problems with reliability or Hewlett-Packard servicing and customer support. Overall, the manufacturer would recommend the HP 3000 product line to prospective users because of cost-effectiveness, reliability, and customer support and servicing.

The second company we contacted was a wholesaler of consumer goods located in the Midwest. The wholesaler uses several older Micro 3000 supermicrocomputers and a Series 930—the predecessor to the Series 925LX, 925, and 935—to perform a business administration and operations automation. Included in the application set are accounting, payroll and personnel management, order processing, customer billing, inventory control, purchasing, and office automation applications. The Micro 3000 computers are distributed among several branch locations. The Series 930 is located at the central office and runs automation applications for the central office while also serving as a host for the distributed Micro 3000s.

The wholesaler has always used HP 3000 computers. Before it moved to the Series 930- and Micro 3000-based network, the wholesaler employed a Series 48 which handled the work load for the entire organization. The wholesaler moved to the distributed environment to improve system-wide performance and to increase the level of service to the branch offices.

The wholesaler moved from the Series 48 to a Series 930 to meet current needs and to prepare for business growth. The respondent stated that the organization did not experience too many hardships when it moved applications from the Series 48 to the Series 930. Series 48 applications were run in the compatibility mode on the Series 930 until they could be moved to native mode. Additionally, the respondent stated that the organization did not experience too many inconveniences when it set up the distributed network. The respondent added that the Hewlett-Packard and independent consultants were of great assistance in organizing and establishing the distributed processing environment.

The respondent reported that the workstation users were satisfied with the responsiveness, data crunching capabilities, and network application services of the Micro 3000s and the Series 930. The wholesaler's representative also reported that the computers have been very reliable and that his company has been satisfied with the responsiveness and technical troubleshooting capabilities of the maintenance personnel. He stated that maintenance and service personnel were well versed in troubleshooting problems and very responsive when answering service requests. When asked to indicate weaknesses, however, he said that system documentation could be improved; people in the organization found it very hard to understand. ➤

➤ The Series 52 can be configured with the following:

- A maximum of 8M bytes of main storage: The standard 4M-byte memory can be upgraded to a 6M- or 8M-byte memory via a 2M- or 4M-byte expansion option.
- Up to 4.5G bytes of online mass storage.
- Up to four magnetic tape drives.
- Up to 92 hardwired display workstations.
- Four line and eight serial printers.
- One local area network interface.
- Three communications lines for system-to-system communications.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

Expansion options allow the Series 58 to be sized as follows:

- A maximum of 8M bytes of main storage: The standard 4M-byte memory is upgraded to a 6M- or 8M-byte memory via a 2M- or 4M-byte expansion option.
- Up to 9.1G bytes of online mass storage.
- Up to eight magnetic tape drives.
- Up to 152 hardwired display workstations.
- Eight line and eight serial printers.
- One local area network interface.
- Up to seven communications lines for system-to-system communications.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

The Series 70 is a large-scale minicomputer. The standard Series 70 comes with a system unit that contains the central processor and 8M bytes of main storage and with MPE V, fundamental operating system utilities, and TurboImage. Mass storage and terminal I/O device connectivity options are add-on devices. Software options include programming languages, information management software tools, communications and networking software, office system software, or business automation software.

The Series 70 can include the following:

- A maximum of 16M bytes of main storage: Main storage is expanded using add-on 4M- or 8M-byte memory arrays.
- Up to 13.7G bytes of online mass storage.
- Up to eight magnetic tape drives. ➤

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▷ The third company we contacted was a manufacturing firm that specializes in the manufacturing of automotive parts. The firm uses several HP 3000 Series 52, 58, and 70 minicomputers in addition to a Series 930 and a Series 950 superminicomputer. The HP 3000 computers run departmental applications for business administration and operations while communicating with a central IBM mainframe.

The manufacturer said the firm has employed HP 3000s at the departmental level ever since the firm moved to a distributed data processing environment. The HP 3000 computers were selected over IBM System/36 and System/38 minicomputers and IBM System/370-compatible computers because of their cost-effectiveness, reliability, and data crunching capabilities. Furthermore, the manufacturer likes the HP 3000 because of its PC integration capabilities. The manufacturer also complemented Hewlett-Packard on its customer support and product servicing programs. When asked to indicate weaknesses, however, he said system documentation could be improved; people in his organization found it very hard to understand.

The fourth company was a small financial corporation specializing in retail banking. The firm uses a Micro 3000XE for business administration and an HP 3000 Series 52 for banking automation. Before the acquisition of the HP 3000 computers, the firm looked at the IBM System/36 and System/38, Data General MV/Eclipse, Motorola/Four-Phase, and MAI/Basic Four systems. The HP 3000s were selected because of multiuser capabilities, system packaging, reliability, and customer support.

The features that the organization likes best are HP 3000's maintenance service and customer support. The organization said the system did what was expected. As a matter of fact, the organization is a member a local chapter of the HP Users Group and says that it hears very few complaints from the other users within the group. Moreover, the respondent stated that his company is planning to move from the Series 52 to a Series 935 to improve transaction processing performance; he expects few complications from the move. Like the other respondents, he would recommend the HP 3000 products to prospective customers. □

- ▶
- Up to 400 hardwired display workstations.
 - One or two page, 1 to 10 line, and 1 to 16 serial printers.
 - One local area network interface.
 - Up to 24 communications lines for system-to-system communications.
 - A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

The Series 925LX, 925, and 935 are midrange superminicomputers that implement the HP Precision Architecture.

Standard Series 925LX, 925, and 935 models each feature a base platform consisting of a system cabinet with the central processor and standard memory. In addition, the standard Series 925LX, 925, and 935 each come with the MPE XL operating system, basic operating utilities, Allbase/XL database management system, and the System Dictionary/XL system dictionary. Mass storage and terminal I/O device connectivity options are not included. Furthermore, the base platforms do not come with programming languages, information management software tools, communications and networking software, office system software, or business automation software.

Expansion options permit the Series 925LX to have the following:

- A maximum of 48M bytes of main storage: Main storage is expanded in 8M-byte increments. The base memory includes 24M bytes of storage.
- Up to 4.5G bytes of online mass storage.
- A maximum of four magnetic tape drives.
- Up to 32 hardwired display workstations.
- Up to four page, up to four system, and up to eight serial printers.
- One local area network interface for system-to-system communication and one local area network interface for workstation and host system communication.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

The Series 925 can be configured with the following:

- A maximum of 48M bytes of main storage: Main storage is expanded by adding 8M-byte memory arrays. The Series 925 comes with 32M-byte main storage.
- Up to 9.1G bytes of online mass storage.
- A maximum of four magnetic tape drives.
- Up to 152 hardwired display workstations.
- Up to four page, up to four line, and up to eight serial printers.
- One local area network interface for system-to-system communication and one local area network interface for workstation and host system communication.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

Expansion options permit the Series 935 to grow to a configuration that contains:

- A maximum of 96M bytes of main storage: Main storage is expanded in 8M- or 32M-byte increments. The standard Series 935 has 32M-byte main storage.
 - Up to 13.7G bytes of online mass storage.
- ▶

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- ▶ • A maximum of eight magnetic tape drives.
- Up to 240 hardwired display workstations.
- Up to four page, up to eight system, and up to 32 serial printers.
- One local area network interface for system-to-system communication and one local area network interface for workstation and host system communication.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

The Series 950 and 955 are high-end superminicomputers that implement the HP Precision Architecture.

Like the Series 925LX, 925, and 935, the Series 950 and 955 both come in a base system package that consists of a system cabinet with one central processor and standard memory and the MPE XL, basic utility, Allbase/XL, and System Dictionary/XL software. Mass storage and terminal I/O device connectivity options must be added to the platform along with programming languages, information management software tools, communications and networking software, office system software, or business automation software.

A fully configured Series 950 contains the following:

- A maximum of 128M bytes of main storage: Main storage can be expanded in 16M-byte increments. The base Series 950 contains 48M bytes of storage.
- Up to 17.1G bytes of online mass storage.
- A maximum of eight magnetic tape drives.
- Up to 400 hardwired display workstations.
- Up to four page, up to eight line, and up to 32 serial printers.
- One local area network interface for system-to-system communication and one local area network interface for workstation and host system communication.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

A fully configured Series 955 features the following:

- A maximum of 128M bytes of main storage: Main storage can be expanded in 16M-byte increments. The base Series 955 contains 48M bytes of storage.
- From 48M to 128M bytes of main storage.
- Up to 27.1G bytes of online mass storage.
- A maximum of eight magnetic tape drives.
- Up to 400 hardwired display workstations.
- Up to four page, up to eight line, and up to 32 serial printers.

- One local area network interface for system-to-system communication and one local area network interface for workstation and host system communication.
- A variety of programming languages, information management software tools, communications and networking software, office system software, and business automation software.

Auto restart after power failure is standard on all HP 3000 Series systems. When the line voltage falls below 90 percent, a power-fail warning is issued. All register contents are moved to memory, system activities are completed, and the system shuts itself down. All models include a rechargeable battery pack to maintain memory data during power failure. A minimum of 15 minutes is provided with the total amount of backup time dependent on memory size and battery condition (age and level of charge). When voltages reach 90 percent of their values, all registers are automatically restored and processing resumes.

WORKSTATIONS: The HP 3000 Series computers accommodate alphanumeric terminals, graphics terminals, data entry terminals, and personal computers. The personal computers must be configured with the appropriate asynchronous terminal emulation equipment to access the applications running on the HP 3000 models.

DISK STORAGE: The 81M-, 130M-, 152M-, and 304M-byte fixed-media drives are compact storage units that feature disks with 5.25-inch form factors. Up to three 304M-byte drives can be placed in the external 304M-byte or disk package; the fourth slot of the disk drive box contains the power supply. The 152M-byte drive package accommodates up to three 152M-byte drives in addition to a power supply.

The 307M- and 571M-byte fixed-media disk drives utilize eight-inch disk platters implemented in thin-film media technology. Up to eight 307M- or 571M-byte drives can be packaged in a 307M-/571M-byte drive cabinet.

The 404M-byte disk drive contains 14-inch disk platters. The drive is available in either a fixed-media or removable-media model. The fixed-media version is used to provide online data storage for continuously available data while the removable-media version is primarily used for disk-to-disk backup/restore, archival storage, and private volume configurations. Each cartridge/removable disk pack holds 404M bytes of formatted data.

Cache memories are featured on the 307M-, 404M-, and 571M-byte disk drives. The read and write cache provide high-speed response without the overhead of mechanical movements. The read cache maintains a copy of frequently requested data in random access memory (RAM) to reduce average read access time. The write cache gives an immediate response to the central processor after a write operation, then writes to the disk during mechanism idle times.

Each disk storage device contains its own controller. The controller communicates with the host processor over the HP-IB or HP-FL interface which interfaces to the I/O bus. Up to four disk drives can be supported on a HP-IB interface and up to eight on the HP-IB interface.

The Micro 3000LX accommodates one 81M-, 152M-, or 304M-byte drive. The drive resides in the system (central processing complex) cabinet.

The Micro 3000GX uses 81M-, 152M-, 304M-, 307M-, and 571M-byte drives. Up to four can be accommodated by ▶

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► Micro 3000GX. One or two 81M-, 152M-, or 304M-byte drives reside in the system cabinet while the remainder reside in expansion cabinets.

The Micro 3000XE supermicro and the Series 52, 58, and 70 minicomputers support the 81M-, 131M-, 152M-, 304M-, 307M-, and 571M-byte disk drives. The Micro 3000XE and the Series 52 each accommodate up to eight drive units. The Series 58 configurations feature as many as 16 drives while the Series 70 accommodates up to 24.

The Series 900 computers' primary online mass storage devices are the 307M- and 571M-byte disk drives. Up to 8 drives are attached to the Series 925LX; up to 16 are accommodated by the Series 925; and up to 24 are supported on the Series 935. The Series 950 configurations contain a maximum of 30 disk drive units while the Series 955 supports up to 48 drives.

MAGNETIC TAPE: Cartridge tape drives, cartridge tape auto changers, and open-reel tape drives provide for online storage backup, archival storage, data exchange, and software distribution. The cartridge tape drive places 67.1M bytes of data on each tape cartridge. The cartridge tape auto changer accesses up to eight tape cartridges from a removable magazine. The open-reel tape drives utilize 0.5 inch media and read and write in either the 800, 1600, or 6250 bit-per-inch (bpi) mode at 75-, 100-, or 125 inches per second (ips). The HP-IB interface attaches magnetic tape drives to the host processor.

PRINTERS: A variety of printers is available. The matrix line printers handle text, numerics, OCR, bar code, and graphics character sets and offer maximum print speeds ranging from 300 to 1,200 lines per minute (lpm). The matrix serial printers run at maximum speeds ranging from 200 to 480 characters per second (cps). The inkjet printers provide nonimpact matrix printing at maximum speeds ranging from 150 to 192 cps. The laser printers output documents, images, and graphics at up to 45 pages per minute (ppm).

The matrix line printers and page printers are used at the data center or on a departmental processor. The matrix serial and inkjet printers address printing requirements on the small-scale (stand-alone or departmental) system and at the individual workstation. All printers connect to the host processor or workstation using an RS-232-C, RS-422, or HP-IB interface.

MASS STORAGE

See Chart B for specifications on the disk storage devices.

INPUT/OUTPUT UNITS

See Chart C for specifications on terminals and PC-based workstations. Chart D lists the specifications on printers. Chart E describes magnetic tape equipment.

COMMUNICATIONS CONTROL

GENERAL: System-to-system communications can be conducted using *HP ThinLAN* or *HP ThickLAN*. Both local area networks (LANs) are Hewlett-Packard implementations of IEEE 802.3 Ethernet. *HP ThinLAN* uses thin coaxial cabling while *HP ThickLAN* uses thick coaxial cabling. Both networks contain the Carrier-Sense Multiple Access with Collision Detection protocol to control network access and the Defense Advanced Research Project Agency (DARPS)-recommended Transmission Control Protocol/

Internet Protocol (TCP/IP) transport-level protocol. Up to 10M bytes of data can be transmitted across the network per second.

The Series 800 systems are connected to the network through the LAN3000 Link intelligent controller. The LAN3000 Link contains the hardware and transport and interface software required to connect a HP 3000 computer to an IEEE 802.3-recommended cable. LAN3000 Link hardware components include the following:

- Local Area Network Interface Controller (LANIC)—a microprocessor-based communication controller that plugs into the HP 3000 backplane. It handles buffering, IEEE 802.2 and 802.3 protocols and error checking, and keeps track of network statistics.
- Attachment Unit Interface (AUI) Cable—the interface cable plus internal LANIC cable to connect the LANIC to the Medium Attachment Unit (MAU).
- Medium Attachment Unit—provides the physical and electrical connection to the network coaxial cable. The MAU receives signals from and sends signals to the coaxial cable, and also detects collisions resulting from two nodes starting to transmit simultaneously. It also performs a number of other functions to ensure network reliability.

LAN3000 Link software is described in this report's COMMUNICATIONS subsection of the SOFTWARE section.

The *HP ThinLAN Hub* interconnects up to four separate HP ThinLAN segments. It also includes hardware for attaching up to four HP ThinLAN segments to an HP ThickLAN cable.

The *HP Starlan* and *HP Starlan-10* LANs connect HP Vectra, MS-DOS-based, and IBM PC and compatible microcomputers to the HP 3000. Both are Hewlett-Packard's implementation of the de facto, industry-standard StarLAN. Both Hewlett-Packard StarLAN products work over standard, unshielded, twisted-pair phone wire. While *HP Starlan* supports 1M bps data transfer rates, *HP Starlan-10* operates at 10M bps.

The hubs for *HP Starlan* and *HP Starlan-10* connect up to four network segments and offer a connection to a network bridge. The *HP Starlan Bridge* connects an *HP Starlan* network to an IEEE 802.3-based Ethernet. The *HP Starlan-10 Bridge* connects an *HP Starlan-10* network to an 10M bps IEEE 802.3 Ethernet.

The *Point-to-Point Link* provides the network connection to allow an HP 3000 to communicate with another remote HP 3000. It includes an Intelligent Network Processor (INP) or Programmable Serial Interface (PSI) communications/network processor and transport-level software. The link permits communications to occur over dial, leased line, X.21, and digital phone network modems. Data transmission rate is 19.2K bps when an RS-232-C interface is used to support the communication line and 64K bps when a CCITT V.35 interface is used.

The *NS X.25 3000/V Link* for MPE V-based computers provides the network connection to connect HP 3000 computers to private and public X.25 packet switched networks. It consists of the INP and the TCP/IP protocols. ►

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Besides offering a microcomputer connection, the *HP Asynchronous Serial Network Link HP ASNL* provides a point-to-point link for connecting two HP 3000s. The HP ASNL makes the connection through an ATP and includes all the software for a complete network connection.

The *SNA Link* provides the network connection to an IBM System/370-compatible host processor in an IBM Systems Network Architecture (SNA) environment. The SNA Link allows HP 3000 systems to emulate the functions of the transmission, path, and data link control SNA layers on an HP 3000. Each SNA Link connects to a single-switched or nonswitched data communications line. The HP 3000 supports multiple SNA Links for connection to multiple IBM mainframes or multiple data communications lines to a single mainframe.

The SNA Link can only be used to support the operation of Hewlett-Packard's BSC software products, which are described in this report's COMMUNICATIONS subsection of the SOFTWARE section.

The *BSC Link* provides the network connection to an IBM System/370-compatible mainframe using the bisynchronous protocol (BSC). The BSC Link connects to an IBM 37XX communications controller on the host through a pair of synchronous modems.

The BSC Link only supports operation of Hewlett-Packard's BSC software products, which are described in this report's COMMUNICATIONS subsection of the SOFTWARE section.

The Point-to-Point Link, NS X.25 3000/V Link, SNA Link, and BSC Link include an *Intelligent Network Processor (INP)*—a serial communications controller—or a *Programmable Serial Interface (PSI)*. The INP is supported on MPE V-based HP 3000s and the PSI serial communications controller is used on the Series 900 computers. Both communications controllers run the various protocols, interfaces, and lines that allow the HP 3000s to communicate with other computers on X.25 packet switched, SNA, or BSC networks.

The INP features the following:

- 16-bit microprocessor.
- Data communications protocols handling.
- Character handling and buffer storage capabilities.
- Modem and direct-connect interfaces with data transmission capabilities of up to 56K bps.
- Built-in diagnostics and self-test.
- Collection of data volume and error statistics.
- Battery backup to prevent loss of buffered data during a power failure.
- BSC and SDLC protocol compatibility.
- EIA RS-232-C, RS-422, CCITT V.24, and CCITT V.35 interfacing standards.
- Direct memory access (DMA) for data.
- Support of auto dial capability.

The INP features the following:

- 10MHz MC68000 microprocessor.
- Data communications protocols handling.
- Character handling and buffer storage capabilities.
- Data rates at up to 64K bps.
- Built-in diagnostics and self-test.
- Collection of data volume and error statistics.
- Battery backup to prevent loss of buffered data during a power failure.
- BSC and SDLC protocol compatibility.
- EIA RS-232-C, RS-422, RS-423, RS-449, and RS-366A and CCITT V.24, V.28, V.10, V.11, and V.35 and X.21 interfacing standards.
- DMA for data.
- Support of auto dial capability.

SOFTWARE

GENERAL: The HP 3000 Series supports the Multiprogramming Executive (MPE) operating system, of which there are two versions—the MPE V and the MPE XL. The MPE V operating system is supported on the following models: Micro 3000LX, Micro 3000GX, Micro 3000XE, Series 52, Series 58, and Series 58. The MPE XL is supported on the Series 900 systems only.

OPERATING SYSTEM: Both MPE V and MPE XL enable the HP 3000 to perform transaction processing, timesharing, online program development, and data communications in interactive and batch modes concurrently. MPE monitors and controls program input, compilation, execution, and output; arranges the order in which programs are executed; and dynamically allocates hardware and software resources as required.

The following major components are included within MPE V:

- A system configurator and initiator.
- A system console manager.
- A command interpreter.
- A file management system.
- An input/output system.
- A virtual memory manager.
- A disk space manager and a disk cache manager.
- A private volumes facility.
- A serial disk interface.
- A tape labels facility.

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- ▶ • A spooling facility.
- A job/session scheduler.
- A process dispatcher.
- A code segmenter.
- A system accounting facility.
- A transaction logging facility.
- A backup and restore facility.
- A power failure recovery and automatic restart facility.
- Native-language customization tools.
- An online help facility.

The MPE V internal system data structure supports up to 400 concurrent sessions. Virtual memory can be spread across multiple-system domain disks so that more and larger applications can run simultaneously on one system. The disk caching facility is intended to further improve I/O performance by using excess main memory to buffer reads and writes to disk subsystems. Internal file system management is used to make internal control block handling more efficient, and all changes to the file system are transparent to the user. The dispatcher-scheduler gives users more control over system work load. Disk access is queued on a priority basis to ensure better access to disk and memory resources. The "TUNE" command allows users to filter out long transactions, such as batch operations, to improve online performance during periods of heavy interactive load.

Under the MPE V virtual memory allocation, each program can be segmented into as many as 63 segments. Each code segment can be up to 32K bytes in length, and each data segment up to 64K bytes. The principle of memory allocation dictates that only the essential segments be in memory at any particular time. The operating system remembers all segments brought into memory under a concept called segment trapping. The goal is to keep as much as possible of a program's working set—the code, data, and system data segments used most recently—in memory. This is accomplished by using Hewlett-Packard-developed algorithm called the segment trap frequency algorithm. This algorithm remembers the frequency of use of each segment of each working set and overlays only the least used segment of a low-priority work set.

Disk caching places those frequently accessed portions of files and directories in available portions of main storage, where they can be read repeatedly by an executing program. Thus, instead of going immediately to the disk to get requested information, disk caching first checks to see if the information is already in main storage. When the information is located in the disk cache, I/O performance is improved in two ways. First, several time-consuming disk accesses are eliminated. Second, since information can be accessed in main storage 10 to 100 times faster than accessed from disk, disk caching greatly reduces the time to complete an I/O operation. The dual improvement means better response and higher throughput for I/O-intensive applications.

The MPE V file system is a collection of routines in the system-segmented library. A user may open a file, obtain status information, read or write data, perform control functions, and close the file. File security is provided either

through passwords to limit access or through file access modes and user restrictions. File access modes are provided on a read-, append-, write-, execute-, lock-, and save-files basis. Users are given access to system services based on user, group, and account types. This combination allows files to be controlled at several levels ranging from unrestricted access to file access limited to its creator only.

Under MPE V, all I/O is handled by the file system; thus, programs are essentially device independent. The input/output program allows for file manipulation without extensive job control language (JCL). In any access mode, whether sequential or direct, security is maintained for users, groups, accounts, and individual files.

The MPE V accounting facility ensures that information such as central processor time, connect time, and disk file space is kept by user, group, and account. A "REPORT" command allows extraction of this information for each logon group.

The command language, which is processed by the command interpreter, contains all the necessary commands to direct and control the system. Commands can be entered interactively through a session or through a batch job. If the command interpreter detects an error in command syntax during a session, it informs the user with a meaningful message that specifies the erroneous parameter and prompts the user to reenter the command correctly. If the command interpreter detects an error during a job, it lists the error on the output device and halts the job. The user, however, can specify that the command interpreter ignore errors during a job so that the job will be completed.

MPE V provides an online help facility to assist with command syntax or command usage. The help facility offers encyclopedic information on all MPE commands. "Help" can be requested on a certain command or on a general topic or task. Command definitions explain the command's operation and parameters. Accessing information by topics or tasks enables users to perform specific tasks without prior knowledge of commands.

MPE XL, the operating system utilized on the Series 900 computers, provides a superset of MPE V system functionality, while maintaining object-code and source-code compatibility with MPE V systems. Programs written for MPE V-based computers can be run on MPE XL-based systems without modification, or can be recompiled using new optimizing compilers for MPE XL systems in order to obtain maximum performance on the Series 900 systems.

MPE XL delivers enhanced performance and system capacity through the exploitation of the Series 900 architecture and advanced software capabilities. File mapping, whereby virtual memory management hardware is used to decrease much of the software overhead associated with I/O operations, significantly increases performance for I/O-intensive processing environments.

System capacity is enhanced via support of 48-bit virtual addressing, which provides over 65,000 times the addressability of typical 32-bit systems. The virtual memory is organized as a set of 65,536 linear spaces. Each space is 4G bytes long. Spaces are further divided into fixed-length, 2K-byte pages, each of which can hold either code, data, or both. A single data structure can be up to 4G bytes long.

MPE XL uses a demand-page virtual memory management scheme. Demand paging allows an increased number of processes to simultaneously reside in main storage, thus allowing more efficient central processor utilization. ▶

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► MPE XL increases system availability via a concurrent backup facility, allowing system files to be backed up while still being accessed by users. Availability is also increased via enhanced system resiliency in the event of peripheral and subsystem failures, and via transaction management tools which allow applications developers to build more reliable applications that ensure data integrity and easier recovery in the event of failures.

System management is streamlined via a simplified system configuration dialogue and automatic system table expansion when required. System management and ease of use have been further enhanced via a more flexible, powerful command interpreter, which allows simplified manipulation of files and control of session/job environments. Further, a window-oriented program debugger enhances programmer productivity.

DATABASE MANAGEMENT SYSTEM (DBMS): Several data management systems are featured across the HP 3000 line of computers.

TurboImage/V runs on MPE V-based systems. This DBMS is oriented toward general-purpose database processing. It supports large, high-performance databases as well as those with less demanding requirements. Because it implements a two-level network structure with owner/member relationships, TurboImage provides fast access to complex relationships among data. Transactions—database record updates, deletions, modifications, queries, etc.—are processed in both interactive and batch modes.

TurboImage/V consists of a database definition subsystem, a database management subsystem, and a database utility subsystem. The database definition subsystem defines the database. The database utility subsystem is used to create and maintain the database. The database language is used to write applications which operate on the database.

TurboImage/V allows for 1,023 data items in a database; 199 data sets (files) in a database; 255 data items per data set; a total of 2 billion records in a data set; and 2 billion records in a data chain.

Data entry and selection are made utilizing one of several access methods: serial, directed, calculated, or chained. In serial access, TurboImage starts at the most recently accessed data record and searches all adjacent records sequentially until the desired entry is found. In directed access, the calling program specifies the record address of the data entry where the requested data items should be located. In calculated access, master entries are retrieved by calculating an address based on a key. In chained access, entries having a common search item (key) value are linked through pointers forming a doubly linked chain. A doubly linked chain allows for fast forward and backward searches. Access to data is accomplished by identifying the proper chain and searching the chain until the desired entry is found.

Security is provided at the database, data set, and data item levels using a class-type scheme with over 60 levels.

TurboImage/V offers several methods of recovery: intrinsic-level recovery, roll-forward recovery, and rollback recovery. Intrinsic-level recovery ensures the database's physical integrity. Intrinsic that alter the chains in the database are logged to an ILR log file. If a hardware or software failure occurs before the intrinsic completes, TurboImage will reapply the interrupted intrinsic.

Roll-forward and rollback recovery ensures the logical and physical integrity in the event of a soft crash. Transactions

are logged automatically to a tape or disk log file. In the event of a failure, the roll-forward recovery system reads the log file and reexecutes those transactions that have been successfully completed. With rollback recovery, the recovery system rolls back any incomplete transactions.

Query/V, *TurboImage DBchange/V*, and *TurboImage Profiler/V* are database support tools for TurboImage/V.

Query/V offers commands such as "FIND", "REPORT", and "UPDATE" to locate, report, and update values in a TurboImage/V database. Reporting of retrieved data can be formatted to include page titles, column headings, and group subtotals, among other desired items. All security provisions invoked through TurboImage are adhered to in Query/V. A command file can be utilized to store complex or often used command sets on disk. For display purposes, nine data types may be converted and error checked.

TurboImage DBchange/V is an interactive utility that allows dynamic restructuring and capacity expansion of a TurboImage/V database. Database changes are input from a menu and executed online or in batch mode.

TurboImage Profiler/V is an analysis tool that guides developers in tuning databases and application programs. TurboImage Profiler/V provides performance and usage statistics to determine the optimal design of a TurboImage/V database. TurboImage Profiler/V uses trace data gathered while applications are running, and via a forms-drive interface, provides a wide range of statistical reports.

HPSQL/V is a relational database management system for general-purpose processing. As a relational database system, HPSQL/V does not require that explicit relationships between sets of data be defined. Relationships are determined at the time the query is performed. Users can redefine record sequences, subset records by select/omit criteria, and subset and concatenate fields to create new fields. Programs that use a logical view of the data are unaware of changes in the physical data. File access paths remain unchanged when a change to data occurs.

HPSQL/V uses the de facto, industry-standard Structured Query Language (SQL) database language for the data definition language (DDL) and data manipulation language (DML). SQL commands may be entered interactively via the Interactive Structured Query Language facility (ISQL), or as commands embedded in Cobol or Pascal application programs. Higher performance is achieved via the use of a sophisticated query optimizer, which is invoked by source code preprocessors at program preparation time. In addition, HPSQL/V detects whether a change in the database structure has invalidated the new structure's access strategy.

Included with HPSQL/V are the following capabilities: concurrent access, multilevel access privileges, multiple logical views, automatic rollback recovery, roll-forward recovery, dual-logging, dynamic data restructuring, fast index access, automatic locking for data integrity, optional explicit locking, flexible security designation, transaction backout, and generic retrieval.

HPSQL/V applications are compatible with Allbase/XL's relational database component.

Allbase/XL is the database management system for the Series 900. It includes TurboImage/XL and HPSQL/XL. TurboImage/XL is TurboImage/V optimized for the MPE XL environment and HPSQL/XL is an MPE XL version of HPSQL/V. TurboImage/XL is chosen when a network

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► data model interface is required and HPSQL/XL is selected when a relational model is needed.

HP Visor/HP-UX is available to users of the HPSQL interface in Allbase/XL. It gives HPSQL users menu-driven tools to perform ad hoc queries and to generate customized reports.

The *Keyed Sequential Access Method/V (KSAM/V)* runs under MPE V and under MPE XL in the compatibility mode. It allows users to create and maintain disk files whose records are accessed by the value of the key fields within the data records. Each data record contains 1 primary key field and may include up to 15 alternate key fields. Data records are written to a KSAM/V file in any order without regard to a key sequence. Records are accessed sequentially or randomly by primary or alternate key value, by logical record number, or in chronological order.

Dictionary/V is a MPE V-based data dictionary and directory that provides the means to control and coordinate an organization's data processing resources more efficiently. It provides one consistent source for all data definitions and locations. Dictionary/V contains information that describes programs, data definitions, data structures, input forms, and security. It consists of a TurboImage/V database, a high-level user interface, and a set of utilities.

System Dictionary is a global dictionary for both MPE-V-based systems and MPE-XL-based systems. It assists data administrators in managing system and network resources and increases programmer productivity by providing system information for software development. Contained in the System Dictionary are explanations of data, programs, files, user accounts, input forms, and network configuration. The dictionary can be accessed and updated by application development tools or by packaged or user-written features.

LANGUAGES: All of the HP 3000 computers are multilingual systems that support several high-level programming languages. Cobol II, Fortran 66, Fortran 77, Pascal, RPG, C, Basic, and Business Basic are offered throughout the product line. All implemented languages can call a subroutine written in another language. Of equal importance is the facility provided by the file system for all languages to utilize a common file structure, providing uniform access to disk and tape.

COMMUNICATIONS: Low-level networking is performed by software within products such as LAN3000 Link, HP ASNL, and products for X.25 network connectivity. Application-level networking is performed by packages such as Network Services 3000 (NS3000) and APRA Services.

The *LAN3000 Link software* provides IEEE 802.2 and 802.3 Ethernet link control and media access control functions and contains the transport and interface programs required to connect a HP 3000 to an IEEE 802.3-recommended, coaxial cable-based, 10M bps Ethernet network. The transport-level protocols are based on the de facto, industry-standard Transmission Control Protocol/Internet Protocol (TCP/IP) communications set. The set of node management programs provides for online configuration, diagnostics, and logging.

The *HP Asynchronous Serial Network Link (HP ASNL)* system-to-system communication software provides all the programs for connecting two HP 3000 computers. It comes with virtual terminal access capabilities and the interfaces to accommodate Network Services 3000 (NS3000).

The *Point-to-Point Link software* provides the network connection programs to allow an HP 3000 to communicate with another remote HP 3000. With the Point-to-Point Link software, the HP 3000 computer can send communications over dial, leased line, X.21, and digital phone network modems. Data transmission rate is 19.2K bps when an RS-232-C interface is used to support the communication line and 64K bps when a CCITT V.35 interface is used.

The *NS X.25 3000/V Link software* provides the network connection programs which allow HP 3000 computers to connect to private and public X.25 packet switched networks. It has code for link control and media access control functions and for the transport and interface functions. It corresponds to Levels 1 through 5 of the International Standard Organization's (ISO's) Open Systems Interconnection (OSI) networking model. The TCP/IP protocol set is used.

NS X.25 3000/V Link software provides programmatic access to the protocols at Levels 3 and 4 within the OSI networking model. This enables programmers and network administrators to develop proprietary protocols and services for communications with remote Hewlett-Packard or non-Hewlett-Packard systems over an X.25 network.

The *Network Services 3000 (NS3000)* enables the HP 3000 computers to perform virtual terminal access, file transfer, remote file and peripheral access, remote database access, and network interprocess communications amongst themselves. NS3000 runs in conjunction with the LAN3000 Link and Point-to-Point Link, HP ASNL, and NS X.25 3000/V Link products.

The *Network File Transfer* protocol permits HP 3000, HP 1000, and HP 9000 computers to transfer files amongst themselves using the Hewlett-Packard-developed Network File Transfer (NFT) protocol set.

ARPA Services allows HP 3000 computers to communicate with computer systems that implement Department of Defense Advanced Research Projects Agency (ARPA) networking standards. APRA Services' network application services include FTP for file transfer, Telenet for terminal login access, and SMTP for electronic mail. APRA Services runs in conjunction with the LAN3000 Link and Point-to-Point Link, HP ASNL, and NS X.25 3000/V Link products.

Upper level HP 3000 network management tools include the following:

- *Integrated Network Console Support*—enables centralized management of multiple HP 3000 computers in a network.
- *NetCI*—allows an operator to execute commands on any HP 3000 remote system.
- *OPT/3000*—provides facilities for network performance management.
- *Network Configuration Management*—a menu-driven configuration utility.
- *LAN Node Diagnostic*—provides an online diagnostic tool for an HP 3000-based LAN.

For communications with Digital Equipment VAX computers, there is *Network Services/DEC VAX/VMS (NS/DEC VAX/VMS)*. This tool integrates Digital Equipment's

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► VAX/VMS computers into the HP 3000 environment. It permits files to be transferred between HP 3000 and Digital Equipment VAX/VMS computers and allows bidirectional virtual services between HP 3000 and VAX/VMS computers.

For SNA communications, gateway and stand-alone solutions are available. The SNA stand-alone products are *SNA Interactive Mainframe Facility* for interactive communications, *SNA Network Remote Job Entry (NRJE)* for batch communications, and *HP LU6.2 Application Programming Interface* for program-to-program communications. Both SNA IMF and SNA NRJE are available for all HP 3000 systems. These products work in conjunction with SNA Link, which provides the physical interface and lower layer SNA software for SNA network communication.

SNA IMF allows access to 3270 applications on the IBM mainframe via programmatic or pass-through mode. In programmatic mode, application programs on the HP 3000 emulate IBM 3270 terminals and printers, exchanging data with the host via intrinsics (user-callable procedures). In the pass-through mode, users of Hewlett-Packard HP 3000 terminals and printers can access 3270 applications as though they were using IBM 3270 devices.

SNA NRJE allows HP 3000 computers to submit large batch jobs and transfer files between the IBM mainframe and the HP 3000 computer. It also permits a user connected to an IBM mainframe to start a job on the HP 3000 computer.

LU6.2 Application Programming Interface allows the HP 3000 applications to be developed so that the HP 3000 computer can communicate program-to-program with LU6.2 applications running on IBM systems elsewhere in the SNA network.

The SNA gateway products include *SNA Server* and *SNA Access*. SNA Server allows a single, MPE V-based system in a network to act as a transparent gateway for SNA IMF or SNA NRJE communication for all HP 3000 computers on a LAN. SNA Access allows a computer to transparently transmit input to, and receive output from, an IBM mainframe through the MPE V-based HP 3000 system with SNA Server.

Hewlett-Packard also provides interactive and batch communications products for the BSC-based IBM network. These products include the following:

- *Remote Job Entry (RJE)* for single-user remote job entry using the 2780/3780 BSC protocol;
- *Multileaved Remote Job Entry (MRJE)* for multiuser remote job entry using the HASP multileaving BSC protocol; and
- *IMF* for interactive communication using the 3270 BSC protocol.

Furthermore, Hewlett-Packard provides communication tools which allow an HP 3000 to participate with an IBM System/370-compatible computer in an office networking environment. *HP OfficeConnect-to-PROFS* allows HP DeskManager to support electronic mail exchange with any system running IBM's bisynchronous office-support mainframe software. *HP OfficeConnect-to-DISOSS* works with HP LU 6.2 products to allow electronic mail exchange, filing, and automatic document conversion between an HP 3000 system running HP DeskManager and an IBM mainframe running DISOSS.

UTILITIES: A number of add-on utility programs and systems is available. System management tools include the following:

- *On-Line Performance Tool/V (OPT/V)*: This is an interactive performance measurement package for the systems analyst. Bottlenecks can be isolated and performance improved by tracking CPU use, memory management activity, I/O traffic, program and process activity, and system table usage.
- *Application Program Sampler/V (APS/V)*: This is an interactive performance measurement software product for tuning application programs. It helps the programmer identify procedures consuming a large amount of computation time. Online histograms display CPU time spent directly in user code or indirectly in system services. APS/V can be used on programs in development or on existing programs.
- *HP Security Monitor/V*: This is a security system which protects both system resources and sensitive data from unauthorized access. Building on the integral security of the HP 3000s, it allows improved password protection, stricter audit trails, and tighter terminal security. Some of its features are password encryption, terminal passwords, and disabled selected commands.

Available application development tools included the following:

- *Virtuoso Code Generator*: This programmer's productivity tool provides for development and maintenance of large-scale business data processing applications. The Virtuoso Code Generator accomplishes this by structuring and standardizing the manner in which applications are developed. This structure and standardization provides higher quality and more consistent code, and lower maintenance cost and less time spent in testing and debugging new applications, since standard code is used.
- *Transact*: This is a fourth-generation language for transaction processing applications. Designed as a procedural language, Transact provides the functionality of a third-generation language, such as Cobol or Pascal, combined with a set of powerful, high-level constructs that can perform several functions with a single statement. Applications written in Transact are easier to write and require fewer lines of code than third-generation languages. Access to TurboImage/V databases, MPE/V files, and Vplus/V form files supports the creation of transition processing applications.
- *System Programming Language/V (SPL/V)*: This system programming language for MPE V-based HP 3000 computers combines the efficiency of a machine-dependent language with the structure of a high-level programming language. SPL/V is used to write or modify operating system, language compiler, system utility, database management, and data communications and networking subsystems.
- *HP Toolset*: This productivity aid assists programmers in designing and implementing Cobol II, Pascal, and Fortran 77 programs. It includes symbolic debuggers, full-screen editors, workspace file managers, and help facilities.
- *HP Symbolic Debugger*: This symbolic debugger helps programmers locate and correct errors in C, Fortran 77, and Pascal. ►

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- ▶ **HiLi/V:** This is a high-level screen management library.
- Vplus/V:** This consists of a set of intrinsics that programmers can use to develop the display workstation I/O portions of applications. Vplus/V provides facilities to configure terminal workstations; retrieve form definitions from a form file; display a form; return data in formatted fashion; execute terminal management routines; and debug terminal workstation I/O programs.
- Formspec/V:** This is a form design facility for programmers. With this tool, application screens are laid out interactively on a terminal screen.

Several major data management utilities are available for MPE V and MPE XL.

Edit/V is the text editor used to create, manipulate, and store files of upper- and lowercase alphanumerics in the form of lines, strings, or individual characters.

Sort-Merge/V and **Sort-Merge/XL** allow the user to order records in a file and merge sorted files.

FCopy/V and **FCopy/XL** perform general file copying tasks.

TurboStore/V eliminates the bottlenecks associated with disk-to-tape backups.

Copycat/V provides for disk-to-disk backup.

TurboImage DBchange/V and **TurboImage Profiler/V** are support tools for TurboImage/V.

TurboImage DBchange/V is an interactive utility that allows dynamic restructuring and capacity expansion of a TurboImage/V database. Database changes are input from a menu and executed online or in batch mode.

TurboImage Profiler/V is an analysis tool that guides developers in tuning databases and application programs. TurboImage Profiler/V provides performance and usage statistics that can be used to determine the optimal design of a TurboImage/V database. TurboImage Profiler/V uses trace data gathered while applications are running, and via a forms-drive interface provides a wide range of statistical reports.

Silhouette is a software product that provides high availability by automatically duplicating the TurboImage and Image databases on multiple HP 3000s over network links. This shadowing allows users to continue database applications during a hardware or software failure.

Query/V, **HP Visor**, **Inform/V**, **Business Report Writer**, and **Report/V** are used for the reporting and information presentation function.

Query/V offers commands such as "FIND", "REPORT", and "UPDATE" to locate, report, and update values in a TurboImage/V database. Reporting of retrieved data can be formatted to include page titles, column headings, and group subtotals, among other desired items. All security provisions invoked through TurboImage are adhered to in Query/V. A command file can be utilized to store complex or often used command sets on disk. For display purposes, nine data types may be converted and error checked.

HP Visor is a terminal interface to **HPSQL/V** and the relational data model within **Allbase/XL**. It enables users

to perform queries and generate reports without involving a programmer. Queries and reports are generated through forms-based screens and executing function keys. The more experienced user can opt to use **HP Visor** or **SQL** database language commands when creating queries and reports. Context-sensitive help is available for both command-line entry and menu-driven routines.

HP Inform/V is an interactive inquiry and report generation facility which works on TurboImage/V databases, the TurboImage/V database within Allbase/XL, KSAM/V files, MPE V files, and MPE XL files. It enables users to access data and generate reports without involving a programmer. Inform/V and a data dictionary work together to simplify data access. End users can access information without knowing how or where it is stored. A menu interface and automated report formatting simplify report generation. Reports can be generated online or in batch mode.

Business Report Writer (BRW) is a high-performance report writing system for data processing professionals. It allows report writing without numerous lines of programming code or complex report syntax. A menu-driven interface, report design and prototyping tools, design aids for building equations and business functions, and an online help facility assist users in designing reports. BRW interfaces with **Dictionary/V** or **Systems Dictionary** to access data definitions, maintain documentation, and define access paths to the data.

Report/V is a command-driven, nonprocedural report writer. It provides layout, heading, and editing capabilities.

Personal computer integration and support are provided through the following software packages:

- Cooperative Services:** This development tool helps designers create cooperative processing applications between the HP 3000 computer and personal computers. It consists of both an MS-DOS procedure library and an HP 3000 intrinsic server and features personal computer connection and session management routines and routines for packaging and transmitting TurboImage database, file, and procedure requests and responses.
- HP Information Access:** This information server permits personal computers to access data within the HP 3000 database or a database on the network and to upload data to the database. Information Access automatically performs data conversations and supports application-to-application communications. Data is accessed based on security provisions.
- HP Resource Sharing:** This software package enables personal computers to store files on HP 3000-based disk storage devices and to use HP 3000 print services.
- AdvanceMail:** This software enables personal computers to participate in the electronic mail network that operates on the host.
- AdvanceLink:** This software lets personal computers emulate HP 3000 terminals so that HP 3000 applications can be accessed.

The **HP Easytime** user interface is a menu-driven interface for executing system management routines. It only runs on the Micro 3000LX and Micro 3000GX supermicrocomputers.

OFFICE AUTOMATION: Hewlett-Packard's primary office system solution and professional support offering is ▶

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► **HP Business System Plus.** This system combines key office system and professional support applications with HP 3000 computers and personal computers. The personal computers and HP 3000s, with their respective software, are integrated into a single, centrally managed system.

The HP Business System Plus software, which comes on a single HP 3000 tape, includes:

- HP DeskManager—provides electronic mail.
- HP Information Access—enables personal computers to retrieve and send data from and to the host or network-based database.
- HP Resource Sharing—enables personal computers to share HP 3000-attached peripherals.
- HP Vectra Office Professional Pack—provides MS-DOS and IBM PC XT and PC AT-compatible computers with word processing, spreadsheets, graphics, data management, and personal computer-based communications.
- HP NewVave—a uniform user interface for host-based and personal computer applications that features icons, agents, menus, and windowing. It resides on the personal computer.

Other Hewlett-Packard office system solution and professional support products include the following:

- *HP Word*—a full-feature word processor.
- *HP Slate*—a full-screen text editor.
- TDP/3000—a text and document processor.
- DSG/3000—a presentation graphics processor.
- IDS/3000—an interactive design system.
- IFS/3000—an interactive formatting system.
- Print Central—a host print server for personal computers.
- HP Draw—a text and figure presentation system.
- HP EasyChart—a chartmaker graphics package.
- HP Menu—an interactive office menu facility.
- HP File—provides shared filing.
- *Curator/3000*—a translator between HP 3000 graphics and personal computer graphics.
- HP DeskManager—an electronic mail system.
- HP Schedule—a time and resource scheduler.
- HP Information Access—provides personal computers with database access.
- HP Resource Sharing—enables personal computers to share HP 3000-attached peripherals.
- *AdvanceMail*—enables personal computers to connect to HP DeskManager.

- *AdvanceLink*—permits personal computers to emulate HP 3000 display terminals.
- HP MAP—a business mapmaker.
- HP Spell—American and English dictionary.
- HP Listkeeper—a personal information management system.
- HP Telex—a software package for Telex communications.
- Visicalc/3000—a spreadsheet program.

APPLICATIONS: Hewlett-Packard offers the following business automation applications for the HP 3000 computers:

- HP Manufacturing Management II—a manufacturing resource planning system.
- HP Maintenance Management—planning and control software for maintenance departments.
- HP FA—a financial accounting system.
- HP Payroll—a payroll processing system.
- HP FB—a financial budgeting system.

In addition, HP offers *HP Plus*, a marketing program that finds software written by independent software suppliers, qualifies the packages, and then merchandises them in conjunction with the software suppliers. The HP Plus program currently offers over 1,000 products. Products cover the operational planning and control and administrative functions of businesses and agencies. Targeted markets include the financial, discrete, and process manufacturing, distribution, and health care industry and state and local governments.

For more detailed information on applications available for the HP 3000 systems, please refer to our *Datapro Directory of Software*.

PRICING

POLICY: The HP 3000 Series systems are available on a purchase basis. All HP 3000 computers come with system software as part of the basic configuration. The Micro 3000 products come standard with the MPE V operating system, HP Easytime interface, fundamental operating system utilities, and the TurboImage/V database management system. The Series 52, 58, and 70 minicomputers come standard with the MPE V operating system, fundamental operating system utilities, and the TurboImage/V database management system. The standard Series 900 computers come with the MPE V operating system, basic operating system utilities, Allbase/XL database, and the System Dictionary/XL global dictionary.

Volume discounts are available for hardware equipment. Customers purchasing multiple copies of the same applications software are offered price reductions.

SUPPORT: The *Standard System Maintenance Services (SSMSs)* and *Basic System Maintenance Service (BSMS)* are the system hardware maintenance plans for the HP 3000 computers. ►

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► **Standard System Maintenance Services (SSMSs)** provides same-day response, typically within four hours of the request, at sites within 100 miles of a servicing office. Support coverage is from 8 a.m. to 9 p.m., Monday through Friday. Extended coverage options are available, which can provide service up to 7 days a week, 24 hours a day. Preventive maintenance is scheduled regularly. Environmental site surveys and installation services for new products are included at no extra charge under SSMS.

Basic System Maintenance Service (BSMS) is a more economical form of maintenance service. It provides next-day response to service calls if the customer site is within 100 miles of the service office. Longer response times prevail for calls beyond the 100-mile radius. Coverage is from 8 a.m. to 5 p.m., Monday through Friday. As an option, extended coverage options can be purchased; these improve response times and lengthen the coverage hours per day.

Workstation Maintenance Service is provided for workstation products, such as personal computers, terminals, and printers. On-site service is available with same-day or next-day response. Furthermore, a customer return service plan can be purchased where the customer sends parts and units to a Hewlett-Packard repair center. For on-site servicing plans, scheduled preventive maintenance can be purchased.

There are several standard support software services: Account Management Support, Custom Support Plan, Response Center Support, Software Materials Subscription, and Startup Response Center Support.

The **Account Management Support (AMS)** plan provides a locally assigned support representative who personally oversees system support. The representative assists in preparing for future needs and avoiding potential problems. Services include support management reviews, software release planning, access to Hewlett-Packard's Response Center Support service, system performance analysis reporting, on-site assistance, software problem reporting, and software materials and documentation.

Custom Support Plan (CSP) is an extension to the Account Management Support plan for users requiring additional personalized assistance. It allows the incorporation of any software support service Hewlett-Packard offers into an annual plan developed by the user and the Hewlett-Packard account support representative.

The **Response Center Support (RCS)** plan includes a subset of the services available through Account Management Support, with all assistance from Hewlett-Packard provided over the telephone. It is recommended that, with this plan, the user have sufficient experience with the Hewlett-Packard system so that on-site assistance or other local attention will rarely, if ever, be needed. On-site assistance is available, if needed, on a time-and-materials basis. This plan also provides the support materials necessary to keep current on the changes and improvements in Hewlett-Packard software.

The **Software Materials Subscription (SMS)** plan provides all the materials and information required to keep up to date on Hewlett-Packard software and documentation. It is an integral part of both Account Management and Response Center Support, but is also available as a separate service. The support materials include software and firmware releases, a software status bulletin, the *HP Communicator* periodical, and reference manual updates.

The **Startup Response Center Support (Startup RCS)** plan is designed to help customers manage their HP 3000 system software during the first year of its operation. It includes services to implement the new system and to maximize system availability after implementation is complete. Online problem resolution assistance, complete RCS, and SMS are provided with Startup RCS.

Optional services that can be added to a support program are as follows:

- **Additional system coverage**—provides flexibility in structuring support for multiple systems by extending the central system coverage to additional systems.
- **HP Trend System Performance Analysis plan**—a year-long service that provides the customers with periodic reports on system usage overtime. HP Trend System Performance Analysis reports are an aid for high-level resource planning, as well as for balancing loads across multiple HP 3000s and across shifts, hours in the day, and days in the month. Performance statistics are collected on the customer's computer, and at specific, predetermined times are transmitted to the Response Center for analysis and report generation.
- **Additional Response Center Caller**—with the AMS or RCS plans, only the system manager or designated alternate can call the Response Center. Each purchase of this option authorizes one additional response center caller, with no limit on the total number of calls allowed. Additional callers have the same benefits as the system manager, except for requesting on-site assistance, which remains the System Manager's responsibility.
- **Off-Hours Emergency Assistance**—provides on-site emergency assistance outside normal business hours through a central dispatch center. An AMS customer is charged a fixed fee for each call. An RCS customer is charged a fixed fee per call, plus time-and-materials charges for on-site assistance.
- **Software Update Installation Assistance**—provides installation assistance for each software update.
- **Off-Hours Software Update Installation Assistance**—allows the installation of one software update by an HP support representative within specified times outside normal working hours.
- **Extended Materials Subscription**—extends the Software Materials Subscription to one additional system. It provides the right to make one copy of all central system support materials for use on one additional system.

Hewlett-Packard provides a set of consulting services. Standard services include FastLane 3000, HP Capacity Planning and Performance Analysis (HP Caplan), HP-Snapshot, and HP-Assist.

The **FastLane 3000** service assists the installation move from an MPE V-based system to an MPE XL-based Series 900 computer. It consists of system planning and application migration planning.

Capacity Planning and Performance Analysis (HP Caplan) assists the customer plan for system expansion and budget for additional computing power. Hewlett-Packard system engineers perform capacity planning and performance analysis and recommend changes. ►

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► The *HP Snapshot* service helps customers identify performance bottlenecks and their causes and recommends a strategy for corrective action. The Hewlett-Packard specialist uses advanced capacity planning software tools to perform this analysis and to understand the profile of the system usage.

The *HP-Assist* program provides implementation and applications assistance. HP-Assist services are designed to fit specific needs. The three phases of HP-Assist include:

- **Customer Applications Analysis**—provides defined and documented analysis of specific business requirements and shows how HP applications can meet the needs.
- **Implementation Team Training**—teaches the customer's product team to manage the integration of the HP 3000 into the business.
- **Project Implementation Assistance**—offers project management guidance. It includes product training and tracking implementation progress.

To meet individual needs not addressed by the standard consulting services, Hewlett-Packard offers *Custom Project Services*. This plan designs a customized solution to meet the customer's needs. Included are business system analysis, requirements planning, software design, implementation assistance, and customer training services.

When the content and duration of the assistance a customer requires are difficult to determine, Hewlett-Packard provides consulting on a time-and-materials basis. Additionally, consulting on an ad hoc basis is provided for new system installations.

TRAINING: Training courses are available at an educational center or at the customer site. A full range of courses is offered to meet the need to manage, operate, and develop applications. Typical topics include system introduction, management, operations, application and systems programming, database administration, and data communications.

EQUIPMENT PRICES

		Purchase Price (\$)	Std. Month. Maint. (\$)
Basic System Packages			
32520A	Micro 3000LX with 2M bytes of main storage, 81M-byte fixed disk drive, cartridge tape drive, one terminal, MPE V fundamental operating software, and Turbolmage/V database	10,950	98
32536A	Micro 3000GX with 2M bytes of main storage, 152M-byte fixed disk drive, cartridge tape drive, one terminal, MPE V fundamental operating software, and Turbolmage/V database	15,950	100
32545A	Micro 3000XE with 2M bytes of main storage, MPE V fundamental operating software and Turbolmage/V database	27,000	70
32552C	HP 3000 Series 52 with its system processor unit containing 4M bytes of main storage, MPE V fundamental operating software, and Turbolmage/V database	45,890	233
32558C	HP 3000 Series 58 with its system processor unit having 4M bytes of main storage, MPE V fundamental operating software, and Turbolmage/V database	76,490	297
32471A	HP 3000 Series 70 with its system processor unit having 8M bytes of main storage, MPE V fundamental operating software, and Turbolmage/V database	160,000	623
A1032A	HP 3000 Series 925LX with its system processor unit having 24M bytes of main storage, MPE XL fundamental operating software, Allbase/XL, and System Dictionary/XL	50,000	300
A1007A	HP 3000 Series 925 with its system processor unit having 32M bytes of main storage, MPE XL fundamental operating software, Allbase/XL, and System Dictionary	80,000	300
A1060A	HP 3000 Series 935 with its system processor unit having 48M bytes of main storage, MPE XL fundamental operating software, Allbase/XL, and System Dictionary/XL	150,000	515
32490B	HP 3000 Series 950 with its system processor unit having 64M bytes of main storage, MPE XL fundamental operating software, Allbase/XL, and System Dictionary	270,000	724
A1109A	HP 3000 Series 955 with its system processor unit having 64M bytes of main storage, MPE XL fundamental operating software, Allbase/XL, and System Dictionary	390,000	850
Memory Expansion			
32520A	4M-byte main storage expansion option for Micro 3000LX and Micro 3000GX	3,000	0
32519A	Expands main storage to 4M bytes; used on the Micro 3000XE	3,500	0
30462A	2M-byte memory expansion option; used on the Micro 3000XE	4,500	24
32502C	2M-byte add-on memory option for Series 52 and 58	3,375	19
32503C	4M-byte add-on memory option for Series 52 and 58	6,750	26
32500A	4M-byte add-on memory option for Series 70	7,500	40
32501A	8M-byte add-on memory option for Series 70	15,000	80
A10501	4M-byte memory module for Series 925LX, 925, and 935	8,000	0
A10516	8M-byte memory module for Series 925LX, 925, and 935	16,000	0
324500	16M-byte memory module for Series 950 and Series 955	16,000	0

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		Purchase Price (\$)	Std. Month. Maint. (\$)
I/O Expansion			
19742A	Series 900 Floating-Point Co-processor	10,000	13
A1101A	Series 950 Channel Adapter	15,750	45
19742A	Series 930 Channel Adapter	15,000	45
—	One GIC peripheral channel for MPE V-based computers	2,520	0
—	One IMB channel adapter	10,300	38
—	CIO adapter	11,550	0
2345A	DTC for MPE XL-based systems	7,020	36
2346A	Add-on DTC serial interface card; provides eight RS-232-C local ports	2,860	0
2346B	Add-on DTC serial interface card; provides six RS-422 local ports	3,605	0
2346C	Add-on DTC serial interface card; provides six RS-232-C modem ports	2,860	0
27113A	Series 930 HP-IB channel	2,140	4
27115A	Fiber Optic interface for Series 900	5,800	5
30018A	Asynchronous Data Communications Controller (ADCC)—main	2,985	11
30018A	Asynchronous Data Communications Controller (ADCC)—extender	1,795	10
40290A	ATP/M for Micro 3000 systems	3,780	8
30144A	ATP System Interface Board	3,335	16
30145A	Direct-connect port controller for ATP	6,920	30
30155A	Modem-connect port controller for ATP	8,550	37
30273A	Expansion package for direct connection on ATP	7,890	46
30274A	Modem-connect expansion package for ATP	9,510	53
Field Upgrades for Basic System Packages			
—	Upgrade to Micro 3000GX from a Micro 3000LX; add 8 asynchronous ports	2,000	8
—	Upgrade to Micro 3000GX from a Micro 3000LX; substitute 304M-byte disk drive for 152M-byte disk drive	3,650	33
—	Upgrade to Micro 3000GX from a Micro 3000LX; add 304M-byte disk drive	6,950	33
—	Upgrade to Micro 3000GX from a Micro 3000LX; add two 304M-byte disk drives to replace one 152M-byte drive	9,950	33
—	Upgrade to Micro 3000GX from Micro 3000LX; expands memory to 4M bytes	3,000	—
A1016A	Upgrade to a HP 3000 Series 925 system processor from Series 925LX system processor	30,000	—
A1062	Upgrade to a HP 3000 Series 935 system processor from a Series 925	70,000	55
A1117A	HP 3000 Series 950-to-Series 955 field upgrade package	120,000	—
Mass Storage			
7933H	404M-byte fixed disk drive with integrated controller and HP-IB interface	—	—
7933XP	404M-byte fixed disk drive with integrated controller, cache, and HP-IB interface	—	—
7935H	404M-byte removable disk drive with integrated controller and HP-IB interface	24,000	130
7935XP	404M-byte removable disk drive with integrated controller, cache, and HP-IB interface	25,500	120
7936FL	307M-byte fixed disk drive with integral controller and HP-FL interface	15,500	42
7936H	307M-byte fixed disk drive with integral controller and HP-IB interface	14,250	42
7937FL	571M-byte fixed disk drive with integral controller and HP-FL interface	16,950	50
7937H	571M-byte fixed disk drive with integral controller and HP-IB interface	15,700	50
7957A/B	81M-byte Winchester disk drive with integral controller and HP-IB interface	4,250	40
7958A	130M-byte Winchester disk drive with integral controller and HP-IB interface	6,450	43
7958B	152M-byte Winchester disk drive in a small desktop package	5,475	30
7959B	304M-byte Winchester disk drive with integral controller and HP-IB interface	9,350	34
7962B	152M-byte Winchester disk drive with integrated controller and HP-IB interface	6,300	30
7963B	Winchester disk drive package containing one 304M-byte Winchester disk drive with an integral controller and HP-IB interface and room for two more 304M-byte Winchester disk drives with their controllers and HP-IB interfaces	10,750	34
Magnetic Tape Equipment			
7974A	Magnetic tape drive with a 800/1600 bpi read/write mode and 100-ips operating capabilities	16,500	110
7974A Opt.800	Additional 7974A	2,000	17
7978B	Magnetic tape drive with a 1600/6250 bpi read/write mode and 75-ips tape speed	27,000	106
7979A	Magnetic tape drive with a 1600 bpi read/write mode and a tape speed of 125 ips	13,400	44
7980A	Magnetic tape drive with a 1600/6250 bpi read/write mode and a tape speed of 125 ips	23,200	44
9144A	Cartridge tape drive capable of storing 67M bytes of data on tape cartridges	2,300	16
35401A	Cartridge tape drive with an auto changer that accommodates 8 tape cartridges	8,000	42
Printers			
2563B	Matrix line printer that runs at up to 300 lpm	7,790	59
2564B	600-lpm matrix line printer	12,950	94
2566B	900-lpm matrix line printer	22,641	219
2567B	1,200-lpm matrix line printer	29,170	233
2932	200 cps matrix serial printer with draft-mode printing only	2,595	26
2934A	Matrix serial printer running at up to 200 cps	2,995	30
2235B/D	Matrix serial printer running at up to 480 cps	1,695	22
2225	A 150 cps inkjet printer	495	—

Hewlett-Packard HP 3000 Series

		Purchase Price (\$)	Std. Month. Maint. (\$)
2227A	A 192 cps inkjet printer that accommodates paper with a width ranging up to 14 inches	799	—
2228A	A 192 cps inkjet printer that accommodates 8.5 x 11 inch paper	599	—
3630A	Inkjet printer running at up to 167 cps	1,395	10
33440	8-ppm laser printer	2,595	54
2686	8-ppm laser printer with extensive paper-handling capabilities	2,995	—
2684	20-ppm laser printer	19,995	362
2680	45-ppm laser printer	87,750	1,100

Terminals and Workstations

C1001	HP 700/92 alphanumeric display terminal	895	6
C1002	HP 700/94 alphanumeric display terminal	1,095	6
C1003	HP 700/41 alphanumeric display terminal	375	6
C1004	HP 700/22 alphanumeric display terminal	575	6
C1005	HP 700/43 alphanumeric display terminal	475	6
2392A	HP 2392A alphanumeric display	1,400	6
2393A	HP 2393A graphics terminal	2,295	5
2394A	HP 2394A data entry terminal	1,910	5
2397A	HP 2397A color graphics terminal	3,595	6
3081A	HP 3081 industrial data entry terminal	935	5
45850A/B	HP Touchscreen II Terminal	2,730	—
72425A	Vectra PC microcomputer, basic configuration	3,199	26
—	NS X.25 3000/V Network Link for Micro 3000 models	4,400	55
—	NS X.25 3000/V Network Link for Series 52 and 58	6,770	55
—	NS X.25 3000/V Network Link for Series 70	8,200	55
—	BSC Link for Micro 3000 models	4,700	29
—	BSC Link for Series 52 and 58	6,625	55
—	BSC Link for Series 70	7,925	55
—	SNA Link for Micro 3000 models	5,400	29
—	SNA Link for Series 52 and 58	8,825	55
—	SNA Link for Series 70	10,050	55
—	NS Point-to-Point Link for Micro 3000 models	3,085	55
—	NS Point-to-Point Link for Series 52, 58, and 70	4,105	55
—	Asynchronous Serial Network Link for Micro 3000 models	710	0
—	Asynchronous Serial Network Link for Series 52 and 58	1,165	0
—	Asynchronous Serial Network Link for Series 70	2,080	0
28247A	HP StarLAN Bridge	5,000	0
28663A	HP StarLAN Hub	2,995	0
—	ThinLAN Link for Micro 3000 models	3,800	16
—	ThinLAN Link for Series 52 and 58	7,200	32
—	ThinLAN Link for Series 70	8,700	32
—	ThinLAN Link for Series 925 models	7,200	32
—	ThinLAN Link for Series 935, 950, and 955	10,700	26
2333A	MTS Cluster Controller	2,415	17
2334A	X.25 statistical multiplexer	2,415	17

SOFTWARE PRODUCTS

		Purchase Price (\$)
Operating System		
—	MPE V fundamental operating software; includes the MPE V operating system, file copy and sort/merge utilities, an interactive screen manager, and a text editor	NC
—	MPE V fundamental operating software; includes the MPE V operating system, file copy and sort/merge utilities, an interactive screen manager, and a text editor	NC
Database Management		
—	TurboImage/V	NC
—	TurboImage/XL	NC
—	KSAM/V	NC
Programming languages		
31500A	Cobol II/XL Compiler	
430	First copy for Series 930	8,500
31500R	Right to copy Cobol II/XL Compiler	0
430	RTC for Series 930	5,950
		0

Hewlett-Packard HP 3000 Series

		Purchase Price (\$)
31501A	HP Fortran 77/XL Compiler	
430	First copy for Series 930	7,000
31501R	Right to copy HP Fortran 77/XL Compiler	0
430	RTC for Series 930	4,900
31502A	HP Pascal/XL Compiler	
430	First copy for Series 930	7,000
31502R	Right to copy HP Pascal/XL	0
430	RTC for Series 930	4,900
32100A	SPL/V Compiler	
320	First copy for Series 52 through 70	2,725
430	First copy for Series 930	2,725
32100R	Right to copy SPL/V Compiler	0
320	RTC for Series 52 through 70	1,910
430	RTC for Series 930	1,900
32102B	Fortran 66/V Compiler	
320	First copy for Series 52 through 70	2,050
32102R	Right to copy 32102B	0
320	RTC for Series 52 through 70	1,435
32104A	RPG/V Compiler	
430	First copy for Series 930	3,000
32104R	Right to copy RPG/V Compiler	0
320	RTC for Series 52 through 70	2,100
430	RTC for Series 930	2,100
32106A	Pascal/V Compiler	
320	First copy for Series 52 through 70	5,000
32106R	Right to copy Pascal/V Compiler	0
320	RTC for Series 52 through 70	3,500
32111A	Basic/V Interpreter and Compiler	
320	First copy for Series 52 through 70	2,050
32111R	Right to copy Basic/V Interpreter/Compiler	0
320	RTC for Series 52 through 70	1,435
32115A	Business Basic/V	
320	First copy for Series 52 through 70	5,500
430	First copy for Series 930	5,500
32115R	Right to copy Business Basic/V	0
320	RTC for Series 52 through 70	3,850
32116A	Fortran 77/V Compiler	
320	First copy for Series 52 through 70	5,000
32116R	Right to copy Fortran 77/V	0
320	RTC for Series 52 through 70	3,500
32213R	Right to copy Cobol/V Compiler	0
320	First copy for Series 52 through 70	875
32233A	Cobol II/V Compiler	
320	First copy for Series 52 through 70	6,500
32233R	Right to copy Cobol II/V	0

Communications

30245	SNA NRJE Network Remote Job Entry	0
320	For Series 52 through 70	5,300
30247	SNA IMF Interactive M/F Facility	
320	For Series 52 through 70	8,050
30248	RJE Remote Job Entry	
320	For Series 52 through 70	2,950
30249	MRJE Multileaving Remote Job Entry	
320	For Series 52 through 70	5,050
30250	IMF Interactive Mainframe Facility	
320	For Series 52 through 70	8,050
30252	LU 6.2 Base	
320	For Series 52 through 70	8,000
30254	SNA Server	
320	For Series 52 through 70	1,000
30255	SNA Server Access/V	
320	For Series 52 through 70	1,000
30256	SNA Server Access/XL	
430	For Series 930	1,200
32344	HP Network Services/3000	
320	For Series 52 through 70	5,500
36920	Network Services 3000/XL	
430	For Series 930	7,500

UTILITIES

—	Edit/3000	NC
—	Sort-Merge/3000	NC
—	FCopy/3000	NC
—	VPlus/3000	NC
—	Text and Document Processor/3000	NC

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Information Management Tools		Purchase Price (\$)
19550A	Copycat/3000	3,000
19550R	Right to copy 19550A	2,100
30302A	Silhouette/3000	22,000
30302M	Right to copy 30302A	9,000
31503A	Cobol II Developer's Package	0
320	First copy for Series 52 through 70	8,000
430	First copy for Series 930	12,400
31503R	Right to copy Cobol II Developer's Package	0
320	For Series 52 through 70	5,600
430	For Series 930	8,680
31504A	Fortran 77 Developer's Package	0
430	First copy for Series 930	11,200
31504R	Right to copy Fortran 77 Developer's Package	0
430	For Series 930	7,840
31505A	Pascal Developer's Package	0
320	First copy for Series 52 through 70	8,000
430	First copy for Series 930	11,200
31505R	Right to copy Pascal Developer's Package	0
320	For Series 52 through 70	5,600
430	For Series 930	7,840
32180A	APS/3000 Application Program Sampler	0
320	First copy for Series 52 through 70	2,000
32180R	Right to copy APS/3000 Application Program Sampler	0
320	For Series 52 through 70	1,400
32238A	OPT/3000 Online Performance Tool	0
320	First copy for Series 52 through 70	6,400
32238M	Right to copy 32238A	0
32244A	Dictionary/3000 Data Dictionary	0
320	First copy for Series 52 through 70	5,500
430	First copy for Series 930	5,500
32244R	Right to copy 32244A	0
320	For Series 52 through 70	3,850
430	For Series 930	3,850
32245A	Report/V General-Purpose Report Writer	0
320	First copy for systems up through Model 70	5,000
430	First copy for Series 930	5,000
32245R	Right to copy 32245A	0
430	RTC for systems up through Series 70	3,500
430	RTC for Series 930	3,500
32246A	HP Inform/V Inquiry and Report Generator	0
320	First copy for systems up through Series 70	6,000
430	First copy for Series 930	6,000
32246R/M	Right to copy 32246A	0
320	RTC for systems up through Series 70	4,200
430	RTC for Series 930	4,200
32247A	Transact/V	0
320	First copy for systems up through Series 70	6,000
430	First copy for Series 930	6,000
32247R	Right to copy 32247A	0
320	RTC for systems up through Series 70	4,200
430	RTC for Series 930	4,200
32248A	Programmer productivity package (Report/3000, Dictionary/3000, Transact/3000)	13,000
32248R	Right to copy 32248A	9,100
32254A	Dictionary/V	0
320	First copy for Series 52 through 70	6,500
32254R	Right to copy Dictionary/V	0
320	RTE for Series 52 through 70	4,550
32255A	System Dictionary Cobol Definition Extractor/V	0
320	First copy for Series 52 through 70	2,000
32255R	Right to copy 32255A	0
320	RTC for Series 52 through 70	1,400
32256A	System Dictionary/XL	0
430	First copy for Series 930	9,750
32256R	Right to copy 32256A	0
430	RTC for Series 930	6,825
32257A	System Dictionary Cobol Definition Extractor/XL	0
430	First copy for Series 930	3,000
32257R	Right to copy 32257A	0
430	RTC for Series 930	2,100
32258A	HP Report Writer Package (Report/V, Inform/V, Dictionary/V)	13,000
32258R	Right to copy 32258A	9,100
32350A	Toolset/V Program Development System	0
320	First copy for Series 52 through 70	5,000
32350R	Right to copy 32350A	3,500
36020A	Turbolmage DBchange/V	0
320	First copy for Series 52 through 70	5,000
430	First copy for Series 930	5,000

NC—No charge.

Hewlett-Packard HP 3000 Series

		Purchase Price (\$)
36020R	Right to copy 36020A	0
320	RTC for Series 52 through 70	3,500
430	RTC for Series 930	3,500
36044A	Toolset/XL Program Development Environment. Supported on MPE XL-based systems.	0
430	First copy for Series 930	7,000
36044R	Right to copy 36044A	0
430	RTC for Series 930	4,900
36070A	Business Report Writer/V	0
320	First copy for Series 52 through 70	8,000
430	First copy for Series 930	8,000
36070R	Right to copy 36070A	0
320	RTC for Series 52 through 70	5,600
430	RTC for Series 930	5,600
36215A	SQL/V	0
320	First copy for Series 52 through 70	15,000
36215R	Right to copy 36215A	0
320	RTC for Series 52 through 70	10,500
36216A	Allbase/XL	0
430	First copy for Series 930	30,000
36216R	Right to copy 36216A	0
430	RTC for Series 930	21,000
36913A	Database Tools/V (TurboImage database restructuring and performance tuning package)	0
320	First copy for Series 52 through 70	6,800
430	First copy for Series 930	6,800
36913R	Right to copy 36913A	0
320	RTC for Series 52 through 70	4,800
430	RTC for Series 930	4,800
36014A	TurboImage Profiler/V	0
320	First copy for Series 52 through 70	3,500
430	First copy for Series 930	3,500
36914R	Right to copy 36914A	0
320	RTC for Series 52 through 70	2,450
430	RTC for Series 930	2,450
99940A	Transform/3000	2,000

NC—No charge. ■