

Hewlett-Packard HP 9000 Multiuser Systems

MANAGEMENT SUMMARY

UPDATE: *Hewlett-Packard has significantly changed its HP 9000 multiuser computer product line within the last 18 months. The HP 9000 Series 500 multiuser computers have been withdrawn, while HP Series 800 computing has been revised significantly. The HP 9000 Series 800 Model 840S accommodates more online mass storage and terminal devices, and several new members have been added to the Series 800 product line. The Model 825S, 835S, 835SE, and 850S—the new entry-level, mid-range, and high-end superminis—improve the performance, configurability, expandability, and cost-effectiveness of the Series 800.*

Hewlett-Packard is busy trying to recapture the superminicomputer market share it lost to Digital Equipment Corporation within the manufacturing automation, engineering, scientific, and process control and monitoring application areas. At the same time, Hewlett-Packard is becoming more forceful within those vertical markets demanding solutions based on UNIX for their general-purpose computing requirements.

Hewlett-Packard overhauled its HP 9000 multiuser computer product line to create more attractive superminicomputers for technical computing and realtime processing within manufacturing, process control and monitoring, engineering, and scientific environments and for general-purpose UNIX processing within the private business and public service sectors. Hewlett-Packard withdrew the older, less powerful HP 9000 Series 500 computers; enhanced HP 9000 Series 800 Model 840 computing; and added

The HP 9000 Series 800 superminicomputer is primarily oriented towards technical and realtime computing within the manufacturing industries and towards general-purpose computing within the government and education markets. It is based on the RISC-based HP Precision Architecture and uses de facto industry-standard system software facilities and data communications tools.

MODELS: Series 800 Models 825S, 835S, 835SE, 840S, 850S.

MEMORY: 8M to 128M bytes.

DISK CAPACITY: Up to 18.27G bytes.

WORKSTATIONS: Up to 300.

PRICE: Ranges from \$35,000 to \$188,500 for a basic configuration.

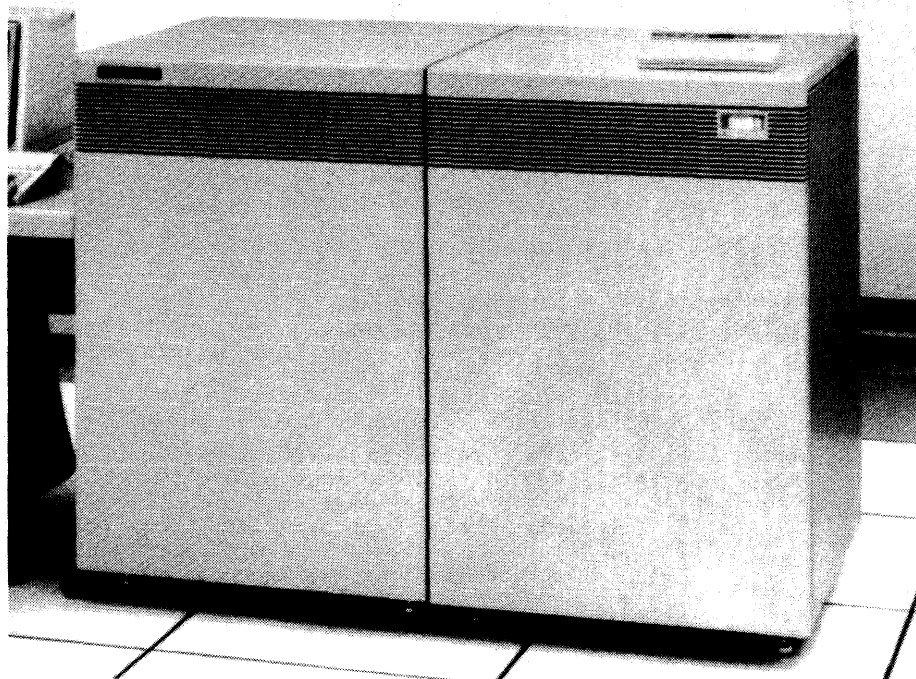
CHARACTERISTICS

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

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

DATA FORMATS

BASIC FORMAT: 32-bit word.



Within the last 18 months, Hewlett-Packard increased the performance, capacities, and cost-effectiveness of the Series 800 by introducing Models 825S, 835S, 835SE, and 850S and modifying the Model 840S. These adjustments are an attempt to meet growing processing requirements and to make the product line more attractive to potential customers. Pictured here is the HP 9000 Series 800 Model 850, a 7-MIPS system that accommodates up to 300 local terminal I/O devices.

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CHART A. SYSTEM COMPARISON

MODEL	Model 825S	Model 835S	Model 835SE	Model 840S	Model 850S
SYSTEM CHARACTERISTICS					
Date of introduction	May 1987	April 1988	April 1988	May 1986	May 1987
Date of first delivery	3rd quarter 1987	3rd quarter 1988	3rd quarter 1988	November 1986	4th quarter 1987
Operating system	HP-UX (a superset of UNIX System V.2)	HP-UX (a superset of UNIX System V.2)	HP-UX (a superset of UNIX System V.2)	HP-UX (a superset of UNIX System V.2)	HP-UX (a superset of UNIX System V.2)
Upgradable from	Not applicable	825S	825S, 835S	Not applicable	Not applicable
Upgradable to	835S, 835SE	835SE	Not applicable	Not applicable	Not applicable
MIPS	3	6	6	4.5	7
Relative performance (based on a rating of the 840S at 1.0)	0.5 to 0.7	1.0 to 1.4	1.0 to 1.4	1.0	1.5 to 1.6
MEMORY					
Minimum capacity, bytes	8M	8M	24M	8M	32M
Maximum capacity, bytes	56M	112M	112M	96M	128M
Cache memory, bytes	16K	128K	128K	128K	128K
INPUT/OUTPUT CONTROL					
Number of channels	1 or 2	1	1 or 2	1 or 2	2 to 12
MAXIMUM DISK STORAGE					
NUMBER OF WORKSTATIONS	9.1G bytes	9.1G bytes	9.1G bytes	6.9G bytes	18.3G bytes
COMMUNICATIONS PROTOCOLS					
	IEEE 802 Ethernet, NS/9000 (NFT), TCP/IP, ARPA/Berkeley, NFS, uucp, SNA/3770, SNA/3270, NS/DEC VAX/VMS	IEEE 802 Ethernet, NS/9000 (NFT), TCP/IP, ARPA/Berkeley, NFS, uucp, SNA/3770, SNA/3270, NS/DEC VAX/VMS	IEEE 802 Ethernet, NS/9000 (NFT), TCP/IP, ARPA/Berkeley, NFS, uucp, SNA/3770, SNA/3270, NS/DEC VAX/VMS	IEEE 802 Ethernet, NS/9000 (NFT), TCP/IP, ARPA/Berkeley, NFS, uucp, SNA/3770, SNA/3270, NS/DEC VAX/VMS	IEEE 802 Ethernet, NS/9000 (NFT), TCP/IP, ARPA/Berkeley, NFS, uucp, SNA/3770, SNA/3270, NS/DEC VAX/VMS
PURCHASE PRICE (basic)					
	\$35,000	\$45,000	\$99,000	\$85,550	\$188,500

➤ new Model 800 computers at the low, mid-range, and high ends of the supermini spectrum. These strategic changes make HP 9000 multiuser computing more competitive along the price/performance and function cost front.

The Series 800 Model 825S replaces the Series 500 multiuser computers and represents the new entry point into HP 9000 multiuser computing. The Model 825S, which runs at up to 3 MIPS and supports up to 64 direct-connect terminals, offers three times more processing power than the Series 500 Model 550 or 560 and accommodates twice as many direct-connect terminal I/O devices. Moreover, the Model 825S offers more price/performance than the Series 500 Model 550 or 560. For example, the Model 825S costs \$11,667 per MIPS at the entry level, whereas a similarly configured Model 550 is priced at \$26,180 per MIPS.

The Models 835S and 835SE upgrade the capacities of the Model 825S. Both the Model 835S and 835SE offer twice the performance of the 825S—applications on both the Model 835S and 835SE run at up to 6 MIPS. Furthermore, the Model 835SE offers greater terminal I/O expandability than the 32-terminal 825S. The 835SE can accommodate up to 2.4 times more directly connected terminal I/O devices.

The enhanced Model 840 enables a Model 840 installation to better accommodate growth requirements. With the modifications, the 4.5-MIPS Model 840 now accommodates up to 128 terminal I/O devices and up to 9.1G bytes of online mass storage—twice the amount of terminals and 1.3 times more online mass storage than the previous version of the 4.5-MIPS Model 840.

Even though the Models 835S and 835SE offer 1.3 times more processing power than the enhanced Model 840S, ➤

➤ **FIXED-POINT OPERAND:** The HP 9000 Series 800 superminicomputers, implementing the HP Precision Architecture, support 16-bit and 32-bit integers, either signed or unsigned. Signed integers are in 2's complement form. 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.

Both packed and unpacked decimal data representations are supported. Packed decimal data is aligned on a word boundary and consists of 7, 15, 23, or 31 Binary Coded Decimal digits.

FLOATING-POINT OPERAND: The Series 800 computers support single- (32 bit), double- (64 bit), and quadruple- (128 bit) precision arithmetic operations. Single-precision floating-point numbers must be aligned on word boundaries, and double- and quadruple-precision numbers must be aligned on double-word boundaries.

The floating-point instructions can either be executed directly in hardware by a co-processor or emulated in software. A floating-point co-processor performs calculations while the CPU continues to execute in parallel. The Series 800 floating-point format conforms to ANSI/IEEE 754-1985 standard floating-point format.

INSTRUCTIONS: The HP Precision Architecture of the Series 800 defines 140 instructions. Each instruction is 32 bits long and has a fixed format. The instruction set directly implements only simple functions to minimize processor complexity.

Data stored in memory is referenced via Load and Store instructions. This accessing technique, coupled with support for a relatively large number of central processor registers, allows for frequently required operands to be held in the central processor. Minimizing the number of accesses to cache and main memory increases performance.

The arithmetic and logical functions are limited to relatively simple functions with appropriate primitives provided for common operations. More complicated arithmetic ➤

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▶ they are not meant to replace the Model 840S. The Model 840S is marketed to those installations looking for a cost-effective entry into large-scale computing. The Model 840 is suited for those installations that need more terminal I/O device connectivity than the Models 835S and 835SE but do not want to purchase the more expensive Model 850S.

The Model 850S permits Hewlett-Packard to extend HP 9000 superminicomputer capabilities beyond the small-system and midsize range represented by the Series 800 Models 825S, 835S, 835SE, and 840S. The Model 850S allows Hewlett Packard to effectively enter large-scale processing—a market it has yet to address effectively.

The Model 850S offers approximately 1.5 times more computing power than the Model 840S and accommodates up to 2.4 times more terminal I/O devices than the Model 840S. The Model 850S processes data at up to 7 MIPS and accommodates up to 300 terminal I/O devices.

The Model 850S provides the capabilities to meet growing customer requirements while preserving compatibility. This large-scale superminicomputer presents installations with the capacities and expandability that permit growth without the need to reinvest in another vendor's computer architecture. Peripheral device, communications, and software compatibility with the rest of the Series 800 supermini product line allow easy migration to the Model 850S. Furthermore, the Model 850S has a longer life expectancy than the other Series 800 minicomputers—they can address a broad range of work loads during the installation's growth. For example, the Model 850S can grow from a 75-user to a 200-user system.

Several technological and marketing strategies and tactics are being used to sell the new and enhanced HP 9000 multiuser computer systems.

For instance, Hewlett-Packard bases its Series 800 on innovative, nonconventional computer designs. The Series 800 superminicomputers are implemented in HP Precision Architecture, a Hewlett-Packard design technology based on reduced instruction set computing (RISC) concepts and extensions. At this time, Hewlett-Packard is the *only major superminicomputer vendor* to use RISC-based technology as a foundation for superminicomputer computing. RISC-based technology offers price/performance and reliability benefits over conventional, complex instruction set computing (CISC) machines. Furthermore, RISC allows the vendor to develop less expensive systems more quickly, because the complex designs of the CISC systems are avoided. Such attributes help Hewlett-Packard deliver a more competitive system.

Series 800 computing is based on de facto industry standards. The Series 800 operating environment contains such elements as a UNIX operating system based on AT&T's UNIX System V and University of California at Berkeley's 4.2 Berkeley Software Distribution (4.2 BSD) ▶

▶ and logical functions are implemented by executing a sequence of simple instructions.

INTERNAL CODE: ASCII.

MAIN STORAGE

CAPACITY: The Series 800 computers are virtual memory machines. 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 virtual memory pages. Main storage consists of memory array boards having either 2M, 8M, 16M, or 32M bytes of storage implemented in 256K- or 1M-bit dynamic random access memory (DRAM) chips. Each board also has a memory controller. The Series 800 supports from 8M to 128M bytes of main storage. Chart A provides the main storage capacities of specific models.

CHECKING: The memory controllers perform bit error detection/correction. Seven bits are provided to store a Hamming code, enabling each memory controller to correct all single-bit errors automatically and detect all multibit errors.

STORAGE PROTECTION: Virtual memory access is protected by the translation lookaside buffer hardware in the central processor. The translation lookaside buffer supports protection mechanisms to ensure 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 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 user has sufficient authorization to perform that access.

Main storage is backed up in such a way that if AC power is lost and restored within 15 minutes, the operating system is automatically restarted and processing can resume without data loss. Battery power can only power memory for 15 minutes.

CACHE MEMORY: All the Series 800 computers have a cache. By using a cache, the central processors have high-speed access to frequently used data and instructions. This improves systems performance, because 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.

Series 800 computers have up to 128K bytes of cache memory. Separate instruction and data caches (each 64K bytes in size) promote parallel operation. Both the instruction cache and the data cache are one-way associative (direct mapped) and are organized as sets of 4,096 cache lines, with 16 bytes per cache line. The instruction cache is read-only. A write-to cache management scheme is used with the data cache.

▶ So that the machine cycle time can be minimized, the I/O subsystems do not interface to the cache. Furthermore, it is ▶

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CHART B. MASS STORAGE

MODEL	HP 7907A	HP 7914ST	HP 7914CT	HP 7933H	HP 7935H
Type	Winchester/ removable	Winchester	Winchester	Winchester	Removable
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	20 fixed, 20 removable	132	132	404	404
Average seek time	30 ms	27.7 ms	27.7	24 ms	24 ms
Average rotational/relay time	8.5 ms	8.3 ms	8.3 ms	11.1 ms	—
Average access time	38.5 ms	36 ms	36 ms	35.1 ms	—
Data transfer rate	1M bytes/second	—	—	1M bytes/second	1M bytes/second
Supported by system models	835S, 835SE, 850S	825S, 840S, 850S	825S, 840S, 850S	825S, 840S, 850S	825S, 840S, 850S
Purchase price (basic)	—	—	\$7,350	—	\$24,000
Comments	Requires an HP-IB inter- face to communi- cate with the host.	Includes a built-in 0.5-inch, 1600 bpi reel-to-reel magnetic tape drive.	Includes a built-in 0.25-inch, 67M-byte cartridge tape drive.	Uses an HP-IB inter- face to connect to and to communicate with the host. Up to 4 units can be at- tached to the HP-IB.	Communicates with the host via an HP-IB.

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CHART B. MASS STORAGE (Continued)

MODEL	HP 7936FL	HP 7936H	HP 7937FL	HP 7937H
Type	Winchester	Winchester	Winchester	Winchester
Controller model	Integrated	Integrated	Integrated	Integrated
Drives per subsystem/controller	1/controller	1/controller	1/controller	1/controller
Formatted capacity per drive, megabytes	307	307	571	571
Average seek time	20.5 ms	20.5 ms	20.5 ms	20.5 ms
Average rotational/relay time	8.3 ms	8.3 ms	8.3 ms	8.3 ms
Average access time	28.8 ms	37.3 ms	37.3 ms	25.9 ms
Data transfer rate	2.35M bytes/second	2.35M bytes/second	2.35M bytes/second	2.35M bytes/second
Supported by system models	All	All	All	All
Purchase price (basic)	—	\$14,250	—	\$15,700
Comments	Requires the HP-FL inter- face to communi- cate with the host. Up to 8 drives, each with their own con- troller, 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.

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

➤ enhancements; programming languages based on industry standards; the SQL database language; Graphics Kernel System (GKS) graphics; and IEEE 802.3 and 803.3 Ethernet communications.

By using common operating environment facilities for the Series 800, Hewlett-Packard creates an "open computing environment." Customers want industry-standard solutions to reduce the system migration and applications porting costs when moving to or from another hardware platform; to increase applications accessibility; to standardize computing across the organization; and to provide a degree of compatibility between systems in a multivendor or multiple-system-architecture computing environment.

The Series 800 superminicomputers implement an "open network computing" philosophy to attract customers with a multivendor or multiple-architecture computer infrastructure. The communications and networking scheme of the Series 800 superminis provides the openness required in a departmental and distributed processing environment. Tools are available to:

- Integrate MS-DOS-based microcomputing with Series 800 processing;

➤ the responsibility of the software to update main storage contents with any modified cache contents before launching a direct memory access (DMA) I/O operation.

CENTRAL PROCESSOR

GENERAL: The Series 800 processor implements HP-Precision Architecture, which embodies the basic principles of Reduced Instruction Set Computers (RISC). The Series 800 processor is hardwired-controlled and is pipelined at the instruction level so that three 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 they are implemented and scheduled to achieve effective execution rates approaching one cycle per instruction.

The central processor of the Series 800 Model 825S has an instruction execution cycle time of 80 nanoseconds (ns). The Model 825S central processor contains a central processing unit (CPU), which performs arithmetic, logic, and system control instruction execution; a floating-point coprocessor, which performs floating-point arithmetic operations; a cache controller and cache; and the translation lookaside buffer, which performs virtual-to-physical address translations. The central processor communicates with main storage over a central system bus, which also

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CHART B. MASS STORAGE (Continued)

MODEL	HP 7957A/B	HP 7958A/B	HP 7959B	HP 7963B
Type	Winchester	Winchester	Winchester	Winchester
Controller model	Integrated	Integrated	Integrated	Integrated
Drives per subsystem/controller	1/controller	1/controller	1/controller	1/controller
Formatted capacity per drive, megabytes	81	131	304	304
Average seek time	29 ms	29 ms	17 ms	17 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	835S, 835SE, 840S, 850S	835S, 835SE, 840S, 850S	835S, 835SE, 840S, 850S	835S, 835SE, 840S, 850S
Purchase price (basic)	\$4,250	\$6,450	—	—
Comments	Has a 5.25-inch form factor. Can be rack-mounted. Requires the HP-IB to communicate with the host.	Has a 5.25-inch form factor. Up to 4 can be connected to a HP-IB.	Has a 5.25-inch form factor. Requires the HP-IB for connectivity.	Has a 5.25-inch form factor. Up to three HP 7963s can reside in one disk drive packaging. The HP-IB interface is required for connectivity.

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

- • Interact with Hewlett-Packard HP 1000 technical computing and realtime processing systems, HP 9000 workstations, existing HP 9000 Series 500 multiuser computers, and HP 3000 business computers; and
- Communicate with non-Hewlett-Packard computers with proprietary and industry-standard architectures that are connected to IEEE 802.2- or 802.3-recommended Ethernet or X.25 communications lines.

The Series 800 systems can also communicate with IBM System/370-architecture mainframe and supermini host systems running MVS or VM operating systems and can directly interface with DECnet-connected Digital Equipment Corporation computers.

Hewlett-Packard is committed to enhancing its Series 800 product line to accommodate customer's growing power, functionality, and system expansion requirements. For example, Hewlett-Packard is planning to release a new high-end Series 800 supermini model by the end of the first quarter of 1989. The Series 800 Model 855 will offer 50 percent more performance than the Model 850—the current high-end Series 800 computer. Furthermore, Hewlett-Packard is planning to introduce multiprocessor versions of its Series 800 superminicomputers. Currently, each Series 800 model is configured with only one central processor, but internal bus structures and control schemes can accommodate multiple central processors. Multiprocessor versions of the Series 800 computers can be expected sometime in 1989.

Installed HP 1000 technical and realtime computing systems can be replaced by Series 800 computers. The Series 800 computers address the same application areas as the HP 1000 computers and offer more price/performance and functionality. For instance, the Series 800 Model 825S offers 1.5 to 2 times the performance of the HP 1000 A900, while the Model 840 offers 3 times the performance of the HP 1000 A900. With over 60,000 HP 1000 computers functioning in manufacturing, engineering, scientific,

- supports direct memory access (DMA) communications between main storage and I/O subsystems.

The central processor of both the Series 800 Model 835S and 835SE has an instruction execution cycle time of 66.7 ns. Included within the central processor is an execution unit for arithmetic, logic, and system control instruction execution; an instruction unit for instruction fetching and decoding; a floating-point co-processor; a cache controller and cache; and the translation lookaside buffer. Processor-to-memory communications occur over a central system bus.

The Series 800 Model 840S central processor has an instruction execution cycle time of 125 ns. The central processor features an execution unit, instruction unit, floating-point co-processor, cache controller and cache, and the translation lookaside buffer. It communicates with main storage over a central bus.

The central processor of the Series 800 Model 850S central processor has an instruction execution cycle time of 73 ns. The central processor features a CPU to handle instruction fetching and decoding and system control; arithmetic and logical processors for fixed-point arithmetic operations and a floating-point co-processor; cache controller and cache; translation lookaside buffer; and a main storage interface chip. The central processor communicates with main storage over a high-speed, dedicated processor-to-memory link.

CONTROL STORAGE: The HP 9000 Series 800 does not provide any control storage, as it is not microprogrammed.

REGISTERS: The HP Precision Architecture 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 are also 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.

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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	RS-232-C	RS-232-C	RS-232-C
PURCHASE PRICE (basic)	\$2,295	—	\$1,894	\$3,595	\$830
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.

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and process control environments, the Series 800 presents Hewlett-Packard with a large base of potential users. The Series 800 migration tool called Port/HP-UX promotes system migration. Port/HP-UX helps installations migrate HP 1000 programs running under the RTE operating system to the HP-UX operating environment of the Series 800.

Hewlett-Packard is marketing the Series 800 in a variety of application markets. Although the Series 800 superminicomputer is primarily oriented towards technical and realtime computing within the manufacturing industries, Hewlett-Packard also sells Series 800 units to service industry, government, and educational institutions where systems based on UNIX are required.

By focusing on such a wide range of target markets, Hewlett-Packard increases the sales potential for Series 800 superminicomputers. Hewlett-Packard is guaranteed sales income from market segments that are automating faster than the marketplace as a whole. Revenues from those traditional marketplaces still offer significant sales opportunities.

To compete in its target markets, Hewlett-Packard ensures that applications software for the Series 800 systems are readily available. Independent software developers are the major source of applications software.

Register-intensive operation increases processor performance. Since data is not processed in memory, the number of references to memory are reduced. Memory references require machine cycles. By reducing the number of memory references, the time to execute an instruction is reduced. Furthermore, 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 faster processor speed.

ADDRESSING: As stated previously, the HP Precision Architecture supports 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 access virtual page translations, and to implement page-level access protection.

In addition to virtual addressing, HP Precision Architecture 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.

OPERATING ENVIRONMENT: The central processor resides in the system processing unit (SPU) along with memory and the I/O controllers. The SPU of both the Model 825S and 835S is packaged in a cabinet measuring 9.2 inches high, 12.8 inches wide, and 19.7 inches deep. The Model 835S system processor cabinet measures 18.4 inches high, 12.8 inches wide, and 19.7 inches deep.

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CHART C. WORKSTATIONS (Continued)

MODEL	Touchscreen Terminal	Touchscreen II Terminal	Portable Plus	Vectra PC
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
KEYBOARD PARAMETERS Style	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
PURCHASE PRICE (basic)	—	\$2,730	—	\$3,199
COMMENTS	An alphaumeric display terminal with touchscreen technology.	An intelligent workstation with advanced touchscreen technology.	A portable microcomputer that runs MS-DOS operating system.	A IBM PC-compatible microcomputer.

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CHART C. WORKSTATIONS (Continued)

MODEL	Integral PC	HP 9666A	HP 9000 Series 300 Models 310, 320, 330, 350
DISPLAY PARAMETERS Screen format	24 lines, 80 columns per line	24 lines, 80 columns per line	1,024 x 768 or 1,280 x 1,024 pixel matrix screen
KEYBOARD PARAMETERS Style	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY	Detachable, low-profile, QWERTY
TERMINAL INTERFACE	RS-232-C, LAN/9000	RS-232-C	RS-232-C, LAN/9000
PURCHASE PRICE (basic)	\$4,995	\$3,300	\$4,905 for Model 310; \$8,260 for 320; \$10,850 for 330; \$22,650 for 350
COMMENTS	A microcomputer that runs HP-UX software.	A terminal for timesharing and realtime programming. It features touchscreen technology and is packaged for the factory floor.	Technical workstations using HP-UX software.

➤ 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 packages directly.

Hewlett-Packard increased the size of its direct and indirect sales channel to increase the market visibility of its Series 800 computers. 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.

COMPETITIVE POSITION

Although the Series 800 superminicomputer product line goes up against a multitude of competitors, its toughest competition comes from Digital Equipment Corporation. Digital Equipment holds the largest percentage of systems within the Hewlett-Packard's primary target market—discrete and process manufacturing industries and research and development facilities.

The HP 9000 Series 800 models compare favorably in price/performance to the Digital Equipment VAX 6200 ➤

➤ Each of the Model 825S, 835S, and 835SE SPUs require an operating environment where the temperature ranges between 32 and 131 degrees Fahrenheit and where the relative humidity ranges between 15 and 95 percent. Maximum heat dissipation on the Model 825S is 200 Btu per hour and 2,050 Btu per hour on both the Model 835S and 835SE.

A line with 90 to 127 V AC at a frequency of 47.5 or 66 hertz (Hz) or a line with 180 to 254 V AC at a frequency of 47.5 or 66 Hz is required to power the system processor of the Model 825S. The Model 835S and 835SE system processors both require a line with 90 to 110 V AC, 108 to 132 V AC, or 180 to 264 V AC and a frequency of 47.5 or 66 Hz.

The Model 840S system processor cabinet measures 39 inches high, 23.6 inches wide, and 38 inches deep. It operates in an environment with a temperature of 32 to 131 degrees Fahrenheit and 5 to 95 percent relative humidity. It requires a line with 200 to 240 V AC at a frequency of 50 or 60 Hz. Maximum heat dissipation on the is 4,600 Btus per hour.

The Model 850S system processor is packaged in a cabinet measuring 39.4 inches high, 51.2 inches wide, and 27.9 inches deep. It operates in an environment with a temperature of 41 to 104 degrees Fahrenheit and 20 to 95 percent relative humidity. It requires a line with 208 V AC at 60 Hz, 380 V AC at 60 Hz, or 408 V AC at 60 Hz. Maximum heat dissipation is 15,000 Btu per hour.

INPUT/OUTPUT CONTROL

➤ Both the Model 825S and 835S come with one 16-bit, 5M-byte bandwidth general-purpose channel I/O bus for ➤

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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
Paper size	3 to 18 in. wide	3 to 18 in. wide	3 to 18 in. wide	3 to 18 in. wide	2.25 to 15.75 in. wide
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, 10, 12, 13.3, 15, 16.7	5, 10, 12, 13.3, 15, 16.7	5, 10, 12, 13.3, 15, 16.7	5, 10, 12, 13.3, 15, 16.7	5, 10, 16.3
Controller/Interface	RS-232-C or HP-IB interface	RS-232-C or HP-IB interface	RS-232-C or HP-IB interface	RS-232-C or HP-IB interface	RS-232-C 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 type styles 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.

models. For example, the 3-MIPS Series 800 Model 825S costs \$11,666 per MIPS for a base configuration. In contrast, the VAX 6210, which runs at 2.9 MIPS, costs \$45,380 per MIPS. For another example, the 7-MIPS Series 800 Model 850S costs \$26,930 per MIPS for a basic configuration, while a comparative VAX 6230, which operates at 8.7 MIPS, costs \$37,472 per MIPS.

The Series 800 units are at a disadvantage in configurability and system expandability, however. Generally, the VAX 6200 systems offer greater mass storage and terminal I/O device connectivity than the Series 800 supermini-computers. For instance, the Model 825 accommodates up to 9.1G bytes of mass storage and 64 local terminal I/O devices. In contrast, the VAX 6210 accommodates up to 20M bytes of mass storage and 128 local terminal I/O devices. As further evidence, the Model 6-MIPS 835SE supports up to 9.1G bytes of mass storage and 78 terminal I/O devices; the VAX 6220, its competitor, supports up to 20G bytes of mass storage and 128 local terminal I/O devices.

The other primary competition for the HP 9000 Series 800 systems comes from Unisys, with its Series 5000 and 7000, and NCR, with its Tower Series microprocessor-based multiuser computers. These vendors are the most active within the UNIX data processing, information system, professional automation, and office automation marketplace. Generally, when compared to the UNIX offerings from vendors such as Unisys, TI, and NCR, the Series 800 systems remain competitive.

Although the Series 800 superminicomputers offer competitive price/performance and capacities, it is highly unlikely that users will replace a competitor's system with an HP 9000 Series 800. Customers rarely change vendors or computer architectures, because of the high cost of the migration. The Series 800 computers do, however, give Hewlett-Packard a better chance to compete with Digital Equipment, Unisys, and NCR for new corporate accounts or for first-time automation sales.

the connection of peripheral device cards and data communications cards. Up to seven cards can be placed on the channel. Each peripheral device or data communications card consumes one I/O slot.

The channel I/O bus requires a channel I/O adapter, which interfaces the channel I/O bus to the central bus, synchronizing differing speeds and bandwidths. It also manages direct memory access transfers between main storage and channel I/O interfaces with their associated peripherals. The channel I/O adapter accomplishes this function with little central processor intervention, interrupting only to signal completion of DMA transfers. Large blocks of data can be transferred to and from main storage at rates up to 5M bytes per second with negligible central processor overhead.

As an option, the Model 825S can be configured with an I/O extender. This I/O extender provides one channel I/O bus and a channel I/O adapter. Up to seven peripheral or data communications cards can be attached to the channel. The adapter is required to carry DMA communications between the channel I/O bus and central bus.

The Model 835SE comes with two channel I/O adapters. The first adapter supports a channel accommodating up to seven peripheral or data communications cards. The second adapter accommodates an I/O expander that supports a channel with eight I/O slots.

The Model 840S comes with one general-purpose channel I/O bus as standard. The 16-bit, 5M-byte bandwidth I/O bus has 12 I/O slots. Expansion options permit an I/O extender to be added. This I/O extender provides 16 I/O slots. The I/O extender attaches to the central bus via a channel I/O adapter.

The standard Model 850S has two channel I/O adapters. Two additional channel I/O adapters can be added to accommodate I/O expansion. Each adapter supports a channel I/O bus with five I/O slots.

The 850S also can be configured with a channel I/O terminal expander to accommodate terminal I/O configuration growth. The channel I/O terminal expander consists of two add-on cabinets. Each cabinet contains up to two expansion modules. Each module supports one or two channel I/O bus adapters. Each adapter accommodates one channel

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CHART D. PRINTERS (Continued)

MODEL	HP 2934A	HP 2235B/D	HP 2225	HP 2227A	HP 2228A
Type	Matrix serial	Matrix serial	Inkjet	Inkjet	Inkjet
Speed	200 cps	480 cps	150 cps	192 cps	192 cps
Paper size	2.25 to 15.75 in. wide	Up to 15 in. wide	8.5 x 11 in.	Up to 14 in. wide	8.5 x 11 in.
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, 10, 16.3	—	6, 10.7, 12, 21.3	5, 6, 10, 10.6, 12, 21.3	5, 6, 10, 10.6, 12, 21.3
Controller/Interface	RS-232-C or HP-IB interface	RS-232-C or HP-IB interface	RS-232-C or HP-IB interface	RS-232-C interface	HP-IB 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	—	\$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.

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

CHART D. PRINTERS (Continued)

MODEL	HP 3630A	HP 33440	HP 2686D	HP 2684
Type	Inkjet	Laser	Laser	Laser
Speed	167 cps	8 ppm	8 ppm	20 ppm
Character formation	—	300 x 300 dpi	300 x 300 dpi	300 x 300 dpi
Horizontal character spacing (char./inch)	—	10, 16.7	10, 16.7	10, 16.7
Controller/Interface	RS-232-C	RS-232-C	RS-232-C	RS-232-C
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
Purchase price (basic)	\$1,395	\$2,595	\$2,995	\$19,995
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 dash (—) in a column indicates that the information is unavailable from the vendor.

▷ ADVANTAGES AND RESTRICTIONS

One of the primary advantages of the Series 800 computing is its adherence to de facto industry standards. The Series 800 operating environment is based on de facto industry-standard software—a UNIX operating system based on AT&T's UNIX System V and University of California at Berkeley's 4.2 BSD enhancements, industry-standard programming languages, the SQL database language, Graphics Kernel System (GKS) graphics, and IEEE 802.3 and 803.3 Ethernet communications. This "open computing environment" reduces the user's cost of migrating from or to another vendor's system that employs such facilities. In addition, these commonly available facilities enable NCR to provide Series 800 users with access to a broad range of applications.

The Series 800 communications and networking scheme provides an advantage. The data communications tools used on the Series 800 provide flexibility in creating networking and distributed processing environments and provide the open connectivity required in departmental processing.

The Network Services/9000 software package links the Series 800 systems to HP 9000 workstations, older

▷ I/O bus. Each channel I/O bus has eight slots for the multiplexer interfaces used to attach the multiplexers for terminal device connectivity.

Disk storage devices, magnetic tape drives, printers, plotters, and instrumentation connect to a channel I/O bus via a Hewlett-Packard Interface Bus (HP-IB). This eight-bit-wide, IEEE-488 standard interface supports up to 14 slow-speed or 4 high-speed devices.

The HP-IB interface is managed by the HP-IB card, which puts peripheral communications onto the channel I/O bus and pulls communications from the channel I/O bus. The HP-IB card consumes one I/O slot on the channel I/O bus.

The Hewlett-Packard Fiber Optic Link (HP-FL) provides connectivity for up to eight Winchester disk storage devices. The interface supports transfer rates of 5M bytes per second. Additionally, the HP-FL interface allows Winchester disk storage devices to be placed up to 500 meters away from the host, surpassing the 15-meter capability of the HP-IB interface. The HP-FL interface is supported by the HP-FL card. Each HP-FL card consumes one I/O slot on the channel I/O bus.

Asynchronous six-channel multiplexers connect workstations, modems, serial printers, and other serial devices. Each multiplexer provides six asynchronous ports with full-duplex modem control capability for the connection of

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CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	HP 7974A	HP 7978B	HP 7979A	HP 7980A	HP 9144A	HP 35401A
TYPE	Reel-to-reel with 0.5-inch media	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	781K bytes	35K bits	35K bits
Streaming technology	Yes	Yes	Yes	Yes	Yes	Yes
Start/stop mode speed, inches per second	50	—	—	—	—	—
Supported by system models	All	825S, 840S	All	All	All	All
PURCHASE PRICE (basic)	\$16,500	\$27,000	\$13,400	\$23,200	\$2,300	\$8,000
COMMENTS	Requires an HP-IB interface to communicate with the host.	Requires an HP-IB for connectivity.	Requires an HP-IB for connectivity.	Requires an HP-IB for connectivity.	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.

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

➤ HP 9000 Series 500 multiuser computers, HP 1000 computers, HP 3000 Series minicomputers, and Vectra PC microcomputers for bidirectional file transfer and remote file access. The UNIX-to-UNIX Copy (uucp), Connect to UNIX (cu), and UNIX-to-UNIX Execute (uux) commands provide for file transfers, electronic mail, remote logins, and remote command executions between the Series 800 and other computers with UNIX implementations.

ARPA Services/9000 Series 800 provides communications among professional workstations and multiuser computers that implement the Department of Defense Advanced Research Projects Agency (ARPA) or Berkeley 4.2 BSD networking standards—i.e., the Transmission Control Protocol/Internet Protocol (TCP/IP) communications model for data transportation and system interfacing and the FTP, Telenet, and SMTP or rcp, rlogin, and rsh protocols for file transfer, terminal login access, electronic mail, and remote command execution.

The Network File System Services/9000 Series 800 provides multivendor remote file access to other computers supporting the de facto industry-standard Network File System (NFS) services. The SNA communications tools permit Series 800 superminicomputers to communicate with IBM System/370-architecture mainframe and super-mini host systems with MVS or VM operating systems. The DECnet communications facilities permit the Series 800 computers to interact with DECnet-connected Digital Equipment systems with the VAX/VMS operating system.

The most important component of the Series 800's open system approach to networking and distributed processing is the IEEE 802.3 Ethernet local area network. IEEE 802.3 ➤

➤ RS-232-C devices. Each port supports one device and sends and receives data 19.2K bits per second (bps).

The multiplexers connect to the channel I/O bus via a multiplexer interfaces. Each multiplexer interface requires one I/O slot.

A parallel asynchronous first-in, first-out (FIFO) interface is used to connect factory floor, scientific devices, and automation control devices to the Series 800 host. It provides multipurpose 8- or 16-bit parallel communications capabilities between external devices and the Series 800 host.

The parallel asynchronous FIFO interface card hosts the parallel asynchronous FIFO interface. The interface card requires one I/O slot on the channel I/O bus.

CONFIGURATION RULES

GENERAL: The standard Series 800 Model 825S comes with an SPU containing the following:

- One central processor with 16K bytes of cache memory and a floating-point co-processor
- 8M bytes of main storage
- One asynchronous six-channel multiplexer
- One HP-IB interface

Main storage can be expanded to 56M bytes in 2M- and 8M-byte increments. Maximum online mass storage capacity is 6.9G bytes when only the HP-IB interface options are used and 9.1G bytes when the HP-FL interface options are employed. Up to 64 terminals devices can be attached to the Model 825S. One LAN link can be placed on the Model 825S for attachment to Hewlett-Packard's LAN/9000 LAN.

The basic Series 800 Model 835S comes with an SPU containing the following: ➤

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▷ is one of the most popular for interconnecting information systems and workstations—especially at the departmental level. By employing IEEE 802.3 Ethernet, the Series 800 superminicomputers 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 hard-wired 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 MVS or VM environments or Digital Equipment VAX/VMS environments.

Although the Series 800 superminicomputers can gain access to IBM mainframes and SNA networks, the connections are difficult to implement. Missing within the Series 800-to-IBM mainframe communications channel is the popular Advanced-Peer-to-Peer Communications (APPC)/LU6.2 protocol. If the Series 800 employed the APPC/LU6.2 protocol and communications interface set, they could establish sessions with applications on IBM mainframes without running the multiple layers of emulation that are now required to communicate with the IBM mainframes. Running APPC/LU6.2 reduces the complications and performance degradations caused by file format limitations and emulation overhead.

Application availability is not a problem with the Series 800. Through HP Plus, Hewlett-Packard's third-party vendor program, customers have access to an abundance of packaged software programs written for Series 800 computers. The program provides users with applications software for both commercial and technical computing disciplines, including accounting, manufacturing resource planning, office automation, mechanical engineering, factory floor automation, artificial intelligence, and scientific laboratory automation.

The Series 800 multiuser computers are object-code compatible. Applications developed on one Series 800 multiuser model—such as the Model 825S—can be moved to another Series 800 multiuser model—such as the Model 850S—without undergoing modification or recompiling. Such compatibility preserves the complete software investments, thus prompting system migration and bottom-to-top and top-to-bottom application development.

The Series 800 multiuser computer models remain program, file, and data compatible with the older, conventionally designed HP 9000 Series 500 multiuser computers, despite their RISC-based HP Precision Architecture. The HP-UX operating system, which runs across the HP 9000 line of conventional and RISC-technology-based superminicomputers, provides protection for software investments and provides a measure of bottom-to-top software development and execution.

- ▶ • One central processor with 128K bytes of cache memory and a floating-point co-processor
- 8M bytes of main storage
- One asynchronous six-channel multiplexer
- One HP-IB interface

Main storage can be expanded to 112M bytes in 8M-, 16M-, and 32M-byte increments. Maximum online mass storage capacity is 6.9G bytes when only the HP-IB interface options are used and 9.1G bytes when the HP-FL interface options are employed. Up to 30 terminal devices can be attached. One LAN link can be placed on the Model 835S.

The standard Series 800 Model 835SE comes with an SPU containing the following:

- One central processor with 128K bytes of cache memory and a floating-point co-processor
- 24M bytes of main storage
- One asynchronous six-channel multiplexer
- One HP-IB interface

Main storage can be expanded to 112M bytes in 8M-, 16M-, and 32M-byte increments. Maximum online mass storage capacity is 6.9G bytes when only the HP-IB interface options are used and 9.1G bytes when the HP-FL interface options are employed. A maximum of 78 terminal devices can be connected. One LAN link is supported.

The standard Series 800 Model 840S comes with an SPU containing the following:

- One central processor with 128K bytes of cache memory and a floating-point co-processor
- 8M bytes of main storage
- One asynchronous six-channel multiplexer
- One HP-IB interface

Main storage can be expanded to 96M bytes in 8M- and 32M-byte increments. Maximum online mass storage capacity is 6.9G bytes when only the HP-IB interface options are used and 9.1G bytes when the HP-FL interface options are employed. A maximum of 128 terminal devices can be accommodated. One LAN link is supported.

The standard Series 800 Model 850S comes with an SPU containing the following:

- One central processor with 128K bytes of cache memory and a floating-point co-processor
- 32M bytes of main storage
- One asynchronous six-channel multiplexer
- One HP-IB interface

Main storage can be expanded to 128M bytes in 16M- and 32M-byte increments. Maximum online mass storage capacity is 6.9G bytes when only the HP-IB interface options

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➤ Even though HP-UX programs and files can be moved from the Series 500 to a Series 800, the software compatibility provided by HP-UX does not protect the entire software investment. Programs developed on a Series 500 model cannot run on a Series 800 superminicomputer until the source code has been modified for the new operating environment. The different instruction sets and system architectures of the Series 500 and Series 800 dictate recompilations or changes in programming code upon an application porting maneuver to ensure operability on the targeted system.

Besides maintaining compatibility with each other and the older Series 500 multiuser systems, the Series 800 multiuser models also maintain compatibility with Series 800 superworkstations and conventionally designed HP 9000 workstations for top-to-bottom and bottom-to-top applications development. However, the entire software investment is not preserved upon an application porting maneuver. Applications developed on an HP Precision Architecture-based Series 800 workstation can be moved to the Series 800 superminicomputer without undergoing modification, only when the application has been developed to run in a multiuser, multitasking environment. Programs moved between the Series 800 superminicomputers and the conventionally designed HP 9000 Series 200 and Series 300 workstations must undergo rewrites and recompilations to adjust for the differences in architecture. (For a detailed description of the Series 800 superworkstations and the conventional HP 9000 workstations, see the *CAD/CAM/CAE Systems* volume of *Datapro Manufacturing Automation Series*.)

In-place upgrade options for moving from one Series 800 model to another are somewhat limited. Only the Model 825S and 835S are provided with upgrade options. By simply swapping processors, the 825S can be upgraded to the 835S or 835SE; the 835S can be turned into a 835SE. Moving from a Model 825S, 835S, or 835SE to a Model 840S or 850S requires a reinvestment in the system's main unit; i.e., the system processing unit boxes must be exchanged. Such an investment is costly, since the entire investment in the main unit is lost. In most cases, 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 file upgrade.

Moving from the Series 500 to a Series 800 is a fairly expensive venture. The move requires the replacement of the main processing cabinet. Only some of the terminals, printers, and magnetic tape units used on the Series 500 can be moved over to the Series 800. Furthermore, as stated previously, some of the applications on the Series 500 will have to undergo modifications and recompiles to run on the Series 800.

Moving from the aging HP 1000 realtime and compute-intensive timesharing computers to the Series 800 is very expensive. Besides replacing the basic processing complexes, many peripherals will have to be replaced as well. ➤

➤ are used and 18.3G bytes when the HP-FL interface options are employed. A maximum of 300 terminal devices can be accommodated. One LAN link is supported.

WORKSTATIONS: The Series 800 computers accommodate alphanumeric terminals, graphics terminals, data entry terminals, technical workstations, and personal computers. The technical workstations and personal computers must be configured with the appropriate asynchronous terminal emulation equipment to access the applications running on the Series 800.

The Series 800 workstations connect to the Series 800 host processor via the asynchronous six-channel multiplexers, which interface with a channel I/O bus. The six-channel multiplexers support six interactive terminals running at 19.2K bps.

DISK STORAGE: A variety of disk storage devices can be configured on a Series 800. The HP 7935H provides 404M bytes of removable disk storage. The HP 7907 has 20M bytes of Winchester (nonremovable) disk storage and 20M bytes of removable disk storage. The HP 7914ST and HP 7914CT offer 132M bytes of Winchester disk storage with either a cartridge or reel-to-reel tape drive. The HP 7957A/B and HP 7958A/B provide 81M and 131M bytes of Winchester disk storage, respectively. For installations requiring high-performance, high-capacity Winchester disk drives, the HP 7933H, HP 7936FL, HP 7936H, HP 7937FL, HP 7937H, HP 7959B, and HP 7963B are available; these Winchesters offer either 304M, 307M, 404M, or 571M bytes of online storage.

Each disk storage device contains its own controller. The controller communicates with the host processor over the HP-IB interface, which interfaces to the central bus. Up to four Winchester disk drives can be supported on an HP-IB interface.

MAGNETIC TAPE: The Series 800 computers use the HP 7974A, HP 7978B, HP 7979A, HP 7980A, HP 9144A, and HP 35401A magnetic tape drives for online storage backup, archival storage, data exchange, and software distribution. The HP 7974A, HP 7978B, HP 7979A, and HP 7980A are reel-to-reel tape drives that utilize 0.5-inch media and read and write in either the 800, 1600, or 6250 bits-per-inch (bpi) mode at 75, 100, or 125 inches per second (ips). The HP 9144A and HP 35401A are cartridge tape drives that store up to 67.1M bytes of data. The HP-IB interface attaches the HP 7974A, HP 7978B, HP 7979A, HP 7980A, HP 9144A, and HP 35401A to the host processor.

PRINTERS: The Series 800 computers support an assortment of printers. The matrix line printers handle text, numerics, OCR, bar code, and graphics character sets and offer maximum print speeds ranging 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 20 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 departmental processor and at the individual workstation. All Series 800 printers connect to a Series 800 host processor or Series 800 workstation using an RS-232-C or HP-IB interface. ➤

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➤ In addition, much of the software investment is lost. Applications on the HP 1000 will have to be reworked to accommodate the HP 9000 Series 800 architecture, because the HP 1000 architecture and HP 9000 Series 800 architecture are incompatible. This is a time-consuming and personnel-intensive task.

To ease application migration efforts during an HP 1000-to-HP 9000 Series 800 move, Hewlett-Packard offers a migration tool called the Port/HP-UX, which allows the migration of existing HP 1000 programs running under the RTE operating system to be upgraded to the HP 9000 running under the HP-UX operating system. This tool reduces the complexity of the migration, thus lowering expenses, not only in the cost of the application porting itself, but in training costs as well.

USER REACTION

In June 1988, Datapro Research conducted telephone interviews with three HP 9000 Series 800 users. Users' names were obtained from Datapro Research resources.

The first user we contacted was the computer services director at a small-to-mid-sized manufacturing plant specializing in the automotive components industry. The installation employs three networked Series 800 Model 840s that automate engineering, manufacturing resource planning, shop floor control, inventory management, customer order processing, accounting, and office functions.

The user stated that when the firm moved from a manual operation to an on-line operation, it looked at computers from Digital Equipment Corporation and Prime Computer. The Series 800 systems were selected based on multiuser capacities and price.

All the system users are satisfied with the responsiveness and data crunching capabilities of the Series 800. Furthermore, the respondent praised Hewlett-Packard's maintenance service and technical troubleshooting capabilities. He also reported that the Series 800 are very reliable. He said system documentation could be improved, however; his staff found it somewhat difficult to understand. He also indicated that Hewlett-Packard needs to provide more in-depth customer education and training. Overall, the respondent said that he would recommend the Series 800 superminicomputers to other users because of their performance, reliability, and cost-effectiveness.

The second user interviewed was a programmer at a small computer systems consultancy specializing in developing and installing computer-aided design, manufacturing, and engineering (CAD/CAM/CAE) systems. One Series 800 Model 840 was used to build software and to provide documentation.

This respondent gave the Model 840 high marks for performance and reliability. Furthermore, he was pleased with the quality of technical troubleshooting, maintenance responsiveness, and level of education. ➤

➤ MASS STORAGE

See Chart B for specifications on the disk storage devices.

INPUT/OUTPUT UNITS

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

OTHER: Several types of plotters can be attached to the Series 800 computers. The HP 7550A is an eight-pen plotter supporting A- and B-size media. The HP 7570 is an eight-pen plotter that uses C- and D-sized media. The HP 7595 and HP 7596 are eight-pen plotters that accommodate A- and E-size media.

COMMUNICATIONS CONTROL

GENERAL: The Series 800 computers communicate with each other, with other Hewlett-Packard computers, and with other vendors' systems via the Hewlett-Packard LAN/9000 local area network. The LAN/9000 is an Ethernet LAN supporting IEEE 802.2- or IEEE 802.3-recommended media and protocols. It has a bandwidth of 10M bps and allows file transfer, remote file access, process start and terminate, and communications between processes running anywhere on the network.

The Series 800 systems are connected to the network through an intelligent controller known as the *LAN/9000 Series 800 Link*. The LAN/9000 Series 800 Link contains the hardware and transport and interface software required to connect a Series 800 computer to an IEEE 802.2 or IEEE 802.3 cable. Hardware components of the LAN/9000 Series 800 Link include the following:

- **Local Area Network Interface Controller (LANIC)**—a microprocessor-based communications controller that plugs into the Series 800 backplane. It handles buffering, IEEE 802.2 and 802.3 protocols, and error checking, and it keeps track of network statistics.
- **Attachment Unit Interface (AUI) Cable**—the interface cable plus a 2-meter internal LANIC cable connect the LANIC to the Medium Attachment Unit (MAU).
- **Medium Attachment Unit (MAU)**—provides the physical and electrical connection by connecting the AUI cabling to the network coaxial cable. The MAU is powered by the LANIC through the AUI cable. The MAU receives signals from, and sends signals to, the coax cable; it also detects collisions resulting from two nodes transmitting simultaneously.

LAN/9000 Series 800 Link software is described in the "Communications" subsection of the "SOFTWARE" section.

The Series 800 systems can also communicate with other computer systems using one or more multiplexer channels and hardwired modem links. The asynchronous six-channel multiplexer accommodates up to six communications links for remote communications using RS-232-C communications lines. The X.25 multiplexer provides for attachment to a X.25 packet-switching network.

IBM communications are supported via SNA 3270 and 3370 products using a LAN-attached HP 9000 Series 300 workstation as a nondedicated gateway. The gateway allows a cluster of Series 800 computers to have access to ➤

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▷ The third user interviewed was the data processing and systems automation director at a small manufacturing company functioning within the aerospace industry. The company employs two Series 800 Model 850S computers to run manufacturing resource planning (MRP); shop floor control; and inventory management, customer order processing, accounting, and office functions. The Model 850 communicates with a network of workstations that handle engineering applications.

Before choosing the Model 850, the user looked at the Data General MV/Eclipse, Prime, and Digital Equipment computers. The Model 850 was selected because of price and performance, system packaging, and reliability.

The features that the user likes best are the remote diagnostics and maintenance service. The user said the system did what was expected and that he would recommend the Series 800 to a prospective customer. □

▶ resources on an IBM System/370-compatible mainframe running under MVS or VM operating systems.

SOFTWARE

OPERATING SYSTEMS: The Series 800 computers operate under the HP-UX operating system.

HP-UX is a superset of the AT&T UNIX System V.2 operating system. Complying with the AT&T UNIX System V Interface Definition and System V Verification Suite (SVVS) specifications for compatibility, HP-UX includes all the non-hardware-dependent utilities from UNIX System V.2. In addition, the HP-UX operating system contains University of California at Berkeley Release 4.2 Berkeley Software Distribution (BSD) commands and utilities and HP-developed enhancements. Significant Hewlett-Packard enhancements include realtime processing extensions, native-language support, and power failure recovery capabilities.

HP-UX realtime processing tools include the following:

- **Realtime process scheduling.** The HP-UX process scheduler differentiates between realtime and time-shared processes. The scheduler will always dispatch a process with realtime priority before a process with a time-shared priority.
- **Kernel preemption.** In traditional UNIX systems, a process executing in its own "user" code can be preempted immediately, but if the kernel is executing in behalf of a process, such as when the user process makes a system call, that process surrenders the central processor only voluntarily. Thus, the kernel can execute for a significant period of time before giving the central processor another process. This period of time is called "preemption latency" and is unacceptable in a realtime system. Therefore, Hewlett-Packard placed facilities within HP-UX that allow a realtime process to preempt the kernel.
- **Process locking.** This feature prevents paging or swapping of a process, so it can be guaranteed immediate execution when it becomes runnable.
- **File locking.** A region of a file or the entire file can be locked.

- **File space preallocation.** In standard UNIX systems, file system blocks are allocated dynamically for every write operation. HP-UX can preallocate file system space for realtime applications to avoid this overhead during activities such as high-speed continuous data collection.

The native-language support feature provides for localization—the process of adapting a software application for use in different countries. The native-language support tools permit installations to develop applications that are localizable with software modification.

The power failure recovery feature ensures transaction and data integrity when power is lost. When HP-UX detects a power failure, the central processor state and cache data are flushed out to battery backed-up memory. If power is restored within 15 minutes, I/O devices are reset, I/O transactions going on at the time of failure are restored, and a signal is sent to every process informing it of the power failure.

With HP-UX, over 500 user processes can run concurrently. To support this capability, HP-UX implements UNIX System V's "pipes," FIFO files, and System V IPC (messages, semaphores, and shared memory). The pipes and FIFO features allow interprocess communications, in which data can be passed asynchronously between two tasks using a high-level language's read and write commands. IPC facilities allow interprocess communications and synchronization using system calls unique to each IPC subsystem. In addition, HP-UX intrinsics permit synchronization to control the initiation and resumption of task execution.

HP-UX virtual memory consists of 4G byte spaces which are divided into 2K-byte pages. Pages can hold code, data, or a combination of both. Code can span spaces and a single data structure can be up to 4G bytes in length. Using HP-UX' demand loading feature, the user can choose between having an entire program loaded into memory before execution and loading program segments only when they are required for execution.

HP-UX implements the UNIX hierarchical file system, which allows users to organize files in a logical fashion. Permission for each file to read, write, and execute can be assigned on an individual, group, or community basis.

To transport data among other HP computers, HP-UX supports a set of utilities that will selectively convert and copy HP-UX files to Logical Interchange Format (LIF), a vehicle for transporting ASCII files on removable mass storage media among a wide variety of HP computers. Standard UNIX commands are supported to transport files between HP-UX and other UNIX systems.

DATABASE MANAGEMENT SYSTEM: Database management is provided by *Allbase/HP-UX*, a database management system (DBMS). *Allbase/HP-UX* offers data independence so that changes can be made to the database structure without having to modify application programs. Concurrent access allows multiple users to access data simultaneously. Automatic locking and automatic (rollback) recovery ensures data integrity.

Both a relational and a network data model interface are offered with *Allbase/HP-UX*. HP SQL is selected when the application requires a relational model interface, and HP IMAGE is chosen when a network model interface is needed. HP SQL maintains compatibility with IBM's Structured Query Language (SQL) product. HP-IMAGE is upwardly compatible with existing Image/9000 ▶

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► databases—the databases running on HP 9000 technical workstations and the defunct 500 multiuser computers.

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

LANGUAGES: HP-UX supports the following high-level programming languages: Fortran 77, Pascal, C, and Cobol. These languages are provided with optimization and full symbolic support. They can be linked at the object level. Programs written in any of HP-UX supported languages can access all HP-UX system intrinsics and other libraries.

COMMUNICATIONS: Low-level networking is performed by LAN/9000 Series 800 Link software and software for X.25 network connectivity. Application-level networking is performed by packages such as Network Services/9000 Series 800, ARPA Services/9000 Series 800, Network File System Services/9000 Series 800, and Network Services/DEC VAX/VMS (NS/DEC VAX/VMS).

The *LAN/9000 Series 800 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 Series 800 to a IEEE 802.2 or 802.3 Ethernet network. It corresponds to layers 1 through 5 of the International Standard Organization's (ISO's) Open Systems Interconnection (OSI) networking model. 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 provide for online configuration, diagnostics, and logging.

A *X.25 host packet assembler/disassembler software package* allows the Series 800 computers to communicate over a X.25 packet-switching public or private data network (PDN). Its primary functions are to provide login functions for terminals connected to the Series 800 and to allow protocols to run across the network.

The *Network Services/9000 Series 800* enables the Series 800 to transfer files to and from other HP 9000, HP 1000, HP 3000, and HP Vectra (IBM PC-compatible) using the Network File Transfer (NFT) protocol. It also provides for remote file access between HP 9000 computers using the Remote File Access (RFA) protocol and network interprocess communications among Series 800 computers using the Network Interprocess Communication (NET IPC) protocol.

ARPA Services/9000 Series 800 allows communications among professional workstations and multiuser computers that implement the Department of Defense Advanced Research Projects Agency (ARPA) and Berkeley 4.2 BSD networking standards. The ARPA services include FTP for file transfer, Telenet for terminal login access, and SMTP for electronic mail. The Berkeley 4.2 BSD networking services include rcp for file transfer, rlogin for terminal login access, and rsh for remote command execution.

Network File System Services/9000 Series 800 provides multivendor remote file access to other computers supporting the standard Network File System (NFS) services. It also provides NFS-specific Remote Procedure Call (RPC) and Yellow Pages (YP) network administration services.

Network Services/DEC VAX/VMS (NS/DEC VAX/VMS) integrates Digital Equipment's VAX/VMS computers into the Series 800 environment. It permits files to be transferred between Series 800 and Digital Equipment VAX/

VMS computers and allows bidirectional virtual services between Series 800 and VAX/VMS computers.

The *Unix uucp, uux, cu, and mail commands* within HP-UX are useful when communicating with other UNIX or HP-UX-based systems. The uucp command performs file transfers and works in conjunction with the mail command to allow electronic mail to be sent to a user on another computer. The uux command allows remote command execution and the cu command permits terminal emulation.

IBM communications are supported via the *HP-UX Gateway SNA/3270 for HP 9000 Series 800* and the *HP-UX Gateway SNA/3770 for HP 9000 Series 800* communications packages. These packages allow for interactive and batch communications between a Series 800 and an IBM System/370-compatible mainframe using SNA 3270 and SNA 3770 protocols.

Both *HP-UX Gateway SNA/3270 for HP 9000 Series 800* and the *HP-UX Gateway SNA/3770 for HP 9000 Series 800* run on a LAN 9000-attached HP 9000 Model 300 workstation. The workstation functions as a gateway server, providing a cluster of Series 800 computers with access to IBM 3270 and 3770 communications—interactive access, remote command execution, and file transfer.

UTILITIES: As stated previously, HP-UX contains UNIX System V.2 utilities for programming, professional support, and system administration. Included are the following:

- The Documenter's Workbench. This provides a full set of text processing, formatting, and typesetting facilities and controls for document and publication creation.
- The Source Code Control System (SCCS). This system provides a means for controlling changes to a program's source code or text file, and it documents the progress of a project as versions are created and modified throughout the development process. It stores, updates, and retrieves source code modules; allows modules to be manipulated by version number or date; keeps track of the changes; protects versions from unauthorized changes; and allows generations to be combined, modified, and compared.
- The Resource Accounting System. This system collects resource utilization data to record user connect time and monitor CPU disk utilization for the purpose of charging fees to individual users and fine-tuning the system.
- Interactive and noninteractive graphics facilities and editors for the construction of data plots, pie charts, bar charts, and histograms and free-form graphics images.
- Electronic mail.
- Professional support tools including an electronic systems news service, automatic reminder services, and a desk calculator.

In addition, a number of add-on system-level applications are available for applications development and support.

The *Port/HP-UX* package is a collection of tools and utilities for migrating applications from the HP 1000 computers running the RTE-6/VM and RTE-A operating systems to the HP 9000 Series 800 with its HP-UX operating system. In addition to emulating most RTE calls on HP-UX, *Port/HP-UX* provides tools to analyze applications to determine what program statements need to be modified, as well as providing instructions on the type of modification. ►

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► **HPtoday/HP-UX** is used to develop data or transaction processing applications. HPtoday applications are created without traditional programming methods. HPtoday applications are written using formatted screens with menu selections and fill-in-the-blank forms. Programmers don't have to code reams of program instructions.

HPtoday/HP-UX consists of two parts. HPtoday/HP-UX Developer Kit is used to build and modify applications. The HPtoday/HP-UX Run-Time Environment software package supports the execution of developed HPtoday applications.

The Series 800 computers support several graphics libraries for the development and support of applications.

The *Starbase/HP-UX Graphics Library* is a two-dimensional (2-D) and 3-dimensional (3-D) graphics library based on the American National Standards Institute's (ANSI's) Computer Graphics Interface (CGI) standard. It is compatible with the current implementations of Starbase on the HP 9000 Series 300 workstations and Series 500 multiuser computers, allowing a graphics application written on a Series 300 or 500 to be moved to a Series 800 and vice versa.

The *Starbase/HP-UX Display List* supports hierarchical display lists for modeling of graphics data.

The HP GKS/HP-UX package provides de facto industry-standard Graphics Kernel System (GKS) graphics. The GKS graphics system, an implementation of the two-dimensional graphics standard approved by the ISO, provides programmers with a framework for designing graphics application software. It consists of a software library of subroutines with specific calling sequences which, when loaded with a user program and executed, produce defined actions. GKS runs with programs written in Fortran, Cobol, and Pascal. GKS constructs images from any number of input devices and generates output to any output device.

The *DGL/AGP/HP-UX Graphics Library* provides the routines for executing applications based on Device-independent Graphics Library (DGL) and Advanced Graphics Library graphics. It serves as a migration tool for moving the DGL and AGP graphics applications residing on the HP 1000 computers and older, existing HP 9000 workstations and multiuser computers to the Series 800 computers.

Computer Graphics Metafile (CGM) provides users with the ability to run capture and display picture files.

The *X Window System* provides a platform for building window-based applications and user interfaces. It features the MIT-developed, industry-supported X Windows System for defining how multiple, local applications and tasks are to be displayed on the screen simultaneously and for defining how multiple remote computing sessions are to be displayed on the screen with local applications or with other remote computing sessions.

OFFICE AUTOMATION: *Alis/HP-UX* provides a set of professional services. Included within Alis/HP-UX is a document composer, a graphics editor, spreadsheet analysis, a personal database, electronic mail, and calendar and personal time management.

APPLICATIONS: There are large number of applications solutions available for the Series 800 superminicomputers. These solutions are provided by both Hewlett-Packard and

independent vendors that have established business relationships with Hewlett-Packard through the HP Plus program.

Applications sold and supported through the HP Plus third-party program run the gamut of established business and technical processing markets. Applications cover areas such as as the following:

- Accounting and business administration
- Education institute administration
- Medical/health care organization patient care
- Financial security trading
- Office automation
- MRP and production control
- Industrial engineering
- Process monitoring
- Computer-aided testing
- Electronic/electrical and mechanical engineering
- Architectural and civil engineering
- Earth sciences engineering
- Artificial intelligence
- Software engineering

PRICING

POLICY: The Series 800s are sold primarily through Hewlett-Packard's direct sales force and are available on a purchase-only basis. Series 800s are offered as preconfigured systems; the HP-UX operating system, device I/O libraries, the C programming language, a symbolic debugger, and an assembler are included as part of the basic system.

SUPPORT: Several types of monthly maintenance contracts are available for the computer systems hardware. The Basic Monthly Maintenance hardware support agreement provides on-site servicing with next-day response. Under the agreement, service is available from 8 a.m. to 5 p.m., or up to 24 hours per day, five days a week. The Standard Monthly Maintenance hardware support agreement provides on-site servicing with a four-hour response time. The coverage period is from 8 a.m. to 9 p.m., or up to 24 hours per day, five to seven days a week. Customers who prefer to employ Hewlett-Packard service on a time-and-materials basis can take advantage of the Per-Call service. A Hewlett-Packard representative can tailor a maintenance plan to meet their needs.

A variety of system software support services can be purchased. The Account Management Support (AMS) service offers on-site assistance for problems that cannot be solved on the telephone, on-site account reviews, software release planning, and Response Center Support (RCS) service. Response Center Support provides telephone consulting to resolve problems. The Software Materials Subscription ►

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► (SMS) service provides software and manual updates. Software Notification Service (SNS) offers a subscription to a newsletter and monthly periodical, which discuss software product happenings and product deployment strategies. Manual Update Service (MUS) provides updates to a product's documentation. Additional System Coverage (ASC) extends AMS or RCS coverage to an additional system; it includes the right to make a copy of the central system's software and documentation. The Extended Materials Support (EMS) service extends the right to copy the software and documentation updates supplied on the central system's SMS service. The Additional Response Cen-

ter Caller (ARCC) service extends RCS telephone privileges to an additional caller (beyond the administrator or alternate).

Series 800 installations can purchase consulting services from Hewlett-Packard. The General Consulting Services program provides on-site and off-site assistance by a qualified Hewlett-Packard systems engineer or product specialist. Consulting is provided on a daily or hourly basis.

TRAINING: On-site and off-site customer training is available. Training covers general system overviews as well as detailed instruction for system administration and programming.

EQUIPMENT PRICES

		Purchase Price (\$)	BMM Charge (\$)	SMM Charge (\$)
Series 800 Base Systems				
A 1004A	Model 825S system with a system processor containing a floating-point co-processor, 8M bytes of main storage, a channel I/O bus, an HP-IB, and a six-channel multiplexer; a system processor cabinet; a 16-user HP-UX; a C compiler; a symbolic debugger; an assembler; and a I/O device library	35,000	156	194
A 1035A	Model 835S system with a system processor containing a floating-point co-processor, 8M bytes of main storage, a channel I/O bus, an HP-IB, and a six-channel multiplexer; a system processor cabinet; a 16-user HP-UX; a C compiler; a symbolic debugger; an assembler; and an I/O device library	45,000	199	263
A 1040A	Model 835SE system with a system processor containing a floating-point co-processor, 24M bytes of main storage, 2 channel I/O buses, an I/O extender, an HP-IB, a 6-channel multiplexer; a system processor cabinet; a 64-user HP-UX, a C compiler and debugger; an assembler; and an I/O library HP-UX, a C compiler and debugger; an assembler; and an I/O device library	99,000	319	421
9741A	Model 840S system with a system processor containing a floating-point co-processor, 8M bytes of main storage, a channel I/O bus, an HP-IB, and a 6-channel multiplexer; a system processor cabinet; a 16-user HP-UX; a C compiler; a symbolic debugger; an assembler; and a I/O device library	85,550	284	355
9742A	Model 850S system with a system processor containing a floating-point co-processor, 32M bytes of main storage, 2 channel I/O buses, an HP-IB, and a 6-channel multiplexer; a system processor cabinet; a 64-user HP-UX; a C compiler; a symbolic debugger; an assembler; and an I/O device library	188,500	498	623
Field Upgrades				
A 1036A	Model 825S-to-835S/SE central processor upgrade package	10,000	NA	NA
A 1038A	Model 825S-to-835SE multiuser computer system upgrade package; includes central processor upgrade, I/O extender and additional I/O channel adapter, 16M bytes of main storage, powerfail battery backup system, and 16-to-64 user HP-UX upgrade	72,460	NA	NA
A 1039A	Model 835S-to-835SE multiuser computer system upgrade; includes an additional I/O channel adapter and I/O extender, 16M bytes of main storage, a powerfail battery backup system, and a 16-to-64-user HP-UX upgrade	57,460	NA	NA
Series 800 Accessories				
A 1009A	2M-byte memory board for Models 825, 835S, and 835SE	4,000	NC	NC
A 1010A	8M-byte memory board for Models 825, 835S, and 835SE	10,000	NC	NC
A 1037A	16M-byte memory board for Models 825, 835S, and 835SE	20,000	NC	NC
19748A	8M-byte memory board for Model 840S	20,000	NC	NC

NC—No charge.

NA—Not applicable.

Notes:

Monthly BMMC Fee is the monthly charge for the Basic Monthly Maintenance support service.

Monthly SMM Fee is the monthly charge for the Standard Monthly Maintenance support service.

Monthly AMS Fee is the monthly charge for Account Management Support service.

Monthly RCS Fee is the monthly charge for Response Center Support service.

Monthly SMS Support Fee is the monthly charge for the Software Materials Subscription service.

Extended SMS Support Fee is the monthly charge for the Extended Software Materials Subscription service.

Footnotes. LAN/9000 Series 800 Link software is bundled with LAN/9000 Series 800 Link hardware. The purchase price for the LAN/9000 Series 800 Link listing in the "Data Communications" subsection of the "EQUIPMENT PRICES" section includes the price of both hardware and software. The hardware and software for the LAN/9000 Series 800 Link are priced separately for maintenance.

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		Purchase Price (\$)	BMM Charge (\$)	SMM Charge (\$)
19733A	32M-byte memory board for Model 840S	64,000	NC	NC
A1104A	16M-byte memory board for Model 850S	40,000	NC	NC
A1013A	I/O expander with channel I/O adapter for Model 835SE	16,000	17	21
19744A	Channel I/O adapter for Model 840S	15,750	—	—
19746B	I/O expander for 840S; contains a channel I/O adapter, 16-slot expansion bay, and cabinet	31,500	50	63
A1101A	Channel I/O adapter for Model 850S	15,750	—	—
A1122A	Channel I/O terminal expander for Model 850S	35,000	47	37
A1123A	Expansion kit for A1122A	28,000	34	43
A1124A	Add-on expander for A1122A	32,500	37	47
27110B	HP-IB interface	1,540	3	4
27110B	A parallel asynchronous FIFO interface	1,600	2	3
98196A	6-channel multiplexer	2,525	5	6
A1014A	A powerfail battery backup system	5,000	—	—

Mass Storage

		Purchase Price (\$)	BMM Charge (\$)	SMM Charge (\$)
7907	Mass storage subsystem with 20M bytes of Winchester disk storage and 20M bytes of removable disk storage	—	—	—
7914CT	132M-byte Winchester disk drive with a 67M-byte cartridge tape drive and integral controller	17,350	65	81
7914ST	132M-byte Winchester disk drive with a reel-to-reel magnetic tape drive	—	—	—
7933H	404M-byte Winchester disk drive with integrated controller and HP-IB interface	—	—	—
7935H	404M-byte removable disk drive with integrated controller and HP-IB interface	24,000	103	130
7936FL	307M-byte Winchester disk drive with integral controller and HP-FL interface	—	—	—
7936H	307M-byte Winchester disk drive with integral controller and HP-IB interface	14,250	33	42
7937FL	571M-byte Winchester disk drive with integral controller and HP-FL interface	—	—	—
7937H	571M-byte Winchester disk drive with integral controller and HP-IB interface	15,700	40	50
7957A/B	81M-byte Winchester disk drive with integral controller and HP-IB interface	4,250	32	40
7958A/B	131M-byte Winchester disk drive with integral controller and HP-IB interface	6,450	33	43
7959B	304M-byte Winchester disk drive with integral controller and HP-IB interface	—	—	—
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	—	—	—

Magnetic Tape Equipment

7974A	Magnetic tape drive with an 800/1600 bpi read/write mode and 100-ips operating capabilities	16,500	88	110
7974A Opt.800	Additional 7974A	2,000	14	17
7978B	Magnetic tape drive with a 1600/6250 bpi read/write mode and 75-ips tape speed	27,000	85	106
7979A	Magnetic tape drive with a 1600 bpi read/write mode and a tape speed of 125 ips	13,400	35	44
7980A	Magnetic tape drive with a 1600/6250 bpi read/write mode and a tape speed of 125 ips	23,200	35	44
9144A	Cartridge tape drive capable of storing 67M bytes of data on tape cartridges	2,300	13	16
35401A	Cartridge tape drive with an auto changer that accommodates 8 tape cartridges	8,000	35	42

NC—No charge.

NA—Not applicable.

Notes:

Monthly BMMC Fee is the monthly charge for the Basic Monthly Maintenance support service.

Monthly SMM Fee is the monthly charge for the Standard Monthly Maintenance support service.

Monthly AMS Fee is the monthly charge for Account Management Support service.

Monthly RCS Fee is the monthly charge for Response Center Support service.

Monthly SMS Support Fee is the monthly charge for the Software Materials Subscription service.

Extended SMS Support Fee is the monthly charge for the Extended Software Materials Subscription service.

Footnotes. LAN/9000 Series 800 Link software is bundled with LAN/9000 Series 800 Link hardware. The purchase price for the LAN/9000 Series 800 Link listing in the "Data Communications" subsection of the "EQUIPMENT PRICES" section includes the price of both hardware and software. The hardware and software for the LAN/9000 Series 800 Link are priced separately for maintenance.

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		Purchase Price (\$)	BMM Charge (\$)	SMM Charge (\$)
Printers and Plotters				
2563B	Matrix line printer that runs at up to 300 lpm	7,790	47	59
2564B	600-lpm matrix line printer	12,950	75	94
2566B	900-lpm matrix line printer	22,641	175	219
2567B	1,200-lpm matrix line printer	29,170	186	233
2932	200 cps matrix serial printer with draft-mode printing only	2,595	21	26
2934A	Matrix serial printer running at up to 200 cps	2,995	24	30
2235B/D	Matrix serial printer running at up to 480 cps			
2225	A 150 cps inkjet printer	495	—	—
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-by-11 inch paper	599	—	—
3630A	Inkjet printer running at up to 167 cps	1,395	NA	10
33440	8-ppm laser printer	2,595	NA	54
2686D	8-ppm laser printer with extensive paper-handling capabilities	2,995	—	—
2684	20-ppm laser printer	19,995	289	362
7550A	A- and B-size, 8-pen plotter with sheet feeder	3,900	32	40
7570A	C- and D-size, 8-pen plotter	4,900	—	—
7595A	8-pen plotter with A- and E-size media	9,900	—	—
7596A	8-pen roll-feed plotter with A- and E-sized media	11,900	—	—
Terminals and Workstations				
C1001	HP 700/92 alphanumeric display terminal	895	NA	5
C1002	HP 700/94 alphanumeric display terminal	1,095	NA	5
C1003	HP 700/41 alphanumeric display terminal	375	NA	5
C1004	HP 700/22 alphanumeric display terminal	575	NA	5
C1005	HP 700/43 alphanumeric display terminal	475	NA	5
2392A	HP 2392A alphanumeric display	2,295	8	10
2393A	HP 2393A graphics terminal	—	—	—
2394A	HP 2394A data entry terminal	1,894	—	—
2397A	HP 2397A color graphics terminal	3,595	NA	12
3081A	HP 3081 industrial data entry terminal	830	—	—
45610B	HP Touchscreen Terminal	—	—	—
45850A/B	HP Touchscreen II Terminal	2,730	—	—
9666A	HP 9666A industrial terminal	3,300	—	—
98561A	HP 9000 Series 300 Model 310 workstation, basic configuration	4,905	15	19
98561A	HP 9000 Series 300 Model 320 workstation, basic configuration	8,260	21	26
98562A	HP 9000 Series 300 Model 330 workstation, basic configuration	10,850	NA	18
98563A	HP 9000 Series 300 Model 350 workstation, basic configuration	22,650	NA	36
72425A	Vectra PC microcomputer, basic configuration	3,199	NA	26
9807A	Integral PC microcomputer, basic configuration	3,199	—	—
Data Communications				
2334A	X.25 multiplexer	1,950	14	17
98196A	LAN/9000 Series 800 Link hardware for Models 825S, 835S, and 835SE	See Note 1.	13	18
98196A	LAN/9000 Series 800 Link for Models 825S, 835S, and 835SE; includes the LAN controller, media link, and link control, interface, and transport software	4,120	13	18
98196A	LAN/9000 Series 800 Link for Model 840S; includes the LAN controller, media link, and link control, interface, and transport software	5,660	13	18
98196A	LAN/9000 Series 800 Link for Model 850S; includes the LAN controller, media link, and link control, interface, and transport software	5,600	13	18

NC—No charge.

NA—Not applicable.

Notes:

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SOFTWARE PRICING

Operating System		License Fee (\$)	Monthly AMS Fee (\$)	Monthly RCS Fee (\$)
92452A	1-to-16 user version of HP-UX Operating System	5,250	360	200
92453A	1-to-32 user version of HP-UX Operating System	10,500	435	240
92454A	1-to-64 user version of HP-UX Operating System	18,375	510	280
92455A	HP-UX unlimited license	34,125	1,025	560

Programming and Application Development Tools		License Fee (\$)	Monthly SMS Support Fee (\$)	Extended SMS Support Fee (\$)
92447	Development pack for Models 825S, 835S, and 835SE; includes Fortran-77, Pascal, Starbase Graphics Library, and DGL/AGP Graphics Library	10,300	—	—
92443A	Fortran-77 compiler for Models 825S, 835S, and 835SE	4,775	15	10
92443R	Pascal for Models 825S, 835S, and 835SE	4,775	15	10
35328A	Cobol development package for Models 825S, 835S, and 835SE; includes a Cobol compiler, a debugging tool, and a screen generator	10,750	—	—
35329A	Cobol compiler for Models 825S, 835S, and 835SE	6,600	—	—
35335A	Run-time system for Cobol programs; runs on Models 825, 835S, and 835SE	1,085	—	—
92438A	Development pack for Models 840S; includes Fortran-77, Pascal, Starbase Graphics Library, and DGL/AGP Graphics Library	15,850	—	—
92430A	Fortran-77 compiler for Model 840S	7,350	25	15
92431A	Pascal for Model 840S	7,350	25	15
35326A	Cobol development package for Model 840; includes a Cobol compiler, a debugging tool, and a screen generator	16,500	—	—
35336A	Cobol compiler for Model 840S	10,500	—	—
35327A	Run-time system for Cobol programs; runs on Model 840	1,665	—	—
92465A	Development pack for Model 850S; includes Fortran-77, Pascal, Starbase Graphics Library, and DGL/AGP Graphics Library	22,200	25	15
92461A	Fortran-77 compiler for Model 850S	10,300	25	15
92462A	Pascal for Model 850S	10,300	25	15
35330A	Cobol development package for Models 850S; includes a Cobol, a debugger, and a screen generator	23,100	—	—
35329A	Cobol compiler for Model 850S	13,750	—	—
35331A	Run-time system for Cobol programs; runs on Model 850S	2,325	—	—

Graphics Libraries

92445A	Starbase/HP-UX Graphics Library for Models 825S, 835S, and 835SE	2,600	15	10
92524R	Starbase/HP-UX Display List for Models 825S, 835S, and 835SE	1,000	15	10
92446A	DGL/AGP/HP-UX Graphics Library for Models 825S, 835S, and 835SE	3,750	15	10
92521A	GKS/HP-UX for Models 825S, 835S, and 835SE	2,000	15	10
92524A	X Window System for Models 825S, 835S, and 835SE	2,100	15	10
92436A	Starbase/HP-UX Graphics Library for Model 840S	4,000	25	15
92526A	Starbase/HP-UX Display List for Model 840S	1,500	25	15
92437A	DGL/AGP/HP-UX Graphics Library for Model 840S	5,750	25	15
92525A	GKS/HP-UX for Models 840S	3,300	25	15
92528A	X Window System for Model 840S	2,100	25	15
92463A	Starbase/HP-UX Graphics Library for Model 850S	5,600	25	15
92464A	DGL/AGP/HP-UX Graphics Library for Model 850S	8,050	25	15
92529A	GKS/HP-UX for Models 850S	4,260	25	15
92532A	X Window System for Model 850S	4,500	25	15

NC—No charge.

NA—Not applicable.

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Hewlett-Packard HP 9000 Multiuser Systems

		License Fee (\$)	Monthly AMS Fee (\$)	Monthly RCS Fee (\$)
Productivity Tools and Data Management Software				
92459A	Allbase/HP-UX and HPtoday/HP-UX developer pack; includes Allbase and HPtoday; runs on Models 825S, 835S, and 835SE	30,700	15	10
92460A	Allbase/HP-UX for Models 825S, 835S, and 835SE	17,050	15	10
35305A	HPtoday/HP-UX for Models 825S, 835S, and 835SE	17,400	15	10
35306A	HPtoday/HP-UX for Models 825S, 835S, and 835SE	3,500	15	10
92533A	HP Visor/HP-UX for Models 825S, 835S, and 835SE	6,830	15	10
92442A	Allbase/HP-UX and HPtoday/HP-UX developer pack for Model 840S; includes Allbase/HP-UX and HPtoday/HP-UX	42,000	25	15
36217A	Allbase/HP-UX for Model 840S	26,250	25	15
92440A	HPtoday/HP-UX for Model 840S	26,800	25	15
92441A	HPtoday/HP-UX runtime system for Model 840S	5,400	25	15
92534A	HP Visor for Model 840S	10,500	25	15
92468A	Allbase/HP-UX and HPtoday/HP-UX developer pack for Model 850S; includes Allbase/HP-UX and HPtoday/HP-UX	58,800	35	20
36269A	Allbase/HP-UX for Model 850S	36,750	35	20
35307A	HPtoday/HP-UX for Model 850S	37,500	35	20
35308A	HPtoday/HP-UX runtime system for Model 850S	5,400	35	20
92535A	HP Visor for Model 850S	14,700	35	20
Data Communications/Networking Tools				
91786A	LAN/9000 Series 800 Link (software) for Models 825S, 835S, and 835SE	See Footnotes	15	10
91787A	NS/9000 for Models 825S, 835S, and 835SE	2,060	15	10
50981A	ARPA Services/HP 9000 Series 800 for Models 825S, 835S, and 835SE	2,142	15	10
50970A	NFS Services for Models 825S, 835S, and 835SE	1,400	15	10
36918A	HP-UX Gateway SNA/3270 for Models 825S, 835S, and 835SE	3,150	15	10
98185A	HP-UX Gateway SNA/3770 for Models 825S, 835S, and 835SE	3,000	15	10
50950A	NS/DEC VAX/VMS for Models 825S, 835S, and 835SE	6,350	15	10
91794A	LAN/9000 Series 800 Link (software) for Model 840S	See Footnotes	25	15
91795A	NS/9000 for Model 840S	3,605	25	15
50981A	ARPA Services/HP 9000 Series 800 for Model 840S	4,284	25	15
50971A	NFS Services for Model 840S	3,500	25	15
36911A	HP-UX Gateway SNA/3270 for Model 840S	7,497	25	15
98186A	HP-UX Gateway SNA/3770 for Model 840S	7,140	25	15
50950A	NS/DEC VAX/VMS for Models 840S	6,300	25	15
91788A	LAN/9000 Series 800 Link (software) for Model 850S	See Footnotes	35	20
91789A	NS/9000 for Model 850S	6,180	35	20
50982A	ARPA Services/HP 9000 Series 800 for Model 850S	7,497	35	20
50972A	NFS Services for Model 850S	6,500	35	20
36919A	HP-UX Gateway SNA/3270 for Model 850S	10,500	35	20
98187A	HP-UX Gateway SNA/3770 for Model 850S	10,000	35	20
50950A	NS/DEC VAX/VMS for Models 850S	6,300	35	20

NC—No charge.

NA—Not applicable.

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