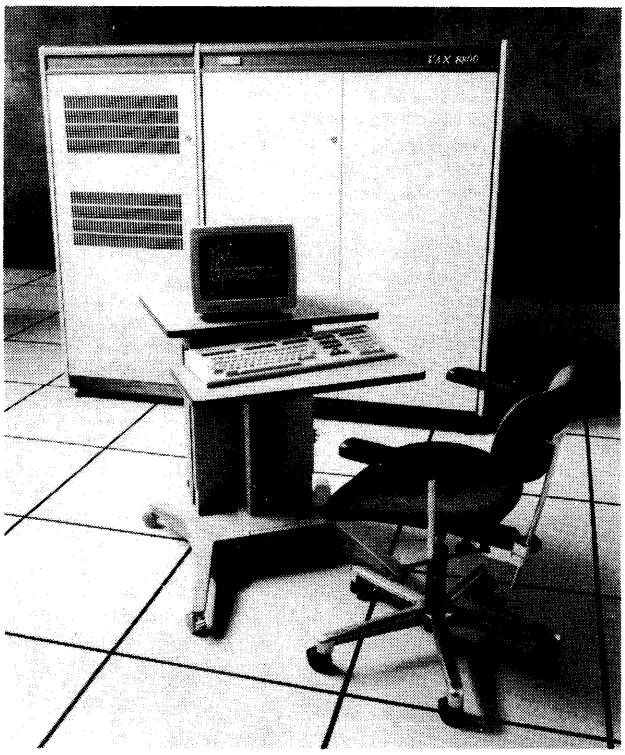
DEC VAX 8000 Systems

MANAGEMENT SUMMARY

UPDATE: *Since the report's last update, Digital Equipment Corporation has again announced price reductions on the low-end VAX 8000s while raising prices on the high-end systems. The company has also made available high-density memory modules for all VAX 8000 systems, as well as performance enhancement packages for upgrading the 8200 and 8250 to the 8350, the 8530 to the 8550, and the 8700 to the 8800.*

Having arrived at a goal, one does not usually become complacent nor return to a former, more obscure existence. The competitive challenge, the thrill of glory, the taste of blood, and most important the monetary rewards urge the competitor onward. Digital continues to play out this classic battle against IBM in the mid-range systems market and, having successfully broken through IBM's defensive line in corporate commercial computing at the departmental level, intends to increase its presence there, wresting away even more of IBM's market share.

Over the past year, Digital's competitive strategy has materialized into a manic pace of activity—introducing both ➢



Digital has again increased prices at the high end of the VAX 8000 product line taking advantage of its captive engineering and scientific user base. Even though Digital's current focus is on selling low-end systems into the commercial marketplace, the vendor will continue to address the needs of the technical user.

Digital Equipment Corporation markets the VAX 8000s as departmental processors for corporate computing environments. The entry-level VAX 8250, 8350, and 8530 provide a stronghold in corporate commercial computing, while the high-end 8550, 8700, and 8800 continue to serve Digital's traditional engineering and scientific user base. The systems are suitable for use in a range of environments, from office automation to compute-intensive engineering and scientific applications. United by a common architecture and the VAX/VMS operating system, the VAX 8000s can be used as standalone processors, but Digital emphasizes their configuration in multinode VAXclusters for enhanced power, mass storage, and availability.

MODELS: VAX 8250, 8350, 8530, 8550, 8600, 8650, 8700, 8800, 8974, and 8978.
MAIN MEMORY: 4M bytes to 2G bytes.
DISK CAPACITY: 205M bytes to 300G bytes.
WORKSTATIONS: Up to 2,560 (practical limit).
PRICE: $72,450 to $5,502,000 (base configuration prices).

CHARACTERISTICS

MANUFACTURER: Digital Equipment Corporation, 146 Main Street, Maynard, Massachusetts 01754-2571. Telephone (617) 897-5111.

CANADIAN ADDRESS: Digital Equipment of Canada Ltd., P.O. Box 13000, 100 Herzberg Road, Kanata, Ontario K2K 2A6. Telephone (613) 592-5111.

DATA FORMATS

BASIC UNIT: 32-bit word.

FIXED-POINT OPERANDS: Integers can be 8-bit bytes, 16-bit words, 32-bit longwords, 64-bit quadwords, and 128-bit octawords. Integer data is stored in a binary format that can be signed or unsigned. As unsigned quantities, integers increment from zero. As signed quantities, the integers are represented in two's complement form.

FLOATING-POINT OPERANDS: The VAX instruction set supports floating-point data in longwords, quadwords, and octawords. Four types of floating-point data are available. Two types—D and G—are 8 bytes long; the third type—F—is 4 bytes long; the last type—H—is 16 bytes long. Data type F is single precision; type D is double precision.

A Floating-Point Accelerator (FPA) is optional on the VAX 8600 and 8650 but standard on all other VAX 8000 ➢

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CHART A. SYSTEM COMPARISON

MODEL	VAX 8250	VAX 8350	VAX 8530	VAX 8550	VAX 8600
SYSTEM CHARACTERISTICS					
Date of introduction	March 1987	March 1987	March 1987	August 1986	October 1984
Date of first delivery	March 1987	March 1987	March 1987	—	April 1985
Operating system	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32
Upgradable from	8200	VAX 8200 and 8250	Not applicable	8530	Not applicable
Upgradable to	VAX 8350	Not applicable	8550	Not applicable	VAX 8650
MIPS	1.2 (approx.)	2.2-2.3 (approx.)	4.2 (approx.)	6.0 (approx.)	4.4 (approx.)
Relative performance (based on a rating of the VAX 8200 at 1.0)	1.2	2.0	4.0	6.0	4.2
MEMORY					
Minimum capacity, bytes	16M	32M	32M	48M	4M
Maximum capacity, bytes	128M	128M	256M	256M	128M
Type	MOS	MOS	MOS	MOS	MOS
Cache memory	8KB	8KB per CPU	64KB	64KB	16KB
Cycle time, nanoseconds	600	600 to 1600	135 to 1260	495	560
INPUT/OUTPUT CONTROL					
Number of channels	2	2	2	3	11
High-speed buses	1 VAXBI	1 VAXBI	2 VAXBI	2 VAXBI	4 MASSBUS
Low-speed buses	1 UNIBUS	1 UNIBUS	1 UNIBUS	1 UNIBUS	7 UNIBUS
MINIMUM DISK STORAGE	205MB	205MB	205MB	205MB	205MB
MAXIMUM DISK STORAGE	3.6GB local; 164GB in VAXcluster	1.8GB local; 164GB in VAXcluster	5.4GB local; 164GB in VAXcluster	5.4GB local; 164GB in VAXcluster	25.5GB local; 164GB in VAXcluster
NUMBER OF WORKSTATIONS	16-64 (typical)	24-96 (typical)	32-200 (typical)	72-370 (typical)	512 (56-256 typical)
COMMUNICATIONS PROTOCOLS	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP
PURCHASE PRICE					
System Building Blocks	$72,450 to $97,650	$98,700 to $129,150	$301,350 to $342,300	$456,750 to $528,150	$469,875 to $501,900
Preconfigured Systems	$121,800 to $152,250	$148,050 to $183,750	$349,650 to $390,600	$506,100 to $554,400	Not applicable

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

new systems based on the company's highly touted single-system architecture and connectivity products that provide smooth integration of Digital's systems into IBM mainframe environments. The availability of these products makes Digital's VAX 8000s viable alternatives to IBM's higher priced yet less communicative mid-range System/36 and System/38.

Now that IBM is addressing the lack of connectivity among its divergent product lines with new communications products and the recently shipped 9370, the battle lines are more evenly drawn. IBM is launching a greater challenge to Digital in departmental computing, and Digital is rising to the challenge by continuing to introduce strategic systems and networking products. Moreover, Digital is now targeting commercial markets that have traditionally been IBM strongholds.

Notable in Digital's competitive strategy is the reshaping of its marketing image from a vendor of technologically sound engineering and scientific computer systems to a savvy and enterprising contender in the business world. Targeting the high-power corporate environment as its primary market, Digital has retrained its sales force to speak a language that emphasizes business solutions over the nuts and bolts of computer technology. Strategic alliances with third-party marketing partners experienced in commercial computing provide much of the critical business-oriented software that Digital cannot take the time to develop itself. Discounts offered on volume purchases of hardware and software licenses are intended to attract

systems. The FPA executes in parallel with the base CPU, taking advantage of the CPU's instruction buffer to prefetch instructions and of the memory cache to access main memory. Once the CPU has the required data, the FPA overrides the normal execution flow of the standard floating-point microcode and forces the use of its own code. Then, while the FPA is executing, the CPU performs other operations in parallel.

INSTRUCTIONS: The native VAX instruction set consists of 304 basic operations, most of which can be applied to any one of several types of data, which can in turn be addressed in any one of nine ways. The native instruction set provides 32-bit addressing, 32-bit I/O operations, and 32-bit arithmetic.

In conjunction with a software executive running in native mode, the VAX 8000 processors can concurrently execute a compatibility-mode instruction set, which is a subset of the Digital Equipment PDP-11 instruction set. This is not done by emulation or simulation; both instruction sets are built into the microcode and logic of the processor. The compatibility-mode instruction set contains all the PDP-11 instructions except those which perform execution of floating-point instructions, use of both instruction space and data space, and execution of privileged functions.

INTERNAL CODE: ASCII for text-oriented data; binary for calculations.

MAIN STORAGE

TYPE: Main memory for all VAX 8000 processors is 256K-bit ECC MOS RAM. The processors also support add-on memory modules based on 1M-bit DRAM chips: 16M-byte modules are available for the VAX 8250 and

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CHART A. SYSTEM COMPARISON (Continued)

MODEL	VAX 8650	VAX 8700	VAX 8800	VAX 8974	VAX 8978
SYSTEM CHARACTERISTICS					
Date of introduction	December 1985	August 1986	January 1986	January 1987	January 1987
Date of first delivery	1st quarter 1986	—	2nd quarter 1986	—	—
Operating system	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32	VAX/VMS, ULTRIX-32
Upgradable from	VAX 8600	Not applicable	8700	Not applicable	8974
Upgradable to	Not applicable	8800	Not applicable	8978	Not applicable
MIPS	6.3 (approx.)	6.0 (approx.)	9.5-12.7 (approx.)	26.0 (approx.)	53.0 (approx.)
Relative performance (based on a rating of the VAX 8200 at 1.0)	6.0	6.0	9.0-12.0	20-25	40-50
MEMORY					
Minimum capacity, bytes	16M	48M	64M	128M	256M
Maximum capacity, bytes	128M	256M	256M	1G	2G
Type	MOS	MOS	MOS	MOS	MOS
Cache memory	16KB	64KB	64KB per CPU	64KB	64KB
Cycle time, nanoseconds	384	495	135 to 1260	495	495
INPUT/OUTPUT CONTROL					
Number of channels	12	6	6	24	48
High-speed buses	4 MASSBUS	4 VAXBI	4 VAXBI	16 VAXBI	32 VAXBI
Low-speed buses	7 UNIBUS	2 UNIBUS	2 UNIBUS	8 UNIBUS	16 UNIBUS
MINIMUM DISK STORAGE	205MB	205MB	205MB	2.5GB	5GB
MAXIMUM DISK STORAGE	25.5GB local; 218.8GB in VAXcluster	7.2GB local; 218.8GB in VAXcluster	7.2GB local; 218.8GB in VAXcluster	300GB	300GB
NUMBER OF WORKSTATIONS	512 (56-256 typical)	72-320 (typical)	72-320 (typical)	288-1,280 (typical)	576-2,560 (typical)
COMMUNICATIONS PROTOCOLS	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP	Bisync, DNA, Ethernet, SNA, 2780/3780, 3271, X.25, X.400, LU6.2, TCP/IP
PURCHASE PRICE					
System Building Blocks	$522,375 to $554,400	$543,900 to $695,200	$821,100 to $872,550	Not applicable	Not applicable
Preconfigured Systems	$522,375 to $554,400	$543,900 to $592,200	$821,100 to $872,550	$2,698,500 to $2,950,500	$5,031,600 to $5,502,000

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

large corporate users that seek to integrate the entire organization with hardware systems and applications packages based on a common, comprehensive architecture

Cultivating this first-class image, however, is exacting a price, literally speaking, from Digital's VAX 8000 customer base. Twice in the past nine months, the company made significant price changes designed to attract new commercial users into the proprietary VAXBI computing web and then take advantage of that captive user. The first wave of repricing, which occurred in March 1987, was intended to attract new commercial users to the product line. Digital cut VAX 8000 entry level prices by approximately 15 percent with the introduction of the VAX 8250, 8350, and 8530 (upgrades and replacements for the VAX 8200, 8300, and 8500, respectively). Simultaneously, prices were raised on the higher-end systems, making up for revenue lost at the low end by increasing costs to users that need to upgrade from their existing VAX-11 or low-end VAX 8000 system to a larger machine.

In August 1987 Digital announced a second wave of repricing, *claiming* to have reduced prices on the low-end and mid-range systems (the 8250, 8350, 8530, and 8550) from 4 to 6 percent. Prices were increased at the high end (the 8700, 8800, and 8900) by about 5 percent. Prices were also increased by about 5 percent on nearly all other Digital hardware and software (excluding the slow-moving MicroVAX 2000s, on which prices were reduced by up to 20 percent).

8350, and 64M-byte modules are available for the VAX 8530, 8550, 8600, 8650, 8700, and 8800.

CYCLE TIME: Depending on the operation, main memory cycle times on VAX 8000 systems range from 135 to 1600 nanoseconds. Refer to Chart A for the cycle times of individual machines.

CAPACITY: Main memory capacities range from 4M to 2G bytes. All VAX 8000 systems provide up to 4G bytes of virtual memory space. For the main memory capacities of specific VAX 8000 systems, refer to Chart A.

CHECKING: Information unavailable from the vendor.

STORAGE PROTECTION: The system's memory management logic divides memory into 512-byte pages. Each page is assigned a protection code specifying which, if any, access modes are to be permitted read or write access to the page. In addition, fault detection hardware causes a memory error-correcting code to detect all double-bit errors and correct all single-bit errors. Each VAX 8000 features a 7-bit error-correcting code per 32-bit longword.

Battery backup is standard on the VAX 8600, 8650, 8700, 8800, 8974, and 8978; it is optional on the 8250 and 8350.

RESERVED STORAGE: Minimum reserved storage for the VAX/VMS operating system is 2M bytes on the VAX 8600 and 8650 VAXclusters with the CI780 Computer Interconnect (CI). Information on other models is unavailable from the vendor.

CACHE MEMORY: All VAX 8000 systems include cache memory. Refer to Chart A for cache sizes on specific machines.

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CHART B. MASS STORAGE

MODEL	RA60	RA81	SA482	RL02	RC25
Type	Removable	Winchester	Storage Array	Cartridge	Fixed/Removable
Controller model	UDA50, KDA50, KDB50, HSC5X-BA (on HSC70 or HSC50)	UDA50, KDA50, KDB50, HSC5X-BA (on HSC70 or HSC50)	UDA50, KDA50, KDB50, HSC50, HSC70	Integrated	Integrated
Drives per subsystem/controller	4	4	—	4	2
Formatted capacity per drive, megabytes	205	456	2.5GB	10.4	26/26
Number of usable surfaces	6	7	32	2	—
Number of sectors or tracks per surface	1600 tracks	2496 tracks	—	512 tracks	—
Bytes per sector or track	512/sector	512/sector	512/sector	256/sector	—
Average seek time	41.7 ms	28 ms	24 ms/spindle	55 ms	35 ms
Average rotational/relay time	8.3 ms	8.3 ms	8.3 ms/spindle	12.5 ms	10.5 ms
Average access time	50 ms	36.3 ms	32.3 ms/spindle	67.5 ms	45.5 ms
Data transfer rate	1.98MB/sec	2.2MB/sec	2.4MB/sec/spindle	512KB/sec	1.25MB/sec
Supported by system models	All	All	All	8600, 8650	All
Purchase price	$19,425 to $22,470	$16,800 to $21,000	$88,200	$7,455	$6,195
Comments				Not supported as system disk; data transfer device only	Not supported as system disk; data transfer device only

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

More is going on here, however, than a simple repricing. When Digital reduced prices on the entry-level VAX 8000s, system configurations were adjusted to include more memory. Base memory was increased from 8M bytes to 16M bytes on the 8250, from 12M bytes to 32M bytes on the 8350, and from 16M bytes to 32M bytes on the 8530. Configured with the additional memory, an entry-level base configuration or System Building Block (SBB) is *more* expensive than the previous comparable configuration and SBB, which are no longer listed in the price book. For example, in March the VAX 8250 SBB with 8M bytes of memory and one-year VAX/VMS and DECnet licenses was available for $65,000. In August, this 8M-byte SBB model was replaced with the 16M-bytes SBB model listed at $72,450. So the price decrease is actually a price increase. The price of the new configurations including the additional memory *is* lower, were a customer to purchase the memory separately and add it to the previously available base configuration, but the customer is required to make a larger initial outlay and pay for additional memory that perhaps may not be needed at the time of purchase, if ever.

The same is true at the high end of the product line, where base memory was increased from 32M bytes to 48M bytes on the VAX 8700 and from 48M bytes to 64M bytes on the 8800. In March, an 8700 SBB with 32M bytes and one-year VAX/VMS and DECnet licenses was priced at $433,000. This 32M-byte SBB model has been replaced by a 48M-byte model priced at $543,900. So even though Digital claims only a 6 percent increase on the 8700s, the customer must actually pay 25 percent more now than in March to purchase an 8700 SBB.

This strategy, bordering on retailer bait-and-switch techniques, is simply an extension of Digital's overall pricing strategy: announce price reductions on strategic systems to attract new customers, but find other ways to make up the difference.

Digital also claims that its customers are compensated for price increases by new high-capacity memory modules,

CENTRAL PROCESSOR

GENERAL: All VAX 8000 CPUs feature virtual memory management facilities; bootstrap loader; cache memory; programmable realtime clock; time-of-year clock with battery backup; control store; and console subsystem. The VAX 8530, 8550, 8600, 8650, 8800, 8974, and 8978 CPUs employ Emitter Coupled Logic (ECL) gate array circuitry; the 8250 and 8350 use ZMOS technology.

The VAX 8250 and 8350 feature 200-nanosecond cycle times. The 8250 is a single-board CPU with a built-in hot floating-point accelerator. The system uses a VAXBI memory interconnect and incorporates testing checks and diagnostic facilities. The 8350 is a dual-CPU system that delivers up to 1.9 times the performance of the 8250. It is basically the same as the 8250, except that it incorporates a second CPU module and VAX/VMS support facilities. Main memory is sharable by both processors over the VAXBI system bus.

The VAX 8530 employs four-stage pipelining; the VAX 8550, which offers 1.5 times the processing power of the 8530, employs five-stage pipelining. On both systems a three-way interleaved memory controller and private memory bus reportedly provide average read and write bandwidths in excess of 50M bytes per second.

The VAX 8600 and 8650 CPUs employ four-stage pipeline processing. The VAX 8600 achieves a CPU cycle time of 80 nanoseconds; the cycle time of the VAX 8650 is 55 nanoseconds. The VAX 8600 and 8650 CPUs interface to their respective memory controllers through a dedicated memory bus called the MD-Bus. The memory controller, in turn, interfaces to the main memory arrays over the Array Bus. The CPU also features a system diagnostic bus and incorporates self-monitoring and error-testing programs.

The VAX 8700 CPU employs five-stage pipelining and achieves a 45-nanosecond cycle time.

The VAX 8800, comprising two tightly coupled CPUs sharing a memory controller, uses a five-stage pipelining scheme to deliver a CPU speed of 45 nanoseconds. The internal CPU-to-memory bus transfers data at 60M bytes per second. In case one of the VAX 8800 processors fails or suffers intermittent faults, the system can be reconfigured as a uniprocessor until remedial maintenance is performed.

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based on 1M-bit chips, that quadruple the memory capacity on the 8250 and 8350 and double the memory capacity of the 8530, 8550, 8700, and 8800 systems. Such memory enhancements are reputed to improve system throughput dramatically, by up to 40 percent, and thus should extend the life of a system before a true processor upgrade is required to handle increased processing loads. They result in better performance for certain applications because more data is stored in memory and is more readily accessible than data stored on disk. This is a real benefit to commercial users that deal with large amounts of data.

Memory enhancements also benefit technical users that run memory-intensive engineering and scientific applications. Increased memory, however, does not increase the speed of the system's internal CPU functions. Instead, technical users would be helped much more if Digital delivered parallel processing systems that make much better use of the large memory capacities.

COMPETITIVE POSITION

Digital bases its competitive strategy on selling directly against IBM—a far cry from the coexistence once espoused. Then, Digital primarily sold engineering and scientific systems to the corporate marketplace and avoided direct confrontation with IBM among commercial computing buyers.

Digital's dynamic product strategy throughout 1986 and 1987 took full advantage of IBM's vulnerability at the mid-range systems level. While IBM developed the initial versions of its 9370, Digital was busy populating the market with its VAX 8000s—11 hardware- and software-compatible systems were announced within 16 months—continually putting itself in the spotlight at a time when IBM only promised equal connectivity among its own divergent product lines. By August 1987, when IBM finally began volume shipments of the 9370, Digital already had a line of fully compatible VAX 8000 systems on the market. Digital responded to the 9370 shipments by announcing the (supposed) price cuts on the low-end VAX 8000 systems that compete directly with the 9370 models being shipped.

Following the 8250, 8350, and 8530 introductions in March 1987, Digital refocused its product strategy. The company turned to its entry-level MicroVAX and VAXstation, strengthening those product lines against the influx of competition from new Intel 80386-based PCs, the IBM PS/2, and technical workstations from Sun Microsystems and Apollo Computers. In September, Digital returned its focus to the mid-range with the introduction of the MicroVAX 3000s, which fill the processing gap between the MicroVAX II and the VAX 8000 entry-level systems, and overlap the processing capabilities of systems at the entry point to the VAX 8000 line. The MicroVAX 3000s also compete directly with the 9370 Models 20 and 40 shipped in August.

The VAX 8974 and VAX 8978 are VAXcluster configurations consisting of four and eight VAX 8700 CPUs, respectively. The CPUs are loosely coupled, each having its own memory and running its own copy of the operating system. (See CONFIGURATION RULES for a more detailed discussion of VAXclusters.)

Internal diagnostic facilities, invoked either locally through the system console or remotely from a Digital Service Center, are intrinsic to the VAX 8530, 8550, 8700, 8800, 8974, and 8978.

System Performance Enhancement packages are available to upgrade an 8200 (no longer marketed) or 8250 to an 8350, an 8530 to an 8550, and an 8700 to an 8800. The 8200 to 8350 package requires replacement of the system's existing 8200 CPU with two upgraded 8250 CPUs. The 8250 to 8350 package requires the addition of a second CPU module. These upgrade packages are available with either 4M bytes of memory alone or 4M bytes of memory and a 456M-byte RA81 disk drive.

The 8530 to 8550 package requires replacement of the existing CPU and backplane with new CPU modules and backplanes. This upgrade package is available with either 16M bytes of memory alone or 16M bytes of memory and two RA81 disk drives.

The 8700 to 8800 package requires the addition of one CPU module. This upgrade package is available with either 16M byte of memory alone or 16M byte of memory and a 2.5G-byte SA482 storage array.

An upgrade kit is also available to upgrade the 8600 to the 8650.

CONTROL STORAGE: The control store sizes on the VAX 8000 systems are as follows:

- **VAX 8250—15K 40-bit words of ROM, plus 1K 40-bit words of RAM.**
- **VAX 8350—Same as 8250 for each processor.**
- **VAX 8530/8550—16K 144-bit words writable and 1K 144-bit words user accessible.**
- **VAX 8600/8650—8K 86-bit words writable.**
- **VAX 8700—16K 144-bit words writable.**
- **VAX 8800—16K 144-bit words writable on each processor.**
- **VAX 8974/8978—16K 144-bit words writable on each processor.**

REGISTERS: The VAX systems provide sixteen 32-bit general registers that can be used for temporary storage, as accumulators, as index registers, and as base registers. A base register contains the address of the base of a software data structure such as a table or queue, and an index register contains a logical offset into a data structure. Whenever a register is used to contain data, the data is stored in the register in the same format as it would appear in memory. If a quadword or double floating operand is stored in a register, it is actually stored in two adjacent registers.

Four registers have special significance: the Program Counter contains the address of the next instruction to be

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CHART C. WORKSTATIONS

MODEL	VT220	VT240	VT241	VT320	VT330	VT340
DISPLAY PARAMETERS						
Max. chars./screen	3,168	3,168	3,168	3,168	3,168	3,168
Buffer capacity	—	—	—	—	19K characters	19K characters
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132
Tilt/swivel screen	Tilt standard	Standard	Standard	Optional	Standard	Standard
Symbol formation	7 x 10 dot matrix	8 x 10 dot matrix	8 x 10 dot matrix	7 or 12 x 7 dot matrix	8 or 9 x 11 (80 col.); 4 or 5 x 9 (132 col.)	8 or 9 x 11 (80 col.); 4 or 5 x 9 (132 col.)
Character phosphor	White, green, or amber	White, green, or amber	P4	White, green, or amber	White, green, or amber	White, green, or amber
Total colors/no. simult. displayed	Not applicable	Not applicable	—	Not applicable	4 shades of gray	4,096/16
KEYBOARD PARAMETERS						
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character/code set	ASCII, Digital Special Graphics and Supplemental	ASCII, Digital Special Graphics and Supplemental	ASCII, Digital Special Graphics and Supplemental	ASCII, NRCS, ISO Latin 1, Digital Special Graphics and Supplemental	ASCII, NRCS, ISO Latin 1	ASCII, NRCS, ISO Latin 1
Detachable	Yes	Yes	Yes	Yes	Yes	Yes
Program function keys	15	15	15	15	15	15
TERMINAL INTERFACE	RS-232-C, RS-423, and 20 mA std.	RS-232-C, RS-423, and 20 mA std.	RS-232-C, RS-423, and 20 mA std.	DEC-423, RS-232-C	DEC-423, RS-232-C	DEC-423, RS-232-C
PURCHACE PRICE	$609	$2,079	$3,129	$545	$1,990	$2,935
COMMENTS		800 x 240 pixel graphics array	800 x 240 pixel graphics array; includes color monitor	1200 by 300 pixel resolution	800 x 500 pixel graphics array; supports split-screen viewing, ReGIS, Sixels, Tektronix 4010/4014	800 x 500 pixel graphics array; supports split-screen viewing, ReGIS, Sixels, Tektronix 4010/4014

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

Having experienced a lull in the announcements of new VAX 8000s, the industry was surprised that Digital did not introduce the expected "VAX 8400" in September at DECworld. Rather than include the 8400 in the avalanche of other products announced at its proprietary show, Digital apparently was waiting to react to the October volume shipments of IBM's 9370 Model 90. However, at this writing (late October), the industry is still awaiting Digital's announcement of the next mid-range addition to the VAX 8000 line.

The current lull in product announcements could be interpreted as a deliberate slowdown by Digital—some industry analysts predict that Digital must eventually run out of steam and lose some of the market share gained from IBM. It is Datapro's opinion that Digital is guarding against a market loss by conserving its strength and picking its spots more carefully now, announcing systems that really offer something new rather than just make more noise. Digital must take care now to time product introductions to counteract IBM's actions (to zig when IBM zags), and not to deluge the market with systems that offer minor increases in processing power at a time when other vendors are increasing their MIPS ratings by leaps and bounds.

For instance, a VAX 8400, expected to be rated at 3 MIPS, would offer approximately 1 MIPS more than the existing 2+ MIPS 8350. In addition, a 3-MIPS 8400 would run into significant competition from Digital's recently announced MicroVAX 3000s, which average 3.2 MIPS of processing power. Digital intends the 3000s to be as successful as the industry-favorite MicroVAX II and would certainly not do

executed; the Stack Pointer contains the address of the base (or top) of a stack maintained for subroutine and procedure calls; the Frame Pointer contains the address of the base of a software data structure stored on the stack and called the stack frame, which is maintained for procedure calls; and the Argument Pointer contains the address of the base of a software data structure called the argument list, which is maintained for procedure calls.

In addition, the first six registers have special significance for instructions whose execution must be interruptible, including character and packed decimal string instructions, cyclic redundancy check, and polynomial instructions. These instructions use the first six registers to store temporary results and, upon completion, leave results in the registers that a program can use as the operands of subsequent instructions.

A register's special significance does not preclude its use for other purposes, except for the Program Counter. The Program Counter cannot be used as an accumulator, as a temporary register, or as an index register.

ADDRESSING: The processor's addressing modes allow almost any operand to be in a register or in memory, or used as an immediate constant. There are nine basic addressing modes that use the general registers to identify the operand location: Register; Register Deferred; Autodecrement; Autoincrement; Immediate; Autoincrement Deferred; Absolute; Displacement; and Displacement Deferred. The processor also provides Literal Mode addressing.

INTERRUPTS: Each VAX 8000 processor recognizes 31 interrupt priority levels—16 for hardware and 15 for software. Normal user software runs at the process level, which is interrupt priority level zero.

The interrupt service routine executes at the interrupt priority level of the interrupt request. When the processor

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CHART D. PRINTERS

MODEL	LXY12	LP25	LP27	LG01/LG02
Type	Dot matrix	Band	Band	Matrix
Speed	300 lpm	300 or 300/215 lpm	1,200/800 lpm	600 lpm
Bidirectional printing	No	Not applicable	Not applicable	—
Paper size	—	Up to 15 inches	Up to 18.75 inches	4-16 in wide, 3-20 in long
Character formation	Variable	Full	Full	Dot matrix
Horizontal character spacing (char./inch)	Variable	Variable	10	Variable
Vertical line spacing (char./inch)	—	6 or 8	6 or 8	—
Character set	96 or 192	64 or 64/96	64/96	64 (data proc. mode)
Controller/Interface	LP11, RS-232-C, DMF32, DMB32	LP11, DMF32, DMB32	Integrated, DMF32, DMB32	RS-232-C, Data-products parallel
No. of printers per controller/interface	—	—	—	—
Printer dimensions, in. (h x w x d)	46.5 x 30 x 24.3	43.8 x 30.3 x 33.6	49 x 35 x 38	38 x 33.5 x 22.3
Graphics capability	Yes	No	No	LG02 only
Purchase price	$13,335	$12,180	$34,020	$13,454 (LG01); $16,695 (LG02)
Comments				LG01 text printer upgradable to LG02 text/graphics printer

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

CHART D. PRINTERS (Continued)

MODEL	LN03	LN03 Plus	LPS40
Type	Laser	Laser	Laser
Speed	8 ppm	8 ppm	40 ppm
Bidirectional printing	Not applicable	Not applicable	Not applicable
Paper size	8.5 x 11 inches	8.5 x 11 inches	7.5 to 11 in. wide; 10.5 to 17 in. long
Character formation	300 x 300 dots/in.	300 x 300 dots/in.	Electrophotographic
Horizontal character spacing (char./inch)	Variable	Variable	Variable
Vertical line spacing (char./inch)	Variable	Variable	Variable
Character set	ASCII; 16 resident Courier/Elite fonts	ASCII; technical; 17 resident fonts	29 resident typefaces
Controller/Interface	RS-232-C	RS-232-C	—
No. of printers per controller/interface	1	1	—
Printer dimensions, in. (h x w x d)	15 x 21 x 23.5	15 x 21 x 23.5	40.4 x 60 x 28.4
Graphics capability	150 dpi (average)	300 x 300 dpi	300 x 300 dpi
Purchase price	$3,670	$5,245	$60,795
Comments		Includes PLOTLN software and 2 EPROMs	Ethernet-based print server suitable for local area networks

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

anything to handicap those systems' opportunities in the marketplace.

The industry and user communities are also awaiting the introduction of new systems at the high end of the product line, where Digital really needs to focus some attention. The VAX 8700 is over a year old and has not yet received its expected mid-life kicker, the so-called VAX 8750. The VAX 8800 is nearly two years old. Since Digital targets these systems at its captive technical computing user base, they are not marketed and upgraded as actively as the systems targeted at the more competitive commercial markets.

Digital is being threatened, however, by minisupercomputer vendors such as ELXSI, Alliant, and Sequent, which also target systems at engineering and scientific users. Digital fears that some of its existing users will convert to minisupercomputer products if Digital doesn't address their needs for more processing power on the VAX 8000s.

receives an interrupt request at a level higher than that of the currently executing software, the processor honors the request and services the new interrupt at its priority level. When the interrupt service routine issues the Return from Exception or Interrupt (REI) instruction, the processor returns control to the previous level.

OPERATING ENVIRONMENT: Configuration one (with a 12-slot backplane) of both the VAX 8250 and 8350 is 42 inches (106 cm.) high, 22 inches (54 cm.) wide, and 32 inches (81 cm.) deep and weighs 400 pounds (180 kg). Configuration two (with a 24-slot backplane) of both the 8250 and 8350 is 42 inches (106 cm.) high, 29 inches (73 cm.) wide, and 32 inches (81 cm.) deep and weighs 500 pounds (230 kg.). Each system has a power requirement of 92 to 132 V AC or 184 to 264 V AC, 47 to 63 Hz, single-phase. Maximum AC power consumption is 1.69 kilowatts. Maximum heat dissipation is 5,760 Btu per hour.

Both the VAX 8530 and 8550 are 60 inches (152 cm.) high, 27 inches (68.5 cm.) wide, and 30 inches (76 cm.) deep and weigh 650 pounds (295 kg.). Power requirements are 180 to

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CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	TA78	TU78	TA81	TU80	TU81-Plus
TYPE	Reel-to-Reel	Reel-to-Reel	Streaming	Streaming	Streaming
FORMAT					
Number of tracks	9	9	9	9	9
Recording density, bits per inch	1600/6250	1600/6250	1600/6250	1600	1600/6250
Recording mode	PE/GCR	PE/GCR	PE/GCR	PE	PE/GCR
CHARACTERISTICS					
Controller model	HSC5X-CA (on HSC70 or HSC50)	TA78 master (on HSC5X-CA) or MASSBUS adapter	HSC5X-CA (on HSC70 or HSC50)	UNIBUS adapter	UNIBUS or VAXBI adapter
Drives per controller	4 per HSC5X-CA	3 per TA78 or 32 on MASSBUS adapter	4 per HSC5X-CA	1	—
Storage capacity, bytes	40M PE, 145M GCR	145M GCR	40M PE, 145M GCR	40M	—
Tape speed, inches per second	125	125	75 and 25 (streaming)	25 and 100 (streaming)	75 ips
Data transfer rate, units per second	200KB PE; 781KB GCR	781KB	468KB	160KB	—
Streaming technology	No	No	Yes	Yes	Yes
Start/stop mode; speed	Not applicable	Not applicable	Yes; 25 ips	Yes; 25 ips	—
Switch selectable	Yes	Yes	—	No	—
PURCHASE PRICE	$59,430	$54,705 (master); $29,400 (slave)	$32,970	$14,280	$28,665 (UNIBUS); $30,765 (VAXBI)

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

In this more narrowly defined market, system performance and functionality are often more important than conversion costs and purchase prices.

Digital has confirmed plans to develop its own minisupercomputer with vector processing capabilities. In the mean time, it signed marketing agreements with Floating Point Systems and Cray Research to develop better communications between these vendors' minisupercomputers and the VAXs. In addition, a cooperative marketing agreement with Star Technologies allows Digital to market Star's array processor for use with the VAX.

At the extreme high end of the VAX 8000 line, the introduction of the VAX 8974 and 8978 signified Digital's intention to compete with IBM at the mainframe level. The industry is waiting for Digital to make its next move in this direction by introducing a *real* mainframe computer system, rather than the loosely coupled VAXcluster configurations of 8700s, upon which the VAX 8900s are currently based. The previously mentioned vector processing minisupercomputer being developed will be targeted specifically for technical applications. What Digital really needs so that it gains credibility against IBM in the corporate mainframe market is a system that addresses commercial mainframe processing.

Digital's future product and marketing strategies will, of course, be affected by the October stock market crash. Many corporations will undoubtedly tighten their data processing budgets and either wait to make new system purchases or purchase less expensive systems from smaller vendors. To remain competitive, Digital must be ready to respond accordingly by lowering its own system prices.

Digital must also offer more alternatives to new system purchases. Some users will be looking to make do with what they have and settle for small increases in performance by adding more memory, utilizing CPU upgrades,

220 VRMS, 59 to 61 Hz; 331 to 407 VRMS, 49 to 51 Hz; or 360 to 443 VRMS, 49 to 51 Hz, all triple-phase. Maximum AC power consumption is 3.2 kilowatts; maximum heat dissipation is 12,000 Btu per hour. The system occupies 5.6 square feet of space; noise level is 6.2 dBA.

The VAX 8600 and VAX 8650 each stand 60.5 inches (153.7 cm.) high, 73.5 inches (186.7 cm.) wide, and 30 inches (76.2 cm.) deep. Both weigh 1,700 pounds (773 kg.). Power requirements are 120/208 V AC, 47 to 63 Hz, triple-phase. Power of 240/415 V AC, 50 Hz is also available. Maximum AC power consumption is 6.5 kilowatts. Heat dissipation is 22,200 Btu per hour on the 8600 and 23,000 Btu on the 8650. Maximum noise generated by the 8600 is 60 dBA. The VAX 8600 and 8650 can be positioned on either a solid or raised floor, because both can draw air under the skirt of the machine as well as through the floor.

The VAX 8700 and VAX 8800 are both 60 inches (152 cm.) high, 74 inches (188 cm.) wide, and 30 inches (76.2 cm.) deep; each occupies 15.5 square feet of space. Weight with a 60-Hz power supply is 1,474 pounds (668 kg.); a 50-Hz system weighs 1,769 pounds (802 kg.). Power requirements for the VAX 8800 are 156 to 220 VRMS, 59 to 61 Hz, or 360 to 443 VRMS, 49 to 51 Hz, triple-phase. Surge current is 500 Amp for 60 Hz and 250 Amp for 50 Hz. Maximum power consumption is 3.7 kilowatts. Maximum heat dissipation is 12,600 Btu per hour.

The VAX 8974, a complete VAXcluster configuration, occupies 312 square feet and weighs 8,780 pounds (3,951 kg.). The VAX 8978, also a VAXcluster configuration, occupies 603.25 square feet and weighs 17,410 pounds (7,834.5 kg.). Power consumption on the VAX 8974 is 60 kVA, 20 kW; that on the VAX 8978 is 115 kVA, 40 kW. Maximum heat dissipation is 58.86K Btu per hour for the VAX 8974 and 117.72K Btu per hour for the VAX 8978.

Operating temperature for all VAX 8000 systems is 59 to 90 degrees Fahrenheit (15 to 32 degrees Celsius). Relative operational humidity for the 8250, 8350, 8600, and 8650 is 20 to 80 percent, noncondensing; that for the 8530, 8550, 8700, 8800, 8974, and 8978 is 10 to 90 percent, noncondensing. (A VAX 8250 not using an RX50 diskette operates at 50 to 104 degrees Fahrenheit—10 to 40 degrees Celsius—at 10 to 90 percent humidity, noncondensing.) Maximum altitude for all systems is 8,000 feet (2,400 meters).

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or installing multiple processors on an existing system. The Configuration 2 of both the VAX 8250 and 8350 carries a 24-slot backplane that accommodates additional processors. By offering support for multiprocessor configurations and system upgrades, Digital might partially recoup losses from a decline in new system purchases. Digital may also decide to begin offering the higher capacity disk drives that its users are seeking.

As for competing with IBM in the mid-range market, a number of factors come into play. The good news for Digital is that its departmental system is less expensive than IBM's. Customers with tight budgets will be attracted to the better price/performance ratios of the Digital systems. Of course, users will also be looking for better prices within Digital's own product lines as well and may be more inclined to buy the less expensive MicroVAX 3500 or 3600 than a VAX 8250 or 8350. On the other hand, users may be more willing to wait. If, by the time they're ready to buy, IBM's promised connectivity products are available, the competitive picture will take on an entirely different perspective.

It is particularly unfortunate for Digital that the market crash came just when it intended to step into the mainframe market as well as make a stronger showing with its low-end products. The expansion of its product lines at the both the high and low ends is considered crucial to Digital's image as a total systems provider and to the company's continued success in corporate commercial computing. Research and development efforts will certainly be cut back now in accordance with lowered demand, somewhat hampering Digital's attempts to compete with IBM beyond both ends of the mid-range markeplace.

ADVANTAGES AND RESTRICTIONS

The VAX 8000s' most notable assets are their common I/O architecture and networking capabilities. All systems but the VAX 8600 and 8650 (which will slowly be phased out) are based on the VAXBI, which features a throughput rate of at least 13.3M bytes per second (and higher aggregate rates if multiple VAXBIs are configured)—a great improvement over the 1M to 2M bytes per second throughput rate of the UNIBUS implemented on earlier VAX models. By basing newer VAX 8000 systems on the VAXBI, Digital is committed to keeping the VAX 8000 systems as the company's pacesetters for 32-bit computing, protecting users' investments in VAX products for years down the line. The VAXBI also allows easy movement of peripherals from one system to another—including UNIBUS-based systems through UNIBUS adapters—simplifying the allocation and management of computer resources and also protecting users' investments in peripherals purchased to operate in a VAX 8000 environment.

Digital's emphasis on networking and communications is a distinct advantage for the VAX 8000 systems. The company's IBM/SNA connectivity products and other networking software provide gateways to IBM mainframes

INPUT/OUTPUT CONTROL

The input/output information provided here is for systems running under VAX/VMS; ULTRIX-32 systems use the same I/O control devices, but are more restricted as to the number that can be configured.

The newer VAX 8000s are based on the VAXBI I/O architecture which is superceding the older MASSBUS and UNIBUS I/O architectures upon which the VAX 8600 and 8650 are based.

The *VAX Bus Interconnect (VAXBI)*, a 32-bit synchronous bus, serves as a combination system and I/O bus on the VAX 8250 and 8350 and as the I/O bus only on the 8530, 8550, 8700, 8800, 8974, and 8978, all of which employ a high-speed memory interconnect as the system bus.

In the VAXBI bus, all arbitration, address, and data transmissions are time-multiplexed over 32 data lines. Physical address space is 1G bytes. The maximum data transfer rate, as implemented by the Bus Interconnect Interface Chip (BIIC), is 13.3M bytes per second for 16-byte transfers.

The VAXBI provides connection for up to 16 VAXBI nodes. A VAXBI node consists of one or more VAXBI modules. A node is a VAXBI interface that occupies 1 of 16 logical locations on a VAXBI bus; it can be a mix of processors, memories, and adapters. Processor nodes execute machine instructions, access memory, and control the action of adapters. Memory nodes store instructions and data for, and respond to the read and write transactions issued by, processors and adapters. Adapter nodes transfer data to and from memory and accept control from processors.

Types of VAXBI adapters include mass storage adapters, which provide high-speed data transfers to and from VAXBI memory nodes; bus adapters, which permit connections to Digital's UNIBUS options, to VAXclusters, and to the private memory interconnects on other VAX processors; and communications adapters, which link the VAXBI to Ethernet local area networks and provide communications between modems and terminals in VAXBI systems.

The BIIC, a single ZMOS interface chip, is the primary interface between the VAXBI bus and the user interface logic on each node. The BIIC implements the VAXBI bus protocol. The VAXBI chip interface, or BCI, is a synchronous interface bus that provides all communications between the BIIC and the user interface.

The VAXBI bus provides a built-in multiprocessing capability, as well as self-test and error control functions.

The VAXBI supports the following adapters:

- ***CIBCI*—a high-speed interface to the Computer Interconnect, which is used to create VAXclusters; data can be transferred between the VAXBI and the CIBCI at 2M bytes to 3M bytes per second.**
- ***DB88*—interface between the Memory Interconnect (MI) bus and the VAXBI bus on the 8530, 8550, 8700, 8800, 8974, and 8978. The DB88 is the principal I/O path to VAXBI-based disk storage, terminals, and other peripheral devices. DB88s can be added to increase the number of VAXBI channels on a system.**
- ***DMB32 Communications Adapter*—transfers data between host processors on the VAXBI bus and various**

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and strengthen department-level VAX 8000 systems as intermediaries between mainframes and personal computers. Digital also provides a product that implements the LU6.2 protocol, the linchpin in peer-to-peer communications with IBM systems and among all types of hardware. Digital's MAILbus, a set of distributed applications software, links Digital's ALL-IN-1 users, IBM SNA Distribution Services (SNADS) and Distributed Office Support System (DISOSS) users, and users of other X.400-compliant mail systems into a global electronic messaging network.

In the realm of non-IBM communications, the VAX OSI Transport Service and the Message Router X.400 Gateway simplify information exchange both among multivendor systems in a network and among different networks, linking disparate systems that support International Standards Organization (ISO) Open Systems Interconnect (OSI) protocols. These products will prove particularly useful in the future, as more vendors introduce products that conform to the ISO/OSI model. With its announcement of Phase V of the Digital Networking Architecture (DNA) Digital continues to espouse full compatibility with the ISO/OSI model.

Digital's principal networking product is DECnet, which allows creation of Ethernet local area networks and wide area networks centered around VAX/VMS-based Digital systems. The company recently announced support for OSI-standard Ethernet on unshielded twisted-pair wire (telephone wire), allowing an organization to install an Ethernet network using its existing wiring scheme. Digital's Internet products permit interconnection of Digital computers and Digital networks to systems built by IBM and other manufacturers.

The VAX 8000s feature a high degree of software compatibility. Because all systems run the VMS operating system, applications are transportable among systems from the bottom of the line to the top. This congruent operating environment actually provides a dual advantage: it allows users to migrate upward to more powerful single systems without altering their applications and also permits networked systems users to load applications up, down, and across the systems on the network, as the computing requirements of the organization dictate. It also provides software compatibility with the MicroVAX systems and with VAXstations, which run under the MicroVMS superset.

VMS also includes support for VAXclusters—configurations of up to 16 processors and intelligent storage subsystems. A single application can be used across every processor in a VAXcluster, with shared files, allowing multiple users to access the same data. A VAXcluster can be expanded incrementally by adding VAXcluster building blocks and storage to the existing configuration. Clustering also provides load balancing among the processors and a measure of fault tolerance through processor failover and automatic dual-ported disk failover for Hierarchical Stor-

communications interfaces. For further details on the DMB32, see the COMMUNICATIONS CONTROL section of this report.

- *DWBUA*—VAXBI-to-UNIBUS adapter; transfers data between the high-speed, synchronous VAXBI and the asynchronous UNIBUS. Maximum data transfer rate is approximately 1M bytes per second.

- *KDB50*—an intelligent disk controller that connects up to four Standard Disk Interconnect (SDI) drives to VAXBI systems. The KDB50 provides throughput rates as high as 1M bytes per second.

- *KLESI*-B—connects a host to a tape or disk device (such as Digital's TU81 streamer or RC25 Winchester disk) using the Low End Storage Interconnect (LESI).

The VAXBI provides a bandwidth of 13.3M bytes per second on the VAX 8250 and 8350. The VAX 8530 and 8550 support two VAXBI channels, which provide an aggregate I/O rate in excess of 16M bytes per second. The VAX 8700 and 8800 permit configuration of four VAXBI channels and deliver a usable I/O bandwidth of up to 30M bytes per second. The 8974 supports up to 16 VAXBIs for an aggregate I/O rate of 212.8M bytes per second. The 8978 supports up to 32 VAXBIs for an aggregate I/O rate of 425.6M bytes per second.

All VAX systems support *UNIBUS*, an asynchronous bidirectional bus, which controls all Digital- and user-developed realtime peripherals other than high-speed disk drives and magnetic tape transports. UNIBUS is connected to the memory interconnect through the UNIBUS adapter. The UNIBUS adapter handles priority arbitration among devices on UNIBUS. UNIBUS adapters may be placed on the memory interconnect as follows: 1 on the VAX 8250, 8350, 8530, and 8550; up to 7 on the VAX 8600 and 8650; up to 2 on the VAX 8700 and 8800; up to 8 on the 8974; and up to 16 on the 8978.

The UNIBUS adapter provides access from the VAX processors to the UNIBUS peripheral device registers by translating UNIBUS addresses, data transfer requests, and interrupt requests to their memory interconnect equivalents, and vice versa. The UNIBUS adapter includes an address translation map.

The VAX 8600 and 8650 support the *MASSBUS* adapter, which is used to attach high-speed disk or magnetic tape devices and perform control, arbitration, and buffering functions. Up to four MASSBUS adapters can be attached to each of those systems. Each VAX MASSBUS adapter includes its own address translation map and 32-bit data buffer.

The *Hierarchical Storage Controller (HSC)* family is a series of intelligent servers for high-speed disks and tapes, primarily in VAXclusters. (For details on VAXclusters, see the CONFIGURATION RULES section of this report.) These controllers conform both to the Digital Storage Architecture (DSA) standard and to the Systems Communication Architecture (SCA); the latter architecture specifies the methods and protocol for communications among clustered systems.

The HSC connects to the host system through Digital's Computer Interconnect (CI), a serial bus with a bandwidth of 70M bytes per second; the CI features a dual-path interface to hosts in a cluster. The port onto the CI bus can support a sustained 4.2M bytes per second transfer rate.

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age Controller (HSC) storage controllers. Digital plans to pursue the implementation of fault-tolerant capabilities on the VAX 8000s in order to market the systems more effectively in online transaction processing markets.

The availability of the ULTRIX-32 operating system for all of the VAX 8000s is also advantageous, for it allows users to choose between the realtime VMS and timesharing UNIX environments, depending upon their application requirements. Though based on Berkeley UNIX, ULTRIX-32 has features that provide compatibility with AT&T's UNIX System V—the version of UNIX around which most supermicro, mini, and supermini vendors are converging. Thus, it increases the possibility of application portability between ULTRIX-based VAX systems and System V-based computers.

Digital's leasing scheme for VMS software on the VAX 8000s (excepting the 8600 and 8650) is a very good feature, for it gives VAX users an alternative to outright purchase. Leasing permits the distribution of costs at regular intervals over a period of time; in addition, the 90-day cancellation provision allows users to try software before committing to it.

On the hardware service side, a one-year warranty is available on all Digital hardware, deferring the time users must begin paying maintenance fees. A one-year warranty, even on the obsolescent 8600 and 8650, is needed to compete against IBM. At the time of purchase, customers can elect to extend their hardware warranties up to three years. In addition, Digital's guaranteed two-hour service response for all VAX 8000s but the 8250 and 8350 is commendable, signaling the company's commitment to providing maximum uptime for its mid-range and large-system users. Users looking for a lower end system to run critical applications, however, should keep in mind that the VAX 8250 and 8350 are guaranteed only a four-hour service response time.

Limited upgradability within the product line could be a problem for users that expect to expand system performance. Digital has made available kits to upgrade the 8200 and 8250 to the 8350 and the 8530 to the 8550. Upgrade kits are also available for upgrading the 8600 to the 8650 and the 8700 to the 8800. Also, each 8700 processor in an 8900 configuration can be upgraded to an 8800. No upgradability is possible, however, between low-end, mid-range, and high-end systems (e.g., the 8250 cannot become an 8550), necessitating replacement of the processor box if a user wants to upgrade to a more powerful processor or increase the number of VAXBIs beyond the number supported by the existing system.

The cross-system peripheral compatibility, combined with the VAXclustering concept, compensates somewhat for the lack of direct system upgradability, allowing the incremental development of more powerful multisystem con-

The HSC servers use the Standard Disk Interconnect (SDI) and the Standard Tape Interconnect (STI) to attach disk drives and tape formatters. The SDI and STI buses both support burst transfer rates up to 3.1M bytes per second.

The two members of the HSC family are the HSC70 and the HSC50. According to Digital, the former is designed for mid-range to high-end cluster configurations and for standalone VAX 8650 and 8800 processors. The latter is intended more for low-range to mid-range VAX processors and clusters.

The HSC70 allows up to eight data channels, providing direct support for up to 32 RA-series disk drives; up to 16 can be Digital's TA-series tape formatters. The HSC70 can support up to eight SA482 storage arrays. The HSC50 can directly support up to 24 devices through six data channels.

In the VAX 8600 and 8650, the interface between the memory controller and the Synchronous Backplane Interconnects (SBIs)—the TTL logic subsystems that control I/O—is handled through the *DB86 SBI Adapters*, which are connected to the Adapter Bus, or A-Bus. Those adapters control the asynchronism between the CPU cycle and the slower SBI cycle. One SBI is standard on the system; an optional second SBI supports up to eight more adapters. The VAX 8600 can support up to 11 SBI adapters; the 8650 can support up to 12.

CONFIGURATION RULES

***System Building Blocks (SBBs)* are available for the VAX 8250, 8350, 8530, 8550, 8600, 8650, 8700, and 8800. SBBs can be added to the already configured VAX 8974 and 8978. SBBs begin with a core of components: CPU; main memory; cabinet, disk/tape controllers, and, in some cases, other controllers; and VAX/VMS or ULTRIX-32 operating system license. To the core of the SBB the user must add selections from the mass storage (system device and load device), communications interface, and console terminal menus; selections from the software and software services menus are optional. (See EQUIPMENT PRICES, at the end of this report, for further details on SBBs.)**

A *VAXcluster* is a multiprocessing system composed of one or more VAX 8000 (and/or VAX-11/750, 11/780, and 11/785) processors and/or HSC Hierarchical Storage Controllers running under VAX/VMS and connected by a high-speed Computer Interconnect bus. Each processor or HSC in the configuration is considered a node. The smallest VAXcluster configuration can be two VAX processors connected by an interconnect and a Star Coupler. An HSC is not required for a cluster; VAX/VMS allows locally connected disks to be shared by VAXcluster users.

Available for VAXclusters is a VAXcluster Console System, linked to nodes in the cluster through fiber optic facilities. The Console System, based on Digital's MicroVAX II, allows system management operations to be performed from any terminal, local or remote, attached to it. The VAXcluster Console System typically comprises a MicroVAX II computer with 5M bytes of memory, a 71M bytes RD53 disk drive, a TK50 cartridge tape drive, a DEQNA Ethernet-to-Q-bus synchronous communications controller, eight serial lines, fiber optic converters and power supply, fiber optic cable, and associated software.

In general, VAXclusters are based on *VAXcluster SBBs*, of which there are two types. The first type is a basic system element, which consists of a CPU with memory, a Computer Interconnect, an HSC storage controller, a Star Cou-

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figurations and homogenous networks. Also, the availability of UNIBUS adapters enables attachment of peripherals used with older UNIBUS-based systems.

Another restriction, however, is the limited VAXBI licensing extended to third-party vendors, resulting in only a few vendors now offering products for the VAXBI-based systems. Licensed vendors are provided VAXBI interface chip design information only as long as they do not manufacture products too similar to those offered by Digital. Nonlicensed vendors must design their own interface chip to be able to connect their products to the VAXBI. Thus, customers may be forced to buy add-on and peripheral devices from Digital and pay more than if they purchased from a third-party vendor. Also, the possibility of technological improvements coming out of third-party shops is limited—a disadvantage considering the inferior reputation of Digital's mass storage devices. Digital's strategy is not intended simply to maintain its own peripheral sales, but also to standardize controllers and peripherals to alleviate some of the service problems in maintaining and servicing networked systems.

Limited VAXBI licensing could encourage users to continue buying the 8600, 8650, and high-end configurations of MicroVAX systems, which are based on the open UNIBUS technology, thus holding back sales of the more strategic VAXBI systems. Digital is steadily closing down this avenue however, by gradually removing the UNIBUS-based peripherals from the market.

The inclusion of additional memory in all VAX 8000 SBBs and preconfigured systems is also an attempt to shut out third-party add-on memory vendors. Last March and again in September Digital dramatically cut its add-on memory prices in order to compete more effectively. By automatically providing more memory with all new systems Digital further limits third-party vendors' opportunities to sell to the Digital user base. The ultimate disadvantage, however, is to the Digital end user. Once Digital realizes full control of the memory aftermarket, the company will begin raising its memory prices again.

USER REACTION

Datapro's 1987 Computer Users Survey received responses from seven VAX 8600 and 8650 users and from nine users of the newer VAX 8000 systems. Because of their architectural differences and because Digital is phasing the 8600 and 8650 out of the product line, ratings for these two groups of systems were tabulated separately and are listed in two separate tables below.

The following table shows the ratings for the VAX 8200, 8300, 8500, and 8800. At the time the survey was conducted the 8250, 8350, and 8530 had not yet been announced.

pler, a disk/tape interface, and VAX/VMS and DECnet licenses. The second type of VAXcluster SBB is an upgrade to an existing VAXcluster. The upgrade consists of a CPU with main memory, a Computer Interconnect, and VAX/VMS and DECnet licenses; mass storage devices and a console terminal must also be ordered. VAXcluster SBBs are available for the 8250 up through the 8800.

The VAX 8250, 8350, 8530, 8550, 8700, 8800, 8974, and 8978 are also available in several preconfigured systems.

GENERAL: The configuration rules provided here are for SBBs under VAX/VMS. Systems operating under ULTRIX-32 use the same components, but configurability is more limited.

Two types of configurations are available for the VAX 8250 and 8350. Configuration one provides a 12-slot backplane; configuration two provides a 24-slot backplane.

VAX 8250 or 8350 SBBs consist of the following:

- **CPU; dual CPUs on 8350**
- **16M bytes of memory on the 8250; 32M bytes of memory on the 8350**
- **Integral floating point**
- **VAXBI Ethernet communications interface**
- **KDB50 disk controller**
- **One year hardware on-site warranty**
- **Available VAXBI expansion slots: six on 8250 configuration one; 18 on 8250 configuration two; four on 8350 configuration one; 16 on 8350 configuration two**

An 8250 or 8350 VAXcluster SBB is the same as the respective VAX SBBs but includes a VAXcluster port and one set of CI cables. It does not include the KDB50 disk controller.

The preconfigured 8250 and 8350 are similar to the respective SBBs but also include an LA100 console terminal with stand; RA81 disk drive; TU81-Plus tape drive; and a DMB32 communications controller and cabinet kit (on configuration two only).

Options for the 8250 and 8350 include memory up to 128M bytes, available in 4M bB and 16M increments; battery backup; VAXBI disk controllers; HSC storage controllers and disk and tape interfaces; additional 205M-byte RA60 and 456M-byte RA81 disk drives; tape drives; and one UNIBUS adapter.

The 8250 and 8350 also support up to two DMF32 8-line communications controllers, two DMZ32 24-line communications controllers, four DHU11 16-line communications controllers, two DMR11 synchronous interfaces, and an 8-line DMB32-M communications printer controller. They also support DECserver 100 or 200 eight-line Ethernet terminal servers.

The VAX 8530 and 8550 SBBs consist of the following:

- **CPU**
- **32M bytes of memory on the 8530; 48M bytes on the 8550**
- **Integral floating point processor**
- **One VAXBI channel**
- **A KDB50 disk controller**
- **A VAXBI Ethernet communications controller**
- **Console subsystem**
- **One-year hardware on-site warranty**
- **Two available VAXBI expansion slots**

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	Excellent	Good	Fair	Poor	WA*
Ease of operation	4	5	0	0	3.44
Reliability of system	5	2	2	0	3.33
Reliability of peripherals	5	1	3	0	3.22
Maintenance service:					
Responsiveness	5	4	0	0	3.56
Effectiveness	5	1	2	0	3.38
Technical support:					
Troubleshooting	4	4	1	0	3.33
Education	4	5	0	0	3.44
Documentation	4	4	0	1	3.22
Manufacturer's software:					
Operating system	5	4	0	0	3.56
Compilers & assemblers	4	5	0	0	3.44
Application programs	2	7	0	0	3.22
Ease of programming	3	6	0	0	3.33
Ease of conversion	2	5	2	0	3.00
Overall satisfaction	4	5	0	0	3.44

*Weighted Average on a scale of 4.0 for Excellent.

The following table shows the ratings for the VAX 8600 and 8650.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	4	2	1	0	3.43
Reliability of system	5	2	0	0	3.71
Reliability of peripherals	1	6	0	0	3.14
Maintenance service:					
Responsiveness	3	3	1	0	3.29
Effectiveness	2	4	1	0	3.14
Technical support:					
Troubleshooting	1	6	0	0	3.14
Education	2	5	0	0	3.29
Documentation	5	2	0	0	3.71
Manufacturer's software:					
Operating system	5	2	0	0	3.71
Compilers & assemblers	6	1	0	0	3.86
Application programs	4	2	0	0	3.67
Ease of programming	3	3	0	0	3.50
Ease of conversion	3	3	1	0	3.29
Overall satisfaction	3	4	0	0	3.43

*Weighted Average on a scale of 4.0 for Excellent.

Both groups of VAX systems achieved an Overall satisfaction rating comparable to those systems that received special recognition in the "U.S. User Ratings of Minicomputers and Supermicros" report in *Datapro Reports on Minicomputers*. To qualify for special merit, the systems had to receive an Overall satisfaction of at least 3.20 and no less than 2.80 in all other system ratings categories. Both groups of VAX 8000s met these qualifications but did not meet the third qualification of a minimum of 20 user responses. However, responses received for all the VAXs were fairly consistent, with most categories rated as Excellent or Good. Approximately 78 percent of the newer VAX 8000 users indicated that they would recommend the system to another user; the other 22 percent did not answer the question. Approximately 86 percent of VAX 8600/8650 users said that they would recommend the systems to another user; 14 percent were undecided.

A preconfigured 8530 or 8550 includes the above, as well as a DMB32 communications controller and cabinet kit; RA81 disk drive; and TU81-Plus tape drive.

An 8530 or 8550 VAXcluster SBB is similar to the appropriate SBB, but also includes a VAXcluster port, one set of CI cables, and an expansion cabinet for the VAXcluster port. The 8530 and 8550 VAXcluster SBBs do not include the KDB50 disk controller.

Options for the 8530 and 8550 include additional memory up to 256M bytes in 16M- and 64M-byte increments; a second VAXBI channel; VAXBI expansion box with 11 VAXBI slots; one UNIBUS adapter, UNIBUS expansion box, and UNIBUS backplane; two KDB50 disk controllers; and all other options available for the 8250 and 8350.

The VAX 8600 and 8650 SBBs comprise a CPU cabinet and a CPU front-end cabinet. The CPU cabinet contains the following:

- **CPU**
- **The memory controller**
- **4M bytes of memory on the 8600; 16M bytes on the 8650**
- **One DW780 UNIBUS adapter**
- **One DB86 SBI adapter**
- **RB86 integrated disk and tape controller**
- **One-year hardware on-site warranty**

The CPU cabinet contains dedicated space for a CI780 Computer Interconnect, an FP86 floating-point accelerator, a second UNIBUS adapter, and a second SBI adapter. Up to eight adapters can be connected to the second SBI. The front-end cabinet includes the console, disk, and UNIBUS expansion box.

Main memory in the VAX 8600 and 8650 CPU cabinets can be expanded to 128M bytes in 4M-, 16M-, and 64M-byte increments.

The two 8600-series systems can support the DHU11, DMF32, and DMZ32 asynchronous interfaces and the DEUNA, DMP11, DMR11, DR11-W, and DUP11 communications interfaces; the maximum number of those devices is dependent on total communications requirements and other considerations.

The VAX 8700 SBB consists of the following:

- **CPU**
- **48M bytes of memory**
- **Battery backup**
- **Integral floating-point processor**
- **One VAXBI bus**
- **KDB50 disk controller**
- **VAXBI Ethernet communications interface**
- **Console subsystem**
- **One-year hardware on-site warranty**

A preconfigured 8700 includes the SBB and a DMB32 communications controller, RA81 disk drive, and TU81-Plus tape drive. An 8700 VAXcluster SBB includes the same features as the SBB, as well as a VAXcluster port and set of CI cables.

Options available for the 8700 include additional memory up to 256M bytes in 16M- and 64M-byte increments; three additional VAXBI buses; two UNIBUS adapters; and all communications devices, mass storage controllers, and disk and tape devices available for use on the other VAX systems.

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While attending the VAX Business User Forum (sponsored by *Digital NEWS*, a publication of the International Data Group), Datapro interviewed Basil Fedynyshyn, the Director of Information Systems at Health Care Services (HCS), located in Bala-Cynwyd, Pennsylvania. HSC provides a mail service prescripton drug plan to large corporations.

HSC started out with a PDP-11/44 and migrated upward to two VAX-11/780s. One was dedicated to production and the other to development. In October 1986, the company installed a VAX 8300 and at that time linked the 780s and the 8300 together in a VAXcluster. The 780s are now dedicated to production, while the 8300 is used for development.

When asked what he liked most about the VAX 8300, Fedynyshyn indicated the additional computational capability provided by the system's dual processors. He hopes to magnify this processing power by adding additional processors once Version 5 of VAX/VMS becomes available to support symmetric multiprocessing on the system.

The only drawback Fedynyshyn experienced was slow installation of the 8300. At the time the system was installed, Digital was announcing so many new products that there was some confusion in the coordination of field services in the area. Also, being one of the first 8300s installed in the Philadelphia area, the system was somewhat unfamiliar to field personnel. He believes Digital has now straightened out these problems.

Fedynyshyn would like to see Digital add more online transaction processing (OLTP) efficiences to its systems (Digital is currently targeting the OLTP market and integrating OLTP capabilities into VAX/VMS). He would also like Digital to offer optical disk storage and larger disk drives.

Fedynyshyn has noticed a change in Digital's marketing strategies over the past five years. When he first began using Digital systems he dealt primarily with OEMs. Then Digital account reps began turning up regularly to sell everything from terminals to software to systems. Now, he says, unless a user is buying a big system, Digital just sends a quote and expects the user to buy the item at the purchase price, no questions asked.

He has also noted Digital's strategy of cutting prices at the entry point and raising prices at the high end in an attempt to increase overall margins. He believes Digital's solutions are worth the extra money for some computing situations, and he certainly considers Digital's service and support worth the extra cost. He said that he is confident that Digital will continue to provide the solutions his company requires.

When asked what advice he would give to a prospective buyer of the VAX 8300, Fedynyshyn replied that he would recommend Digital. The company offers a wide range of growth and excellent field service, he said. He

A VAX 8800 SBB consists of the following:

- **Tightly coupled dual CPUs**
- **48M bytes of memory**
- **Battery backup**
- **Integral floating-point processor**
- **Two VAXBI channels**
- **VAXcluster port and set of CI cables**
- **VAXBI Ethernet communications interface**
- **Console subsystem**
- **One-year hardware on-site warranty**

Options for the 8800 include additional memory up to 256M bytes, available in 16M- and 64M-byte increments, two additional VAXBI channels, and two UNIBUS channels. Two slots in the first VAXBI channel are used for the Computer Interconnect port; one slot in the second VAXBI channel is used for the DWBUA UNIBUS interface. One DWBUA is allowed on any given VAXBI channel. The 8800 can also support two DMF32 communications controllers, one DR11 UNIBUS interface, and one DMR11 synchronous interface. The 8800 supports all communications devices, storage controllers, disk and tape drives available for the other VAX systems.

The VAX 8974 and 8978 are, respectively, 6- and 12-node VAXclusters. The VAX 8974 consists of the following:

- **Four 8700 CPUs**
- **128M bytes of memory, expandable to 1G bytes in 16M- and 64M-byte increments**
- **VAXcluster Computer Interconnect in each processor**
- **Four VAXBIs, expandable to sixteen**
- **An Ethernet adapter in each processor**
- **Two HSC70 I/O processors**
- **One 2.4G-byte SA482 storage array**
- **12 disk and two tape channels**
- **TA78 tape drive**
- **System console**
- **One-year hardware on-site warranty**

The VAX 8978 consists of the following:

- **Eight 8700 CPUs**
- **256M bytes of memory, expandable to 2G bytes in 16M- and 64M-byte increments**
- **VAXcluster Computer Interconnect in each processor**
- **Eight VAXBIs, expandable to 32**
- **An Ethernet adapter in each processor**
- **Four HSC70 I/O processors**
- **Two 2.4G-byte SA482 storage arrays**
- **24 disk and four tape channels**
- **Two TA78 tape drives**
- **System console**
- **One-year hardware on-site warranty**

The VAX 8974 and 8978 support all communications, disk, and tape devices available for the other VAX systems. These two systems can be expanded by adding preconfigured VAX systems or SBBs. The systems also accommodate two UNIBUS channels per processor, providing support for UNIBUS-based peripherals.

WORKSTATIONS: Digital contends that the number of users supported by any system depends on the type of application and the associated demands on the processor and bus. Consequently, the company shies away from stating maximums, except for the 8600 and 8650, for which it has cited 512 terminals as the most that can be locally connected, with more available through terminal servers; the local connection/terminal server combination is applicable to all systems. However, Digital does provide typical workstation ranges for each VAX 8000 system, cutting

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does find Digital weak in the availability of graphics software, and the spreadsheet applications software is not extraordinary, but is good enough to get by with if you want to go with Digital. □

across a range of different applications. Refer to Chart A for the range for each system.

Digital also states that for large numbers of users or in distributed environments, Ethernet is the most efficient means of handling user interconnection.

DISK STORAGE: The KDB50 disk controller supports up to four RA60 (205M fixed/removable) and RA81 (456M Winchester) drives in any combination. The number of KDB50s configurable on each VAX system is as follows:

- VAX 8250: two on configuration one; four on configuration two
- VAX 8350: one on configuration one; three on configuration two
- VAX 8530/8550: four
- VAX 8700/8800: eight
- VAX 8974: 32
- VAX 8978: 64.

On the VAX 8600 and 8650, one RB86 disk controller is integral to the system. Each system can support up to 13 UDA50 UNIBUS disk controllers; each UDA50 controls up to four RA60, RA81, or RA80 (no longer marketed) drives, in any combination. The first UNIBUS supports only one UDA50; each UNIBUS thereafter supports two. The 8600 and 8650 also allow configuration of one RL02 (10.4M-byte cartridge) disk subsystem per computer. (The RL02 is not used as a system disk, but, rather, as a data file-resident device for transport of data to or from other Digital computer systems.)

The intelligent HSC70 and HSC50 storage controllers can be attached to the VAX 8000 systems through the Computer Interconnect. The HSC70 supports eight HSC5X-BA disk and HSC5X-CA tape interfaces (32 RA-disk devices, or 8 SA482s) in any combination; the HSC50 supports six (24 devices). Each HSC5X-BA disk interface supports up to four RA60 and RA81 drives in any combination, or one SA482 storage array.

MAGNETIC TAPE: The VAX 8250 and 8350 each support one or three TU80 UNIBUS tape drives depending on the type of configuration (configuration one or configuration two). The 8530, 8550, 8700, and 8800 each allow configuration of four TU81-Plus VAXBI tape units.

The 8600 and 8650 permit attachment of four TU81 tape subsystems (no longer marketed) per UNIBUS; each computer supports up to seven UNIBUS adapters. Eight tape devices per MASSBUS adapter can be configured on both the 8600 and the 8650; each system supports up to four MASSBUS adapters. Tape devices can also be connected through the HSC70 and HSC50.

As stated in the MASS STORAGE subsection, the HSC70 and HSC50 controllers, attachable to all VAX 8000 systems through the Computer Interconnect, support eight and six HSC5X-CA tape interfaces, respectively. Each HSC5X-CA supports four TA78 and TA81 tape drives in any combination. The HSC70 and HSC50 can each support up to eight TA81, TA78, and TU78 add-on units in any combination. (A TA78 can control three TU78s.)

PRINTERS: Up to 16 line printers can be supported on each VAX 8000 system. On the VAX 8250, 8350, 8530, 8550, 8700, and 8800, each printer must connect to an asynchronous line or to a DMF32 (on the 8250, 8350, or 8800) or DMB32 (on the 8530) controller. A maximum of two DMF32 or DMB32 printer ports can be used per system.

MASS STORAGE

For information on available mass storage devices for VAX systems, please refer to Chart B, Mass Storage.

The SA482—included with the VAX 8974 and 8978 but available for use on the other VAX systems—consists of four 622M-byte RA82 disk drives and provides 2.488G bytes of disk storage. The KDB50, KDA50, and UDA50 controllers each connect one SA482; the HSC50 connects six SA482s; and the HSC70 connects eight SA482s.

INPUT/OUTPUT UNITS

Refer to Chart C for terminals, Chart D for printers, and Chart E for magnetic tape equipment.

OTHER PERIPHERALS: VAX systems also support printing terminals, a pen plotter, and a voice synthesis module.

The LA100 is a microprocessor-controlled hard copy terminal and printer; it can print up to 240 cps in draft mode, 30 cps in letter-quality mode, and 80 cps in memo mode. The LA120 is a 180 cps printing terminal. Those two printing terminals constitute the console options for the VAX 8000 systems.

The LVP16, a six-color graphics pen plotter with print speeds up to 15 ips, is supported by all VAX systems that use HP-GL graphics software. The LVP16 holds up to six pens and prints up to six colors without manual intervention; it includes an RS-232-C interface.

DECtalk, a speech synthesis unit, converts standard ASCII text into speech output. The unit features 10 voices (9 predefined and 1 user defined). Available in single- and eight-line versions, DECtalk uses an RS-232-C interconnection for each line. DECtalk accepts input from a Touch-tone telephone keypad and provides voice output through a built-in speaker, headphones, audio jack, or telephone. The eight-line version is upward-compatible with the single-line version.

COMMUNICATIONS CONTROL

The variety of communications interfaces supported by the VAX/VMS operating system allows VAX systems to be connected to other VAX systems, to other Digital systems, and to other manufacturers' computer systems. Synchronous, point-to-point, and multipoint connections are supported for interprocessor communications. For terminal-to-host communications, asynchronous connections are supported. While systems running under ULTRIX-32 use the communications control devices discussed below, the models and the number of lines that can be configured vary from those available for VAX/VMS-based systems.

The *DMB32 Communications Controller* is an intelligent device for VAXBI systems. It includes eight full-duplex asynchronous ports, one synchronous port, and one line printer interface. The asynchronous and synchronous ports are fully programmable and provide full modem control. The synchronous ports support DDCMP, HDLC, SDLC, and IBM Bisync protocols.

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The *DMF32 Communications Controller* is an intelligent device that enables a combination of modems and terminals to communicate with UNIBUS-based VAX systems. The unit contains three basic elements: an eight-line asynchronous interface for operation with modems and terminals; a single-line synchronous interface for connection to a network communications facility; and a parallel interface for either a line printer (in DMA mode) or a user-developed device. The DMF32 uses DMA mode and first-in/first-out (FIFO)buffers. Only the asynchronous lines of the DMF32 are supported under ULTRIX-32.

The *DHU11 Asynchronous Multiplexer* interfaces up to 16 asynchronous lines to any VAX computer with an integral UNIBUS operating under VAX/VMS. It connects to external equipment through RS-232-C and RS-432-A interfaces and features Direct Memory Access (DMA) and first-in/first-out (FIFO) operations. The DHU11 can provide half- or full-duplex communications. It is programmable for split speeds on each of its lines and provides full modem control on all channels.

The *DMZ32 Asynchronous Multiplexer* supports up to 24 asynchronous lines to UNIBUS VAX computers. The DMZ32 has 24 RS-232-C connectors and allows DMA and FIFO operations; it permits half- or full-duplex communications.

The *DMR11* network link is a single-line synchronous interface for local and remote support. It implements DDCMP in hardware and supports direct memory access data transfers, DECnet point-to-point configurations, and full modem control. The DMR11 can communicate with another DMR11 or synchronous interface implementing DDCMP.

The *DR11* is a general-purpose digital interface that permits bidirectional 16-bit parallel transfers between a user's device and the UNIBUS; the interface is also available in a long-line version.

The *DEBNA Ethernet Controller* connects VAXBI systems to both Ethernet V.2.0 and IEEE 802.3 local area networks. The DEBNA supports one Ethernet port, providing physical and data link communications layers, and has up to 5M bits per second of peak hardware throughput capability.

The *DELUA Ethernet-/IEEE 802.3-to-UNIBUS Communications Controller* connects UNIBUS VAX 8000 systems to both Ethernet and IEEE 802.3 LANs. The microprocessor-based DELUA operates at 10M bps and allows 4M bps throughput.

The *H4000 Ethernet Transceiver* is a device that provides the functional interface between the Ethernet coaxial cable and Ethernet nodes. The H4000 station transmits signals onto and receives signals from the cable and detects any message collisions that may occur.

The *H4005 Ethernet/IEEE 802.3 Transceiver*, a replacement for the H4000, physically attaches to an Ethernet coaxial cable; it meets Ethernet and IEEE 802.3 LAN specifications. It accommodates devices that require heartbeat, that is, verification that collision detection circuitry is working through a test of the circuitry at the end of each transmission. The 4005 can also be field-configured to accommodate devices that do not permit heartbeat.

The *DELNI Local Network Interconnect (LNI)* allows up to eight Ethernet-compatible devices (not terminals) to be grouped together. The LNI can be configured three ways: standalone, hierarchical standalone, and connected.

The *DECSA Ethernet Terminal Server* is a network terminal switch that supports the simultaneous operation of up to 32 terminals at speeds up to 19.2K bps full-duplex. The Terminal Server employs the Local Area Transport (LAT) software protocol for intersystem operations; the protocol is supported under the VAX/VMS operating system. It also provides logical terminal connections to hosts that do not employ LAT protocols. The DECSA server is available in 16- and 32-terminal versions.

DECserver 100 is a network terminal switch that connects up to eight asynchronous terminals to one or more service nodes (hosts) on an Ethernet. Transmission is at speeds between 75 and 19.2K bps. DECserver 100 supports split-speed (transmit and receive) terminal operation, block-mode transfers, and X-on/X-off handling, among other features.

DECserver 200 provides all the features of DECserver 100 and is available in two versions—DECserver 200/ Modem Control (MC) and DECserver 200/Data Leads (DL). DECserver 200/MC provides modem control and monitoring, an RS-232-C line interface, LED-enhanced visual communications monitors, and connection to non-LAT (Digital's Local Area Transport) hosts. DECserver 200/DL does not support modems or applications with devices that require modem control signals; it is intended for applications utilizing the DECconnect cabling system.

SOFTWARE

OPERATING SYSTEMS: Operating systems for the VAX systems are the general-purpose VAX/VMS and ULTRIX-32, Digital's version of Berkeley UNIX.

VAX/VMS is a general-purpose operating system that provides the environment for the concurrent execution of multiuser timesharing, batch, and time-critical applications. It also contains special features for VAXcluster support and provides programming tools, scheduling services, and protection mechanisms for multiuser program development.

Under VAX/VMS, applications can be divided into several independent subsystems whose data and code are protected from one another but which have general communications and data sharing facilities. Jobs can communicate using general, group, or local communications facilities.

Jobs can be scheduled as time-critical jobs that have strict priorities of execution. When a time-critical job is ready to execute, it executes until it becomes blocked or until another time-critical job of higher priority needs the resources of the processor. Normal jobs can be scheduled using a modified preemptive algorithm that ensures that they receive processor and peripheral resources at regular intervals commensurate with their processing needs.

If insufficient memory is available for keeping concurrently executing jobs resident, the operating system will swap jobs into and out of memory to allocate each its share of processor time. Time-critical jobs can be locked in memory to ensure that they can be started up rapidly when they need to execute.

The I/O request processing system is optimized for throughput and interrupt response. The operating system provides the user with several data accessing methods, from logical record accessing for device-independent programming to direct I/O accessing for rapid data processing. Files can be stored in any of several ways to optimize subsequent processing.

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The VAX/VMS operating system's own jobs run as independent activities. They include the Job Controller, which initiates and terminates user processes and manages spooling; the Operator Communications Manager, which handles messages queued to the system operators; and the Error Logger, which collects all hardware and software errors detected by the processor and the operating system.

A command interpreter executes as a service for interactive and batch jobs. It enables the general user to request the basic functions that the operating system provides, such as program development, file management, and system information services.

Both hardware-detected and software-detected exception conditions are tracked through the exception dispatcher, which passes control to user-programmed condition handlers or, in the case of system-wide exception conditions or the absence of user routines, to operating system condition handlers.

The operating system's memory management routines include the virtual activator, which controls the mapping of virtual memory to system and user jobs, and the pager, which moves portions of a process into and out of memory as required. They respond to a program's dynamic memory requirements and enable programs to control their allocated memory, share data and code, and protect themselves from one another. The scheduler controls the allocation of processor time to system and user jobs.

The operating system's I/O processing software includes interrupt service routines, device-dependent I/O drivers, device-independent control routines, and user-programmed record processing services.

For system and data security, VAX/VMS provides password and login limits to control access to the system; methods of defining data access; operator interface facilities that allow different classes of operators to be defined; and security auditing capabilities for monitoring unusual or suspicious system activities.

VAX/VMS also features user and operator interfaces. The former allows special prompts and command recall and editing, while the latter permits management of batch and print queues.

VAX/VMS incorporates VAXcluster support features that allow the creation of homogenous environments providing transparent cross-cluster data access and resource sharing to loosely coupled systems. Those features include:

- Distributed File System, which manages all files in the VAXcluster as a single entity.
- Distributed Lock Manager, which synchronizes resource use across the VAXcluster.
- Terminal Server support, which allows terminals to be connected flexibly to VAXcluster systems and provides load balancing and availability features.
- Cluster Operator support, which enables a single person to manage an entire VAXcluster.
- Mass Storage Control Protocol server, which allows disks connected locally to a system to be accessed from anywhere in the cluster.
- Cluster-wide balancing, through the Job Controller, of the number of jobs per system.

ULTRIX-32 is Digital's native-mode implementation of the UNIX operating system. It is based on the University of California at Berkeley's Fourth Berkeley Software Distribution (4BSD) and is compatible with AT&T's UNIX System V, Release 2.0. ULTRIX-32 can be used on all VAX systems. ULTRIX-32 supports all VAX, MicroVAX, and VAXstation servers and diskless workstations. Depending upon the application, ULTRIX-32 can support over 64 users.

ULTRIX-32 is an interactive, timesharing system. It employs a demand-paging scheme to take advantage of the virtual memory architecture of VAX systems. It features a hierarchical file system with demountable volumes, sharing of input/output resources among processes, and asynchronous process execution.

ULTRIX-32 incorporates the Source Code Control System (SCCS) from AT&T's UNIX System III, a diagnostic testing facility for loading and testing corrections from an ULTRIX-32 file system, as well as System V interprocess communications mechanisms.

ULTRIX-32 supports UNIX Version 7 Bourne and C shells. Among other features, ULTRIX-32 provides a file transfer utility, backup/restore, file system integrity checking, remote login and job execution, line editors (ex and ed), a screen editor (vi), and text processing utilities.

ULTRIX-32 also has facilities that permit communications among UNIX and non-UNIX systems, including UNIX-to-UNIX Copy facility, allowing point-to-point file transfer between an ULTRIX-32 system and other UNIX systems using the "g" protocol; Ethernet connection between homogenous systems using DEC's Ethernet adapter; ability to communicate with Ethernet networks based on TCP/IP, UDP/IP, ThinWire, and baseband protocols; and a mail utility that allows communications among users in single-user or multinode environments. ULTRIX-32 supports the Digital Network Services Protocol (NSP) if DECnet-ULTRIX is present.

ULTRIX-32 has limited compatibility with ULTRIX-11, the UNIX Version 7-based operating system available for PDP-11 systems. Source programs written in the C language can be passed between the two systems; the systems' Bourne shells are also compatible. VAX processors are capable of directly executing portions of ULTRIX-11-developed UNIX images in compatibility mode.

DATA BASE MANAGEMENT SYSTEM: The data base management facilities available for the VAX 8000 systems are part of a larger scheme called VAX Information Architecture—a collection of data base and data management tools arranged in layers above the operating system.

On the top layer, the VAX languages and VAX Forms Management System (FMS) provide a user interface for interactive and language-callable video forms.

On the next level, the VAX Common Data Dictionary (CDD) integrates the other components of the architecture. The CDD provides a facility for storing logical data definitions. Also on this level are the VAX Datatrieve high-level and distributed data management facilities, which allow access to data without the user's having to specify the means to access it, such as the file type and keys. Datatrieve uses definitions in the CDD that contain information about data characteristics and user needs. The high-level data access facility also supports a "relational join" capability that can be used to dynamically link related records.

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The distributed data access facility retrieves data from remote VAX nodes running VAX Datatrieve. The process is transparent to the user.

The lowest level consists of four online, multiuser data management facilities: VAX Data Base Management System (DBMS), VAX Rdb/VMS, VAX Record Management Services (RMS), and VAX Application Control and Management System (ACMS). The first two products, discussed below, are the actual data base management systems for the VAX 8000 series.

The VAX programming languages are integrated into the information architecture. Language support for high-level access and direct access to VAX RMS files and VAX DBMS data bases is provided through the VAX standard calling interface to VAX Datatrieve.

Some VAX Information Architecture products are offered in bundles, called VAXinfo packages; three are available.

VAX DBMS is a multiuser, general-purpose, Codasyl-compliant data base management system based on the March 1981 Working Document of the ANSI Data Definition Committee. VAX DBMS is used to administer data bases ranging from simple hierarchies to complex, multisystem networks with multilevel relationships. The VAX Information Architecture allows DBMS data to be accessed directly from programming languages through VAX Datatrieve or DBMS utilities. VAX DBMS can operate in a VAXcluster environment and can access remote data bases through DECnet networking software.

VAX Rdb/VMS is a relational data base management system. Unlike VAX DBMS, designed for large, highly structured data bases, the Rdb/VMS system is designed for medium-volume applications in which data items and relationships among records change frequently.

In Rdb/VMS, data is independent of application programs; users can change data definitions without modifying or recompiling their programs. The product can retrieve and update information both from local data bases and from remote data bases through DECnet. The VAX Rdb/VMS system also features a data definition language; an interactive query language; transaction management facilities; data validation functions; transaction recovery facilities; security constraints; and contention arbitration facilities that handle simultaneous attempts to access the same information. VAX Rdb/VMS can work with VAX Datatrieve to access the VAX Rdb/VMS data base interactively; it can also work in conjunction with other VAX information management tools.

VAX Rdb/VMS can operate in a VAXcluster, providing shared data base access, transparent failover, and automatic recovery.

Available for use with Rdb/VMS is *VAX Structured Query Language (SQL)*, a complete data base language that may be used to define and access relational data bases and to manipulate the data stored there. VAX SQL offers an interactive data manipulation language (DML); a data definition language (DDL) utility; preprocessors for VAX Cobol, VAX Fortran, and VAXPL/1; and dynamic SQL.

VAX Data Distributor manages the automated distribution of relational data among multiple processors running VMS. VAX Data Distributor provides two methods of data distribution—extraction and replication. Both methods allow a complete copy or subset of a source data base to be created at a user-specified location. Data can be transferred to the target data base on demand or on a scheduled basis.

LANGUAGES: VAX/VMS provides a native programming environment which consists of language processors that produce native object code and program development tools that support native program development. VAX Fortran, RPG II, Cobol, Dibol, Basic, PL/1, Pascal, Coral 66, Bliss-16, Bliss-32, APL, Digital Standard Mumps (DSM), C, Ada, Lisp, and OPS5 (for artificial intelligence programming) are native-mode language processors that produce native object code and take advantage of the native instruction set and 32-bit architecture of the VAX hardware. A VAX Macro assembler is available.

C, Fortran, and Lisp are available for the ULTRIX-32 operating system.

COMMUNICATIONS: Digital Network Architecture (DNA) is a set of protocols governing the format, control, and sequencing of message exchange for all DECnet implementations. DNA controls all data that travels through a DECnet network and provides a modular design for DECnet. Further information on DNA is included in the "DEC Digital Network Architecture (DNA) and DECnet" report in *Datapro Reports on Minicomputers*. Since the publication of that report, which discusses DNA development up through Phase IV, Digital has announced the beginning of DNA Phase V, which over the next three years will embrace even more of the standards established by the International Standardization Organization (ISO) Open System Interconnect (OSI) model.

Conforming to the ISO/OSI model, DNA consists of the following seven functional layers (corresponding OSI layers are provided in parentheses): User and Network Management (Application); Network Application (Presentation); Session Control

(Session); End Communications (Transport); Routing (Network); Data Link (same in OSI); and Physical Link (Physical).

DNA specifies the interface by which DECnet software modules in the same system interact with one another. Within each node, a layer contains only those modules required to support modules in higher layers.

In addition to defining vertical interfaces, DNA also defines the protocols governing interaction between modules in different nodes. A module in one node communicates only with a module in the same layer that is servicing the same function in another node.

The protocols define the form and content of messages to be exchanged by modules.

Some of the DNA protocols and their functions are:

- Network Information and Control Exchange (NICE) protocol, which defines mechanisms for exchanging network, node, and configuration data and for servicing requests from modules residing in the Network Management Layer.
- The Data Access Protocol (DAP), which defines mechanisms for performing remote file access and remote file transfer on behalf of software modules residing in the Network Management Layer.
- The Network Services Protocol (NSP), which defines a mechanism for creating and maintaining logical links between modules of higher level that reside in the same or different nodes.

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- The Transport protocol, which defines a mechanism for dispatching data to any node in the network via the best possible route.

- The Maintenance Operation Protocol (MOP), which defines mechanisms for transmitting data over a communications channel for downline loading of a remote node, upline dumping from a remote node, testing node and network connections, and starting up an unattended remote node.

- The Digital Data Communications Message Protocol (DDCMP), which defines a mechanism for ensuring the integrity and sequentiality of data transmitted over a communications channel.

DECnet-VAX permits suitably configured VAX/VMS-based systems to participate as routing or end nodes in DECnet computer networks. DECnet-VAX was introduced as a Phase IV network product warranted only for use with other Digital Equipment Phase III and Phase IV products. Now that DNA is in Phase V, DECnet will certainly be upgraded for use with Phase III, IV, and V products. It offers task-to-task communications, file management, downline system and task loading, network command terminals, and network resource-sharing capabilities through Digital Network Architecture (DNA) protocols. DECnet-VAX currently communicates with adjacent and nonadjacent Phase III and Phase IV nodes. Among its features, DECnet-VAX permits area routing for development of networks containing several thousand processors. DECnet-VAX interfaces are standard with VAX/VMS.

DECnet-VAX provides task-to-task communications, access control, remote file access, and terminal-to-terminal communications.

Task-to-task communications is a method of creating a logical link between two tasks, exchanging data between the tasks, and disconnecting the link when the communication is complete.

Access control is the method by which network users are screened before gaining access to network facilities. With the appropriate access control information, a user program can log into a remote system and access any of the remote system's resources.

Remote file access permits exchange of sequential ASCII or binary files. The DECnet software translates the file syntax of the sending node into a common network syntax and then retranslates at the receiving end appropriately for that node.

For terminal-to-terminal communications, a DECnet/VAX utility enables a user to send messages to any VAX system. Messages can be directed to a specific terminal or to the operator's console at the destination node.

Nodes communicate based on some combination of physical and logical capabilities. The physical capabilities for DECnet-VAX are point-to-point, multipoint, and adaptive routing. A point-to-point node communicates only with adjacent nodes to which it is directly connected. A multipoint network party line shares time on one line with several nodes. Routing is a method for sending messages from source to a destination through intermediate nodes.

DECnet-ULTRIX is a Phase IV Ethernet-based end-node implementation of the Digital Network Architecture for the ULTRIX-32 operating system. It provides communications among Digital systems using DNA Phase III or IV protocols and communications, including electronic mail, with non-Digital systems using TCP/IP protocols. DECnet-ULTRIX will be upgraded to comply with DNA Phase V.

DECnet-ULTRIX allows users to transfer data and files between ULTRIX- and VMS-based systems and also permits DECnet and TCP/IP protocols to share system resources, such as Ethernet communications controllers.

Other capabilities of DECnet-ULTRIX are remote resource access from other Digital systems; a network command terminal facility; task-to-task communications between programs on different systems; and interface to network management facilities for the administration and troubleshooting of ULTRIX-based nodes.

Digital's *Internet* family of products supports the interconnection of Digital computers and Digital networks to systems built by IBM and other manufacturers. Members of the Internet family are DECnet/SNA Gateway, DECnet/SNA VMS DISOSS Document Exchange Facility (DDXF), DECnet/SNA VMS Distributed Host Command Facility (DHCF), DECnet/SNA VMS Printer Emulator (PrE), VAX 2780/3780 Protocol Emulator, VAX 3271 Protocol Emulator, and MUX200/VAX.

DECnet/SNA Gateway allows a DECnet network and an IBM Systems Network Architecture (SNA) network to be connected. One version of this product links Digital local area networks to SNA networks, and another connects Digital wide area networks to SNA nets.

VMS/SNA allows VAX systems to directly participate in an IBM SNA network. A VAX running VMS/SNA appears to the SNA network as a remote Physical Unit Type 2 node, providing access to IBM applications programs or other system resources and allowing the VAX to act as a 3270 display station, exchanging documents and electronic mail between the VMS operating system and IBM's DISOSS.

Access Routine software packages are required for both the DECnet/SNA Gateway and a VMS/SNA host for communications with the SNA network. The following Access Routine products are available:

- DECnet/SNA Gateway Management
- DECnet/SNA VMS 3270 Terminal Emulator (3270 TE)
- DECnet/SNA VMS Remote Job Entry (RJE)
- DECnet/SNA Data Transfer Facility
- DECnet/SNA VMS DISOSS Document Exchange Facility
- EDE with IBM DISOSS
- DECnet/SNA VMS Distributed Host Command Facility (DHCF)
- DECnet/SNA VMS Printer Emulator (PrE)
- DECnet/SNA VMS Advanced Program-to-Program Communication (APPC)/LU6.2 Programming Interface
- DECnet/SNA VMS 3270 Data Stream (3270 DS) Programming Interface
- DECnet/SNA VMS Application Programming Interface

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The *DECnet/SNA VMS Printer Emulator (PrE)* allows bulk data transfers from an IBM system to a Digital system for printing. Either an IBM or a Digital terminal user operating in 3270 emulation mode can have a document printed on a Digital printer attached to a local VMS-based VAX system.

The *DECnet/SNA VMS DISOSS Document Exchange Facility (DDXF)* allows VMS-based VAX systems to exchange documents with an IBM host and office systems running in a Distributed Office Support System (DISOSS) environment. It allows both Digital and IBM users to participate in a common office network in which documents can be transferred, edited, and deleted.

The *DECnet/SNA VMS Distributed Host Command Facility (DHCF)* allows IBM 3270-class displays connected to an IBM host running the Host Command Facility (HCF) program product in an SNA network to access VMS-based VAX systems; Digital refers to this connection as the IBM-to-DEC equivalent of 3270 terminal emulation. Through this connection, an IBM network manager can control both the IBM and Digital networks from an IBM display; IBM users can also access mail and perform program development tasks on a VAX system.

DECnet/SNA VMS Advanced Program-to-Program Communications (APPC)/LU6.2 Programming Interface allows VMS-based applications for VAX systems to communicate with IBM host applications on a peer-to-peer basis through the DECnet/SNA Gateway; all DECnet/SNA interconnect functions are transparent to the user.

In *DECnet/SNA VMS Application Programming Interface (API)*, SNA functionality is apparent to the user. The API product is a collection of routines that allows user-written applications running on VAX systems in a DECnet network to exchange information, files, and data with IBM host applications; it is designed for users doing more advanced applications programming with SNA resources and requiring a flexible interface to an IBM application system.

DECnet/SNA VMS 3270 Data Stream Program Interface, specifically designed for 3270 emulation interfaces, enables programmers to develop programs that implement Logical Unit 2 sessions for communications with IBM application programs, build a color graphics interface, and intercept preprocess/postprocess terminal data. In the 3270 Data Stream Program Interface, as in APPC, SNA functionality is transparent to the user.

The *VAX 2780/3780 Protocol Emulator* allows data files to be transferred between VAX systems and other host computer systems capable of using 2780 or 3780 communications protocol. VAX 2780/3780 emulates Binary Synchronous Communications (BSC) protocol, appearing to be an actual IBM 2780 or 3780 remote batch terminal on a point-to-point line. The product can run concurrently on up to four lines, each with a different set of attributes at speeds up to 9600 bps per line.

The *VAX 3271 Protocol Emulator* permits user programs running on VAX systems to communicate interactively with user tasks running on systems with IBM's System/370 architecture. The IBM application program may run under either the IMS/VS or CICS/VS DB/DC system. The Protocol Emulator uses the BSC protocol.

VAX-to-IBM Data Access (VIDA) enables VAX end users to interactively access data on IBM mainframes running the MVS operating system. VIDA employs Digital's VAX Information Architecture and SNA Gateway, as well as Cullinet Software's Information Center Management System (C/ICMS) for IBM-hosted processing.

Mux200/VAX is a VAX-based software package that allows communications with a CDC Cyber series or other host computer system capable of using the 200UT communications protocol. It can be configured to support either the ASCII or the extended BCD versions of the protocol.

VAX Bisync Terminal Support (BTS) is a VAX-based software package that enables VAX/VMS systems to support block-mode synchronous terminals using the Binary Synchronous Communications (BSC) protocol. Bisync terminal users can then either run applications on the VAX system or use the VAX as a pass-through device to access applications on an IBM mainframe.

VAX PSI (Packetnet System Interface) allows suitably configured VAX systems to connect to both private and public Packet Switching Data Networks (PSDNs) conforming to the CCITT X.25 Recommendations for 1978, 1980, or 1984; access to the PSDN is through a PSDN physical connection. Other VAX systems in the same DECnet network can use another package, *VAX PSI Access*, to communicate with the same PSDN.

VAX OSI Transport Service (VOTS) is an implementation of the OSI Transport and Network layers (layers four and three of the OSI model) as defined by ISO 8072, 8073, and 8473. VOTS provides VMS users with a program-to-program interface for exchanging data between a local VAX/VMS system and one or more remote VAX or non-VAX systems that also support corresponding OSI protocols.

Message Router X.400 Gateway is a layered VMS application that provides a communications path between a message router-based network and any other message transport system that conforms to the CCITT 1984 X.400 Recommendations for Message Handling Systems. The X.400 Gateway allows users of mail agents running on a message router, such as Digital's ALL-IN-1 office software, to send messages to other X.400 mail systems in other networks or within the same network. The X.400 Gateway requires VAX PSI and VOTS.

Network Management Control Center (NMCC)/DECnet Monitor is a layered VMS software product that allows all Phase III and IV DECnet systems in a network to be monitored from a single VAX node. The system uses English-like commands and screen displays presenting traffic data, error statistics, and status information both graphically and textually.

NMCC/VAX Ethernim, a VMS layered product, reports the current online status of an entire Ethernet LAN, including non-Digital nodes. The system depicts the network graphically and maintains a historical reference file of events.

VAX/VMS Services for MS-DOS is a software product that allows a VAX 8000 (or a MicroVAX) to act as a server for a group of VAXmate PCs in a DECnet Thinwire network. The product allows resource sharing between VMS and MS-DOS and permits server-based licensing of MS-DOS applications. (Through server-based licensing, Digital licenses applications for a specific number of users on a single server; only one license per server need be purchased, rather than one license per user.)

DECnet System Services (DSS) is a set of products that facilitate access to distributed information and peripherals within a network environment. DSS consists of *VAX Distributed File Service (DFS)*, which provides users with

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transparent access to files stored on remote systems in a DECnet network; *VAX Distributed Queuing Service (DQS)*, which allows any VMS user on any system in a DECnet network to access any printer located anywhere in the network; and *VAX Distributed Name Service (DNS)*, which provides consistent network-wide naming of network resources, allowing DFS users to refer to network resouces using the same name from any system on the network.

UTILITIES: Available for the VAX 8000 systems are a number of utility programs (or, as Digital categorizes them, program development tools), including text editors, a linker, a librarian, a common runtime procedure library, and a symbolic debugger. More specialized products include a code management system, a UNIX-like command line interpreter, a spreadsheet package, a ReGIS graphics library (RGL) package, and a graphical kernel system. These tools are available to the programmer through the VAX/VMS command language.

The text editors can be used to create memos, documentation, and data files, as well as source program modules for any language processor. The linker, librarian, debugger, and runtime procedure library are used only in conjunction with language processors that produce native code.

More specialized tools available for VAX systems are *VAX RSX*, an environmental aid for the development and execution of applications for Digital's PDP-11 minicomputers; *Fortran IV/VAX-to-RSX Cross Compiler*, for the development and execution of RSX Fortran programs for VAX systems with VAX RSX facilities; *RPG II Migration Assistance Service*, allowing IBM System/34 and /36 users to transfer application programs to VAX systems; *VAX RALLY*, *VAX TEAMDATA*, and *VAX Cobol Generator*, three fourth-generation information management products; and *Spatial II*, a specialized data base management product for petroleum exploration and production, utilities, telecommunications, and government applications.

OFFICE AUTOMATION: *VAX ALL-IN-1 Integrated Office and Information System* is a menu-oriented software package that provides office applications such as electronic mail; word and document processing; calendar, time, and desk management; electronic filing; communications; and forms development on VAX/VMS-based systems. The system also features voice messaging support, DECtalk mail access through Touch-tone telephones, and integrated computer-based instruction for all major functions. A flow-control facility allows a user at a VT100, VT200, or VT300 family terminal to select from an option menu, moving from one application to another. The ALL-IN-1 software requires a VAX/VMS system with at least 2M bytes of dedicated main memory.

WPS-Plus/VMS, an ALL-IN-1 application, provides users with DECmate-style "gold key" full-function word processing. It includes scientific/technical character sets accessible from a word processing keyboard and a standard two-dimensional text editor that allows building and editing of equations, diagrams, matrices, and charts. It also incorporates the DECspell spelling checker with advanced linguistics.

MAILbus is a set of distributed applications software that links Digital's ALL-IN-1 users, IBM SNA Distribution Services (SNADS) and DISOSS users, and users of other X.400-compliant mail systems into a global electronic messaging network. MAILbus is composed of the *VAX Message Router/S Gateway* and *VAX Message Router Version 3.0*. The Message Router/S Gateway allows transparent exchange of electronic mail messages, revisable and final form documents, and MS-DOS files among users of Digital and IBM office automation systems networks. It also provides a network server function for the interchange of electronic information between Digital's messaging service and an IBM SNADS environment.

The VAX Message Router provides store-and-forward message transfer. It consists of the Message Router Base, which contains the message transfer system, a gateway directory service, and management services; the Message Router VMSmail Gateway, which interfaces VMSmail to Message Router, supporting VMS-style addressing and converting incoming Digital DX format and WPS-Plus documents into ASCII before delivering them to the VMS user; and the Message Router Programmer's Kit, which provides a set of high-level interfacing routines for writing a user agent, gateway, or other application to run on the Message Router.

VAX DECmail is a standalone, single-node mail and filing system that runs under the VAX/VMS operating system. *DECdx/VMS* is an exchange facility that allows two-way transfer of documents between Digital word processing systems and VAX systems while fully preserving document content and format.

External Document Exchange (EDE) is a VAX-based software package that permits full, two-way document transfer and conversion between a Digital VAX system and a Wang OIS.

EDE with DISOSS is a software product that allows DECdx/VMS and WPS-Plus users to search for, retrieve, file, edit, or delete text contained in an IBM DISOSS document library. Documents can also be created on VAX systems, transformed into IBM final or revisable Document Content Architecture (DCA) DISOSS documents, and filed in an IBM host document library. Conversely, Digital states that EDE with DISOSS transparently converts IBM documents to WPS-Plus or DECdx formats. Both final form and revisable IBM documents can be accessed through EDE menus. Those menus can also be integrated into the ALL-IN-1 main menu system. EDE with DISOSS also includes online help facilities.

According to Digital, EDE with DISOSS provides an interface conforming to Document Interchange Architecture (DIA)/DCA using Logical Unit 6.2, IBM's peer-to-peer communications capability. Prerequisite software includes DECnet-VAX, Gateway Access Routines (incuding those for Gateway Management and DDXF), and DECnet/SNA VMS DISOSS Document Exchange Facility (DDXF).

APPLICATIONS: Digital offers both proprietary and third-party applications packages for VAX systems. The company's External Applications Software (EAS) Library service acquires software from third parties and makes it available through the company's software distribution channels. Software is tested by Digital for operation, documentation, and ease of installation prior to being included in the EAS Library. Software products from the EAS Library are sold on an "as is" unsupported basis, although the author of the software may offer a separate maintenance agreement.

PRICING

POLICY: Digital provides VAX systems on a purchase basis, with separately priced maintenance agreements. Leasing arrangements are available through Digital's U.S. Customer Finance Group.

Digital software is licensed rather than sold. Users purchase licenses and distribution rights separately. A license

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can be purchased outright for all systems. A licensing option available for the 8250, 8350, 8530, 8550, 8700, 8800, 8974, and 8978 is the Periodic Payment License. Through this option the user pays an initial license fee, then makes monthly payments thereafter. The software is licensed with a 90-day cancellation option. The monthly licensing option applies to all Digital-engineered, VMS-compatible software.

Customers ordering the ULTRIX-32 product receive a UNIX binary license directly from Digital. For new VAX system purchasers, an ULTRIX-32 license can be ordered as part of a VAX System Building Block. Current users of Digital's VAX/VMS operating system and VAX users with third-party UNIX licenses can order the ULTRIX-32 license as an add-on product.

SUPPORT: All VAX systems come with a one-year on-site warranty on CPU components and peripherals. The warranty includes system installation; repair parts and labor; Field Change Orders installation; and optional coverage up to 7 days a week, 24 hours a day. The hardware warranty can be extended up to three years.

Digital's Field Service organization offers both on-site and off-site support services for VAX systems.

Standard on-site services include the Basic Service Agreement, the DECservice Agreement, and Per Call service. The Basic Service Agreement includes the following components:

- On-call remedial maintenance from 8 a.m. to 5 p.m., Monday though Friday, excluding locally observed Digital holidays.
- A planned preventive maintenance program.
- All material and labor required to complete repairs.
- Installation of engineering changes.
- Priority response during hours of coverage (typically next day).
- An assigned account representative responsible for system maintenance.
- A Site Management Guide.
- A problem escalation system.
- A fixed monthly charge.
- A minimum term of one year.
- A remote diagnostics capability.

The DECservice Agreement, for higher level support, incorporates the features of the Basic Service Agreement and adds the following provisions:

- An option for extended coverage to 12-, 16-, and 24-hour workdays, as well as for Saturdays, Sundays, and holidays.
- Defined response for calls placed within the contracted hours of coverage.
- Continuous remedial service until the system is fully operational, as long as the call is received within a specific period immediately following system failure.

Support for the VAX 8974 and 8978 also includes preinstallation site evaluation; complete hardware and software installation; one-year on-site software consulting through a resident systems engineer; one year VAXcluster DECsupport Software Product Services; and Educational Services training credits. DECservice is available in the United States without distance restrictions.

In addition, Digital has committed itself to delivering two-hour service response for the VAX 8530, 8550, 8600, 8650, 8700, 8800, 8974, and 8978, as well as a four-hour response for the 8250 and 8350. The response time guarantee is available at no charge to customers located up to 50 road miles from any of Digital's 166 United States service locations.

Per Call Service is available to customers without service agreements, or as a supplementary program for service agreement customers requiring remedial maintenance outside their normal hours of coverage. Per Call Service is available on a best-efforts basis 24 hours a day, 7 days a week. Customers are billed for time and materials; charges are portal-to-portal, with labor, parts, and travel expenses rated separately.

An optional adjunct to Digital's on-site field service, Recover-all, provides full product repair or replacement for equipment damage caused by accidents or incidents normally not covered under service agreements, such as fire or water damage, power failures, and natural disasters. The cost of Recover-all is a percentage of the total monthly service charge of each covered contract line item. Actual charges depend on system configuration and type of service coverage.

Off-site maintenance is available through Digital's Customer Returns Center, Product Repair Center, and Digital Servicenters, which are all equipped with parts inventories, special diagnostic systems, and repair kits.

The Customer Returns Center, in Woburn, Maine, provides service for all products under return-to-factory warranties, as well as for products requiring postwarranty work. The Customer Returns Center services products returned under the DECmailer agreement, which guarantees users a replacement within five working days for any defective board shipped to the center; it also provides as-needed service for modules and subassemblies under Digital's Loose Piece Module Repair Service plan.

The worldwide Product Repair Centers fix and refurbish modules, subassemblies, options, and systems for customers who have some technical expertise but who require additional field service assistance.

Digital Servicenters provide carry-in service for terminal products on a contractual or per-call basis; they also permit over-the-counter module swaps for users who prefer to perform maintenance themselves.

Software support is provided through Digital's Software Services organization; installation, training, telephone support, newsletter, and on-site support services are available.

Digital also offers the DECompatible Service program, through which the company's Field Service organization provides maintenance for over 120 specific non-Digital hardware products linked to Digital systems. The company

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claims that the designated products receive the same response time and service coverage as Digital hardware under standard service agreements.

All warranted VAX software products are covered under a policy guaranteeing that the product conforms to the Software Product Description (SPD) shipped with it. The warranty is included with most VAX software products at no extra charge. Delivery of the warranty is provided through automated and manual problem reporting. Services included in warranty prior to January 2, 1984 have been unbundled; customers can purchase added-value services such as installation, training, telephone support, newsletters, and on-site support separately, or they can select a System Startup Service Package.

System Startup Service Packages provide customers with the system-level support and training required to start up and manage their systems. Currently available only in the United States, the packages provide training, documentation, and software service. The user selects from among three levels of support, based on a number of factors, including computer experience and system use. All three levels include dial-in telephone support, and both the operating system and associated software products purchased with the system are supported. Prices are based on the size and complexity of the system and the level of support required.

Another software support service is the Digital Software Information Network, which enables customers to access informational data bases for help with software problems. The network provides messages that alert users to critical software problems and their solutions, a symptom/solution data base to answer questions on software problems, and a means of submitting questions to Digital support personnel. The network is available at no extra charge to customers in the United States with systems currently under warranty or covered by a DECsupport or Basic Support service contract.

For general support, Digital also sponsors the Digital Equipment Computer Users Society (DECUS), a voluntary, nonprofit users' group. DECUS provides an extensive program library, users' groups, special interest groups, and workshops/symposia. The society is responsible for maintaining the DECUS program library and publishing a library catalog, the proceedings of symposia, and a periodic newsletter.

TRAINING: Digital maintains over 25 training centers worldwide. Courses covering both Digital equipment-related and non-product-related topics are offered. A variety of instructional methods are used, including Digital's Interactive Video Information System (IVIS), which provides system-based instruction. Digital's Educational Services division publishes a digest listing available courses four times a year.

TYPICAL CONFIGURATIONS: Sample configurations for the VAX 8250, 8530, and 8800 are provided in the following tables. Complete hardware and software prices follow these configurations.

VAX 8250:

VAX 8250 VAX/VMS System Building Block; includes CPU; 16MB main memory; hot floating-point; Ethernet interface; KDB50 disk controller; 1-year hardware warranty; paid-up VAX/VMS and DECnet licenses	$ 97,650
LA100-BA hard copy console terminal	2,515
RA81-AA 456MB fixed disk drive	16,800
TU81E 75-ips streaming tape drive	30,765
Two DMB32 8-line communications controllers	7,036
16 VT220-F2(F3) terminals/keyboards with country kits	13,360
LG01-AA 600-lpm matrix text printer	13,545
TOTAL PURCHASE PRICE:	$181,671

VAX 8530:

VAX 8530 VAX/VMS System Building Block; includes CPU; 32MB main memory; hot floating-point; KDB50 disk controller; one VAXBI channel; Ethernet communications interface; console; one-year hardware warranty; paid-up VAX/VMS and DECnet licenses	$342,300
RA81-EA(ED); three 456MB fixed disk drives in cabinet	52,500
TU81E-BA; TU81-Plus 75-ips streaming tape drive	30,765
Five DMB32 8-line communications controllers	17,590
40 VT220-F2(F3) terminals/keyboards with country kits	33,400
Two LG02-AA 600-lpm matrix text/graphics printers	33,390
TOTAL PURCHASE PRICE:	$509,945

VAX 8800:

882CB-AP VAXcluster System Building Block; includes dual CPU; 48MB main memory; battery backup; hot floating-point; two VAXBI channels; VAXcluster port and Computer Interconnect cables; Ethernet communications interface; console; 1-year hardware warranty; paid-up VAX/VMS and DECnet licenses	$ 885,150
SC008-AC Star Coupler	8,663
HSC70-AA intelligent storage controller	57,330
HSC5X-BA(BB) disk interface	10,500
RA81-JA(JD); four 456MB fixed disk drives in cabinet	71,400
HSC5X-CA tape interface	10,500
TA81-AA(AB); two 75-ips streaming tape drives	64,940
Two DMB32 8-line communications controllers	7,036
Two DECSA-DA 32-line Ethernet terminal servers with software licenses	54,936
60 VT220-F2(F3) terminals/keyboards with country kits	50,100
20 VT241-AA color terminals with country kits	67,100
Two LG02-AA 600-lpm matrix text/graphics printers	33,390
LN03 8-ppm laser printer	3,670
TOTAL PURCHASE PRICE:	$1,324,715

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EQUIPMENT PRICES

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
VAX SYSTEM BUILDING BLOCKS (SBBs)				
VAX System Building Blocks (SBBs) are available for all 8000 systems except the VAX 8800. SBBs begin with a core of components: CPU, main memory, cabinetry, and the VAX/VMS or ULTRIX-32 operating system license. To that core the user must add selections from the mass storage (system and load devices), communications interface, and console terminal menus. Choices from the software and software services menus are optional.				
VAX 8800 SBBs				
882BD-BE	VAX 8800 CPU; 64MB of 256K-bit main memory; hot floating-point, battery backup unit; two VAXBI channels; KDB50 disk controller; Ethernet interface; console terminal; one-year hardware warranty; paid-up ULTRIX-32 and DECnet licenses	872,550	2,449	2,916
882BD-EE	Same as 882BD-BE but with one-year ULTRIX-32 and DECnet licenses	821,100	2,449	2,916
VAX 8700 SBBs				
871BD-AE	VAX 8700 CPU; 48MB of 256K-bit main memory; hot floating-point; battery backup unit; VAXBI channel; KDB50 disk controller; Ethernet interface; console terminal; one-year hardware warranty; and paid-up VAX/VMS and DECnet licenses	592,200	1,784	2,124
871BD-DE	Same as 871BD-AE, but with one-year VAX/VMS and DECnet licenses	543,900	1,784	2,124
871BD-BE	Same as 871BD-AE but with paid-up ULTRIX-32 and DECnet licenses	592,200	1,784	2,124
871BD-EE	Same as 871BD-AE but with one-year ULTRIX-32 and DECnet licenses	543,900	1,784	2,124
VAX 8650 SBBs				
865XB-AE	VAX 8650 CPU; 16MB ECC MOS memory; RB86-AA integrated disk and tape controller; VAX/VMS license and warranty	522,375	1,701	2,132
865XB-BE(BJ)	Same as 865XB-AE, but with ULTRIX-32 license and warranty for 1 to 32 users	522,375	1,791	2,132
VAX 8600 SBBs				
861XA-AE	VAX 8600 CPU; 4MB ECC MOS memory; RB86-AA integrated disk and tape controller; VAX/VMS operating system license and warranty	469,875	1,301	1,549
861XA-BE	Same as 861XA-AE but with ULTRIX-32 license and warranty for 1 to 32 users	469,875	1,301	1,549
VAX 8550 SBBs				
855BC-AE	System Building Block (SBB); includes CPU, 48MB of 256K-bit main memory, hot floating-point, VAXBI channel, KDB50 disk controller, Ethernet interface, console terminal, one-year hardware warranty, and paid-up VAX/VMS and DECnet licenses	506,100	1,407	1,675
855BC-DE	Same as 855BC-AE, but with one-year VAX/VMS and DECnet licenses	465,750	1,407	1,675
855BC-BE	Same as 855BC-AE, but with paid-up ULTRIX-32 and DECnet licenses	506,100	1,407	1,675
855BC-EE	Same as 855BC-AE, but with one-year ULTRIX-32 and DECnet licenses	456,750	1,407	1,675
855BB-HE	ALL-IN-1 system; includes CPU, 48MB of 256K-bit main memory, hot floating-point, VAXBI channel, KDB50 disk controller, Ethernet interface, console terminal, one-year hardware warranty, and paid-up ALL-IN-1, VAX/VMS, and DECnet licenses	547,050	1,407	1,675
855BB-JE	Same as 855BB-HE, but with one-year ALL-IN-1, VAX/VMS, and DECnet licenses	463,050	1,407	1,675
VAX 8530 SBBs				
851BC-DE/DJ	VAX 8530 CPU; 32MB of 256K-bit ECC MOS memory; integral hot floating-point; KDB50 disk controller; VAXBI channel; Ethernet communications interface; console; one-year hardware warranty; and one-year VAX/VMS and DECnet licenses	301,350	1,243	1,480
851BC-AE	Same as 851BC-DE/DJ, but with paid-up VMS and DECnet licenses	342,300	1,243	1,480
851BC-BE	Same as 851BC-DE/DJ, but with paid-up ULTRIX-32 and DECnet licenses	342,300	1,243	1,480
851BC-EE/EJ	Same as 851BC-DE/DJ, but with one-year ULTRIX-32 and DECnet licenses	301,350	1,243	1,480

**Contact vendor.*
NA—Not applicable.
NC—No charge.

DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
VAX 8350 SBBs				
834BB-DE	VAX 8350 CPU; 32MB of 256K-bit ECC MOS memory; integral hot floating-point; Ethernet communications interface; KDB50 disk controller; one-year hardware warranty; one-year VAX/VMS and DECnet licenses; 12-slot backplane	98,700	484	576
834BB-AE	Same as 834BB-DE (12-slot backplane), with paid-up VAX/VMS and DECnet licenses	123,900	484	576
834BB-BE	Same as 834BB-DE (12-slot backplane), but with paid-up ULTRIX-32 and DECnet licenses	123,900	484	576
834BB-EE	Same as 834BB-DE (12-slot backplane), but with one-year ULTRIX-32 and DECnet licenses	98,700	484	576
835BB-DE	Same as 834BB-DE, but with 24-slot backplane	103,950	559	665
835BB-AE	Same as 834BB-DE, but with 24-slot backplane and paid-up VAX/VMS and DECnet licenses	129,150	559	665
835BB-EE	Same as 834BB-DE, but with 24-slot backplane	103,950	559	665
835BB-BE	Same as 834BB-DE, but with 24-slot backplane and paid-up ULTRIX-32 and DECnet licenses	129,150	559	665
VAX 8250 SBBs				
824BC-DE	VAX 8250 CPU; 16MB of 256K-bit ECC MOS memory; integral hot floating-point; Ethernet communications interface; KDB50 disk controller; one-year hardware warranty; one-year VAX/VMS and DECnet licenses; 12-slot backplane	72,450	394	469
824BC-AE/AJ	Same as 824BC-DE (12-slot backplane), but with paid-up VAX/VMS and DECnet licenses	92,400	394	469
824BC-EE	Same as 824BC-DE (12-slot backplane), but with one-year ULTRIX-32 and DECnet licenses	72,450	394	469
824BC-BE/BJ	Same as 824BC-DE (12-slot backplane), but with paid-up ULTRIX-32 and DECnet licenses	92,400	394	469
825BB-DE	Same as 824BC-DE, but with 24-slot backplane	77,700	469	558
825BB-AE	Same as 824BC-DE, but with 24-slot backplane and paid-up VAX/VMS and DECnet licenses	97,650	469	558
825BB-EE	Same as 824BC-DE, but with 24-slot backplane and one-year ULTRIX-32 and DECnet licenses	77,700	469	558
825BB-BE	Same as 824BC-DE, but with 24-slot backplane and paid-up ULTRIX-32 and DECnet licenses	97,650	469	558
VAXCLUSTER SBBs				

A VAXcluster is composed of one or more VAX 8000, VAX-11/750, 11/780, or 11/785 processors running on VAX/VMS connected by a high-speed bus, one or more mass storage servers, and communications links to the user community. Each cluster element connected to the high-speed bus is referred to as a cluster node. Cluster nodes interconnect via a Star Coupler. There are two types of VAXcluster SBBs. The first type is a basic system element comprising a CPU complex, Star Coupler, high-speed storage controller, disk and tape interfaces, and Computer Interconnect cables. Mass storage (system and load devices) must be selected. The second type of VAXcluster SBB is an upgrade to an existing VAXcluster. It consists of a CPU, main memory, a Computer Interconnect, cables, VAX/VMS license, and DECnet full-function VAXcluster license.

VAX 8800 VAXcluster SBBs				
882CC-DP	VAX 8800 CPU; 64MB of 256K-bit ECC MOS memory; battery backup; integral hot floating-point; two VAXBI channels; VAXcluster port and set of Computer Interconnect cables; Ethernet communications interface; console; one-year hardware warranty; and one-year VAX/VMS and DECnet licenses	833,700	2,529	3,011
882CC-AP	Same as 882CC-DP, but with paid-up VAX/VMS and DECnet licenses	885,150	2,529	3,011
VAX 8700 VAXcluster SBBs				
871CC-AP	VAX 8700 CPU; 48MB of 256K-bit main memory; hot floating-point; battery backup unit; VAXBI channel; Computer Interconnect port; Ethernet interface; console; one-year hardware warranty; and paid-up VAX/VMS and DECnet licenses	615,300	1,865	2,220
871CC-DP	Same as 871CC-AP, but with one-year VAX/VMS and DECnet licenses	562,800	1,865	2,220
VAX 8650 VAXcluster SBB				
865CD-AP(AT)	VAX 8650 CPU; 32MB of memory; Ethernet port; VAX/VMS license and warranty; a DECnet full-function license	554,400	1,839	2,189

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DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
VAX 8600 VAXcluster SBB				
861CC-AP	VAX 8600 CPU; 16MB of ECC MOS memory; Computer Interconnect port; cables; DEUNA Ethernet-to-UNIBUS controller; VAX/VMS license and warranty; and DECnet full-function license	501,900	1,360	1,619
VAX 8550 VAXcluster SBBs				
855CD-AP	VAX 8550 CPU; 48MB of 256K-bit main memory; hot floating-point; VAXBI channel; Computer Interconnect port; Ethernet interface; console; one-year hardware warranty; and paid-up VAX/VMS and DECnet licenses	528,150	1,488	1,771
855CD-DP	Same as 855CD-AP(AT), but with one-year VAX/VMS and DECnet licenses	474,600	1,488	1,771
VAX 8530 VAXcluster SBBs				
851CD-DP/DT	VAX 8530 CPU; 32MB of 256K-bit ECC MOS memory; integral hot floating-point; VAXcluster port and Computer Interconnect cables; expansion cabinet for VAXcluster port; one VAXBI channel; Ethernet communications interface; console; one-year hardware warranty; and one-year VAX/VMS and DECnet licenses	323,400	1,324	1,576
851CD-AP	Same as 851CD-DP/DT, but with paid-up VAX/VMS and DECnet licenses	363,300	1,324	1,576
VAX 8350 VAXcluster SBBs				
834CC-DP	VAX 8350 CPU; 32MB of 256K-bit ECC MOS memory; integral hot floating-point; VAXcluster port and set of Computer Interconnect cables; Ethernet communications interface; one-year hardware warranty; one-year VAX/VMS and DECnet licenses; and 12-slot backplane	102,900	564	671
834CC-AP	Same as 834CC-DP (12-slot backplane), but with paid-up VAX/VMS and DECnet licenses	128,100	564	671
835CC-DP	Same as 834CC-DP but with 24-slot backplane	108,150	639	761
835CC-AP	Same as 834CC-DP, but with 24-slot backplane and paid-up VAX/VMS and DECnet licenses	133,350	639	761
VAX 8250 VAXcluster SBBs				
824CC-DP/DT	VAX 8250 CPU; 16MB of 256K-bit ECC MOS memory; integral hot floating-point; VAXcluster port and Computer Interconnect cables; Ethernet communications interface; one-year hardware warranty; one-year VAX/VMS and DECnet licenses; and 12-slot backplane	76,650	474	564
824CC-AP/AT	Same as 824CC-DP/DT (12-slot backplane), but with paid-up VAX/VMS and DECnet licenses	96,600	474	564
825CD-DP	Same as 824CC-DP/DT, but with 24-slot backplane	81,900	549	654
825CD-AP	Same as 824CC-DP/DT, but with 24-slot backplane and paid-up VAX/VMS and DECnet licenses	101,850	474	564
VAX 8900 PRECONFIGURED SYSTEMS				
894CB-DP	VAX 8974 with four VAX 8700 processors; 128MB of 256K-bit main memory; VAXcluster Interconnect and Ethernet adapter in each processor; four VAXBIs; two HSC70s; SA482 storage array; console; TA78 tape drive; one-year warranty; and one-year VAX/VMS and DECnet licenses	2,698,500	9,724	11,576
8974CB-AP	Same as 8974CB-DP but with paid-up VAX/VMS and DECnet licenses	2,950,500	9,724	11,576
898CB-DP	VAX 8978 with eight VAX 8700 processors; 256MB of 256K-bit main memory; VAXcluster Interconnect and Ethernet adapter in each processor; eight VAXBIs; four HSC70s; two SA482 storage arrays; console; two TA78 tape drives; one-year warranty; and one-year VAX/VMS and DECnet licenses	5,031,600	19,136	22,781
898CB-AP	Same as 898CB-DP, but with paid-up VAX/VMS and DECnet licenses	5,502,000	19,136	22,781
VAX 8700 PRECONFIGURED SYSTEMS				
SV-87EEC-EK/EN	VAX 8700 CPU; 48MB of main memory; hot floating-point; VAXBI channel; KDB50 disk controller; RA81 456MB disk drive and TU81-Plus streaming tape drive; Ethernet interface; console terminal; DMB32 communications controller; one-year hardware warranty; and paid-up VAX/VMS and DECnet licenses; also includes battery backup unit	641,550	2,066	2,460
SV-87EEC-EL	Same as SV-87EEC-EK/EN, but with one-year VAX/VMS and DECnet licenses	593,250	2,066	2,460

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DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
VAX 8550 PRECONFIGURED SYSTEMS				
SV-8EEED-EK/EN	VAX 8550 CPU; 48MB of main memory; hot floating-point; VAXBI channel; KDB50 disk controller; RA81 456MB disk drive; TU81-Plus streaming tape drive; Ethernet interface; console terminal; DMB32 communications controller; one-year hardware warranty; and paid-up VAX/VMS and DECnet licenses	554,000	1,689	2,011
SV-8EEED-EL(EM)	Same as SV-8EEED-EK/EN, but with one-year VAX/VMS and DECnet licenses	506,100	1,689	2,011
VAX 8530 PRECONFIGURED SYSTEMS				
SV-85EEC-EL/EM	VAX 8530 CPU; 32MB of main memory; disk controller; RA81 456MB disk drive; TU81-Plus 1600/6250 bpi tape drive; Ethernet port; DMB32 communications controller; console; VAXBI I/O channel; one-year hardware warranty; and one-year VAX/VMS and DECnet licenses	349,650	1,525	1,816
SV-85EEC-EK	Same as SV-85EEC-EL/EM, but with paid-up VAX/VMS and DECnet licenses	390,600	1,525	1,816
VAX 8350 PRECONFIGURED SYSTEMS				
SV-8BEEB-GL	VAX 8350 CPU; 32MB of 256K-bit ECC MOS memory; integral hot floating-point; disk controller; Ethernet communications interface; UNIBUS adapter, cabinet, box, and backplanes; LA100 console terminal with stand; RA81 disk drive and TU81 tape drive; one year-warranty; one-year VAX/VMS and DECnet licenses; 12-slot backplane	148,050	746	888
SV-8BEED-GK/GN	Same as SV-8BEEB-GL (12-slot backplane), but with paid-up VAX/VMS and DECnet licenses	173,250	746	888
SV-8BEES-GL/GM	Same as SV-8BEEB-GL, but with 24-slot backplane	158,550	868	1,033
SV-8BEES-GK/GN	Same as SV-8BEEB-GL, but with 24-slot backplane and paid-up VAX/VMS and DECnet licenses	183,750	868	1,033
VAX 8250 PRECONFIGURED SYSTEMS				
SV-8AEEB-GL	VAX 8250 CPU; 16MB of 256K-bit ECC MOS memory; integral hot floating-point; disk controller; Ethernet communications interface; LA100 console terminal with stand; RA81 disk drive and TU81 tape drive; one-year hardware warranty; one-year VAX/VMS and DECnet licenses; 12-slot backplane	121,800	656	781
SV-8AEEB-GK	Same as SV-8AEEB-GL (12-slot backplane), but with paid-up VAX/VMS and DECnet licenses	141,750	656	781
SB-8AEEP-GL	Same as SV-8AEEB-GL, but with 24-slot backplane	132,300	778	926
SV-8AEEP-GK	Same as SV-8AEEB-GL, but with 24-slot backplane and paid-up VAX/VMS and DECnet licenses	152,250	778	926
UPGRADE KITS				
835UB-AE	8250 to 8350 upgrade kit; one CPU board, 4MB of memory, one-year hardware warranty, and paid-up VAX/VMS license	40,000	NA	NA
835UB-BE	8250 to 8350 upgrade kit; same as 835UB-AE but with paid-up ULTRIX-32 license	40,000	NA	NA
835UB-DE	8250 to 8350 upgrade kit; same as 835UB-AE but with VAX/VMS initial license fee	34,000	NA	NA
835UB-EE	8250 to 8350 upgrade kit; same as 835UB-AE but with ULTRIX-32 initial license fee	34,000	NA	NA
835UC-AE/AJ	8250 to 8350 upgrade kit; same as 835UB-AE but also with 456MB RA81-A disk drive	56,000	NA	NA
835UC-DE/DJ	8250 to 8350 upgrade kit; same as 835UB-AE but with VAX/VMS initial license fee; also with RA81-A disk drive	50,000	NA	NA
835UP-AE	8200 to 8350 upgrade kit; two CPU boards, 4MB of memory, one-year warranty, paid-up VAX/VMS license. Requires return of 8200 CPU board	49,000	NA	NA
835UP-BE	8200 to 8350 upgrade kit; same as 835UP-AE but with paid-up ULTRIX-32 license	49,000	NA	NA
835UP-DE	8200 to 8350 upgrade kit; same as 835UP-AE but with VAX/VMS initial license fee	43,000	NA	NA
835UP-EE	8200 to 8350 upgrade kit; same as 835UP-AE but with ULTRIX-32 initial license fee	43,000	NA	NA
835UR-AE/AJ	8200 to 8350 upgrade kit; same as 835UP-AE but also with RA81-A disk drive	65,000	NA	NA
835UR-DE/DJ	8200 to 8350 upgrade kit; same as 835UP-AE but with VAX/VMS initial license fee, also an RA81-A disk drive	59,000	NA	NA
855UB-AE	8500/8530 to 8550 upgrade kit; one CPU board, 16MB of memory, one-year on-site warranty, paid-up VAX/VMS license. Requires return of CPU board	179,000	NA	NA

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DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
855UB-BE	8500/8530 to 8550 upgrade kit; same as 855UB-AE but with paid-up ULTRIX-32 license	179,000	NA	NA
855UB-DE	8500/8530 to 8550 upgrade kit; same as 855UB-AE but with VAX/VMS initial license fee	166,000	NA	NA
855UB-EE	8500/8530 to 8550 upgrade kit; same as 855UB-AE but with ULTRIX-32 initial license fee	166,000	NA	NA
855UB-XE	8500/8530 to 8550 upgrade kit without software	156,000	NA	NA
855UC-AE/AJ	8500/8530 to 8550 upgrade kit; same as 855UB-AE, but also with RA81-A disk drive	213,500	NA	NA
855UC-DE/DJ	8500/8530 to 8550 upgrade kit; same as 855UB-AE, but with VAX/VMS initial license fee, also with an RA81-A disk drive	200,500	NA	NA
861UP-AA	VAX 8600-to-8650 upgrade kit	95,000	NA	NA
882UB-AE	8700 to 8800 upgrade kit; 8800 CPU module set, 16MB of memory, one-year on-site warranty, paid-up VAX/VMS license	336,000	NA	NA
882UB-BE	8700 to 8800 upgrade kit; same as 882UB-AE but with paid-up ULTRIX-32 license	336,000	NA	NA
882UB-DE	8700 to 8800 upgrade kit; same as 882UB-AE but with VAX/VMS initial license fee	336,000	NA	NA
882UB-EE	8700 to 8800 upgrade kit; same as 882UB-AE but with ULTRIX-32 initial license fee	336,000	NA	NA
882UC-AE/AJ	8700 to 8800 upgrade kit; same as 882UB-AE but also with SA482-AD storage array	420,000	NA	NA
882UC-DE/DJ	8700 to 8800 upgrade kit; same as 882UB-AE but with VAX/VMS initial license fee and also an SA482-AD storage array	420,000	NA	NA
CPU OPTIONS				
VAX 8600/8650 Options				
FP86-AA	Floating-Point Accelerator	29,400	65	77
DW780-AA(AB)	UNIBUS adapter	12,900	39	46
DW780-MB	Second UNIBUS adapter	12,900	39	46
DB86-AA	Second SBI adapter	10,000	30	36
VAX 8250/8350 Options				
H7231-L	Battery backup	1,800	16	19
MEMORY EXPANSION OPTIONS				
VAX 8800, 8700, 8550, 8530 Options				
MS85-HA	32MB and backplane memory upgrade for 8500/8550	24,400	NC	NC
MS88-CA	16MB ECC MOS (256K-bit) memory module	16,800	NC	NC
MS88-DA	64MB (1M-bit) memory module	25,000	NC	NC
MS88-HA	32MB memory upgrade for 8800	24,400	NC	NC
VAX 8600/8650 Options				
MS86-AA/BA	4MB ECC MOS (256K-chip) memory module	4,200	NC	NC
MS86-CA	16MB ECC MOS (256K-chip) memory module	7,525	NC	NC
MS86-DA	64MB ECC MOS (1M-bit) memory module	26,800	NC	NC
VAX 8250/8350 Options				
MS820-BA	4MB ECC MOS (256K-chip) memory with controller	4,300	NC	NC
MS820-CA	16MB ECC memory	8,000	NC	NC
VAXcluster OPTIONS				
CI780-MA	Computer Interconnect adapter for VAX 8600 and 8650	22,523	158	188
SC008-AC	Star Coupler; 8-node with cabinet; for all VAX 8000 systems	8,663	23	27
SC008-AD	Upgrade to Star Coupler; for 9 to 16 nodes	6,353	23	27
BNCIA-10	CI cable set; 32 ft (10 m)	630	NC	NC
BNCIA-20	CI cable set; 65 ft (20 m)	872	NC	NC
BNCIA-45	CI cable set; 145 ft (45 m)	1,533	NC	NC

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DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
MASS STORAGE				
HSC50-AA(AB)	HSC50 intelligent I/O server with space for six HSC5X; cables not included	39,375	155	185
HSC5X-BA(BB)	Data channel interface for interfacing up to four disk drives	10,500	45	54
HSC5X-EA(EB)	Second power supply for over three HSC5X on the HSC50	3,465	26	31
HSC70-AA(AB)	HSC70 Computer Interconnect-based intelligent controller; includes space for eight HSC5X-BA; cables not included	57,330	220	262
RB86-AA	RB86 integrated disk and tape controller; for VAX 8600/8650	19,320	110	131
KDB50-A	KDB50 VAXBI controller with 8-ft cable	8,800	60	71
KDB50-B	KDB50 VAXBI controller with 15-ft cable	8,800	60	71
UDA50-A	UNIBUS controller; allows attachment of up to four disk drives	6,510	53	63
RA60-AA(AD)	205MB rack-mounted RA60 drive (no cabinet); requires controller and mounting cabinet	19,845	105	125
RA60-CA(CD)	205MB cabinet-mounted RA60-AA add-on drive	22,470	105	125
RA60-EA(ED)	Three 205MB RA60 drives in cabinet	55,860	315	375
RA60-JA(JD)	Four 205MB RA60 drives in cabinet	75,180	420	500
RA60-UA	RA60 reconfiguration kit; for remounting RA60s originally configured in an H9642 cabinet in an H9646 cabinet	420	NA	NA
RA81-AA(AD)	456MB RA81 rack-mounted drive; requires controller and mounting cabinet	16,800	95	113
RA81-CA(CD)	456MB cabinet-mounted RA81 drive; requires controller	19,425	95	113
RA81-EA(ED)	Three 456MB RA81 drives mounted in a cabinet; requires controller	52,500	284	338
RA81-FA(AD)	456MB RA81 cabinet-mounted drive; requires controller	21,000	95	113
RA81-HA(HD)	456MB RA81 rack-mounted drive; requires controller, cabinet, and cable	16,422	95	113
RA81-JA(JD)	Four cabinet-mounted 456MB RA81 disk drives; requires controller	71,400	380	452
RA81-UA	RA81 reconfiguration kit; required for remounting RA81s originally configured in an H9642 cabinet; not required for RA81-AA	420	NA	NA
RL211-AK	10.4MB RL02 top-loading, rack-mounting, removable cartridge drive and controller with interconnect cabling	9,345	75	89
RL02-AK	10.4MB RL02 add-on cartridge drive; requires RL211-AK	5,460	72	86
RL02K-DC	10.4MB cartridge for the RL02	242	NA	NA
RUC25-AA(AB)	Tabletop 26MB/26MB RC25 fixed/removable disk drive with UNIBUS adapter	13,650	114	136
RUC25-BA(BB)	Rack-mounted 26MB/26MB RC25 fixed/removable disk drive with UNIBUS adapter	13,650	114	136
RC25-DA(DB)	Tabletop add-on RC25 disk drive	6,195	85	101
RC25-EA(EB)	Rack-mounted add-on RC25 disk drive	6,195	85	101
RC25K-DC	Removable 26MB RC25 cartridge	314	NA	NA
SA482	2.4GB storage array	88,200	*	*
MAGNETIC TAPE EQUIPMENT				
HSC70-AA(AB)	HSC70 Computer Interconnect-based intelligent controller; includes space for eight HSC5X-CA; cables not included	57,330	220	262
HSC5X-CA	Tape interface for HSC50 I/O controller	10,500	45	54
TA78-BF(BJ)	TA78 PE/GCR tape subsystem; requires HSC50 with HSC5X-CA	59,430	357	425
TA81-AA(AB)	TA81 magnetic tape subsystem	32,970	150	179
TU81E-BA(BB)	TU81-Plus 1600/6250 bpi, 75-ips streaming tape drive	30,765	140	167
TU80-AA(AB)	TU80 9-track magnetic tape subsystem in cabinet	12,280	89	106
TU78-AB(AD)	TU78 magnetic tape transport and formatter; requires TM78-C for dual-porting capability	54,705	322	383
TU78-AF(AJ)	TU78 magnetic tape transport without formatter; requires TU78 master	29,400	196	233
TM78-C	TU78 dual-port kit containing drive logic and cables to provide dual-porting capability	5,408	21	25
TSU05-AA(AB)	UNIBUS TS05 magnetic tape subsystem with hardware for rack-mounting, control module, and cables; also available in 100 V AC (-AC) and 220 V AC (-AD) models	15,435	89	106
TK50-DA/-DB	TK50 desktop cartridge tape drive (120/240 V AC); includes 9-ft cable	3,750	22	26
TK50-RA/-RB	TK50 rack-mounted cartridge tape drive (120/240 V AC); includes 9-ft cable	3,750	22	26
TUK50-AB	UNIBUS controller for TK50-DX/RX drives; includes cabinet and bulkhead plate	2,100	8	10
EXPANSION OPTIONS				
DB88-AB	First VAXBI channel expansion for VAX 8800	315	20	24
DB88-AE	Third VAXBI channel for VAX 8800; requires BA32-BA/BB VAXBI expansion box and space in H9652-EC/ED expansion cabinet	15,225	60	71
DB88-AC	Internal second VAXBI channel for VAX 8700	15,225	40	48
DB88-AD	External second or fourth VAXBI channel for VAX 8700/8800 or second external VAXBI channel for 8530/8550. Requires DB88-AB(AE) and BA32-BA/BB on 8700/8800; requires BA32-BA/BB on 8530/8550	15,225	20	24

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DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
DWBUA-CA	VAX 8800 UNIBUS adapter; requires BA11-AW/AX expansion box and space in H9652-EC/ED expansion cabinet	6,300	40	48
DWBUA-FA(FB)	VAXBI-to-UNIBUS adapter for 8250/8350	13,650	65	77
H9652-EC(ED)	VAX 8800/8530 expansion cabinet; provides space for any combination of up to two BA32-BA(BB) VAXBI expansion boxes or BA11-AW(AX) UNIBUS expansion boxes on 8800; space for one BA32 VAXBI box on 8530; includes 37 panel units	5,250	NC	NC
BA32-BA(BB)	VAX 8800/8530 rack-mountable VAXBI expansion box with slides for H9652-EC(ED) expansion cabinet; provides five VAXBI mounting slots (with a sixth slot used for VAXBI system interface)	6,300	75	89
H9652-FA(FB)	VAX 8600/8650 expansion cabinet; includes one BA11-A box and 40 panel units; can be expanded with a second BA11-A; requires DD11-DK/CK backplanes	7,560	NC	NC
H9652-FC(FD)	VAX 8600/8650 UNIBUS expansion cabinet; includes two BA11-A boxes and 40 panel units; requires DD11-DK/CK backplanes	11,235	NC	NC
H9652-FE (FF)	VAX 8600/8650 UNIBUS expansion cabinet; customer-configurable	3,885	NC	NC
H9652-CA(CB)	VAX 8600/8650 SBI expansion cabinet; provides four option panel spaces	5,250	NC	NC
H9642-FC(FD)	VAX 8250 and 8350 UNIBUS expansion cabinet; fully shielded; contains controller, I/O connector panel, and space for BA11-A expander box	2,153	NC	NC
BA11-AL(AM)	Rack-mountable expansion box with slides for VAX 8600/8650 UNIBUS expansion cabinets; provides mounting space for six system units and is compatible with DD11-DK/CK expansion backplanes	3,675	25	30
BA11-AW(AX)	Rack-mountable exansion box with slides for VAX 8800, 8350, and 8250 UNIBUS expansion cabinets; provides mounting space for six system units and is compatible with DD11-DK(CK) expansion backplanes	3,804	25	30
DD11-CK	Expansion backplane mounting for BA11 box; provides for two hex- and two quad-slot modules; mounts in one system unit	470	NC	NC
DD11-DK	Same as DD11-CK except for providing seven hex- and two quad-slot modules; mounts in two system units	987	NC	NC
UNIBUS ASYNCHRONOUS OPTIONS				
DMB32-M	Eight-line asynchronous multiplexer with single-line synchronous interface and dual-purpose parallel interface; for VAXBI	3,518	47	56
DMF32-M	Eight-line asynchronous multiplexer with single-line synchronous interface and dual-purpose parallel interface; for UNIBUS	4,395	58	69
DHU11-M	16-line multiplexer with direct memory access and full modem control for EIA/CCITT terminals; includes base module only; requires appropriate external cables and cabinet kit	4,309	45	54
DMZ32-M	24-line multiplexer with direct memory access for EIA/CCITT terminals; base module only, without modem control; requires appropriate cables and cabinet kit	3,679	90	107
DMZ32-N	Base module, modem control upgrade kit	801	NA	NA
UNIBUS SYNCHRONOUS OPTIONS				
DMR11-M	Single-line interface for EIA/CCITT devices; base module only; requires appropriate external cable and cabinet kit	6,266	41	49
DUP11-M	Single-line interface for EIA/CCITT devices; base module only; requires appropriate external cable and cabinet kit	1,957	13	15
ETHERNET COMMUNICATIONS				
DEUNA-M	Ethernet-to-UNIBUS synchronous communications controller	2,835	44	52
H4000	Ethernet transceiver	315	4	5
DELUA-M	Ethernet/IEEE 802.3 UNIBUS single-line interface communications controller	3,964	33	39
DELNI-AA	Local Network Interconnect; supports up to eight Ethernet-compatible, nonterminal devices	1,444	10	12
DECSA-DA	32-line terminal server with 16 DCSAX-LC line cards	27,468	354	421
DECSK-AA	U.S. country kit for DECSA-DA; includes power cord, hardware manuals, and labels with front panel display; required	28	NC	NC
DCSAX-LC	Two-line asynchronous EIA RS-232-C/CCITT V.28 line card	429	7	8
DSRVB-AA	DECserver 200, supports eight RS-232 ports; includes country kit	3,806	30	36
DSRVB-BA	DECserver 200, supports eight DECconnect ports; includes country kit	3,360	28	33
REALTIME OPTIONS				
DR11-W	General-purpose UNIBUS DMA digital interface; requires appropriate cables and cabinet kit	1,418	14	17

**Contact vendor.*
NA—Not applicable.
NC—No charge.

DEC VAX 8000 Systems

		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
DR11-WC	Longline, general-purpose interface; includes differential adapter module, interconnect cables, test connectors, and FCC-compliant user I/O panel	3,460	42	50
DR11-WD	Long-line upgrade kit for DR11-W; includes all items in DR11-WC except DR11-W interface module	1,885	24	29
BAND PRINTERS				
LP11-AA	132-column, 64-character LP25 UNIBUS band printer; 300 lpm	8,768	175	208
LP11-BA	132-column, 64- and 96-character LP25 UNIBUS band printer; 300/215 lpm	9,398	175	208
LP32-AA	132-column, 64-character LP25 printer and universal power supply, 300 lpm; prerequisite, DMF32 UNIBUS controller	8,768	98	117
LP32-BA	Same as LP32-AA, but can also operate at 215 lpm with a 96-character set	9,398	98	117
LSP25-CA	Longline LP25 UNIBUS printer, 300/215 lpm; includes U.S./U.K. bands, universal power supply, and 50-ft. cable	12,180	119	142
LP27-UA(UB)	LP27 UNIBUS band printer, 1,200/800 lpm	35,070	259	308
LP27-DA(DB)	Longline LP27 UNIBUS band printer, 1,200/800 lpm	38,220	310	369
LP27-VA(VB)	LP27 UNIBUS band printer with 30-ft. data cable and controller; requires DMF32	34,020	252	300
MATRIX LINE PRINTERS				
LG01-AA	600-lpm matrix text printer with 64-character data processing mode; UNIBUS device	13,545	128	152
LG01-CA	Same type as LG01-AA, but requires DMF32 controller	13,545	118	140
LG02-AA	600-lpm matrix text and graphics printer with 64-character data processing mode; UNIBUS device	16,695	128	152
LG02-CA	Same type as LG02-AA, but requires DMF32 controller; includes 30-ft cable	16,695	118	140
LG02-DA	Same type as LG02-AA, but requires DMF32 controller and RS-232-C serial interface; includes 25-ft cable	16,695	118	140
LG01-UG	Upgrade kit to convert LG01 to LG02	3,675	NA	NA
LASER PRINTERS				
LN03-AA	8-ppm desktop laser printer; includes two toner cartridges, organic photo receptor (OCP) cartridge, AC power cord, toner collection bottle, 250 sheets of letter-size paper, and documentation; 150 dpi graphics capability	3,670	49	58
LN03S-AA	Same as LN03-AA but with 300 dpi graphics capability	3,670	*	*
PRINTERS/PLOTTERS				
LXY12-CA(CB)	Freestanding line printer/plotter, 170/240/300 lpm; with LP11 controller for UNIBUS interface, 30-ft cable, pedestal with basket, and paper guide	13,335	104	124
LXY12-DA(DB)	Same type as LXY12-CA(CB), but with RS-232-C interface cable, pedestal with basket, and paper guide	13,335	104	124
LXY12-EA(EB)	Same type as LXY12-CA(CB), but with DMF32 interface cable, pedestal with basket, and paper guide	13,335	104	124
COLOR GRAPHICS PEN PLOTTER				
LVP16-AA	Six-color graphics pen plotter, 15 ips; includes RS-232-C interface, documentation, and initial supplies; requires interface cable	2,200	10	12
CONSOLE TERMINALS				
LA100-BA	KSR 30/80/240 cps hard copy terminal with keyboard, numeric keypad, tractors, cable, ribbon cartridge, package of paper, and Courier-10/Orator-10 fonts in U.S./U.K. character sets only	2,515	27	32
TERMINALS				
VT220-A2(A3)	VT220 terminal with white phosphor, nonglare screen	609	12	14
VT220-B2(B3)	VT220 terminal with green phosphor, nonglare screen	609	12	14
VT220-C2(C3)	VT220 terminal with amber phosphor, nonglare screen	609	12	14
VT22K-AA	Data entry keyboard for VT220	226	NC	NC
VT22K-BA	Word processing keyboard for VT220	226	NC	NC
VT22X-AA	Integral 300/1200 baud auto answer modem for VT220 series	415	6	7

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		Purchase Price ($)	Basic Service (Monthly) ($)	DECserv. (Monthly) ($)
VT240-A2(A3)	VT240 text/graphics terminal; includes monochrome monitor, system box with logic and power supply, and keyboard; white phosphor, nonglare screen	2,079	19	23
VT240-B2(B3)	VT240 terminal with green phosphor, nonglare screen	2,079	19	23
VT240-C2(C3)	VT240 terminal with amber phosphor, nonglare screen	2,079	19	23
VT241-AA	VT241 color text/graphics terminal; includes monitor, system box with logic and power supply, and keyboard	3,129	26	31
VT24K-AA	Data entry keyboard for VT240/VT241 terminals	226	NC	NC
VT24K-BA	Word processing keyboard for VT240/VT241 terminals	226	NC	NC
VT24X-AA	300/1200 baud auto dial integral modem for VT240 series	520	6	7
VT320-AA	VT320 monochrome text terminal, white phosphor display	545	3	4
VT320-BA	VT320 monochrome text terminal, green phosphor display	545	4	3
VT320-CA	VT320 monochrome text terminal, amber phosphor display	545	4	3
VT320-DA	VT320 monochrome WPS terminal, white phosphor display	545	4	3
VT320-FA	VT320 monochrome WPS terminal, amber phosphor display	545	4	3
VT330-A2	VT330 graphic terminal, white phosphor display, no keyboard	1,780	19	23
VT330-AA	VT330 graphic terminal, white phosphor display, USA keyboard	1,990	19	23
VT330-B2	VT330 graphic terminal, green phosphor display, no keyboard	1,780	19	23
VT330-C2	VT330 graphic terminal, amber phosphor display, no keyboard	1,780	19	23
VT330-CA	VT330 graphic terminal, amber phosphor display, USA keyboard	1,990	19	23
VT330-DA	VT330 graphic WPS terminal, white phosphor display, USA keyboard	1,990	19	23
VT330-EA	VT330 graphic WPS terminal, green phosphor display, USA keyboard	1,990	19	23
VT330-FA	VT330 graphic WPS terminal, amber phosphor display, USA keyboard	1,990	19	23
VT340-A3	VT340 color graphic terminal, no keyboard	2,725	26	31
VT340-AA	VT340 color graphic terminal, USA keyboard	2,935	26	31
VT340-DA	VT340 color graphic WPS terminal, USA keyboard	2,935	26	31
VT3XX-CA	Tilt/swivel base	20	NA	NA
VOICE SYNTHESIS MODULE				
DTC01-AA	Single-line DECtalk text-to-speech unit; includes cable	4,200	22	26

**Contact vendor.*
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NC—No charge.

SOFTWARE PRICES

		Paid-up License Primary Sys. ($)	Initial License Fee ($)	Periodic Payment Primary Sys. ($)	Periodic Payment Cluster Sys. ($)	Paid-up License Cluster Sys. ($)
VAX/VMS SOFTWARE						
VMS system and layered software licenses for the VAX 8600 and 8650 are available for purchase only. Licenses for all other VAX systems software are available either for purchase (paid-up) or for monthly rental (periodic payment). The Periodic Payment License (PPL) option also requires payment of an initial license fee. These options are available on both primary standalone processors and systems configured in VAXclusters.						
Communications						
Q5D05	DECnet-VAX for VAX 8250	9,335	788	182	NA	NA
Q7D05	DECnet-VAX for VAX 8350	6,921	788	182	NA	NA
Q9D05	DECnet-VAX for VAX 8530	11,970	788	247	NA	NA
Q2D05	DECnet-VAX for VAX 8550/8700	14,364	788	285	NA	NA
QKD05	DECnet-VAX for VAX 8600/8650	15,803	NA	NA	NA	9,482
QMD05	DECnet-VAX for VAX 8800	17,955	935	334	NA	NA
Q2D05-UA	DECnet-VAX for VAX 8974	44,604	NA	NA	NA	NA

**Non-hardware-dependent, single-use license and warranty.*

DEC VAX 8000 Systems

		Paid-up License Primary Sys. ($)	Initial License Fee ($)	Periodic Payment Primary Sys. ($)	Periodic Payment Cluster Sys. ($)	Paid-up License Cluster Sys. ($)
Q2D05-U3/13/J3	DECnet-VAX for VAX 8978	89,208	6,321	2,275	NA	NA
Q5545	DECnet/SNA Gateway for VAX 8250	2,520	788	69	29	1,512
Q7545	DECnet/SNA Gateway for VAX 8350	3,276	788	69	29	1,966
Q9545	DECnet/SNA Gateway for VAX 8530	4,620	788	95	44	2,772
Q2545	DECnet/SNA Gateway for VAX 8550/8700	5,544	788	111	55	3,329
QK545	DECnet/SNA Gateway for VAX 8600/8650	4,620	NA	NA	NA	2,772
QM545	DECnet/SNA Gateway for VAX 8800	7,560	788	137	69	4,536
Q2545-UA/1A/JA	DECnet/SNA Gateway for VAX 8974	8,715	788	191	NA	NA
Q2545-U3/13/J3	DECnet/SNA Gateway for VAX 8978	9,975	788	221	NA	NA
Q5727	DECnet Router/X.25 Gateway for VAX 8250	4,358	788	103	NA	NA
Q7727	DECnet Router/X.25 Gateway for VAX 8350	4,358	788	103	NA	NA
QK725	DECnet Router Server for VAX 8600/8650	2,793	NA	NA	NA	NA
Q5044	DECnet/SNA VMS Printer Emulator for VAX 8250	1,260	788	19	11	756
Q7044	DECnet/SNA VMS Printer Emulator for VAX 8350	1,638	788	19	11	983
Q9044	DECnet/SNA VMS Printer Emulator for VAX 8530	2,310	788	32	11	1,386
Q2044	DECnet/SNA VMS Printer Emulator for VAX 8550/8700	2,772	788	40	12	1,659
QK044	DECnet/SNA VMS Printer Emulator for VAX 8600/8650	2,310	NA	NA	NA	1,386
QM044	DECnet/SNA VMS Printer Emulator for VAX 8800	3,780	788	53	19	2,268
Q2044-UA/1A/JA	DECnet/SNA VMS Printer Emulator for VAX 8974	4,358	788	80	NA	NA
Q2044-U3/13/J3	DECnet/SNA VMS Printer Emulator for VAX 8978	4,988	788	95	NA	NA
Q5070	Mux200/VAX for VAX 8250	7,319	788	260	144	4,389
Q7070	Mux200/VAX for VAX 8350	9,500	788	260	144	5,700
Q5708	DECdx/VMS for VAX 8250	2,961	788	87	40	1,775
Q7708	DECdx/VMS for VAX 8350	3,849	788	87	40	2,310
Q9708	DECdx/VMS for VAX 8530	5,429	788	117	58	3,255
Q2708	DECdx/VMS for VAX 8550/8700	6,510	788	137	69	3,906
QK708	DECdx/VMS for VAX 8600/8650	5,429	NA	NA	NA	3,255
QM708	DECdx/VMS for VAX 8800	8,883	788	166	87	5,334
Q2708-UA/1A/JA	DECdx/VMS for VAX 8974	10,238	788	230	NA	NA
Q2708-U3/13/J3	DECdx/VMS for VAX 8978	11,718	788	265	NA	NA
QK071	VAX Packetnet System Interface (PSI) and PSI Access for VAX 8600/8650	3,465	NA	NA	NA	2,079
Q5111	VAX 2780/3780 Protocol Emulator for VAX 8250	6,689	788	235	133	4,011
Q7111	VAX 2780/3780 Protocol Emulator for VAX 8350	8,681	788	235	129	5,208
Q9111	VAX 2780/3780 Protocol Emulator for VAX 8530	12,243	835	300	167	7,350
Q2111	VAX 2780/3780 Protocol Emulator for VAX 8550/8700	14,690	946	340	189	8,820
QK111	VAX 2780/3780 Protocol Emulator for VAX 8600/8650	11,319	NA	NA	NA	6,468
QM111	VAX 2780/3780 Protocol Emulator for VAX 8800	18,522	1,029	371	206	11,109
Q2111-UA/1A/JA	VAX 2780/3780 Protocol Emulator for VAX 8974	23,090	1,470	531	NA	NA
Q2111-U3/13/J3	VAX 2780/3780 Protocol Emulator for VAX 8978	26,429	1,670	601	NA	NA
Q5112	VAX 3271 Protocol Emulator for VAX 8250	8,078	819	290	162	4,841
Q7112	VAX 3271 Protocol Emulator for VAX 8350	10,483	819	290	162	6,290
Q9112	VAX 3271 Protocol Emulator for VAX 8530	14,784	1,008	363	202	8,873
Q2112	VAX 3271 Protocol Emulator for VAX 8550/8700	17,745	1,142	412	229	10,647
QK112	VAX 3271 Protocol Emulator for VAX 8600/8650	13,398	NA	NA	NA	7,972
QM112	VAX 3271 Protocol Emulator for VAX 8800	21,924	1,218	439	244	13,157
Q2112-UA/1A/JA	VAX 3271 Protocol Emulator for VAX 8974	27,888	1,785	641	NA	NA
Q2112-U3/13/J3	VAX 3271 Protocol Emulator for VAX 8978	31,920	2,016	726	NA	NA
Q5730	VMS Message Router for VAX 8250	2,772	788	80	35	1,670
Q7730	VMS Message Router for VAX 8350	3,604	788	80	35	2,162
Q9730	VMS Message Router for VAX 8530	5,082	788	107	51	3,045
Q2730	VMS Message Router for VAX 8550/8770	6,101	788	126	63	3,665
QK730	VMS Message Router for VAX 8600/8650	5,082	NA	NA	NA	3,045
QM730	VMS Message Router for VAX 8800	8,316	788	153	80	4,988
Q2730-UA/1A/JA	VMS Message Router for VAX 8974	9,587	788	213	NA	NA
Q2730-U3/13/J3	VMS Message Router for VAX 8978	10,973	788	246	NA	NA
Q5726	Ethernet Terminal Server for VAX 8250	809	NA	NA	NA	NA
Q7726	Ethernet Terminal Server for VAX 8350	1,050	NA	NA	NA	NA
Q9726	Ethernet Terminal Server for VAX 8530	1,050	NA	NA	NA	NA
Q2726	Ethernet Terminal Server for VAX 8550/8700	1,050	NA	NA	NA	NA
QK726	Ethernet Terminal Server for VAX 8600/8650	1,050	NA	NA	NA	NA
QM726	Ethernet Terminal Server for VAX 8800	1,050	NA	NA	NA	NA
Q2726-UA	Ethernet Terminal Server for VAX 8974	1,050	NA	NA	NA	NA
Q2726-U3	Ethernet Terminal Server for VAX 8978	1,050	NA	NA	NA	NA
Q5925	DECserver 100 Terminal Server for VAX 8250	126	NA	NA	NA	NA
Q7925	DECserver 100 Terminal Server for VAX 8350	158	NA	NA	NA	NA
Q9925	DECserver 100 Terminal Server for VAX 8530	158	NA	NA	NA	NA
Q2925	DECserver 100 Terminal Server for VAX 8550/8700	158	NA	NA	NA	NA
QK925	DECserver 100 Terminal Server for VAX 8600/8650	158	NA	NA	NA	NA
QM925	DECserver 100 Terminal Server for VAX 8800	158	NA	NA	NA	NA
Q2925-UA	DECserver 100 Terminal Server for VAX 8974	158	NA	NA	NA	NA
Q2925-U3	DECserver 100 Terminal Server for VAX 8978	158	NA	NA	NA	NA

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DEC VAX 8000 Systems

		Paid-up License Primary Sys. ($)	Initial License Fee ($)	Periodic Payment Primary Sys. ($)	Periodic Payment Cluster Sys. ($)	Paid-up License Cluster Sys. ($)
Data Base Management/Data Management						
Q5897	VAX Common Data Dictionary (CDD) for VAX 8250	2,867	788	83	38	1,722
Q7897	VAX CDD for VAX 8350	3,726	788	83	38	2,235
Q9897	VAX CDD for VAX 8530	5,261	788	112	55	3,150
Q2897	VAX CDD for VAX 8550/8700	6,311	788	131	66	3,791
QK897	VAX CDD for VAX 8600/8650	5,261	NA	NA	NA	3,150
QM897	VAX CDD for VAX 8800	8,600	788	760	93	5,156
Q2897-UA	VAX CDD for VAX 8974	9,912	NA	NA	NA	NA
Q2897-U3/13/J3	VAX CDD for VAX 8978	11,351	788	255	NA	NA
Q5898	VAX Datatrieve for VAX 8250	10,343	1,029	372	207	6,206
Q7898	VAX Datatrieve for VAX 8350	13,432	1,029	372	207	8,059
Q9898	VAX Datatrieve for VAX 8530	18,942	1,292	465	258	11,361
Q2898	VAX Datatrieve for VAX 8550/8700	22,733	1,460	527	293	13,640
QK898	VAX Datatrieve for VAX 8600/8650	18,942	NA	NA	NA	11,361
QM898	VAX Datatrieve for VAX 8800	30,996	1,722	620	344	18,596
Q2898-UA	VAX Datatrieve for VAX 8974	35,732	NA	NA	NA	NA
Q2898-U3/13/J3	VAX Datatrieve for VAX 8978	40,898	2,583	930	NA	NA
Q5899	VAX DBMS for VAX 8250; requires VAX CDD	22,953	2,289	825	459	13,776
Q7899	VAX DBMS for VAX 8350; requires VAX CDD	29,812	2,289	825	459	17,887
Q9899	VAX DBMS for VAX 8530; requires VAX CDD	42,042	286	1,032	573	25,227
Q2899	VAX DBMS for VAX 8550/8700; requires VAX CDD	50,453	3,245	1,170	650	30,724
QK899	VAX DBMS for VAX 8600/8650; requires VAX CDD	42,042	NA	NA	NA	25,221
QM899	VAX DBMS for VAX 8800; requires VAX CDD	68,796	3,822	1,376	764	41,276
Q2899-UA/1A/JA	VAX DBMS for VAX 8974; requires VAX CDD	79,296	5,061	1,823	NA	NA
Q2899-U3/13/J3	VAX DBMS for VAX 8978; requires VAX CDD	90,726	5,733	2,064	NA	NA
Q5706	VAX Terminal Data Management System (TDMS) for VAX 8250	5,208	788	107	51	3,129
Q7706	VAX TDMS for VAX 8350	6,765	788	107	51	4,059
Q9706	VAX TDMS for VAX 8530	9,454	788	142	72	5,723
Q2706	VAX TDMS for VAX 8550/8700	11,445	788	264	146	6,878
QK706	VAX TDMS for VAX 8600/8650	9,545	NA	NA	NA	5,723
QM706	VAX TDMS for VAX 8800	15,614	788	200	107	9,366
Q2706-UA/1A/JA	VAX TDMS for VAX 8974	17,997	1,145	414	NA	NA
Q2706-U3/13/J3	VAX TDMS for VAX 8978	20,601	1,302	468	NA	NA
Q5079	VAX Application Control and Management System (ACMS) for VAX 8250	20,643	2,058	742	413	12,390
Q7079	VAX ACMS for VAX 8350	26,814	1,250	449	250	16,080
Q9079	VAX ACMS for VAX 8530	37,811	2,058	742	413	22,691
Q2079	VAX ACMS for VAX 8550/8700	45.381	2,919	1,052	585	27,227
QK079	VAX ACMS for VAX 8600/8650	37,811	NA	NA	NA	22,691
QM079	VAX ACMS for VAX 8800	61,877	3,434	1,238	688	37,127
Q2079-UA/1A/JA	VAX ACMS for VAX 8974	71,337	4,557	1,640	NA	NA
Q2079-U3/13/J3	VAX ACMS for VAX 8978	81,648	5,156	1,856	NA	NA
Q5354	VAX Rdb/VMS for VAX 8250	14,876	1,491	536	297	8,936
Q7354	VAX Rdb/VMS for VAX 8350	19,328	1,491	536	297	11,597
Q9354	VAX Rdb/VMS for VAX 8530	27,258	1,859	669	372	16,359
Q2354	VAX Rdb/VMS for VAX 8550/8700	32,708	2,111	758	421	19,625
QK354	VAX Rdb/VMS for VAX 8600/8650	27,258	NA	NA	NA	16,359
QM354	VAX Rdb/VMS for VAX 8800	44,604	2,478	893	496	26,765
Q2354-UA/1A/JA	VAX Rdb/VMS for VAX 8974	51,419	3,287	1,181	NA	NA
Q2354-U3/13/J3	VAX Rdb/VMS for VAX 8978	58,853	3,717	1,338	NA	NA
Q5Z96	VAX Data Distributor for 8250	11,351	1,134	408	227	6,815
Q7Z96	VAX Data Distributor for 8350	14,742	1,134	408	227	8,845
Q9Z96	VAX Data Distributor for 8530	18,900	1,418	510	284	11,340
Q2Z96	VAX Data Distributor for 8550/8700	22,680	1,607	579	321	13,608
QKZ96	VAX Data Distributor for 8600/8650	20,790	NA	NA	NA	12,474
QMZ96	VAX Data Distributor for 8800	34,020	1,890	680	378	20,412
Q2Z96-UA/1A/JA	VAX Data Distributor for 8974	39,218	2,510	901	NA	NA
Q2Z96-U3/13/J3	VAX Data Distributor for 8978	44,888	2,835	1,021	NA	NA
Languages						
Q5056	VAX Ada for VAX 8250	31,406	3,140	1,130	628	18,848
Q7056	VAX Ada for VAX 8350	40,786	3,140	1,130	628	24,471
Q9056	VAX Ada for VAX 8530	57,517	3,927	1,412	784	34,514
Q2056	VAX Ada for VAX 8550/8700	61,215	3,927	1,412	784	36,729
QK056	VAX Ada for VAX 8600/8650	57,519	NA	NA	NA	34,514
QM056	VAX Ada for VAX 8800	70,592	3,927	1,412	784	42,357
Q2056-UA/1A/JA	VAX Ada for VAX 8974	96,222	6,143	2,212	NA	NA
Q2056-U3/13/J3	VAX Ada for VAX 8978	110,145	6,962	2,504	NA	NA
Q5020	VAX APL for VAX 8250	10,049	1,008	361	201	6,027
Q7020	VAX APL for VAX 8350	13,055	1,008	361	201	7,833
Q9020	VAX APL for VAX 8530	18,407	1,260	452	251	11,046

**Non-hardware-dependent, single-use license and warranty.*

DEC VAX 8000 Systems

		Paid-up License Primary Sys. ($)	Initial License Fee ($)	Periodic Payment Primary Sys. ($)	Periodic Payment Cluster Sys. ($)	Paid-up License Cluster Sys. ($)
Q2020	VAX APL for VAX 8550/8700	22,092	1,418	512	285	13,262
QK020	VAX APL for VAX 8600/8650	18,407	NA	NA	NA	11,046
QM020	VAX APL for VAX 8800	30,125	1,670	603	335	18,081
Q2020-UA/1A/JA	VAX APL for VAX 8974	34,734	788	247	NA	NA
Q2020-U3/13/J3	VAX APL for VAX 8978	39,753	788	284	NA	NA
Q5095	VAX Basic for VAX 8250	6,689	788	235	129	4,011
Q7095	VAX Basic for VAX 8350	8,681	788	235	129	5,209
Q9095	VAX Basic for VAX 8530	12,243	840	300	167	7,350
Q2095	VAX Basic for VAX 8550/8700	14,690	945	340	167	8,810
QK095	VAX Basic for VAX 8600/8650	12,243	NA	NA	NA	7,350
QM095	VAX Basic for VAX 8800	20,034	1,113	401	223	12,023
Q2095-UA/1A/JA	VAX Basic for VAX 8974	23,090	1,481	530	NA	NA
Q2095-U3/13/J3	VAX Basic for VAX 8978	26,439	1,670	601	NA	NA
Q5106	VAX Bliss-32 for VAX 8250	7,287	788	259	143	4,368
Q7106	VAX Bliss-32 for VAX 8350	9,459	788	259	143	5,675
Q9106	VAX Bliss-32 for VAX 8530	13,346	914	328	182	8,001
Q2106	VAX Bliss-32 for VAX 8550/8700	16,013	1,029	372	206	9,608
QK106	VAX Bliss-32 for VAX 8600/8650	13,346	NA	NA	NA	8,001
QM106	VAX Bliss-32 for VAX 8800	21,830	1,218	437	243	13,094
Q2106-U3/13/J3	VAX Bliss-32 for VAX 8978	28,802	1,817	655	NA	NA
Q5015	VAX C for VAX 8250	5,964	788	207	111	3,581
Q7015	VAX C for VAX 8350	7,740	788	207	111	4,644
Q9015	VAX C for VAX 8530	10,920	788	267	147	6,552
Q2015	VAX C for VAX 8550/8700	13,094	840	303	169	7,854
QK015	VAX C for VAX 8600/8650	10,920	NA	NA	NA	6,552
QM015	VAX C for VAX 8800	17,861	998	357	198	10,721
Q2015-UA/1A/JA	VAX C for VAX 8974	20,591	1,313	474	NA	NA
Q2015-U3/13/J3	VAX C for VAX 8978	23,562	1,491	536	NA	NA
Q5099	VAX Cobol for VAX 8250	10,049	1,008	361	201	6,027
Q7099	VAX Cobol for VAX 8350	13,055	1,008	361	201	7,833
Q9099	VAX Cobol for VAX 8530	18,407	1,260	452	251	11,046
Q2099	VAX Cobol for VAX 8550/8700	22,092	1,418	512	285	13,262
QK099	VAX Cobol for VAX 8600/8650	18,407	NA	NA	NA	11,046
QM099	VAX Cobol for VAX 8800	30,125	1,670	603	335	18,071
Q2099-UA/1A/JA	VAX Cobol for VAX 8974	34,734	2,216	—	NA	NA
Q2099-U3/13/J3	VAX Cobol for VAX 8978	39,753	2,510	—	NA	NA
Q5018	VAX Dibol for VAX 8250	5,240	788	177	94	3,140
Q7018	VAX Dibol for VAX 8350	6,798	788	177	95	4,078
Q9018	VAX Dibol for VAX 8530	9,587	788	230	125	5,754
Q2018	VAX Dibol for VAX 8550/8700	11,508	788	265	146	6,909
QK018	VAX Dibol for VAX 8600/8650	9,587	NA	NA	NA	5,754
QM018	VAX Dibol for VAX 8800	15,687	872	314	174	9,408
Q2018-UA/1A/JA	VAX Dibol for VAX 8974	18,081	1,155	416	NA	NA
Q2018-U3/13/J3	VAX Dibol for VAX 8978	20,696	1,313	470	NA	NA
Q5130	VAX Digital Standard Mumps (DSM) for VAX 8250	11,351	1,134	4,081	227	6,815
Q7130	VAX DSM for VAX 8350	14,742	1,134	408	227	8,845
Q9130	VAX DSM for VAX 8530	20,790	1,418	510	284	12,474
Q2130	VAX DSM for VAX 8550/8700	24,948	1,607	579	321	14,973
QK130	VAX DSM for VAX 8600/8650	20,770	NA	NA	NA	12,474
QM130	VAX DSM for VAX 8800	34,020	1,890	680	378	20,412
Q2130-UA/1A/JA	VAX DSM for VAX 8974	39,218	2,510	901	NA	NA
Q2130-U3/13/J3	VAX DSM for VAX 8978	44,888	2,835	1,021	NA	NA
Q5100	VAX Fortran for VAX 8250	6,521	788	229	125	3,917
Q7100	VAX Fortran for VAX 8350	8,468	788	229	125	5,081
Q9100	VAX Fortran for VAX 8530	11,939	819	293	163	7,161
Q2100	VAX Fortran for VAX 8550/8700	14,333	924	332	185	8,589
QK100	VAX Fortran for VAX 8600/8650	11,939	NA	NA	NA	7,161
QM100	VAX Fortran for VAX 8800	19,541	1,082	391	217	11,718
Q2100-U3/13/J3	VAX Fortran for VAX 8978	25,788	1,628	586	NA	NA
Q9107	Fortran IV/VAX-to-RSX Cross Compiler for VAX 8530	1,617	788	13	11	966
Q2107	Fortran IV/VAX-to-RSX Cross Compiler for VAX 8550/8700	1,943	788	19	11	1,166
QK107	Fortran IV/VAX-to-RSX Cross Compiler for VAX 8600/8650	5,198	NA	NA	NA	966
QM107	Fortran IV/VAX-to-RSX Cross Compiler for VAX 8800	8,505	788	27	11	1,586
Q2107-UA/1A/JA	Fortran IV/VAX-to-RSX Cross Compiler for VAX 8974	3,056	788	46	NA	NA
Q2107-U3/13/J3	Fortran IV/VAX-to-RSX Cross Compiler for VAX 8978	3,498	788	57	NA	NA
Q5917	VAX Lisp for VAX 8250	10,091	1,008	363	202	6,059
Q7917	VAX Lisp for VAX 8350	13,104	1,008	363	202	7,862
Q9917	VAX Lisp for VAX 8530	18,480	1,260	454	252	11,088
Q2917	VAX Lisp for VAX 8550/8700	22,176	1,428	515	286	13,304
QK917	VAX Lisp for VAX 8600/8650	18,480	NA	NA	NA	11,099
QM917	VAX Lisp for VAX 8800	30,240	1,680	605	336	18,144
Q2917-UA/1A/JA	VAX Lisp for VAX 8974	34,860	2,226	801	NA	NA
Q2917-U3/13/J3	VAX Lisp for VAX 8978	39,900	2,520	907	NA	NA
Q5913	VAX OPS5 for VAX 8250	6,311	788	221	120	3,780

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DEC VAX 8000 Systems

		Paid-up License Primary Sys. ($)	Initial License Fee ($)	Periodic Payment Primary Sys. ($)	Periodic Payment Cluster Sys. ($)	Paid-up License Cluster Sys. ($)
Q7913	VAX OPS5 for VAX 8350	8,190	788	221	120	4,914
Q9913	VAX OPS5 for VAX 8530	11,550	788	284	158	6,930
Q2913	VAX OPS5 for VAX 8550/8700	13,860	893	321	179	8,316
QK913	VAX OPS5 for VAX 8600/8650	11,550	NA	NA	NA	6,930
QM913	VAX OPS5 for VAX 8800	18,900	1,050	378	210	11,340
Q2913-UA/1A/JA	VAX OPS5 for VAX 8974	21,788	1,397	501	NA	NA
Q2913-U3/13/J3	VAX OPS5 for VAX 8978	24,938	1,575	567	NA	NA
Q5126	VAX Pascal for VAX 8250	5,964	788	207	111	3,581
Q7126	VAX Pascal for VAX 8350	7,740	788	207	111	4,644
Q9126	VAX Pascal for VAX 8530	10,920	788	267	147	6,552
Q2126	VAX Pascal for VAX 8550/8700	13,094	840	303	169	7,854
QK126	VAX Pascal for VAX 8600/8650	10,920	NA	NA	NA	6,552
QM126	VAX Pascal for VAX 8800	17,861	998	357	198	10,721
Q2126-UA/1A/JA	VAX Pascal for VAX 8974	20,591	1,313	474	NA	NA
Q@126-U3/13/J3	VAX Pascal for VAX 8978	23,562	1,491	536	NA	NA
Q5114	VAX PL/1 for VAX 8250	10,049	1,008	361	201	6,027
Q7114	VAX PL/1 for VAX 8350	13,055	1,008	361	201	7,833
Q9114	VAX PL/1 for VAX 8530	18,407	1,260	452	251	11,046
Q2114	VAX PL/1 for VAX 8550/8700	22,092	1,418	512	285	13,262
QK114	VAX PL/1 for VAX 8600/8650	18,407	NA	NA	NA	11,046
QM114	VAX PL/1 for VAX 8800	30,125	1,670	603	335	18,081
Q2114-UA/1A/JA	VAX PL/1 for VAX 8974	34,734	2,216	798	NA	NA
Q2114-U3/13/J3	VAX PL/1 for VAX 8978	39,753	2,510	904	NA	NA
Q5631	VAX RPG II for VAX 8250	3,969	788	127	64	2,384
Q7631	VAX RPG II for VAX 8350	5,160	788	127	64	3,095
Q9631	VAX RPG II for VAX 8530	7,277	788	167	87	4,368
Q2631	VAX RPG II for VAX 8550/8700	8,736	788	193	104	5,240
QK631	VAX RPG II for VAX 8600/8650	7,277	NA	NA	NA	4,368
QM631	VAX RPG II for VAX 8800	11,907	788	233	127	7,140
Q2631-UA/1A/JA	VAX RPG II for VAX 8974	13,724	882	315	NA	NA
Q2631-U3/13/J3	VAX RPG II for VAX 8978	15,708	998	357	NA	NA
ULTRIX-32 SOFTWARE						
Q5716	DECnet-ULTRIX for VAX 8250	2,752	788	54	NA	NA
Q7716	DECnet-ULTRIX for VAX 8350	2,752	788	54	NA	NA
Q9716	DECnet-ULTRIX for VAX 8530	5,576	788	135	NA	NA
Q2716	DECnet-ULTRIX for VAX 8550/8700	6,689	788	159	NA	NA
QK716	DECnet-ULTRIX for VAX 8600/8650	7,529	NA	NA	NA	NA
QM716	DECnet-ULTRIX for VAX 8800	8,363	788	199	NA	NA
Q5917	VAX Lisp-ULTRIX for VAX 8250	10,091	1,008	363	202	6,059
Q7917	VAX Lisp-ULTRIX for VAX 8350	13,104	1,008	363	202	7,862
Q9917	VAX Lisp-ULTRIX for VAX 8530	18,480	1,260	284	252	11,088
Q2917	VAX Lisp-ULTRIX for VAX 8550/8700	22,176	1,428	515	286	13,304
QK917	VAX Lisp-ULTRIX for VAX 8600/8650	18,480	NA	NA	NA	11,088
QM917	VAX Lisp-ULTRIX for VAX 8800	30,240	1,680	605	336	18,144
Q2917-UA/1A/JA	VAX Lisp-ULTRIX for VAX 8974	34,860	2,226	801	NA	NA
Q2917-U3/13/J3	VAX Lisp-ULTRIX for VAX 8978	39,900	2,520	907		

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