

Digital Equipment Corp.

VAX 6000

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Note: Digital announced six new models in the VAX 6000 product line on October 30, 1991. The new models constitute a new 600 series within the VAX 6000 product line and effectively replace the previous generation of 500 series systems excluding the 510, which Digital will retain as a lower cost offering.

A year or two of flat hardware sales will do a lot to focus a computer company's attention, and Digital Equipment Corp. has been focusing on the VAX 6000 line of late. The result of DEC's concentration has been the revitalization of the 6000 line when these products represent a critical bridge to the RISC-based VAX.

Dismal sales of DEC's vaunted VAX 9000 and continual performance gains by competitors have tarnished the image and eroded the customer base of DEC's VAX empire. In the midst of these problems the VAX 6000 line has served as DEC's anchor offering midrange to mainframe capabilities and the VMS operating system.

After previous upgrades failed to help DEC keep pace with CISC and RISC offerings from IBM and HP, DEC engineered its way to bring the 6000 back into the midrange race. The announcement of a remodeled VAX 6000 lineup at the end of October 1991 buys DEC renewed competitiveness.

Strengths

- Best-in-class performance of 83 transactions per second for the VAX 6000 610.
- Industry leading price/performance of 12.9 K\$/tps (thousands of dollars per transaction per second). (Both according to TPC Benchmark A ratings published October 1991.)
- CMOS technology incorporates RISC design to maximize performance from existing VAX CISC architecture.
- Increasingly open VMS operating system.
- Expandable VAX/VMS platform.

- VAXcluster Multi Datacenter Facility (MDF) for disaster tolerant computing.
- Excellent application availability.
- Low cost board swap field upgrades.

Limitations

- Proprietary VMS operating system commands higher price tag than a UNIX-based solution.
- Support for Ultrix (DEC's UNIX derivative) not available immediately.
- Ultrix systems not competitively priced with other vendor's UNIX systems.
- Latest performance boost may be the culmination of an aging CISC architecture.
- System resale value may diminish as Digital prepares for RISC-based VAX.

Vendor

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Price

Range from \$121,000 to \$659,000.

GSA Schedule: Yes.

—By Don Marks, Senior Analyst
and Bill Sharp

Product Analysis

Symmetric multiprocessing, vast expandability and clustering capability are the claims to fame for the VAX 6000 line, along with the 10,000 customer applications DEC now claims for the VAX family. Multiprocessing and expandability in links to other systems, internal memory and connected disks all differentiate the 6000 family from the VAX 4000 models. VAX 6000s are general purpose midrange-to-mainframe systems designed for client/server, central data center or on-line transaction processing applications.

Like the last round of upgrades, new models this time offer improved performance. Unlike the last round, the substantial performance gains are coupled with price reductions that bring these systems back onto a competitive par with systems from IBM and HP.

Basically, the new VAX 6000 lineup offers roughly double the performance of the previous models with accompanying price cuts of 10% to 30%. The Model 310 has been retired to a silicon pasture in southern New Hampshire, making the Model 410 the new base of the line, while the Model 510 is retained as well. Previous Models 520 through 560 are replaced by 610 through 660, each using the new VAX 6000 chip. (See Overview table.) The second digit of each model number indicates the number of processors in the system. Models 410, 510, and 610 are uni-processor systems, while 620 through 660 climb to a maximum of six symmetric processors.

Target Applications

DEC numbers applications for VAX systems at 10,000 and growing. Installations for the VAX 6000 cover a broad range of customer types, including finance, health care, scientific and laboratory installations, as well as telecommunications. Enhanced speed and price performance of the 6000 makes it better than ever for on-line transaction processing (OLTP) applications.

Both proprietary and third-party applications are available from DEC. Third-party software is sold via Digital's External Applications Software (EAS) Library service. Through its Cooperative Marketing Program (CMP), Digital joins forces with independent software vendors in sales calls, trade shows, and technical demonstrations. System Cooperative Marketing Programs (SCMPs) are agreements through which Digital works with OEMs to market, demonstrate, and sell turnkey systems incorporating Digital hardware and third-party products.

Strengths

Digital's strongest asset is its massive installed base of about half a million VAX systems sold, 15,000 of them VAX 6000 systems. These systems are installed in more than 25,000 clusters employed by more than eight million users. Datapro's most recent user satisfaction survey for midrange systems found the VAX 6000 received the highest rating, edging out the HP 3000. While DEC has lost customers to other midrange systems, many users remain intensely loyal "VAX bigots" in the lingo of the computer market. Performance may be an advantage again for the VAX. While results of the tpsA benchmark force customers to compare apples to oranges, it is clear that the 6000 is no lemon. Price performance is also a plus, thanks to more

Overview

Model	Product Type	Base Memory	No. of Processors	VUPS	SPECmarks	Base Price (\$)
VAX 6000-410	Multuser	64MB	1	7	8.5/13.9	121,000
VAX 6000-410	Server	64MB	1	7	8.5/13.9	106,000
VAX 6000-510	Multuser	64MB	1	13	15.3/22.8	155,000
VAX 6000-510	Server	64MB	1	13	15.3/22.8	125,000
VAX 6000-610	Multuser	64MB	1	32	39.7	247,000
VAX 6000-610	Server	64MB	1	32	39.7	197,000
VAX 6000-620	Multuser	128MB	2	58	72.3	359,000
VAX 6000-620	Server	128MB	2	58	72.3	284,000
VAX 6000-630	Multuser	128MB	3	84	103.3	434,000
VAX 6000-630	Server	128MB	3	84	103.3	344,000
VAX 6000-640	Multuser	128MB	4	106	134	509,000
VAX 6000-650	Multuser	128MB	5	128	165.5	584,000
VAX 6000-660	Multuser	128MB	6	150	196.9	659,000

Notes:

VUPS represents VAX Units of Performance. One VUP corresponds roughly to the processing power of a VAX 11/780.

SPECmarks are a unit of performance measurement derived from benchmarks developed by the Software Performance Evaluation Cooperative.

Higher SPECmark numbers for 410 and 510 models reflect the addition of a vector processor. Vector processors are not available for the 600 series models.

Decision Points

Model	Requirement	Comment
VAX 6000 Series	Price	The VAX 6000 is without question an expensive system, but customers benefit from wide application availability, high performance, reliability, and service and support.
	Price/Performance	DEC's leadership in price/performance is narrow (12.9 K\$/TPS as opposed to \$13.7 K\$/TPS from HP) and may be misleading—the traditional VAX architecture is nearing the peak of its performance curve.
	Connectivity	DEC's Network Application Support (NAS) software integrates VAX/VMS systems into multivendor, multiplatform networked environments.
	Standards Compliance	VAX/VMS supports most major portability, interoperability, and communications standards. Support for POSIX 1003.1 and 1003.2 will be available by first quarter 1992.
	Growth Path	The VAX 6000 offers in-cabinet field upgrades across the entire product family. Future performance growth for the current VAX architecture, however, is unlikely. Digital has not detailed plans for upgrading VAX 6000 users to future Alpha RISC platform.
	Reliability	Current users give the VAX 6000 high marks for system availability. New Multi-Datcenter Facility (MDF), which allows for duplicate data centers up to 25 miles apart, extends reliability to disaster-tolerant levels.
	Service and Support	Digital retains an excellent reputation for the quality of its service and support, although many customers consider support fees usuriously high.
	Application Availability	Digital estimates that about one trillion lines of application code have been developed for VAX/VMS systems. Excellent third-party applications abound in such areas as OLTP, financial/accounting, and traditional office productivity.
	User Satisfaction	In DATAPRO's latest User Ratings Survey, the VAX 6000 received the highest ranking for overall customer satisfaction, edging out the HP 3000 and IBM AS/400.

price cuts by DEC. Profit performance is unclear, but DEC is likely willing to live with lower profits to protect its customer base.

Improved VAXcluster capabilities that allow FDDI links between datacenters up to 25 miles apart is both useful and important to large security-minded customers.

Growing reliance on software by DEC is important to the company's long-term health. DEC knows that hardware profits will steadily dwindle, replaced by software, consulting, and other services. For this reason, the emphasis on software products such as NAS will grow, along with efforts to sell consulting such as the new Open Consulting

Services. Digital wisely is moving deliberately in this direction, with nonhardware sales already making up more than half of total sales.

Limitations

Proprietary is still the most important word to keep in mind when looking at VAX systems. With the help of Digital's NAS integration software and the addition of POSIX-compliance to VMS, the VAX is now moving dramatically in the direction of open systems, although it still retains, for good and ill, a proprietary legacy. If VAX systems provide what the user needs and do so in the most effective way for the application, then the choice is clear.

But often proprietary means higher priced, if not for all the hardware, then certainly for software and services. VAX VMS is still an effective lockout for most competition, and Digital would like it to stay that way for as long as possible. "Open" in connection with the VAX can mean connecting to the outside world to protect investment, but it also appears to mean keeping customers and their pocketbooks under DEC's control.

Ultrix is not available on new VAX 6000 Model 600 systems. DEC says this is because the Ultrix team is taxed with other projects and cannot provide Ultrix on the new systems until next year. But users cannot buy what DEC won't sell, and the more customers stay with VMS, the more DEC likes it. It remains unclear whether the lack of Ultrix availability is a workload problem as DEC claims, or reflects a lack of openness in DEC's open systems.

TPC benchmarking may have been used by DEC to present a somewhat better-looking Model 610 than any customer can buy. If in fact the excellent Model 610 tpsA results come in part from performance help in the form of three MicroVAX 3100 systems, then DEC should make this clear in trumpeting the results. And customers should verify performance of the new systems for themselves. Clearly the new models are much better than preceding VAXes. Whether they in fact "obliterate" the competition is something users should determine using their own configurations and applications.

Competitive Analysis

At the core of the revitalized VAX 6000 family is DEC's engineering effort on its CMOS IV chip that is the heart of the systems. The new chip includes 1.3 million transistors and achieves its roughly 40 SPECmark performance in two ways. First, the VAX 6000 borrows technology from the VAX 9000 chip design. VAX 9000 made it possible to reduce cycles per instruction to 4.5 from what had been 10. Cycles per instruction is the big reason why RISC chips outperform CISC designs such as the VAX. VAX 6000 chips now employ some RISC design in a four-stage pipeline where VAX instructions are translated into simpler RISC instructions for a fast trip through the pipe.

Secondly, DEC did some particularly fine work in executing the design. The chips are CMOS IV with a 0.7-micron geometry, meaning traces are extremely close together. Done properly, this means signals travel a shorter distance on the chip, which can then run faster. DEC's VAX 6000 chip races along at 83.3MHz. Reducing the cycles per instruction while also increasing the speed of the chip has brought the VAX 6000 back into the mainstream of midrange computing performance. Whether 6000 performance actually runs past the competition as DEC claims is unclear.

VMS 5.5 Operating System

A new version of VMS accompanies the hardware improvements. The new version is necessary to support VAX 6000 600 models, but adds some other improvements as well.

Batch/print services will run more reliably and will scale better. Access to all VMS tape controllers in a cluster is possible with cluster-wide tape server support, now part of the improved OS. On-line optimization of indexed files

and future on-line disk fragmentation are provided. Host-based volume shadowing for SCSI disks is also part of VMS 5.5. DECthreads, support for concurrent programming, is included as well.

By far the most important changes to VMS are those that are unseen and will not be usable for a while yet. These are changes to make VMS POSIX-compliant, a major move for DEC to help convince users and prospective customers that it indeed plans to become more open. VMS 5.5 for the VAX 6000 will begin shipping in second quarter of fiscal year 1992, according to DEC.

Ultrix: The OTHER Operating System

Oddly, in the midst of trumpeting "No Compromise" to its customer base, Digital made a very large one for Ultrix users—no VAX 6000 support until next year. Daryl Long, product manager for the 6000, cites the demands placed on the Ultrix development team, which supports both VAX and MIPS architectures. "If somebody needs Ultrix today they can buy the Model 510," says Long. But if you use Ultrix, don't plan on using a fast new 600 series VAX 6000 soon—so much for no compromise.

For those considering a UNIX solution, this puts DEC at a considerable disadvantage to HP and IBM. HP, which offers a "desktop to datacenter" commercial UNIX strategy implemented on the RISC-based HP 9000, has seen its UNIX business grow by almost 70% for two consecutive years.

Likewise, IBM has recently taken to marketing its RS/6000 systems more aggressively to commercial accounts. Both IBM and HP offer much more competitive pricing for their UNIX offerings than DEC does for Ultrix. Digital has clearly made a strategic decision regarding UNIX and one that differs from the strategies of its closest competitors.

Features and Functions

Just as important as the number-crunching capabilities of a midrange or larger computer are the disk, memory, and other capabilities that make the whole system work effectively. DEC adds improvements here as well. More memory is on the way. Maximum memory supported by the VAX 6000 today is 512MB. Over the next year, DEC pledges that memory capacity support will grow to a full gigabyte in a future version of the VMS operating system.

Disk arrays have come to the VAX 6000, which now supports DEC's RF73 5.25" disks, with 2GB per drive. Using RF73 drives on VAX DSSI channels provides up to 96GB of storage. In VAXcluster configurations, the VAX 6000 now supports up to 8TB of storage.

DSSI VAXclusters now can include three VAX computers rather than the two supported up to now. Users now can connect two or more VAXcluster systems separated by up to 25 miles to create a single, Multi-Datacenter, VAXcluster system using an FDDI fiber optic network. The connection can provide protection for data and applications in the event one facility is badly damaged. VMEbus support now is available for the VAX 6000. VMEbus is an ANSI IEEE standard in many application areas, with more than 4,000 system boards available. DEC now provides an optional connection between its own XMI bus and VMEbus.

Board-swap upgrades are available for existing VAX 6000 systems to bring aboard the new chips and their performance capabilities.

Performance

By any measure, performance of the VAX 6000 is vastly improved from its position a short time ago. Comparing the VAX 6000 Model 510 with the new Model 610 shows a factor of 2.5 improvement in raw performance.

Defined in SPECmarks, performance for the VAX 6000 Model 510 comes in at 15.3 SPECmarks, while the new Model 610 jumps performance to 40.5 SPECmarks. Performance for the Model 660 reaches 196.9 SPECmarks, nearly 200 SPECmarks from a VAX—quite an accomplishment.

Viewed using VUPs, traditional VAX lovers can have a performance vantage point that is comfortable to them. VUPs, are in fact a measurement unit equivalent to the performance of the VAX 11/780. Using this time-honored yardstick, the Model 510 measures out at 13 VUPs. Compare this to the new Model 610 at 32 VUPs, or the Model 640 at up to 106 VUPs, or the Model 660 at up to 150 VUPs. VUP lovers will be thrilled.

But the performance numbers that have gotten the greatest amount of attention for the VAX 6000 are the results of DEC's new computers running the TPC Benchmark A developed by the Transaction Processing Performance Council. Using the benchmark, DEC showed performance and price performance that exceeded those of rival products, competitive performance levels that have not been available from DEC for quite a while.

This vendor-neutral benchmark provides a useful measure of system performance for on-line transaction processing (OLTP) applications. OLTP applications are characterized by large numbers of concurrent user sessions, frequent fast database updates, heavy disk use, and transaction integrity. Using the benchmark produces two measures. The benchmark provides a performance measure called tpsA-Local, defined as the number of transactions executed per second by the system under test. It also provides \$ per tpsA-Local, a cost per tps based on five-year cost of ownership.

Results for the VAX 6000 Model 610 are impressive—83.6 tpsA-Local outruns the nearest competitor by a good distance. Competing midrange systems from Hewlett-Packard and IBM are hanging back around the 40 to 50 tpsA range. In addition, price performance of the DEC system comes in at \$12,922 per tpsA-Local, nearly \$1,000 per tpsA less than the nearest competing system. This is an exciting result for DEC that would be more exciting were it not for a flaw in the benchmarking procedures and in DEC's reporting of results for the Model 610.

On close examination, DEC's configuration for the benchmark includes not just the Model 610, but three MicroVAX 3100 systems running as front-end processors, says Kim Shanley, TPC administrator for the Transaction Processing Performance Council. Because of the way regulations are written for the benchmark, this preprocessing is allowed, says Shanley, but the MicroVAXes "did add performance to the tpsA result."

Even this is not necessarily a problem. The difficulty is that when reporting results of the benchmark to the press and customers, DEC makes no mention of the MicroVAX systems and the performance they added. DEC simply reports its results as being for the VAX 6000 Model 610, and compares its results head on with competing systems that include no such preprocessing systems.

Shanley says the council is reviewing the problem and will likely change its regulations governing the benchmarks. That will help for future measures. For the present,

however, DEC customers will likely find OLTP performance of the VAX 6000 to be quite good, but not as good as the TPC benchmark would imply. As with any determination of true system performance, customers should rely if at all possible on a test using their own application software.

Competitive Position

DEC's introduction of new 6000 models, in spite of posturing to the contrary, is indeed the last gasp of an aging architecture. The investment of people and dollars for Digital to make improvements using its current designs is considerable. Costs for 600 models must be high indeed and represent DEC's efforts to keep the VAX customer base satisfied long enough for Alpha to arrive.

Competitors will not sit idly by, so DEC's performance marks set with the new family will not stand for very long. The ultimate answer to RISC must in fact be RISC, not a band aid RISC/CMOS hybrid. DEC's latest improvement to the 6000 works because RISC pipelining speeds the processing enough to keep chip performance in the ballpark with rival RISC silicon. So Alpha must come riding DEC's RISC to the rescue as soon as possible.

Look for both HP and IBM to use repricing and performance improvements to quickly eclipse DEC's gains and keep the pressure on. Loyal VAX users have gradually and reluctantly been leaving the fold to buy competing systems, some searching for more performance, others for open systems and some seeking both. DEC is hoping that its 6000 performance will bring the flock back into the fold and prevent others from wandering away. Success of the strategy will depend on how long users are convinced that DEC's performance and statements of openness are enough to meet their needs.

User Opinions

Eight million VMS users can't be wrong, and for a long time devoted VAX hordes have been regularly rewarded for their fidelity. In such communities of users, loyalty can evolve to vice, and DEC users refer to "VAX bigots" who will consider no computing offspring not begot by Ken Olsen & Co. It is these people DEC is trying to reach with new 600 models. And they are happy—for now.

Mark Bronson, R&D director for Aeon Systems, Inc., Albuquerque, NM, considers the new VAX 6000 models "a refreshing change from the VAX 8000, which I was not very impressed with. The price performance of the new entries is beginning to look real. DEC is doing what they have been saying they would do for a long time." He admits he has been worried about price performance and customers buying his firm's data acquisition, and control systems built around the VAX have been complaining. Bronson sees this as a critical time in his market, and DEC's moves to provide VMEbus capability, good price performance, and moves toward open standards have come "just in time."

Eric Beals, senior VMS programmer at Lawrence Berkeley Laboratory, Berkeley, CA, has been working with a VAX 6000 Model 610 for several months. "It has been a very favorable experience," says Beals. "We have it in a cluster with some Model 510s. We have had a number of people do a lot of work with the system with no problems whatsoever." However, he adds, "Performance is a problem. This machine is two to three times faster than the previous one, but it is still not as fast as some systems that

are available." There is more growth in demand for systems from Sun, HP, and Silicon Graphics than for VAX. At LBL, however, many users still prefer VAX systems. Final performance on any application depends at least as much on the nature of the application, the quality of the software, and the experience of the user as it does on the hardware.

Dave Mallery, Editorial Director of DEC Professional magazine and VP of Professional Press, Inc., Horsham, PA, is a happy fellow. He is happy because he considers the VAX 6000 600 models "phenomenal." Mallery, a long-time VAX user and consultant before starting DEC Professional a decade ago, still manages a VAXcluster at the publishing company. He is pleased. "They about tripled the performance . . . skipped a whole generation . . . extraordinarily cost effective . . . they obliterated the competition . . . absolutely back in the game and should release a pent-up order stream." So much for the new hardware. About DEC's marketing, Mallery is not so complimentary. "Digital has always engineered their way out of trouble instead of marketing, and they have done it again." Asked what DEC should do to improve marketing of the VAX line, he replies, "Start."

Datapro's most recent user ratings survey (October 1991) credits upgradability and reliability for making the VAX 6000 the top vote-getter in the midrange class for user satisfaction. DEC's 6000 climbed to first place this year, barely edging out the HP 3000, which held first place last year. The 6000 climbed to first from third place last year. Scores were:

VAX 6000	4.34
HP 3000	4.33
IBM AS/400	4.21
IBM System/38	4.15
VAX 8000	4.13
MicroVAX	4.13
Prime 50	4.00

Vendor Analysis

Digital thinks of itself as the world's leading supplier of networked computing systems, as well as a leader in systems integration. After several years of criticizing the trend toward open systems, Digital now claims strong support for openness and industry standards. Digital is a key participant in the Open Systems Foundation, an industry group founded in 1988 to develop industry recognized specifications for UNIX.

Network Application Support (NAS) is a Digital initiative that addresses VAX compatibility with other systems and multivendor connectivity. NAS products and consulting services help VAX users integrate desktop system and midrange and mainframe systems, both Digital and non-Digital.

Nobody is about to take away Digital's number two ranking in the U.S. computer industry as measured by total revenues. But the meteoric growth Digital enjoyed through the 70s and particularly the 80s has ground to a

halt in the few years. DEC's income began a rapid fall-off in 1989, culminating in the company's first-ever annual loss during fiscal 1990. Hardware sales for DEC have been flat for the past several years, so that as software and services have grown in revenue, the percentage of DEC revenue from hardware has fallen steadily. Hardware for 1992 may represent only about 45% of total revenues for Digital.

Even Digital's introduction of new VAX 6000 models is unlikely to make dramatic changes in hardware revenues for fiscal 1992. Purchase cycles on these systems are long, and the profits on the CMOS IV technology is not likely to be substantial due to the higher inherent costs of the CISC logic and system designs. Digital's dramatic price cuts will serve primarily to preserve market share for upcoming Alpha RISC-based systems.

Market Strategy

Digital these days expends large amounts of energy and cash getting out the message that it is serious about open systems. Unfortunately, the company's multiyear dance with openness has left many customers mistrusting the firm's professed position. While talking publicly about open systems and aiding OSF, DEC often pushed customers hard to buy VAX/VMS systems.

Digital may now be a convert to open systems, but customers are unsure what to believe—Digital claims to open systems, or the Model 600 systems they can only buy with VMS until sometime in 1992 when Digital ships Ultrix for them. But Digital loudly professes its products to be "No Compromise" solutions thanks to NAS capabilities for integration to most anything.

It remains unclear whether Digital in fact means to be completely open and is just having a tough time getting there, or if the strategy is to talk open while selling closed systems to keep customers tied to the more profitable VMS.

Market Position

Digital has lost its number one position in the minicomputer market, replaced by IBM as that firm's AS/400 took market share away. Hewlett-Packard is also taking off with large pieces of Digital business. HP is particularly delighted that DEC so often mentions the Palo Alto company in new product announcements, when just a few years ago Digital scoffed at the notion that HP was worth considering as a competitor.

Both IBM and HP have gone after the low end of the midrange market, a piece of the pie Digital seems to have neglected to some large extent. By partitioning its VAX line into segments, Digital makes it difficult for customers to move their investments up the line as they grow in computer system size. IBM and HP can be expected to keep up the pressure on Digital as Alpha slowly nears completion.

Although it has been remodeled, Digital still uses the old brick wool mill in Maynard where Ken Olsen and three engineers founded Digital Equipment Corp. in 1957. The group used their own money, along with venture capital from a Boston firm, to get started.

Executive Turmoil

In efforts to control rising costs at a time when revenues are not growing, Digital has eliminated more than 9,000 jobs in the past year or so, with nearly an equal number of cuts yet to come. These included Digital's first-ever layoffs in addition to attrition and early retirement reductions.

Company Activity

Date	Event
January 1991	Announced VAX 4000 Model 200, a low-end VMS system/server designed to replace the MicroVAX line.
February 1991	Enhanced Pathworks network operating system to allow NetWare users access to VAX/VMS and Ultrix hosts.
March 1991	Released Ultrix Version 4.2, which provided vector processing support for VAX 6000 line.
April 1991	Announced Polycenter strategy for distributed, multivendor systems management. Widely considered DEC's answer to IBM SystemView, Polycenter consists of data center management software from DEC and third-party vendors. Shipment slated for 1995 or 1996.
May 1991	Announced plans to implement the VAX architecture on a RISC-based, promising a ten-fold increase in VAX/VMS price/performance. Code-named project Alpha, the proposed plan would deliver the first RISC-based VAX by 1993.
June 1991	Reduced prices for VAX 6000 line by 18 to 37% for systems and 30 to 69% for upgrades.
June 1991	Reorganized into four main units — commodities (including PCs and networks), VAX/VMS systems, systems integration, and services.
June 1991	Introduced integrated FDDI adaptors for VAX 6000; unveiled first Ethernet-to-FDDI router.
July 1991	Took a charge of \$1.1 billion and reported a \$617.4 million loss for the fiscal year.
October 1991	Reported net income up 9.2% for first quarter of its new fiscal year, demonstrating stable growth.
October 1991	Added support for open systems and standards, including the OSI model and TCP/IP protocol, to DECnet, its proprietary network services.
October 1991	Introduced new layered software licensing scheme designed to allow customers to purchase software in more cost-effective increments.
October 1991	Introduced VAX 4000 500, the third member of the VAX 4000 family, along with two new VAXstation products—including the ultra low-cost VAXstation VLC (\$3,450)—and the six new VAX 6000 600 systems discussed in this report.
November 1991	Announced that a version of VMS capable of running on the new Alpha RISC-based architecture would not be ready for at least a year, leading many to conclude that OSF/1 would be the first operating system to ship on early Alpha workstations.

A number of high-ranking executives also have departed Digital as the times have gotten tougher, seeking opportunities in other firms. These include James M. Osterhoff, until recently Digital's vice president of finance, who now is chief financial officer of US West, Denver, CO, and Gary Eichorn who was in charge of Digital's Application DEC strategy until he left to become General Manager of Hewlett-Packard's workstation group.

Finally, DEC faces at some point the retirement of Ken Olsen, founder and heavy-handed top manager. No named successor has lasted for very long as number two to Olsen, and the top guy now refuses to even name a successor. Many would like to see management turned over, or power in the company at least distributed more evenly, but this seems unlikely soon. For now, Digital is the child of Kenneth H. Olsen, and he will run it as he sees fit. Olsen, age 65, is the youngest member of Digital's board of directors. He pledged at the firm's most recent shareholder's meeting to expand and add some new blood to his board.

Sales and Distribution

Digital has yet to find a solution to its sales force problems, which range from hard sell approaches about the VMS operating system to simple unavailability at some customer sites. DEC's Executive Partner Program, which assigns DEC managers to key customer executives.

Digital markets its products and services through direct and indirect sales channels. Worldwide sales offices concentrate on three major segments: *Business Week* 1000 companies; business centers including dealers, distributors, systems houses, and retailers that sell to end users; and some smaller individual businesses.

DEC's Daryl Long says DEC will be concentrating on technical OEM channels that were once the mainstay of the company, but had been ignored of late. Recent attention to these markets will stimulate a resurgence, he says.

While it is too early to tell how the new models are performing in the marketplace, Long confidently predicts a

large influx of orders. He expects DEC to bring back some of the customers who have been leaving to buy competing systems.

Support

Digital is noted for superb, if somewhat expensive, customer service and support. All VAX systems come with a one year, on-site warranty for CPU components and peripherals. Warranty coverage includes system installation; repair parts and labor; Field Change Orders installation; and optional coverage for up to seven days a week, 24 hours a day, wind, sleet, rain, or snow. This hardware warranty can be extended up to three years.

DEC's Field Service organization offers both on-site and off-site support services for VAX systems. (They'll come to your place, but as with most service vendors, only for a price.) 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 also available on a best-efforts basis 24 hours a day, seven days a week. DEC bills you for time and materials; charges are portal to portal (or, for those in the nautical trade, portal to porthole), with labor, parts, and travel expenses rated separately. An optional adjunct to Digital's on-site field service, RecoverALL, provides full product repair or replacement for equipment damage caused by accidents, shipwrecks included.

Offsite maintenance is available through the Customer Returns Center, Product Repair Center, and Digital Service centers. The Customer Returns Center, which sounds like the place where you'd go to take back a VAX that didn't fit, is actually a repair depot located in Woburn, MA. The Returns Center provides service under return-to-factory warranties and also does post-warranty work (on

your dime, of course). Product Repair Centers fix and refurbish systems for customers who have some technical expertise and perform some of their own repairs but occasionally need a little extra help. Digital Service centers provide carry-in service for terminals and peripherals. They'll also furnish board swaps for those who prefer to do their own repairs.

DEC's Software Services organizations provides software support, installation, training, telephone support, publications, and even on-site help. Under Digital's software support policy, all VAX software products are covered by a basic warranty, and customers must purchase some of the services, such as training and telephone support separately. Customers may also select the System Startup Program which entitles them to system level support, system management training, and telephone assistance. Finally, DEC also offers customers access to the Digital Software Information Network, which provides online help, including a facility for submitting questions to support personnel and several databases containing problem resolution information. This service is free to U.S. customers covered by basic support contracts.

Open Consulting Services

Digital maintains training centers worldwide and offers courses covering both DEC equipment and systems and peripherals from other vendors. The company publishes a quarterly digest of available courses. Lately, in accordance with industry trends, much of the emphasis has been on networking, standards, and open systems.

The most crucial part of building open systems is figuring out what systems and capabilities are needed in the first place. Making that task simpler is part of a new consulting service just announced by DEC along with the revitalized VAX 6000 line. Open Consulting Services for NAS assists DEC customers in planning, designing, implementing, and maintaining open multivendor computing systems using NAS. DEC hopes to match customer needs with its NAS capabilities using the consulting program, which includes four modules: definition and assessment, technology infrastructure design, technology selection, and implementation strategy planning.

Specifications

Enhancements

Date	Event
Oct-91	Added the VAX 6000 600 model family.
Oct-91	Increased total storage capacity to 8.0GB with the introduction of the 700MB RA71 and the 1.0GB RA72 disk drives. Up to four RA72 disk drives can fit into the space of the 1.5 RA92 drive.
Mar-91	Enhanced Ultrix with support of X Windows and SQL.
Jan-91	Announced dual host configurations, as well as the KFMSA disk and tape adapter, SF200 Storage Array, RF837 Tape Subsystem, SF72 Storage Array, and RF72 DSSI disk products for increased storage capacity at lower costs.

Features/Functions

Model	410	510	610	620
Model Characteristics				
Number of Processors	1	1	1	2
Min./Max. Memory (bytes)	32M-512M	64M-512M	64M-512M	128M-512M
Memory Type	CMOS	CMOS	CMOS	CMOS
Expansion Increments (bytes)	32M, 64M, 128M	32M, 64M, 128M	32M, 64M, 128M	32M, 64M, 128M
Cache Memory per Processor (bytes)	2K on chip/128K on board	2K on chip/512K on board	10K on chip/2M on board	10K on chip/2M on board
Word Size (bits)	32	32	32	32
Battery Backup	Yes	Yes	Yes	Yes

General Performance

Relative Performance	7*	13*	32*	58*
SPECmarks	7.1	13.2	40	72
Processor Cycle Time (ns)	28	16	12	12
Max. I/O Data Rate (bytes/sec)	100M	100M	100M	100M

Input/Output Control

Number of I/O Processors	1 - 7	1 - 7	1 - 7	1 - 7
Number of Channels/Buses	7**	7**	7**	7**

*Performance relative to the VAX 11/780.

**One XMI bus and up to 6 VAXBI buses and/or VME buses.

Model	630	640	650	660
Model Characteristics				
Number of Processors	3	4	5	6
Min./Max. Memory (bytes)	128M-512M	128M-512M	128M-512M	128M-512M
Memory Type	CMOS	CMOS	CMOS	CMOS
Expansion Increments (bytes)	32M, 64M, 128M	32M, 64M, 128M	32M, 64M, 128M	32M, 64M, 128M
Cache Memory per Processor (bytes)	10K on chip/2M on board			
Word Size (bits)	32	32	32	32
Battery Backup	Yes	Yes	Yes	Yes

General Performance

Relative Performance	84*	106*	120*	150*
SPECmarks	103	134	165	197
Processor Cycle Time (ns)	12	12	12	12
Max. I/O Data Rate (bytes/sec)	100M	100M	100M	100M

Input/Output Control

Number of I/O Processors	1 - 7	1 - 7	1 - 7	1 - 7
Number of Channels/Buses	7**	7**	7**	7**

*Performance relative to the VAX 11/780.

**One XMI bus and up to 6 VAXBI buses and/or VME buses.

Peripherals

Hard Disk Storage Devices

Model	RA71	RA72	RA90	RA92
Type	Fixed	Fixed	Fixed	Fixed
Diameter (in.)	5.25	5.25	9	9
Formatted Capacity (bytes)	700M	1.0G	1.2G	1.5G
Controller Model	DKB50, HCS50/70	DKB50, HCS50/70	DKB50, HCS50/70	DKB50, HCS50/70
Average Seek Time	12.5 ms	12.5 ms	32.3 ms	16 ms
Data Transfer (bytes/sec.)	2M	2M	2.8M	2.8M
Supported by System Models	All models	All models	All models	All models

Comments

Note: Disk Arrays: SF200—2-24GB, includes RF72 disks; SF72—2-4GB, includes RF72 disks; SA850—2.7-22.5GB, includes RA92/SA70 disks; SA800—6-24GB, includes RS92/SA70 disks; SA650—3.6-9.5GB, includes RS90/SA70 disks; SA600—1.2-9.7GB, includes RA90 disks; SA70—1.1-1.1GB, includes RA70 disks; SA705—1.1-4.4GB, includes RA70 disks; SA900—40GB, includes a mix of RA92, RA71, and RA72 disks.

Model	RV64	RV20	ESE20	RF72
Type	Optical	Optical	Solid State	DSSI
Diameter (in.)	DNA	DNA	DNA	5.25
Formatted Capacity (bytes)	128G	2G	120M	1G
Controller Model	VAXBI, UNIBUS backplane	VAXBI, UNIBUS backplane	VAXBI, UNIBUS backplane	VAXBI, UNIBUS backplane
Average Seek Time	13-15 sec*	150 ms	NA	13.3 ms
Data Transfer (bytes/sec.)	250K	262K	3.4M	2.0M
Supported by System Models	All models	All models	All models	All models

Comments

Note: Disk Arrays: SF200—2-24GB, includes RF72 disks; SF72—2-4GB, includes RF72 disks; SA850—2.7-22.5GB, includes RA92/SA70 disks; SA800—6-24GB, includes RS92/SA70 disks; SA650—3.6-9.5GB, includes RS90/SA70 disks

*Total cycle time (time to retrieve and insert cartridge and access beginning of file).

Disk Controllers

Model	Description
KDM70	Provides eight ports for DSA device attachments, of which two are available for tapes. A maximum of three KDM70s are supported per host and require two I/O XMI slots.
KDB50	A VAXBI disk controller that requires the VAXBI expansion option and two VAXBI slots. Up to four KDB50s are supported per VAXBI channel; total of 12 per system. A maximum of four disk drives are supported per KDB50.
HSC70	A Hierarchical Storage Controller that connects to the host through the CI, connecting up to eight data channels, providing direct support for up to 32 SDI disk drives or a combination of SDI disk drives and up to 24 TA Series tape drives.
CI (Computer Interconnect)	Provides additional storage through a VAXcluster storage configuration.
HSC50	A Hierarchical Storage Controller that connects to the host through the CI, supporting up to 24 SDI disk drives or 16 SDI drives and eight TA tape drives.
DSSI Storage Array System	Provides up to 48GB disk storage and uses two cabinets. Up to 12 DSSI channels are supported.
KFMSA	A disk/tape adapter that connects DSSI to the XMI bus and supports up to 14 integrated storage elements, two of which can be tapes.
CIXCD	VAXcluster disk controller.
CIBCA	CI VAXcluster interface.
Comments	Up to 8GB of storage is available in the system cabinet. Space is provided for two SA70 building blocks (eight RA70s), two RA92 disk drives, or one of each, or eight RA71 or RA72 disk drives.

Peripherals (Continued)**Tape Devices**

Models	TA81	TA91	TF85	TF857
Type	Reel-to-reel	Cartridge	Cartridge	Cartridge DSSI
Size (in.)	0.5	5.25	5.25	5.25
Recording Density	1600/6250	38000	42500	42500
Recording Mode	PE/GCR	IBM 3480/3490 compatible	Serpentine	Serpentine
Controller Model	HSC50, HSC70, KDM70	HSC50, HSC70, KDM70	DSSI	DSSI
Unformatted Storage Capacity	145MB (GCR); 40MB (PE)	1.2GB	2.6GB	2.6GB*
Tape Speed	75/25 ips	100 ips	100 ips	100 ips
Data Transfer Rate (bytes/sec.)	4.78M	2.7M	800K	1.1M

*Up to 7 cartridges of 2.6GB each.

Printers

Models	LA75	LG06	LG31	LP37	LP29
Type	Matrix	Matrix	Line	Band	Band
Speed	250/125/42/32 cps	800 lpm	300 lpm	900/1200 lpm	2000 lpm
Interface/Controller	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)

Models	LN05/LN06 2100/2200	DECclasser 3200/3250	LPS20	LPS40
Type	Laser	Laser	Laser	Laser
Speed	8 ppm	13 ppm	20 ppm	40 ppm
Graphics Resolution	300x300	300x300	300x300	300x300
Interface/Controller	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)	LP11; LLLF01; EIA C-232; DMB32; DMF32; Parallel (Dataproducts)

Workstations/Terminals

Models	VT330 Plus	VT340 Plus	VT420
Screen Size (in.)	14	14	14
Screen Size (lines x char.)	24x80; 24x132	24x80; 24x132	24, 25, 36, 48 x 80, 132
Symbol Formation	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.)	5 or 8 x 7 or 10 (80 col.); 5 or 8 x 7 or 9 (132 col.)
Character Phosphor	White; green; amber	White; green; amber	White; green; amber
Max. No. Simultaneous Colors/Grays	16 colors from a palette of 4096	16 colors from a palette of 4096	None
Interface	DEC 423; RS-232-C	DEC 423; RS-232-C	DEC 423; RS-232-C

Peripherals (Continued)

Other Peripherals

Model	Description
RV20	Write Once Read Many (WORM) optical storage device. Average seek time is 150 ms, the continuous data transfer rate is approximately 250KB/s, and the master drive can be daisy-chained to three slave drives to provide up to 4GB of storage.
LA100	A microprocessor-controlled hard copy terminal and printer, printing at 240 cps in draft mode, 30 cps in letter-quality mode, and 80 cps in memo mode.
LA120	A 180-cps printing terminal
DECtalk	A speech synthesis unit, converts standard ASCII text into speech output.

Communications

Networking Features

Networking Interfaces	DEC LANcontroller 400 (DEMNA) 802.3/Ethernet controller. Network Application Support (NAS) provides standard program interfaces. Synchronous, asynchronous, point-to-point, and multipoint connections are supported for interprocess of communications. WANrouter 100 and 500 are multiprotocol (OSI, TCP/IP, and DECnet) routers that support frame relay, a high-speed version of packet switching. DSB32 (WANcontroller 220). DEBNA Ethernet-to-VAXBI communications controller. LAN Bridge 100 enables users to link several Ethernet LANs.
Network Protocols	Digital Network Architecture (DNA) using DDCMP protocol; Ethernet; TCP/IP; DEC/OSI; HDLC; ADCCP; LU 6.2; X.25; X.400; SNA/SDLC; BSC; 2780/3780 emulation; 3271 emulation.
Network Applications	Network Application Support (NAS), Digital's set of open software that enables users to integrate, port, and distribute applications across a network of disparate computer systems. X.400; SNA/SDLC; BSC; 2780/3780 emulation; 3271 emulation.

Software

Operating System	VMS (Virtual Memory System), a proprietary, general-purpose operating system. ULTRIX-32 (currently supported on Models 410 and 510 only; will be supported on the 600 family in 1992).
UNIX Implementation	ULTRIX-32, Digital's version of Berkeley UNIX. 4BSD which is compatible with AT&T's UNIX System V, Release 2.0. It does not comply fully with AT&T's System V interface Definition (SVID).
Complied Standards	X/Open; POSIX; Network File System (NFS); X Windows.
Compilers	APL; Ada; Basic; Bliss 32; C; Cobol; Fortran; Pascal; PL/1; Lisp.
DBMS(s)	VAX Rdb/VMS; VAX Data Base Management System (DBMS); Oracle; Sybase; Progress.
Appli. Development Tools	Includes text editors, a linker, a librarian, a common runtime procedure library, and a symbolic debugger. Some specific packages include VAXELN Tool Kit and DECtp.
Communications Software	Digital Network Architecture (DNA), a set of protocols governing the format, control, and sequencing of message exchange for all DECnet implementations. DECnet-VAX, permits VMX-based systems to participate as routing or end nodes in DECnet computer networks. DECnet-ULTRIX, a Phase IV Ethernet-based end-node implementation of the DNA for the ULTRIX operating system. DECmcc Extended LAN Manager, a network management system under Digital's Enterprise Management Architecture, which manages DECbridge, LANbridge, and DECconcentrator products.

Other Software

Package	Source	Description
ALL-IN-1	Digital	Integrated office and information system.

Security Features

Tempest Version Available	A militarized version of the VAX 6000 Model 600 will be announced in 1992.
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Operating Requirements

Hardware Components needed for base systems/servers include the CPU, memory, infoServer 100 or TK70 for software distribution, disk/tape controller, disk device, console terminal, VAXcluster software license. These items are included with a preconfigured system.

Software VMS or ULTRIX operating systems.

Configuration

Configuration Rules

VAX 6000 systems are offered as base systems, as preconfigured systems, in a three-system DSSI VAXcluster configuration, in a VAXcluster configuration, in a networked configuration, or as server systems.

Depending on the model, up to six processors can be placed in the same CPU cabinet. Multiprocessor models are distinguished by symmetric multiprocessor system (SMPs) and permit multistream computing and parallel execution of Fortran applications.

VAXclusters differ from SMP systems in that they are a set of cooperating but independent processors, each with its own memory-resident copy of the operating system, while the SMP system is a single-image system composed of multiple processors with a shared operating system.

A VAXcluster Console System based on the MicroVAX II is available for VAXclusters. It is linked to nodes in the cluster through fiber optic facilities and allows system management operations to be performed from any terminal.

The VAX 6000 three-system DSSI VAXcluster, made up of three 6000 systems connected by a Digital Storage System Interconnect (DSSI) storage bus, provides access to the other two systems or stored data should one system fail.

The VAX 6000 Series uses an Extended Memory Interconnect (XMI) high-speed system bus. The XMI is based on RISC technology.

The VAXBI bus is available as an option to connect peripheral controllers, communications controllers, and other buses (such as UNIBUS) to the system via the XMI.

Vector processors are also supported for numerically intensive Fortran applications on Models 410 and 510 only.

Input/Output Control

The XMI high-speed system interconnect used as the system bus cannot exceed 14 modules. XMI options are as follows:

- Up to six processors.
- Maximum one vector processor for Models 410 and 510.
- Maximum 512MB of memory per system.
- Maximum four CIXCDs per system; CIXCDs and CIBCAAs cannot be configured in the same system.
- Maximum of six DEMNA Ethernet controllers per system.
- Up to three KDM 70 disk/tape controllers per system.
- Up to five XMI-to-VAXBI interfaces per system.

The VAXBI bus (VAXBI) 32-bit synchronous bus serves only as the I/O bus, providing for up to 16 VAXBI nodes, each of which is an interface occupying a logical position on the VAXBI bus. The node can be a mix of processors, memory upgrades, and adapters.

The UNIBUS is an asynchronous, bidirectional bus real-time peripherals other than tape and disk drives. The UNIBUS connects to the system or I/O bus through the UNIBUS adapter.

Disk/Tape Storage

Up to 8GB of storage is available in the system cabinet. Space is provided for two SA70 building blocks (eight RA70s), two RA92 disk drives, or one of each, or eight RA71 or RA72 disk drives.

The Hierarchical Storage Controller (HSC) family is a series of intelligent servers for high-speed disks and tapes, primarily in VAXclusters. It connects to the host system through Digital's Computer Interconnect (CI). Based on PDP-11 microprocessors,

The HSCs use the Standard Disk Interconnect (SDI) and the Standard Tape Interconnect (STI) to attach disk drives and tape formatters. The HSC controllers, HSC70 and HSC50, support volume shadowing, providing a measure of fault tolerance.

The HSC70 allows up to eight data channels, providing direct support for up to 32 SDI drives (32 RA-series or eight SA482 storage arrays) or a combination of SDI disk drives and up to 24 TA-series tape drives.

The HSC50 directly supports up to 24 SDI disk drives (including six SA482 Storage Arrays) or 16 SDI drives and eight TA-Series tape drives.

The KDM70 disk/tape controller provides eight ports for DSA device attachments, of which two are available for tapes. A maximum of three KDM70s are supported per host and require two I/O XMI slots.

The KDB50 disk controller requires the VAXBI expansion option and two VAXBI slots. Up to four DKB50s are supported per VAXBI channel; total of 12 per system. A maximum of four disk drives are supported per KDB50.

Configuration (Continued)

Configuration Rules (Continued)

The DSSI storage array system provides up to 48GB disk storage and uses two cabinets. Up to 12 DSSI channels are supported.

The Electronic Storage Element (ESE20) is a solidstate disk device that offers 120MB of semiconductor storage configured as a nonvolatile disk device. When used with the KDM70 controller, the ESE20 can service more than 1200 I/O requests/second.

A maximum of four CIXCD controllers are supported per system; requires one I/O SMI slot.

A maximum of four CIBCA controllers are supported per system; requires two VAXBI slots.

Workstations

Asynchronous connections are provided for terminal-to-host communications.

Terminals can also be connected via Ethernet servers.

Up to six Ethernet adapters are supported per system.

Configuration Rules (Continued)

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. Theoretically, using Ethernet terminal servers, each system can be connected to over 1,000 servers.

Printers

Each VAX system can support up to 16 line printers. Each printer must connect to an asynchronous line or to a DMF32 or DMB32 port. Each system can use a maximum of two DMF32 or DMB32 printer ports.

Sample Configuration

Model	Description	Purchase Price (\$)
SV-6F04A-AK	VAX 6000 Model 610 Preconfigured System	316,000
66AMA-XE	VAX 6000 Model 610 Processor	Bundled
MS65A-DA	128MB Memory Module	Bundled
KFMSA-BA	KFMSA DSSI Disk Adapter	Bundled
SF73-HA	2 RF73 (2GB each) DSSI Disks	Bundled
TF85B-AA	TF85 Cartridge Tape	Bundled
DEMNA-M	DEMNA XMI Ethernet Adapter	Bundled
VT420-SA	VT420 Console Terminal	Bundled
LA75S-AA	LA75 Console Printer and Access	Bundled
VT420-SA	5 VT420 Terminal	3,395
LN03-AA	1 8-ppm Laser Printer	3,040
	VMS Paid Up License, Unlimited Users	Bundled
	DECnet Full Function License	Bundled
	Pathworks Media Kit	Bundled
	Total	322,435

Physical Environment

Model	410	510	610	620
Physical Specifications				
Height (in.)	60.5	60.5	60.5	60.5
Width (in.)	30.5	30.5	30.5	30.5
Depth (in.)	30	30	30	30
Weight (lbs.)	700	700	700	700
Operating Environment				
Temperature Range (°F)	59 - 90	59 - 90	59 - 90	59 - 90
Humidity (%)	10 - 90	10 - 90	10 - 90	10 - 90
Heat Output (BTU/hr.)	5440	5440	5440	5440

Physical Environment (Continued)

Model	630	640	650	660
Physical Specifications				
Height (in.)	60.5	60.5	60.5	60.5
Width (in.)	30.5	30.5	30.5	30.5
Depth (in.)	30	30	30	30
Weight (lbs.)	700	700	700	700
Operating Environment				
Temperature Range (°F)	59 - 90	59 - 90	59 - 90	59 - 90
Humidity (%)	10 - 90	10 - 90	10 - 90	10 - 90
Heat Output (BTU/hr.)	5440	5440	5440	5440

Compatibility**Standards Supported**

Ulrix is compliant with X/OPEN Portability Guide 3 (XPG3) base level specifications. VAX VMS supports full X/OPEN branding and is POSIX compliant. Supports connection to the IBM SNA network. Supports X.25, X.400, TCP/IP, and X.29 protocols.

Pricing

Model	Description	Price (\$)	Monthly Maint.
Base Systems			
64AMK-AE	VAX 6000-410 VMS SBB, 64MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	121,000	902
64AMD-AE	VAX 6000-510 VMS SBB, 64MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	155,000	986
65AME-AE	VAX 6000-510 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	192,000	986
65AMC-AE	VAX 6000-610 VMS SBB, 64MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	247,000	1,185
66AMA-AE	VAX 6000-610 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	284,000	1,185
66BMA-AE	VAX 6000-620 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter VMS operating system, DECnet Full Function license	359,000	1,339
66CMA-AE	VAX 6000-630 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter VMS operating system, DEC Full Function license	434,000	1,508
66DMA-AE	VAX 6000-640 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	509,000	1,665
66EMA-AE	VAX 6000-650 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	584,000	1,804
66FMA-AE	VAX 6000-660 VMS SBB, 128MB memory, DEMNA XMI Ethernet Adapter, VMS operating system, DECnet Full Function license	659,000	1,948
Server Base Systems			
64APK-AE	VAX 6000-410 VMS Server, 64MB memory	106,000	892
65AMB-BE	VAX 6000-510 VMS Server, 64MB memory	125,000	892
65APE-AE	VAX 6000-510 VMS Server, 128MB memory	162,000	892
66APC-AE	VAX 6000-610 VMS Server, 64MB memory	197,000	933
66APA-AE	VAX 6000-610 VMS Server, 128MB memory	234,000	933
66BPA-AE	VAX 6000-620 VMS Server, 128MB memory	284,000	1,133
66CPA-AE	VAX 6000-630 VMS Server, 128MB memory	344,000	1,263

Model	Description	Price (\$)	Monthly Maint.
Ultrix Base Systems			
64APJ-BE	VAX 6000-410 Ultrix Server, no memory	90,000	899
	VAX 6000-410 Ultrix Server, no memory	108,000	848
65APB-BE	VAX 6000-510 Ultrix Server, no memory	110,000	989
65APB-AE	VAX 6000-510 Ultrix Server, no memory	125,000	861
VAX 6000 Preconfigured Systems			
SV6C03A-AK	VAX 6000-410 VMS System, 64MB memory, two RF72 disk drives, TF85 tape drive, DEC LAN controller 400 (DEMNA) Ethernet interface, KFMSA disk/tape adapter (DSSI) console and printer, VMS, DECnet with pathworks	163,000	1,283
SV6E03B-AK	VAX 6000-510 VMS System, 128MB memory, two RF72 disk drives, TF85 tape drive, DEC LAN controller 400 (DEMNA) Ethernet interface, KFMSA disk/tape adapter (DSSI) console and printer, VMS, DECnet with pathworks	214,000	1,367
SV-6F04A-AK	VAX 6000-610 VMS System, 128MB memory, two RF73 disk drives, TF85 tape drive, DEC LAN controller 400 (DEMNA) Ethernet interface KFMSA disk/tape adapter (DSSI), console and printer, VMS, DECnet with pathworks	316,000	1,585
SV-6F04A-BK	VAX 6000-620 VMS System, 128MB memory, two RF73 disk drives, TF85 tape drive, DEC LAN controller 400 (DEMNA) Ethernet interface, KFMSA disk/tape adapter (DSSI), console and printer, VMS, DECnet with pathworks	392,000	1,739
SV-6F04A-DK	VAX 6000-640 VMS System, 256MB memory, four RF73 disk drives, TF857 in SF210, DEC LAN controller 400 (DEMNA) Ethernet interface, KFMSA disk/tape adapter (DSSI), console and printer, VMS, DECnet with pathworks	656,000	1,665
Memory Expansion			
MS65A-BA	32MB Memory Module	34,650	NC
MS65A-CA	64MB Memory Module	54,400	NC
MS65A-DA	128MB Memory Module	96,000	NC
Additional Processors			
FV64A-AA	Vector Processor	26,200	84
Expansion Cabinets			
DWMBB-BA	XBIA Plus Expander Cabinet	24,600	63
Mass Storage			
RA71	700MB Disk Drive	6,024	NA
RA72	1.0GB Disk Drives	6,024	NA
RA90-CA	1.2GB Disk Drive	27,500	89
RA92-CA	1.5GB Disk Drive	20,084	99
RV20-A	2GB Optical Drive	26,775	200
RBV64-AA	Optic Library	127,500	1,180
ESE20-AA	Solid State	80,000	275
SA70-HK	Storage Array, 1.1GB	20,000	142
SA6000-CA	Storage Array, 2.4GB	27,500	89
SA650-HA	Storage Array, 6.6GB (RA90/SA70)	135,000	410
SA800-CA	Storage Array, 1.5GB (RA92/SA70)	20,084	99
SA850-FA	Storage Array, 4 RA70 and two RA70 and two RA92	70,856	430
SF200	Storage Array, 2GB (FR72s)	28,148	144
SF72	Storage Array Bldg Block, 2GB (RF72s)	26,000	144
RF72	1 GB 5.25 DSSI Disk	10,576	55
Tape Drives			
TA81-AA	IPS for HSC	37,084	150
TA91-AA	Dual Drive	85,000	677
TF85	Tape Subsystem	11,000	96
TF857	Tape Subsystem	29,000	245
Printers			
LA75-CA	Impact Matrix	749	8
LG06	Laser Printer	8,900	NA
LG31-A2	Matrix Line	8,390	85
LP37-VA	Band	25,869	187
LP29-QA	Band	41,373	394
LN05-CA	DEC laser 2100 Laser, one-sided printing	2,399	33
LN06-CA	DEC laser 2200 Laser, two-sided printing	3,599	50

Model	Description	Price (\$)	Monthly Maint.
Printers (Continued)			
LN08-CA	DECclaser 3200	4,799	NA
LN08U-CA	DECclaser 3250	6,299	NA
LPS20-GA	Laser, 20 ppm	19,495	375
LPS40-FA	Laser, 40 ppm	39,900	635
Terminals and Workstations			
VT330-MA	Mono Graphics	1,885	19
VT340-GA	Color Graphics	2,725	26
VT420-AA	Mono Video	629	3
Controllers			
DHB32-M	Async Communications, 16 lines	6,640	40
DMB32-M	Multifunction VAXBI, 8 lines	8,943	47
HSC50	Hierarchical Storage Controller	11,710	45
HSC70-AA	Hierarchical Storage Controller	62,270	231
DEBNA-M	Ethernet Controller	4,177	30
DEBNI-M	Ethernet Controller	NA	NA
CIXCD-AB	CIXCD XMI-to-CI Controller	36,750	86
KFM5A-AA	Dual DSSI Bus to XMI Adapter	14,000	67
DEMFA	XMI to FDDI SAS Adapter	19,900	175
KDM70	XMI Disk/Tape Controller	23,700	151
KDB50	Disk Controller	9,425	60
Communication Devices			
DELQA-M	Ethernet/802.3 Adapter	2,887	15
DMR11-M	UNIBUS Synchronous DECnet Option	16,173	41
DUP11-M	Single-Line Interface	5,698	13
KMS11-BD	8-Line Synchronous Communications Processor	15,298	102
DELNI-AB	Local Network Interconnect	1,522	10
DEREN-AA	Local Ethernet Repeater	1,626	24
DRB32-W	Parallel Port	7,632	55
DEMSB-WA	WANrouter 100	5,500	44
DEMSA-WA	WANrouter 500	12,600	90
Software			
Model	Description	Users	List Price
Operating Systems			
QL-0001A2-BK	VAX/VMS	40	33,750*
QL-VEYA2-BL	Ultrix	3-8	2,170*
QL-VEYAU-BC	Ultrix	65+	173,000*
Languages			
QL-020A9-JB	APL	10	1,540
QL-020A9-JE	APL	100	6,190
QL-056A9-JB	Ada	10	7,550
QL-056A9-JE	Ada	100	19,400
QL-095A9-JB	Basic	10	1,030
QL-095A9-JE	Basic	100	4,120
QL-106A9-JB	Bliss 32	10	1,120
QL-106A9-JE	Bliss 32	100	4,490
QL-015A9-JB	C	10	1,070
QL-015A9-JE	C	100	3,680
QL-099A9-JB	Cobol	10	1,180
QL-099A9-JE	Cobol	100	4,700
QL-100A9-JB	Fortran	10	905
QL-100A9-JE	Fortran	100	3,620
QL-126A9-JB	Pascal	10	902
QL-126A9-JE	Pascal	100	3,680
QL-114A9-JB	PL/1	10	1,560
QL-114A9-JE	PL/1	100	6,200
QL-917AV-AA	Lisp/VME License	NA	45,800

Model	Description	Users	List Price
Data Management			
QL-899A9-JB	DBMS	10	6,440
QL-899A9-JE	DBMS	100	25,700
QL-VCLA9-JB	Rdb/VMS	10	1,980
QL-VCLA9-JE	Rdb/VMS	100	7,930
System Software			
QL-VD7A9-JB	FMS	10	1,400
QL-VD7A9-JE	FMS	100	5,620
QL-810A9-JB	GKS for VMS	10	1,700
QL-810A9-JE	GKS for VMS	100	4,670
QL-375A9-JB	VAXELN Toolkit	10	1,380
QL-375A9-JE	VAXELN Toolkit	100	5,540
QL-365A9-JB	Cobol Generator	10	3,980
QL-365A9-JE	Cobol Generator	100	15,900
QL-VF1A9-JB	DECintact	10	5,300
QL-VF1A9-JE	DECintact	100	21,200
Communications Software			
QL-043A9-JB	DEC/SNA Distributed Host Command Facility	10	625
QL-043A9-JE	DEC/SNA Distributed Host Command Facility	100	2,520
QL-044A9-JB	DEC/SNA Printer Emulation	10	285
QL-044A9-JE	DEC/SNA Printer Emulation	100	1,140
QL-454A9-JB	DEC/SNA 3270 Emulation	10	285
QL-454A9-JE	DEC/SNA 3270 Emulation	100	1,140
QL-453A9-JB	DEC/SNA RJE	10	285
QL-453A9-JE	DEC/SNA RJE	100	1,140
QL-455A9-JB	DEC/SNA Application Programming Interface	10	535
QL-455A9-JE	DEC/SNA Application Programming Interface	100	2,130
Office Automation Software			
QL-AAAA9-JB	ALL-IN-ONE	10	5,200
QL-AAAA9-JE	ALL-IN-ONE	100	21,100
QL-741A9-JB	VAX TEAMDATA	10	585
QL-741A9-JE	VAX TEAMDATA	100	5,440
QL-A98A9-JB	DECcalc-PLUS	10	1,760
QL-A98A9-JE	DECcalc-PLUS	100	7,000
QL-310A9-JB	DECcalc	10	660
QL-310A9-JE	DECcalc	100	2,640
QL-AAMA9-JB	WPS-PLUS/VMS	10	1,470
QL-AAMA9-JE	WPS-PLUS/VMS	100	5,880
QL-729A9-JB	XWAY	10	590
QL-729A9-JE	XWAY	100	2,330

NC—No Charge.

NA—Not Available.

*Initial operating system software bundle with system. ■