Digital Equipment Corporation

Background

Founded in 1957, Digital Equipment Corporation (DEC) carved an early sales niche as a supplier of computer add-in modules, primarily for specialized technical applications. Digital's early sales experience soon alerted it to the industry's need for affordable, stand-alone, complete computer systems. Digital responded in 1960 by introducing its first in a line of Programmable Data Processor (PDP) computers: the PDP-1. Digital's PDP family of computer products established appeal in technical and scientific systems markets and quickly attracted the enthusiastic support of OEMs who had been looking for cost-effective embedded computers for their system products.

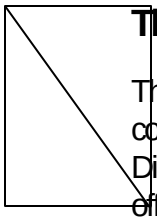
Digital's small, stand-alone computers also gained favor in commercial environments, as they offered a distributed-processing alternative to the large, centralized, and very expensive machines that were used in a typical large company's data-processing department. The natural tendency among Digital's large customers to network their Digital systems prompted the company's introduction of its Digital network architecture and DECnet (Phase I) in the early 1970s. Continued customer acceptance and demand fueled its evolution to the powerful and comprehensive DECnet Phase IV, released in 1983 and recognized as one of the computer industry's leading network architectures. DECnet continues to evolve toward DECnet Phase V, based on OSI standards.

In the mid-1970s, Digital began work on a new computer system that would serve as the future development focus of the PDP-11. The VAX system, which offers virtual address extension, was introduced in 1977. This new 32-bit addressing architecture offered programmers practically unlimited amounts of virtual memory (the PDP-11 16-bit architecture confined programmers to 64K areas) and provided a compatibility mode of operation that supported the direct execution of most existing PDP-11 applications software.

Digital sought to standardize on a single VAX operating system. Digital's VMS š operating-system software, a virtual memory system, offers real-time, time-sharing, and batch-processing capabilities suitable for general use in both scientific and commercial environments.

Digital also offers an alternative operating system, ULTRIX š, for organizations requiring UNIX compatibility. The ULTRIX-32 operating system for VAX computers

is a compatible System V UNIX implementation with the commonly sought Berkeley 4.2 functional extensions.



The VAX Family Today

The VAX family quickly established itself as the foundation of Digital's future computing strategy. With the rapid growth of market acceptance for VAX systems, Digital refocused its corporate approach on high-end computing in 1983, with official plans for future high-end VAX systems eventually to replace its older DECsystem 20. Thus, the first product based on the new VAX computer technology (the VAX-11/780), released in 1977, quickly evolved into the full range of larger and smaller VAX systems available today. The VAX 6000 Series and more powerful VAX 9000 Series, both complemented by VAXcluster™ and MicroVAX™, are the current systems.

VAXclusters: Connecting VAX Systems

Digital offers the VAXcluster™, which connects up to 16 VAX systems and Hierarchical Storage Controller (HSC) mass-storage control devices into a single system offering a pool of up to 100 MIPS of processing power. Minicomputers with VAXclusters clearly rival IBM mainframes, and compete with minicomputers made by Prime, Data General, and Hewlett-Packard. VAXclusters have been very popular; Digital estimates that 75 percent of 8600s and 8650s are clustered.

MicroVAX: A VMS Microcomputer

MicroVAX 3300/3400 systems provide two-and-one-half times the CPU performance and three times the data throughput and bandwidth of the MicroVAX II. These systems offer high-end storage functionality with the new Digital Storage Systems Interconnect (DSSI) bus. The same CMOS microprocessor technology is featured in the MicroVAX 3500/3600.

With three times the processing power of MicroVAX II in compact, quiet packages, MicroVAX 3500/3600 systems are powerful enough to provide complete time-sharing computer support for a large work group or department. The systems support 80 directly connected users, and even more users through the network.

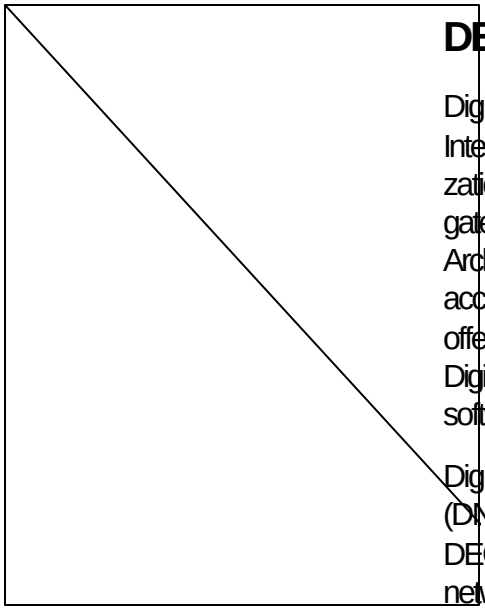
The VAXserver™ 3300/3400 systems are designed as Local Area VAXcluster boot nodes and PC LAN managers, and for control of local dedicated services. Designed to perform as cluster boot nodes, VAXserver 3500/3600/3602 systems are ideal for customers who want the high performance of the MicroVAX 3500 and 3600 without time-sharing capabilities.

The Environment

All MicroVAX systems can run either ULTRIX-32 or MicroVMS. (MicroVMS operating system is a repackaged version of VMS requiring less space on smaller MicroVAX system disks.) MicroVAX systems fully support all levels of DECnet, interconnected either via Ethernet cable (for the MicroVAX II or 2000) or using point-to-point lines (for the MicroVAX II only). Where Ethernet is available, up to 30 MicroVAX systems can be linked together using VAXclusters, allowing them to share (and, if necessary, even bootstrap from) each other's disks.

VAXstations: Engineering and Graphics

Digital's family of VAXstation systems offers engineering workstations based on MicroVAX technology and fitted with various high-resolution graphics displays. The systems range from the low-end VAXstation 3100 to the high-end VAXstation 3520 and 3540 models, and run either VMS- or UNIX-based engineering and graphics applications.



DECnet--An Architectural Overview

Digital is committed to building products that comply with the Open Systems Interconnection (OSI) model recommended by the International Standards Organization (ISO). In addition, Digital supports multivendor networks by providing gateways to networks developed by other vendors, such as IBM's Systems Network Architecture (SNA) network and X.25-compliant systems. These gateways allow access to the functions of other vendors' networks. In cases where Digital does not offer an off-the-shelf method for communications with different vendors' products, Digital's Computer Special Systems group can build customized hardware and software to create such a link.

Digital uses its own network architecture, called Digital Network Architecture (DNA), to tie its many systems together. Digital's implementation of DNA is DECnet--a family of software and hardware products that link systems into a single network. DECnet software is layered on each of Digital's operating systems as well as MS-DOS/PC-DOS, OS/2 and the Macintosh operating system, allowing all Digital systems and select non-Digital systems to communicate across the network with compatible functions. DECnet supports a wide variety of physical media and data-link protocols. For example, it can use simple twisted-pair cabling, Ethernet, or X.25 packet-switched data networking, making everything from local area networks (LANs) to wide area networks (WANs) seamless and transparent to the end user. The DNA provides peer-to-peer communications over a variety of LAN and WAN technologies.

DNA's data-link layer handles the communications hardware and performs message packeting. For point-to-point links using Digital's own family of synchronous

or asynchronous communications devices, DECnet builds, transmits, and decodes these packets using its own Digital Data Communications Message Protocol (DDCMP). Ethernet or X.25 communications, if used, replace DNA's link layer with their own message-handling software and hardware.

DNA's end-communication and routing layers assume responsibility for finding and routing messages between sending and receiving DECnet systems (nodes). Its routing capability connects the sender and receiver by calculating the lowest-cost alternative from among the variety of physical links that the network might offer. At the same time, its adaptive routing capability will automatically establish alternative connections in response to the failure of selected communications lines or intermediate (routing) network nodes.

DNA's application layer allows programs running on different network nodes to easily exchange logical messages and cooperate with each other, in a manner similar to that of IBM's LU 6.2 software. These task-to-task DECnet transactions, in turn, are used by DECnet to provide end users with networked applications, such as electronic mail and access to data on remote computer systems.

Developed before the ISO established the OSI seven-layer network model, DECnet nonetheless generally corresponds to and can work together with OSI-standard networking software, and can communicate via gateways to other network systems, such as the Manufacturing Automation Protocol (MAP) and Apple's AppleTalk® network. DECnet Phase V is fully OSI-compliant. Digital offers several OSI-based refinements to DECnet:

- **X.25 Router 2000 and VAX P.S.I.** The company's packet-switching interface hardware and software products underscore Digital's long-standing commitment to support X.25 and other widely accepted communications standards. Either VAX P.S.I. or Ethernet (standardized by IEEE's 802.3 specifications) can provide the necessary low-level OSI network protocols required for OSI integration.
- **VAX DEC/MAP.** This product consists of the hardware and software necessary to integrate VAX systems into MAP networks. This is an evolving product, and its underlying MAP specifications (version 2.1) are still incomplete.
- **VAX OSI Applications Kernel (OSAK).** This software provides OSI program-to-program communications for LAN and WAN environments. It provides programs running on a networked VAX system with a callable interface through which they can cooperate with programs running on other nodes (even non-Digital systems) using OSI's Network, Transport, and Session layers.
- **VAX File-Transfer Access and Management (FTAM).** This software provides for file transfer among open systems. VAX FTAM complies with the require-

Digital's DECnet/SNA Gateway Products:

Flexible Transports:

- *VMSSNA*
- *DECnet/SNA Gateway-ST*
- *DECnet/SNA Gateway-CT*

Interactive Access:

- *DECnet/SNA VMS 3270 TE*
- *DECnet/SNA 3270 TE for MS-DOS*
- *DECnet/SNA 3270 TE for ULTRIX*
- *Distributed Host Command Facility*

Application Interfaces:

- *DECnet/SNA 3270*
- *Data Stream Programming Interface*
- *DECnet/SNA APPC/LU6.2*
- *DECnet/SNA API*

Information Access:

- *DECnet/SNA Data Transfer Facility*
- *DECnet/SNA RJE*
- *DECnet/SNA PrE (Printer Emulation)*
- *DISOSS Document Exchange Facility (DDXF)*
- *Edelw ith IBM DISOSS*
- *VIDA*
- *VAXLink*

ments for National Bureau of Standards (NBS) Phase II FTAM. VAX FTAM uses the services of OSAK and VAX PSI.

- **Message Router X.400 Gateway.** This software product provides an electronic-mail gateway service between Digital's traditional VAX-to-VAX mail products (such as ALL-IN-1 integrated office system's mail) and external mail services (normally using X.25 communications) that conform to the NBS Specification for the Message Format for Computer-Based Message Systems.
- **MAILbus.** MAILbus is a set of applications software based on X.400 that links multivendor electronic-mail systems and messaging applications into an enterprise-wide electronic messaging system. MAILbus is Digital's Message Transfer Service and also includes VAX Message Router, VAX Message Router VMS mail Gateway, VAX Message Router/SGateway (for IBM SNADS), VAX Message Router/PGateway (for IBM PROFS), VAX MAILGATE for MCI Mail, and VAX Message Router Programmer's Kit.

Digital's DECnet-to-SNA Gateway Capabilities

Digital offers a number of solutions for communications with IBM's SNA. It already offers support of IBM's LU6.2 Advanced Program-to-Program Communications (APPC) protocol, which provides peer-to-peer communications in IBM's SNA world. Digital's implementation of SNA lets individual workstations in a Digital network participate in a peer-to-peer manner with nodes on an SNA network. Digital's SNA and gateway products for communicating with the IBM world include the products listed on this page.

Digital's Internet family of products supports the connection of Digital computers and networks to other systems, including IBM, UNIVAC, CDC, Wang, UNIX, Packetnet, and DSI.