Software Product Description

PRODUCT NAME: OpenVMS Operating System for VAX and Alpha, Version 7.0
Version 6.2 Appended **SPD 25.01.46**

Note: The OpenVMS Version 6.2 Software Product Description (SPD) is appended to the end of the OpenVMS Version 7.0 SPD.

This SPD describes OpenVMS Operating System Software for the Alpha and VAX computer family. Except where explicitly noted, the features described in this SPD apply equally to Alpha and VAX systems. OpenVMS Alpha and OpenVMS VAX operating system licenses and part numbers are architecture specific. Please refer to the Ordering Information section of this SPD for further details.

DESCRIPTION

OpenVMS is a general-purpose multiuser operating system that runs in both production and development environments. OpenVMS Alpha supports Digital Equipment Corporation's Alpha series computers, while OpenVMS VAX supports VAX, MicroVAX, VAXstation, and VAXserver series computers. OpenVMS software supports industry standards, facilitating application portability and interoperability. OpenVMS provides symmetric multiprocessing (SMP) support for multiprocessing Alpha and VAX systems.

The OpenVMS operating system can be tuned to perform well in a wide variety of environments. This includes combinations of compute-intensive, I/O-intensive, client/server, real-time, and other environments. Actual system performance depends on the type of computer, available physical memory, and the number and type of active disk and tape drives.

The OpenVMS operating system has well-integrated networking, distributed computing, client/server, multiprocessing, and windowing capabilities. It contains extensive features that promote ease-of-use, improve the productivity of programmers, and facilitate system management.

OpenVMS is an open software environment that supports key standards such as OSF/Motif, POSIX, XPG4, and the OSF Distributed Computing Environment (DCE). The right to use POSIX for OpenVMS and the DCE Runtime Services for OpenVMS is bundled with the OpenVMS operating system base license. DECwindows Motif is available exclusively as a separate layered product.

OpenVMS Alpha Version 7.0 and OpenVMS VAX Version 7.0 are functional releases of the OpenVMS operating system for Digital's Alpha and VAX systems respectively. OpenVMS Alpha Version 7.0 provides the new functions listed below that are specifically designed to take advantage of the Alpha architecture's industry-leading performance capabilities:

- 64-bit virtual addressing that allows the address space to be expanded beyond the past maximum capacity of 4 GB. The new maximum capacity for address space is currently 8 TB. Future hardware implementations will provide greater capacity. The OpenVMS Version 7.0 operating system is already prepared to handle the additional space. OpenVMS Alpha compilers and applications take advantage of 64-bit processing by using 64-bit data types. Refer to the SPDs for the OpenVMS Alpha compilers for further details. Note that application-virtual address space defaults to a 32-bit implementation for compatibility and migration purposes.
- Kernel threads extends process scheduling to allow a process to run concurrently on multiple CPUs in a multiprocessor system. Use of the new kernel threads capabilities provide many performance improvements for applications. DECthreads is the interface for the kernel threads.
- Fast I/O provides a suite of new system services that are designed to give high CPU performance and improved SMP scaling of I/Os.

- Fast Path restructures the I/O mainline code path to improve both uniprocessor and multiprocessor I/O performance. Using Fast Path to create a path to a disk reduces the CPU use per I/O task. On multiprocessor systems, all I/O activity for a process can be tied to a specific CPU, avoiding any primary CPU bottleneck issues. With multiple CPUs and ports, parallelism of I/O is greatly increased. User application changes are not required to take advantage of the Fast Path feature.

- Hypersort is a portable library of user-callable routines that provide a high-performance sorting capability for Alpha systems.

- Global sections maximum size has been expanded from the previous 3,276 KB to 65,535 KB.

With OpenVMS Version 7.0, the following new functions are available on both Alpha and VAX systems:

- A POSIX 1003.1C-1995 style interface to DECthreads.

- Thread-independent services (TIS) that allow threadsafe APIs to be written.

- A cluster-wide $CREPRC parameter that allows users to create processes on remote nodes within a VMScluster.

- Enhanced Mail utility integration with TCP/IP that provides support for signature files with MAILSHR and standard screen functions (scrolling) for reading messages and reviewing directory listings. Also provided are improvements that resolve quoting problems when attempting to reply to a mail message and provide the capability for parsing node names.

- Added network identification support that provides users with a display (by using the SHOW NETWORK command from DCL) of all the networks that are currently running.

- An extended Monitor utility for TCP/IP-only environments that uses the TCP/IP protocol to collect cluster-wide information. In the past, DECnet was the only protocol available to the Monitor utility.

- The maximum number of process identifiers for queuing requests was raised to 1024.

Refer to the *OpenVMS Version 7.0 New Features Manual* for further details on the above enhancements, features, and functions.

System Support

New systems will continue to be supported under the OpenVMS Version 6.2 code base, as follows:

This Version	Approximate Release	Will Support
OpenVMS Version 6.2-1H1	December 1995	The AlphaServer 2000A and the new AlphaStation 1000A 500/266.
OpenVMS Version 6.2-1H2	March 1996	Any new hardware introduced in the January-to-March timeframe.
OpenVMS Version 6.2-1H3	End of June 1996	New hardware for that period.

The support for all three releases is cumulative. This means that all the support in OpenVMS Version 6.2-1H1 will be included in OpenVMS Version 6.2-1H2; all the support in OpenVMS Version 6.2-1H2 will be included in OpenVMS Version 6.2-1H3; and finally all of the Version 6.2-1H3 support will be included in OpenVMS Version 7.1.

Note: The new systems supported under the above releases will not be supported under OpenVMS Version 7.0.

User Environment

Users can access the OpenVMS software by using the English-like DIGITAL Command Language (DCL), the command language for OpenVMS that is supplied with the system. DCL commands provide information about the system and initiate system utilities and user programs. DCL commands take the form of a command name followed by parameters and qualifiers. OpenVMS prompts users to enter required DCL parameters, making it easy for novice users.

Users can enter DCL commands at a terminal or include them in command procedures. These command procedures can be run interactively or submitted to a batch queue for later processing.

Information on DCL and OpenVMS utilities is available online through the OpenVMS Help system. Online help includes summary information on all aspects of system operation.

The following tools and utilities are integrated into the OpenVMS operating system.

Text Processing

The Extensible Versatile Editor (EVE), one of several text editors supplied by Digital, is the default editor for OpenVMS. EVE allows users to insert, change, and delete text quickly. Written in the Digital Text Processing Utility (DECTPU) language, EVE is a full-screen editor that allows users to scroll through text on a terminal screen. EVE provides an EDT-style keypad, allowing EDT users to move easily to EVE. EDT is also supported on OpenVMS Alpha Version 7.0 and OpenVMS VAX Version 7.0.

Mail Utility

The Mail utility allows users to send messages to any other user on the system. Multinode operation is available if DECnet or DECnet/OSI is installed and licensed on each participating node on the network.

Command-Level Programming

Command-level programming allows users to create special files, called command procedures, that contain a series of DCL commands. When users execute a command procedure, the system processes the commands in the command procedure consecutively. Users can also use special DCL commands to:

- Assign symbolic names
- Evaluate numerical and logical expressions
- Accept parameters
- Communicate interactively with the user invoking the command procedure
- Perform conditional (IF-THEN-ELSE) and branching (GOTO) logic
- Handle error conditions

User Environment Tailoring

Users can customize the computing environment with login command procedures, shorthand commands, binding of commands to function keys, and command recall and editing.

Terminal Fallback Facility (TFF)

This facility allows Digital 7-bit terminals to input and output the Digital Multinational character set (MCS). Specific tables allow conversion for a number of different 7-bit National Replacement Character sets to MCS, such as French, German, Spanish, and Swedish. TFF also allows character composition on terminals that do not have the compose key.

National Character Set (NCS) Utility

This utility allows users to define non-ASCII string collating sequences and to define conversion functions. Conversion functions use conversion algorithms to change an input string; for example, to change lowercase characters to uppercase. NCS also allows OpenVMS Record Management Services (RMS) indexed files to be collated using user-specified collating sequences.

Program Development Environment

OpenVMS includes a comprehensive set of tools for developing programs, including: run-time libraries (RTLs), a linker, a librarian, and a symbolic debugger. The assembly-level VAX MACRO-32 language is supplied with OpenVMS VAX. The following tools are available to the OpenVMS programmer.

Language and Run-Time Library Support

OpenVMS includes several RTLs that provide:

- String manipulation
- Parallel processing support
- I/O routines
- I/O conversion
- Terminal-independent screen handling
- Date and time formatting routines
- Highly-accurate mathematical functions
- Signaling and condition handling
- Other general-purpose functions

With OpenVMS VAX, these routines can be called from programs written in such languages as VAX MACRO-32, VAX Ada, VAX BASIC, VAX BLISS-32 Implementation Language, VAX C, DEC C, DEC C++, VAX COBOL, VAX DIBOL, DEC Fortran, VAX Pascal, and VAX PL/I.

With OpenVMS Alpha, these routines can be called from programs written in such languages as MACRO-64, DEC Ada, DEC BASIC, DEC C, DEC C++, DEC COBOL, DEC Fortran, DEC Pascal, and DEC PL/1.

Also included in OpenVMS Alpha are language-support libraries. While each language is different, all provide support for sequential file I/O and most support direct and indexed file I/O. Language RTLs also provide support for I/O formatting, error handling, and in DEC Fortran, the ability to read unformatted files that contain data from other vendors.

RTLs are provided to support translated images created from user-mode images built on OpenVMS VAX Version 4.0 through Version 5.5-2. Depending on the method used to create the VAX image, these RTLs can be useful for images built on later versions of OpenVMS VAX that do not use features which were developed since OpenVMS VAX Version 5.5-2.

Translated image RTLs are used to support a few architectural features that differ between VAX and Alpha systems, such as VAX D-float and H-float. They also support programs converted to run on Alpha systems before native Alpha compilers were available for particular programming languages.

Many Digital languages adhere to the common calling standard. This means that routines written in any of these languages can directly call routines written in any other language. Development of applications using multiple languages is simple and straightforward.

All user accessible routines in the RTLs follow the OpenVMS Alpha or OpenVMS VAX calling standard and condition-handling conventions, and most are contained within shareable images.

At a lower level, programs can call system services directly for security, event flag, asynchronous system trap, logical name, record and file I/O, process control, timer, time conversion, condition handling, lock management, and memory management. Again, system services use the OpenVMS VAX or OpenVMS Alpha calling standard and condition-handling conventions.

OpenVMS supports the execution of user-mode images created on earlier versions of OpenVMS. Typically, recompiling and relinking are not required.

MACRO Compiler (Alpha only)

For migration purposes, the MACRO compiler is supplied with the OpenVMS Alpha software.

DECthreads

OpenVMS includes a user-mode multithreading capability, referred to as DECthreads. DECthreads provides a POSIX 1003.1C-1995 standard style interface and is Digital's implementation of the Distributed Computing Environment (DCE) Threads as defined by the Open Software Foundation (OSF).

DECthreads is a library of run-time routines that allows the user to create multiple threads of execution within a single address space. Multithreading allows computation activity to overlap I/O activity. Synchronization elements, such as mutexes and condition variables, are provided to help ensure that shared resources are accessed correctly. For scheduling and prioritizing threads, DECthreads provides multiple scheduling policies. For debugging multithreaded applications, DECthreads is supported by the OpenVMS debugger. DECthreads also provides Thread-Independent services (TIS) which assist in the development of thread-safe APIs.

Librarian Utility

The Librarian utility permits storage of object modules, image files, macros, help text, or any general record-oriented information in central, easily accessible files. Object module and image file libraries are searched by the linker when the linker finds a reference it cannot resolve in one of its input files. Alpha macro libraries are searched by the MACRO-32 compiler and MACRO-64 assembler when either finds a macro name that is not defined in the input file. VAX macro libraries are searched by the assembler when the assembler finds a macro that is not defined in the input file.

Debugger

The OpenVMS Debugger allows users to trace program execution, as well as display and modify register contents using the same symbols that are present in the source code.

Alpha System-Code Debugger

The OpenVMS Alpha System-Code Debugger is a kernel code debugger. It allows a system code developer to trace the execution of nonpageable system code at any Interrupt Priority Level (IPL). Based on the OpenVMS Alpha Debugger, the system-code debugger uses the same interface and a majority of the same command set.

System Dump Analyzer (SDA) Utility

In the event of a system failure, OpenVMS writes the contents of memory to a pre-allocated dump file. This dump file can later be analyzed using SDA. System dumps can either be full memory dumps, where all memory is written, or selective memory dumps, where only memory in use at the time of the system failure is written. Full memory dumps require a dump file big enough to hold all memory. Selective memory dumps write as much of the memory in use at the time of the system failure that will fit into the dump file. Therefore, this file is often much smaller in size. Dump compression enables these dump files to reside on the system disk.

OpenVMS for Alpha supports selective dumps on systems configured with any supported amount of memory. Full dumps are only supported on systems configured with up to 4 GB of memory.

RMS File Utilities

RMS file utilities allow users to analyze the internal structure of an RMS file and to determine the most appropriate set of parameters for the file. The RMS file utilities can also be used to create, load, and reclaim space in an RMS file. Refer to the Operating System Environment section of this SPD for more information on RMS.

File Differences Utility

This utility compares the contents of two files and lists those records that do not match.

Translated Image Environment (TIE) (Alpha only)

OpenVMS Alpha provides an array of services that allow the operation of programs which have undergone binary translation from OpenVMS VAX images. These programs perform virtually all user-mode functions on OpenVMS Alpha and operate in combination with other programs (images) that have been translated from OpenVMS VAX or have been built using native compilers on OpenVMS Alpha. Without requiring special source code, the TIE resolves differences between the VAX and Alpha architectures, including floating-point registers, condition codes, exception handling, and ASTs.

The TIE included with OpenVMS Alpha can run images that have been translated elsewhere. The DECmigrate for OpenVMS Alpha layered product can be used to translate user-mode images from OpenVMS VAX. For additional information on the characteristics of programs suitable for binary translation, refer to the *DECmigrate for OpenVMS AXP Systems Software Product Description (SPD 39.44.xx)*.

System Management Environment

OpenVMS provides a variety of features that aid the system manager in configuring and maintaining an optimal system. The following features are available to system managers.

OpenVMS Management Station Version 1.0

The new OpenVMS Management Station enables user account management on one or more VMScluster systems from a single Microsoft Windows-based PC. It provides the ability to perform management tasks across multiple systems, making it possible to easily modify many accounts in a single operation. The Management Station provides a comprehensive interface to the user account management features of AUTHORIZE, DISKQUOTA, and some DCL directory maintenance commands. This enables system managers to add a user authorization file (UAF) entry, grant rights identifiers, and create directories, disk quotas, and mail profiles. In addition, the Management Station allows system managers to create network proxy records and support storing personal information such as phone number, location, and site-specific identification.

The Management Station supports such account management operations as account creation, modification, and deletion, as well as renaming accounts and displaying account attributes.

The following are Version 1.0 restrictions to managing OpenVMS systems:

- Managing OpenVMS cluster members as individual nodes is not supported. OpenVMS cluster systems are treated as indivisible entities; an operation cannot be performed on specific cluster members.
- OpenVMS clusters with multiple UAFs are not supported.
- PCs currently support DECnet Phase IV only. However, due to the built-in backward compatibility between DECnet/OSI and DECnet Phase IV, this does not impose any restrictions on operations between a PC client and the server, as long as the node addresses are within the Phase IV address space (maximum 63 areas with maximum 1,023 nodes per area).

The Management Station is a client/server application based on PATHWORKS ManageWORKS. The PC client requires Microsoft Windows Version 3.1 (or Microsoft Windows for Workgroups Version 3.11) and PATHWORKS V5.0A or V5.1 for DOS and Windows client which, includes ManageWORKS. The PATHWORKS server is not required. The Management Station server component must be installed on OpenVMS VAX Version 6.1 or higher or OpenVMS Alpha Version 6.2 or higher. The Management Station software is included under the OpenVMS base license.

InfoServer Tape Backup

With Version 6.1 of the OpenVMS operating system, system managers can now back up and restore the system disk to tapes connected to an InfoServer system.

Batch and Print Queuing System

OpenVMS provides an extensive batch and print capability that allows the creation of queues and the setup of spooled devices in order to process noninteractive workloads in parallel with timesharing or real-time jobs.

The OpenVMS batch and print operations support two types of queues: generic queues and execution queues. A generic queue is an intermediate queue that holds a job until an appropriate execution queue becomes available to initiate the job. An execution queue is a queue through which the job (either print or batch) is actually processed.

The system queues batch jobs for execution. The system manager can regulate the number of queues and the number of streams per queue which is the number of batch jobs in the queue that can execute concurrently.

Both generic and execution batch queues can have different attributes, such as the maximum CPU time permitted, working set size, and priority. Facilities are provided for starting and stopping queues and for starting and stopping jobs in a queue. Because multiple execution queues can be associated with a generic queue, OpenVMS VAX enables load balancing across available CPUs in a VMScluster system, increasing overall system throughput.

Print queues, both generic and execution, together with queue management facilities, provide versatile print capabilities, including support of ANSI and PostScript file printing.

Accounting Utility

For accounting purposes, OpenVMS keeps records of system resource usage. These statistics include processor and memory utilization, I/O counts, print symbiont line counts, image activation counts, and process termination records. The OpenVMS Accounting utility enables various reports to be generated using this data.

Audit Analysis Utility

For security auditing purposes, OpenVMS selectively records critical security-relevant events in the system security audit log file. These records contain the date and time the event occurred, the identity of the associated user process, and information specific to each event type. This information is intended to aid the system manager in maintaining system security and to deter possible intruders. The OpenVMS Audit Analysis utility enables various reports to be generated from this data.

Autoconfigure/AUTOGEN Utilities

The Autoconfigure and AUTOGEN utilities automatically configure the available devices in the system tables and set system parameters based on the peripheral and memory architecture. This eliminates the need for a traditional system generation process when the hardware configuration is expanded or otherwise modified.

The OpenVMS AUTOGEN command procedure sets a number of system parameters automatically by detecting the devices installed in a configuration. A feedback option can be used to generate a report of recommended parameter settings based on previous usage patterns.

Backup Utility

The Backup utility provides full-volume and incremental file backups for file-structured, mounted volumes and volume sets. Individual files, selected directory structures, or all files on a volume set can be backed up and restored. Files can be selected by various dates (such as creation or modification) and can be backed up to magnetic tape, magnetic disk, or Write Once Read Many (WORM) optical disk. The Backup utility can also be used to restore a save set or list the contents of a save set.

The Backup Manager for OpenVMS provides a screen-oriented interface to the Backup utility which assists users in performing routine backup operations. The Backup Manager is menu-driven and provides:

- Access to the save, restore, and list operations without having to understand Backup command syntax
- The ability to create, modify, recall and delete Backup Manager templates that describe the Backup save operations

The Backup Manager works on all supported OpenVMS configurations with a video terminal. It uses the Screen Management (SMG) RTL routines to provide a window-like user interface. The software does not assume any particular privilege on the part of its user beyond access to the files and devices being operated upon.

Standalone BACKUP Utility (VAX only)

Standalone BACKUP provides a mechanism for system managers to back up and restore system disks. This utility can also be used during the installation of the OpenVMS VAX operating system.

Analyze Disk Structure Utility

The Analyze Disk Structure utility compares the structure information on a disk volume with the contents of the disk, prints the structure information, and permits changes to that information. It also can be used to repair errors that are detected in the file structure of disks.

Monitor Utility

The Monitor utility enables the system manager to monitor different classes of systemwide performance data including: process activity, I/O activity, memory management activity, vector processing activity (VAX only), and two-phase commit transaction activity at specified intervals. The data may be displayed as it is gathered or saved in a file for later use.

License Management Facility (LMF)

The License Management facility allows the system manager to enable software licenses and to determine which software products are licensed on an OpenVMS system.

System Management Utility (SYSMAN)

The System Management utility allows system managers to define a management environment in which operations performed from the local OpenVMS system can be executed on all other OpenVMS systems in the environment. The environment can include OpenVMS Alpha and VAX systems configured in a VMScluster or multiple systems networked through DECnet or DECnet/OSI.

Operations

OpenVMS allows for varying levels of privilege to be assigned to different operators. Operators can use the OpenVMS Help Message utility to receive online descriptions of error messages. In addition, system-generated messages can be routed to different terminals based on their interest to the console operators, tape librarians, security administrators, and system managers.

Security

For OpenVMS Version 7.0, security APIs for intrusion detection, proxy access, and impersonation services have been added on both the Alpha and VAX platform to provide better security in client/server applications.

As the following table illustrates, OpenVMS is committed to consistently delivering rated security in our base products.

Version	Rating	Evaluation Date
OpenVMS Alpha 6.1†	C2	1996
SEVMS Alpha 6.1†	B1	1996
OpenVMS VAX 6.1	C2	1995
SEVMS VAX 6.1	B1	1995
OpenVMS VAX 6.0	C2	1993
SEVMS VAX 6.0	B1	1993
VAX/VMS 4.3	C2	1988

†Currently in Rating Maintenance Phase (RAMP).

Digital also plans to continue to maintain C2 and B1 ratings on future versions of the OpenVMS and SEVMS operating systems.

The ratings represent NCSC validation of the design of OpenVMS and SEVMS operating systems against *DoD 5200.28-STD Department of Defense Trusted Computer System Evaluation Criteria*. To obtain an in-depth, 230-page report on the security of these systems, contact the NCSC at (410)859-4452 and ask for a copy of the *Final Evaluation Report Digital Equipment Corporation OpenVMS VAX and SEVMS VAX Version 6.0, CSC-EPL-93/002, C-Evaluation No.14-94.*

OpenVMS provides a rich set of tools to control user access to system-controlled data structures and devices that store information. OpenVMS employs a reference monitor concept that mediates all access attempts between subjects (such as user processes) and security-relevant system objects (such as files). OpenVMS also provides a system security audit log file that records the results of all object access attempts. The audit log can also be used to capture information regarding a wide variety of other security-relevant events.

User account information is maintained by the system manager in the system user authorization file (SYSUAF). When creating user accounts with the Authorize utility, the system manager assigns the privileges and quotas associated with each user account. The system manager also assigns a user name, password, and unique user identification code (UIC) to each account. Additional identifiers can be assigned to each account, allowing users to belong to multiple overlapping groups or projects. Account use may be limited by the time of day, day of week, and type of access, such as local, remote, network, or batch.

To log in and gain access to the system, the user must supply a valid user name and password. The password is encoded and does not appear on terminal displays. Users can change their password voluntarily, or the system manager can specify how frequently passwords change, along with minimum password length, and the use of randomly-generated passwords.

In addition, OpenVMS provides a password dictionary filter that screens password choices for common words, and a user password history filter that prevents users from reusing passwords that they have used within the past year. In addition to these built-in filters, a site can design and install its own filter to screen passwords according to a site-specific password policy.

The system password hash algorithm can also be replaced with a private algorithm for those sites that have contractual obligations to use specific public or private password encryption algorithms. This feature can be enabled on a per-user, per-password basis.

Login security includes break-in detection, which disables terminals when password guessing is detected. Also, users retain a secure login path, which can thwart Trojan horse attacks against local terminals. Additionally, a system password can be associated with dial-in terminal lines to prevent the display of any operating system-specific identification that might yield clues to possible attack methods. When a user logs in, the system also displays a message stating when the last login for the account occurred and the number of failed attempts since the last successful login.

Every security-relevant system object is labeled with the UIC of its owner along with a simple protection mask.

The owner UIC consists of two fields, the user field and a group field. System objects also have a protection mask that allows read, write, execute, and delete access to the object's owner, group, privileged system users, and to all other users. System objects can be protected with access control lists (ACLs) that allow access to be granted or denied to a list of individual users, groups, or identifiers. ACLs can also be used to audit access attempts to critical system objects.

OpenVMS applies full protection to the following system objects:

- Capabilities (VAX only)
- Common event flag clusters
- Devices
- Files
- Group global sections
- Logical name tables
- Batch/print queues
- Resource domains
- Security classes
- System global sections
- Volumes (ODS-2)
- Spiralog volumes

OpenVMS provides security attribute defaults in the form of security profile templates. These templates are referenced whenever a new object is created and provide a means of associating default security information with each system object class, except for files. Protection information for files is inherited from the previous version of an existing file, the parent directory, or the default protection of the creating process.

Data scavenging protection can be enabled in the form of high-water marking and erase on delete attributes. These attributes ensure that the contents of a file cannot be read after the file has been deleted. The system manager can also enforce file erasure on a per-volume basis. The disk erasure pattern can also be replaced with a private pattern for those sites that have contractual obligations to use a specific pattern.

Security auditing is provided for the selective recording of security-related events. This auditing information can be directed to security operator terminals (alarms) or to the system security audit log file (audits). Each audit record contains the date and time of the event, the identity of the associated user process, and additional information specific to each event.

OpenVMS provides security auditing for the following events:

- Login and logout
- Login failures and break-in attempts
- Object creation, access, deaccess, and deletion, selectable by use of privilege, type of access, and on individual objects
- Authorization database changes
- Network logical link connections and terminations for DECnet for OpenVMS VAX, DECnet/OSI, DECwindows, IPC, and SYSMAN (VAX only)
- Use of identifiers as privileges
- Installed image additions, deletions, and replacements
- Volume mounts and dismounts
- Use of the Network Control Program (NCP) utility (VAX only)
- Use or failed use of individual privileges
- Use of individual process control system services
- System parameter changes
- System time changes and recalibrations

Note: Since no system can provide complete security, Digital cannot guarantee complete system security. However, Digital continually strives to enhance the security capabilities of its products. Customers are strongly advised to follow all industry-recognized security practices.

Operating System Environment

OpenVMS VAX Processes and Scheduling

The basic unit of execution in OpenVMS is the process. A process consists of individual address space and registers known as context, and code called an executable image. The context identifies the process and describes its current state. Executable images consist of system programs and user programs that have been compiled and linked.

The maximum number of concurrent processes is 8,192 per OpenVMS VAX system.

Processes receive time to execute their images based on the priority. Thirty-two priorities are recognized on OpenVMS VAX, and sixty-four priorities are recognized on OpenVMS Alpha. Priorities 0 to 15 are for timesharing processes and applications that are not time critical (four is the typical default for timesharing processes). Priorities 16 to 32 on VAX and 16 to 63 on Alpha are for real-time processes.

Each time an event such as an I/O interrupt occurs, the system services the event first and then passes control to the highest priority process ready to execute. The system automatically adjusts the priorities of processes in the range of 0 to 15 to favor I/O-bound and interactive processes. However, the system does not adjust the priority of a process in the range of 16 to 31 for VAX or 16 to 63 for Alpha.

Real-time processes can be assigned higher priorities to ensure that they receive processor time whenever they are ready to execute. Real-time processes are scheduled preemptively; that is, if a real-time process is ready to execute, it is given to the processor immediately, unless a process with a higher priority is ready to execute.

OpenVMS uses paging and swapping to provide sufficient virtual memory for concurrently executing processes. Also, paging and swapping are provided for processes whose memory requirements exceed available physical memory. The maximum working set size is 512 MB of memory for VAX and 4 GB for Alpha.

Programmers can control memory management from within an image. An image executing in a real-time process, for example, can inhibit paging or swapping of critical code and data.

Peripheral devices can be managed by the system or allocated by individual processes. At least one disk must be a system disk. Other disks can be designated as data disks for the general use of all users logging in to the system or for a specific group of users. The system controls interactive terminals and one or more printers.

OpenVMS Alpha Processes and Scheduling

The basic unit of execution in OpenVMS Alpha is the kernel thread. A kernel thread consists of individual address space and registers known as context, and code called an executable image. The context identifies the kernel thread and describes its current state. Each process can have up to 16 kernel threads. Executable images consist of system programs and user programs that have been compiled and linked.

The maximum number of concurrent processes is 16,384 per OpenVMS Alpha system.

Kernel threads receive processor time to execute their images based on the priority of the process. Thirty-two priorities are recognized on OpenVMS VAX and sixty-four priorities are recognized on OpenVMS Alpha. Priorities 0 to 15 are for time-sharing processes and applications that are not time critical (four is the typical default for timesharing processes). Priorities 16 to 32 on VAX and 16 to 63 on Alpha are for real-time processes.

Each time an event such as an I/O interrupt occurs, the system first services the event and then passes control to the highest priority kernel thread ready to execute. The system adjusts the priorities of kernel threads whose base priority is in the range of 0 to 15 to favor I/O-bound and interactive processes. However, the system does not adjust the priority of a kernel thread in the range of 16 to 31 for VAX or 16 to 63 for Alpha.

Real-time processes can be assigned higher priorities to ensure that they receive processor time whenever they are ready to execute. Real-time processes are scheduled preemptively; that is, if a real-time process is ready to execute, it is given to the processor immediately, unless a a higher priority process is ready to execute.

OpenVMS uses paging and swapping to provide sufficient virtual memory for concurrently executing processes. Also, paging and swapping is provided for processes whose memory requirements exceed available physical memory.

Programmers can control memory management from within an image. An image executing in a real-time process, for example, can inhibit paging or swapping of critical code and data.

Peripheral devices can be managed by the system or allocated by individual processes. At least one disk must be a system disk. Other disks can be designated as data disks for the general use of all users logging in to the system or for a specific group of users. The system controls interactive terminals and one or more printers.

Extended Physical Addressing (VAX only)

With OpenVMS VAX Version 6.0, physical address space was extended from 30 bits to 32 bits. The OpenVMS VAX operating system can provide 3.5 GB of physical memory and .5 GB of I/O and adapter space. This enables large applications and workloads to access the large amounts of physical memory that they require. The following table lists the VAX processors that support this extended physical addressing.

System	Accessible Physical Memory	I/O and Adapter Space
VAX 6000 model 600	1.25 GB	.5 GB
VAX 7000 series	3.5 GB	.5 GB
VAX 10000 series	3.5 GB	.5 GB

Vector Processing (VAX only)

A single data item with only one value is known as a scalar value. A group of related scalar values, or elements, with the same data type, is known as a vector.

An extension to the VAX architecture defines an optional design for integrated vector processing that has been adopted by several VAX systems. The VAX vector architecture includes sixteen 64-bit vector registers (V0 through V15), each containing 64 elements; vector control registers; vector function units; and a set of vector instructions. VAX vector instructions transfer data between the vector registers and memory; perform integer and floating-point arithmetic; and execute processor control functions.

A more detailed description of the VAX vector architecture, vector registers, and vector instructions appears in the *VAX MACRO and Instruction Set Reference Manual*.

The OpenVMS VAX operating system provides fully shared, multiprogramming support for VAX vector processing systems. By default, OpenVMS VAX loads vector support code when initializing vector-present systems but does not load it when initializing vector-absent systems. System managers can control this behavior by using the VECTOR_PROC system parameter.

The presence of vector support code in a system has little effect on processes running in a scalar-only system, or scalar processes running in a vector-present system. If many processes must compete simultaneously for vector processor resources, the system manager can maintain good performance by adjusting system resources and process quotas.

The OpenVMS VAX operating system makes the services of the vector processor available to system users by means of a software abstract known as a capability. A system manager can restrict the use of the vector processor to users holding a particular identifier by associating an ACL entry with the VECTOR object.

The VAX Vector Instruction Emulation facility (VVIEF) is a standard feature of the OpenVMS VAX operating system. It allows vectorized applications to be written and debugged in a VAX system in which vector processors are not available. VVIEF emulates the VAX vector processing environment, including the nonprivileged VAX vector instructions and the OpenVMS VAX vector system services. Use of VVIEF is restricted to code in user mode.

DECdtm Services

The DECdtm services embedded in the OpenVMS operating system support fully distributed databases using a two-phase commit protocol. The DECdtm services provide the technology and features for distributed processing, ensuring both transaction and database integrity across multiple Digital resource managers. Updates to distributed databases occur as a single all-or-nothing unit of work, regardless of where the data physically resides. This ensures the consistency of distributed data.

DECdtm services allow applications to define global transactions that may include calls to any number of Digital data management products. Regardless of the mix of data management products used, the global transaction either commits or stops. OpenVMS is unique in providing transaction processing functionality with base operating system services.

DECdtm features include:

- Embedded OpenVMS system services that support the DECtp architecture, providing the features and technology for distributed transaction processing.
- The ability for multiple disjoint resources to be updated atomically. These resources can be either physically disjointed (for example, on different CPUs) or logically disjointed (for example, in different databases on the same CPU).
- Encourages robust application development. Applications can be written to ensure that data is never in an inconsistent state, even in the event of system failures.
- Can be called using any Digital TP monitor or database product. This is useful for applications using several Digital database products.

Interprocess Communication

OpenVMS provides the following facilities for applications that consist of multiple cooperating processes:

- Mailboxes as virtual devices that allow processes to communicate with queued messages.
- Shared memory sections on a single processor or an SMP system that permits multiple processes to access shared address space concurrently.
- Common event flags that provide simple synchronization.
- A lock manager that provides a more comprehensive enqueue/dequeue facility with multilevel locks, values, and asynchronous system traps (ASTs).

Symmetric Multiprocessing (SMP)

OpenVMS provides symmetric multiprocessing (SMP) support for Alpha and VAX multiprocessor systems. SMP is a form of tightly coupled multiprocessing in which all processors perform operations simultaneously. The processors can perform operations in all OpenVMS access modes, such as user, supervisor, executive, and kernel.

OpenVMS SMP configurations consist of multiple CPUs executing code from a single shared memory address space. Users and processes share a single copy of OpenVMS Alpha or OpenVMS VAX address space. SMP also provides simultaneous shared access to common data in global sections to all processors. OpenVMS SMP selects the CPU where a process will run based on its priority.

SMP support is an integral part of OpenVMS and is provided to the user transparently. Because an SMP system is a single system entity, it is configured into a network and VMScluster configurations as a single node.

Networking Facilities

OpenVMS provides device drivers for all Digital Local Area Network (LAN) adapters listed in the LAN Options section of Appendix A of this SPD. Application programmers can use the QIO system service to communicate with other systems connected via the LAN using either Ethernet or Institute of Electrical and Electronics Engineer (IEEE) 802.3 packet format. Simultaneous use of Digital Ethernet and the IEEE 802.3 protocols are supported on any Digital LAN adapter.

DECnet/OSI offers task-to-task communications, file management, downline system and task loading, network command terminals, and network resource sharing capabilities as defined in the Digital Network Architecture (DNA) Phase V protocols. DECnet/OSI provides the newest DECnet features such as extended addressing and downline-load performance enhancements. DECnet/OSI integrates DECnet and OSI protocols and now provides a linkage to TCP/IP using Request for Comments (RFC) 1006 and RFC 1006+. DECnet and OSI applications can now be run over DECnet (NSP), OSI (CLNS), and TCP/IP transports.

DECnet for OpenVMS Alpha and DECnet–VAX offer the networking capabilities as defined in the Digital Network Architecture (DNA) Phase IV. For more information, refer to the DECnet/OSI and DECnet Software portion of the Associated Products section of this SPD.

Terminal Server Products

Digital's terminal server products can be used for terminal server access to OpenVMS. When used in a VMScluster environment, terminal servers distribute users across the available Alpha and VAX systems at login time.

OpenVMS can also establish a connection to other devices (such as printers) that are attached to such terminal servers.

Reliability

OpenVMS handles hardware errors as transparently as possible while maintaining data integrity and providing sufficient information to diagnose errors. The system limits the effects of an error by first determining if the error is fatal. If the error occurs in system context, then the current OpenVMS system shuts down. If the error is not fatal, the system recovers actions pertinent to the error and continues the current operation.

In all cases, information relevant to the error is written to the error log file for later analysis. Hardware errors include the following categories:

- **Processor errors.** These include processor soft errors, processor hard errors, processor machine checks, and adapter errors.
- **Memory errors.** These can be unrecoverable (hard) errors or recoverable (soft) errors. The system examines memory at startup time and does not use any bad pages. During system operation, the system corrects all single-bit memory errors for those systems with error correction code (ECC) memory. On OpenVMS VAX, an unrecoverable error causes the memory page on which the error occurred to be added to the bad page list. If the page has not been modified, system operation continues with a new copy of the page.
- **Correctable memory errors.** A primary cause of these correctable memory errors is Alpha particle radiation. On some processors, when correctable memory errors occur, the memory controller corrects only the data returned to the CPU or I/O controller. The actual data in memory is left with the error intact. Subsequent read operations cause correction cycles to occur and, in most cases, an interrupt to report the error. On many of these processors, OpenVMS monitors the occurrence of correctable memory errors and, in almost all cases, is able to remove the error condition by rewriting the data in memory. Rewriting the data causes the data to be corrected in that memory location. On OpenVMS VAX, if the cause of the error is not transient, and the error condition persists, the operating system attempts to move the data from the existing page which contains the error to a new page. The original page is then retired from use.

Other failures include:

- Operating system errors (system-detected inconsistencies or architectural errors in system context)
- User errors
- I/O errors

The system logs all processor errors, all operating system errors detected through internal consistency checks, all double-bit memory errors (and a summary of corrected single-bit memory errors), and most I/O errors.

If the system is shut down because of an unrecoverable hardware or software error, a dump of physical memory is written. The dump includes the contents of the processor registers. The OpenVMS System Dump Analyzer (SDA) utility is provided for analyzing memory dumps.

Power Failures (VAX only)

If the power fails, the system shuts down automatically. When power is restored, the system restarts automatically and resumes processing at the point of interruption under these circumstances:

- If the system has a time-of-day clock and a memory battery backup unit
- If the contents of memory is still valid
- If the system is set to permit automatic rebooting

The system restarts devices and communications lines and all I/O operations in progress, including magnetic tape I/O operations. On request, programs can be notified of power restoration. An optional battery-operated hardware clock resets the date and time of day when the system restarts. If the system does not have a battery backup unit, or if the memory contents are not valid on power restoration, the system reboots automatically if it is set to permit automatic rebooting.

If, for any reason, after a power failure the system disk does not come back on line within a specific time after the CPU regains power, the system shuts down.

Input/Output

The QIO system service provides a direct interface to the operating system's I/O routines. These services are available from within most OpenVMS programming languages using the $IO_PERFORM command and can be used to perform low-level I/O operations efficiently with a minimal amount of system overhead for time-critical applications.

Device drivers execute I/O instructions to transfer data to and from a device and to communicate directly with an I/O device. Each type of I/O device requires its own driver. Digital supplies drivers for all devices supported by the OpenVMS operating system and provides QIO system service routines to access the special features available in many of these devices.

OpenVMS supports a variety of disk and tape peripheral devices, as well as terminals, networks, and mailboxes (virtual devices for interprocess communication), and more general I/O devices.

With OpenVMS Alpha, users can write drivers for I/O devices without supplied drivers. OpenVMS Alpha Version 7.0 supports the Step 2 device driver interface, which allows device drivers to be written in DEC C and MACRO-32. OpenVMS Alpha documentation is available that describes how to write OpenVMS Alpha device drivers and how to convert existing Step 1 drivers to OpenVMS Alpha Step 2 device drivers. The DEC C compiler for OpenVMS Alpha is an optional layered product.

With OpenVMS VAX, users can write their own drivers in MACRO-32 for I/O devices without drivers. The *OpenVMS VAX Device Support Manual* and the *OpenVMS VAX Device Support Reference Manual* in the OpenVMS Full Documentation Set describe how to write device drivers.

Record Management Services (RMS)

RMS is a set of I/O services that helps application programs to process and manage files and records. Although it is intended to provide a comprehensive software interface to mass storage devices, RMS also supports device-independent access to unit-record devices.

RMS supports sequential, relative, and indexed file organizations in fixed-length and variable-length record formats. RMS also supports byte stream formats for sequential file organization.

RMS record access modes provide access to records in four ways:

- Sequentially
- Directly by key value
- Directly by relative record number
- Directly by record file address

RMS also supports block I/O operations for various performance-critical applications that require user-defined file organizations and record formats.

RMS promotes safe and efficient file sharing by providing multiple file access modes, automatic record locking (where applicable), and optional buffer sharing by multiple processes.

RMS utilities aid file creation and record maintenance. These utilities convert files from one organization and format to another; restructure indexed files for storage and access efficiency; and reclaim data structures within indexed files. These utilities also generate appropriate reports.

For systems that have DECnet–VAX, DECnet for OpenVMS Alpha, or DECnet/OSI installed, RMS provides a subset of file and record management services to remote network nodes. Remote file operations over the network are generally transparent to user programs.

Commands such as EDIT, CREATE, COPY, TYPE, and PRINT allow users to manipulate RMS records within RMS files at the DCL command level.

Virtual I/O Cache

OpenVMS provides a standalone or clusterwide, file-oriented disk cache. Applications benefit from the advantages of the virtual I/O cache without any special coding. The virtual I/O file-caching algorithm is chosen based on the type of clusterwide access currently in progress. Virtual I/O caching reduces current and potential I/O bottlenecks within OpenVMS systems. It reduces the number of I/Os to the disk subsystem, thereby reducing systemwide bottlenecks.

Disk and Tape Volumes

Disk volumes can be organized into volume sets. Volume sets can contain a mix of disk device types and can be extended by adding volumes. Within a volume set, files of any organization type can span multiple volumes. Files can be allocated to the set as a whole (the default) or to specific volumes within the set. Optionally, portions of indexed files can be allocated to specific areas of a single disk or to specific volumes in a volume set.

Quotas can be placed on a disk to control the amount of space individual users can allocate. Quota assignment is made by UIC and can be controlled for each individual volume set in the system (or for each individual volume if the volume is not part of a set).

Disk structure information can be cached in memory to reduce the I/O overhead required for file management services. Although not required to do so, users can preallocate space and control automatic allocation. For example, a file can be extended by a given number of blocks, contiguously or noncontiguously, for optimal file system performance.

The system applies software validity checks and checksums to critical disk structure information. If a disk is improperly dismounted because of user error or system failure, the system rebuilds the disk's structure information automatically the next time the disk is mounted. The system detects bad blocks and prevents their reuse once the files to which the blocks were allocated are deleted. On DIGITAL Storage Architecture (DSA) disks, the disk controller detects and replaces bad blocks automatically.

The system provides eight levels of named directories and subdirectories whose contents are alphabetically ordered. Device and file specifications follow Digital conventions. Logical names can be used to abbreviate the specifications and to make application programs device and file name independent. A logical name can be assigned to an entire specification, to a portion of a specification, or to another logical name.

OpenVMS supports multivolume magnetic tape files with transparent volume switching. Access positioning is done either by file name or by relative file position.

Monitoring Performance History (MPH) Software

MPH software is distributed with the OpenVMS distribution kit and is installed separately. MPH is a tool which collects error logs, crash dump summaries, and configuration data from the system on which it is installed. This data, such as Mean Time between Crash (MTBCr) and Mean Time Between System Interruption (MTBSi), is transmitted back to Digital and is used to set standard requirements for future releases of OpenVMS.

The required disk space for installing the MPH software is approximately 1,200 blocks. After installation, the MPH software requires 300 blocks of disk space per node. For more information please refer to the *OpenVMS Version 7.0 Release Notes*.

ASSOCIATED PRODUCTS

OpenVMS Cluster Software

OpenVMS Cluster Software is available for Alpha and VAX systems as a separately licensed System Integrated Product (SIP). It provides a highly integrated OpenVMS computing environment that is distributed over multiple systems which can contain up to 96 nodes.

VMScluster systems communicate using any combination of the following interconnects:

- Computer Interconnect (CI)
- DIGITAL Storage Systems Interconnect (DSSI)
- Fiber Distributed Data Interface (FDDI)
- Ethernet
- Small Computer System Interface (SCSI)

In addition, when configured with suitable FDDI bridges, VMScluster configurations can use DS3/T3 and asynchronous transfer mode (ATM) networking infrastructures.

Applications running on one or more nodes in a VMScluster system share resources in a coordinated manner. While updating data, the VMScluster software synchronizes access to shared resources, preventing multiple processes on any node in the cluster from interfering with each other. This coordination ensures data integrity during concurrent update transactions. Application programs specify the level of VMScluster file sharing that is required; access is then coordinated by the extended QIO processor (XQP) and RMS.

The OpenVMS queue manager controls the VMScluster batch and print queues, which can be accessed by any node in the VMScluster. Batch jobs submitted to VMScluster queues are routed to any available CPU so that the batch load is shared.

The Lock Manager provides synchronized services between systems in a cluster, for use both by system components such as RMS and XQP, and also for direct use by applications.

Two or more Alpha and VAX computers connected to the same CI, DSSI, or SCSI interconnect must be configured as members of the same VMScluster system. Mixed-architecture and mixed-version clusters that contain both Alpha systems and VAX systems are supported.

VMScluster systems provide a uniform computing environment that is highly scalable, highly available, and secure. OpenVMS Cluster Software implements a single-security environment within a cluster configuration. The security subsystem ensures that all cluster-visible objects maintain consistent security profiles and that system security auditing controls operate clusterwide.

Refer to the *OpenVMS Cluster Software Product Description (SPD 29.78.xx)* for more information.

DECamds

DECamds Version 7.0 is available on the OpenVMS distribution kit. DECamds is a separately installable, real-time, high-performance multisystem monitoring utility. It is supported on any system running OpenVMS Version 7.0. The right to use DECamds is included under the terms and conditions of the OpenVMS Cluster Software products (both Alpha and VAX).

DECamds provides system resource monitoring, investigation aid, and correction capability. This enables system managers to proactively and effectively manage multiple systems from a centralized, mouse-driven DECwindows display.

The DECamds software includes an OpenVMS device driver which runs on every node that is monitored. It also includes console software which runs on the centralized X-Window monitoring station.

Volume Shadowing for OpenVMS

Digital provides Volume Shadowing for OpenVMS Alpha and VAX products for performing disk mirroring operations, using a redundant arrays of independent disks (RAID) 1 storage strategy. In this description, every use of Volume Shadowing for OpenVMS means both Volume Shadowing for OpenVMS Alpha and Volume Shadowing for OpenVMS VAX.

Volume Shadowing for OpenVMS is a SIP that is separately licensed. Volume Shadowing for OpenVMS provides high data availability for disk devices by ensuring against data loss that results from media deterioration or controller or device failure. This prevents storage subsystem component failures from interrupting system or application tasks.

The system disk and Files–11 On-Disk Structure 2 (ODS-2) data disks can be volume shadowed. Spiralog data disks can also be shadowed.

Volume Shadowing for OpenVMS supports the clusterwide shadowing of Digital SCSI and DSA storage systems. Volume Shadowing for OpenVMS also supports shadowing of all mass storage control protocol (MSCP) served DSA disks and Digital SCSI disks. All disks in a single shadow set must have the same number of logical blocks and the same physical geometry. Shadow set members can be located on a single system or anywhere in a VMScluster system. Disks can be configured on any MSCP- or Digital SCSI-compliant controller.

Volume Shadowing for OpenVMS provides fault tolerance resulting from disk media errors or controller errors across the full range of Alpha and VAX processors and configurations. Shadow set member units can be located on different controllers and OpenVMS Alpha and OpenVMS VAX MSCP servers, providing configuration flexibility and a high degree of data availability.

Volume Shadowing for OpenVMS supports an unlimited number of single-member shadow sets and up to 400 disks in multi-member (2 or 3 member) shadow sets on a standalone or VMScluster system.

Phase I of Volume Shadowing (also known as controller-based shadowing) which was available in the past on OpenVMS VAX, is no longer supported.

The binary kit for Volume Shadowing ships with the OpenVMS Alpha and VAX distribution kits. To run the software, customers need to purchase a license and documentation. Refer to the *Volume Shadowing for OpenVMS Software Product Description (SPD 27.29.xx)* for more information.

DECnet/OSI and DECnet Software

The DECnet software is a SIP that is licensed separately from the OpenVMS operating system. Refer to the *DECnet for OpenVMS VAX and Alpha Software Product Description (SPD 48.48.xx)* for further information on supported communications devices and software features.

DECnet/OSI is available as a layered product. The license for DECnet for OpenVMS Alpha and DECnet for OpenVMS VAX will also grant the rights to use DECnet/OSI. Note that only one version of DECnet may be active on a single system at any one time. Refer to the *DECnet/OSI for OpenVMS Alpha Software Product Description (SPD 50.45.xx)* and the *DECnet/OSI for OpenVMS VAX Software Product Description (SPD 25.03.xx)* for further information on supported hardware configurations and software features.

Digital TCP/IP Software

Internet networking is available through the Digital TCP/IP Services for OpenVMS layered product. This product provides TCP/IP networking, Network File System (NFS), File Transfer Protocol (FTP), Remote Terminal Services (TELNET), and other features. Refer to the *Digital TCP/IP Services for OpenVMS Software Product Description (SPD 46.46.xx)* for further information.

RMS Journaling for OpenVMS

Digital provides the RMS Journaling for OpenVMS Alpha and VAX products as separately-licensed SIPs that enable a system manager, user, or application to maintain the data integrity of RMS files in the event of a number of failure scenarios. These journaling products protect RMS file data from becoming lost or inconsistent.

RMS Journaling provides the following three types of journaling:

- **After-image journaling.** Provides the ability to reapply modifications that have been made to a file. This type of journaling allows users to recover files that are inadvertently deleted, lost, or corrupted. RMS Journaling recovers the file by applying the journaled modifications to a backup copy, thereby restoring its final state. Application modifications are not necessary in order to use after-image journaling.
- **Before-image journaling.** Provides the ability to reverse modifications that have been made to a file. This type of journaling provides the ability to return a file to a previous known state. This is useful in the event that a file is updated with incorrect or bad data. Application modifications are not necessary in order to use before-image journaling.
- **Recovery unit journaling.** Provides the ability to maintain transaction integrity. A transaction can be defined as a series of file updates on one or more files. In the event of any failure during the transaction, recovery unit journaling rolls back the partially completed transaction to its starting point. This allows complex transactions to be completed as an atomic event—partially completed transactions can be avoided. Recovery unit journaling requires application modification.

The binary kit for RMS Journaling ships with the OpenVMS Alpha and VAX distribution kits. To run the software, customers need to purchase a license and documentation. Refer to the *RMS Journaling for OpenVMS Software Product Description (SPD 27.58.xx)* for more information.

DECram for OpenVMS

DECram for OpenVMS, a separately orderable layered product, is a disk device driver that enables system managers to create pseudo disks (RAMdisks) that reside in main memory for the purpose of improving I/O performance. Frequently accessed data can be accessed much faster from a DECram device than from a physical disk device. These RAMdisks can be accessed through the file system just as physical disks are accessed, requiring no change to application or system software.

Since main memory is allocated for the DECram device, an amount of extra memory is required. The amount of memory dedicated is selectable. The system manager designates the amount of memory dedicated to the DECram device(s) and the files that will be stored on it. The maximum size of a DECram device is 524,280 blocks. Refer to the *DECram for OpenVMS Software Product Description (SPD 34.26.xx)* for more information.

DECwindows Motif for OpenVMS

Digital offers a separately orderable layered product called DECwindows Motif for OpenVMS. This product provides support for both OSF/Motif, a standards-based graphical user interface, and the X user interface (XUI) in a single run-time and development environment. By default, DECwindows Motif displays the OSF/Motif user interface. Because both Motif and XUI are based on MIT's X Window System, applications written on either toolkit will run regardless of which environment the user selects. Refer to the *DECwindows Motif for OpenVMS Software Product Description (SPD 42.19.xx)* for more information.

The OpenVMS software installation procedure contains an optional step to install the DECwindows Motif for OpenVMS workstation and font support, which is required to run the DECwindows Motif for OpenVMS layered product. Refer to the *OpenVMS Alpha Version*

7.0 Upgrade and Installation Manual or *OpenVMS VAX Version 7.0 Upgrade and Installation Manual* for details concerning the optional installation of the DECwindows Motif for OpenVMS device support.

Enhanced X Window System Display PostScript

The X Window System Display PostScript system provided with DECwindows Motif extends the native X graphical programming environment for DECwindows users. This system allows users to display text or images on workstations that support the XDPS extension. The DECwindows Motif for OpenVMS layered product must be installed and licensed in order to use Display PostScript.

The X Window System Display PostScript has two components:

- Display PostScript server extension, which is provided with the display server in the OpenVMS Alpha and OpenVMS VAX operating systems. A workstation is required to use this server.
- Adobe client libraries, which are used by applications to perform PostScript operations, such as rotating and scaling fonts, generating curves, and displaying PostScript documents. The Adobe client libraries are available in the DECwindows Motif for OpenVMS layered product, as well as on third-party platforms, including IBM, Sun, and Silicon Graphics.

X Display PostScript adds the following capabilities to the basic X11R5 Window System environment:

- All DECwindows fonts can be displayed at any size and rotation angle.
- Display PostScript graphics are specified in a user-defined coordinate system independent of monitor density.
- Color or gray-scale rendition is automatically modified to take advantage of the monitor type through either direct display, color dithering, or half-toning.
- Display PostScript display routines can be downloaded to the server and executed on command.
- Sophisticated graphics primitives, such as precisely controlled Bezier curves, can be displayed.

The Display PostScript system also allows users to view PostScript files with such applications as DECwindows Mail and the CDA Viewer without generating hard copy. The Terms and Conditions for Display PostScript can be found in the *DECwindows Motif for OpenVMS Software Product Description (SPD 42.19.xx).*

CONFORMANCE TO STANDARDS

OpenVMS is based on the following public, national, and international standards.

POSIX Support and XPG4 BASE Profile Branding

The OpenVMS environment, with POSIX for OpenVMS Version 2.0 and DEC C installed, extends the support for POSIX standards to include the X/Open BASE specifications defined in the *X/Open Portability Guide*, Issue 4 (XPG4). The XPG4 BASE specifications extend the system application programming interface and shell and utilities offered in the IEEE POSIX standards. XPG4 also includes standards-based internationalization support.

Platforms and components that successfully complete the branding process and pass X/Open Verification Test Suite for XPG4 (VSX4) are awarded the X/Open XPG4 BASE Profile Brand. Components must pass a series of more than 11,500 tests in VSX4 to earn the X/Open BASE Profile Brand. These tests ensure that the OpenVMS environment with POSIX for OpenVMS Version 2.0 and DEC C installed supports the essential set of interfaces necessary in an open system.

The inclusion of XPG4 BASE support in the OpenVMS environment gives application developers a broader set of standards-based portability features to incorporate into their applications. Most applications that strictly conform to the POSIX and XPG4 specifications can be developed on an OpenVMS system with POSIX for OpenVMS and the DEC C compiler, and then ported without modification to any other platform that also supports the same POSIX standards and XPG4 specifications.

Distributed Computing Environment (DCE) Support

The DCE for the OpenVMS product family provides a set of the distributed computing features specified by the Open Software Foundation's (OSF) DCE, as well as tools for application developers. With DCE, the OSF has established a standard set of services and interfaces that facilitate the creation, use, and maintenance of client/server applications. DCE for OpenVMS serves as the basis for an open computing environment where networks of multivendor systems appear as a single system to the user. Because DCE makes the underlying networks and operating systems transparent, application developers can easily build portable, interoperable client/server applications. Users can locate and share information safely and easily across the entire enterprise. DCE for OpenVMS supplies system managers with a set of tools to consistently manage the entire distributed computing environment, while assuring the integrity of the enterprise.

The DCE for OpenVMS product family currently consists of the following products:

- DCE Runtime Services for OpenVMS, which is required for all systems participating in the DCE cell. The Runtime Services includes DCE client functions as well as DCE administration tools. DCE Runtime Services provides client/server applications the ability to interoperate over DECnet, TCP/IP, and UDP/IP network protocols.
- DCE Application Developers' Kits for OpenVMS, which is required for developers of distributed applications but is optional for other users. The DCE Application Developers' Kit provides programmers with an Interface Definition Language (IDL), an easy-to-use, ANSI C-based language for writing remote procedure calls.
- DCE Cell Directory Service (CDS), one of which is required for each DCE cell. The DCE CDS is a central repository that contains information about the location of resources in the DCE cell. It allows access to resources by a single name, regardless of their physical location.
- Digital DCE Security Server, one of which is required for each DCE. The DCE Security Server protects resources from illegal access and provides secure communications within and between DCE cells.

The right-to-use the DCE Runtime Services is bundled with the OpenVMS operating system base license. All other DCE products are available as separate layered products. Refer to the *Digital Distributed Computing Environment (DCE) for OpenVMS Software Product Description (SPD 43.05.xx)* for more detailed information.

Support for OSF/Motif and X Window System Standards

DECwindows Motif provides support for OSF/Motif, a standards-based graphical user interface, and the X Consortium's X Window System, Version 11, Release 5 (X11R5) server.

Standards Supported by OpenVMS

The OpenVMS operating system is based on the public, national, and international standards listed below. These standards are developed by the American National Standards Institute (ANSI), U.S. Federal Government (responsible for FIPS), Institute of Electrical and Electronics Engineers (IEEE), and the International Organization for Standardization (ISO). The following information may be useful in determining responsiveness to stated conformance requirements as enabled in particular commercial and/or government procurement solicitation documents.

- ANSI X3.4-1986: American Standard Code for Information Interchange
- ANSI X3.22-1973: Recorded Magnetic Tape (800 BPI, NRZI)
- ANSI X3.27-1987: File Structure and Labeling of Magnetic Tapes for Information Interchange
- ANSI X3.39-1986: Recorded Magnetic Tape (1600 BPI, PE)
- ANSI X3.40-1983: Unrecorded Magnetic Tape
- ANSI X3.41-1974: Code Extension Techniques for Use with 7-bit ASCII
- ANSI X3.42-1975: Representation of Numeric Values in Character Strings
- ANSI X3.54-1986: Recorded Magnetic Tape (6250 BPI, GCR)
- ANSI X3.131-1986 (SCSI I): Small Computer System Interface
- ANSI X3.131-1994 (SCSI II): Small Computer System Interface
- ANSI/IEEE 802.2-1985: Logical Link Control
- ANSI/IEEE 802.3-1985: Carrier Sense Multiple Access with Collision Detection
- FIPS 1-2: Code for Information Interchange, Its Representations, Subsets, and Extensions

  Note: 1-2 includes ANSI X3.4-1977(86)/FIPS 15; ANSI X3.32-1973/FIPS 36; ANSI X3.41-1974/FIPS 35; and FIPS 7.

- FIPS 3-1/ANSI X3.22-1973: Recorded Magnetic Tape Information Interchange (800 CPI, NRZI)
- FIPS 16-1/ANSI X3.15-1976: Bit Sequencing of the Code for Information Interchange in Serial-by-Bit Data Transmission

  Note: FED STD 1010 adopts FIPS 16-1.

- FIPS 22-1/ANSI X3.1-1976: Synchronous Signaling Rates Between Data Terminal and Data Communication Equipment

  Note: FED STD 1013 adopts FIPS 22-1.

- FIPS 25/ANSI X3.39-1986: Recorded Magnetic Tape for Information Interchange (1600 CPI, Phase Encoded)
- FIPS 37/ANSI X3.36-1975: Synchronous High-Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment

  Note: FED STD 1001 adopts FIPS 37.

- FIPS 50/ANSI X3.54-1986: Recorded Magnetic Tape for Information Interchange, 6250 CPI (246 CPMM), Group Coded Recording

- FIPS 79/ANSI X3.27-1987: Magnetic Tape Labels and File Structure for Information Interchange
- FIPS 86/ANSI X3.64-1979: Additional Controls for Use with American National Standard Code for Information Interchange

  Note: Other FIPS are not applicable.
- POSIX 1003.1, 1990: System application programming interface
- POSIX 1003.1b, Real Time Programming
- POSIX 1003.2, Shell and Utilities

  Note: Information regarding interchangeability of ANSI and FED standards with FIPS is contained in "ADP Telecommunications Standards Index," July 1988, published and maintained by the General Services Administration.
- ISO 646: ISO 7-bit Coded Character Set for Information Exchange
- ISO 1001: File Structure and Labeling of Magnetic Tapes for Information Interchange
- ISO 1863: Information Processing — 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 32 rpmm (800 rpi)
- ISO 1864: Information Processing — Unrecorded 12, 7 mm (0.5 in) wide magnetic tape for information interchange — 35 ftpmm (800 ftpi) NRZI, 126 ftpmm (3 200) ftpi phase encoded and 356 ftmm (9 042 ftpi), NRZI
- ISO 2022: Code Extension Techniques for Use with ISO 646
- ISO 3307: Representations of Time of the Day
- ISO 3788: Information Processing — 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 63 rpmm (1 600 rpt), phase encoded
- ISO 4873: 8-Bit Code for Information Interchange — Structure and Rules for Implementation
- ISO 5652: Recorded Magtape (6250)
- ISO 6429: Control Functions for Coded Character Sets
- ISO 9316: 1989 (SCSI-1) Small Computer System Interface
- ISO 9660: Information Processing — Volume and file structure of CD–ROM for information exchange
- ISO 10288: 1994 (SCSI-2) Small Computer System Interface

INSTALLATION

OpenVMS Alpha is distributed as a binary kit on CD–ROM. Procedures for setting up the system disk from media and for preparing the system for day-to-day operations are provided. The procedures use the POLYCENTER Software Installation utility to configure and install the OpenVMS Alpha Version 7.0 operating system. These procedures are described in the *OpenVMS Alpha Version 7.0 Upgrade and Installation Manual* and cover letter.

OpenVMS VAX is distributed as binary kits on CD–ROM and tape. Procedures for setting up the system disk from a kit and for preparing the system for day-to-day operations are provided. The procedures are described in the *OpenVMS VAX Version 7.0 Upgrade and Installation Manual*. Computer-specific information is contained in the upgrade and installation supplements for each family of VAX computers.

POLYCENTER Software Installation

The POLYCENTER Software Installation utility is now included in OpenVMS. The utility is distributed with the OpenVMS Version 7.0 distribution kit, and the right to use the POLYCENTER software is bundled with the OpenVMS operating system base license. The POLYCENTER Software Installation utility simplifies the installation and management of OpenVMS products.

For system managers, the POLYCENTER Software Installation utility provides DCL and DECwindows Motif interfaces which can be used to install, configure, reconfigure, and deinstall software products that have been prepared with the utility. In addition, the POLYCENTER software provides a database to track the installation, reconfiguration, and deinstallation of software. For products installed with other installation technologies, the POLYCENTER Software Installation utility provides a mechanism for adding information about them into the POLYCENTER database. The POLYCENTER Software Installation utility also provides the ability to manage dependencies between products during the installation process.

For software providers, the POLYCENTER software simplifies the task of packaging software by providing a simple, declarative language for describing material for the installation kit and defining how it is installed. The POLYCENTER Software Installation utility handles the functions, while the developer instructs the utility what to do. This significantly reduces the complexity and time to develop installation procedures. The language allows the developer to easily specify dependencies on other software, manage objects in the execution environment (such as files and directories), and anticipate and resolve conflict before it occurs. The POLYCENTER software also significantly simplifies the packaging of multiple software products into one logical product.

VMSINSTAL

OpenVMS VAX includes the VMSINSTAL facility to automate operating system software updates, as well as to handle the installation of optional Digital-supplied software products. OpenVMS Alpha includes the VMSINSTAL facility to handle the installation of optional Digital-supplied software products that have not converted to PCSI.

Test Package and Diagnostics

OpenVMS includes a User Environment Test Package (UETP), which verifies that the OpenVMS operating system is properly installed and ready for use on the customer's systems.

Diagnostics can be run on individual devices during normal system operation. Certain critical components can operate in degraded mode.

OpenVMS Alpha DISK SPACE REQUIREMENTS

Operating System Disk Space Requirements

The disk space requirements for OpenVMS Alpha vary according to which options are installed:

File Category	Space Used	Running Total
Minimum OpenVMS Files	95 MB	95 MB
Other OpenVMS Files	89 MB	184 MB
Paging File (required)	38 MB	222 MB
Swap File (suggested)	3 MB	225 MB
Dump File (optional)	28 MB	253 MB
Decompressed Help Files (optional)	15 MB	268 MB
Full DECwindows Motif V1.2-3 (optional)	65 MB	333 MB
Safeguard for upgrading	50 MB	383 MB

The minimum OpenVMS files listed above are for a system configuration where all optional features have been declined during the initial installation. For most applications, this is not a realistic OpenVMS environment.

The paging, swap, and dump file requirements above are the minimum for a system with 32 MB of main memory. Additional memory in most cases adds to the space needed for these files, as will particular needs of your application. With careful system management it is possible to use the paging file space as a temporary dump file.

For a VMScluster system disk, paging, swap, and dump files cannot be shared between nodes so the files must either be duplicated on the system disk or located on some other disk.

DECwindows Motif for OpenVMS Alpha Disk Space Requirements

To support OpenVMS Alpha and DECwindows Motif for OpenVMS Alpha, a system disk of greater than 380 MB is recommended. However, a subset of DECwindows Motif can be installed. The disk space required for the installation of DECwindows Motif is 64 MB. The permanent amount of space used is 62 MB. An additional 33 MB is needed to install the DECwindow X11 Display Server and associated files. (These DECwindow X11 Display Server and associated files are included in the OpenVMS Alpha Version 7.0 media.) These disk space requirements are in addition the disk space required for the OpenVMS Alpha Version 7.0 operating system as indicated in the OpenVMS Alpha Disk Space Requirements table.

Installation of the DECwindows Motif Version 1.2-3 layered product gives customers the option of installing any or all of the following components:

- **User environment and applications** — 34 MB. This section provides support for running DECwindows Motif applications on VAX servers.
- **Programming support** — 7 MB. This section includes support for the DEC C, DEC C++, DEC Fortran, Pascal, and VAX C programming languages. If a subset of languages is installed, the amount of disk space required will be less.
- **Example files** — approximately 7 MB.
- **Translated image support** — approximately 17 MB.

Layered Product Disk Space Requirements

In addition to the disk space used directly by Digital or third-party layered products, there may be additional space used to store information from those products in OpenVMS help libraries, command tables, object libraries and elsewhere. The exact amount of additional disk space required cannot be exactly predicted due to the possibility of recovering unused space already existing in those library files. Unusually large modules contributed by layered products can also affect the amount of space required for upgrading to a new version of the OpenVMS Alpha operating system.

OpenVMS VAX DISK SPACE REQUIREMENTS

Disk Space Requirements (Block Cluster Size = 3)

To support the complete OpenVMS VAX operating system environment, a system disk of greater than 150 MB is recommended. When a smaller disk is used, additional tailoring is required prior to installing some of the OpenVMS VAX options. This does not include the dump file space. Refer to the *OpenVMS VAX Version 7.0 Upgrade and Installation Manual* for information on tailoring.

Operating System Disk Space Requirements

The disk space requirements for OpenVMS VAX vary according to which options are installed:

File Category	Space Used	Running Total
OpenVMS Files	98 MB	98 MB
Paging File (after installation)	6 MB	104 MB
Swap File (suggested)	1.2 MB	105.2 MB
Dump File (optional)	6.2 MB	111.4 MB
Decompressed Help Files (optional)	7 MB	118.4 MB
Safeguard for upgrading	25 MB	143.4 MB
Variable additional space (additional files, INDEXF.SYS, etc.)	3.3 MB	146.7 MB

The above data was created from an installation on a VAXServer 2000 with 6 MB of memory and an RD54 disk.

Additional memory adds to the space required for page, swap, and dump files and the variable additional space increases with larger memory and disk.

DECwindows Motif for OpenVMS VAX Disk Space Requirements

To support OpenVMS VAX and the DECwindows Motif for OpenVMS VAX layered product, a system disk of greater than 225 MB is recommended. The disk space required for the installation of DECwindows Motif is 39 MB. The permanent amount of space used is 34 MB. An additional 16 MB are needed to install the DECwindows X11 Display Server and associated files. (These DECwindows X11 Display Server and associated files are included in the OpenVMS VAX Version 7.0 media.) These disk space requirements are in addition to the 78 MB required for the other components of the OpenVMS VAX operating system environment. Refer to the *OpenVMS VAX Version 7.0 Upgrade and Installation Manual* for details on tailoring small system disks in order to support the DECwindows Motif environment.

Installation of the DECwindows Motif Version 1.2-3 layered product gives customers the option of installing any or all of the following components:

- **User environment and applications** — 22 MB. This section provides support for running DECwindows Motif applications on VAX servers.
- **Programming support** — 6 MB. This section includes support for the DEC C, DEC C++, DEC Fortran, Pascal, and VAX C programming languages. If a subset of languages is installed, the amount of disk space required is less.
- **Example files** — approximately 6 MB.

Note that the individual sizes add up to more than the total because some components are shared by multiple portions of the environment.

MEMORY SPACE REQUIREMENTS

OpenVMS Alpha Memory Space Requirements

The minimum amount of memory required to install, boot, and log in to an OpenVMS Alpha system is 32 MB. To ensure satisfactory performance for particular applications or numbers of users, additional memory may be required. Refer to specific layered product documentation for memory requirements.

OpenVMS VAX Memory Space Requirements

The minimum amount of memory supported for an OpenVMS VAX environment is dependent upon the specific system(s) being used and the overall type of configuration and application requirements. The minimum amount of memory supported for a standalone VAX system running OpenVMS VAX Version 7.0 is 4 MB. The minimum amount of memory supported for a VAX workstation running OpenVMS VAX Version 7.0 is 12 MB.

The following tables give examples of the minimum amount of memory required for a system user to install, boot, and log in to OpenVMS VAX Version 7.0. Specific requirements depend upon the type of system being used and what other software is installed. To ensure satisfactory performance of applications, additional memory is required.

Component	Necessary Memory
OpenVMS VAX Version 7.0	4.0 MB
DECnet–VAX	.5 MB
VAXcluster	1.5 MB
DECwindows Motif with remote execution of applications (X11 Display Server only)	1.5 MB
DECwindows Motif with local execution of applications (Includes X11 Display Server and DECwindows Motif layered product)	5.0 MB

The following example configurations are based on the previous table:

System	Minimum Supported Memory
OpenVMS VAX Version 7.0, DECwindows Motif with applications executing remotely, and DECnet (standalone system)	6 MB
OpenVMS VAX V7.0, DECwindows Motif with applications executing locally, VAXcluster and DECnet	12 MB

Note: These are the minimum memory requirements. More memory will be required for satisfactory performance of the operating system and DECwindows Motif applications. The performance and memory usage of DECwindows Motif systems is particularly sensitive to system configuration and window and application usage. Remote execution of an application requires an additional system that runs the application while the display of the application occurs on the local workstation.

Please refer to the associated layered product Software Product Descriptions for their memory requirements. Please refer to the OpenVMS VAX documentation for more information concerning performance considerations.

DISTRIBUTION AND BACKUP MEDIA

OpenVMS Alpha

OpenVMS Alpha is available on CD–ROM only. The OpenVMS Alpha Version 7.0 Binary CD–ROM contains the OpenVMS Alpha Version 7.0 save sets and selected documentation in text and Postscript format. The OpenVMS Version 7.0 Online Documentation CD–ROM contains all OpenVMS Documentation in Bookreader format. An InfoServer or local drive is needed for upgrades and system disk backups.

OpenVMS VAX

OpenVMS VAX is available on CD–ROM, TK50, or Magnetic tape distribution media.

The OpenVMS VAX Version 7.0 Binary CD–ROM contains the OpenVMS VAX Version 7.0 save sets, OpenVMS VAX Version 7.0 standalone BACKUP, and selected OpenVMS documentation in text and PostScript format. The OpenVMS Version 7.0 Online Documentation CD–ROM contains all OpenVMS Documentation in Bookreader format.

The TK50 Streaming Tape contains the OpenVMS VAX Version 7.0 save sets and OpenVMS VAX Version 7.0 standalone BACKUP.

The 9-track 1600 BPI Magnetic tape contains the OpenVMS VAX Version 7.0 save sets.

The OpenVMS VAX operating system is also available as part of the OpenVMS VAX Consolidated Software Distribution (ConDIST) on CD–ROM.

GROWTH CONSIDERATIONS

The minimum hardware and software requirements for any future version of this product may be different from the requirements for the current version.

DOCUMENTATION

For OpenVMS Version 7.0, there will be one documentation set for both the Alpha and VAX platforms. Most manuals are common to both platforms, although there are still some platform-specific manuals.

OpenVMS offers documentation in a variety of formats:

- Online books (viewed using the DECwindows Motif Bookreader)

For Version 7.0, online documentation will be distributed on a separate CD–ROM that will ship with the OpenVMS Binary CD–ROMs. Customers will automatically receive the entire OpenVMS documentation offering in Bookreader format on the Documentation CD–ROM. Viewing online documentation in Bookreader requires that DECwindows Motif be installed on the system and that a valid DECwindows Motif license be registered and loaded.

- Printed books (hardcopy)

OpenVMS hardcopy documentation is made up of two offerings: the OpenVMS Full Documentation Set and the OpenVMS Base Documentation Set. A complete listing of all hardcopy manuals and their part numbers is contained in the *Overview of OpenVMS Documentation*.

  — Full Documentation Set

The Full Documentation Set is for users who need extensive explanatory information on all major OpenVMS components, complete reference information on system routines and utilities, detailed examples, guidelines for VMScluster systems, programming concepts, a master index, and information on the Help Message utility. This set meets the needs of system managers and of system and application programmers. It includes the Base Documentation Set.

— Base Documentation Set

The Base Set includes the most commonly used OpenVMS manuals, addressing the needs of general users and system managers of small standalone systems. Documents, such as the Release Notes, New Features, and the DCL Dictionary are included in the Base Set.

Each book in these sets is also separately orderable.

- Printable files

In addition to the online and hardcopy manuals, several OpenVMS archived books will be offered as PostScript files on the OpenVMS Documentation CD–ROM. For a complete listing of OpenVMS archived books refer to the *Overview of OpenVMS Documentation*. These books can be ordered separately and on demand through the Software Supply Business (SSB) group.

Printable PostScript and text files will also be offered for the Release Notes, Installation Guides, and SPDs.

You may print the electronic documentation that accompanies the software as often as necessary.

SOURCE LISTINGS

OpenVMS Operating System Source Listings are available on CD–ROM. These discs contain all source listings files and the Alpha specific debug symbol tables that make up the OpenVMS operating system. Digital provides source listings for all key modules of the OpenVMS operating system that are appropriate for end users or application developers. The debug symbol files (DSF) on the OpenVMS Alpha Source Listings CD–ROM contain information used by the OpenVMS Alpha System-Code Debugger. Certain company confidential source listings and debug symbol files, however, are excluded from the CD–ROM.

The orderable CD–ROM kit includes the license required to view these files on a standalone system or a VMScluster system. If users want to make these files available to another system (possibly at a remote site), they need to purchase another kit.

ORDERING INFORMATION

Alpha Software Licenses

QL-MT1A*-6*	OpenVMS Alpha Operating System Base License
QL-MT1A*-7*	OpenVMS Alpha Operating System Base Update License
QL-MT1A9-6*	OpenVMS Alpha Operating System Symmetric Multiprocessing (SMP) Base Extension License
QL-MT1A9-7*	OpenVMS Alpha Operating System Symmetric Multiprocessing (SMP) Base Extension Update License
QL-MT2A*-**	OpenVMS Alpha Individual User License (No Longer Available...order the Concurrent Use License)
QL-MT2A*-Y*	OpenVMS Alpha Individual User Update License
QL-MT3A*-B*	OpenVMS Alpha Distributed Interactive User License (No Longer Available...order the Concurrent Use License)
QL-MT3A*-Y*	OpenVMS Alpha Distributed Interactive User Update License
QL-MT3A*-3*	OpenVMS Concurrent Use License
QL-MT3A*-5*	OpenVMS Concurrent Use Update License

VAX Software Licenses

The Operating System Base License is a prerequisite for all Concurrent Use Licenses and all SMP BASE Extension Licenses. The Operating System Base License provides the right to use only the OpenVMS VAX or OpenVMS Alpha features of the current version. Interactive use of systems licensed with and OpenVMS VAX or Alpha O/S Base License requires the addition of an OpenVMS Concurrent Use License (for one or more users).

QL-001A*-**	VAX VMS Operating System License and Update License for OpenVMS
QL-005A*-6*	OpenVMS VAX Operating System Base License
QL-005A*-7*	OpenVMS VAX Operating System Base Update License
QL-005A9-6*	OpenVMS VAX Operating System Symmetric Multiprocessing (SMP) Base Extension License
QL-005A9-7*	OpenVMS VAX Operating System Symmetric Multiprocessing (SMP) Base Extension Update License
QL-XULA*-**	OpenVMS VAX Individual User License (No Longer Available)
QL-XULA*-Y*	OpenVMS VAX Interactive User Update License
QL-09SA*-**	OpenVMS VAX Distributed Interactive User License (No Longer Available)
QL-09SA*-Y*	OpenVMS VAX Distributed Interactive User Update License
QL-MT3A*-3*	OpenVMS Concurrent Use License
QL-MT3A*-5*	OpenVMS Concurrent Use Update License

Alpha and VAX CD–ROM Media and Online Documentation

QA–MT1AA–H8	OpenVMS Alpha software and online documentation CD–ROM
QA–XULAA–H8	OpenVMS VAX software and online documentation CD–ROM
QA–MT3AA–H8	OpenVMS VAX/Alpha software and online documentation CD–ROM

VAX Media and Hardcopy Documentation

QA-09SA*-H*	With Base Documentation Set
QA-001A*-H*	With Full Documentation Set

OpenVMS Alpha Software Products Library CD–ROM Offerings

QA–4KL8A–A8	OpenVMS Alpha Software Products Library
QA–4KM8A–G8	OpenVMS Alpha Online Documentation Library
QA–03XAA–H8	OpenVMS Alpha Software Library Package (includes both software and online documentation)

OpenVMS VAX Software Products Library CD–ROM Offerings

QA–VWJ8A–A8	OpenVMS VAX Software Products Library
QA–VYR8A–G8	OpenVMS VAX Online Documentation Library
QA–YL48A–H8	OpenVMS VAX Software Library Package (includes both software and online documentation)

Hardcopy Documentation Sets

QA–09SAA–GZ	OpenVMS Base Documentation Set
QA–001AA–GZ	OpenVMS Full Documentation Set

Source Listings Kits

QB–MT1AB–E8	OpenVMS Alpha Listings CD–ROM Kit & License
QB–001AB–E8	OpenVMS VAX Listings CD–ROM Kit & License

Software Product Services

QT–MT1A*–**	OpenVMS Alpha Base System Software Support Service
QT–MT2A*–**	OpenVMS Alpha Interactive User Software Support Service
QT–001A*–**	VAX VMS Operating System Software Support Service
QT–005A*–**	OpenVMS VAX Operating System Base Software Support Service
QT–XULA*–**	OpenVMS VAX Interactive User Software Support Service
QT–09SA*–**	OpenVMS VAX Distributed Interactive User Software Support Service

A variety of integrated and à la carte hardware and software product services are available. For additional information, contact your local Digital office or Digital representative.

CD–ROM

Media and Online Documentation Update Service

QT–MT1AA–E8	OpenVMS Alpha software and online documentation CD–ROM
QT–XULAA–E8	OpenVMS VAX software and online documentation CD–ROM
QT–MT3AA–E8	OpenVMS VAX/Alpha software and online documentation CD–ROM

OpenVMS Alpha Software Products Library CD–ROM Service

QT–4KL8A–C8	OpenVMS Alpha Software Products Library
QT–4KM8A–C8	OpenVMS Alpha Online Documentation Library
QT–03XAA–C8	OpenVMS Alpha Software Library Package (includes both software and online documentation)

OpenVMS VAX Software Products Library CD–ROM Service

QT–VWJ8A–C8	OpenVMS VAX Software Products Library
QT–VYR8A–C8	OpenVMS VAX Online Documentation Library
QT–YL48A–C8	OpenVMS VAX Software Library Package (includes both software and online documentation)

Hardcopy Documentation Only Update Service

QT–09SAA–KZ	OpenVMS Base Documentation Set
QT–001AA–KZ	OpenVMS Full Documentation Set

OpenVMS VAX Media and Hardcopy Documentation Update Service

QT–09SA*–E*	With Base Documentation Set
QT–001A*–E*	With Full Documentation Set

OpenVMS Source Listings Service

QT–MT1AB–Q8	OpenVMS Alpha Source Listings Service
QT–001AB–Q8	OpenVMS VAX Source Listings Service

* Denotes variant fields. For additional information on available licenses, services, and media, refer to the appropriate Digital price book.

SOFTWARE LICENSING

The OpenVMS operating system software is furnished under the licensing provisions of Digital Equipment Corporation's Standard Terms and Conditions.

Software License Information (Alpha only)

The OpenVMS Alpha operating system license includes the license for DECprint Supervisor for OpenVMS, Base. The DECprint Supervisor (DCPS) for OpenVMS has separate documentation, media kit, and service products. Refer to the *DECprint Supervisor for OpenVMS Software Product Description (SPD 44.15.xx)* for more information.

The right to use POSIX for OpenVMS is included with the OpenVMS base operating system license. Refer to the *POSIX for OpenVMS Software Product Description (SPD 34.82.xx)* for more information.

The right to use the DCE Runtime Services is included with the OpenVMS base operating system license. Refer to the *Digital Distributed Computing Environment (DCE) Software Product Description (SPD 43.05.xx)* for more detailed information on the DCE for OpenVMS product family.

The following are separately licensed products:

Product Name	Related Software Product Description (SPD)
DECnet for OpenVMS Alpha and DECnet for OpenVMS VAX	SPD 48.48.xx
TCP/IP for OpenVMS	SPD 46.46.xx
OpenVMS Cluster Software	SPD 29.78.xx
Volume Shadowing for OpenVMS	SPD 27.29.xx
RMS Journaling for OpenVMS	SPD 27.58.xx
DECwindows Motif for OpenVMS	SPD 42.19.xx
DECram for OpenVMS	SPD 34.26.xx
DECmigrate for OpenVMS AXP Systems	SPD 39.44.xx

Software License Information (VAX only)

The OpenVMS VAX operating system uses one of two different categories of licenses depending on the hardware and software configurations used and currently supported. This information is also provided in the applicable country's Price List.

These are the two categories of operating system licenses for OpenVMS VAX:

- VAX VMS Licensing
- OpenVMS VAX Licensing

Digital provides the proper license type with the purchase of the system. Not all license types are available for every system model.

VAX VMS License Information

Note: Effective February 6, 1995, the VAX VMS (UPI001) licenses no longer include the rights for the Digital Rdb Run-Time option for OpenVMS VAX, and do not permit use of Rdb Runtime on prior versions of OpenVMS VAX.

Each of the following licenses are for a specified hardware system, which is either the system the license was originally shipped with or the system on which the license was first used:

- Operating System Base License (QL-001**-**)
- Operating System User License for OpenVMS VAX (QL-001**-**)
- Traditional License for OpenVMS VAX (QL-001**-**)

There are four types of VAX VMS licenses:

1. Traditional License (QL-001A*-**)

This type of license provides unlimited use to the users on a defined system. VAX VMS traditional licenses are sized to capacity according to system type.

2. Multi-User License (QL-001A*-**)

This type of license provides use according to a specified number of concurrent users. This is an activity-based license. The Multi-User License provides the customer with the right to use the operating system up to the limit of users specified in the license. An operating system ''user'' is a person who is logged in to the system and is using the system interactively. This license is only available on limited system models, primarily MicroVAX and VAX 4000 systems.

Interactive use of VAX systems licensed with the Multi-User License may be increased by the addition of OpenVMS User Licenses* (for one or more users). Refer to the section on Ordering Information for further information.

3. VAX VMS Workstation License (QL-001A*-**)

This type of license provides use for a single user on a VAX workstation. This license type allows one direct login for the single user and then one additional login for system management purposes only.

Additional interactive use of VAX workstations licensed with the VAX VMS Workstation License requires the addition of an OpenVMS User License* (for one or more users). Refer to the section on Ordering Information for further information.

4. File and Application Server License (QL-001A*-**)

This type of license provides for the noninteractive use of OpenVMS.

OpenVMS based VAXservers are sold with a File and Application Server License. The intent of an OpenVMS-based VAXserver is to provide file, print, application, and compute ''services'' to clients who have submitted their requests remotely (for example via network/remote submit/batch jobs, and so forth). This license type also allows one direct login for system management purposes only.

Additional interactive use of OpenVMS VAXservers licensed with the File and Application Server License requires the addition of an OpenVMS User License* (for one or more users). Refer to the section on Ordering Information for further information.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

Notes: Not all VAX VMS license types are available for all versions of VMS, OpenVMS, or all VAX models.

The OpenVMS VAX Individual Use Licenses are not supported by the VMS or OpenVMS VAX operating system releases prior to Version 5.5.

OpenVMS VAX License Information

There are five types of OpenVMS VAX licenses:

1. OpenVMS VAX O/S Base License (QL-005A*-**)

LMF Product Name: BASE-VMS-250136

OpenVMS VAX O/S Base License grants the right to unrestricted, noninteractive use of the OpenVMS VAX operating system for the execution of remotely submitted requests for batch, print, application, and computing services, on a designated, single processor. This license authorizes one direct login for system management purposes only.

The OpenVMS VAX Base License does not include the license right for the DEC Rdb Run-Time Option for OpenVMS VAX. The DEC Rdb for OpenVMS VAX Run-Time License is available separately.

The Operating System Base License is a prerequisite for all Interactive User Licenses and all SMP Base Extension Licenses.

Interactive use of systems licensed with an OpenVMS VAX O/S Base License requires the addition of an OpenVMS User License (for one or more users). Refer to the section on Ordering Information for further information.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

The OpenVMS VAX O/S Base License also includes the license for DECprint Supervisor for OpenVMS VAX. The DECprint Supervisor for OpenVMS VAX has separate documentation, media kits, and service products. Refer to SPD 44.15.xx for further details.

2. Symmetric Multiprocessing (SMP) Base Extension License (QL-005A9-6*)

LMF Product Name: BASE-VMS-250136

SMP Base Extensions extend the O/S Base License to enable symmetric multiprocessing capability on a select number of OpenVMS VAX systems supporting SMP. SMP Base Extensions are permanently tied to the O/S Base License and can not be separated from the O/S Base License if an SMP board is removed from the system.

SMP Extensions grant the right to use the same version of the operating system software as permitted for the corresponding O/S Base License at the time when the SMP Extension is granted.

3. OpenVMS VAX Individual User License
   (QL-XULA*-**)

LMF Product Name: VMS-USER

The OpenVMS VAX Individual User License provides the right to interactively use the operating system by the specified or unlimited number of concurrent users on a designated, single processor. A user is an individual who is logged in to a processor and is interactively using the operating system software by means other than a login. An OpenVMS VAX O/S Base License or one of the five types of VAX VMS Licenses (QL-001A*-**) is a prerequisite for the OpenVMS User License.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

The OpenVMS VAX O/S Base, the SMP Base Extension, and Interactive User licenses are not supported by the VMS or OpenVMS VAX operating system releases prior to OpenVMS VAX Version 5.5.

4. OpenVMS VAX Distributed Interactive User License
   (QL-09SA*-**)

LMF Product Name: ADL-USER

This license grants the right to interactive use of the OpenVMS VAX operating system, provided the appropriate Operating System Base License or one of the five types of VAX VMS Licenses has been previously installed on a VAX system. The Distributed Interactive User licenses are concurrent use licenses and are available in any quantity, except unlimited. Distributed Interactive User licenses are mobile (redesignatable) and may be installed and used on a single OpenVMS VAX processor or shared in a single OpenVMS VAXcluster.

A Distributed Interactive user is defined as an individual who is logged in to an OpenVMS VAX processor or OpenVMS VAXcluster or is interactively using the operating system software by means other than a login.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

5. OpenVMS Concurrent Use License (For both VAX and Alpha)

   (QL-MT3A*-3*)

LMF Product Name: OPENVMS-ALPHA-USER-ADL

This license grants the right to interactive use of the OpenVMS operating system, provided the appropriate OpenVMS Operating System Base License is installed on an OpenVMS VAX processor, or on an OpenVMS Alpha processor, or on OpenVMS VAX processors if one of the five types of VAX VMS Licenses has been previously installed on a VAX system. The OpenVMS Concurrent Use Licenses are available in any quantity desired except unlimited. OpenVMS Concurrent Use Licenses are mobile (redesignatable) and may be installed and used on a single OpenVMS VAX or OpenVMS Alpha processor, or shared in a single OpenVMS VAXcluster, a single OpenVMS Cluster, or shared in a mixed OpenVMS Cluster.

A user that enables a Concurrent Use License is defined as an individual who is logged in to an OpenVMS VAX processor, or an OpenVMS Alpha processor, or an OpenVMS VAXcluster, or an OpenVMS Cluster, or a mixed OpenVMS Cluster and/or is interactively using the OpenVMS operating system software by means other than a login.

When an OpenVMS VAX SMP System upgrade is performed, the SMP Extension to the OpenVMS Alpha Operating System License permits the use of all existing Distributed Interactive User Licenses on the upgraded system.

The Operating System Base License provides the right to use only the OpenVMS features of the current or prior versions of the OpenVMS operating system.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

OpenVMS Alpha License Information

There are five types of OpenVMS licenses available on Alpha processors.

1. Operating System Base License (QL-MT1A*-6*)

LMF Product Name: OpenVMS-ALPHA

This license grants the right to noninteractive use of the remote batch, print, application, and computing services of the OpenVMS Alpha operating system on a single processor. This license authorizes one direct login for system management purposes only.

The Operating System Base License is a prerequisite for OpenVMS User Licenses and SMP Base Extension Licenses.

The Operating System Base License provides the right to use only the OpenVMS features of the current or prior versions of the OpenVMS Operating System.

2. Symmetric Multiprocessing (SMP) Base Extension License (QL-MT1A9-6*)

LMF Product Name: OpenVMS-ALPHA

SMP Base Extensions extend the Operating System Base License to enable symmetric multiprocessing capability on those OpenVMS Alpha systems supporting SMP. SMP Base Extensions are permanently tied to the Operating System Base License and may not be separated from the Operating System Base License if an SMP board is removed from the system.

SMP Extensions grant the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the SMP Extension is granted.

3. Individual User License (QL-MT2A*-**)
   (No Longer Offered)

LMF Product Name: OpenVMS-ALPHA-USER

This license grants the right to interactive use of the OpenVMS Alpha operating system, provided the appropriate Operating System Base License has been previously installed on the OpenVMS Alpha system. The Individual User Licenses are available in any quantity desired or as an unlimited user license.

Individual User Licenses are redesignatable and may be installed and used on a single OpenVMS Alpha processor only. They may not be shared in a single OpenVMS Alpha VMScluster environment. An Individual user is defined as an user who is logged in an OpenVMS Alpha processor or is interactively using the operating system software by means other than a login.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

4. OpenVMS Alpha Distributed Interactive User License (QL-MT3A*-**)
   (No Longer Offered)

LMF Product Name: OpenVMS-ALPHA-ADL

This license grants the right to interactive use of the OpenVMS Alpha operating system, provided the appropriate Operating System Base License has been previously installed on an Alpha system. The ADL Interactive User Licenses, are concurrent use licenses and are available in any quantity desired except unlimited. ADL Interactive User Licenses are redesignatable and may be installed and used on a single OpenVMS Alpha processor, or shared in a single OpenVMS Cluster environment.

A Distributed Interactive user is defined as an individual who is logged in to an OpenVMS Alpha processor or OpenVMS Cluster or is interactively using the operating system software by means other than a login.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

5. OpenVMS Concurrent Use License (For both VAX and Alpha) (QL-MT3A*-3*)

LMF Product Name: OPENVMS-ALPHA-USER-ADL

This license grants the right to interactive use of the OpenVMS operating system, provided the appropriate OpenVMS Operating System Base License in installed on an OpenVMS VAX processor, and/or on an OpenVMS Alpha processor, or on OpenVMS VAX processors if one of the five types of VAX VMS Licenses has been previously installed on a VAX system. The OpenVMS Concurrent Use licenses are available in any quantity desired except unlimited. OpenVMS Concurrent Use Licenses are mobile (redesignatable) and may be installed and used on a single OpenVMS VAX or OpenVMS Alpha processor, or shared in a single OpenVMS VAXcluster, a single OpenVMS Cluster, or shared in a mixed OpenVMS Cluster.

A user that enables a Concurrent Use License is defined as an individual who is logged in to an OpenVMS VAX processor, or an OpenVMS Alpha processor, or an OpenVMS VAXcluster, or an OpenVMS Cluster, or a mixed OpenVMS Cluster and/or is interactively using the OpenVMS operating system software by means other than a login.

When an Alpha SMP System upgrade is performed, the SMP Base Extension to the OpenVMS Alpha Operating System License permits the use of all existing User Licenses on the upgraded system.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the User License is installed.

License Management Facility Support

The OpenVMS operating system supports Digital's License Management Facility (LMF).

If an OpenVMS license is not registered and activated using LMF, then only a single login is permitted for system management purposes through the system console (OPA0:).

Several of the VAX VMS and OpenVMS VAX license types are based on the number of concurrent users, called an activity license. Every product has the option to define an activity as related to the LMF. OpenVMS Interactive User and ADL Interactive User Licenses define the number of concurrent users that are activity licenses as defined by the LMF. OpenVMS defines activities, sometimes referred to as an OpenVMS "user", as follows:

- Each remote terminal connection is considered an activity. This is true even if users set host to their local nodes (SET HOST 0).
- Each connection from a terminal server is considered an activity.
- A multiple-window session on a workstation is considered one activity, regardless of the number of windows.
- A batch job is not considered an activity.
- A remote network connection that is a connection other than a remote terminal connection, is not considered an activity.

For more information about Digital's licensing terms and policies, contact your Digital account representative.

SOFTWARE PRODUCT SERVICES

A variety of service options are available from Digital. For more information, contact your local Digital account representative.

SOFTWARE WARRANTY

Warranty for this software product is provided by Digital with the purchase of a license for the product as defined in the Software Warranty Addendum of this SPD and the applicable Digital Standard Terms and Conditions.

SYSTEMS SUPPORTED BY OpenVMS Alpha and VAX Version 7.0

Alpha Systems Supported

This section of the SPD lists the Alpha systems that are supported by OpenVMS Alpha Version 7.0. Refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide* for details concerning Alpha hardware configurations and options.

Maximum Memory Support

OpenVMS supports the following memory for the systems listed:

Server	Memory
AlphaServer 8200	14 GB
AlphaServer 8400	14 GB
AlphaServer 2100	2 GB
AlphaServer 2000	640 MB
AlphaServer 1000	512 MB
AlphaServer 400	192 MB
AlphaStation 400	192 MB
AlphaStation 250	192 MB
AlphaStation 200	192 MB
DEC 7000 Model 700	14 GB
DEC 4000 Model 700	2 GB
DEC 3000 Model 300	256 MB
DEC 3000 Model 700	512 MB
DEC 3000 Model 900	1 GB
DEC 2000 Model 300	256 MB

On all other AlphaServer and AlphaStation systems, OpenVMS will support the maximum physical memory configured.

EISA Bus Based Systems

- DEC 2000 Models 300/500

TURBOChannel Bus Based Systems

- DEC 3000 Models 300/300L/300LX
- DEC 3000 Models 400/400S
- DEC 3000 Models 500/500S/500X
- DEC 3000 Models 600/600S
- DEC 3000 Models 700/700LX
- DEC 3000 Models 800/800S
- DEC 3000 Models 900/900LX

DSSI Bus Based Systems

- DEC 4000 Model 600
- DEC 4000 Model 700

XMI Bus Based Systems

- AlphaServer 8400 5/300
- DEC 7000 Model 600
- DEC 10000 Model 600

PCI Bus Based Systems

- AlphaServer 8200 5/300
- Digital 2100 Server Model A500MP
- Digital 2100 Server Model A600MP
- AlphaServer 2100 4/233
- AlphaServer 2100 5/250
- AlphaServer 2000 4/233
- AlphaServer 1000 4/200
- AlphaServer 400 4/166
- AlphaStation 600 5/266
- AlphaStation 400 4/266
- AlphaStation 250 4/233
- AlphaStation 200 4/233
- AlphaStation 200 4/166
- AlphaStation 200 4/100

The following are the Digital Semiconductor Microprocessor Development Reference Boards supported by OpenVMS Alpha.

- Alpha 21064/21064A PCI Reference Board (EB64+)
- AlphaPC64 Reference Board (APC64)

VAX Systems Supported

This section of the SPD lists the VAX systems that are supported by OpenVMS VAX Version 7.0. Refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide* for details concerning VAX hardware configurations and options.

Q–bus Based Systems

- MicroVAX II
- VAXstation II/GPX[1], VAXstation II/QVSS[2]
- MicroVAX 3200, VAXserver 3200, VAXstation 3200
- MicroVAX 3300, VAXserver 3300
- MicroVAX 3400, VAXserver 3400
- MicroVAX 3500, VAXserver 3500, VAXstation 3500, VAXstation 3520, VAXstation 3540
- MicroVAX 3600, VAXserver 3600
- MicroVAX 3800, VAXserver 3800
- MicroVAX 3900, VAXserver 3900
- VAX 4000, Models 100, 200, 300, 500, 600
- VAX 4000, Models 50, 100A, 105A, 500A, 505A, 600A, 700A, 705A
- VAXserver 4000, Models 200, 300, 400, 500, 600

NMI Bus Based Systems

- VAX 8530, VAXserver 8530, VAX 8550, VAXserver 8550
- VAX 8700, VAXserver 8700
- VAX 8800, VAX 8810, VAX 8820, VAX 8830, VAX 8840
- VAXserver 8800, VAXserver 8810, VAXserver 8820, VAXserver 8830, VAXserver 8840

XMI Bus Based Systems

- VAX 6000 Series, Models 210, 220, 230, 240
- VAX 6000 Series, Models 310, 320, 330, 340, 360
- VAX 6000 Series, Models 410, 420, 430, 440, 450, 460
- VAX 6000 Series, Models 510, 520, 530, 540, 550, 560
- VAX 6000 Series, Models 610, 620, 630, 640, 650, 660
- VAXserver 6000, Models 210, 220, 310, 320, 410, 420, 510, 520
- VAX 8530, VAX 8550, VAXserver 8530, VAXserver 8550
- VAX 8700, VAXserver 8700
- VAX 8800, VAX 8810, VAX 8820, VAX 8830, VAX 8840
- VAXserver 8800, VAXserver 8810, VAXserver 8820, VAXserver 8830, VAXserver 8840
- VAX 7000, Models 610, 620, 630, 640, 650, 660, 710, 720, 730, 740, 750, 760
- VAX 10000, Models 610, 620, 630, 640, 650, 660

VAXBI Bus Based Systems

- VAX 8200, VAX 8250, VAXserver 8200, VAXserver 8250
- VAX 8300, VAX 8350, VAXserver 8300, VAXserver 8350

SBI Bus Based Systems

- VAX 11/780, VAX 11/785

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[1] Graphics Processing Accelerator (GPX)

[2] Q–bus Video Sub System (QVSS)

- VAX 8600, VAX 8650, VAXserver 8600, VAXserver 8650

CMI Bus Based Systems

- VAX 11/750

Special System Specific Internal Bus

- VAX 11/730
- MicroVAX 2000, VAXstation 2000, VAXstation 2000/GPX, VAXstation 2000/MFB[3]
- VAXft 3000, Models 110, 310, 410, 610, 612
- MicroVAX 3100, Models 10, 10E, 20, 20E, 30, 40, 80, 85, 90, 95, 96
- VAXserver 3100, Models 10, 10E, 20, 20E
- VAXstation 3100, Models 30, 38, 40, 48, 76
- VAXstation 3100/GPX, Models 38, 48, 76
- VAXstation 3100/SPX[4], Models 38, 48, 76
- VAXstation 4000, Models 60, 90, 95, 96
- VAXstation 4000-VLC
- VAX 9000, Models 110, 110VP[5], 210, 210VP, 310, 310VP
- VAX 9000, Models 320, 320VP, 330, 330VP, 340, 340VP
- VAX 9000, Models 410, 410VP, 420, 420VP, 430, 430VP
- VAX 9000, Models 440, 440VP

System Restrictions

The following list describes version specific restrictions. The DECwindows Motif environment is not supported on these systems.

MicroVAX I/VAXstation I Systems

The final version of OpenVMS VAX that supports these systems is VMS V5.1-1.

VAX–11/725

VMS V5.1 was the final version to support the VAX–11/725.

VAX–11/730 System

The VAX–11/730 system supports additional memory to a maximum of 5 MB for systems configured with R80 /RL02 or dual RL02 disks. Other VAX–11/730 system configurations support a maximum of 3 MB of memory for the VAX–11/730 only. To run OpenVMS VAX Version 6.1, 4 MB of memory is required.

VMS Version 6.2 was the final version to support the following:

VAX–11/750

VAX–11/751

VAX–11/780

VAX–11/782

VAX–11/785

MicroVAX I

VAXstation I

Appendix A

This appendix describes Digital Equipment Corporation terminals, disks, tapes, controllers, graphics, and network options. Some restrictions for specific devices are listed, if applicable.

Digital reserves the right to change the number and type of devices supported by OpenVMS Alpha, OpenVMS VAX, DECnet for OpenVMS Alpha, DECnet for OpenVMS VAX, DECnet/OSI, and OpenVMS Cluster Software. The minimum hardware requirements for future versions and updates of these software products may be different from current hardware requirements. For configuration details about Alpha or VAX hardware, refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide*.

Refer to the following SPDs for detailed product information: DECnet for OpenVMS (SPD 48.48.xx), DECnet/OSI (SPD 50.45.xx, 25.03.xx), and OpenVMS Cluster Software (SPD 29.78.xx).

Terminals and Terminal Line Interfaces

To prevent input from overflowing a buffer, terminals use the ASCII control characters DC1 and DC3 for synchronization as defined by Digital's DEC STD 111, Revision A. VXT windowing terminals support standard ANSI applications and X windows using the LAT transport protocol.

The following table lists the terminals that are supported by OpenVMS Alpha:

VT200 series	VT300 series	VT400 series
VT500 series	VXT2000 series	

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[3] Monochrome Frame Buffer (MFB)

[4] 2D Scanline Processor Accelerator Graphics System (SPX)

[5] Vector Processor (VP)

The following table lists the terminals that are supported by OpenVMS VAX:

- VT52
- VT300-series
- VT200-series
- VT100-series
- VT1000-series
- VT500-series
- LA-series
- LQP02

Terminals on Professional 350, Rainbow 100, and DECmate II systems emulate VT100 terminals.

Only limited support is available for the VT52. The VT131, when running an application, operates in block mode. When interacting with OpenVMS VAX and associated utilities, the VT131 operates only in VT100 (or interactive) mode and not in block mode.

Note: The VT1000 is a monochrome windowing terminal that supports standard ANSI applications and "X" windows. The transport protocols supported are LAT for VMS. The product supports 15-inch and 19-inch monitors.

Disks

The first column lists the disk drive. The second column is a description of the device. The third column lists the bus the device is supported on. The fourth column lists the minimum required version of OpenVMS Alpha that supports these devices.The fifth column lists the minimum required version of OpenVMS VAX that supports these devices. ("NS" stands for "Not Supported")

Disk Drive	Description	Bus	Alpha Version	VAX Version
EF51R[3]	107 MB solid state	DSSI	NS	5.5-2
EF52R[4]	205 MB solid state	DSSI	NS	5.5-2
EF53[4]	267 MB solid state	DSSI	NS	5.5-2
ESE-20[3]	120 MB solid state	SDI	NS	
ESE-52[3]	120 MB solid state	SDI	1.0	5.5-2
ESE-56	600 MB solid state	SDI	1.5	5.5-2
ESE-58	960 MB solid state	SDI	1.5	5.5-2
EZ51R[3]	100 MB solid state	SCSI	1.5	5.5-2
EZ54R	467 MB solid state	SCSI	1.5	5.5-2
EZ58R	855 MB solid state	SCSI	1.5	5.5-2
RA60[4]	205 MB removable	SDI	NS	6.1
RA70	280 MB fixed	SDI	NS	6.1
RA71	700 MB fixed disk	SDI	NS	5.4-2
RA72	1 GB fixed disk	SDI	1.0	5.4-2
RA73	2 GB fixed disk	SDI	1.0	5.5-2
RA80[3]	128 MB fixed disk	SDI	NS	6.1
RA81	456 MB fixed disk	SDI	NS	6.1
RA82	622 MB fixed disk	SDI	NS	6.1
RA90	1.2 GB fixed disk	SDI	1.0	6.1
RA92	1.5 GB fixed disk	SDI	1.0	6.1
RC25[3]	2 disks each 26 MB (1 fixed and 1 removable) disk drive with shared spindle	Q–bus	NS	6.1
RD32[3]	VAX 42 MB fixed disk	Q–bus	NS	
RD51[3]	10 MB fixed disk	Q–bus	NS	6.1
RD52[3]	31 MB fixed disk	Q–bus	NS	6.1
RD53[3]	71 MB fixed disk	Q–bus	NS	
RD54[4]	159 MB fixed disk	Q–bus	NS	
RF30[4]	150 MB fixed disk	DSSI	NS	6.1
RF31	381 MB fixed disk	DSSI	1.5	
RF31F[1]	200 MB fixed disk	DSSI	NS	5.4-2
RF31T	381 MB fixed disk	DSSI	1.5	5.5-2
RF35	800 MB fixed disk	DSSI	1.0	5.5
RF36	1.6 GB fixed disk	DSSI	6.1	6.0
RF71	400 MB fixed disk	DSSI	1.5	6.1
RF72	1 GB fixed disk	DSSI	1.5	5.5-2
RF74	3.5 GB fixed disk	DSSI	6.1	6.0
RK06[3]	14 MB removable disk	UNIBUS	NS	
RK07[3]	28 MB removable disk	UNIBUS	NS	
RL02[3]	10 MB removable disk	UNIBUS	NS	
RM03+[3]	67 MB removable disk	M-bus	NS	
RM05	256 MB removable disk	M-bus	NS	
RM80[3]	124 MB fixed disk	M-bus	NS	
RRD40[3]	600 MB read-only optical disk drive	Q–bus and SCSI	NS	
RRD42	600 MB read-only optical disk drive	SCSI	1.0	5.4-2
RRD43	680 MB read-only optical disk drive	SCSI	6.1	5.5-2
RRD44	680 MB read-only optical disk drive	SCSI	6.1	

Disk Drive	Description	Bus	Alpha Version	VAX Version
RRD50[3]	600 MB read-only optical disk drive	Q–bus	NS	
RP05[3]	88 MB removable disk drive	M-bus	NS	
RP06[4]	176 MB removable disk drive	M-bus	NS	
RP07	516 MB fixed disk drive	M-bus	NS	
RWZ01	594 MB optical removable disk drive	SCSI	1.0	
RX02[3]	512 KB diskette	UNIBUS	NS	
RX23	1.47 MB diskette	SCSI	NS	
RX26	2.8 MB diskette drive	I82077	1.5-1H1	
RX26	2.8 MB diskette drive	SCSI	1.0	5.5
RX33[3]	1.2 MB diskette drive. Requires minimum RQDX3 microcode of V3.0	Q–bus	NS	
RX50[3]	400 KB diskette	Q–bus	NS	
RV20[3]	2 GB Write Once Read Many optical disk drive	Q–bus, UNIBUS, VAXBI	NS	
RV64[3]	2 GB Write Once Read Many optical disk sub-system	Q–bus, UNIBUS, VAXBI	NS	
RZ22[3]	52 MB fixed disk	SCSI	NS	
RZ23[3]	104 MB fixed disk	SCSI	NS	
RZ23L[3]	121 MB fixed disk	SCSI	1.5	5.4-1
RZ24[1]	209 MB fixed disk	SCSI	1.5	6.1
RZ24L	245 MB fixed disk	SCSI	1.0	5.4-3
RZ25	425 MB fixed disk	SCSI	1.0	5.4-3
RZ25L	500 MB fixed disk	SCSI	1.5	5.5-2
RZ25M	540 MB fixed disk	SCSI	6.1	6.1
RZ26	1.05 GB fixed disk	SCSI	1.0	5.5-2
RZ26B	1.05 GB fixed disk	SCSI	1.5	6.0
RZ26L	1.0 GB fixed disk	SCSI	1.5	5.5-2
RZ26N	1.0 GB fixed disk	SCSI	6.2	6.2
RZ28	2.1 GB fixed disk	SCSI	1.5	5.5-2
RZ28B	2.1 GB fixed disk	SCSI	1.5	6.0
RZ28M	2.1 GB fixed disk	SCSI	6.2	6.2
RZ29B	4.4 GB fixed disk	SCSI	6.1	NS
RF35	852 MB fixed disk	SCSI	NS	5.4-3
RZ55	332 MB fixed disk	SCSI	1.0	6.1
RZ56	665 MB fixed disk	SCSI	1.0	6.1
RZ57[2]	1 GB fixed disk	SCSI	1.5	5.4-3
RZ58	1.35 GB fixed disk	SCSI	1.0	5.5
RZ73	2 GB fixed disk	SCSI	1.0	6.0

Disk Options Supported by Digital's Services Enterprise Integration Center (SEIC) (VAX only)

RF30-RA[4]	150 MB removable disk	(DSSI)
RF31-RA	381 MB removable disk	(DSSI)
RF71-RA	400 MB removable disk	(DSSI)
RF71-RA	1 GB removable disk	(DSSI)
RWZ01	594 MB optical removable disk	(SCSI) (V5.4-3)

Tapes

The first column lists the device name. The second column is a description of the device. The third column lists the bus the device is supported on. The fourth column lists the minimum required version of OpenVMS Alpha and the fifth column lists the minimum required version of OpenVMS VAX that supports these devices. ("NS" stands for "Not Supported")

Tape	Description	Bus	Alpha Version	VAX Version
TA78	1600/6250 BPI, STI TU78	STI	1.0	
TA79	STI TU79	STI	NS	
TA81	145 MB tape drive	STI	1.0	
TA90	1.2 GB tape cartridge subsystem. (5-inch 200 MB cartridge)	STI	1.0	
TA90E	1.2 GB tape cartridge subsystem. Compacts data records automatically	STI	NS	
TA91	High performance tape drive	STI	NS	5.4-2
TE16	9-track magnetic tape drive	M-BUS	NS	
TF70	290 MB TK70 tape cartridge drive	DSSI	NS	5.4-2

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[1] Specific tailoring is required in order to use this device as an OpenVMS Alpha or VAX system disk with the DECwindows Motif environment.

[2] Minimum revision firmware is V6000.

[3] Device cannot be used as an OpenVMS VAX system disk.

[4] Device cannot be used as an OpenVMS VAX system disk with DECwindows Motif environment.

Tape Description Bus Alpha Version VAX Version

Tape	Description	Bus	Alpha Version	VAX Version
TF85	**2.6 GB streaming tape cartridge drive**	**DSSI**	**6.1**	**5.5-2**
TF857	**18.2 GB tape cartridge loader**	**DSSI**	**6.1**	**5.5-2**
TF86	**6.0 GB DLT tape cartridge**	**DSSI**	**6.1**	**6.1**
TF867	**42 GB DLT tape loader**	**DSSI**	**6.1**	**6.1**
TK50	**95 MB, 5 1/4-inch streaming tape cartridge drive**	**Q–bus and SCSI**	**NS**	
TK70	**296 MB, 5 1/4-inch streaming tape cartridge drive**	**Q–bus**	**NS**	
TKZ09	**5.0 GB, 8mm tape drive**	**SCSI**	**1.5**	
TKZ60	**200 MB, 3480 tape drive (no compression)**	**SCSI**	**1.0**	
TLZ04	**1.2 GB, 4mm, DAT tape drive**	**SCSI**	**1.0**	
TLZ06	**4 GB, 4mm, DAT tape drive**	**SCSI**	**1.0**	**6.1**
TLZ07	**8 GB, 4mm, DAT tape drive**	**SCSI**	**6.1**	**6.1**
TLZ08	**5.25-inch, 2 GB, 8mm tape drive**	**SCSI**	**NS**	
TLZ6L	**4 GB, 3.5-inch, 4mm DAT tape loader**	**SCSI**	**6.1**	
TLZ7L	**8 GB, 3.5-inch, 4mm DAT tape loader**	**SCSI**	**6.1**	**6.1**
TS05	**9-track magnetic tape drive**	**Q–bus**	**NS**	
TS11	**9-track magnetic tape drive**	**UNIBUS**	**NS**	
TSZ05	**1600 bits/in tape drive**	**SCSI**	**1.5**	
TSZ07	**1600/6250 BPI tape drive**	**SCSI**	**1.0**	
TU77	**9-track magnetic tape drive**	**M-BUS**	**NS**	
TU78	**9-track magnetic tape drive**	**M-BUS**	**NS**	
TU80	**9-track magnetic tape drive**	**UNIBUS**	**NS**	
TU81	**9-track magnetic tape drive**	**UNIBUS**	**NS**	
TU81-Plus	**Streaming 9-track magnetic tape drive**	**Q–bus, UNIBUS, VAXBI**	**NS**	
TZ30	**95 MB, half-height DLT tape drive**	**SCSI**	**1.0**	
TZ85	**2.6 GB DLT tape drive**	**SCSI**	**1.0**	
TZ857	**18 GB, DLT tape loader**	**SCSI**	**1.0**	
TZ86	**6.0 GB, DLT tape drive**	**SCSI**	**1.5**	
TZ867	**42 GB, DLT tape loader**	**SCSI**	**1.5**	
TZ87	**20 GB, DLT tape drive**	**SCSI**	**6.1**	**6.1**
TZ875	**100 GB, DLT tape loader**	**SCSI**	**6.1**	**6.1**
TZ877	**140 GB, DLT tape loader**	**SCSI**	**6.1**	**6.1**
TZK08	**2.2 GB 8mm, tape drive**	**SCSI**	**6.1**	
TZK10	**320/525 MB, QIC tape drive**	**SCSI**	**1.0**	
TZK11	**2.0 GB, QIC tape drive**	**SCSI**	**6.1**	

Controllers

HS111	StorageWorks FDDI StorageServer.
HS121	StorageWorks FDDI StorageServer.
HSC40	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC50	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 4.1.) Refer to SPD 32.96.xx for supported configurations.
HSC60	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC65	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC70	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC90	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.

HSC95	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSD05	DSSI to SCSI-2 FSE StorageWorks bus adapter (Firmware must be at minimum Version X36.)
HSD10	DSSI to SCSI-2 FSE StorageWorks bus adapter
HSD30	DSSI based StorageWorks controller that supports up to 3 SCSI-2 FSE ports. (HSD firmware must be at minimum Version V15D.)
HSJ30	CI based StorageWorks controller that supports up to 3 SCSI-2 FSE ports. (HSJ firmware must be at minimum Version V15J.)
HSJ40	CI based StorageWorks controller that supports up to 6 SCSI-2 FSE ports. (HSJ firmware must be at minimum Version V15J.)
HSZ40-BX	Fast Wide Differential SCSI based StorageWorks controller that supports up to 6 SCSI-2 FSE ports. (HSZ firmware must be at minimum Version V2.5Z.)
KDM70	Mass-storage controller for XMI systems with eight SDI ports.
KFESA	Mass-storage controller for EISA systems with one DSSI port. (Alpha only)
KFESB	Mass-storage controller for EISA systems with one DSSI port. (Alpha only)
KFMSB	Mass-storage controller for XMI systems with two DSSI ports. (Alpha only)
KZESC-AA	Backplane RAID controller for EISA systems with one SCSI-2 FSE port. (Alpha only)
KZESC-BA	Backplane RAID controller for EISA systems with three SCSI-2 FSE ports. (Alpha only)
KZMSA	Mass-storage controller for XMI systems with two SCSI ports. (Limited SCSI-2 support - Alpha only)
KZPSA	Mass-storage adapter for PCI systems with one SCSI-2 FWD port. (Alpha only)
KZPSC-AA	Backplane RAID controller for PCI systems with one SCSI-2 FSE port. (Alpha only)
KZPSC-BA	Backplane RAID controller for PCI systems with three SCSI-2 FSE ports. (Alpha only)
KZPAA	Mass-storage adapter for PCI systems with one SCSI-2 FSE port. (Alpha only)
KZTSA	Mass-storage adapter for TURBOchannel systems with one SCSI-2 FWD port. (Alpha only)
PB2HA-SA	Mass-storage controller for EISA systems with one SCSI port. (Limited SCSI-2 support. (Alpha only) On systems with no greater than 1GB of memory.)
PMAZB	Mass-storage adapter for TURBOchannel systems with two SCSI-2 FSE ports. (Alpha only)
PMAZC	Mass-storage adapter for TURBOchannel systems with two fast SCSI-2 FSE ports. (Alpha only)

Controllers (VAX only)

HSZ10	SCSI based StorageWorks controller that supports up to 2 SCSI-2 ports.
IDC	Integrated Disk Controller for VAX–11/725 and VAX–11/730 systems.
IDTC	Integral Disk and Tape Controller for VAX 8600 and VAX 8650 systems.
LPA11-K	Microprocessor controller for laboratory acquisition I/O devices, accommodating up to two AD11-Ks, one AA11-K, one KW11-K, two AM11-Ks, and five DR11-Ks. One LPA11-K controller is supported per UNIBUS and a maximum of two are supported per system.
KDA50	Q–bus MSCP disk controller. The KDA50 disk controller supports up to four of the following drives: RA60, RA70, RA80, RA81, and RA82.
KDB50	VAXBI MSCP disk controller. The KDB50 disk controller supports up to four of the following drives: RA60, RA80, RA81, and RA82.
KFMSA	Mass-storage controller for XMI systems with two DSSI ports.
KFQSA	Q–bus to DSSI bus adapter. This adapter allows up to seven DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Multi-Host Configuration.)
KLESI	Q–bus, UNIBUS, and VAXBI tape controller for the TU81-Plus, RV20, or RC25.
KRQ50	Q–bus controller for the RRD40/RRD50 compact disc reader.
KZQSA	Q–bus to SCSI bus adapter. This adapter allows up to 7 SCSI storage devices to attach to the SCSI bus.
KFDDA	VAX 4000 model 100 DSSI bus adapter. This adapter allows up to 7 DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Multi-Host Configuration.)

KFDDB	VAX 4000 model 500/600/700 DSSI bus adapter. This adapter allows up to 7 DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Multi-Host Configuration.)
LP11	UNIBUS parallel high-speed line printer controller for the LPxx printers.
LPV11	Q–bus parallel high-speed line printer controller.
RK711	UNIBUS disk controller for RK07 disk drives.
RL211	UNIBUS disk controller for the RL02 disk drive.
RQDXx	Q–bus disk controller for MicroVAX and VAXstation systems. There is an RQDX1, RQDX2, and an RQDX3 controller. The RQDXx disk controller supports as many as four disk units, with each RX50 diskette drive counting as two units. Due to controller limitations, the system supports a maximum of four devices; the number of RD/RX devices the system supports depends on the enclosure. The RQDX3 disk controller is required for the RD54 and the RX33 drives.
RX211	UNIBUS diskette controller for two RX02 drives. One RX211 diskette controller is supported per system.
RUX50	UNIBUS diskette controller for RX50 drives. One RUX50 diskette controller is supported per system.
TM03	MASSBUS tape controller for the TE16 and TU77 magnetic tape drives.
TM32	BI-bus 9-track tape controller only with large record support.
TM78	MASSBUS tape controller for the TU78 magnetic tape drive.
TQK50	Q–bus tape controller for the TK50 cartridge tape drive.
TQK70	Q–bus tape controller for the TK70 cartridge tape drive.
TS11	UNIBUS tape controller for the TS11 magnetic tape drive.
TBK50	BI-bus tape controller for the TK50 cartridge tape drive.
TBK50	BI-bus tape controller for the TK50 cartridge tape drive.
TBK70	BI-bus tape controller for the TK70 cartridge tape drive.
TUK50	UNIBUS tape controller for the TK50 cartridge tape drive. One TUK50 tape controller is supported per system.
UDA50	UNIBUS MSCP disk controller. The UDA50 controller must have a minimum microcode version of REV 3. The UDA50 controller supports up to 4 of the following disk drives: RA60, RA80, RA81, and RA82.

Asynchronous Terminal Controllers (VAX only)

CXA16	16-line serial terminal multiplexer (DEC-423), maximum baud rate supported: 38400. (No modem control) (Q–bus)
CXB16	16-line serial terminal multiplexer (RS422), maximum baud rate supported: 38400. (No modem control) (Q–bus)
CXY08	8-line serial terminal multiplexer (RS232), maximum baud rate supported: 19200. (Full modem control) (Q–bus)
DHB32	16-line asynchronous terminal controller for VAXBI, maximum baud rate supported: 19200. (VAXBI)
DHF11	32-line asynchronous terminal controller (DEC 423), maximum baud rate supported: 19200. (No modem control) (Q–bus)
DHT32	8-line asynchronous terminal controller (DEC 423). (No modem control) (MicroVAX 2000)
DHQ11	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 19200. (Full modem control) (Q–bus)
DHU11	16-line asynchronous terminal controller (RS-232-C), maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control) (UNIBUS)
DHV11	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control) (Q–bus)
DMB32	8-line asynchronous terminal controller, maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control) (VAXBI)
DMF32	8-line asynchronous terminal controller, maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control on first 2 lines) (UNIBUS)
DMZ32	24-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Modem support dependent on configuration) (UNIBUS)
DZ11	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 9600. (Partial modem control) (UNIBUS)

DZ32	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 9600. (Partial modem control) (UNIBUS)
DZQ11	4-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Partial modem control) (Q–bus)
DZV11	4-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Partial modem control) (Q–bus)

Synchronous Controllers (VAX only)

The VAX Wide Area Network Device Drivers software product contains the synchronous device drivers and is required when using synchronous communication options. Refer to SPD 29.64.xx for more information.

DMB32	Point-to-point synchronous interface. (VAXBI)
DMC11	High-speed local point-to-point synchronous interface; retired device, no longer offered as an option. (UNIBUS)
DMF32	Point-to-point or multipoint synchronous interface. (UNIBUS)
DMP11	Point-to-point or multipoint synchronous interface; (UNIBUS) retired device, no longer offered as an option.
DMR11	Remote point-to-point synchronous interface; (UNIBUS) replaces DMC11.
DMV11	Point-to-point or multipoint synchronous interface. (Q–bus)
DPV11	Synchronous, 1 line, half or full-duplex point-to-point communication interface supporting DDCMP, HDLC, SDLC, or BISYNC protocols.
DSB32	Two-line, multiple protocol, synchronous adapter. (VAXBI)
DSH32	One-line synchronous (full modem control) and 8-line asynchronous (no modem control) communications controller for the MicroVAX 2000. DEC423 devices are supported. Maximum baud rates supported: OpenVMS VAX, 19.2 KBPS (kilobits/second); 9.6 KBPS for MicroVAX 2000, etc.
DST32	Synchronous single-line support for DDCMP up to 9.6 KBPS, full duplex for MicroVAX 2000 systems. Concurrent use with the DHT32 is not supported.
DSV11	Synchronous, 2-line, half or full-duplex point-to-point communication interface supporting DDCMP (1 or 2 lines up to 64 KBPS).
DSF32	DEC WANcontroller 620 — Two-line synchronous communications controller designed specifically for the VAXft 3000 processors, supporting DDCMP. DDCMP is supported at speeds up to 64 KBPS per line for a two-line operation.

Graphics Options

PMAG	A 24-plane graphics adapter upgrade.
PMAGB	A multiscreen graphics adapter for TURBOchannel systems to connect multiple 8/24-plane color or grayscale monitors.
PMAGC	A multiscreen graphics adapter for TURBOchannel systems to connect multiple ZLX 8/24-plane color or grayscale monitors.
PMAGD	A multiscreen graphics adapter for TURBOchannel systems to connect multiple ZLX 8-plane color or grayscale monitors.
PBXGA-AA	A multiscreen graphics adapter for PCI systems to connect ZLX 8-plane color or grayscale monitors.
PBXGA-BA/CA	Multiscreen graphics adapters for PCI systems to connect ZLX 24-plane color or grayscale monitors.
PB2GA-AA	Compaq QVision VGA adapter for EISA systems.
PB2GA-CA	Compaq QVision VGA adapter for PCI systems.
PB2GA-FA	ATI Mack-64 CX (2mbDRAM) VGA adapter for PCI systems.
PCXBV-DE/DG	A 15" color quadmode monitor.
PCXAV-FC/FD	A 19" color monitor.

LAN Options

DEFAA	A high-performance network adapter that connects FUTUREBUS+ systems to ANSI FDDI local area networks.
DEFEA	A high-performance network adapter that connects EISA systems to ANSI FDDI local area networks.
DEFPA	A high-performance network adapter that connects PCI systems to ANSI FDDI local area networks.
DEFTA	A high-performance network adapter that connects TURBOchannel systems to ANSI FDDI local area networks.
DEFZA	A high-performance network adapter that connects TURBOchannel systems to ANSI FDDI local area networks. (DMA receive only.)

DEMFA	A high-performance network adapter that connects XMI systems to ANSI FDDI local area networks.
DETRA	A network adapter that connects the TURBOchannel bus to a Token Ring local area network.
DEMNA	A high-performance network adapter that connects XMI systems to both the Ethernet and IEEE 802.3 local area networks.
DE422	A network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks.
DE425	A high-performance network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks.
DE434	A high-performance network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks.
DE435	A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks.
DE436	A high-performance network adapter that connects QUAD PCI systems to both the Ethernet and IEEE 802.3 local area networks.
DW300	A network adapter that connects the EISA bus to a Token Ring local area network.
PB2CA-AA	A network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks.
PMAD	A network adapter that connects TURBOchannel systems to both the Ethernet and IEEE 802.3 local area networks.

LAN Options (VAX only)

DEUNA	Ethernet to UNIBUS controller.
DELUA	Ethernet to UNIBUS controller. The minimum revision level required is F1.
DEBNA	Ethernet to VAXBI communication controller.
DEBNI	Ethernet to VAXBI communication controller.
DEMNA	The DEMNA is a high performance network adapter that connects XMI systems to both the Ethernet and IEEE 802.3 local area networks.
DESVA	Ethernet controller interface.
DEQNA	Ethernet controller to Q–bus. The minimum revision level required is K3. All systems utilizing a DEQNA must operate with software data checking enabled. Since AUTOGEN will automatically set the correct parameter, no system management intervention is required. Not supported by VAXcluster software. Not supported for any interfaces except for access using QIO or ALTSTART interfaces.
DELQA	Ethernet controller to Q–bus. This is the replacement for DEQNA. The minimum revision level required is C3.
DESQA	Ethernet controller to Q–bus for S-BOX configurations.
DEFQA	FDDI to Q–bus controller
DEFZA	FDDI to TURBOchannel controller
DEFTA	FDDI to TURBOchannel controller
KFE52	DSSI/Ethernet Adapter for the VAXft 3000. Minimum of two adapters per system providing redundant connection to the Ethernet and the DSSI buses.

CI Options

CIXCD-AC	Native CI adapter for DEC 7000 and 10000 Alpha XMI systems. (Minimum microcode version REV 1.0 is required.)

CI Options (VAX only)

VAXcluster Software may support multiple CI adapters per system. Refer to the VAXcluster Software Product Description (SPD 29.78.xx) for the supported configurations.

CI750	CI Adapter for VAX–11/750 systems. (Minimum microcode version REV 8.7 is required.)
CI780	CI Adapter for VAX–11/780, VAX–11/785, VAX 8600, and VAX 8650 systems. (Minimum microcode version REV 8.7 is required.)
CIBCI	CI Adapter for VAXBI systems. (Minimum microcode version REV 8.7 is required.)
CIBCA-AA	Native CI Adapter for VAXBI systems. (Minimum microcode version REV 7.5 is required.)
CIBCA-BA	Native CI Adapter for VAXBI systems. (Minimum microcode version REV 5.2 is required.)
CIXCD-AA	Native CI Adapter for VAX 9xxx XMI systems. (Minimum microcode version REV 1.0 is required.)
CIXCD-AB	Native CI Adapter for VAX 6xxx XMI systems. (Minimum microcode version REV 1.0 is required.)

Miscellaneous

InfoServer	An integrated hardware and software system that sits directly on the Ethernet to provide CD–ROM, hard disk, magneto-optical, and tape access to OpenVMS clients in a local area network. It supports up to 14 SCSI devices and can be used for software distribution and initial system load (ISL). For more information, refer to the InfoServer Software Product Description (SPD 33.20.xx.)
PC4XD-AA	Parallel/serial port adapter.
PMTCE	TURBOchannel Extender.

Miscellaneous (VAX only)

CR11	Card reader. One CR11 card reader is supported per system. (UNIBUS)
DRV11-WA	General purpose DMA interface. (Q–bus)
DR11–W	General purpose high-speed DMA interface — one DR11–W interface supported per UNIBUS.
DR750	High performance general purpose interface for the VAX–11/750. One DR750 interface is supported per system. This device may not be used in conjunction with the CI750.
DR780	High performance general purpose interface for the VAX–11/780 and VAX–11/785. One DR780 interface is supported per system. On the VAX 8600 and VAX 8650 as many as four per system are permitted provided that the M8297-YA is used.
DWBUA	XMI to UNIBUS adapter.
DWMBA	XMI to BI adapter; also the adapter used to connect the XMI to VAX expander cabinet.
DWMVA	XMI to VME adapter.
DW750	UNIBUS Adapter for second UNIBUS for the VAX–11/750 system.
DW780	UNIBUS Adapter for VAX–11/780, VAX 8600 and VAX 8650.
FP730	Floating Point Accelerator for the VAX–11/730 system.
FP750	Floating Point Accelerator for the VAX–11/750 system.
FP780	Floating Point Accelerator for the VAX–11/780 system.
FP785	Floating Point Accelerator for the VAX–11/785 system.
FP86-AA	Floating Point Accelerator for the VAX 8600 and VAX 8650 systems.
FV64A	Vector Processing option for the VAX 6000-400.
H7112	Memory battery backup for VAX–11/750, VAX–11/780, VAX–11/785, VAX 8600, and VAX 8650 systems. This is required for power-fail/recovery.
KE780	G and H floating point microcode for the VAX–11/780 system.
KU780	User-writable control store for the VAX–11/780 system.
RH750	MASSBUS adapter for the VAX–11/750 system.
RH780	MASSBUS controller for the VAX–11/780, VAX–11/785, VAX 8600, and VAX 8650 systems.
SBI	System Backplane Interconnect for the VAX–11/780, VAX–11/785, and I/O BUS for the VAX 8600 and VAX 8650 systems.
VS40X	4-plane graphics coprocessor.
WS01X	VAXstation 3100 SPX Graphics option.

Abbreviations

DLT	Digital Linear Tape
DSSI	DIGITAL Storage Systems Interconnect
EISA	Extended Industry Standard Interconnect
FDDI	Fiber Distributed Data Interface
IEEE	Institute for Electrical and Electronics Engineers
I80277	Intel 82077 PC Compatible Floppy Interface
MSCP	Mass Storage Control Protocol
PCI	Peripheral Component Interconnect
QIC	Quarter Inch Cartridge
SCSI	Small Computer Systems Interface
SDI	Standard Drive Interface
STI	Standard Tape Interface
TMSCP	Tape Mass Storage Control Protocol
XMI	Extended Memory Interconnect
M-BUS	MASSBUS
SCSI-2 FSE	SCSI-2 Fast Single Ended
SCSI-2 FWD	SCSI-2 Fast Wide Differential
RAID	Redundant Array of Independent Disks

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Software Product Description

PRODUCT NAME: OpenVMS Operating System for VAX and Alpha, Version 6.2 SPD 25.01.45

Note: This Software Product Description describes OpenVMS Operating System Software for the Alpha and VAX computer family. Except where explicitly noted the features described in this SPD apply equally to Alpha and VAX systems. OpenVMS Alpha and OpenVMS VAX operating system licenses and part numbers are architecture specific; please refer to the Ordering Information section of this SPD for further details.

DESCRIPTION

OpenVMS is a general-purpose multiuser operating system that runs in both production and development environments. OpenVMS Alpha supports Digital Equipment Corporation's Alpha series computers, while OpenVMS VAX supports VAX, MicroVAX, VAXstation, and VAXserver series computers. OpenVMS software supports industry standards, facilitating application portability and interoperability. OpenVMS provides symmetric multiprocessing (SMP) support for multiprocessing Alpha and VAX systems.

The OpenVMS operating system can be tuned to perform well in a wide variety of applications, including compute-intensive, I/O-intensive, client/server, real-time, and combinations of those and other environments. Actual performance depends on the type of computer, available physical memory, and the number and type of disk and tape drives on the system.

OpenVMS has well-integrated networking, distributed computing and client/server, multiprocessing, and windowing capabilities. OpenVMS contains extensive features that promote ease-of-use, improve the productivity of programmers, and facilitate system management.

OpenVMS is an open software environment that supports key standards such as OSF/Motif, POSIX, XPG4, and the OSF Distributed Computing Environment (DCE). The right to use POSIX for OpenVMS and the DCE Runtime Services for OpenVMS is bundled with the OpenVMS operating system base license. DECwindows Motif is available exclusively as a separate layered product.

OpenVMS Alpha Version 6.2 and OpenVMS VAX V6.2 are functional releases of the OpenVMS operating system for Digital's Alpha and VAX systems respectively. These releases include a number of new features, enhancements and expanded hardware support. Refer to the *OpenVMS Version 6.2 New Features Manual* for details.

OpenVMS Alpha compilers and applications take advantage of 64 bits by using 64-bit data types. Consult the Software Product Descriptions of OpenVMS Alpha compilers for further details. Note that application virtual address space is a 32-bit implementation for compatibility and migration purposes.

User Environment

Users can access OpenVMS software by using the English-like DIGITAL Command Language (DCL), the command language for OpenVMS that is supplied with the system. DCL commands take the form of a command name followed by parameters and qualifiers. DCL commands provide information about the system, initiate system utilities, and initiate user programs. OpenVMS prompts users to enter required DCL parameters, making it easy for novice users.

Users can enter DCL commands at a terminal or include them in command procedures. Command procedures can be run interactively or submitted to a batch queue for deferred execution.

Information on DCL and OpenVMS utilities is available through the online OpenVMS Help system. Online Help includes summary operational information on all aspects of system operation.

A number of tools and utilities are integrated into the OpenVMS operating system. They include:

Text Processing

The Extensible Versatile Editor (EVE), one of several text editors supplied by Digital, is the default editor for OpenVMS. EVE allows users to insert, change, and delete text quickly. Written in the DEC Text Processing Utility language (DECTPU), EVE is a full-screen editor that allows users to scroll through text on a terminal screen. EVE provides an EDT-style keypad, allowing EDT users to move to EVE easily. EDT is also supported on OpenVMS Alpha Version 6.2 and OpenVMS VAX Version 6.2.

Mail Utility

The Mail utility allows users to send messages to any other user on the system. Multinode operation is available if DECnet or DECnet/OSI is installed and licensed on each participating node on the configured network.

Command-Level Programming

Command-level programming allows users to create special files called command procedures that contain a series of DCL commands. When users execute a command procedure, the system consecutively processes the commands in the command procedure. Users can also use special DCL commands to assign symbolic names, evaluate numerical and logical expressions, accept parameters, communicate interactively with the user invoking the command procedure, perform conditional (IF-THEN-ELSE) and branching (GOTO) logic, and handle error conditions.

User Environment Tailoring

Users can customize the computing environment with user login command procedures, shorthand commands, binding of commands to function keys, and command recall and editing.

Terminal Fallback Facility (TFF)

This facility allows Digital 7-bit terminals to input and output the DEC Multinational character set (MCS). Specific tables allow conversion for a number of different 7-bit National Replacement Character sets, such as French, German, Spanish, and Swedish, to MCS. TFF also allows character composition on terminals that do not have the compose key.

National Character Set (NCS) Utility

This utility allows users to define non-ASCII string collating sequences and to define conversion functions. Conversion functions use conversion algorithms to change an input string; for example, to change lowercase characters to uppercase. NCS also allows RMS indexed files to be collated using user-specified collating sequences.

Program Development Environment

OpenVMS includes a comprehensive set of tools for developing programs, including run-time libraries (RTLs), a linker, a librarian, and a symbolic debugger. The assembly-level VAX MACRO language is supplied with OpenVMS VAX. Tools available to the OpenVMS programmer include the following:

Language and Run-Time Library Support

OpenVMS includes several run-time libraries (RTLs) that provide string manipulation, parallel processing support, I/O routines, I/O conversion, terminal-independent screen handling, date and time formatting routines, highly accurate mathematical functions, signaling and condition handling, and other general-purpose functions.

On OpenVMS VAX, these routines can be called from programs written in such languages as VAX MACRO, VAX Ada, VAX BASIC, VAX BLISS-32 Implementation Language, VAX C, DEC C, DEC C++, VAX COBOL, VAX DIBOL, VAX FORTRAN, VAX Pascal, VAX PL/I, and VAX SCAN.

On OpenVMS Alpha, these routines can be called from programs written in such languages as MACRO-64, DEC Ada, DEC BASIC, DEC C, DEC C++, DEC COBOL, DEC Fortran, DEC Pascal, and DEC PL/1.

Also included in OpenVMS Alpha are language-support libraries. While each language is different, all provide support for sequential file I/O and most support direct and indexed file I/O as well. Language RTLs also provide support for I/O formatting, error handling, and in DEC Fortran, the ability to read unformatted files containing data from other vendors.

Run-Time Libraries are provided to support Translated Images created from user mode images built on OpenVMS VAX Version 4.0 through Version 5.5-2. Depending on the method used to create the VAX image, these Run-Time Libraries may be useful for images built on later versions of OpenVMS VAX, which do not use features which were developed since OpenVMS VAX Version 5.5-2.

Translated Images Run-Time Libraries are used to support a few architectural features (such as VAX D-float and H-float), which differ between VAX and Alpha systems, and support programs converted to run on Alpha systems before native Alpha compilers were available for particular programming languages.

Many Digital languages (including those listed previously) adhere to the common calling standard, meaning that routines written in any of these languages can directly call routines written in any other language. Development of applications using multiple languages is simple and straightforward.

All user accessible routines in the Run-Time Libraries follow the OpenVMS Alpha or OpenVMS VAX calling standard and condition-handling conventions, and most are contained within shareable images.

At a lower level, programs can call system services directly for security, event flag, asynchronous system trap, logical name, record and file I/O, process control, timer, time conversion, condition handling, lock management, and memory management services. Again, system services use the OpenVMS VAX or OpenVMS Alpha calling standard and condition-handling conventions.

OpenVMS supports execution of user mode images created on earlier versions of OpenVMS. Recompiling and relinking typically are not required.

Macro-32 Compiler - Alpha

The Macro-32 compiler for OpenVMS Alpha is supplied with OpenVMS Alpha software for migration purposes.

DECthreads

OpenVMS includes a user-mode multithreading capability referred to as DECthreads. DECthreads provides an implementation of draft 4 of the proposed POSIX 1003.4a standard and is Digital's implementation of the Distributed Computing Environment (DCE) Threads as defined by the Open Software Foundation. DECthreads is a library of run-time routines that allows the user to create multiple threads of execution within a single address space. Multithreading capability allows computation activity to be overlapped with I/O activity. Synchronization elements, such as mutexes and condition variables, are provided to help ensure that shared resources are accessed correctly. DECthreads also provides multiple scheduling policies for scheduling and prioritizing threads. DECthreads is supported by the OpenVMS debugger, to aid in the debugging of multithreaded applications.

Librarian Utility

The Librarian utility permits storage of object modules, image files, macros, Help text, or any general record-oriented information in central, easily accessible files. Object module and image file libraries are searched by the linker when the linker finds a reference it cannot resolve in one of its input files. Alpha macro libraries are searched by the Macro-32 compiler and Macro-64 assembler when either finds a macro name that is not defined in the input file. VAX macro libraries are searched by the assembler when the assembler finds a macro that is not defined in the input file.

Debugger

The OpenVMS Debugger allows users to trace program execution as well as display and modify register contents using the same symbols that are present in the source code.

Alpha System-Code Debugger

The OpenVMS Alpha System-Code Debugger is a kernel code debugger. It allows a system code developer to trace the execution of nonpageable system code at any IPL (Interrupt Priority Level). Based on the OpenVMS Alpha Debugger, the system-code debugger uses the same interface and a majority of the same command set.

System Dump Analyzer

In the event of a system failure, OpenVMS will write the contents of memory to a pre-allocated dump file. This dump file can later be analyzed using the System Dump Analyzer (SDA). System dumps can either be full memory dumps, where all memory is written, or selective memory dumps, where only memory in use at the time of the system failure is written. Full memory dumps require a dump file big enough to hold all memory. Selective memory dumps will write as much of the memory in use at the time of the system failure that will fit into the dump file, which can therefore be much smaller in size.

OpenVMS for Alpha supports selective dumps on systems configured with any supported amount of memory. Full dumps are only supported on systems configured with up to 4 GB of memory.

RMS File Utilities

RMS file utilities allow users to analyze the internal structure of an RMS file and to determine the most appropriate set of parameters for an RMS file. These utilities can also be used to create, load, and reclaim space in an RMS file. Refer to the *Operating System Environment* section of this Software Product Description for more information on RMS.

File Differences Utility

This utility compares the contents of two files and lists those records that do not match.

Translated Image Environment - Alpha

OpenVMS Alpha provides an array of services to allow the operation of programs that have undergone binary translation from OpenVMS VAX images. These programs can perform virtually all user-mode functions on OpenVMS Alpha, and can operate in combination with other programs (images) that have been translated from OpenVMS VAX or have been built using native compilers on OpenVMS Alpha. Without requiring special source code, the Translated Image Environment resolves differences between the VAX and Alpha architectures, including floating-point registers, condition codes, exception handling, ASTs, and so forth.

The Translated Image Environment included with OpenVMS Alpha is sufficient to run such images that have been translated elsewhere. The DECmigrate for OpenVMS AXP layered product can be used to translate user mode OpenVMS VAX images. For additional information on the precise characteristics of programs suitable for binary translation, refer to the DECmigrate for OpenVMS AXP Systems Software Product Description (SPD 39.44.xx).

System Management Environment

OpenVMS provides a variety of features to aid the system manager in configuring and maintaining an optimal system. Features available for the system manager include the following:

OpenVMS Management Station V1.0

The new OpenVMS Management Station enables user account management on one or more VMScluster systems from a single Windows-based PC. It provides the ability to perform management tasks across multiple systems, making it possible to easily modify many accounts in a single operation. It provides a comprehensive interface to the user account management features of AUTHORIZE, DISKQUOTA, and some DCL directory maintenance commands, transparently enabling the steps of adding a UAF entry, granting rights identifiers, creating a directory, disk quota, and mail profile. In addition, the Management Station also allows creation of network proxy records and supports storing personal information such as phone number, location, and site-specific identification.

The Management Station supports the account management operations of account creation, modification, and deletion as well as renaming accounts and displaying account attributes.

The following are V1.0 restrictions with regard to managing OpenVMS systems:

- Managing OpenVMS Cluster members as individual nodes is not supported. OpenVMS Cluster systems are treated as indivisible entities; an operation cannot be performed on particular cluster members.
- OpenVMS Clusters with multiple user authorization files (UAFs) are not supported.
- The PCs currently support DECnet Phase IV only. However, due to the built-in backward compatability between DECnet/OSI and DECnet Phase IV this does not impose any restrictions on operations between a PC client and the server, as long as the node addresses are within the Phase IV address space (maximum 63 areas with maximum 1023 nodes per area).

The Management Station is a client/server application based on PATHWORKS ManageWORKS. The PC client requires Microsoft® Windows™ V3.1 (or Microsoft Windows for Workgroups V3.11) and PATHWORKS V5.0A or V5.1 for DOS and Windows client which includes ManageWORKS. The PATHWORKS server is not required. The Management Station server component must be installed on OpenVMS VAX Version 6.1 or higher, or OpenVMS Alpha Version 6.2 or higher. The Management Station software is included under the OpenVMS base license.

InfoServer Tape Backup

With Version 6.1 of the OpenVMS operating system, system managers can now back up and restore the system disk to tapes connected to an InfoServer system.

Batch and Print Queuing System

OpenVMS provides an extensive batch and print capability that allows the creation of queues and the setup of spooled devices in order to process noninteractive workloads in parallel with timesharing or real-time jobs.

The OpenVMS batch and print operations support two types of queues: generic queues and execution queues. A generic queue is an intermediate queue that holds a job until an appropriate execution queue becomes available to initiate the job. An execution queue is a queue through which the job (either print or batch) is actually processed or executed.

The system queues batch jobs for execution. The system manager can regulate the number of queues and the number of streams per queue (that is, the number of batch jobs in the queue that can execute concurrently).

Both generic and execution batch queues can have different attributes, such as the maximum CPU time permitted, working set size, and priority. Facilities are provided for starting and stopping queues and for starting and stopping jobs in a queue. Because multiple execution queues can be associated with a generic queue, OpenVMS VAX enables load balancing across available CPUs in a VMScluster system, increasing overall system throughput.

Print queues, both generic and execution, together with queue management facilities, provide versatile print capabilities, including support of ANSI and PostScript® file printing.

Accounting Utility

For accounting purposes, OpenVMS keeps records of system resource usage. These statistics include processor and memory utilization, I/O counts, print symbiont line counts, image activation counts, and process termination records. The OpenVMS Accounting utility allows various reports to be generated using this data.

Audit Analysis Utility

For security auditing purposes, OpenVMS selectively records critical security-relevant events in the system security audit log file. These records contain the date and time the event occurred, the identity of the associated user process, and information specific to each event type. This information is intended to aid the system manager in maintaining system security and to deter possible intruders. The OpenVMS Audit Analysis utility allows various reports to be generated from this data.

Autoconfigure/AUTOGEN Utilities

OpenVMS provides utilities to automatically configure the available devices into the system tables and to set system operational parameters based on the detected peripheral and memory configuration. There is no need for a traditional "system generation" process when the hardware configuration is expanded or otherwise modified.

The OpenVMS Alpha AUTOGEN command procedure automatically sets a number of system parameters by detecting devices installed in a configuration. A feedback option can be used to generate a report of recommended parameter settings based on previous usage patterns.

Backup Utility

The Backup utility provides full volume and incremental file backup for file-structured, mounted volumes and volume sets. Individual files, selected directory structures, or all files on a volume set can be backed up and restored. Files can be selected by various dates (creation, modification, etc.). Files can be backed up to magnetic tape, magnetic disk, or WORM (Write Once Read Many) optical disk. The Backup utility can be used to restore a save set or list the contents of a save set.

Backup Manager for OpenVMS provides a screen-oriented interface to the Backup utility which assists users in performing routine Backup operations.

Backup Manager is menu-driven and provides:

- Access to Backup's save, restore, and list operations without having to understand Backup command syntax
- The ability to create, modify, recall and delete Backup Manager "templates" describing Backup save operations

Backup Manager will work on all supported OpenVMS configurations with a video terminal. It uses the Screen Management (SMG) RTL routines to provide a window-like user interface. The software does not assume any particular privilege on the part of its user beyond access to the files and devices being operated upon.

Standalone Backup Utility - VAX

Standalone BACKUP provides a mechanicsm for system managers to back up and restore system disks. Standalone BACKUP can also be used during the installation of the OpenVMS VAX operating system.

Analyze Disk Structure Utility

The Analyze Disk Structure utility compares the structure information on a disk volume with the contents of the disk, prints the structure information, and permits changes to that information. It also can be used to repair errors that are detected in the file structure of disks.

Monitor Utility

The Monitor utility permits the system manager to monitor different classes of systemwide performance data, including process activity, I/O activity, memory management activity, vector processing activity (VAX), and two phase commit transaction activity at specified intervals. The data may be displayed as it is gathered or saved in a file for later use.

License Management Facility (LMF)

The License Management Facility (LMF) allows the system manager to enable software licenses and to determine which software products are licensed on an OpenVMS system.

System Management Utility (SYSMAN)

SYSMAN allows the system manager to define a system management environment so that operations performed from the local OpenVMS system can be executed on all other OpenVMS systems in the defined environment. The environment may include OpenVMS Alpha and VAX systems configured in a VMScluster, or multiple systems networked via DECnet or DECnet/OSI.

Operations

OpenVMS enables varying levels of privilege to be assigned to different operators. In addition, system-generated messages can be routed to different terminals based on their interest to the console operators, tape librarians, security administrators, and system managers. Operators can use the OpenVMS Help Message utility to obtain online error messages descriptions.

Security

Digital achieved a C2 security rating for OpenVMS VAX 6.0 and a B1 security rating for SEVMS VAX V6.0 in 1993 and is currently participating in a Ratings Maintenance Phase (RAMP) with the National Computer Security Center (NCSC) to obtain C2 and B1 security ratings for Version 6.1 of OpenVMS and SEVMS, respectively, on both Alpha and VAX platforms. Digital expects to achieve C2 and B1 ratings for OpenVMS VAX V6.1 and SEVMS VAX V6.1 in mid 1995. Digital completed the NCSC Future Change Review Board (FCRB) process, presenting its plans for RAMPing to Version 6.1 of OpenVMS and SEVMS on the Alpha platform. The entire RAMP process should be completed in the Fall of 1995. Digital plans to continue to maintain C2 and B1 ratings on future versions of the OpenVMS and SEVMS operating systems.

The ratings represent NCSC validation of the design of OpenVMS and SEVMS operating systems against DoD 5200.28-STD "Department of Defense Trusted Computer System Evaluation Criteria". To obtain an in-depth, 230-page report on the security of these systems, contact the NCSC at (410)859-4452 and ask for a copy of the "Final Evaluation Report Digital Equipment Corporation OpenVMS VAX and SEVMS VAX Version 6.0," CSC-EPL-93/002, C-Evaluation No.14-94.

For OpenVMS V6.2 security API's for Intrusion detection, Proxy access and Impersonation services have been added on both the Alpha and VAX platform to allow for better security in your Client/Server applications.

OpenVMS provides a rich set of mechanisms to control user access to system-controlled data structures and devices that store information. OpenVMS employs a Reference Monitor concept that enforces the system security policy by mediating all access attempts between subjects, such as user processes, and security-relevant system objects, such as files. OpenVMS also provides a system security audit log file that optionally records the results of all object access attempts. The audit log can also be used to capture information regarding a wide variety of other security-relevant events.

User account information is maintained by the system manager in the system user authorization file (SYSUAF). When creating user accounts with the Authorize utility, the system manager assigns the privileges and quotas associated with each user account. The system manager also assigns a user name, password, and unique user identification code (UIC) to each account. Optionally, additional identifiers can be assigned to each account, permitting users to belong to multiple overlapping groups or projects. Account use may be limited by time of day, day of week, and type of access (such as local, remote, network, or batch).

To log in and gain access to the system, the user must supply a valid user name and password. The password is encoded and does not appear on terminal displays. Users can change their password voluntarily, or the system manager can selectively enforce how frequently passwords change, along with minimum password length, or optional use of randomly generated passwords.

Additionally, OpenVMS provides a password dictionary filter that screens password choices for common words, and a user password history filter that prevents users from reusing passwords that they have used within the last year. In addition to these built-in filters, a site can design and install its own filter to screen passwords against a site-specific password policy.

The system password hash algorithm can also be replaced with a private algorithm for those sites that have contractual obligations to use specific public or private password encryption algorithms. This feature can be enabled on a per-user, per-password basis.

Login security includes break-in detection, which allows terminals to be disabled when password guessing is detected, and a secure login path, which can be used to thwart Trojan horse attacks against local terminals. Additionally, a system password may be associated with dial-in terminal lines to prevent the display of any operating system specific identification that might yield clues to possible attack methodologies. When a user logs in, the system also displays a message stating when the last login for the account occurred and the number of failed attempts to log in since the last successful login.

Every security-relevant system object is labeled with the UIC of its owner (normally the user who created the object) along with a simple protection mask. The owner UIC consists of two fields, the user field and a group field. System objects also have associated with them a protection mask that allows read, write, execute, and delete access to be selectively granted to the object's owner, group, privileged system users, to all other users. In addition, system objects can be protected with access control lists to allow access to be selectively granted or denied to a list of individual users, groups, or identifiers. Access control lists can also be used to audit access attempts to critical system objects.

OpenVMS applies full protection to the following system objects:

- Capabilities (VAX only)
- Common Event Flag Clusters
- Devices
- Files
- Group Global Sections
- Logical Name Tables

- Batch/Print Queues
- Resource Domains
- Security Classes
- System Global Sections
- Volumes (ODS-2)

In addition to the protection mechanisms previously described, OpenVMS provides a security attribute defaulting mechanism, in the form of security template profiles. These template profiles are referenced whenever a new object is created and provide a means of associating default security information with each system object class except files. Protection information for files is inherited from the previous version of an existing file, the parent directory, or the creating process' default protection.

Data scavenge protection can be enabled selectively in the form of file high-water marking and erase on delete attributes. These attributes ensure that file contents cannot be read after a file has been deleted. The system manager can also enforce file erasure on a per-volume basis. The disk erasure pattern can also be replaced with a private pattern for those sites that have contractual obligations to use a specific pattern.

Security auditing is provided to allow for the selective recording of security related events. This auditing information can be separately directed to security operator terminals (alarms) or to the system security audit log file (audits). Each audit record contains the date and time of the event, the identity of the associated user process, and additional information specific to each event.

OpenVMS provides security auditing for the following events:

- Login and logout
- Login failures and break-in attempts
- Object creation, access, deaccess, and deletion, selectable by use of privilege, type of access, and on individual objects (ACL)
- Authorization database changes
- Network logical link connections and terminations for DECnet–VAX, DECnet/OSI, DECwindows, IPC, and SYSMAN (VAX only)
- Use of identifiers as privileges
- Installed image additions, deletions, and replacements
- Volume mounts and dismounts
- Use of the Network Control Program utility (VAX only)
- Use or failed use of individual privileges
- Use of individual process control system services
- System parameter changes
- System time changes and recalibrations

Note: No system can provide complete security and Digital cannot guarantee system security. However, Digital continually strives to enhance the security capabilities of its products. Customers are strongly advised to follow industry recognized security practices.

Operating System Environment

Processes and Scheduling

The basic unit of execution in OpenVMS is the process. A process consists of individual address space and registers known as "context," and code called an "executable image." The context identifies the process and describes its current state. Executable images consist of system programs and user programs that have been compiled and linked.

The maximum number of concurrent processes is 8192 per OpenVMS Alpha or OpenVMS VAX system.

Processes receive processor time to execute their images based on the priority of the process. Thirty-Two priorities are recognized on OpenVMS VAX and sixty-four priorities are recognized on OpenVMS Alpha: priorities 0 to 15 are for time-sharing processes and applications that are not time critical (four is the typical default for timesharing processes), and priorities 16 to 32 on VAX and 16 to 63 on Alpha are for real-time processes.

Each time an event such as an I/O interrupt occurs, the system first services the event and then passes control to the highest priority process ready to execute. The system automatically adjusts the priorities of processes whose base priority is in the range of 0 to 15 to favor I/O-bound and interactive processes, but the system will not adjust the priority of a process in the range of 16 to 31 for VAX or 16 to 63 for Alpha.

Real-time processes can be assigned higher priorities to ensure that they receive processor time whenever they are ready to execute. Real-time processes are scheduled preemptively; that is, if a real-time process is ready to execute, it is given the processor immediately, unless a real-time process with a higher priority is ready to execute.

OpenVMS uses paging and swapping mechanisms to provide sufficient virtual memory for multiple concurrently executing processes. Also, paging and swapping is provided for processes whose memory requirements exceed available physical memory. The maximum working set size is 512 MB of memory for Alpha and VAX.

Programmers can exercise control over memory management from within an image. An image executing in a real-time process, for example, can inhibit paging or swapping of critical code and data.

Peripheral devices can be managed by the system or allocated by individual processes. At least one disk must be a system disk. Other disks can be designated as data disks for the general use of all users logging in to the system or for a specific group of users. The system controls interactive terminals and one or more printers.

Extended Physical Addressing - VAX

With OpenVMS VAX Version 6.0, physical address space was extended from 30 bits to 32 bits. The OpenVMS VAX operating system can provide 3.5 GB of physical memory, and .5 GB of I/O and adapter space. This capability enables large applications and workloads to access the huge amounts of physical memory that they require. The following table lists the VAX processors that support this extended physical addressing:

System	Accessible Physical Memory	I/O and Adapter Space
VAX 6000 model 600	1.25 GB	.5 GB
VAX 7000 series	3.5 GB	.5 GB
VAX 10000 series	3.5 GB	.5 GB

Vector Processing - VAX

A single data item, having one value, is known as a scalar value. A group of related scalar values, or elements, all of the same data type, is known as a vector.

An extension to the VAX architecture defines an optional design for integrated vector processing that has been adopted by several VAX systems. The VAX vector architecture includes sixteen 64-bit vector registers (V0 through V15), each containing 64 elements; vector control registers; vector function units; and a set of vector instructions. VAX vector instructions transfer data between the vector registers and memory, perform integer and floating-point arithmetic, and execute processor control functions.

A more detailed description of the VAX vector architecture, vector registers, and vector instructions appears in the *VAX MACRO and Instruction Set Reference Manual*.

The OpenVMS VAX operating system provides fully shared, multiprogramming support for VAX vector processing systems. By default, OpenVMS VAX loads vector support code when initializing vector-present systems, but does not load it when initializing vector-absent systems. A system manager can control this behavior by using the system parameter VECTOR_PROC, as described in the OpenVMS VAX documentation.

The presence of vector support code in a system has little effect on processes running in a scalar-only system, or scalar processes running in a vector-present system. If many processes must compete simultaneously for vector processor resources in a system, the system manager can maintain good performance by adjusting system resources and process quotas as indicated in the OpenVMS VAX documentation.

The OpenVMS VAX operating system makes the services of the vector processor available to system users by means of a software abstract known as a capability. A system manager can restrict the use of the vector processor to users holding a particular identifier by associating an access control list (ACL) entry with the CAPABILITY object VECTOR.

The VAX Vector Instruction Emulation Facility (VVIEF) is a standard feature of the OpenVMS VAX operating system that allows vectorized applications to be written and debugged in a VAX system in which vector processors are not available. VVIEF emulates the VAX vector processing environment, including the nonprivileged VAX vector instructions and the OpenVMS VAX vector system services, as described by the OpenVMS VAX documentation. Use of VVIEF is restricted to user mode code.

DECdtm Services

The DECdtm services embedded in the OpenVMS operating system support fully distributed databases using a "two-phase commit" protocol. The DECdtm services provide the technology and features for distributed processing, ensuring both transaction and database integrity across multiple Digital resource managers. Updates to distributed databases occur as a single "all or nothing" unit of work, regardless of where the data physically resides. This ensures consistency of distributed data.

DECdtm services allow applications to define "global transactions" that may include calls to any of a number of Digital data management products. Regardless of the mix of data management products used, the global transaction will either commit or abort. OpenVMS is unique in providing transaction processing functionality as base operating system services.

DECdtm features include:

- Embedded OpenVMS system services support the DECtp architecture, providing features and the technology for distributed transaction processing.
- Allows multiple disjoint resources to be updated atomically. These resources can be either physically disjointed (for example, on different CPUs) or logically disjointed (for example, in different databases on the same CPU).

- Encourages robust application development. Applications can be written to ensure that data is never in an inconsistent state, even in the event of system failures.
- Can be called using any Digital TP monitor or database product. This is useful for applications using several Digital database products.

Interprocess Communication

OpenVMS provides a number of facilities for applications that consist of multiple cooperating processes.

- Mailboxes are virtual devices that allow processes to communicate with queued messages.
- Shared memory sections on a single processor or a symmetrical multiprocessing (SMP) system permit multiple processes to access shared address space concurrently.
- Common event flags provide simple synchronization.
- The lock manager provides a more comprehensive enqueue/dequeue facility with multilevel locks, values, and ASTs (asynchronous system traps).

Symmetric Multiprocessing

OpenVMS provides symmetric multiprocessing (SMP) support for Alpha and VAX multiprocessor systems. SMP is a form of tightly coupled multiprocessing in which all processors perform operations simultaneously. The processors can perform operations in all OpenVMS access modes (user, supervisor, executive, and kernel).

OpenVMS SMP configurations consist of multiple central processing units executing code from a single shared memory address space. Users and processes share a single copy of OpenVMS Alpha or OpenVMS VAX. SMP also provides simultaneous shared access to common data in global sections to all processors. OpenVMS SMP dynamically selects the CPU where a process will run based on process priority.

SMP support is an integral part of OpenVMS and is provided transparently to the user. Because an SMP system is a single system entity, it is configured into a network and VMScluster configurations as a single node.

Networking Facilities

OpenVMS provides device drivers for all Digital LAN adapters listed in the *LAN Options* section of *Appendix A* of this SPD. Application programmers can use the QIO system service to communicate with other systems connected via the LAN using either Ethernet or IEEE 802.3 packet format. Simultaneous use of Digital Ethernet and IEEE 802.3 protocols are supported on any Digital LAN adapter.

DECnet/OSI offers task-to-task communications, file management, downline system and task loading, network command terminals, and network resource sharing capabilities as defined in the Digital Network Architecture (DNA) Phase V protocols. DECnet/OSI provides the newest DECnet features such as Extended Addressing, and downline load performance enhancements. DECnet/OSI integrates DECnet and OSI protocols and now provides a linkage to TCP/IP using RFC 1006 and RFC 1006+. DECnet and OSI applications can now be run over DECnet (NSP), OSI (CLNS), and /or TCP/IP transports.

DECnet for OpenVMS Alpha and DECnet–VAX offer the networking capabilities as defined in the Digital Network Architecture (DNA) Phase IV. For more information, refer to the *DECnet Software* description in the *ASSOCIATED PRODUCTS* section of this SPD.

Terminal Server Products

Digital's terminal server products can be used for terminal server access to OpenVMS. When used in a VMScluster system environment, terminal servers automatically distribute users at login time across the available Alpha and VAX systems.

OpenVMS can also establish a connection to other devices (such as printers) attached to such terminal servers.

Reliability

The system handles hardware errors as transparently as possible while maintaining data integrity and providing sufficient information to diagnose the cause of the error. The system limits the effects of an error by first determining if the error is fatal. If the error occurs in system context, then the current OpenVMS system is shut down. If the error is not fatal, then recovery actions pertinent to the error are executed and the current operation is continued.

In all cases, information relevant to the error is collected and put in the error log file for later analysis. Hardware errors include the following categories:

- Processor errors. These include processor soft errors, processor hard errors, processor machine checks, and adapter errors.
- Memory errors. These can be unrecoverable (hard) errors or recoverable (soft) errors. The system examines memory at startup time and does not use any pages found to be bad. During system operation, the system transparently corrects all single-bit memory errors for those systems with Error Correction Code (ECC) memory. On OpenVMS VAX, an unrecoverable error causes the memory page on which the error occurred to be added to the bad page list. If

the page has not been modified, system operation continues with a new copy of the page.

- Correctable memory errors. A primary cause of these correctable memory errors is Alpha particle radiation. On some processors, when correctable memory errors occur, the memory controller corrects only the data returned to the CPU or I/O controller. The actual data in memory is left with the error intact. Subsequent read operations will cause correction cycles to occur and in most cases an interrupt to report the error. On many of these processors, OpenVMS monitors the occurrence of correctable memory errors and in almost all cases is able to remove the error condition by rewriting the data in memory. Rewriting the data causes the data to be corrected in the memory location. On OpenVMS VAX, if the cause of the error is not transient, and the error condition persists, the operating system will attempt to move the data from the existing page which contains the error to a new page. The original page is then retired from use.

Other failures include:

- Operating system errors (system-detected inconsistencies or architectural errors in system context)
- User errors
- I/O errors

The system logs all processor errors, all operating system errors detected through internal consistency checks, all double-bit memory errors (and a summary of corrected single-bit memory errors), and most I/O errors.

If the system is shut down because of an unrecoverable hardware or software error, a dump of physical memory is written. The dump includes the contents of the processor registers. The OpenVMS System Dump Analyzer utility is provided for analyzing memory dumps.

Power Failures - VAX

If power fails, the system shuts down automatically. When power is restored, the system restarts automatically and resumes processing at the point of interruption if the system has a time-of-day clock and a memory battery backup unit, if the contents of memory are still valid, and if the system is set to permit automatic rebooting.

The system restarts devices and communications lines. All I/O operations in progress, including magnetic tape I/O operations, are restarted. On request, programs can be notified of power restoration. An optional battery-operated hardware clock resets the date and time of day when the system restarts. If the system does not have a battery backup unit, or if the memory contents are not valid on power restoration, the system will reboot automatically if the system is set to permit automatic rebooting.

If, for any reason, after a power failure the system disk does not come back on line within a specific time after the CPU regains power, the system shuts down.

Input/Output

The QIO system service provides a direct interface to the operating system's I/O routines. These services are available from within most OpenVMS programming languages and can be used to perform low-level I/O operations efficiently with a minimal amount of system overhead for time-critical applications.

Device drivers execute I/O instructions to transfer data to and from a device and to communicate directly with an I/O device. Each type of I/O device requires its own driver. Digital supplies drivers for all devices supported by the OpenVMS operating system and provides QIO system service routines to access the special device-dependent features available in many of these devices.

OpenVMS supports a variety of disk and tape peripheral devices, as well as terminals, networks, and mailboxes (virtual devices for interprocess communication), and more general I/O devices.

On OpenVMS Alpha, users can write device drivers for I/O devices for which the operating system does not provide drivers. OpenVMS Alpha Version 6.2 supports the Step 2 device driver interface, which allows device drivers to be written in DEC C and MACRO-32. OpenVMS Alpha documentation is available that describes how to write OpenVMS Alpha device drivers and how to convert existing OpenVMS VAX and OpenVMS Alpha Step 1 device drivers to OpenVMS Alpha Step 2 device drivers. The DEC C compiler for OpenVMS Alpha is an optional orderable layered product.

On OpenVMS VAX, users can write their own device drivers in MACRO-32 for I/O devices for which the operating system does not provide drivers. The *OpenVMS VAX Device Support Manual* and the *OpenVMS VAX Device Support Reference Manual* in the OpenVMS Full Documentation Set describe how to write device drivers.

Record Management Services (RMS)

Record Management Services (RMS) is a set of I/O services that helps application programs to process and manage files and records. Although it is primarily intended to provide a comprehensive software interface to mass storage devices, RMS also supports device-independent access to unit-record devices.

RMS supports sequential, relative, and indexed file organizations in fixed-length and variable-length record formats. RMS also supports byte stream formats for sequential file organization.

RMS record access modes provide access to records in four ways: sequentially, directly by key value, directly by relative record number, and directly by record file address. RMS also supports block I/O operations for various performance-critical applications that may require user-defined file organizations and record formats.

RMS promotes safe and efficient file sharing by providing multiple file access modes, automatic record locking where applicable, and optional buffer sharing by multiple processes.

RMS utilities aid file creation and record maintenance. These utilities convert files from one organization and format to another, restructure indexed files for storage and access efficiency, and reclaim data structures within indexed files. The utilities also generate appropriate reports.

For systems that have DECnet–VAX, DECnet for OpenVMS Alpha or DECnet/OSI installed, RMS provides a subset of file and record management services to remote network nodes. Network remote file operations are generally transparent to user programs.

DCL commands such as EDIT, CREATE, COPY, TYPE, and PRINT allow manipulation of RMS files and records within RMS files at the DCL command level.

Virtual I/O Cache

OpenVMS provides a standalone or clusterwide, file-oriented disk cache. Applications automatically benefit from the advantages of the virtual I/O cache without any special coding. The virtual I/O cache file-caching algorithm is dynamically chosen based on the type of clusterwide access currently in progress. Virtual I/O caching reduces current and potential I/O bottlenecks within OpenVMS systems. It reduces the number of I/Os to the disk subsystem, thereby reducing a systemwide bottleneck.

Disk and Tape Volumes

Disk volumes can be organized into volume sets. Volume sets can contain a mix of disk device types and can be extended by adding volumes. Within a volume set, files of any organization type can span multiple volumes. Files can be allocated to the set as a whole (the default) or to specific volumes within the set. Optionally, portions of indexed files can be allocated to specific areas of a single disk volume or to specific volumes in a volume set.

Disk quotas can be placed to control the amount of space individual users can allocate. Quota assignment is made by user identification code and can be controlled for each individual volume set in the system (or for each individual volume if the volume is not part of a set).

Disk structure information can be cached in memory to reduce the I/O overhead required for file management services. Although not required to do so, users can preallocate space and control automatic allocation. For example, a file can be extended by a given number of blocks, contiguously or noncontiguously, for optimal file system performance in specific cases.

The system applies software validity checks and checksums to critical disk structure information. If a disk is improperly dismounted because of user error or system failure, the system automatically rebuilds the disk's structure information the next time the disk is mounted. The system detects bad blocks dynamically and prevents their reuse once the files to which the blocks were allocated are deleted. On DIGITAL Storage Architecture (DSA) disks, the disk controller dynamically detects and replaces bad blocks automatically.

The system provides eight levels of named directories and subdirectories whose contents are alphabetically ordered. Device and file specifications follow Digital conventions. Logical names can be used to abbreviate the specifications and to make application programs device and file name independent. A logical name can be assigned to an entire specification, to a portion of a specification, or to another logical name.

OpenVMS supports multivolume magnetic tape files with transparent volume switching. Access positioning is done either by file name or by relative file position.

Monitoring Performance History Software (MPH)

Monitoring performance History (MPH) software is distributed with the OpenVMS distribution kit and is installed seperately. MPH is a tool which collects error logs, crash dump summaries and configuration data from the system on which it is installed. This data is transmitted back to Digital and is used to set standard requirements for future releases of OpenVMS, such as Mean Time Between Crash (MTBCr) and Mean Time Between System Interruption (MTBSi). The disk space requirement for MPH installation is approximately 1200 blocks. MPH requires 300 blocks of disk space per node after installation. For more information please refer to the *OpenVMS Version 6.2 Release Notes*.

ASSOCIATED PRODUCTS

OpenVMS Cluster Software

OpenVMS Cluster Software is available for Alpha and VAX systems as a separately licensed System Integrated Product. It provides a highly integrated OpenVMS computing environment distributed over multiple systems. This environment is called a VMScluster system and may contain up to 96 nodes.

VMScluster systems communicate using any combination of the following interconnects; CI, DSSI, FDDI, Ethernet, and SCSI. Additionally, when configured with suitable FDDI bridges, VMScluster configurations may utilize DS3/T3 and ATM networking infrastructures.

Applications running on one or more nodes in a VMScluster system access shared resources in a coordinated manner. VMScluster software components synchronize access to shared resources, preventing multiple processes on any node in the VMScluster from interfering with each other when updating data. This coordination ensures data integrity during multiple concurrent update transactions. Application programs can specify the level of VMScluster file sharing that is required; access is then coordinated by the OpenVMS Extended QIO Processor (XQP) and Record Management Services (RMS).

The OpenVMS queue manager controls VMScluster batch and print queues, which can be accessed by any VMScluster node. Batch jobs submitted to VMScluster queues are routed to any available CPU so that the batch load is shared.

The Lock Manager provides synchronized services between systems in a cluster, for use both by system components such as RMS and XQP, and also for direct use by applications.

Two or more Alpha and VAX computers connected to the same Computer Interconnect (CI), DIGITAL Storage Systems Interconnect (DSSI), or Small Computer Systems Interconnect (SCSI) must be configured as members of the same VMScluster system.

Mixed-architecture and mixed-version clusters containing both Alpha systems and VAX systems are supported.

VMScluster systems provide a uniform computing environment that is highly scalable, highly available, and secure. OpenVMS Cluster Software implements a single security environment within a cluster configuration. The security subsystem ensures that all cluster-visible objects maintain consistent security profiles and that system security auditing controls operate clusterwide.

Refer to the OpenVMS Cluster Software SPD (29.78.xx) for more information.

DECamds

DECamds Version 6.2 is available on the OpenVMS distribution kit. DECamds is a separately installable realtime high performance multisystem monitoring utility. It is supported on any system running OpenVMS Version 6.2. The right to use DECamds is included under the terms and conditions of the OpenVMS Cluster Software products (both Alpha and VAX).

DECamds provides system resource availability monitoring, investigation aid, and correction capability. This enables system managers to proactively and effectively manage multiple systems from a centralized, mouse-driven DECwindows display.

DECamds software comprises an OpenVMS device driver which runs on every node that is being monitored, and console software which runs on the centralized X-Window monitoring station.

Volume Shadowing for OpenVMS

Digital provides the Volume Shadowing for OpenVMS Alpha and VAX products for performing disk mirroring operations, using a RAID 1 storage strategy implementation. In this description, every use of Volume Shadowing for OpenVMS means both the Volume Shadowing for OpenVMS Alpha product and the Volume Shadowing for OpenVMS VAX product.

Volume Shadowing for OpenVMS is a System Integrated Product (SIP) that is separately licensed. Volume Shadowing for OpenVMS provides high data availability for disk devices by ensuring against data loss resulting from media deterioration or controller or device failure. This prevents storage subsystem component failures from interrupting system or application operations.

The system disk and Files–11 On-Disk Structure 2 (ODS2) data disks can be volume shadowed.

The Volume Shadowing for OpenVMS product supports shadowing of all MSCP compliant DSA disks and all Digital SCSI disks. All disks in a single shadow set must have the same number of logical blocks and the same physical geometry. Shadow set members can be located on a single system or anywhere in a VMScluster system. Disks can be configured on any MSCP or Digital SCSI compliant controller.

Volume Shadowing for OpenVMS provides fault tolerance resulting from disk media errors or controller errors across the full range of Alpha and VAX processors and configurations. Shadow set member units can be located on different controllers and OpenVMS Alpha and VAX MSCP servers, providing configuration flexibility and a high degree of data availability.

Volume Shadowing for OpenVMS supports an unlimited number of single member shadow sets and up to 400 disks in multi-member (2 or 3 member) shadow sets on a standalone or VMScluster system.

Phase I of Volume Shadowing (also known as Controller-Based Shadowing) which was available in the past on OpenVMS VAX, is no longer supported.

The binary kit for Volume Shadowing ships with the OpenVMS Alpha and VAX distribution kits. To run the software, customers need to purchase a license and documentation. Refer to the Volume Shadowing for OpenVMS Software Product Description (SPD 47.04.xx) for more information.

DECnet/OSI and DECnet Software

DECnet software is a System Integrated Product (SIP) that is separately licensed from the OpenVMS operating system. Refer to the DECnet for OpenVMS VAX and Alpha SPD (48.48.xx) for further information on supported communications devices and software features.

DECnet/OSI is available as a layered product. The license for DECnet for OpenVMS Alpha and DECnet/VAX will also grant the rights to use DECnet/OSI. Note that only one version of DECnet may be active on a single system at any one time. Refer to the DECnet/OSI for OpenVMS Alpha Software Product Description (SPD 50.45.xx) and the DECnet/OSI for OpenVMS VAX Software Product Description (SPD 25.03.xx) for further information on supported hardware configurations and software features.

DEC TCP/IP Software

Internet networking is available through the DEC TCP/IP Services for OpenVMS layered product. This product provides TCP/IP networking (useful with DECwindows), Network File System (NFS), File Transfer Protocol (FTP), Remote Terminal Services (TELNET), and other features. Refer to the DEC TCP/IP Services for OpenVMS Alpha Software Product Description (SPD 46.46.xx) and DEC TCP/IP Services for OpenVMS VAX Software Product Description (SPD 25.A4.xx) for further information.

RMS Journaling for OpenVMS

Digital provides the RMS Journaling for OpenVMS Alpha and VAX products as separately licensed System Integrated Products (SIPs) that enable a system manager, user, or application to maintain the data integrity of RMS files in the event of a number of failure scenarios. These products protect RMS file data from becoming lost or inconsistent.

RMS Journaling provides the following three types of journaling:

- After-image journaling. Provides the ability to ''redo'' modifications that have been made to a file. This type of journaling allows users to recover files that are inadvertently deleted, lost, or corrupted. RMS Journaling recovers the file by applying the journaled modifications to a backup copy, thereby restoring its final state. No application modifications are necessary in order to use after-image journaling.
- Before-image journaling. Provides the ability to ''undo'' modifications that have been made to a file. This type of journaling provides the ability to return a file to a previous known state. This is useful in the event that a file is updated with erroneous or bad data. No application modifications are necessary in order to use before-image journaling.
- Recovery unit journaling. Provides the ability to maintain transaction integrity. A transaction may be defined as a series of many file updates, on one or more files. In the event of any failure during the transaction, recovery unit journaling will roll back the partially completed transaction to its starting point. This allows complex transactions to be completed as an atomic event—partially completed transactions can be avoided. Recovery unit journaling requires application modification.

The binary kit for RMS Journaling ships with the OpenVMS Alpha and VAX distribution kits. To run the software, customers need to purchase a license and documentation. Refer to the RMS Journaling for OpenVMS Software Product Description (SPD 47.03.xx) for more information.

DECram for OpenVMS

DECram for OpenVMS, a separately orderable layered product, is a disk device driver that lets a system manager create pseudo disks (RAMdisks) that reside in main memory for the purpose of improving I/O performance. Frequently accessed data can be accessed much faster from a DECram device than from a physical disk device. These RAMdisks can be accessed through the file system just as physical disks are accessed, requiring no change to application or system software.

Since main memory is allocated for the DECram device, an amount of extra memory is generally required. The amount of memory dedicated is selectable. The system manager designates the amount of memory dedicated to the DECram device(s) and the files that will be stored on it. The maximum size of a DECram device is 524,280 blocks. Refer to the DECram for OpenVMS Software Product Description (SPD 34.26.xx) for more information.

DECwindows Motif® for OpenVMS

Digital offers a separately orderable layered product called DECwindows Motif for OpenVMS, which provides support for both OSF/Motif®, a standards-based graphical user interface, and the X user interface (XUI) in a single run-time and development environment. By default, DECwindows Motif displays the OSF/Motif user interface. Because both Motif and XUI are based on MIT's X Window System, applications written to either toolkit will run regardless of which environment the user selects. Refer to the DECwindows Motif for OpenVMS

Software Product Description (SPD 42.19.xx) for more information.

The OpenVMS software installation procedure contains an optional step to allow installation of the DECwindows Motif for OpenVMS workstation and font support, which is required to run the DECwindows Motif for OpenVMS layered product. Refer to the *OpenVMS Alpha Version 6.2 Upgrade and Installation Manual* or *OpenVMS VAX Version 6.2 Upgrade and Installation Manual* for details concerning the optional installation of the prerequisite DECwindows Motif for OpenVMS device support.

Enhanced X Window System Display PostScript®

The X Window System Display PostScript system provided with DECwindows Motif extends the native X graphical programming environment for DECwindows users displaying text or images on workstations that support the XDPS extension. The DECwindows Motif for OpenVMS layered product must be installed and licensed in order to use Display PostScript.

The X Window System Display PostScript has two components:

- Display PostScript server extension, which is provided with the display server in the OpenVMS Alpha and OpenVMS VAX operating systems. A workstation is required to use this server.
- Adobe® client libraries, which are used by applications to perform PostScript operations, such as rotating and scaling fonts, generating curves, and displaying PostScript documents. The Adobe client libraries are available in the DECwindows Motif for OpenVMS layered product, as well as on third-party platforms, including IBM®, Sun®, and Silicon Graphics.

X Display PostScript adds the following capabilities to the basic X11 Window System environment:

- All DECwindows fonts can be displayed at any size and rotation angle.
- Display PostScript graphics are specified in a user-defined coordinate system independent of monitor density.
- Color or gray-scale rendition is automatically modified to take advantage of the monitor type through either direct display, color dithering, or half-toning.
- Display PostScript display routines can be downloaded to the server and executed on command.
- Sophisticated graphics primitives, such as precisely controlled Bezier curves, can be displayed.
- Any display can be scaled and rotated arbitrarily.

The Display PostScript system also allows users to view PostScript files with such applications as DECwindows Mail and the CDA Viewer without generating hard copy. (Terms and Conditions for Display PostScript can be found in the DECwindows Motif for OpenVMS Software Product Description (SPD 42.19.xx).

CONFORMANCE TO STANDARDS

OpenVMS is based on the following public, national, and international standards:

POSIX Support

OpenVMS supports a large number of industry standards, facilitating application portability and interoperability. This standards support includes POSIX (Portable Operating System Interface). POSIX defines a set of interface standards for various parts of an operating system. The POSIX standards have been generated by the Institute of Electrical and Electronics Engineers (IEEE) and are supported by organizations such as the International Organization for Standardization (ISO).

The OpenVMS environment with POSIX for OpenVMS and DEC C installed includes standards support for the system application programming interface (POSIX 1003.1), shell and utilities (1003.2), and real-time programming (1003.1b, ex 1003.4 draft).

The OpenVMS environment, in conjunction with POSIX for OpenVMS Version 2.0 and DEC C, has been certified by the National Institute of Standards and Technology (NIST) as conforming to the Federal Information Processing Standard (FIPS 151-2).

XPG4 BASE Profile Branding

The OpenVMS environment, with POSIX for OpenVMS Version 2.0 and DEC C installed, extends the support for POSIX standards to include the X/Open BASE specifications defined in the *X/Open Portability Guide*, Issue 4 (XPG4). The XPG4 BASE specifications extend the system application programming interface and shell and utilities offered in the IEEE POSIX standards. XPG4 also includes standards-based internationalization support.

The OpenVMS environment, with POSIX for OpenVMS Version 2.0 and DEC C installed was awarded the X/Open XPG4 BASE Profile Brand.

Platforms and components that successfully complete the branding process and pass X/Open Verification Test Suite for XPG4 (VSX4) are awarded the X/Open XPG4 BASE Profile Brand. Components must pass a series of more than 11500 tests in VSX4 to earn the X/Open BASE Profile Brand. These tests ensure that the OpenVMS environment with POSIX for OpenVMS

Version 2.0 and DEC C installed supports the essential set of interfaces necessary in an open system.

The inclusion of XPG4 BASE support in the OpenVMS environment gives application developers a broader set of standards-based portability features to incorporate into their applications. Most applications that strictly conform to the POSIX and XPG4 specifications can be developed on an OpenVMS system with POSIX for OpenVMS and the DEC C compiler, and then ported without modification to any other platform that also supports the same POSIX standards and XPG4 specifications.

Distributed Computing Environment (DCE) Support

The Distributed Computing Environment (DCE) for the OpenVMS product family provides a set of the distributed computing features specified by the Open Software Foundation's (OSF) Distributed Computing Environment, as well as tools for application developers. With DCE, the OSF has established a standard set of services and interfaces that facilitate the creation, use, and maintenance of client/server applications. The DCE for OpenVMS serves as the basis for an open computing environment where networks of multivendor systems appear as a single system to the user. Because DCE makes the underlying networks and operating systems transparent, application developers can easily build portable, interoperable client/server applications. Users can locate and share information safely and easily across the entire enterprise. The DCE for OpenVMS supplies system managers with a set of tools to consistently manage the entire distributed computing environment while assuring the integrity of the enterprise.

The DCE for OpenVMS product family currently consists of the following products.

- DCE Runtime Services for OpenVMS, which is required for all systems participating in the DCE cell. The DCE Runtime Services includes DCE client functions as well as DCE administration tools. The DCE Runtime Services provides client/server applications the ability to interoperate over DECnet, TCP/IP, and UDP/IP network protocols.
- DCE Application Developers' Kits for OpenVMS, which is required for developers of distributed applications but is optional for other users. The DCE Application Developers' Kit provides programmers with an Interface Definition Language (IDL), an easy-to-use, ANSI C-based language for writing remote procedure calls.
- DCE Cell Directory Server (CDS), one of which is required for each DCE cell. The DCE CDS is a central repository containing information about the location of resources in the DCE cell. It allows access to resources by a single name, regardless of physical location.
- Digital DCE Security Server, one of which is required for each DCE. The DCE Security Server protects resources from illegal access and provides secure communications within and between DCE cells.

The right-to-use the DCE Runtime Services is bundled with the OpenVMS operating system base license. All other DCE products are available as separate layered products. Refer to the Digital Distributed Computing Environment (DCE) for OpenVMS Software Product Description (SPD 43.05.xx) for more detailed information.

Support for OSF/Motif and X Window System Standards

DECwindows Motif provides support for OSF/Motif, a standards-based graphical user interface, and the X Consortium's X Window System, Version 11, Release 5 (X11R5) server.

Standards Supported by OpenVMS

The OpenVMS operating system is based on the public, national, and international standards listed below. These standards are developed by the American National Standards Institute (ANSI), U.S. Federal Government (responsible for FIPS), Institute of Electrical and Electronics Engineers (IEEE), and the International Organization for Standardization (ISO). The following information may be useful in determining responsiveness to stated conformance requirements as enabled in particular commercial and/or government procurement solicitation documents.

- ANSI X3.4-1986: American Standard Code for Information Interchange
- ANSI X3.22-1973: Recorded Magnetic Tape (800 BPI, NRZI)
- ANSI X3.27-1987: File Structure and Labeling of Magnetic Tapes for Information Interchange
- ANSI X3.39-1986: Recorded Magnetic Tape (1600 BPI, PE)
- ANSI X3.40-1983: Unrecorded Magnetic Tape
- ANSI X3.41-1974: Code Extension Techniques for Use with 7-bit ASCII
- ANSI X3.42-1975: Representation of Numeric Values in Character Strings
- ANSI X3.54-1986: Recorded Magnetic Tape (6250 BPI, GCR)
- ANSI X3.131-1986 (SCSI I): Small Computer System Interface
- ANSI X3.131-1994 (SCSI II): Small Computer System Interface

- ANSI/IEEE 802.2-1985: Logical Link Control
- ANSI/IEEE 802.3-1985: Carrier Sense Multiple Access with Collision Detection
- FIPS 1-2: Code for Information Interchange, Its Representations, Subsets, and Extensions

  Note: 1-2 includes ANSI X3.4-1977(86)/FIPS 15; ANSI X3.32-1973/FIPS 36; ANSI X3.41-1974/FIPS 35; and FIPS 7.
- FIPS 3-1/ANSI X3.22-1973: Recorded Magnetic Tape Information Interchange (800 CPI, NRZI)
- FIPS 16-1/ANSI X3.15-1976: Bit Sequencing of the Code for Information Interchange in Serial-by-Bit Data Transmission

  Note: FED STD 1010 adopts FIPS 16-1.
- FIPS 22-1/ANSI X3.1-1976: Synchronous Signaling Rates Between Data Terminal and Data Communication Equipment

  Note: FED STD 1013 adopts FIPS 22-1.
- FIPS 25/ANSI X3.39-1986: Recorded Magnetic Tape for Information Interchange (1600 CPI, Phase Encoded)
- FIPS 37/ANSI X3.36-1975: Synchronous High-Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment

  Note: FED STD 1001 adopts FIPS 37.
- FIPS 50/ANSI X3.54-1986: Recorded Magnetic Tape for Information Interchange, 6250 CPI (246 CPMM), Group Coded Recording
- FIPS 79/ANSI X3.27-1987: Magnetic Tape Labels and File Structure for Information Interchange
- FIPS 86/ANSI X3.64-1979: Additional Controls for Use with American National Standard Code for Information Interchange
- FIPS 151-2: Portable Operating System Interface (POSIX 1003.1)

  Note: Other FIPS are not applicable.
- POSIX 1003.1, 1990: System application programming interface
- POSIX 1003.1b, Real Time Programming
- POSIX 1003.2, Shell and Utilities

  Note: Information regarding interchangeability of ANSI and FED standards with FIPS is contained in "ADP Telecommunications Standards Index," July 1988, published and maintained by the General Services Administration.
- ISO 646: ISO 7-bit Coded Character Set for Information Exchange
- ISO 1001: File Structure and Labeling of Magnetic Tapes for Information Interchange
- ISO 1863: Information Processing — 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 32 rpmm (800 rpi)
- ISO 1864: Information Processing — Unrecorded 12, 7 mm (0.5 in) wide magnetic tape for information interchange — 35 ftpmm (800 ftpi) NRZI, 126 ftpmm (3 200) ftpi phase encoded and 356 ftmm (9 042 ftpi), NRZI
- ISO 2022: Code Extension Techniques for Use with ISO 646
- ISO 3307: Representations of Time of the Day
- ISO 3788: Information Processing — 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 63 rpmm (1 600 rpt), phase encoded
- ISO 4873: 8-Bit Code for Information Interchange — Structure and Rules for Implementation
- ISO 5652: Recorded Magtape (6250)
- ISO 6429: Control Functions for Coded Character Sets
- ISO 9316: 1989 (SCSI-1) Small Computer System Interface
- ISO 9660: Information Processing — Volume and file structure of CD–ROM for information exchange
- ISO 10288: 1994 (SCSI-2) Small Computer System Interface

INSTALLATION

OpenVMS Alpha is distributed as a binary kit on CD–ROM. Procedures for setting up the system disk from media and for preparing the system for day-to-day operations are provided. The procedures use POLYCENTER Software Installation utility to configure and install the OpenVMS Alpha Version 6.2 operating system. These procedures are described in the *OpenVMS Alpha Version 6.2 Upgrade and Installation Manual* and cover letter.

OpenVMS VAX is distributed as binary kits on CD–ROM and tape. Procedures for setting up the system disk from a kit and for preparing the system for day-to-day operations are easy and straightforward. The procedures are described in the *OpenVMS VAX Version 6.2 Upgrade and Installation Manual*. Computer-specific information is contained in the upgrade and installation supplements for each family of VAX computers.

POLYCENTER Software Installation

The POLYCENTER Software Installation utility is now included in OpenVMS. The POLYCENTER Software Installation utility is distributed with the OpenVMS Version 6.2 distribution kit, and the right to use the POLYCENTER software is bundled with the OpenVMS operating system base license. The POLYCENTER Software Installation utility is a new technology that simplifies the installation and management of OpenVMS products.

For system managers, the POLYCENTER Software Installation utility provides DIGITAL Command Language (DCL) and DECwindows Motif interfaces which can be used to install, configure, reconfigure, and deinstall software products that have been prepared with the POLYCENTER Software Installation utility. In addition, the POLYCENTER software provides a database to track the installation, reconfiguration, and deinstallation of software. For products installed with other installation technologies, the POLYCENTER Software Installation utility provides a mechanism for adding information about them to the POLYCENTER database. The POLYCENTER Software Installation utility also provides the ability to manage dependencies between products during the installation process.

For software providers, the POLYCENTER software simplifies the task of packaging software by providing a simple, declarative language for describing material for the installation kit and defining how it is installed. The POLYCENTER Software Installation utility handles the functions; the developer instructs the utility what to do. This significantly reduces the complexity and time to develop installation procedures. The language allows the developer to easily specify dependencies on other software, manage certain ‘‘objects’’ in the execution environment (such as files and directories), and anticipate and resolve conflict before it occurs. The POLYCENTER software also significantly simplifies the packaging of multiple software products into one logical product.

VMSINSTAL

OpenVMS VAX includes the VMSINSTAL facility to automate operating system software updates, as well as to handle the installation of optional Digital-supplied software products. OpenVMS Alpha includes the VMSINSTAL facility to handle the installation of optional Digital-supplied software products that have not converted to PCSI.

Test Package and Diagnostics

OpenVMS includes a User Environment Test Package (UETP), which verifies that the OpenVMS operating system is properly installed and ready for use on the customer’s systems.

Diagnostics can be run on individual devices during normal system operation. Certain critical components can operate in degraded mode.

OpenVMS Alpha DISK SPACE REQUIREMENTS

Operating System Disk Space Requirements

The disk space requirements for OpenVMS Alpha vary according to which options are installed:

File Category	Space Used	Running Total
Minimum OpenVMS Files	80 MB	80 MB
Other OpenVMS Files	89 MB	169 MB
Paging File (required)	38 MB	207 MB
Swap File (suggested)	3 MB	210 MB
Dump File (optional)	28 MB	238 MB
Decompressed Help Files (optional)	15 MB	253 MB
Full DECwindows Motif V1.2-3 (optional)	65 MB	318 MB
Safeguard for upgrading	50 MB	368 MB

The Minimum OpenVMS Files listed above are for a system configuration where all optional features have been declined during the initial installation. For most applications, this is not a realistic OpenVMS environment.

The Paging, Swap, and Dump file requirements above are the minimum for a system with 32 MB of main memory. Additional memory in most cases will add to the space needed for these files, as will particular needs of your application. With careful system management it is possible to use Paging file space as a temporary dump file.

For a VMScluster system disk, Paging, Swap, and Dump files cannot be shared between nodes so the files must either be duplicated on the system disk or located on some other disk.

DECwindows Motif for OpenVMS Alpha Disk Block Requirements

To support OpenVMS Alpha and the DECwindows Motif for OpenVMS Alpha, a system disk of greater than 380 MB is recommended, however, a subset of DECwindows Motif can be installed. The disk space required for the installation of DECwindows Motif is 64 MB. The permancent amount of space used is 62 MB. An additional 33 MB is needed to install the DECwindow X11 Display Server and associated files. (These DECwindow X11 Display Server and associated files are included in the OpenVMS Alpha Version 6.2 media.) These disk space requirements are in addition the disk space required for the OpenVMS Alpha V6.2 operating system as indicated in the *OpenVMS Alpha DISK SPACE REQUIREMENTS* table.

Installation of the DECwindows Motif Version 1.2-3 layered product gives customers the option of installing any or all of the following components:

- User environment and applications — 34 MB. This section provides support for running DECwindows Motif applications on VAX compute servers.
- Programming support — 7 MB. This section includes support for the DEC C, DEC C++, DEC Fortran, Pascal, and VAX C programming languages. If a subset of languages is installed, the amount of disk space required will be less.
- Example files — approximately 7 MB.
- Translated Image Support — approximately 17 MB.

Layered Product Disk Space Requirements

In addition to the disk space used directly by Digital or third-party layered products (as specified in documentation for those products), there may be additional space used to store information from those products in OpenVMS Help Libraries, Command Tables, Object Libraries and elsewhere. The exact amount of additional disk space required cannot be totally predicted due to the possibility of recovering unused space already existing in those library files. Unusually large modules contributed by layered products can also affect the amount of space required for upgrading to a new version of the OpenVMS Alpha operating system.

OpenVMS VAX DISK SPACE REQUIREMENTS

Disk Space Requirements (Block Cluster Size = 3)

To support the complete OpenVMS VAX operating system environment, a system disk of greater than 100 MB is recommended. When a smaller disk is used, additional tailoring is required prior to installing some OpenVMS VAX options. This does not include the dump file space. Refer to the *OpenVMS VAX Version 6.2 Upgrade and Installation Manual* for information on tailoring.

Operating System Disk Space Requirements

The disk space requirements for OpenVMS VAX vary according to which options are installed:

File Category	Space Used	Running Total
OpenVMS Files	83 MB	83 MB
Paging File (after installation)	6 MB	89 MB
Swap File (suggested)	1.2 MB	90.2 MB
Dump File (optional)	6.2 MB	96.4 MB
Decompressed Help Files (optional)	7 MB	103.4 MB
Safeguard for upgrading	25 MB	128.4 MB
Variable additional space (additional files, INDEXF.SYS, etc.)	3.3 MB	131.7 MB

The above data was created from an installation on a VAXServer 2000 with 6 MB of memory and an RD54 disk.

Additional memory will add to the space required for Page, Swap, and Dump files and the variable additional space will increase with larger memory and disk.

DECwindows Motif for OpenVMS VAX Disk Block Requirements

To support OpenVMS VAX and the DECwindows Motif for OpenVMS VAX layered product, a system disk of greater than 175 MB is recommended. The disk space required for the installation of DECwindows Motif is 39 MB. The permanent amount of space used is 34 MB. An additional 16 MB are needed to install the DECwindows X11 Display Server and associated files. (These DECwindows X11 Display Server and associated files are included in the OpenVMS VAX Version 6.2 media.) These disk space requirements are in addition to the 78 MB required for the other components of the OpenVMS VAX operating system environment. Refer to the *OpenVMS VAX Version 6.2 Upgrade and Installation Manual* for details on tailoring small system disks in order to support the DECwindows Motif environment.

Installation of the DECwindows Motif Version 1.2-3 layered product gives customers the option of installing any or all of the following components:

- User environment and applications — 22 MB. This section provides support for running DECwindows Motif applications on VAX compute servers.
- Programming support — 6 MB. This section includes support for the DEC C, DEC C++, DEC Fortran, Pascal, and VAX C programming languages. If a subset of languages is installed, the amount of disk space required will be less.
- Example files — approximately 6 MB.

Note that the individual sizes add up to more than the total because some components are shared by multiple portions of the environment.

MEMORY SPACE REQUIREMENTS

OpenVMS Alpha Memory Space Requirements

The minimum amount of memory required to install, boot, and log in to an OpenVMS Alpha system is 32 MB. To ensure satisfactory performance for particular applications or numbers of users, additional memory may be required. Refer to specific layered product documentation for memory requirements.

OpenVMS VAX Memory Space Requirements

The minimum amount of memory supported for an OpenVMS VAX environment is dependent upon the specific system(s) being used and the overall type of configuration and application requirements. The minimum amount of memory supported for a standalone VAX system running OpenVMS VAX Version 6.2 is 4 MB. The minimum amount of memory supported for a VAX workstation running OpenVMS VAX Version 6.2 is 12 MB.

The following tables give examples of the minimum amount of memory required for a system user to install, boot, and log in to OpenVMS VAX Version 6.2. Specific requirements will depend upon the type of system being used and what other software is installed. To ensure satisfactory performance of applications, additional memory will be required.

Component	Necessary Memory
OpenVMS VAX Version 6.2	4.0 MB
DECnet–VAX	.5 MB
VAXcluster	1.5 MB
DECwindows Motif with remote execution of applications (X11 Display Server only)	1.5 MB
DECwindows Motif with local execution of applications (Includes X11 Display Server and DECwindows Motif layered product)	5.0 MB

The following example configurations are based on the previous table:

System	Minimum Supported Memory
OpenVMS VAX Version 6.2, DECwindows Motif with applications executing remotely, and DECnet (standalone system)	6 MB
OpenVMS VAX V6.2, DECwindows Motif with applications executing locally, VAXcluster and DECnet	12 MB

Note: These are the minimum memory requirements. More memory will be required for satisfactory performance of the operating system and DECwindows Motif applications. The performance and memory usage of DECwindows Motif systems is particularly sensitive to system configuration and window and application usage. Remote execution of an application requires an additional system that runs the application while the display of the application occurs on the local workstation.

Please refer to specific layered product Software Product Descriptions for their memory requirements.

Please refer to the OpenVMS VAX documentation for more information concerning performance considerations.

DISTRIBUTION AND BACKUP MEDIA

OpenVMS Alpha:

OpenVMS Alpha is available on CD–ROM only. The OpenVMS Alpha Version 6.2 Binary CD–ROM contains the OpenVMS Alpha Version 6.2 save sets and selected documentation in text and Postscript format. The OpenVMS Version 6.2 Online Documentation CD–ROM contains all OpenVMS Documentation in Bookreader format. An InfoServer or local drive is needed for upgrades and system disk backups.

OpenVMS VAX:

OpenVMS VAX is available on CD–ROM, TK50, or Magnetic tape distribution media.

The OpenVMS VAX Version 6.2 Binary CD–ROM contains the OpenVMS VAX Version 6.2 save sets, OpenVMS VAX Version 6.2 standalone BACKUP, and selected OpenVMS documentation in text and PostScript format. The OpenVMS Version 6.2 Online Documentation CD–ROM contains all OpenVMS Documentation in Bookreader format.

The TK50 Streaming Tape contains the OpenVMS VAX Version 6.2 save sets and OpenVMS VAX Version 6.2 standalone BACKUP.

The 9-track 1600 BPI Magnetic tape contains the OpenVMS VAX Version 6.2 save sets.

The OpenVMS VAX operating system is also available as part of the OpenVMS VAX Consolidated Software Distribution (ConDIST) on CD–ROM.

GROWTH CONSIDERATIONS

The minimum hardware and software requirements for any future version of this product may be different from the requirements for the current version.

DOCUMENTATION

For OpenVMS Version 6.2, there will be one Documentation Set for both the Alpha and VAX platforms. Most manuals will be common to both platforms, although there are still some platform-specific manuals.

OpenVMS offers documentation in a variety of formats:

- Online books (viewed using the DECwindows Motif Bookreader)

For Version 6.2, online documentation will be distributed on a separate CD–ROM that will ship with the OpenVMS Binary CD–ROMs. Customers will automatically receive the entire OpenVMS documentation offering in Bookreader format on the Documentation CD–ROM. Viewing online documentation in Bookreader requires that DECwindows Motif be installed on the system and that a valid DECwindows Motif license be registered and loaded.

- Printed books (hardcopy)

OpenVMS hardcopy documentation is made up of two offerings: the OpenVMS Full Documentation Set and the OpenVMS Base Documentation Set. A complete listing of all hardcopy manuals and their part numbers is contained in the *Overview of OpenVMS Documentation*.

Full Documentation Set

The Full Documentation Set is for users who need extensive explanatory information on all major OpenVMS components, complete reference information on system routines and utilities, detailed examples, guidelines for VMScluster systems, programming concepts, a master index, and information on the Help Message utility. This set meets the needs of system managers and of system and application programmers. It includes the Base Documentation Set.

Base Documentation Set

The Base Set includes the most commonly used OpenVMS manuals, addressing the needs of general users and system managers of small standalone systems. Manuals, such as the Release Notes, New Features, and the DCL Dictionary are included in the Base Set.

Each book in these sets is also separately orderable.

- Printable files

In addition to the online and hardcopy manuals, several OpenVMS archived books will be offered as PostScript files on the OpenVMS Documentation CD–ROM. For a complete listing of OpenVMS archived books refer to the *Overview of OpenVMS Documentation*. These books can be ordered separately and on demand through the Software Supply Business (SSB) group.

Printable PostScript and text files will also be offered for the Release Notes, Installation Guides, and SPDs.

You may print the electronic Software documentation accompanying the Software as reasonably necessary to exercise your license to use the Software.

SOURCE LISTINGS

OpenVMS Operating System Source Listings are available on CD–ROM. These discs contain all source listings files and the Alpha specific debug symbol tables that make up the OpenVMS operating system. Digital provides source listings for all key modules of the OpenVMS operating system that are appropriate for end users or application developers. The debug symbol files (DSF) on the OpenVMS Alpha Source Listings CD–ROM contain information used by the OpenVMS Alpha System-Code Debugger. Certain company confidential source listings and debug symbol files, however, are excluded from the CD–ROM.

The orderable CD–ROM kit includes the license required to view these files on a standalone system or a VMScluster system. If users want to make these files available to another system (possibly at a remote site), they will need to purchase another kit.

ORDERING INFORMATION

Alpha Software Licenses

QL-MT1A*-6*	OpenVMS Alpha Operating System Base License
QL-MT1A9-6*	OpenVMS Alpha Operating System Symmetric Multiprocessing (SMP) Base Extension License
QL-MT2A*-**	OpenVMS Alpha Individual User License (No Longer Available)
QL-MT3A*-B*	OpenVMS Alpha Distributed Interactive User License (No Longer Available)
QL-MT3A*-3*	OpenVMS Concurrent Use License

VAX Software Licenses

QL-001A*-**	VAX VMS Operating System License for OpenVMS
QL-005A*-6*	OpenVMS VAX Operating System Base License
QL-005A9-6*	OpenVMS VAX Operating System Symmetric Multiprocessing (SMP) Base Extension License
QL-XULA*-**	OpenVMS VAX Individual User License (No Longer Available)
QL-09SA*-AA	OpenVMS VAX Distributed Interactive User License (No Longer Available)
QL-MT3A*-3*	OpenVMS Concurrent Use License

Alpha and VAX CD–ROM Media and Online Documentation

QA–MT1AA–H8	OpenVMS Alpha software and online documentation CD–ROM
QA–XULAA–H8	OpenVMS VAX software and online documentation CD–ROM
QA–MT3AA–H8	OpenVMS VAX/Alpha software and online documentation CD–ROM

VAX Media and Hardcopy Documentation

QA-09SA*-H*	With Base Documentation Set
QA-001A*-H*	With Full Documentation Set

Digital Alpha Layered Product Media

QA–03XAA–H8	Digital CD–ROM Software Library for OpenVMS Alpha

Digital VAX Operating System and Layered Product Media

QA–VWJ8A–A8	OpenVMS VAX Consolidated Software Distribution on Compact Disc

Hardcopy Documentation Sets

QA–09SAA–GZ	OpenVMS Base Documentation Set
QA–001AA–GZ	OpenVMS Full Documentation Set

Source Listings Kits

QB–MT1AB–E8	OpenVMS Alpha Listings CD–ROM Kit & License
QB–001AB–E8	OpenVMS VAX Listings CD–ROM Kit & License

Software Product Services

QT–MT1A*–**	OpenVMS Alpha Base System Software Support Service
QT–MT2A*–**	OpenVMS Alpha Interactive User Software Support Service
QT–001A*–**	VAX VMS Operating System Software Support Service
QT–005A*–**	OpenVMS VAX Operating System Base Software Support Service
QT–XULA*–**	OpenVMS VAX Interactive User Software Support Service
QT–09SA*–**	OpenVMS VAX Distributed Interactive User Software Support Service

A variety of integrated and à la carte hardware and software product services are available. For additional information, contact your local Digital office or Digital representative.

CD–ROM
Media and Online Documentation Update Service

QT–MT1AA–E8	OpenVMS Alpha software and online documentation CD–ROM
QT–XULAA–E8	OpenVMS VAX software and online documentation CD–ROM
QT–MT3AA–E8	OpenVMS VAX/Alpha software and online documentation CD–ROM

Digital Alpha Layered Product Media Update Service

QT–03XAA–C8	Digital CD–ROM Software Library for OpenVMS Alpha

Digital VAX Operating System and Layered Product Update Service

QT–VWJ8A–C8	OpenVMS VAX Consolidated Software Distribution on CD–ROM

Hardcopy Documentation Only Update Service

QT–MT1AB–KZ	OpenVMS Alpha Base Documentation Set
QT–MT1AH–KZ	OpenVMS Alpha Full Documentation Set

OpenVMS VAX Media and Hardcopy Documentation Update Service

QT–09SA*–E*	With Base Documentation Set
QT–001A*–E*	With Full Documentation Set

OpenVMS Source Listings Service

QT–MT1AB–Q8	OpenVMS Alpha Source Listings Service
QT–001AB–Q8	OpenVMS VAX Source Listings Service

* Denotes variant fields. For additional information on available licenses, services, and media, refer to the appropriate Digital price book.

SOFTWARE LICENSING

The OpenVMS operating system software is furnished under the licensing provisions of Digital Equipment Corporation's Standard Terms and Conditions.

The OpenVMS Alpha operating system license includes the license for DECprint Supervisor for OpenVMS, Base. The DECprint Supervisor (DCPS) for OpenVMS has separate documentation, media kit, and service products. Refer to the DECprint Supervisor for OpenVMS Software Product Description (SPD 44.15.xx) for more information.

The right-to-use POSIX for OpenVMS is included with the OpenVMS base operating system license. Refer to the POSIX for OpenVMS Software Product Description (SPD 38.82.xx) for more information.

The right-to-use the DCE Runtime Services is included with the OpenVMS base operating system license. Refer to the Digital Distributed Computing Environment (DCE) SPD 43.05.xx for more detailed information on the DCE for OpenVMS product family.

The System Integrated Products DECnet for OpenVMS Alpha and DECnet–VAX are separately licensed products. Refer to the DECnet for OpenVMS VAX and Alpha Software Product Description (SPD 48.48.xx) for more information.

The System Integrated Products (SIPs), OpenVMS Cluster Software (29.78.xx), Volume Shadowing for OpenVMS (SPD 47.04.xx), and RMS Journaling for OpenVMS (SPD 47.03.xx) are separately licensed products. Refer to the appropriate Software Product Description for more information.

DECwindows Motif for OpenVMS is a separately licensed layered product. Refer to the DECwindows Motif for OpenVMS Software Product Description (SPD 42.19.xx) for more information.

DECram for OpenVMS is a separately licensed layered product. Refer to the DECram for OpenVMS Software Product Description (SPD 34.26.xx) for more information.

DECmigrate for OpenVMS AXP Systems is a separately licensed layered product. Refer to the DECmigrate for OpenVMS AXP Systems Software Product Description (SPD 39.44.xx) for more information.

Software License Information - VAX

The OpenVMS VAX operating system uses one of two different categories of licenses depending on the hardware and software configurations used and currently supported. This information is also provided in the applicable country's Price List.

These are the two categories of operating system licenses for OpenVMS VAX:

1. VAX VMS Licensing
2. OpenVMS VAX Licensing

Digital provides the proper license type with the purchase of the system. Not all license types are available for every system model.

VAX VMS License Information

The VAX VMS licenses include the rights for the DEC Rdb Run-Time Option for OpenVMS VAX. This allows the running of an application developed using DEC Rdb for OpenVMS VAX software. However, DEC Rdb for OpenVMS VAX has separate media and documentation. In addition, should a user want to perform Rdb development, a separate license must be purchased. Refer to SPD 25.59.xx for further information.

Effective February 6, 1995, the VAX VMS (UPI001) licenses no longer include the rights for the Digital RDB Run-Time option for OpenVMS VAX, and do not permit use of RDB Runtime on prior versions of OpenVMS VAX.

Each of the following license are for a specified hardware system, which is either the system the license was originally shipped with or the system on which the license was first used:

- Operating System Base License (QL-001**-**)
- Operating System User License for OpenVMS VAX (QL-001**-**)
- Traditional License for OpenVMS VAX (QL-001**-**)

There are four types of VAX VMS licenses:

1. Traditional License (QL-001A*-**)

This type of license provides unlimited use to the users on a defined system. VAX VMS traditional licenses are sized to capacity according to system type.

2. Multi-User License (QL-001A*-**)

This type of license provides use according to a specified number of concurrent users. This is an activity-based license. The Multi-user License provides the customer with the right to use the operating system up to the limit of users specified in the license. An operating system "user" is a person who is logged in to the system and/or is using the system interactively. This license is only available on limited system models, primarily MicroVAX and VAX 4000 systems.

Interactive use of VAX systems licensed with the Multi-user License may be increased by the addition of OpenVMS User Licenses* (for one or more users). Refer to the section on *Ordering Information* for further information.

3. VAX VMS Workstation License (QL-001A*-**)

This type of license provides use for a single user on a VAX Workstation. This license type allows one direct login for the single user and then one additional login for system management purposes only.

Additional interactive use of VAX Workstations licensed with the VAX VMS Workstation License requires the addition of an OpenVMS User License* (for one or more users). Refer to the section on *Ordering Information* for further information.

4. File and Application Server License (QL-001A*-**)

This type of license provides for the noninteractive use of OpenVMS.

OpenVMS based VAXservers are sold with a File and Application Server License. The intent of an OpenVMS based VAXserver is to provide file, print, application, and compute ‘‘services’’ to ‘‘clients’’ who have remotely submitted their requests (for example via network/remote submit/batch jobs, and so forth). This license type also allows one direct login for system management purposes only.

Additional interactive use of OpenVMS VAXservers licensed with the File and Application Server License requires the addition of an OpenVMS User License* (for one or more users). Refer to the section on *Ordering Information* for further information.

The Operating System Base License provides the right to use only the OpenVMS Alpha features of the current version license.

Not all VAX VMS license types are available for all versions of VMS, OpenVMS or all VAX models.

* The OpenVMS VAX Individual Use licenses are not supported by the VMS or OpenVMS VAX operating system releases prior to Version 5.5.

OpenVMS VAX License Information

There are four types of OpenVMS VAX licenses:

1. OpenVMS VAX O/S Base License (QL-005A*-**)

LMF Product Name: BASE-VMS-250136

OpenVMS VAX O/S Base License grants the right to unrestricted, noninteractive use of the OpenVMS VAX operating system for the execution of remotely submitted requests for batch, print, application, and computing services, on a designated, single processor. This license authorizes one direct login for system management purposes only.

The OpenVMS VAX Base License does not include the license right for the DEC Rdb Run-Time Option for OpenVMS VAX. The DEC Rdb for OpenVMS VAX Run-Time License is available separately.

The Operating System Base License is a prerequisite for all Interactive User Licenses and all SMP Base Extension Licenses.

Interactive use of systems licensed with an OpenVMS VAX O/S Base License requires the addition of an OpenVMS User License (for one or more users). Refer to the section on *Ordering Information* for further information.

The Operating System Base License provides the right to use only the OpenVMS Alpha features of the current version license.

The OpenVMS VAX O/S Base License also includes the license for DECprint Supervisor for OpenVMS VAX. The DECprint Supervisor for OpenVMS VAX has separate documentation, media kits, and service products. Refer to SPD 44.15.xx for further details.

2. Symmetric Multiprocessing (SMP) Base Extension License (QL-005A9-6*)

LMF Product Name: BASE-VMS-250136

SMP Base Extensions extend the O/S Base License to enable symmetric multiprocessing capability on a select number of OpenVMS VAX systems supporting SMP. SMP Base Extensions are permanently tied to the O /S Base License and may not be separated from the O/S Base License if an SMP board is removed from the system.

SMP Extensions grant the right to use the same version of the operating system software as permitted for the corresponding O/S Base License at the time when the SMP Extension is granted.

3. OpenVMS VAX Individual User License (QL-XULA*-**)

LMF Product Name: VMS-USER

The OpenVMS VAX Individual User License provides the right to interactively use the operating system by the specified or unlimited number of concurrent users on a designated, single processor. A user is an individual who is logged in to a processor and/or is interactively using the operating system software by means other than a login. An OpenVMS VAX O/S Base License or one of the four types of VAX VMS Licenses (QL-001A*-**) is a prerequisite for the OpenVMS User License.

The Operating System Base License provides the right to use only the OpenVMS Alpha features of the current version license.

The OpenVMS VAX O/S Base, the SMP Base Extension, and Interactive User licenses are not supported by the VMS or OpenVMS VAX operating system releases prior to OpenVMS VAX Version 5.5.

4. OpenVMS VAX Distributed Interactive User License (QL-09SA*-**)

LMF Product Name: ADL-USER

This license grants the right to interactive use of the OpenVMS VAX operating system, provided the appropriate Operating System Base License or one of the four types of VAX VMS Licenses has been previously installed on a VAX system. The Distributed Interactive User licenses are concurrent use licenses and are available in any quantity desired except unlimited. Distributed Interactive User licenses are mobile (redesignatable) and may be installed and used on a single OpenVMS VAX processor, or shared in a single OpenVMS VAXcluster.

A Distributed Interactive user is defined as an individual who is logged in to OpenVMS VAX processor or OpenVMS VAXcluster and/or is interactively using the operating system software by means other than a login.

5. OpenVMS Concurrent Use License (For both VAX and Alpha)
(QL-MT3A*-3*)

LMF Product Name: OPENVMS-ALPHA-USER-ADL

This license grants the right to interactive use of the OpenVMS operating system, provided the appropriate OpenVMS Operating System Base License is installed on an OpenVMS VAX processor, and/or on an OpenVMS Alpha processor, or on OpenVMS VAX processors if one of the four types of VAX VMS Licenses has been previously installed on a VAX system. The OpenVMS Concurrent Use licenses are available in any quantity desired except unlimited. OpenVMS Concurrent Use licenses are mobile (redesignatable) and may be installed and used on a single OpenVMS VAX or OpenVMS Alpha processor, or shared in a single OpenVMS VAXcluster, a single OpenVMS Alpha Cluster, or shared in a mixed OpenVMS VAX/Alpha Cluster.

A user that enables a Concurrent Use license is defined as an individual who is logged into an OpenVMS VAX processor, or an OpenVMS Alpha processor, or an OpenVMS VAXcluster, or an OpenVMS Alpha Cluster, or a mixed OpenVMS VAX/Alpha Cluster and/or is interactively using the OpenVMS operating system software by means other than a login.

When an OpenVMS VAX SMP System upgrade is performed, the SMP Extension to the OpenVMS AXP Operating System License permits the use of all existing Distributed Interactive User Licenses on the upgraded system.

The Operating System Base License provides the right to use only the OpenVMS Alpha features of the current version license.

The OpenVMS VAX Distributed Interactive Use licenses are not supported by the VMS or OpenVMS VAX operating system releases prior to OpenVMS VAX Version 6.0.

OpenVMS Alpha License Information

There are four types of OpenVMS licenses available on Alpha processors.

1. Operating System Base License (QL-MT1A*-6*)

LMF Product Name: OpenVMS-ALPHA

This license grants the right to noninteractive use of the remote batch, print, application, and computing services of the OpenVMS Alpha operating system on a single processor. This license authorizes one direct login for system management purposes only.

The Operating System Base License is a prerequisite for OpenVMS User Licenses and SMP Base Extension Licenses.

The Operating System Base License provides the right to use only the OpenVMS Alpha features of the current version license.

2. Symmetric Multiprocessing (SMP) Base Extension License (QL-MT1A9-6*)

LMF Product Name: OpenVMS-ALPHA

SMP Base Extensions extend the Operating System Base License to enable symmetric multiprocessing capability on those OpenVMS Alpha systems supporting SMP. SMP Base Extensions are permanently tied to the Operating System Base License and may not be separated from the Operating System Base License if an SMP board is removed from the system.

SMP Extensions grant the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the SMP Extension is granted.

3. Individual User License (QL-MT2A*-**)
(No Longer Offered)

LMF Product Name: OpenVMS-ALPHA-USER

This license grants the right to interactive use of the OpenVMS Alpha operating system, provided the appropriate Operating System Base License has been previously installed on the OpenVMS Alpha system. The Individual User Licenses are available in any quantity desired or as an unlimited user license.

Individual User Licenses are redesignatable and may be installed and used on a single OpenVMS Alpha processor only. They may not be shared in a single OpenVMS Alpha VMScluster environment. An Individual user is defined as an user who is logged in an OpenVMS Alpha processor or is interactively using the operating system software by means other than a login.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the Interactive User License is installed.

4. OpenVMS Alpha Distributed Interactive User License (QL-MT3A*-**)

   (No Longer Offered)

LMF Product Name: OpenVMS-ALPHA-ADL

This license grants the right to interactive use of the OpenVMS Alpha operating system, provided the appropriate Operating System Base License has been previously installed on an Alpha system. The ADL Interactive User Licenses, are concurrent use licenses and are available in any quantity desired except unlimited. ADL Interactive User Licenses are redesignatable and may be installed and used on a single OpenVMS Alpha processor, or shared in a single OpenVMS Alpha VMScluster environment.

A Distributed Interactive user is defined as an individual who is logged in an OpenVMS Alpha processor or OpenVMS Alpha VMScluster or is interactively using the operating system software by means other than a login.

This license grants the right to use the same version of the operating system software as permitted for the corresponding Operating System Base License at the time when the ADL Interactive User License is installed.

5. OpenVMS Concurrent Use License (For both VAX and Alpha) (QL-MT3A*-3*)

LMF Product Name: OPENVMS-ALPHA-USER-ADL

This license grants the right to interactive use of the OpenVMS operating system, provided the appropriate OpenVMS Operating System Base License in installed on an OpenVMS VAX processor, and/or on an OpenVMS Alpha processor, or on OpenVMS VAX processors if one of the four types of VAX VMS Licenses has been previously installed on a VAX system. The OpenVMS Concurrent Use licenses are available in any quantity desired except unlimited. OpenVMS Concurrent Use licenses are mobile (redesignatable) and may be installed and used on a single OpenVMS VAX or OpenVMS Alpha processor, or shared in a single OpenVMS VAXcluster, a single OpenVMS Alpha Cluster, or shared in a mixed OpenVMS VAX/Alpha Cluster.

A user that enables a Concurrent Use license is defined as an individual who is logged into an OpenVMS VAX processor, or an OpenVMS Alpha processor, or an OpenVMS VAXcluster, or an OpenVMS Alpha Cluster, or a mixed OpenVMS VAX/Alpha Cluster and/or is interactively using the OpenVMS operating system software by means other than a login.

When an Alpha SMP System upgrade is performed, the SMP Base Extension to the OpenVMS Alpha Operating System License permits the use of all existing ADL Interactive User Licenses on the upgraded system.

License Management Facility Support

The OpenVMS operating system supports Digital's License Management Facility (LMF).

If an OpenVMS license is not registered and activated using the License Management Facility, then only a single login is permitted for system management purposes through the system console (OPA0:).

Several of the VAX VMS and OpenVMS VAX license types are based on the number of concurrent users, called an activity license. Every product has the option to define an activity as related to the License Management Facility. OpenVMS Interactive User and ADL Interactive User Licenses define the number of concurrent users that are activity licenses as defined by the LMF. OpenVMS defines activities, sometimes referred to as an OpenVMS "user", as follows:

- Each remote terminal connection is considered an activity. This is true even if users set host to their local nodes (SET HOST 0).
- Each connection from a terminal server is considered an activity.
- A multiple-window session on a workstation is considered one activity, regardless of the number of windows.
- A batch job is not considered an activity.
- A remote network connection that is a connection other than a remote terminal connection, is not considered an activity.

For more information about Digital's licensing terms and policies, contact your Digital account representative.

SOFTWARE PRODUCT SERVICES

A variety of service options are available from Digital. For more information, contact your local Digital account representative.

SOFTWARE WARRANTY

Warranty for this software product is provided by Digital with the purchase of a license for the product as defined in the Software Warranty Addendum of this SPD and the applicable Digital Standard Terms and Conditions.

SYSTEMS SUPPORTED BY OpenVMS Alpha and VAX Version 6.2

Alpha Systems Supported

This section of the SPD lists the Alpha systems that are supported by OpenVMS Alpha Version 6.2. Refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide* for details concerning Alpha hardware configurations and options.

Maximum Memory Support

OpenVMS supports the following memory for the systems listed:

Server	Memory
AlphaServer 8200	14 GB
AlphaServer 8400	14 GB
AlphaServer 2100	2 GB
AlphaServer 2000	640 MB
AlphaServer 1000	512 MB
AlphaServer 400	192 MB
AlphaStation 400	192 MB
AlphaStation 250	192 MB
AlphaStation 200	192 MB
DEC 7000 Model 700	14 GB
DEC 4000 Model 700	2 GB
DEC 3000 Model 300	256 MB
DEC 3000 Model 700	512 MB
DEC 3000 Model 900	1 GB
DEC 2000 Model 300	256 MB

On all other AlphaServer and AlphaStation systems, OpenVMS will support the maximum physical memory configured.

EISA Bus Based Systems

- DEC 2000 Models 300/500

TurboChannel Bus Based Systems

- DEC 3000 Models 300/300L/300LX
- DEC 3000 Models 400/400S
- DEC 3000 Models 500/500S/500X
- DEC 3000 Models 600/600S
- DEC 3000 Models 700/700LX
- DEC 3000 Models 800/800S
- DEC 3000 Models 900/900LX

DSSI Bus Based Systems

- DEC 4000 Model 600
- DEC 4000 Model 700

XMI Bus Based Systems

- AlphaServer 8400 5/300
- DEC 7000 Model 600
- DEC 10000 Model 600

PCI Bus Based Systems

- AlphaServer 8200 5/300
- Digital 2100 Server Model A500MP
- Digital 2100 Server Model A600MP
- AlphaServer 2100 4/233
- AlphaServer 2100 5/250
- AlphaServer 2000 4/233
- AlphaServer 1000 4/200
- AlphaServer 400 4/166
- AlphaStation 600 5/266
- AlphaStation 400 4/266
- AlphaStation 250 4/233
- AlphaStation 200 4/233
- AlphaStation 200 4/166
- AlphaStation 200 4/100

The following are the Digital Semiconductor Microprocessor Development Reference Boards supported by OpenVMS Alpha.

- Alpha 21064/21064A PCI Reference Board (EB64+)
- AlphaPC64 Reference Board (APC64)

VAX Systems Supported

This section of the SPD lists the VAX systems that are supported by OpenVMS VAX Version 6.2. Refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide* for details concerning VAX hardware configurations and options.

Q–bus Based Systems

- MicroVAX II
- VAXstation II/GPX[1], VAXstation II/QVSS[2]
- MicroVAX 3200, VAXserver 3200, VAXstation 3200
- MicroVAX 3300, VAXserver 3300
- MicroVAX 3400, VAXserver 3400
- MicroVAX 3500, VAXserver 3500, VAXstation 3500, VAXstation 3520, VAXstation 3540

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[1] Graphics Processing Accelerator (GPX)

[2] Q–bus Video Sub System (QVSS)

- MicroVAX 3600, VAXserver 3600
- MicroVAX 3800, VAXserver 3800
- MicroVAX 3900, VAXserver 3900
- VAX 4000, Models 100, 200, 300, 500, 600
- VAX 4000, Models 50, 100A, 105A, 500A, 505A, 600A, 700A, 705A
- VAXserver 4000, Models 200, 300, 400, 500, 600

NMI Bus Based Systems

- VAX 8530, VAXserver 8530, VAX 8550, VAXserver 8550
- VAX 8700, VAXserver 8700
- VAX 8800, VAX 8810, VAX 8820, VAX 8830, VAX 8840
- VAXserver 8800, VAXserver 8810, VAXserver 8820, VAXserver 8830, VAXserver 8840

XMI Bus Based Systems

- VAX 6000 Series, Models 210, 220, 230, 240
- VAX 6000 Series, Models 310, 320, 330, 340, 360
- VAX 6000 Series, Models 410, 420, 430, 440, 450, 460
- VAX 6000 Series, Models 510, 520, 530, 540, 550, 560
- VAX 6000 Series, Models 610, 620, 630, 640, 650, 660
- VAXserver 6000, Models 210, 220, 310, 320, 410, 420, 510, 520
- VAX 8530, VAX 8550, VAXserver 8530, VAXserver 8550
- VAX 8700, VAXserver 8700
- VAX 8800, VAX 8810, VAX 8820, VAX 8830, VAX 8840
- VAXserver 8800, VAXserver 8810, VAXserver 8820, VAXserver 8830, VAXserver 8840
- VAX 7000, Models 610, 620, 630, 640, 650, 660, 710, 720, 730, 740, 750, 760
- VAX 10000, Models 610, 620, 630, 640, 650, 660

VAXBI Bus Based Systems

- VAX 8200, VAX 8250, VAXserver 8200, VAXserver 8250
- VAX 8300, VAX 8350, VAXserver 8300, VAXserver 8350

SBI Bus Based Systems

- VAX 11/780, VAX 11/785
- VAX 8600, VAX 8650, VAXserver 8600, VAXserver 8650

CMI Bus Based Systems

- VAX 11/750

Special System Specific Internal Bus

- VAX 11/730
- MicroVAX 2000, VAXstation 2000, VAXstation 2000/GPX, VAXstation 2000/MFB[3]
- VAXft 3000, Models 110, 310, 410, 610, 612
- MicroVAX 3100, Models 10, 10E, 20, 20E, 30, 40, 80, 85, 90, 95, 96
- VAXserver 3100, Models 10, 10E, 20, 20E
- VAXstation 3100, Models 30, 38, 40, 48, 76
- VAXstation 3100/GPX, Models 38, 48, 76
- VAXstation 3100/SPX[4], Models 38, 48, 76
- VAXstation 4000, Models 60, 90, 95, 96
- VAXstation 4000-VLC
- VAX 9000, Models 110, 110VP[5], 210, 210VP, 310, 310VP
- VAX 9000, Models 320, 320VP, 330, 330VP, 340, 340VP
- VAX 9000, Models 410, 410VP, 420, 420VP, 430, 430VP
- VAX 9000, Models 440, 440VP

System Restrictions

The following list describes version specific restrictions. The DECwindows Motif environment is not supported on these systems.

MicroVAX I/VAXstation I Systems

The final version of OpenVMS VAX that supports these systems is VMS V5.1-1.

VAX–11/725

VMS V5.1 was the final version to support the VAX–11/725.

VAX–11/730 System

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[3] Monochrome Frame Buffer (MFB)

[4] 2D Scanline Processor Accelerator Graphics System (SPX)

[5] Vector Processor (VP)

The VAX–11/730 system supports additional memory to a maximum of 5 MB for systems configured with R80 /RL02 or dual RL02 disks. Other VAX–11/730 system configurations support a maximum of 3 MB of memory for the VAX–11/730 only. To run OpenVMS VAX Version 6.1, 4 MB of memory is required.

OpenVMS VAX 6.2 is planned to be the final version to support the following systems:
VAX–11/730
VAX–11/750
VAX–11/751
VAX–11/780
VAX–11/782
VAX–11/785
MicroVAX I
VAXstation I

Appendix A

This appendix describes Digital Equipment Corporation terminals, disks, tapes, controllers, graphics, and network options. Some restrictions for specific devices are listed, if applicable.

Digital reserves the right to change the number and type of devices supported by OpenVMS Alpha, OpenVMS VAX, DECnet for OpenVMS Alpha, DECnet–VAX, DECnet/OSI, and OpenVMS Cluster Software. The minimum hardware requirements for future versions and updates of these software products may be different from current hardware requirements. For configuration details about Alpha or VAX hardware, refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide*.

Refer to the following SPDs for detailed product information: DECnet for OpenVMS (SPD 48.48.xx), DECnet/OSI (SPD 50.45.xx, 25.03.xx), and OpenVMS Cluster Software (SPD 29.78.xx).

Terminals and Terminal Line Interfaces

To prevent input from overflowing a buffer, terminals use the ASCII control characters DC1 and DC3 for synchronization as defined by Digital's DEC STD 111, Revision A. VXT windowing terminals support standard ANSI applications and X windows using the LAT transport protocol.

The following table lists the terminals that are supported by OpenVMS Alpha:

VT200 series	VT300 series	VT400 series
VT500 series	VXT2000 series	

The following table lists the terminals that are supported by OpenVMS VAX:

VT52	VT100-series	LA-series
VT300-series	VT1000-series	LQP02
VT200-series	VT500-series	

Terminals on Professional 350, Rainbow 100, and DECmate II systems emulate VT100 terminals.

Only limited support is available for the VT52. The VT131, when running an application, operates in block mode. When interacting with OpenVMS VAX and associated utilities, the VT131 operates only in VT100 (or interactive) mode and not in block mode.

Note: The VT1000 is a monochrome windowing terminal that supports standard ANSI applications and "X" windows. The transport protocols supported are LAT for VMS. The product supports 15-inch and 19-inch monitors.

Disks

The first column lists the disk drive. The second column is a description of the device. The third column lists the bus the device is supported on. The fourth column lists the minimum required version of OpenVMS Alpha that supports these devices.The fifth column lists the minimum required version of OpenVMS VAX that supports these devices. ("NS" stands for "Not Supported")

Disk Drive	Description	Bus	Alpha Version	VAX Version
EF51R	107 MB solid state	DSSI	NS	5.5-2
EF52R	205 MB solid state	DSSI	NS	5.5-2
EF53	267 MB solid state	DSSI	NS	5.5-2
ESE-20	120 MB solid state	SDI	NS	
ESE-52	120 MB solid state	SDI	1.0	5.5-2
ESE-56	600 MB solid state	SDI	1.5	5.5-2
ESE-58	960 MB solid state	SDI	1.5	5.5-2
EZ51R	100 MB solid state	SCSI	1.5	5.5-2
EZ54R	467 MB solid state	SCSI	1.5	5.5-2
EZ58R	855 MB solid state	SCSI	1.5	5.5-2
RA60	205 MB removable	SDI	NS	6.1
RA70	280 MB fixed	SDI	NS	6.1
RA71	700 MB fixed disk	SDI	NS	5.4-2
RA72	1 GB fixed disk	SDI	1.0	5.4-2
RA73	2 GB fixed disk	SDI	1.0	5.5-2
RA80[1]	128 MB fixed disk	SDI	NS	6.1
RA81	456 MB fixed disk	SDI	NS	6.1
RA82	622 MB fixed disk	SDI	NS	6.1
RA90	1.2 GB fixed disk	SDI	1.0	6.1
RA92	1.5 GB fixed disk	SDI	1.0	6.1
RC25[3]	2 disks each 26 MB (1 fixed and 1 removable) disk drive with shared spindle	Q–bus	NS	6.1
RD32[3]	VAX 42 MB fixed disk	Q–bus	NS	
RD51[3]	10 MB fixed disk	Q–bus	NS	6.1
RD52[3]	31 MB fixed disk	Q–bus	NS	6.1
RD53[3]	71 MB fixed disk	Q–bus	NS	
RD54	159 MB fixed disk	Q–bus	NS	
RF30	150 MB fixed disk	DSSI	NS	6.1
RF31	381 MB fixed disk	DSSI	1.5	
RF31F	200 MB fixed disk	DSSI	NS	5.4-2
RF31T	381 MB fixed disk	DSSI	1.5	5.5-2
RF35	800 MB fixed disk	DSSI	1.0	5.5
RF36	1.6 GB fixed disk	DSSI	6.1	6.0
RF71	400 MB fixed disk	DSSI	1.5	6.1

Disk Drive	Description	Bus	Alpha Version	VAX Version
RF72	1 GB fixed disk	DSSI	1.5	5.5-2
RF74	3.5 GB fixed disk	DSSI	6.1	6.0
RK06[3]	14 MB removable disk	UNIBUS	NS	
RK07[3]	28 MB removable disk	UNIBUS	NS	
RL02[3]	10 MB removable disk	UNIBUS	NS	
RM03+	67 MB removable disk	M-bus	NS	
RM05	256 MB removable disk	M-bus	NS	
RM80[1]	124 MB fixed disk	M-bus	NS	
R80[4]	124 MB fixed disk drive for VAX–11/725 and VAX–11/730		NS	
RRD40[3]	600 MB read-only optical disk drive	Q–bus and SCSI	NS	
RRD42	600 MB read-only optical disk drive	SCSI	1.0	5.4-2
RRD43	680 MB read-only optical disk drive	SCSI	6.1	5.5-2
RRD44	680 MB read-only optical disk drive	SCSI	6.1	
RRD50[3]	600 MB read-only optical disk drive	Q–bus	NS	
RP05[4]	88 MB removable disk drive	M-bus	NS	
RP06	176 MB removable disk drive	M-bus	NS	
RP07	516 MB fixed disk drive	M-bus	NS	
RWZ01	594 MB optical removable disk drive	SCSI	1.0	
RX02[3]	512 KB diskette	UNIBUS	NS	
RX23	1.47 MB diskette	SCSI	NS	
RX26	2.8 MB diskette drive	I82077	1.5-1H1	
RX26	2.8 MB diskette drive	SCSI	1.0	5.5
RX33[3]	1.2 MB diskette drive. Requires minimum RQDX3 microcode of V3.0	Q–bus	NS	
RX50[3]	400 KB diskette	Q–bus	NS	
RV20[3]	2 GB Write Once Read Many optical disk drive	Q–bus, UNIBUS, VAXBI	NS	
RV64[3]	2 GB Write Once Read Many optical disk sub-system	Q–bus, UNIBUS, VAXBI	NS	
RZ22[3]	52 MB fixed disk	SCSI	NS	
RZ23[4]	104 MB fixed disk	SCSI	NS	
RZ23L[1]	121 MB fixed disk	SCSI	1.5	5.4-1
RZ24	209 MB fixed disk	SCSI	1.5	6.1
RZ24L	245 MB fixed disk	SCSI	1.0	5.4-3
RZ25	425 MB fixed disk	SCSI	1.0	5.4-3
RZ25L	500 MB fixed disk	SCSI	1.5	5.5-2
RZ25M	540 MB fixed disk	SCSI	6.1	6.1
RZ26	1.05 GB fixed disk	SCSI	1.0	5.5-2
RZ26B	1.05 GB fixed disk	SCSI	1.5	6.0
RZ26L	1.0 GB fixed disk	SCSI	1.5	5.5-2
RZ26N	1.0 GB fixed disk	SCSI	6.2	6.2
RZ28	2.1 GB fixed disk	SCSI	1.5	5.5-2
RZ28B	2.1 GB fixed disk	SCSI	1.5	6.0
RZ28M	2.1 GB fixed disk	SCSI	6.2	6.2
RZ29B	4.4 GB fixed disk	SCSI	6.1	NS
RZ35	852 MB fixed disk	SCSI	NS	5.4-3
RZ55	332 MB fixed disk	SCSI	1.0	6.1
RZ56	665 MB fixed disk	SCSI	1.0	6.1
RZ57[2]	1 GB fixed disk	SCSI	1.5	5.4-3
RZ58	1.35 GB fixed disk	SCSI	1.0	5.5
RZ73	2 GB fixed disk	SCSI	1.0	6.0

Disk Options Supported by Digital's Services Enterprise Integration Center (SEIC) - VAX only

RF30-RA	150 MB removable disk	(DSSI)
RF31-RA	381 MB removable disk	(DSSI)
RF71-RA	400 MB removable disk	(DSSI)
RF71-RA	1 GB removable disk	(DSSI)
RWZ01	594 MB optical removable disk	(SCSI) (V5.4-3)

Tapes

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[1] Specific tailoring is required in order to use this device as an OpenVMS Alpha or VAX system disk with the DECwindows Motif environment.

[2] Minimum revision firmware is V6000.

[3] Device cannot be used as an OpenVMS VAX system disk.

[4] Device cannot be used as an OpenVMS VAX system disk with DECwindows Motif environment.

The first column lists the device name. The second column is a description of the device. The third column lists the bus the device is supported on. The fourth column lists the minimum required version of OpenVMS Alpha and the fifth column lists the minimum required version of OpenVMS VAX that supports these devices. ("NS" stands for "Not Supported")

Tape	Description	Bus	Alpha Version	VAX Version
TA78	**1600/6250 BPI, STI TU78**	**STI**	**1.0**	
TA79	**STI TU79**	**STI**	**NS**	
TA81	**145 MB tape drive**	**STI**	**1.0**	
TA90	**1.2 GB tape cartridge subsystem. (5-inch 200 MB cartridge)**	**STI**	**1.0**	
TA90E	**1.2 GB tape cartridge subsystem. Compacts data records automatically**	**STI**	**NS**	
TA91	**High performance tape drive**	**STI**	**NS**	**5.4-2**
TE16	**9-track magnetic tape drive**	**M-BUS**	**NS**	
TF70	**290 MB TK70 tape cartridge drive**	**DSSI**	**NS**	**5.4-2**
TF85	**2.6 GB streaming tape cartridge drive**	**DSSI**	**6.1**	**5.5-2**
TF857	**18.2 GB tape cartridge loader**	**DSSI**	**6.1**	**5.5-2**
TF86	**6.0 GB DLT tape cartridge**	**DSSI**	**6.1**	**6.1**
TF867	**42 GB DLT tape loader**	**DSSI**	**6.1**	**6.1**
TK50	**95 MB, 5 1/4-inch streaming tape cartridge drive**	**Q–bus and SCSI**	**NS**	
TK70	**296 MB, 5 1/4-inch streaming tape cartridge drive**	**Q–bus**	**NS**	
TKZ09	**5.0 GB, 8mm tape drive**	**SCSI**	**1.5**	
TKZ60	**200 MB, 3480 tape drive (no compression)**	**SCSI**	**1.0**	
TLZ04	**1.2 GB, 4mm, DAT tape drive**	**SCSI**	**1.0**	
TLZ06	**4 GB, 4mm, DAT tape drive**	**SCSI**	**1.0**	**6.1**
TLZ07	**8 GB, 4mm, DAT tape drive**	**SCSI**	**6.1**	**6.1**
TLZ08	**5.25-inch, 2 GB, 8mm tape drive**	**SCSI**	**NS**	
TLZ6L	**4 GB, 3.5-inch, 4mm DAT tape loader**	**SCSI**	**6.1**	
TLZ7L	**8 GB, 3.5-inch, 4mm DAT tape loader**	**SCSI**	**6.1**	**6.1**
TS05	**9-track magnetic tape drive**	**Q–bus**	**NS**	
TS11	**9-track magnetic tape drive**	**UNIBUS**	**NS**	
TSZ05	**1600 bits/in tape drive**	**SCSI**	**1.5**	
TSZ07	**1600/6250 BPI tape drive**	**SCSI**	**1.0**	
TU77	**9-track magnetic tape drive**	**M-BUS**	**NS**	
TU78	**9-track magnetic tape drive**	**M-BUS**	**NS**	
TU80	**9-track magnetic tape drive**	**UNIBUS**	**NS**	
TU81	**9-track magnetic tape drive**	**UNIBUS**	**NS**	
TU81-Plus	**Streaming 9-track magnetic tape drive**	**Q–bus, UNIBUS, VAXBI**	**NS**	
TZ30	**95 MB, half-height DLT tape drive**	**SCSI**	**1.0**	
TZ85	**2.6 GB DLT tape drive**	**SCSI**	**1.0**	
TZ857	**18 GB, DLT tape loader**	**SCSI**	**1.0**	
TZ86	**6.0 GB, DLT tape drive**	**SCSI**	**1.5**	
TZ867	**42 GB, DLT tape loader**	**SCSI**	**1.5**	
TZ87	**20 GB, DLT tape drive**	**SCSI**	**6.1**	**6.1**
TZ875	**100 GB, DLT tape loader**	**SCSI**	**6.1**	**6.1**
TZ877	**140 GB, DLT tape loader**	**SCSI**	**6.1**	**6.1**
TZK08	**2.2 GB 8mm, tape drive**	**SCSI**	**6.1**	
TZK10	**320/525 MB, QIC tape drive**	**SCSI**	**1.0**	
TZK11	**2.0 GB, QIC tape drive**	**SCSI**	**6.1**	

Controllers

HS111	StorageWorks FDDI StorageServer.
HS121	StorageWorks FDDI StorageServer.
HSC40	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.

HSC50	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 4.1.) Refer to SPD 32.96.xx for supported configurations.
HSC60	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC65	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC70	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC90	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSC95	Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations.
HSD05	DSSI to SCSI-2 FSE StorageWorks bus adapter (Firmware must be at minimum Version X36.)
HSD10	DSSI to SCSI-2 FSE StorageWorks bus adapter
HSD30	DSSI based StorageWorks controller that supports up to 3 SCSI-2 FSE ports. (HSD firmware must be at minimum Version V15D.)
HSJ30	CI based StorageWorks controller that supports up to 3 SCSI-2 FSE ports. (HSJ firmware must be at minimum Version V15J.)
HSJ40	CI based StorageWorks controller that supports up to 6 SCSI-2 FSE ports. (HSJ firmware must be at minimum Version V15J.)
HSZ40-BX	Fast Wide Differential SCSI based StorageWorks controller that supports up to 6 SCSI-2 FSE ports. (HSZ firmware must be at minimum Version V2.5Z.)
KDM70	Mass-storage controller for XMI systems with eight SDI ports.
KFESA	Mass-storage controller for EISA systems with one DSSI port. (Alpha only)
KFESB	Mass-storage controller for EISA systems with one DSSI port. (Alpha only)
KFMSB	Mass-storage controller for XMI systems with two DSSI ports. (Alpha only)
KZESC-AA	Backplane RAID controller for EISA systems with one SCSI-2 FSE port. (Alpha only)
KZESC-BA	Backplane RAID controller for EISA systems with three SCSI-2 FSE ports. (Alpha only)
KZMSA	Mass-storage controller for XMI systems with two SCSI ports. (Limited SCSI-2 support - Alpha only)
KZPSA	Mass-storage adapter for PCI systems with one SCSI-2 FWD port. (Alpha only)
KZPSC-AA	Backplane RAID controller for PCI systems with one SCSI-2 FSE port. (Alpha only)
KZPSC-BA	Backplane RAID controller for PCI systems with three SCSI-2 FSE ports. (Alpha only)
KZPAA	Mass-storage adapter for PCI systems with one SCSI-2 FSE port. (Alpha only)
KZTSA	Mass-storage adapter for TURBOchannel systems with one SCSI-2 FWD port. (Alpha only)
PB2HA-SA	Mass-storage controller for EISA systems with one SCSI port. (Limited SCSI-2 support. (Alpha only) On systems with no greater than 1GB of memory.)
PMAZB	Mass-storage adapter for TURBOchannel systems with two SCSI-2 FSE ports. (Alpha only)
PMAZC	Mass-storage adapter for TURBOchannel systems with two fast SCSI-2 FSE ports. (Alpha only)

Controllers - VAX only

HSZ10	SCSI based StorageWorks controller that supports up to 2 SCSI-2 ports.
IDC	Integrated Disk Controller for VAX–11/725 and VAX–11/730 systems.
IDTC	Integral Disk and Tape Controller for VAX 8600 and VAX 8650 systems.
LPA11-K	Microprocessor controller for laboratory acquisition I/O devices, accommodating up to two AD11-Ks, one AA11-K, one KW11-K, two AM11-Ks, and five DR11-Ks. One LPA11-K controller is supported per UNIBUS and a maximum of two are supported per system.

KDA50	Q–bus MSCP disk controller. The KDA50 disk controller supports up to four of the following drives: RA60, RA70, RA80, RA81, and RA82.
KDB50	VAXBI MSCP disk controller. The KDB50 disk controller supports up to four of the following drives: RA60, RA80, RA81, and RA82.
KFMSA	Mass-storage controller for XMI systems with two DSSI ports.
KFQSA	Q–bus to DSSI bus adapter. This adapter allows up to seven DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Multi-Host Configuration.)
KLESI	Q–bus, UNIBUS, and VAXBI tape controller for the TU81-Plus, RV20, or RC25.
KRQ50	Q–bus controller for the RRD40/RRD50 compact disc reader.
KZQSA	Q–bus to SCSI bus adapter. This adapter allows up to 7 SCSI storage devices to attach to the SCSI bus.
KFDDA	VAX 4000 model 100 DSSI bus adapter. This adapter allows up to 7 DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Multi-Host Configuration.)
KFDDB	VAX 4000 model 500/600/700 DSSI bus adapter. This adapter allows up to 7 DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Multi-Host Configuration.)
LP11	UNIBUS parallel high-speed line printer controller for the LPxx printers.
LPV11	Q–bus parallel high-speed line printer controller.
RK711	UNIBUS disk controller for RK07 disk drives.
RL211	UNIBUS disk controller for the RL02 disk drive.
RQDXx	Q–bus disk controller for MicroVAX and VAXstation systems. There is an RQDX1, RQDX2, and an RQDX3 controller. The RQDXx disk controller supports as many as four disk units, with each RX50 diskette drive counting as two units. Due to controller limitations, the system supports a maximum of four devices; the number of RD/RX devices the system supports depends on the enclosure. The RQDX3 disk controller is required for the RD54 and the RX33 drives.
RX211	UNIBUS diskette controller for two RX02 drives. One RX211 diskette controller is supported per system.
RUX50	UNIBUS diskette controller for RX50 drives. One RUX50 diskette controller is supported per system.
TM03	MASSBUS tape controller for the TE16 and TU77 magnetic tape drives.
TM32	BI-bus 9-track tape controller only with large record support.
TM78	MASSBUS tape controller for the TU78 magnetic tape drive.
TQK50	Q–bus tape controller for the TK50 cartridge tape drive.
TQK70	Q–bus tape controller for the TK70 cartridge tape drive.
TS11	UNIBUS tape controller for the TS11 magnetic tape drive.
TBK50	BI-bus tape controller for the TK50 cartridge tape drive.
TBK50	BI-bus tape controller for the TK50 cartridge tape drive.
TBK70	BI-bus tape controller for the TK70 cartridge tape drive.
TUK50	UNIBUS tape controller for the TK50 cartridge tape drive. One TUK50 tape controller is supported per system.
UDA50	UNIBUS MSCP disk controller. The UDA50 controller must have a minimum microcode version of REV 3. The UDA50 controller supports up to 4 of the following disk drives: RA60, RA80, RA81, and RA82.

Asynchronous Terminal Controllers - VAX only

CXA16	16-line serial terminal multiplexer (DEC-423), maximum baud rate supported: 38400. (No modem control) (Q–bus)
CXB16	16-line serial terminal multiplexer (RS422), maximum baud rate supported: 38400. (No modem control) (Q–bus)
CXY08	8-line serial terminal multiplexer (RS232), maximum baud rate supported: 19200. (Full modem control) (Q–bus)
DHB32	16-line asynchronous terminal controller for VAXBI, maximum baud rate supported: 19200. (VAXBI)
DHF11	32-line asynchronous terminal controller (DEC 423), maximum baud rate supported: 19200. (No modem control) (Q–bus)
DHT32	8-line asynchronous terminal controller (DEC 423). (No modem control) (MicroVAX 2000)
DHQ11	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 19200. (Full modem control) (Q–bus)

DHU11	16-line asynchronous terminal controller (RS-232-C), maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control) (UNIBUS)
DHV11	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control) (Q–bus)
DMB32	8-line asynchronous terminal controller, maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control) (VAXBI)
DMF32	8-line asynchronous terminal controller, maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Full modem control on first 2 lines) (UNIBUS)
DMZ32	24-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rates supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Modem support dependent on configuration) (UNIBUS)
DZ11	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 9600. (Partial modem control) (UNIBUS)
DZ32	8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 9600. (Partial modem control) (UNIBUS)
DZQ11	4-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Partial modem control) (Q–bus)
DZV11	4-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: OpenVMS VAX, 19200; DECnet–VAX, 9600. (Partial modem control) (Q–bus)

Synchronous Controllers - VAX only

The VAX Wide Area Network Device Drivers software product contains the synchronous device drivers and is required when using synchronous communication options. Refer to SPD 29.64.xx for more information.

DMB32	Point-to-point synchronous interface. (VAXBI)
DMC11	High-speed local point-to-point synchronous interface; retired device, no longer offered as an option. (UNIBUS)
DMF32	Point-to-point or multipoint synchronous interface. (UNIBUS)
DMP11	Point-to-point or multipoint synchronous interface; (UNIBUS) retired device, no longer offered as an option.
DMR11	Remote point-to-point synchronous interface; (UNIBUS) replaces DMC11.
DMV11	Point-to-point or multipoint synchronous interface. (Q–bus)
DPV11	Synchronous, 1 line, half or full-duplex point-to-point communication interface supporting DDCMP, HDLC, SDLC, or BISYNC protocols.
DSB32	Two-line, multiple protocol, synchronous adapter. (VAXBI)
DSH32	One-line synchronous (full modem control) and 8-line asynchronous (no modem control) communications controller for the MicroVAX 2000. DEC423 devices are supported. Maximum baud rates supported: OpenVMS VAX, 19.2 KBPS (kilobits/second); 9.6 KBPS for MicroVAX 2000, etc.
DST32	Synchronous single-line support for DDCMP up to 9.6 KBPS, full duplex for MicroVAX 2000 systems. Concurrent use with the DHT32 is not supported.
DSV11	Synchronous, 2-line, half or full-duplex point-to-point communication interface supporting DDCMP (1 or 2 lines up to 64 KBPS).
DSF32	DEC WANcontroller 620 — Two-line synchronous communications controller designed specifically for the VAXft 3000 processors, supporting DDCMP. DDCMP is supported at speeds up to 64 KBPS per line for a two-line operation.

Graphics Options

PMAG	A 24-plane graphics adapter upgrade.
PMAGB	A multiscreen graphics adapter for TURBOchannel systems to connect multiple 8/24-plane color or grayscale monitors.
PMAGC	A multiscreen graphics adapter for TURBOchannel systems to connect multiple ZLX 8/24-plane color or grayscale monitors.
PMAGD	A multiscreen graphics adapter for TURBOchannel systems to connect multiple ZLX 8-plane color or grayscale monitors.
PBXGA-AA	A multiscreen graphics adapter for PCI systems to connect ZLX 8-plane color or grayscale monitors.
PBXGA-BA/CA	Multiscreen graphics adapters for PCI systems to connect ZLX 24-plane color or grayscale monitors.
PB2GA-AA	Compaq QVision VGA adapter for EISA systems.
PB2GA-CA	Compaq QVision VGA adapter for PCI systems.

PB2GA-FA	ATI Mack-64 CX (2mbDRAM) VGA adapter for PCI systems.
PCXBV-DE/DG	A 15" color quadmode monitor.
PCXAV-FC/FD	A 19" color monitor.

LAN Options

DEFAA	A high-performance network adapter that connects FUTUREBUS+ systems to ANSI FDDI local area networks.
DEFEA	A high-performance network adapter that connects EISA systems to ANSI FDDI local area networks.
DEFPA	A high-performance network adapter that connects PCI systems to ANSI FDDI local area networks.
DEFTA	A high-performance network adapter that connects TURBOchannel systems to ANSI FDDI local area networks.
DEFZA	A high-performance network adapter that connects TURBOchannel systems to ANSI FDDI local area networks. (DMA receive only.)
DEMFA	A high-performance network adapter that connects XMI systems to ANSI FDDI local area networks.
DETRA	A network adapter that connects the TURBOchannel bus to a Token Ring local area network.
DEMNA	A high-performance network adapter that connects XMI systems to both the Ethernet and IEEE 802.3 local area networks.
DE422	A network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks.
DE425	A high-performance network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks.
DE434	A high-performance network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks.
DE435	A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks.
DE436	A high-performance network adapter that connects QUAD PCI systems to both the Ethernet and IEEE 802.3 local area networks.
DW300	A network adapter that connects the EISA bus to a Token Ring local area network.
PB2CA-AA	A network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks.
PMAD	A network adapter that connects TURBOchannel systems to both the Ethernet and IEEE 802.3 local area networks.

LAN Options - VAX only

DEUNA	Ethernet to UNIBUS controller.
DELUA	Ethernet to UNIBUS controller. The minimum revision level required is F1.
DEBNA	Ethernet to VAXBI communication controller.
DEBNI	Ethernet to VAXBI communication controller.
DEMNA	The DEMNA is a high performance network adapter that connects XMI systems to both the Ethernet and IEEE 802.3 local area networks.
DESVA	Ethernet controller interface.
DEQNA	Ethernet controller to Q–bus. The minimum revision level required is K3. All systems utilizing a DEQNA must operate with software data checking enabled. Since AUTOGEN will automatically set the correct parameter, no system management intervention is required. Not supported by VAXcluster software. Not supported for any interfaces except for access using QIO or ALTSTART interfaces.
DELQA	Ethernet controller to Q–bus. This is the replacement for DEQNA. The minimum revision level required is C3.
DESQA	Ethernet controller to Q–bus for S-BOX configurations.
DEFQA	FDDI to Q–bus controller
DEFZA	FDDI to TURBOchannel controller
DEFTA	FDDI to TURBOchannel controller
KFE52	DSSI/Ethernet Adapter for the VAXft 3000. Minimum of two adapters per system providing redundant connection to the Ethernet and the DSSI buses.

CI Options

CIXCD-AC	Native CI adapter for DEC 7000 and 10000 Alpha XMI systems. (Minimum microcode version REV 1.0 is required.)

CI Options - VAX only

VAXcluster Software may support multiple CI adapters per system. Refer to the VAXcluster Software Product Description (SPD 29.78.xx) for the supported configurations.

CI750	CI Adapter for VAX–11/750 systems. (Minimum microcode version REV 8.7 is required.)

CI780	CI Adapter for VAX–11/780, VAX–11/785, VAX 8600, and VAX 8650 systems. (Minimum microcode version REV 8.7 is required.)
CIBCI	CI Adapter for VAXBI systems. (Minimum microcode version REV 8.7 is required.)
CIBCA-AA	Native CI Adapter for VAXBI systems. (Minimum microcode version REV 7.5 is required.)
CIBCA-BA	Native CI Adapter for VAXBI systems. (Minimum microcode version REV 5.2 is required.)
CIXCD-AA	Native CI Adapter for VAX 9xxx XMI systems. (Minimum microcode version REV 1.0 is required.)
CIXCD-AB	Native CI Adapter for VAX 6xxx XMI systems. (Minimum microcode version REV 1.0 is required.)

Miscellaneous

InfoServer	An integrated hardware and software system that sits directly on the Ethernet to provide CD–ROM, hard disk, magneto-optical, and tape access to OpenVMS clients in a local area network. It supports up to 14 SCSI devices and can be used for software distribution and initial system load (ISL). For more information, refer to the InfoServer Software Product Description (SPD 33.20.xx.)
PC4XD-AA	Parallel/serial port adapter.
PMTCE	TURBOchannel Extender.

Miscellaneous - VAX only

CR11	Card reader. One CR11 card reader is supported per system. (UNIBUS)
DRV11-WA	General purpose DMA interface. (Q–bus)
DR11–W	General purpose high-speed DMA interface — one DR11–W interface supported per UNIBUS.
DR750	High performance general purpose interface for the VAX–11/750. One DR750 interface is supported per system. This device may not be used in conjunction with the CI750.
DR780	High performance general purpose interface for the VAX–11/780 and VAX–11/785. One DR780 interface is supported per system. On the VAX 8600 and VAX 8650 as many as four per system are permitted provided that the M8297-YA is used.
DWBUA	XMI to UNIBUS adapter.
DWMBA	XMI to BI adapter; also the adapter used to connect the XMI to VAX expander cabinet.
DWMVA	XMI to VME adapter.
DW750	UNIBUS Adapter for second UNIBUS for the VAX–11/750 system.
DW780	UNIBUS Adapter for VAX–11/780, VAX 8600 and VAX 8650.
FP730	Floating Point Accelerator for the VAX–11/730 system.
FP750	Floating Point Accelerator for the VAX–11/750 system.
FP780	Floating Point Accelerator for the VAX–11/780 system.
FP785	Floating Point Accelerator for the VAX–11/785 system.
FP86-AA	Floating Point Accelerator for the VAX 8600 and VAX 8650 systems.
FV64A	Vector Processing option for the VAX 6000-400.
H7112	Memory battery backup for VAX–11/750, VAX–11/780, VAX–11/785, VAX 8600, and VAX 8650 systems. This is required for power-fail/recovery.
KE780	G and H floating point microcode for the VAX–11/780 system.
KU780	User-writable control store for the VAX–11/780 system.
RH750	MASSBUS adapter for the VAX–11/750 system.
RH780	MASSBUS controller for the VAX–11/780, VAX–11/785, VAX 8600, and VAX 8650 systems.
SBI	System Backplane Interconnect for the VAX–11/780, VAX–11/785, and I/O BUS for the VAX 8600 and VAX 8650 systems.
VS40X	4-plane graphics coprocessor.
WS01X	VAXstation 3100 SPX Graphics option.

Abbreviations

DLT	Digital Linear Tape
DSSI	DIGITAL Storage Systems Interconnect
EISA	Extended Industry Standard Interconnect
FDDI	Fiber Distributed Data Interface
IEEE	Institute for Electrical and Electronics Engineers
I80277	Intel 82077 PC Compatible Floppy Interface
MSCP	Mass Storage Control Protocol
PCI	Peripheral Component Interconnect
QIC	Quarter Inch Cartridge
SCSI	Small Computer Systems Interface
SDI	Standard Drive Interface
STI	Standard Tape Interface
TMSCP	Tape Mass Storage Control Protocol
XMI	Extended Memory Interconnect

M-BUS	MASSBUS
SCSI-2 FSE	SCSI-2 Fast Single Ended
SCSI-2 FWD	SCSI-2 Fast Wide Differential
RAID	Redundant Array of Inexpensive Disks

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