Software Product Description

PRODUCT NAME: VMS Operating System, Version 5.4 **SPD 25.01.34**

DESCRIPTION [1]

VMS is a general purpose multiuser operating system which supports VAX, MicroVAX, VAXstation, and VAXserver series computers in both development and production environments. VMS can be tuned to perform well in a wide variety of applications, including compute-intensive, I/O-intensive, real-time, and combinations of those and other environments. (Actual performance depends upon the type of VAX computer, available physical memory, and the number and type of disk and tape drives on your system.)

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

VMS also supports a large number of industry standards, facilitating application portability and interoperability.

User Environment

Users may access VMS by using the English-like Digital Command Language (DCL), the command language for VMS which 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. VMS prompts users to enter required DCL parameters, making it easy for novice users to use.

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

Information on DCL and VMS Utilities is available through online HELP. Online HELP includes summary operational information on all aspects of system operation.

A number of tools and utilities are integrated into the VMS operating system. This section briefly describes some of these tools and utilities.

Text processing - The Extensible VAX Editor (EVE), one of several text editors supplied by Digital, lets you quickly insert, change, and delete text. Written in the VAX Text Processing Utility Language (VAXTPU), EVE is a full screen editor that lets you scroll text on a terminal screen. EVE provides an EDT-style keypad, allowing users of EDT to transition to EVE easily.

Mail facility - The Mail facility lets you send messages to any other user on the system. Multi-node operation is available if DECnet-VAX is installed and licensed on each participating node.

Command-level programming - Command-level programming lets you create special files called command procedures that contain a series of DCL commands. When you start a command procedure, the system processes the commands in the command procedure. You 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 - You can customize your computing environment with user login command procedures, shorthand commands, binding of commands to function keys, and command recall and editing.

Program Development Environment

VMS provides a comprehensive set of tools for developing programs including editors (for editing source programs), a linker, a librarian, and a symbolic debugger. The assembly-level VAX MACRO language is supplied with VMS.

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[1] "Licensee agrees to only execute Display PostScript on those Digital computer systems identified as licensed systems in this Software Product Description, and that in any event licensee agrees not to make use of the software directly or indirectly, to print bitmap images with print resolutions greater than 150 DPI, or to generate fonts or typefaces for use other than with the Digital licensed system." (Terms and Conditions for Display PostScript can be found Appendix C of this SPD.)

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The VMS Run-Time Library provides string manipulation, Input/Output (I/O) routines, I/O conversion, terminal independent screen handling, date and time formatting routines, common mathematical functions, signaling and condition handling, and other general purpose functions. These routines can be called from programs written in VAX MACRO or from VAX Ada, VAX BASIC, VAX BLISS-32 Implementation Language, VAX C, VAX COBOL, VAX DIBOL, VAX FORTRAN, VAX PASCAL, VAX PL/I, and VAX SCAN.

Major VAX languages (including those listed above) adhere to the VAX 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 routines in the run-time library follow the VMS calling standard and condition handling conventions and most are contained within a shareable image.

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 VMS calling standard and condition handling conventions.

VMS supports execution of non-privileged images created on earlier versions of VMS. Recompiling and relinking are typically not required.

Some tools available to the VMS programmer are:

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

Debugger - The debugger lets you trace program execution as well as display and modify register contents using the same symbols that are in the source code.

RMS file utilities - RMS file utilities lets you analyze the internal structure of an RMS file. Use them to determine the most appropriate set of parameters for an RMS file. They can also be used to create, efficiently 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.

Terminal Fallback Facility (TFF) - This facility allows Digital 7-bit terminals, such as the VT100, 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 the user 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 lower case characters to upper case. NCS also allows RMS indexed files to be collated using user-specified collating sequences.

System Management Environment

VMS provides a variety of tools to aid the system manager in configuring and maintaining an optimal system. Some tools available for the system manager are:

Backup - This 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. With standalone backup, system managers can back up and restore selected files or entire volumes. The Backup Utility can be used to restore a saveset or list the contents of a saveset.

Analyze disk structure - This 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 - This utility permits the system manager to monitor different classes of system-wide performance data including process activity, I/O activity, and memory management activity, vector processing activity 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) - This facility allows the system manager to easily determine which software products are licensed and installed on a standalone VAX and on each of the VAX systems in a VAXcluster System. It lets the system manager select which subset of systems in a VAXcluster may use the software products. LMF also provides an audit trail which allows the system manager to track license changes that occur within a VAXcluster system. Refer to the section entitled "VAXcluster Support" for more information on VAXcluster Systems.

VMS System Management (SYSMAN) Utility - This utility allows the system manager to define a system management environment so that operations performed from the local VAX system can be executed on all other VAX systems in the defined environment. The environment may include VAX systems in a DECnet-VAX network or in a VAXcluster System.

Operations - VMS 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 VMS HELP facility to get an online description of VMS Error Messages.

Security and Control- VMS provides privilege, protection, and quota mechanisms to control user access to system-controlled structures in physical memory, to system-structured files and volumes, and to certain devices.

User account information is maintained by the system manager in the User Authorization File (UAF). 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 unique user name, password, and user identification code (UIC) to each account. Optionally, additional identifiers may 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, or batch.

To log in and gain access to the system, the user must supply the 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, password length, and generation of random alphabetic passwords.

Additionally, VMS provides several password filters which screen all user password changes against a dictionary of common passwords. This prevents users from reusing passwords which they have used within the last year. In addition to these built-in filters, a site can install their 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 which have contractual agreements to use specific password encryption algorithms. This feature can be enabled on a per-user, per-password basis.

Login security includes breakin detection, which allows terminals to be disabled when password guessing is detected. When a user logs in, the system displays a message stating when the last login for the account occurred and if there have been failed attempts to log in since the last successful login.

A UIC consists of two fields, the unique user field and a group field. Every file, device, queue, or other system object is labeled with the UIC of its owner (normally the user who created the object).

Files, devices, queues, and other system objects are assigned a protection mask which allows read, execute, write, and delete access to be selectively granted to the object's owner and group, to privileged system users, and to all other users. In addition, files, devices, queues, and some other system objects may be protected with access control lists to allow access to be selectively granted or denied to a list of individual users, groups or identifiers.

Scavenge protection may be selectively enabled in the form of file high-water marking, erase on allocate, and erase on delete, to ensure that file contents cannot be read after a file has been deleted.

Security alarms are provided to allow selective auditing of security related events, including:

- Login and logout
- Login failures and breakin attempts
- Authorization changes
- File access, selectable by use of privilege, type of access, and by individual file

Note that 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.

INSTALLATION

VMS is distributed as binary kits on tape, disk, and compact disc. 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 VMS Version 5.4 Upgrade and Installation Manual. Computer-specific information is contained in the upgrade and installation supplements for each family of VAX computers.

The VMS AUTOGEN command automatically sets a number of system parameters by detecting installed devices in a configuration. A feedback option can be used to generate a report of recommended parameter settings for system tuning.

VMSINSTAL

VMS includes a facility to automate operating system software updates, as well as to handle the installation of optional Digital-supplied software products.

Tailoring Facility

Tailoring lets the system manager remove groups of VMS files from the system disk or add groups of VMS files that were formerly removed. The VMSTAILOR program supplies step-by-step instructions. The DECW$TAILOR program is used to add or remove groups of DECwindows files from the system disk.

Due to space constraints, there is no guarantee that layered products can be installed if user files reside on the system disk.

Application programs will execute as long as the layered products or optional software DO NOT DEPEND on optional software run-time components that are not supported in the tailored environment. Refer to the product's System Support Addendum (SSA) for the optional products supported in the tailored environment.

Batch/Print Facility

VMS provides an extensive batch/print facility which allows the creation of queues and the setup of spooled devices in order to process non-interactive workloads in parallel with timesharing or real-time jobs.

In the VMS Operating System, 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, VMS enables load balancing across available CPUs in a VAXcluster 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.

Sites requiring sophisticated batch job dependency checking and job restart capabilities should refer to the DECscheduler for VMS (SPD 32.19.xx).

Accounting

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

Autoconfigure/Autogen

VMS 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.

Operating System Environment

Process and Scheduling

The basic unit of execution in VMS 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 VAX system.

Processes receive processor time to execute their images based on the priority of the process. Thirty-two priorities are recognized: Priorities 0-15 are for time-sharing processes and applications that are not time critical (four is the typical default for time-sharing processes) and priorities 16-31 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 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.

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 pre-emptively; 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.

VMS 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 200,000 pages of memory.

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 into the system or for a specific group of users. The system controls interactive terminals, and one or more printers.

Vector Processing

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 16 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 VMS Operating System provides fully-shared, multiprogramming support for VAX vector processing systems. By default, VMS 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 SYSGEN parameter VECTOR_PROC, as described in the VMS Version 5.4 New Features Manual.

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 simultaneously compete 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 VMS Version 5.4 New Features Manual.

The VMS 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 VMS 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 non-privileged VAX vector instructions and the VMS vector system services, as described in the VMS Version 5.4 New Features Manual. Use of VVIEF is restricted to user mode code.

DECdtm Services

The DECdtm services embedded in the VMS 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 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. VMS is unique in providing transaction processing functionality as base operating system services.

Key Features

- Embedded VMS system services support the DECtp architecture, providing features and the technology for distributed transaction processing.
- It 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), to be updated "atomically".

- It 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.
- As a VMS service, DECdtm can be called using any Digital TP monitor (ACMS or DECintact) or database product (DBMS, RDB, RMS). This is useful for applications using several database products.

Interprocess Communication

VMS 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 multi-level locks, values, and ASTs (Asynchronous System Traps).

Symmetric Multiprocessing

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

VMS 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 VMS. SMP also provides simultaneous shared access to common data in global sections to all processors. VMS SMP dynamically balances the execution of all processes across all available processors based on process priority.

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

VAXcluster Support

A VAXcluster system is formed combining any number of VAX computers. A VAXcluster environment can include mass storage servers known as “Hierarchical Storage Controllers” (HSCs). These cooperating, independent VAX computers may share: a single disk-resident copy of VMS, RMS data down to the record level, batch and print queues and locally attached or HSC-based disks. VAXcluster systems provide data sharing and easy incremental growth, and may be configured to provide high availability computing environments.

Two or more VAX computers connected to the same Computer Interconnect (CI) or Digital Storage Systems Interconnect (DSSI) must run VAXcluster software and be part of the same VAXcluster system.

VAXcluster Software is a System Integrated Product (SIP) that is separately licensed from the VMS Operating System. Refer to VAXcluster Software (SPD 29.78.xx) for more information.

Networking Facilities

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

VMS also provides device drivers for Digital asynchronous adapters which are supported by DECnet-VAX. Customers must order the VAX Wide Area Network Device Drivers kit (reference SPD 29.64.xx) to obtain synchronous device drivers for Digital synchronous adapters. Not all devices are supported, and certain restrictions apply relative to line speed and line utilization. Refer to the Hardware charts and Appendix B in this SPD, as well as the DECnet-VAX SPD (25.03.xx) for more information.

DECnet-VAX offers task-to-task communications, file management, downline system and task loading, network command terminals, and network resource sharing capabilities using the Digital Network Architecture (DNA) protocols.

DECnet-VAX Software is a System Integrated Product (SIP) that is separately licensed from the VMS Operating System. Refer to the DECnet-VAX Software Product Description (SPD 25.03.xx) for further information on supported communications devices and software features.

Internet networking is available through the VMS/ULTRIX Connection 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 VMS/ULTRIX Connection Software Product Description (SPD 25.A4.xx).

Terminal Server Products

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

VMS 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 is fatal then the process that encountered the error is aborted. If the error occurs in system context then the current VMS session is shut down. If the error is not fatal then recovery actions pertinent to the error are executed and 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, adapter errors)
- Memory errors are hardware errors which are handled in a slightly different manner. The system examines memory at start-up time and does not use any pages found to be bad. During system operation, the hardware transparently corrects all single-bit memory errors, for those systems with ECC memory. 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.

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 errors), and all I/O errors. (Double-bit errors are detected only on those VAX and MicroVAX systems with ECC memory.)

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 VMS System Dump Analyzer utility is provided for analyzing memory dumps.

Power Failures

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 back-up 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, the system disk does not come back on line after a power failure within a specific time after the CPU regains power, the system shuts down.

Test Package and Diagnostics

VMS includes a User Environment Test Package (UETP) which verifies that the VMS 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. For example, the memory cache can be disabled. The system places a component in degraded mode when errors pass a threshold level.

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 VAX 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 the 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 VMS Operating System and provides QIO system service routines to access the special device dependent features available in many of these devices. Users with special needs or non-VMS supported devices can write their own device drivers. (The VMS Device Support Manual and the VMS Device Support Reference Manual in the VMS Extended Documentation set describes how to write your own device driver.)

The VMS Operating System supports a variety of disk and tape peripheral devices, as well as terminals, networks, mailboxes (virtual devices for interprocess communication), and more general I/O devices. These I/O devices include line printers, card readers, and general purpose data acquisition devices such as the DRB32.

VMS Record Management Services (VMS RMS)

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

VMS RMS supports sequential, relative, and indexed file organizations in fixed-length and variable-length record formats. VMS RMS also supports byte stream formats for sequential file organization. VMS 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. VMS RMS also supports block I/O operations for various performance-critical applications that may require user-defined file organizations and record formats.

VMS 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.

VMS 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 installed, VMS 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

VAX RMS Journaling

VAX RMS Journaling is a tool which maintains the data integrity of RMS files in the face of a number of failure scenarios. It helps to protect RMS file data from becoming lost or inconsistent. RMS Journaling is a System Integrated Product (SIP) that is separately licensed. Refer to the VAX RMS Journaling SPD (SPD 27.58.xx) for more information.

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 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 volume is improperly dismounted because of user error or system failure, the system automatically rebuilds the volume's structure information the next time the volume 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.

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

VMS Volume Shadowing

Digital provides a volume shadowing product with two methods for performing shadowing operations.

VMS Volume Shadowing Phase I

Phase I volume shadowing provides for centralized shadowing on VMS systems using Hierarchical Storage Controller (HSC) controllers with compatible (have the same physical geometry) Digital Standard Architecture (DSA) disks. The system disk and Files-11 On-Disk Structure 2 (ODS2) data disks can also be volume shadowed. This type of shadowing is limited to Computer Interconnect (CI) configurations on a single system or a VAXcluster.

VMS Volume Shadowing Phase II

Phase II allows shadowing on the same configurations as Phase I plus it supports:

- Clusterwide shadowing of all MSCP-compliant DSA disks having the same physical geometry, on a single system or located anywhere in a VAXcluster system.

Volume shadowing Phase II supports clusterwide shadowing of all DSA devices. Phase II is not limited to HSC-controlled disks, but extends volume shadowing capabilities to all DSA disks including those on local adapters, all Digital Storage System Interconnect (the DSSI RF-series) disk devices on any VAX computer, all interfaces (CI, Ethernet, mixed), and across MSCP servers.

- Distributed shadowing

Volume shadowing Phase I creates and maintains virtual units in a distributed fashion on each node in the cluster. Phase II supports shadowing on a single system or a VAXcluster system where interprocessor communication is carried out over either Computer Interconnect (CI), Ethernet, Digital Storage System Interconnect (DSSI), Mixed-interconnect (a combination of CI, Ethernet, and/or DSSI).

Thus, Phase II provides fault tolerance resulting from disk media errors or controller errors across the full range of VAX processors and configurations.

- Shadowing capabilities across different controllers

Shadow set member units can be located on different controllers and VMS MSCP servers, providing a high degree of data availability.

Phase I and Phase II can be used simultaneously on the same standalone or VAXcluster system. VAX Volume Shadowing is a System Integrated Product (SIP) that is separately licensed. Refer to the VAX Volume Shadowing Software Product Description (SPD 27.29.xx) for more information.

VMS DECwindows Environment

Integral to VMS is support for the VMS DECwindows desktop environment.

VMS DECwindows is based on M.I.T.'s specification for the X Window System, Version 11, Release 3. X Window System standards supported as part of DECwindows include the X11 network protocol, a base set of workstation fonts, the C language binding for the Xlib programming library and the C language binding for the Xtoolkit library. Also featured within DECwindows for workstation users is support for Adobe's Display PostScript integrated into X11.

Support of the X11 network protocol in the client, library and display server components provides VMS with the ability to interoperate with other X11-compliant systems in a distributed fashion.

To determine the set of systems and applications for which VMS has verified correct distributed operation, consult the DECwindows Interoperability Compliance Table matrix (SPD 01.25.xx).

DECwindows supports the server-client distribution inherent in the X Window System, with three VMS-provided transport interfaces - local shared memory, DECnet, and TCP/IP (using Digital's VMS/ULTRIX Connection (UCX) layered product). Users can also provide their own transport subsystems and transport interfaces.

To determine whether a separately orderable DECwindows or X application runs on or can communicate with a VMS DECwindows system, consult the application's software product description.

The DECwindows desktop environment provides a graphical user interface to VMS. This user interface defines a powerful model for interacting with the VMS Operating System using a point and click metaphor. It includes a set of integrated desktop applications that demonstrate the power of this new metaphor and that provide VMS users with a base set of desktop tools.

The user environment consists of four basic components:

1. The Session Manager provides the top-level user interface to a DECwindows workstation. It performs application activation, session-wide customization, screen printing, security management, and session

control. The session manager also lets you specify the language in which DECwindows should run, provided that you have ordered and installed a VMS DECwindows language variant kit.

2. The Window Manager provides user control for managing windows.
3. FileView is a graphical interface to VMS file management that allows users to navigate through the VMS file system and perform operations on files.
4. The DECterm terminal emulator provides workstation users with a traditional character cell interface for existing VMS features and applications. It is a ReGIS and Sixel compatible VT320 terminal emulator. Programs written for VT52, VT100, VT220, or VT320 class terminals and using VMS terminal driver features operate without modification in this workstation window. DECterm also provides workstation-oriented features such as mouse-based cursor positioning, variable screen sizes, and cutting and pasting of text between terminal emulators and other DECwindows applications.

Applications

A set of integrated desktop applications is provided as a base component of the DECwindows environment. These applications establish and demonstrate the consistent DECwindows user model. They also provide significant end user capabilities.

These applications are:

- Bookreader - A tool for viewing the contents of books that are distributed and stored on-line
- Calculator - A basic scientific calculator
- Calendar - A personal time management system
- Cardfiler - A hierarchical information storage application similar to an online address and/or phone book
- Clock - An analog and/or digital date and time display with notification by alarm.
- Compound document viewer - tools for reading documents containing compound text, graphics, and image data on terminals and DECwindows workstations
- DEBUG - A DECwindows user interface to the VMS DEBUGGER
- Mail - A DECwindows user interface to the VMS mail facility
- Notepad - A simple text editor
- Paint - A simple bitmap graphics editor
- Puzzle game - A game that challenges you to sort mixed up puzzle tiles
- TPU/EVE - A DECwindows user interface to the VMS TPU/EVE editor

DECwindows workstation users can display PostScript files featuring true WYSIWYG (what you see is what you get) compatibility between the display and any of Digital's PostScript printers. Display PostScript ability is available within the Compound Document viewer and DECwindows Mail.

Programming Support

The VMS DECwindows environment includes an extensive set of programming libraries and tools for use by developers of new applications. These components support the development of portable applications by focusing on three broad areas:

- X Window System (X) support
- X User Interface (XUI) support
- Compound Document Architecture (CDA) support

Components from each of these areas can be used in any combination to address the needs of applications. They can also use the tools from a variety of different programming languages. All programming libraries have been provided with procedural language bindings in both the style of the VAX calling standard and the style of the MIT C language programming conventions.

Support is provided for the following languages:

VAX Ada	VAX FORTRAN
VAX BASIC	VAX MACRO
VAX BLISS-32 Implementation Language	VAX PASCAL
VAX C (VAX calling standard or MIT convention)	VAX PL/I

X Window System (X) Programming Support

The X Window System compatible X programming library (Xlib) provided by the VMS DECwindows environment provides basic resource management (windows, color maps, input devices) and bitmap graphics services. It defines a mapping of the X network protocol to a procedure library.

The Xtoolkit programming library is also supported by the VMS DECwindows environment. It is described further under XUI Programming Support.

X User Interface (XUI) Programming Support

XUI determines the application model for Digital and third-party software tailored for the DECwindows environment. It establishes the conventions and styles that are encouraged for applications that share a DECwindows workstation. Applications use XUI components to build user interfaces that make them look and feel like integrated members of the Digital computing environment.

The XUI Style Guide, available in the VMS DECwindows Programming Kit, describes the principles, philosophy, and components used to build consistent and well-integrated DECwindows applications.

Its concepts are implemented by the XUI Toolkit. The XUI Toolkit is a superset of the X Window System Xtoolkit and contains four components:

- Xtoolkit components (known as intrinsics) for managing, modifying, and creating user interface objects (known as widgets and gadgets).
- DECwindows widgets and gadgets for implementing common user interface objects such as scroll bars, menus, and push buttons
- Utility routines that provide applications with functions for performing common tasks such as cut and paste
- Resource manager routines for loading user interface definition files and creating widgets and gadgets based on the contents of the definition files.

The XUI Toolkit is used in conjunction with the DECwindows User Interface Language (UIL) compiler. The user interface definition files produced by this compiler contain the data to separate form and function in DECwindows applications and allow DECwindows toolkit widget and gadget details, such as menu item labels, to be stored separately from the toolkit and application runtime code. This capability allows application developers to prototype and modify user interface designs, separate form and function in applications, and support internationalizable products.

Enhanced X Windows™ Display PostScript (XDPS)

The Display PostScript system provided with VMS DECwindows extends the native X graphical programming environment for Digital DECwindows workstation users.

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

- All DECwindows fonts can be displayed at any size and rotation angle
- XDPS graphics specified in a user-defined coordinate systems are independent of monitor density
- Color or gray-scale rendition are automatically modified to take advantage of the monitor type through either direct display, color dithering, or half-toning
- DPS 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

Programming access to XDPS is through the Adobe Client Library. In addition, a converter called pswrap allows you to convert PostScript code into C programs which can be called from other languages.

Compound Document Architecture (CDA) Programming Support

The CDA Toolkit provides access routines that applications can use to create, read, and write files containing compound text, graphics, and imaging data. These files provide a vehicle for recording this information on disk, a medium for interchange of this data between applications, and an intermediate form from which high-resolution printable graphics data can be generated.

In addition to providing support for developing new applications to access compound documents, VMS also provides fallback support allowing many existing utilities to read and operate on these new kinds of files.

Transport Mechanisms

VMS DECwindows supports three different user-selectable mechanisms for transport of X network protocol packets between applications and display servers.

A VMS DECwindows-specific shared memory-based transport is used when the DECwindows application and display server are located on the same workstation. This optimization provides significantly greater performance. It is the default transport under these circumstances.

DECnet is used when the DECwindows application and display server are distributed across two different machines in the network. It is the default transport under these circumstances.

TCP/IP is used when the DECwindows application and display server are distributed across two different machines in the network and the Digital-supplied VMS/ULTRIX Connection (UCX) layered product is being used to make the connection. See the SOFTWARE LICENSING section of this SPD for licensing details.

Workstation Device Support

The VMS DECwindows environment provides several software components to support displaying graphics and windowing output on and receiving keyboard and pointer driver input from VAX workstations.

Device drivers are provided to support output to monochrome and color displays and to receive input from keyboard, mouse, and tablet devices.

A display server compatible with the X Window System receives output requests from applications and translates those requests into driver commands. They also relay driver generated input events back to the applications.

Over 400 video fonts are provided in a variety of styles and point sizes for use on 75 and 100 dot per inch (dpi) monitors. These video fonts have been designed to correspond directly to the fonts used by Digital's PostScript (R) printers. In addition, a font compiler is provided so that customers can make their own private fonts available on their DECwindows workstations and terminals.

Multi-headed Workstation Support

A multi-headed workstation consists of one system box, one keyboard and one mouse, but more than one monitor and graphics controller. It is a single user workstation. Multi-headed workstations provide more screen area for complex applications.

The screens on the multiple monitors are controlled by a single server. The mouse cursor can be moved freely between screens, and the keyboard can be used to generate input to windows on any screen. The server implementation handles each monitor as a separate X11 screen. This means that a single window cannot cross screen boundaries; for example, users cannot drag a window from one monitor to another. However, users can cut and paste between windows on different screens, and windows may be opened on either screen, or both, by user applications.

The Dual Monitor Adapter is a cable (model number BC09E-06) that allows two monitors to be connected at the same time to a single VAXstation 3100 system box (models 30, 38, 40, and 48). The system must include one of the 8 plane graphics options, either the GPX graphics or SPX graphics accelerator.

The system must include at least one monochrome monitor, VR150 or VR262, driven by the single plane frame buffer that is standard on all VAXstation 3100s.

The second monitor, connected to the 8 plane graphics option, may be color, or it may be monochrome for gray scale operation. Supported color monitors are the VR160, VR290, VR297, VR299, and VRT19.

Desktop-VMS Software

The VMS Operating System is a component of Desktop-VMS Software. The full complement of VMS is delivered to the Desktop-VMS Software user. Desktop-VMS Software is an easy-to-use, VMS Operating System environment for the desktop offering simplified system installation and system management.

It is delivered as a pre-integrated, pre-installed VMS system on compact disc that includes the following system software components:

- VMS Operating System including VMS DECwindows
- DECnet-VAX End Node Software
- VAXcluster Software
- Desktop-VMS "ease-of-use" Software

Various layered products have been pre-installed on the Desktop-VMS software compact disc. Desktop-VMS Software is a separately licensed product. Please refer to to the Desktop-VMS Software SPD (25.F4.xx).

Standards

The VMS Operating System is based upon the public, national, and international standards listed below. These standards are American National Standards Institute (ANSI), U.S. Federal Information Processing (FIPS), and International Standards Organization (ISO) standards. 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 X3.26-1980: Hollerith Punched Card Code
- 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 X3T9.2/89-042 (SCSI II): Small Computer System Interface as described in REV 10C.
- 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 2-1/ANSI 3.6-1965: Perforated Tape Code for Information Interchange
- FIPS 3-1/ANSI X3.22-1973: Recorded Magnetic Tape Information Interchange (800 CPI, NRZI)
- FIPS 13/ANSI X3.21-1967: Rectangular Holes in Twelve-row Punched Cards
- FIPS 14/ANSI X3.26-1980: Hollerith Punched Card Code
- 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 26/ANSI X3.18-1967: One Inch Perforated Paper Tape for Information Interchange
- 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
- Other FIPS not applicable

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

GROWTH CONSIDERATIONS

This section describes the set of disk and memory requirements for the current version of VMS. The minimum hardware requirements for any future version of this product may be different from the minimum hardware requirements of this version.

VMS Disk Block Requirements

Block Space Requirements (Block Cluster Size = 2):

The disk block size for the VMS Operating System, Version 5.4, after installation is approximately 82,000 blocks. This figure includes 5,600 blocks for page and swap files. Most systems will require larger page and swap files. This figure also includes help library files which are in data-compressed format. Most system managers choose to expand these files (for faster access). The expansion requires approximately 8,500 additional blocks.

At least 35,000 free blocks are required to upgrade from VMS V5.3 or V5.3-x to VMS V5.4.

To support full VMS, a system disk of greater than 100 MB is recommended. When a smaller disk is used, additional tailoring is required prior to installing some VMS options. This does not include the dump file space. Refer to VMS Upgrade and Installation Procedures Manual for information on tailoring.

VMS DECwindows Disk Block Requirements

The disk block size for the complete VMS DECwindows environment after installation is approximately 55,000 blocks. This is in addition to the 82,000 blocks required for the other components of the VMS operating system environment. A subset of the DECwindows environment can be installed. For example, programming support need not be installed in a user environment.

The following list describes how many blocks are needed for each section:

- User environment and applications - 12,000 blocks. This section provides support for running VMS DECwindows applications on VAX compute servers.
- Workstation device support - 13,000 blocks. This number includes 2,300 blocks for the 75 dpi fonts and 2,800 blocks for the 100 dpi fonts. On 75 dpi systems, the 100 dpi fonts do not have to be installed. On 100 dpi systems, both sets of fonts must be installed.
- Programming support - 27,000 blocks (approximately 3,500 per language). This number includes support for all the programming languages. If only a subset of languages are installed, the amount of disk space will be less.
- Example files - approximately 3,000 blocks.

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

The VMS DECwindows software installation is an optional step in the VMS installation or upgrade procedure. It has been designed this way to allow users who do not need the VMS DECwindows software to conserve disk space and to allow systems with less than minimum configuration requirements to continue to run VMS. Please refer to VMS Installation and Upgrade Procedures for details concerning the partial installation of the VMS DECwindows software.

Memory Requirements

The following tables describe the minimum amount of memory required for a system user to install, boot, and log into a VMS system. To ensure satisfactory performance of applications, additional memory will be required.

The minimum amount of memory supported for a standalone VMS system is 2 MB. This first table contains the minimum amount of additional memory required for the following components to be installed on a VMS system.

Component	Necessary Memory
DECnet	.5 MB
VAXcluster	1.5 MB
DECwindows with remote execution of applications	1.5 MB
DECwindows with local execution of applications	2.0 MB

Two example configurations based on the previous table are:

System	Minimum Supported Memory
DECwindows with applications executing remotely, and DECnet	4.0 MB
DECwindows with applications executing locally, VAXcluster and DECnet	6.0 MB

Note: These are the minimum memory requirements. More memory will be required for satisfactory performance of the operating system and DECwindows applications. The performance and memory usage of VMS DECwindows systems is particularly sensitive to system configuration and window and application usage. Remote execution of an application requires an additional system which 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 VMS documentation for more information on performance.

SOFTWARE LICENSING

The VMS software is furnished under the licensing provisions of Digital's Standard Terms and Conditions.

The VMS license also includes the license for the VAX Rdb/VMS Run-time Option. VAX Rdb/VMS Run-time has separate documentation, media kit and service products. This allows the running of an application developed using VAX Rdb/VMS. However, should one want to perform Rdb development a separate Rdb media and documentation kit must be purchased. Refer to SPD 25.59.xx for further information.

VMS DECwindows is an integral part of the VMS Operating System requiring no separate license.

Customers who wish to run DECwindows over TCP/IP need only purchase the VMS/ULTRIX Connection product media and documentation kit. A separate license is not required. Customers who want to utilize the full VMS/ULTRIX Connection functionality (FTP, NFS, TELNET) do need to purchase a separate license. Refer to the VMS/ULTRIX Connection System Support Addendum (SPD 25.A4.xx) for required versions.

Please see the Third Party Licensing section in Appendix C, for information regarding the Adobe licensing.

The System Integrated Products (SIPs), VAXcluster Software (SPD 29.78.xx), DECnet-VAX (SPD 25.03.xx), VAX Volume Shadowing (SPD 27.29.xx) and VAX RMS Journaling (SPD 27.58.xx), are separately licensed products. Please refer to the appropriate product's SPD for more information.

VMS License Information

The VMS Operating System uses one of four different kinds 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.

Digital provides the proper license type with the purchase of the system. However, all VMS license types are not available for all system models.

These are the four types of VMS licenses:

1. VMS Availability License

This type of license provides unlimited use to the users on a defined system. These licenses are sometimes referred to as capacity licenses. VMS availability licenses are sized according to system type.

2. VMS Multiuser License

This type of license provides use according to a specified number of concurrent users. This is an activity-based license. The Operating System 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 onto the system and is using the system interactively. Interactive use of the operating system includes the display of information upon any video or hardcopy display product whether in a DECwindows/X Windows environment or otherwise.

3. VMS Workstation License

This type of license provides use for a single-user on a VAX Workstation.

4. VMS Server License

This type of license provides for the non-interactive use of VMS.

VAX/VMS based VAXservers are sold with a VMS File and Application Server License. The intent of a VAX/VMS 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, etc.)

The software licensing implications are that no direct operating system log-ons are intended upon the VAX/VMS based VAXserver. One direct log on is allowed for system management purposes only.

While remote submission of VAX/VMS based layered products for execution upon a VAX/VMS based VAXserver is allowed, interactive use (direct log-on and execution) of VAX/VMS based layered products is prohibited.

Not all VMS license types are available for all system models.

LICENSE MANAGEMENT FACILITY SUPPORT

The VMS Operating System supports the License Management Facility.

If no VMS license is registered and activated using the License Management Facility, then a single login is permitted for system management purposes through the system console (OPA0:).

Several of the VMS 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. VMS defines activities, sometimes referred to as VMS "users" as follows:

- Each remote terminal connection is considered an activity. This is true even if you set host to your local node (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 local Digital office.

DOCUMENTATION

Extensive documentation is available for VMS. The documentation is organized into functional subkits, based on usage. For example, all system management manuals are in one subkit. An easy-to-use desk-top set of manuals is also available for users who do not require extensive documentation.

Documentation for VMS DECwindows is available in two different sets. The VMS DECwindows User Kit is for the end and the VMS DECwindows Programming Kit is for the DECwindows software developer.

In addition, the VMS Online Documentation Library compact disc contains the following VMS documentation, which can be read using the DECwindows Bookreader application:

- VMS Base Documentation Set
- VMS Extended Documentation Set
- VMS DECwindows User Kit and Programmer Kit *
- Selected VMS Layered Product Documentation

* With the exception of the Adobe PostScript Documentation which is not available online.

ORDERING INFORMATION

This section contains order numbers for VMS media, licenses, documentation, and services.

Software License: QL-001A*-**

Media and Documentation

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

Additional Documentation Sets

Base Documentation Set: QA-09SAA-GZ
Extended Documentation Set: QA-001AA-GZ
DECwindows User Kit Documentation:[1]
QA-09SAB-GZ
DECwindows Programmers Kit Documentation:
QA-001AM-GZ
VMS Online Documentation Library on Compact Disc:
QA-VYR8A-G8

[1] Included in both VMS Base Documentation and Extended Documentation Sets

Software Product Services

Software Support Service:[2] QT-001A*-**

Media and Documentation Update Service

With Base Documentation Set: QT-09SA*-E*
With Extended Documentation Set: QT-001A*-E*

Documentation Only Update Service

Base Documentation Set: QT-09SAA-KZ Extended Documentation Set: QT-001AA-KZ DECwindows Programmers Kit Documentation: QT-001AM-KZ VMS Online Documentation Library on Compact Disc: QT-VYR8A-C8

[2] A variety of integrated and a la carte Hardware and Software Products are available. For additional information, please contact your local office.

The Software Media and Extended Documentation Set (QA-001A*-H*) is recommended for users managing high-end VAX systems e.g., VAX 8600 or VAX 8830, VAXcluster systems, or DECnet-VAX networks. The Software Media and Base Documentation Set (QA-09SA*-H*) is recommended for managers of small standalone systems and for general end-users.

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

DISTRIBUTION MEDIA

Disk: Compact Disc

Tape: 9-track 1600 BPI Magnetic tape, TK50 Streaming Tape

The VMS Operating System is also available as part of the VMS Consolidated Software Distribution on compact disc. The VMS Documentation is also available as part of the VMS Online Documentation Library on compact disc.

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.

SOFTWARE PRODUCT SERVICES

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

Supported Hardware for VMS, VMS DECwindows, VAXcluster and DECnet-VAX

This section of the SPD contains four parts: Hardware Charts, Appendix A, Appendix B and Appendix C.

The charts list the hardware that VMS, VMS DECwindows, DECnet-VAX, and VAXcluster Software support. Combinations of hardware options are subject to limitations such as bandwidth, physical configuration constraints, and electrical load and power supply.

Appendix A describes system-specific restrictions for the configurations listed.

Appendix B describes Digital terminals, disks, tapes, controllers, communications options, and VAXcluster options. Some restrictions for specific devices are listed if applicable.

The content of this hardware configuration appendix is intended to specify the device limitations and provide a general guide. It does not describe all possible hardware configurations or circumstances. Any particular configuration should be discussed with Digital. Contact Digital for the most up-to-date information on possible hardware configurations.

Digital reserves the right to change the number and type of devices supported by VMS, VMS DECwindows, DECnet-VAX, and VAXcluster Software. The minimum hardware requirements for future versions and updates of VMS, VMS DECwindows, DECnet-VAX, and VAXcluster Software may be different from current hardware requirements. For configuration details about VAX hardware, refer to the VAX System and Options Catalog and the Networks and Communications Buyers Guide.

Refer to the individual SPDs for DECnet-VAX and VAXcluster Software for detailed product information.

Product Name	SPD Number
DECnet-VAX	SPD 25.03.xx
VAXcluster Software	SPD 29.78.xx

How to Read Charts

The first column lists the VAX system, the media (tape, disk, or compact disc) from which the VMS Operating System can be loaded onto the system disk, and the maximum number of busses supported on the system.

The second column lists the disk controllers and drives that can be used on the system. A disk controller can be used with any disk drive listed next to it: for example, on a MicroVAX II or VAXstation II system the RQDX3 disk controller can be used with an RD52, RD53, RD54, RX50, or RX33 disk drive.

The third column lists the tape controllers and drives that can be used on the system. The tape controller can be used with any tape drive listed next to it: for example, on a MicroVAX II or VAXstation II system, the TQK50 controller can be used with the TK50 tape drive.

The fourth column lists the communications options available for the system. See the Load Unit Table in the DECnet-VAX SPD to calculate the number of adapters allowed on each system.

The fifth column lists the VAXcluster options (Ethernet and Computer Interconnect) available for connecting systems into VAXcluster Configurations. The listed Ethernet devices may also be used for network connections.

The sixth column lists other hardware that can be used and the maximum amount of memory allowed on the systems in each category.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	**DRIVE**	**CTRL**	**DRIVE**				
	(Q-bus)		(Q-bus)				(Ethernet)	
MicroVAX II,	KDA50	RA-series*	TQK50	TK50	Asynch-	CXA16*+	DEQNA	DRV11-WA*
VAXstation II			TQK70	TK70		CXB16*+	DELQA	LPV11
			TSV05	TS05		CXY08*	DESQ#	VCB01-KP
			KLESI	TU81-Plus*		DZV11		(VsII)
				RV20*		DHV11*		VCB02-B
						DHQ11		(VsII/GPX)
						DZQ11		VCB02-D
								(VsII/GPX)
								RQDXE
								16MB Max Mem
(Load Media)	RQDX2	RD51						
TK50		RD52						
Magtape		RD53						
RX33##		RX50						
CDROM								
	RQDX3	RD52						
		RD53						
		RD54						
		RX50						
		RX33						
	KRQ50	RRD50						
		RRD40						
	KLESI	RC25						
(BUSSES)	(DSSI)				Synch-	DMV11		
1 Q-bus						DSV11		
2 DSSI**								
	KFQSA	RF30						
		RF71						

* Can be used on a MicroVAX II system only.

** Only available via the KFQSA.

+ DECnet-VAX does not support these options.

# Only available with BA200-series enclosures.

## VMS distribution on this media has been retired.

System	Disks CTRL	Disks DRIVE	Tapes CTRL	Tapes DRIVE	Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
							(Ethernet)	
MicroVAX	Integral	RD32	TZK50	TK50	Asynch-	DST32*+	Integral	VS40X (Vs2000)
2000		RD53				DSH32		14MB Max Mem
VAXstation		RD54						
2000		RX33						
(Load Media)					Synch-	DST32*+		
TK50						DSH32*		
RX33#								
(BUSSES)								
N/A								

* Can be used on a MicroVAX 2000 system only. # VMS distribution on this media has been retired.

+ Concurrent use of the DST32 and the DHT32 is not supported. Supports Display PostScript.

System	**Disks**		**Tapes**		**Communication Options**	**VAXcluster Options (Ether-net/CI)**	**Miscellaneous**
	CTRL	**DRIVE**	**CTRL**	**DRIVE**			
	(SCSI)		(SCSI)			(Ethernet)	
MicroVAX 3100 VAXserver 3100	Integral	RX23 RZ23 RZ24 RRD40	TKZ50	TK50Z	DSH32 (1 sync. & 8 async. lines)	Integral	32MB Max Mem
(Load Media*) TK50 CDROM							
(BUSSES) Integral SCSI							
* Factory-loaded RZ23 and RZ24 on all configurations.							
	(SCSI)		(SCSI)			(Ethernet)	
VAXstation 3100 Series (Load Media) TK50 CDROM	Integral	RZ22 RZ23 RZ24 RZ55 RZ56 RRD40 RX23	Integral	TK50Z TZ30		Integral	WS01X VCB02 Graphics VS40X-PA Graphics Coprocessor 32MB Max Mem
(BUS) SCSI							
Supports Display PostScript.							
						(Ethernet)	
VAXstation 3200	RQDX3	RD53 RD54	TQK50 TSV05	TK50 TS05	Asynch- DHV11 DZQ11	DELQA	Graphics Sub-system for the Vs3200
(Load Media) TK50 CDROM					Synch- DSV11		32MB Max Mem
(BUS) 1 Q-bus	KRQ50	RRD40 RRD50					
Supports Display PostScript.							

System	**Disks**		**Tapes**		**Communication Options**		**VAXcluster Options (Ether-net/CI)**	**Miscellaneous**
	CTRL	**DRIVE**	**CTRL**	**DRIVE**				
	(DSSI)		(Q-bus)				(Ethernet)	
MicroVAX 3300/3400 VAXserver 3300/3400	Integral KFQSA	RF30 RF31 RF71	TQK70 TQK50	TK70 TK50	Asynch-	CXA16+ CXB16+ CXY08		52MB Max Mem
(Load Media) TK50 CDROM Magtape	(Q-bus)							
	KRQ50	RRD40 RRD50	TSV05	TS05				
(BUSSES) 1 DSSI* 1 Q-bus	KDA50	RA-series	KLESI	TU81+	Synch-	DSV11		

* Second DSSI available only via the KFQSA.

+ DECnet-VAX does not support these options.

Note: Refer to the Systems and Options Catalog for listing of supported Q-bus options.

	(Q-bus)		(Q-bus)				(Ethernet)	
MicroVAX 3500 VAXserver 3500 VAXstation 3500	RQDX3	RD53* RD54*	TQK70 TQK50 TSV05	TK70 TK50 TS05	Asynch-	CXA16+ CXB16+ CXY08	DELQA DESQA	Graphics Sub-system for the Vs3500
(Load Media) TK50 Magtape CDROM	KDA50 KRQ50	RA-series	KLESI RV20	TU81-Plus	Synch-	DSV11		64MB Max Mem
(BUSSES) 1 Q-bus 1 DSSI **	(DSSI)							
	KRQ50	RRD40 RRD50						

* Available on MicroVAX 3500 system only.

+ DECnet-VAX does not support these options.

** Only available via the KFQSA. Supports Display PostScript.

Note: Refer to the Systems and Options Catalog for listing of supported Q-bus options.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ethernet/CI)	Miscellaneous
	CTRL	DRIVE	CTRL	DRIVE				
		(SCSI)					(Ethernet)	
VAXstation 3520 VAXstation 3540	I/O Adapter	RZ55 RZ56 RRD40	TQK70	TK70	Asynch-	CXA16+ CXB16+ CXY08	Integral	Graphic Subsystem for the Vs3520/3540 VCB03 optional graphics
(Load Media) TK50 CDROM					Synch-	DSV11		64MB Max Mem
(BUSSES) 1 SCSI 1 Q-bus								

Supports Display PostScript.

+ DECnet-VAX does not support these options.

Note: Refer to the Systems and Options Catalog for listing of supported Q-bus options.

		(Q-bus)	(Q-bus)				(Ethernet)	
MicroVAX 3600 VAXserver 3600 VAXserver 3602 (Load Media) TK50 Magtape CDROM	KDA50 KRQ50	RA-series RRD40 RRD50	TQK70 TQK50 TSV05 KLESI	TK70 TK50 TS05 TU81-Plus RV20	Asynch-	CXA16+ CXB16+ CXY08	DELQA DESQA	64MB Max Mem
(BUSSES) 1 Q-bus 1 DSSI**		(DSSI)			Synch-	DSV11		
	KFQSA	RF30 RF31 RF71						

+ DECnet-VAX does not support these options.

** Only available via the KFQSA.

Note: Refer to the Systems and Options Catalog for listing of supported Q-bus options.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	DRIVE	CTRL	DRIVE				
	(DSSI)		(Q-bus)				(Ethernet)	
MicroVAX	KFQSA	RF30	TQK70	TK70	Asynch-	CXA16+	DESQA	64MB Max Mem
3800		RF31	TQK50	TK50		CXB16+	DELQA	
VAXserver		RF71	TSV05	TS05		CXY08		
3800			KLESI	TU81-Plus				
(Load Media)								
TK50								
CDROM								
(BUSSES)	(Q-bus)				Synch-	DSV11		
1 Q-bus								
1 DSSI*								
	KRQ50	RRD40						
	KDA50	RRD50						
		RA-series						

* Only available via the KFQSA.

+ DECnet-VAX does not support these options.

Note: Refer to the Systems and Options Catalog for listing of supported Q-bus options.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	DRIVE	CTRL	DRIVE				
	(Q-bus)		(Q-bus)				(Ethernet)	
MicroVAX	KDA50	RA-series	TQK70	TK70	Asynch-	CXA16+	DESQA	64MB Max Mem
3900	KRQ50	RRD40	TQK50	TK50		CXB16+	DELQA	
VAXserver		RRD50	KLESI	TU81-Plus		CXY08		
3900			TSV05	TS05				
(Load Media)								
TK50								
CDROM								
Magtape								
(BUS)	(DSSI)				Synch-	DSV11		
1 Q-bus								
1 DSSI*								
	KFQSA	RF30						
		RF31						
		RF71						

* Only available via the KFQSA.

+ DECnet-VAX does not support these options.

Note: Refer to the Systems and Options Catalog for listing of supported Q-bus options.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	DRIVE	CTRL	DRIVE				
	(UNIBUS)		(UNIBUS)				(Ethernet)	
VAX-11/730	UDA50	RA-series	TS11	TS11	Asynch-	DMF32	DEUNA+	CR11
(Load Media)			TUK50	TU80		DZ11	DELUA+	DR11-W
RL02*			KLESI	TU81		DZ32		DMF32-LP
Magtape				TU81-Plus		DMZ32		LP11
						DHU11		LPA11
								FP730
(BUS)	RK711	RK07			Synch-	DMF32		5MB Max Mem
1 UNIBUS	RL211	RL02				DMR11		
	RX211	RX02						
	RUX50	RX50						
	(Integral)							
	IDC	RL02						
		R80						

* VMS distribution on this media has been retired.

+ VAX-11/730 systems are not supported in VAXcluster systems.

System	Disks CTRL	Disks DRIVE	Tapes CTRL	Tapes DRIVE	Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	(UNIBUS)		(UNIBUS)				(Ethernet)	
VAX-11/750	UDA50	RA-series	TS11	TS11	Asynch-	DMF32	DEUNA	DMF32-LP
(Load Media)	RK711	RK07	KLESI	TU80		DZ11	DELUA	DR11-W
RL02*	RL211	RL02		TU81		DZ32	(CI)	DR750
RK07*	RX211	RX02		TU81-Plus		DMZ32	CI750	DW750
RA60*	KLESI	RC25		RV20		DHU11		FP750
Magtape	RUX50	RX50						H7112
								KU750
								LPA11
								RH750
								LP11
								14MB Max Mem
			TUK50	TK50				
			(CI)	TA-series				
			HSC					
(BUSSES)	(MASSBUS)		(MASSBUS)		Synch-	DMF32		
2 UNIBUS						DMR11		
3 MASSBUS								
		RM03	TM03	TE16				
		RM05	TM78	TU77				
		RM80		TU78				
		RP06						
		RP07						
	(CI)	ESE-20						
	HSC	RA-series						

* VMS is not distributed on this media type.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	**DRIVE**	**CTRL**	**DRIVE**				
	(UNIBUS)		(UNIBUS)				(Ethernet)	
VAX-11/780	UDA50	RA-series	TS11	TS11	Asynch-	DMF32	DEUNA	DM32-FP
VAX-11/785			KLESI	TU80		DZ11	DELUA	DR11-W
(Load Media)				TU81		DMZ32	(CI)	DR780
RK07*				TU81-Plus		DHU11	CI780	DW780
RA60*				RV20				H7112
Magtape								FP780**
								FP785***
(BUSSES)	RK711	RK06	TUK50	TK50	Synch-	DMF32		KE780**
4 UNIBUS	RL211	RK07	(CI)	TA-series		DMR11		KU780**
4 MASSBUS	RX211	RL02	HCS					RH780
	KLESI	RX02						LP11
	RUX50	RC25						64MB Max Mem
		RX50						
	(MASSBUS)		(MASSBUS)					
		RM03	TM03	TE16				
		RM05	TM78	TU45				
		RM80		TU77				
		RP05		TU78				
		RP06						
		RP07						
	(CI)	ESE-20						
	HSC	RA-series						

* VMS is not distributed on this media.

** These options are used on the VAX-11/780 only.

*** Used on the VAX-11/785.

							(Ethernet)	
VAXft 3000-310	KFE52	RF31	KFE52	TF70	Synch-	DSF32	Integral	128MB Max Mem
(Load Media)								
TK50								
(BUSSES)								
2 DSSI								

System	**Disks**		**Tapes**		**Communication Options**		**VAXcluster Options (Ether-net/CI)**	**Miscellaneous**
	CTRL	**DRIVE**	**CTRL**	**DRIVE**				
	(DSSI)		(Q-bus)				(Ethernet)	
VAX 4000 Model 300 VAXserver 4000 Model 300 (Load Media) TK50 CDROM	Integral & KFQSA	RF30 RF31 RF71	TQK70 TQK50 TSV05 KLESI	TK70 TS05 TU81-Plus	Asynch-	CXA16+ CXB16+ CXY08	Integral DESQA DELQA	128MB Max Mem
	(Q-bus)				Synch-	DSV11		
(BUS) 1 Q-bus 4 DSSI	KDA50 KRQ50	RA-series						
	(SCSI)							
	KZQSA	RRD40						
Note: Factory loaded software on all configurations.								
	(VAXBI)		(VAXBI)			VAXBI	(Ethernet)	
VAX 6000-200 Series+ VAXserver 6000-210 VAXserver 6000-220	KDB50 KDM70 TM32	RA-series	KLESI	TU81-Plus RV20	Asynch-	DMB32 DHB32	DEBNA DEBNI DEMNA	LP11* DMB32-LP DR11-W* DWMUA* DRB32
(Load Media) TK50 16MT9								
	(CI)		(CI)				(CI)	
(BUSSES) 6 VAXBI 1 UNIBUS	HSC	ESE-20 RA-series	HSC KDM70	TA-series	Synch-	DMB32 DSB32	CIBCA-AA CIBCA-BA CIXCD-AB	512MB Max Mem

+ Formerly named the VAX 6210, 6220, 6230, 6240.

* Supported on the VAX 6000-210 and VAX 6000-220 systems only.

System	Disks		Tapes		Communication Options		VAXcluster Options (Ethernet/CI)	Miscellaneous
	CTRL	**DRIVE**	**CTRL**	**DRIVE**				
	(VAXBI)			(VAXBI)		(VAXBI)	(Ethernet)	
VAX 6000-300 Series+ VAXserver 6000-310/320 (Load Media) TK50	KDB50 KDM70 TM32	RA-series	KLESI TBK70	TU81-Plus TK70	Asynch-	DMB32 DHB32	DEBNA DEBNI DEMNA	LP11* DMB32-M DR11-W* DRB32 DWMUA* 512MB Max Mem
(BUSSES) 6 VAXBI 1 UNIBUS*	(CI) HSC	ESE-20 RA-series	(CI) HSC KDM70	TA-series	Synch-	DMB32 DSB32	(CI) CIBCA-AA CIBCA-BA CIXCD-AB	

+ Formerly named the VAX 6310, 6320, 6330, 6340, 6360.

* Supported on the VAX 6000-310 and VAX 6000-320 systems only.

	(VAXBI)		(VAXBI)		(VAXBI)		(Ethernet)	
VAX 6000-400 Series VAXserver 6000-410/420 (Load Media) TK50	KDB50 KDM70 TM32	RA-series	KLESI TBK70 TBK50	TU80-Plus TK70 TK50	Asynch-	DMB32 DHB32	DEBNA DEBNI DEMNA	LPA11 DR11-W 512MB Max Mem FV64A
(BUSSES) 6 VAXBI 1 UNIBUS			(CI) HSC	TA-series	Synch-	DMB32 DSB32	(CI) CIBCA-BA CIXCD-AB	
	(VAXBI)		(VAXBI)			(VAXBI)	(Ethernet)	
VAX 6000-500 Series VAXserver 6000-510/520 (Load Media) InfoServer 100 TK50	KDB50 KDM70 TM32	RA-series	KLESI TBK70 TBK50	TU80-Plus TK70 TK50	Asynch-	DMB32 DHB32	DEBNA DEBNI DEMNA	LPA11 DR11-W 512MB Max Mem FV64A
(BUSSES) 6 VAXBI			(CI) HSC	TA-series	Synch-	DMB32 DSB32	(CI) CIBCA-BA CIXCD-AB	

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	DRIVE	CTRL	DRIVE				
	(VAXBI)		(VAXBI)			(VAXBI)	(Ethernet)	
VAX 8200	KDB50	RA-series	KLESI	TU81-Plus	Asynch-	DHB32	DEBNA	DMB32-LP
VAX 8250	(CI)	ESE-20	TM32	RV20		DMB32	DEBNI	DR11-W
(Load Media)	HSC		(UNIBUS)	RV64		(UNIBUS)	DELUA	DWBUA
Magtape				TU80		DHU11	(CI)	DRB32
RA60*			TS11	TU81		DMF32	CIBCA-AA	LP11
			TUK50	TU81-Plus		DMZ32	CIBCA-BA	128MB Max
			(CI)	TK50			CIBCI	Mem
			HSC	TA-series				
(BUSSES)		RA-series			Synch-	(VAXBI)		
1 VAXBI						DMB32		
1 UNIBUS						DSB32		
* VMS Operating System is not distributed on RA60 media.								
	(VAXBI)			(VAXBI)		(VAXBI)	(Ethernet)	
VAX 8300	KDB50	RA-series	KLESI	TU81-Plus	Asynch-	DHB32	DEBNA	DMB32-LP
VAX 8350	(CI)	ESE-20	TM32	RV20		DMB32	DEBNI	DR11-W
(Load Media)	HSC		(UNIBUS)	RV64		(UNIBUS)	DELUA	DWBUA
Magtape				TU80		DHU11	(CI)	DRB32
RA60*			TS11	TU81-Plus		DMF32	CIBCA-AA	LP11
			TUK50	TK50		DMZ32	CIBCA-BA	128MB Max
			(CI)	TA-series			CIBCI	Mem
			HSC					
(BUSSES)		RA-series			Synch-	DMB32		
1 VAXBI						DSB32		
1 UNIBUS								
* VMS Operating System is not distributed on RA60 media.								
	(VAXBI)			(VAXBI)		(VAXBI)	(Ethernet)	
VAX 85xx	KDB50	RA-series	KLESI	TU81-Plus	Asynch-	DHB32	DEBNA	DMB32-LP
(Load Media)				RV20		DMB32	DEBNI	DR11-W
Magtape				RV64		(UNIBUS)	DELUA	DWBUA
						DHU11	(CI)	DRB32
						DMF32	CIBCA-AA	LP11
						DMZ32	CIBCA-BA	256MB Max
							CIBCI	Mem
(BUSSES)	(CI)	ESE-20	(CI)	TA-series	Synch-	(VAXBI)		
2 VAXBI	HSC	RA-series	HSC			DMB32		
1 UNIBUS						DSB32		

System	**Disks**		**Tapes**		**Communication Options**		**VAXcluster Options (Ether-net/CI)**	**Miscellaneous**
	CTRL	**DRIVE**	**CTRL**	**DRIVE**				
	(UNIBUS)		(UNIBUS)				(Ethernet)	
VAX 8600	UDA50	RA-series	TS11	TS11	Asynch-	DMF32	DEUNA	DMF32-LP
VAX 8650	RL211	RL02	KLESI	TU80		DZ11	DELUA	DR11-W
(Load Media)	RX211	RX02	TUK50	TU81		DZ32		DR780
Magtape	RUX50	RX50	(CI)	TU81-Plus		DMZ32		DW780
	KLESI	RC25	HSC	RV20		DHU11		FP86-AA
				TK50				RH780
				TA-series				260MB Max Mem
(BUSSES)	(MASSBUS)		(MASSBUS)		Synch-	DMF32	(CI)	
7 UNIBUS						DMR11	CI780	
6 MASSBUS								
2 SBI								
		RM03	TM03	TE16				
		RM05	TM78	TU77				
		RM80		TU78				
		RP05						
		RP06						
		RP07						
	(Integral)	RA60	IDTC	TU81				
	IDTC	RA80						
	(CI)	RA81						
	HSC	RA82						
		ESE-20						
		RA-series						

System	Disks		Tapes		Communication Options		VAXcluster Options (Ether-net/CI)	Miscellaneous
	CTRL	DRIVE	CTRL	DRIVE				
	(VAXBI)			(VAXBI)		(VAXBI)	(Ethernet)	
VAX 8700 VAX 8800 VAX 8810 (Load Media) Magtape	KD850	RA-series	KLESI	TU81-Plus RV20 RV64	Asynch-	DHB32 DMB32	DEBNA DEBNI DELUA	DMB32-LP DR11-W DRB32
(BUSSES 4 VAXBI 2 UNIBUS	(CI) HSC	ESE-20 RA-series	(CI) HSC	TA-series		(UNIBUS) DMF32 DMZ32	(CI) CIBCA-AA CIBCA-BA CIBCI	DWBUA LP11 512MB Max Mem
					Synch-	(VAXBI) DMB32 DSB32		
	(VAXBI)		(VAXBI)				(Ethernet)	
VAX 8810* VAX 8820 VAX 8830 VAX 8840 (Load Media) Magtape	KD850	RA-series	KLESI	TU81-Plus RV20 RV64	Asynch-	DMB32 DHB32	DEBNA DEBNI (CI) CIBCA-AA CIBCA-BA CIBCI**	DMB32-LP DR11-W DWBUA DRB32 LP11 512MB Max Mem
(BUSSES) 6 VAXBI 1 UNIBUS	(CI) HSC	ESE-20 RA-series			Synch-	DMB32 DSB32		

* The VAX 8810 can support a maximum of 4 VAXBIs.

** Supported only on the VAX 8810.

VAX 9000-210 VAX 9000-410 (Load Media) 9-track Tape (BUSSES) 1 XMI 4 VAXBI	(XMI) KDM70	RA-series ESE-20	KLESI KDM70	RV20 RV64 TA-series	Asynch-	DMB32 DHB32	DEMNA (4 Max) (CI) CIXCD (4 Max)	512MB Max Mem DRB32-M/E/W/C DWMBB(VAXBI EXP) KDB50
	(CI) HSC	ESE-20 RA-series	(CI) HSC		Synch-	DMB32 DSB32		

NOTE: The VMS software that runs on the MicroVAX console subsystem is licensed for use only with standard console activities. No other use is intended or implied.

Appendix A

This appendix describes some restrictions to the system configurations listed in the charts. See the VAX System and Options Catalog and the Network and Communications Buyers Guide for details of VAX hardware configurations.

MicroVAX I/VAXstation I Systems

The final version of VMS which supports these systems is VMS V5.1-1.

MicroVAX II System

The CX series boards and DESQA controller can be used in a BA213 cabinet only.

MicroVAX 2000 and VAXstation 2000 Systems

DECnet-VAX supports only one asynchronous data/modem RS-232C serial line up to 9600 baud on the integral 4 line asynchronous controller.

VAXserver 3602 System

The VAXserver 3602 is two VAXserver 3600 systems.

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.

A maximum of two RL02 disk drives can be added to the dual RL02 and the R80/RL02 configuration for VAX-11/730 only.

The VAX-11/730 systems supports one UNIBUS magnetic tape subsystem.

Refer to Hardware System and Options Catalogue for the different hardware options supported on these systems.

The VMS DECwindows environment is not supported on these systems.

Appendix B

This appendix describes Digital terminals, disks, tapes, controllers, communications options, and VAXcluster options.

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.

The following table lists the terminals that are supported by VMS:

VT52	VT100-series	VT200-series	
VT300-series	VT1000-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 VMS and its associated utilities, the VT131 only operates 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" and 19" monotors.

Disks

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

ESE-20	120 MB solid state disk drive	(MSCP)
RA60	205 MB removable disk drive	(MSCP)
RA70	280 MB fixed disk drive	(MSCP)
RA80	128 MB fixed disk drive	(MSCP)
RA81	456 MB fixed disk drive	(MSCP)
RA82	622 MB fixed disk drive	(MSCP)
RA90	1.2 GB fixed disk drive	(MSCP)
RA92	1.5 GB fixed disk drive	(MSCP)
RC25 *	2 disks each 26 MB (1 fixed and 1 removable) disk drive with shared spindle	(Q-bus, UNIBUS)
RD32 *	VAX 42 MB fixed disk drive for MicroVAX 2000 and VAXstation 2000	
RD51 *	10 MB fixed disk drive	(Q-bus)
RD52 *	31 MB fixed disk drive	(Q-bus)

RD53 +	71 MB fixed disk drive	(Q-bus, or Integral Controller on MicroVAX 2000)
RD54	159 MB fixed disk drive	(Q-bus, or Integral Controller on MicroVAX 2000)
RF30	150 MB disk drive	(DSSI)
RF31-KA	381 MB disk drive	(DSSI)
RF31-JA	381 MB shockmounted removable disk drive	(DSSI)
RF71	400 MB disk drive	(DSSI)
RK06 *	14 MB removable disk drive	(UNIBUS)
RK07 *	28 MB removable disk drive	(UNIBUS)
RL02 *	10 MB removable disk drive	(UNIBUS)
RM03 +	67 MB removable disk drive	(MASSBUS)
RM05	256 MB removable disk drive	(MASSBUS)
RM80	124 MB fixed disk drive	(MASSBUS)
R80 +	124 MB fixed disk drive for VAX-11/725 and VAX-11/730	
RRD50 *	600 MB read-only optical disk drive	(Q-bus)
RRD40 *	600 MB read-only optical disk drive	(Q-bus and SCSI)
RP05 +	88 MB removable disk drive	(MASSBUS)
RP06	176 MB removable disk drive	(MASSBUS)
RP07	516 MB fixed disk drive (2.2 MB/sec transfer rate is supported if the RH780 is at REV B1 or greater for the VAX-11/780, VAX-11/785, VAX 8600 and VAX 8650.)	(MASSBUS)
RX02 *	512K byte diskette. The RX02 drive also writes using single-density RX01 diskettes.	(UNIBUS)
RX50 *	400K byte diskette	(Q-bus, or Integral Controller on MicroVAX 2000)
RX33 *	1.2 MB diskette. Requires minimum RQDX3 microcode of V3.0.	(Q-bus, or Integral Controller on MicroVAX 2000)
RX23	1.47 MB diskette (SCSI)	
RV20 *	2 GB Write Once Read Many Optical disk	(Q-bus, UNIBUS, VAXBI)
RV64 *	2 GB Write Once Read Many Optical disk sub-system	(Q-bus, UNIBUS, VAXBI)
RZ22 *	52 MB SCSI disk	
RZ23	104 MB SCSI disk	
RZ24	209 MB SCSI disk	
RZ55	332 MB SCSI disk	
RZ56	665 MB SCSI disk	

* Device cannot be used as a VMS system disk.

+ Device cannot be used as a VMS system disk with VMS DECwindows environment.

Tapes

TA78	STI TU78	(MSCP)
TA79	STI TU79	(MSCP)
TA81	STI TU81	(MSCP)
TA90	1.2 GB, tape cartridge subsystem (5" 200 MB cartridge)	(MSCP)
TK50	95 MB, 5 1/4" streaming tape cartridge	(Q-bus and SCSI)
TK70	296 MB, 5 1/4" streaming tape cartridge	(Q-bus)
TZ30	Tape drive for the VAXstation 3100	(SCSI)
TE16	9-track magnetic tape	(MASSBUS)
TM32	9 track tape controller only with large record support	(VAXBI)
TU77	9-track magnetic tape	(MASSBUS)
TU78	9-track magnetic tape	(MASSBUS)
TU80	9-track magnetic tape	(UNIBUS)
TU81	9-track magnetic tape	(UNIBUS)
TU81-Plus	Streaming 9-track magnetic tape	(Q-bus, UNIBUS, VAXBI)
TS05	9-track magnetic tape	(Q-bus)
TS11	9-track magnetic tape	(UNIBUS)

Controllers

DMB32-LP	VAXBI DMA parallel high speed line printer controller.
DRB32	High speed general purpose parallel interface for VAXBI (systems).
DMF32-LP	Synchronous/Asynchronous communication option with printer port for use on UNIBUS based systems.
HSC40	Hierarchical Storage Controller for MSCP disks and TMSCP tapes. (HSC Software must be a minimum Version of 5.00.)
HSC50	Hierarchical Storage Controller for MSCP disks and TMSCP tapes. (HSC Software must be a minimum Version 4.00.)
HSC70	Hierarchical Storage Controller for MSCP disks and TMSCP tapes. (HSC Software must be a minimum Version 5.00.)
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.
KDM70	The KDM70 is an intelligent MSCP/TMSCP mass-storage controller which supports RA Series Disks and Storage Arrays, TA Series Tape, and ESE20. The minimum version 2.2 is requrired with VMS.
KFQSA	Q-bus DSSI bus storage adapter. This adapter allows up to seven DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a Dual-Host Configuration.)
KLESI	Q-bus, UNIBUS and VAXBI tape controller for the TU81-Plus, RV20 or RC25.
KRQ50	Q-bus controller for the RRD50/RRD40 compact disk reader.
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 a RQDX1, RQDX2 and a 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 4 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.
TF70	290 MB TK70 cartridge tape drive with DSSI adapter.
TM03	MASSBUS tape controller for the TE16 and TU77 magnetic tape drives.
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.
TSV05	Q-bus tape controller for the TS05 magnetic tape drive.
TS11	UNIBUS tape controller for the TS11 magnetic 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.

MASSBUS Adapter/Tape Subsystems

These include a MASSBUS adapter, a tape formatter, and a transport (a TU77 for the TxU77 subsystems, a TE16 transport for TxE16 subsystem, or a TU78 for the TEU78 subsystem).

A maximum of three additional TU77 magnetic tape transports can be added to a TxU77 subsystem and a maximum of seven additional TE16 magnetic tape transports can be added to a TxE16 subsystem. Different magnetic tape transports cannot be mixed on the same tape subsystem.

With disks and magnetic tape transports mixed on the same MASSBUS, the following rules apply:

- Disks can be added to a magnetic tape subsystem, to a maximum of seven additional disks per tape subsystem.
- Tapes cannot be added to a disk subsystem.

Asynchronous Terminal Controllers

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: VMS 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: VMS 19200, DECnet-VAX 9600. (Full modem control) (Q-bus)
DMB32	8 line asynchronous terminal controller, maximum baud rates supported: VMS 19200, DECnet-VAX 9600. (Full modem control) (VAXBI)
DMF32	8 line asynchronous terminal controller, maximum baud rates supported: VMS supports 19200, DECnet-VAX supports 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: VMS 19200 , DECnet-VAX 9600. (Modem support dependent on configuration) (UNIBUS)
DSH32	1 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: VMS 19.2 KBPS (kilobits/second).
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: VMS supports 19200, DECnet-VAX supports 9600. (Partial modem control) (Q-bus)
DZV11	4 line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: VMS supports 19200, DECnet-VAX supports 9600. (Partial modem control) (Q-bus)

Integral asynchronous serial lines for the MicroVAX 2000 and the VAXstation 2000.

On the MicroVAX 2000, one line is the modem/data line and three are data- only lines. On the VAXstation 2000, the lines support keyboard, mouse, modem connection, and printer or plotter. DECnet-VAX supports all four asynchronous data/modem RS-232C serial lines up to 9.6 kilobits/second on the integral 4 line asynchronous controller for MicroVAX 2000.

Synchronous Controllers

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)
DSB32	Two line, multiple protocol, synchronous adapter. (VAXBI)
DSH32	1 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: VMS 19.2 KBPS (kilobits/second). 9.6 KBPS for MicroVAX 2000, etc.
DST32	Synchronous single line support for DDCMP up to 9.6 kilobits/second, 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.

Ethernet Options

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 in clusters of over 42 nodes.
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.
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

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

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.
DSSI	Digital Storage Systems Interconnect.
DWBUA	XMI to UNIBUS adapter.
DWMBA	XMI to BI adapter; also the adaptor used to connect the XMI to VAX expander cabinet.
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 back-up 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.
MA780	Multiport shared memory. A multiple version VMS 4.7 and VMS 5.x-n VAXcluster system is not supported if the system is configured with MA780 memory.
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.
SCSI	Small Computer System Interconnect.
VS40X	4-plane graphics co-processor.
WS01X	VAXstation 31000 SPX Graphics option.
InfoServer 100	InfoServer 100 is a stand-alone Ethernet-based virtual disk server. The server has locally attached SCSI removable CDROMs and SCSI disk storage. VMS V5.4 supports virtual disk reads. For other features, please refer to the InfoServer 100 Software Product Description.

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Appendix C

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