

# Software Product Description

PRODUCT NAME: VMS Operating System, Version 5.1

SPD 25.01.31

## DESCRIPTION

### *System Overview*

VMS is a general purpose multiuser operating system which supports VAX, MicroVAX and VAXstation series computers. It works reliably and efficiently 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. (The actual amount of work supported with good performance depends upon the processor type, available physical memory, and secondary storage operations.)

VMS has well integrated networking, distributed computing, and multiprocessing capabilities. It contains extensive ease-of-use, programmer productivity, and system management features.

### *User Environment*

#### *General Access*

Users may access VMS by using the English-like DIGITAL Command Language (DCL), the standard 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 can be entered from a terminal or can be included in command procedures. Command procedures may be invoked directly in an interactive session or may be submitted to a batch queue for deferred execution. DCL commands provide information about the system, initiate system utilities, and initiate user programs.

DCL and VMS Utilities have a consistent integrated help subsystem to provide summary operational information on all aspects of system operation.

#### *Tools and Utilities*

VMS provides a number of tools and utilities for general users, programmers and system managers. This section briefly describes each group of tools and utilities.

### *General User*

**Text Processing** - The Extensible VAX Editor (EVE) is one of several text editors supplied by DIGITAL and it permits the user to quickly insert and delete text. EVE is a full screen editor that allows the text to be scrolled on the screen of an interactive terminal. EVE is written in the Text Processing Utility (TPU) language. EVE provides an EDT-style keypad.

**Mail Facility** - The Mail facility permits a user to send messages to any other user by typing the recipient's name, the subject of the message, and the text of the message. Multi-node operation is available if DECnet-VAX is installed.

**Command-level Programming** - Command-level programming allows the user to create special files called command procedures that contain a series of DCL commands. When a user invokes a command procedure, the system processes the commands in the command procedure. The user 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** - VMS allows user tailoring of their environment, including user specific login command files, shorthand commands, binding of commands to function keys, and command recall and editing.

Other utilities include Sort/Merge, DIRECTORY, COPY, DELETE, TYPE, PRINT, PURGE, RENAME and SET/SHOW status.

### *Programmer*

**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.

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January 1989

AE-HQ86F-TE

**Symbolic Debugger** - The symbolic debugger helps the user trace program execution and allows a user to display and modify register contents using the same symbols that are in the source code.

**RMS File Utilities** - RMS file utilities allow the user to analyze the internal structure of an RMS file. They can help the user determine the most appropriate set of parameters for an RMS file, and how to create, efficiently load, and reclaim space in an RMS file. (Refer to "VMS Record Management Services" 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 DEC 7bit terminals, such as the VT100, to input and output the DEC Multinational Character Set (MCS). Specific tables allow conversion for a number of different 7bit National Replacement Character sets, such as French, German, Spanish and Swedish, to MCS. TFF also allows character composing on terminals without use of the compose key.

**National Character Set (NCS) Utility** - This utility allows the user to define non-ASCII standard string collating sequences and to define conversion functions. Conversion functions use conversion algorithms to change an input string, for example, change lower case characters to upper case. NCS also allows RMS indexed files to be collated via user-specified collating sequences.

#### *System Manager*

**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 using standard file naming conventions and can be selected by date. Files can be backed up to magnetic tape or to another disk. You can back up and restore selected files using on-line backup or entire volumes using standalone backup.

**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.

**MONITOR** - This utility permits the system manager to monitor different classes of systemwide performance data (for example, process activity, I/O activity, and memory management activity) at user-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 allows the system manager to limit use of the software products to a subset of systems in a VAXcluster and it 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 are 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.

#### *Program Development*

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

The VMS Run-Time Library provides general string manipulation, Input/Output (I/O), 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, VAX C, VAX COBOL, VAX DIBOL, VAX FORTRAN, VAX PASCAL, VAX PL/I, VAX RPG, 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 may 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 standard call 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 standard call and condition handling conventions.

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

#### *System Management*

##### *Security and Control*

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

The system maintains information about user accounts in the user authorization file (UAF), which can be modified by the system manager. 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 vs. remote vs. 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 password length, change frequency, and generation of pronounceable nonsense passwords.

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.

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 the 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 DIGITAL does not warrant that the system is secure, although DIGITAL will fix security problems brought to our attention as promptly as circumstances warrant.

#### *Tailoring Facility*

Tailoring allows users to enjoy the full functionality of VMS while providing a compact version of the operating system on the system disk that is tailored to the users' needs. Tailoring is supported on processors with small disk configuration. VMS upgrade procedures are not supported in tailored environments.

Due to space constraints, there is no guarantee that products can be installed if user code and data 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.

#### *Installation*

VMS is distributed as binary kits on tape, disk, or CDROM. Procedures for setting up the system disk from a kit and for preparing the system for day-to-day operations are simple and straightforward. The procedures are described in the installation and operation guide for each processor.

#### *Batch/Print Facility*

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

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).

Different batch job queues may have different attributes such as the maximum CPU time permitted, working set size, and priority. Facilities are provided for starting and stopping queues, as well as the jobs in a queue.

Print queues, both generic and specific (with forms recognition) together with queue management facilities give the user versatile print capabilities.

#### *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.

#### *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.

#### *VMSINSTAL*

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

#### *System Environment*

##### *Process and Scheduling*

The basic unit of execution in VMS is the process which 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 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 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 physical memory for both multiple concurrently executing processes and for processes whose memory requirements exceed available physical memory. The maximum working set size is 100,000 pages of memory.

Processes can, however, exercise control over memory management. 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 group of users. Interactive terminals are controlled by the system, and the system normally controls one or more printers.

#### *Interprocess Communication*

VMS provides a number of facilities for application that consist of multiple cooperating processes:

- Mailboxes are virtual devices that allow processes to communicate with queued messages.
- Shared memory sections permit multiple processes concurrent access to shared address space.
- Common event flags provide simple synchronization.
- The lock manager provides a more comprehensive enqueue/dequeue facility with multi-level locks, values, and ASTs.

#### *Symmetric Multiprocessing*

VMS provides symmetric multiprocessing (SMP) support for multiprocessor 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 by coupling a VAX processor with mass-storage servers or with other VAX systems, and, optionally, with mass storage servers known as "Hierarchical Storage Controllers" (HSCs). These cooperating, independent processors may share a single disk-resident copy of VMS, RMS data down to the record level, 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.

Refer to VAXcluster Software (SPD 29.78.xx) for more information.

#### *Networking Facilities*

VMS provides device drivers for all DIGITAL Ethernet adapters listed below. 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. Refer to the DECnet-VAX Software Product Description (SPD 25.03.xx) for further information on supported communications devices.

DIGITAL's terminal server products can be used for terminal 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.

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. Refer to DECnet-VAX (SPD 25.03.xx) for more information on this product.

#### *Reliability*

The system handles errors as transparently as possible while maintaining data integrity and providing sufficient information to diagnose the errors. The system limits the effects of an error by first attempting to recover from the

error: then if recovery fails, by reporting the error to the current process for action; and finally (if the error cannot be clearly bounded), by shutting down and restarting the system. VMS will shut itself down rather than continue operating with a condition that could propagate undetected bad data. The types of errors possible are as follows:

- Processor errors (machine checks)
- Operating system errors (system errors or undetected hardware failures)
- User errors
- Memory errors (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.)
- 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 dumps.

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 re-booting. The system restarts devices and communications lines. All I/O operations in progress, including magnetic tape, 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 gains power, the system shuts down.

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.

VMS includes a User Environment Test Package which verifies that the VMS operating system is properly installed on the customer's configuration and ready for use.

#### *Input/Output*

The QIO system services provide a direct interface to the operating systems 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 nonstandard devices can write their own device drivers. (The "VMS Device Support 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, including line printers, card readers, and general data acquisition devices.

#### *VMS Record Management Services (VMS RMS)*

VMS RMS is a set of I/O services that help application programs 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 ensures 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 at the DCL command level of RMS files and records within RMS files.

#### *Disks 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 on 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 standard 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 multi-volume magnetic tape files with transparent volume switching. Access positioning is done either by filename or by relative file position.

#### *VMS DECwindows Features*

Integral to VMS V5.1 is support for the DECwindows desktop environment. This new computing environment is based on the industry standard X Window System™. X Version 11 is a network based window system. The protocol is implemented in the servers on the display end, and libraries on the client end. DIGITAL fully supports the X 11 Protocol in the VMS DECwindows Clients, Libraries, and Server with DECnet as the underlying communications protocol.

To determine whether a specific DECwindows application runs distributed across different operating systems, refer to the application's product description. The applications included with VMS, described in following section, are supported for distributed operation between VMS systems.

The DECwindows desktop environment also provides a new user interface to VMS and promotes the establishment of a consistent style of graphical VMS user interface by including a new set of integrated desktop applications.

#### *X Window System Support*

The VMS implementation of the DECwindows environment is compatible with the X Window System, Version 11. This conformance has been validated by use of the X Testing Consortium's validation suites. Specifically, conformance is provided as follows:

- Support is included for the X display server, X network protocol, and X programming library (Xlib) from Release 2 of the X Window System.
- Support is included for the X toolkit programming library from Release 3 of the X Window System.

#### *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.

Display servers compatible with the X Window System receive output requests from applications and translate 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® printers. In addition, a font compiler is provided so that customers can make their own private fonts available on their DECwindows systems.

#### *The User Environment*

The user environment consists of four basic components.

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 Window Manager provides user control for overlapping windows through various functions.

FileView is a graphical interface to the VMS Operating System that allows users to execute system commands and run DECwindows applications.

The DECterm terminal emulator provides workstation users with a familiar interface for accessing existing VMS features and applications. It is a ReGIS and sixel capable VT320 terminal emulator. Programs written for VT52, VT100, VT220, or VT320 class terminals and using standard VMS terminal driver features operate without modification in this workstation window. DECterm additionally provides workstation-oriented features such as mouse-based cursor positioning, variable screen sizes, and cutting and pasting of text between terminal emulators and other DECwindow 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 some basic end user capabilities.

These applications are:

- Bookreader - A tool for viewing the contents of books that are distributed and stored on-line
- Calculator - A simple four function 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
- Compound document viewers - Tools for reading documents containing compound text, graphics, and image data on terminals and DECwindows workstations
- 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/bul;

Execution of and output display from each of the above applications is supported across the network between VMS systems.

#### *Programming*

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 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. The X and XUI programming libraries have all 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. The CDA libraries have been provided only with VAX calling standard bindings.

Specific support is provided for the following languages:

VAX Ada	VAX FORTRAN
VAX BASIC	VAX MACRO
BLISS-32	VAX PASCAL
Implementation Language	

VAX C (VAX calling standard of VAX PL/I MIT convention.

#### *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 procedure library.

The Xtoolkit programming library included with Release 3 of the X Version 11 Window System 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 for managing, modifying, and creating user interface components (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 their contents

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 run-time code. This capability allows application developers to easily prototype and modify user interface designs, separate form and function in applications, and support internationalizable products.

#### *Compound Document Architecture (CDA) Programming Support*

The CDA Toolkit provides access routines that applications can use to easily 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 two different mechanisms for transport of X network protocol packets between applications and display servers.

The first mechanism is DECnet. This transport is used when the DECwindows application and display server are distributed across two different machines in the network.

The second mechanism is a VMS DECwindows-specific shared memory-based transport. 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.

#### *VAX Volume Shadowing*

VAX Volume Shadowing is a feature available on VAX systems using HSC-series controllers with RA-series disks. This feature enhances data availability by duplicating all data written to disk onto two or three compatible disk volumes. Refer to VAX Volume Shadowing (SPD 27.29.xx) for more information.

#### *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. Refer to VAX RMS Journaling (SPD 27.58.xx) for more information.

#### *Standards*

VMS is based on the following American National Standards Institute (ANSI), U.S. Federal Information Processing (FIPS), and International Standards Organization (ISO) standards:

- 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 X3.39-1986: 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 X3.27-1987: File Structure and Labeling of Magnetic Tapes for Information Interchange (Level 3)
- ANSI X3.54-1986: Recorded Magnetic Tape (6250 BPI, GCR)
- ANSI/IEEE 802.2-1985: Logical Link Control
- ANSI/IEEE 802.3-1985: Carrier Sense Multiple Access with Collision Detection
- FIPS PUB 1, 2, 3-1, 7, 13, 14, 15, 16, 22, 25, 26, 35, 37, and 79, but not FIPS PUB 17-1 or 46; other FIPS PUBs are not applicable
- ISO 646: ISO 7-bit Coded Character Set for Information Exchange
- ISO 1001: File structure and labelling of magnetic tapes for information interchange (Level 3)
- ISO 1863: Information Processing - 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 32 rpm (800 rpi)
- ISO 1864: Information Processing - Unrecorded 12, 7 mm (0.5 in) wide magnetic tape for information interchange - 35 ft/mm (800 fpi) NRZI, 126 ft/mm (3 200 fpi) phase encoded and 356 ft/mm (9 042 fpi), 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 rpm (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
- X display server, X network protocol, and X programming library (Xlib) from Release 2
- X toolkit programming library from Release 3

**GROWTH CONSIDERATIONS**

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 5.1, after installation is approximately 61,000 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 library files which are in data-reduced format. Most system managers choose to expand these files (for faster access). The expansion requires approximately 7,000 additional blocks.

At least 9,000 free blocks are required to upgrade from VMS V5.0 or VMS V5.0-x to VMS V5.1. The recommended amount is 23,000 free blocks.

*VMS DECwindows Disk Block Requirement*

The disk block size for the complete VMS DECwindows environment after installation is approximately 50,000 blocks. This is in addition to the 61,000 blocks required for the other components of the VMS Operating System environment. Select portions of the environment may be installed therefore using less disk space. Peak usage during installation is within 5,000 blocks of the net usage for that installation.

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

- User environment and applications - 16,500 blocks. This section provides support for running VMS DECwindows applications on VAX computer servers.
- Workstation device support - 8,000 blocks. This number includes 2,500 blocks for the 75 dpi fonts and 3,000 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 - 25,000 blocks (approximately 3,000 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.

Note that the individual sizes add up to more than the total because some components are shared by multiple portions of the environment. Please refer to documentation 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 login to 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
VAXcluster	1.5
DECwindows with remote execution of applications	1.5
DECwindows with local execution of applications	2.0

Two example configurations based on the above table are:

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

**Note:** These memory requirements are the minimums. 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 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.

*VMS DECwindows System Restrictions*

The VMS DECwindows software is not supported on the MicroVAX I, VAXstation I, VAX-11/725, and the VAX-11/730.

*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. These are the four types of VMS licenses:

**VMS Availability License**

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

**VMS Multiuser License**

This type of license provides use according to a specified number of concurrent users. This is an activity-based license.

**VMS Workstation License**

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

**VMS Server License**

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

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

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

Several of the VMS license types are based on number of concurrent uses 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 (other than a remote terminal connection) is not considered an activity.

**SOFTWARE LICENSING**

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

The VMS software is furnished under the licensing provisions of DIGITAL's Standard Terms and Conditions. For more information about DIGITAL's licensing terms and policies, contact your local DIGITAL office.

**License Management Facility Support**

This product requires the use of the License Management Facility.

License units for this product are allocated on a per-CPU plus per-user basis.

**Documentation**

Extensive and complete documentation is available for VMS. The documentation is organized into functional subkits, based on usage of the subkit. 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 printed form, in two different sets. The VMS DECwindows User Kit is for the end application user and the VMS DECwindows Programming Kit is for the DECwindows software developer.

The VMS DECwindows Online Documentation compact disc contains both the User Kit and the Programmer Kit.

**ORDERING INFORMATION**

Software License: QL-001A\*-\*\*

Software Media (with Extended Documentation Set): QA-001A\*-\*\*

Software Documentation (with Extended Documentation Set): QA-001AA-GZ

Software Product Services (with Extended Documentation Set): QT-001A\*-\*\*

Software Media (with Base Documentation Set): QA-09SA\*-\*\*

Software Documentation (with Base Documentation Set): QA-09SAA-GZ

Software Product Services (with Base Documentation Set): QA-09SA\*-\*\*

VMS DECwindows User Kit Documentation: QA-09SAB-GZ

VMS DECwindows Programming Kit Documentation: QA-001AM-GZ

VMS DECwindows Online Documentation CD: QA-VP4AA-G8

The Software Media with the Extended Documentation Set is recommended for users managing a high-end VAX system (e.g., a VAX 8600 or VAX 8830), VAXcluster systems, or a DECnet-VAX network. The Software Media with the Base Documentation Set is recommended for managers of small standalone systems, for general end-users.

**DISTRIBUTION MEDIA****VMS**

Disk: RA60, RX33, RL02, RK07, RC25

Tape: 9-track 1600 BPI Magtape (PE), TK50 Streaming Tape

**VMS DECwindows**

Disk: Compact Disk

Tape: 9-track 1600 BPI Magnetic Tape (PE), TK50 Streaming Tape

The VMS DECwindows software is available on the three media types listed above. The VMS DECwindows software is a separately installable option. It has been designed this way to allow users who do not have the need to install VMS DECwindows software to conserve disk space and also to allow systems with less than minimum configuration requirements to continue to run VMS.

#### SOFTWARE PRODUCT SERVICES

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

#### 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.

#### VMS, VAXcluster, and DECnet-VAX Supported Hardware

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

The charts list the hardware that VMS, DECnet-VAX, and VAXcluster Software support. The minimum hardware configuration must include a load device and a system disk. 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 appendices is intended to be a general guide and 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, 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	25.03.xx
VAXcluster Software	29.78.xx

#### How to Read Charts

- The first column lists the VAX system, the devices (tape, disk, or CDROM) from which the VMS Operating System can be loaded onto the system disk, and the maximum number of bus(es) 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 (synchronous and asynchronous) 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 also may 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 CTRL DRIVE		TAPES CTRL DRIVE		COMMUNICATION OPTIONS	VAXCLUSTER OPTIONS (Ethernet/CI)	MISCELLANEOUS
MicroVAX I VAXstation I (LOAD DEVICE) RX50 ** (BUS) 1 Q-bus	RQDX1	RD51 RD52 RX50			(Asynch) DZV11 DHV11 * DZQ11	(Ethernet) DEQNA +	VCB01-KP (VSI)  4 MB max mem
<p>* Can be used on a MicroVAX I system only.</p> <p>** RX50 diskette is not a VMS distribution media.</p> <p>+ VAXcluster Software does not support this option. MicroVAX I and VAXstation I systems are not supported in a VAXcluster system.</p>							
MicroVAX II VAXstation II (LOAD DEVICE) TK50 Magtape RX33 RRD50 (BUS) 1 Q-bus	KDA50  RQDX2  RQDX3  KRQ50 KLESI	RA60 * RA80 * RA81 * RA82 * RD51 RD52 RD53 RX50 RD52 RD53 RD54 RX50 RX33 RRD50 RC25	TQK50 TK50 TQK70 TK70 TSV05 TS05 KLESI TU81-Plus * RV20 *		(Asynch) CXA16 *+ CXB16 *+ CXY08 * DZV11 DHV11 * DHQ11 DZQ11  (Synch) DMV11 DSV11	(Ethernet) DEQNA DELQA	DRV11-WA * LPV11 VCB01-KP (VSI) VCB02-B (VSI/GPX) VCB02-D (VSI/GPX) RQDXE  16 MB max mem
<p>* Can be used on a MicroVAX II system only.</p> <p>+ DECnet-VAX does not support these options.</p>							
MicroVAX 2000 VAXstation 2000 (LOAD DEVICE) TK50 RX33 (BUS) N/A	Integral	RD32 RD53 RD54 RX33	TZK50 TK50		(Asynch) Integral serial Controller + DHT32 *+  (Synch) DST32 *+	(Ethernet) DEQNA	VS40X (VS2000)  14 MB max mem
<p>* Can be used on a MicroVAX 2000 system only.</p> <p>+ DECnet-VAX does not support the DHT32. See the appendices for further DECnet-VAX restrictions.</p>							
VAXstation 3200 (LOAD DEVICE) TK50 (BUS) 1 Q-bus	RQDX3	RD53 RD54	TQK50/07 TK50  TSV05 TS05		(Asynch) DHV11  DZQ11  (Synch) DSV11	(Ethernet) DELQA	Graphic Subsystem for the VS 3200  32 MB max mem

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SYSTEM	DISKS		TAPES		COMMUNICATION OPTIONS	VAXCLUSTER OPTIONS (Ethernet/CI)	MISCELLANEOUS
	CTRL	DRIVE	CTRL	DRIVE			
MicroVAX 3300/3400 VAXserver 3300/3400 (LOAD DEVICE) TK70 (BUS) 1 DSSI 1 Q-bus	Integral DSSI	RF30	TQK70 TQK50	TK70 TK70	(Asynch) CXA16 + CXB16 + CXY08  (Synch) DSV11	(Ethernet) Imbedded Controller	28 MB max mem
+ DECnet-VAX does not support these options.							
MicroVAX 3500 VAXstation 3500 VAXserver 3500 (LOAD DEVICE) TK70 Magtape (BUS) 1 Q-bus	RQDX3  KDA50	RD53 * RD54 * RA60 RA70 RA80 RA81 RA82	TQK70  TSV05  KLESI	TK70  TS05  TU81-Plus RV20	(Asynch) CXA16 + CXB16 + CXY08 (Synch) DSV11	(Ethernet) DELQA DESQA	Graphic Subsystem for the VS 3500 64 MB max mem
* Can be used on a MicroVAX 3500 system only.							
+ DECnet-VAX does not support these options.							
MicroVAX 3600 VAXserver 3600 VAXserver 3602 (LOAD DEVICE) TK70 Magtape (BUS) 1 Q-bus	KDA50	RA60 RA70 RA80 RA81 RA82	TQK70  TSV05  KLESI	TK70  TS05  TU81-Plus RV20	(Asynch) CXA16 + CXB16 + CXY08 (Synch) DSV11	(Ethernet) DELQA DESQA	LPV11-SA  64 MB max mem
+ DECnet-VAX does not support these options.							
VAXstation 8000 (LOAD DEVICE) TK50 (BUS) VAXBI	KRBTA	RD53 RD54	DEBNK	TK50		(Ethernet) DEBNK	3 disk drives max 32 MB max mem
** High Performance Workstation Software is needed in addition to VMS.							

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SYSTEM	DISKS CTRL DRIVE		TAPES CTRL DRIVE		COMMUNICATION OPTIONS	VAXCLUSTER OPTIONS (Ethernet/CI)	MISCELLANEOUS
VAX-11/725 VAX-11/730 (LOAD DEVICE) RC25 * RL02 ** RA60 ** Magtape ** (BUS) 1 UNIBUS	(UNIBUS) UDA50	RA60 RA80 RA81 RA82  RK07  RK07  RL02 **  RX02 ** RX50 KLESI RC25 *  (INTEGRAL) IDC RL02 R80	(UNIBUS) TS11	TS11 TU80 TU81  TU81-Plus	(Asynch) DMF32 DZ11 DZ32 DMZ32 DHU11  (Synch) DMF32  DMR11	(Ethernet) DEUNA + DELUA +	CR11 DR11-W DMF32-LP LP11 LPA11 FP730  3 MB max mem (VAX-11/725) 5 MB max mem (VAX-11/750)
<p>* Can be used on VAX-11/725 systems only.                  ** Can be used on VAX-11/730 systems only.                  + VAXcluster Software does not support the option. The VAX-11/725 and VAX-11/730 systems are not supported in VAXcluster systems.</p>							
VAX-11/750 (LOAD DEVICE) RL02 RK07 RA60 MAGTAPE (BUSSES) 2 UNIBUS 3 MASSBUS	(UNIBUS) UDA50	RA60 RA80 RA81 RA82  RK07  RK07  RL02 RX02 RC25 RX50  (MASSBUS) RM03 RM05 RM80 RP06 RP07	(UNIBUS) TS11	TS11 TU80 TU81  TU81-Plus RV20  TK50   (MASSBUS) TM03 TE16 TU77  TM78 TU78	(Asynch) DMF32 DZ11 DZ32 DMZ32 DHU11  (Synch) DMF32 DMR11	(Ethernet) DEUNA DELUA  (CI) CI750	DR11-W DR750 DW750 FP750 H7112 KU750  14 MB max mem
VAX-11/780 VAX-11/785 (LOAD DEVICE) RK07 RA60 Magtape (BUSSES) 4 UNIBUS 4 MASSBUS	(UNIBUS) UDA50	RA60 RA80 RA81 RA82  RK06 RK07  RK07  RL02 RX02 RC25 RX50  (MASSBUS) RM03 RM05 RM80 RP05 RP06 RP07	(UNIBUS) TS11	TS11 TU80 TU81  TU81-Plus RV20  TK50   (MASSBUS) TM03 TE16 TU45 TU77  TM78 TU78	(Asynch) DMF32 DZ11 DZ32 DMZ32 DHU11 (Synch) DMF32 DMR11	(Ethernet) DEUNA DELUA  (CI) CI780	DR11-W DR780 DW780 H7112 FP780 KE780 KU780  64 MB max mem

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SYSTEM	DISKS		TAPES		COMMUNICATION OPTIONS	VAXCLUSTER OPTIONS (Ethernet/CI)	MISCELLANEOUS
	CTRL	DRIVE	CTRL	DRIVE			
VAX 8600 VAX 8650 (LOAD DEVICE) Magtape (BUSSES) 7 UNIBUS 6 MASSBUS 2 SBI	(UNIBUS) UDA50	RA60 RA80 RA81 RA82	TS11	TS11 TU80 TU81 TU81-Plus RV20	(Asynch) DMF32 DZ11 DZ32 DMZ32 DHU11 (Synch) DMF32 DMR11	(Ethernet) DEUNA DELUA  (CI) CI780	DR11-W DR780 FP86-AA  260 MB max mem
	RL211	RL02	KLESI				
	RX211	RX02	TUK50	TK50			
	RUX50	RX50					
	KLESI	RC25					
	(MASSBUS)	RM03 RM05 RM80 RP05 RP06 RP07	(MASSBUS) TM03	TE16 TU77			
	(INTEGRAL)	IDTC	TM78	TU78			
		RA60 RA80 RA81 RA82 TU81					
VAX 8200 VAX 8250 (LOAD DEVICE) Magtape RA60 (BUSSES) 1 VAXBI 1 UNIBUS	(VAXBI) KDB50	RA60 RA80 RA81 RA82	KLESI	TU81-Plus RV20  (UNIBUS) TS11 TU80 TU81-Plus TUK50	(Asynch VAXBI) DHB32 DMB32  (Asynch UNIBUS) DHU11 DMF32 DMZ32  (Synch VAXBI) DMB32 DSB32	(Ethernet) DEBNA DELUA  (CI) CIBCA-AA CIBCI	DMB32-LP DR11-W DWBUA LP11  128 MB max mem
VAX 8300 VAX 8350 (LOAD DEVICE) Magtape RA60 (BUSSES) 1 VAXBI 1 UNIBUS	(VAXBI) KDB50	RA60 RA80 RA81 RA82	KLESI	TU81-Plus RV20  (UNIBUS) TS11 TU80 TU81-Plus TUK50	(Asynch VAXBI) DHB32 DMB32  (Asynch UNIBUS) DHU11 DMF32 DMZ32  (Synch VAXBI) DMB32 DSB32	(Ethernet) DEBNA DELUA  (CI) CIBCA-AA CIBCI	DMB32-LP DR11-W DWBUA LP11  128 MB max mem

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SYSTEM	DISKS CTRL DRIVE	TAPES CTRL DRIVE	COMMUNICATION OPTIONS	VAXCLUSTER OPTIONS (Ethernet/CI)	MISCELLANEOUS
VAX 85xx (LOAD DEVICE) Magtape (BUSSES) 2 VAXBI 1 UNIBUS	(VAXBI) KDB50 RA60 RA80 RA81 RA82	(VAXBI) KLESI TU81-Plus RV20	(Asynch VAXBI) DHB32 DMB32  (Asynch UNIBUS) DHU11 DMF32 DMZ32  (Synch VAXBI) DMB32 DSB32	(Ethernet) DEBNA DELUA  (CI) CIBCA-AA	DMB32-LP DR11-W DWBUA LP11  256 MB max mem
VAX 8700 VAX 8800 (LOAD DEVICE) Magtape (BUSSES) 4 VAXBI 2 UNIBUS	(VAXBI) KDB50 RA60 RA80 RA81 RA82	(VAXBI) KLESI TU81-Plus RV20	(Asynch VAXBI) DHB32 DMB32  (Asynch UNIBUS) DHU11 DMF32 DMZ32  (Synch VAXBI) DMB32 DSB32	(Ethernet) DEBNA DELUA  (CI) CIBCA-AA  CIBCI	DMB32-LP DR11-W DWBUA LP11  512 MB max mem
VAX 6210/6220 VAX 6230/6240 VAX 6210 VAX 6220 (LOAD DEVICE) TK50 (BUSSES) 6 VAXBI 1 UNIBUS *	(VAXBI) KDB50 RA60 RA80 RA81 RA82	(VAXBI) KLESI TU81-Plus	(Asynch) DMB32 DHB32  (Synch) DMB32 DSB32	(Ethernet) DEBNA  (CI) CIBCA-AA CIBCA-BA	LP11 * DMB32-LP DR11-W * DWBUA *  256 MB max mem
* The DWBUA UNIBUS adapter is supported on the VAX 6210 and VAX 6220 systems only.					
VAX 8810 * VAX 8820 VAX 8830 VAX 8840 (LOAD DEVICE) Magtape (BUSSES) 6 VAXBI 1 UNIBUS	(VAXBI) KDB50 RA60 RA80 RA81 RA82	(VAXBI) KLESI TU81-Plus	(Asynch) DMB32 DHB32  (Synch VAXBI) DMB32 DSB32	(Ethernet) DEBNA  (CI) CIBCA-AA CIBCA-BA	LP11 DMB32-LP DR11-W DWBUA  512 MB max mem
* The VAX 8810 can support up to a maximum of 4 VAXBIs.					
<b>Note:</b> 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.					
<b>Note:</b> The Wide Area Network Software product contains the synchronous device drivers and is required for the use of the synchronous communication option. Refer to SPD 29.64.xx for more information.					

**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.

**Note:** The Wide Area Network Software Product contains the synchronous device drivers and is required for the use of the synchronous communication option. Refer to SPD 29.64.xx for more information.

**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 VMS DECwindows environment is not supported on these systems.

**MicroVAX II System**

The CX series boards 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 and 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.

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

The VAX-11/725 and the VAX-11/730 systems supports one UNIBUS magnetic tape subsystem.

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

The VMS DECwindows environment is not supported on these systems.

**VAX-11/750 System**

The VAX-11/750 system must be at a minimum hardware ECO Revision of 4. However, if the VAX-11/750 system has a CI750 adapter or a UDA50 controller, the system must be at a minimum hardware ECO Revision of 5. If the VAX-11/750 system has both a CI750 adapter and a UDA50 controller, the system must be at a minimum hardware ECO Revision of 7.

If the VAX-11/750 system has a CI750 adapter and a UDA50 controller the UDA50 controller must be at REV 5.

One DR750 high performance, general purpose interface is supported. However the DR750 interface and the CI750 adapter are not supported on the same system.

The VAX-11/750 system console TU58 tape cartridge only can be used as console media and not as a storage device.

The VAX-11/750 system can support up to two magnetic tape subsystems.

**VAX-11/780 and VAX-11/785 Systems**

The VAX-11/780 and the VAX-11/785 systems can support up to two UNIBUS magnetic tape subsystems.

**VAX 82xx / VAX 83xx Systems**

The VAX 82xx and the VAX 83xx series systems support up to a maximum of four KDB50 disk controllers for configuration 2 systems and a maximum of two KDB50 controllers for configuration 1 systems.

The VAX 82xx and the VAX 83xx series systems support a maximum of three TU80 or TU81-Plus tape drives per system for configuration 2 systems and one TU80 or TU81-Plus drive for configuration 1 systems.

One TUK50 tape controller per system is supported.

**VAX 8600 and VAX 8650 Systems**

Two CR11 Card readers are supported per system.

The VAX 8600 and the VAX 8650 systems can support up to four TU80, TU81 or TU81-Plus magnetic tape drives per UNIBUS.

**VAX 85xx, VAX 8700 and VAX 8800 Systems**

The VAX 85xx, VAX 8700 and VAX 8800 systems support a maximum of two TU81-Plus tape drives per VAXBI channel to a maximum of four TU81-Plus tape drives per system.

On systems configured with 512 MB of memory, only 511.5 MB is addressable by VMS. The upper .5MB of memory is reserved.

**VAX 8810, VAX 8820, VAX 8830, VAX 8840 Systems**

On systems configured with 512 MB of memory, only 511.5 MB is addressable by VMS. The upper .5MB of memory is reserved.

**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	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.

**Disks**

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)
RC25 +	2 disks each 26 MB (1 fixed and 1 removable) disk drive with shared spindle	(Q-bus, UNIBUS)
RD32 +	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)
RD54	159 MB fixed disk drive	(Q-bus)
RF30	150 MB fixed 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)
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)
RX33* +	1.2 MB diskette Requires minimum RQDX3 microcode of Version 3.0.	(Q-bus)

RV20\* + 2GB Write Once Read Many Optical disk (Q-bus, UNIBUS, VAXBI)  
Cannot be used as a system disk. VMS treats as tape device.

\* Device cannot be used as a system disk.

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

**Tapes**

TK50	95 MB, 5 1/4" streaming tape cartridge	(Q-bus)
TK70	296 MB, 5 1/4" streaming tape cartridge	(Q-bus)
TE16	9 track magnetic tape	(MASSBUS)
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
DMF32-LP	UNIBUS DMA parallel high speed line printer controller for VAX-11/725 and VAX-11/730 systems
HSC50	Hierarchical Storage Controller for MSCP disks and TMSCP tapes. (HSC Software, minimum Version 3.50 must be running for dual porting of TA-series tape drives.)
HSC70	Hierarchical Storage Controller for MSCP disks and TMSCP tapes. (HSC Software, minimum Version 3.50 must be running for dual porting of TA-series tape drives.)
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, accomodating 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

**KLES1** Q-bus, UNIBUS and VAXBI tape controller for the TU81-Plus, RV20 or RC25.

**KRQ50** Q-bus Controller for the RRD50 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. The RQDXx disk controller supports as many as 4 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

**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

**TUK50** UNIBUS tape controller for the TK50 cartridge tape drive. One TUK50 tape controller 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: 19200. (No modem control) (Q-bus)

**CXB16** 16 line serial terminal multiplexer (RS422), maximum baud rate supported: 19200. (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)

With its next major functional release, DECnet-VAX will retire support for this device when used on a DWBUA UNIBUS adapter on a VAXBI.

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 supports 19200, DECnet-VAX supports 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 supports 19200, DECnet-VAX supports 9600. (Modem support dependent on configuration) (UNIBUS)
	With its next major functional release, DECnet-VAX will retire support for this device when used on a DWBUA UNIBUS adapter on a VAXBI.
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 only one asynchronous data/modem RS-232C serial line up to 9600 baud on the integral 4 line asynchronous controller.

### Synchronous Controllers

The Wide Area Network Software Product contains the synchronous device drivers and is required for the use of the synchronous communication option. 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)
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)

### 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
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.
DELQA	Ethernet Controller to Q-bus. This is the replacement for DEQNA. The minimum revision level required is C3.

**CI Options**

VAXcluster Software supports one CI adapter per system.

CI750 CI Adapter for VAX-11/750 systems - (Minimum microcode version REV 8 is required.)

CI780 CI Adapter for VAX-11/750, VAX-11/780, VAX-11/785, VAX 8600, and VAX 8650 systems. (Minimum microcode version REV 8 is required.)

CIBCI CI Adapter for VAXBI systems - (Minimum microcode version REV 8 is required.)

CIBCA-AA Native CI Adapter for VAXBI systems - (Minimum microcode version REV 5 is required.)

CIBCA-BA Native CI Adapter for VAXBI systems

**Miscellaneous**

CR11 Card reader. One CR11 card reader supported per system. (UNIBUS)

DRV11-WA General Purpose DMA Interface (Q-bus)

DR11-W General Purpose high speed DMA Interface - One DR11-W interface is supported per UNIBUS

DR750 High performance general purpose interface for the VAX-11/750. One DR750 interface is supported per system.

DR780 High performance general purpose interface for the VAX-11/780 and VAX-11/785. One DR780 interface is supported per system.

DSSI

Digital Small Storage Interconnect.

DWBUA

VAXBI to UNIBUS adapter

DW750

UNIBUS Adapter for second UNIBUS for the VAX-11/750 system.

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 and VAX-11/785 systems.

FP86-AA

Floating Point Accelerator for the VAX 8600 and VAX 8650 systems.

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 and the VAX-11/785 systems.

KU780

User Writable Control Store for the VAX-11/780 and the VAX-11/785 systems.

MA780

Multiport shared memory. A multiple version VMS V4.7 and VMS V5.x-n VAXcluster system is not supported if the system is configured with MA780 memory.

SBI

System Backplane Interconnect for the VAX-11/780, VAX-11/785, and I/O BUS for the VAX 8600 and VAX 8650 systems.

VS40X

4-plane graphics coprocessor