COMPAQ

# Software Product Description

**PRODUCT NAME: Compaq OpenVMS Operating System for Alpha and VAX, Version 7.3**
**SPD 25.01.63**

**Note:**

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

## DESCRIPTION

OpenVMS is a general-purpose, multiuser operating system that runs in both production and development environments. OpenVMS Alpha supports Compaq Computer Corporation's Alpha series computers, while OpenVMS VAX supports VAX, MicroVAX, VAXstation, and VAXserver series computers. OpenVMS software supports industry standards, facilitating application portability and interoperability. OpenVMS provides symmetric multiprocessing (SMP) support for multiprocessing Alpha and VAX systems. The OpenVMS Alpha operating system provides support for 64-bit virtual memory addressing and Very Large Memory (VLM).

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

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

OpenVMS Version 7.3 provides the following new features:

- Improved disaster tolerant capabilities with ATM and Gigabit Ethernet as cluster interconnects because of their inherent high performance and long distance capabilities.
- Greater system availability during backups with faster reintegration of shadow members after copies.
- Enhanced OpenVMS support for the latest ENSA Storage offerings.
- Greater serviceability for the AlphaServer GS160/320 systems with CPU Online Replace.
- Substantial application performance benefits can be realized with the new Extended File Cache.
- Improved cluster, SMP and system performance through enhancements to RMS and the clusterwide Lock Manager, as well as FastPath support for Fibre Channel and SCSI storage architectures.
- OpenVMS adds industry standard Kerberos V5 security, which allows VMS applications to communicate and authenticate with Windows 2000 domains and UNIX platforms.
- OpenVMS Intrusion Detection expands to be clusterwide, reducing chances of system break-ins.
- Enterprise Capacity and Performance (ECP) Data Collector and ECP Performance Analyzer are now included with the purchase of OpenVMS Version 7.3.

- The OpenVMS license is expanded to include all of these new e-Business technologies:

– Compaq Secure Web Server Version 1.0-1 for OpenVMS Alpha (based on Apache).

– Compaq COM for OpenVMS (Alpha)

– Extensible Markup Language (XML) Technology (XML parser and XSLT stylesheet processor)

– Java 2 SDK, Standard Edition, Version 1.2.2-3 for OpenVMS Alpha

– Attunity Connect "On Platform" Package (native JDBC driver included)

– Reliable Transaction Router (RTR) for OpenVMS Alpha and VAX

– Compaq OpenVMS Enterprise Directory for e-Business (X.500)

– Compaq BridgeWorks

Now, with Version 2.0 of Compaq DECprint Supervisor (DCPS) for OpenVMS, the right to use all DCPS products (-Base, -Open, and -Plus) is bundled with the OpenVMS Operating System license. Media, documentation, and services are sold separately.

Refer to the *OpenVMS Version 7.3 New Features and Documentation Overview* manual and the *OpenVMS Version 7.3 Release Notes* for further details on the new enhancements, features, and functions for this release.

## USER ENVIRONMENT

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

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

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

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

### Text Processing

The Extensible Versatile Editor (EVE), one of several text editors supplied by Compaq, is the default editor for OpenVMS. EVE allows users to insert, change, and delete text quickly. Written in the DIGITAL Text Processing Utility (DECTPU) language, EVE is a full-screen editor that allows users to scroll through text on a terminal screen. EVE provides an EDT-style keypad, allowing EDT users to move easily to EVE. EDT is also supported on OpenVMS Alpha Version 7.3 and OpenVMS VAX Version 7.3.

### Mail Utility

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

### Command-Level Programming

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

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

### User Environment Tailoring

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

### Terminal Fallback Facility (TFF)

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

### National Character Set (NCS) Utility

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

## PROGRAM DEVELOPMENT ENVIRONMENT

OpenVMS includes a comprehensive set of tools for developing programs, including: run-time libraries (RTLs), a linker, a librarian, and a symbolic debugger. The assembly-level VAX MACRO-32 language is supplied with OpenVMS VAX. In addition, the Java 2 SDK provides an environment in which to develop and deploy Java applications on OpenVMS Alpha. The following tools are available to the OpenVMS programmer.

### Java 2 Software Development Kit

The Java 2 SDK is a set of building blocks containing basic development tools and a rich set of class libraries.

### Language and Run-Time Library Support

OpenVMS includes several RTLs that provide:

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

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

With OpenVMS Alpha, these routines can be called from programs written in such languages as MACRO-32, MACRO-64, Compaq Ada, Compaq BASIC, Compaq C, Compaq C++, Compaq COBOL, Compaq Fortran, Compaq Pascal, Java, and Compaq PL/I.

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

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

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

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

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

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

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

### MACRO Compiler (Alpha Only)

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

With minor modifications, VAX MACRO-32 sources can be compiled for execution on Alpha.

### Compaq POSIX Threads Library

OpenVMS includes a user-mode, multithreading capability called Compaq POSIX Threads Library. Compaq POSIX Threads Library provides a POSIX 1003.1-1996 standard style threads interface. Additionally, Compaq POSIX Threads Library provides an interface that is the

OpenVMS implementation of Distributed Computing Environment (DCE) threads as defined by the Open Software Foundation (OSF).

Compaq POSIX Threads Library is a library of run-time routines that allows the user to create multiple threads of execution within a single address space. With Compaq POSIX Threads Library Kernel Threads features enabled, Compaq POSIX Threads Library provides for concurrent processing across all CPUs in a symmetric multiprocessor system by allowing a multithreaded application to have a thread executing on every CPU. On an asymmetric (e.g. NUMA) system, a single process can have a thread executing on all processors in the process's home RAD. Multithreading allows computation activity to overlap I/O activity. Synchronization elements, such as mutexes and condition variables, are provided to help ensure that shared resources are accessed correctly. For scheduling and prioritizing threads, Compaq POSIX Threads Library provides multiple scheduling policies. For debugging multithreaded applications, Compaq POSIX Threads Library is supported by the OpenVMS Debugger. Compaq POSIX Threads Library also provides Thread Independent Services (TIS), which assist in the development of thread-safe APIs.

**Visual Threads**

Visual Threads is a new tool available with OpenVMS Version 7.3 that lets you analyze your multithreaded applications. You can use it to debug potential thread-related logic problems, even those hard-to-find problems that only occur due to slight timing differences. You can also use Visual Threads to pinpoint bottlenecks and performance problems by using its rule-based analysis, statistics capabilities and visualization techniques.

Visual Threads can be used with any application that uses a POSIX threads API (POSIX, DCE, or CMA API), or is written in Java.

Visual Threads features include the following:

- Detects violation conditions based on the application of particular rules in your application. Several predefined rules look for deadlock conditions, programming errors, and performance issues.
- Lets you use templates to define your own rules to specify criteria for violation conditions.
- Records events to a trace file so that you can play back and analyze them later.
- Dynamically displays events as they occur, with controls for searching and filtering.
- Suspends execution of the application when it detects violation conditions. You can choose from several options at this point, including invoking the debugger in the appropriate context for your application.
- Dynamically monitors multithreading objects (threads, mutexes, and so on) in real time.
- Provides easy access to object-level statistics and current state information, including use of resources (for example, the mutexes a particular thread holds).
- Automatic analysis of lock contention and lock granularity, statistical hotspots, and processor utilization.
- Visualizes thread state over time, level of contention, and object-level usage statistics.

**Librarian Utility**

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

**Hypersort**

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

**Traceback Facility**

When an application is compiled and linked with traceback information, the Traceback facility translates stack frame addresses into routine names and line numbers and displays a symbolic traceback whenever a runtime error occurs in that application.

**Debugger**

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

The debugger contains a Heap Analyzer feature that displays a graphic view of memory allocations and deallocations in real time.

**Alpha System-Code Debugger**

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

**System Dump Analyzer (SDA) Utility**

In the event of a system failure, OpenVMS writes the contents of memory to a preallocated dump file. This dump file can later be analyzed using System Dump Analyzer (SDA). System dumps can either be full memory dumps, where all memory is written, or selective memory dumps, where only portions of memory in use at the time of the system failure is written. The dump file can be located on any locally connected disk. On Alpha only, dump compression allows both full and selective dumps to be written to smaller files than required for uncompressed dumps. Full memory dumps, if not compressed, require a dump file big enough to hold all memory. Selective memory dumps write as much of the memory in use at the time of the system failure that will fit into the dump file.

*Spinlock Tracing Utility*

The Spinlock Tracing Utility provides a mechanism for characterizing spinlock usage and can collect performance data for a given spinlock on a per-CPU basis.

**Process Dumps**

When an application fails, a copy of its registers and memory can be written to a data file, which can be examined using the ANALYZE PROCESS utility. This utility uses the same interface and commands as the OpenVMS Debugger to allow registers and memory to be examined. On Alpha only, another process can initiate the writing of the memory dump.

**RMS File Utilities**

Record Management Services (RMS) file utilities allow users to analyze the internal structure of an RMS file and tune the I/O, memory, space and performance parameters of the file. The RMS file utilities can also be used to create, load, and reclaim space in an RMS file. Refer to the Operating System Environment section of this SPD for more information on RMS.

**File Differences Utility**

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

**Translated Image Environment (TIE) (Alpha Only)**

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

## SYSTEM MANAGEMENT ENVIRONMENT

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

**Compaq Availability Manager Version 1.4**

Compaq Availability Manager is a system management tool that, from either an OpenVMS Alpha or a Windows 2000 node, enables you to monitor one or more OpenVMS nodes on an extended local area network (LAN). This tool helps system managers and analysts target a specific node or process for detailed analysis. The Availability Manager collects system and process data from multiple OpenVMS nodes simultaneously. It analyzes the data and displays the output using a native Java GUI. It is included in the OpenVMS distribution kit.

The Availability Manager tool evolved from the OpenVMS only DECamds product and its Motif graphical user interface (GUI). Because the Availability Manager Data Analyzer requires a run-time environment, it does not run on OpenVMS VAX, which does not support Java. To perform real-time system monitoring on VAX systems, one should use DECamds.

Installation of Java Version 1.1.8 or later is required for the Availability Manager Version 1.4 client on an OpenVMS system. Compaq recommends using, at a minimum, the following hardware configuration: 500 MHz Alpha processor with 128 MB of memory. The Availability Manager Version 1.4 kit for OpenVMS includes the Data Analyzer and Data Collector:

- The Java Data Analyzer can be installed only on OpenVMS Alpha Versions 7.1, 7.1-2, 7.2, 7.2-1, and 7.2-1 variants.
- The Data Collector can be installed on OpenVMS VAX and Alpha Versions 6.2, 7.1, 7.1-2, 7.2, 7.2-1, and 7.2-1 variants.

On a Windows system, Compaq recommends using, at a minimum, either of the following hardware configurations:

- Windows NT or 2000—300 MHz Intel Pentium processor with 96 MB of memory
- Windows NT—500 MHz Alpha processor with 128 MB of memory

You can install the Availability Manager Data Analyzer on any system running Windows NT 4.0 SP3 or later or on Windows 2000. Please note that you must reinstall Availability Manager Version 1.4 after upgrading to Windows 2000.

**DECamds Version 7.2-1B**

DECamds version 7.2-1B is available on the OpenVMS distribution kit. DECamds is a separately installable, real time, high performance, multisystem monitoring utility. It is supported on any system running OpenVMS Version 7.1 or higher. With OpenVMS Version 7.1, the right to use DECamds was included under the terms and conditions of the OpenVMS operating system base license for both Alpha and VAX. DECamds is the predecessor of the newer application Availability Manager.

DECamds provides system resource monitoring, investigation aid, and correction capability. This enables system managers to proactively and effectively manage multiple systems from a centralized DECwindows display. DECamds software includes an OpenVMS device driver, which is installed on every node on the LAN that is to be monitored. The software includes a Motif GUI application that allows a system manager to perform monitoring functions. The Motif application can be installed on any OpenVMS Alpha or VAX workstation. DECamds is currently in maintenance mode. All new system management functionality requested for DECamds will be directed to our Availability Manager product.

**Compaq Management Agents for OpenVMS Version 2.1**

Compaq Management Agents for OpenVMS Version 2.1 consists of a web server for system management, with management agents that allow you to communicate with devices on their OpenVMS systems over the Internet or intranet. Compaq Management Agents for OpenVMS utilizes Web-based enterprise management (WBEM) architecture. This is an architecture that allows one to use a web browser to monitor many devices that are connected to a network. Devices can be computer systems, networked printers, or network components such as router. WBEM uses a three-tiered architecture that includes a management server, devices managed by web agents, and a web browser.

Compaq Management Agents for OpenVMS use SNMP and TCP/IP protocols that allow the "management server" to communicate with OpenVMS devices. The management agents use common web-enabling components to provide registration, discovery, HTTP communications, and a home page for the managed devices. The management agents can send information directly to the "management server" or they can create an HTML file to communicate directly with a browser.

Compaq Management Agents for OpenVMS utilize Compaq Insight Manager XE on an NT server as the ''management server/application.'' With the introduction of Compaq Insight Manager XE on an NT server, management of all your Compaq platforms inclusive of OpenVMS from a single NT server becomes a possibility. Compaq Insight Manager XE, which is an example of a ''management server/application,'' is a web-based interface that enables you to look across a heterogeneous computing services environment and access information about devices connected to the network. Using the Insight Manager XE, one can obtain information about the configuration of OpenVMS systems and their components or peripherals. Compaq Management Agents for OpenVMS is an example of a Compaq Insight Manager XE web agent. Management Agents for OpenVMS provides the means of communication between OpenVMS devices and the web browser. The Compaq Insight Manager XE ''management server'' provides a single reference point for data from all devices. The ''management server'' uses its connection with the web browser to display device data to the user.

**OpenVMS Management Station Version 3.0**

OpenVMS Management Station is a powerful, Microsoft Windows NT based management tool for system managers and others who perform system management tasks on OpenVMS systems. OpenVMS Management Station features a powerful, intuitive user interface. System managers and help desk staff no longer need to remember complicated DCL syntax or command procedures to manage their OpenVMS systems. OpenVMS Management Station makes system management much easier.

Three functional areas are now implemented in OpenVMS Management Station: user account management, printer queue management, and storage configuration management. For user account management, OpenVMS Management Station supports account creation, modification, and deletion, as well as renaming accounts and displaying account attributes. Printer queue management makes it possible for system managers to manage all printers, print queues, and jobs in their environment using a centralized Windows GUI. This includes monitoring one or more printers, adding or removing printers, and their associated queues, examining and modifying queue and printer attributes, and requeuing or deleting jobs.

The current release of OpenVMS Management Station adds storage management support. OpenVMS Management Station now makes it easy for one to manage their disk storage devices across multiple OpenVMS Cluster systems and OpenVMS Nodes. With OpenVMS Management Station one no longer needs to maintain complicated command files to control their storage environment. One can create, delete, and manage stor-

age from an easy-to-use Windows interface. It provides a persistent database that can automatically determine and configure your system's storage configuration at system startup.

OpenVMS Management Station is now based on the Microsoft Management Console (MMC). The Microsoft Management Console provides a common management framework for various administration programs. OpenVMS Management Station is implemented as an MMC snap-in and includes all of the MMC components you need.

Features include:

- Storage Configuration Management—You can create, delete, and manage a disk volume under one interface. Wizards make it easy to add systems to be managed, create a volume, and so forth.
- Configuration Control Over Reboots— If you allow it to, OpenVMS Management Station preserves the disk configuration across reboots. OpenVMS Management Station can mount and maintain your storage configuration without intervention. And, OpenVMS Management Station mounts volumes much faster than is possible with DCL or command procedures, so performance is enhanced.
- Coexistence with Established Environment—You do not have to change your existing DCL command procedures if you don't want to. You can use the display capabilities of OpenVMS Management Station without having to use the automated mount feature. In this way, you can give OpenVMS Management Station as little or as much control as you are comfortable with.
- Remote Management Supported—You can use OpenVMS Management Station to remotely manage your OpenVMS systems. Once you establish a TCP/IP RAS connection, you can then use OpenVMS Management Station to manage your OpenVMS systems from home or on the road.

**Note:**

The version of MMC included in this baselevel requires files provided by Microsoft Internet Explorer. Version 3.02 or later of Internet Explorer must be present on the system. The OpenVMS Management Station client supports only TCP/IP connections for primary servers, so at least one OpenVMS system must be running TCP/IP. If you are running Version 6.2 of OpenVMS and plan to manage shadow volumes, remedial kits are required. Additional TCP/IP stacks for OpenVMS have not been tested. However, TCP/IP stacks that are 100% compliant with the QIO interface for Compaq TCP/IP Services for OpenVMS should also work. Contact your TCP/IP vendor for additional information and support issues.

**Enterprise Capacity and Performance (ECP) Data Collector and ECP Performance Analyzer**

Beginning with the release of OpenVMS Version 7.3, ECP Data Collector and ECP Performance Analyzer Version 5.4, engineered and supported by Compaq, are licensed with the OpenVMS operating system and available from the OpenVMS System Management web page at:

http://www.openvms.compaq.com/openvms

/system_management.html

ECP Data Collector and ECP Performance Analyzer will be licensed with the OpenVMS Alpha and VAX Operating System Version 6.2 to Version 7.3.

ECP Data Collector is a highly efficient, detailed performance data collector and ECP Performance Analyze provides graphic historical reporting of OpenVMS performance parameters. Satisfying the needs of Enterprise Management, ECP Data Collector also contains an API that provides an interface for the access of collected performance data. This interface converts the contents of the .CPC data file generated by the data collector into a formatted, comma-separated ASCII file that can then be used for performance analysis and reporting programs.

The ECP Data Collector provides:

- Robust data collection set—It collects more system metrics than other vendors (for example, over 250 VMS performance parameters).
- Flexible data collection—The sampling rate of data can be tuned down to sub-second intervals.
- Low overhead—Audited production systems now running have routinely shown that the collector has less than 1.5% impact on CPU.

The ECP Performance Analyzer provides:

- Native OpenVMS product running under Motif
- Viewing of performance data in graphical format
- Analyzed data including CPU, Memory and I/O
- User-selected sampling rate

Software Support Service for these products is sold separately and is available on an incremental basis. Please contact your Compaq Services representative for further details.

**Class Scheduler for CPU Scheduling**

With OpenVMS Version 7.3, a new SYSMAN-based interface for defining and controlling scheduling classes has been added. This new class scheduler for both Alpha and VAX systems allows you to designate the percentage of CPU time that a system's users may receive by placing users into scheduling classes.

**Batch and Print Queuing System**

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

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

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

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

Print queues, both generic and execution, together with queue management facilities, provide versatile print capabilities, including support for various print file formats.

The maximum number of process identifiers for queuing requests is 1024.

**Accounting Utility**

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

**Audit Analysis Utility**

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

**Autoconfigure/AUTOGEN Utilities**

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

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

**Backup Utility**

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

A BACKUP API has been added for invoking backup routines from an executable procedure.

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

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

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

**Standalone BACKUP Utility (VAX Only)**

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

**Analyze Disk Structure Utility**

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

**Monitor Utility**

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

**License Management Facility (LMF)**

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

**System Management Utility (SYSMAN)**

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

**Operations**

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

**Security**

*Kerberos*

Kerberos Version 1.0 for OpenVMS Alpha and OpenVMS VAX, based on MIT Kerberos Version 5 Release 1.0.5, is included on the OpenVMS Version 7.3 distribution media. (Kerberos documentation provided by MIT is included on the OpenVMS documentation CD-ROM in HTML format.)

Kerberos is a network authentication protocol designed to provide strong authentication for client/server applications by using secret-key cryptography.

The Kerberos for OpenVMS authentication system, based upon work done by Massachusetts Institute of Technology (MIT), is provided in three separate components:

- Key Distribution Center (KDC) server
- Client subsystem
- Two application-programming interfaces, one written to comply with the Generic Security Service Application Programming Interface (GSS-API V2) specification as defined by RFC2078. The second API presents the Kerberos interface to the users. Both APIs are delivered as sharable images on OpenVMS.

Kerberos was created by the Massachusetts Institute of Technology as a solution to network security problems. The Kerberos protocol uses strong cryptography so that a client can prove its identity to a server (and vice versa) across an insecure network connection. After a client and server have used Kerberos to prove their identity, they can also encrypt all of their communications to assure privacy and data integrity.

General information about Kerberos is available from the following World Wide Web address:

http://web.mit.edu/kerberos/www/

*Per-Thread Security Profiles*

Thread-level security allows for simplified multiprofile application development and improves overall performance while maintaining a high level of security. This feature allows each execution thread of a multithreaded process to run an independent security profile without impacting the security profiles of other threads in the process.

This feature, known as Per-thread security profiles, includes a new security structure, known as the Persona Security Block (PSB), which supersedes many process-wide structures and fields including the ARB, JIB username and account information, PHD privilege bits, and the PCB NOAUDIT cell.

A new SYSGEN parameter, ARB_SUPPORT, has been added to allow system managers to control the level by which the current security data in the PSB will be backported to these old privilege data cells. There are four levels of support ranging from NONE (ARB_SUPPPORT = 0) to FULL (ARB_SUPPORT = 3).

*External Authentication*

External authentication is an optional feature that enables OpenVMS systems to authenticate designated users within a LAN Manager domain using their LAN Manager user name and password.

If you want to enable external authentication on your system, you need DECwindows Version 1.2-4 or later and any requirements outlined in the *Compaq Advanced Server for OpenVMS Server Installation and Configuration Guide* and the *Compaq PATHWORKS for OpenVMS Server Installation and Configuration Guide*. See these manuals and the *OpenVMS Guide to System Security* for detailed information about using external authentication. For additional information on Advanced Server for OpenVMS and PATHWORKS for OpenVMS, refer to the Associated Products section of this SPD.

Users who are externally authenticated by their LAN Manager need only remember a single user name/password combination to gain access to their OpenVMS and LAN Manager accounts. In addition, the OpenVMS DCL command SET PASSWORD has been enhanced to update the user's password in the LAN Manager domain database (as well as optionally synchronize the SYSUAF password).

For externally authenticated users, the normal system authorization database (SYSUAF.DAT) is used to construct the OpenVMS process profile (UIC, privileges, quotas, and so on) and to apply specific login restrictions. However, there are two key differences between externally authenticated users and normal OpenVMS users. For externally authenticated users:

- The password stored in the SYSUAF is not the password used to verify the user at login time.
- The SYSUAF user name selected to be used for OpenVMS process identification may not be the same as the LAN Manager user name that was used to authenticate the user at login. The system manager specifies the LAN Manager to OpenVMS user name mapping for each user.

*Security APIs*

Security APIs for intrusion detection, proxy access, and impersonation services are available on both the Alpha and VAX platforms to provide better security in client/server applications. With OpenVMS Version 7.3, Intrustion Detection capabilities have now been expanded to be clusterwide.

The Security Persona services provide the ability to support alternate security models. OpenVMS security persona services allow OpenVMS applications the ability to attach NT or any other Non-OpenVMS security credentials to an OpenVMS security profile.

*Government Security Ratings*

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

| Version | Rating | Evaluation Date |
|---|---|---|
| OpenVMS Alpha 6.2–1H3† | E3 | 2001 |
| OpenVMS Alpha 6.1 | C2 | 1996 |
| SEVMS Alpha 6.1 | B1 | 1996 |
| OpenVMS VAX 6.1 | C2 | 1995 |
| SEVMS VAX 6.1 | B1 | 1995 |
| OpenVMS VAX 6.0 | C2 | 1993 |
| SEVMS VAX 6.0 | B1 | 1993 |
| VAX/VMS 4.3 | C2 | 1988 |

†Currently in ITSEC Rating

These ratings represent the National Computer Security Center validation of the design of the OpenVMS and SEVMS operating systems against *DoD 5200.28-STD Department of Defense Trusted Computer System Evaluation Criteria*. To obtain an evaluation summary, please visit the US NCSC at Trusted Product Evaluation Program (TPEP) homepage at:

http://www.radium.ncsc.mil/tpep/

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

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

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

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

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

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

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

OpenVMS applies full protection to the following system objects:

- Capabilities (VAX only)
- Common event flag clusters
- Devices
- Files
- Group global sections
- Logical name tables
- Batch/print queues
- Resource domains
- Security classes
- System global sections
- Volumes (ODS-2)
- Volumes (ODS-5)

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

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

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

OpenVMS provides security auditing for the following events:

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

**Note:** Because no system can provide complete security, Compaq cannot guarantee complete system security. However, Compaq continues to enhance the security capabilities of its products. Customers are

strongly advised to follow all industry-recognized security practices. OpenVMS recommended procedures are included in the *OpenVMS Guide to System Security*.

## OPERATING SYSTEM ENVIRONMENT

### OpenVMS VAX Processes and Scheduling

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

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

Processes receive time to execute their images based on the priority. Thirty-two priorities are recognized on OpenVMS VAX, and 64 priorities are recognized on OpenVMS Alpha. Priorities 0 to 15 are for timesharing processes and applications (four is the typical default for timesharing processes). Priorities 16 to 32 on VAX and 16 to 63 on Alpha are for real-time processes.

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

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

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

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

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

### OpenVMS Alpha Processes and Scheduling

The basic unit of execution in OpenVMS Alpha is the kernel thread. A kernel thread consists of individual address space and registers known as context, and code called an executable image. The context identifies the kernel thread and describes its current state. Each process can have up to 256 kernel threads. Executable images consist of system programs and user programs that have been compiled and linked.

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

Kernel threads receive processor time to execute their images based on the priority of the process. Thirty-two priorities are recognized on OpenVMS VAX, and 64 priorities are recognized on OpenVMS Alpha. Priorities 0 to 15 are for time-sharing processes and applications (four is the typical default for timesharing processes). Priorities 16 to 32 on VAX and 16 to 63 on Alpha are for real-time processes.

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

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

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

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

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

### 64-Bit Virtual Addressing (Alpha Only)

The OpenVMS Alpha operating system provides support for 64-bit virtual memory addressing. This capability makes the 8TB virtual address space, defined by the Alpha architecture, available to the OpenVMS Alpha operating system and to application programs. Future hardware implementations will provide greater capacity. OpenVMS Alpha compilers and applications take advantage of 64-bit processing by using 64-bit data types. Refer to the SPDs for the OpenVMS Alpha compilers for further details. Note that the application virtual address space defaults to a 32-bit implementation for compatibility and migration purposes.

**Very Large Memory (VLM) Features (Alpha Only)**

OpenVMS Alpha provides the following additional memory management VLM features beyond those provided by 64-bit virtual addressing:

- Memory-resident global sections
- Fast I/O for global sections
- Shared page tables
- Expandable global page table
- Reserved memory registry

*Memory-resident global sections* allow a database server to keep larger amounts of "hot" data cached in physical memory. The database server then accesses the data directly from physical memory without performing I/O read operations from the database files on disk. With faster access to the data in physical memory, runtime performance increases dramatically.

As of OpenVMS Alpha Version 7.2, VLM applications that share a large memory-resident cache can use Fast I/O for memory shared by processes through global sections. Fast I/O improves the ability of a VLM application, such as a database server, to handle larger capacities and higher data throughput rates. By reducing the CPU costs per I/O request, Fast I/O and memory-resident global sections dramatically increase performance for critical database server I/O operations.

*Shared page tables* allow that same database server to reduce the amount of physical memory consumed within the system. Because multiple server processes share the same physical page tables that map the large database cache, an OpenVMS Alpha system can support more server processes. This increases overall system capacity and decreases response time to client requests.

Also, with shared page tables, the database server startup time is dramatically reduced because server processes can map memory-resident global sections hundreds of times faster than traditional global sections. With a multiple gigabyte global database cache, the server startup performance gains can be significant.

The system parameters *GBLPAGES* and *GBLPAGFIL* are dynamic parameters. Users with the CMKRNL privilege can change these parameter values on a running system. Increasing the value of the GBLPAGES parameter allows the global page table to expand, on demand, up to the new maximum size.

The *Reserved Memory Registry* supports memory-resident global sections and shared page tables. Through its interface within the SYSMAN utility, the Reserved Memory Registry allows an OpenVMS system to be configured with large amounts of memory set aside for use within memory-resident sections or other privileged code. The Reserved Memory Registry also allows an OpenVMS system to be properly tuned through AUTOGEN, thus accounting for the preallocated reserved memory.

**Extended Physical Addressing (VAX Only)**

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

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

**Vector Processing (VAX Only)**

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

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

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

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

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

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

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

**DECdtm Services**

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

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

DECdtm features include:

- Embedded OpenVMS system services that support the DECtp architecture, providing the features and technology for distributed transaction processing.
- Ability for multiple disjoint resources to be updated automatically. These resources can be either physically disjointed on different clusters at separate sites, or logically disjointed in different databases on the same node.
- Robust application development. Applications can be written to ensure that data is never in an inconsistent state, even in the event of system failures.
- Ability to be called using any Compaq TP monitor or database product. This is useful for applications using several Compaq database products.

**Interprocess Communication**

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

- Mailboxes as virtual devices that allow processes to communicate with queued messages.
- Shared memory sections on a single processor or an SMP system that permit multiple processes to access shared address space concurrently.
- Galaxywide sections on a Galaxy platform that permit multiple processes in multiple instances to access shared address space concurrently.
- Common event flags that provide simple synchronization.
- A lock manager that provides a more comprehensive enqueue/dequeue facility with multilevel locks, values, and asynchronous system traps (ASTs).
- Intracluster communication services through which two processes running on the same system or on different OpenVMS Cluster nodes can establish a connection and exchange data.
- Logical names through which one process can pass information to other processes running on the same system or on different OpenVMS Cluster nodes.
- Network interprocess communication is available via TCP/IP Services and DECnet-PLUS (product licenses are required).

**Symmetric Multiprocessing (SMP)**

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

OpenVMS SMP configurations consist of multiple CPUs executing code from a single shared memory address space. Users and processes share a single copy of OpenVMS Alpha or OpenVMS VAX address space. SMP also provides simultaneous shared access to common data in global sections to all processors. OpenVMS SMP selects the CPU where a process will run based on its priority and in special cases as directed by the application. OpenVMS uses a specialized scheduling algorithm when running a nonuniform memory access (NUMA) platform.

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

**Networking Facilities**

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

OpenVMS supports the standards defined by the ATM Forum's LANE Version 1.0 specifications for LAN emulation over an ATM network. By implementing an emulated LAN over an ATM network, you enable a group of ATM stations to act like a traditional LAN. LAN emulated over an ATM network allows you to run your existing applications basically unchanged, while the computers on which your applications are running are connected to the ATM network.

DECnet-Plus offers task-to-task communications, file management, downline system and task loading, network command terminals, and network resource sharing capabilities as defined in the DIGITAL Network Architecture (DNA) Phase V protocols. DECnet-Plus provides the newest DECnet features such as extended addressing and downline-load performance enhancements. DECnet-Plus integrates DECnet and OSI protocols and now provides a linkage to TCP/IP using Request for Comments (RFC) 1006 and RFC 1859. DECnet and OSI applications can now be run over DECnet (NSP), OSI (CLNS), and TCP/IP transports.

DECnet for OpenVMS VAX and Alpha offers the networking capabilities as defined in the DIGITAL Network Architecture (DNA) Phase IV. For more information, refer to the DECnet-Plus and DECnet Software portion of the Associated Products section of this SPD.

**Terminal Server Products**

Compaq's terminal server products provide terminal server access to OpenVMS. When used in an OpenVMS Cluster environment, terminal servers distribute users across the available Alpha and VAX systems at login time.

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

**Reliability**

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

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

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

Other failures include:

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

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

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

**Power Failures (VAX Only)**

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

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

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

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

**Input/Output**

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

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

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

With OpenVMS Alpha, users can write drivers for I/O devices that do not have inherent OpenVMS support. OpenVMS Alpha allows device drivers to be written in Compaq C and MACRO-32. Documentation is available that describes how to write OpenVMS Alpha device drivers and how to convert existing OpenVMS VAX drivers to run on OpenVMS Alpha systems. The Compaq C compiler for OpenVMS Alpha is an optional layered product.

With OpenVMS VAX, users can write their own drivers in MACRO-32 for I/O devices that do not have inherent OpenVMS support, as described in the appropriate documentation.

**I/O Performance Features**

Fast I/O provides a suite of additional system services that applications can use to improve I/O throughput. The fast I/O services minimize the CPU resources required to perform I/O.

Fast Path provides a streamlined mainline code path through the I/O subsystem to improve both uniprocessor and multiprocessor I/O performance. On multiprocessor systems, Fast Path allows all CPU processing for specific I/O adapters to be handled by a specific CPU. This can significantly lower the demands on the primary CPU and increase the I/O throughput on multiprocessor systems with multiple I/O ports. Disk and port drivers for the CIXCD, CIPCA, KGPSA, and KZPBA ports have been enhanced to take advantage of the Fast Path capability. No user application changes are needed to take advantage of Fast Path. Fast Path can be utilized by the $QIO system service or the Fast I/O services.

**Extended File Cache (XFC) Alpha**

The Extended File Cache (XFC) is a new virtual block data cache provided with OpenVMS Alpha Version 7.3. Similar to the Virtual I/O Cache, the XFC is a cluster-wide, file system data cache. Both file system data caches are compatible and coexist in the OpenVMS Cluster.

The XFC improves I/O performance with the following features that are not available with the Virtual I/O Cache:

- Read-ahead caching
- Automatic resizing of the cache
- Larger maximum cache size
- No limit on the number of close files that can be cached
- Control over the maximum size of I/O that can be cached
- Control over whether cache memory is static or dynamic

**Virtual I/O Cache**

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

**Record Management Services (RMS)**

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

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

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

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

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

RMS promotes safe and efficient file sharing by providing multiple file access modes and automatic record locking (where applicable). RMS offers the options of enabling global buffers for buffer sharing by multiple processes.

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

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

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

**Disk and Tape Volumes**

The system manager can organize disk volumes 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, the system manager can allocate portions of indexed files to specific areas of a single disk or to specific volumes in a volume set.

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

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

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

The system provides 255 levels of named directories and subdirectories whose contents are alphabetically ordered. Device and file specifications follow Compaq conventions. Users can use logical names to abbreviate the specifications and to make application programs device and file name independent. Users can assign a

logical name to an entire specification, to a portion of a specification, or to another logical name.

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

**OpenVMS Alpha Support for New AlphaServer GS Series Systems**

OpenVMS Version 7.3 provides support for Compaq's AlphaServer GS80, GS160 and GS320 systems. This support includes:

- OpenVMS support for hard and soft partitions (Galaxy) on AlphaServer GS80, GS160 and GS320 systems
- OpenVMS Resource Affinity Domain (RAD) support for applications
- OpenVMS Support for CPU Online Replace

**OpenVMS Support for Hard and Soft Partitions**

Hard partitioning is a physical separation of computing resources by hardware-enforced access barriers. It is impossible to read or write across a hard partition boundary. There is no resource sharing between hard partitions.

Soft partitioning is a separation of computing resources by software-controlled access barriers. Read and write access across a soft partition boundary is controlled by the operating system. OpenVMS Galaxy is an implementation of soft partitioning.

The way that customers choose to partition their systems depends on their computing environments and application requirements. For more information about using hard partitions and OpenVMS Galaxy, see the *OpenVMS Alpha Partitioning and Galaxy Guide*.

**OpenVMS Application Support for Resource Affinity Domains (RADs)**

The large amount of physical memory in the AlphaServer GS80/160/320 systems provides opportunities for extremely large databases to be completely in memory. The nonuniform memory access (NUMA) system architecture of the new AlphaServer GS80/160/320 systems provides the bandwidth to efficiently access this large amount of memory. NUMA is an attribute of a system in which the access time to any given physical memory is not the same for all CPUs.

OpenVMS Alpha Version 7.3 includes NUMA awareness in OpenVMS memory management and process scheduling. This capability (application support for resource affinity domains) ensures that applications running in a single instance of OpenVMS on multiple quad building blocks (QBBs) can execute as efficiently as possible in a NUMA environment.

The operating system treats the hardware as a set of **resource affinity domains (RADs)**. A RAD is a set of hardware components (CPUs, memory, and I/O) with common access characteristics. On AlphaServer GS80/160/320 systems, a RAD corresponds to a Quad Building Block (QBB) in an AlphaServer GS80, GS160 or GS320 system.

For more information about using the OpenVMS RAD support for application features, see the *OpenVMS Alpha Partitioning and Galaxy Guide*.

**OpenVMS Support for CPU Online Replace**

With OpenVMS Alpha Version 7.3, you can replace secondary CPUs on a running system without rebooting, which provides increased system maintainability and serviceability. This feature is supported only on AlphaServer GS160/320 systems. Note that replacing the primary CPU requires rebooting.

## E-BUSINESS TECHNOLOGIES

The Compaq OpenVMS e-Business Infrastructure Package provides key Internet and e-Business software technology that enhances the OpenVMS Alpha operating system. These technologies are licensed as part of the Compaq OpenVMS Alpha Operating System and are provided on the OpenVMS e-Business Infrastructure CD-ROM (Ordering number QA–6LYAA–H8). Additional details can be found in the OpenVMS e-Business Infrastructure Package Software Product Description, SPD 80.58.00. Most of these technologies can also be downloaded from:

http://www.openvms.compaq.com/ebusiness/index.html

**Java 2 Software Development Kit for OpenVMS Alpha**

The Java 2 Software Development Kit (SDK) provides an environment in which to develop and deploy Java applications on OpenVMS Alpha. Java applications can be written once and run on any operating system that implements the Java run-time environment, which consists primarily of the Java Virtual Machine (JVM).

The Java 2 SDK is a set of building blocks containing basic development tools and a rich set of class libraries including:

- Java Compiler
- Java Virtual Machine (JVM)
- Java Class Libraries
- Java Applet Viewer
- Java Debugger and other tools

- A POSIX threads (pthreads) implementation that provides increased performance on multiprocessor systems
- Flexible options for representing UNIX directory and file specifications on OpenVMS system

Services for the Java 2 SDK for OpenVMS Alpha are provided under existing OpenVMS Operating System service agreements.

**Compaq Secure Web Server for OpenVMS Alpha**

Compaq Secure Web Server for OpenVMS Alpha (CSWS) provides a powerful, flexible web server based on the popular Apache Web Server 1.3.12 from the Apache Software Foundation and provides the following features:

- HTTP/1.1 compliance (RFC2616)
- All standard Apache extensions (modules)
- Perl support (mod_perl)
- Java support (mod_jserv)
- Secure Sockets Layer (SSL) support (mod_ssl) using OpenSSL and RSA Crypto-C (BSAFE)
- Digital certificates from VeriSign Inc.

Services for Compaq Secure Web Server for OpenVMS Alpha are provided under existing OpenVMS Operating System service agreements.

**Attunity Connect "On Platform" Package**

Attunity Connect is object-oriented middleware that facilitates the development of applications that access, integrate, and update data from multiple, heterogeneous sources across a wide range of operating system platforms.

The Attunity Connect "On Platform" package for OpenVMS provides the ODBC, JDBC, and XML client APIs and ODBC, XML and Oracle8i adapters for accessing data sources. Additional data adapters for OpenVMS Alpha and Attunity Connect are available directly from Attunity.

The full Attunity Connect product provides ODBC, JDBC, XML, ADO and OLEDB client APIs and adapters for a large number of relational and nonrelational data sources and support for a large number of popular platforms including UNIX, Windows, OpenVMS, Tandem, and mainframes.

Services for the Attunity Connect "On Platform" Package for OpenVMS Alpha are provided under existing OpenVMS Operating System service agreements.

**Extensible Markup Language (XML) Technology**

Using open source software from Apache Software Foundation, an XML parser and an XSLT stylesheet processor are provided that give applications the ability to parse, generate, manipulate, validate, and transform XML documents and data.

Services for the XML Technology for OpenVMS Alpha are provided under existing OpenVMS Operating System service agreements.

**Compaq OpenVMS Enterprise Directory for e-Business (LDAPv3/X.500)**

The Compaq OpenVMS Enterprise Directory for e-Business, based on the X.500 standard, delivers robust and scaleable directory services across intranets, extranets and the Internet to customers, suppliers and partners. It combines the best of both the industry standard LDAPv3 and X.500 capabilities. The former allows access by a myriad of Lightweight Directory Access Protocol (LDAP) clients, user agents and applications and the latter brings very high performance, resilience, advanced access controls and easy replication across the enterprise.

Certified with Entrust/PKI 5, this directory ensures at sign on that all users may be authenticated with zero latency and that each gains access only to those resources they are authorized to use.

The OpenVMS Enterprise Directory for e-Business may contain information on anything of interest, including people, systems, network resources, applications, authentication certificates and databases. It is designed to be accessed by individual users, applications and software developers. Both the established DAP interface and the LDAPv3 interface may be accessed simultaneously by disparate applications, thereby delivering full integration with existing environments.

The OpenVMS Enterprise Directory for e-Business is available with OpenVMS Alpha Version 7.3 and is licensed with the OpenVMS Alpha operating system. It is also available on the OpenVMS Alpha Software Layered Products Library. Software Support Service for this product is sold separately. For further information, refer to the Compaq OpenVMS Enterprise Directory for e-Business Software Product Description (SPD 40.77.xx)

**Reliable Transaction Router**

Reliable Transaction Router (RTR) is fault tolerant transactional messaging middleware used to implement large, distributed applications using client/server technology. Reliable Transaction Router enables computing enterprises to deploy distributed applications on OpenVMS Alpha and VAX systems.

Software Support Service for this product is sold separately. Refer to the Reliable Transaction Router for OpenVMS Software Product Description (SPD 51.04.xx) for additional information.

**Compaq BridgeWorks**

Compaq BridgeWorks is a distributed application development and deployment tool for OpenVMS 3GL applications. Compaq BridgeWorks consists of a GUI development tool on the Windows NT desktop, a server manager component on OpenVMS, and extensive online help. Compaq BridgeWorks provides developers with an easy means to create distributed applications using OpenVMS as the enterprise server and Windows NT as the departmental server. Compaq BridgeWorks enables software developers to develop components that encapsulate selected functionality in 3GL OpenVMS applications using an interactive PC environment. It generates all the necessary files and code to build these components into a three-tier, distributed connection. Components generated by Compaq BridgeWorks use established standard technologies internally, including COM, DCE/RPC, C, and C++.

Compaq BridgeWorks does not directly assist with the development of the clients; it provides the code that exposes the 3GL routine as a component. The client can be developed using any COM-capable tool, such as Visual Basic, Visual C++, and many scripting tools.

Software Support Service for this product is sold separately.

**Compaq COM for OpenVMS**

Component Object Model (COM) is a technology from Microsoft that allows developers to create distributed network objects. Digital Equipment Corporation and Microsoft jointly developed the COM specification. First released by Microsoft on Windows NT as Network Object Linking and Embedding (NetOLE), and then renamed Distributed COM (DCOM), the COM specification now includes network objects.

COM is used to create distributed applications made up of reusable objects. COM locates objects locally or in a network and uses the Remote Procedure Call (RPC) wire protocol to communicate between these objects across the network.

COM on OpenVMS delivers connectivity and interoperability between OpenVMS and Windows NT systems. With Compaq COM for OpenVMS, programmers write distributed applications that run across a heterogeneous environment of systems. Compaq COM for OpenVMS is based on the Microsoft COM shipped on Windows NT Version 4.0 SP3 and implements many of the features of Microsoft COM including activation, automation, monikers, Type Libraries, and structured storage on OpenVMS.

COM on OpenVMS requires OpenVMS Alpha Version 7.2 or higher.

The binary kit for COM (both developer kit and run-time) ships with the OpenVMS Alpha distribution kit. COM is not available on VAX. Software Support Service for this product is sold separately. For more information, see the Compaq COM for OpenVMS Software Product Description (SPD 70.45.xx).

**Netscape FastTrack Server for OpenVMS Alpha**

Netscape FastTrack Server Version 3.02 for OpenVMS Alpha is a general-purpose Web server for creating, building, publishing, and serving Web pages and applications.

Netscape FastTrack Server is being replaced by Compaq Secure Web Server (based upon Apache) for OpenVMS Alpha. FastTrack will continue to be supported until December 31, 2001 on OpenVMS Version 7.1 and Version 7.2 systems.

Services for the Netscape FastTrack Server for OpenVMS Alpha are provided under existing OpenVMS service agreements.

## ASSOCIATED PRODUCTS

**Compaq Advanced Server for OpenVMS Alpha**

Compaq Advanced Server for OpenVMS is supported on OpenVMS Alpha systems only. Advanced Server V7.3 for OpenVMS is the only version of that product supported on OpenVMS Alpha Version 7.3. The Advanced Server for OpenVMS product evolved from the PATHWORKS for OpenVMS (Advanced Server).

Advanced Server is an OpenVMS-based network operating system (NOS) compatible with Microsoft networking technology. The software lets you establish Compaq OpenVMS systems as servers to provide Windows desktop users easy and efficient access to OpenVMS file and print services. Desktop users can use Microsoft products and utilities such as Windows Explorer to access these resources shared over the network.

Advanced Server for OpenVMS combines the networking strengths and rich application set of Windows NT with the proven availability, scalability, and security of OpenVMS. The software supports the Windows NT integration features of OpenVMS Alpha Version 7.3 and is compatible with Windows NT and Windows 2000 servers running in the same network.

Advanced Server for OpenVMS can function as a file and print server for a small, isolated community of users or as the foundation of a large network distributed over a wide geographical area. The Advanced Server software

also provides a flexible system for network administration and security, for both wide area networks (WANs) and local area networks (LANs).

**Compaq PATHWORKS for OpenVMS (Advanced Server)**

Compaq PATHWORKS for OpenVMS (Advanced Server), also known as PATHWORKS Advanced Server, runs on OpenVMS Alpha and VAX systems. The only version supported on OpenVMS Alpha or VAX Version 7.3 is PATHWORKS Version 6.0D for OpenVMS (Advanced Server). PATHWORKS Advanced Server, as with Advanced Server for OpenVMS, is an OpenVMS-based network operating system compatible with, and enhancing, the Microsoft networking technology, and providing file and print services for Windows desktop users. It is compatible with Windows NT servers running in the same network.

**Compaq Galaxy Software Architecture on OpenVMS Alpha**

Compaq Galaxy Software Architecture on OpenVMS Alpha is available as a separately licensed System Integrated Product (SIP).

By running multiple instances of OpenVMS in a single computer or hard partition, an OpenVMS Galaxy computing environment gives you quantum improvements in:

- Compatibility—Existing applications run without changes.
- Availability—Presents opportunities to upgrade software and expand system capacity without downtime.
- Scalability—Offers scaling alternatives that improve performance of SMP and cluster environments.
- Adaptability—Physical resources can be dynamically reassigned to meet changing workload demands.
- Cost of ownership—Fewer computer systems reduce system management requirements, floor space, and more.

For companies looking to improve their ability to manage unpredictable, variable, or growing IT workloads, OpenVMS Galaxy technology provides a flexible way to dynamically reconfigure and manage system resources.

An OpenVMS Galaxy computing environment is ideal for high-availability applications, such as:

- Database servers
- Transaction processing systems
- Data warehousing
- Data mining
- Internet servers

With OpenVMS Alpha Version 7.3 and forward, you can create an OpenVMS Galaxy computing environment that allows you to run multiple instances of OpenVMS on AlphaServer systems, and also allows you to:

- Reassign CPUs between instances
- Perform independent booting and shutdown of instances
- Use shared memory for inter-instance communication
- Create a shared memory RAMdisk with Compaq DECram for OpenVMS Alpha Version 3.0
- Cluster instances within an OpenVMS Galaxy using the shared memory cluster interconnect
- Cluster instances with non-Galaxy systems
- Create applications using OpenVMS Galaxy APIs for resource management, event notification, locking for synchronization, and shared memory for global sections
- Use the Galaxy Configuration Utility to view and control the OpenVMS Galaxy environment
- Run a single-instance OpenVMS Galaxy on any Alpha system for application development

Compaq Galaxy Software Architecture on OpenVMS Alpha requires OpenVMS Alpha Version 7.2 or later.

For more information about OpenVMS Galaxy licensing requirements, refer to the Galaxy Software Architecture on OpenVMS Alpha Software Product Description (SPD 70.44.xx).

For more information about how to create, manage, and use an OpenVMS Galaxy computing environment, refer to the *OpenVMS Alpha Partitioning and Galaxy Guide*.

**Compaq OpenVMS Cluster Software**

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

OpenVMS Cluster systems and storage communicate using a combination of the following interconnects:

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

- Shared Memory Cluster Interconnect (SMCI) (Galaxy only)
- Fibre Channel (Storage Only) Version 7.2-1 and above

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

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

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

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

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

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

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

**Compaq Volume Shadowing for OpenVMS**

Compaq provides Volume Shadowing for OpenVMS Alpha and VAX products for performing disk mirroring operations, using a redundant array of independent disks (RAID) 1 storage strategy.

Compaq Volume Shadowing for OpenVMS is available for Alpha and VAX systems as a separate licensed System Integration Product (SIP). Volume Shadowing for OpenVMS provides high data availability for disk devices by ensuring against data loss that results from media deterioration or controller or device failure. This prevents storage subsystem component failures from interrupting system or application tasks.

The system disk and Files-11 On-Disk Structure (ODS-2, ODS-5) data disks can be volume shadowed.

Volume Shadowing for OpenVMS supports the cluster-wide shadowing of Compaq SCSI and DSA storage systems. Volume Shadowing for OpenVMS also supports shadowing of all MSCP served DSA disks and Compaq SCSI disks. All disks in a single shadow set must have the same number of logical blocks. Shadow set members can be located on a single system or anywhere in an OpenVMS Cluster system. Disks can be configured on any MSCP or Compaq SCSI-compliant controller.

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

Volume Shadowing for OpenVMS supports up to 10,000 single-member shadow sets, and up to 500 devices in multiple member (two or three member) shadow sets, on a standalone or OpenVMS Cluster system.

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

**Compaq TCP/IP Services for OpenVMS**

Compaq TCP/IP Services for OpenVMS, Version 5.1, (VAX and Alpha) is Compaq's industry-standard implementation of the TCP/IP and NFS networking protocols on the OpenVMS platform. Compaq TCP/IP Services for OpenVMS is integrated with the OpenVMS operating system installation. Compaq TCP/IP Services for OpenVMS provides interoperability and resource sharing among systems running OpenVMS, UNIX, Windows NT, and other operating systems that support TCP/IP. Version 5.1 provides a comprehensive suite of functions and applications that support industry-standard protocols for heterogeneous network communications and resource sharing. TCP/IP Services Version 5.1 incorporates the TCP/IP protocols stack from Compaq Tru64 UNIX Version 5.1.

Compaq TCP/IP Service for OpenVMS, Version 5.1, provides enhancements such as NFS V3, the ability to run NFS over TCP and an Anti-SPAM relay for SMTP mail. This release also contains Internet Protocol Version 6 (IPv6) support for Transmission Control Protocol (TCP), User Datagram Protocol (UDP), raw sockets, and IPv6 support for commands and utilities. This support is for those customers who want to start using IPv6 today and for those who want to test or experiment with IPv6. This support is in addition to the IPv4 support already in TCP/IP Services for OpenVMS.

Compaq TCP/IP Services for OpenVMS provides a full TCP/IP protocol suite including IP/Multicasting, Dynamic Load Balancing, Rlogin PROXY, network file access, remote terminal access, remote command execution, remote printing, mail, application development, Post Office Protocol (POP), SNMP Extensible agent (eSNMP) and Finger Utility.

Compaq TCP/IP Services for OpenVMS, Version 5.1 ensures transparent backward compatibility with earlier versions of TCP/IP Services for OpenVMS and is supported on OpenVMS Alpha Versions 7.1, 7.2 and 7.3 and OpenVMS VAX Versions 7.1, 7.2 and 7.3.

**Compaq DECnet-Plus and DECnet Software**

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

Compaq DECnet-Plus (formerly DECnet/OSI) is licensed separately from the OpenVMS operating system. The license for Compaq DECnet for OpenVMS VAX and Alpha also grants the rights to use DECnet-Plus. Note that only one version of DECnet can be active on a single system at any one time. Refer to the Compaq DECnet-Plus for OpenVMS Alpha Software Product Description (SPD 50.45.xx) and the Compaq DECnet-Plus for OpenVMS VAX Software Product Description (SPD 25.03.xx)) for further information on supported hardware configurations and software features.

**Compaq RMS Journaling for OpenVMS**

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

RMS Journaling provides the following three types of journaling:

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

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

**Compaq DECram for OpenVMS**

Compaq DECram for OpenVMS is a disk device driver that improves I/O performance by allowing an OpenVMS system manager to create pseudo disks (RAMdisks) that reside in main memory. Frequently accessed data can be accessed much faster from a DECram device than from a physical disk device. These RAMdisks can be accessed through the file system just as physical disks are accessed, requiring no change to application or system software.

Because main memory is allocated for the DECram device, extra memory is generally required. The OpenVMS system manager can designate the amount of memory dedicated to the DECram device(s) and the files that will be stored on it.

In Compaq DECram for OpenVMS Version 3.0, DECram's capability is extended to use OpenVMS Galaxy shared memory to create a VMS shared memory disk. This will allow customers to take advantage of OpenVMS Galaxy shared memory with no modifications to any of their applications.

Compaq DECram for OpenVMS Version 3.0 is supported on OpenVMS Alpha Version 7.2-1H1 or higher. Compaq DECram for OpenVMS Version 2.3 will continue to be available and supported on OpenVMS Alpha Versions 7.1, 7.2 and 7.3 and OpenVMS VAX Version 6.2 or higher.

DECram Version 3.0 cannot run on an OpenVMS VAX system, however, the RAMdisk can be accessed by OpenVMS VAX systems in an OpenVMS Cluster system.

Refer to the Compaq DECram for OpenVMS Software Product Description (SPD 34.26.xx) for more information.

**Compaq DECwindows Motif for OpenVMS**

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

Compaq DECwindows Motif Version 1.2-5 for OpenVMS Alpha and higher delivers the New Desktop environment for OpenVMS Alpha systems, which is derived from the Common Desktop Environment (CDE) technology. CDE provides and defines a consistent user interface for end users and a consistent development environment for application developers across multiple platforms.

The OpenVMS software installation procedure contains an optional step to install the DECwindows Motif for OpenVMS workstation and font support, which is required to run the DECwindows Motif for OpenVMS layered product. Refer to the *OpenVMS Alpha Version 7.3 Upgrade and Installation Manual* or *OpenVMS VAX Version 7.3 Upgrade and Installation Manual* for details concerning the optional installation of the DECwindows Motif for OpenVMS device support.

## CONFORMANCE TO STANDARDS

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

**Distributed Computing Environment (DCE) Support**

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

Compaq DCE for OpenVMS currently consists of the following products:

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

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

**Support for OSF/Motif and X Window System Standards**

DECwindows Motif provides support for OSF/Motif, a standards based graphical user interface. DECwindows Motif also provides support for the X Consortium's X

Window System, Version 11, Release 6 (X11R6) server and the Version 11, Release 5 (X11R5) client.

**Standards Supported by OpenVMS**

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

- ANSI X3.4-1986: American Standard Code for Information Interchange
- ANSI X3.22-1973: Recorded Magnetic Tape (800 BPI, NRZI)
- ANSI X3.27-1987: File Structure and Labeling of Magnetic Tapes for Information Interchange
- ANSI X3.298: Limited support. Information Technology—AT Attachment-3 Interface (ATA-3)
- ANSI X3.39-1986: Recorded Magnetic Tape (1600 BPI, PE)
- ANSI X3.40-1983: Unrecorded Magnetic Tape
- ANSI X3.41-1974: Code Extension Techniques for Use with 7-bit ASCII
- ANSI X3.42-1975: Representation of Numeric Values in Character Strings
- ANSI X3.54-1986: Recorded Magnetic Tape (6250 BPI, GCR)
- ANSI X3.131-1986 (SCSI I): Small Computer System Interface
- ANSI X3.131-1994 (SCSI II): Small Computer System Interface
- ANSI/IEEE 802.2-1985: Logical Link Control
- ANSI/IEEE 802.3-1985: Carrier Sense Multiple Access with Collision Detection
- FIPS 1-2: Code for Information Interchange, Its Representations, Subsets, and Extensions

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

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

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

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

  **Note:** Other FIPS are not applicable.

  **Note:** Information regarding interchangeability of ANSI and FED standards with FIPS is contained in "ADP Telecommunications Standards Index," July 1988, published and maintained by the General Services Administration.
- ISO 646: ISO 7-bit Coded Character Set for Information Exchange
- ISO 1001: File Structure and Labeling of Magnetic Tapes for Information Interchange
- ISO 1863: Information Processing — 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 32 rpmm (800 rpi)
- ISO 1864: Information Processing — Unrecorded 12, 7 mm (0.5 in) wide magnetic tape for information interchange — 35 ftpmm (800 ftpi) NRZI, 126 ftpmm (3 200) ftpi phase encoded and 356 ftmm (9 042 ftpi), NRZI
- ISO 2022: Code Extension Techniques for Use with ISO 646
- ISO 3307: Representations of Time of the Day
- ISO 3788: Information Processing — 9-track, 12, 7 mm (0.5 in) wide magnetic tape for information interchange recorded at 63 rpmm (1 600 rpt), phase encoded

- ISO 4873: 8-Bit Code for Information Interchange — Structure and Rules for Implementation
- ISO 5652: Recorded Magtape (6250)
- ISO 6429: Control Functions for Coded Character Sets
- ISO 9316: 1989 (SCSI-1) Small Computer System Interface
- ISO 9660: Information Processing — Volume and file structure of CD–ROM for information exchange
- ISO 10288: 1994 (SCSI-2) Small Computer System Interface

## INSTALLATION

OpenVMS Alpha is distributed as a binary kit on CD–ROM. Procedures for setting up the system disk from media and for preparing the system for day-to-day operations are provided. The procedures use the POLYCENTER Software Installation utility to configure and install the OpenVMS Alpha operating system. These procedures are described in the *OpenVMS Alpha Version 7.3 Upgrade and Installation Manual*.

OpenVMS VAX is distributed as binary kits on CD–ROM and tape. OpenVMS VAX Version 7.3 is the last OpenVMS release for which TK50 and Magnetic tape media will be distributed. Future OpenVMS VAX releases will be distributed on CD–ROM only. Procedures for setting up the system disk from a kit and for preparing the system for day-to-day operations are provided. The procedures are described in the *OpenVMS VAX Version 7.3 Upgrade and Installation Manual*. Computer-specific information is contained in the upgrade and installation supplements for each family of VAX computers.

### POLYCENTER Software Installation

The POLYCENTER Software Installation utility simplifies the installation and management of OpenVMS products. It is used to install, configure, reconfigure, and deinstall software products that have been prepared with the utility. In addition, the POLYCENTER utility provides a database to track the installation, reconfiguration, and deinstallation of software. For products installed with other installation technologies, the POLYCENTER utility provides a mechanism for adding information about them into the product database. The POLYCENTER utility also provides the ability to manage dependencies between products during the installation process.

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

For OpenVMS Alpha, you use the POLYCENTER Software Installation utility to install the operating system and to install layered products that are compliant with the POLYCENTER utility.

For OpenVMS VAX, you use the POLYCENTER Software Installation utility to install layered products that are compliant with the POLYCENTER utility.

### VMSINSTAL

OpenVMS includes the VMSINSTAL facility to handle the installation of optional Compaq supplied software products that have not been converted to use the POLYCENTER Software Installation utility. OpenVMS VAX also includes the VMSINSTAL facility to automate operating system software updates.

### Test Package and Diagnostics

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

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

## OpenVMS Alpha DISK SPACE REQUIREMENTS

### Operating System Disk Space Requirements

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

| File Category | Space Used | Running Total |
|---|---|---|
| Minimum OpenVMS files | 78 MB | 78 MB |
| Optional OpenVMS files | 106 MB | 184 MB |
| DECwindows Support | 32 MB | 216 MB |
| Paging file (required) | 38 MB | 254 MB |
| Swap file (suggested) | 3 MB | 257 MB |
| Dump file (optional) | 28 MB | 285 MB |
| Decompressed Help files (optional) | 15 MB | 300 MB |
| Full DECwindows Motif Version 1.2-6 (optional) | 159 MB | 459 MB |
| Safeguard for upgrading | 50 MB | 509 MB |

**Note:** The minimum OpenVMS files listed in the table will allow you to run with minimal functionality. Not all OpenVMS commands and utilities will function fully as documented in this minimum configuration. Not all Compaq and other layered products will work in this minimum configuration.

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

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

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

**Compaq DECwindows Motif for OpenVMS Alpha Disk Space Requirements**

To support OpenVMS Alpha and DECwindows Motif for OpenVMS Alpha, Compaq recommends a system disk of greater than 550 MB. However, you can install a subset of DECwindows Motif. The disk space required for the installation of DECwindows Motif is 159 MB. The permanent amount of space used is 145 MB. An additional 33 MB is needed to install the DECwindows X11 Display Server and associated files. (The DECwindows X11 Display Server and associated files are included in the OpenVMS Alpha operating system media.) These disk space requirements are in addition to the disk space required for the OpenVMS Alpha operating system, as indicated in the OpenVMS Alpha Disk Space Requirements table.

Installation of the DECwindows Motif Version 1.2-6 layered product gives customers the option of installing any or all of the following components:

- **Run-time support base kit** — 33 MB. This section provides support for running DECwindows Motif for OpenVMS Alpha applications on Alpha compute servers and is a required part of the installation.
- **New Desktop** — 24 MB. This is an optional component that allows use of the New Desktop environment. It includes applications and application programming interfaces (APIs).
- **DECwindows desktop** — 11 MB. This component is also optional, but you should install either the New Desktop or the DECwindows desktop to create a usable system. The DECwindows desktop is the user interface that was included in previous versions of DECwindows Motif and includes the DECwindows Session Manager, FileView, and the Motif Window Manager.
- **Programming support** — 32 MB. This section includes support for the Compaq C, Compaq C++, Compaq Fortran, and Pascal programming languages. If you install a subset of languages, the amount of disk space required will be less.
- **Example files** — approximately 26 MB.
- **Translated image support** — approximately 20 MB.

**Layered Product Disk Space Requirements**

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

## OpenVMS VAX DISK SPACE REQUIREMENTS

**Disk Space Requirements (Block Cluster Size = 3)**

To support the complete OpenVMS VAX system, Compaq recommends a system disk of greater than 150 MB. When you use a smaller disk, additional tailoring is required before installing some of the OpenVMS VAX options. This does not include the dump file space. Refer to the *OpenVMS VAX Version 7.3 Upgrade and Installation Manual* for information on tailoring.

**Operating System Disk Space Requirements**

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

| File Category | Space Used | Running Total |
|---|---|---|
| Minimum OpenVMS files | 32.0 MB | 32.0 MB |
| Optional OpenVMS files | 52.0 MB | 84.0 MB |
| DECwindows Support | 14.0 MB | 98.0 MB |
| Paging file (after installation) | 6.0 MB | 104.0 MB |
| Swap file (suggested) | 1.2 MB | 105.2 MB |
| Dump file (optional) | 6.2 MB | 111.4 MB |
| Decompressed Help files (optional) | 7.0 MB | 118.4 MB |
| Safeguard for upgrading | 25.0 MB | 143.4 MB |
| Variable additional space (additional files, INDEXF.SYS, etc.) | 3.3 MB | 146.7 MB |

**Note:** The minimum OpenVMS files listed in the table will allow you to run with minimal functionality. Not all OpenVMS commands and utilities will function fully as documented in this minimum configuration. Not all Compaq and other layered products will work in this minimum configuration.

The data in the table was created from an installation on a VAXserver 2000 with 6 MB of memory and an RD54 disk.

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

### Compaq DECwindows Motif for OpenVMS VAX Disk Space Requirements

To support OpenVMS VAX and the DECwindows Motif for OpenVMS VAX layered product, Compaq recommends a system disk of greater than 300 MB. The disk space required for the installation of DECwindows Motif is 60 MB. The permanent amount of space used is 54 MB. An additional 16 MB are needed to install the DECwindows X11 Display Server and associated files. (The DECwindows X11 Display Server and associated files are included in the OpenVMS VAX Version 7.3 media.) These disk space requirements are in addition to the disk space required for the OpenVMS VAX Version 7.3 operating system, as indicated in the OpenVMS VAX Disk Space Requirements table.

Installation of the DECwindows Motif Version 1.2-6 layered product gives customers the option of installing any or all of the following components:

- **Run-time support files base kit** — 41 MB. This section provides support for running DECwindows Motif for OpenVMS VAX applications on VAX compute servers and is a required part of the installation. It includes the DECwindows desktop applications and libraries.
- **Programming support** — 7 MB. This section includes support for the Compaq C, Compaq C++, Compaq Fortran, Pascal, and VAX C programming languages. If a subset of languages is installed, the amount of disk space required is less.
- **Example files** — approximately 7 MB.

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

## MEMORY SPACE REQUIREMENTS

### OpenVMS Alpha Memory Space Requirements

The minimum amount of memory required to install, boot, and log in to an OpenVMS Alpha system is 64 MB. Additional memory may be required to ensure satisfactory performance for either of the following:

- Particular applications or number of users
- Particular hardware configurations

Refer to specific layered product documentation for their memory requirements.

### OpenVMS VAX Memory Space Requirements

The minimum amount of memory required to install, boot, and log in to an OpenVMS VAX system is 14 MB. To ensure satisfactory performance for particular applications or number of users, additional memory may be required. Refer to specific layered product documentation for their memory requirements.

## DISTRIBUTION AND BACKUP MEDIA

### OpenVMS Alpha

OpenVMS Alpha is available on CD–ROM only. The OpenVMS Alpha Version 7.3 Binary CD–ROM contains the operating system binaries and selected documentation in both text and PostScript format. The OpenVMS Version 7.3 Online Documentation CD–ROM contains all OpenVMS manuals in .HTML and .PDF formats. Associated product manuals are in .HTML and selected product and archived manuals are in .PDF format.

The OpenVMS Documentation CD–ROM is a dual-formatted system CD–ROM that can be mounted and read on both an OpenVMS system and a Windows 95 or Windows NT PC system. An InfoServer or local drive is required for upgrades and system disk backups.

The OpenVMS Alpha operating system is also available as part of the OpenVMS Alpha Software Products Library CD–ROM offering.

### OpenVMS VAX

OpenVMS VAX is available on CD–ROM, TK50, or 9-track 6250 BPI magnetic tape media. The 9-track 6250 BPI magnetic tape media is available only through the OpenVMS VAX media and hardcopy documentation update service. OpenVMS VAX Version 7.3 is the last OpenVMS release for which TK50 and Magnetic tape media will be distributed.

The OpenVMS VAX Version 7.3 Binary CD–ROM contains the OpenVMS VAX Version 7.3 save sets, OpenVMS VAX Version 7.3 standalone BACKUP, and selected OpenVMS documentation in text and PostScript format. The OpenVMS Version 7.3 Online Documentation CD–ROM contains all OpenVMS manuals in .HTML and .PDF formats. Associated product manuals are in .HTML and selected product and archived manuals are in .PDF format.

The OpenVMS Documentation CD–ROM is a dual-formatted system CD–ROM that can be mounted and read on both an OpenVMS system and a Windows 95 or Windows NT PC system.

The TK50 streaming tape contains the OpenVMS VAX Version 7.3 save sets and OpenVMS VAX Version 7.3 standalone BACKUP.

The 9-track 6250 BPI magnetic tape contains the OpenVMS VAX Version 7.3 save sets.

The OpenVMS VAX operating system is also available as part of the OpenVMS VAX Software Products Library CD–ROM offering.

## DOCUMENTATION

For OpenVMS Version 7.3, documentation is available in the following formats:

*Printed Books*

OpenVMS printed documentation is available in two sets: the OpenVMS Full Documentation Set and the OpenVMS Base Documentation Set.

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

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

Each book in these sets is also separately orderable. A complete listing of all hardcopy manuals and their part numbers is in the *OpenVMS Version 7.3 New Features and Documentation Overview* manual.

*Online Books*

For Version 7.3, online documentation is provided on the OpenVMS Documentation CD-ROM, an ISO9660 CD-ROM that can be read on OpenVMS, Windows, and Macintosh systems.

The OpenVMS Version 7.3 Online Documentation CD–ROM contains all OpenVMS manuals in .HTML and .PDF formats. Associated product manuals are in .HTML and selected product and archived manuals are in .PDF format.

## GROWTH CONSIDERATIONS

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

## SOURCE LISTINGS

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

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

## ORDERING INFORMATION

### Alpha Software Licenses

| | |
|---|---|
| QL–MT1A*–6* | OpenVMS Alpha Operating System Base License |
| QL–MT1A*–7* | OpenVMS Alpha Operating System Base Update License |
| QL–MT1A9–6* | OpenVMS Alpha Operating System Symmetric Multiprocessing (SMP) Base Extension License |
| QL–MT1A9–7* | OpenVMS Alpha Operating System Symmetric Multiprocessing (SMP) Base Extension Update License |
| QL–MT2A9–** | OpenVMS Alpha Individual User License (No Longer Available...order the Concurrent Use License or Unlimited User License) |
| QL–MT2A*–AA | OpenVMS Alpha Unlimited User License |
| QL–MT2A*–Y* | OpenVMS Alpha Individual User Update License |
| QL–MT3A*–B* | OpenVMS Alpha Distributed Interactive User License (No Longer Available...order the Concurrent Use License) |
| QL–MT3A*–Y* | OpenVMS Alpha Distributed Interactive User Update License |
| QL–MT3A*–3* | OpenVMS Concurrent Use License |
| QL–MT3A*–5* | OpenVMS Concurrent Use Update License |

### VAX Software Licenses

| | |
|---|---|
| QL–001A*–** | VAX VMS Operating System License and Update License for OpenVMS |
| QL–005A*–6* | OpenVMS VAX Operating System Base License |
| QL–005A*–7* | OpenVMS VAX Operating System Base Update License |
| QL–005A9–6* | OpenVMS VAX Operating System Symmetric Multiprocessing (SMP) Base Extension License |
| QL–005A9–7* | OpenVMS VAX Operating System Symmetric Multiprocessing (SMP) Base Extension Update License |
| QL–XULA9–** | OpenVMS VAX Individual User License (No Longer Available...order the Concurrent Use License or Unlimited User License) |
| QL–XULA*–AA | OpenVMS VAX Unlimited User License |
| QL–XULA*–Y* | OpenVMS VAX Interactive User Update License |
| QL–09SA*–** | OpenVMS VAX Distributed Interactive User License (No Longer Available...order the Concurrent Use License) |
| QL–09SA*–Y* | OpenVMS VAX Distributed Interactive User Update License |
| QL–MT3A*–3* | OpenVMS Concurrent Use License |
| QL–MT3A*–5* | OpenVMS Concurrent Use Update License |

### Alpha and VAX CD–ROM Media and Online Documentation

| | |
|---|---|
| QA–MT1AA–H8 | OpenVMS Alpha software and online documentation CD–ROM |
| QA–MT1AG–H8 | OpenVMS Alpha Version 6.2–1H3 software and online documentation CD–ROM. This includes Version 6.2–1H1 and Version 6.2-1H2. (QA–MT1AA–H8.6.2 is required) |
| QA–MT1AD–H8 | OpenVMS Alpha Version 7.1–1H2 software and online documentation CD–ROM. (QA–MT1AA–H8.7.1 is required) |
| QA–MT1AR–H8 | OpenVMS Alpha Version 7.1–2 software and online documentation CD–ROM |
| QA–MT1AT–H8 | OpenVMS Alpha Version 7.2–1 software and online documentation CD–ROM |
| QA–MT1AU–H8 | OpenVMS Alpha Version 7.2–1H1 software and online documentation CD–ROM |
| QA–XULAA–H8 | OpenVMS VAX software and online documentation CD–ROM |
| QA–MT3AA–H8 | OpenVMS VAX/Alpha software and online documentation CD–ROM |
| QA–MT3AE–G8 | OpenVMS VAX/Alpha online documentation CD–ROM |

### VAX Media and Hardcopy Documentation

| | |
|---|---|
| QA–09SAA–H8 | OpenVMS VAX Software CD–ROM and Base Documentation Set |
| QA–09SAA–H5 | OpenVMS VAX Software TK50 and Base Documentation Set |
| QA–001AA–H8 | OpenVMS VAX Software CD–ROM and Full Documentation Set |
| QA–001AA–H5 | OpenVMS VAX Software TK50 and Full Documentation Set |

### Hardcopy Documentation Sets

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

### Source Listings Kits

| | |
|---|---|
| QB–MT1AB–E8 | OpenVMS Alpha Listings CD–ROM Kit and License |
| QB–001AB–E8 | OpenVMS VAX Listings CD–ROM Kit and License |

### OpenVMS Alpha Software Products Library CD–ROM Offerings

| | |
|---|---|
| QA–5FX8A–A8 | OpenVMS Alpha Software Layered Products and Operating System Library (Software Layered Product binaries only—no online documentation, complete Operating System kit) |
| QA–4KM8A–G8 | OpenVMS Alpha Online Documentation Library |
| QA–5G98A-H8 | OpenVMS Alpha Software Layered Products and Operating System Library Package (Software Layered Product binaries and online documentation, complete Operating System kit) |
| QA–03XAA–H8 | OpenVMS Alpha Software Library Package (Software Layered Product binaries and online documentation) |

### OpenVMS VAX Software Products Library CD–ROM Offerings

| | |
|---|---|
| QA–VWJ8A–H8 | OpenVMS VAX Software Layered Products and Operating System Library (Software Layered Product binaries only—no online documentation, complete Operating System kit) |
| QA–VYR8A–G8 | OpenVMS VAX Online Documentation Library |
| QA–YL48A–H8 | OpenVMS VAX Software Layered Products and Operating System Library Package (Software Layered Product binaries and online documentation, complete Operating System kit) |
| QA–5G88A–H8 | OpenVMS VAX Software Library Package (Software Layered Product binaries and online documentation) |

### Software Update Distribution Services

Provides an automatic distribution of software media and documentation update. Choices include:

- Media and Documentation Distribution
- Documentation Distribution
- Consolidated Software Engineering Change Order Distribution
- Consolidated Distribution of Software Binaries
- Consolidated Distribution with Software Binaries and Documentation
- Consolidated Online Documentation

For additional ordering and pricing information, contact your local Compaq Account Representative.

### CD–ROM Media and Online Documentation Update Service

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

### Hardcopy Documentation Only Update Service

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

### OpenVMS VAX Media and Hardcopy Documentation Update Service

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

### OpenVMS Source Listings Service

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

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

### OpenVMS Alpha Software Products Library CD–ROM Service

| | |
|---|---|
| QT–5FX8A–C8 | OpenVMS Alpha Software Layered Products and Operating System Library (Software Layered Product binaries only—no online documentation, complete Operating System kit) |
| QT–4KM8A–C8 | OpenVMS Alpha Online Documentation Library |
| QT–5G98A–C8 | OpenVMS Alpha Software Layered Products and Operating System Library Package (Software Layered Product binaries and online documentation, complete Operating System kit) |
| QT–03XAA–C8 | OpenVMS Alpha Software Library Package (Software Layered Product binaries and online documentation) |

### OpenVMS VAX Software Products Library CD–ROM Service

| | |
|---|---|
| QT–VWJ8A–C8 | OpenVMS VAX Software Layered Products and Operating System Library (Software Layered Product binaries only—no online documentation, complete Operating System kit) |
| QT–VYR8A–C8 | OpenVMS VAX Online Documentation Library |
| QT–YL48A–C8 | OpenVMS VAX Software Layered Products and Operating System Library Package (Software Layered Product binaries and online documentation, complete Operating System kit) |
| QT–5G88A–C8 | OpenVMS VAX Software Library Package (Software Layered Product binaries and online documentation) |

## SOFTWARE LICENSING

The OpenVMS operating system software is furnished under the licensing provisions of Compaq Computer Corporation's Standard Terms and Conditions. The OpenVMS Version 7.3 Online Documentation CD–ROM contains all OpenVMS manuals in .HTML and .PDF formats. Associated product manuals are in .HTML and selected product and archived manuals are in .PDF

### Software License Information (Alpha Only)

The OpenVMS Alpha operating system license includes the right to use OpenVMS Alpha licenses for multiple instances of OpenVMS on the first and then once again on each subsequent hard partition of a single AlphaServer GS80/160/320 system.

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

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

The right to use Compaq Capacity On Demand for OpenVMS is included with the OpenVMS base operating system license.

The following technologies are licensed as part of the OpenVMS Alpha operating system:

| Product Name | Related Software Product Description (SPD) |
|---|---|
| Attunity Connect "On Platform" Package for OpenVMS Alpha | SPD 80.58.xx |
| Compaq COM for OpenVMS Alpha | SPD 70.45.xx |
| Compaq BridgeWorks | SPD 80.58.xx |
| Compaq Secure Web Server for OpenVMS Alpha | SPD 80.58.xx |
| ECP Data Collector for OpenVMS | SPD 80.88.00 |
| ECP Performance Analyzer for OpenVMS | SPD 80.89.00 |
| Extensible Markup Language (XML) Technology | SPD 80.58.xx |
| Java 2 Software Development Kit for OpenVMS Alpha | SPD 80.58.xx |
| Netscape FastTrack Server for OpenVMS Alpha | SPD 80.58.xx |
| OpenVMS Enterprise Directory for e-Business (LDAPv3/X.500) | SPD 40.77.xx |
| Reliable Transaction Router (Alpha and VAX) | SPD 51.04.xx |

The following are separately licensed products:

| Product Name | Related Software Product Description (SPD) |
|---|---|
| Compaq Advanced Server for OpenVMS | SPD 30.50.xx |
| Compaq DECnet-Plus for OpenVMS VAX | SPD 25.03.xx |
| Compaq DECnet-Plus for OpenVMS Alpha | SPD 50.45.xx |
| Compaq DECnet for OpenVMS VAX and Alpha | SPD 48.48.xx |
| Compaq DECram for OpenVMS | SPD 34.26.xx |
| Compaq DECwindows Motif for OpenVMS | SPD 42.19.xx |
| Compaq Galaxy Software Architecture on OpenVMS Alpha | SPD 70.44.xx |
| Compaq PATHWORKS for OpenVMS (Advanced Server) | SPD 30.50.xx |
| Compaq OpenVMS Cluster Software | SPD 29.78.xx |
| Compaq RMS Journaling for OpenVMS | SPD 27.58.xx |
| Compaq TCP/IP Services for OpenVMS | SPD 46.46.xx |
| Compaq Volume Shadowing for OpenVMS | SPD 27.29.xx |

### Software License Information (VAX Only)

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

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

- VAX VMS Licensing
- OpenVMS VAX Licensing

### System Support Services

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

### VAX VMS License Information

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

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

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

There are four types of VAX VMS licenses:

All use the LMF Product Name of VAX-VMS.

1. Traditional License (QL–001A*–**)

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

2. Multi-User License (QL–001A*–**)

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

The customer can increase interactive use of VAX systems licensed with the Multi-User License by the addition of OpenVMS User Licenses* (for one or more users). Refer to the section on Ordering Information for further information.

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

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

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

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

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

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

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

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

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

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

**OpenVMS VAX License Information**

There are five types of OpenVMS VAX licenses:

1. OpenVMS VAX Operating System Base License (QL–005A*–**)

LMF Product Name: BASE-VMS-250136

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

The OpenVMS VAX Base License does not include the license right for the Oracle Rdb Run-Time Option for OpenVMS VAX.

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

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

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

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

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

LMF Product Name: BASE-VMS-250136

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

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

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

LMF Product Name: VMS-USER

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

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

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

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

LMF Product Name: ADL-USER

This license grants the right to interactive use of the OpenVMS VAX operating system, provided the appropriate Operating System Base License or one of the five types of VAX VMS Licenses has been previously installed on a VAX system. The Distributed Interactive

User licenses are concurrent-use licenses and are available in any quantity, except unlimited. Distributed Interactive User licenses are mobile (and can be redesignated) and may be installed and used on a single OpenVMS VAX processor or shared in a single OpenVMS VAXcluster.

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

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

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

LMF Product Name: OPENVMS-ALPHA-ADL

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

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

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

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

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

**OpenVMS Alpha License Information**

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

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

LMF Product Name: OpenVMS-ALPHA

This license grants the right to noninteractive use of the remote batch, print, application, and computing services of the OpenVMS Alpha operating system on a single processor. This license authorizes one direct login for system management purposes only. For dual processor systems (Compaq AlphaServer 8200, 8400 and the AlphaServer GS60, GS60E, and GS140), the base license for these specific systems grants the right to noninteractive use of the remote batch, print, application, and computing services of the OpenVMS Alpha operating system on a dual processor.

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

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

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

LMF Product Name: OpenVMS-ALPHA

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

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

3. Individual User License (QL–MT2A*–**)

(No Longer Offered)

LMF Product Name: OpenVMS-ALPHA-USER

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

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

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

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

   (No Longer Offered)

LMF Product Name: OpenVMS-ALPHA-ADL

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

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

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

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

LMF Product Name: OPENVMS-ALPHA-ADL

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

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

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

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

**License Management Facility Support**

The OpenVMS operating system supports the Compaq License Management Facility (LMF).

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

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

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

For more information about Compaq's licensing terms and policies, contact your Compaq Account Representative.

## SOFTWARE PRODUCT SERVICES

A variety of service options are available from Compaq. System Support Services provides integrated hardware and software remedial support, telephone advisory support, and the right-to-use new version of kernel software. For more information, contact your local Compaq Account Representative.

## SYSTEMS SUPPORTED

### Alpha Systems Supported

This section lists the Alpha systems that are supported by OpenVMS Alpha Version 7.3. Refer to the appropriate page at the following website for details concerning Alpha hardware configurations and options: http://www.compaq.com/alphaserver/configure.html

*TURBOchannel Bus-Based Systems*

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

*DSSI Bus-Based Systems*

- DEC 4000 Model 600
- DEC 4000 Model 700

*XMI Bus-Based Systems*

- AlphaServer 8400 (All chip speeds)
- DEC 7000 Model 600
- DEC 10000 Model 600

*PCI Bus-Based Systems*

- AlphaServer 300 (All chip speeds)
- AlphaServer 400 (All chip speeds)
- AlphaServer 800 (All chip speeds)
- AlphaServer 1000 (All chip speeds)
- AlphaServer 1000A (All chip speeds)
- AlphaServer 1200 (All chip speeds)
- AlphaServer 2000 (All chip speeds, except 5/375)
- AlphaServer 2100 (All chip speeds, except 5/375)
- AlphaServer 2100A (All chip speeds, except 5/375)
- AlphaServer 2100A LP (All chip speeds)
- AlphaServer 4000 (All chip speeds)
- AlphaServer 4100 (All chip speeds)
- AlphaServer 8200 (All chip speeds)
- AlphaServer 8400 (All chip speeds)
- Compaq AlphaServer DS10
- Compaq AlphaServer DS10L
- Compaq AlphaServer DS20
- Compaq AlphaServer DS20E
- Compaq AlphaServer ES40
- Compaq AlphaServer GS60
- Compaq AlphaServer GS60E
- Compaq AlphaServer GS80
- Compaq AlphaServer GS140
- Compaq AlphaServer GS160
- Compaq AlphaServer GS320
- DIGITAL 2100 Server Model A500MP, A600MP
- AlphaStation 200 (All chip speeds)
- AlphaStation 250 (All chip speeds)
- AlphaStation 255/233, 255/300
- AlphaStation 400 (All chip speeds)
- AlphaStation 500/266, 500/333, 500/400, 500/500
- AlphaStation 600 (All chip speeds)
- AlphaStation 600A (All chip speeds)
- DPWau 433au, 500au, 600au
- Compaq AlphaStation DS20e
- Compaq AlphaStation ES40
- Compaq AlphaStation XP900/DS10
- Compaq AlphaStation XP1000

The following are the Compaq semiconductor microprocessor development reference boards supported by OpenVMS Alpha:

- Alpha 21064/21064A PCI reference board (EB64+)
- Alpha 21164 PCI reference board (EB164)
- Alpha PC64 reference board (APC64)

*Compaq Modular Computing Component*

- Alpha 4/233 PICMG SBC
- Alpha 4/266 PICMG SBC
- Alpha 5/366 PICMG SBC
- Alpha 5/500 PICMG SBC
- CompactPCI CS-1000

## VAX Systems Supported

This section of the SPD lists the VAX systems that are supported by OpenVMS VAX Version 7.3. Refer to the *Systems and Options Catalog* and the *Network and Communications Buyers Guide* for details concerning VAX hardware configurations and options.

*Q-bus Based Systems*

- MicroVAX II
- MicroVAX 3300, VAXserver 3300
- MicroVAX 3400, VAXserver 3400
- MicroVAX 3500, VAXserver 3500, VAXstation 3500, VAXstation 3520, VAXstation 3540
- MicroVAX 3600, VAXserver 3600
- MicroVAX 3800, VAXserver 3800
- MicroVAX 3900, VAXserver 3900
- VAX 4000, Models 100, 200, 300, 400, 500, 600
- VAX 4000, Models 50, 100A, 105A, 106A, 108, 500A, 505A, 600A, 700A, 705A,
- VAXserver 4000, Models 200, 300, 400, 500, 600

*XMI Bus-Based Systems*

- VAX 6000 Series, Models 210, 220, 230, 240
- VAX 6000 Series, Models 310, 320, 330, 340, 350, 360
- VAX 6000 Series, Models 410, 420, 430, 440, 450, 460
- VAX 6000 Series, Models 510, 520, 530, 540, 550, 560
- VAX 6000 Series, Models 610, 620, 630, 640, 650, 660
- VAXserver 6000, Models 210, 220, 310, 320, 410, 420, 510, 520, 610, 620, 630
- VAX 7000, Models 610, 620, 630, 640, 650, 660, 710, 720, 730, 740, 750, 760, 810, 820, 830, 840, 850, 860
- VAX 10000, Models 610, 620, 630, 640, 650, 660

*Special System-Specific Internal Bus*

- MicroVAX 3100, Models 10, 10E, 20, 20E, 30, 40, 80, 85, 88, 90, 95, 96, 98
- VAXserver 3100, Models 10, 10E, 20, 20E
- VAXstation 4000, Models 60, 90, 95, 96
- VAXstation 4000-VLC
- VAX 9000, Models 110, 110VP[5], 210, 210VP, 310, 310VP

## System Restrictions

*DECwindows Restrictions*

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

*MicroVAX I and VAXstation I Systems*

*OpenVMS Restrictions*

The final version of OpenVMS VAX that supports the following systems is VMS Version 5.1-1.

VAX-11/725

OpenVMS VAX Version 6.2 was the final version to support the following:

VAX-11/730
VAX-11/750
VAX-11/751
VAX-11/780
VAX-11/782
VAX-11/785
VAXft 110
VAXft 310
VAXft 410
VAXft 610
VAXft 810
MicroVAX I
VAXstation I

OpenVMS VAX Version 7.2 is the final version to support the following:

MicroVAX II
VAXstation II/GPX, VAXstation II/QVSS
VAXstation 2000, VAXstation 2000/GPX, VAXstation 2000/MFB
MicroVAX 2000

OpenVMS VAX Version 7.3 is the last version to support the following:

[5] Vector processor (VP)

VAX 8200, VAX 8250, VAXserver 8200, VAXserver 8250
VAX 8300, VAX 8350, VAXserver 8300, VAXserver 8350
VAX 8530, VAXserver 8530, VAX 8550, VAXserver 8550
VAX 8600, VAX 8650, VAXserver 8600, VAXserver 8650
VAX 8700, VAXserver 8700
VAX 8800, VAX 8810, VAX 8820, VAX 8830, VAX 8840
VAXserver 8800, VAXserver 8810, VAXserver 8820, VAXserver 8830, VAXserver 8840, VAX 8842, VAX 8974, VAX 8978
VAX 9000, Models 110, 110VP, 210, 210VP, 310, 310VP
VAX 9000, Models 320, 320VP, 330, 330VP, 340, 340VP
VAX 9000, Models 410, 410VP, 420, 420VP, 430, 430VP, 440, 440VP

OpenVMS Alpha Version 7.3-1 is the last version to support the following:

- DEC 2000 Models 300/500
- Tadpole ALPHAbook 1

## APPENDIX A

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

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

Refer to the following SPDs for detailed product information: Compaq DECnet for OpenVMS (SPD 48.48.xx), Compaq DECnet-Plus for OpenVMS (SPD 50.45.xx, 25.03.xx), Compaq TCP/IP Services for OpenVMS (SPD 46.46.xx), Compaq Cluster Software (SPD 29.78.xx), and Compaq Open3D for OpenVMS Alpha (SPD 45.08.xx).

### Terminals and Terminal Line Interfaces

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

The following table lists the terminals supported by OpenVMS Alpha:

| | | |
|---|---|---|
| VT200 series | VT300 series | VT400 series |
| VT500 series | VXT2000 series | |

The following table lists the terminals supported by OpenVMS VAX:

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

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

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

**Note:** The VT1000 is a monochrome windowing terminal that supports standard ANSI applications and the X Window System. The transport protocol supported is LAT for VMS. The product supports 15-inch and 19-inch monitors.

### Disks

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

| Disk Drive | Description | Bus | Alpha Version | VAX Version |
|---|---|---|---|---|
| EF51R[3] | 107 MB solid state | DSSI | NS | 5.5-2 |
| EF52R[4] | 205 MB solid state | DSSI | NS | 5.5-2 |
| EF53[4] | 267 MB solid state | DSSI | NS | 5.5-2 |
| ESE-20[3] | 120 MB solid state | SDI | NS | |
| ESE-52[3] | 120 MB solid state | SDI | 1.0 | 5.5-2 |
| ESE-56 | 600 MB solid state | SDI | 1.5 | 5.5-2 |
| ESE-58 | 960 MB solid state | SDI | 1.5 | 5.5-2 |
| EZ31 | 134 MB solid state | SCSI | 6.2-1H3 | NS |
| EZ32 | 268 MB solid state | SCSI | 6.2-1H3 | NS |
| EZ51R[3] | 100 MB solid state | SCSI | 1.5 | 5.5-2 |
| EZ54R | 467 MB solid state | SCSI | 1.5 | 5.5-2 |
| EZ58R | 855 MB solid state | SCSI | 1.5 | 5.5-2 |
| EZ64 | 475 MB solid state | SCSI | 6.2-1H3 | 5.5-2 |
| EZ69 | 950 MB solid state | SCSI | 6.2-1H3 | 5.5-2 |
| DS-EZ41 | 134 MB solid state | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-EZ42 | 268 MB solid state | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-EZ705 | 536 MB solid state | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-EZ711 | 1.07 GB solid state | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-EZ716 | 1.6 GB solid state | SCSI | 6.2-1H3 | 6.2-1H3 |
| PBXRW-JC | 2 GB wide fixed disk | UltraSCSI | 6.2-1H3 | |
| PBXRW-NB | 4 GB wide fixed disk | UltraSCSI | 6.2-1H3 | |
| PBXRW-SA | 9 GB wide fixed disk | UltraSCSI | 6.2-1H3 | |
| PBXRZ-JC | 2 GB narrow fixed disk | SCSI | 6.2-1H3 | |
| PBXRZ-NB | 4 GB narrow fixed disk | SCSI | 6.2-1H3 | |
| PBXRZ-SA | 9 GB narrow fixed disk | SCSI | 6.2-1H3 | |
| RA60[4] | 205 MB removable | SDI | NS | 6.1 |
| RA70 | 280 MB fixed | SDI | NS | 6.1 |
| RA71 | 700 MB fixed disk | SDI | NS | 5.4-2 |

| Disk Drive | Description | Bus | Alpha Version | VAX Version |
|---|---|---|---|---|
| RA72 | 1 GB fixed disk | SDI | 1.0 | 5.4-2 |
| RA73 | 2 GB fixed disk | SDI | 1.0 | 5.5-2 |
| RA80[3] | 128 MB fixed disk | SDI | NS | 6.1 |
| RA81 | 456 MB fixed disk | SDI | NS | 6.1 |
| RA82 | 622 MB fixed disk | SDI | NS | 6.1 |
| RA90 | 1.2 GB fixed disk | SDI | 1.0 | 6.1 |
| RA92 | 1.5 GB fixed disk | SDI | 1.0 | 6.1 |
| RC25[3] | 2 disks each 26 MB (1 fixed and 1 removable) disk drive with shared spindle | Q-bus | NS | 6.1 |
| RD32[3] | VAX 42 MB fixed disk | Q-bus | NS | |
| RD51[3] | 10 MB fixed disk | Q-bus | NS | 6.1 |
| RD52[3] | 31 MB fixed disk | Q-bus | NS | 6.1 |
| RD53[3] | 71 MB fixed disk | Q-bus | NS | |
| RD54[4] | 159 MB fixed disk | Q-bus | NS | |
| RF30[4] | 150 MB fixed disk | DSSI | NS | 6.1 |
| RF31 | 381 MB fixed disk | DSSI | 1.5 | |
| RF31F[1] | 200 MB fixed disk | DSSI | NS | 5.4-2 |
| RF31T | 381 MB fixed disk | DSSI | 1.5 | 5.5-2 |
| RF35 | 800 MB fixed disk | DSSI | 1.0 | 5.5 |
| RF36 | 1.6 GB fixed disk | DSSI | 6.1 | 6.0 |
| RF71 | 400 MB fixed disk | DSSI | 1.5 | 6.1 |
| RF72 | 1 GB fixed disk | DSSI | 1.5 | 5.5-2 |
| RF74 | 3.5 GB fixed disk | DSSI | 6.1 | 6.0 |
| RK06[3] | 14 MB removable disk | UNIBUS | NS | |
| RK07[3] | 28 MB removable disk | UNIBUS | NS | |
| RL02[3] | 10 MB removable disk | UNIBUS | NS | |
| RRD40[3] | 600 MB read-only optical disk drive | Q-bus and SCSI | NS | |
| RRD42 | 600 MB read-only optical disk drive | SCSI | 1.0 | 5.4-2 |
| RRD43 | 680 MB read-only optical disk drive | SCSI | 6.1 | 5.5-2 |
| RRD44 | 680 MB read-only optical disk drive | SCSI | 6.1 | |
| RRD45 | 600 MB 4x read-only optical disk drive | SCSI | 6.1 | 6.1 |
| RRD46 | 600 MB 12x read-only optical disk drive | SCSI | 6.2-1H3 | 5.5-2H4 |
| RRD47 | 600 MB 32x read-only optical disk drive | SCSI | 6.2-1H3 | 6.2-1H3 |
| RRD50[3] | 600 MB read-only optical disk drive | Q-bus | NS | |
| RWZ01 | 594 MB optical removable disk drive | SCSI | 1.0 | |
| RWZ53 | 2.6 GB magneto optical disk drive | SCSI | 6.1 | 6.1 |
| RX02[3] | 512 KB diskette | UNIBUS | NS | |
| RX23 | 1.47 MB diskette | SCSI | NS | |
| RX23L | 1.44 MB diskette drive | SCSI | 6.2-1H3 | NS |
| RX26 | 2.8 MB diskette drive | I82077 | 1.5-1H1 | |
| RX26 | 2.8 MB diskette drive | SCSI | 1.0 | 5.5 |
| RX33[3] | 1.2 MB diskette drive, requires minimum RQDX3 microcode of Version 3.0 | Q-bus | NS | |
| RX50[3] | 400 KB diskette | Q-bus | NS | |
| RV20[3] | 2 GB Write Once Read Many optical disk drive | Q-bus, UNIBUS, VAXBI | NS | |
| RV64[3] | 2 GB Write Once Read Many optical disk subsystem | Q-bus, UNIBUS, VAXBI | NS | |
| RZ1BB | 2 GB wide fixed disk | UltraSCSI | 6.2-1H3 | |
| RZ1CB | 4 GB wide fixed disk | UltraSCSI | 6.2-1H3 | |
| RZ1DB | 9 GB wide fixed disk | UltraSCSI | 6.2-1H3 | |
| RZ22[3] | 52 MB fixed disk | SCSI | NS | |
| RZ23[3] | 104 MB fixed disk | SCSI | NS | |
| RZ23L[3] | 121 MB fixed disk | SCSI | 1.5 | 5.4-1 |
| RZ24[1] | 209 MB fixed disk | SCSI | 1.5 | 6.1 |
| RZ24L | 245 MB fixed disk | SCSI | 1.0 | 5.4-3 |
| RZ25 | 425 MB fixed disk | SCSI | 1.0 | 5.4-3 |
| RZ25L | 500 MB fixed disk | SCSI | 1.5 | 5.5-2 |
| RZ25M | 540 MB fixed disk | SCSI | 6.1 | 6.1 |
| RZ26 | 1.05 GB fixed disk | SCSI | 1.0 | 5.5-2 |
| RZ26B | 1.05 GB fixed disk | SCSI | 1.5 | 6.0 |
| RZ26L | 1.0 GB fixed disk | SCSI | 1.5 | 5.5-2 |
| RZ26N | 1.0 GB fixed disk | SCSI | 6.2 | 5.5-2H4 |
| RZ28 | 2.1 GB fixed disk | SCSI | 1.5 | 5.5-2 |
| RZ28B | 2.1 GB fixed disk | SCSI | 1.5 | 6.0 |
| RZ28D | 2.1 GB fixed disk | SCSI | 6.2 | 6.2 |

| | | | | |
|---|---|---|---|---|
| RZ28L | 2 GB narrow fixed disk | SCSI | 6.2-1H3 | 5.5-2H4 |
| RZ28M | 2.1 GB fixed disk | SCSI | 6.2-1H3 | 5.5-2H4 |
| RZ29B | 4.3 GB fixed disk | SCSI | 6.1 | 5.5-2H4 |
| RZ29L | 4 GB narrow fixed disk | SCSI | 6.2-1H3 | 5.5-2H4 |
| RZ35 | 852 MB fixed disk | SCSI | NS | 5.4-3 |
| RZ40 | 9 GB narrow fixed disk | SCSI | Version 6.2-1H3 | 6.1 |
| RZ55 | 332 MB fixed disk | SCSI | 1.0 | 6.1 |
| RZ56 | 665 MB fixed disk | SCSI | 1.0 | 6.1 |
| RZ57[2] | 1 GB fixed disk | SCSI | 1.5 | 5.4-3 |
| RZ58 | 1.35 GB fixed disk | SCSI | 1.0 | 5.5 |
| RZ73 | 2 GB fixed disk | SCSI | 1.0 | 6.0 |
| RZ2CC | 4 GB fixed disk | SCSI | 7.1-1H2 | |
| RZ2DC | 9 GB fixed disk | SCSI | 7.1-1H2 | |
| RZ1EF | 18 GB fixed disk | SCSI | 7.1-1H2 | |

Note: The preceding list is not complete in terms of currently shipping disk and tape devices, as that list changes frequently. Currently, supported disk and tape devices are reflected in the AlphaServer Supported Options Lists that can be found at the individual AlphaServer WEB pages:

http://www.compaq.com/alphaserver/servers.html

After clicking on the requested AlphaServer, one can access links from the left hand columns under Technical Information under Supported Options. From there, you can sort by type of option and have it display disks, tapes, etc.

*Disk Options Supported by Compaq's Services Enterprise Integration Center (SEIC) (VAX Only)*

| | | |
|---|---|---|
| RF30-RA[4] | 150 MB removable disk | (DSSI) |
| RF31-RA | 381 MB removable disk | (DSSI) |
| RF71-RA | 400 MB removable disk | (DSSI) |
| RF71-RA | 1 GB removable disk | (DSSI) |
| RWZ01 | 594 MB optical removable disk | (SCSI) (Version 5.4-3) |

## Tapes

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

[2] Minimum revision firmware is V6000.

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

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

[5] TSZ05 is not supported in Version 7.2. Last version supported was Alpha Version 6.1.

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

| Tape | Description | Bus | Alpha Version | VAX Version |
|---|---|---|---|---|
| TA78 | 1600/6250 BPI, STI TU78 | STI | 1.0 | |
| TA79 | STI TU79 | STI | NS | |
| TA81 | 145 MB tape drive | STI | 1.0 | |
| TA90 | 1.2 GB tape cartridge subsystem. (5-inch 200 MB cartridge) | STI | 1.0 | |
| TA90E | 1.2 GB tape cartridge subsystem. Compacts data records automatically | STI | NS | |
| TA91 | High-performance tape drive | STI | NS | 5.4-2 |
| TE16 | 9-track magnetic tape drive | M-BUS | NS | |
| TF70 | 290 MB TK70 tape cartridge drive | DSSI | NS | 5.4-2 |
| TF85 | 2.6 GB streaming tape cartridge drive | DSSI | 6.1 | 5.5-2 |
| TF857 | 18.2 GB tape cartridge loader | DSSI | 6.1 | 5.5-2 |
| TF86 | 6.0 GB DLT tape cartridge | DSSI | 6.1 | 6.1 |
| TF867 | 42 GB DLT tape loader | DSSI | 6.1 | 6.1 |
| TK50 | 95 MB, 5 1/4-inch streaming tape cartridge drive | Q-bus and SCSI | NS | |
| TK70 | 296 MB, 5 1/4-inch streaming tape cartridge drive | Q-bus | NS | |
| TKZ09 | 5.0 GB, 8mm tape drive | SCSI | 1.5 | NS |
| TKZ9E | 1-14 GB, 8mm tape drive | SCSI | 6.2-1H3 | 5.5-2 |
| TKZ15 | Exabyte 8505 8mm tape drive | SCSI | 6.1 | 6.1 |
| TKZ20 | 2 GB, DC2000 tape drive | SCSI | 6.1 | 6.1 |
| TKZ60 | 200/400 MB, 3480/3490 tape drive | SCSI | 1.0 | 5.5-2 |
| TKZ61 | 4.4 GB, 3480/3490 tape loader | SCSI | 6.1 | 5.5-2 |
| TKZ62 | 24 GB, 3480/3490/3490E tape loader | SCSI | 6.1 | 5.5-2 |

| Tape | Description | Bus | Alpha Version | VAX Version |
|---|---|---|---|---|
| TL893 | 18.4 TB, 4mm, DAT tape drive | SCSI | 6.2-1H3 | NS |
| TL894 | 3.3 TB, 4mm, DAT tape drive | SCSI | 6.2-1H3 | NS |
| TL896 | 12.3 TB, 4mm, DAT tape drive | SCSI | 6.2-1H3 | NS |
| TLZ04 | 1.2 GB, 4mm, DAT tape drive | SCSI | 1.0 | |
| TLZ06 | 4 GB, 4mm, DAT tape drive | SCSI | 1.0 | 6.1 |
| TLZ07 | 8 GB, 4mm, DAT tape drive | SCSI | 6.1 | 6.1 |
| TLZ08 | 5.25-inch, 2 GB, 8mm tape drive | SCSI | NS | |
| TLZ09 | 4 GB, DAT tape drive | SCSI | 6.1 | 5.5-2H4 |
| TLZ10 | 12/24 GB, DAT tape drive | SCSI | 6.2-1H3 | 5.5-2 |
| TLZ6L | 4 GB, 3.5-inch, 4mm DAT tape loader | SCSI | 6.1 | |
| TLZ7L | 8 GB, 3.5-inch, 4mm DAT tape loader | SCSI | 6.1 | 6.1 |
| TLZ9L | 32/64 GB, 3.5-inch, 4mm DAT tape loader | SCSI | 6.2-1H3 | |
| TL812 | 1.92 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| TL822 | 10.4 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| TL826 | 7.0 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-TL890 | 1.12 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-TL891 | 700 GB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-TL893 | 18.4 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-TL894 | 3.3 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-TL895 | 6.7 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| DS-TL896 | 12.3 TB, DLT tape library | SCSI | 6.2-1H3 | 6.2-1H3 |
| TS05 | 9-track magnetic tape drive | Q-bus | NS | |
| TS11 | 9-track magnetic tape drive | UNIBUS | NS | |
| TSZ05 | 1600 bits/in tape drive | SCSI | 1.5 | |
| TSZ07 | 1600/6250 BPI tape drive | SCSI | 1.0 | 5.4-1 |
| TU77 | 9-track magnetic tape drive | M-BUS | NS | |
| TU78 | 9-track magnetic tape drive | M-BUS | NS | |
| TU80 | 9-track magnetic tape drive | UNIBUS | NS | |
| TU81 | 9-track magnetic tape drive | UNIBUS | NS | |
| TU81-Plus | Streaming 9-track magnetic tape drive | Q-bus, UNIBUS, VAXBI | NS | |
| TZ30 | 95 MB, half-height DLT tape drive | SCSI | 1.0 | |
| TZ85 | 2.6 GB DLT tape drive | SCSI | 1.0 | |
| TZ857 | 18 GB, DLT tape loader | SCSI | 1.0 | |
| TZ86 | 6.0 GB, DLT tape drive | SCSI | 1.5 | |
| TZ867 | 42 GB, DLT tape loader | SCSI | 1.5 | |
| TZ87 | 20 GB, DLT tape drive | SCSI | 6.1 | 6.1 |
| TZ875 | 100 GB, DLT tape loader | SCSI | 6.1 | 6.1 |
| TZ877 | 140 GB, DLT tape loader | SCSI | 6.1 | 6.1 |
| TZ88 | 20/40 GB, DLT tape drive | SCSI | 6.2 | 5.5-2H4 |
| TZ88N | 40/80 GB, DLT tape drive | SCSI | 6.2 | 5.5-2H4 |
| TZ89N | 35/70 GB, DLT tape drive | SCSI | 6.2-1H3 | 5.5-2H4 |
| TZ885 | 40/80 GB, DLT tape loader | SCSI | 6.2-1H2 | 5.5-2H4 |
| TZ887 | 40/80 GB, DLT tape loader | SCSI | 6.2-1H2 | 5.5-2H4 |
| TZK08 | 2.2 GB 8mm, tape drive | SCSI | 6.1 | |
| TZK10 | 320/525 MB, QIC tape drive | SCSI | 1.0 | |
| TZK11 | 2.0 GB, QIC tape drive | SCSI | 6.1 | |
| TZS20 | 25/50 GB, AIT 8mm, tape drive | SCSI | 7.1 | |
| ESL9326 | 40/80 GB, DLT tape library family | SCSI | 7.2 | |
| ESL9198 | 40/80 GB, DLT tape library family | SCSI | 7.2 | |

Note: The preceding list is not complete in terms of currently shipping disk and tape devices, as that list changes frequently. Currently, supported disk and tape devices are reflected in the AlphaServer Supported Options Lists that can be found at the individual AlphaServer WEB pages:

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### Networks Storage Servers

| | |
|---|---|
| HS111 | StorageWorks FDDI StorageServer |
| HS121 | StorageWorks FDDI StorageServer |
| HS211 | StorageWorks FDDI StorageServer |
| HS221 | StorageWorks FDDI StorageServer |
| HS241 | StorageWorks FDDI StorageServer |
| SWXNA | StorageWorks FDDI StorageServer |
| InfoServer | An integrated hardware and software system that sits directly on the Ethernet to provide CD–ROM, hard disk, magneto-optical, and tape access to OpenVMS clients in a LAN. It supports up to 14 SCSI devices and can be used for software distribution and initial system load (ISL). For more information, refer to the InfoServer Software Product Description (SPD 33.20.xx.) |

### Enterprise Storage Arrays

| | |
|---|---|
| SWXES | StorageWorks Enterprise Storage Array 10000, 12000 |
| SWXRA | StorageWorks RAID Array 7000, 310, 450, 3000, 8000 |

### Controllers and Adapters

| | |
|---|---|
| HSC40 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations. |
| HSC50 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 4.1.) Refer to SPD 32.96.xx for supported configurations. |
| HSC60 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations. |
| HSC65 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations. |
| HSC70 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations. |
| HSC90 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations. |
| HSC95 | Hierarchical storage controller for MSCP served disks and TMSCP served tapes. (HSC software must be at minimum Version 8.1.) Refer to SPD 42.81.xx for supported configurations. |
| HSD05 | DSSI to SCSI-2 FSE StorageWorks bus adapter. (Firmware must be at minimum Version X36.) |
| HSD10 | DSSI to SCSI-2 FSE StorageWorks bus adapter |
| HSD30 | DSSI based StorageWorks controller that supports up to three SCSI-2 FSE ports. (HSD firmware must be at minimum Version V15D.) |
| HSD50 | DSSI based StorageWorks controller that supports up to six SCSI-2 FSE ports. (HSD firmware must be at minimum Version Version 5.0D.) |
| HSJ30 | CI based StorageWorks controller that supports up to three SCSI-2 FSE ports. (HSJ firmware must be at minimum Version V15J.) |
| HSJ40 | CI based StorageWorks controller that supports up to six SCSI-2 FSE ports. (HSJ firmware must be at minimum Version V15J.) |
| HSJ50 | CI based StorageWorks controller that supports up to six SCSI-2 FSE ports. (HSJ firmware must be at minimum Version Version 5.0J–2 or later.) |
| HSZ20 | Fast wide differential SCSI based StorageWorks controller that supports up to three SCSI-2 FSE ports. (Alpha only) |
| HSZ40-Bx/Cx | Fast wide differential SCSI based StorageWorks controller that supports up to six SCSI-2 FSE ports. (HSZ firmware must be at minimum Version V2.5Z.) (Alpha only) |
| HSZ50 | Fast wide differential SCSI based StorageWorks controller that supports up to six SCSI-2 FSE ports. (HSZ firmware must be at minimum Version Version 5.0Z) (Alpha only) |

| | |
|---|---|
| HSZ70 | UltraSCSI wide differential based StorageWorks controller that supports up to six UltraSCSI wide single ended device ports and one host port. (Alpha only) |
| HSZ80 | UltraSCSI wide differential based StorageWorks controller that supports up to six UltraSCSI wide single ended device ports and two host ports. (Alpha only) |
| HSZ22 | UltraSCSI wide differential based StorageWorks controller that supports up to two UltraSCSI wide single ended device ports and two host ports. (Alpha only) |
| HSG60 | Fibre Channel based StorageWorks controller that supports up to two UltraSCSI wide single ended device ports and two host ports. (Alpha only - Version 7.2-1 and higher) |
| HSG80 | Fibre Channel based StorageWorks controller that supports up to six UltraSCSI wide single ended device ports and two host ports. (Alpha only - Version 7.2-1 and higher) |
| MDR | Compaq StorageWorks Modular Data Router for connecting SCSI tape devices to a FC switch. (Alpha only) |
| KDM70 | Mass-storage controller for XMI systems with eight SDI ports. |
| KFESA | Mass-storage controller for EISA systems with one DSSI port. (Alpha only) |
| KFESB | Mass-storage controller for EISA systems with one DSSI port. (Alpha only) |
| KFMSB | Mass-storage controller for XMI systems with two DSSI ports. (Alpha only) |
| KFPSA | Mass-storage controller for PCI systems with one DSSI port. (Alpha only - Version 6.2-1H2 minimum support) |
| KZESC-AA | Backplane RAID controller for EISA systems with one SCSI-2 FSE port. (Alpha only) |
| KZESC-BA | Backplane RAID controller for EISA systems with three SCSI-2 FSE ports. (Alpha only) |
| KZMSA | Mass-storage controller for XMI systems with two SCSI ports. (Limited SCSI-2 support - Alpha only) |
| KZPAA | Mass-storage adapter for PCI systems with one SCSI-2 FSE port. (Alpha only) |
| KZPBA-CA | Mass-storage adapter for PCI based servers with one UltraSCSI port. Single host support in Version 6.2-1H3, and Version 7.1-1H1 and higher. (Alpha only) |
| KZPBA-CB | Mass-storage adapter for PCI based servers with two UltraSCSI ports. Single host support in Version 6.2-1H3, and multi-host support in Version 7.1-1H1 and higher. (Alpha only) |
| KZPDA | Mass-storage adapter for PCI systems with one SCSI-2 FWSE port. (Alpha only) |
| KZPSA | Mass-storage adapter for PCI systems with one SCSI-2 FWD port. (Alpha only - 26 per system maximum with Version 6.2-1H3 and Version 7.1) |
| KZPSC-AA | Backplane RAID controller for PCI systems with one SCSI-2 FSE port. (Alpha only) |
| KZPSC-BA | Backplane RAID controller for PCI systems with three SCSI-2 FSE ports. (Alpha only) |
| KZPAC-AA,CA,CB | One and two channel Backplane RAID controller for PCI systems. (Alpha only) |
| KZPCM | Mass-storage/network adapter for PCI systems with one SCSI-2 FSE port, an Ethernet port to connect to IEEE 802.3 local area networks. (Alpha only - Version 6.2-1H1 minimum support) |
| KZPCA | Mass-storage adapter for PCI based servers with one UltraSCSI, Ultra-2 port . (Alpha only) |
| KGPSA | Mass-storage adapter for PCI-based servers with one Fibre Channel port. (Alpha only - Version 7.2-1 and higher) |
| KZTSA | Mass-storage adapter for TURBOchannel systems with one SCSI-2 FWD port. (Alpha only) |
| PB2HA-SA | Mass-storage controller for EISA systems with one SCSI port. (Limited SCSI-2 support. Alpha only on systems with no greater than 1GB of memory.) |
| PMAZB | Mass-storage adapter for TURBOchannel systems with two SCSI-2 FSE ports. (Alpha only) |
| PMAZC | Mass-storage adapter for TURBOchannel systems with two fast SCSI-2 FSE ports. (Alpha only) |

### Hubs and Switches

| | |
|---|---|
| DWZZH-03 | 3 port SCSI hub |
| DWZZH-05 | 5 port SCSI hub |
| DSGGA-AA/B | 8/16 port Fibre Channel switch |

### Controllers (VAX Only)

| | |
|---|---|
| HSZ10 | SCSI based StorageWorks controller that supports up to two SCSI-2 ports. |
| IDC | Integrated Disk Controller for VAX-11/725 and VAX-11/730 systems. |
| IDTC | Integral Disk and Tape Controller for VAX 8600 and VAX 8650 systems. |
| LPA11-K | Microprocessor controller for laboratory acquisition I/O devices, accommodating up to two AD11-K, one AA11-K, one KW11-K, two AM11-Ks, and five DR11-K devices. 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. |
| KFQSA | Q-bus to DSSI bus adapter. This adapter allows up to seven DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a multi-host configuration.) |
| KLESI | Q-bus, UNIBUS, and VAXBI tape controller for the TU81-Plus, RV20, or RC25. |
| KRQ50 | Q-bus controller for the RRD40/RRD50 compact disc reader. |
| KZQSA | Q-bus to SCSI bus adapter. This adapter allows up to seven SCSI storage devices to attach to the SCSI bus. Supported only for CD-ROM and specific tape devices. |
| KFDDA | VAX 4000 model 100 DSSI bus adapter. This adapter allows up to seven DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a multi-host configuration.) |
| KFDDB | VAX 4000 model 500/600/700 DSSI bus adapter. This adapter allows up to seven DSSI storage devices to attach to the DSSI bus. (Six DSSI storage devices are allowed in a multi-host configuration.) |
| LP11 | UNIBUS parallel high-speed line printer controller for the LPxx printers. |
| LPV11 | Q-bus parallel high-speed line printer controller. |
| RK711 | UNIBUS disk controller for RK07 disk drives. |
| RL211 | UNIBUS disk controller for the RL02 disk drive. |
| RQDXx | Q-bus disk controller for MicroVAX and VAXstation systems. There is an RQDX1, RQDX2, and an RQDX3 controller. The RQDXx disk controller supports as many as four disk units, with each RX50 diskette drive counting as two units. Due to controller limitations, the system supports a maximum of four devices; the number of RD/RX devices the system supports depends on the enclosure. The RQDX3 disk controller is required for the RD54 and the RX33 drives. |
| RX211 | UNIBUS diskette controller for two RX02 drives. One RX211 diskette controller is supported per system. |
| RUX50 | UNIBUS diskette controller for RX50 drives. One RUX50 diskette controller is supported per system. |
| TM03 | MASSBUS tape controller for the TE16 and TU77 magnetic tape drives. |
| TM32 | BI bus, 9-track tape controller only with large record support. |
| TM78 | MASSBUS tape controller for the TU78 magnetic tape drive. |
| TQK50 | Q-bus tape controller for the TK50 cartridge tape drive. |
| TQK70 | Q-bus tape controller for the TK70 cartridge tape drive. |
| TS11 | UNIBUS tape controller for the TS11 magnetic tape drive. |
| TBK50 | BI bus tape controller for the TK50 cartridge tape drive. |
| TBK50 | BI bus tape controller for the TK50 cartridge tape drive. |
| TBK70 | BI bus tape controller for the TK70 cartridge tape drive. |
| TUK50 | UNIBUS tape controller for the TK50 cartridge tape drive. One TUK50 tape controller is supported per system. |
| UDA50 | UNIBUS MSCP disk controller. The UDA50 controller must have a minimum microcode version of REV 3. The UDA50 controller supports up to four of the following disk drives: RA60, RA80, RA81, and RA82. |

### Asynchronous Terminal Controllers (Alpha Only)

| | |
|---|---|
| PBXDA-AA | 4-port PCI asynchronous terminal controller |
| PBXDA-AB | 8-port PCI asynchronous terminal controller |
| PBXDA-AC | 16-port PCI asynchronous terminal controller |

### Asynchronous Terminal Controllers (VAX Only)

| | |
|---|---|
| CXA16 | 16-line serial terminal multiplexer (DEC-423), maximum baud rate supported: 38400. (No modem control) (Q-bus) |
| CXB16 | 16-line serial terminal multiplexer (RS422), maximum baud rate supported: 38400. (No modem control) (Q-bus) |
| CXY08 | 8-line serial terminal multiplexer (RS232), maximum baud rate supported: 19200. (Full modem control) (Q-bus) |
| DHB32 | 16-line asynchronous terminal controller for VAXBI, maximum baud rate supported: 19200. (VAXBI) |
| DHF11 | 32-line asynchronous terminal controller (DEC 423), maximum baud rate supported: 19200. (No modem control) (Q-bus) |
| DHT32 | 8-line asynchronous terminal controller (DEC 423). (No modem control) (MicroVAX 2000) |
| DHQ11 | 8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 19200. (Full modem control) (Q-bus) |
| DHU11 | 16-line asynchronous terminal controller (RS-232-C), maximum baud rates supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Full modem control) (UNIBUS) |
| DHV11 | 8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rates supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Full modem control) (Q-bus) |
| DMB32 | 8-line asynchronous terminal controller, maximum baud rates supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Full modem control) (VAXBI) |
| DMF32 | 8-line asynchronous terminal controller, maximum baud rates supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Full modem control on first two lines) (UNIBUS) |
| DMZ32 | 24-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rates supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Modem support dependent on configuration) (UNIBUS) |
| DZ11 | 8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 9600. (Partial modem control) (UNIBUS) |
| DZ32 | 8-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: 9600. (Partial modem control) (UNIBUS) |
| DZQ11 | 4-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Partial modem control) (Q-bus) |
| DZV11 | 4-line asynchronous terminal controller (EIA RS-232-C or RS-423-A), maximum baud rate supported: OpenVMS VAX, 19200; DECnet-VAX, 9600. (Partial modem control) (Q-bus) |

### Synchronous Controllers—(Alpha Only)

The X.25 for OpenVMS Alpha Systems software product contains the synchronous device drivers and is required when using synchronous communications options. Refer to SPD 47.37xx for more information.

| | |
|---|---|
| SCC | Integral Synchronous Communications controller on DEC 3000 systems |
| DSYT1 | 2-port TurboChannel/Synchronous Communications controller |
| DNSES | 2-port EISA/Synchronous Communications controller (Version 6.2-1H2 minimum support.) |
| PBXDI-Ax | 2 or 4-port ISA/Synchronous Communications controller |
| PBXDP-Ax | 2, 4 or 8-port PCI/Synchronous Communications controller |

### Synchronous Controllers (VAX Only)

The optional VAX Wide Area Network Device Drivers component of the Compaq DECnet-Plus for OpenVMS software product contains the synchronous device drivers and is required when using synchronous communication options. Refer to SPD 25.03.xx for more information.

| | |
|---|---|
| DMB32 | Point-to-point synchronous interface. (VAXBI) |
| DMC11 | High-speed, local, point-to-point synchronous interface; retired device, no longer offered as an option. (UNIBUS) |
| DMF32 | Point-to-point or multipoint synchronous interface. (UNIBUS) |
| DMP11 | Point-to-point or multipoint synchronous interface; (UNIBUS) retired device, no longer offered as an option. |
| DMR11 | Remote, point-to-point, synchronous interface; (UNIBUS) replaces DMC11. |
| DMV11 | Point-to-point or multipoint synchronous interface. (Q-bus) |
| DPV11 | Synchronous, 1-line, half or full-duplex, point-to-point communication interface supporting DDCMP, HDLC, SDLC, or BISYNC protocols. |
| DSB32 | 2-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: OpenVMS VAX, 19.2 KbPS (kilobits/second); 9.6 kBPS for MicroVAX 2000, etc. |
| DST32 | Synchronous single-line support for DDCMP up to 9.6 KbPS, full duplex for MicroVAX 2000 systems. Concurrent use with the DHT32 is not supported. |
| DSV11 | Synchronous, 2-line, half or full-duplex point-to-point communication interface supporting DDCMP (one or two lines up to 64 KbPS). |
| DSF32 | DEC WANcontroller 620 — 2-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 2-line operation. |

### Graphics Options

| | |
|---|---|
| PBXGK | ELSA/GLoria Synergy+ graphics option that provides 2D acceleration for supported PCI-based Alpha Workstations and Servers. |
| PBXGD | PowerStorm 300/3500 graphics option that provides 3D acceleration or 3D acceleration with stereo viewing capabilities for supported PCI-based Alpha Workstations and Servers. |
| PBXGF-AB | 3DLabs OXYGEN VX1 graphics option that provides 2D acceleration for supported PCI-based Alpha Workstations and Servers. |

OpenGL 1.1 supports PowerStorm 350 and 300 graphics accelerators on the following platforms:

- XP900
- XP1000
- DS10
- DS20
- DS20e
- ES40

OpenGL 1.1 is included with the OpenVMS Alpha operating system distribution kit.

For more information, refer to the Compaq Open3D for OpenVMS Alpha Software Product Description (SPD 45.08.xx), and the Compaq DECwindows Motif Software Product Description (SPD 42.19.xx)

### LAN Options (VAX and Alpha)

| | |
|---|---|
| DEFTA | A network adapter that connects TURBOchannel systems to ANSI FDDI local area networks.(100 mbits/sec) |
| DEFZA | A network adapter that connects TURBOchannel systems to ANSI FDDI local area networks. Not supported as a cluster interconnect or boot device. (100 mbits/sec) |
| DEMFA | A network adapter that connects XMI systems to ANSI FDDI local area networks. (100 mbits/sec) |
| DEMNA | A network adapter that connects XMI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec) |
| PMAD | A network adapter that connects TURBOchannel systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec) |

### LAN Options (Alpha Only)

| | |
|---|---|
| DEFAA | A network adapter that connects FUTUREBUS+ systems to ANSI FDDI local area networks. (100 mbits/sec) |
| DEFEA | A network adapter that connects EISA systems to ANSI FDDI local area networks. (100 mbits/sec) |
| DEFPA | A network adapter that connects PCI systems to ANSI FDDI local area networks. (100 mbits/sec) |
| DGLPB | ATMworks 350 network adapter that connects PCI systems to ATM local area networks. Version 7.1-1H1 minimum. (155 mbits/sec—OC3) |
| DGLPA | ATMworks 351 network adapter that connects PCI systems to ATM local area networks. Version 7.1-1H1 minimum. (155 mbits/sec—OC3) |
| DAPBA | FORE Systems HE155 network adapter that connects PCI systems to ATM local area networks. Version 7.1-1H1 minimum. (155 mbits/sec—OC3) |
| DAPCA | FORE Systems HE622 network adapter that connects PCI systems to ATM local area networks. Version 7.1-1H1 minimum. (622 mbits/sec—OC12) |
| DE205 | A network adapter that connects ISA/EISA systems to both the Ethernet and IEEE 802.3 local area networks. (Version 6.2-1H2 minimum support or Version 6.2 with AXPLAN01_062 Remedial kit.) (10 mbits/sec) |
| DE422 | A network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec) |

DE425 A high-performance network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DE434 A high-performance network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DE435 A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DE436 A quad channel network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DE450 A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DE500-AA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 6.2-1H3 minimum support.) (10 or 100 mbits/sec)

DE500-BA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 6.2-1H3 minimum support.) (10 or 100 mbits/sec)

DE504-BA A quad channel network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 7.1-1H1 minimum support.) (10 or 100 mbits/sec)

DE500-FA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 7.1-1H1 minimum support.) (100 mbits/sec)

DE500-XA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 6.2-1H2 minimum support.) (10 or 100 mbits/sec)

DE600-AA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 7.1-2 minimum support.) (10 or 100 mbits/sec)

DE600-FA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 7.1-2 minimum support.) (100 mbits/sec)

DE602-AA A dual channel network adapter that connects PCI systems to both the Ethernet and IEEE 802.3 local area networks. (Version 7.1-2 minimum support.) (10 or 100 mbits/sec)

DEGPA-SA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.2 local area networks. (Version 7.1-2 minimum support.) (1000 mbits/sec)

DEGPA-TA A network adapter that connects PCI systems to both the Ethernet and IEEE 802.2 local area networks. (Version 7.1-2 minimum support.) (10, 100, or 1000 mbits/sec)

DW300 A network adapter that connects the EISA bus to a Token Ring local area network. (4 or 16 mbits/sec)

PBXNP-DA A network adapter that connects PCI systems to a Token Ring local area network. (Version 6.2-1H3 minimum support.) (4 or 16 mbits/sec)

PBXNP-AA A network adapter that connects PCI systems to a Token Ring local area network. (Version 6.2-1H3 minimum support.) (4 or 16 mbits/sec)

DETRA A network adapter that connects the TURBOchannel systems to a Token Ring local area network. (4 or 16 mbits/sec)

PB2CA-AA A network adapter that connects EISA systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

### LAN Options (VAX Only)

DEUNA A network adapter that connects UNIBUS systems to both Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DELUA A network adapter that connects UNIBUS systems to both the Ethernet to IEEE 802.3 local area networks. The minimum revision required is F1. (10 mbits/sec)

DEBNA A network adapter that connects VAXBI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DEBNI A network adapter that connects VAXBI systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DESVA An embedded network adapter that connects VAX systems to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

DEQNA A network adapter that connects Q-bus systems to both the Ethernet and IEEE 802.3 local area networks. The minimum revision level required is K3. Supported for application use only. Not supported beyond Version 5.4-3. (10 mbits/sec)

DELQA A network adapter that connects Q-bus systems to both the Ethernet and IEEE 802.3 local area networks. This is the replacement for DEQNA. The minimum revision level required is C3. (10 mbits/sec)

DESQA A network adapter that connects Q-bus for S-BOX configurations to both the Ethernet and IEEE 802.3 local area networks. (10 mbits/sec)

| | |
|---|---|
| DEFQA | A network adapter that connects Q-bus systems to ANSI FDDI local area networks. (100 mbits/sec) |
| DGLTA-FA | ATMworks 750 network adapter that connects TurboChannel systems to local area networks. (OC3) |
| KFE52 | Ethernet adapter for the VAXft 3000. Minimum of two adapters per system providing redundant connection to the Ethernet and the DSSI buses. |

### CI Options (Alpha Only)

| | |
|---|---|
| CIPCA | Native CI adapter for PCI AlphaServer systems with one CI port. (Alpha only—Version 6.2-1H2 minimum support) |
| CIXCD-AC | Native CI adapter for Alpha XMI systems. (Minimum microcode version REV 1.0 is required.) |

### CI Options (VAX Only)

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

| | |
|---|---|
| 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.) |
| CIPCI | |
| 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.) |

### Memory Channel Options (Alpha Only)

| | |
|---|---|
| CCMAA-AA | PCI-based Memory Channel Controller |
| CCMAA-BA | PCI-based Memory Channel Controller |
| CCMHA-AA | Memory Channel Hub With 4 Line Cards |
| CCMLA-AA | Memory Channel Line Card for use with Memory Channel Hub(CCMHA-AA) |
| CCMAB-AA | PCI-based Memory Channel 2 Controller |
| CCMHB-AA | Memory Channel 2 Hub with 4 Line Cards |
| CCMLB-AA | Memory Channel 2 Line Card for use with Memory Channel 2 Hub (CCMHB-AA) |

### Miscellaneous

| | |
|---|---|
| PC4XD-AA | Parallel/serial port adapter. |
| PMTCE | TURBOchannel extender. |

### Miscellaneous (VAX Only)

| | |
|---|---|
| CR11 | Card reader. One CR11 card reader is supported per system. (UNIBUS) |
| DRV11-WA | General-purpose DMA interface. (Q-bus) |
| DR11-W | General-purpose, high-speed DMA interface — one DR11-W interface supported per UNIBUS. |
| DR750 | High-performance, general-purpose interface for the VAX-11/750. One DR750 interface is supported per system. This device cannot be used in conjunction with the CI750. |
| DR780 | High-performance, general-purpose interface for the VAX-11/780 and VAX-11/785. One DR780 interface is supported per system. On the VAX 8600 and VAX 8650 as many as four per system are permitted provided that the M8297-YA is used. |
| DWBUA | XMI to UNIBUS adapter. |
| DWMBA | XMI to BI adapter; also the adapter used to connect the XMI to VAX expander cabinet. |
| DWMVA | XMI to VME adapter. |
| FP86-AA | Floating point accelerator for the VAX 8600 and VAX 8650 systems. |
| FV64A | Vector processing option for the VAX 6000-400. |
| H7112 | Memory battery backup for VAX 8600 and VAX 8650 systems. This is required for power-fail/recovery. |
| RH780 | MASSBUS controller for the VAX 8600 and VAX 8650 systems. |
| SBI | System backplane interconnect and I/O bus for the VAX 8600 and VAX 8650 systems. |
| VS40X | 4-plane graphics coprocessor. |
| WS01X | VAXstation 3100 SPX graphics option. |

### Abbreviations

| | |
|---|---|
| APMP | Adaptive Partitioned Multi-Processing |
| ATA-3 | AT Attachment, Version 3 |
| COM | Component Object Model |
| DLT | Digital Linear Tape |
| DSSI | DIGITAL Storage Systems Interconnect |
| EISA | Extended Industry Standard Interconnect |
| FDDI | Fiber Distributed Data Interface |
| FSE | Fast Single Ended (SCSI) |
| FWD | Fast Wide Differential (SCSI) |

| | |
|---|---|
| IDE | Integrated Device (or Drive) Electronics |
| IEEE | Institute of Electrical and Electronics Engineers |
| I80277 | Intel 82077 PC Compatible Floppy Interface |
| MSCP | Mass Storage Control Protocol |
| NCS | National Character Set |
| PCI | Peripheral Component Interconnect |
| QIC | Quarter Inch Cartridge |
| RAID | Redundant Array of Independent Disks |
| RMC | Remote Procedure Call |
| RMS | Record Management Services |
| SDI | Standard Drive Interface |
| SMP | Symmetric Multiprocessing |
| STI | Standard Tape Interface |
| TFF | Terminal Fallback Facility |
| TIE | Translated Image Environment |
| TMSCP | Tape Mass Storage Control Protocol |
| VLM | Very Large Memory |
| VVIEF | VAX Vector Instruction Emulation Facility |
| XMI | Extended Memory Interconnect |

## SOFTWARE WARRANTY

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