digital
Software Product Description

PRODUCT NAME: VAX/VMS Operating System, Version 2.0   **SPD 25.1.5**

DESCRIPTION:

VAX/VMS is the single operating system for the VAX-11 series systems. It provides a reliable, high-performance multiuser environment for the concurrent execution of timesharing, data processing, and real-time applications written in a broad variety of high-level languages (BASIC, COBOL-74, FORTRAN, PASCAL, CORAL, BLISS-32) or in assembly language. It can also be used as the base to build high availability, transaction processing, and communications intensive application systems.

System Features:

- Simple installation procedures
- Easy-to-use, easily extended command language
- System assistance facilities
- Extensive tools for developing user application programs
- Powerful file and record management services
- Common run-time environment; user callable system services; and system-wide standard call procedure
- Multistream, multiqueue batch processing
- Host development capabilities
- Virtual memory management for the execution of large programs
- Security/Protection facilities
- Event-driven, pre-emptive priority scheduling
- Resource allocation control
- System reliability and maintenance utilities
- Flexible operating environment

Installation Bootstrap and Configuration

VAX/VMS installation procedures are straightforward and efficient, and they automatically configure the system to reflect the actual working hardware configuration.

The user can select a prebuilt parameter file that most closely matches the environment. This parameter file can be refined as needed while the system is running, for later restart and use. Some parameters can be changed dynamically without rebooting.

During start-up, the operator can override the standard settings of many system parameters. Both at start-up and during on-line operations, devices, input/output drivers, etc., can be added to the configuration and incorporated into the running system. All device names, allocations, addresses, and configuration parameters can be specified by the operator. Hardware and software configuration descriptions can be included in files that are processed automatically at start-up time.

Command Languages

Two command interpreters are supplied with VAX/VMS: MCR and DCL. The MCR interpreter accepts RSX-11M system commands. The second interpreter is the powerful VAX/VMS DIGITAL Command Language (DCL) interpreter whose commands are composed of English words that can be abbreviated. The choice of a user's default command interpreter, MCR or DCL, is established at LOGIN time based on the user's entry in the authorization file. For the most part, users wanting to utilize the full range of VAX/VMS facilities will use DCL.

The DCL command language is used for both interactive and batch processing. When used interactively, DCL prompts for any necessary missing parameters. This command language interpreter includes a HELP facility that gives guidance on the use of commands. The DCL command interpreter assumes standard defaults for many fields to save user keystrokes. Wild-card characters in file specifiers can be used to reduce further the number of required keystrokes.

DCL commands provide:

- Program development and execution control: to invoke the compilers, the assembler, the editors, the linker and user-written programs; to stop and continue program execution
- Resource allocation: to allocate and deallocate devices, mount and dismount volumes
- Environmental control: to assign and deassign logical names; to set and show parameters such as terminal type, default directory, and quotas
- File maintenance: to create, copy, type, print, rename, and delete files; to list the contents of directories and subdirectories; initialize volumes; to recover previously allocated, but unused disk space
- Operational control: to log in and log out, submit batch jobs, and send messages to the operator

- Command language extension: to assign logical names to file specifications, assign symbolic names to character strings or numeric values, and create and execute command procedures

Logical names can be used to make file specifications brief and application programs device independent. A logical name can be assigned to a file specification, a portion of a file specification, or another logical name. The logical names used for defining separate portions of a file specification can be assigned their values independently by operators, system and group managers, and by the application programmers and users.

Command procedures can be used to simulate new commands. A command procedure is a file containing a collection of commands that are executed when the command procedure is invoked. Command parameters can be defined symbolically in the procedure file and assigned values when the procedure is invoked. A command line can be labeled, continued on subsequent lines, and commented. Symbols can be defined and tested for conditionally transferring control to labeled lines. Control can also be transferred on errors or unconditionally. Because a command procedure may be invoked during the log in sequence, user-specific defaults for a command environment can be set up automatically at every log in.

The operator has access to the user commands and has special commands to manipulate batch and spool queues, control the system-wide user environment, control jobs, authorize users, show system activity, and respond to mount requests. Commands can be included in a command procedure that is executed automatically at system start-up. Command procedures can also provide a closed application environment to specific accounts.

System Assistance Facilities

In addition to a HELP mechanism and the prompt facilities of the VAX/VMS DIGITAL Command Language (DCL), there are several components available with VAX/VMS so that the first-time user can become familiar with portions of the system. The VAX/VMS Primer provides simple introductory steps for getting started with VAX/VMS. The Computer-aided instruction (EDTCAI) course introduces the user to the basic capability of the DIGITAL Standard Editor, EDT.

Program Development Tools

VAX/VMS provides a comprehensive set of tools for developing both VAX-11 native mode programs and PDP-11 compatibility mode programs. These tools include programming languages, editors, a symbolic debugger, LINKER, LIBRARIAN, PATCH utility, MAIL utility, and Network Command Terminal capability.

Native mode programming languages include MACRO assembly language and the optional VAX-11 FORTRAN, VAX-11 BASIC, VAX-11 COBOL-74, VAX-11 PASCAL, and VAX-11 BLISS-32 languages. Compatibility mode programming languages include the MACRO-11 assembly language and the optional PDP-11 BASIC-PLUS-2/VAX, FORTRAN-IV/RSX-to-VAX, and PDP-11 CORAL 66/VAX languages.

VAX/VMS includes several interactive and batch editors (e.g., EDT, SOS, SLP/SUMSLP). With EDT, lines can be identified by number, by relative position, or by contents. Editing can be accomplished by replacing, deleting, transposing, or copying a line or group of adjacent lines; by substituting strings; or, by interactively modifying lines one character at a time. Character editing can be accomplished in line mode or in keypad mode. Editing can be done to the file in any order. User-selected editing environment parameters can be set automatically at editor start-up.

VAX/VMS provides a file differences utility (DIF) that contrasts two files by automatically aligning matching text, and optionally ignoring comments, empty records, trailing blanks, or multiple blanks. The output can be a file-by-file list of differences, an interleaved list of differences, a list with change bars, or a batch editor command input file.

The VAX/VMS LINKER is a program development tool that takes the output of a language processor and binds it into an image file that can be executed on the VAX-11 hardware. Images can be executable, system standalone, or shareable. Shareable images allow the sharing of procedures and data among multiple processes within the system. They also provide a way of incrementally linking very large application programs.

For native mode programs, VAX/VMS provides a symbolic DEBUGGER that can be used in both interactive and batch mode. The debugging language is similar to the DCL command language. Expressions and data formats are similar to those of the programming language being debugged.

The VAX/VMS LIBRARIAN is a utility program that provides for storage of frequently used modules in central, easily accessible locations or libraries. Libraries can be different types — object, macro, help and text — and correspond to the type of module that they contain. The LIBRARIAN utility can be used to create, modify, list, and maintain libraries by using a DCL command. User programs can link with the LIBRARIAN shareable image to gain access to libraries.

PATCH is a utility that assists in ongoing program test and debug. PATCH can be used to correct programming errors in native mode image files without reassembling or recompiling or relinking the program. Its features include symbolic instruction and automatic creation/use of patch area. Symbols available to the DEBUGGER are also available at PATCH time.

The Personal Mail utility (MAIL) allows the user to send stored messages to other users on the system or any other VAX-11 computer that is connected by means of the optional DECnet VAX product. Messages can be filed, forwarded, deleted, printed, and answered.

The Network Command Terminal capability requires the optional DECnet-VAX product. It allows the user to connect and log onto a remote VAX system. Once

logged onto the remote system, the user can connect to and log onto yet another VAX system, or proceed to use DCL commands as if on the local VAX system.

Record Management Services

VAX/VMS includes a record management input/output system known as VAX-11 RMS that provides device-independent access to disks, tapes, unit record equipment, terminals, networks (via the optional DECnet-VAX product), and mailboxes. VAX-11 RMS provides both record access to the supported file organizations and an option to bypass record processing so that a program can deal directly with the blocks within a file. RMS allows a user to create, access, and alter records within the files. The variety of file organizations and access modes available gives the user the ability to choose methods that best suit individual applications. The user defines file attributes during file creation.

For disk devices, RMS supports three file organizations: sequential, relative, and multikey indexed. In the sequential file organization, the physical order in which records appear is identical to the order in which they were originally written in the file by application programs.

In relative files, a numeric value representing the position of each record relative to the beginning of the file serves as a unique identification for the record. This number can be used to randomly retrieve or store the record.

The indexed organization permits a record to be identified using the contents of a specific data field or "key" within the record. Every indexed file has at least one key, called the primary key. Optionally, up to 254 additional keys can be specified when the file is created. By specifying a particular value for one of the keys, the user program can retrieve a particular record in a random manner, or sequentially in ascending order by key values.

Using VAX-11 RMS, all relative and indexed files can be shared for writing with the system, thus providing an automatic single record lock. In addition, VAX-11 RMS supports sharing for sequential files with 512 byte fixed-length records. The user can also explicitly control record locks that allow multiple records to be locked simultaneously.

File Management Services

The VAX/VMS on-disk structure supports volume sets containing up to 255 volumes. A volume set is defined as a logical storage entity made up of a collection of related volumes. A volume is a single, physical unit of storage such as a disk spindle. Files of any organization type can span any number of volumes within a volume set, and they can be explicitly placed and allocated on a particular volume or set of volumes. Volume sets can contain a mix of disk device types and can be extended by adding more volumes after initial definition.

The system provides eight levels of named directories and subdirectories whose contents are alphabetically ordered. Users are not required to preallocate space, although they can do so. Users can control automatic allocation. For example, when a file is automatically extended, it can be extended by a given number of contiguous blocks.

The disk structure has duplicates of its critical volume information. Volumes are mounted to identify them to the system. The system detects bad disk blocks dynamically and prevents their reuse once the files to which these blocks are allocated have been deleted.

VAX/VMS supports multivolume magnetic tape files with transparent volume switching. Tape access positioning is either by name or by relative file position. The tape block size (blocking factor) is under program control. VAX/VMS also supports unlabeled tapes. Error recovery is automatic but can be overridden under program control.

VAX/VMS includes a file SORT utility that accepts input files in binary or ASCII format. The file organization can be sequential, relative, or indexed. The information can be reordered in ascending or descending sequence. There are four possible sorting methods: Record Sort, Tag Sort, Address Routing Sort, and Index Sort. The sort utility also includes a set of procedures that are callable from any native mode language program.

Common Run-Time Environment

The VAX/VMS common run-time environment consists of several aspects: interface to common Run-Time Library (RTL); standard system-wide call mechanism for access to system services, to other languages, and to SORT; Record Management System (RMS); a symbolic traceback; symbolic debug; and, common exception handling.

The common Run-Time Library is a set of general purpose and language-specific libraries of procedures for native programs. The Run-Time Library includes a mathematical library, resource allocation library, general utility library, condition handling library, language-independent support library, string-handling procedures and language-specific support libraries. New libraries can be installed without requiring the user to relink existing programs. Much of the Run-Time Library is linked as a shareable image.

In addition to a common Run-Time Library, VAX/VMS provides system services that control processes and process execution, real-time response, scheduling, and the obtaining of information. Process control services allow the creation of subprocesses and independent detached processes. Such processes can communicate and synchronize by using mailboxes, shared areas of memory, shared files, and multiple common event flag clusters.

Other system services allow a process to handle most exception conditions such as arithmetic trap, input/output error, or system resource wait. Resource control system services include the ability to lock the process or pages in memory, to lock shared areas in memory via an application-specific program, to cluster pages in order to minimize paging overhead, and to adjust priority. Scheduling services include setting a timer and scheduling wakeup.

The common run-time environment can be extended for specific application environments. Such extensions can include user-written system services, user-written device drivers, user-controlled interrupt handling and memory mapping.

Batch Processing

VAX/VMS supports multiple stream, multiple queue batch processing. Batch jobs can be submitted by a user at a terminal, by another batch job, by a program, or from a card reader. The DCL commands used to control these batch jobs are the same as those used at a terminal. Submitted jobs are entered into a queue.

The VAX/VMS system supports transparent line printer output spooling. Line printer spooling includes page accounting. A print job can be one or more print files. Such jobs can be submitted to a selected print queue by a terminal user, a batch job, or a program. There can be multiple print queues: one for any printer, and several for designated printers. Jobs within queues are priority ordered. Forms selection can also be specified.

While VAX/VMS can run unattended (i.e., without an operator), environments with heavy demands for utilizing the multistream batch capabilities may require an operator.

By manipulating the parameters of the various queues, an operator can control the number of batch jobs that run concurrently. DCL commands allow the operator to control batch and print jobs by altering their queue priority; by holding jobs for a specific time or indefinitely; and, by starting, stopping, restarting, and aborting jobs or portions of jobs. The operator can initialize, delete, merge, and list queues, and control forms mounting.

Host Development Capabilities

In addition to the environment in which native mode programs are created, compiled, debugged, and executed, VAX/VMS provides host development capabilities through which PDP-11 users can develop applications on VAX/VMS for subsequent execution either in that environment or in a PDP-11 RSX-11M and RSX-11S environment.

These host development capabilities consist of the RSX-11M Application Migration Executive (AME), the MCR command language interpreter, and the optional PDP-11 compatibility mode language processors. These processors are PDP-11 FORTRAN IV, PDP-11 BASIC-PLUS-2, and PDP-11 CORAL 66.

VAX/VMS also includes an RSX/IAS-compatible on-disk file structure for easy cross migration of programs and data. Both file structures are readily accessible from programs running in either compatibility or native mode.

In many cases, the RSX-11M AME makes cross-system development to an RSX-11M or RSX-11S system from a VAX/VMS host system possible by allowing:

- Compilation of programs written in MACRO-11 or optional language processors that generate compatibility mode object modules

- Building of these programs into RSX-11M tasks

- Partial debugging of these tasks

- Building of RSX-11M (Version 3.2) or RSX-11S (Version 2.2) system images if the customer has an RSX-11M or RSX-11S kit

- Creation and maintenance of RSX-11 libraries

- Execution of RSX-11 indirect MCR command files

- Development of applications that are to run on both RSX-11 and VAX/VMS systems

- Downline load of RSX-11S system (via optional DECnet-VAX) if the customer has an RSX-11S kit

- Creation, reading, and writing of disks or tapes for transport to and from RSX systems

There are certain limitations placed on tasks developed under the RSX-11M AME. If they are to be executed and/or debugged in VAX-11 compatibility mode, these tasks must:

- Not depend on the performance provided by PDP-11 Floating Point Instructions

- Not require RSX-11 privileges

- Not access the PDP-11 I/O "page"

- Not issue DECnet system service directives

- Not issue PLAS memory management directives

- Not depend on the sense switches

- Not depend on devices that are not supported on the VAX/VMS system

- Not depend on the ability to share write access to files through RMS-11

Applications requiring the cooperation of a number of tasks can or cannot operate, depending on the system environmental assumptions that they make.

The RSX-11M Application Migration Executive (AME) also makes possible the migration of many existing applications from RSX-11M systems to VAX/VMS by allowing

- Recompilation and rebuilding of nonprivileged tasks originally developed under the RSX-11 or IAS systems for which a compatibility mode optional compiler is available

- Subsequent execution of these tasks under VAX/VMS

- Direct execution of tasks built originally under RSX-11M Version 3.2

Security/Protection Facilities

Security/Protection facilities include data protection for shared pages, file and interprocess communication based on ownership and application groups, user privileges, and resource allocation control.

Application designers can use the VAX/VMS protection and privilege mechanisms to implement system security and privacy. VAX/VMS provides memory access protection both between and within processes. Each process has its own independent virtual address space that can be mapped to private pages or shared pages. A process cannot access any other process's private pages. VAX/VMS uses the four processor access modes to read- and/or write-protect individual pages within a process.

Protection of shared pages of memory, files, and interprocess communication facilities such as mailboxes and event flags is based on User Identification Codes (UIC) individually assigned to users and data by the System Manager. The UICs establish the user's relationship to the data structure as the Owner or as part of the Owner's Group, the System, or the World (all other). Depending on the relationship, the user may or may not have read or write access to a particular data structure. If the data structure is a file, the user may or may not have Read, Write, Execute, or Delete access.

Resource Allocation Control

VAX/VMS controls the use of certain system services by privileges and resource quotas assigned to a user by the system manager. Program execution control, interprocess control, access to the system, and access to files and devices are each controlled by several distinct privileges. These privileges can be assigned individually or in a set of simultaneously open files and the number of created subprocesses, as well as the amount of disk space any user can control.

The system manager can also designate certain programs as having amplified privileges. These programs can exercise specific privileges beyond that of the user invoking the program.

Virtual Memory Management

VAX/VMS provides for the execution of very large programs by using the VAX-11 memory management features for swapping and paging of both code and data. The architecture provides for 4-gigabyte addressing. Program size can be as large as 2-gigabytes (2×10^9) with disk space being the practical limit and 176MB, the typical upperlimit. Memory is allocated dynamically. By the use of system services, applications can optionally control the number of pages, swapping, and their execution priority characteristics. These controls can be added or adjusted after the application is implemented. Memory management also provides for protection and sharing of code and data.

Efficiencies of the virtual memory management are achieved by design implementations such as:

- Technique of process paging

  (Processes pages against itself so that little significant impact on other processes occurs)
- Techniques of handling I/O

  (Paging I/O is reduced by caching of modified pages and clustering of page reads and writes
- Extensive facilities for sharing pages

  (Pages are shared in memory by shared procedure sets, shared COMMON, and shared read-only portions of many commonly used programs)

Event-Driven, Pre-emptive Priority Scheduling

VAX/VMS schedules CPU time and memory residency on a pre-emptive priority basis. Thus, real-time processes do not have to compete with lower priority processes for scheduling services. Scheduling rotates among processes of the same priority because of event waits, rescheduling, or quantum expiration. The scheduler adjusts the priorities of processes assigned one of the low 15 priorities to overlap I/O and computation. Real-time processes can be placed in one of the top 16 scheduling priorities; in this case, the scheduler does not alter their priority. Their priorities can be altered, however, by the system manager or an appropriately privileged user.

System Reliability and Maintenance Utilities

VAX/VMS automatically monitors for machine checks and performs internal software consistency checks. If a check fails, VAX/VMS tries to gracefully shut down and subsequently displays critical system status. If the system is set for auto-restart after a system failure, VAX/VMS reboots the system.

If the hardware detects power failure, VAX/VMS shuts the system down automatically. When the hardware detects power restoration, VAX/VMS begins the automatic restart procedure. If the contents of memory are still valid (this requires memory battery backup), VAX/VMS resumes processing at the point of interruption and attempts to restart devices and communications lines. All I/O operations in progress, including magnetic tape, are restarted. On request, programs can be notified of power restoration.

Disk file backup and restore operations can be performed selectively on-line. Disk volume backup operations require exclusive access to the volume.

VAX/VMS supports user mode on-line diagnostics for the supported peripherals. VAX/VMS includes on-line error logging for CPU errors, memory errors, peripheral errors, and software failures. The error log can be printed and interpreted on-line. The UNIBUS can be individually powered down for service without adversely affecting the system operation if the system disk is not connected to that UNIBUS.

The System Dump Analyzer utility describes relevant portions of hardware registers and memory to aid isolation of errors that can cause system failures.

VAX/VMS includes a User Environment Test Package (UETP) that verifies that the major hardware and software system components are complete, properly installed, and ready to be used. This package is normally executed as part of system installation but can be rerun in standalone mode at any time to increase confidence in the system's integrity. This verification constitutes a significant, but not exhaustive, test of the system.

Flexible Operating Environment

VAX/VMS provides the operating environment for building and executing applications for data processing, multiuser timesharing and batch users.

VAX/VMS provides a base for building real-time applications such as sensor-based systems, transaction applications, or computation applications. The design of VAX/VMS minimizes operating system overhead because it

- Uses the processor's context-switching instructions and queue instructions to schedule processes
- Uses the processor's software interrupt delivery mechanism to minimize the amount of CPU time to return from system services
- Uses the AST delivery mechanism and hardware queue instructions to minimize the amount of CPU time required for I/O request processing
- Uses the multiple hardware priority levels to improve I/O response time. These can also be used for customer-written drivers and communication handlers.

Components Summary

The VAX/VMS product includes the following facilities:*

- System installation package
- User Environment Test Package
- Operating system nucleus including virtual memory manager, swapper, system services, and many input/output device drivers
- RSX-11M, Version 3.2 Executive Emulator, Utilities (e.g. MACRO-11, Task Builder, PIP, FLX), RMS-11 Version 1.8, RMS Utilities, and SORT-11

- User authorization control program
- Job initiator and symbiont manager
- Card reader input symbiont
- Line printer output symbiont
- Accounting manager
- Operator Communications Manager
- Message Facility
- Error-logging and print utility
- HELP
- DCL command interpreter
- MCR command interpreter
- DISPLAY program for monitoring system performance
- Interactive and batch editors
- Network Command Terminals (requires the optional DECnet-VAX product)
- Mail Utility (can require the optional DECnet-VAX product)
- MACRO assembler with cross-reference
- Linker with cross-reference
- Library maintenance utility with cross-reference
- Common Run-Time Procedure Library
- Symbolic debugger for native programs
- Record Management Services for sequential, relative, and multikey indexed file organizations
- FILES-11 disk file manager with multivolume disk file support
- Magnetic tape file manager (based on ANS Level 3)
- Sort utility
- File Management utilities
- File Differences utility
- File Dump utility
- Image File Patch Utility
- System Dump Analyzer
- Disk Backup/Restore utilities
- Disk Structure Verification utilities
- Disk Bad Block Locator utility
- Software Maintenance Release Update utility
- EDTCAI Course

*(See the VAX-11 Software Installation Guide for a complete list of modules.)

VAX/VMS Sources

A source kit for the VAX/VMS Operating System is available primarily to customers who wish to retrieve and modify selected source modules. Retrieval of these selected modules can occur once the sources are copied to disk. In addition, source modules can be used as templates for writing components similar to those provided, for example, device drivers, file Ancillary Control Processes (ACPs), or Command Language Interpreters (CLIs). The source kit can be used for a complete rebuilding of the VAX/VMS Operating System, except as noted below. The source kit includes the tools that DIGITAL used to build the final binaries; any patches released since that build are not reflected in that source kit. Although every attempt is made to provide an accurate source tape

binaries; any patches released since that build are not reflected in that source kit. Although every attempt is made to provide an accurate source tape including the source modules, appropriate compiler version binaries, and supporting command procedures, DIGITAL does not warrant the ability to build binary images of the complete VAX/VMS system. DIGITAL will neither warrant the compiler version binaries nor supply updates and support services. To rebuild the EDTCAI software, the optional VAX-11 BASIC product is required. No supporting documentation is provided and sources for intermediate updates of VAX/VMS are not available (i.e., source kits are available only on major releases, Version 1.0, Version 2.0, etc.). Depending upon how must of the source kit a customer wishes to manipulate, up to two dedicated RP06s can be required for processing source modules after their retrieval from tape.

The following components of VAX/VMS are *not* included in the Version 2.0 source kit:

- Unsupported bundled components: e.g. RUNOFF, TECO
- SOS
- Components from the RSX-11M and RSX-11S products:
  PIP, FLX, SORT-11, RMS-11

Standards

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

- X3.4-1977 American Standard Code for Information Interchange
- X3.6-1973 Perforated Tape Code for Information Exchange
- X3.18-1974 One-inch Perforated Paper Tape for Information Exchange
- X3.41-1974 Code Extension Techniques for use with 7-bit ASCII
- X3.42-1975 Representation of Numeric Values in Character Strings
- X3.27-1978 Magnetic Tape Labels and File Structure, Level 3 (except for user-file labels)
- X3.39-1973 Recorded Magnetic Tape (1600 cpi, PE)
- X3.22-1973 Recorded Magnetic Tape (800 cpi, NRZI)
- X3.26-1970 Hollerith Punched Card Code
- FIPS PUB 1, 2, 3-1, 7, 13, 14, 15, 16, 22, 25, 26, 35, and 37 but not FIPS PUB 17-1 or 46; other FIPS PUBs are not applicable
- ISO 646-1973 7-bit Coded Character Set for Information Interchange
- ISO 1001-1979 Magtape Labelling and File Structure, Level 3
- ISO 2022-1973 Code Extension Techniques for Use with ISO 646
- ISO 3307-1975 Representations of Time of the Day

MINIMUM HARDWARE REQUIRED:

Any VAX-11/780 system at ECO REV 3 with at least one of the following:

- Two RK07 disk drives and at least 256K bytes of memory, or
- One RM03/RP05/RP06 disk drive and one TE16/TU45/TU77 magnetic tape and at least 256K bytes of memory

Additional memory can be required if additional devices are included in configuration. Additional memory and/or disk storage can be required if multiple optional software products are installed/executing concurrently.

OPTIONAL HARDWARE:

(For configuration details refer to the VAX-11/780 Systems and Option Summary.)

CPU Options

- Additional memory
- MA780 Multiport Memory, unless DR780 high performance general purpose interface is present
- H7112 memory battery backup (required for powerfail/recovery)
- FP780 floating point accelerator
- DW780 UNIBUS adaptors for a system total of four including the integral UNIBUS adaptor
- KU780 User Writeable Control Store

Disk Systems

- Up to eight disk drives per UNIBUS (RK06 and/or RK07 and/or RL02)
- Up to 32 disk drives (RM03 and/or RP05 and/or RP06) less one drive for each magnetic tape controller included on each MASSBUS
- Up to four RX02 dual drive subsystems per UNIBUS

Magnetic Tape Systems

- Up to 32 magnetic tape transports (TE16, TU45, and/or TU77) less eight transports for each RM03, RP05, or RP06 disk drive included in the configuration, beyond 28 disk drives (MASSBUS devices) for each MASSBUS
- Up to four TS11 magnetic tape subsystems per UNIBUS

MASSBUS disk drives and magnetic tape transports can be attached to the same MASSBUS.

Card Readers

- Up to a system total of two CR11 card readers

Line Printers

- Up to a system total of 16 LA11, LP11-A, -C, -D, -R, -S, -V, -W, -Y, and -Z line printers

Terminals and Terminal Line Interfaces

- Up to a system total of 12 DZ11 8-line multiplexers or six DZ11 16-line multiplexers (or a combination of 8-line and 16-line DZ11s not to exceed 96 asynchronous lines) connected to, at most, 96 VT52, VT100, LA34, LA36, LA38, and/or LA120 terminals. The characteristics of the software application and system loading may impose constraints on aggregate throughput. The aggregate terminal throughput is up to 8K characters per second on output to the terminals, and 1K characters per second on input from the terminals.

    These rates assume that the CPU is only being utilized for terminal handling from a user program. To prevent buffer over-runs on input, the terminal use the ASCII control characters DC1 and DC3 for synchronization as defined by DIGITAL's DEC STD 111, Revision A. When used with the EDT Computer Aided Instruction Course, VT100 terminals should be run at 600-2400 baud rates by only four active EUTCAI users concurrently.

Communications Devices

- Up to a system total of 16 DMC11 interprocessor communications links operating at a maximum of 9.6 kilobits per second, four DMC11 links operating at a maximum of 56 kilobits per second, or two DMC11 links operating (half-duplex only) at a maximum of 1 megabit per second. These line speeds are hardware specifications. The characteristics of the software application (including DECnet) using such devices may impose additional constraints on effective throughput.

- Up to a system total of four DUP11 synchronous interfaces each operating at maximum of 9.6 kilobits per second.

Real-Time Devices

- Up to a system total of two LPA11-K microprocessor controllers for laboratory data acquisition I/O devices. Each LPA11-K can accommodate up to two AD11-Ks, one AA11-K, one KW11-K, five DR11-Ks, and two AM11-Ks.

- One DR780 high-performance general purpose channel interface, unless MA780 multiport memory is present

PREREQUISITE SOFTWARE:

None

OPTIONAL SOFTWARE:

VAX-11 BASIC
VAX-11 FORTRAN
VAX-11 COBOL-74
VAX-11 PASCAL
VAX-11 BLISS-32

PDP-11 BASIC-PLUS-2/VAX
PDP-11 DATATRIEVE/VAX
PDP-11 CORAL 66/VAX
FORTRAN IV/VAX to RSX
DECnet-VAX
VAX-11 2780/3780 Protocol Emulator

TRAINING CREDITS:

FIVE (5) — Applies only to options that include support services. Consult the latest Educational Services Catalog at your local DIGITAL office for the available courses, course requirements, and guidelines.

SUPPORT CATEGORY:

DIGITAL SUPPORTED
VAX/VMS is a DIGITAL Supported Software Product.

SOFTWARE INSTALLATION:

DIGITAL INSTALLED
DIGITAL installation is required for Software Product Support. There is no charge for installation if performed at the time of system installation. DIGITAL installed software products, except for operating systems, are subject to an add-on installation fee when purchased subsequent to system installation.

SOFTWARE PRODUCT SUPPORT

With the exception of the *Newsletter*, VAX/VMS includes standard warranty services as defined in the Software Support Categories Addendum of this SPD.

GROWTH CONSTRAINTS:

An update is the primary method by which DIGITAL provides corrected versions of a software product to users of that product. A VAX/VMS Version 2.0 Update is functionally the same product as VAX/VMS Version 2.0, but it includes corrections to deficiencies discovered in this product and it may include enhancements. An enhancement is a capability not explicitly provided by this product or it is an improvement in stability or efficiency. The following items describe the growth constraints of a VAX/VMS Version 2.0 Update:

1. For the same device configurations supported by VAX/VMS Version 2.0, the minimum hardware requirements for executing a VAX/VMS Version 2.0 Update may be greater than the VAX/VMS Version 2.0 minimum hardware requirements.

2. If a VAX/VMS Version 2.0 Update includes enhancements, the minimum memory or disk (hardware) requirements for such Update may be greater than the minimum memory or disk (hardware) requirements for VAX/VMS Version 2.0.

ORDERING INFORMATION:

All binary licensed software, including any subsequent updates, is furnished under the licensing provisions of DIGITAL's Standard Terms and Conditions of Sale, which provide in part that the software and any part

thereof may be used on only the single CPU on which the software is first installed, and may be copied, in whole or in part (with the proper inclusion of the DIGITAL copyright notice and any DIGITAL proprietary notices on the software) only for use on such CPU. All source licensed software is furnished only under the terms and conditions of a separate Software Program Sources License Agreement between Purchaser and DIGITAL.

Options with no support services are available only after the purchase of one supported license.

A single-use license only option is a license to copy the software previously obtained under license.

Sources and/or listings options are only available after the purchase of at least one supported license and after a source license agreement is in effect.

The following key (M, R, V, Z) represents the distribution media for the product and must be specified at the end of the order number, e.g., QE001-AM = binaries on 9-track 1600 BPI Magtape (PE)

M = 9-track 1600 BPI Magtape (PE)
R = Microfiche
V = RK07 Disk Cartridge
Z = No hardware dependency

QE001 -A— Single-use license, binaries, documentation, listings on microfiche, support services (media: M, V)

QE001 -D— Single-use license only, no binaries, no documentation, no support services (media: Z)

Sources/Listings Options

QE001 -M— Sources and source listings (media: M)

QE001 -F— Sources listings (media: R)

Update Options

Users of VAX/VMS whose specified Support Category warranty has expired can order under license the following software update at the then current charge for such update. The update is distributed in binary form on the appropriate medium and it includes no installation or other services unless specifically stated.

QE001 -H— Binaries, documentation, listings on microfiche (media: M, V)

QE001 -H— Right to copy for single use (under existing license), no binaries, no documentation, (media: Z)

Users of VAX/VMS whose specified Support Category warranty has not expired will receive automatically the following software update. The update is distributed in binary form on the appropriate medium and includes no installation of other services unless specifically stated.

QE001 -W— Binaries, documentation (media: M, V)

Sources/Listings Update Options

The following options are available to licensed users as updates to sources and/or listings options. The update is distributed in source form on the appropriate medium and includes no installation or other services unless specifically stated.

QE001 -N— Sources update (media: M)

Miscellaneous Options

QE001 -G— Documentation only kit (media: Z)

ADDITIONAL SERVICES:

Post-warranty Software Product Services are available for licensed customers. Customers should contact their local DIGITAL office for additional information.