Software Product Description

PRODUCT NAME: DECmpp Mx System Software Environment, Version 1.0   **SPD 43.91.01**

DESCRIPTION

DECmpp Mx System Software Environment is a comprised set of products for Digital's 12000/Mx Model 100 platform manufactured by Intel™ Corporation and distributed by Digital Equipment Corporation:

- Operating System Software: AT&T® UNIX® System V™ Version 3.2 for the System Resource Manager, Node Operating System for DECmpp 12000/Mx Model 100, a Concurrent File System, Ethernet TCP/IP, NFS®, NQS, and X Window Interface.

- Development Software: Optimizing Compilers for C and FORTRAN (with standard UNIX utilities), Interactive Parallel Debugger, and Performance Analysis Tools.

- Run-Time Libraries: Basic Linear-Algebra Subroutine Libraries.

- System Management Tools: Multi-User Account, Control, and Scheduling System.

These products are a comprehensive offering of software engineering tools to develop, test, and maintain application programs. For interactive graphics, Ethernet supports an X Window client interface connecting DECmpp 12000/Mx nodes with graphics servers over the network. Descriptions of the component products of DECmpp Mx System Software Environment follow.

Operating System Software

- *System Resource Manager Operating System (SRM)*: The System Resource Manager oversees services for system management and system diagnostics. The SRM is responsible for allocating and deallocating portions of the DECmpp 12000/Mx Model 100 to various users. As the DECmpp 12000/Mx's diagnostic console, the SRM has a broad set of system test routines that assist in isolating faults.

  In addition to these primary functions, the SRM supports tasks such as file storage, network gateway services (through TCP/IP), and an AT&T UNIX System V software development environment. For maximum system throughput, storage and network services are ordinarily performed by the DECmpp 12000/Mx's I/O nodes while software development tools run on the SRM. System administrators can work either directly at the SRM or remotely from a workstation over Ethernet.

- *Node Operating System (NX/2)*: The DECmpp Mx system software emphasizes performance, UNIX standard application interfaces, and ease of use. Based on a light-weight kernel operating system, called NX/2, the DECmpp Mx system software maintains a consistent run-time environment while offering fast and flexible message-passing services. NX/2 resides on each node of the compute node and I/O nodes in the system, and provides synchronous, asynchronous, and interrupt-driven communication services with automatic flow control and buffering as well as support for global operations. By maintaining compatibility with UNIX I/O services, NX/2 simplifies the effort required to port new applications to the DECmpp 12000/Mx.

- *Concurrent File System (CFS)*: DECmpp's Concurrent File System provides a UNIX-compatible file system for secondary storage while hiding the concurrence of multiple I/O nodes and disks. Limited in size only by the aggregate space of all the disks in the system, CFS can support file sizes of many gigabytes without partitioning.

  CFS executes reads and writes to multiple disks in parallel for greater performance. The CFS manages parallel I/O through methods similar to, but more efficient than, disk striping because the CFS does not require users to synchronize reads or writes. The file system automatically distributes blocks of individual files across all available disks, using algorithms for reading and writing that allow several independent applications to run simultaneously. Programmers thus gain the performance of parallel disk access while keeping the simplicity of a single, non-partitioned file. CFS also supports nine-track and 8mm tape drives.

- *Ethernet TCP/IP*: DECmpp provides a rich set of features for using the supercomputer in a networked environment. The system uses Ethernet and TCP/IP software as the base for an extended set of standard networking capabilities. Dedicated I/O nodes with hardware-assisted TCP/IP protocols provide high-performance, industry-standard connection to a wide variety of systems. Through the use of gateways, the DECmpp 12000/Mx Model 100 can be connected to non-UNIX systems such as Digital's VAX/VMS* computers. Multiple I/O nodes can expand network connections and throughput while keeping networking tasks from interfacing with applications running on the DECmpp 12000/Mx. Ethernet includes:

  — Hardware and software for high-speed connections to CFS

  — On-board TCP/IP protocol processing

  — Efficient file transfers via File Transfer Protocol

  — Socket support for customized peer-to-peer communications

  — Client interface between DECmpp 12000/Mx and display servers for X Window System

- *Network File System (NFS)*: In addition to TCP/IP networking, a full complement of standards-based, applications-level software is available for file access, interactive processing, and batch processing on the network. The Network File System is provided for DECmpp 12000/Mx nodes and for the SRM's disk files. Concurrent I/O disk files can be accessed directly via the File Transfer Protocol (FTP).

- *Network Queuing System (NQS)*: The Network Queuing System is a UNIX-based facility that allows system administrators and users a convenient way to submit job requests for later execution to manage access to network resources. Using NQS, system administrators can control access to DECmpp 12000/Mx computers and other networked systems by establishing batch or pipe job queues at various levels. Users can submit jobs for execution from local or remote workstations. Cooperating NQS processes on each system automatically manage job submissions across networks, and minimizes the need for remote logins and file accesses. NFS supports:

  — Batch and pipe queues

  — Ability to set timing and resource limits

  — Job tracking and error reporting commands

  — Foundation for DECmpp 12000/Mx resource management capabilities

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* The terms OpenVMS and VMS refer to the OpenVMS Operating System.

- *X Window Interface*: For interactive processing, DECmpp Mx software offers the graphical interface of the industry-standard X Window System, UNIX sockets, and the DECmpp 12000/Mx's Remote Host Facilities. X Window System client services allow DECmpp 12000/Mx nodes to communicate with distributed workstations over the network. Currently, Ethernet supports Version 11, Release 4 of the X Window System interface. Also included are the MIT-supported X libraries (including the core library, Athena widget set, and X Toolkit), which provide valuable utilities for the interface developer.

Development Software

- *C and FORTRAN Compilers, Assembler, Linker*:
  For the critical step of compilation, DECmpp Mx C and FORTRAN compilers offer high run-time execution speed and fast compilations. Both compilers use sophisticated optimization techniques to ensure that applications fully exploit the superscalar architecture of the i860™ microprocessor. Among the optimizations are:

  — Vectorization

  — Procedure in-lining

  — Cache utilization strategies

  — Software pipelining

  — i860 dual instruction mode

  — i860 dual operation mode

  — Global optimization

  — Local optimization

  — Loop optimization

  The compilers' internal vectorizer can exploit more vector processing opportunities than vector preprocessors. When combined with the software pipeliner, the internal vectorizer can utilize the pipelined i860 floating point units and optimize cache management. As a result, the DECmpp Mx compilers achieve run-time speeds that are up to three times faster than conventional compilers.

  To simplify porting and user training, the compilers meet a broad range of industry standards. DECmpp Mx C conforms to the proposed ANSI C standard (X3JII), and DECmpp Mx FORTRAN is a true superset of FORTRAN 77 that includes VAX/VMS FORTRAN 4.0 extensions. The compilers support IEEE-compliant floating-point run-time libraries, as well as faster non-iEEE floating-point libraries. The compilers also provide language-compatible libraries for DECmpp Mx message passing and file-system services.

Included with the compilers are UNIX-style tools with enhanced versions of the i860 assembler and linker to process the compiler output. For object code management, the environment provides a librarian and the UNIX tools *nm, size, strip,* and *dump.*

- *Interactive Parallel Debugger:* The DECmpp Mx Interactive Parallel Debugger (IPD) is a full-featured symbolic source-level debugger for parallel C, FORTRAN, and assembly language programs running on the DECmpp system. IPD incorporates most of the features of standard debuggers designed for serial programs, and adds custom features that support the parallel programming model. IPD allows you to debug software designed to run on 386-based and i860-based nodes, or software running on both types of nodes.

IPD contains features specifically designed to aid debugging in parallel environments. Among its features are the debug context, data reduction, an asynchronous user interface, and facilities to help debug message passing. For example, you can set breakpoints for some processes and not others, monitor the message queues, and display a process status table. One can also display and change program variables using symbolic names with:

— Control and breakpoint options

— Context debugging of distributed processes

— Direct control of multiple processes

— Concise display of redundant data

— Asynchronous control of debugger and program I/O

— Source- and machine-level display of instructions and data

— Ability to modify source- and machine-level data

— Debug session logging facility

— Display of Send and Receive message queues

— Call stack traceback

— Command aliasing and command-line variable

As an aid to the programmer, IPD's command and display syntax follows the language conventions of the program being debugged. For FORTRAN programs, variable specifications follow the FORTRAN language conventions, while for C programs, variable specifications follow the C language conventions.

- *Performance Analysis Tools:* The Parallel Performance Analysis Tools (PAT) are a set of utilities for DECmpp 12000/Mx Model 100 systems. PAT routines are post-processing tools that gather performance data at runtime and then output the data to disk when the application terminates. PAT provides a powerful set of analysis features that convert the performance data to graphical and tabular forms that can be analyzed interactively on standard Sun® workstations. PAT profiles each node's CPU usage, for example, making it easy to identify opportunities for performance tuning. PAT supports:

— Quick identification of computation and communication hot spots

— Profiling data for node-by-node sequential analysis

— Communication and I/O profiling

— Event profiling with system-wide event tracing

— Invocations via compiler switches, environment variable, or program interface

— Non-intrusive port-mortum presentation of runtime data as graphs and tables for detailed analysis

PAT tracks the three major areas that affect parallel computer performance. An execution profiler tool, *xtool*, monitors time spent in individual routines. The communication profiler tool, *ctool*, assesses time spent in communication and I/O. An event profiler tool, *etool*, shows the interactions between processors and allows user-specified events to be monitored. Each tool is kept separate so users may concentrate on the particular problems as they arise.

PAT produces CPU-usage histograms, and event tracing of multiple processes and inter-node communications, to help programmers spot opportunities for greater parallel processing efficiency. Menu-driven utilities allow the presentation of accumulated data in simple graphical form under complete control of the user. Optionally, data can be presented in tabular, hardcopy graphical, or hardcopy tabular form for more detailed analysis. These interfaces give programmers greater insight into their applications.

Note that as a product for Sun workstation, PAT—though sold by Digital as a part of this program—is not supported by Digital Services.

Run-Time Libraries

Numeric computation is the cornerstone of most super-computing applications. Digital's applications toolset for the DECmpp 12000/Mx provides both broad functionality and high performance for numerically intensive applications. The toolset includes a family of linear equation solvers with a comprehensive set of basic linear algebra sub-programs (BLAS):

*   *Linear Algebra Subroutine Libraries*: Basic Linear Algebra Subroutine Libraries offer hand-coded performance for single-processor computational kernels. The libraries provide a portable set of building blocks that support 32-bit and 64-bit precision as well as complex data types for dense numerical linear-algebra programs. The BLAS libraries include:

    — Vector-vector operations
       (e.g., inner product, BLAS 1)

    — Matrix-vector operations
       (e.g., matrix-vector product, BLAS 2)

    — Matrix-matrix operations
       (e.g., matrix-matrix product, BLAS 3)

    BLAS library routines exploit the caching and the multiple functional units of the i860 microprocessor for maximum performance. The libraries conform to the subroutine names and calling sequences developed by Argonne National Laboratories.

System Management Tools

The Multi-User Accounting, Control and Scheduling System (MACS) extends the DECmpp Network Queuing System to give system administrators flexible mechanisms for controlling and monitoring access to system resources. MACS provides several important capabilities:

*   Flexible, automatic job scheduling schemes, for partitioning and assigning system resources

*   Priority-based allocation and pre-emption, for convenient enforcement of established policies

*   Report generators, for presenting meaningful statistics on resource utilization and user capacity

*   Sophisticated capabilities for allocating and monitoring system resource usage

*   Support for a variety of system usage models

*   Automated process scheduling plus flexibility to adjust as requirements change

*   Programmable job mix scheduling, including shape-based and priority-based scheduling

*   Enforcement and control mechanism

*   Extensive job record and resource usage data, plus formatting tool

MACS supplies the features needed for efficient system usage in dynamic computing environments. Scheduling schemes support a wide variety of usage models, including open, first-come, first-served; tennis court, with time slots reserved for specified users; and priority-based batch queue built upon NQS services. By offering both automated process scheduling and flexible real-time scheduling, MACS allows the system administrator to accommodate heavy interactive work loads, large batch jobs, and open allocation periods, as needed throughout the computing day.

HARDWARE REQUIREMENTS

DECmpp 12000/Mx Model 100 as specified in the System Support Addendum (SSA 43.91.01-x).

ORDERING INFORMATION

Software Licenses: QL-05BAX-AA

Media and Documentation: QA-05BAA-HP

Software Product Services: Consult your Digital Sales Representative

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System
Support
Addendum

PRODUCT NAME: DECmpp Mx System Software Environment,   SSA 43.91.01-A
Version 1.0

HARDWARE REQUIREMENTS

Processors Supported

Digital DECmpp 12000/Mx Model 100 system with DECmpp 12000/Mx Model 100 System Resource Manager (SRM).

Processors Not Supported

All other processors.

Secondary Storage Requirements on SRM

- 380 megabyte hard disk
- 60 megabyte tape drive

These counts refer to the space required on the SRM. The sizes are approximate; actual sizes may vary depending on the user's system environment, configuration, and software options.

Memory Requirements

- 8 megabytes on SRM
- A minimum of 16 megabytes on Digital workstations for DECwindows clients

GROWTH CONSIDERATIONS

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

DISTRIBUTION MEDIA

8mm Tape

ORDERING INFORMATION

Software Licenses: QL-05BAX-AA

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