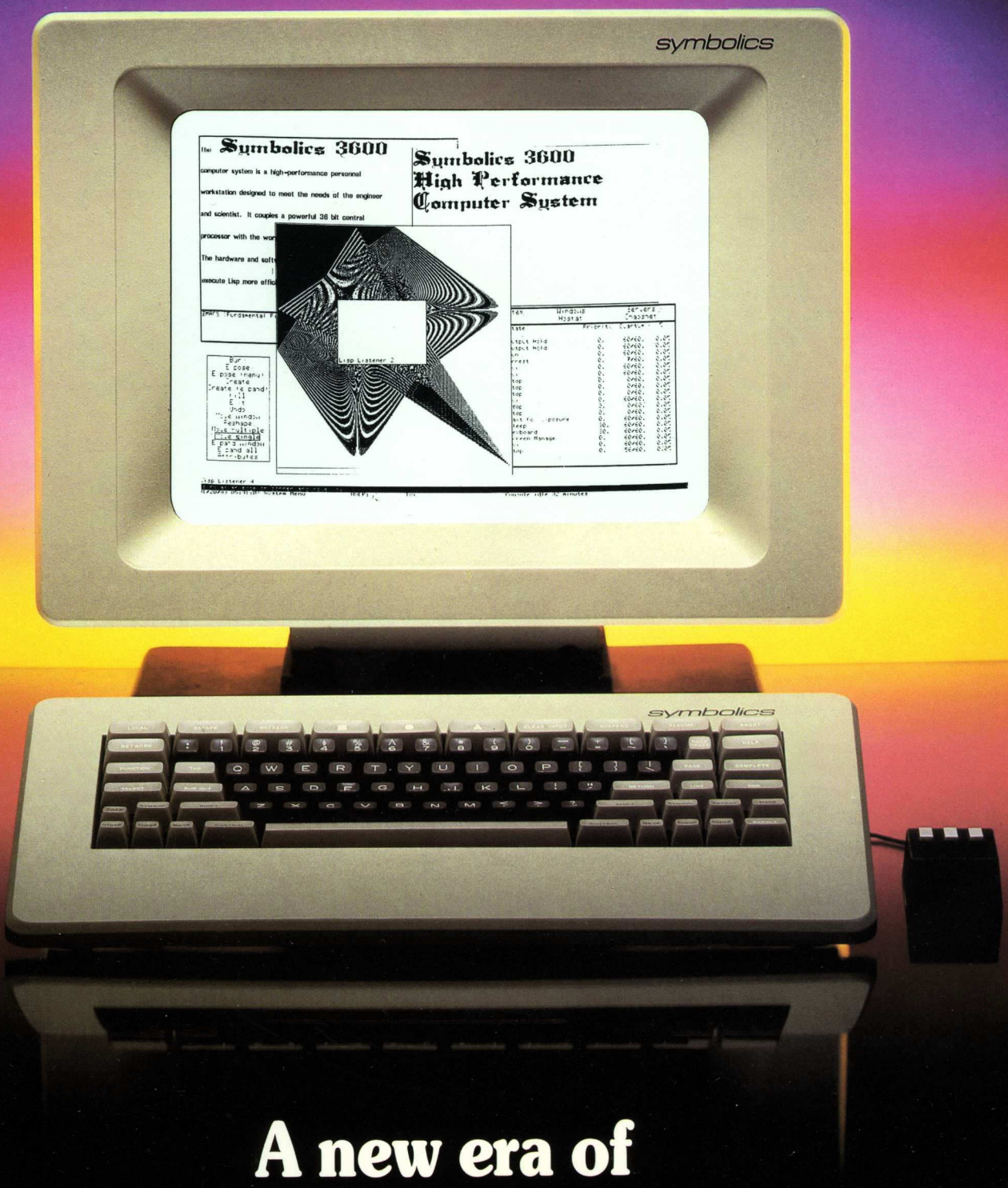
symbolics™

3600 Symbol Processing Systems



A new era of intelligent computing

Symbolic processing is the latest step in the evolution of computer technology. It has been developed over the last 10 years as part of artificial intelligence research in the leading university computer science departments in the U.S. Researchers and scientists, responding to the need to represent knowledge more flexibly than by a rigid structure of numbers (which still limits current computers), created an environment in which arbitrary information structures can be easily built and dynamically manipulated.

The term symbolic processing describes the manipulation of knowledge that is represented by symbols, which are constructed as lists of properties. The unique advantages of symbolic processing are now being applied to solve difficult problems and create new products in artificial intelligence, speech and image understanding, language translation, training systems, robotics, expert systems, VLSI design systems, and many other areas that until recently were still considered beyond computer capabilities.

During their early development, symbolic programs required the whole capacity of mainframes to achieve acceptable performance. Users also regarded the time-sharing terminal/user interface as relatively unfriendly. The Symbolics 3600 computer system solves both of these problems. It provides a dedicated environment, an unequalled user interface, and the processing power of a mainframe. It also has more memory capacity than most mainframes and the most extensive system software available for symbolic program development.

Processing power of the 3600 is delivered with less hardware than many super-minicomputers, due to such innovations in CPU architecture as memory-tagging and hardware-supported data typing. Optimized to execute the Lisp language, the system's performance is the best available.

By utilizing its own intelligent capabilities plus a high-resolution graphics display with direct memory access, the 3600 provides an interface that maximizes the productivity of both the programmer and the user. The incremental compile-and-link capability makes possible the shortest edit-compile-test cycle available for large, complex programs. The multiple window display management system enables the user to access several contexts simultaneously.

Symbolic Processing Features

- Complex data structure processing
- High programmer and user productivity
- No syntactic, semantic, or contextual differences between applications and systems programming language or environment
- Automatic and dynamic memory allocation at run time
- Generic data-typing with hardware checking
- Extensible language for developing specific problem solving languages
- Simultaneous, multiple context user interface
- Incremental compiling and linking for shortest possible edit-compile-run cycle
- Both interpretive and compile modes for instant testing
- High-level debugging tools
- Intelligent error handling and recovery

The primary language of the 3600 is Symbolics' Zetalisp, in which all system programs are written. Zetalisp is an expressive, efficient and extensible programming language. User applications systems written in Zetalisp merge naturally into the integrated programming environment; no syntactic or semantic distinctions are made between system software and the applications programming language, or environment.

Less programmer time is wasted on details. No data-type declarations are necessary, and all arithmetic is generic. Storage allocation and de-allocation are fully automatic. The language can easily be extended to suit particular applications. Zetalisp has powerful control structures, including primitives that allow programs to deal gracefully with errors and nonlocal transfers of control.

The Symbolics 3600 software system is a complete programming environment, with advanced program development tools integrated in a coherent and consistent way. These tools include:

- Sophisticated real-time display-oriented editor with many unique features
- Advanced window system to manage the bit-map display
- Full support for optional high-resolution bit-mapped color graphics display
- Mouse-oriented Display Debugger
- Resident incremental compiler fully integrated with editor
- Remote file access and robust local file system
- Powerful electronic mail facility
- Languages: Zetalisp, FORTRAN 77 and Interlisp compatibility

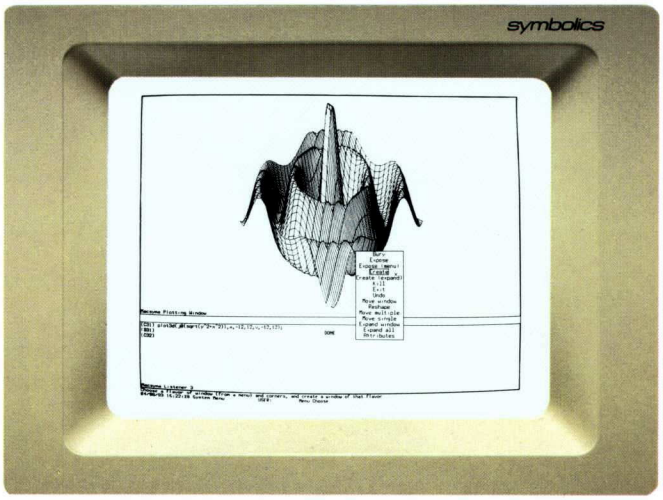
Object Oriented Programming Features

- Reliable fast programming for evolving systems
- Data encapsulated with the procedures that use it
- Multiple specific objects instantiated from generic prototypes
- Inheritance of procedures and data from multiple parents with flexible priority and precedence setting
- Procedures and their data that are hidden and protected from their users

Object Oriented Programming

Continued work with symbolic programming's capabilities has resulted in a new programming paradigm. Traditionally, data and procedures are separated requiring that all the procedures operating on a set of data agree as to its structure and interpretation. This has been a major source of unreliability as data definitions may be incomplete and programmers make subtle differences in interpretation among different subroutines. By encapsulating the data with all the procedures permitted to directly process it, object oriented programming not only solves this reliability problem, but also permits a tested generic object to serve as replicable model for specific instances of required objects. Indirect access to the data is accomplished by passing messages consisting of keywords and arguments which trigger specific procedures within an object. This programming paradigm has found success in a growing number of difficult situations such as graphics, simulation, and operating system level software.

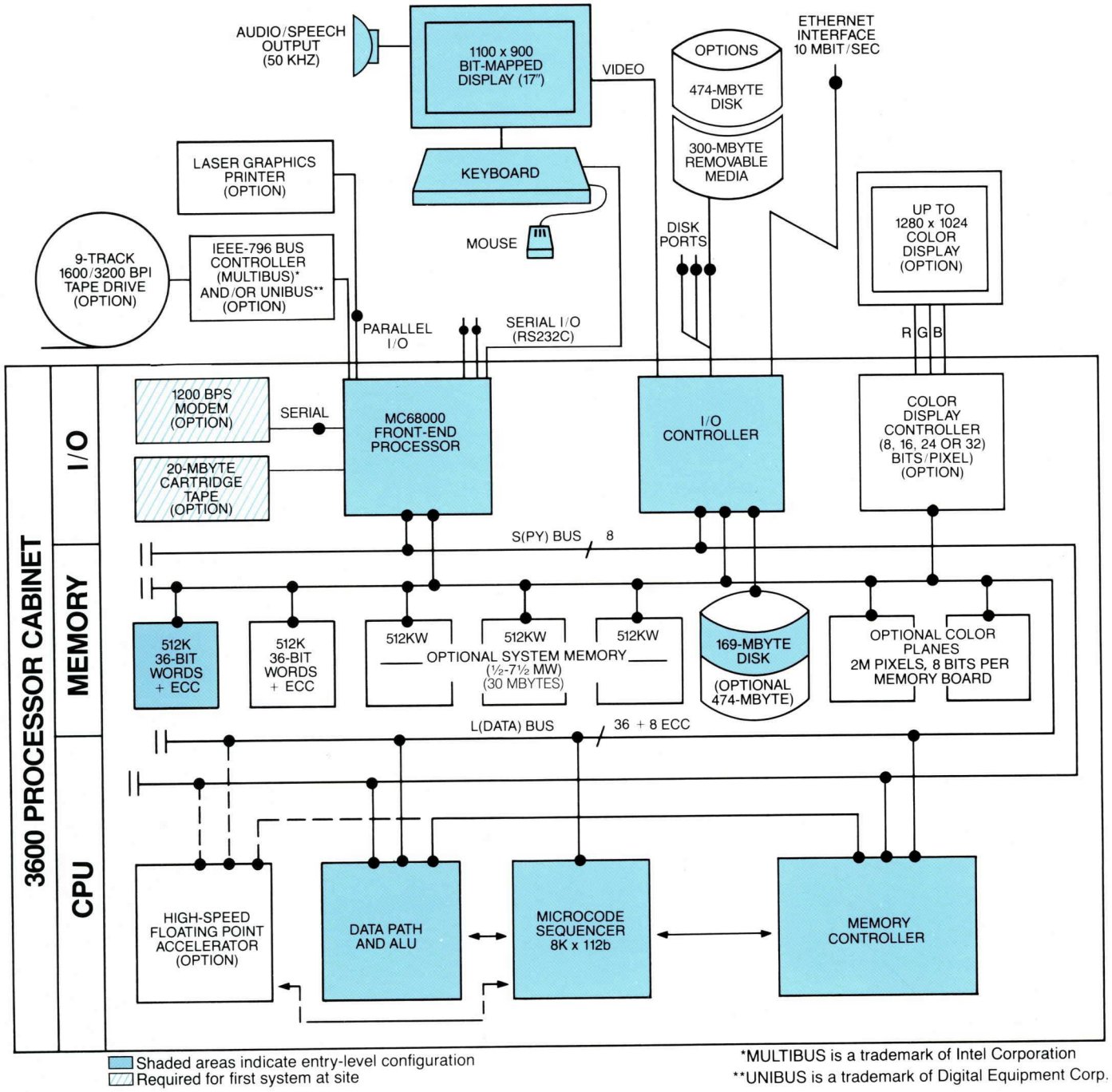
The 3600 symbolic processing system provides the most complete highest performance object-oriented programming environment available. Rather than being a self-contained environment, Flavors is an extension of Zetalisp and is fully integrated into the entire software suite on the 3600. The power of the 3600 allows object-oriented programming to be used as an implementation system for the first time. It is used to implement the window display manager and error handling system.



3600 Window System

The window system, implemented in message-passing style with Flavors, provides an elegant way to manage the bit-mapped display. The system allows programs to create windows, rectangular regions that may be fully visible, partially visible, or wholly obscured by other windows. Manipulating windows like pieces of paper on a desk, the user can allocate display space dynamically to suit the task at hand. Programmers can easily create new types of windows designed specifically for their applications, either by choosing from existing capabilities, by implementing new capabilities, or by combining new and old capabilities.

The window system allows programs to display output or graphics without prior specification of where on the screen the output will appear or the size of the window. The user can dynamically configure the size, shape, and arrangement of windows on the screen to obtain the most effective combination of displays from different programs.



The 3600 Symbol Processor consists of three major subsystems as shown on the simplified diagram above.

I/O Subsystem

The input/output system is comprised of a powerful MC68000-based front-end processor that supports low- and medium-speed devices as well as a high-performance I/O board that supports 10 Mbit/sec Ethernet, SMD disk, and the high-performance black and white console display. Optional devices available include a high-resolution color display system, modem, a Laser Graphics Printer, magnetic tape units, and additional disk drives. Other serial or parallel devices can be connected as shown.

Memory

The 3600 offers a large virtual address space. 256 million 36-bit words (1 gigabyte) of virtual memory may be directly addressed. The system may be configured with up to 7.5 MWords of error-corrected physical memory.

Central Processing Unit

The 3600 processor is built around a dedicated, high-performance microprogrammed 36-bit stack-oriented and memory-tagged architecture with 32-bit datapaths. The instruction fetch unit is overlapped with normal execution and permits many opcodes to execute in as little as 200 nsec.

3600 CPU

The 3600 hardware was designed to support the software system. The 3600 CPU has the following characteristics:

- Microprogrammed 36-bit tagged architecture with 32-bit data paths
- Stack-oriented, with high-speed buffering of the top stack frames
- Run-time checking, assisted by hardware, for data-type mismatches, uninitialized variables, and array-bound errors
- Fast array indexing
- IEEE 32-bit floating point

3600 Front-End Processor

The 3600 includes a MC68000-based front end processor (FEP) that performs two functions: during normal operation, the FEP controls low- and medium-speed I/O devices and does error logging and recovery; when the 3600 is not running, the FEP is used to diagnose the machine.

Devices such as the keyboard, the mouse, and the serial lines are connected to the 3600 via the FEP. An optional cabinet may be used to attach additional commercially available MULTIBUS* or UNIBUS peripherals to the 3600. Programs can be down-loaded into the FEP to control these peripherals. When the 3600 detects errors the FEP logs them for diagnostic purposes.

For diagnosing the 3600 CPU, the FEP has access to all CPU registers and buses, and to the main memory, disk, and network. For diagnosing microcode, the FEP can single step and breakpoint the CPU. All debugging functions can be accessed from the console of the 3600, through the local network or over a serial line (possibly connected to a modem for remote diagnosis capability)

3600 File Systems

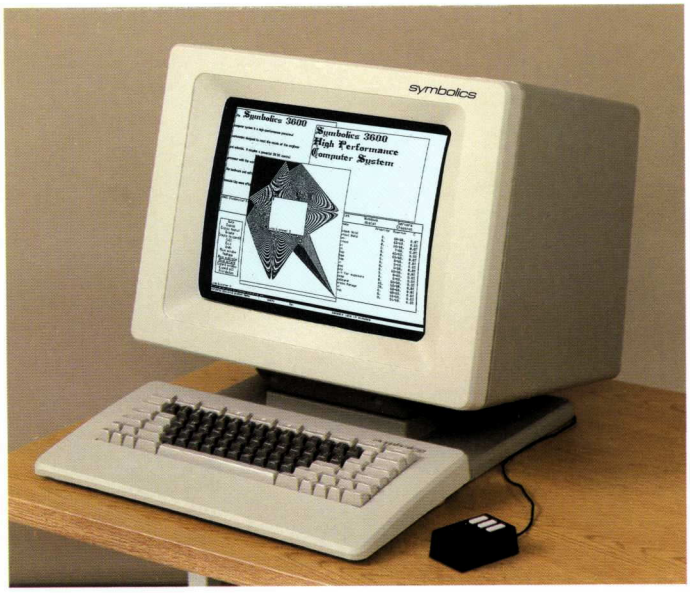
The 3600 uses disk files as its long-term storage mechanism. It comes with a hierarchical file system that can be accessed locally or remotely over the high-speed local network. A 3600 system with large disks can be used as a dedicated file system resource to serve a community of 3600s. Full backup and archiving to tape are provided. The robust file system can recover from most crashes without running a salvager because disk blocks are written redundantly. The 3600 file system allows users to add their own attribute types.

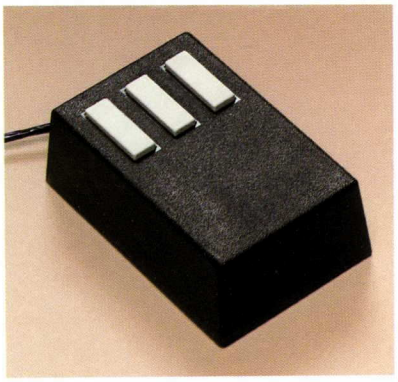
The 3600 can also access the file systems of time-shared mainframes. Currently, the file systems of DEC* VAX computers using VMS or BSD*UNIX can be accessed using the Ethernet network.

*MULTIBUS is a trademark of Intel Corporation
*DEC, UNIBUS, VMS are trademarks of Digital Equipment Corporation
* BSD is a trademark of the Regents of the University of California

3600 Graphics Display Terminal

The 3600 graphics display terminal consists of a high-resolution monitor, mouse, keyboard, and audio output. This black-and-white monitor is noninterlaced and flicker-free with true white phosphor. It is driven by a 1100 x 900 pixel bit-mapped controller. The optional color display is a high resolution monitor that is driven by a bit map with 8, 16, 24 or 32 bits per pixel mapped into 10 bits/RGB color. Maximum displayable resolution is 1280 x 1024.





The mouse is a hand-held device that transmits any change in its X or Y position as it is moved over a smooth surface. This movement information updates the position of a cursor on the display, providing immediate visual feedback. The mouse has three buttons that the user can press to give commands as an alternative to typing on the keyboard.

A mouse documentation line on the screen describes the function of each button. The user can easily pick items from menus, designate screen locations, highlight text, and point to icons, creating a flexible and powerful user interface.

Audio/Speech Output

The 3600 provides two 16-bit audio channels capable of a 50 KHz rate. The console provides a single output channel using a 12 bit D/A and speakers. A headphone jack is also provided at the console.

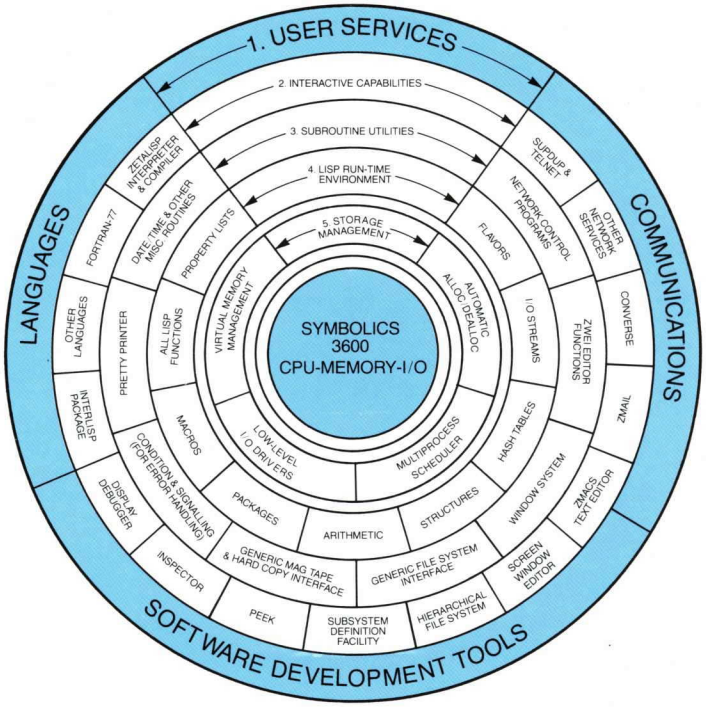
1. USER SERVICES—Symbolics Lisp-based software environment offers a unique blend of expressive power, development power and communications. The environment is comprised of more than 15 Mbytes of system software shown as layers 2–5 summarized below:

2. INTERACTIVE CAPABILITIES—Software development is totally interactive. The on-line edit, compile, inspect, and debug environment is fully integrated with the window system. Electronic mail and Converse are fully integrated with the window system editor and file system. High-level remote communication services enhance overall ease of use.

3. SUBROUTINE UTILITIES—Program developers have access to a collection of powerful subroutines which include high-level system functions that shorten the program development cycle.

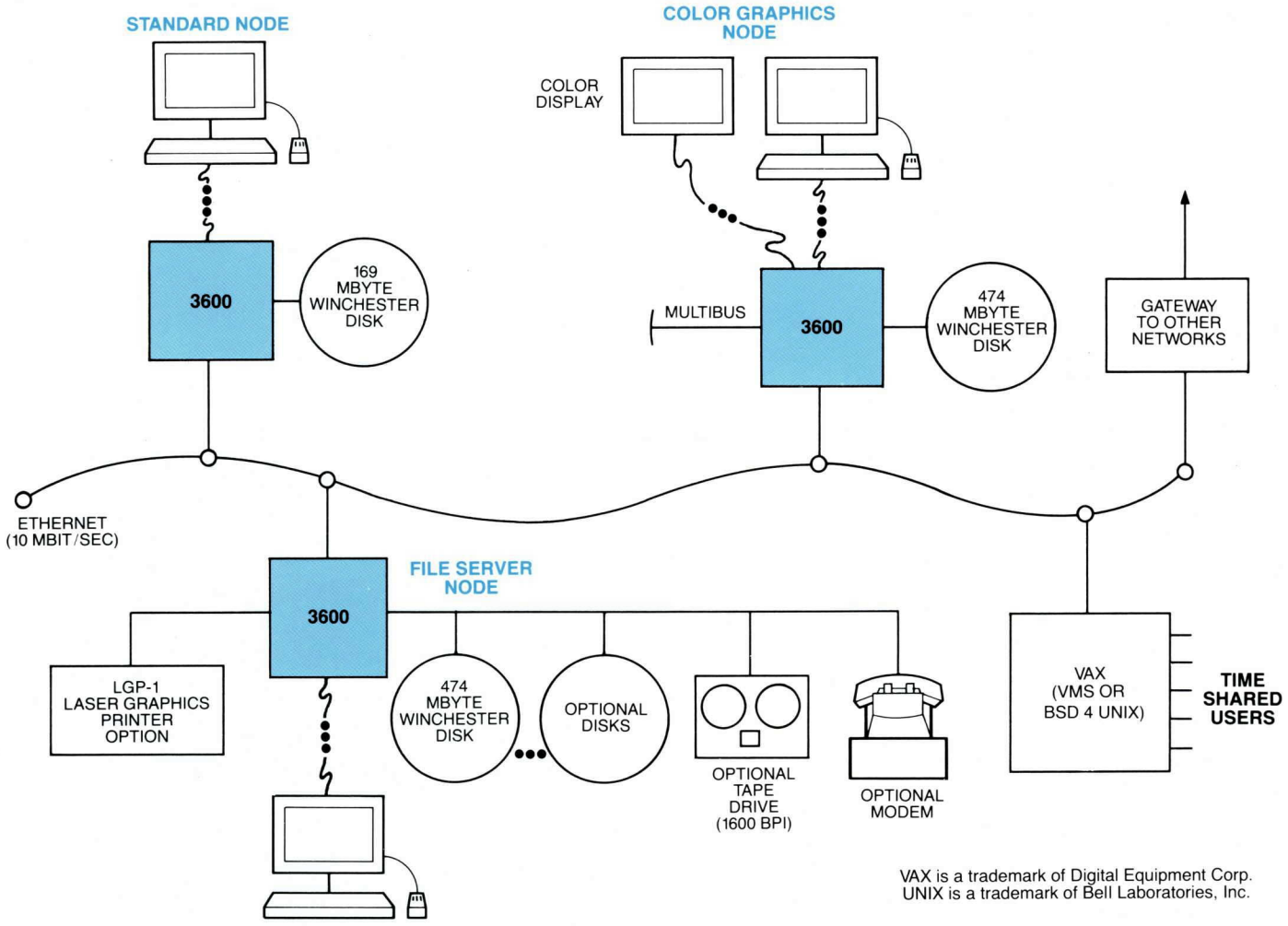
4. LISP RUN-TIME ENVIRONMENT—All of the functions that implement Lisp are available to the user. Extensions to Lisp such as Flavors are included here as well.

5. STORAGE MANAGEMENT—The lowest level system software (above microcoded 3600 routines shown at center) are the predefined system functions that provide the complete machine operating systems environment.



3600 HIGH-SPEED LOCAL NETWORK

The Symbolics Network System enables Symbolics computers to share resources and exchange information comprehensively with each other and with standard time-shared computer systems. Communication and access are supported via an industry-standard 10 Mbit/sec Ethernet local network. High-level user services, including generic file-system access, file transfer, electronic mail, remote login, and real-time message sending are implemented compatibly across supported operating systems. Geographically separated local networks can be interconnected via gateways with full services provided.



VAX is a trademark of Digital Equipment Corp.
UNIX is a trademark of Bell Laboratories, Inc.

3600 SYSTEM PHYSICAL SPECIFICATIONS

The console must be located within 15 meters (50 feet) of the CPU cabinet. The local network transceiver is mounted on the local network coaxial cable and must be within 6 meters (20 feet) of the CPU cabinet.

Physical Dimensions:

	Width	Height	Depth	Weight
Processor:	24″ 610mm	66″ 1676mm	34″ 864mm	700-800 lbs. 320-363 kg
Display:	20″ 508mm	20″ 508mm	15″ 381mm	50 lbs. 23 kg
Keyboard:	18.5″ 470mm	2.75″ 70mm	9.5″ 241mm	5.25 lbs 2.4 kg
Mouse:	2″ 51mm	1.3″ 33mm	3.25″ 83mm	5 oz 0.142 grams

Electrical Requirements—Domestic
Processor/Display/Keyboard

Voltage	115 VAC (+/− 10%)
Frequency	60 Hz
Current	20 Amps
Receptacle	30 Amps, 3 Prong NEMA L5-30R

Electrical Requirements—International
100 VAC-240 VAC/50 Hz versions available

Operating Environment:

Temperature	+32 to +90 F (0 to +32 C)
Relative Humidity	15-80% (noncondensing)
Heat Dissipation	6800 BTU/hour (2000 watts)

Specifications subject to change

Symbolics, Inc. designs, manufactures, sells and supports advanced state-of-the-art, high-performance, dedicated computer systems that feature a highly interactive man/machine interface. These systems were designed in response to the growing demand for increasing the productivity of highly skilled professional staff in various high technology disciplines. Present applications include the design of very large scale integrated (VLSI) circuits, symbolic mathematical analysis, genetic engineering, seismic studies for oil and mineral exploration, training simulation, software production, and artificial intelligence research and development. The system design objective, achieved to an extent never before offered commercially, has been to greatly enhance programmer and user productivity.

Symbolics, Inc. brings together most of the team who designed and produced the Massachusetts Institute of Technology Lisp machine computer series and its operating system. We believe that this team will enable Symbolics to remain at the forefront of future technological developments in both hardware and software.

Symbolics Quality Commitment

The development of a superior product coupled with quality manufacturing, and fully responsive customer support are the keywords of Symbolics' success in the marketplace.

Our Chatsworth manufacturing facility utilizes the latest testing equipment and techniques. Exacting quality standards are an integral part of the Symbolics manufacturing process.

Symbolics' quality commitment extends to customer systems through extensive customer support programs provided by our Customer Service and Education groups. These services include: installation, maintenance, repair, software and hardware training and extensive system documentation.

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