sun microsystems, inc.

The Sun-2 Product Family: A Technical Overview


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The Sun-2 Product Family: A Technical Overview

Product Description

Sun Workstations® are powerful general-purpose computers providing state-of-the art computing environments for the technical professional. Operating in a distributed network, each workstation supplies its user with a dedicated 32-bit architecture CPU, memory, and a high-resolution bit-mapped graphics display, while using high-speed local area communications to share other network resources and services.

All Sun Workstations run the most advanced version of the UNIX™ operating system, as enhanced at the University of California at Berkeley. UNIX 4.2bsd facilitates implementing and executing technical applications by supporting large demand-paged virtual address spaces, fast I/O to disk and local network, multiprocessing, and flexible inter-process communication.

The Sun-2 product family comprises several workstations offering the user the identical processing power across a range of flexible configurations and packaging alternatives. The Sun-2/120 and Sun-2/170 are two members of this family. The Sun-2/120 Deskside SunStation™ provides the user with a high-performance personal workstation configured either as an expandable network node or as a self-contained stand-alone system. The Sun-2/170 Rackmountable SunStation provides the user with the maximum configuration flexibility and expandability for building network servers.

In both these systems, fast hardware combines with the power of the UNIX operating system and more than 220 standard UNIX utility programs, plus additional tools such as Sun's multi-window display manager and device-independent graphics library, to create the most productive computing environment available today.

The Sun-2/120 desktop components include the standard 19-inch landscape monochrome display, optical mouse, low-profile keyboard, and an optional 19-inch landscape color display. A separate pedestal unit houses the processor, memory, display electronics, and local network interface, along with options such as mass storage peripherals and color display controller.

The Sun-2/170 enclosure mounts in Sun's standard 19-inch full-height rack, and contains the processor, memory, and local network interface. Both monochrome and color displays are available as options, along with several rack-mountable mass storage peripherals offering a wide range of capacity.

Common Features

- 32-bit architecture MC68010 processor
- 16 megabytes of virtual address space per process
- Up to 4 megabytes of physical memory
- Hardware floating point processor option
- UNIX operating system supporting demand-paged virtual memory
- Network File System (NFS) providing transparent access to files and directories on a multi-vendor network
- Ethernet local area network interface
- High-resolution (1152 x 900) non-interlaced bit-mapped monochrome display (standard on Sun-2/120, optional on Sun-2/170)
- Medium-resolution (640 x 480) bit-mapped color display option with 8 color planes (256 simultaneous colors from a palette of over 16 million)
- SunCore™ and SunCGI™ graphics libraries
- SunWindows™ flexible multi-window display manager supporting overlapped windows, pop-up menus, and icons
- C, Fortran, and Pascal programming languages

Sun-2/120 Features

- 9-slot Multibus® card cage (four slots used in basic product)
- One megabyte main memory standard
- Integral disk and tape options for local mass storage
- Attractive office-environment packaging with desktop display unit and electronics in slim-line pedestal
- Ergonomic design with low-profile keyboard, tilt-and-swivel display and optical mouse
- 8-channel asynchronous line multiplexer

Sun-2/170 Features

- 15-slot Multibus card cage four slots used in basic product)
- Two megabytes main memory standard
- Packaged for mounting in 19-inch instrument rack
- Large-capacity, rackmountable mass storage options
- 8- or 14-channel asynchronous line multiplexer
- Full-height, 19-inch rack for the Sun-2/170 and its peripherals

Sun-2 Workstation Architecture

The Sun-2 architecture specification standardizes, independently of implementation method, the capabilities of the basic workstation hardware and a common set of input/output devices that are available to the operating system and to user programs. The architecture supports a multitasking operating system (UNIX 4.2), virtual memory, communications (Ethernet local networking), and bit-mapped graphics displays.

The Sun-2 architecture is based on industry and international standards and was designed for a long, useful lifetime. As the fundamental Sun-2 technologies evolve, advances can be incorporated rapidly into Sun-2 products while maintaining compatibility at the software level. The Sun-2 architecture lends itself to both low-cost and very high-performance implementations. All Sun Workstations in the Sun-2 product family adhere to the architectural specification, providing the user with software portability across a range of workstations with differing features.

Card Cage and Backplane

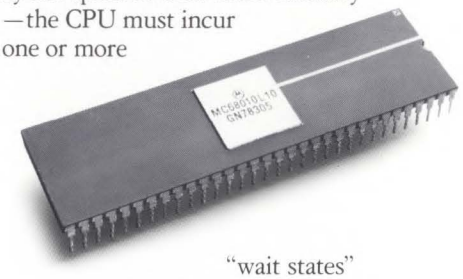
The design of the Sun-2/120 Deskside SunStation and Sun-2/170 Rackmountable SunStation is based on the industry-standard Multibus (IEEE-796 Bus) for system card cage and backplane. The unique Sun design uses the private bus provided by the Multibus specification (the "P2" bus) for high-speed access to main memory and display memory, while using the basic ("P1") bus as an I/O bus for access to a wide variety of peripherals.

Central Processing Unit

The computational power of all Sun Workstations begins with one of the most advanced microprocessors available today: the MC68010. This CPU supports virtual memory operation, allowing users to develop application programs larger than the amount of available main memory without complicated overlay schemes. Every process may use up to 16 megabytes of virtual address space, enough for the most sophisticated technical applications.

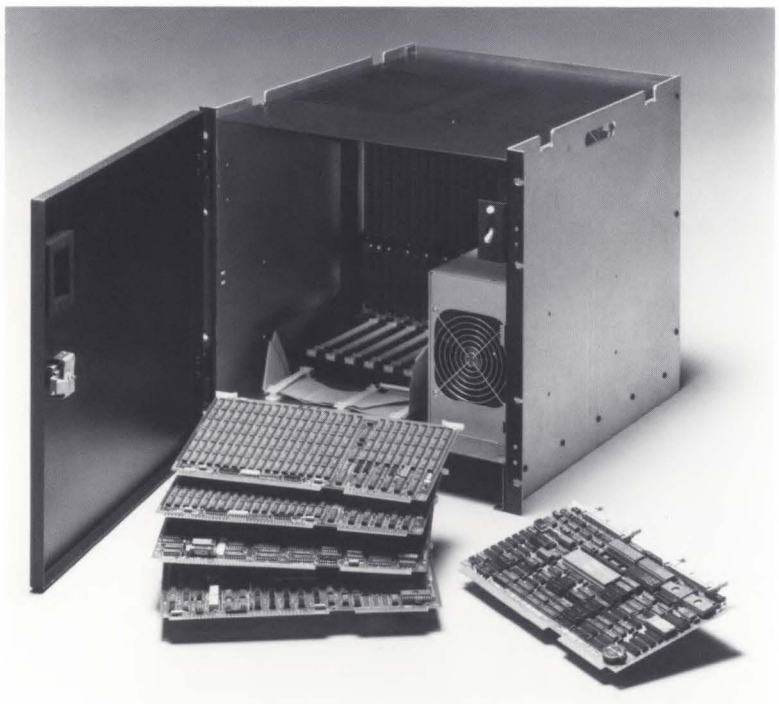
Memory Management Unit

Sun-2 workstations operate the MC68010 processor with a 10 MHz clock. At this high clock rate most microprocessor systems are limited by the speed of their main memory —the CPU must incur one or more



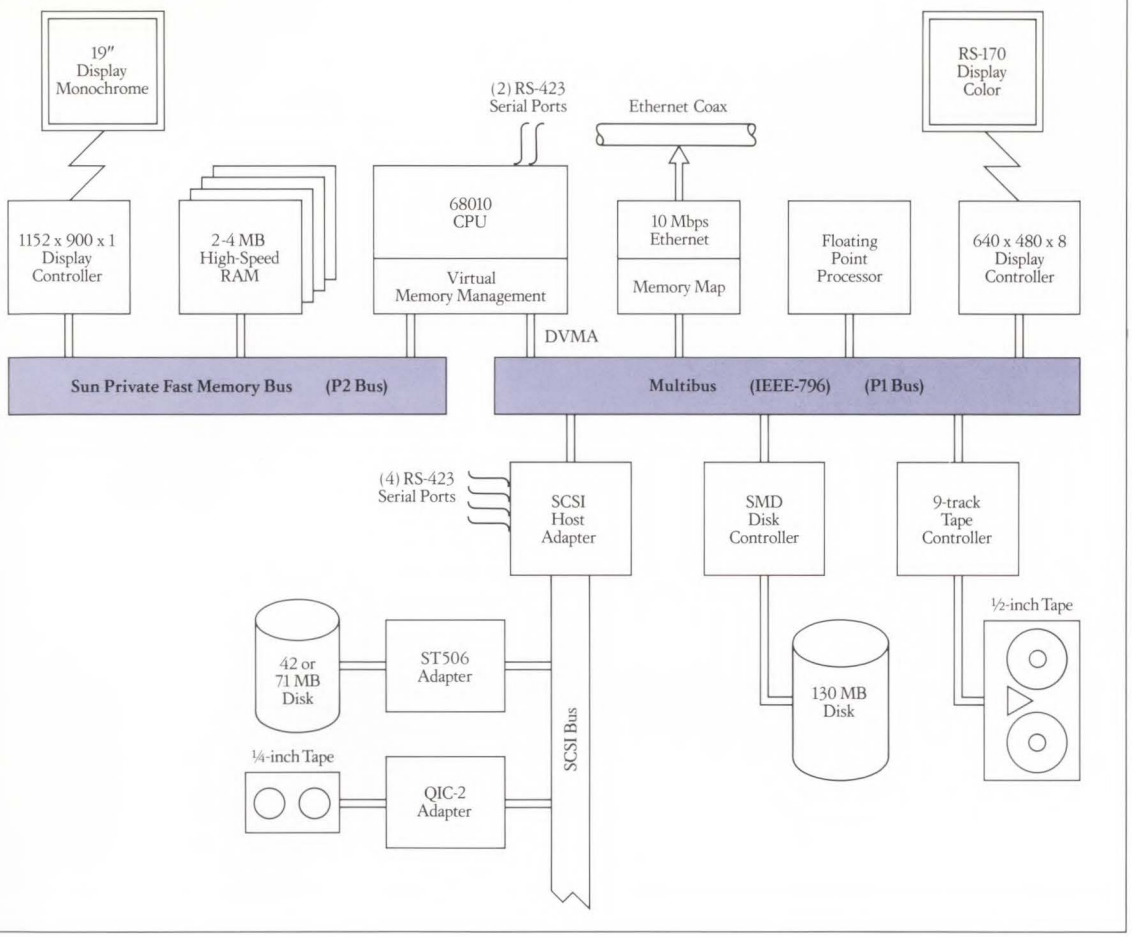
"wait states" (wasted clock cycles) on every access to memory. Some system designs attempt to relieve this problem by introducing expensive high-speed cache memory to speed up memory access. The high-speed Sun-2 memory management unit allows the processor to access all of main memory with no wait states—in effect turning all of main memory into cache.

The memory management unit (MMU) for the Sun-2 family implements two-level address translation for virtual memory operations, providing both segment and page addressing. The MMU hardware provides a protected system environment for multiprocessing by supporting separate *read, write,* and *execute* permissions for both the operating system and the user on every page of memory. Optimizations for the UNIX operating system include referenced and modified bits for each page of memory (to facilitate efficient demand paging algorithms) and hardware support for eight separate contexts (to facilitate rapid process switching).



Sun-2/170

System Block Diagram



Direct Virtual Memory Access

For greater system performance, the Sun-2 MMU also supports Direct Virtual Memory Access (DVMA™). High-speed peripheral devices such as disk and tape drives are able to transfer data directly to and from private memory through the MMU on the processor board. The MMU enhances system reliability by allowing DMA devices to operate with virtual memory addresses that are translated and protected, exactly as are program accesses to main memory.

Main Memory

The Sun-2/120 and Sun-2/170 are equipped with 2 megabytes of main memory standard. Both may be expanded up to 4 megabytes in 1-megabyte increments. Sun main memory uses high-speed (150 nanosecond) dynamic RAMs to complement the 10 MHz processor and no-wait-state memory management. All system memory is equipped with parity error detection.

CPU On-board Peripherals

Additional features of the Sun-2 processor architecture include a time-of-day clock with battery backup, used by the operating system during the completely automatic system boot procedure; and two RS-423 serial ports with modem control. Compatible with the older RS-232C standard, these serial ports are useful for driving output devices such as printers and plotters.

Monochrome Graphics Display

The black-and-white monitor (standard on a Sun-2/120 Deskside SunStation, optional on a Sun-2/170 Rackmountable SunStation) displays more than one million pixels, organized in 900 rows of 1152 columns. This high-bandwidth 19-inch landscape console provides the large viewing area and high resolution required by advanced user interface software, such as integrated text and graphics editors and the Sun multi-window display manager. The Sun-2 video controller refreshes the screen at 66 Hz non-interlaced, providing a flicker-free display for even the most detailed images.

Monochrome Frame Buffer

From a logical viewpoint, the Sun-2 frame buffer is part of main memory: programs create display images by modifying "frame buffer memory." Programs access this region exactly as they would any other part of their address space, through direct memory manipulations, leading to simpler programming.

Physically, the Sun-2 monochrome frame buffer resides on the high-speed private bus along with the processor and main memory. It provides 128 kilobytes of dual-ported frame buffer memory that drives the actual video output. This eliminates memory contention that would degrade performance, if the display were refreshed out of program memory, and increased expense, if all of main memory were dual-ported.

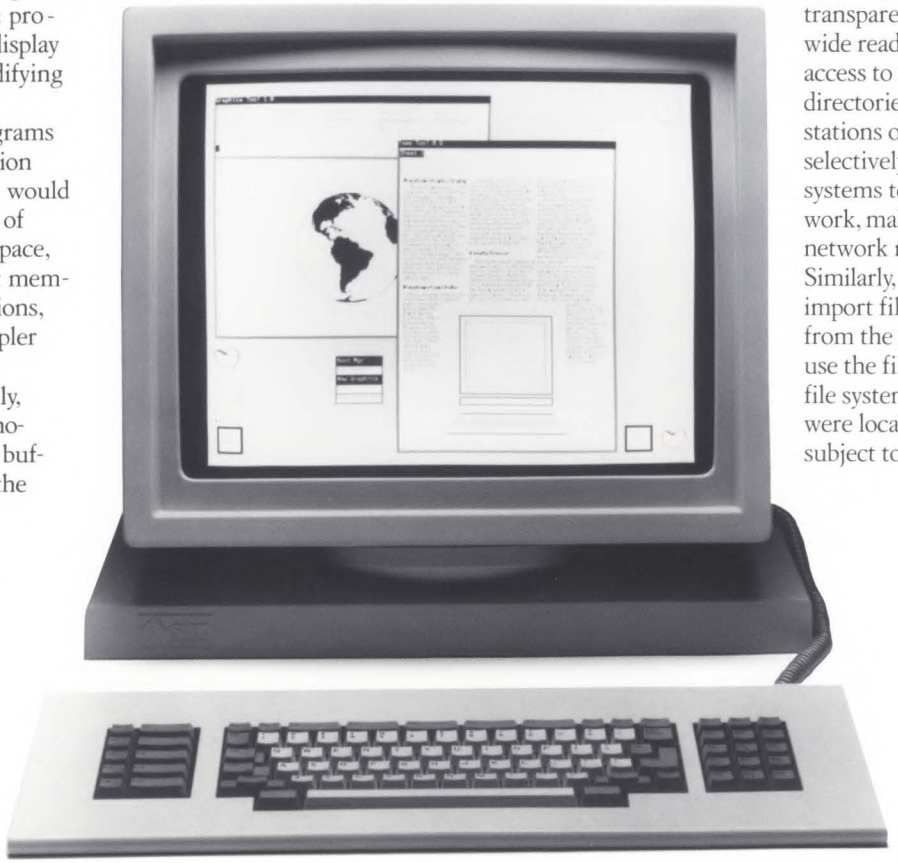
Local Network Support

Local area network communications is a standard capability of every Sun-2 Workstation. The local network hardware and software permit several types of resource sharing among clusters of Sun Workstations, such as common printer service and common modems for remote telecommunications. They also provide traditional distributed system communications functions, such as file transfer and electronic mail between individual network nodes.

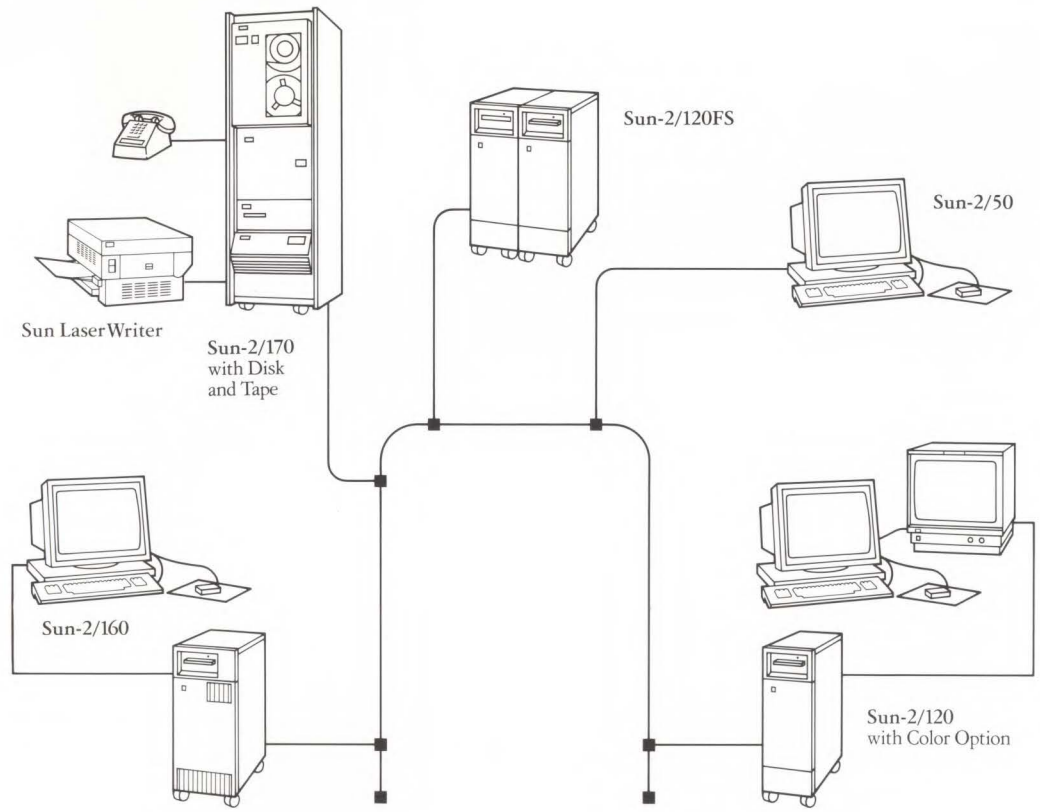
Most importantly, the local net enables Sun Workstations to operate without disk storage on every node. Instead, diskless nodes use the network to perform demand paging as well as ordinary file input and output. One node (a Sun-2/120FS or Sun-2/170) can supply mass storage for multiple diskless nodes. This allows the use of larger, more cost-effective peripherals, located away from the users' offices and possibly maintained by a network administrator.

Network File System

In addition to sharing disks, Sun Workstations use the network to share files. The Network File System (NFS) supports transparent network-wide read and write access to files and directories. Workstations or servers selectively export file systems to the network, making them network resources. Similarly, workstations import file systems from the network and use the files in those file systems as if they were locally resident, subject to normal



Network Diagram



system access protection. While conceptually simple, sharing files in this manner can bring substantial benefits: improved data consistency, simplified system administration, easier integration of new network nodes, and conservation of disk space.

The NFS design is independent of any particular hardware or operating system, allowing it to evolve with developing network and computer technologies. Further, it can be implemented on heterogeneous operating systems and processors on the same network, providing a uniform interface for sharing resources.

The NFS exemplifies Sun's commitment to open systems and industry standards. In this new and crucial area where there is no industry standard, Sun intends to establish the standard. Accordingly, Sun has published the NFS and supporting protocol specifications.

Ethernet Interface

The design of the Ethernet interface for the Sun-2 Workstations is an integral part of the Sun-2 family architecture. Meeting peak performance requirements in a network server configuration, where many clients may be funneling requests to a single server, was a key design criterion.

For that reason, the Sun-2 Ethernet controller is equipped with 256 kilobytes of on-board buffer memory. It accepts back-to-back packets from the Ethernet while simultaneously accepting DMA transfers from disk controllers. After the CPU initiates a disk transfer, the processor can build Ethernet packet headers while the disk transfers data into Ethernet buffer memory. The Ethernet controller, using its own on-board memory management unit, then "gathers" the complete packet as it transmits it, avoiding the overhead of copying data. Less overhead on the server results in better performance for every client.

Sun-2/120 FS with second 130 MB Winchester disk pedestal.

Network Configurations

One high-performance Ethernet interface is standard with each Sun-2/120 and Sun-2/170, whether it will be a client or a server. A second Ethernet interface may be added to a Sun-2/120 or Sun-2/170 in order to build a gateway between physically separate Ethernets in the same local area. When the physical network topology includes these gateways, the gateways are not visible to application programs. All network services (except disk service for diskless workstations) proceed as if there was a single logical network.

Sun-1/100U and Sun-1/150U workstations, if upgraded to run the same software release, may coexist on the same physical Ethernet. Either Sun-1 or Sun-2 nodes may be servers for either Sun-1 or Sun-2 clients.

Dedicated Server Configurations

One possible use of the Sun-2/120 is as a dedicated network server for a small cluster of Sun Workstations. The Sun-2/120FS deletes the bitmapped monitor, display controller, keyboard, and optical mouse to provide a cost-effective configuration for this situation. Instead of the graphics display, the customer supplies a standard ASCII terminal for use as the system console. Otherwise, all the standard system features and options are identical for both the Sun-2/120 and Sun-2/120FS.

The Sun-2/170 is most frequently used as a dedicated network server, because the most cost-effective large-capacity disk drives are only available for rack mounting. Also, the 15-slot card cage provides much greater configuration and expansion flexibility, allowing the use of multiple disk controllers, tape controllers, and other peripheral interfaces. For these reasons the standard Sun-2/170 does *not* include the bitmapped display; it is available as an option.

Stand-alone Configuration

For applications where the Sun-2/120 or the Sun-2/170 will be used in a stand-alone environment, the network interface may be deleted from the normal configuration. The system then requires both a local disk and tape option.

Multi-vendor Networks

Sun's choice of the industry-standard 10 megabit-per-second Ethernet for networking Sun Workstations simplifies the task of building multi-vendor networking environments. On top of the Ethernet low-level protocols, Sun Workstations implement the Address Resolution Protocol (ARP), Internetwork Protocol (IP), and Transmission Control Protocol (TCP) developed by the United States Department of Defense. Implementations of TCP and IP exist for many operating systems on hardware ranging from supercomputer mainframes to personal computers. With compatible higher-level protocols, file transfer and other user-level services are possible between heterogeneous systems.

As one example, networks containing Sun Workstations and a DEC® VAX®-11 system running UNIX 4.2bsd are easily built. While a Sun Workstation must provide the network disk service for diskless workstations, the same user-level network services (file transfer, printer sharing, virtual terminal access, and so on) operate between the Suns and the VAXes as between the Suns.

In addition to the Berkeley UNIX 4.2 network protocols for user-level services, Sun Workstations also support ARPANET application service protocols. The standard Sun software distribution includes ARPANET FTP (File Transfer Protocol) and TELNET (a virtual terminal protocol).

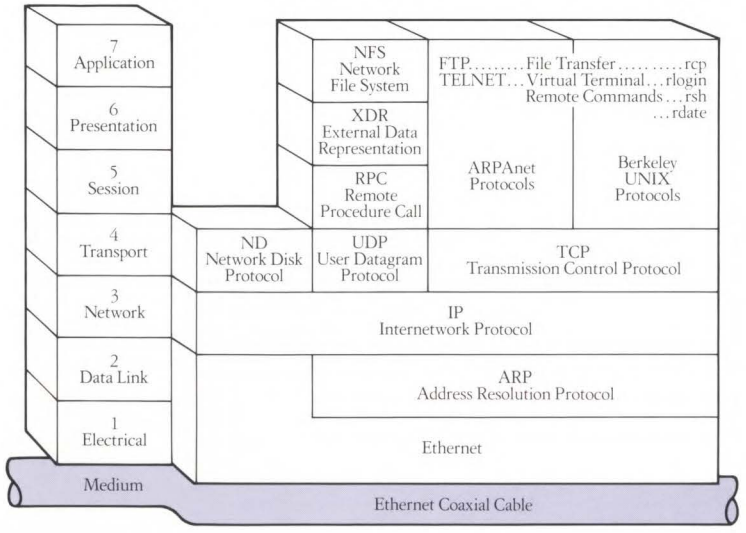
Additional Communications Capability

All Sun Workstations are equipped with two RS-423 serial ports, that may be used for communications as well as driving peripheral devices. An optional asynchronous line multiplexer is available on the Sun-2/120 and Sun-2/170 for 8 or 14 additional RS-232 ports.

Standard Sun software provides two communication services that use these serial lines. The first is a utility called *uucp* (UNIX-to-UNIX copy), which implements a reliable file transfer protocol between UNIX systems. Uucp also provides the basis for several additional network services, including remote command execution and electronic mail.

Second, the standard distribution includes a terminal emulator called *tip* that runs as a user program under UNIX. Tip allows a user at a Sun Workstation to connect as a terminal to other systems that support asynchronous ASCII terminals. Tip works with non-UNIX systems, and supports a rudimentary file transfer capability.

Data Communications Protocols



Standard Software Capabilities

All Sun Workstations run the same software. The standard software distribution bundled with every workstation includes the UNIX operating system, UNIX utilities, three programming languages, a graphics library, and multi-window display manager.

Sun Workstations run the Berkeley 4.2 version of UNIX. This multi-processing operating system has been optimized for the technical application environment. It supports demand-paged virtual memory, large virtual address spaces, a fast file and network I/O system, and flexible inter-process communication.

Beyond the basic UNIX operating system, Sun Workstations support more than 220 UNIX utilities. Included among these are line and screen editors *(ed, sed, ex, vi)*, text formatters *(eqn, tbl, nroff, troff)*, a spelling checker *(spell)*, a general-purpose sort utility *(sort)*, and electronic mail and bulletin-board programs *(Mail, news)*.

For application development, Sun Workstations provide many programmer productivity tools. The standard software distribution also includes C, Fortran, and Pascal programming languages, a source-level debugger *(dbx)*, a program portability checker *(lint)*, 68010 assembler, an assembly-level debugger *(adb)*, and the UNIX source code control system *(SCCS)*.

Graphics Libraries

To aid programmers in developing or porting graphics applications, Sun software includes the SunCore graphics library, Sun's version of the ACM Siggraph Core specification, the SunCGI library, the proposed Computer Graphics Interface (CGI) standard, and the pixrect library, Sun's bitmap graphics package.

SunCore provides a library of high-level procedures for creating graphics images, such as commands for drawing vectors, filling solid regions, and moving and scaling image segments. SunCore routines are callable from C, Fortran or Pascal.

SunCore implements the Siggraph Core standard to level 3C for output primitives and level 2 for input primitives. SunCore device-independent 2-D, 3-D, and raster graphics primitives support all Sun Workstation displays and are integrated with the Sun window system. Sun has added a number of extensions to SunCore for capabilities not specified in the Siggraph standard, including smooth surface shading of polygons (for the Sun color display) and hidden surface removal using a virtual memory z-buffer.

SunCGI is a 2-D standard with an integer logical device coordinate system for fast 2-D graphics. It is highly integrated into the Sun window system and provides an extended set of 2-D graphics primitives plus asynchronous input routines.

The pixrect library is an object-oriented bitmap graphics package that uses a pixel coordinate system. Rasterops, vectors, polygons, stencils, text, and curve bounded regions are supported.

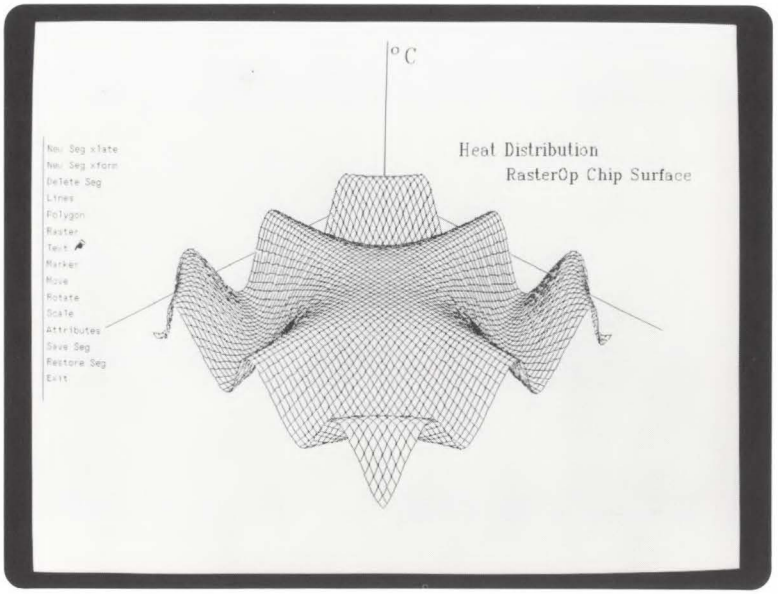
SunWindows

The Sun window system provides complete display management and user interface design facilities for the Sun Workstation. SunWindows allows the user to create many, possibly overlapping, windows containing both text and graphics, in order to visually manage multiple concurrent tasks. Interacting with the optical mouse, the window manager supports pop-up menus for manipulating the window environment: creating new windows; opening and closing windows and icons; and hiding, exposing, moving, and changing the size of existing windows.

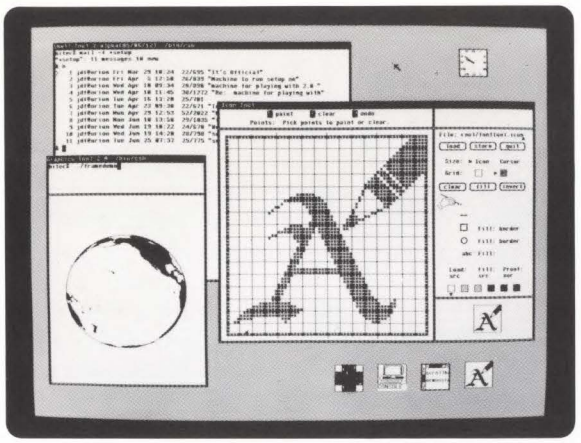
Sun has implemented standard "application windows" which provide a virtual terminal interface to UNIX, giving easy access to existing terminal-based applications that are not integrated with the window system. With these virtual terminal windows, users in effect have multiple terminals on their desks. They can use standard utilities such as the screen editor *vi* and electronic mail, while simultaneously compiling new program modules and debugging an application that generates graphic output. Using the mouse, the user can select data from one window and insert it into another, as well as modify the windows themselves.

In addition to these standard windows, SunWindows is "open" to the user who wishes to more completely integrate an application into the window environment. Sun has specified layers of functionality within the window system architecture and provides subroutine libraries implementing a programmatic interface to each layer. Each layer of the window system adds additional capabilities built from the facilities provided by the lower layers, permitting users to customize SunWindows for their needs.

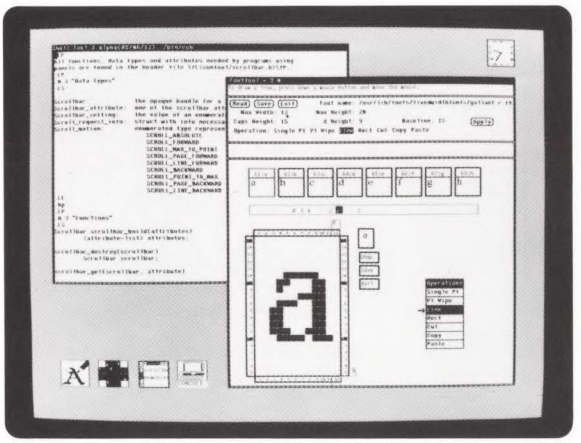
At the lowest level, SunWindows provides two device-independent interfaces: raster output primitives for displays, and a stream input format for keyboards and mice. Above the input-output level, SunWindows provides tools for defining a hierarchical set of windows on the display. If windows overlap, the window manager automatically performs clipping and display locking



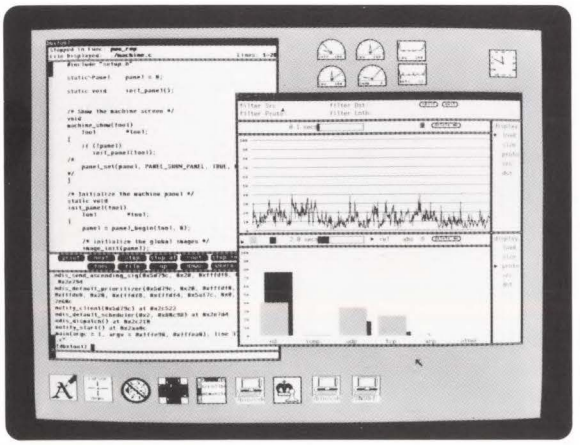
SunCore facilitates the development of device-independent 2D and 3D images.



SunWindows supports the creation and manipulation of overlapping windows containing both text and graphics.



The optical mouse and pop-up menus provide a uniform user interface for manipulating windows, window contents and icons (small symbolic representations of closed windows).



SunWindows provides building blocks such as control panels, which ease the construction of sophisticated window-based applications.

during screen updates. At higher levels, SunWindows provides the building blocks necessary for the construction of sophisticated user interfaces, including pop-up, stackable menus, pop-up messages, and flexible control panels containing text, buttons, and analog sliders. Users have programmatic access to any or all of these levels in the SunWindows system.

Sun also provides a built-in collection of tools for tailoring the programming environment. These tools include a mouse-driven symbolic debugger and editors for generating icons and fonts.

Catalyst Third-Party Program

Sun Microsystems sponsors an active program to promote the development of new software and add-on hardware and the porting of existing software to the Sun Workstation. Many products are already available from third-party vendors, and the number is growing rapidly.

Third-party program catalogs and bulletins are issued regularly and are available at any Sun field office. Products available today include additional "horizontal" (general-purpose) software tools, such as database managers, word processors, and programming languages; "vertical" (specific) application packages, such as printed circuit board layout and page composition for phototypesetting; and support for additional hardware devices, such as high-resolution printers.

Optional Hardware and Peripherals

The "open system" hardware and software design philosophy and the selection of a Multibus system backplane for the Sun-2/120 and Sun-2/170 facilitates the integration of a variety of peripherals into these Workstations. Options available from Sun Microsystems provide mass storage, backup, enhanced computational performance, and color display capability.

Hardware Floating Point Option

Floating point arithmetic on Sun Workstations is normally performed by software subroutines, using IEEE-754 standard formats for 32-bit single and 64-bit double precision operations. The hardware floating point option equips a Sun-2 workstation with a floating point processor (FPP) that supports IEEE standard format. Adding an FPP will substantially reduce the execution time of computationally intensive algorithms.

Floating point support is architecturally designed into the Sun-2 product family so that the user's programs need not be aware of the presence or absence of the hardware FPP. Using the "vector library" compiler switch, *binary* applications are transportable between machines with and without the FPP option. Moving programs requires no recompilation or relinking, a major benefit in networks where not every node has an FPP. For non-networked application environments and where binary portability is not required, the "in-line code" compiler switch provides peak floating point performance.

Mass Storage Options

Both Sun-2 models offer ¼-inch and ½-inch tape options, and disk options in several capacities. All Sun-2/170 disk and tape options are packaged for mounting in a 19-inch rack; Sun-2/120 disk and tape options, except the ½-inch tape drive, are pedestal-mounted for office installation.

The Sun-2/120 basic pedestal provides for the installation of one 5¼-inch Winchester disk drive and one ¼-inch streaming tape cartridge drive. The 5¼-inch Winchester is available in either 42 megabytes or 71 megabytes (50 MB or 85 MB unformatted) capacities.

Only one interface is required for both the disk and the ¼-inch tape. Called SCSI host adapter, it supports the ANSI-standard (ANSC X3T9.2) Small Computer System Interface (SCSI), which specifies a high-speed parallel bus for multiple intelligent device controllers. The host adapter for the Sun-2/120 also provides four RS-423 serial ports for driving additional output devices (in addition to the two RS-423 ports provided by the Sun-2 processor).

The SCSI interface, with four RS-423 ports, is also used for the ¼-inch tape backup option on the Sun-2/170.

If larger storage capacity is required, the Sun-2/120 is available with a second pedestal unit containing 130 megabytes (168 MB unformatted) or 260 megabytes (336 MB unformatted) of disk space. The second pedestal connects to the Sun-2/120 through a high-performance non-interleaved SMD disk controller instead of the SCSI interface. (If present, the ¼-inch tape unit using the SCSI interface is mounted in the first pedestal.)

High-speed Winchester disk drives in two capacities are available for the Sun-2/170, all connecting through the SMD disk controller: 130 megabytes (169 MB unformatted) and 380 megabytes (474 MB unformatted). Each of these disks connects to the system through an SMD disk controller, with either one or two drives per controller.

For environments where traditional ½-inch tapes are desirable, the Sun-2/120 and Sun-2/170 offer a ½-inch, 1600 bpi, 9-track tape drive option. This tape drive requires a separate 19-inch rack for mounting, and connects to either system through a dedicated controller.

Color Display Options

Many workstation applications require color displays in addition to monochrome. Color is often used to assist the user in assimilating complex data, such as VLSI circuitry layers. Some applications are not possible without many additional intensity levels, such as image processing.

The Sun-2/120 and Sun-2/170 offer a medium-resolution color display controller option that displays pixels in 480 rows of 640 columns. Each pixel is stored with 8 bits of color value, resulting in up to 256 colors simultaneously on the screen. However, the display controller uses this 8-bit value as an index into a color lookup table which is separately set up by the application. The lookup table yields 24 bits of color—8 bits each of red, green, and blue—thus providing a palette of over 16 million colors.

The color display controller generates RS-170 standard output (separate red, blue, green, and sync signals) for a 60 Hertz interlaced monitor. The color option is available either as display controller alone, or with a 19-inch landscape color monitor.

Sun Service

Sun Microsystems™ offers a comprehensive hardware and software support program for all its products.

Sun technical support staff located in each Sun field office or at Sun Microsystems' headquarters in California provide each customer with a single point of contact for both software and hardware support questions.

Comprehensive Support Service includes on-site hardware and software support. It features:

- Toll-free access to software hotline
- All new software releases
- Software technical bulletins and manual updates
- On-site hardware support by Sun field engineers
- Factory-specified field change orders

Standard Support Service provides hardware and software support through Sun Regional Support Centers. It features:

- Toll-free access to software hotline
- All new software releases
- Software technical bulletins and manual updates
- Toll-free phone-in hardware diagnostic assistance
- Overnight shipment of customer-replaceable parts
- Major repairs at Sun Regional Support Center with three-day turnaround
- Factory-specified field change orders

Hardware and software support can also be purchased individually. Installation of all hardware and Sun software is available at fixed rates.

Sun Microsystems offers major system modules as spare parts for those customers who wish to perform their own service or who desire a local repair parts stock. These modules are completely tested and burned-in by Sun to ensure reliable operation.

Fixed-cost module repair service is available from the field service organization at Sun's headquarters. Schematics and other detailed technical specifications are not part of spare parts documentation.

Specifications

Card Cage/Backplane

Bus Type	Multibus (IEEE-796)
Bus Arbitration	Parallel

Processor

CPU Type	MC68010
Clock Rate	10 MHz, 0 wait states
Firmware	32 KB PROM monitor

Memory Management

Virtual Memory	16 MB per process
Address Translation	2 level (segment and page)
Protection	Page-level R, W, X
Contexts	8 in hardware
I/O Interface	DMA (DVMA)

Main Memory

Maximum RAM	4 megabytes
Error detection	Byte parity

Ethernet Interface

Media Type	Coaxial cable
Data Rate	10 Mbps
Access Control	CSMA/CD Protocol
Buffer Size	256 KB

Monochrome Display

Monitor Format	19-inch landscape
Resolution	1152 x 900 x 1
Refresh Rate	66 Hz, non-interlaced
Bandwidth	100 MHz
Phosphor	P-104

Keyboard

Keypads	10-key (left), 15-key (right)
Function Keys	9 keys (top row)
Signaling	Programmable up/down encoding
Interface	Serial

Standard Software

Operating System	UNIX 4.2bsd
Languages	C, Fortran, Pascal, Assembler
Graphics	SunCore library
User Interface	Window manager

Miscellaneous Peripherals

CPU I/O Ports	(2) RS-423 serial (RS-232C compatible)
I/O Speed	19.2 Kbps output, 9.6 Kbps input, asynchronous
CPU Clock	Time-of-day and date with battery backup
SCSI Bus	Single-host subset
SCSI I/O Ports	(4) RS-423 serial (RS-232C compatible)
I/O Speed	19.2 Kbps output, 9.6 Kbps input, asynchronous

Floating Point Processor Option

Data Format	IEEE-754 standard
Precision	32-bit single, 64-bit double

Color Display Option

Monitor Format	19-inch landscape
Resolution	640 x 480 x 8
Refresh Rate	60 Hz, interlaced
Interface	511-line RS-170 (Red, Green, Blue, Sync)

Tape Options

¼-inch Cartridge Tape Drive

Drive Type	8000 bpi, 4-track
Operating Mode	90 ips, streaming
Capacity	20 MB per cartridge
Interface	SCSI to QIC-II

½-inch Tape Drive

Drive Type	1600 bpi, 9-track
Operating Mode	25 ips, start-stop
Capacity	45 MB per reel
Interface	Pertec

Regulatory

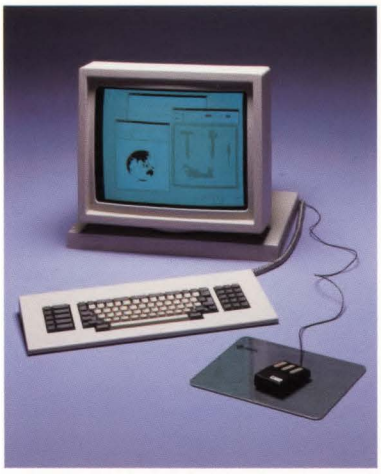
RFI Emissions	FCC Class A, VDE Class A
Safety Approval	UL approved, CSA Certified

Facility Planning

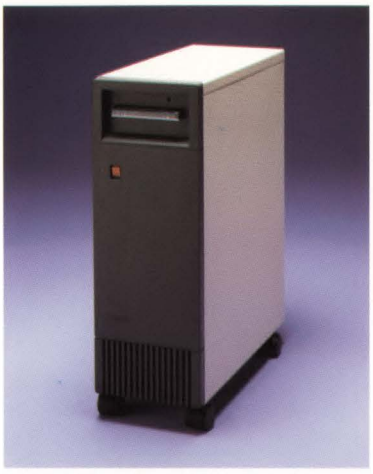
Temperature	5° to 40°C (41° to 104°F)
Humidity	5 to 80%, non-condensing
AC Voltage	95-125 or 210-250 VAC
AC Frequency	48 to 62 Hz
Cable Length	15 ft. from pedestal to monitor, keyboard, mouse

	Sun-2/120				Sun-2/170	
Multibus Card Slots	9 (5 used standard)				15 (4 used standard)	
Power Supply Output	450 watts (card cage only)				750 watts	
Standard Main Memory	2 megabytes				2 megabytes	
Formatted Disk Capacity	**42 MB**	**71MB**	**130 MB**	**260 MB**	**130 MB**	**380 MB**
Winchester Platter Size	5¼"	5¼"	8"	8"	8"	10½"
Unformatted Capacity	50 MB	85 MB	168 MB	336 MB	168 MB	474 MB
Controller Interface	SCSI	SCSI	SMD	SMD	SMD	SMD+
Average Seek Time	33 ms.	35 ms.	20 ms.	20 ms.	20 ms.	18 ms.
Average Latency Time	8.3 ms.	8.3 ms.	8.3 ms.	8.3 ms.	8.3 ms.	7.5 ms.
Average Access Time	41.3 ms.	43.3 ms.	28.3 ms.	28.3 ms.	28.3 ms.	25.5 ms.
Data Transfer Rate	5 Mbps	5 Mbps	10 Mbps	10 Mbps	10 Mbps	15 Mbps

Specifications



Sun-2/120 Desktop Components



Sun-2/120 Deskside Component

Sun-2/170

19-inch Color Monitor

380 MB Winchester Disk Drive

1/2-inch Tape Drive

DIMENSIONS and POWER						
Component	**Height**	**Width**	**Depth**	**Weight**	**Power**	**Heat**
120 Pedestal	73.7 cm (29.0″)	24.1 cm (9.5″)	54.6 cm (21.5″)	41.8 kg (92 lb.)	750 watts	2560 BTU/hr.
170 Enclosure	45.7 cm (18.0″)	48.3 cm (19.0″)	53.3 cm (21.0″)	27.3 kg (60 lb.)	750 watts	2560 BTU/hr.
Monochrome Display	49.5 cm (19.5″)	53.3 cm (21.0″)	40.6 cm (16.0″)	27.7 kg (61 lb.)	100 watts	340 BTU/hr.
Keyboard	3.8 cm (1.5″)	53.3 cm (21.0″)	21.6 cm (8.5″)	2.3 kg (5 lb.)	N/A	N/A
Mouse Pad	N/A	27.9 cm (11.0″)	22.9 cm (9.0″)	N/A	N/A	N/A
19-inch Color	47.0 cm (18.5″)	45.7 cm (18.0″)	53.3 cm (21.0″)	43.2 kg (95 lb.)	150 watts	515 BTU/hr.
130 MB Disk (Pedestal)	73.7 cm (29.0″)	24.1 cm (9.5″)	54.6 cm (21.5″)	40.9 kg (90 lb.)	170 watts	580 BTU/hr.
260 MB Disk (Pedestal)	73.7 cm (29.0″)	24.1 cm (9.5″)	54.6 cm (21.5″)	54.5 kg (120 lb.)	340 watts	1160 BTU/hr.
130 MB Disk (Rack)	17.8 cm (7.0″)	49.5 cm (19.5″)	63.5 cm (25.0″)	38.6 kg (85 lb.)	170 watts	580 BTU/hr.
380 MB Disk (Rack)	26.7 cm (10.5″)	48.3 cm (19.0″)	71.1 cm (28.0″)	62.0 kg (137 lb.)	550 watts	1880 BTU/hr.
½-inch Tape	61.0 cm (24.0″)	48.3 cm (19.0″)	40.6 cm (16.0″)	51.8 kg (114 lb.)	275 watts	940 BTU/hr.
¼-inch Tape	17.8 cm (7.0″)	49.5 cm (19.5″)	63.5 cm (25.0″)	29.5 kg (65 lb.)	170 watts	580 BTU/hr.

Specifications are subject to change without notice.

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