

# Sun Enterprise™ 10000 Server

## Just the Facts



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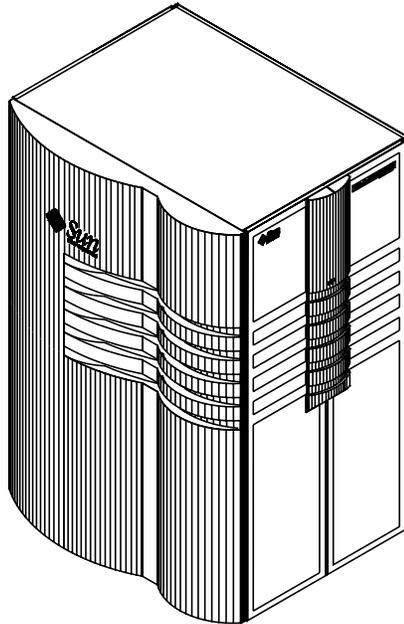
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## Overview



**Figure 1.** The Sun Enterprise 10000 server

The Sun Enterprise™ 10000 server is a SPARC™ processor-based, scalable symmetrical multiprocessing (SMP) computer system running on the Solaris™ Operating Environment (UNIX® System V, Release 4). It is an ideal, general-purpose application and data server for host-based or client-server applications such as on-line transaction processing (OLTP), decision support systems (DSS), data warehousing, communications services, or multimedia services.

The Sun Enterprise 10000 server can be configured with up to 64 processors, up to 64 GB of memory, over 120 TB of on-line disk storage, and a wide range of UNIX application software. All functional areas of the Sun Enterprise 10000 server are field upgradeable, and most upgrades can be performed without disrupting users or halting the system.

The Sun Enterprise 10000 server incorporates RAS features that were pioneering for a UNIX server and have since been migrated to the newer line of Sun Fire™ enterprise servers. Two examples are dynamic reconfiguration (the ability to on-line service boards) and dynamic system domains (whereby the Sun Enterprise 10000 server can be logically partitioned into multiple smaller servers).

The Sun Enterprise 10000 server combines the power of Gigaplane-XB™ interconnect technologies with hardware and software based on UltraSPARC™ technology. By using the Gigaplane-XB interconnect at the core of the system, the Sun Enterprise 10000 server provides a data bandwidth of up to 12.8 GB per second. In addition to a large system memory, each Sun Enterprise 10000 processor utilizes an efficient, fully coherent, local mirrored cache to support scalable multiprocessing in an SMP environment.

The physical package of the Sun Enterprise 10000 server houses the system and control boards, the centerplane, the DC power supplies, and the cooling fans. There is also room in the system cabinet for more than 1.5 TB of disk storage. The I/O expansion cabinets can hold additional disks and tape drives.

Each Sun Enterprise 10000 server has a system service processor (SSP) to perform system management functions while monitoring the Sun Enterprise 10000 host for problems and to take corrective action when needed.

The Sun Enterprise 10000 server may be clustered for availability (failover) or scalability. Up to four nodes can be clustered.

## Specifications of the Sun Enterprise 10000 Server

Specifications	Sun Enterprise 10000 Server
<b>Packaging</b>	Rack
<b>Maximum CPUs</b>	64
<b>Clock Rate</b>	400 or 466 MHz
<b>Cache per CPU</b>	8 MB mirrored SRAM
<b>Maximum memory</b>	64 GB
<b>System bandwidth</b>	12.8 GB per second
<b>Maximum SBus slots</b>	64
<b>Maximum PCI slots</b>	32
<b>Maximum internal disk</b>	1.5 TB
<b>Maximum total disk</b>	greater than 120 TB
<b>RAS Features</b>	<ul style="list-style-type: none"> <li>• On-line hot swap of boards, power, and cooling components</li> <li>• Fault-tolerant power and cooling</li> <li>• Redundant AC line cords and breakers</li> <li>• Monitoring tools</li> <li>• Automatic system recovery</li> <li>• Dynamic Domains</li> <li>• ECC on memory and Interconnect</li> <li>• Complete parity checking</li> <li>• Environmental monitoring</li> <li>• Remote console support</li> <li>• Redundant consoles</li> <li>• Interconnect data path resiliency</li> <li>• Interconnect address path resiliency</li> <li>• Redundant "housekeeping" functions</li> <li>• Redundant option for all hardware components</li> </ul>
<b>Current Operating Environment</b>	Solaris 8 (2/02)
<b>Warranty</b>	One year (hardware and software) Four hours on site

## Performance

The Sun Enterprise 10000 architecture is designed to offer balanced system performance. Since its introduction in 1997, the Sun Enterprise 10000 server has broken more than 43 benchmark world-records.

These systems feature outstanding integer and floating-point performance, supporting up to sixty-four 400 or 466MHz with 8-MB external cache CPUs. The Gigaplane-XB interconnect runs up to 12.8 GB per second. High-speed networking is supported by 10/100-Mb Ethernet, Gigabit Ethernet, and ATM interfaces. Fast I/O capability is supported through 64-bit SBus, fast/wide SCSI, UltraSCSI, and fibre channel arbitrated loop (FC-AL) interfaces. Optionally available for selected uses is the PCI I/O bus. This can support 32-bit or 64-bit-wide adapters at a clocking frequency of 33 MHz or 66 MHz. The table below shows performance and features of Sun Enterprise 10000 server.

Performance Type	Sun Enterprise 10000 Server
SPECjbb2000 [December 2001]	230,049 (64-466MHz processors) 213,378 (64-400MHz processors)
TPC-H benchmark (3000 GB) [April 2001]	10764.70 QphH \$1250 per QphH Oracle9i Database Ent. Edition 9.0.1 (128-400MHz processors)
Sustained system bus throughput	12.8 GB per second
Memory latency	approximately 500 ns
Networking performance	Up to 622 Mb per second
I/O performance <ul style="list-style-type: none"><li>• SBus</li><li>• PCI</li></ul>	100 to 200 MB per second 132 to 528 MB per second

## Target Markets and Users for the Sun Enterprise 10000 Server

Released in 1997 and updated with improved processors, cache memory, ASICs, and I/O throughout its life, the Sun Enterprise 10000 server has sold more than 7,500 systems and systems upgrades into strategic markets chosen by Sun: Manufacturing, finance, telecommunications, government, education, health care, retail, design automation, and oil and gas.

The Sun Enterprise 10000 server remains one of the highest performing SMP system on the market. It offers enhanced scalability and performance in a large-scale, centralized, enterprise server for parallel processing of commercial and technical applications. Commercial parallel and technical applications will use the scalability of the Sun Enterprise 10000 server along with its standard operating environment and commodity hardware components. Also, technical parallel applications rely heavily on the floating point performance of the Sun Enterprise 10000 server. Commercial parallel applications include large-scale data warehousing, high-volume OLTP, server consolidation, and financial analytic applications.

OLTP customers are now facing high-volume issues associated with providing short response times and high availability for thousands of users. The Sun Enterprise 10000 server addresses these issues by providing mainframe-like RAS capabilities and the ability to handle very high transaction volumes and thousands of concurrent users with a better than two second response time.

Data warehousing customers appreciate the Sun Enterprise 10000 server's ability to provide greater levels of delivered bandwidth where fast query performance is desired. Additionally, the Sun Enterprise 10000 server's large data volume, commodity RDBMS solutions, and mission-critical, high availability make it an even more attractive solution to their needs.

### High Performance and Technical Computing Customers

High Performance and Technical Computing customers seeking high performance compute servers are typically not divided by markets or applications, but by response time, room for growth, and cost.

The Sun Enterprise 10000 system has a peak performance of up to 64 CPUs x 466 MHz x 2 flops/clock = 59.65 Gigaflops. Computationally intensive applications, where the Sun Enterprise 10000 system is preferred, are those that are highly parallelized and scalable or those where large numbers of users are accessing few particular applications. Common technical vertical markets include Mechanical and Computer Aided Engineering, Bioinformatics, Electronic Design Automation, Petroleum, Computational Finance, and Computational Chemistry.

Sun HPC solutions include high performance computing software tools that perform workload and resource management, and support the development and execution of high-performance, parallel applications. Sun HPC ClusterTools Software brings supercomputing-class power with easy-to-manage, commercially available Sun systems, all of which run standard Solaris Operating Environment and maintain binary compatibility across the entire Sun product line, from single and dual CPU systems to 106-CPU SMP systems as well as both single system environments and HPC clusters of SMP systems. For technical customers, the Sun server family is positioned as listed below. Refer to the Sun HPC ClusterTools 4 Software Just The Facts for further information.



- Sun Fire V280R server: A compact, rack-optimized workgroup server for throughput performance
- Sun Fire V880 server: A versatile server with internal storage
- Sun Fire 3800 server: A flexible server delivering exceptional performance and reliability at an affordable price.
- Sun Fire 4800 server: A powerful mid-range server with exceptional availability.
- Sun Fire 4810 server: A highly expandable mid-range server with a compact design.
- Sun Fire 6800 server: Expandable, high-performance systems with exceptional scalability features together with mission critical availability and integrated storage.
- Sun Enterprise 10000 server: A highly available server for high- performance computing which incorporates additional RAS capabilities, like dynamic system domains, dramatically increasing system availability for resource-intensive applications.
- Sun Fire 15K server: An expandable, high reliable, and manageable high-performance system with exceptional memory, internal bandwidth, and computational power capacity.

## Capacity-On-Demand System

The Sun Enterprise 10000 Capacity-On-Demand (COD) program offers lower-cost base systems with instant access to additional CPU resources, thus making easier for the customer to meet his corporate growth requirements without over-committing on hardware. The Sun Enterprise 10000 COD program has been so successful that nearly 1000 COD systems have been shipped to date and more than 3,000 COD CPUs have been activated in the field post-shipment.

The following are the target markets for the Sun Enterprise 10000 Capacity-On-Demand System:

- Customers who require very low entry priced systems with moderate room for expansion. These customers typically favor 8 by 20 systems (8 active CPUs & 12 inactive COD CPUs).
- Customers who require a moderately priced system with significant room for expansion. These customers typically favor  $\geq 20$  by 64 systems.

The Sun Enterprise 10000 Capacity-On-Demand server allows customers to purchase lower-priced Sun Enterprise 10000 configurations, and then, by simply purchasing right-to-use licenses, easily add more CPU resources as needed. This lets customers effectively amortize the price of the Sun Enterprise 10000 infrastructure (crossbar interconnect, centerplane, RAS features, dynamic system domains, System Service Processor features, etc.) over the first 20 CPUs.

Sun Enterprise 10000 Capacity-On-Demand customers will be required to install Sun Enterprise 10000 Capacity-on-Demand software on their Sun Enterprise 10000 Server Service Processor. The Sun Enterprise 10000 Capacity-on-Demand software adds functionality to the Sun Enterprise 10000 Server Service Processor to facilitate management of CPU licensing. The Sun Enterprise 10000 Capacity-on-Demand software monitors CPU usage on the Sun Enterprise 10000 server and compares the total number of CPUs that are in use with the number of valid licenses contained in the license file. License violations will result in warning messages reported and logged on the Sun Enterprise 10000 Server Service Processor.



## Markets and Applications

The following chart illustrates the key markets and applications for the Sun Enterprise 10000.

Product	Positioning	Applications	Markets
<b>Sun Enterprise 10000 Server</b>	Enhanced scalability, availability, and performance in a large-scale, mission-critical, centralized, enterprise server for commercial and technical parallel processing applications.	<ul style="list-style-type: none"> <li>• Data warehousing</li> <li>• Data mining</li> <li>• Business applications</li> <li>• Customer management systems</li> <li>• High-volume OLTP</li> <li>• Engineering</li> <li>• Design automation</li> <li>• Analytics/commercial compute intensive</li> <li>• Inter/Intranet</li> <li>• LAN consolidation</li> </ul>	<ul style="list-style-type: none"> <li>• Manufacturing</li> <li>• Finance</li> <li>• Telecommunications</li> <li>• Government</li> <li>• Education</li> <li>• Health care</li> <li>• Retail</li> <li>• Oil and gas</li> <li>• Pharmaceuticals</li> <li>• Chemical</li> <li>• Internet commerce</li> </ul>

## Positioning With the Sun Fire 15K

With the release of the successor, high-end data center server, the Sun Fire 15K, the Sun Enterprise 10000 server fills a new price/performance niche between the Sun Fire 6800 and Sun Fire 15K. In addition to the price/performance trade-off, Customers will continue to purchase the Sun Enterprise 10000 for other reasons:

- Need to run on Solaris 2.6, 7 or 8 (<10/01)
- Need to use DR, COD or IDN today
- Need smaller total footprint
- Datacenter is not ready or facilitized for the Sun Fire 15K
- Need internally qualified, "production-proven" server capacity immediately

# Selling Highlights

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## Channels and Support

The Sun Enterprise™ 10000 server uses the same selling channels as the rest of the Sun server line: direct and indirect worldwide. The principal support provider is Sun Enterprise Services, which uses all their standard mechanisms for the product. The Sun Enterprise 10000 server warranty level is one year for the hardware and software at the SunSpectrum Gold<sup>SM</sup> service level. Installation of the ServerStart<sup>SM</sup> system is included in the purchase price.

## Key Selling Factors

- **Expandability**

Sun Enterprise servers expand from entry-level configurations to system configurations that can handle terabytes of data and thousands of users. The Sun Enterprise 10000 server is configured from 1 to 64 CPUs, 2 GB to 64 GB of memory, and to over 120 TB of on-line disk storage. There are no slot trade-offs between processors, memory and I/O.

- **Scalability**

The Sun Enterprise 10000 server is highly modular. Customers can easily configure these systems to meet their application and performance requirements by simply adding UltraSPARC™ modules, memory, or I/O boards. The high-throughput Gigaplane-XB™ interconnect technologies and I/O architecture eliminates system bottlenecks and provides balanced system performance, even in systems with the maximum number of UltraSPARC modules and I/O devices.

- **Investment protection**

All of the processor modules, DIMMs, and SBus boards used in the Sun Enterprise 3500, 4500, 5500, and 6500 servers are common to the Sun Enterprise 10000 server. Therefore, when upgrading to the larger Sun Enterprise 10000 server, customers can move these components from the existing chassis to the new chassis, protecting their investment. The Sun Enterprise 10000 server uses the same peripherals in the same expansion cabinets as the rest of the family.

- **Solaris™ Operating Environment applications**

The Sun Enterprise 10000 runs the standard Solaris Operating Environment. Therefore all 12000-plus Solaris applications are binary compatible and will run on the Sun Enterprise 10000 without any conversion.

- **Upgrade programs**

There are trade-in programs available to move customers to the Sun Enterprise 10000 server from Sun's other servers and from selected servers from Sun's competitors or from the Sun Enterprise 10000 server to the new Sun Fire 15K server.

- **Upgradability**

The modular design of the Sun Enterprise 10000 server means easy upgrading to new technologies and higher performance. The Sun Enterprise 10000 server will support future generations of disk arrays, tape devices, host bus adapter cards, and networking interface cards.



- **Reliability, availability and serviceability features that result in uptimes greater than 99.95 percent**
  - No single points of hardware failure: No single component will prevent a properly configured Sun Enterprise 10000 server from automatically reconfiguring itself to resume execution after a failure.
    - Achieved through a combination of redundancy and alternate pathing architecture.
  - Error correction interconnect: Data and address buses are protected by a combination of error correcting codes and parity.
  - Dynamic system domains: Groups of system boards can be arranged in multiprocessor system domains that can run independent copies of the Solaris Operating Environment concurrently.
    - Each system domain is completely isolated from all software errors, and most hardware failures that might occur in another system domain.
  - Dynamic reconfiguration: Enables the system administrator to add, remove, or replace system components or create/remove system domains on line without disturbing production usage.
  - Hot swapping: Power supplies, fans, and most board-level system components can be exchanged while “hot”; that is, while the system is on line and in operation.
- **Manageability**

Using Network Console (netcon) over the network, system administrators can remotely login to the SSP to control the Sun Enterprise 10000 server.

# Enabling Technology

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## Technology

Four principal areas of technology used in the design of the Sun Enterprise™ 10000 server give Sun a significant competitive advantage. They are:

- **The UltraSPARC™ microprocessor family**

This is a high-performance 64-bit processor with features that allow workstations and servers to compute fast.

- **Custom ASICs**

These represent a huge investment in time and money. The benefits compared to discrete logic are: faster internal speed, improvements in system availability, and lower manufacturing cost. The Sun Enterprise 10000 server has three ASICs common to Sun's other servers (the SPARC™ microprocessor, the data buffer on the processor module, and the SBus I/O chip), as well as seven designs that are custom to the product.

- **Enormous system bandwidth**

The Sun Enterprise 10000 server uses a crossbar router instead of a bus to interconnect processors, memory and I/O. System scalability and low latency are a function of having sufficient internal bandwidth. A router's bandwidth scales up as system hardware is added which is exactly what one wants. The crossbar router is packaged on the centerplane. Its manufacture requires use of state of the art manufacturing processes and procedures.

- **The Solaris™ Operating Environment**

Without a stable and well-proven operating system, the best hardware in the world is useless. The Solaris Operating Environment has been enhanced over the past few years to be able to address very large memories and to scale up the 64 processors—both important features for the Sun Enterprise 10000 server.

# System Architecture

## Introduction

The Sun Enterprise™ 10000 server is a shared-memory SMP computer that can be configured with up to 64 UltraSPARC™ processors, 64 SBus boards (or 32 PCI boards), and 64 GB of on-line memory. The Sun Enterprise 10000 server is comprised of system boards, a centerplane, centerplane support boards, control boards, peripherals and power and cooling subsystems. These components and their relationships are illustrated in Figure 2 below and their functions are listed in the following table.

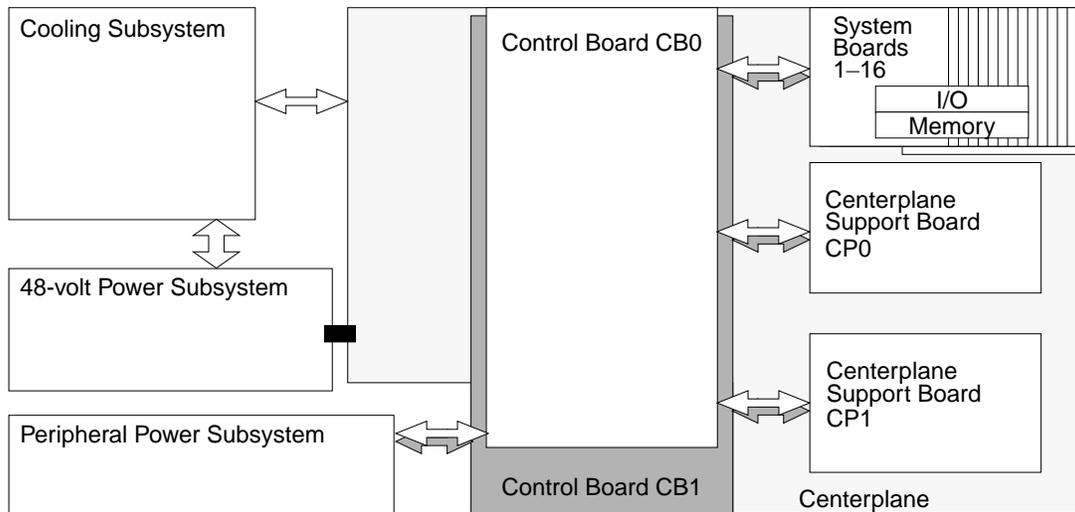


Figure 2. System block diagram

## System Components

Component	Function	Quantity
System board	Contains processors, memory, I/O subsystem, SBus boards, and power converters	Up to 16
Processor modules	Mezzanine boards that contain the UltraSPARC processor and support chips	Up to 64
Memory	Removable DIMMs	Up to 64GB
I/O	Removable SBus or PCI boards	Up to 64
Control board	Controls the system's JTAG, clock, fan, power, serial interface, and Ethernet interface functions	2
Centerplane	Contains address and data interconnect to all system boards	1
Centerplane support board	Provides the centerplane's JTAG, clock, and control functions	2
AC power controller	Receives 220 VAC, monitors it, and passes it to the power supplies	4
Power supply	Converts AC power to DC	8
Circuit breaker panel	Interrupts power to various components within the system	1
19-inch rack-mount power sequencer	Receives 220 VAC, monitors it, and passes it to the peripherals. This unit can be operated in either master or slave mode allowing the on/off function to be controlled by another power sequence.	1 or more
Remote Power Control Unit	Connects the remote control line between two control boards and passes it to one or more power sequencer units	up to 5
Fan centerplane	Provides power to the pluggable fan trays	2
Fan Trays	Contains two fans for system cooling	16

## System Interconnect

The Sun Enterprise 10000 server uses the Gigaplane-XB™ interconnect which adheres to the Ultra™ port architecture (UPA) standard. A combination of improvements have been utilized to increase interconnect bandwidth over previous generation bus-based systems. This amount of bandwidth is enough to keep memory latency nearly constant for data-intensive processing on full 64-processor configurations—with some headroom left over for faster processors in the future.

The following design elements increase system throughput and reduce memory latency:

- **The Gigaplane-XB interconnect uses separate address and data lines**

The UPA defines a separate address and data interconnect. Usually on a bus-based system, only about 70 percent of the wire bandwidth is available for data, with the rest being used for address and control. Separating the functions lets both addresses and data each have 100 percent of the wire bandwidths on their separate paths, and lets the wire topology of each function be optimized differently. Snoop addresses need to be broadcast simultaneously to all the boards, while data packets can be sent point-to-point.

Figure 3 illustrates how the Gigaplane-XB interconnect is used to transfer four 16-byte blocks of data from the memory of one system board to a single 64-byte block of cache memory on the processor module of another system board. In the Sun Enterprise 10000 server, each system board is connected to all other system boards via the Gigaplane-XB interconnect.

- **The Gigaplane-XB interconnect datapath width is 16 bytes.**

	Sun Enterprise 10000 Server	Sun Enterprise 5500 and 6500
Memory data bus	576 bits	576 bits
Data bus	144 bits per board	288 bits
CPU data bus	144 bits	144 bits

- **Sixteen data paths**

To meet the Sun Enterprise 10000 server's bandwidth goals, the 16 data paths allow a separate connection to each board.

- **The Sun Enterprise 10000 server contains four snoop paths**

Sixteen data paths require sufficient performance on the address bus to achieve maximum system performance. The Sun Enterprise 10000 server uses four snoop paths to supply enough address bandwidth to match the data bandwidth.

- **Point-to-point wires versus multi-drop buses**

In a multi-drop bus, all the processors, I/O devices, and memory modules attach to a single set of wires. As the number of connections rises, the clock rate must be lowered to maintain reliability in the face of increasing electrical load. A failure of any component on the bus may bring down the entire bus, not just the connections to the failing component.

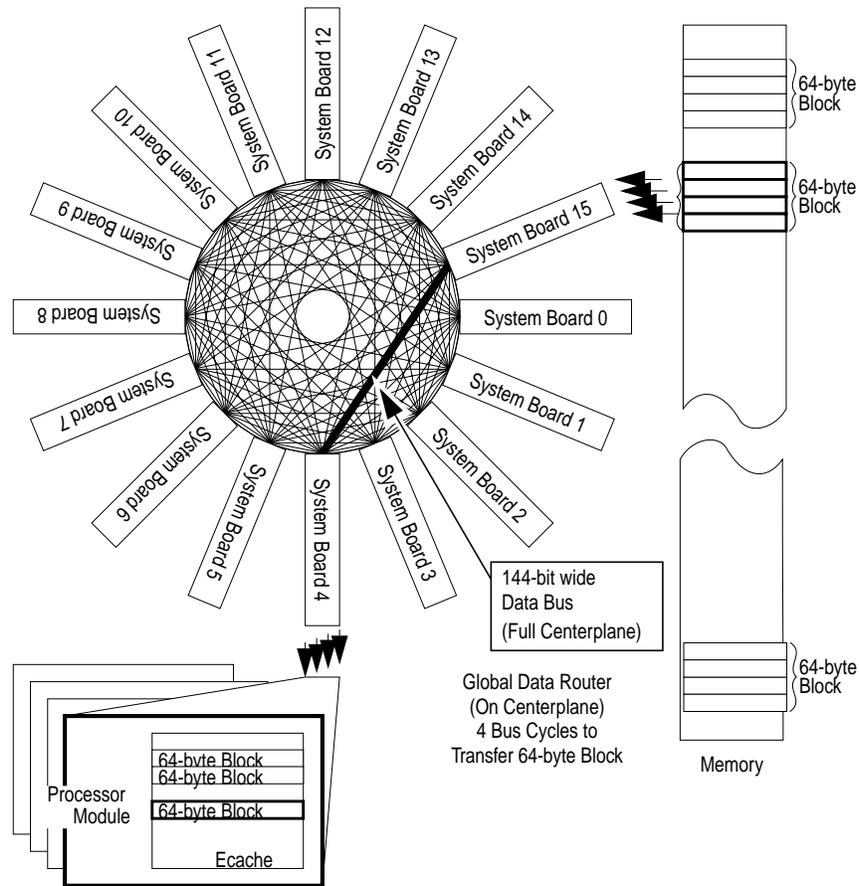
- **Multistage address and data routers**

The Sun Enterprise 10000 server has a two-stage routing topology based upon the physical board partitioning. Local many-to-one routers gather on-board requests, and connect them to one off-board port. A global-data crossbar connects one port from each board together. Four point-to-point address buses broadcast addresses to all the boards.

- **The system clock rate**

The UltraSPARC-II processor requires the system clock rate and the processor clock rate be an integer multiple. The Sun Enterprise 10000 server uses an 100-MHz system clock speed for 400-MHz processors (a 4X ratio) and an 93.2-MHz system clock speed for 466-MHz processors (a 5X ratio).





**Figure 3.** Data routing

Figure 4 shows the system board architecture. Data routing in the Sun Enterprise 10000 server is conducted at two levels: global and local. The global data router (located on the centerplane) is an 18-byte wide, 16 x 16 crossbar that steers data packets between the 16 system boards. With the 16 x 16 crossbar, any port can be connected to any other throughout the centerplane. Of the 18 bytes, 16 are for data and the remaining 2 bytes are for error correction.

Address routing on the Sun Enterprise 10000 server is implemented over a separate set of four global address buses. Although called “address buses” to convey that addresses are broadcast, the implementation is as a point-to-point router. The significance of this is that routers have more inherent reliability than a bus. The buses are 48 bits wide including error correcting code bits. Each bus is independent, meaning that there can be four distinct address transfers simultaneously. An address transfer takes two clock cycles, equivalent to a snoop rate of 167 million snoops per second on all four address buses. Should an uncorrectable failure occur on an address bus, degraded operation is possible using the remaining buses.

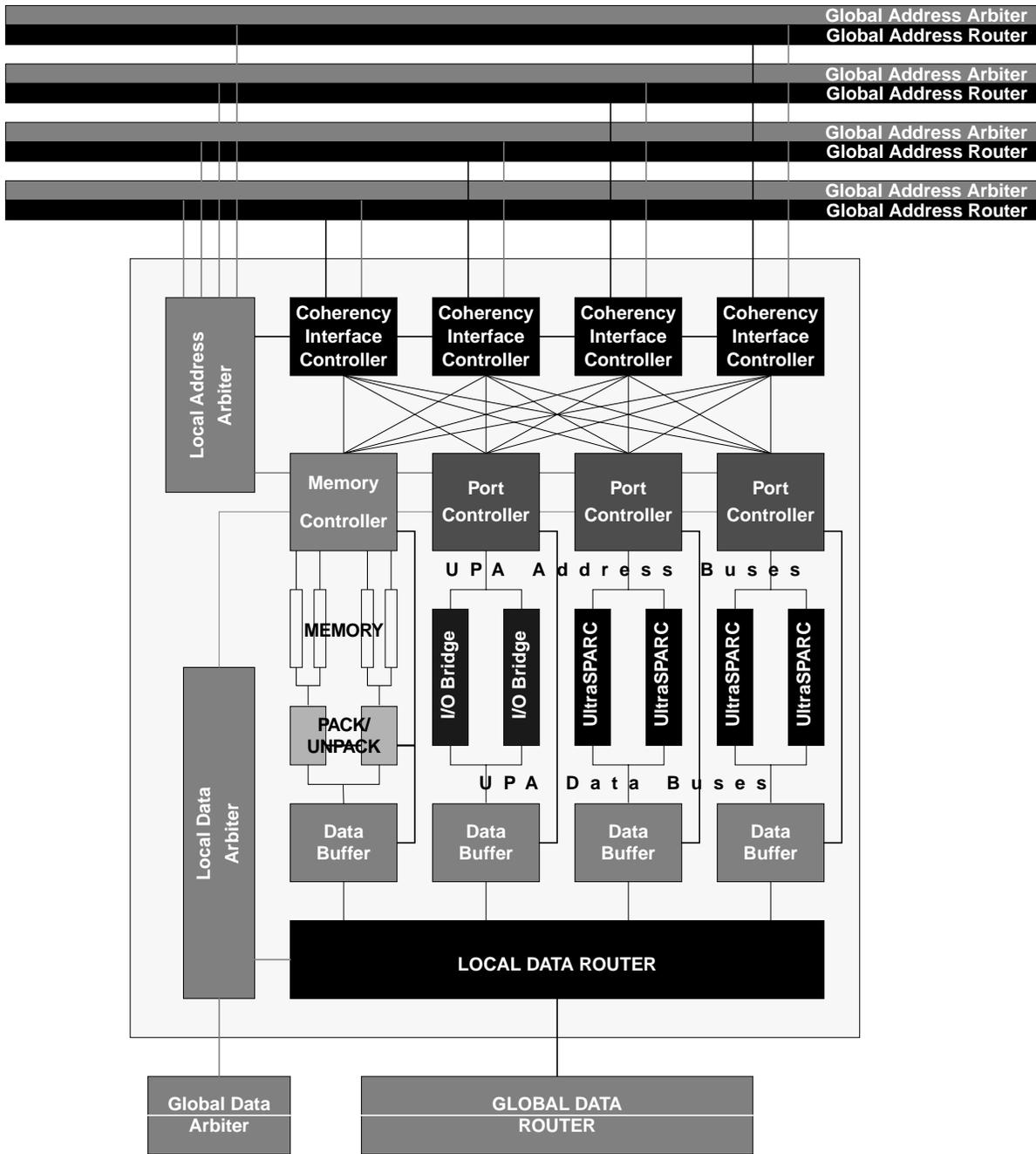


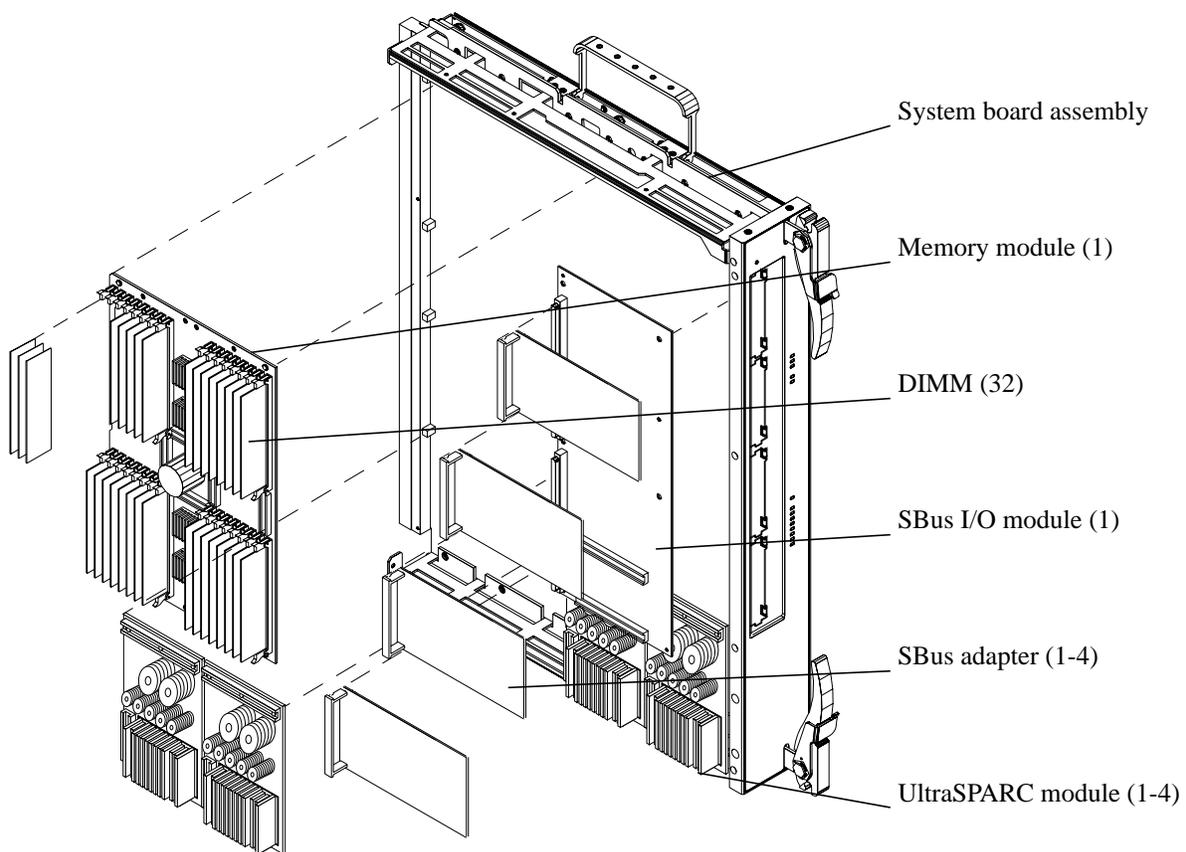
Figure 4. System board architecture

## System Boards (with SBus I/O)

The Sun Enterprise 10000 server consists of multiple system boards (refer to Figure 5) interconnected by a centerplane. A single system cabinet holds up to 16 of these system boards, each of which can be independently configured with processors, memory, and I/O channels, as follows:

- One-to-four 400-MHz or 466-MHz UltraSPARC microprocessor modules per system board. Processor clock frequencies may not be mixed within any one Sun Enterprise 10000 server.
- Four memory banks with a capacity of up to 4 GB per system board (64 GB per system). Each memory bank consists of eight high density (128-Mb) DIMMs. System boards can have just two banks of DIMMs giving 2 GB of storage.
- Two SBuses or PCI modules per system board with SBus supporting 4 slots per system board and PCI supporting 2 slots per system board.

The mechanical assembly of the system board is as shown in Figure 5.



**Figure 5.** System board assembly (with SBus I/O)

The CPU/memory boards have temperature sensors located under the UltraSPARC modules. This allows the actual temperature of individual boards to be monitored through the SSP's GUI called Hostview.

## UltraSPARC™ Processor Module

The Sun Enterprise 10000 server houses up to 64 UltraSPARC processors which can execute four instructions per clock cycle. The processor mounts on a small daughterboard, the UltraSPARC module, which also houses the 8-MB, second-level mirrored cache and the UltraSPARC data buffer (UDB) circuitry. The second-level cache handles cache misses from the processor's on-chip data cache memory. In total, the architectural elements on the processor chip and the module support the Sun Enterprise 10000 server's ability to execute two floating point instructions, add or subtract, and two integer instructions during a single clock cycle.

## Memory Subsystem

Large-scale systems must provide sufficient memory capacity to sustain high performance from the processors and I/O channels. Additionally, memory must be quickly accessible in order to avoid interfering with other subsystem activities. Finally, the large concentration of data in today's data center systems and production environments necessitates a highly reliable design. The Sun Enterprise 10000 server is designed to meet all of these requirements. Using currently-available 128-Mbit DRAM chips, a fully configured system offers 64 GB of system memory.

The memory in the Sun Enterprise 10000 server is located on the memory board mounted as a daughter board on the system board. Up to 4 GB of RAM can be installed on each system board. The memory subsystem in the Sun Enterprise 10000 server is designed to offer fast, reliable data access.

- The memory controller manages four banks of memory on each memory module. Each bank of memory consists of eight standard JEDEC DIMM modules, implemented in 3.3v CMOS.
- The Sun Enterprise 10000 server supports up to eight way memory interleave, but normally only four-way interleaving is used. Going beyond this would not allow dynamic reconfiguration to be used.
- The interleaved memory banks can be different sizes on different system boards.
- The Solaris Operating Environment has been enhanced to provide scalability consistent with this memory capacity.

The entire memory data path is protected by ECC mechanisms, and DIMM organization is specifically designed so each DRAM chip contributes only one bit to one half-byte of data. In this way, the failure of a DRAM chip will result in correctable memory errors in four successive words.

## I/O Subsystem, Devices and Networking

### SBus I/O

The Sun Enterprise 10000 I/O module is a mezzanine card that plugs into the system board and connects the UPA to a pair of SBuses. Each of these SBuses can in turn be populated with one or two single-width, SBus adapters, or one double-width.

- Incrementally expandable I/O by configuring up to 64 SBus slots on 32 independent buses
- Each SBus interface includes its own memory management unit to translate between virtual and physical addresses
- SBus supports 32-bit or 64-bit data transfers

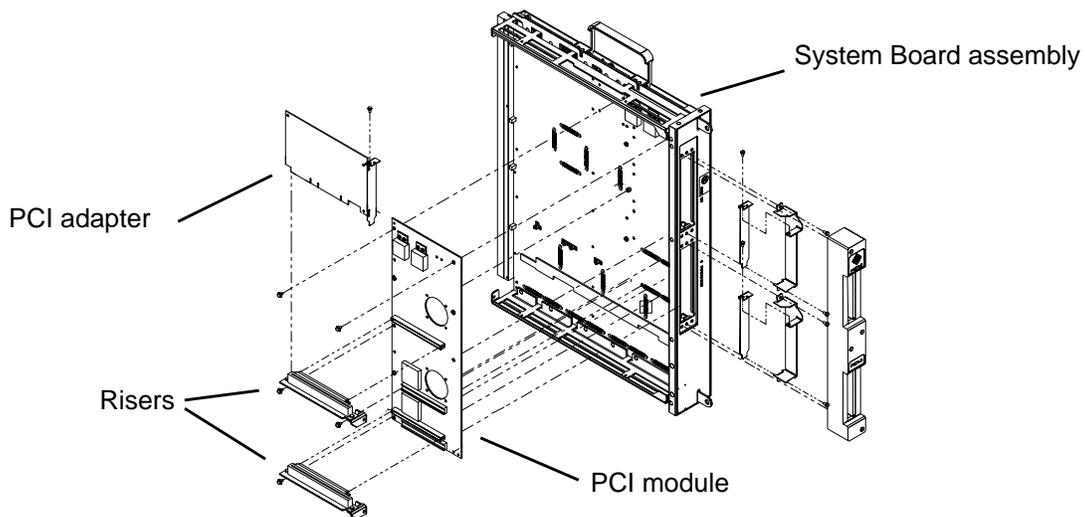


- The following SBus SCSI, UltraSCSI, and fiber host bus adapters are available on the Sun Enterprise 10000 server:
  - SCSI, Fast/Wide, Single-ended
  - Ultra SCSI, Fast/Wide, Differential
  - Fiber Channel Controller
  - Dual Fiber Channel Network Adapter
- The following SBus network adapters and combo-cards are available on the Sun Enterprise 10000 server:
  - SunSwift 100Mb-Ethernet/FW SCSI
  - Quad Fast Ethernet
  - SunFastEthernet 2.0 10/100
  - Cluster Interconnect SCI/S
  - Gigabit Ethernet Adapter 2.0
  - Serial Sync Adapter HSI
- Legacy SBus adapters that have reached end of life will be supported on the installed base. These include FDDI, ATM, ISDM, Token Ring, and High-speed, serial interface adapters.

## PCI I/O

PCI is an open I/O standard to which Sun products have now moved. The main advantage of using PCI, in a server application, is the higher speed of PCI when compared to SBus. PCI adapters are available with 32-bit or 64-bit data paths and run at a clock frequency of 33 MHz or 66 MHz.

System Boards for the Sun Enterprise 10000 server are available with a PCI module in place of the standard SBus module. This PCI module has two 66-MHz buses and each can accommodate one PCI adapter. (These adapters are the 6.5-inch cards, not the 11-inch cards).



**Figure 6.** System Board with PCI module

The figure above shows how the PCI module is mounted to a system board. The “risers” allow the PCI adapters to be mounted in the same plane as the PCI module.

- The following PCI host bus adapters are available on the Sun Enterprise 10000 server:
  - Dual Fiber Channel Network Adapter
  - Single Fiber Channel Network Adapter
- The following PCI network adapters are currently available on the Sun Enterprise 10000 server:
  - Sun HIPPI/P 1.1
  - Sun Enterprise Systems Interface (ESCON)
  - Gigabit Ethernet 2.0
  - SunATM 4.0/5.0-155Mb Fiber
  - SunATM 4.0/5.0-155Mb UTP
  - SunATM 4.0/5.0-622Mb Fiber

Due to the conversion to PCI technology, new adapters are being created and qualified regularly on the Sun Enterprise 10000 server.

## Storage

- The following Sun StorEdge products are also available for the Sun Enterprise 10000 server. These include:
  - Sun StorEdge 9960 & 9910
  - Sun StorEdge 3900 & 6900
  - Sun StorEdge T3
  - Sun StorEdge A5200
  - Sun StorEdge A3500
  - Sun StorEdge D1000
  - Netra™ st D130
  - StorEdge S1
  - Sun StorEdge UniPack disks (mounted in the system cabinet only) for booting the Solaris Operating Environment
  - Sun StorEdge Tape systems

## Reliability, Availability, and Serviceability (RAS)

### Strategy

The Sun Enterprise 10000 server offers excellent reliability, availability, and serviceability (RAS). These RAS features result in the Sun Enterprise system 10000 being the highest fault-resistant systems in its class. Customers want the highest possible uptime. Reliability and maintainability are features designed into the system for delivering the greatest possible uptime (“availability”).

The following is a list of RAS features found on the Sun Enterprise 10000 server.

### Reliability

- Current-sharing power circuitry supports redundant power capability.
- ECC-protected data throughout the system increases data integrity.
- Parity-protected address and control signals increase the integrity of those signals.
- All I/O cables have a positive lock mechanism and a strain-relief support.
- Built-in, self-test logic in all the ASICs applies pseudo-random patterns at system clock rate providing at least 80 percent single-stuck-at-fault coverage of combinatorial logic.
- The power-on self-test (POST), controlled from the SSP, tests each logic block first in isolation, then with progressively more and more of the system. Failing components are electrically isolated from the centerplane. The result is that the system is booted only with logic blocks that have passed this self-test and which should operate without error.
- All Sun Enterprise 10000 server ASICs have *paranoid* logic which checks for anomalous conditions indicating an error has occurred, such as queue overflows, invalid internal states, and missing events, rather than let the error propagate and become corrupted data or access timeouts that would be difficult to correlate with the actual failure.
- The Sun Enterprise 10000 server uses a highly reliable distributed power system. Each system, control, or centerplane support board within the system has DC-to-DC converters for that board only, with multiple converters for each voltage.
- The internal temperature of the system is monitored at key locations as a fail-safe mechanism. If an over-temperature threshold is reached on a system board, that board is excluded from its domain following an auto-reboot. Other domains (if any) do not require a reboot.
- Tachometers detect that the cooling system is moving air into the system. A failed fan will trigger the SSP to log a warning message.
- Additional sensing is performed by the Sun Enterprise 10000 server in order to enhance the reliability of the system by allowing constant “health” checks. DC voltages are monitored at key points within the Sun Enterprise 10000 server and DC current from each power supply is monitored and reported to the SSP.
- The reset signals in the Sun Enterprise 10000 server are sequenced with the DC power levels in order to guarantee stability of voltage throughout the cabinet prior to removing reset and allowing normal operation of any of the Sun Enterprise 10000 server’s logic.

## Availability

- Sophisticated system diagnostics minimize downtime.
- Multiple UltraSPARC modules provide redundancy.
- Fan trays each have two fans. Should one of a pair fail, the survivor provides sufficient cooling. A warning message is logged.
- Remote administration control allows remote reboots and power-cycling.
- Redundant components can be added to augment the system's already high reliability and availability. There are no components in the system which cannot be configured redundantly if the customer so desires.
- Intelligent SSP identifies system and component errors and then takes corrective action.
- During an automatic reboot, the system uses power-on self-test (POST) to automatically reconfigure around a hard failure prior to bringing the system up.
- Each side of the centerplane has its own 48V distribution bus, and each system board develops its own low-voltage supplies locally with on-board regulators. Should a regulator fail, the system adapts automatically by reconfiguring itself to exclude the offending board.
- The base Sun Enterprise 10000 server uses three line cords, each fed by a separate 220V, single-phase, 50/60-Hz, AC circuit, to deliver the required input power to the bulk DC supplies. A fourth discrete line cord serves the system's I/O space. This level of redundancy ensures against a system-wide power loss and also reduces the current through any one circuit.
- Multiple operating systems and/or diagnostics can be co-hosted by the hardware using several, independent system domains. This keeps development work isolated from production, thereby improving the production availability.
- For even higher availability, a pair of Sun Enterprise 10000 servers can be configured in a redundant fashion so, should the primary system fail, processing continues with the secondary Sun Enterprise 10000 server. All this is under control of Sun Cluster failover software that effects a rapid and seamless switchover from one machine to the other.
- The Solaris Operating Environment panics and hangs result in an auto-boot of the system.
- In the event of a centerplane data crossbar component failure, one half of the crossbar is disabled and the system will again be operational following a reboot. This holds true for the address router as well.
- Error correction on the interconnect ensures that transient errors do not affect availability.

## Serviceability

- Modular system design makes it easy to replace failed components.
- Most hardware maintenance can be performed without taking the system off line; only the components actually being worked on are taken out of service. This uses the Sun Enterprise 10000 server's dynamic reconfiguration (DR) and hot-swap capabilities.
- The ability of Hostview to notify a system administrator of a failure allows the system administrator to know immediately which components have failed and need service.
- All centerplane connections are point-to-point making it possible to logically isolate system boards by dynamically reconfiguring the system.
- Improved remote administration control allows users to reboot and power-cycle in a "lights out" environment.
- SunVTS™ software (Sun Validation Test Suite) allows users to perform UNIX® system-level diagnostics.
- The DR capability allows concurrent servicing of the system. It also allows system boards to be upgraded with different processors, more memory or have SBus cards added—all without materially disturbing a production system.
- When uncorrectable errors occur, information about the error is saved to help with further isolation.
- The Sun Enterprise 10000 server has extensive error logging capabilities
- Connectors are keyed so that boards may not be plugged in upside down
- Special tools are *not* required to access the inside of the system for changing of field-replaceable units.
- No jumpers are required for configuration of the Sun Enterprise 10000 server.
- Air filters are replaceable while the system is operational.
- The Sun Enterprise 10000 server uses a distributed DC power system with each system board having its own power supply.
- This type of power system allows each system board to be powered on/off individually.
- All ASICs that interface to the centerplane have a loop-back mode, which allows a system board to be verified before it is dynamically reconfigured into the system.

## RAS Summary Table

Reliability Features	Availability Features	Serviceability Features
ECC-protected data <ul style="list-style-type: none"> <li>• Parity-protected address and control signals</li> <li>• Current-sharing power circuitry</li> <li>• Environment monitors and controls</li> <li>• Connectors, cables, and guides all designed for robustness</li> <li>• Point-to-point routers to maintain bus integrity over multi-drop buses.</li> </ul>	Redundant UltraSPARC modules <ul style="list-style-type: none"> <li>• Redundant CPU/memory boards</li> <li>• Redundant power supplies</li> <li>• Twin fans in each cooling unit</li> <li>• Dual disk array host interfaces</li> <li>• Automatic reboot</li> <li>• Multiple operating system support using dynamic system domains</li> <li>• Compatible with commercial battery-backup systems</li> <li>• Fault-tolerant AC power system</li> <li>• Four independent address buses</li> <li>• Sixteen-by-sixteen data interconnect with two independent routers</li> </ul>	Modular system design <ul style="list-style-type: none"> <li>• Hot-swap system boards</li> <li>• Hot-swap control boards</li> <li>• Remote booting and power-cycling</li> <li>• Hot-swap disk drives</li> <li>• Hot-swap power/cooling modules</li> <li>• SunVTS software</li> <li>• Several internal self-tests for error reporting</li> <li>• Dynamic reconfiguration for trouble isolation and repair on line</li> </ul>

### Replacing or Upgrading Concurrently Serviceable Components

Concurrently serviceable components, those that can be removed and replaced while the system is running, include all field-replaceable units except the fan centerplane and system centerplane. Concurrently serviceable components must be configured for redundancy prior to removal to prevent system interruption. This can be done while the system is running.

If an UltraSPARC module, DIMM, SBus board, memory module, I/O module, system board, control board, centerplane support board, power supply, or fan fails, the system attempts to recover without any service interruption. After the failed CPU/memory or I/O board is deconfigured from the system, the failed board may be removed, replaced, and reconfigured into the system, again, while the system is on line. This uses the dynamic reconfiguration capability of the Sun Enterprise 10000 server.

## Service and Support

The linchpin to the Sun Enterprise 10000's high reliability, availability, and serviceability is Sun's global Service and Support. The following table illustrates the SunSpectrum<sup>SM</sup> features and warranties offered on the Sun Enterprise 10000 server.

### SunSpectrum

The SunSpectrum program is an innovative and flexible service offering that allows customers to choose the level of service best suited to their needs ranging from mission-critical support for maximum solution availability to backup assistance for self-support customers. The SunSpectrum program provides a simple pricing structure in which a single fee covers support for an entire system, including related hardware and peripherals, the Solaris Operating Environment software, and telephone support for Sun software packages. The majority of Sun customers today take advantage of the SunSpectrum program, underscoring the value it represents. Customers should check with their local Sun Enterprise Services representative for program/feature variance and availability in their area.

<b>FEATURE</b>	<b>SUNSPECTRUM PLATINUM<sup>SM</sup> Mission-Critical Support</b>	<b>SUNSPECTRUM GOLD<sup>SM</sup> Business-Critical Support</b>
<b>Account Services</b>		
Skills assessment	Yes	
Skills analysis & employee development planning	Yes	
System check	Yes	
Account support plan	Yes	Yes
Account support reviews	Quarterly	Semi-annual
Account support management	Yes	
<b>System Monitoring</b>		
Event monitoring & management service	Yes	Yes
Asset reporting & self-monitoring	Yes	Yes
<b>Technical Support &amp; Hardware Service</b>		
Sun Vendor Integration Program (SunVIP <sup>SM</sup> )	Yes	Yes
Mission-critical escalation support	Yes	Yes
System activity log	Yes	Yes
On-site service coverage	24/7	8 am-8 pm M-F
On-site service response	2 hrs	4 hrs
Customer-defined priority	Yes	Yes
Parts replacement	By Sun	By Sun
Field change orders	Yes	Yes
Online & telephone technical support	24/7	24/7
Online & telephone support response	Next Available Engineer	Next Available Engineer
Remote diagnostic analysis	Yes	Yes
Online & telephone support response	Yes	Yes



<b>Online Resources</b>		
Online Support Center access	Yes	Yes
SunSolve <sup>SM</sup> Online	Yes	Yes
<b>Software</b>		
Solaris Operating Environment releases	Yes	Yes
Bundled & embedded software	Yes	Yes
Software patch access	Yes	Yes
SunSpectrum InfoExpress <sup>TM</sup> bulletins	Yes	Yes

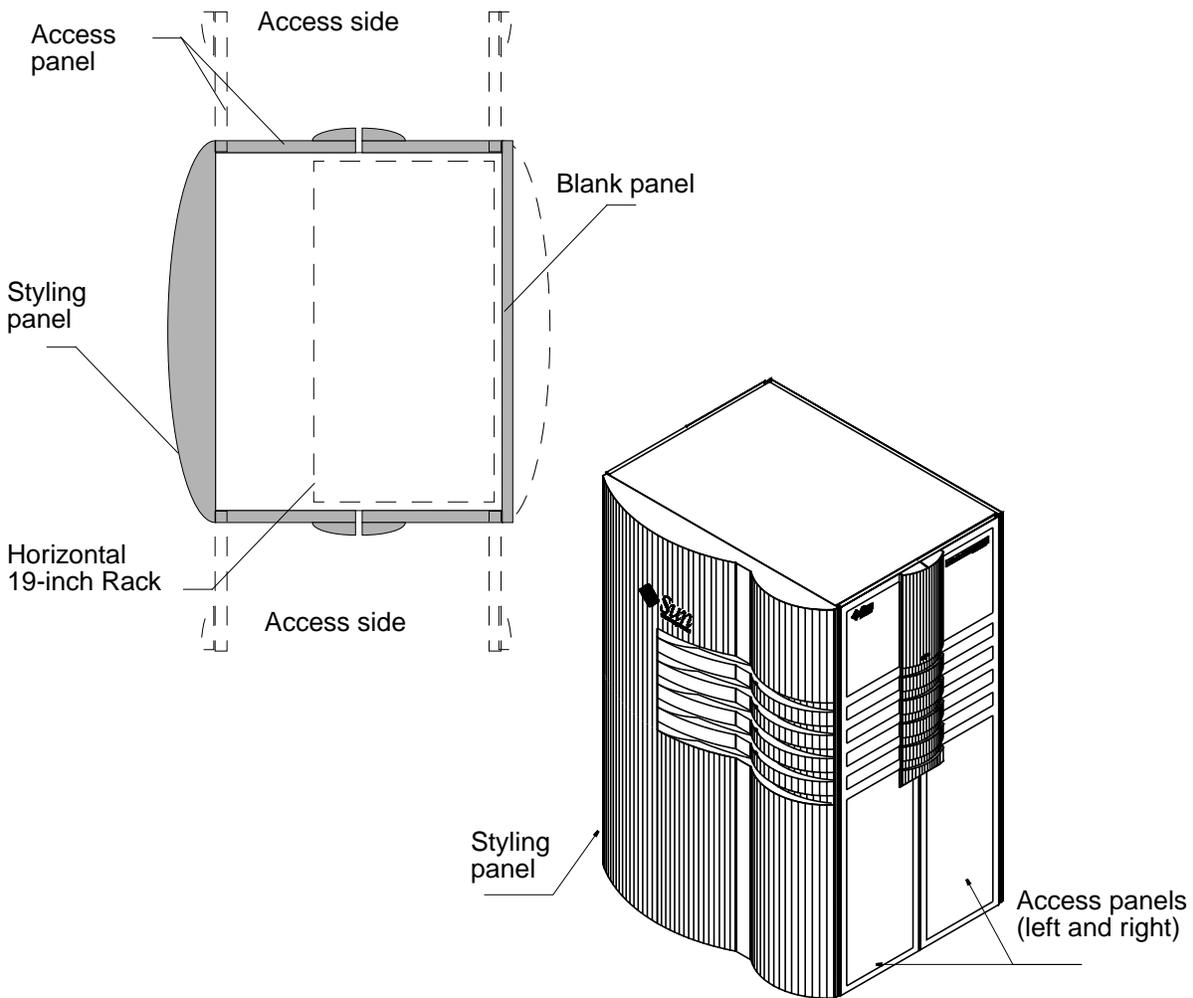
## Warranty

The table below describes the Sun Enterprise 10000 server warranties (warranties may vary in different countries).

Hardware	1 year
Software	1 year
Telephone Assistance	7x24
On-site Assistance	8x8 with four hour response, M-F
Installation	E10000 ServerStart Installation

## Mechanical Packaging

### Sun Enterprise 10000 Server Cabinet



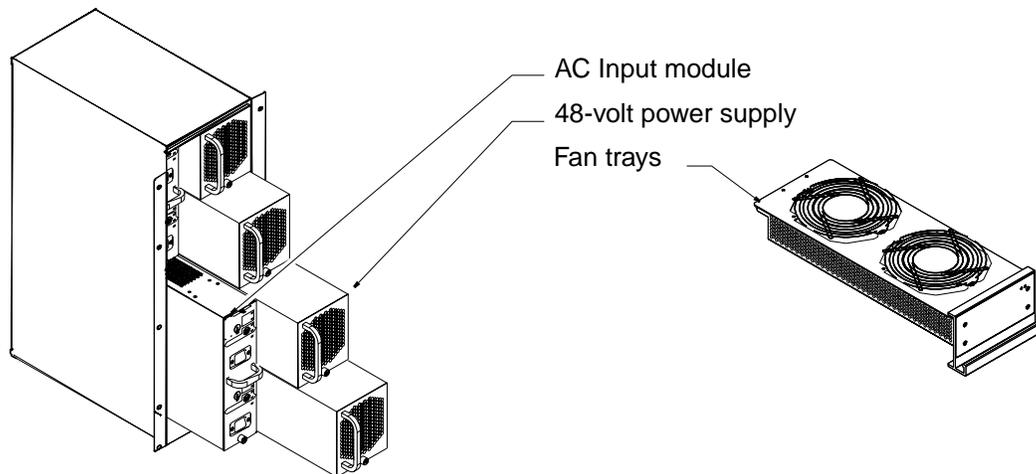
**Figure 1.** Sun Enterprise 10000 cabinet

- The Sun Enterprise 10000 server enclosure is a 70-inch high, 39-inch wide, 50-inch deep, data center cabinet when viewed from the styling panel side.
- Inside the cabinet is a 18-slot card cage for system boards, control boards, and centerplane support boards.
- Directly above and below the card cage are the fan trays which draw air up through the cabinet and filters to exhaust out the top. These trays each include two fans.
- Above the top fan trays and over the control board are two power shelves. Each power shelf contains one AC input unit and two power supplies for a total of four AC input units and eight power supplies.
- Above the top fan trays, in both the primary and secondary sides of the cabinet, is the peripheral area which can be configured with up to 5U of standard RETMA, rack mountable components. In addition to peripheral trays, this area contains one or two rack mountable AC power sequencer units and remote power control module.

- The system cabinet can also be configured with the Netra T1-based SSP package and/or the following boot storage: Up to two StorEdge D1000 array disk trays; or up to 14 Netra st D130s or StorEdge S1s; or up to 16 StorEdge UniPack disks.
- The peripheral area also houses one or two Ethernet hubs used for communicating with the SSP
- A hinged access door covers the left and right sides of the primary and secondary side of the cabinet. They can be opened without the use of tools and offer easy access to internal components.
- A modular styling panel is installed on one end, with a blank panel on the other end. I/O expansion cabinets are placed adjacent to the blank panel.

## Power and Cooling

The Sun Enterprise 10000 server provides a highly configurable power and cooling system designed for N+1 system redundancy (where “N” is the minimum number of either the power supplies or fan trays required). Both the power supplies and the fan trays can be replaced or upgraded while the system is running. Power is distributed such that power supply failures, while noted by the system, do not affect the system’s operation.



**Figure 2.** Hot-swappable power and cooling components

## 48-volt Power Subsystem

The Sun Enterprise 10000 server power system is distributed and consists of three functional pieces: Universal 220 VAC-to-48 DC volt, front-end power supplies, 48-volt filter, distribution and protection box, centerplane, and system logic boards.

- Safe, “extra-low voltage” (ELV), 48-volt distribution system
- No individual load is capable of keeping the system from operation
- Modular design makes troubleshooting easier while providing redundant power in the event of a failure
- All power, while originating at separate sources, is bused together to provide fault tolerance
- For redundancy, each of the power shelves are separately powered via individual AC line cords
- Each of the individual power supplies is capable of being serviced without interrupting the 48-volt output of the N+1 configuration
- AC input module LEDs indicate when it is safe to service either the AC input module or the associated power supplies
- Separate circuit breakers are used to protect each of the twenty loads so that no individual load is capable of keeping the system from operation
- A separate, 19-inch, rack mount power distribution subsystem provides power to all of the I/O peripherals in the system cabinet

## Dual Power Grid

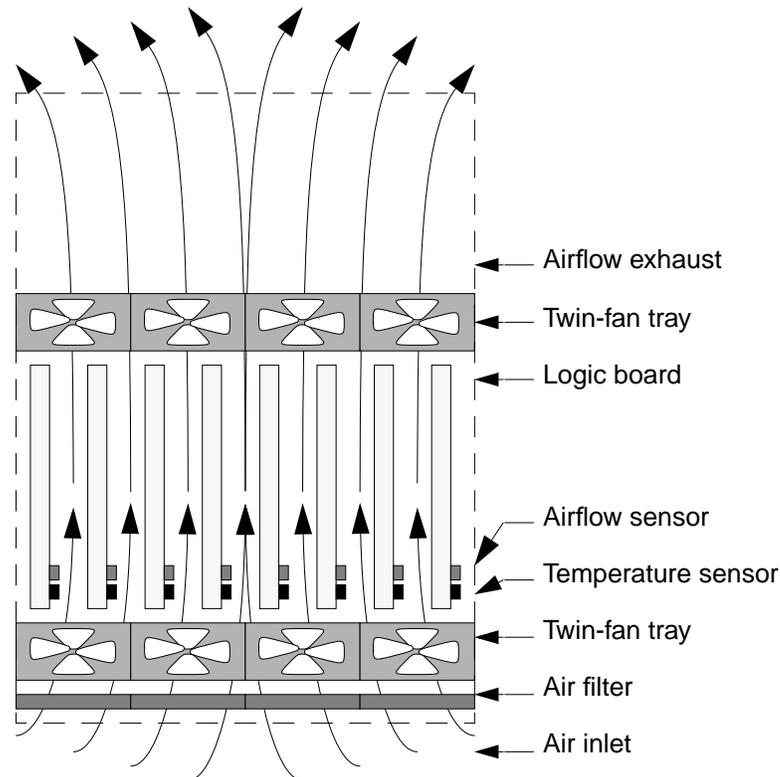
The Sun Enterprise 10000 Dual Power Grid option is another mainframe-like feature pioneered by the Starfire server and is designed for customers who desire very high availability. The AC power subsystem is completely duplicated, which allows a connection to a different power grid. This is different from having redundant power supplies that will power the system, but will not protect the system if the main power source goes down. The Dual Power Grid provides redundancy and access to a completely separate source of power.

The Dual Power Grid hardware is installed in the peripheral space that normally contains the boot drives. Consequently, all boot devices and SSPs must be installed in an external cabinet (however, there is sufficient room to keep the 2 ethernet hubs and 2 power sequencers in side the Starfire cabinet). The Dual Power Grid hardware can be retrofitted to existing Starfires, but the same rules apply such that all peripherals must be relocated to an external cabinet. Furthermore, any single-ended SCSI devices such as Unipacks will become unusable and must be replaced, since they will not support the longer cabling required.

The Dual Power Grid hardware includes 8 x 48V power supplies, 4 x AC input modules, and 4 x power chords and requires SSP 3.3 or later software.

## Cooling Subsystem

The processor cabinet is cooled by the flow of pressurized air drawn into the bottom of the cabinet from the ambient environment and exhausted out the top to the outside environment. The flow of cooled air is produced by a redundant system consisting of 16 fan trays operating through four circuit breakers to alleviate a source of single point failure (SPF). Each fan tray contains two fans and, in the event of a failure, can be removed while the system is operating.

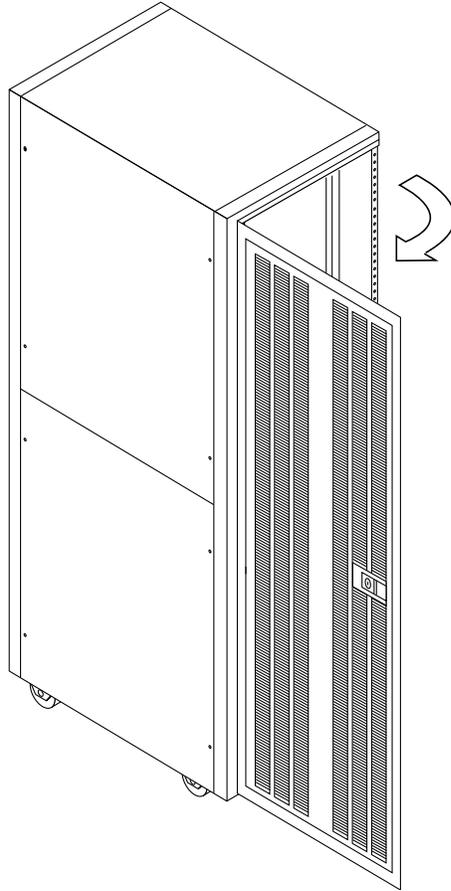


**Figure 3.** Airflow

- The fan trays have two fans and a tachometer that senses that both fans are rotating. A failed fan will result in a warning message being logged by the SSP.
- If a fan or fan tray fails, the fan tray can be replaced while the system is running without adverse effects to the system.
- Temperature sensors on each board detect that ambient air blowing across the board is within the specified temperature range.
- If the “temperature warning” level is reached, the condition is logged to the SSP. If the “temperature threshold” level is reached, the offending board is powered off.

All Sun Enterprise 10000 servers now ship complete with the maximum number of power supplies and fan trays.

## Expansion Cabinet



**Figure 4.** Data center expansion cabinet

The 72-inch Sun Enterprise expansion cabinet is available for use with the Sun Enterprise 10000 server. The expansion cabinet can be configured to a user's specific needs. Supported storage includes the StorEdge T3, StorEdge D1000, and StorEdge A5200.

- Each expansion cabinet has one cabinet fan tray that includes four fans supported by two power supplies. Each power supply supports two fans.
- The expansion cabinet features redundant cooling. If a power supply fails, two fans stop running and two fans continue to operate, providing enough cooling to keep the devices in the expansion cabinet cool.
- Expansion cabinets can be controlled by the system cabinet and can send status information to the system cabinet, through a connection between the expansion cabinets and the system cabinet. Specifically, the connection supports the following:
  - When a cabinet fan tray fails in an expansion cabinet, the system cabinet is notified. A system administrator monitoring the system cabinet status can see when a cabinet fan tray fails in an expansion cabinet.
  - The system administrator is able to turn off the system cabinet and all the expansion cabinets connected to the system cabinet with either the system cabinet key switch or through a software command.
- An optional Power Control Module (PCM) is also available to allow AC power to the expansion cabinets to be switched on and off from the SSP. Multiple cabinets can be controlled by one PCM, and up to 5 PCMs per server is supported.



## Dynamic System Domains

### Subdividing the Sun Enterprise™ 10000 Server into Multiple Computers

The Sun Enterprise™ 10000 server's dynamic system domain feature allows the Sun Enterprise 10000 server to be subdivided into multiple computers, each consisting of one or more system boards. System domains are similar to partitions on a mainframe. Each domain is a separate, shared-memory SMP system that runs its own local copy of the Solaris™ Operating Environment. Within a system domain, the system boards share a common physical address space and can access each other's non-cacheable (command and status) address space. Key features are:

- Up to 16 domains. Each one has its own copy of the Solaris Operating Environment, its own boot disk and data storage and a connection to the SSP. Domains are from one system board to 16 system boards in size.
- Domains are logical, not physical. They may be dynamically changed in size (number of system boards) online.

Because individual system domains have access to the interconnect bandwidth but are logically isolated from other system domains, software errors will be confined to their respective system domain and will not affect the rest of the system. This allows a system domain to be used to test updates to the Solaris Operating Environment, device drivers, or other, new application software without impacting production usage.

System domains are configured to have their own disk storage and networking. Administration of each system domain is done from one SSP that services all the system domains. The system administrator may create domains dynamically without impacting work in progress on the Sun Enterprise 10000 server. Dynamic system domains may be used for many purposes that enable the site to manage the Sun Enterprise 10000 resources effectively:

- **Server consolidation**

A single Sun Enterprise 10000 server can replace two, three, or more, smaller servers. It is easier to administer (uses a single SSP), more robust (more RAS features), and offers the flexibility to freely shift resources from one "server" to another. This is a benefit as applications grow, or when demand reaches peak levels requiring rapid deployment of additional computing resources.

- **Development, production, and test environments**

In a production environment, most sites require separate development and test facilities. Having isolated facilities enables the development work to continue on a regular schedule, while assuring that those efforts do not impact production. Using an Sun Enterprise 10000 server, those functions can safely coexist on the same platform.

- **Software migration**

Dynamic system domains may be used as a means of migrating systems or application software to updated versions. This applies to the Solaris Operating Environment, database applications, new administrative environments, or any type of application.

- **Special I/O or network functions**

A system domain may be established to deal with specific I/O devices or functions. For example, a high-end tape device could be attached to a dedicated system domain, which is alternately merged into other system domains which need to make use of the device for backup or other purposes.

- **Departmental systems**

A single Sun Enterprise 10000 server may be shared by multiple projects or departments, simplifying cost justification and cost accounting requirements.

- **Configuring for Resource Requirements**

There are a variety of ways to deal with applications with special resource requirements or limitations. Projects which have resource requirements that might overflow onto other applications may be isolated to their own system domain. Also, for applications that cannot take advantage of all resources (that is, they lack scalability) multiple instances of the application may be run in separate system domains.

- **Data Warehouses Applications.** Many data warehouses use multiple systems to tier data. The Sun Enterprise 10000 server can tier data on the same system and dynamically allocate more resources to individual tiers as needed.

The figure below shows an example of how the Sun Enterprise 10000 server may be divided into dynamic system domains. Domain #3 is a 36 processor production domain running standard the Solaris Operating Environment. Domain #2 is running a special application with eight processors (for instance proving that the application is fully stable before allowing it to run on the production domain #3). Domain #1, with four processors, is being used to check out an early version of the Solaris 7 Operating Environment. Note that each domain has its own boot disk and storage, as well as a network connection. All are controlled from a common SSP.

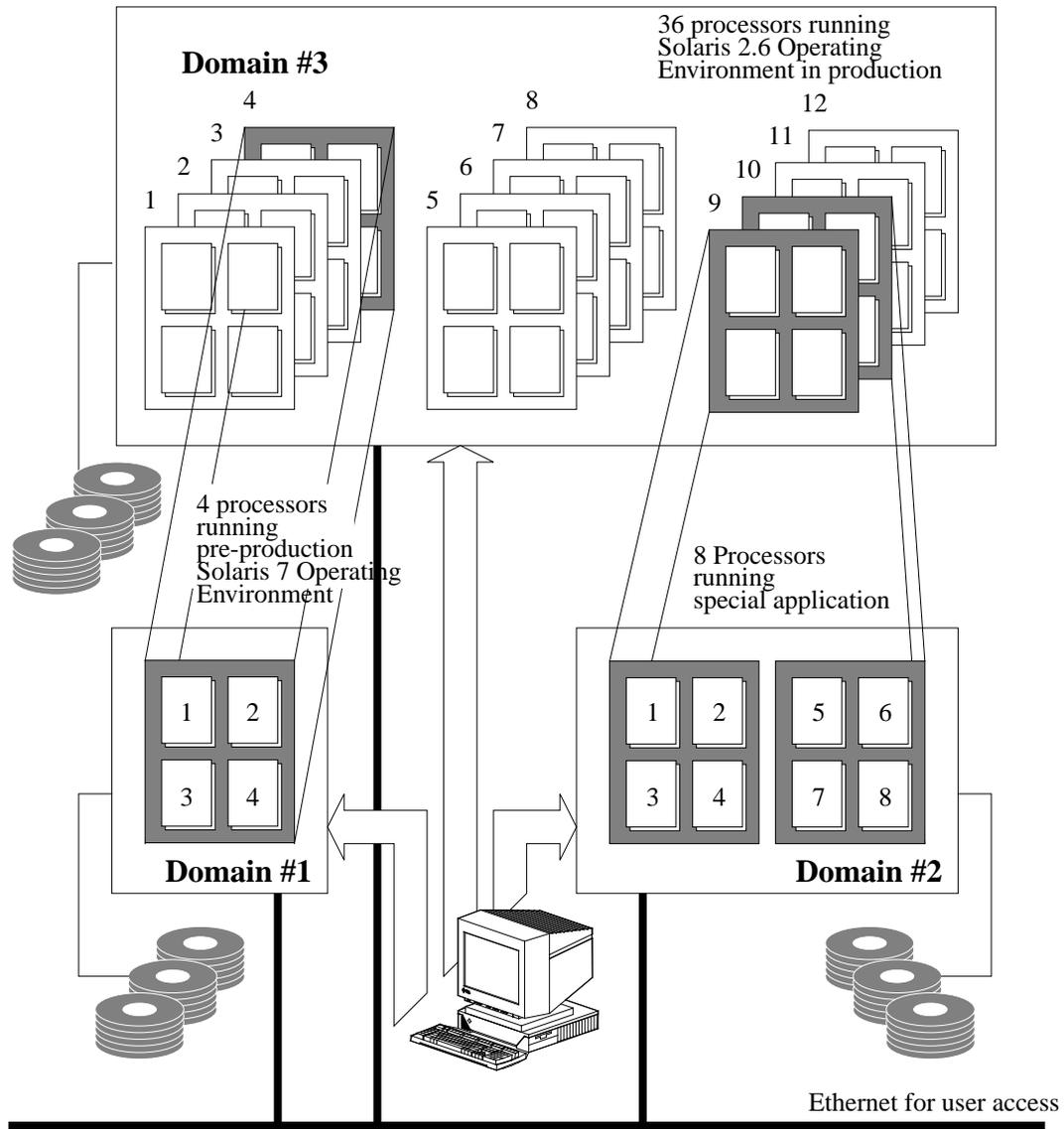


Figure 5. Sample domain configuration

## InterDomain Networks (IDN)

### High-Speed Domain-to-Domain Networking

The unique hardware capabilities and versatility of the Sun Enterprise 10000 server is further expanded by InterDomain Networking (IDN), a feature that supports high-speed networking between dynamic system domains within a single Starfire server. IDN allows domains of any configuration within the same server to communicate with each other over the Starfire Gigaplane™-XB interconnect using standard TCP/IP networking protocols. The key advantage of this feature is that it allows very high-speed, secure, Domain-to-Domain traffic with no cabling or special hardware and the throughput is greater than any interface available for Starfire.

InterDomain networks enable any set of resident domains to communicate among themselves over the system backplane using shared memory. A shared memory region (SMR) is used as a conduit for network packets. The SMR is maintained in one domain in the IDN and is used by all other domains in that IDN. There may be multiple, independent IDNs within a single Sun Enterprise 10000 server. Each network can comprise multiple logical network interfaces or channels, with each channel representing a separate IP subnet. Configure the number of networks, and the domains that make up a particular network, based on the performance considerations of your applications. For example, consider which domains require high-speed connectivity and also have sufficient processing power to effectively take advantage of InterDomain networking. InterDomain networks can be used for many purposes.

### Uses for IDN

1. Bulk Data transfer between domains.

When one has to transfer a large amounts of data between domains. Moving data from a OLTP database to a Data Warehouse or from a data warehouse to a data mart would be another. Depending on the application 8 Kbyte to 1MByte packets would be typical for the network. A Single-stream IDN transfer can achieve more than 60MB/sec.

2. Net Backup.

You can keep backup devices on the domain with the most drives and backup the smaller domains very quickly using IDN. Depending on the application 8 Kbyte to 1MByte packets would be typical for the network.

3. ERP & eCommerce (Many Small packets).

In many kinds of ERP or eCommerce applications, it is typical to have a multi-tier application with lots of small packets being transferred between application servers and database servers. IDN can handle a huge number of small packets and not take up a slot in each domain for an NIC card. In addition, multiple domains can transfer data to a single domain. 100 Byte to 1 Kbyte are typical packet sizes for these applications. Multi-Stream tests showed IDN could deliver more than 430,000 packets of 100 bytes.

NOTE: We do not recommend IDN for clustering two domains into an Highly Available (HA) cluster. For complete hardware isolation, we recommend the two nodes in an HA configuration use two physically separated domains or separated systems.



# System Service Processor

## Introduction

The System Service Processor (SSP), the system console, is a custom-configured Sun Enterprise 250 server or a Netra T1 AC200 server that runs the standard Solaris Operating Environment plus a suite of diagnostics and management programs. These include power-on self-test (POST), Hostview, and Network Console utilities developed for use on the Sun Enterprise 10000 server. The SSP enables the operator to monitor and control the Sun Enterprise 10000 server. These programs assist the SSP with sequencing the boot process, assisting in configuration decisions, managing dynamic system domains, monitoring environmental conditions, helping the Sun Enterprise 10000 server recover from interrupts, and sending information to Sun Enterprise Services regarding interrupts. The SSP is connected via remote console support to the Sun Enterprise 10000 server using Ethernet. Using Network Console, the SSP can be accessed remotely to facilitate system administration functions of the Sun Enterprise 10000 server. Figure 6 shows the network connections between the SSP and the Sun Enterprise 10000 server. A second (redundant) SSP is strongly recommended as a hot spare for automatic failover. While a single E250-based SSP can be procured, the Netra T1 AC200-based SSP only comes in pairs.

## The SSP

The SSP runs the standard Solaris Operating Environment and SSP software (latest version 3.5) and includes the following features and software:

- **Automatic SSP and Control Board failover**

Beginning with SSP release 3.4, upon main SSP failure, main SSP functions will be switched automatically to the spare SSP. Furthermore, upon primary control board failure, the JTAG clock source will be automatically switched to the secondary control board.

- **Hostview**

This is a graphical user interface (GUI) that assists the system administrator with management of the Sun Enterprise 10000 server's hardware, including dynamic system domains and dynamic reconfiguration functions.

- **SSP commands**

All of the functions provided in Hostview are also available via a command line interface, which may be used for more rapid remote access or to script certain operations.

- **POST**

This software performs diagnosis on the hardware and configuration management based on the diagnosis. It assures that the system components are operational.

- **Network Console (netcon)**

This software enables remote logins to the Sun Enterprise 10000 SSP. Using netcon, a system administrator can operate a Sun Enterprise 10000 server remotely, from anywhere there is a network connection, via an X-Window interface. The SSP uses these programs to assist the Sun Enterprise 10000 server to recover from the following events:

- **Heartbeat detection**

The SSP monitors the Sun Enterprise 10000 server by a "heartbeat". When a heartbeat failure is detected, the SSP attempts to send an interrupt to the Sun Enterprise 10000 server which will cause a dump and ordinary recovery. If this fails, the SSP logs this event and reboots the system.



- **Error recovery**

The SSP provides recovery for fatal errors by logging the event, initiating any required reconfiguration, and testing to try to isolate and remove components which may have caused the fatal error.

- **Message logging**

The SSP logs standard system messages that represent important information indicating a problem in the Sun Enterprise 10000 server (or a system partition) due to some hardware/software failure. These messages can range from a kernel panic to an over-temperature reading within the hardware. The SSP logs user software errors that include items such as what was executed, failures in booting, or incorrect command semantics. The SSP logs eight types of messages: Emergency, alert, critical, error, warning, information, debug, and console messages.

- **Sun Enterprise 10000 server Capacity-On-Demand software**

The Sun Enterprise 10000 Capacity-on-Demand software adds functionality to the Sun Enterprise 10000 Server Service Processor to facilitate management of CPU licensing. The Sun Enterprise 10000 Capacity-on-Demand software monitors CPU usage on the Sun Enterprise 10000 server and compares the total number of CPUs that are in use with the number of valid licenses contained in the license file. License violations will result in warning messages reported and logged on the Sun Enterprise 10000 System Service Processor.

- **Environmental emergency response**

The SSP protects the system from environmental conditions by signaling the Solaris Operating Environment on the host to take appropriate action when a potentially dangerous condition exists.

- **Program execution**

Supervisory programs running on each CPU export their state to the SSP to allow debug and other information to be displayed.

- **Hardware and environmental conditions**

Hardware and environmental faults are displayed until cleared by definitive action by a system administrator. The setting and clearing of events are logged.

- **Power problems**

The SSP controls, monitors, and manages the power to the Sun Enterprise 10000 server. The Sun Enterprise 10000 power status and control can be accomplished through simple network management protocol (SNMP) directly, so that standard SNMP tools can be used to power the Sun Enterprise 10000 server on and off. The SSP can power individual power supplies on and off, with the exception of housekeeping power which can only be powered off.

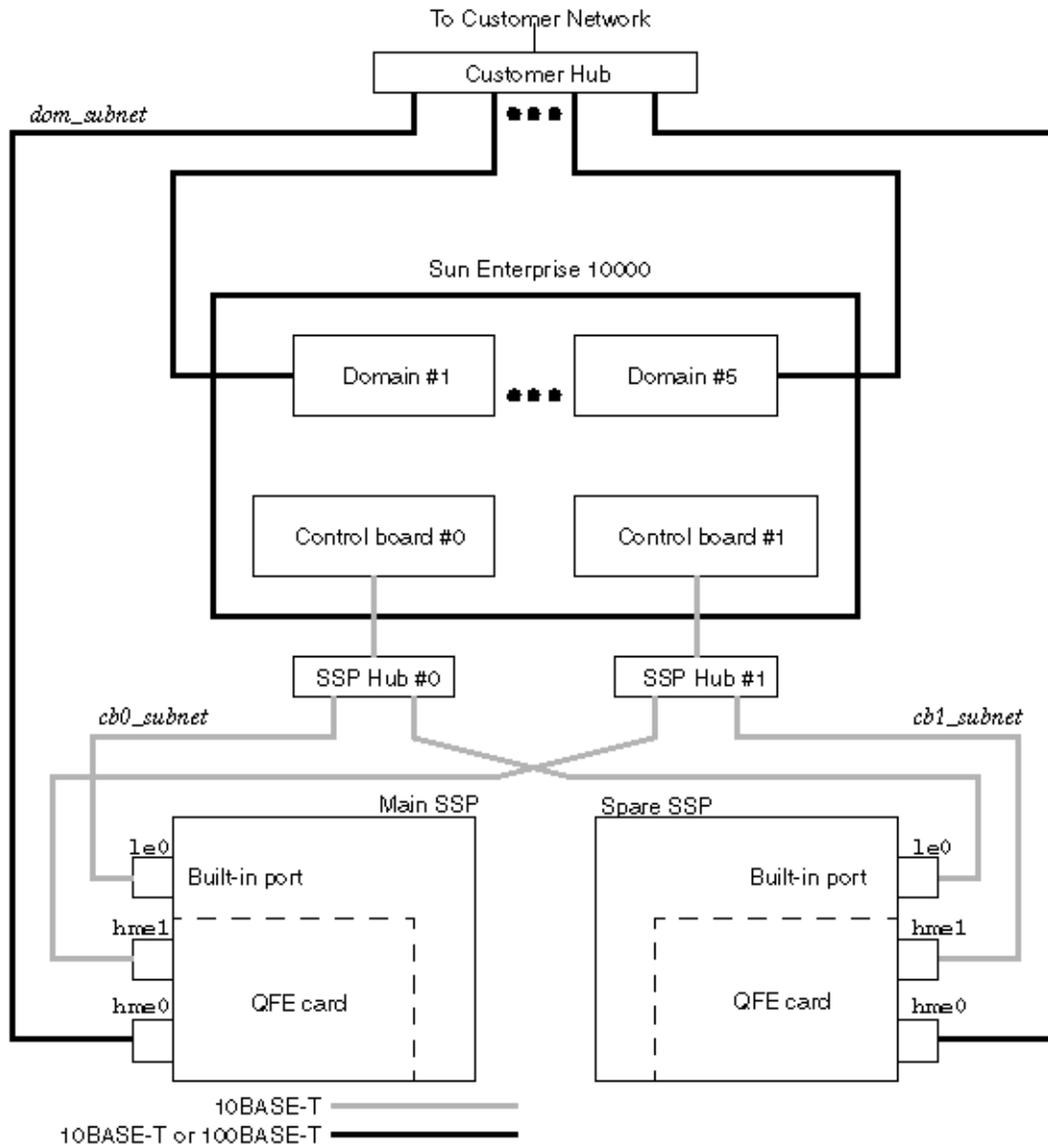
- **Boot heuristics**

The boot heuristics service is intended to perform as a human; trying to solve a problem not caught by diagnostics by physically or logically removing components in order to isolate a bad component, yet still have an operational configuration. Boot heuristics measures the success of the previous boot by how long it stayed up before an interrupt. If boot heuristics fail, a “boot failure” state is entered.

- **Remote service**

All functions on the SSP that can be performed remotely are set up for dumb terminal execution for use over modem connections.





**Figure 6.** Redundant system service processor configuration

The diagram above shows the following connections to the SSP from the Sun Enterprise 10000 server:

- Each control board has its own private Ethernet hub between itself and the SSP. These are 10BASE-T networks and service levels between the SSP and the Sun Enterprise 10000 server are therefore efficiently communicated, as there is no other network traffic.
- Each Sun Enterprise 10000 server domain is connected to another Ethernet hub (the “customer hub”). This is a 10/100BASE-T Ethernet network to which the SSP is connected. This network is used to first-time boot up each domain. (Subsequent boots are from the private storage connected to the domain).
- Users can access each domain using a common network to all domains or a private one to each domain.

## Power-on Self-test (POST)

Power-on self-test (POST) is the principal, bring-up diagnostic program for the Sun Enterprise 10000 server. It verifies that all components (memory, processors, I/O controllers, etc.) are functional before allowing them to be configured into the Sun Enterprise 10000 server.

- Exercises the Sun Enterprise 10000 server logic at a level below that of the field replaceable unit, and with a high degree of accuracy, finding failing components allowing isolation to the field-replaceable unit
- Provides a highly-available platform for customer applications, even in the face of hardware failures
- Provides low-level, start-of-day configuration services, including detailed interaction with specific hardware components
- Records sufficient information about failed and marginal components so that both field replacement and subsequent factory repairs are expedited
- Remembers which components passed the tests, and will configure only those components into the final system configuration. This is possible by using the JTAG access to each of the key Sun Enterprise 10000 server ASICs
- Can also be told to ignore certain components by looking them up in the *blacklist*. In this way, components scheduled for service, are of questionable functionality, or have a certain revision level can be kept out of a system configuration
- Has the responsibility of establishing the final system hardware configuration; if there is a failed or blacklisted component, there may be a variety of ways in which the final system may be configured. For example, if a coherency interface controller chip has failed, one option is to configure the final system with only three global address buses, thus avoiding the bad coherency interface controller, but allowing access to the processors. This maximizes compute power at the expense of system bandwidth. A second choice would be to configure the entire system board out of the system, which would allow concurrent servicing of the board at a later time without the need to do a dynamic reconfiguration operation

The amount of testing done by POST is controlled by the “level” of testing requested. At higher levels, more tests are run and POST thoroughly tests additional components—even those with little chance of failure.

## Hostview

Hostview is the graphical user interface program on the SSP that monitors the Sun Enterprise 10000 components and functions. Hostview simplifies monitoring and control of the Sun Enterprise 10000 server by providing a series of easy-to-follow menus. Hostview is able to make reasonable decisions about environmental problems, making the Sun Enterprise 10000 server less susceptible to single-point failures.

Hostview enables you to perform the following actions:

- Power the Sun Enterprise 10000 server on and off
- Dynamically reconfigure the boards within the Sun Enterprise 10000 server, logically attaching or detaching them from the operating system, resetting them, and running diagnostics on them
- Create and manage dynamic system domains
- View status of processors (for example, booting, running the Solaris Operating Environment, etc.)
- Start an SSP window for each system domain
- Access the SSP log messages file for each system domain



- Remotely login to each system domain
- Modify the blacklist file to enable or disable hardware components on each system domain

Hostview enables the system administrator to monitor and respond to various system events, such as:

- Hardware faults; for example, over-voltage
- Environmental faults; for example, excessive heating
- Loss of “heartbeat” from the Sun Enterprise 10000 server

### Capacity-On-Demand Software (optional item)

The Sun Enterprise 10000 server Capacity-on-Demand software adds functionality to the Sun Enterprise 10000 Server Service Processor to facilitate management of CPU licensing. The Sun Enterprise 10000 server Capacity-on-Demand software monitors CPU usage on the Sun Enterprise 10000 server and compares the total number of CPUs that are in use with the number of valid licenses contained in the license file. License violations will result in warning messages reported and logged on the Sun Enterprise 10000 Server Service Processor. A Sun Enterprise 10000 server with Capacity-On-Demand 1.0 is shipped with the Capacity-On-Demand software installed.

The Sun Enterprise 10000 server Capacity-On-Demand software consists of:

- Sun Enterprise 10000 server Capacity-On-Demand daemon, `codd`, which performs license validation check on startup and at regular intervals
- `codlit`, a utility for installing license keys
- `codcheck`, a utility for validating the secure log
- `codsendlog`, a utility used to send the secure log to Sun once a month

### SunVTS™ Software

SunVTS™ software (Sun Validation Test Suite) is the replacement product for SunDiag™ software. Like SunDiag software, SunVTS software is run at the UNIX® level and is designed to exercise the entire system. It supports either a graphical or TTY user interface and provides error and information logging. The key features of SunVTS software are:

- **UNIX-level diagnostics**  
System tests execute real UNIX code under the Solaris Operating Environment.
- **Automatic system probing**  
The system configuration is displayed through the user interface.
- **Two user interfaces**  
A graphical-based interface and a character-based interface are both available. The SunVTS kernel is cleanly separable from the user interface, such that multiple-user interfaces can communicate with the same SunVTS kernel. The character-based interface permits the writing of shell scripts to control SunVTS software.
- **Application programming interface (API)**  
The API provides a defined interface into the SunVTS kernel from other processes, as well as the user interfaces. A SunVTS execution could be initiated in a cron-like fashion, with no direct user interface at all.
- **Advanced configuration and execution control**  
Tests can be grouped together based on user requirements, with fine-grained execution control for status and logging information.



## Network Console

The SSP provides a service called Network Console (netcon). Netcon provides a “console” for single-user operations. Normally, a SSP must be on the same subnetwork as the Sun Enterprise 10000 server; with netcon, they can be anywhere in the world that has a network attachment. The service is provided such that sessions, similar to rlogin sessions, can be provided to X-Windows clients on the same network as the SSP. This enables system administrators to access the SSP from any location on the same network as the SSP.

- No dedicated hardware line between host and SSP
- Remote control from any workstation
- Multiple sessions allows administrators to observe console access simultaneously

## Simple Network Management Protocol (SNMP) Support

All events noted by the Sun Enterprise 10000 monitoring functions are broadcast to the network via SNMP messages. This means that, in addition to the Hostview program, they may be trapped by any software package that processes SNMP messages. Thus, messages specific to Sun Enterprise 10000 servers can be integrated conveniently into a site's existing systems and network management toolsets.

A management information base (MIB) has been defined for the Sun Enterprise 10000 server series. This includes a wealth of information that can be used by third-party system and network management products. A typical monitoring tool would be Solstice Site Manager™ software, Solstice Domain Manager™ software, or Solstice Enterprise Manager™ software. The Sun Enterprise 10000 server's MIB and adherence to SNMP provide the hooks to allow a manager such as this to support the Sun Enterprise 10000 server.

## The Solaris™ Operating Environment

The Sun Enterprise servers include the industry's leading enterprise operating environment, the Solaris Operating Environment. Built on the latest UNIX technology, the Solaris Operating Environment delivers unparalleled scalability and performance. With enterprise integration by design, the Solaris Operating Environment provides easy access to a wide range of computing environments and network technologies. It delivers a competitive advantage to business through networked computing, scalability, and multi-architecture support. The Solaris Operating Environment provides an advanced, superior solution for all customer IT needs, both technical and business. The Solaris Operating Environment is an industrial-grade solution with the performance, quality, and robustness to deliver mission-critical reliability.

The Solaris Operating Environment delivers a unique advantage for mission-critical environments, providing advanced features and functionality that, combined with built-in networking, gives users a high-performance computing environment enabling faster, higher quality, and more productive work.

The Solaris Operating Environment delivers the power of the Sun Enterprise servers to users through enhanced networking capabilities and performance, graphics and imaging, increased standards compliance, and key operating system management advancements.

The Sun Enterprise 10000 server will run the Solaris Operating Environment revisions 2.5.1, 2.6, 7 & 8. Version 9 is currently in development and will be supported in 2002.



# Glossary

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CIC	Coherency interface controller. Handles coherency transactions for the three port controllers on a board. Connects to one of four global address buses. Snoops for one quarter of the address space.
Circuit-switched bus	A bus in which a transaction is normally implemented in an automatic fashion. Simple and easy to construct, a circuit-switched bus is often less efficient than a comparable packet-switched bus. SBus is a circuit-switched bus.
ECC	Error checking and correcting. ECC code is used to verify the integrity of data and can be used to correct some data errors. The ECC code used in the Sun Enterprise™ X000 servers is able to detect and correct single-bit errors and detect double-bit errors.
Fault resistant	Systems that are fault-resistant are able to withstand and recover from many types of system problems.
Fault tolerant	Systems that are fault-tolerant are able to withstand and recover from any system problem and offer 100 percent uptime. These systems are typically more expensive than comparable fault-resistant systems.
GAARB	Global Address Arbiter. Arbitrates for a global address buses. Implemented by a Sun Enterprise 10000 arbiter chip.
GAB	Global Address Buses. Four 16:16, 48-bit wide multiplexers that connect a coherent interface controller from each system board. The multiplexers broadcast one of the inputs to all the outputs. Implemented by 16 XMUX ASICs. Functions like a snoopy bus for coherency purposes, but is really a point-to-point address router.
Gigaplane™	The Gigaplane bus is the centerplane bus that is used in the Sun Enterprise 3000, 4000, 5000, and 6000 servers. The Gigaplane bus is a packet-switched bus offering a sustained data transfer rate of 2.5 GB/sec.
Gigaplane-XB™ Interconnect	The Gigaplane-XB Interconnect is the centerplane bus that is used in the Sun Enterprise 10000 server. The Gigaplane-XB interconnect is a packet-switched bus offering a data transfer rate of 10.67 GB per second with a 83.3-MHz clock and 12.8 GB per second with a 100-MHz clock
GDR	Global data router. Sixteen 16:1, 144-bits wide multiplexers that connect the local data routers on each system board. Implemented by 12 XMUX ASICs.
High availability	Availability is the time a particular resource, such as a system, application, or data is accessible and usable. High availability means the resource is accessible and usable a maximum amount of time.
Hostview	Hostview is the graphical user interface program on the SSP that monitors the components and functions of the Sun Enterprise 10000 server.



Hot plug	A hot-plug component means that it is electrically safe to remove or add that component while the machine is still running. Typically, the system must be rebooted before the hot-plug component is configured into the system.
Hot swap	A hot-swap component can be installed or removed by simply pulling the component out and putting the new one in. The system will either automatically recognize the component change and configure itself as necessary or will require user interaction to configure the system, but a reboot is not required. All hot-swappable components are hot pluggable, but not all hot-pluggable components are hot swappable.
InterDomain Networks (IDN)	IDN is a feature that supports high-speed networking between dynamic system domains within a single Starfire server. It allows domains of any configuration within the same server to communicate with each other over the Starfire Gigaplane™-XB interconnect using standard TCP/IP networking protocols. The key advantage of this feature is that it allows very high-speed, secure, Domain-to-Domain traffic with no cabling or special hardware and the throughput is greater than any interface available for Starfire.
Interleaved memory	Interleaved memory helps reduce memory access time by permitting multiple memory components to operate in parallel. In interleaved memory schemes, memory is divided into $n$ banks arranged so that every $n$ th byte is supplied by a different memory bank. In a two-way interleaved system, the first doubleword is supplied by bank 0 while the second is supplied by bank 1; normally the size and extent of interleave is arranged so that a single typical request is satisfied by as many banks as possible. This permits a single memory request to be fulfilled without waiting for memory recycle time. The Sun Enterprise 10000 server uses 4-way interleaved memory.
LDARB	Local Data Arbiter. Arbitrates for the local data router.
LDR	Local Data Router. Two unidirectional 144-bit wide 4:1 multiplexers that connect the four UPA data buses on a system board with the global data router. Implemented by four XMUX ASICs per system board.
MC	Memory Controller chip. Accepts memory addresses from the four Coherent Interface Controllers, and data from the Sun Enterprise 10000 data buffer (XDB), and performs reading and writing of 64-byte blocks of data into one to four banks of memory.
Memory bank	512 data bits, plus 64 ECC bits, made up of 8 DIMMs.
OBP	OpenBoot™ PROM. In the Sun Enterprise 10000 server, OBP is held in RAM by the SSP.
Packet-switched bus	A bus in which information is transmitted in fixed-sized units. Often associated with the use of split transactions. Gigaplane and UPA are packet-switched buses.
Parity	Parity is a simple technique used to verify the integrity of data. Parity detects single-bit errors.

PC	Port Controller chip. Interfaces UPA modules to the Sun Enterprise 10000 server. The PC controls address flow between the UPA port and the four Coherent Interface Controllers, and controls data flow between the UPA port and the Sun Enterprise 10000 data buffer (XDB).
POST	Power-on self-test. POST is a suite of hardware integrity tests implemented in firmware that verifies the integrity of system components.
RAS	Reliability, availability, and serviceability. Reliability is a measure of the likelihood that problems will occur. A highly reliable system will have few problems. Once a problem occurs, availability is the measure of how the system will protect the user from being adversely affected by the problem. Serviceability is a measure of how easy it is to repair the problem.
SSP	The System Service Processor, the system console, is a SPARC™ processor-based workstation that runs the standard Solaris™ Operating Environment plus a suite of diagnostics and management programs.
SunVTS™	Sun Validation Test Suite. This is the replacement for SunDiag™ software.
UPA Bus	Ultra™ port architecture bus. Used as an intermediate bus on the CPU/memory and I/O boards.
XARB	Sun Enterprise 10000 arbiter chip. Has modes to implement three functional units: The local address arbiter, the local data arbiter, and global address arbiter.
XDB	Sun Enterprise 10000 data buffer chip. Buffers cache lines that are in transit between a UPA data port or a memory bank and the local data router.
XMUX	Multiplexer chip. Has modes to implement four functional units: The global address router, the local data router, the global data router, and the 144 / 576-bit wide pack/unpack on the memory module

# Materials Abstract

All materials are available on SunWIN, except where noted.

Collateral	Description	Purpose	Distribution	Token # or COMAC Order #
<b>Power Pack</b>				
– <i>Sun Enterprise™ 10000 Server, Just The Facts</i>	Reference Information (this document), 2/02	Sales Tool Training	SunWIN, Reseller Web	57933
– <i>Sun Enterprise 10000 Presentation and Slide Notes, 2/98</i>	Presentation and Slide Notes Covering Product, Market, Performance, and Competition	Sales Tool	SunWIN, Reseller Web	62298, 62304
<b>References</b>				
– <i>Sun Intro: Sun Enterprise 10000</i>	Product Introduction Document, 1/97	Sales Tool	SunWIN, E-mail	62201
– <i>High Performance Computing 3.1 Just The Facts</i>	Detailed Information Concerning the Sun Enterprise 10000 Server in HPC, 3/00	Sales Tool	SunWIN, Reseller Web	75001
– <i>SunCluster 2.2, Just The Facts</i>	Information on Clustering the Sun Enterprise 10000 Server, 10/00	Sales Tool	SunWIN, Reseller Web	74006
– <i>Sun Enterprise 10000 Server Overview</i>	Quick reference material	Sales Tool	SunWIN, Reseller Web	66505
– <i>Consolidation in the Data Center Customer Presentation and Speaker Notes</i>	High level customer presentation on the business problem that consolidation solves, Sun's vision, and consolidation methodology. 1/02	Sales Tool	SunWIN, Reseller Web	330832
<b>Product Literature</b>				
– <i>Ultra™ Server family Sun Enterprise 10000</i>	Data Sheet	Sales Tool	SunWIN, Reseller Web, COMAC	62102, DE675-1
– <i>Sun Enterprise 10000</i>	Product Brief	Sales Tool	SunWIN, Reseller Web	62118
<b>White Papers</b>				
– <i>Sun Enterprise 10000 Technical White Paper</i>	High-level Architectural Information, 1/00	Sales Tool	SunWIN, Reseller Web	62355
– <i>Server Consolidation at Sun</i>	One Large Server Instead of Multiple Smaller Ones, 7/01	Sales Tool	SunWIN, Reseller Web	308150
– <i>Sun Enterprise 10000: SunTrust™ Reliability, Availability, and Serviceability</i>	High Uptime Features and Discussion, 2/99	Sales Tool	SunWIN, Reseller Web	62345
– <i>Sun Enterprise 10000: Dynamic System Domains</i>	Partitioning a High-end Server, 1/00	Sales Tool	SunWIN, Reseller Web	62348
– <i>Sun Enterprise 10000 Open SSP</i>	Running third party software on the SSP, 11/00	Sales Tool	SunWIN, Reseller Web	127994
<b>External Web Site</b>				



<b>Collateral</b>	<b>Description</b>	<b>Purpose</b>	<b>Distribution</b>	<b>Token # or COMAC Order #</b>
<ul style="list-style-type: none"> <li>- <i>Sun Enterprise 10000 Server Web Site</i></li> </ul>	<a href="http://www.sun.com/servers/highend/10000">http://www.sun.com/servers/highend/10000</a>			
<b>Internal Web Site</b> <ul style="list-style-type: none"> <li>- <i>Sun Enterprise 10000 Server Web Site</i></li> </ul>	<a href="http://systems.corp/products/servers/datacenter/e10000/index.html">http://systems.corp/products/servers/datacenter/e10000/index.html</a>			

# Internal Information

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## **Configuring and Ordering**

### **Overview of the ordering process**

For specific ordering and configuration information for the Sun Enterprise™ 10000 server, please go to the following web page:

[http://systems.corp/products/servers/datacenter/e10000/E10000\\_config\\_info.html](http://systems.corp/products/servers/datacenter/e10000/E10000_config_info.html)

or

<http://sales-desk.west/e10k.shtml>