



# SUN FIRE™ X2100 M2 SERVER AND SUN FIRE™ X2200 M2 SERVER **SYSTEM ARCHITECTURE**

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**Note** – The server systems described in this document, and referenced by the names Sun Fire™ X2100 server and Sun Fire™ X2200 server, reflect the features and specifications of the Sun Fire X2100™ M2 and Sun Fire X2200™ M2 servers systems, respectively. Organizations should take care to reference the full system name in order to receive accurate system support and maintenance.

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## Chapter 1

# Building A Smarter, More Powerful Infrastructure

IT organizations are constantly under pressure to improve operations and get more work done while lowering costs. Often constrained by technology barriers, IT managers strive to gain efficiencies by standardizing platforms and procedures. Unfortunately, these efforts stall as data centers are often stocked with a mix of new 64-bit applications and a large inventory of 32-bit code which require a variety of different chip architectures and operating environments for execution. As a result, organizations are forced to purchase separate, incompatible servers for each type of application. This multi-platform scheme reduces flexibility and increases management and acquisition costs. Adding to platform related frustrations, enterprises frequently deploy faster processors in an attempt to speed up software, but hardware architectures with high memory latencies and I/O bottlenecks limit the gains realized at the application level.

At the same time, the total number of servers in the data center continues to increase at a rapid pace, pushing facilities and system management plans to the breaking point. Many of these systems contain high frequency processors which require more power and run hotter than previous generations of servers. In addition to increased energy costs, proper power and cooling of full racks of these systems is impossible, and valuable floor space is lost as technicians are forced to leave racks largely empty to maintain airflow. Once systems are finally racked and powered, organizations strain to find scalable methods to cost effectively monitor and maintain so many servers.

To help these efforts, enterprises are looking for smarter options for building a cost effective, powerful infrastructure based on standardized components. Sun Fire™ x64 systems reduce cost and complexity by providing a universal platform that simultaneously runs 32-bit and 64-bit applications at full speed on a choice of operating systems, including the Solaris™ Operating System (OS), Linux, and Windows. These modular, rackmount servers are designed to Sun's exacting standards to take full advantage of the exceptional power of AMD Opteron™ processors and the AMD Direct Connect Architecture, resulting in significantly greater performance than comparable servers with Intel Xeon processors.

In addition, Sun Fire x64 servers run cooler and require less power than comparable platforms from other suppliers, delivering significant energy savings and the ability to preserve expensive data center floor space by stacking servers tightly into racks. Adding even more value, Sun Fire x64 servers integrate lights out management with in-band and out-of-band control, improving service levels and reducing operational costs. Sun's latest additions to this line, the Sun Fire™ X2100 and Sun Fire™ X2200 servers, continue these trends and serve as smart solution enablers for rack-dense, scale-out architectures.

### Scalable Computing Without Complexity — Sun Fire™ X2100 and Sun Fire™ X2200 Servers

Hosting applications across an array of inexpensive servers, *scale-out computing* maximizes server utilization, raises application availability, and lowers acquisition costs. Unfortunately, organizations often find that resulting performance, power and cooling, and system management challenges resulting outweigh the benefits. The Sun Fire X2100 and Sun Fire X2200 servers are designed to help enterprises realize the positive aspects of a scale-out architecture while reducing the hidden costs and complexities. Featuring dual-core Next Generation AMD Opteron processors, an AMD Direct Connect Architecture, an embedded service processor, and Sun software tools to enable

the management of many servers as one, Sun's compact Sun Fire X2100 and Sun Fire X2200 servers deliver speed, energy efficiency, and simplified management. By taking advantage of Sun Fire X2100 and Sun Fire X2200 servers, organizations can create a more powerful infrastructure, reduce costs, and ease administrative burdens. Table 1-1 describes the features of the Sun Fire X2100 and Sun Fire X2200 servers.

Table 1-1. The Sun Fire X2100 and Sun Fire X2200 servers provide many features in a small footprint

	Sun Fire X2100 Server	Sun Fire X2200 Server
<b>Enclosure</b>	<ul style="list-style-type: none"> <li>• 1U 19" rackmount system</li> </ul>	<ul style="list-style-type: none"> <li>• 1U 19" rackmount system</li> </ul>
<b>Processors</b>	<ul style="list-style-type: none"> <li>• One 1.8 GHz, 2.2 GHz, 2.4 GHz, or 2.6 GHz dual-core AMD Opteron 1000 Series processors</li> <li>• 1 MB level 2 cache per core</li> </ul>	<ul style="list-style-type: none"> <li>• Up to two 1.8 GHz, 2.2 GHz, 2.4 GHz, or 2.6 GHz dual-core AMD Opteron 2000 Series processors</li> <li>• 1 MB level 2 cache per core</li> </ul>
<b>Memory</b>	<ul style="list-style-type: none"> <li>• Four DIMM slots</li> <li>• Unregistered DDR2 667Hz SDRAM DIMMs</li> <li>• 512 MB, 1GB and 2 GB memory DIMMs</li> <li>• Up to 8 GB memory</li> <li>• ECC error correction</li> </ul>	<ul style="list-style-type: none"> <li>• Sixteen DIMM slots</li> <li>• Registered DDR2 667 Hz SDRAM DIMMs</li> <li>• 512 MB, 1 GB, 2 GB and 4 GB memory DIMMs<sup>a</sup></li> <li>• Up to 64 GB memory (using 4 GB DIMMs)</li> <li>• ECC error correction</li> </ul>
<b>Internal Storage</b>	<ul style="list-style-type: none"> <li>• Up to two 3.5" 250GB or 500 GB 7,200 RPM</li> <li>• SATA-II hard drives</li> <li>• EIDE tray load DVD-ROM (optional)</li> </ul>	<ul style="list-style-type: none"> <li>• Up to two 3.5" 250GB or 500 GB 7,200 RPM</li> <li>• SATA-II hard drives</li> <li>• EIDE tray load DVD-ROM (optional)</li> </ul>
<b>System I/O</b>	<ul style="list-style-type: none"> <li>• Four 10/100/1000 Base-T Ethernet ports</li> <li>• One serial DB-9 port</li> <li>• Six USB 2.0 ports</li> </ul>	<ul style="list-style-type: none"> <li>• Four 10/100/1000 Base-T Ethernet ports</li> <li>• One serial DB-9 port</li> <li>• Six USB 2.0 ports</li> </ul>
<b>Graphics</b>	<ul style="list-style-type: none"> <li>• One VGA graphics port</li> </ul>	<ul style="list-style-type: none"> <li>• One VGA graphics port</li> </ul>
<b>Expansion Bus</b>	<ul style="list-style-type: none"> <li>• Standard: Two internal 64-bit, 8-lane, low-profile, half length PCI-Express slots</li> <li>• Optional: Riser card to provide one internal 64-bit, 16-lane, low-profile, half length PCI-Express slot<sup>a</sup></li> </ul>	<ul style="list-style-type: none"> <li>• Standard: Two internal 64-bit, 8-lane, low-profile, half length PCI-Express slots</li> <li>• Optional: Riser card to provide one internal 64-bit, 16-lane, low-profile, half length PCI-Express slot<sup>a</sup></li> </ul>
<b>Operating System<sup>b</sup></b>	<ul style="list-style-type: none"> <li>• Solaris™ 10 Operating System 06/06, 64-bit</li> <li>• Red Hat Enterprise Linux 3 U7, 32-bit/64-bit</li> <li>• Red Hat Enterprise Linux 4 U3, 32-bit/64-bit</li> <li>• SUSE Linux Enterprise Server 9 SP3, 32-bit/64-bit</li> <li>• Windows Server 2003 Standard Edition SP1, 32-bit/64-bit</li> </ul>	<ul style="list-style-type: none"> <li>• Solaris 10 Operating System 06/06, 64-bit</li> <li>• Red Hat Enterprise Linux 3 U7, 32-bit/64-bit</li> <li>• Red Hat Enterprise Linux 4 U3, 32-bit/64-bit</li> <li>• SUSE Linux Enterprise Server 9 SP3, 32-bit/64-bit</li> <li>• Windows Server 2003, Standard Edition SP1, 32-bit/64-bit</li> <li>• VMware ESX Server 3.0<sup>c</sup></li> </ul>
<b>Embedded Service Processor</b>	<ul style="list-style-type: none"> <li>• IPMI 2.0 compliant</li> <li>• Web, graphical, and command line interface</li> <li>• SNMP V1, V2c, and V3 support</li> <li>• SSH V2</li> <li>• One serial DB-9 port (shared host port)</li> <li>• One shared 10/100/1000 Base-T Ethernet port (one of four host network ports)</li> <li>• Keyboard, Video, Mouse over IP (KVM over IP)</li> <li>• Virtual storage</li> </ul>	<ul style="list-style-type: none"> <li>• IPMI 2.0 compliant</li> <li>• Web, graphical, and command line interface</li> <li>• SNMP V1, V2c, and V3 support</li> <li>• SSH V2</li> <li>• One serial DB-9 port (shared host port)</li> <li>• One shared 10/100/1000 Base-T Ethernet port (one of four host network ports)</li> <li>• Keyboard, Video, Mouse over IP (KVM over IP)</li> <li>• Virtual storage</li> </ul>

a.4 GB DIMMs and PCI-Express riser card are expected to be released in late 2006.

b.Additional drivers and patches may be required. Utilize the Tools and Drivers CD or download Web site located at <http://sun.com/download/>.

c.Qualification of the Sun Fire X2200 server for VMware ESX Server 3.0 is underway. Completion date to be determined.

## Flexible, High Performance Systems — Meeting Modern Enterprise Needs

The flexibility and power of the Sun Fire X2100 and Sun Fire X2200 servers extends the usefulness of these servers to a broad range of industries and applications. Part of the only family of x64 servers with application portability across the entire line through binary compatibility on the Solaris OS, Linux, and Windows operating systems, the Sun Fire X2100 and Sun Fire X2200 servers maximize computing power without impacting budgets. In addition, the

exceptional 64 GB memory expansion capability of the Sun Fire X2200 server provides particular benefit to organizations running compute-intensive applications or simulations. Table 1-2 contains a list of some of the ideal uses for the Sun Fire X2100 and Sun Fire X2200 servers.

*Table 1-2. The Sun Fire X2100 and Sun Fire X2200 servers address a broad range of computing needs*

Industry	Applications
Automotive	Crash testing, stress testing, aerodynamics modeling, visualization
Education	Large computational problems, collaboration, research and development
Energy	Reservoir simulations, seismic analysis, visualization
Financial Service	Risk and portfolio analysis, simulations, financial modeling
Government	High performance computing
Manufacturing	RFID, regression testing, simulations
Media, Entertainment, Publishing	Grid computing, frame rendering
Scientific	Genetic sequencing, database queries
Telecommunications and Service Providers	Firewalls, domain servers, log processing, authentication, Web servers, proxy servers, application servers

### Raising Expectations for Entry-Level Servers

The Sun Fire X2100 and Sun Fire X2200 servers are a breakthrough offering in rack-dense, enterprise-class, entry-level systems (Figure 1-1). Providing a valuable combination of high performance, flexibility, and ease of management on a limited budget, these systems enable organizations to better manage the steady stream of infrastructure changes, keep up with resource demands, and consolidate system operations. Indeed, the Sun Fire X2100 and Sun Fire X2200 servers speed results and remove barriers, enabling organizations to plan ahead, get ahead, and stay ahead of the competition.



*Figure 1-1. The Sun Fire X2100 and Sun Fire X2200 servers provide the foundation for a smarter, more powerful infrastructure.*

## Chapter 2

# Flexible, High Speed x64 Architecture

Innovation and technology leadership combine within the Sun Fire x64 server family to deliver some of the most flexible, high performance systems ever created. With the ability to run 32-bit and 64-bit applications on a single high speed platform, Sun Fire x64 servers address the real challenges and bottlenecks found in many system architectures, and deliver world record benchmark results.

### A Universal Computing Platform

For years, organizations refrained from adopting 64-bit computing in a pervasive manner. With the majority of applications still based on 32-bit code and budgets as constrained as ever, expensive 64-bit systems which emulated 32-bit execution environments did not provide sufficient performance, flexibility, and investment protection. The need for a revolutionary low cost platform that could ease the adoption of 64-bit computing was evident. The x64 architecture implementation from AMD, also known as AMD64, paved the way forward by producing a cost conscious x86-compatible instruction set that provides for simultaneous 32- and 64-bit computing. As a result, existing 32-bit applications and operating systems run at peak performance, while providing a 64-bit capable migration path. This instruction set is implemented on the AMD Opteron processor used by all Sun Fire x64 servers. By leveraging the x64 architecture, Sun Fire x64 servers create a new class of computing which enables organizations to build solutions based upon today's needs without barriers to future innovations.

Key to the x64 architecture, the x64 Instruction Set Architecture (ISA) simply extends the existing x86 ISA and natively executes 32-bit code — emulation modes which tend to degrade performance are not needed. Benefiting both 32-bit and 64-bit applications, the x64 ISA enables continued performance scaling for applications that demand multiprocessor scalability or larger addressable memory. In addition, true 64-bit applications experience gains in multimedia performance and improvements in computational accuracy. The x64 ISA is designed for applications that:

- Need large memory addressing to handle datasets larger than 3 GB per process, such as financial and scientific modeling applications.
- Need to manage a large number of concurrent users or application threads, such as large-scale, thin-client solutions, large databases, data warehousing applications for solutions in customer relationship management (CRM), supply chain management (SCM), enterprise resource planning (ERP), and digital rights management (DRM) systems.
- Require real-time encryption and decryption for enhanced security, including e-commerce and the protection of private or classified data.
- Require mathematical precision and floating-point performance, including modeling, simulation, statistics and financial analysis, imaging, video, and signal processing, physics, medical research, telecommunications, encryption, and compression.
- Require large, high power database performance, including decision support, searching and indexing, document and content management, and voice recognition.

- Require x86 compatibility or the economies of scale of x86 systems, as well as the large memory addressing capabilities of 64-bit computing, including many high performance computing (HPC) cluster applications.
- Provide digital content creation capabilities, such as computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE), digital music production and video editing, and real-time media streaming solutions.
- Require maximum performance for rendering of realistic and cinematic scenes for use in computer generated cinema, next generation computer games, and various digital and real time video processing applications.

Compatibility with the x86 architecture makes the x64 computing platform the first 64-bit platform designed to run mainstream PC applications while offering world-class performance at an affordable price. This technology is suitable for solutions ranging from consumer PCs to high performance clusters. The flexibility and scalability offered by x64 computing provides organizations with enhanced investment protection as this single architecture addresses a broad range of current and future capability and performance requirements.

### **Breaking Away with the AMD Direct Connect Architecture**

There is more to the exceptional performance of Sun Fire x64 systems than simply a processor and instruction set. The use of the AMD Direct Connect Architecture offers enterprises a superior x64 platform over traditional x86 Northbridge/Southbridge designs. Instead of a system bus which shares bandwidth among all motherboard components, the AMD Direct Connect Architecture directly connects the processors, memory controller, and I/O to the CPU to enable overall system performance and efficiency. Directly connected CPUs provide more linear, symmetrical multiprocessing. A memory controller directly connected to a CPU optimizes memory performance, while directly connected I/O provides more balanced throughput and performance. Dual-core processors extend the benefits of the AMD Direct Connect Architecture by connecting two CPU cores to each other on one die to reduce latencies between cores.

### **HyperTransport Technology**

HyperTransport technology is the high speed, high performance, point-to-point link employed by the AMD Direct Connect Architecture to provide a scalable direct connection between processors, I/O subsystems, and other chipsets. It connects the I/O to the processors at a rate of 8 GB/second aggregate bandwidth per link. These capabilities enable HyperTransport technology to help reduce the number of buses in a system, which in turn can help reduce system bottlenecks and enable today's faster microprocessors to use system memory more efficiently.

HyperTransport technology:

- Helps increase overall system performance by removing I/O bottlenecks typically found in Front Side Bus (FSB) architectures and efficiently integrating with legacy buses, increasing bandwidth and speed, and reducing processor latency.
- Provides up to 8 GB/second bandwidth per link at 16x16 bits, 1 GHz operation, providing sufficient bandwidth for supporting new interconnects, such as PCI-Express.

### Memory Interface

In traditional x86 Northbridge/Southbridge architectures, processors share a memory controller and are not directly connected to one another. Memory transactions must propagate through the Northbridge chip fabric which also carries I/O traffic. This can present a bottleneck at the front-side bus that greatly reduces productivity and performance potential. In the AMD Direct Connect Architecture, each CPU has its own integrated memory controller, fostering more linear, symmetrical multiprocessing and optimized memory performance. This direct connection to the memory controller significantly reduces the memory latency seen by the processor. Latency continues to drop as the processor frequency scales.

Additionally, hardware and software memory pre-fetching mechanisms can further reduce the effective memory latency seen by the processor. This reduction in memory latency, coupled with the additional increase in memory bandwidth enabled by a directly connected processor, presents a critical advantage as it greatly enhances system performance across all application segments.

### I/O Expansion Capability to High Speed Industry Buses

The traditional Northbridge/Southbridge architecture is not intended to support more than two core-logic elements. Adding additional high speed functionality, such as Gigabit Ethernet, PCI-Express, or the InfiniBand architecture, can impact system performance and cost. HyperTransport technology provides system designers with a high speed interconnect between system components. These elements connect in a building block fashion to achieve a platform with specific feature set and performance objectives.

### Powering Forward with Sun Fire X2100 and Sun Fire X2200 Server Performance

Getting more work done by doing it faster makes a server more valuable to the business. Powered by AMD Opteron processors, the Sun Fire x64 family of servers continues to beat the competition in performance tests, setting over 70 world record benchmarks to date — and the Sun Fire x2100 and Sun Fire X2200 servers continue this trend. Since each server can get more work done in the same time than competitive systems, the same overall workload can be processed with fewer servers in the infrastructure. With leadership that spans multiple hardware architectures and form factors, Sun Fire x64 servers surpass systems from IBM, HP, and Dell on a variety of industry benchmarks for e-mail and Web-based services, business processing and database transactions, business intelligence applications, and compute-intensive applications, such as those used in financial services, product development and manufacturing, animation, graphic design, software development, and pharmaceuticals.

More information on system performance, including a complete list of over 100 record breaking performance results achieved by Sun Fire x64 platforms, can be found at <http://sun.com/x64/benchmarks/>.

## Chapter 3

# The Sun Fire X2100 and Sun Fire X2200 Server Architecture

The Sun Fire X2100 and Sun Fire X2200 servers are rack-dense, power efficient, high performance, low cost servers rich with manageability features. With designs centered around the x64 architecture, the Sun Fire X2100 and Sun Fire X2200 servers deliver extreme power, superior flexibility, and low operational costs.

The following pages describe the architecture of the Sun Fire X2100 and Sun Fire X2200 servers in detail. The motherboard, AMD Opteron processor, memory architecture, I/O expansion, hardware RAID support, networking, power and cooling, and enclosure and rackmount designs are discussed. Because the Sun Fire X2100 and Sun Fire X2200 servers also include a service processor with very powerful management capabilities, additional detail on these important facilities can be found in the Systems Management chapter that immediately follows this one.

### Motherboard

The compact Sun Fire X2100 and Sun Fire X2200 server motherboards utilize state-of-the-art chip sets to deliver world-class performance to today's compute-intensive workloads. While these servers share a common core motherboard design, the Sun Fire X2200 server incorporates a second processor socket and twelve additional memory slots. Features integrated into, or supported by, the motherboards in the Sun Fire 2100 and Sun Fire 2200 servers include:

- High performance, dual-core AMD Opteron CPU socket that supports a single AMD Opteron 1000 Series processor (Sun Fire X2100 server) or two AMD Opteron 2000 Series processors (Sun Fire X2200 server)
- One 1 GHz 16x16 HyperTransport link per supported processor with 8GB/second bandwidth
- DDR2 667 MHz DIMM slots that support up to 4 DIMM slots and 8GB of ECC memory (Sun Fire X2100 server), or up to 16 DIMM slots and 32 GB of ECC memory, with support for 64 GB using 4 GB DIMMs expected in late 2006 (Sun Fire X2200 server)
- Nvidia nForce 3400 chip set
- Two low profile, half length, eight lane PCI-Express slots, or one sixteen lane PCI-Express slot using optional riser card (available late 2006)
- Two SATA-II lanes for disk drives
- One ATAPI channel for CD-ROM or DVD-ROM drives
- Four 10/100/1000 Base-T Gigabit Ethernet ports
- Six USB ports
- On-board PCI 2D graphics controller with 8 MB of graphics memory and HD 15 video display connector
- One serial port

Figure 3-1 and Figure 3-2 depict the designs of the Sun Fire X2100 server and Sun Fire X2200 server, respectively.

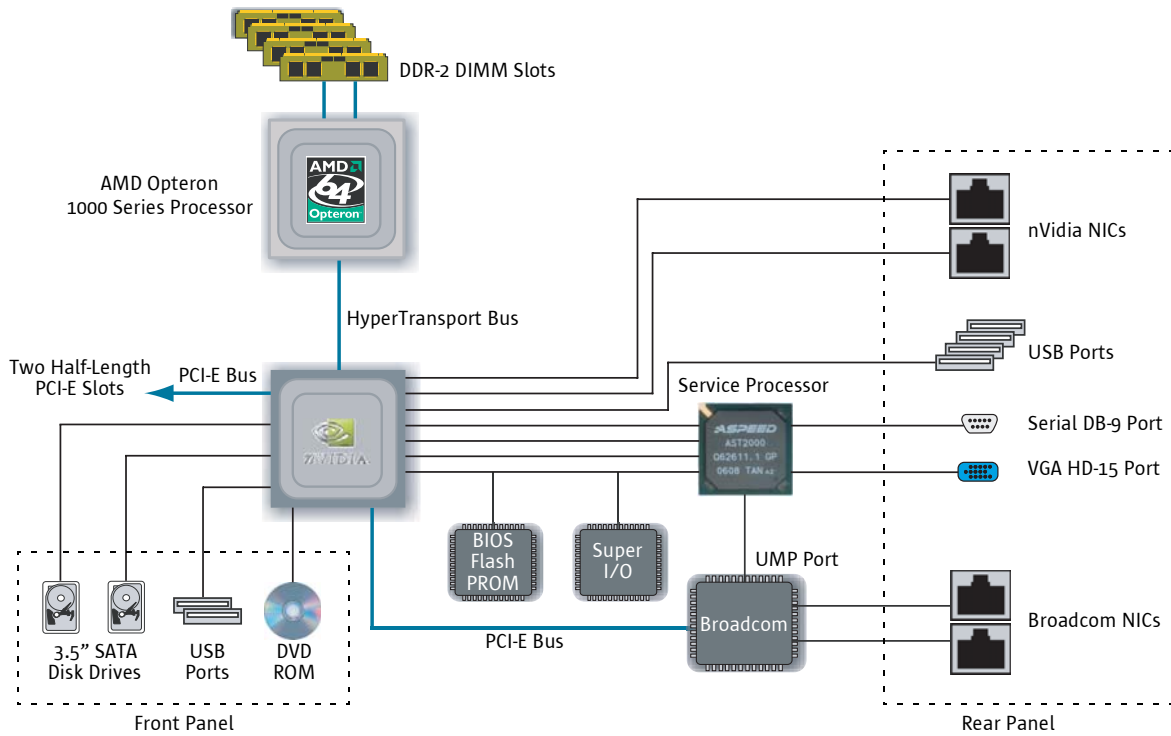


Figure 3-1. The Sun Fire X2100 system architecture offers high end performance in a compact design.

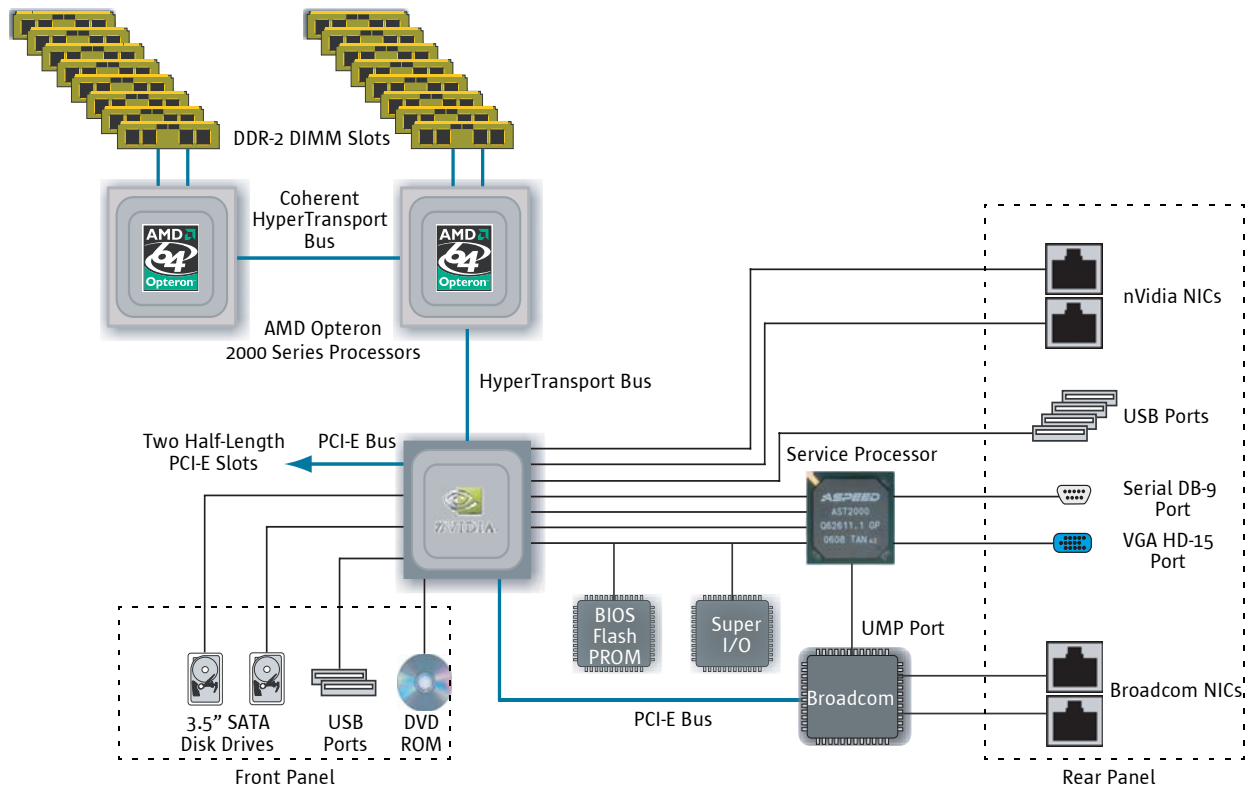


Figure 3-2. The Sun Fire X2200 system architecture scales performance with an additional CPU, memory controller, and HyperTransport link.

## The AMD Opteron™ Processor

Key to the exceptional performance of the Sun Fire X2100 and Sun Fire X2200 servers are dual-core Next Generation AMD Opteron processors running at speeds of 1.8GHz, 2.2GHz, 2.4 GHz, and 2.6GHz. The Sun Fire X2100 server utilizes AMD Opteron 1000 Series processors, while the Sun Fire X2200 server features AMD Opteron 2000 Series processors. Each processor contains two directly connected CPU cores and an integrated memory controller supporting a 128-bit wide path to memory. The primary CPU of both servers contains one 16x16 bit HyperTransport link which provides a data path to the I/O subsystem. In the Sun Fire X2200 server, the AMD Opteron 2000 Series processor provides an additional HyperTransport link that is used as a data path between processors.

The dual-core Next Generation AMD Opteron 1000 Series and AMD Opteron 2000 Series processors offer the following key features:

- One die with two CPU cores, maintaining the same power requirement as single core CPUs
- A shared memory controller with two 64-bit channels to memory
- x64 architecture (64-bit extensions) with AMD Direct Connect Architecture using HyperTransport technology
- Native support for 32-bit x86 ISA, SSE, SSE2, MMX, and 3DNow!
- One HyperTransport link supporting up to 8 GB/second of bandwidth to I/O
- One HyperTransport link supporting up to 8 GB/second of direct inter-socket coherent HyperTransport bandwidth (AMD Opteron 2000 Series processor only)
- ECC protection for Level 1 (L1) data cache, Level 2 (L2) unified cache, and DRAM with hardware scrubbing of all ECC protected arrays
- Individual 64 KB two-way associative, parity protected L1 instruction cache per CPU core with advanced branch prediction
- Individual 64 KB two-way associative, ECC protected L1 data cache per CPU core
- Individual 1 MB 16-way associative, ECC protected L2 cache per CPU core
- Exclusive cache architecture storage, in addition to L1 caches
- 256 TB of memory address space

This new generation of AMD Opteron processors provides the following improvements to reduce cost and complexity for scale-out and stand-alone system architectures:

- A socket design compatible with quad-core Next Generation AMD Opteron processors, helping reduce total cost of ownership by enabling incremental increases in system performance without the need for full server replacement.
- Architectural features, such as a consistent processor thermal window, built-in memory controller, and DDR2 memory which minimize power consumption, enabling organizations to reduce energy costs and save valuable floor space by safely cooling more systems in a single rack.
- Hardware-enabled AMD virtualization, enhancing security and reducing the complexity of implementing virtual machines by adding instructions to the hardware, selectively intercepting information destined for guest operating systems, and allowing guest operating systems to run unmodified. This feature increases operating system isolation, resulting in improved virtual machine security.

## Memory Architecture

The memory architecture of the Sun Fire X2100 and Sun Fire X2200 servers contribute to the platform's high performance and low operational costs. The CPUs employed by these servers include a low latency, high bandwidth, integrated memory controller that reduces memory access times over traditional Intel front-side bus-based memory controllers, thereby speeding application performance. The Sun Fire X2100 and Sun Fire X2200 servers use pairs of DDR2 667 SDRAM DIMMs which conserve power and reduce energy costs. DDR2 memory uses 30 percent less power than DDR1 memory and 58 percent less power than FBDIMM memory technology. Memory expansion capabilities for the Sun Fire X2100 and Sun Fire X2200 servers are detailed in Table 3-1.

*Table 3-1. Memory capacity of the Sun Fire X2100 and Sun Fire X2200 servers*

The Sun Fire X2100 server supports:	The Sun Fire X2200 server supports:
• Four DIMM Slots (2 pairs)	• Sixteen DIMM slots (8 pairs)
• 512 MB, 1 GB, and 2 GB memory DIMMs	• 512MB, 1 GB, 2GB, and 4 GB memory DIMMs <sup>a</sup>
• Up to 8 GB memory	• Up to 64 GB memory <sup>a</sup>

<sup>a</sup>.4 GB DIMMs are undergoing qualification and are expected to be released in late 2006.

The AMD Opteron processor's memory controller works in 64-bit or 128-bit mode ECC operation. For best performance, it is recommended to run 128-bit ECC operation mode. To run in 128-bit mode, populate DIMMs in pairs such that they occupy one-half of the AMD Opteron processor's 128-bit controller interface.

## PCI-Express Expansion

The PCI-Express slots in the Sun Fire X2100 and Sun Fire X2200 servers provide high bandwidth I/O access and flexible expansion to meet evolving business and application requirements. Populating these slots with optional Infiniband, Fibre Channel, Ethernet, or SCSI cards enables connectivity to additional network or storage devices. The x64 architecture with integrated memory controller and HyperTransport datapath assures CPU performance is not impacted by the addition of these high speed data cards. The Sun Fire X2100 and Sun Fire X2200 servers provide two internal 64-bit, 8-lane, low profile, half length PCI-Express slots and the option to use a riser card to create one 64-bit, 16-lane, low-profile, half length PCI-Express slot. This riser card is expected to be available in late 2006. The PCI slots support a maximum of 25 watts per card.

## Hardware RAID

The Sun Fire X2100 and Sun Fire X2200 servers support up to two hot-swappable, 3.5", 250 GB or 500 GB SATA-II disk drives. An integrated RAID controller supports RAID 0 and RAID 1 for striping and mirroring of the internal drives to provide increased reliability. Hardware RAID support is operating system dependent, requiring installation of device drivers that are available for download.

## Networking and I/O

In order to accommodate the attachment of a complement of I/O devices, the Sun Fire X2100 and Sun Fire X2200 servers provide four integrated Gigabit Ethernet ports, one serial port, six USB ports, and a VGA graphics interface. These interfaces are found on the front and back panels of the servers as shown in Figure 3-3.

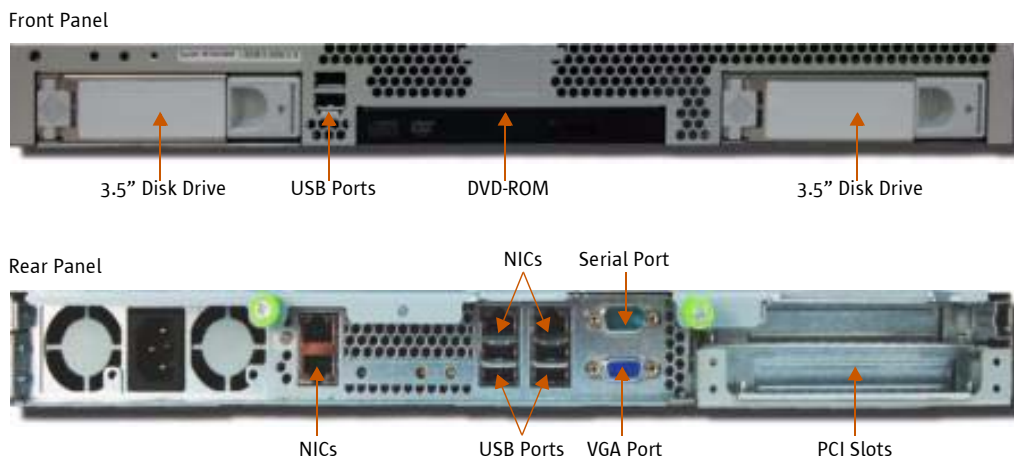


Figure 3-3. The Sun Fire X2100 and Sun Fire X2200 servers include Ethernet, USB, serial, and VGA graphics interfaces

- *Ethernet*

To support higher performance network connectivity, as well as increased network reliability when installed in failover configurations, Sun Fire X2100 and Sun Fire X2200 servers provide four Gigabit Ethernet interfaces. In addition, the port labeled NET MGT provides shared access to the physical NET 1 interface for the service processor. This feature is provided by use of the Broadcom Universal Management Port (UMP) specially designed for this purpose. The UMP port allows an internal device such as the service processor to share a host Ethernet interface without significantly affecting traffic flows to either unit.

- *Serial Port*

Adding to the administrative flexibility of these platforms, the Sun Fire X2100 and Sun Fire X2200 servers include one asynchronous serial port with a DB-9 connector. This port facilitates asynchronous transfers at speeds up to 115.2 Kbaud. This RS-232 serial port enables serial line access to both the server console and the on-board service processor command line interface.

- *USB Ports*

The six USB 2.0 ports built into the Sun Fire X2100 and Sun Fire X2200 servers provide a simple method to connect a wide variety of handheld devices for configuration management, as well as peripheral devices, such as scanners, printers, DVD players, and CD-ROM drives.

- *Graphics*

The Sun Fire X2100 and Sun Fire X2200 servers provide a VGA port for connecting video display devices. This HD-15 VGA interface supports 8 MB RAM with up to 1600x1200 resolution.

- *Removable Media*

The Sun Fire X2100 and Sun Fire X2200 servers offer an optional built-in DVD-ROM drive to enable localized physical media access.

## Enclosure and Rackmount

The compact chassis employed by the Sun Fire X2100 and Sun Fire X2200 servers saves valuable floor space, simplifies maintenance, and reduces operation costs. The Sun Fire X2100 and Sun Fire X2200 servers are 1U enclosures measuring 1.73 inches (44 mm) high, 16.8 inches (425.5 mm) wide and 24.5 inches (621.8 mm) deep. The Sun Fire X2100 server has a maximum weight of 23.45 lbs (10.66 kg) and the Sun Fire Sun Fire X2200 servers has a maximum weight of 24.64 lbs (11.60 kg). The small form factor of these servers lowers real estate costs by enabling system administrators to pack many units into a single data center rack.

This well designed enclosure provides access to configurable and upgradeable components such as CPUs, memory, and PCI cards by opening a single panel, making installation and replacement of these components simple and reliable. Power, fault, and location informational LEDs on the front and rear panel further enhance serviceability. In addition, the hot-swappable hard disk drives are front panel accessible without extracting the system from the rack. Rackmount slide rails and a cable management arm are available as options for easy installation and removal of a unit in conjunction with the use of the following cabinet types:

- Sun Fire expansion cabinet
- Sun StorEdge cabinet
- Sun Rack™ 900 or 1000 cabinets
- Third-party ANSI/EIA 310-D-1992 compliant cabinets
- Third-party IEC 60927 compliant cabinets

## Power and Cooling

The Sun Fire X2100 and Sun Fire X2200 architectural design creates a system that runs cooler and leads the industry in power efficiency, making them ideal for scale-out applications such as intensive grid computing. These servers feature a single AC power supply rated at 340 watts for the Sun Fire X2100 server and 450 watts for the Sun Fire X2200 server. In addition, front to back cooling eliminates the need to install and run rear fan doors.

## Specifications and Compliance

The Sun Fire X2100 and Sun Fire X2200 servers meet all relevant domestic and international agency safety, ergonomics, EMI, and environmental requirements. Table 3-2 and Table 3-3 summarize the Sun Fire X2100 and Sun Fire X2200 server environmental specifications and compliance, respectively.

Table 3-2. Sun Fire X2100 and Sun Fire X2200 specifications

	Sun Fire X2100 Server and Sun Fire X2200 Server
<b>AC Power</b>	<ul style="list-style-type: none"> <li>• 90-264 VAC</li> <li>• 47-63 Hz</li> </ul>
<b>Operating Temperature, Humidity (Single Non-rack System)</b>	<ul style="list-style-type: none"> <li>• 2 °C to 38 °C (36 °F to 100°F), 7% to 93% relative humidity, non-condensing</li> <li>• 27°C max wet bulb</li> </ul>
<b>Non-operating Temperature, Humidity (Single Non-rack System)</b>	<ul style="list-style-type: none"> <li>• -40 °C to 68 °C (-40° F to 154 °F), up to 93% relative humidity, non-condensing</li> <li>• 38 °C max wet bulb</li> </ul>

Sun Fire X2100 Server and Sun Fire X2200 Server	
<b>Altitude (Operating) (Single Non-rack System)</b>	<ul style="list-style-type: none"> <li>• Up to 3,000m/9000ft</li> <li>• maximum ambient temperature is derated by 1° C per 300m above 900m</li> </ul>
<b>Altitude (Non-operating) (Single Non-rack System)</b>	<ul style="list-style-type: none"> <li>• Up to 12,000 m</li> </ul>
<b>Noise Emissions</b>	<ul style="list-style-type: none"> <li>• Less than 70 dB sound power in operating mode</li> </ul>

Table 3-3. Sun Fire X2100 and Sun Fire X2200 compliance

<b>Safety</b>	<ul style="list-style-type: none"> <li>• IEC 60950</li> <li>• UL/CSA60950</li> <li>• EN60950</li> <li>• CB scheme with all country differences</li> </ul>
<b>RFI/EMI</b>	<ul style="list-style-type: none"> <li>• FCC Class A</li> <li>• Part 15.47 CFR</li> <li>• EN55022</li> <li>• CISPR 22</li> <li>• EN300-386:v1.31</li> <li>• ICES-003</li> </ul>
<b>Immunity</b>	<ul style="list-style-type: none"> <li>• EN55024</li> <li>• EN300-386:v1.3.2</li> </ul>
<b>Certifications Safety EMC</b>	<ul style="list-style-type: none"> <li>• CE Mark, GOST, GS Mark, cULus Mark, CB scheme, CCC, SMark</li> <li>• CE Mark, Emissions and Immunity Class A Emissions Levels: FCC, C-Tick, MIC, CCC, GOST, BSMI, ESTI, DOC, S Mark</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>• Labeled per WEEE (Waste Electrical and Electronic Equipment) Directive</li> </ul>

## Chapter 4

# System Management

As the number of systems in the data center escalates, the systems management burden experienced by enterprises multiplies as well. Organizations need smart, standardized methods for addressing system control, monitoring, provisioning, and patching. The Sun Fire X2100 and Sun Fire X2200 servers provide extensive built-in system management features and add-on software to help simplify system operation, reduce complexity and costs, and ease the creation and deployment of system images and updates.

### **Embedded Service Processor — Out of Band System Management**

The need for continuous operation in mission- and business-critical systems demands strong management capabilities. To meet these requirements, the Sun Fire X2100 and Sun Fire X2200 servers feature an embedded lights out manager. This built-in, hardware-based service processor enables organizations to consolidate system management functions with remote power control and monitoring capabilities. The service processor is IPMI 2.0 compliant and enables specific capabilities including system configuration information retrieval, key hardware component monitoring, remote power control, full local and remote keyboard, video, mouse (KVM) access, remote media attachment, SNMP V1, V2c, and V3 support, and event notification and logging.

Administrators simply and securely access the service processor on the Sun Fire X2100 and X2200 servers using a secure shell command line, redirected console, or SSL-based Web browser interface from a remote workstation. The Desktop Management Task Force's (DMTF) Systems Management Architecture for Server Hardware (SMASH) command line protocol is supported over both the serial interface and the secure shell network interface. A Web server and Java™ Webstart remote console application are embedded in the service processor, minimizing the need for any special purpose software installation on the administrative workstation to take advantage of Web-based access. For enhanced security, the service processor includes multi-level role based access to features. The service processor flexibly supports native and Active Directory Service lookup of authentication data. All functions can be provided out-of-band through a designated serial or network interface, eliminating the performance impact to workload processing.

### **Keyboard Video Mouse Over IP**

Providing ease of access to management functions, the service processor provides Keyboard Video Mouse (KVM) over IP to redirect the server video screen, keyboard, and mouse data to an administrative workstation via the network. Users can access the KVM over IP function in the Java Webstart remote console application by using a standard Web browser and SSL authentication.

The service processor captures the keyboard and mouse input and output at the remote workstation and emulates USB keyboard and mouse devices. The Sun Fire X2100 and Sun Fire X2200 servers then detect these emulated devices as directly connected interfaces. The service processor captures, compresses, encrypts, and sends the video output to the remote workstation. The workstation subsequently receives and displays the server's video screen. Advanced Encryption Standard (AES) governs the encryption and decryption of the control commands of the KVM to protect the managed server from intervention by a remote hacker.

Specifications for the video screen include:

- Video mode support for both text and graphics mode
- Frame resolution up to 1600x1200 @60 Hz
- Frame frequency up to 85 Hz for other resolutions
- Frame transfer rate greater than 30 frames per second for generic operation

### Virtual Storage

Simplifying access to data and media, the *virtual storage* feature of the service processor provides device emulation to enable store and retrieval operations on remote storage as if the units are physically attached to the Sun Fire X2100 or Sun Fire X2200 server. The service processor incorporates a USB 2.0 device controller that connects to the Sun Fire X2100 and Sun Fire X2200 server board USB host controller. By using the Java Webstart remote console application to launch the virtual storage function at an administrative workstation, the Sun Fire X2100 and Sun Fire X2200 servers detect USB storage device attachment. This feature applies to a variety of remote storage devices such as DVD, CD-ROM, and floppy drives, as well as USB flash disk drives and ISO image files. For example, when CD-ROM emulation is enabled, the Sun Fire X2100 and Sun Fire X2200 servers will find a USB CD-ROM. A target disk placed in the CD-ROM drive of the remote PC becomes accessible by the Sun Fire X2100 and Sun Fire X2200 server. To assure secure operation, the Advanced Encryption Standard governs remote storage transmissions. In addition, administrators can use KVM over IP and virtual storage in combination to enable remote booting, as well as remote installation of operating systems, device drivers, or application software for the Sun Fire X2100 and Sun Fire X2200 servers with the convenience of local storage devices.

### In-Band System Management

Some organizations prefer in-band system management in order to standardize administrative tasks across multi-vendor, heterogeneous environments. Using in-band system management, administrators perform monitoring and maintenance tasks through the host operating system. The Sun Fire X2100 and Sun Fire X2200 servers provide in-band systems management using two methods, IPMI v2.0 with a Keyboard Controller Style interface and IPMI kernel driver or by using SNMP operating system resident agents. IPMI 2.0 and SNMP V1, V2c, and V3 are the industry supported standards for performing autonomous platform management functions.

### Sun N1™ System Manager Software

Managing infrastructures that include a large number of servers is often difficult. Adding in a requirement to frequently provision these servers many times over during the technology life cycle provides challenge for even the most sophisticated IT organizations. The Sun N1™ System Manager software enables rapid discovery, configuration, and provisioning of hundreds of Sun servers from a single console. Designed to simplify data center management tasks, the Sun N1 System Manager software enables remote power control, operating system deployment and patching, system BIOS and firmware updates, event logging and notification, and hardware and operating system monitoring. In addition, the software features the ability to create logical groups of systems and perform actions across these groupings as easily as performing actions on a single node. By providing fast and easy access to systems for monitoring and maintenance, the Sun N1 System Management software reduces total cost of ownership and increases operational efficiency.

Sun N1 System Manager provides a simple to use and secure interface. Management tasks are executed through a hybrid user interface that integrates the graphical and command line interfaces in a single console. The software also includes role-based access control for increased security and a Web browser and command line interface for increased flexibility. Figure 4-1 shows an example of the Sun N1 System Manager user interface.

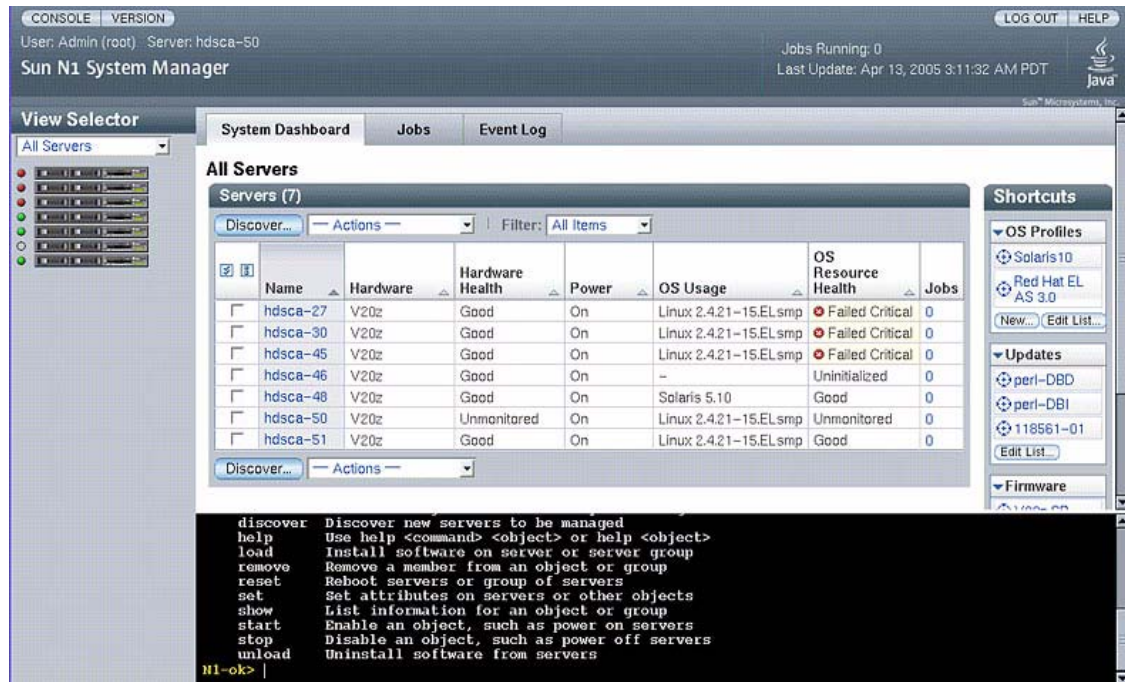


Figure 4-1. The Sun N1 System Manager software simplifies infrastructure life cycle management

The Sun N1 System Manager software is provided with a free-to-use license available for download from [http://www.sun.com/software/products/system\\_manager/index.xml](http://www.sun.com/software/products/system_manager/index.xml). Full support of Sun Fire X2100 and Sun Fire X2200 servers is planned for version 1.4 of the Sun N1 System Manager software.

## Chapter 5

# Software Operating Environment

### A Choice of Operating Systems

Providing organizations with unparalleled flexibility and investment protection, the Sun Fire x2100 and Sun Fire X2200 servers support multiple 32-bit and 64-bit operating systems, including the Solaris OS, Linux, and Windows operating environments. Sun's support for multiple operating systems enables organizations to deploy a choice of application environments without having to shift hardware platforms when software requirements change. This added flexibility enables enterprises to reduce the cost and complexity required to support and manage multiple vendors, in turn helping organizations to increase return on investment while reducing risk.

The Sun Fire X2100 and Sun Fire X2200 servers are certified to run the following operating system versions. Subsequent releases of these operating systems are also expected to be supported and qualified.

- Solaris™ 10 Operating System (Solaris 10 OS) 06/06
- Red Hat Enterprise Linux 3 U7 (32-bit)
- Red Hat Enterprise Linux 3 U7 (64-bit)
- Red Hat Enterprise Linux 4 U3 (32-bit)
- Red Hat Enterprise Linux 4 U3 (64-bit)
- SUSE Linux Enterprise Server 9 SP3 (32-bit)
- SUSE Linux Enterprise Server 9 SP3 (64-bit)
- Windows Server 2003, Standard Edition SP1 (32-bit)
- Windows Server 2003, Standard Edition SP1 (64-bit)

Additional patches and drivers required to complete the full installation of these operating systems are available on the Sun download Web site (<http://sun.com/download/>) and the Tools and Drivers CD-ROM provided with every Sun Fire X2100 and Sun Fire X2200 server. The drivers and installation scripts on the Tools and Drivers CD-ROM reduce the complexity of installing supported operating system distributions. In addition, the Solaris 10 Operating System, Red Hat Enterprise Linux 3.0, Red Hat Enterprise Linux 4.0, and SUSE Linux Enterprise Server 9 operating environments are available from Sun along with support contracts. Support contracts from Sun are also available for Microsoft Windows 2003 Standard Edition.

### The Solaris™ Operating System

In a class by itself, the Solaris 10 OS offers many innovative technologies that change the equation for organizations needing to reduce costs, minimize complexity, and eliminate risk. Optimized for Sun Fire systems with 64-bit AMD Opteron processors and supported on hundreds of third-party x86, AMD64, and EM64T systems, the Solaris 10 OS brings flexibility and power to the enterprise. Running on hardware ranging from laptops and single-board computers to data center and grid installations, the Solaris OS serves applications ranging from military command and control systems, to telecommunication switch gear, to stock trading.

Provided on all Sun systems at no charge, the Solaris OS delivers performance, security, scalability, and reliability advantages for scale-out computing environments. Underlying technologies, such as a high performance

networking stack, advanced file system, and modern memory model, combine to optimize the performance of hosted applications. A suite of security features previously only found in Sun's military-grade Trusted Solaris™ operating system are now included to fortify the commercial enterprise. The Solaris OS supports near linear scalability from 1 to 72 CPUs and addressability of up to 2<sup>64</sup> bytes of memory, well beyond the physical memory limits of even Sun's largest server. In addition, by providing the ability to automatically recover from hardware faults, the Solaris OS enables maximum data and application availability.

The most advanced operating system on the planet, the Solaris OS includes features not found in any other operating system, including:

- Solaris™ Dynamic Tracing (DTrace) is a powerful tool that provides a true, system-level view of application and kernel activities, even those running in a Java™ Virtual Machine. System administrators, integrators, and developers can use this dynamic instrumentation to reduce the time to diagnose problems from days and weeks to minutes and hours, enabling faster data-driven fixes.
- Solaris™ Containers technology provides a break-through approach to virtualization and software partitioning, enabling the creation of many private execution environments within a single instance of the Solaris OS. Using this technology, organizations can improve resource utilization, reduce downtime, and lower solution costs.
- Predictive Self-Healing technology automatically diagnoses, isolates, and recovers from many hardware and application faults. As a result, business-critical applications and essential system services can continue uninterrupted in the event of software failures, major hardware component breakdowns, and software misconfiguration problems.
- Resource management facilities built into the Solaris 10 OS enable computing resources to be allocated among individual tasks and users in a structured, policy-driven fashion. Using the Solaris OS resource management facilities to proactively allocate, control, and monitor system resources — such as CPU time, processes, virtual memory, connect time, and logins — on a fine-grained basis helps organizations obtain more predictable service levels.

## Linux Environments

Organizations seeking the broadest possible x86 platform support and open source community resources often turn to Linux. Sun offers and supports the leading Linux environments on all Sun Fire x64 servers, including Red Hat Enterprise Linux and SUSE Linux Enterprise Server. Sun support contracts for Linux provide all front line support and transparent access to back line support from Red Hat and SUSE.

As the leader in enterprise services for UNIX®, Sun brings decades of expertise to Linux environments. Indeed, Sun provides key hardware and software offerings for Linux including Java™ technology, x64-based servers and workstations, the Sun Java™ Enterprise System software stack, N1™ software, StarOffice productivity suite, and Sun™ Studio developer tools. Furthermore, Sun is one of the largest contributors to the GNU/Linux operating system. Areas of contribution include OpenOffice.org, Mozilla, and X.org.

## Microsoft Windows Environments

Organizations are constantly seeking to reduce the variety of platforms in the data center, even when a wide range of workloads are present. To help this effort, the Sun Fire X2100 and Sun Fire X2200 servers can run the Microsoft

operating environment. Indeed, the Sun Fire X2100 and Sun Fire X2200 servers have passed stringent Microsoft compatibility test suites, achieving the *Designed for Windows* certification and a listing in Windows catalogs. This certification demonstrates Sun's commitment to providing the best platforms to run not only the Solaris OS and Linux, but Windows as well.

## Chapter 6

# Summary

Increasingly competitive markets, deregulation, and globalization drive new levels of urgency and budget pressures. IT organizations must respond with solutions that can help speed operations and gain a competitive edge. If IT is to succeed, computing systems must deliver greater power and readily adapt to changes. At the same time, keeping costs low remains a priority. With hundreds of servers deployed, system management and energy costs become key factors in achieving a low total cost of ownership.

Sun Fire x64 servers featuring AMD Opteron processors are more than just a family of servers. These systems provide the modular infrastructure organizations need to rapidly deploy new solutions and adjust to changing business demands. The Sun Fire X2100 and Sun Fire X2200 servers set a new standard for low cost, high performance, entry-level computing. With an architecture that continues to set world records for performance, the Sun Fire X2100 and Sun Fire X2200 servers offer sophisticated functionality in an easy to cool compact design. Combined with a choice of operating systems and scalable system management tools, the Sun Fire X2100 and Sun Fire X2200 servers give organizations powerful, manageable servers that can help simplify the data center.

For over 20 years, Sun has brought enterprise expertise and leadership to creating computing environments that help organizations plan ahead, get ahead, and stay ahead of the competition. Now, Sun joins forces with AMD to deliver flexible, innovative products with extreme performance to the x64 market. Indeed, Sun's fast x64 servers are gaining market share at a rapid pace. By taking advantage of these extraordinary servers, businesses gain a strategic asset for their own competitive race.

## Appendix A

### References

Sun Microsystems posts product information in the form of data sheets, specifications, and white papers on its Internet web site at <http://sun.com>. Documents related to the Sun Fire x64 family of servers are available at the locations listed in Table A-1 and Table A-2.

*Table A-1. Related documents*

Web Site URL	Title
<a href="http://sun.com/blueprints/0206/819-5548.pdf">sun.com/blueprints/0206/819-5548.pdf</a>	Consolidating Legacy Applications onto Sun x64 Servers — How to Move Microsoft Windows NT Applications onto Sun x64 Servers using VMware ESX Server
<a href="http://sun.com/blueprints/0905/819-2889.html">sun.com/blueprints/0905/819-2889.html</a>	Configuring Multiboot Environments on Sun x64 Systems with AMD Opteron Processors
<a href="http://sun.com/amd/briefs/consolidation-sol-bf.pdf">sun.com/amd/briefs/consolidation-sol-bf.pdf</a>	Consolidation through Virtualization with Sun Fire x64 Servers
<a href="http://sun.com/x64/briefs/EDA_appbrief.pdf">sun.com/x64/briefs/EDA_appbrief.pdf</a>	Sun x64 Systems for EDA — Optimizing Electronic Design Automation with x64 Servers and Workstations from Sun
<a href="http://sun.com/x64/briefs/databasegrid-brief.pdf">sun.com/x64/briefs/databasegrid-brief.pdf</a>	Sun x64 Systems — Powerful Database Solutions
<a href="http://sun.com/x64/briefs/computegrid-brief.pdf">sun.com/x64/briefs/computegrid-brief.pdf</a>	Sun x64 Servers and Grids for High Performance Computing
<a href="http://sun.com/x64/briefs/Security_Brief.pdf">sun.com/x64/briefs/Security_Brief.pdf</a>	A Defense-In-Depth Approach to Security — Sun x64 Systems Featuring the AMD Opteron Processor

*Table A-2. Web sites for additional information*

Web Site URL	Description
<a href="http://sun.com/servers">sun.com/servers</a>	Sun Server Product Line
<a href="http://sun.com/software/solaris">sun.com/software/solaris</a>	Solaris 10 Operating System
<a href="http://sun.com/x64">sun.com/x64</a>	Sun x64 Product Offerings
<a href="http://sun.com/service/about">sun.com/service/about</a>	Sun Services Overview
<a href="http://sun.com/products/networking/switches">sun.com/products/networking/switches</a>	Sun Secure Application Switches
<a href="http://sun.com/storage">sun.com/storage</a>	Sun Storage Solutions
<a href="http://sun.com/solutions/blueprints">sun.com/solutions/blueprints</a>	Sun BluePrints Program
<a href="http://sun.com/products/architectures-platforms/refarch">sun.com/products/architectures-platforms/refarch</a>	Sun Reference Architectures



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