SUN FIRE™ X2100 M2 AND X2200 M2 SERVER ARCHITECTURE

Scalable, Compact, and Efficient Systems Based on Powerful Dual-Core and Quad-Core AMD Opteron™ Processors

White Paper
April 2008

Table of Contents

Executive Summary

IT organizations are under constant pressure to improve operations and lower costs. Many IT managers strive to gain efficiencies by standardizing platforms and procedures. Unfortunately, these efforts can stall as datacenters are often stocked with a mix of new 64-bit applications and a large inventory of legacy 32-bit code — requiring a variety of different chip architectures and operating environments for execution. As a result, organizations are often forced to purchase separate, incompatible servers for each type of application. This multiplatform approach reduces flexibility and increases management and acquisition costs.

At the same time, scale-out architectures are causing a rapid increase in the total number of servers deployed for each application. Many datacenter facilities are pushing toward maximum physical, power, and thermal capacity. Adding to concerns, some systems contain high-frequency processors that 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 can be difficult, 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 monitor and maintain so many servers in a cost-effective fashion.

In response to these challenges, many organizations are pursuing smarter options for building high performance and cost-effective infrastructure based on standardized components. Sun Fire™ X2100 M2 and X2200 M2 servers 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 (Solaris OS), Linux, Ubuntu, and Microsoft Windows. These modular rackmount servers are designed to Sun's exacting standards to take full advantage of the latest AMD Opteron™ processors and the AMD Direct Connect Architecture, resulting in exceptional performance and value. Adding even more value, these servers integrate lights out management with in-band and out-of-band control, improving service levels and reducing operational costs.

Sun™ also helps organizations enhance the longevity of Sun Fire X2100 M2 and X2200 M2 servers by offering upgrade paths that expand the performance and capacity of these servers while protecting initial capital investments. The latest round of enhancements introduce support for Third-Generation Quad-Core AMD Opteron processors on Sun Fire X2200 M2 servers, in addition to Second-Generation Dual-Core AMD Opteron processors on Sun Fire X2100 M2 servers. As a total package, Sun Fire X2100 M2 and X2200 M2 servers help organizations build solutions with high levels of efficiency, flexibility, and longevity.

Chapter 1
Scalable Computing without Complexity

Scale-out computing works by hosting applications across an array of inexpensive servers, maximizing server utilization, raising application availability, and lowering acquisition costs. Unfortunately, organizations sometimes find that resulting performance, power, cooling, and system management challenges outweigh the benefits. Sun Fire X2100 M2 and X2200 M2 servers (Figure 1-1) are designed to help organizations realize the positive aspects of a scale-out architecture while reducing the hidden costs and complexities.

Figure 1-1. Sun Fire X2100 M2 and X2200 M2 servers provide the foundation for smarter, more powerful infrastructure

Sun's compact Sun Fire X2100 M2 and X2200 M2 servers are designed to support enterprise needs in the areas of performance, efficiency, and system management. Dual-Core and Quad-Core AMD Opteron processors and the innovative AMD Direct Connect architecture help these servers deliver high-performance while maintaining power efficiency. An embedded service processor and Sun software tools help facilitate the task of managing many servers as one. By taking advantage of Sun Fire X2100 M2 and X2200 M2 servers, organizations can create more powerful infrastructure, reduce costs, and ease administrative burdens. Table 1-1 describes the features of Sun Fire X2100 M2 and X2200 M2 servers.

Table 1-1. Sun Fire X2100 M2 and X2200 M2 servers provide many features in a small footprint

	Sun Fire X2100 M2 Server	Sun Fire X2200 M2 Server
Enclosure	• 1U 19” rackmount system	• 1U 19” rackmount system
Processor Type	• One Dual-Core AMD Opteron 1000 Series processor	• Up to two Dual-Core or Quad-Core AMD Opteron 2000 Series processors
Processor Speed	• AMD Opteron 1222 (3.0 GHz, dual-core) • AMD Opteron 1220 (2.8 GHz, dual-core) • AMD Opteron 1218 (2.6 GHz, dual-core) • AMD Opteron 1210 (1.8 GHz, dual-core)	• AMD Opteron 2222 (3.0 GHz, dual-core) • AMD Opteron 2220 (2.8 GHz, dual-core) • AMD Opteron 2218 (2.6 GHz, dual-core) • AMD Opteron 2218 HE (2.6 GHz, dual-core) • AMD Opteron 2210 (1.8 GHz, dual-core) • AMD Opteron 2356 (2.3 GHz, quad-core) • AMD Opteron 2354 (2.4 GHz, quad-core)
Level 2 cache	Dual-core • 1 MB level 2 cache per core	Dual-core • 1MB level 2 cache per core Quad-core • 128 KB level 1 cache per core • 512 KB level 2 cache per core • 2 MB shared cache
Memory	• Four DIMM slots per CPU • Unbuffered DDR2 667 MHz memory DIMMs • 512 MB, 1 GB and 2 GB • Up to 8 GB memory • ECC error correction	• Eight DIMM slots per CPU • Registered DDR2 667 MHz SDRAM DIMMs[b] • 1 GB, 2 GB and 4 GB memory DIMMs • Up to 64 GB memory (using 4 GB DIMMs) • ECC error correction
Internal Storage	• Up to two 3.5” hot-pluggable SATA II or SAS drives • 250 GB, 500 GB, 750 GB, or 1 TB 7200 RPM SATA • 146 GB or 300 GB 15000 RPM SAS • Use of SAS drives requires SAS host bus adapter • RAID 0/1 for SAS or SATA drives with installation of optional SAS host bus adapter • EIDE tray load DVD-ROM (optional)	• Up to two 3.5” hot-pluggable SATA II or SAS drives • 250 GB, 500 GB, 750 GB, or 1 TB 7200 RPM SATA • 146 GB or 300 GB 15000 RPM SAS • Use of SAS drives requires SAS host bus adapter • RAID 0/1 for SAS or SATA drives with installation of optional SAS host bus adapter • EIDE tray load DVD-ROM (optional)
System I/O	• Four 10/100/1000 Base-T Ethernet ports • One serial DB-9 port • Six USB 2.0 ports	• Four 10/100/1000 Base-T Ethernet ports • One serial DB-9 port • Six USB 2.0 ports
Graphics	• One VGA graphics port	• One VGA graphics port
Expansion Bus	• Standard: Two internal 64-bit, 8-lane, low-profile, half length PCI Express slots • Optional: Riser card to provide one internal 64-bit, 16-lane, low-profile, half length PCI Express slot[a]	• Standard: Two internal 64-bit, 8-lane, low-profile, half length PCI Express slots • Optional: Riser card to provide one internal 64-bit, 16-lane, low-profile, half length PCI Express slot[a]
Embedded Service Processor	• IPMI 2.0 compliant • Web, graphical, and command line interface • SNMP V1, V2c, and V3 support • SSH V2 • One serial DB-9 port (shared host port) • One shared 10/100/1000 Base-T Ethernet port (one of four host network ports) • Keyboard, Video, Mouse over IP (KVM over IP) • Virtual storage	• IPMI 2.0 compliant • Web, graphical, and command line interface • SNMP V1, V2c, and V3 support • SSH V2 • One serial DB-9 port (shared host port) • One shared 10/100/1000 Base-T Ethernet port (one of four host network ports) • Keyboard, Video, Mouse over IP (KVM over IP) • Virtual storage

a. Only supported x16 lane card is PCI card needed for NVIDIA QuadroPlex system

b. If more than four DIMMs per CPU are used, memory clocks down to 533 MHz

Meeting Modern Enterprise Needs

The agility and power of Sun Fire X2100 M2 and X2200 M2 servers extends the usefulness of these systems to a broad range of industries and applications. With the flexibility to run the Solaris OS, as well as Linux and Microsoft Windows operating environments, Sun Fire X2100 M2 and X2200 M2 servers maximize application compatibility while minimizing complexity. In addition, the exceptional 64 GB memory expansion capability of the Sun Fire X2200 M2 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 Sun Fire X2100 M2 and X2200 M2 servers.

Table 1-2. Sun Fire X2100 M2 and X2200 M2 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 Services	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

With leadership that spans multiple hardware architectures and form factors, Sun Fire servers surpass competitive systems on a variety of industry benchmarks and head-to-head value comparisons. Sun Fire X2100 M2 and X2200 M2 servers represent a high value offering in rack-dense, enterprise-class, entry-level systems — providing a valuable combination of performance, flexibility, and ease of management on a limited budget. With these servers, organizations can speed results, better manage the steady stream of infrastructure changes, keep up with resource demands, and consolidate system operations.

Features of Sun Fire X2100 M2 and X2200 M2 systems include:

- High-performance AMD Opteron processors
- HyperTransport connectivity between processors and I/O
- Large memory footprint (up to 64 GB in the Sun Fire X2200 M2 server)
- Large-capacity internal storage
- RAID 0/1 support with optional host bus adaptor
- PCI Express expandability
- Built-in quad Gigabit Ethernet support
- Embedded Lights Out Management (eLOM) service processor and firmware
- Support for the Solaris OS, Linux, and Windows operating environments

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

Maximizing Solution Longevity

Sun Fire X2100 M2 and X2200 M2 servers offer outstanding features and performance in the highly competitive scale-out computing platform market. As new technology is introduced, Sun offers the opportunity to enhance existing platforms. As such, organizations can extend the useful life of solutions and optimize the investments already made in hardware, integration efforts, and training.

As an example of investment protection, the introduction of support for Quad-Core AMD Opteron processors on Sun Fire X2200 M2 servers nearly doubles computing resources without increasing power and cooling requirements. Since Quad-Core AMD Opteron processors maintain compatibility with existing 32-bit and 64-bit applications and popular operating system versions, organizations can take advantage of quad-core performance with minimal disruption and expense. AMD Opteron processors also maintain similar thermal and electrical properties across multiple CPU generations, simplifying facilities-planning tasks for the upgrade.

Two options exist for organizations that want to upgrade to Quad-Core AMD Opteron processors. One upgrade path accepts the trade-in of current Sun or competitive systems for a discount on the purchase of a new Sun Fire X2200 M2 server equipped with Quad-Core AMD Opteron processors. As an alternative, organizations can also physically replace Dual-Core AMD Opteron processors with Quad-Core AMD Opteron processors in an existing Sun Fire X2200 M2 server. Sun offers Upgrade Kits that offer all the parts, tools, and instructions needed to upgrade to quad-core performance, helping administrators and technicians successfully complete the upgrade process. Please consult your local Sun representative for details related to these upgrade paths.

Chapter 2

AMD Opteron™ Processor Technology

Sun Fire X2100 M2 and X2200 M2 servers are powered by AMD Opteron processors, utilizing AMD's Direct Connect Architecture and NVIDIA chipsets for scalability and fast I/O throughput. The Sun Fire X2100 M2 server supports Second-Generation Dual-Core AMD Opteron processors and the Sun Fire X2200 M2 server supports both Dual-Core and Third-Generation Quad-Core AMD Opteron processors. The sections that follow describe the architecture and feature set of AMD Opteron processors.

Second-Generation Dual-Core AMD Opteron Processors

Second-Generation AMD Opteron processors are native Dual-Core AMD Opteron processors that feature AMD's Direct Connect Architecture. These processors offer a common core architecture that is similar across 1-socket, 2-socket, and 4-socket systems, and is also consistent with previous generations of AMD Opteron processors. This strategy helps organizations minimize the cost of transitions while they maximize past investments in software and hardware optimization.

Innovative Processor Technology

The AMD Opteron processor offers industry-leading performance and efficiency. Dual-Core AMD Opteron processors offer the following specific advantages.

- ***AMD64 technology***

  AMD64 technology lets 64-bit operating systems provide full, transparent, and simultaneous 32-bit and 64-bit platform application multitasking. This approach lets systems run the existing installed-base of 32-bit applications and operating systems at peak performance, while providing a 64-bit migration path.

- ***Direct Connect Architecture***

  AMD's Direct Connect Architecture helps to reduce the very real challenges and bottlenecks of system architecture.

  - Memory is directly connected to the CPU, optimizing memory performance
  - I/O is directly connected to the CPU, for more balanced throughput and I/O
  - CPUs are directly connected to other CPUs, allowing for more linear symmetrical multiprocessing

- ***Integrated DDR2 memory controller***

  An on-chip DDR2 memory controller provides 144 bits, 128 bits for data, and 16 bits for ECC. Both ECC and Enhanced ECC technologies are supported, while offering low-latency memory bandwidth that scales as processors are added.

- *AMD HyperTransport technology*

  AMD HyperTransport Technology provides a scalable bandwidth interconnect between processors, I/O subsystems, and other chipsets.

- *Quad-Core upgradeability*

  AMD Opteron processors with DDR2 memory are designed to offer a seamless upgrade path from dual-core to quad-core processors. Similar power and thermal envelops help protect investments, letting organizations upgrade to Quad-Core AMD Opteron processors while realizing similar power efficiencies.

- *AMD Virtualization (AMD-V)*

  AMD Virtualization reduces overhead by selectively intercepting instructions destined for guest environments while the Direct Connect Architecture helps guest operating systems run at near native speed. A virtualization-aware integrated memory controller provides efficient isolation of virtual machine memory.

- *Enhanced performance per watt*

  Energy-efficient DDR2 memory uses up to 30 percent less power than DDR1 memory, and up to 58 percent less power than FBDIMM memory. In addition, *AMD PowerNow!* technology with Optimized Power Management can deliver performance on demand, while minimizing power consumption[1].

Dual-Core Processor Architecture

The AMD Opteron processor (Figure 2-1) was designed from the start for multicore functionality, with a crossbar switch and system request interface. This approach defines a new class of computing by combining full x86 compatibility, a high-performance 64-bit architecture, and the economics of an industry-standard processor. Enhancements of the AMD Opteron processor over the legacy x86 architecture include:

- 16 64-bit general-purpose integer registers that quadruple the general-purpose register space available to applications and device drivers as compared to x86 systems
- 16 128-bit XMM registers provide enhanced multimedia performance to double the register space of any current SSE/SSE2 implementation
- A full 64-bit virtual address space offers 40 bits of physical memory addressing and 48 bits of virtual addressing that can support systems with up to 256 terabytes of physical memory

1. For AMD PowerNow technology to work, both the operating system and server BIOS must be qualified to run AMD's PowerNow.

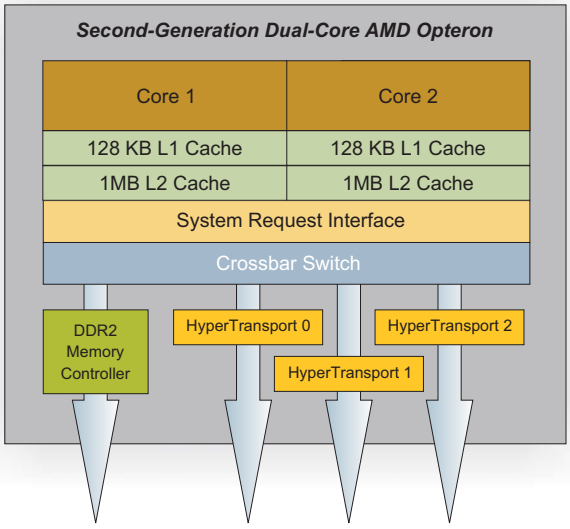

Figure 2-1. High-level architectural perspective of a Dual-Core AMD Opteron processor

Each processor core has a dedicated 1MB Level-2 cache, and both cores use the System Request Interface and Crossbar Switch to share the memory controller and access the three HyperTransport links. This sharing represents an effective approach since performance characterizations of systems based on single-core processors have revealed that the memory and HyperTransport bandwidths are typically under-utilized, even while running high-end server workloads.

The Second-Generation Dual-Core AMD Opteron processor integrates three HyperTransport technology links, providing a scalable bandwidth interconnect among processors, I/O subsystems, and other chip-sets. HyperTransport technology interconnects help increase overall system performance by removing I/O bottlenecks and efficiently integrating with legacy buses — increasing bandwidth and speed, and reducing processor latency. At 16 x 16 bits and 1 GHz operation, HyperTransport technology provides support for up to 8 GB/s bandwidth per link.

Third-Generation Quad-Core AMD Opteron Processors

Unlike other multichip module approaches to quad-core support, native Quad-Core AMD Opteron processors incorporate four processor cores on a single silicon die. Despite this innovation, Quad-Core AMD Opteron processors are electrically, thermally, and socket compatible with dual-core AMD Opteron Socket F (1207) processors. Figure 2-2 provides a block-level diagram of the Third-Generation Quad-Core AMD Opteron processor.

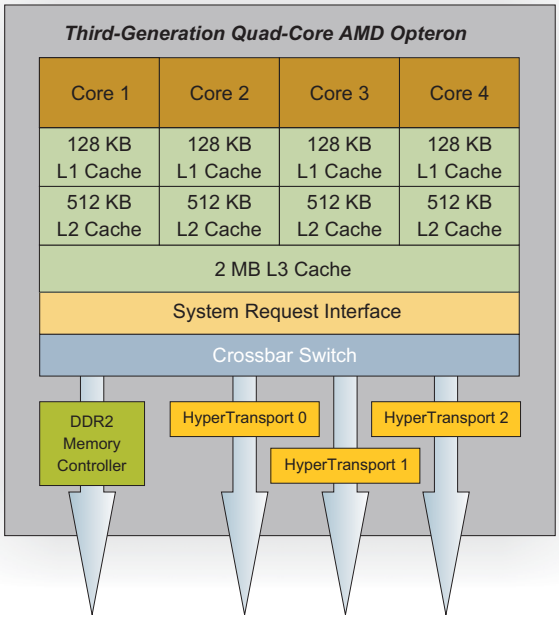

Figure 2-2. Third-Generation Quad-Core AMD Opteron processor block-level diagram

The Quad-Core AMD Opteron processor architecture features a cache controller and three stages of caches. The dedicated per-core 128 KB L1 cache provides a 64 KB instruction cache and a 64 KB for data, and is capable of delivering two data loads per cycle (rather than one load per cycle as with competing x86 processors). The latency for the L1 cache is three clock cycles with very fast access time.

The Quad-Core AMD Opteron architecture also features a dedicated per-core 512 KB L2 cache to eliminate conflicts common in shared caches. These caches are 16-way set associative, and the latency for each core to retrieve data from its L2 cache is 12 clock cycles. A large, 2 MB L3 cache is shared between all processor cores in Quad-Core AMD Opteron processors. The L3 cache is 32-way set associative and is based on a non-inclusive victim cache architecture. The latency for any core to retrieve data from the L3 cache is less than 38 clock cycles.

The L2 cache was designed for those applications that are running on a single core and consume most or all of the 2 MB L3 cache. This situation can cause a problem on other processor architectures that do not have three levels of cache, since the shared cache can be busy serving one core while the others are starved. In AMD Opteron processors, threads running on other cores can usually run effectively from the L2 cache, which is sized to accommodate the majority of modern working sets.

Advanced Processor Design

Quad-Core AMD Opteron processors go beyond simply adding two additional cores. With a native multicore design, all four cores share the same silicon, and are directly connected via AMD's Direct Connect Architecture. Processors, I/O, and memory controller logic are all connected to each other, aiding performance and reducing bottlenecks. Quad-Core AMD Opteron processors provide a broad set of significant enhancements, including:

- *Enhanced AMD PowerNow! Technology*

  Enhanced AMD PowerNow! technology provides significant power-management advancements. AMD CoolCore technology can reduce energy consumption and heat generation by turning off unused parts of the processor. Independent Dynamic Core technology allows each core to vary its clock frequency depending on the specific performance requirements of the applications it is supporting, helping to reduce power consumption.

- *Investment Protection*

  Not only are Quad-Core AMD Opteron processors the first native x86 quad-core processors, but they are the first quad-core processors designed to operate within similar thermal and power envelopes as AMD's current Dual-Core processors. This consistency allows simplified upgrades and protects enterprise investments in AMD Opteron based systems.

- *Virtualization Enhancements*

  Virtualization is memory intensive, and Quad-Core AMD Opteron processors provide exceptional memory throughput through an integrated memory controller. AMD Virtualization introduces Rapid Virtualization Indexing (formerly called "nested page tables") and translation look-a-side buffer (TLB). While TLBs exist in every processor architecture, AMD introduced tagged TLBs that can generate enhanced virtual-to-physical memory lookups from one virtual machine to another. AMD's Rapid Virtualization Indexing feature is designed to reduce the overhead penalty associated with virtualization technologies by moving the process of managing virtual memory from software to hardware. This approach reduces the complexity of existing software virtualization solutions and facilitates increased performance and efficiency for many virtualized workloads.

- *Support for High Performance Computing (HPC)*

  A variety of features coalesce in Quad-Core AMD Opteron processors to make them ideal for HPC workloads. AMD Memory Optimizer Technology increases memory throughput by up to 50 percent compared to previous generations of the AMD Opteron processor. AMD Wide Floating Point Accelerator provides 128-bit Streaming SIMD Extensions (SSE) floating point capabilities, letting each core simultaneously execute up to four floating point operations (FLOPS) per clock — four times the

floating-point computations of Dual-Core AMD opteron processors. AMD Balanced Smart Cache provides significant cache enhancements with 128 KB of Level-1 cache, and 512 KB of Level-2 cache per core, combined with 2 MB of shared Level-3 cache shared across all cores.

High-Bandwidth I/O for High Performance Computing

Implementing a multicore processor is only one part of providing fast and reliable performance. In addition to computational performance, high performance computing and other demanding applications require the ability to move data between processors, memory, and I/O with a minimum of bottlenecks. Systems with AMD Opteron processors are designed to provide high-bandwidth chip-level interconnects, to other processors, memory, and system I/O. In addition, integrated memory controllers support fast low-latency access to memory.

HyperTransport Technology

HyperTransport technology is a high-speed, low-latency, point-to-point link designed to increase the communication speed between integrated circuits in computers, servers, embedded systems, and networking and telecommunications equipment. Dual-Core and Quad-Core AMD Opteron processors continue to use HyperTransport technology links to provide a scalable bandwidth interconnect among processors, I/O subsystems, and other chip sets. HyperTransport technology:

- Helps increase overall system performance by removing I/O bottlenecks typically found in Front Side Bus (FSB) architectures, efficiently integrating with legacy buses, reducing the latency of processors, and increasing bandwidth and speed.
- Provides up to 8 GB/second per link at 16 x 16 bits, 1 GHz operation, yielding significantly more bandwidth than most current technologies, and sufficient throughput for supporting new interconnects such as PCI Express
- Uses low-latency responses and low pin counts, improving reliability
- Maintains compatibility with legacy PC buses while being extensible to new Systems Network Architecture (SNA) buses
- Appears transparent to operating systems, so that peripheral drivers continue to operate.

Integrated Memory Technology

In order to enhance performance, AMD Opteron processors integrate a DDR memory controller directly into the processor. The memory controller operates close to the frequency of the cores and provides substantial bandwidth to the processor, minimizing latencies. The performance-enhancing effect is even more dramatic within an AMD

Opteron multiprocessing environment. Since each additional processor includes a separate memory controller, memory bandwidth within the server actually scales as processors are added.

Utilizing a type of Double Data Rate (DDR) SDRAM known as DDR2 also helps speed throughput on Sun Fire X2100 M2 and X2200 M2 servers. Similar to first-generation DDR memory, DDR2 memory cells transfer data both on the rising and falling edge of the clock (a technique called “dual pumping”). The key difference between DDR and DDR2 is that in DDR2 the bus is clocked at twice the speed of the memory cells — four words of data can be transferred per memory cell cycle. As a result, DDR2 can effectively operate at twice the bus speed of DDR without speeding up the actual memory cells.

AMD Virtualization Technology

Virtualization technology lets organizations achieve higher levels of efficiency, utilization, and flexibility by dividing a given system into several virtual machines — offering the potential to consolidate many legacy systems onto one physical machine. AMD's Virtualization (AMD-V) technology provides an enhanced AMD Opteron instruction set that subsumes some tasks that virtual machine managers (VMMs) typically perform through software emulation.

Dual-Core and Quad-Core AMD Opteron processors with Direct Connect Architecture help support industry leading virtualization platform efficiency. Featuring AMD-V technology with Rapid Virtualization Indexing, Quad-Core AMD Opteron processors can accelerate the performance of virtualized applications and improve the efficiency of switching among virtual machines. AMD virtualization features help organizations host more virtual machines and users per system to maximize returns on consolidation and power-saving projects.

Quad-Core AMD Opteron processors offer enhancements to AMD-V that provide a balanced approach to improve virtualization performance and yield near-native performance for virtualized applications. AMD Opteron processors provide silicon feature-set enhancements that are designed to improve performance, reliability, and security of existing and future virtualization environments to support more users. Some of the AMD-V enhancements that are built into the Quad-Core AMD Opteron architecture are described in the sections that follow.

- ***Direct Connect Architecture to Host More Virtual Machines (VMs) per Server***

  AMD’s Direct Connect Architecture helps improve application performance within a virtual machine. This architecture provides direct CPU-to-memory, CPU-to-I/O, and CPU-to-CPU connections to streamline server virtualization. The Integrated Memory Controller is designed to improve performance on memory-intensive virtualization

environments through high bandwidth, low latency, and scalable access to memory. HyperTransport technology optimizes the movement of data and the sharing of resources among VMs and I/O for greater system scalability.

- ***Tagged Translation Look-aside Buffer for Increased Responsiveness***

  Unique to AMD Opteron processors, the Tagged Translation Look-aside Buffer (TLB) allows for faster switching times between virtual machines by maintaining a mapping to the memory space of each virtual machine. Competing solutions cannot distinguish individual memory spaces for each virtual machine, resulting in additional memory management overhead and reduced responsiveness when switching between virtual machines.

- ***Device Exclusion Vector (DEV) for More Efficient Security***

  The Device Exclusion Vector (DEV) performs security checks in hardware, protecting memory access to unauthorized requests from external devices. The DEV controls access to virtual machine memory based on permission, isolating virtual machines for secure operation. The DEV performs these security checks in hardware, rather than software — resulting in greater efficiency. The DEV creates Protection Domains that deny memory access for unauthorized requests from external devices, such as hard disks, network controllers, and other devices.

- ***Rapid Virtualization Indexing for Better Performance in a Virtualization Environment***

  Rapid Virtualization Indexing is an enhancement to AMD-V technology in Quad-Core AMD Opteron processors. This feature is designed to dramatically increase the performance of virtualized applications while providing faster switching between virtual machines. This technology allows users to host more VMs per server and maximize the benefits of virtualization. Formerly referred to as “Nested Page Tables”, this feature will need to be supported in the virtualization software.

Processor Design for Energy Efficiency

Power consumption continues to be one of the top concerns for managing today's datacenters. Dual-Core and Quad-Core AMD Opteron processors address this concern by providing industry-leading overall power-efficiency. All AMD Opteron processor series — current Single-Core, Dual-Core, Quad-Core, and future AMD Opteron processors — have been designed to a similar power and thermal specification. As a result, organizations can upgrade systems to realize significant performance gains while operating in a similar thermal envelope.

Average CPU Power

Average CPU Power (ACP) is a metric that offers a relevant estimation of the power consumption for AMD Opteron processors. ACP is determined by breaking down multiple components of power consumed within the processor, including the power

dedicated to the cores, the integrated memory controller, and HyperTransport technology links. In contrast, Thermal Design Power (TDP) is a reference point used by system designers and specifies the power that processors are capable of consuming. ACP and TDP are both valid indicators of processor power.

AMD has referenced processor power consumption using TDP values to date. However, ACP represents a relevant metric that reflects power consumption while running server-class enterprise workloads. ACP is particularly useful for datacenter operators to use when estimating power budgets to size their datacenters. TDP is more useful and relevant to system designers. As a point of comparison, Table 2-1 provides a few sample TDP and ACP values for various AMD Opteron processors.

Table 2-1. Sample TDP and ACP values for AMD Opteron Processors

AMD Opteron Processor		Low Power CPU Modules (HE)	Standard Power Modules	Performance Optimized Power (SE)
Dual-core processor	TDP	68 W	95 W	120 W
Quad-core processor	TDP	79 W	115 W	137 W
	ACP	55 W	75 W	105 W

Enhanced PowerNow! Technology and Independent Dynamic Core Technology

Enhanced AMD PowerNow! Technology is designed to reduce power consumption of the entire quad-core processor. The native quad-core design in Quad-Core AMD Opteron processors lets enhanced power management address each of the four cores independently. Independent Dynamic Core technology allows each core to vary its frequency, based on the specific needs of the application. This ability allows for more precise power management to reduce datacenter energy consumption and thereby reduce total cost of ownership (TCO).

Power consumption is related to the voltage level of the voltage supply to the processor as well as the frequency of operation. General purpose systems are designed to operate at a voltage level and frequency level that meets their peak computational performance. This level of operation can consume significant amounts of power, especially when peak processor performance is not required. Power is typically saved by reducing the supply voltage of the processor when peak performance is not needed. In this approach, the sections of the processor which are unused have the clock frequency reduced which reduces power consumption.

As shown in Figure 2-3, the core frequency with the Dual-Core AMD Opteron processor is locked based on the Core 0 load characteristics. Core 1 will operate at the same core frequency even though it's load characteristics are low. With Independent Dynamic Core Technology, the native quad-core processor can operate each of the cores at different frequencies based on the load characteristics of that particular core.

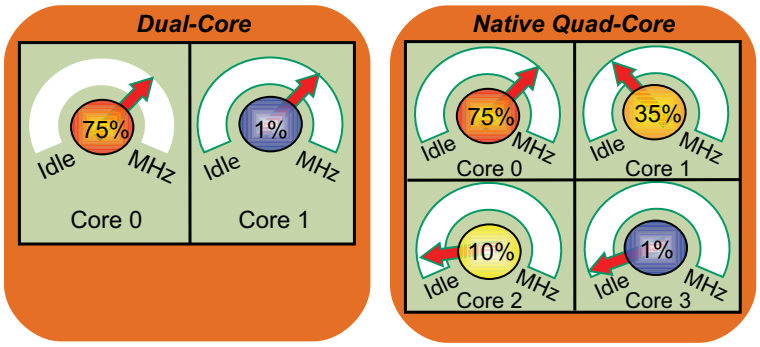

Figure 2-3. AMD Independent Dynamic Core technology adjusts frequency on a per-core basis

Chapter 3

Sun Fire X2100 M2 and X2200 M2 Server Architecture

With designs centered around the x64 architecture, Sun Fire X2100 M2 and X2200 M2 servers deliver high-performance, superior flexibility, and low operational costs. The following sections describe the architecture of these servers in greater detail. Sun Fire X2100 M2 and X2200 M2 servers also include an embedded Lights Out Management (eLOM) service processor with very powerful management capabilities. Additional detail on eLOM can be found in Chapter 4, “Systems Management”.

Motherboard

Compact Sun Fire X2100 M2 and X2200 M2 servers utilize a common motherboard design with state-of-the-art chip sets to deliver world-class performance. Ready to tackle today’s compute-intensive workloads, the Sun Fire X2100 M2 server features a single processor socket and supports up to 8 GB of memory. The Sun Fire X2200 M2 server incorporates two processor sockets and supports up to 64 GB of memory. Features integrated into, or supported by, the motherboards in Sun Fire X2100 M2 and X2200 M2 servers include:

- One processor socket that supports installation of a Dual-Core AMD Opteron 1000 Series processor (Sun Fire X2100 M2 server only)
- Two processor sockets that each support installation of a Dual-Core or Quad-Core AMD Opteron 2000 Series processor (Sun Fire X2200 M2 server only)
- One 1 GHz 16x16 Coherent HyperTransport link between each processor and the NVIDIA nForce Pro (NFP) 3600 chip set, supporting 8GB/second bandwidth
- One 1 GHz 16x16 HyperTransport link between processors (Sun Fire X2200 M2 server only)
- Four slots that support 512MB, 1GB, and 2GB unbuffered ECC DDR2 667 MHz memory DIMMs (Sun Fire X2100 M2 server only)
- 16 slots that support 1GB, 2GB, and 4GB registered ECC DDR2 667 MHz memory DIMMs (Sun Fire X2200 M2 server only)[1]
- AMD Opteron integrated memory controller supports up to 10.7 GB/second access between the processor and memory
- NVIDIA nForce Professional 3600 chip set that functions as a bridge and controller chip to provide support for SATA II, PCI Express, USB 2.0, ATA-133, Gigabit Ethernet, and PCI 33MHz 32-bit bus for legacy devices

1. Please note, the memory in the Sun Fire X2200 M2 server will clock down to 533 MHz in the BIOS for a system configuration with more than 4 DIMMs per CPU.

- Two low-profile, half-length, eight lane PCI Express slots, or one sixteen-lane PCI Express slot using optional riser card
- 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 2.0 ports
- On-board PCI 2D graphics controller with 8 MB of graphics memory and HD 15 video display connector, attached to the embedded LOM service processor
- One serial port, attached to the embedded LOM service processor

Figure 3-1 and Figure 3-2 provide high-level block diagrams of Sun Fire X2100 M2 server and Sun Fire X2200 M2 server, respectively.

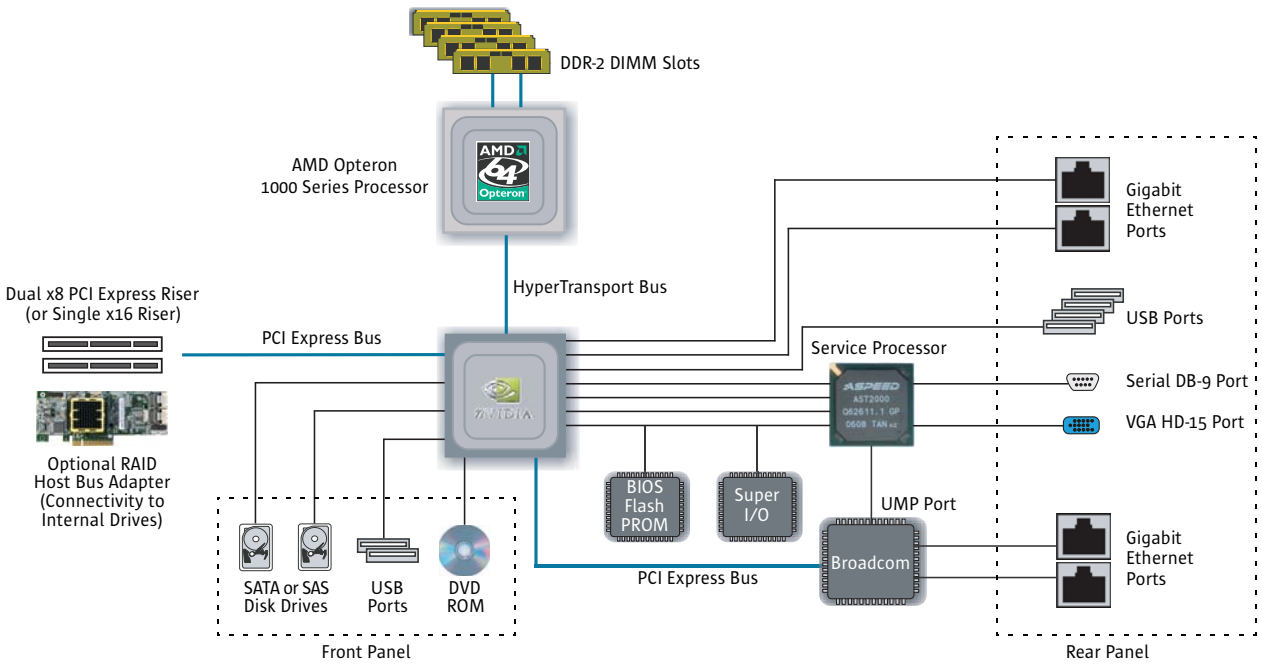

Figure 3-1. The Sun Fire X2100 M2 system architecture offers high end performance in a compact design.

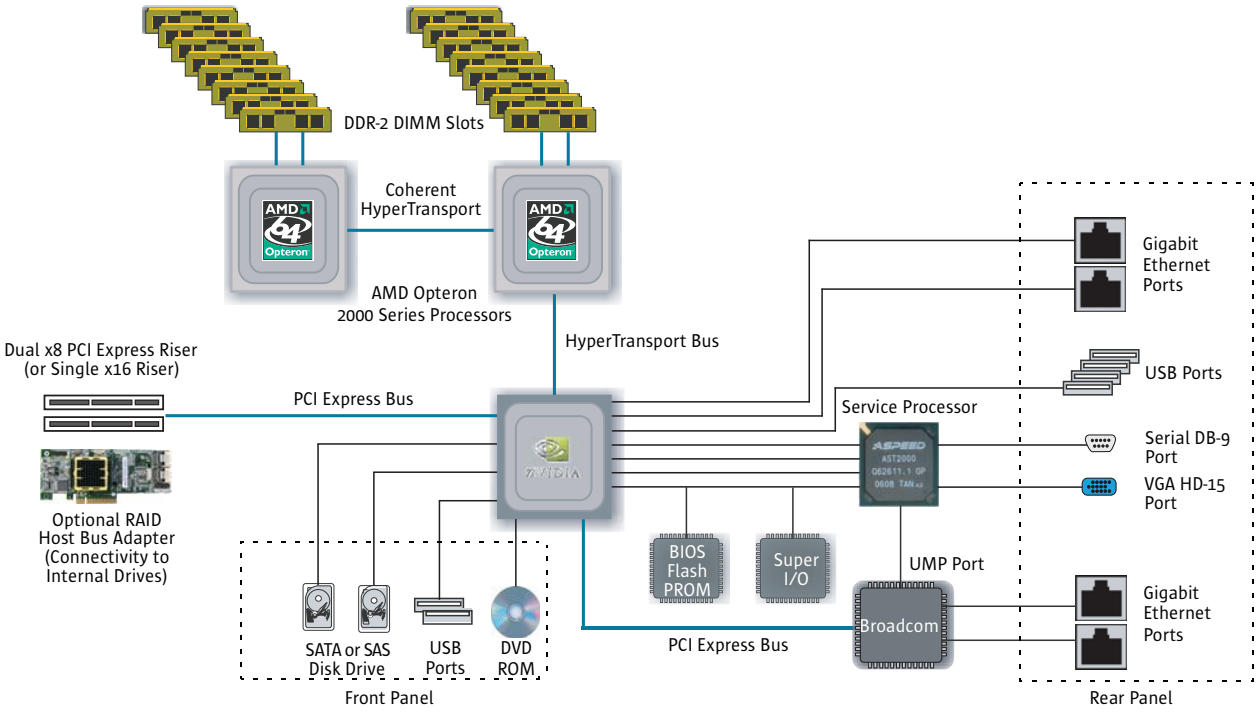

Figure 3-2. The Sun Fire X2200 M2 system architecture scales performance with an additional processor socket, and associated memory controller, and HyperTransport link.

Memory Architecture

The memory architecture of Sun Fire X2100 M2 and X2200 M2 servers contribute to the platform's high performance and low operational costs. The servers use pairs of DDR2 667 SDRAM DIMMs which conserve power and reduce energy costs. DDR2 memory uses less power than DDR1 memory and FBDIMM memory technology. Memory expansion capabilities for Sun Fire X2100 M2 and X2200 M2 servers are detailed in Table 3-1.

Table 3-1. Memory capacity of Sun Fire X2100 M2 and X2200 M2 servers

The Sun Fire X2100 M2 server	The Sun Fire X2200 M2 server
• Four DIMM Slots (2 pairs)	• Sixteen DIMM slots (8 pairs)
• 512 MB, 1 GB, and 2 GB memory DIMMs	• 1 GB, 2GB, and 4 GB memory DIMMs
• Up to 8 GB memory	• Up to 64 GB memory

The integrated memory controller in the AMD Opteron processor 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, DIMMs are populated in pairs so that they occupy one-half of the AMD Opteron processor's 128-bit controller interface.

PCI Express Expansion

The PCI Express slots in Sun Fire X2100 M2 and X2200 M2 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 provides connectivity to additional network or storage devices. The AMD64 architecture with integrated memory controller and HyperTransport datapath minimizes the performance impact of adding these high speed data cards. Sun Fire X2100 M2 and X2200 M2 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. The PCI Express slots support a maximum of 25 watts per card.

Disk Drive and Hardware RAID

Sun Fire X2100 M2 and X2200 M2 servers support up to two hot-swappable, 3.5-inch disk drives. SATA-II disk drives are available in 250 GB, 500 GB, 750 GB, or 1 TB increments. Installation of an optional PCI Express 4-port SAS host bus adapter (HBA) coverts the drive slots to support 3.5-inch, 146 GB or 300 GB SAS disk drives. However, mixing of SAS and SATA disk drives is not supported within these systems. The SAS HBA adds RAID capabilities to Sun Fire X2100 M2 and X2200 M2 servers. Both SAS and SATA drives can take advantage of RAID 0 (striping) and RAID 1 (mirroring) support offered by the SAS HBA to increase 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, Sun Fire X2100 M2 and X2200 M2 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 and Figure 3-4.

- *Gigabit Ethernet*
  To support higher-performance network connectivity, as well as increased network reliability when installed in failover configurations, Sun Fire X2100 M2 and X2200 M2 servers provide four Gigabit Ethernet interfaces. In addition, the port labeled NET MGT provides shared access to the physical NET 1 interface for the embedded LOM 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, Sun Fire X2100 M2 and X2200 M2 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 provides 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 Sun Fire X2100 M2 and X2200 M2 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*
  Sun Fire X2100 M2 and X2200 M2 servers provide a VGA port for connecting video display devices. This HD-15 VGA interface supports 8 MB of RAM for up to 1600x1200 resolution.
- *Removable Media*
  Sun Fire X2100 M2 and X2200 M2 servers offer an optional built-in DVD-ROM drive to support localized physical media access.

Figure 3-3. Front panel of the Sun Fire X2100 M2 and X2200 M2 servers

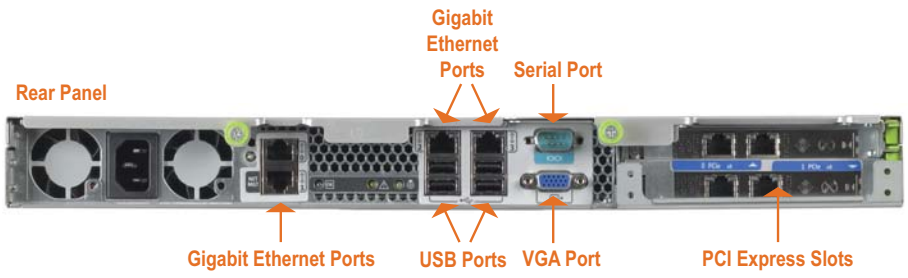

Figure 3-4. Rear Panel of the Sun Fire X2100 M2 and X2200 M2 servers

Enclosure and Rackmount

The compact chassis employed by Sun Fire X2100 M2 and X2200 M2 servers saves valuable floor space, simplifies maintenance, and reduces operation costs. The small form factor of these servers lowers real estate costs by enabling system administrators to pack many units into a single datacenter rack. Exact measurements of Sun Fire X2100 M2 and X2200 M2 servers are detailed in Table 3-2.

Table 3-2. Size and weight specifications for the Sun Fire X2100 M2 and X2200 M2 servers

	Sun Fire X2100 M2 and X2200 M2 Servers
Rack Units	1 RU
Height	1.7 inches (43 mm)
Width	16.8 inches (425.5 mm)
Depth	25.0 inches (633.7 mm)
Maximum Weight	23.5 lbs (10.7 kg) for Sun Fire X2100 M2 server 24.6 lbs (11.6 kg) for Sun Fire X2200 M2 server

This well designed enclosure provides access to configurable and upgradeable components such as processors, memory, and PCI Express 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 and don't require 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 or IEC 60927 compliant cabinets[1]

Power and Cooling

Sun Fire X2100 M2 and X2200 M2 servers run cool and provide power efficiency, making them ideal for scale-out applications such as compute-intensive cluster and grid computing. Minimizing power consumption lowers heat dissipation and enhances the ability to stack these servers tightly into racks. The Sun Fire X2100 M2 server utilizes an AC power supply rated at 345 watts and the Sun Fire X2200 M2 server includes an AC power supply rated at 450 watts.

1. Installation of the optional slide rail kit and cable management arm required

Specifications and Compliance

Sun Fire X2100 M2 and X2200 M2 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 M2 and X2200 M2 server environmental specifications and compliance, respectively.

Table 3-2. Sun Fire X2100 M2 and X2200 M2 specifications

AC Power	• 100-240 VAC (47-63 Hz), Auto-sensed
Operating Temperature, Humidity (Single Non-rack System)	• 2 ºC to 38 ºC (36 ºF to 100ºF), 7% to 93% relative humidity, non-condensing, 27ºC max wet bulb
Non-operating Temperature, Humidity (Single Non-rack System)	• -40 ºC to 68 ºC (-40º F to 154 ºF), up to 93% relative humidity, non-condensing, 38 ºC max wet bulb
Altitude (Operating) (Single Non-rack System)	• Up to 3,000m/9000ft • maximum ambient temperature is derated by 1º C per 300m above 900m
Altitude (Non-operating) (Single Non-rack System)	• Up to 12,000 m
Noise Emissions	• Less than 72 dB sound power in operating mode

Table 3-3. Sun Fire X2100 M2 and X2200 M2 compliance

Safety	• IEC 60950 • UL/CSA60950 • EN60950 • CB scheme with all country differences
RFI/EMI	• FCC Class A • Part 15 47 CFR • EN55022 • CISPR 22 • EN300-386:v1.31 • ICES-003
Immunity	• EN55024 • EN300-386:v1.3.2
Certifications **Safety** **EMC**	• CE Mark, GOST, GS Mark, cULus Mark, CB scheme, CCC, SMark • CE Mark, Emissions and Immunity Class A Emissions Levels: FCC, C-Tick, MIC, CCC, GOST, BSMI, ESTI, DOC, S Mark
Other	• Labeled per WEEE (Waste Electrical and Electronic Equipment) Directive

Chapter 4
System Management

As the number of systems in the datacenter escalates, the systems management burden multiplies as well. Organizations need smart and standardized methods for addressing system control, monitoring, provisioning, and patching. Sun Fire X2100 M2 and X2200 M2 servers provide extensive built-in system management features and integrated 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-critical and business-critical systems demands strong management capabilities. To meet these requirements, Sun Fire X2100 M2 and X2200 M2 servers feature an embedded lights out manager. This built-in, hardware-based service processor gives organizations the ability to consolidate system management functions with remote power control and monitoring capabilities. The service processor is IPMI 2.0 compliant and facilitates capabilities:

- 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
- Event notification and logging.

Administrators simply and securely access the eLOM service processor using a secure shell command line, redirected console, or SSL-based Web browser interface from a remote system. 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 system to take advantage of Web-based access. For enhanced security, the service processor includes multilevel role-based access. The service processor also 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 system 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 system and emulates USB keyboard and mouse devices. Sun Fire X2100 M2 and X2200 M2 servers then detect these emulated devices as directly connected interfaces. The service processor captures, compresses, encrypts, and sends the video output to the remote system which 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 enhance the security of the managed server.

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 eLOM service processor provides device emulation to facilitate store and retrieval operations on remote storage — as if the storage was physically attached to the server. The service processor incorporates a USB 2.0 device controller that connects to the USB host controller. By using the Java Webstart remote console application to launch the virtual storage function at an administrative system, Sun Fire X2100 M2 and X2200 M2 servers detect USB storage device attachment.

This virtual storage 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 in use, a target disk placed in the CD-ROM drive of the remote PC becomes accessible by the 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 accomplish remote booting, as well as remote installation of operating systems, device drivers, or application software 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 multivendor, heterogeneous environments. Using in-band system management, administrators perform monitoring and maintenance tasks through the host operating system. Sun Fire X2100 M2 and X2200 M2 servers provide in-band systems management using either, SNMP agents that reside in the operating system, or through IPMI 2.0 with a keyboard controller style interface and IPMI kernel driver. IPMI 2.0 and SNMP V1, V2c, and V3 are the industry-supported standards for performing autonomous platform management functions.

Sun xVM Ops Manager Software

Managing infrastructure that includes a large number of servers is often difficult. Current infrastructure trends can result in the provisioning of servers many times over during the technology life cycle, providing a challenge for even the most sophisticated IT organizations. Heterogeneous infrastructure that requires use of multiple provisioning and maintenance procedures can create even more administrative burden. Sun xVM Ops center software is a complete solution for managing and virtualizing datacenter infrastructure consisting of systems from multiple vendors, including support for servers with SPARC®, Intel, and AMD processors running the Solaris OS and Linux operating environments.

Sun xVM Ops Manager software provides rapid discovery, configuration, and provisioning of hundreds of servers from a single console. Designed to simplify datacenter management tasks, the Sun xVM Ops Manager software facilitates the following tasks:

- Bare metal operating system deployment
- Hypervisor management
- Application provisioning
- Automated software updates
- System BIOS and firmware updates
- Event logging and notification
- 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, Sun xVM Ops Manager software reduces total cost of ownership and increases operational efficiency.

Chapter 5
A Universal Computing Platform

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. The AMD64 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 AMD64 ISA yields 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 AMD64 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, signal processing, physics, medical research, telecommunications, encryption, and compression.
- Require large, high throughput database performance, including decision support, searching and indexing, 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.

A Choice of Operating Systems

Based on the AMD64 architecture, Sun Fire X2100 M2 and X2200 M2 servers provide organizations with unparalleled flexibility and investment protection. Sun Fire X2100 M2 and X2200 M2 servers support a variety of 32-bit and 64-bit operating systems, including the Solaris OS, Linux, and Microsoft Windows operating environments. Sun Fire X2200 M2 servers also support VMware ESX server. Sun's support for multiple operating systems lets organizations deploy a choice of application environments without having to shift hardware platforms when software requirements change. This added flexibility can reduce the cost and complexity required to support and manage systems from multiple vendors, in turn helping organizations to increase return on investment while lowering risk.

Sun Fire X2100 M2 and X2200 M2 servers are certified to run the operating system versions found in Table 5-1. Subsequent releases of these operating systems are also expected to be supported and qualified. Additional patches and drivers required to complete the full installation of these operating systems are available on the Sun download Web site at *http://sun.com/download/*. The Solaris 10 Operating System, Red Hat Enterprise Linux SUSE Linux Enterprise Server, and Microsoft Windows operating environments, as well as VMware virtualization products are available from Sun along with support contracts.

Table 5-1. Supported Operating Systems for Sun Fire X2100 M2 and X2200 M2 Servers

Systems	Supported Operating Systems and Environments
Sun Fire X2100 M2 and X2200 M2 Servers with Dual-Core AMD Opteron processors	• Solaris OS 10 06/06 • Red Hat Enterprise Linux 3, U8 • Red Hat Enterprise Linux 4, U4 • Red Hat Enterprise Linux 5 • SUSE Linux Enterprise Server 9, SP 3 • SUSE Linux Enterprise Server 10 • Ubuntu 8.04 LTS • Windows Server 2003, Enterprise and Standard Editions, SP1 • VMware ESX Server 3.0.2 (Sun Fire X2200 M2 only)
Sun Fire X2200 M2 Servers with Quad-Core AMD Opteron processors	• Solaris OS 10 05/08 • Red Hat Enterprise Linux 4, Update 5 • Red Hat Enterprise Linux 5, Update 1 • SUSE Linux Enterprise Server 10, SP1 • Ubuntu 8.04 LTS • Windows Server 2003, Enterprise and Standard Editions, SP1

The Solaris™ Operating System

Distributed under a commercial and open source licensing model, the Solaris 10 OS offers many innovative technologies that change the equation for organizations needing to reduce costs, minimize complexity, and eliminate risk. The Solaris 10 OS is optimized for Sun systems and supported on over one thousand third-party x86/x64

systems. In addition, the Solaris 10 OS is free for download without requirement to purchase a support contract, offering an economic advantage over other community-based operating system offerings.

Taking advantage of the Solaris 10 OS can bring added flexibility and power to the enterprise. Running on hardware ranging from laptops and single-board computers to datacenter and cluster installations, the Solaris 10 OS serves applications ranging from military command and control systems, to telecommunication switch gear, to stock trading. The Solaris 10 OS also includes more than 180 applications from the free and open source software (F/OSS) community, and thousands of others are freely available for download over the Internet.

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^{64} 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 provides maximum data and application availability.

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, providing 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.
- *Sun 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 allow 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 systems. Resources such as CPU time, processes, virtual memory, connect time, and logins can be managed on a fine-grained basis to help organizations obtain more predictable service levels.

Linux Environments

Sun offers and supports the leading Linux variants on Sun Fire x64 servers, including Red Hat Enterprise Linux and Novell SUSE Linux Enterprise Server. As the leader in enterprise services for UNIX®, Sun brings decades of expertise to Linux environments. Sun support contracts for Linux provide all front-line support and transparent access to back-line support from Red Hat and Novell.

Sun is one of the largest contributors to the open-source community. Areas of contribution include OpenOffice.org, Mozilla, GNOME, and X.org. In addition, Sun provides key software offerings for Linux including

- Lustre parallel file system
- Sun Ray™ Server Software
- Sun xVM software
- StarOffice productivity suite
- Java Desktop Powered Program
- Sun Studio, Java Studio Creator, and NetBeans IDE software
- MySQL™ database

Microsoft Windows Environments

Organizations are constantly seeking to reduce the variety of platforms in the datacenter, even when a wide range of workloads are present. To help this effort, Sun Fire X2100 M2 and X2200 M2 servers can run the Microsoft Windows operating environment. Sun Fire X2100 M2 and X2200 M2 servers have passed stringent Microsoft compatibility test suites, achieving the *Designed for Windows* certification and a listing in Microsoft Windows catalogs. Support contracts for Microsoft Windows are also available from Sun. This certification and support demonstrates Sun's commitment to providing the best platforms to run not only the Solaris OS and Linux, but Microsoft Windows as well.

VMware

Ground-breaking virtualization solutions from VMware help improve asset utilization, operational efficiency, and business agility. Sun offers the VMware Infrastructure product suite on Sun hardware systems with full support from Sun. VMware virtualization technology also combines with key Solaris 10 OS features such as, DTrace, Solaris Containers, and Solaris Predictive Self Healing software. As a result, organizations can create breakthrough approaches to virtualization. In fact, utilizing

VMware virtual infrastructure software with the Solaris 10 OS for consolidation projects can increase system utilization by up to ten times. By taking advantage of technology from VMware, enterprises can further capitalize on the high performance, scalability, and energy efficiency of Sun Fire X2200 M2 servers[1].

1. At the time of this writing, VMware is supported on Sun Fire X2200 M2 servers with Dual-Core AMD Opteron processors. Support for VMware on Sun Fire X2200 M2 servers with Quad-Core AMD Opteron processors is planned for the future.

Chapter 6
Conclusion

Increasingly competitive markets, deregulation, and globalization are driving new levels of urgency and budget pressures. IT organizations must respond with solutions that can speed operations and help organizations 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 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. Sun Fire X2100 M2 and X2200 M2 servers set a new standard for low-cost, high-performance, entry-level computing. With an architecture built to deliver high-performance, Sun Fire X2100 M2 and X2200 M2 servers offer sophisticated functionality in an easy-to-cool compact design. Combined with a choice of operating systems and scalable system management tools, Sun Fire X2100 M2 and X2200 M2 servers give organizations powerful, manageable servers that can help simplify the datacenter.

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. Sun Fire X2100 M2 and X2200 M2 servers are no exception. By taking advantage of these extraordinary servers, businesses gain a strategic asset for their own competitive race.

For More Information

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 X2100 M2 and X2200 M2 servers are available at the locations listed in Table 6-1.

Table 6-1. Web sites for additional information

Web Site URL	Title
sun.com/servers/entry/x2100	Sun Fire X2100 M2 server
sun.com/servers/x64/x2200	Sun Fire X2200 M2 server
sun.com/software/solaris	Solaris 10 Operating System
sun.com/x64	Sun x64 Product Offerings
sun.com/service	Sun Services Overview
sun.com/xvmopscenter	Sun xVM Ops Manager
sun.com/software/linux	Linux Offerings from Sun
sun.com/software/windows	Microsoft Windows offerings from Sun
sun.com/vmware	VMware offerings from Sun
amd.com/opteron	AMD Opteron Processors

Sun Microsystems, Inc. 4150 Network Circle, Santa Clara, CA 95054 USA **Phone** 1-650-960-1300 or 1-800-555-9SUN (9786) **Web** sun.com

04/08