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# Sun Blade 6000 Server Module Architecture

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|   |    |
|---|----|
| Introduction .....  | 1  |
| Flexible and Expandable Sun Blade 6000 Modular Systems .....                          | 1  |
| Focus of This Paper .....   | 1  |
| Sun Blade 6000 Server Modules Overview .....  | 2  |
| A Choice of Processors .....  | 2  |
| Supported Server Modules and Their Capacities.....                                    | 2  |
| Enterprise-Class Features .....   | 3  |
| A Choice of Operating Systems and Virtualization Support .....                        | 3  |
| Oracle Solaris Support on all Server Modules .....                                    | 4  |
| Oracle VM Server for SPARC Processor Support in SPARC T-Series Server<br>Modules..... | 4  |
| Server Module Architectures .....   | 5  |
| SPARC T5-1B Server Module .....   | 5  |
| SPARC T5 Processor Architecture .....   | 6  |
| SPARC T5-1B Server Module Architecture.....   | 7  |
| SPARC T4-1B Server Module .....   | 9  |
| The SPARC T4 Processor.....   | 10 |
| SPARC T4-1B Server Module Architecture.....   | 10 |
| SPARC T4 Processor Architecture .....   | 12 |
| Sun Blade X4-2B Server Module .....   | 13 |
| Intel Xeon Processor E5-2600 v2 Product Family.....                                   | 14 |
| Sun Blade X4-2B Server Module Architecture .....                                      | 16 |
| Sun Blade X3-2B Server Module .....   | 17 |
| Intel Xeon Processor E5-2600 Product Family .....                                     | 18 |
| Sun Blade X3-2B Server Module Architecture .....                                      | 20 |
| Conclusion .....  | 21 |
| For More Information .....  | 22 |

## Introduction

While many blade systems promise dense packaging to support consolidated infrastructures, most are limited in flexibility and cannot be expanded to handle the scalability requirements of today's high-end Web services and enterprise IT applications. Sun Blade 6000 modular systems are designed with an open architecture and the latest technology so that they can provide high performance, scalable capacity, and massive levels of I/O for the most demanding application environments.

### Flexible and Expandable Sun Blade 6000 Modular Systems

Sun Blade 6000 modular systems support flexible and expandable configurations, built from a range of standard hot-plug, hot-swap modules, including:

- Sun Blade X4-2B and X3-2B, and SPARC T5-1B and T4-1B server modules which can be mixed in any combination up to 10 modules per chassis
- Blade-dedicated PCI Express (PCIe) ExpressModules (EM), which support industry-standard PCIe interfaces and provide each blade with its own unique I/O configuration (just like rack servers)
- NEMs, providing access and an aggregated “chassis-wide” common interface to all of the server modules in the Sun Blade 6000 chassis
- Integral chassis monitoring module (CMM) for transparent management access to server and storage modules
- Hot-swap (N+N) power supply modules and hot-swap redundant (N+1) fan modules

With common system components and a wide choice of compute and I/O modules, organizations can scale capacity of both processing power and I/O throughput with fine or coarse granularity. Sun Blade 6000 modular systems also give organizations a choice of operating systems and virtualization environments. They are optimized to run Oracle Linux, Oracle Solaris and Oracle VM, and are also certified to run Red Hat Enterprise Linux, SUSE Linux Enterprise Server, Windows Server and VMware.

### Focus of This Paper

This paper provides an in-depth review of the architecture of Sun Blade 6000 server modules, describing how Oracle's Sun Blade 6000 server modules are designed to protect investments through industry-leading scalability and an open architecture that leverages industry standard components.

This paper is part of a series of white papers about the architecture of Sun Blade 6000 modular systems. The other two white papers in the series include:

- *Oracle's Sun Blade 6000 Modular Systems* — An overview of the Sun Blade 6000 modular systems architecture.
- *Sun Blade 6000 I/O and Management Architecture* — An in-depth review of the I/O, storage, and management components of the Sun Blade 6000 modular systems architecture.

## Sun Blade 6000 Server Modules Overview

The ability to host demanding compute, memory, and I/O-intensive applications is ultimately dependent on the characteristics of the actual server modules. The innovative Sun Blade 6000 chassis provides customers with considerable flexibility in terms of delivering powerful server modules for a broad range of applications.

Except for labeling, all server modules feature a physically similar front panel design. This design is intentional since any server module can be used in any slot of the chassis, no matter what the internal architecture of the server module. As mentioned, all server modules use the same midplane connectors and have similar I/O capabilities.

Up to 10 Sun Blade 6000 family server modules can be inserted vertically beneath the power supply modules in the front of the chassis. Depending on the server module, up to four slots for storage (HDDs or SSDs) media are provided for easy hot-swap access from the front of the server module. Power efficient solid-state drives (SSDs) based on innovative enterprise Flash technology can be used instead of SAS hard disk drives (HDDs). Indicator LEDs and a high density I/O port are also provided on the front of the server modules for easy access. A number of connectors are provided through the high-density front panel communications port of each server module. These ports are broken out using an available server module adaptor multiport “dongle” cable. Depending on the server module, available ports include a VGA HD-15 monitor port, two USB 2.0 ports, and a DB-9 or RJ-45 serial port that connects to the server module and integral service processors.

### A Choice of Processors

By providing a choice of Oracle SPARC or Intel Xeon processors, the Sun Blade 6000 modular systems can serve a wide range of applications and workloads. Organizations are free to choose the platform that best satisfies their requirements. Server modules of different architectures (SPARC and x86) can co-reside within the same Sun Blade 6000 chassis.

### Supported Server Modules and Their Capacities

Table 1 lists the server modules supported in Sun Blade 6000 modular systems and identifies their capacity in terms of number of processors, cores, threads, and maximum memory.

**TABLE 1. CAPACITIES FOR SUN BLADE 6000 SERVER MODULES**

| SERVER MODULE             | PROCESSOR(S)         | MAXIMUM CORES/THREADS  | MEMORY SLOTS       |
|---------------------------|----------------------|------------------------|--------------------|
| SPARC T5-1B Server Module | 1 SPARC T5 processor | • 16 cores 128 threads | 16 DDR3 DIMM slots |
| SPARC T4-1B Server Module | 1 SPARC T4 processor | • 8 cores 64 threads   | 16 DDR3 DIMM slots |

|                               |   |   |  |
|-------------------------------|---|---|--|
| Sun Blade X4-2B Server Module | 2 Intel Xeon processor E5-2600 v2 product family CPUs | <ul style="list-style-type: none"> <li>• Quad core: 8 cores, 16 threads</li> <li>• Six Core: 12 cores, 24 threads</li> <li>• Eight Core: 16 cores, 32 threads</li> <li>• Ten Core: 20 cores, 40 threads</li> <li>• Twelve Core: 24 cores, 48 threads</li> </ul> | 24 DDR3 DIMM slots – 1600 MT/s support |
| Sun Blade X3-2B Server Module | 2 Intel Xeon processor E5-2600 product family CPUs    | <ul style="list-style-type: none"> <li>• Quad Core: 8 cores, 16 threads</li> <li>• Six Core: 12 cores, 24 threads</li> <li>• Eight Core: 16 cores, 32 threads</li> </ul>  | 24 DDR3 DIMM slots – 1600 MT/s support |

## Enterprise-Class Features

Unlike most traditional blade servers, Sun Blade server modules provide a host of enterprise features that help ensure greater reliability and availability:

- Each server module supports hot-plug capabilities
- Disk Capacity varies between server modules, but when provided (two- or four-disk models), disks are hot-pluggable and provide the option of RAID controllers<sup>1</sup>
- Redundant hot-swap chassis-integrated fans mean greater reliability for the server modules due to a reduction in parts
- Redundant hot-swap chassis-integrated power supply modules mean that no power supplies are located in individual server modules, thereby increasing the reliability of the server modules
- Leveraging chassis-based infrastructure components (power supplies, fans etc.) means there are fewer moving parts on the individual server modules which greatly helps increase reliability and reduce power/cooling requirements

## A Choice of Operating Systems and Virtualization Support

In order to provide maximum flexibility and investment protection, the server modules support a choice of operating systems, including:

- Oracle Solaris
- Multiple versions of the Linux operating system, including Oracle Linux, 64-bit Red Hat, SUSE
- Microsoft Windows Server

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<sup>1</sup> RAID expansion modules (REMs) are supported by the T4-1B, X4-2B and X3-2B server modules.

Virtualization Software:

- Oracle VM
- VMware

## Oracle Solaris Support on all Server Modules

Among the available operating systems, Oracle Solaris is ideal for large-scale enterprise deployments. Supported on all the Sun Blade server modules, Oracle Solaris has certain hardware-specific features that can enhance performance, efficiency, and reliability — with different features mapped to the CPU architecture as noted.

Additional information about the Oracle Solaris operating system are provided in the architecture overview white paper, “Oracle’s Sun Blade 6000 Modular Systems,” and on the Web at:

<http://www.oracle.com/technetwork/server-storage/solaris/overview/>.

## Oracle VM Server for SPARC Processor Support in SPARC T-Series Server Modules

Supported in all Sun SPARC servers that utilize Sun processors, Oracle VM Server for SPARC (formerly Sun Logical Domains) provides a full virtualization layer. Multiple independent virtual machines, each with their own operating system instance, enable virtualized processor, memory, storage, console, and cryptographic devices. Within the Oracle VM Server for SPARC architecture, a small firmware layer known as the Hypervisor provides a stable, virtualized machine architecture to which an operating system can be written. As such, each logical domain is completely isolated. The maximum number of virtual machines created on a single platform relies upon the capabilities of the underlying hardware architecture and the Hypervisor as opposed to the number of physical hardware devices installed in the system. For example, the SPARC T4-1B supports up to 64 logical domains, while the SPARC T5-1B Server supports up to 128 logical domains, and each individual logical domain can run a unique instance of the operating system<sup>2</sup>.

By taking advantage of Oracle VM Server for SPARC, organizations gain the flexibility to deploy multiple operating systems simultaneously on a single server module. In addition, administrators can exploit virtual device capabilities to transport an entire software stack hosted on a logical domain from one physical machine to another. Logical domains can also host Oracle Solaris Zones (formerly Oracle Solaris Containers) to capture the isolation, flexibility, extensive granularity and manageability features of both technologies. By deeply integrating logical domains with both the industry-leading multi-core and multi-thread capabilities of the SPARC T5 and SPARC T4 processors and the Oracle Solaris OS, Oracle VM Server for SPARC technology increases flexibility, isolates workload processing, and improves the potential for maximum server utilization.

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<sup>2</sup> Though technically possible, this practice is not generally recommended.

## Server Module Architectures

The T5-1B, T4-1B, X4-2B and X3-2B server modules are described in the subsections that follow. The Sun Blade X4-2B server module employ processors from the Intel Xeon processor E-2600 v2 product family whereas the SPARC T5-1B and SPARC T4-1B server modules utilize SPARC T5 and SPARC T4 processors, respectively.

The server module descriptions that follow contain some information about I/O processing and storage capabilities that are specific to the server modules. However, they do not cover I/O and storage, and networking technologies that can be deployed in a top-of-rack (ToR) configuration to support all server modules within a Sun Blade 6000 rack. For additional information about I/O and management components related to these blade servers, refer to the white paper, “Sun Blade 6000 I/O and Management Architecture,” which describes the PCIe ExpressModules (EMs), NEMs, Sun Blade Storage Module M2, and the chassis monitoring module (CMM).

### SPARC T5-1B Server Module

The SPARC T5-1B Server Module is a single-socket SPARC system based on the latest generation SPARC T5 processor. The SPARC T5-1B Server Module comes equipped with the new SPARC T5 3.6GHz processor and is packed with 16 DIMM slots supporting up to 256GB DDR3 memory.

The physical layout out of the SPARC T5-1B server module is shown in Figure 1.

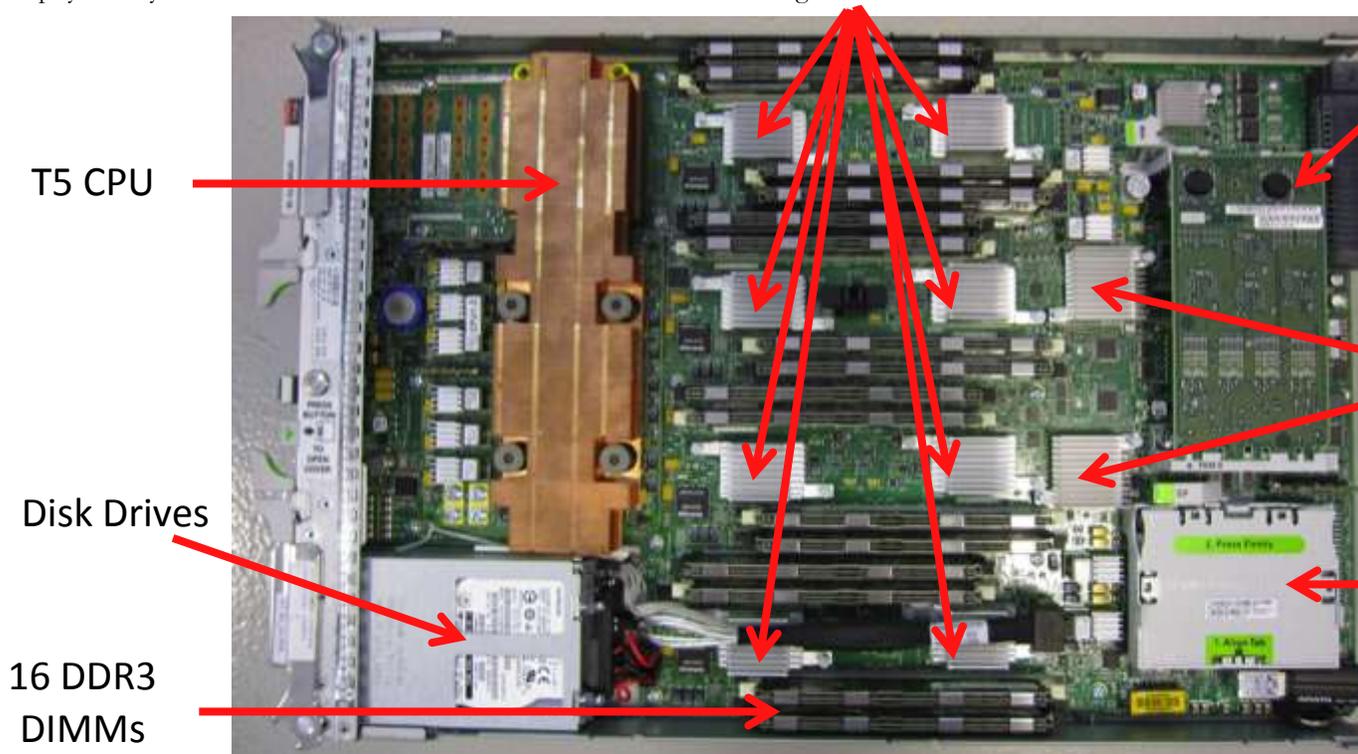


Figure 1. The SPARC T5-1B server module supports a single SPARC T5 processor.

The SPARC T5 systems have been designed specifically for the most demanding data-intensive and enterprise workloads that require the very highest levels of performance, reliability, scalability and security. SPARC T5 builds on the momentum begun with SPARC T4 by increasing SPARC's already record-setting single-thread performance, while simultaneously doubling the number of compute cores. These extraordinary engineering improvements deliver a 2.3x increase in throughput performance.

#### The SPARC T5 Processor

- 16 S3cores, 128-threads, 3.6GHz
- Private 128k L2 cache
- Shared 8MB L3 cache
- On-chip PCIe 3.0\*
- 28nm processtechnology

Crypto Instruction Accelerators enable high-speed encryption for over a dozen industry standard ciphers including DES, 3DES, AES, SSL, and RSA. By integrating encryption capabilities directly inside the instruction pipeline the SPARC T5 processor eliminates the performance and cost barriers typically associated with secure computing

The SPARC T5 processor uses a robust out-of-order, dual-issue processor core that is heavily threaded among eight strands. Additionally, each core has a 16-stage integer pipeline to achieve high operating frequencies, advanced branch prediction to mitigate the effect of a deep pipeline, and dynamic allocation of processor resources to threads. The SPARC T5 processor includes sixteen of these cores, a private 128KB L2 cache per core, a shared 8MB L3 cache with full crossbar, four dual channel memory control units, two PCI Express 3.0 interfaces and seven inter-CPU coherency links – which when combined with a new high performance directory based protocol enables T5 systems to scale to eight sockets without any additional silicon. The T5 processor also includes new advanced power management features such Dynamic Voltage and Frequency Scaling (DVFS), per core pair cycle skip, link scaling and memory control unit low power states which means that power consumption will scale well with work load.

The SPARC T5 processor was designed from the ground up with security as a focus and has Cryptographic Instruction Accelerators integrated directly into each processor core. These accelerators enable high-speed encryption for over a dozen industry standard ciphers including DES, 3DES, AES, SSL, and RSA. By integrating encryption capabilities directly inside the instruction pipeline the SPARC T5 processor eliminates the performance and cost barriers typically associated with secure computing.

\* Cards that are categorized as PCIe 3.0 are qualified to run with the T5-1B, however due to midplane restriction, will only run at 2.0 speeds. Between switch and CPU, the Blade runs at PCIe 3.0. Due to midplane connector capabilities, the speed from switch to the EM/NEM is limited to PCIe 2.0 speed.

#### SPARC T5 Processor Architecture

The SPARC T5 processor further extends Oracle's multicore/multithreaded initiative with an elegant and robust architecture that delivers real performance to applications. Figure 2 provides a block-level diagram of the SPARC T5 processor.

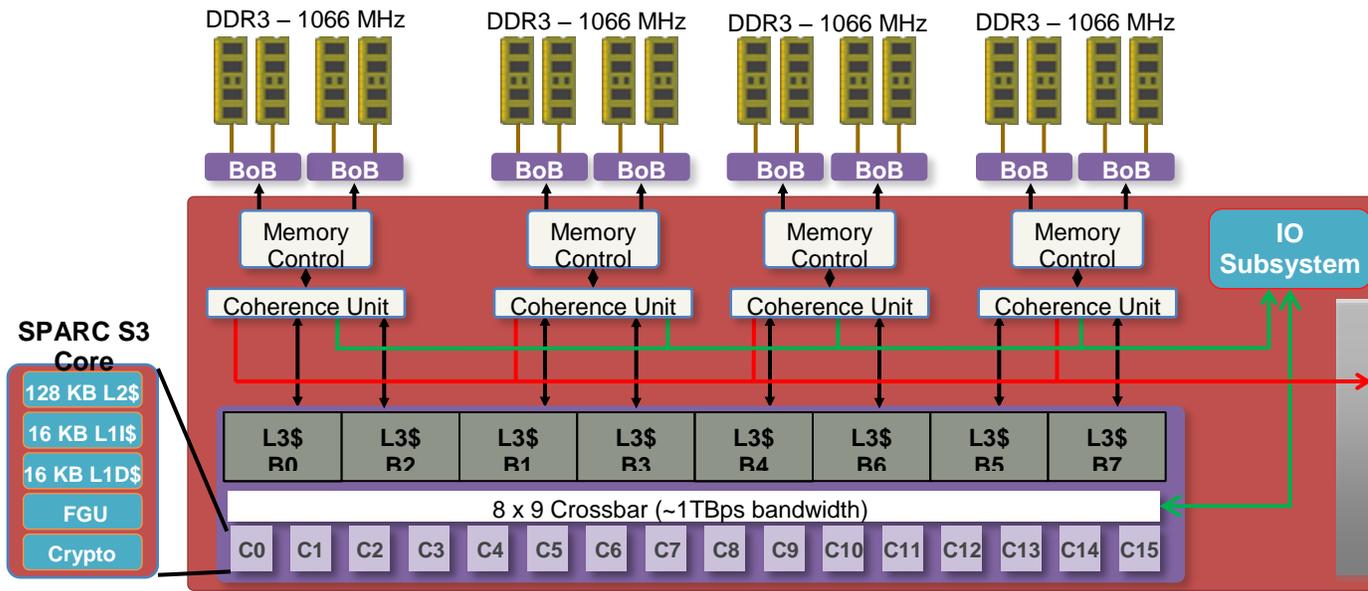


Figure 2. The SPARC T5 processor provides seven coherence links to connect to up to four other processors

### SPARC T5-1B Server Module Architecture

The motherboard design for the T5-1B server module is shown in Figure 3.

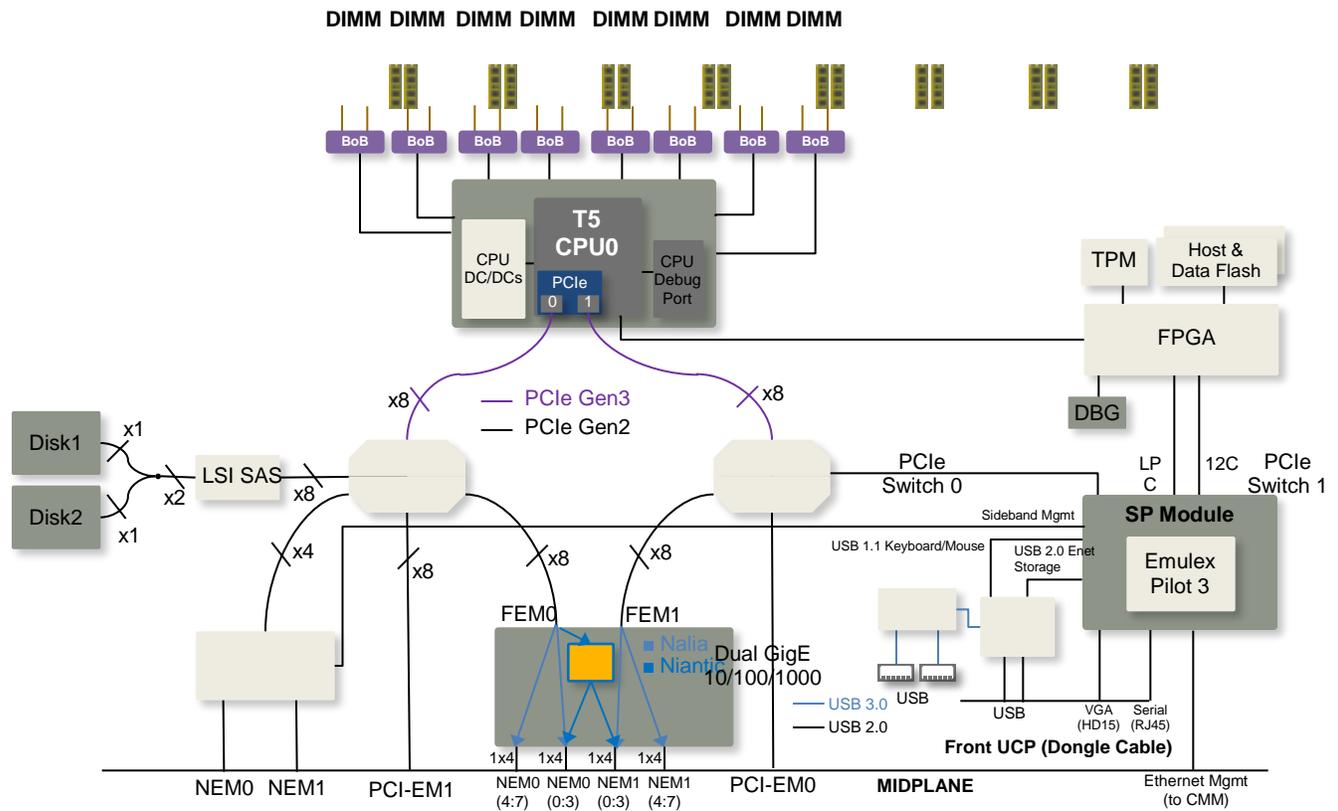


Figure 3. Oracle's SPARC T5-1B server module motherboard design

## Enclosure

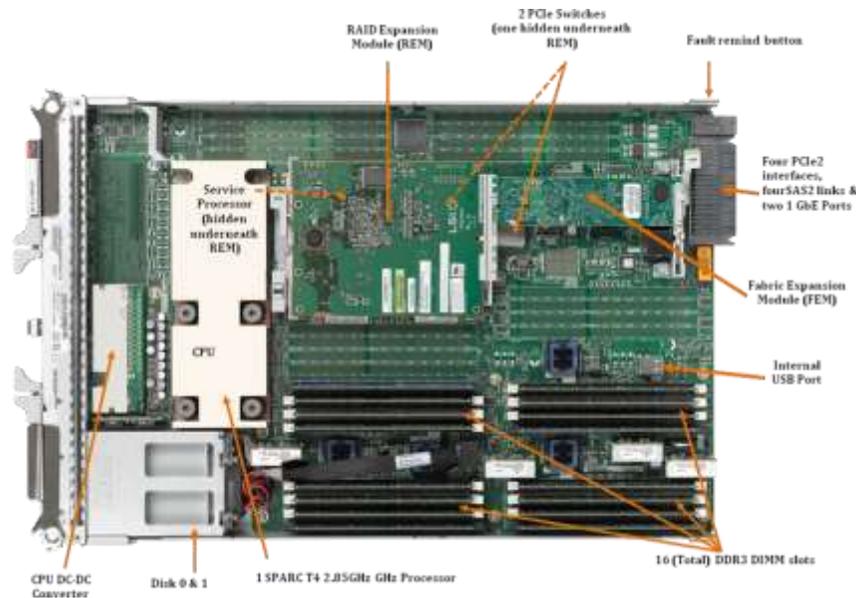
- One 16-core 128-thread 3.6GHz SPARC T5 processor
- Supports 8GB or 16GB DDR3 DIMMs
- 16 DIMM slots, supporting a maximum of 256GB with 16GB DIMM
- Extended ECC, error correction and parity checking memory
- Two 10/100/1000 Base-T Ethernet ports using the Intel Ethernet Controller I350  
One dedicated 10/100 Base-T Ethernet port for the management network which can be optionally shared with the main network ports if desired
- Eight SAS3.0 interfaces using LSI SAS2308 Controller, however only two interfaces are native to the T5-1B system.
  - One SAS3.0 interface to each of the two small form factor (SFF) SAS drive bays with RAID 0,1 support
- Up to two internal 300GB or 600GB 10,000 rpm SAS disk drives, or 100GB SATA solid state drive
- For the Blade, the controller is capable of supporting Integrated RAID Levels 0, 1
- Four x8 PCIe busses:
  - Two dedicated to NEMs, two dedicated to EMs
- Two 10/100/1000 GbE interfaces, one per NEM

- 10/100 Ethernet management port to Chassis Monitoring Module (CMM)
- Cards that are categorized as PCIe 3.0 are qualified to run with the T5-1B, however due to midplane restriction, will only run at 2.0. Between switch and CPU, the Blade runs at PCIe 3.0. However due to the midplane connector capabilities, from switch to the EM/NEM the speed is limited to PCIe 2.0
- Oracle ILOM 3.0 service processor

## SPARC T4-1B Server Module

The SPARC T4-1B server module is a single socket 2.85GHz SPARC T4 processor-based blade module with eight cores and 64 threads. Unique and new to the SPARC T4 processor, The SPARC T4 processor offers superior performance for a broad range of workloads from single-threaded workloads such as database, OLTP, and batch, to multithreaded workloads such as middleware applications. The SPARC T4 processor delivers 5 x the single-thread performance of the previous generation SPARC T3 processor, while maintaining industry leading multi-thread performance.

The physical layout out of the SPARC T4-1B server module is shown in Figure 4.



**Figure 4. The SPARC T4-1B server module supports a single SPARC T4 processor.**

The SPARC T4-1B blade module is based on the latest generation SPARC T4 2.85GHz processor with eight cores, and 64 simultaneous threads. With built-in PCIe Generation 2 expansion, and integrated on-chip cryptographic acceleration, the SPARC T4-1B offers enterprise performance and security delivered in a compact, economical blade form factor.

The SPARC T4-1B includes 16 DIMM slots for up to 512 GB memory and four drive slots for hot-pluggable 2.5 inch SAS or SATA drives. It supports one optional Fabric Expansion Module

(FEM), one RAID Expansion Module (REM), and the ORACLE ILOM/ORACLE ILCOM service processor as shown in Figure 1.

The Sun Blade 6000 chassis supports up to 10 SPARC T4-1B server modules for a total of 80 cores and 640 threads, and I/O throughput up to 6.4 Terabit-per-second.

### The SPARC T4 Processor

- One T4 processor in SPARC T4-1B, eight cores, 64 threads, 2.85GHz
- Private 128K Level 2 Cache per core and shared 4MB Level 3 Cache
- Dual, multithreaded, on-chip 10GbE ports
- Cryptographic stream processing unit (SPU) integrated in the pipeline
- Dual PCIe Generation 2 x8 interfaces integrated in silicon
- Security features include support for AES, Camellia, CRC32c, DES, 3DES, Kasumi, MD5, RSA, ECC, DSA, SHA-1, SHA-224, SHA-256, SHA-384, and SHA-512

Through its system-on-a-chip design, the SPARC T4 processor significantly enhances the general-purpose nature of the CPU—building in 16 newly designed floating-point units (one per core). Enhanced floating-point capabilities further open the SPARC T4 to the world of compute-intensive applications as well as the traditionally CMT-friendly data center throughput applications. No-cost security and cryptographic acceleration is provided by the on-chip, per-core streaming accelerators. In addition, the SPARC T4 processor is significantly aided by two integrated PCIe Generation 2 interfaces that help move data in and out quickly. The SPARC T4 processor also implements cache coherency logic and links on the processor silicon to facilitate a multsocket, glueless system design.

### SPARC T4-1B Server Module Architecture

The motherboard design for the T4-1B server module is shown in Figure 5.



- Up to two available disk drive slots supporting commodity SAS-2 disk drives
- Oracle ILOM 3.0 system controller

## SPARC T4 Processor Architecture

The SPARC T4 processor extends Oracle's multicore/multithreaded initiative with an elegant and robust architecture that delivers real performance to applications. Figure 6 provides a block-level diagram of the SPARC T4 processor.

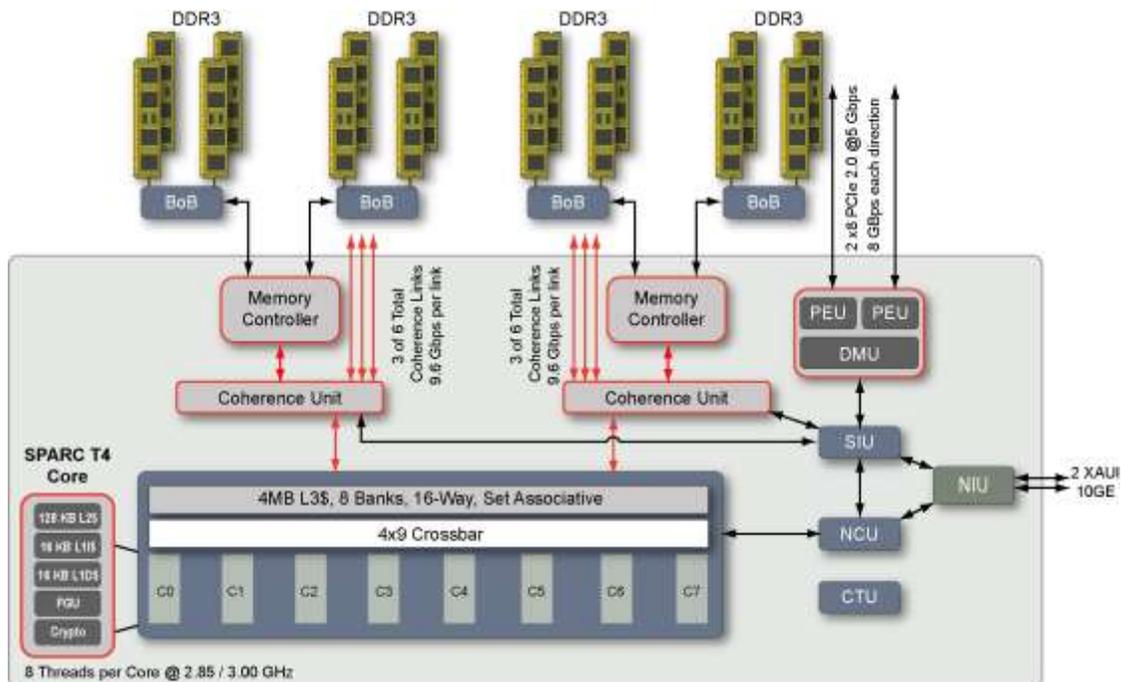


Figure 6. The SPARC T4 processor provides six coherence links to connect to up to four other processors.

The SPARC T4 has coherence link interfaces to allow communication between up to four SPARC T4 processors in a system without requiring any external hub chip. There are six coherence links, each with 14 bits in each direction running at 9.6 Gbps. Each frame has 168 bits, yielding a maximum frame rate of 800M frames per second. The SPARC T4 has two coherence link controllers. Each includes two Coherence and Ordering Units (COU), three Link Framing Units (LFU) and a cross bar (CLX) between COUs and LFUs. Each COU interfaces to two L2 bank pairs. The coherence links run a cache coherence (snoopy) protocol over an FB-DIMM-like physical interface. The memory link speed of the SPARC T4 is maintained at 6.4 Gb/sec, identical to the SPARC T3 processor.

### Integral PCIe Generation 2 Support

SPARC T4 processors provide dual on-chip PCIe Generation 2 interfaces. Each operates at 5 Gbps per x1 lane bi-directionally through a point-to-point dual-simplex chip interconnect, meaning that each x1 lane consists of two uni-directional bit-wide connections, one for northbound and the other for

southbound traffic. An integral IOMMU supports I/O virtualization and process device isolation by using the PCIe BUS/Device/Function (BDF) number. The total theoretical I/O bandwidth (for an x8 lane) is 4 GB/sec, with a maximum payload size of 256 bytes per PCIe Gen2 interface. The actual realizable bandwidth is more likely to be approximately 2.8 GB/sec. An x8 SerDes interface is provided for integration with off-chip PCIe switches.

### Power Management

Beyond the inherent efficiencies of Oracle's multicore/multithreaded design, the SPARC T4 processor incorporates unique power management features at both the core and memory levels of the processor. These features include reduced instruction rates, parking of idle threads and cores, and ability to turn off clocks in both cores and memory to reduce power consumption. Substantial innovation is present in the areas of

- Limiting speculation, such as conditional branches not taken
- Extensive clock gating in the data path, control blocks, and arrays
- Power throttling that allows extra stall cycles to be injected into the decode stage

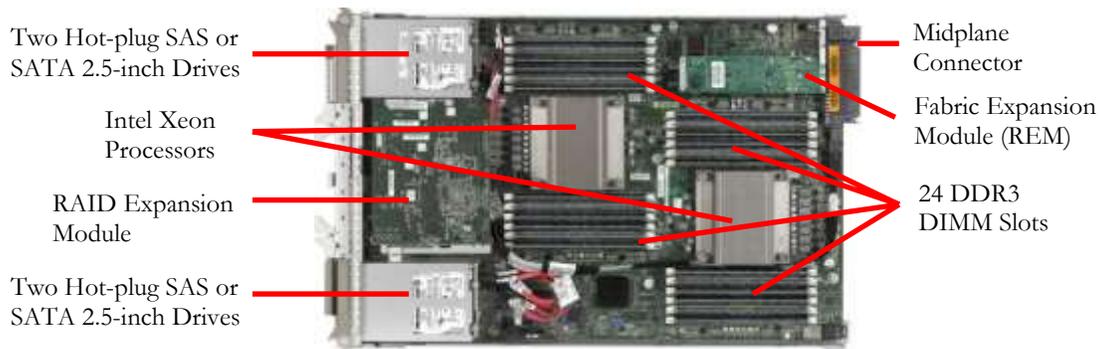
## Sun Blade X4-2B Server Module

The Sun Blade X4-2B server module improves on previous-generation Sun Blade X3-2B server modules by offering support for two Intel Xeon processor E5-2600 v2 product family CPUs. In addition to the increased number of cores, up to 12 cores, offered by these latest CPU's, this server module supports 24 DIMM sockets using low voltage DDR3 Load-Reduced DIMMs or RDIMMs to accommodate memory-intensive applications. Up to four HDDs or SSDs can be accommodated through front accessible SAS-2 based bays in the front panel. FEMs and RAID Expansion Modules are also supported, allowing for flexible storage and I/O connectivity options.

The Sun Blade X4-2B server module builds on the success of previous-generation Sun Blade X3-2B server modules by offering a number of enhancements, including:

- Support for Intel Xeon processor E5-2600 v2 product family CPUs, now with up to twelve cores per CPU
- Support for low voltage 32 GB LRDIMMs, for a total storage capacity of 768 GB of memory
- Support for 400 GB eMLC SATA-3 SSDs, for a total flash capacity of 1.6 TB
- Support for 1.2 TB SAS-2 HDDs, for a total disk storage capacity of 4.8 TB
- Support for a 16 GB FC ExpressModule Universal HBA that can be set as either a 16 GB FC or 10 GbE FCoE connectivity

A top-view of the Sun Blade X4-2B server module is shown in Figure 7.



**Figure 7. The Sun Blade X4-2B server module provides two sockets for quad-core, six-core, or eight-core Intel Xeon Processor E5-2600 product family CPUs**

### Intel Xeon Processor E5-2600 v2 Product Family

With this latest introduction of Intel Xeon processor E5-2600 v2 product family, Intel has continued with a 22 nm manufacturing process, but increased the core computing power from eight processor cores to ten and twelve processor cores and also increased cache in the die. The new Intel Core micro architecture is extremely modular, enabling a range of implementations to meet a variety of application needs and price points. Available in four-, six-, eight-, ten- and twelve-core versions, the Intel Xeon processor E5-2600 v2 product family provide up to 30 MB of shared L3 cache and integrated PCIe 3.0 support. They also utilize Intel Turbo Boost Technology and Intel Hyper-Threading Technology and are equipped with a four-channel DDR3 memory controller, each channel controlling up to three DIMMs. Two bi-directional QuickPath Interconnects are also provided for high-speed CPU-CPU and CPU-I/O subsystem communications.

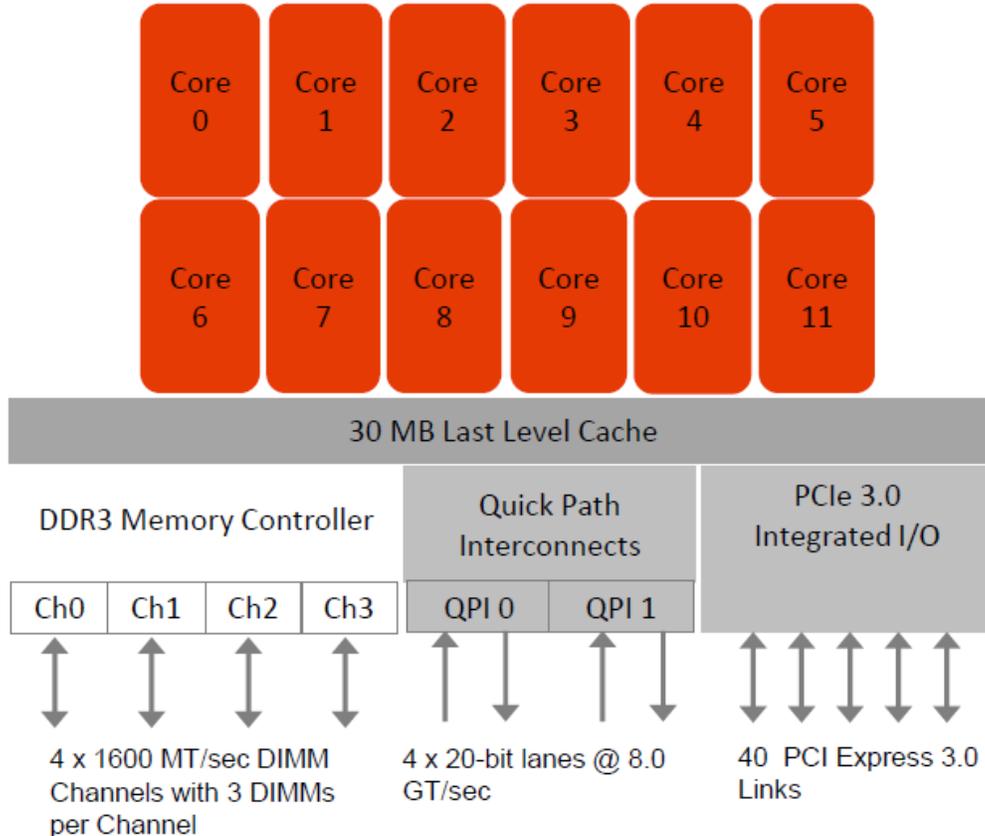


Figure 8. The Intel Xeon processor E5-2600 v2 product family offers up to twelve cores, an integrated memory controller, two bidirectional QuickPath Interconnects, and an integrated PCIe controller.

These new Intel processors are targeted at delivering optimal performance for bandwidth-intensive, threaded applications, with a microarchitecture that features the following significant innovations over previous designs:

- *Intel QuickPath technology* — This technology provides a high-speed, point-to-point interconnect between processors and I/O. The Intel QuickPath Interconnect (QPI) links processors in a design that provides both high-bandwidth and low-latency. Because it is a point-to-point interconnect, processors do not contend for a single bus when accessing memory and I/O, and do not compete for bus bandwidth, enhancing scalability. Each QPI port includes two unidirectional links that support from 6.4 GT/sec up to 8.0 GT/sec per link, offering up to 16 GB/sec bandwidth in each direction for a total bandwidth of 32 GB/sec — significantly higher than previous bus designs.
- *Multiple processor cores* — The Intel Xeon processor E5-2600 v2 product family microarchitecture offers four cores, six cores, eight cores, ten cores and twelve cores per die.
- *Integrated DDR3 memory controller* — The integrated memory controller provides four 1600 MT/sec channels and each channel supports up to three DIMMs. The processor design creates a NUMA-style memory architecture since each processor in multi-socket systems can access local

memory (connected to the local memory controller) as well as remote memory that is connected to another processor.

- *Integrated I/O controller* — In previous generation Intel platforms, PCIe I/O was handled by a separate I/O Hub Controller. In the new Intel Xeon Processor E5-2600 and E5-2600 v2 product families, the processors have PCIe integrated on the processor die, reducing I/O latency. The new processor also supports the new PCIe 3.0 specification that greatly improves the PCIe bandwidth.
- *Advanced cache model* — The Intel Xeon processor E5-2600 v2 product family offers a 30 MB Last-Level cache that is shared by the processor cores.
- *Virtualization enhancements* — Embedded virtualization technologies provide hardware-based assistance for I/O device virtualization, improved virtualization efficiency, enhanced connectivity, and improved security within a virtualized server.
- *Intel HyperThreading Technology* — This technology provides two virtual threads per core, increasing performance for highly threaded applications.
- *Intel Turbo Boost Technology* — For both multithreaded and single-threaded workloads, this technology increases performance by taking advantage of processor and system power as well as thermal headroom. The Turbo Boost feature can opportunistically increase performance up to nine speed bins per core (900 MHz) above typical performance levels where thermal headroom exists. Intel Turbo Boost Technology and Hyper-Threading Technology capabilities vary according to specific processor models.
- *Intel Intelligent Power Technology* — When a processor workload decreases, unneeded components — cores, cache, and memory — are put into sleep mode to reduce power consumption.

## Sun Blade X4-2B Server Module Architecture

As shown in Figure 9, the Sun Blade X4-2B server module supports two Intel Xeon processor E5-2600 v2 CPUs interconnected to each other using Intel's QuickPath Interconnect (QPI) technology. Each Intel Xeon processor E5-2600 v2 product family CPU has an integrated memory controller with four DDR3 channels and support up to three DIMMs per channel. Each processor can provide up to 40 PCIe 2.0 lanes for I/O connectivity. Figure 9 shows two PCIe 2.0 x8 lanes from the top processor going to two FEM sockets, where each PCIe 2.0 x8 lane is connected to one FEM socket, and delivers up to one PCIe 2.0 x8 interfaces or XAUI connections to the chassis midplane for NEM connections. Finally, one PCIe 2.0 x8 lane from each processor goes to an EM slot on the passive mid-plane for an EM connectivity.

From the bottom processor, one PCIe 2.0 x8 lane goes to the optional RAID Expansion Module that hosts the internal HDDs and/or SSDs. The Intel C602J I/O Controller Hub provides SATA and USB connectivity as well as an interface to the ASPEED service processor. The Intel Xeon processor E5-2600 v2 product family CPUs also interface directly with an Intel I350 Gigabit Ethernet controller (formerly known as Powerville) to provide two Gigabit Ethernet interfaces to the passive midplane. An internal USB connector is also provided by the Intel C602J.

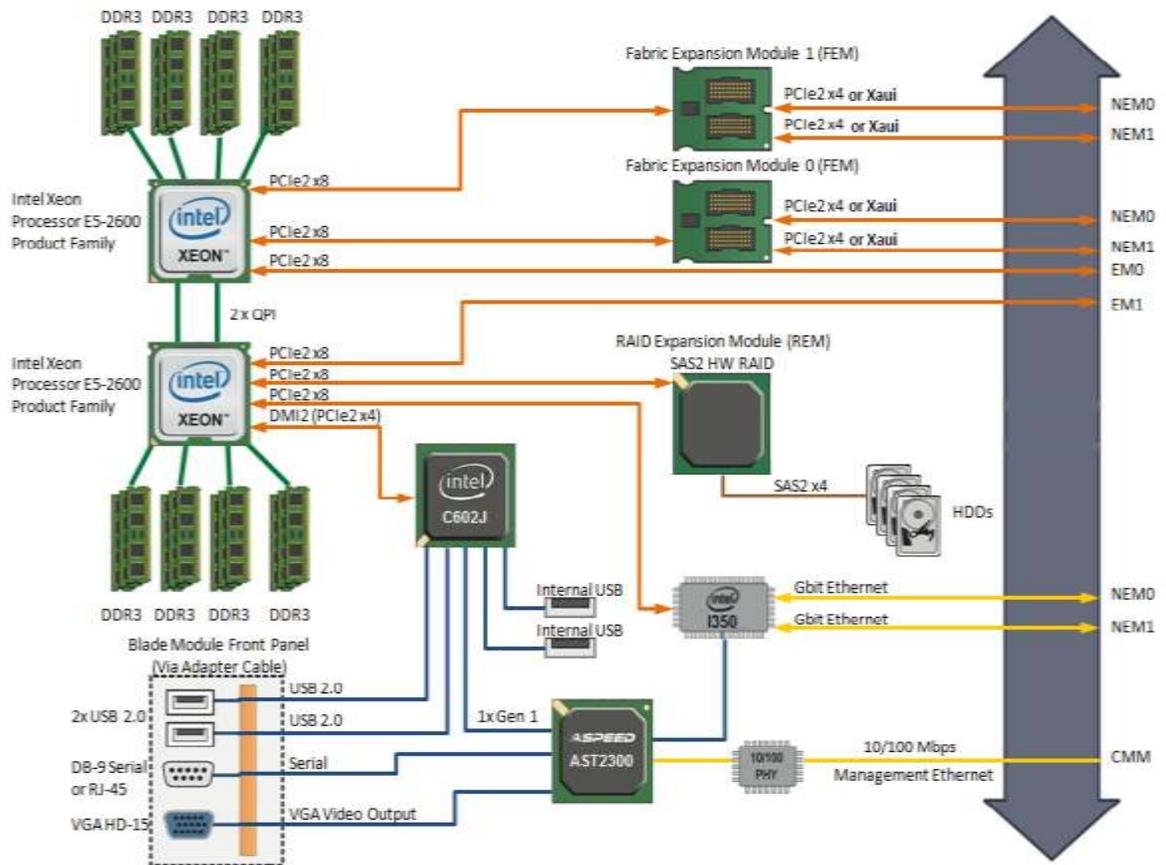


Figure 9. The Sun Blade X4-2B server module introduces support for Intel Xeon processor E5-2600 v2 product family CPUs and SAS-2 storage devices

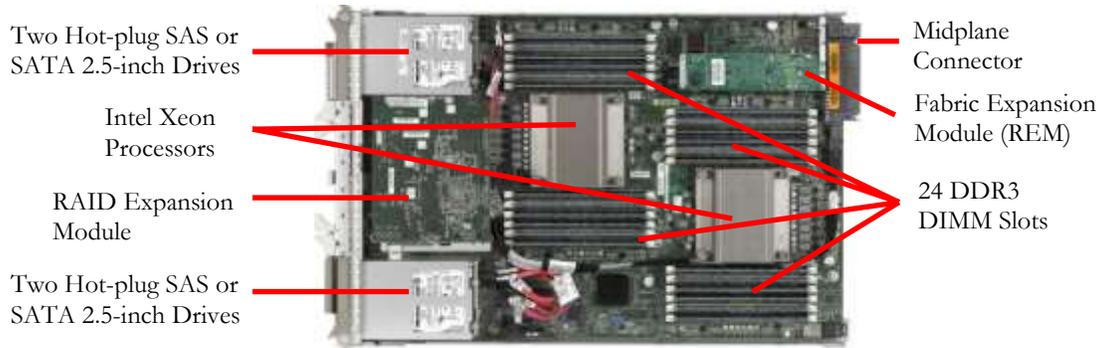
## Sun Blade X3-2B Server Module

The Sun Blade X3-2B server module improves on previous-generation Sun blade X6270 M2 server modules by offering support for two Intel Xeon Processor E5-2600 product family CPUs. In addition to the increased number of cores offered by these latest CPU's, this server module supports 24 DIMM sockets using low voltage DDR3 DIMMs to accommodate memory-intensive applications. Up to four HDDs or SSDs can be accommodated through front accessible SAS-2 based bays in the front panel. FEMs and RAID Expansion Modules are also supported, allowing for flexible storage and I/O connectivity options.

The Sun Blade X3-2B server module builds on the success of previous-generation Sun Blade X6270 M2 server modules by offering a number of enhancements, including:

- Support for Intel Xeon Processor E5-2600 product family CPUs, now with up to eight cores per CPU
- SAS Gen-2 signaling capabilities throughout

A top-view of the Sun Blade X3-2B server module is shown in Figure 10.



**Figure 10. The Sun Blade X3-2B server module provides two sockets for quad-core, six-core, or eight-core Intel Xeon Processor E5-2600 product family CPUs**

### Intel Xeon Processor E5-2600 Product Family

With this latest introduction, Intel continued with a 32 nm manufacturing process, but increased the core computing power from six processor cores to eight processor cores and also increased cache in the die. The new Intel Core micro architecture is extremely modular, enabling a range of implementations to meet a variety of application needs and price points. Available in four-, six-, and eight-core versions, the Intel Xeon Processor E5-2600 product family provide up to 20 MB of shared L3 cache and integrated PCIe 3.0 support. They also utilize Intel Turbo Boost Technology and Intel Hyper-Threading Technology and are equipped with a four-channel DDR3 memory controller, each channel controlling up to three DIMMs. Two bi-directional QuickPath Interconnects are also provided for high-speed CPU-CPU and CPU-I/O subsystem communications.

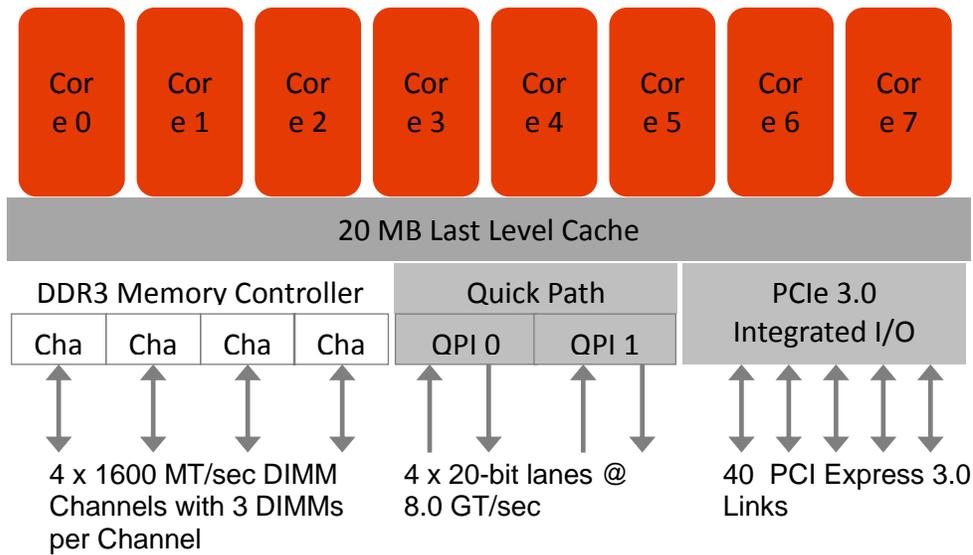


Figure 11. The Intel Xeon Processor E5-2600 product family offers up to eight cores, an integrated memory controller, two bidirectional QuickPath Interconnects, and an integrated PCIe controller.

These new Intel processors are targeted at delivering optimal performance for bandwidth-intensive, threaded applications, with a microarchitecture that features the following significant innovations over previous designs:

- *Intel QuickPath technology* — This technology provides a high-speed, point-to-point interconnect between processors and I/O. The Intel QuickPath Interconnect (QPI) links processors in a design that provides both high-bandwidth and low-latency. Because it is a point-to-point interconnect, processors do not contend for a single bus when accessing memory and I/O, and do not compete for bus bandwidth, enhancing scalability. Each QPI port includes two unidirectional links that support from 6.4 GT/sec up to 8.0 GT/sec per link, offering up to 16 GB/sec bandwidth in each direction for a total bandwidth of 32 GB/sec — significantly higher than previous bus designs.
- *Multiple processor cores* — The Intel Xeon Processor E5-2600 product family microarchitecture offers four cores, six cores, or eight cores per die.
- *Integrated DDR3 memory controller* — The integrated memory controller provides four 1600 MT/sec channels and each channel supports up to three DIMMs. The processor design creates a NUMA-style memory architecture since each processor in multi-socket systems can access local memory (connected to the local memory controller) as well as remote memory that is connected to another processor.
- *Integrated I/O controller* — In previous generation Intel platforms, PCIe I/O was handled by a separate I/O Hub Controller. In the new Intel Xeon Processor E5-2600 product family, the processors have PCIe integrated on the processor die, reducing I/O latency. The new processor also supports the new PCIe 3.0 specification that greatly improves the PCIe bandwidth.
- *Advanced cache model* — The Intel Xeon Processor E5-2600 product family offers a 20 MB Last-Level cache that is shared by the processor cores.

- *Virtualization enhancements* — Embedded virtualization technologies provide hardware-based assistance for I/O device virtualization, improved virtualization efficiency, enhanced connectivity, and improved security within a virtualized server.
- *Intel HyperThreading Technology* — This technology provides two virtual threads per core, increasing performance for highly threaded applications.
- *Intel Turbo Boost Technology* — For both multithreaded and single-threaded workloads, this technology increases performance by taking advantage of processor and system power as well as thermal headroom. The Turbo Boost feature can opportunistically increase performance up to nine speed bins per core (900 MHz) above typical performance levels where thermal headroom exists. Intel Turbo Boost Technology and Hyper-Threading Technology capabilities vary according to specific processor models.
- *Intel Intelligent Power Technology* — When a processor workload decreases, unneeded components — cores, cache, and memory — are put into sleep mode to reduce power consumption.

### Sun Blade X3-2B Server Module Architecture

As shown in Figure 12, the Sun Blade X3-2B server module supports two Intel Xeon processor E5-2600 v2 CPUs interconnected to each other using Intel's QuickPath Interconnect (QPI) technology. Each Intel Xeon processor E5-2600 product family CPU has an integrated memory controller with four DDR3 channels and support up to three DIMMs per channel. Each processor can provide up to 40 PCIe 2.0 lanes for I/O connectivities. Figure 12 shows two PCIe 2.0 x8 lanes from the top processor going to two FEM sockets, where each PCIe 2.0 x8 lane is connected to one FEM socket, and deliver up to one PCIe 2.0 x8 interfaces or XAUI connections to the chassis midplane for NEM connections. Finally, one PCIe 2.0 x8 lane from each processor goes to an EM slot on the passive midplane for an EM connectivity.

From the bottom processor, one PCIe 2.0 x8 lane goes to the optional RAID Expansion Module, which provides SAS-2 links to the midplane, and hosts the internal HDDs and/or SSDs. The Intel C602J I/O Controller Hub provides SATA and USB connectivity as well as an interface to the ASPEED service processor. The Intel Xeon processor E5-2600 product family CPUs also interface directly with an Intel I350 Gigabit Ethernet controller (formerly known as Powerville) to provide two Gigabit Ethernet interfaces to the passive midplane. An internal USB connector is also provided by the Intel C602J.

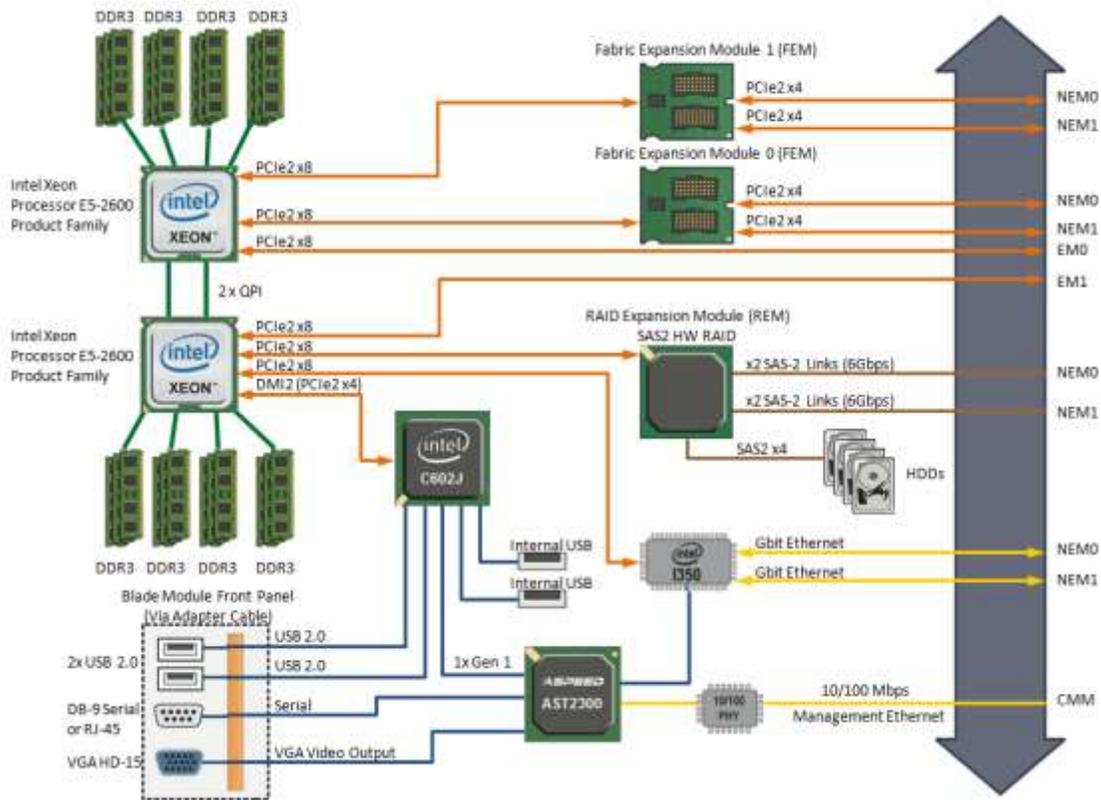


Figure 12. The Sun Blade X3-2B server module introduces support for Intel Xeon processor E5-2600 product family CPUs and SAS-2 storage devices

## Conclusion

Oracle's innovative technology and open-systems approach make modular systems attractive across a broad set of applications and activities — from consolidating infrastructure through virtualization to deploying dynamic enterprise applications or cloud computing. Oracle's Sun Blade 6000 modular system provides the promised advantages of modular architecture while retaining essential flexibility for how technology is deployed and managed.

With a chassis designed for investment protection into the future, organizations can literally cable once, and change their deployment options as required — mixing and matching server modules as desired. A choice of Oracle x86 and SPARC processor-based server modules along with support for a range of operating systems as well as blade-specific I/O capabilities makes it easy to select the right platform for Oracle and non-Oracle enterprise applications.

## For More Information

For more information on Sun Blade 6000 modular systems, please visit <http://www.oracle.com/goto/ blades>, which also contains links to additional Sun Blade 6000 modular system white papers. The Web sites listed below also provide more specific references:

- *Sun Blade systems OTN page:* <http://www.oracle.com/technetwork/server-storage/sun-blade/documentation/index.html>
- *Blades power calculator:* <http://www.oracle.com/sun-power-calculators/calc/6000chassis>
- *Oracle Enterprise Manager Ops Center:* <http://www.oracle.com/technetwork/oem/ops-center/index.html>
- *Oracle Solaris operating system:* <http://www.oracle.com/technetwork/server-storage/solaris/overview/>.



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