Sun Boosts Server Performance with Opteron — Adds More RAS for Commodity Sun Fire

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Management Summary

With the commitment of the President to press forward with alternatives to Social Security, there has been a renewed interest in personal savings and investment options. Making the Stock Market an alternative for retirement savings raises many questions in an uneducated populace with regard to stocks, mutual funds and bond vehicles for long term investment. The major issues raised by many investment counselors concern: **protecting the investments that you have already made and being careful not to put all of your nest eggs in one financial basket.** Do not put all of your investment into a single resource. You must diversify, being sure to invest in some blue chip commodities as well as some high growth opportunities. Protect yourself from a fluctuating stock portfolio with long-term fixed income bonds to ensure a consistent cash flow.

In 2003, we saw a similar investment strategy within the Information Technology (IT) arena. HP chose to diversify their product set, forming a partnership with Intel for the 64-bit Itanium architecture. HP delivered an industry-standard, scale-out architecture for those customers looking for an open solution for 64-bit environments or a scale-up one as an alternative for those customers replacing RISC platforms such as the HP *Precision Architecture* (*PA*) or *Alpha* environments for mission-critical applications. HP enabled applications written for a proprietary environment to be ported to an open systems microprocessor. They created the Integrity product line for customers with industry-standard Windows or Linux infrastructure solutions and business-critical *HP-UX* or *VMS* applications. In 2004, Sun followed suit, testing the waters of commodity x86 processing with AMD rather than Intel. Sun announced the *Sun Fire V20z*, an *Opteron*-based x86 dual-processor server, replacing an older Intel platform, as a stepping-stone to the industry-standard 64-bit world. The V20z was configured with a 32-bit version of Sun's *Solaris 9* x86 operating system, as well as 32- and 64-bit versions of *Windows* and *Linux*. This was followed by the announcement of the *Sun Fire V40z*, a quad-processor version.

Now, Sun has expanded their galaxy of industry-standard 64-bit servers with three new models of the Sun Fire family: the *Sun Fire X2100*, *X4100*, and *X4200*. These models will all operate in single- or dual-core mode, with more RAS capabilities than their predecessors. Qualified with Solaris 10 as well as Windows and Linux, these servers will protect the investment that your data center has already made in Sun solutions as well as significantly lower your total cost of ownership (TCO) through software compatibility and reduced power requirements. To see if Sun's new open systems servers will improve your bottom line, please read on.

IN THIS ISSUE

The Heterogeneous Data Center

Today, there are few, if any, homogeneous data centers. The days when a single vendor could populate an enterprise with a single architecture and single operating environment, are gone. Efforts to improve the performance and lower the TCO of the IT infrastructure have resulted in the implementation of a range of programs, including server upgrades, consolidation, and energy conservation which have opened the data center to a wide range of new technologies.

New platforms are chosen based upon how they can help contribute to an improved bottom line, not simply on the megahertz rating of the CPU. Different enterprise applications have diverse processing requirements.

- *High-performance applications*, for example, operate best in a single-threaded, compute-intensive environment and can take advantage of a processor with a high clock speed in order to run most efficiently.

- *Infrastructure applications*, on the other hand, such as file and print or web servers, service multiple users at the same time, involve high levels of I/O, and perform best in multi-threaded environments.

Many data center managers will cluster these infrastructure servers in a rack, in a scale-out architecture, in order to share system resources and take advantage of low-cost, industry-standard, open systems platforms based upon an x86 architecture and the availability of a plethora of experienced developers and system administrators. These infrastructure platforms also can take advantage of low-cost operating environments with a readily available set of applications. The newest operating system to appear to satisfy this requirement is Linux.

Other business-critical applications can take advantage of the features inherent in multi-CPU, scale-up environments, often based upon a RISC/UNIX architecture as found in platforms such as the *Sun Fire SPARC* from Sun and the *pSeries POWER* server from IBM. The Sun platform can expand to 72 processors and support thousands of users trying to access an enterprise database with OLTP or ERP applications. In these instances, a scale-up architecture can provide the most cost-effective solution.

In order to avoid duplicating system personnel and increase costs, however, these heterogeneous environments need to minimize the number of operating environments installed. The data center needs to be populated with servers tailored to specific consolidated mixes of applications, but operate under control of a common operating system and management framework. Low-cost x86 platforms based upon the Intel *Xeon* or AMD *Opteron* processors run very well under either the *Windows* or Linux environments. Furthermore, there are thousands of applications available that will run on these architectures - no matter what the logo on the front of the platform reads. Unfortunately, while Linux is pervasive across all levels of platforms, from mainframe to 1U entry-level server, it does not have the reliability, availability, and serviceability (RAS) found in most UNIX solutions[1]. Windows, on the other hand, does not run on many of the scale-up platforms that can be found throughout the typical enterprise.

Many enterprises looking to upgrade a legacy data center will find a significant number of Sun servers based upon the SPARC, or *UltraSPARC*, microprocessor throughout their network. These servers will all operate under *Solaris*, Sun's UNIX variation, or Linux. However, unlike other vendors with both legacy and Xeon or Opteron platforms, Sun has also made Solaris available on their commodity x64 Sun Fire servers. A common operating system means that you can execute the same applications across all of your servers without worrying about migrating between disparate environments. This can lower the TCO of the IT network for the enterprise.

The AMD Opteron Solution

In the battle of processor share in the server market, Intel has a clear lead in terms of volume. AMD, however, is making great strides in achieving market acceptance with their Opteron technology, with a stated goal to achieve higher performance and higher scalability at a lower energy level, through customer-centric innovation. In order to satisfy real business needs, technology must address real business problems.

Intel introduced their 64-bit x86 processor, *Itanium*, without 32-bit compatibility. AMD seized the opportunity, in April, 2003, to introduce Opteron with both 32-bit and 64-bit capabilities and a crossbar switch to implement chip-level multiprocessing. This enabled AMD-based servers to provide a flexible upgrade path, allowing for simultaneous 32- and 64-bit execution with a

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[1] And the mainframe, of course.

Exhibit 1 - Opteron Features and Benefits

Feature	Benefits
• **AMD64 Dual-Core Technology** directly connects two processor cores on to a single die for reduced latencies between processors	• Improves system efficiency and application performance for computers running multiple applications at the same time or compute-intensive multi-threaded applications.
• **Simultaneous 32- and 64-bit** computing capabilities	• Allows users to run 32-bit and/or 64-bit applications and operating systems as they desire - without sacrificing performance
• **Direct Connect Architecture** addresses and helps reduce the real challenges and bottlenecks of system architectures	• Provides optimized memory performance, balanced throughput, expandable I/O, and more linear symmetrical multiprocessing
• **Support of up to three coherent Hyper-Transport links**, providing up to 24.0 GB/s peak bandwidth per processor	• Provides substantial I/O bandwidth for your current and future application needs
• **256 Terabytes of memory address space**	• Creates a significant performance benefit for applications in which large (or many) datasets are held in memory
• **Scales from 1-way to 8-way** across entire data or compute centers, utilizing the same hardware and software infrastructure	• Allows for maximum flexibility in IT infrastructure, helping contribute to bottom line success
• **Integrated memory controller** reduces latencies during memory access in a SMP server system	• Yields fast computational processing for increased performance and productivity
• **Low-power processor**s in HE (55 Watt) and EE (30 Watt) - providing uncompromised performance	• Increased compute density; lower TCO for datacenters with limited power budgets

Source: AMD specifications with Clipper analysis

controlled migration and removed the 4GB data restriction that was retarding many enterprises stuck in 32-bit mode. It also enabled AMD to assume industry leadership and to gain a measurable market share that they did not previously have, and "encouraged" Intel to provide a 32/64-bit compatible version of their Xeon microprocessor, the *EM64T*. AMD increased their technological advantage with the introduction, this past spring, of a dual-core Opteron microprocessor with 1MB of cache per core, binary-compatible with the single-core implementation. This enabled Opteron to gain instant acceptance. The major technological advantages incorporated into Opteron also include a direct-connect, *HyperTransport* infrastructure, connecting CPUs to each other, as well as to I/O and memory, to reduce I/O bottlenecks, and an integrated memory management capability to increase application performance by reducing memory latency. (See Exhibit 1, above.)

Trying to compare raw performance between microprocessors is very difficult due to the number of variables: processor clock speed, amount of cache, impact of multiple threads, etc. Extrapolating that to any typical business-critical application is even more so due to the impact of: the overall system architecture, I/O adapters, among others. In commodity benchmarks that have been run measuring compute performance of single-core[2], single- and dual-processors, we see that Opteron is comparable to Xeon in integer math, but is significantly ahead in floating point tests[3]. Comparing a dual-core *Opteron 875* to a single-core *Opteron 852* reveals that the 875 is 65% more performant in integer math and 45% more

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[2] Comparisons between Xeon and Opteron must be kept to single-core implementations, as there are few dual-core Xeon test results available.
[3] Based upon results published on the SPEC web site.

performant in floating point calculations. These characteristics make Opteron a good match for high-performance computing environments.

Using the SAP SD 2-Tier benchmark[4] as an example of ERP performance, a dual-processor, rack-mounted server based upon an *Opteron Model 252* outperforms a dual Xeon 3.6GHz 1MB L2 cache server by 60%. Further, when the Opteron 252 is replaced by *Model 275* dual-core processors, the benchmark achieves another 68% gain. In a blade environment, we see the same results, with the Opteron 252 blade outperforming the Xeon blade by 60%, and the Model 275 outperforming the Model 252 by 68%. This indicates the Opteron processors fit well in business-critical application environments, as well.

A third environment in which Opteron performs very well is server-side *Java*. Using the *SPECjbb2000* and the *SPECjbb2005* benchmarks, the Sun Fire 4x00 Opteron servers top the list for 2-way and 4-way performance, in both 32- and 64-bit JVM. SPECjbb2005 evaluates the performance of server-side Java by emulating a three-tier client/server system. The benchmark exercises the implementations of the *JVM (Java Virtual Machine)*, JIT (Just-In-Time) compiler, garbage collection, threads, and some aspects of the operating system. It also measures the performance of CPUs, caches, memory hierarchy and system scalability.

AMD was not the first vendor to provide dual-core. Sun and IBM, for example, have multiple cores in their RISC processors. AMD, however, is the first to provide that capability in an industry-standard, *x64* server. By incorporating dual-cores into Opteron, AMD effectively doubled the processing[5] capability per socket, while maintaining the power consumption of the CPU, enabling denser packaging and improving all performance per watt calculations. This enables the data center to upgrade a standard, low-cost, 4-way, x86 server with the processing power of an 8-way scale-up platform. **These features directly address the business problems of improving performance and decreasing TCO.**

Sun's Extended Sun Fire Family

With their latest x64 announcement, Sun has introduced three new scale-out Sun Fire models

with Opteron HyperTransport technology: the one-socket *X2100*, and the two-socket *X4100* and *X4200*. All three models come with a three-year, next-business-day warranty. These models join the Sun Fire *V20z* and *V40z*[6], which were introduced last year, as total solutions, including management software, switches, storage, and services, to deliver better performance and increased utilization. Sun's *N1 System Manager*[7] provides centralized lifecycle management for all Sun x64 systems, and many SPARC platforms, integrated with the service processor. N1 simplifies management tasks by monitoring the status of a wide range of Sun Fire servers and operating system and providing remote automation for provisioning and updates. It reduces repetition, lowering the TCO of Sun Fire systems.

Powered by single-core or dual-core Opteron microprocessors, these new models bring data center class computing to the industry-standard x64 platform, combining high performance and energy efficiency in an enterprise-level RAS platform. Sun Fire enables the data center to run existing 32-bit applications as they migrate to next generation 64-bit operating environments, and their choice of new applications, on the same platform. They support 64-bit *Solaris 10*, as well as the latest versions of *Linux*, 32- and 64-bit *RHEL 3* and 64-bit *RHEL 4* and SLES 9. In addition, it is "designed for *Windows*"[8] in both modes. With Solaris support, the enterprise can protect the investment already made in applications running on SPARC servers in the data center. Using the dual-core version of Opteron, these servers set new standards in energy efficiency, running cooler (at 95 watts per CPU[9]) and requiring less air conditioning, in both dual- and quad-processor platforms, than in comparable systems. Furthermore, Sun has committed to an upgrade path with 16-way servers.

Sun Fire 2100

The Sun Fire X2100 has a single socket, with either single- or dual-core CPU in a 1U rack-mount format, along with a pair of hot-pluggable SATA drives. It is ideal for any no-frills, high-performance computing environment. It supports up to 4GB of ECC DDR memory and an 8-lane PCI-Express slot to meet evolving business and

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[4] Source: AMD Opteron Processor-based System Performance Comparison dated June 10, 2005.

[5] Doubling the cores does not necessarily double any measure of system performance.

[6] The Sun Fire V40z is a 4-socket system with 8 cores.

[7] N1 System Manager for the X2100 will be available in 2006.

[8] Sun Microsystems does not offer Windows but will support it. It is available from Microsoft and many Sun partners and is certified on the Sun Fire platform.

[9] Single-core Xeons run at 110-130 watts.

Exhibit 2 – ILOM Features

- Remote management with full keyboard, mouse, video, and storage access
- Control and reporting of environmentals, power, hardware, and BIOS
- Browser UI for control of the system through a graphical interface
- IPMI 2.0 compliant for management and control
- SNMP for system monitoring
- Monitor and report system and component status on all FRUs

Exhibit 3 – RAS Features

- RAID 0, 1 striping/mirroring of on-board, hot-swap SAS disks (front-accessible)
- ECC memory will Chipkill
- Redundant hot-swap power supplies and fans
- Built-in quad Ethernet ports for redundancy
- LEDs on front and back of system to allow easy fault detection and isolation
- Front power switch for easy access
- Optional slide rails for easy service

application needs. It has a pair of integrated giga-bit Ethernet ports to increase network efficiency and availability and an optional *Lights-Out-Management* (*LOM*) adapter to remotely monitor and manage the system through features such as remote power control and remote access to BIOS. Combined with its small form factor and low energy requirements, the X2100 can help reduce the enterprise acquisition costs, increasing the return of IT investment. It is a low-cost, scalable, data center solution.

Sun Fire X4100/X4200

The Sun Fire X4100 and X4200 have two sockets with four cores for scalable performance. The X4100 has a 1U format while the X4200 is a 2U rack-mount server. They are ideal platforms for consolidation using *Solaris 10* containers or, soon, *VMWare*. An integrated LOM capability is standard (see Exhibit 2, above) via a dedicated service processor. The service processor also controls a series of diagnostic lights for rapid fault detection and servicing. A typical X4200 has 50% more performance than a 4-way Xeon (single-core) at up to one-third of the power.

Both systems are configurable with up to 4-2.5" hot-swap SAS drives and up to 16GB of DDR1 ECC memory with Chipkill[10]. The X4100 has two PCI-X slots while the X4200 has five. Both servers have four integrated Ethernet ports and outstanding RAS capability based upon the simplicity of the Opteron design. (See Exhibit 3, in the next column.)

Conclusion

An industry-standard x64 server is measured by more than just the capability of the CPU. By definition, it is a commodity. Anyone can put a commodity processor into a server platform. Not just anyone can integrate that microprocessor with a reliable, scalable platform and an effective management infrastructure. Over the years, Sun has proven that they can. **By integrating enterprise reliability features into a scalable Sun Fire platform, Sun has delivered a mission-critical-ready platform to the data center.**

With Opteron, Sun has provided the most energy efficient open systems platform available. By itself, that is an accomplishment. However, by making Solaris available on their x64 platforms as well as SPARC, Sun has enabled the enterprise with acquisition flexibility and investment protection. No matter where the enterprise needs to provision, scale-out for the branch or scale-up for the data center, they can roll-out identical applications. One set of applications simplifies the IT environment and reduces the TCO to the enterprise. Further, with N1 System Manager, one centralized administrator can control a wide-variety of Solaris platforms – both SPARC and Opteron.

If you are responsible for the enterprise IT environment and you are using Sun today, you are probably facing increasing maintenance costs from legacy platforms which are under attack from a variety of vendors trying to get you to migrate to an open, i.e. Linux, environment. With these new Sun Fire platforms, you have the advantage of the best of both worlds, without disrupting your IT operations. When the time to upgrade is at hand, look into the new Sun Fire Opteron servers. They may be the answer to lowering your TCO and increasing your bottom line.

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[10] The Sun Fire X4x00 systems will support 32GB when 4GB DIMMs become available.

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