



Sun: Leveraging AMD64 Technology to Extend 64-Bit Workstation Leadership

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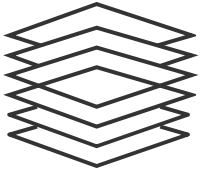
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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
WELL-POSITIONED FOR 64-BIT MARKET LEADERSHIP	2
NEW WORKSTATIONS – SUN JAVA WORKSTATION W1100Z AND W2100Z	6
<i>Table 1: Key Features of Sun Java Workstations</i>	<i>6</i>
<i>Table 2: Sun Java Workstations Benchmark Performance Results.....</i>	<i>8</i>
DHBA BOTTOM LINE.....	9



Sun: Leveraging AMD64 Technology to Extend 64-Bit Workstation Leadership

EXECUTIVE SUMMARY

Driven by their sheer perseverance, engineers, scientists, and designers rely on workstations in their quest to make better and safer cars, potent yet inexpensive medicines, and more realistic movies without physical constraints. While faster processors, larger memory, and powerful graphics are fundamental requirements for workstations, users are also demanding a low cost, solution-based approach

wrapped around a standards-based technology. The newly available Sun Java Workstations, which leverage AMD's AMD64 x86 standards-based technology and provide multiple operating system choices and leading NVIDIA graphics, deliver a platform that offers flexibility and performance in cost-effective packages. More importantly, the **ecosystem** Sun developed for these workstations, backed by its 64-bit depth and expertise, offers an unmatched solution that benefits customers across the board.

The uni-processor Sun Java Workstation W1100z and the dual-processor Sun Java Workstation W2100z are the fruits of Sun's strategic alliance with AMD aimed toward delivering a complete high-volume, AMD64-based product portfolio. The objective behind the alliance is to combine the strengths and intellectual property of the two companies – such as Sun's **Solaris** operating system (x86 Platform Edition) and AMD's HyperTransport technology – to present solid solutions to the marketplace. In addition to the workstations, Sun is also offering servers based on the Opteron processor, allowing customers to standardize on one platform for their low-end and workgroup infrastructure. Sun's backing of the AMD64 technology and its long-term commitment to the platform has provided a major boost to AMD and has received a strong vote of confidence from small, medium, and large enterprises alike.

AMD: Enterprise Market Presence

- Number of Tier-One OEM wins with servers and workstation products
- Strong road map includes availability of dual-core Opteron in the mid-2005 timeframe
- Growing OS and ISV support with more than 250 ISVs

Sun Java Workstations: Benefit to Customers

- Industry-standard x86 hardware with broad IHV/ISV community
- Solaris x86 for leading application performance and ecosystem
- Lower price/performance for Opteron workstations
- Access to Sun Java Desktop System (JDS) and Sun N1 Grid Engine for maximum productivity
- Platform flexibility with multiple OS support for redeployment and investment protection

Users have relied on traditional workstations (such as Sun SPARC-based workstations) for their most demanding jobs, but gravitated toward the better price/performance afforded by the 32-bit x86 architecture delivered through economies of scale. Ultimately, users are interested in a “best of both worlds” platform that allows the simultaneous co-existence of 32-bit and 64-bit applications. A platform with this capability provides incremental investment protection to customers without forcing them to perform a full-fledged 64-bit migration. AMD has led the industry in adding 64-bit extensions to the prevalent

32-bit x86 architecture. D.H. Brown Associates, Inc. (DHBA) clients report a strong inclination toward AMD64 for their x86 requirements for running enterprise workloads.

With the recent availability of new platforms and endorsements from leading players, 64-bit extensions to the x86-architecture are beginning to pervade the marketplace. The technology has matured and the market is ripe to take advantage of the additional processing capability and memory headroom it affords. Further, the unique capability of Sun's Java Workstations to support three leading operating systems, namely Sun Solaris, Microsoft Windows, and Linux, enables customers to migrate to the Sun Java Workstations and drive higher performance at lower costs without losing their operating system affinity. The Sun Solaris x86 Platform Edition brings the same set of capabilities available on the SPARC platform to the x86 platform, opening a new range of opportunities for customers, and raising the bar for x86 operating systems. Currently available in a 32-bit version, the upcoming 64-bit version of the Solaris operating system will allow customers to take full advantage of the AMD64 architecture.

The ecosystem Sun offers through its Solaris x86 operating environment and value-added Sun **N1 Grid Engine** and Sun **Java Desktop System (JDS)** targets productivity improvements at the system and application level at much lower costs for deployment, administration, and management than other alternatives. The optimized and tuned compilers and graphics drivers bring out the best performance from the architecture.

The Sun Java Workstations are positioned to extend Sun's existing RISC/UNIX leadership position to the mainstream workstation market. Instead of a "one-size-fits-all" approach, the new Sun workstation product line provides flexibility and value, with a single focal point for all customer requirements. Existing Sun SPARC customers can add the Sun Java Workstations to derive additional performance and flexibility as well as a broader IHV/ISV ecosystem while retaining the "Sun" advantage. Along with the value provided by the Sun Java Workstations, Sun's massive installed base, ISV support, and engineering expertise lend themselves nicely to new customers looking to maximize value from x86 platforms, while gaining reliability, stability, and a customer-driven solution environment.

WELL-POSITIONED FOR 64-BIT MARKET LEADERSHIP

The workstation market evolves quickly as underlying technology progresses to meet user requirements. The bulk of the workstation market is currently running 32-bit applications in the absence of cost-effective 64-bit platforms and ecosystems (other than Sun SPARC). The 4 GB (native) memory cap imposed by the 32-bit architecture forces applications deployed on these platforms to use only a subset of the available memory. This limitation slows down productivity, especially when users are viewing larger, more complex models. Applications running on 64-bit hardware can access virtually unlimited amounts of memory (16 EB).

The broader availability of 64-bit capabilities in the prevailing x86 instruction set is expected to jumpstart the market adoption toward running more 64-bit applications. ISVs previously relegated to fringe areas of the 64-bit market due to the obvious barriers to entry for customers – the cost points of 64-bit workstations – now have a viable deployment platform especially as pricing for these 64-bit enabled workstations rivals that of existing 32-bit platforms.

Sun: Raising Bar for RISC/UNIX Systems

Historically, the robustness of RISC/UNIX workstations, such as SPARC/Solaris, made them the backbone for running high-end, mission-critical jobs. However, the economics around some of the RISC/UNIX alternatives made them cost prohibitive to deploy for running the bulk of the applications, relegating the overall RISC/UNIX market to niche areas.

DHBA has seen consistent price/performance leadership offerings from Sun in the RISC/UNIX market as competitors have continued to trail and falter in light of renewed competition from low-end players. Sun has raised the bar quite high in this space and this standard is vital for customers as they have witnessed other RISC/UNIX players fall flat on their promise to deliver non-x86-based standards platforms.

Another trend favoring deployment of 64-bit applications is the availability of cost-effective Double Data Rate (DDR) memory modules. Memory prices have come down significantly, especially the prices of higher capacity memory modules. As memory technology transitions to greater densities, further cost reductions are expected, ultimately benefiting customers. Memory often constitutes the second greatest cost factor for workstations (it can be the greatest, depending upon the configuration) and is of vital consideration for larger configurations such as those expected for 64-bit workstations.

The performance curve afforded by the new generation of 64-bit-enabled, standards-based processors is setting high user expectations. Users anticipate being able to visualize and manipulate more complex models in real time without any bottlenecks. Media and entertainment, oil and gas, medical imaging, and seismic analysis verticals, among

others have already been pushing the envelope on existing 32-bit platforms and are expected to be the driving force in the industry for 64-bit x86 deployments. Sun also has **wide presence** in these markets both with its workstations and High Performance Technical Computing (HPTC) portfolio.

Customers will continue to invest in RISC/UNIX workstations due to the large installed base and the investments they have already made to optimize their application codes for these platforms. They have been complementing these investments with x86-based installations running a mix of Microsoft Windows and Linux operating systems, depending upon the application area. For example, the EDA and CAE markets have been swaying toward Linux, while the CAD market has been favoring Windows. Linux has been quick in supporting 64-bit extension-based technology and is readily available for running 64-bit applications.

The Microsoft Windows XP 64-bit Edition for 64-bit Extended Systems (such as AMD64) is expected to be available by early 2005. Nevertheless, customers can deploy the 32-bit version of Microsoft Windows XP today on the Sun Java Workstation (W2100z is WHQL¹ certified) and take advantage of applications

¹ Windows Hardware Qualification List

supported on the operating system. Some of the smaller and more recent ISVs have catered specifically to the needs of customers deploying these operating systems. The ability of the Sun Java Workstations (akin to other x86-based platforms) to support both these operating systems promises huge flexibility for customers who had to earlier look elsewhere for similar capability.

Customers have been demanding UNIX-like stability and robustness from these operating systems for years, in fact UNIX is still setting the bar for the server and workstations market. The availability of UNIX operating systems on x86 platforms has been a much-anticipated capability, as it affords customers with the ideal solution. The Sun Solaris is the only UNIX operating environment supported on industry-standard x86 hardware (x86 Platform Edition) and has received a warm reception, especially by workstation users. Sun Solaris has a major presence in almost all workstation verticals such as CAD, EDA, and CAE, among others. The availability of the Sun Java Workstations with Solaris x86 provides a complete tested, certified, and optimized **solution** for customers. The following key solution components bolster the value of the Sun Java Workstations:

- *Sun Solaris* – This crown jewel of the Sun product portfolio is one of the leading operating environments in the market with the largest ISV following among UNIX operating systems. Sun's upcoming Solaris 10 release adds major features to boost the security, manageability, and availability of systems, including workstations. Sun has invested extensively to maintain binary compatibility, enabling customers to span multiple hardware generations while retaining their investments in software and homegrown application code.

Sun enjoys strong relationships with its customers who have purchased (and continue to do so) in excess of two million workstations, not counting Sun servers. This massive installed base of workstations alone is a significant testimony to the vendor, and the technology and benefits it has provided to its customers. These relationships have also translated into long standing agreements and alliances with major IHVs, ISVs, and developers including the open source community.

- *Sun N1 Grid Engine Software* – This Distributed Resource Management (DRM) solution increases utilization of software and hardware resources by adding idle resource cycles to a compute grid. Instead of adding nodes to dedicated compute farms to address long-running compute jobs or simulations, customers can tap into the powerful computing cycles of their Sun Java (or Sun Blade) Workstations to cut down on unnecessary investments and increase productivity, as well as achieve faster return on investment. Companies of all shapes and sizes can leverage this software to run their complex jobs. The Enterprise Edition version provides more granularity in assigning and managing jobs based on predefined intervals.
- *Sun Java Desktop System (JDS)* – This integrated software environment combines open source innovation with Sun intellectual property to provide a viable alternative for customers looking to reduce cost and leverage Java

investments in a secure, cost-effective, and integrated package. It features the GNOME desktop environment, StarOffice productivity suite, Mozilla browser, Evolution mail and calendar client, and Java 2 Platform Standard Edition. It also includes server-side administrative tools for configuration, deployment, and administration of the user desktops. Additionally, developer tools allow customers to better integrate their applications into the JDS environment for maximum productivity. The JDS is designed to meet enterprise needs and requirements. It is available for both Solaris and Linux platforms.

- *Focus on Quality and Reliability* – Sun has consistently stepped up to the plate to ensure the high quality of its products. The Sun Java Workstations have undergone stringent testing and have passed through the certification processes of the leading IHV/ISV players. This commitment is vital for Sun Java Workstation customers, who strive for that stability especially with the Linux operating system, which has had limited certifications in some of the leading verticals in the workstation market.
- *Breadth of AMD64 Product Line* – The availability of a broader AMD64-based product line (servers and workstations) is highly beneficial to Sun customers. Customers can be, and often are, at risk with vendors that offer point products, because such products are tactically focused for mind share and can be withdrawn at a moment's notice. Sun currently offers four products using the AMD64 processor with the promise of further products in the pipeline. This breadth offers an essential “comfort level” to enterprises looking to make massive investments in Sun's AMD64-based product line.

Through the breadth of its product line, Sun has been able to gain a favorable relationship with AMD. Since the products share components, Sun is able to procure or manufacture them more cheaply and pass these savings on to customers. Moreover, most clients desire to standardize their infrastructure on one architecture to induce and leverage best practices. With the Sun AMD64-based product line, these customers can standardize on the Sun hardware for their x86-based platform requirements, which is not possible with some of the other point product offerings in the market.

Overall, the Sun Java Workstations provide a compelling value proposition for workstation customers. Sun has upped the ante in the workstation space with the Sun Java Workstation W1100z and the Sun Java Workstation W2100z. Sun's decision to embrace AMD64 standards-based technology provides it with an edge over the competition, as customers are striving for a viable alternative from a major player to the traditional options in the market. Further, Sun's 64-bit expertise can guide customers planning to migrate to the 64-bit x86 platform since the 64-bit performance and application challenges (besides the new extensions-based architecture) are more complex than those in the 32-bit world. Sun's competitors either lack experience or lack the right products to address the customer solution.

NEW WORKSTATIONS – SUN JAVA WORKSTATION W1100Z AND W2100Z

Workstations are often looked upon as beefier PC solutions. Sun’s approach of creating value through features, packaging, software, engineering capabilities, and support services is appealing to users, especially the technically adept ones, since this solutions-based approach addresses their challenges and needs.

The uni-processor Sun Java Workstation W1100z with its large memory support, entire gamut of leading 3D graphics, and Solaris and Linux OS options targets software developers and customers in the EDA, MCAD, CAE, and DCC market areas. The dual-processing horsepower of the Sun Java Workstation W2100z with support for up to 16 GB of memory and 3D visualization graphics fulfills customer requirements for high-end applications, which can take advantage of this workstation’s compute and architectural capabilities. Besides the traditional markets, the Sun Java Workstation W2100z is also appealing for scientific visualization, medical imaging, and defense/military customers requiring a secure, robust, and high-performance platform. Table 1, below, shows the key features of the Sun Java Workstations:

TABLE 1
Key Features of Sun
Java Workstations

	Sun Java Workstation W1100z	Sun Java Workstation W2100z
<i>Number of Processors</i>	1	1 – 2
<i>Processor</i>	AMD Opteron 100 Series	AMD Opteron 200 Series
<i>Maximum Memory</i>	8 GB PC3200 Registered ECC Memory	16 GB PC3200 Registered ECC Memory
<i>Disk Bays</i>	2 (Ultra ATA/100)	2 (Ultra320 SCSI)
<i>Media Bays</i>	2 (DVD-ROM/CD-RW, DVD Burner)	2 (DVD-ROM/CD-RW, DVD Burner)
<i>Number of I/O Slots</i>	1 64-bit/133MHz PCI-X, 4 64-bit/100MHz PCI-X, 1 AGP 8x	1 64-bit/133MHz PCI-X, 4 64-bit/100MHz PCI-X, 1 AGP 8x
<i>Graphics</i>	NVIDIA Quadro NVS 280, NVIDIA Quadro FX500, NVIDIA Quadro FX1100, NVIDIA Quadro FX3000	NVIDIA Quadro NVS 280, NVIDIA Quadro FX500, NVIDIA Quadro FX1100, NVIDIA Quadro FX3000
<i>Integrated Ethernet</i>	10/100/1000 Base-T Gigabit Ethernet	10/100/1000 Base-T Gigabit Ethernet
<i>USB / IEEE 1394a Ports</i>	5 USB 2.0 ports / 2 IEEE 1394a ports	5 USB 2.0 ports / 2 IEEE 1394a ports
<i>Operating System</i>	Solaris 9 HW 4/04 (x86 Platform Edition); Red Hat Enterprise Linux WS v3 – x86; Red Hat Enterprise Linux WS v3 – AMD64	Solaris 9 HW 4/04 (x86 Platform Edition); Red Hat Enterprise Linux WS v3 – x86; Red Hat Enterprise Linux WS v3 – AMD64; Microsoft Windows XP (WHQL certified)

The large memory capacity supported on both workstations provides ample headroom for customers across multiple disciplines to push the limits of the Sun Java Workstations for their demanding workloads. Sun’s focus on high reliability

is embedded in the Sun Java Workstations with support for Registered ECC memory, unlike non-ECC memory options supported by some of its competition. This is an imperative for customers running large models where memory failure is not an option as it can affect user productivity. The systems support dual internal disk drives to allow mirroring or striping of the hard drives to enable redundancy or higher performance respectively, using Solstice DiskSuite, a widely used software-based RAID solution. Both workstations provide optimal network connectivity with Gigabit Ethernet ports, and several USB and IEEE 1394 ports for connecting to media devices.

The Sun Java Workstations feature NVIDIA's AGP 8x product line with 2D entry, 3D midrange, and 3D high-end graphics accelerators. NVIDIA has been a trailblazer in the graphics industry in delivering superior features and capabilities well ahead of its competitors. It has consistently led in performance benchmarks and enjoys strong ISV and customer relationships. Customers running primarily graphics-intensive applications can leverage the Sun Java Workstation W1100z with the high-end 3D graphics accelerator in a cost-effective package.

The NVIDIA graphics drivers provide equivalent performance on both 32-bit and 64-bit hardware platforms, therefore customers can gain the additional benefits of the 64-bit workstations without compromising performance. Further, NVIDIA's investments in programmable shaders will provide powerful new capabilities to Sun customers. Sun will transition to the PCI Express specification, so customers will be able to deploy multiple high-end 3D graphics pipelines.

The Sun/AMD alliance promises time-to-market rollouts of new AMD64 processors and supporting technologies such as PCI Express on the Sun Java Workstations and the Sun Fire server products using these processors. The integrated memory controller provides ample dedicated bandwidth per processor so customers do not have to unnecessarily load up faster frequency memory modules just for raw high-bandwidth purposes. The PC3200 DDR1 memory with low CAS latency provides ample performance as seen from the benchmark results below for real-world applications in key verticals:

TABLE 2
Sun Java
Workstations
Benchmark
Performance Results

Application Vertical	Benchmark	Sun Java Workstation W1100z	Sun Java Workstation W2100z
Bio-Informatics	BLAST v2.2.9 ⁽¹⁾ –		
	aa.129295	133.30 (Solaris 10 x86 32-bit)	61.20 (Solaris 10 x86 32-bit)
Computer Aided Engineering	FLUENT v6.1.22 ⁽²⁾ –		
	FL5L1 1-CPU Parallel	91.0	92.7
	FL5L2 1-CPU Parallel	78.3	75.6
	FL5L2 2-CPU Parallel	–	146.6
		(RHEL 3.0 64-bit)	(RHEL 3.0 64-bit)
Mechanical Computer Aided Design	PRO/E WILDFIRE OCUS v4 ⁽³⁾	859	800
		(NVIDIA Quadro FX500 Graphics Accelerator, RHEL 3.0 32-bit)	(NVIDIA Quadro FX3000 Graphics Accelerator, RHEL 3.0 32-bit)
High-Performance Technical Computing	SPECCompM2001 ⁽⁴⁾	–	5085 (SuSE SLES 9 for AMD64)

Notes:

- (1) Performance is measured by the elapsed time in seconds; smaller is better. Both the Sun Java Workstation W2100z and W1100z were configured with 2.4 GHz AMD Opteron processors running the Solaris 10 operating system. The BLAST v2.2.9 benchmark was provided by the National Center for Biotechnology Information (<http://www.ncbi.nih.gov/blast>) and models a Bioinformatics Application performing pattern matching for nucleotides and amino acids.
- (2) The FLUENT results are benchmark ratings representing absolute performance; higher is better. Results can be found on <http://www.fluent.com/software/fluent/fl5bench/>. The Sun Java Workstation W1100z was configured with a 2.4 GHz AMD Opteron Model 150 processor and 4 GB of memory. The Sun Java Workstation W2100z was configured with two 2.4 GHz AMD Opteron Model 250 processors and 8 GB of memory. Both workstations were running the FLUENT v6.1.22 application under Red Hat Enterprise Linux 3.0 update 1 64-bit WS.
- (3) Score is based on elapsed time in seconds; smaller is better. The Sun Java Workstation W1100z was configured with the AMD Opteron 150 processor, 4 GB of memory, and the NVIDIA Quadro FX500 Graphics Accelerator. The Sun Java Workstation W2100z was configured with two AMD Opteron Model 250 processors, 4 GB of memory, and the NVIDIA Quadro FX3000 Graphics Accelerator. Both workstations were configured with the Red Hat Enterprise Linux 3.0 Update 1 32-bit and OCUS (Olaf Corten's Utilities) version 4 benchmark with PTC Pro/ENGINEER Wildfire 2.0. Published results can be found on http://www.ptc.com/appserver/it/icm/cda/icm01_list.jsp?group=201&num=1&show=v&keyword=403.
- (4) The Sun Java Workstation W2100z SPECCompM2001 performance result (higher is better) has been submitted to the Standard Performance Evaluation Corporation (SPEC). For the latest benchmark results, visit <http://www.spec.org/omp/results/ompm2001.html>

The benchmark results using both Solaris and Linux in 32-bit and 64-bit mode demonstrate the strength of the Sun Java Workstations for running the major applications in key workstation verticals. The Sun Java Workstation W1100z is clearly optimized for running single-CPU workloads, while the second processor boosts performance incrementally on the Sun Java Workstation W2100z.

The Sun Java Workstations complement Sun's existing SPARC based Sun Blade Workstation product line by offering customers the option to run the operating system and applications on their preferred architecture. Customers are no longer restricted to a single architecture that limits their ability to drive on industry-leading performance curves. The Sun Blade Workstation portfolio will continue to serve the needs of Solaris/SPARC customers with unmatched price/performance, platform-optimized graphics, and application support.

DHBA BOTTOM LINE

- Existing Sun customers looking for higher 3D graphics performance and OS flexibility are strongly recommended to evaluate the new Sun Java Workstations. Customers running 64-bit applications are recommended to wait until general availability of Solaris x86 (64-bit) unless the application is currently ported to 64-bit Linux.
- Sun has consistently led in price/performance across the major application segments among RISC/UNIX vendors as monitored by DHBA. This consistency is a vital proof point for customers who are buying into the x86-standards platforms to benefit from the perpetual price/performance improvements afforded by the platform through component price reductions.
- The breadth of Sun's AMD64-based systems product line assures the vendor's commitment and continued investment to the platform, including the availability of its flagship Solaris operating system. This commitment is imperative for customers as point products can be withdrawn leaving customers high-and-dry. Sun can procure more common components at cheaper prices to achieve economies of scale.
- The solution portfolio wrapped around the Sun Java Workstations with Sun N1 Grid Engine, Sun JDS, developer tools including Sun Java Studio, engineering expertise, and IHV/ISV relationships garnered through extensive 64-bit experience are invaluable components for all customers to consider the Sun Java Workstations for their workstation applications.