

## WHITE PAPER

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### **Sun's Solaris 10 for x86: A Platform for Enterprise Applications**

Sponsored by: Sun Microsystems

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### **EXECUTIVE SUMMARY**

Sun's Solaris 10 operating system is now available for both SPARC and x86 platforms. Its new features give software partners multiple reasons to update their current Solaris applications written for Solaris 8 and Solaris 9. At the same time, Solaris 10 is broadening the total available market (TAM) for all Solaris applications because x86-32 systems and x86-64 systems account for 90% of all server hardware units shipped worldwide, based on IDC 2004 server market data.

On a larger playing field, Solaris will be one of several operating systems available for x86 systems, including Microsoft Windows, Red Hat Linux, Novell SUSE Linux, Novell NetWare, BSD Unix, and others. The broader TAM is likely to attract a broader audience for Solaris; this phenomenon has already been seen in the early downloads of Solaris 10 from the Sun Web site: Nearly 70% of the downloads have been for the x86 platform.

This IDC white paper examines the Solaris 10 operating system, its new features — including DTrace and containers — and scenarios for deployment at customer sites. It discusses the new opportunities created by Solaris 10 for x86, as well as Sun's programs for independent software vendors (ISVs), and the challenges and opportunities this new product creates for Sun in the worldwide server market.

## SITUATION OVERVIEW

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### **Unix Workloads: Past, Present, and Future**

Servers running Unix operating systems are a keystone component of corporate IT, with Unix systems currently accounting for the single largest subset of worldwide server revenue. IDC's worldwide server data in 4Q04, the quarter ended December 31, 2004, showed that Unix server revenue accounted for \$5.2 billion, or 36%, of the \$14.4 billion in worldwide server factory revenue earned that quarter. By comparison, servers running Windows operating systems accounted for \$4.6 billion, or 32%, of worldwide server factory revenue, and Linux servers accounted for \$1.3 billion, or 9%, of worldwide server factory revenue in 4Q04. IDC notes that 4Q04 Unix server revenue was \$1 billion more than in the previous sequential quarter, 3Q04, reflecting a continued investment in Unix servers worldwide.

Unix servers are the most extensible category of servers by operating system — they play in all 11 price bands tracked in IDC's Quarterly Server Tracker. Systems running other operating systems are also extensible, but they do not show up in all 11 price-band segments.

Unix operating systems are supported across multiple architectures, including RISC microprocessors, 32-bit x86 (x86-32) processors, and more recently, aboard the new generation of 64-bit x86 (x86-64) processors. Servers built using these new 64-bit processors — which can support both 32-bit and 64-bit operating system and application software — are now ramping in shipment volume. IDC server data for 2004 shows that 32-bit x86 servers account for 81% of all unit shipments and 40% of all server factory revenue worldwide. In addition, the 2004 data shows that 64-bit x86 servers account for an additional 9% of unit shipments and 5% of factory revenue worldwide. Thanks to the long development history of Unix operating systems, the leading Unix server operating environment products feature advanced features/functions that support high levels of reliability, availability, and serviceability (RAS); security; scalability; and system management control. Today, Unix systems support virtualization, provisioning, and workload management with advanced functionality.

Unix servers support a wide range of workloads, as measured in IDC's annual workloads customer-based research. These workloads, based on data gathered from an annual survey of more than 1,000 customer sites, include the following: business processing (e.g., enterprise applications, OLTP, and business intelligence); decision support (e.g., data-based workloads); collaborative (e.g., email and groupware); technical workloads (e.g., scientific and technical applications); application development (e.g., programming and test/development); IT infrastructure (e.g., security, network support, and file/print support); and Web infrastructure (e.g., Web serving, proxy, and cache).

## Today's Business Requirements for Enterprise Operating Environments

Business requirements and ownership considerations have taken precedence over IT speeds-and-feeds discussions when companies consider new computer systems for acquisition. This shift in system selection began with the economic downturn of 2001–2003, when IT budgets were tightened by corporate management and technology considerations alone no longer drove the purchase/lease decision. Since then, many companies have put teams into place, combining business managers and IT managers, as experts in both areas consider systems that will be deployed to support changing business requirements. Among the top business requirements being evaluated for any new system are the following:

- ☒ **Uptime.** Businesses today are operating in a 24 x 7 world that often leaves little allowance, if any, for planned or unplanned system downtime when applications or data cannot be accessed by end users. Because global businesses need to access systems across time zones, there is literally no time for downtime. Small and medium-sized businesses (SMBs) face similar challenges when supporting Web-enabled access to an online store or order/entry system. The challenge today is that users can access data at any time of day — or from any location around the world.
  
- ☒ **Security.** Security is another key requirement for modern businesses. The need to offer services and access to Internet-connected users and Internet workloads means it is no longer possible to physically isolate corporate networks from the Internet "cloud." This situation creates a complex environment in which corporate servers and applications can be compromised by hostile code or hostile user access, leading to additional unplanned downtime and data corruption. Therefore, security needs to be a high priority for server installations. Isolation of applications and data, enforced by both hardware and software components of the system, leads to improved uptime and safeguards corporate data.
  
- ☒ **Built-in reliability and manageability.** In today's enterprise computing world, reliability is a top requirement to support business applications. Given the high expectations for system availability, many businesses are challenged by the difficulty or expense of hiring or maintaining sufficient in-house IT skill sets to manage, tune, or optimize their work environment. Likewise, the growing cost and complexity of managing multiple servers within the datacenter must be addressed by advanced workload provisioning and system management capabilities. That is why the task of providing secure foundations for enterprise applications increasingly falls to providers outside corporate IT organizations — to systems vendors, ISVs, and systems integrators.

- ☒ **Operational costs.** With staffing costs typically accounting for over half, and in some situations up to 70%, of the five-year total cost of ownership (TCO) to support a server, the focus today is on systems that are easy to manage and that require few software and hardware repairs and upgrades. Operational costs are directly impacted by uptime, security, and built-in reliability/manageability; therefore, selecting a system that offers the best security, reliability, and manageability has the best potential to offer better overall staffing costs from a TCO perspective.
- ☒ **Interoperability.** Most IT environments are mixed-vendor environments that are the result of many years of purchasing decisions. To create end-to-end solutions, such as Web services and service oriented architectures (SOAs), users developing new applications will likely need those applications to span multiple servers. Therefore, support of industry standards, such as Java, .NET, SOAP, and XML, will ease interoperability of systems. The servers that are deployed with support for interoperability will provide the greatest leverage for use on multiple systems and, therefore, the most business benefit to customers.
- ☒ **Skill set of current staff.** Sun has a very large installed base of servers worldwide, estimated by IDC to be at least 1.5 million active servers, ranging in size from small volume servers to scalable servers, such as midrange enterprise servers and high-end enterprise servers. This means that there is a wide base of knowledge about Solaris. Solaris skill sets are available in each major region of the world and in a variety of companies, from SMBs with fewer than 1,000 employees to large companies with 1,000+ employees and very large companies with 5,000+ employees. Because the source-code guarantee for Solaris was also included in earlier releases, supporting upward compatibility of applications from Solaris 9 to Solaris 10, these skill sets can be leveraged to reduce training costs, deployment costs, and ongoing operational costs.

### ***Software Acquisition Models Are Coming***

At the same time that the evaluation process is changing, so are software acquisition models. Traditionally, software was licensed on a per-site, per-system, or per-processor basis.

Today, the concept of a server that is statically configured, and statically licensed, is increasingly out of sync with the way customers will use their systems in the future. The industrywide trend to embrace storage, file, processor, and system virtualization means that operating systems and infrastructure software — and the workloads that are supported above them — need to have more deployment flexibility. This flexibility may be expressed in terms of having multiple instances of a given software layer on a single system, or across multiple systems, with the result that not all of these operating system instances will be used on a perpetual basis.

Indeed, some operating system and workload instances may have a life cycle related to business needs that are dictated by tactical product marketing programs, by quarterly operational cycles, or by business seasonality requirements.

As a result, software that offers better deployment flexibility can be seen as a better investment for customer organizations with changing business needs. Flexibility may include one or more of the following points:

- ☒ **System or user licensing options.** As customers configure their systems, the ability to license operating system software as well as layered infrastructure and application software on the basis of a systemwide license, or to license on the basis of total connected users, offers flexibility to a dynamically configured environment. If we take the concept of licensing based on connected users or devices one step further, we see that it may need to evolve to consider both the pervasiveness of a given user or the level of access that a device may have. That is, a connected cell phone may leverage fewer corporate resources than a laptop client system.
- ☒ **Perpetual and dynamic licensing.** Customers will continue to have a strong need for perpetual licenses for those workloads that are predictable in terms of deployment life cycle and platform hosting. However, as customers look to limit IT investments by acquiring resources when needed — and only for the duration of peak utilization — the ability to dynamically license on a short-term lease basis will increase in importance.
- ☒ **Platform mobility.** Finally, platform mobility offers another level of flexibility by enabling customers to select the platform that offers the best performance, cost, or availability for a given task or a particular workload. Software products that are available on multiple platforms are especially valuable to customers looking for flexibility.

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## **Solaris 10 on the x86 Platform**

Solaris 10 is the latest version of the Sun Solaris operating system, one of the most widely installed operating systems in the Unix world. It is a highly extensive operating system, with installations on volume servers (servers priced less than \$25,000, as defined by IDC), starting with uniprocessor servers; midrange enterprise servers (servers priced from \$25,000 to \$499,999, as defined by IDC); and high-end enterprise servers (servers priced at \$500,000 or more, as defined by IDC), ranging up to servers with 128 dual-core UltraSPARC IV processors. Because Solaris is deployed across the computing spectrum, its range of features/functions is deep. Solaris was originally based on Unix System V Release 4 (SVR4), and Sun acquired the perpetual rights to the underlying Unix source code in 1994 and has optimized Solaris for network computing, RAS features, security, and high availability since then. Solaris has been a 64-bit operating system since 1998, with the release of Solaris 7; Sun's SPARC-based hardware has been built on 64-bit technology since 1996. However, Solaris has been able to support both 32-bit applications and 64-bit applications, which became important for the Solaris on x86 release running on 32-bit x86 hardware. Beginning in 2003, a new generation of 64-bit x86 microprocessors, such as AMD Opteron, combined support for 32-bit applications and 64-bit applications.

Today, Solaris 10 ships for the x86 server platform and for the UltraSPARC RISC platform, with the two target platforms compiled from a common source code base.

Solaris 10 supports network-enabled tier 1 deployments (e.g., front-end processing, Web serving, and user interface delivery), application serving in tier 2 deployments, and business processing workloads (e.g., database serving, OLTP, business intelligence, and enterprise application workloads) in tier 3 deployments.

### ***Solaris 10 on x86: What It Is***

Sun's Solaris operating system was long considered the crown jewel that made it possible for Sun to grow its strong position in the Unix server market. Historically developed specifically for Sun's SPARC microprocessor architecture, Solaris has consistently marched forward with major releases approximately every two years.

In addition, over the past six years, Sun has delivered a series of x86-based products. Today, Sun has a range of x86 server products running on the AMD Opteron platforms, a family of systems that is expected to grow over time to include a range of server models — including scalable models with up to eight dual-core processors.

Beyond the Sun-built servers, Solaris 10 runs on hundreds of systems made by many vendors. Solaris 10 is certified to run on more than 400 client and server products. Examples of server systems that have been certified to run Solaris 10 include x86 servers made by HP (HP ProLiant) and Dell (Dell PowerEdge), and client examples include PCs, notebooks, and laptops made by IBM (IBM IntelliStation), HP, Dell, Toshiba, and others.

Solaris 10 on x86 is derived today from the same Solaris source code used to create Solaris for SPARC, but it has been compiled to run on the x86 microprocessor architecture. Because the source code is the same as that of the UltraSPARC systems, the full range of features/functions of Solaris is available on both the x86 and the SPARC platforms. This availability has the practical result of making it simple and easy for ISVs to test and certify their systems for use with Solaris 10 aboard both hardware platforms.

IDC's worldwide server data shows that SPARC-based RISC servers accounted for 5% of all server units shipped in 2004; by contrast, x86 servers, inclusive of x86-32 and x86-64 servers running a variety of operating systems, accounted for 90% of all servers shipped in 2004. (IDC notes that these x86 servers ran a range of operating systems, including Microsoft Windows, Unix, Linux, and Novell NetWare). The combined total addressable market for Solaris 10 accounts for 99% of all server units shipped worldwide in 2004. The remainder run on single-vendor processors from a variety of systems vendors.

### **IHV Support**

Solaris 10 was compiled to run on a wide range of x86 server platforms (Intel-based and Opteron-based) — and as of June 2005, the manufacturers of 226 server and client/desktop models and 174 laptop systems have reported that Solaris works on their hardware. A subset of those products has been formally certified by Sun, with a larger portion having passed Sun's test suites.

There is a wide community of interest around the Solaris 10 software, which is available in no-fee downloads (inclusive of periodic security patches). Since Solaris 10 was announced in November 2004 — and shipped in January 2005 — Sun claims that 2.49 million free downloads with registered licenses have been downloaded from its Web site. Of this total, 1.63 million (64%) were reported by Sun to be for the Solaris 10 on x86 build of the operating system.

### ISV Support

Solaris 10 is a 64-bit operating system; yet, like most modern 64-bit operating systems, it supports customers' 32-bit applications and more recent 64-bit applications that take full advantage of the 64-bit hardware platform. Solaris 10 includes both 32-bit libraries and 64-bit libraries — and applications being introduced to a Solaris 10 system are automatically detected and linked to the appropriate libraries. Importantly, 32-bit and 64-bit applications can run side by side and "share" system resources. Sun cites more than 6,500 ISV application software products on Solaris 8, with many of those applications moving to Solaris 10. As of September 2005, 1,500 of these applications have been certified or are in the process of being certified to run on the Solaris 10 on SPARC, and 1,000 applications are being moved to the Solaris 10 on the x86 platform. IDC notes that given the binary and source compatibility between different releases of Solaris, moving to Solaris 10, for most ISVs, is more about certification than about porting.

To reinforce that concept, Sun continues to offer a guarantee on upward compatibility of programs written for Solaris 2.6, Solaris 7, Solaris 8, and Solaris 9. If an application does not run on Solaris 10, Sun will work with the ISV, at no charge, to determine the problem. If the problem is related to the operating system, Sun will fix it.

### Solaris on x86 and the ISV Community

With Solaris 10, the ISV community has new choices for deploying enterprise-level Solaris applications on x86 industry-standard hardware platforms. Both commercial and high-performance computing (HPC) applications will be available, as well as support for IT custom applications that were written in-house for use in specific vertical industries.

Sun is encouraging ISV partners to move current Solaris 8 and Solaris 9 applications to Solaris 10 — and to support Solaris applications aboard SPARC systems on x86 platforms. To make this happen, Sun has established a number of programs for ISVs, including the following.

- ☒ The Ten Moves Ahead program, launched when Solaris 10 was announced in November 2004, provides incentives for ISVs to port their applications to Solaris 10. As of September 2005, 1,500 ISV applications were being certified to run on Solaris 10 for SPARC platforms, and 1,000 were also being certified for Solaris 10 for x86 platforms.
- ☒ Access to Sun Solution Centers worldwide. Each Sun Solution Center has facilities to aid in porting, testing, and benchmarking applications on a range of Sun systems, including both SPARC and x86 platforms.
- ☒ ISV programs for co-advertising and co-selling, along with Sun, for ISV applications ported to Solaris 10.
- ☒ Customer piloting programs, which include support for ISV applications and Sun system "loaners" to customers.
- ☒ Benchmarking support at Sun and its Sun Solution Centers to show good scalability for Solaris 10 as it runs on systems ranging from four or fewer processors up to systems supporting eight or more processors. IDC notes that Sun's UltraSPARC IV and IV+ are dual-core processors today and that AMD Opteron x86-64 processors and Intel EM64T processors will support dual-core later this year.

Sun is supporting ISVs as they evaluate the process of moving their software applications from earlier versions of Solaris to Solaris 10 — and from SPARC-based platforms to x86 platforms.

### ***Clarifying the Role of Solaris on x86 in the Marketplace: What It Is Not***

Historically, Solaris on x86 was not a platform that customers thought of as an equal to Solaris on SPARC. With the launch of Solaris 10 and the new features and approach to new Grid Computing and 64-bit environments, Solaris should capture additional mindshare among potential and existing customers.

Still, because of the historical differences between Solaris for SPARC and x86 platforms, Solaris 10 for x86 continues to be seen by some customers and ISVs as a separate product from mainstream Solaris 10 technology that is deployed on servers and workstations based on the SPARC architecture.

Another misperception is that Solaris on x86 was suitable for use only on small servers, especially standalone workgroup servers. This is not the case today because Solaris on x86 runs on bladed servers, rack-optimized servers, and the full range of x86 servers. Ironically, given the maturity of the Solaris 10 code base, Solaris 10 on x86 has the ability to scale beyond the range of today's scalable x86 servers. IDC expects that x86-64 servers will become more scalable over time and that customers will be able to leverage the scalability of Solaris 10 on x86-64 servers (whether based on AMD Opteron or Intel EM64T microprocessors) to deploy larger SMP system images.

Even on servers with two to eight processors, the advent of multicore processors will lend greater scalability within the system chassis. Solaris 10 can support multithreaded applications today — and this capability will improve the efficiency of multicore system deployments on x86 and x86-64 hardware, enhancing system performance for demanding, compute-intensive workloads.

Although multicore technology is new, operating systems that can scale well in an SMP configuration are pre-positioned to harness and optimize the use of multicore processors. The capability of Solaris to scale up by running across multiple processors has been well proven aboard the SPARC architecture, thanks to an integral design optimized to run on servers with high numbers of individual processors without sacrificing throughput or performance to excessive system overhead. Given that history, it is likely that Solaris will offer optimal performance aboard systems that are built on top of multicore x86 processors.

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## **Top Features of Solaris 10**

The major features of Solaris 10 are described in this paper, including the following: Dynamic Tracing (DTrace) for code optimization; Solaris containers for hosting multiple applications and/or workloads within a single Solaris 10 domain; and enhanced support for RAS, security, and dynamic workload allocations among Solaris 10 partitions or Solaris 10 containers.

- ☒ **DTrace.** This new feature allows system administrators and programmers to identify system bottlenecks and to modify the code within the operating system to speed up performance. Improvements in performance range from 20% to more than 300%, depending on the workload and the cause of the bottleneck. The information generated by running the DTrace utility allows developers to performance-optimize the system tuning and to modify the application code for more efficient processing.

- ☒ **Containers.** This feature, once known as "zones," creates multiple software-defined partitions within a single copy (or domain) of the Solaris 10 operating system. Each container isolates the workload within it — and each container can be restarted or deactivated without affecting the other containers. All of the Solaris containers run within the same copy of the operating system rather than exist on top of separate copies of the operating system. Accordingly, containers cannot support other operating environments, such as Windows or Linux. However, when combined with Sun's Linux Application Environment (LAE), formerly code-named Janus, a future enhancement to Solaris 10, Solaris containers can support Linux applications running on top of the foundation Solaris 10 operating system. Customers can set up dozens of individual Solaris 10 containers within a single instance of the operating system.
  
- ☒ **Inclusion of Trusted Solaris features.** Solaris 10 includes elements of Trusted Solaris, which was previously available in a separate version of Solaris 8. The features of Trusted Solaris that have not yet been incorporated into the first release of Solaris 10 will be made available as a separate package that can be installed on top of Solaris 10 to give it complete Trusted Solaris functionality.
  
- ☒ **New pricing models.** Solaris 10 will be available via subscription services and through a free right-to-use (RTU) license that carries no fee if Solaris 10 is deployed for end-user "commercial" use — or as a system being used to host workloads for production purposes. The intent of the new pricing models, with their support for pricing flexibility, is to broaden Solaris adoption in the marketplace aboard systems across a wide range of customer IT budgets. Customers downloading Solaris have the option to sign up for support and maintenance for a fee and have several levels of support from which to select, depending on the amount of coverage (e.g., 24 x 7, 12 x 5) that is required. Customers who want to receive regular Solaris 10 updates, upgrades, and fixes will pay \$120 per socket per year for a "Basic" level of service. Customers who want 12 x 5 phone support will pay \$240 per socket per year for a "Standard" level of service. Customers who want 24 x 7 phone support and additional training and educational services will pay \$360 per socket per year for a "Premium" level of service. All customers, even those without a service contract, will have access to security fixes and regular updates as they are made available. These updates include all bug fixes — regardless of the size of the server or of whether they acquire the free RTU license.
  
- ☒ **Support for the new Java development toolkit.** Sun announced the latest release of its Java development toolkit: Java 2 Platform Standard Edition (J2SE) 5.0. It will allow programmers of Java-enabled workloads, such as Web services, to gain the enhanced performance improvements of Solaris 10 using DTrace for Java application code that runs on top of the new Solaris 10 release.

- ☒ **Services for Solaris 10 deployments.** Sun is selling services for Solaris 10 deployments, including migration and performance services, upgrades to Solaris 10, or new deployments of Solaris 10. Sun Interim Operations Management pays for Sun engineers to manage a customer's datacenter for 3–12 months, and Sun Site Operations Management pays for Sun engineers to manage a datacenter that is working to achieve the goals of specific service level agreements (SLAs). Sun is also offering services to help move customers' systems to Solaris 10 from a variety of other operating systems, including older versions of Solaris, IBM AIX, HP-UX, and the Red Hat distribution of Linux.
- ☒ **ZFS.** This new approach to managing file systems (available in a future update) includes 64-bit checksum detection to identify and avoid data corruption and data-related errors.
- ☒ **Memory Placement Optimization.** This technology optimizes performance, particularly on multicore systems, by allocating memory use based on the distance and time a block of memory is away from the processor that consumes this memory. Memory is designated as local or nonlocal and is allocated to minimize processor cycles wasted waiting for data or instructions held in memory to arrive for execution.
- ☒ **Source and executable code guarantees.** Sun offers ISV partners two guarantees on code compatibility related to Solaris: one guarantee is related to ABI compatibility between Solaris 10 and earlier versions of Solaris, and the other guarantee is related to source code compatibility between different platforms. The ABI guarantee applies to any application that runs on Solaris 2.6, Solaris 7, Solaris 8, or Solaris 9 and ensures that the application will run on Solaris 10. Under this guarantee, ISVs that have applications operating aboard Solaris 2.6, 7, 8, and 9 can bring their applications to Solaris 10. After an ISV application has been certified for use aboard Solaris 10, the application is qualified to be deployed aboard either Solaris on x86 or Solaris on SPARC. The company offers a less widely known program that offers assurance that a recompile of C or C++ code will be fully compatible with the Solaris OS across SPARC and x86 platforms.
- ☒ **Predictive Self-Healing.** Predictive Self-Healing empowers a system to protect itself from impending failures of memory, I/O, and CPU. When a system sees a component exhibiting prefailure behavior, it can take preventive action. Prefailure error codes generated by the system are cross-referenced against a knowledge base on the Sun Web site, and based on the severity of the potential failure, the system will take appropriate response. For example, if a processor is determined to be at risk of failing, the system will automatically move the workload aboard that processor to the alternative processor, and the defective processor will be brought into a quiescent state. This capability is available aboard systems built upon both SPARC and AMD x86 processors.

## Virtualization Emerges as a Key Component of Next-Generation Systems

One of the key trends that has been gathering speed in the server operating environment market is the concept of virtualization. IDC sees resource virtualization occurring at several levels of the software stack and defines it through the virtual environment software (VES) taxonomy. Product categories include:

- ☒ **Virtual access software.** This software allows applications to be accessed from intelligent access devices over a network, without the applications' having to have been architected to support the devices. Sun's products in this space include Sun Ray Server Software.
- ☒ **Virtual application environment software.** This software creates an application development and deployment environment that allows properly developed applications to be unaware of the underlying operating environments and hardware platforms. Application server software and parallel database software fit in this category. Sun's products in this space include Java, along with its related J2EE Web server products.
- ☒ **Virtual processing software.** This category ranges from virtual machine software making a single system appear to be many systems, each supporting its own operating environment, to single-system image clustering software, which makes many systems appear to be a single computing resource running a single operating environment. This category also includes parallel processing software, load-balancing software, and data and application availability software. Sun's products in this space include Sun Cluster, Sun HPC ClusterTools, and Netra High Availability Suite Foundation Services Software.
- ☒ **Virtual storage software.** This software allows applications to be unaware of where and how data is stored. This category includes storage replication, file system software, and data replication software. The software supports both storage area network (SAN) and network attached software (NAS). Sun offers its own line of StorEdge storage management and data management products and resells a group of Symantec/VERITAS products for storage management, file system management, and volume management.
- ☒ **Provisioning and management software.** This software makes it possible for operators and administrators to load, manage, and operate multisystem configurations. This is a primary component of dynamic IT environments. Sun products that fit into this category include its N1 technology as well as individual products such as Control Station, Solaris Resource Manager, and Solaris Bandwidth Manager.
- ☒ **Security software.** As applications are decomposed into components (sometimes called services), identity management and access control become increasingly important. Sun's products in this space include Enterprise Authentication Mechanism and Solaris Data Encryption.

Sun also offers its Solaris "container" technology. Solaris containers (which offer a controlled and managed application workspace within a single operating system image) don't fit neatly into IDC's taxonomy, but containers do offer benefits similar to those of virtual processing software. Those benefits include application isolation, containment of rogue applications, system resource and processor bandwidth allocation and limitations, and the ability to meet quality-of-service requirements.

## CHALLENGES/OPPORTUNITIES

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### Challenges in a Competitive Marketplace

Like any product in the marketplace, Solaris 10 for x86 faces some competitive challenges. Specific challenges, along with some approaches Sun can take to meet those challenges, include the following:

- ☒ **ISV concerns about Sun's commitment to the x86 platform.** Several years ago, Sun temporarily interrupted its support for Solaris on x86 with the Solaris 9 release, which caused some ISVs to worry about Sun's long-term commitment to the x86 platform. With Solaris 10 for x86 servers, Sun must clearly articulate its commitment to the x86 platform. This task will be made much easier by the fact that Sun is ramping its x86-64 Galaxy server platform, which is based on AMD Opteron processors. Solaris 10 for x86 is the version of Solaris that runs on the Opteron-based Galaxy systems.
- ☒ **Number of ISV titles available for Solaris x86.** Previously, there were fewer ISV titles for Solaris 10 for x86 systems than for RISC systems. Today, Sun is working to ensure that more titles are available across both server platforms — RISC and x86. The shipment of Galaxy x86-64 systems, starting in 4Q05, will bring more market momentum to the list of software titles, which already exceeds 1,000 ISV applications.
- ☒ **Competition from other operating systems on x86 platforms.** Solaris 10 will compete with Linux and Microsoft Windows for specific application workloads running on x86 server systems. The x86 server platform offers Solaris 10 for x86 a very wide available market — with more than 40% of all server factory revenue worldwide and more than 80% of all server unit shipments worldwide. However, Microsoft Windows and Linux drove most of the volume shipments of x86 servers in 2004, and Unix/x86 platforms accounted for a small percentage of total x86 server unit shipments in 2004. With Solaris 10, Sun has the opportunity to take on scalable workloads that are running on x86 servers. The ability of Solaris 10 to scale will be amplified with the shipment of multicore x86-64 platforms, including Sun's vSeries platforms (v20z and v40z) and the Galaxy line of x86 servers. Further, the support of virtualization software, such as VMware ESX (from VMware, an EMC business unit), will increase the coexistence of competing operating systems on x86 platforms.

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### Opportunities

Specific opportunities for Sun Microsystems' Solaris on x86 product include the following:

- ☒ **Conversion of Sun's large installed base.** Sun's Unix server base worldwide — the largest installed base of Unix servers tracked by IDC, with 1.5 million server units worldwide — has created a strong market presence for Solaris operating systems and associated layered software (e.g., middleware and Java-based software layers that run on top of Solaris). This represents a major opportunity to grow future revenue streams, with improved profitability, for Sun and its ISV partners.

- ☒ **Leverage advanced features/functions** on x86 server platforms. Solaris 10 features, such as DTrace, security containers, and workload isolation, to name a few examples, bring advanced features/functions to x86 server platforms that are not yet available from competing products. Further, the DTrace capability allows ISVs to optimize performance for their existing applications, without having to rewrite them to achieve those business results. The maturity of Sun's Solaris 10 operating system offers advanced scalability, RAS, and manageability to a new group of customers; the combined list of new features offers a compelling solution for prospective customers and ISVs.
- ☒ **Sun's broader approach to the Unix marketplace.** Solaris for clients and servers now has broader potential in terms of its deployment on a variety of form factors and across multiple types of servers, at a range of price points. As Sun moves onto more architectures (i.e., x86, x86-64) — and offers a broader range of products that span the full range of computing environments — from workstations and client/desktops, to more types of server deployments, to thin servers in rack-dense deployments, rack-optimized servers, scale-up (SMP) and scale-out (clusters and grids), the company will find itself positioned to offer solutions to more customers in new and different markets.
- ☒ **Leverage customer plans for standardization.** Offering an x86-based solution that includes support for a standardized software stack may be an attraction for certain customer segments, including financial services and telcos. Some of these traditional Unix/RISC customer sets would like to consolidate on x86 server architectures but would also like to bring Unix software solutions to the new x86 server deployments.
- ☒ **Sun's release of the OpenSolaris program,** which encourages programmers and developers worldwide to innovate on top of the Solaris 10 source code, brings a new avenue of innovation to the Solaris world. OpenSolaris is not a Sun-branded product, but innovations coming from this open source community development effort will bring new functionality that can be incorporated into future releases of the Solaris operating system.

## CONCLUSION

Solaris aboard the x86 platform represents an interesting opportunity for ISVs because it brings advanced features associated with datacenter deployments within the reach of the mass-market x86 server community. The value proposition is particularly strong for ISVs that are currently supporting Solaris 8, 9, or 10 on Sun's SPARC architectures because they now have a much broader market to address with their applications, databases, and layered software products. Because of Solaris' continued support for upward compatibility from previous Solaris releases — and support for compilation tools provided by Sun — moving applications to x86 platforms will be a well-defined process. The combination of product support for platform migration and Sun programs to support ISVs moving to Solaris 10 will ensure that the inventory of Solaris 10 applications continues to grow steadily.

The x86 server market, which IDC anticipates will show greater growth than the RISC server market through 2009, is expected to continue its evolution — scaling up-market and preparing to meet a greater range of business requirements and workloads.

ISVs considering how to grow their business should view the Solaris 10 on x86 platform as opening up a new avenue of application deployment — one that will bring features and attributes long associated with datacenter operations to the world of x86-32 and x86-64 computing.

Sun is moving strongly into the x86 server space with a family of Opteron-based servers and plans to create market momentum around Solaris on x86, and Solaris on x86 applications, to grow the Solaris on x86 ecosystem worldwide. At the same time, Sun recognizes that the x86 server platform is supported by hundreds of systems vendors, and it has launched a program to enlist their support for Solaris 10 on x86 as one of the certified operating systems, alongside Windows, Linux, NetWare, and others running on x86 servers worldwide.

### Leveraging Solaris 10 Aboard x86 Workstations

Like the growth prospects for other vendors' high-performance workstations, the growth prospects for Sun's RISC-based workstations running Unix have been negatively impacted by the continued performance increases on workstations built using x86-32 processors. The recent introduction of AMD Opteron-based workstations built using the new generation of 64-bit x86 (x86-64) processors has brought a performance leap that opens the door for x86-64 workstations to compete in nearly all segments of single-user workstation environments.

The historical synergy of Windows solutions aboard x86 PCs and workstations ensures a strong presence for Windows in the x86-32 market, but so far it is not a given that the x86-64 market client market will default to a Windows operating system. For existing Sun workstation customers, Solaris 10 for x86 is a natural solution for this space because the operating system — and, more important, the existing Solaris workstation applications available from the Solaris ISV community — can fully leverage the 64-bit functionality of these new Opteron-based machines.

However, IDC expects this market segment to be competitive because it represents a convergence point for Windows, Linux, and Unix — a convergence point without a preestablished market share segmentation.

The key to winning in this space is to have a comprehensive ISV application portfolio available. That's the good news. The not-so-good news is that because of the ability of x86-64 platforms (and the 64-bit operating systems that will be used aboard these platforms) to support 32-bit applications, existing applications that are available on x86-32 platforms will also enjoy a significant performance improvement aboard x86-64 hardware. The net result is that Microsoft's 32-bit application portfolio can be deployed aboard x86-64 platforms, diluting the ISV portfolio story that Sun will have with its Solaris product. Linux, on the other hand, continues to struggle to develop an application portfolio that can compete with the portfolio available from Sun's ISVs.

Having Solaris 10 aboard client and workstation platforms, Sun arguably has a solution that can offer an alternative to Linux and, in performance-oriented environments, to Windows. Looking forward, Sun has new opportunities to "scale down" in the x86 workstation space, which could well add to the overall Sun ecosystem surrounding Solaris 10.

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