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Oracle Solaris and Oracle SPARC T4 Servers—Engineered Together for Enterprise Cloud Deployments

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Executive Overview

Oracle Solaris and the SPARC T4 processor have been engineered together to improve throughput, security, and resiliency throughout the application solution stack. Learn how this combination can maximize return on investment and help organizations manage costs for their existing infrastructures or for new enterprise cloud infrastructure design.

Introduction

With the trend to evolving enterprise datacenters into an internal cloud resource, many organizations are grappling with how to transform their existing infrastructure to offer the perceived economy and flexibility of the cloud computing model. Some organizations are even thinking about completely redesigning the way they deliver services.

Oracle Solaris has been helping organizations evolve their datacenters toward a more service-oriented model by modernizing datacenter computing, networking, and storage management. Beginning with Oracle Solaris 10, this new design approach has resulted in a number of new technologies that help organizations make the most of their datacenter assets. Amongst these key innovations are built-in virtualization for the operating system with Oracle Solaris Zones (previously known as Containers), storage virtualization through the ZFS filesystem and the ability to safely analyze live production workloads using dynamic tracing (DTrace). In addition, resiliency of system hardware and software services was significantly improved by the self healing capabilities introduced through the Fault Management Architecture (FMA) and Service Management Facility (SMF).

With the advent of Oracle Solaris 11, significant new capabilities build on this baseline to improve traditional datacenter operations and pave the way to building enterprise-class clouds. Here the focus has been on enhancing and accelerating the ability to deliver services through extending virtualization capabilities to the network and the introduction of new installation and software management technologies.

Over the last 25 years, the Oracle Solaris has been developed hand-in-hand with systems built around the SPARC processor. Oracle Solaris is tightly integrated with the many system level capabilities of the SPARC T4 processor, providing scalable, high-performance compute capability coupled with integrated high-speed networking and cryptographic acceleration.

Today, with Oracle Solaris 10 and SPARC T4 systems, existing applications can receive an immediate performance boost and at the same time companies can begin extending their operations into the cloud with Oracle Solaris 11.

The remainder of this paper provides further details of how Oracle Solaris and its companion products Oracle Solaris Cluster and Oracle Solaris Studio work together with SPARC T4 systems and Oracle enterprise software to enable a compelling set of cloud-ready solutions.

"Our benchmark testing of Oracle's SPARC T4 system on our ERP System led to impressive results. We saw performance enhancements of up to 4x compared to our legacy server. Deployment was easy; just a drop in. Our planned worldwide rollout will take advantage of the SPARC T4's very modest space, energy and heat requirements. In our production deployment we plan to use Oracle Solaris virtualization to implement containers and consolidate several workloads onto a single server."

Thomas Kleber, Department Lead IT, Kromberg & Schubert GmbH & Co,

SPARC T4 Processor and System Overview

The SPARC T4 processor marks a significant breakthrough in performance and energy efficiency to meet the demanding challenges of today's increasingly virtualized datacenter. The latest multithreading technology delivers not just the throughput computing capability of its predecessors, but also up to 7x better performance for single threaded workloads. As an example, 64 threads can be supported in two rack units (2RU), providing increased computational density while staying within variously constrained envelopes of power and cooling. Very high levels of integration help reduce latency, lower costs, and improve security and reliability. Optimized system design provides support for a wide range of IT services application types. Uniformity of management interfaces and adoption of standards help reduce administrative costs, while an innovative chassis design shared across Oracle's volume servers provides density, efficiency, and economy for modern data centers.

The SPARC T4 processor family is designed and optimized to address a variety of application environments. Table 1 provides an overview of the key features of the SPARC T4 processor architecture.

TABLE 1. KEY FEATURES OF THE SPARC T4 PROCESSOR ARCHITECTURE

FEATURE	SPARC T4 SPECIFICATIONS
Cores/Threads/Sockets	Up to 8 cores/8 threads/4 sockets Up to 256 processing threads Chip Multithreading (CMT)
Maximum frequency	Up to 3.0 GHz
Shared L3 cache	4 MB on chip Dedicated L2 cache (128KB per core)
On-chip support	PCI Express bridge, integrated dual 10GbE networking with XAUI, crypto acceleration, L1, L2 and L3 cache, integer and floating point execution units, PCIe Gen 2 (x8), hypervisor

Maximum memory (per system)	Up to 1,024 TB (4 sockets)
Reliability features	Predictive Self Healing, hot-swap components, ECC everywhere, redundant components and networking, hot plugging of PCIe, USB, and SCSI devices.
Security	Multiple on-chip cryptographic capabilities, plus additional protections
Virtualization (V12N) Included at no extra charge	Oracle VM Server for SPARC (previously called Logical Domains or LDOMs) and Oracle Solaris zones
Target environments	Network-facing: consolidation and virtualization, Web, Media, security, OLTP, middleware/SOA, batch processing, datamart, application servers

SPARC T4 Systems Portfolio

Providing a seamless upgrade path for existing SPARC systems, Oracle offers three rack-mount configurations and one blade server. The blade server has a single CPU and is compatible with the Sun Blade 6000 Modular System chassis. The rackmount systems are offered in 1,2 and 4 socket configurations.

Oracle Solaris and SPARC T4 servers

Oracle Solaris is a proven, industry-leading operating system with features designed to handle enterprise, business-critical operations. Oracle Solaris provides key functionality for virtualization, optimal utilization, high availability, unparalleled security, and extreme performance for both vertically and horizontally scaled environments. Oracle Solaris runs on a broad range of SPARC (and x86-based) systems and compatibility with existing applications is guaranteed. This is why there are over 55,000 businesses and institutions running over 11,000 certified applications on Oracle Solaris today.

With Oracle Solaris at it's heart, Oracle offers customers a complete integrated stack, from the applications layer at the top to disk storage systems at the bottom, as shown in Figure 1. Oracle is the number one vendor in the top three software segments (applications, middleware, and database), and Oracle Solaris is the number one deployment platform for Oracle Database applications.

"As a leading global financial institution, ING needs servers that provide the highest levels of reliability and performance to support our mission-critical business applications. Our testing of the ING application stack on Oracle's SPARC T4 servers running Oracle Solaris proves Oracle's Sun servers deliver quality, predictability and complete backwards compatibility while greatly enhancing system performance."

Frank Schots, Senior UNIX Systems Engineer, ING Bank

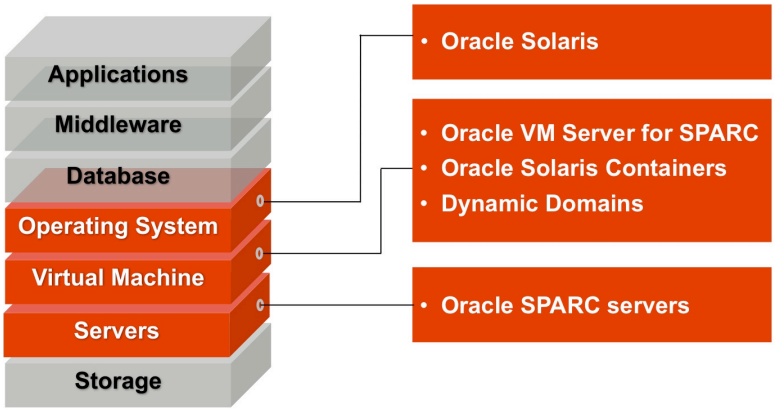

Figure 1. Oracle Solaris and Oracle's SPARC servers are the optimal solution stack for Oracle Database and Applications.

Performance

Oracle's SPARC T4 systems integrate many technologies. Table 1 indicates features with the CPU itself such as networking and cryptoacceleration. The systems also include a service processor (iLOM) and subsystems for memory and I/O. Oracle Solaris is designed to deliver a first-class environment for running enterprise applications by leveraging the capabilities of the underlying hardware.

The multithreaded capabilities of Oracle Solaris leverage the redesigned core of the SPARC T4 processor. In particular, a thread can now be defined as "critical" and consume all the resources of a core resulting in a significant performance boost for single threaded applications. This is in addition to the throughput computing capabilities inherited from previous generations of T-series processors.

Benchmarks

Following on from the many world class performance results set by earlier generations of SPARC systems, the T4 has, in short order, shown impressive performance across a range of benchmarks.

Performance improvements in both single-threaded and throughput computing allow the T4 to compete effectively against IBM's Power and Intel's x86 and Itanium CPUs as illustrated in the table below.

Application	Benchmark	Result/notes
Fusion Middleware	SPECjEnterprise2010	2.4x faster than IBM Power7
E-Business Suite	HR R12.1.2	2400 online users
Peoplesoft Payroll	Batch	3.1x faster than HP Itanium
Peoplesoft HR	HR Self-Service 9.1	3.8x faster then IBM Power
Siebel	Loyalty Batch	7.65M TPH (Reward Accrual)
JD Edwards	"Day in Life" online+batch	2.5x faster than IBM Power7 P750
Communications Activation	Telco provisioning	T4 CPU 7.7x faster than 1.7GHz Itanium
Communications Service Broker	Telco (Java/Intelligent Networks)	T4 CPU 2.7x faster than Intel Nehalem
Database	Security TDE	42% faster than Intel AES-NI implementation
Database	TPC-H	Faster then IBM Power7 780 and HP Itanium

Efficiency

There are many areas where the OS and hardware interoperate to maximize efficiency. Oracle Solaris recognizes SPARC T4 system power management settings to optimize system power consumption. In addition the software components responsible for networking and cryptography will utilize hardware resources rather than wasting CPU resources to implement the various packet processing and security algorithms. This allows for wire-speed encryption without impacting critical workloads and this "free" encryption is also utilized by both Oracle Solaris ZFS for on-the-fly encryption and for secure live migration in VM Server for SPARC as described below.

Security

Oracle Solaris provides a sophisticated network-wide security system that controls the way users access files, protect system databases, and use system resources. Oracle Solaris provides security features such as labeled security, previously only found in the Trusted Solaris 8 OS. It delivers a secure environment right out of the box. Oracle Solaris offers RBAC (Role Based Access Control), Process Rights Management, and least privilege. These technologies reduce security risk by granting users and applications only the minimum capabilities needed to perform tasks. System administrators can grant—or deny—a large number of discrete privileges to any process on the system to create effective security

policies, minimize the likelihood of hostile actions, control access to data, and ensure compliance with regulatory requirements.

Close integration with hardware provides the following:

- SPARC T4 processors include an integrated cryptographic accelerator unit in each of the eight cores. This means Oracle Solaris applications can run securely without the extra cost of a separate cryptographic processor, and without the CPU overhead associated with secure operation. SPARC's integrated cryptographic units support seventeen of the most common ciphers and secure hashing functions and they outperform solutions based on add-in accelerator cards by more than 10x.
- Symmetric key-based encryption and decryption mechanisms, such as Data Encryption Standard (DES), Triple DES (3DES), Advanced Encryption Standards (AES-128, AES-192, and AES-256), MD5, SHA1, SHA-224, SHA256, SHA-384/SHA-512 and Elliptic Curve Cryptography (ECC) mechanisms, such as the ECCp-160 and ECCb-163 and Galois Field Operations. An on-chip Random Number Generator supports random number generation operations intended for cryptographic applications
- RSA operation. This is an important component of the Secure Sockets Layer/Transport Layer Security (SSL/TLS) full handshake. Each core of the SPARC T4 processor includes a Modular Arithmetic Unit (MAU) that supports RSA and Digital Signature Algorithm (DSA) operations. RSA operations utilize a compute-intensive algorithm that can be off-loaded to the MAU. In SPARC T4 processors, moving RSA operations to the MAU speeds SSL/TLS full handshake performance and frees the CPU to handle other computations.

Availability

Oracle Solaris Predictive Self Healing software proactively monitors and manages system components to help organizations achieve maximum availability of IT services. Predictive Self automatically diagnoses, isolates, and recovers from many hardware faults and provides resiliency for software applications. This enables system services to continue uninterrupted in the event of software failures, major hardware component failures, and even misconfigured software. The Oracle Solaris Fault Manager Architecture (FMA) and Oracle Solaris Service Manager Facility (SMF) are the two main components of Predictive Self Healing.

FMA automatically diagnoses faults in the system and initiates self healing actions to help prevent service interruptions. This feature reduces downtime by configuring problem components out of a system before a failure occurs—and in the event of a failure, this feature initiates automatic recovery and application re-start using SMF. The FMA diagnosis engine produces a fault diagnosis once discernible patterns are observed from a stream of incoming errors. Following diagnosis, FMA provides fault information to agents that know how to respond to specific faults. On systems where ASR (Oracle Auto Service Request) is running, a fault notification will cause a service request to be raised. This service is fully integrated with My Oracle Support and helps provide faster problem resolution.

FMA offers comprehensive reliability and availability capabilities on all Oracle SPARC T4 systems. For example:

- CPU "offlining" takes cores and threads (strands) deemed faulty offline. The system will continue to operate in this condition, albeit with slightly degraded capacity, until a repair can be effected.
- Memory page retirement retires pages of memory marked as faulty. They are recorded and remain offline on reboot until the faulty memory has been replaced.
- Cache line retire – this feature retires one or more 64 byte lines of L2 or L3 cache which have been diagnosed as faulty within a processor chip, preventing those lines from generating further ECC errors. They are recorded and remain offline on reboot until the faulty processor has been replaced, at which point they are made available again. Retirement of small numbers of cache lines have minimal effect on system performance, while allowing the system to continue in service without requiring an outage

The SMF facility creates a standardized control mechanism for application services by turning them into first-class objects that administrators can observe and manage in a uniform way. These services will be automatically restarted even if they are accidentally shut down by an administrator, aborted as the result of a software programming error, or are interrupted by an underlying hardware problem. Specifically, SMF enables administrators to do the following tasks easily and efficiently with Oracle SPARC servers running Oracle Solaris:

- Configure and manage services for automatic restart, bringing processes back online after a failure in the correct order of dependency
- Diagnose and repair "misbehaving" or failed services
- Preserve enabling/disabling of services across system upgrades and patches
- Ensure compatibility with legacy services which may still use traditional Unix startup scripts
- Automatically generate snapshots of the service configuration repository to allow for backup, restore and undo operations on the set of system services.
- Provide consistent configuration handling for a range of entities such as network devices and addresses and kernel configuration information

High Availability

A single instance of Oracle Solaris offers a number of availability features, including FMA, network and storage multipathing and hot-swap capabilities. However some applications require an additional level of availability which can only obtained by tightly coupling together multiple server units through an advanced OS based clustering solution. Oracle Solaris Cluster is the clustering solution designed for Oracle Solaris and optimized to leverage the SPARC T4 reliability features. , Through its tight integration with the Oracle Solaris kernel, it enables rapid failover in the event of a problem with one node in a cluster. This close integration encompasses many other aspects of the OS, in particular virtualization where Oracle Solaris Zones and Oracle VM server for SPARC instances can be clustered,

allowing multi-tier application environments to be consolidated across a cluster. Both type of virtual instances can be used as closed entities where the clustering framework considers them as black boxes and moves them across servers triggered by component failures or operator commands. They can be configured as "normal" cluster nodes with fine-grained control of applications components and dependency management. In the case of Oracle Solaris Zones an additional option is offered: the zone cluster. This configuration extends the Oracle Solaris Zones model to a virtual cluster. It provides

- Security isolation. Applications and users within one zone cluster cannot see or access data or applications running in a different zone cluster.
- Application fault isolation. Actions taken by applications within a zone cluster, such as issuing a reboot command, do not affect applications outside of that zone cluster.
- Resource management. Resources, or shares of resources, can be allocated to a zone cluster. This includes resources such as CPUs, memory, devices, and file systems.
- Dedicated cluster model. Zone clusters provide the illusion that the zone cluster is a traditional cluster dedicated for the use of cluster applications within that zone cluster. The applications are not aware of any other clusters on that hardware.

Those characteristics make the zone cluster the perfect environment to consolidate multiple cluster applications or multi-tiered workloads onto a single physical cluster configuration. It offers :

- Full service protection through fine-grained monitoring of application, policy-based restart and failover within virtual cluster
- Reliable operations of multi-tiered workloads through management of dependencies across zones clusters
- Ease of use and administrative isolation through delegated administration extended to virtual cluster

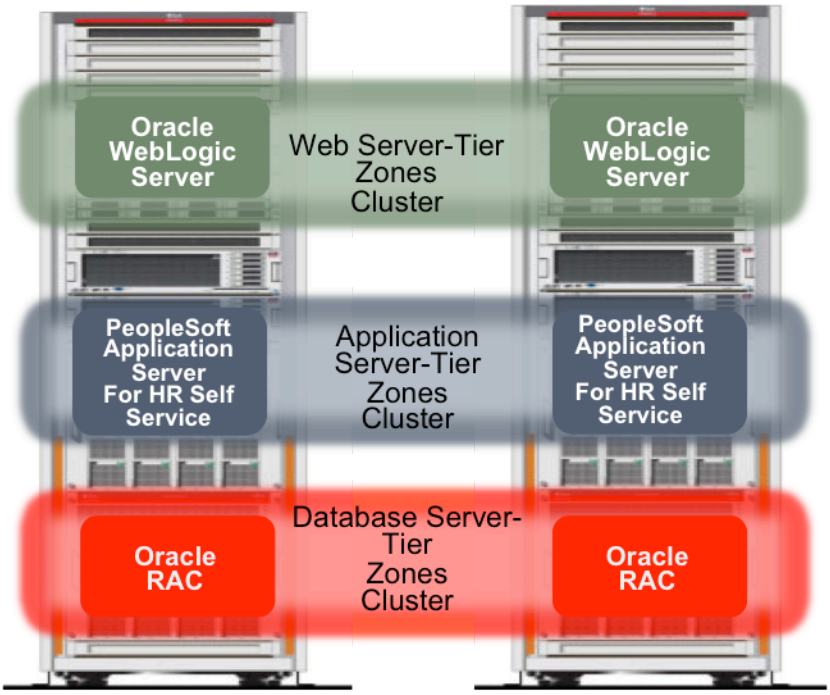

Figure 2. Clustering of zones provides a highly available multi-tier application environment

Where Disaster Recovery is needed Oracle Solaris Clusters also offers support for business continuity with campus-wide or multi-site, multi cluster configuration delivering automated failover of applications and data integrity through coordination with application-, host- and storage based replication.

Virtualization

Oracle supports OS and server virtualization technologies, each of which provide different degrees of isolation, resource granularity, and flexibility. These capabilities are built into Oracle Solaris and Oracle SPARC servers—there are no additional costs to use them.

- Oracle VM Server for SPARC, previously called Sun Logical Domains, leverages the built-in SPARC hypervisor to subdivide supported platforms' resources (CPUs, memory, network, and storage) by creating partitions called logical (or virtual) domains. Each logical domain can run an independent operating system. Oracle VM Server for SPARC provides the flexibility to deploy multiple Oracle Solaris operating systems simultaneously on a single platform. Oracle VM Server also allows you to create up to 128 virtual servers on one system to take advantage of the massive thread scale offered by the Chip Multithreading (CMT) architecture. Flexibility of deployment is also a key feature since the domains can be dynamically resized and can be moved between machines using live migration.
- Oracle Solaris Zones provide security and resource isolation that allows multiple virtual Oracle Solaris environments to share the same OS instance. Oracle Solaris Zones complements the

capabilities of Oracle VM Server for SPARC, and increases security and utilization on all of Oracle's SPARC servers.

Oracle VM Server for SPARC and Oracle Solaris Zones are multithreaded to maximize performance and utilization.

Oracle Solaris 11 – Built for Clouds

Oracle Solaris 11 provides the key attributes for powering the cloud – both on the "bare metal" and at the service layer. This includes ease of developing or migrating workloads, virtualization capabilities that are fully integrated within the OS and technology to address security and data management requirements.

Easy to Integrate – Cloud Ready

Through engineered systems such as the SPARC SuperCluster and Oracle Exalogic Elastic Cloud, Oracle provides highly integrated and easy to install systems that provide the foundation for cloud deployments. New datacenter deployments will benefit from the latest hardware and software innovations brought together in these engineered systems as well as the community of third party application developers that provide products to run on the engineered systems.

Production-ready services can be rapidly developed and deployed using the new installation and packaging tools in Oracle Solaris 11. In addition, existing workloads can easily be consolidated onto new systems, moving from Oracle Solaris 10 into a virtual machine on Oracle Solaris 11 using physical to virtual (P2V) tools. Thanks to the Oracle Solaris guaranteed binary compatibility between earlier versions of Oracle Solaris and Oracle Solaris 11, applications can also be installed directly onto the OS or into a zone or virtual machine. Where Oracle VMserver for SPARC is utilized, cloud-based services can be dynamically scaled and securely migrated using the features described above.

End-to-End Optimization

Optimization extends throughout Oracle's integrated stack. At one level, applications are built, tested and tuned in a holistic manner and based on this Oracle publishes a number of "Optimized Solutions" aimed at facilitating deployment of specific configurations. Looking deeper, there are many examples of optimization extending from the application layer, through the integrated Java JDK down to the kernel and drivers.

Throughout the network stack, for example, there is emphasis on providing maximum throughput with minimum latency. Network virtualization technology ensures that network traffic is mapped to processing threads to provide scalability and high performance, and the fully virtualized network stack in turn allows for control of network bandwidth, both internal to a server across multiple VMs and out onto the external network. Virtualized multi-tier services can now be built inside a single server without the overhead of having to access a physical network.

Data access in ZFS can be accelerated by use of Hybrid Storage Pools where solid-state drives (SSDs) can provide cached access to slower disk storage for database log files. Built-in crypto acceleration provided by the CPU enables on-the-fly ZFS data encryption with minimal CPU overhead. Storage efficiency has been increased with ZFS built-in deduplication technology, which can provide up to 10x savings in storage capacity for virtualized environments where there are many identical files across multiple virtual images.

Security is further enhanced with SPARC T4 systems and Oracle Solaris 11. In addition to on-chip support for 13 encryption algorithms, a hardware security module (TPM) provides storage for RSA keys and OpenSSL is enabled by default. Filesystem security beyond ZFS is also built in, allowing swap files and legacy UFS filesystems to be encrypted.

For the developer, there are further tools to assist in maximizing performance of their applications. Oracle Solaris Studio provides a fully integrated environment to build, debug and tune complex multithreaded applications. The compilers are optimized for the SPARC architecture and deliver the most performant code for the SPARC T4 processor. In fact, the compiler team worked with the SPARC T4 chip architects to ensure efficient execution of compiled code in the new pipeline design, building on many years of experience gained in working with earlier T-series CPUs. The T4 also introduces some new instructions such as a compare and branch which is used to improve performance for T4 specific code. Oracle's leadership in compiler technology for SPARC CPUs and overall improvements in compiler technology for parallelisation, loop optimization and function inlining mean that benchmark results for code developed with the Oracle Solaris Studio compilers are typically far superior to results obtained with open source alternatives. It should also be noted that the Studio product is a rich set of tools built to develop,debug and tune sophisiticated program suites thanks to a full integrated development environment and features to assist in code analysis and performance measurement.

Easy to Deploy and Manage

Oracle Solaris 11 provides a new set of tools to simplify installation and software distribution and management. These tools are based on the new Image Packaging System (IPS), which has robust software packaging dependency checking and also takes advantage of ZFS as the root file system. Organizations can now create custom distribution images and use the Automated Installer to quickly deploy software images across thousands of systems. When the time comes to update those images, Oracle Solaris 11 creates a boot environment (a ZFS snapshot of the root file system), applies the software updates and then the operator boots the new environment. To facilitate a much faster reboot cycle, Oracle Solaris 11 and SPARC systems have been engineered to quickly reboot the system if the software update requires a reboot. Note that with the refactoring of legacy SVr4 software packages into IPS, the majority of software updates in Oracle Solaris 11 do not require a reboot.

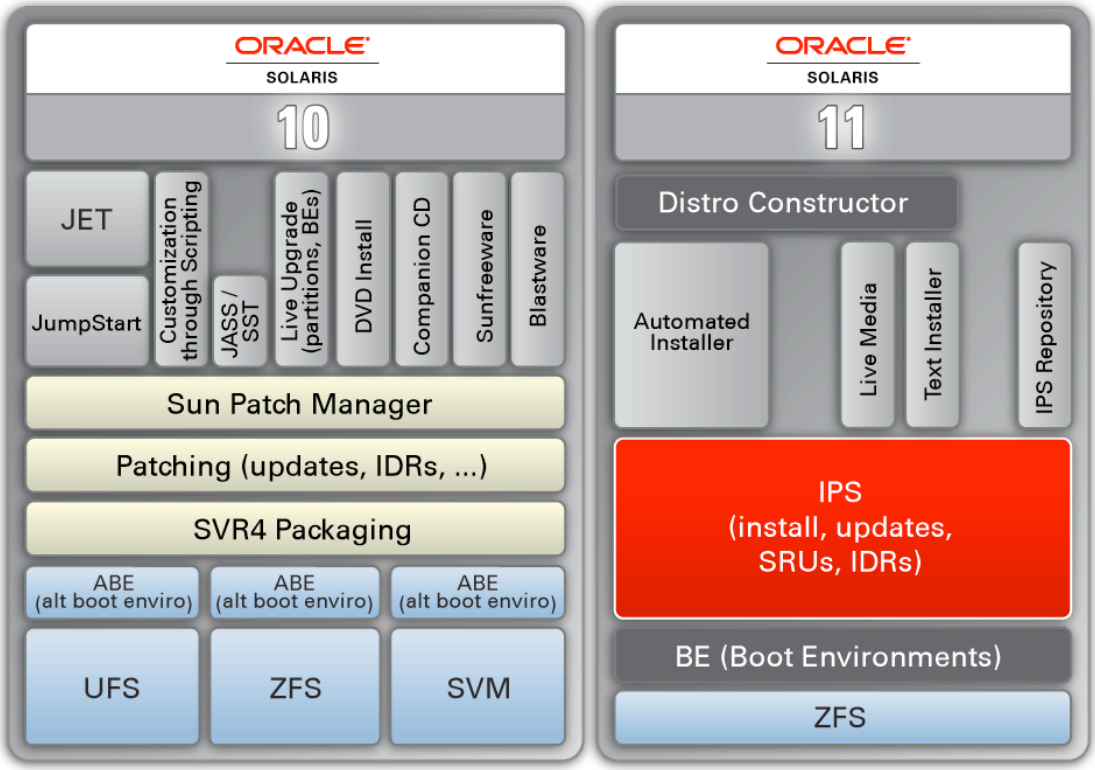

Fig 2. Software Management technologies compared

Figure 2 shows how software management under Oracle Solaris 11 is conceptually much simpler than in the past. Building on the ZFS filesystem which allows low overhead snapshotting and rollbacks, boot environments can easily be manipulated to handle multiple OS configurations and their subsequent updates. Customized distributions, which can be deployed on "bare metal" or into VMs can be created using the Distro Constructor, and deployed across multiple systems or into a cloud environment.

Oracle Enterprise Manager Ops Center

As part of Oracle's integrated stack approach, the OS becomes another component in a comprehensive management environment. Oracle Enterprise Manager 11*g* is the centerpiece of Oracle's integrated IT management strategy. As shown in Figure 3, it connects with Oracle Enterprise Manager Ops Center to form the most comprehensive solution for managing physical and virtual infrastructure, including Oracle's SPARC servers, Oracle Solaris, and Oracle Solaris and SPARC virtualization technologies such as Oracle Solaris Zones and Oracle VM Server for SPARC. It also provides management for other operating systems.

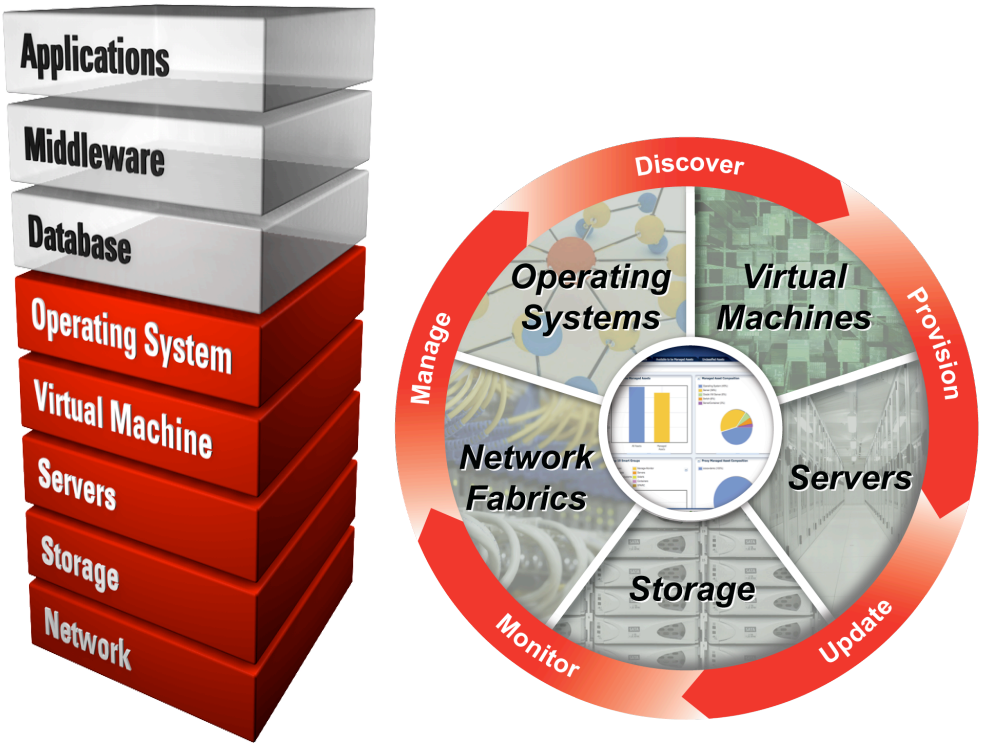

Figure 3: Comprehensive full-stack management, from application to disk

Oracle Enterprise Manager Ops Center streamlines operations and reduces downtime, and provides an end-to-end management solution for physical and virtual systems through a single web-based console. This solution automates the lifecycle management of physical and virtual systems and is the most effective systems management solution for Oracle's SPARC infrastructure. Oracle Enterprise Manager Ops Center is a subset of Oracle Enterprise Manager which is a complete Cloud Management solution, addressing provisioning, management and chargeback of services built on Oracle's set of Database, Middleware and Applications.

Summary

As organizations begin to transform their existing infrastructures to offer the economy and flexibility of the cloud computing model, the combination of Oracle Solaris and SPARC T4 systems forms an ideal base for the modern datacenter. With a proven track record and an aggressive roadmap to ever-greater performance, scalability, and value, Oracle's solutions are the clear choice for the foundation of the 21st century data center.

Resources

The following table contains links to useful information related to this paper.

GET THE PRODUCTS	
Oracle Solaris	www.oracle.com/solaris
Oracle Solaris 11 download	www.oracle.com/technetwork/server-storage/solaris11/downloads/index.html
Oracle Solaris 10 download	www.oracle.com/technetwork/server-storage/solaris/downloads/index.html
Oracle's SPARC servers	www.oracle.com/us/products/servers-storage/servers/sparc-enterprise/index.html
Oracle Enterprise Manager Ops Center	www.oracle.com/us/products/enterprise-manager/opscenter/index.html
Oracle Solaris Cluster	www.oracle.com/technetwork/server-storage/solaris-cluster/downloads/index.html
Oracle Solaris Studio	www.oracle.com/technetwork/server-storage/solarisstudio/downloads/index.html
Oracle Database 11g	www.oracle.com/us/products/database/
Oracle Siebel CRM	www.oracle.com/us/products/applications/siebel/
Oracle PeopleSoft Enterprise Applications	www.oracle.com/us/products/applications/peoplesoft-enterprise/
Oracle Real Application Clusters (RAC)	www.oracle.com/technology/products/database/clustering/
Oracle Applications	www.oracle.com/us/products/applications/index.html
DEEP DIVE ON THE TECHNICAL	
Oracle Technical Network	www.oracle.com/technetwork/index.html
AVAILABILITY	
Oracle Solaris Predictive Self Healing	www.oracle.com/us/products/servers-storage/solaris/solaris-pred-self-healing-ds-075587.pdf
Oracle Solaris Cluster	www.oracle.com/technetwork/server-storage/solaris-cluster/index.html
Oracle Cluster Documentation Center	www.oracle.com/technetwork/server-storage/solaris-cluster/documentation/index.html
Oracle Solaris ZFS	www.oracle.com/us/products/servers-storage/solaris/solaris-zfs-ds-067320.pdf
PERFORMANCE	
Oracle SPARC T-series information	www.oracle.com/us/products/servers-storage/servers/sparc-enterprise/t-series/index.html
Flash Storage	www.oracle.com/us/products/servers-storage/storage/flash-storage/index.html
SECURITY	
Oracle Solaris Trusted Extensions and Common Criteria	www.oracle.com/technetwork/topics/security/oracle-cc-evalsolaris-083233.html
OTN Oracle Solaris Security	www.oracle.com/technetwork/server-storage/solaris/overview/security-163473.html
VIRTUALIZATION	
Oracle Virtualization	www.oracle.com/virtualization
Oracle's Virtualization Blog	blogs.oracle.com/virtualization
Oracle VM Server for SPARC	www.oracle.com/us/oraclevm-sparc-ds-073441.pdf
Oracle VM Server for SPARC—Enabling a Flexible, Efficient IT Infrastructure	www.oracle.com/us/products/servers-storage/servers/sparc-enterprise/vm-server-for-sparc-wp-075964.pdf
Running Oracle Real Application Clusters (RAC) On Oracle VM Server for SPARC	www.oracle.com/technetwork/articles/systems-hardware-architecture/rac-vmsrvrsparc-163927.pdf
Consolidating Oracle's Siebel CRM 8 on Single	www.oracle.com/technetwork/articles/systems-hardware-architecture/siebel-crm-

Oracle SPARC Server	ha-163926.pdf
Consolidating Applications with Oracle Solaris Containers	www.oracle.com/us/products/servers-storage/solaris/consolid-solaris-containers-wp-075578.pdf
Virtualization with Oracle Solaris 10	www.oracle.com/go/?&src=7011689&Act=4
Increase Application Scalability and Improve System Utilization with Oracle VM Server for SPARC	www.oracle.com/technetwork/articles/systems-hardware-architecture/vm-svr-for-sparc-163928.pdf
DEVELOPER TOOLS	
Oracle Solaris Studio	www.oracle.com/technetwork/server-storage/solarisstudio/overview/index.html
Developing Parallel Programs — A Discussion of Popular Models (Whitepaper)	www.oracle.com/technetwork/server-storage/solarisstudio/documentation/oss-parallel-programs-170709.pdf
Optimizing Applications with Oracle Solaris Studio Compilers and Tools (Whitepaper)	www.oracle.com/technetwork/systems/optimizing-apps-oracle-solaris-stud-150254.pdf
DLight Tutorial for Oracle Solaris Studio	download.oracle.com/docs/cd/E18659_01/pdf/821-2126.pdf
DTrace	www.oracle.com/technetwork/server-storage/solaris/overview/observability-163553.html
OTHER	
Locate Oracle Solaris partners or solutions	http://solutions.oracle.com/
Product documentation	www.oracle.com/technetwork/indexes/documentation/index.html
Oracle Solaris Best in Class podcast series	www.oracle.com/podcasts/servers-storage-podcasts.html

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Results as of 9/26/2011.
SPEC and the benchmark name SPECjEnterprise are registered trademarks of the Standard Performance Evaluation Corporation. Results from www.spec.org as of 9/26/2011. SPARC T4-4, 40,104.86 SPECjEnterprise2010 EjOPS; Cisco UCS B440 M1, 17,301.86 SPECjEnterprise2010 EjOPS; IBM Power 780, 16,646.34 SPECjEnterprise2010 EjOPS.Focusing on the critical JEE server hardware & OS, the IBM result includes a JEE server with a list price of $1.30 million. The Oracle JEE servers have a list price of $0.47 million. The JEE server price versus delivered EjOPs is $77.97/EjOP for IBM versus $11.67/EjOP for Oracle. Oracle's $/perf advantage is 6.7x better than IBM ($77.97/$11.67). Pricing details for IBM, IBM p780 512GB based on public pricing at http://tpc.org/results/FDR/TPCH/TPC-H_1TB_IBM780_Sybase-FDR.pdf. Adjusted hardware costs to license all 64 cores. AIX pricing at: http://www-304.ibm.com/easyaccess3/fileserve?contentid=214347 and AIX Standard Edition V7.1 per processor (5765-G98-0017 64*2,600=$166,400). This gives application tier hardware & OS Price/perf: $77.97/EjOPS (1297956/16646.34) Pricing details for Oracle, four SPARC T4-4 512 GB, HW acquisition price from Oracle's price list: $467,856 http://www.oracle.com. This gives application tier hardware & OS Price/perf: $11.67/EjOPS (467856/40104.86) The Oracle application tier servers occupy 20U of space, 40,140.86/20=2007 EjOPS/U. The IBM application tier server occupies 16U of space, 16,646.34/16=1040 EjOPS/RU. 2007/1040=1.9x
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Oracle Solaris and Oracle SPARC T4 Servers—Engineered Together for Enterprise Cloud Deployments
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