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### Built-in Virtualization

There is no additional cost for using virtualization when running Oracle Solaris on Oracle's SPARC systems. Two complementary virtualization technologies are available. At the hardware level, Oracle VM Server for SPARC allows the creation of virtual machines with unique configurations of OS version and workload. Implemented through the hypervisor on Oracle's SPARC T-Series platforms, this approach provides the additional benefit of live migration over a secure network connection. Complementing Oracle VM Server for SPARC, Oracle Solaris Zones is a feature of Oracle Solaris and uses the process management, resource management, and security features of the operating system to isolate and manage multiple workloads. Both technologies are provided at no extra cost.

Oracle's SPARC based systems can support extensive consolidation either through Oracle Solaris Zones or Oracle VM Server for SPARC, or a combination of the two. Further efficiency is gained through flexible power management helping to ensure optimal workload response against the power management policy set for the system. Oracle Solaris Zones can also take on the personality of earlier Oracle Solaris releases. In fact, live migration and physical-to-virtual migration tools can vastly simplify the re-hosting and consolidating of workloads from older Oracle Solaris systems into a zone on newer hardware. This ability means that replacing aging and power-hungry infrastructure is a simple operation, typically requiring no costly re-qualification process for compliance or recoding (or even recompiling) of applications. As Oracle continues to develop and deliver more powerful systems, this flexibility also paves the way to future consolidation and cost savings.

Network virtualization, native to Oracle Solaris, further enhances the consolidation experience since common network functions such as switches and load balancers can become virtual software instances rather than physical components. This ability reduces latency in communication between the different tiers of an application and reduces the amount of physical hardware and cabling that must be deployed. Oracle Virtual Networking allows for consolidation at the interconnect fabric layer, providing seamless interaction with Linux and Microsoft Windows environments along with interoperability with the full set of network and storage protocols.

### Performance, Scalability and Flexibility for Massive Consolidation

To be able to consolidate effectively, new systems must have the performance, capacity, security, and scalability to support expected performance levels for targeted applications—even as applications change and grow over time. The near-linear scalability and flexibility of Oracle's SPARC systems

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<sup>1</sup> SPARC Servers: An Effective Choice for Efficiency in the Datacenter  
(<http://www.oracle.com/us/products/servers-storage/servers/sparc-enterprise/idc-dce-2012-1612359.pdf>)

running Oracle Solaris allows for massive consolidation using Oracle Solaris Zones, Oracle VM server for SPARC or a combination of these technologies. In addition, the security feature inherent in Oracle Solaris means that secure multi-tenant configurations can easily be realized, with end-to-end encryption of network traffic and data. Oracle Solaris also provides the ability to monitor and control processor resources and network bandwidth in virtualized environments, helping to ensure balanced operation and adherence to service level agreements.

As an example of effective consolidation, Mazda Motor Corporation has modernized and consolidated its Mazda Digital Innovation (MDI) system on Oracle SPARC T4-4 and Oracle SPARC T4-2 servers running Oracle Solaris. Since both the old and the new servers were running Oracle Solaris, the migration to the new SPARC T4 servers took only two days to complete. With SPARC T4 servers running Oracle Solaris, Mazda has achieved:

- 50 percent faster PDM tool response time at peak hours, with as many as 3,500 users and 1 million transactions during peak hours
- 40 percent reduction in monthly operational costs
- 75 percent lower monthly server power consumption
- 90 percent reduction in its data-center footprint (12 racks down to one)

## Streamlining IT with a Cloud-Ready Platform

The foundation of a mission-critical cloud must combine agility, flexibility, and security with scale and performance. Oracle Solaris possesses all of the attributes required to power the most demanding enterprise clouds. Built-in virtualization, ease of deployment for applications, and workload mobility are base-line requirements. More importantly, control of these capabilities must be achieved across large pools of compute and storage resources. For compliance purposes, ease of monitoring and reporting are likewise necessary. These features are available in Oracle Solaris 11.1 combined with the benefits of centralized monitoring via the Oracle Audit Vault and Database Firewall appliance.

There are at least two important dimensions to managing a cloud environment that must be considered. When managing Infrastructure as a Service (IaaS), a system administrator will need to be concerned with the physical hardware through managing server configurations, performing bare-metal OS installations, conducting backups, and other typical data center operations. Above that level, the administrative role entails efficient management of virtualized services, and may even extend to consumers engaging in self-provisioning activities. Effective cloud solutions must take these different roles into account.

*“The operating system in a cloud environment must meet a different set of requirements than traditional legacy OS deployments in the areas of: scalability, multi-tenancy, security, virtualization, new storage and networking architectures, Support for cloud middleware, languages, development frameworks, and runtimes. As the cloud market begins to mature from lower-tier applications to enterprise cloud computing, Oracle Solaris traditional strengths in security, scalability, and fault mitigation can bring these capabilities to the cloud.”<sup>2</sup>*

As organizations look to move from a traditional data center model to a cloud-based model, SPARC platforms running Oracle Solaris can greatly simplify the transition. As new technology has emerged, the continued Oracle Solaris binary compatibility of the SPARC processor itself has remained paramount, allowing binary compatibility from generation to generation of Oracle Solaris. For example, when considering a private cloud deployment, binary compatibility greatly simplifies the transition from a traditional data center model to an actual cloud. To save costs and complexity, even legacy environments can be encapsulated for deployment in a cloud environment, and having a common OS means there is no learning curve in moving to the new deployment model. In fact, all of the built-in OS capabilities contribute directly to an Oracle Solaris based cloud, from the native virtualization of CPU and network features, to accelerated encryption, to simple, risk-free lifecycle management.

At the same time, the diverse operational management requirements of cloud computing demand a comprehensive management approach. Oracle Enterprise Manager 12c is Oracle’s premiere cloud management solution. It is the industry’s first complete solution including self-service provisioning balanced against centralized and policy-based resource management, integrated chargeback, and capacity planning. Oracle Enterprise Manager offers complete visibility of the physical and virtual environments from applications to disk. Oracle Enterprise Manager Ops Center also plays a key role in facilitating the basics of cloud operation by providing detailed system management, power monitoring, and software maintenance functions across large populations of servers, all from a single console.

Access to the full suite of Oracle software plus a growing portfolio of ISV applications ensures that Oracle Solaris is perfectly suited to host the entire spectrum of service models, be it IaaS, Software as a Service (SaaS), or Platform as a Service (PaaS). This competence, completeness, and flexibility eases the burden on in-house developers and allows for quicker time to market with complex solutions. Oracle Solaris also boasts a powerful set of development tools that are optimized to ensure the best performance for custom software.

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<sup>2</sup> Source: IDC White Paper: Oracle Delivers Unique Value with Oracle Solaris  
<http://www.oracle.com/us/corporate/analystreports/industries/idc-solaris-1012-1866805.pdf>

As a compelling example, Australian Telco provider, AAPT, is offering “Solaris as a Service” leveraging the secure multi-tenancy capabilities of the OS. AAPT runs a combined private cloud (for internal consumption) on Oracle Solaris 11, and offers this service to external customers as well, with a choice of hardware spanning Oracle’s SPARC T-Series servers and Oracle SPARC M-Series servers, as well as Oracle’s x86-based servers. The company achieves very high consolidation ratios (over 40:1) by taking advantage of low-overhead Oracle Solaris Zones for virtualization along with integrated network virtualization and network services.

## The Best Platform for Oracle Deployments

Oracle software and hardware products are engineered, tested, packaged, certified, deployed, supported, and upgraded together. This unique ability provides an advantage no other vendor can offer—complete integration and optimization across the entire technology stack. As a result, Oracle Solaris running on Oracle’s SPARC technology is simply the best platform for Oracle database, application, and middleware products. With software and hardware designed and tested to work together, management gets dramatically easier as well. Performance and availability increase, at the same time that costs and deployment times decrease.

Oracle runs its own business on Oracle Solaris and SPARC systems. At the time of the Sun acquisition, the Oracle mission critical global single instance database and ERP environment was consolidated onto two Sun SPARC M9000 servers to support the additional 30,000 employees. This large migration was accomplished in under eight weeks with only 12 people.

This entire infrastructure was upgraded in December 2012 to run on SPARC SuperCluster (Figure 4) to provide still greater performance and significant cost savings. The new architecture incorporates Oracle E-Business Suite 12i and a 23 TB database to support 260,000 users and over one million customer accounts. This most recent migration was completed in a matter of weeks and overall the new installation is twice as fast as the previous combination of M9000 and EMC storage. Transaction processing throughput has increased over seven-fold, I/O response times have shortened, and the system still has plenty of capacity headroom to meet increasing demand.

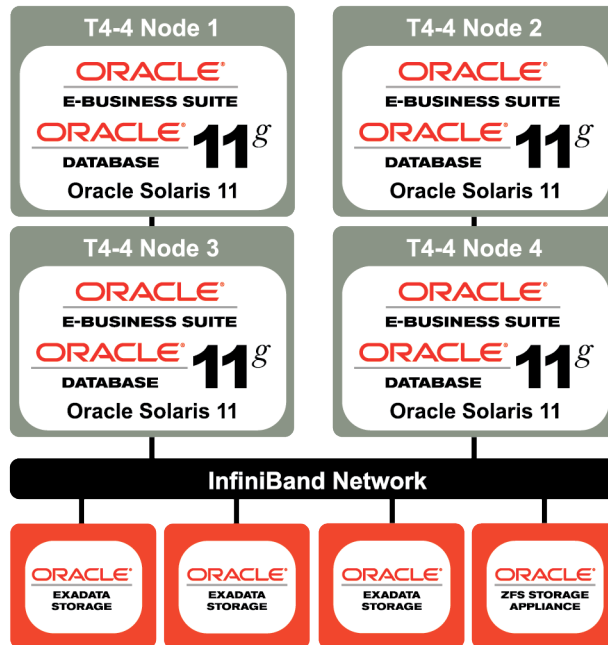


Figure 4. Oracle runs on Oracle's SPARC SuperCluster and Oracle E-Business Suite supporting 260,000 users and over one million customer accounts.

The combination of Oracle Solaris and Oracle SPARC servers provides an unequalled range of benefits, including:

- **Extreme performance.** Oracle's SPARC servers continue to set world records for dozens of performance benchmarks, consistently beating alternative systems.
- **Mission-critical availability.** Near-zero downtime, Oracle Solaris binary compatibility guarantee for over 15 years, and simplified systems management provide unmatched reliability and availability at a low total cost of ownership.
- **Unmatched security.** SPARC servers feature on-chip cryptographic acceleration that combines with the advanced security capabilities of Oracle Solaris.
- **No-cost virtualization.** With virtualization capabilities built into every server and Oracle Solaris at no additional cost, creating an efficient and flexible data center has never been simpler or more affordable.
- **Total integration.** Oracle's unique ability to integrate and optimize across the IT stack offers breakthrough levels of performance, efficiency, and scalability. Oracle's technical roadmap demonstrates that Oracle's SPARC systems and Oracle Solaris will continue to deliver strong integration with Oracle's software to optimize IT for the most demanding workloads.
- **Technical superiority.** Oracle Solaris and SPARC technology have been developed together for over 25 years to help manage complex computing environments. Since acquiring Sun, Oracle has continued to make significant investments in and innovations to these important technologies.

Beyond these general advantages, having control of the entire hardware and software stack also allows Oracle to make key technology improvements to bring performance and other benefits directly to Oracle databases, middleware, and applications. These kinds of enhancements would be impossible on other platforms given the level of integration and co-engineering that is required. Several examples of these kinds of improvements are listed below.

- **Optimized shared memory (OSM).** Designed in conjunction with the Oracle Database team, optimized shared memory (OSM) is a new shared memory interface in Oracle Solaris 11 that permits dynamic resizing of the Oracle Database SGA without a reboot, as well as two-fold faster database instance startup.
- **DTrace for I/O outlier detection.** The Oracle Database can tap into Oracle Solaris DTrace functionality to monitor database I/O performance and quickly resolve I/O issues.
- **New virtual memory subsystem.** Predictive memory page allocation is a key feature of the new virtual memory system in Oracle Solaris 11.1, actively adapting resources to database and application memory needs.
- **Centralized audit reporting.** Integration with the Database Firewall and Audit Vault appliance helps simplify compliance reporting for Oracle Solaris and Oracle Database to help data center personnel meet compliance requirements and more easily detecting and analyzing security threats.
- **Hardware-based cryptography.** Hardware based cryptographic acceleration in SPARC CPUs, a “Software in Silicon” feature, enables pervasive use of encryption to reduce risk, and ensure faster operation of Oracle Transparent Data Encryption (TDE). This same combination of CPU and OS functionality offers similar acceleration of Java security operations.

## Mission-Critical Availability

All of Oracle’s new SPARC T-Series and SPARC M-series platforms boast impressive enterprise-class capabilities in terms of reliability, availability, and serviceability (RAS). Hardware fault management and reporting is handled through close collaboration between embedded service processors and Oracle Solaris. Diagnostic agents in software can identify failed or failing components and take remedial action to keep the system running. At the same time, the integrated Automated Service Request (ASR) facility in Oracle Solaris can proactively submit a problem report to My Oracle Support (MOS) without operator intervention to ensure rapid service response. Oracle SPARC M-Series servers can include redundant pairs of service processors and clock boards to offer full hardware redundancy for the highest levels of uptime and serviceability. Oracle SPARC M-Series servers can be divided into electrically isolated Physical Domains (PDOMs), allowing up to four completely separate OS environments to be installed in a single server.

Oracle Solaris provides further software resiliency for applications. The Oracle Solaris Service Management Facility (SMF) feature treats a set of interdependent processes as a service. In the event any part of the service should fail, SMF will restart the service by bringing the appropriate components back online in the correct order. Availability is also enhanced by Oracle’s software maintenance tools,

which are designed for fast, risk-free updates. As a result of these innovations, unplanned downtime is rare, and planned downtime is minimized.

Continuity of mission-critical services is required even in the event of system or software failure. To address this need, Oracle Solaris Cluster provides high availability ranging from a simple two-node failover configuration to full disaster recovery across data centers spanning multiple geographic locations (Figure 5).

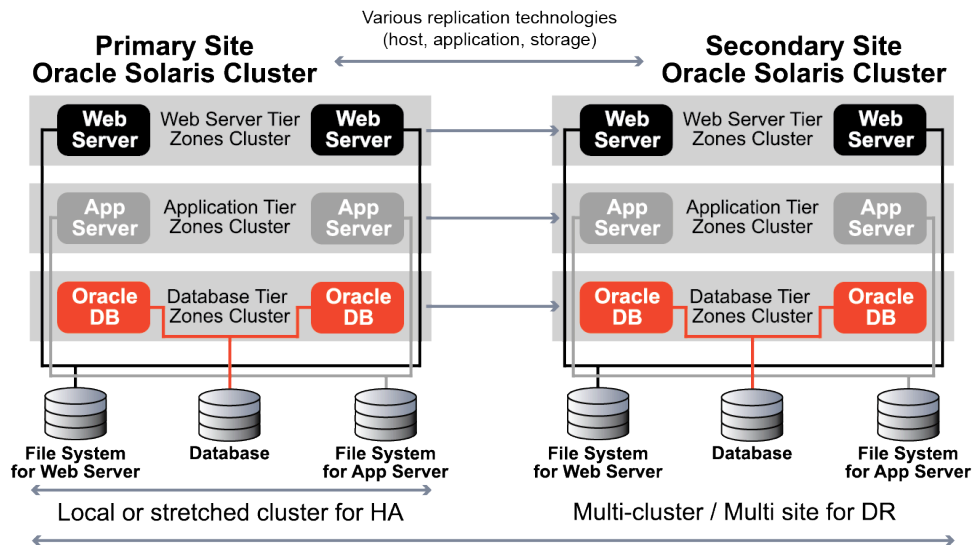


Figure 6. Oracle Solaris Cluster provides high availability and multi-cluster/multi-site disaster recovery for critical applications.

Oracle Solaris Cluster is the only high availability solution that integrates with Oracle Solaris at the kernel level, providing yet another example of Oracle's tightly integrated co-engineering practices. This approach yields near instant failure detection of the entire Oracle stack including applications, middleware, operating system, servers, storage, and network interconnects. Any failure executes a policy-based application-specific recovery and reconfiguration, enabled through redundant infrastructure and intelligent software algorithms.

Oracle Solaris Cluster seamlessly integrates high availability with virtualization for mission-critical cloud infrastructure. By supporting both Oracle Solaris Zones and Oracle VM Server for SPARC, Oracle Solaris Cluster is configurable to offer protection at the application, zone, or VM level—with policy-based recovery behavior and reliable management of multi-tier dependencies. Administrative isolation for multi-tenant environments is also provided, offering ease of operation in conjunction with Oracle Enterprise Manager.

## Summary

Oracle is redefining data center economics with the world's fastest processor and mission critical cloud capabilities. Oracle Solaris and Oracle's SPARC servers deliver robust infrastructure and generation-to-generation compatibility for the most complex and demanding enterprise applications. Oracle continues to invest in this key technology combination, introducing new SPARC processors, new SPARC systems, and innovation in the first cloud-ready operating system, Oracle Solaris.

Oracle SPARC T5 systems, Oracle SPARC M5 systems, the Oracle Engineered Systems and Oracle Optimized Solutions that deploy them now deliver even greater performance and capacity than their accomplished predecessors. Together, these systems satisfy the non-stop need for additional scale, throughput, and security. Consolidation of existing applications onto the new Oracle Solaris SPARC based platforms can yield substantial operating cost reduction as well.

Organizations can continue to rely on Oracle Solaris and SPARC because of Oracle's ongoing investment and co-engineering across the entire Oracle software portfolio, bringing new functionality, better performance, and lower cost to bear on the increasing demands and opportunities of the marketplace—while accommodating the very real constraints of the data center. To begin an evaluation of the latest that Oracle has to offer, or to put Oracle Solaris and SPARC technology to work, please contact your local Oracle Sales Representative.



## For More Information

For more information on Oracle Solaris and Oracle's SPARC servers, please see these references.

### REFERENCES FOR MORE INFORMATION

#### WEB SITES

Oracle Solaris	<a href="http://www.oracle.com/solaris">http://www.oracle.com/solaris</a>
Oracle SPARC Servers	<a href="http://www.oracle.com/sparc">http://www.oracle.com/sparc</a>
Performance Benchmarks	<a href="http://www.oracle.com/benchmark">http://www.oracle.com/benchmark</a>
Oracle Optimized Solutions	<a href="http://oracle.com/optimizedsolutions">http://oracle.com/optimizedsolutions</a>
Enterprise Cloud Infrastructure on SPARC	<a href="http://www.oracle.com/technetwork/server-storage/hardware-solutions/o12-043-cloud-sparc-1659149.pdf">http://www.oracle.com/technetwork/server-storage/hardware-solutions/o12-043-cloud-sparc-1659149.pdf</a>
Oracle SPARC SuperCluster	<a href="http://www.oracle.com/supercluster">http://www.oracle.com/supercluster</a>
Oracle Consulting Services	<a href="http://www.oracle.com/us/industries/professional-services/038040.htm">http://www.oracle.com/us/industries/professional-services/038040.htm</a>
Oracle Technology Network Solaris 11	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/overview/index.html">http://www.oracle.com/technetwork/server-storage/solaris11/overview/index.html</a>
Oracle Solaris 11 and Oracle SPARC Servers	<a href="http://www.oracle.com/technetwork/server-storage/solaris11/technologies/sparc-optimization-1873878.html">http://www.oracle.com/technetwork/server-storage/solaris11/technologies/sparc-optimization-1873878.html</a>
Oracle Technology Network	<a href="http://www.oracle.com/technetwork/index.html">http://www.oracle.com/technetwork/index.html</a>

- (1) SPEC and the benchmark name SPECjEnterprise are registered trademarks of the Standard Performance Evaluation Corporation. Results from [www.spec.org](http://www.spec.org) as of 03/26/2013. SPARC T5-8, 57,422.17 SPECjEnterprise2010 EJOPS; IBM Power 780, 16,646.34 SPECjEnterprise2010 EJOPS. SPARC T5-8 server (SPARC T5-8 server base package, 8x SPARC T5 16-core processors, 128x16GB-1066 DIMMS, 2x600GB 10K RPM 2.5" SAS-2 HDD, 4x power cables, list price \$268,742. IBM Power 780 (IBM Power 780:9179 Model MHB, 8x3.86GHz 8-core, 64xone processor activation, 4xCEC Enclosure with IBM Bezel, I/O backplane and system midplane, 16x 0/32GB DDR3 memory (4x8GB) DIMMS-1066MHz Power7 CoD Memory, 12x Activation of 1 GB DDR3 Power7 Memory, 5x activation of 100GB DDR3 Power7 Memory, 1x Disk/Media Backplane. 2x 146.8GB SAS 15K RPM 2.5" HDD (AIX/Linux only), 4x AC power supply 1725W) list price \$992,023. Source: Oracle price list and IBM.com, collected 03/25/2013. cost/performance ratio = 12.7 = (992,023/16646.34)/(268742/57422.17).
- (2) Source: Transaction Processing Performance Council, [www.tpc.org](http://www.tpc.org) as of 3/26/13. SPARC T5-8 (8/128/1024) with Oracle Database 11g Release 2 Enterprise Edition with Partitioning, 8,552,523 tpmC, \$0.55 USD/tpmC, available 9/25/2013. 3 node IBM Power 780 Server 9179-MHB, Power 7 3.86 GHz (8/64/256) with IBM DB2 9.7, 10,366,254 tpmC, \$1.38/tpmC, available 10/13/10. price performance ratio = 2.5 = (1.38/55).
- (3) SPARC T5-8: \$268,742; 8 x 3.6 GHz T5 CPU, 2024 GB memory. IBM Power 780: \$1,908,530; 8 x 3.92 GHz, 64 core POWER7 CPU, 2024 GB memory; price advantage 7x = (\$1,908,530 / \$268,742)
- (4) SPARC M5-32 (SPARC M5-32 Server base package, 32xM5 6-core processors, 64x16GB-1066 DIMMS, 6x600GB RPM 2.5" SAS-2 HDD, 6x Power Cables) List Price \$1,045,962. IBM Power 795 (IBM Power 795 Primary System Rack comprising of CEC enclosure and BPA, 4x4.0GHz 32-core, 2x 64 Processor Core activation for Power 7, 2x 1024 (8x(4x32GB)) DDR3 DIMMS-1066MHz, 48x Activation of 1GB DDR3 Power7 Memory, 20x Activation of 100GB DDR3 Power7 Memory, 1x 12X I/O 26 SFF drive bays, 2x 600GB SAS 10K RPM HDD, 1x DVD/Tape SAS External Storage Unit, 1x Rack-mounted HW Mgt Console, 1x Power Cable Group: BPD1 to first Processor Node, 1x Power Cable Group: BPD1 to second Processor Node, 1x Power Cable Group: BPD1 to third Processor Node, 1x Power Cable Group: BPD1 to fourth Processor Node, 6x Bulk Power Regulator, 2x Bulk Power Distribution Assembly. List price of \$2,719,336. Source [ibm.com](http://ibm.com), collected 03/25/2013.



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