



An Oracle White Paper
October 2010

Oracle Full-Stack Integration: Maximize the Value of IT Investments from Applications to Disk

| | |
|---|----|
| Executive Overview | 1 |
| Introduction | 1 |
| Hardware and Software. Engineered to Work Together..... | 2 |
| The Benefits of Oracle Integration | 2 |
| A Complete Stack | 3 |
| Best-of-Breed Technologies, Integrated | 4 |
| Proven, Tested, and Optimized Solutions..... | 5 |
| Key Oracle Integration Examples | 5 |
| Performance and Scalability | 5 |
| Availability and Reliability..... | 6 |
| Security | 8 |
| Management | 9 |
| Conclusion | 9 |
| References..... | 11 |

Executive Overview

CIOs and other IT decision makers increasingly view their role as central to the revenue-generation mission of the organization rather than providing mere technology support. Beyond efficiency and cost-cutting, many are now looking to the competitive advantage that effective information technology can bring to bear – viewing IT as a vital business asset rather than a cost center. Contributing strongly to both efficiency and agility, integration plays an increasingly essential role as organizations seek to align their technology investments with the needs of their mission-critical and business-critical applications. Oracle's full applications-to-disk integration helps businesses increase their ROI while accelerating innovation across the entire technology stack.

Introduction

In the quest to generate revenue now and in the future, the alignment of information technology with business and mission has never been more important, and the integration of everything from applications to databases to systems to storage is vital to top-line revenue as well as the bottom line. Traditional IT models have often left integration as a task for the customer, or to third parties. Unfortunately, this integration model has often proven overly complex and costly – in terms of both acquisition and maintenance costs and the time required to time-to-deploy new applications and services. Complexity ultimately drives to both risk and cost, and more complex integration models are not only more costly to support, but they ultimately expose even the most carefully planned deployments to unforeseen risk. Many opportunities for true integration were also often lost in the well-intended but complex interactions of vendors and partners.

The acquisition of Sun Microsystems by Oracle presents an entirely new opportunity for unprecedented levels of integration that contributes directly to the top-line benefits of IT technology can bring to the business, as well as bottom-line efficiencies and cost savings.

Hardware and Software. Engineered to Work Together.

Oracle and Sun customers are engaged in mission-critical enterprise computing, and that requires a comprehensive approach. With hardware software, and database capabilities now unified within a single company, Oracle is building on its software integration expertise to include Sun Server and Storage technologies to exploit the many integration opportunities. Unlike vendors that leave the integration efforts to others, Oracle offers enterprise database and applications software integrated with the underlying infrastructure to provide a full-featured, robust solution operating with maximum performance. More than just having all of the necessary technologies, Oracle takes a holistic approach that provides real results.

- ***Optimizing the full stack.*** Because Oracle now provides a complete stack, engineering, tuning, and collaboration can be done at any level to solve problems or exploit new opportunities. Software can be optimized to take advantage of hardware features, hardware can be engineered to provide direct advantages to software, and functionality can move within the complete system as needed to promote performance, reliability, scalability, or other desired aspects. Full-stack integration and optimization lead to faster innovation.
- ***Synchronization of hardware and software cycles.*** Synchronization of hardware and software cycles is a natural outcome of Oracle's full-stack approach. Synchronization saves both time and money by helping to assure that there are no compatibility issues during deployment and that patches and updates will not break customer deployments.
- ***Organizational alignment.*** By aligning its own internal organizations such that common goals and priorities are shared by engineering teams, Oracle enables faster innovation across the entire stack. Engineers collaborate directly to share core intellectual property across product lines. Unlike professional partnerships and alliances, there are no non-disclosure agreements to sign and no alliance managers required to facilitate sharing of critical information such as core Intellectual Property.

The Benefits of Oracle Integration

By focusing on complete applications-to-disk solutions – rather than individual components – Oracle can deliver solutions that deliver unmatched abilities in key areas.

- ***Performance.*** With a perspective that now includes everything from applications down to underlying hardware, Oracle can ensure that its software takes full advantage of the unique features in Oracle systems and storage, while leveraging open standards and fully supporting other vendors. Examples include Oracle FlashCache in Oracle Database 11g R2 taking advantage of Oracle's innovative Flash hardware technology, Oracle middleware taking advantage of accelerated cryptography on SPARC T-series processors, and Oracle middleware and databases exploiting the high thread count found on Oracle's SPARC systems.

- **Availability.** All Oracle software and hardware components are engineered and tested to work together. Because Oracle can optimize each layer of its technology stack, customers can gain better performance, security, reliability, and ultimately higher uptime for their business-critical applications. Only Oracle performs full stack testing, using real life stacks with applied fault injection, stress, performance, and scalability testing.
- **Security.** Security is only as good as the weakest link in the system, and hackers and criminals often exploit weaknesses at application interfaces or mere lapses and human error related to good deployment practice. In addition to fully taking advantage of key security-related (such as integral advanced encryption technology in SPARC T3 processors), testing the whole stack and deployment path can help improve security.
- **Ease of manageability.** The entire Oracle technology stack is managed by Oracle Enterprise Manager and Oracle Ops Center, providing the most comprehensive management across Oracle servers, operating systems, and Oracle Solaris virtualization. This approach tightly integrates compute, storage, networking, and software components into a single system design, eliminating the need for siloed environments and components that need to be individually managed.

A Complete Stack

Organizations run applications based on their business and operational needs. Unfortunately, rather than focusing on applications, most are resigned to a traditional model where considerable time and budget is spent trying to ascertain whether applications function well on a given platform, with the necessary infrastructure, and at the appropriate patch level. Once a platform has been selected, organizations must spend the time and effort to integrate all of the necessary components into a tested production system. While this burden has traditionally fallen to the customer or integrator, it is hardly an ideal scenario.

In contrast, as a part of its strategy to be complete, open, and integrated, Oracle provides a fully-integrated end-to-end product stack (Figure 1). More than a simple laundry-list of components, Oracle is investing heavily in engineering and testing of complete, open and integrated systems that include software, servers, storage and management. Oracle also offers innovation across the entire stack. For example, Oracle designs and engineers all the standalone components as best-of-breed products, suitable for deployment with existing infrastructure or integration with software and hardware from other vendors. Oracle then re-engineers these products as a part of a complete application stack – testing them, and optimizing them together to offer complete solutions that offer the best-possible performance, the highest reliability, and the highest energy efficiency. These systems are engineered to work together, tested together, certified together, packaged together, deployed together, upgraded together, managed together and supported together.



Figure 1. Oracle provides complete hardware and software stack.

Best-of-Breed Technologies, Integrated

Oracle and Sun have a long history of collaboration around technologies that solve real problems for a wide variety of customers. As one company, these technology strengths are multiplied and focused on providing best-of-breed technologies. In hardware and operating systems, Oracle is now able to offer the best hardware and OS platforms for Oracle software. Oracle servers deliver leading application performance, high scalability, and proven reliability. Oracle is investing in innovative SPARC technology to lead the industry in application performance, scalability, RAS, security, investment protection. Oracle is also increasing investment in the Oracle Solaris operating system, the leading mission-critical operating system – now engineered and optimized for Oracle applications.

In storage, Oracle is delivering technology innovation by developing innovative Flash technology. Oracle FlashFire technology can be 10 to 20 times faster than traditional disk-based storage – accelerating I/O-intensive applications to increase performance without adding servers. Sun Storage 7000 Unified Storage Systems combine these strengths with those of the scalable Oracle Zetabyte file system. Oracle is also investing in StorageTek archive solutions, helping organizations maintain truly enormous amounts of data

Management is another key area where Oracle is placing key emphasis. To this end, Oracle is bringing together Oracle Enterprise Manager enterprise management tools with the Oracle Ops Center systems management tools. This key integration will allow organizations to manage complete applications, including software, hardware, and the operating system stack in one cohesive framework.

Organizations will be able to see all of their services, technology patches, and updates through My Oracle Support.

Proven, Tested, and Optimized Solutions

Oracle has also announced a number of complete applications-to-disk optimized solutions that are tested, certified, managed, and supported to help reduce risk and maximize IT investments. With these solutions, organizations can quickly implement specified, tested, and proven architectures that are easy to deploy and manage using Oracle software and systems to maximize current and new IT resources. Representing best practices in number of disciplines, Oracle's Optimized Solutions include:

- *Optimized Solution for Oracle WebLogic Suite* – offering simplicity in deployment and management, extreme performance, security, and integral acceleration from innovative Oracle FlashFire technology
- *Optimized Solution for Oracle Enterprise Business Suite* – offering mission-critical reliability and broad scale combined with manageability, and performance from Oracle Flash Cache technology for improved batch processing performance
- *Optimized Solution for Oracle PeopleSoft HCM* – offering turnkey infrastructure for PeopleSoft HCM and a choice of consolidation techniques, performance derived from Oracle SPARC T-Series and SPARC Enterprise M-Series servers, and Oracle FlashFire technology
- *Optimized Solution for Oracle Siebel CRM* – offering excellent performance, capacity, integral security, and reliability, and up to 200K transactions/hour in a single consolidated just 4 rack units (4U)
- *Optimized Solution for Oracle WebCenter* – offering manageability and streamlined operations, better performance and faster transaction times, and integrated crypto security
- *Optimized Solution for Oracle Database* – offering a two-fold increase in database application performance with Oracle FlashCache optimization, reliable business-critical architecture for zero downtime with extensive non-disruptive servicing and upgrades

Key Oracle Integration Examples

Much more than a far-off strategy, the Sun acquisition has already borne fruit in terms of real results. The sections that follow highlight a few of the initial results of co-engineering and tight collaborative efforts ongoing at Oracle. Many other integration activities are underway, promising to dramatically change what is possible for databases and mission-critical computing.

Performance and Scalability

By providing direct access and communication between engineering groups, Oracle engineers have already been able to bring about substantial improvements in performance and scalability.

- *Accelerating database performance with Oracle FlashCache.* As a part of the seminal Sun Oracle Database Machine X2-2, the Oracle Database Group and Hardware Engineering invested heavily to develop Oracle FlashCache technology. Leveraging unique Oracle FlashFire technology and the Oracle Solaris OS, the Oracle Database 11g R2 is able to take advantage of a 10 to 20-fold increase in performance as compared to traditional hard disk based architectures. Specifically, Oracle

FlashCache allows database administrators to extend the System Global Area (SGA) and caching beyond physical memory to a large Flash memory storage device such as the innovative Sun Storage F5100 Flash Array.

- ***Exploiting 128-thread x86 systems with virtualization.*** In an effort to provide considerable x86 scalability, the Oracle VM (OVM) team has worked closely with the hardware team to take advantage of the unique design of the Oracle's new Sun Fire X4800 server, which can support up to 64 cores and 128 threads. Oracle has released a hypervisor update in OVM 2.2.1 to take advantage of a full Sun Fire X4800 server configuration – up to 128 threads and 1 TB of RAM. This release increases the previous 64-thread limitation and makes Oracle the first to offer such a high level of scalability for virtualization on an x86 platform.
- ***Delivering extreme OLTP performance.*** The Sun Oracle Database Machine represented a seminal collaboration between Oracle and Sun engineers. In the design of that system, hardware engineering worked with the Database Group to optimize the system's SAS host bus adapters (HBAs). The result of this optimization is a system that provides the best disk performance for high-throughput OLTP database transactions.
- ***Innovation for telecommunications providers.*** Telecommunications companies need to respond to rapidly increasing computing demand within fixed power budgets, all with a choice of operating systems. To this end, Oracle Enterprise Linux (OEL) Engineering worked with Hardware Engineering to add support for Oracle's new carrier-grade Netra CP3270 blade server. As a part of this effort, OEL engineering added support for the new low-power Intel Xeon embedded processors to OEL 5.5, although they are not yet supported in Red Hat Enterprise Linux 5.5.

Availability and Reliability

Reliability is key for mission-critical applications. However, applications can only be as reliable as the middleware, hardware, and storage that they are deployed on. Oracle teams are participating in co-engineering activities to increase reliability with a whole-stack perspective.

- ***Increasing up-time for mission-critical applications.*** Oracle Solaris Predictive Self Healing capabilities have long been used to increase mission-critical application uptime. Now those capabilities are being extended both to hardware, and to Oracle software. As Predictive Self Healing becomes aware of Oracle's software status, the Oracle Solaris OS can take preemptive actions before an application failure impacts the rest of the stack. Hardware Engineering is also publishing best practices to enable Oracle Software to connect to the Service Management Facility (SMF). The result is proactive fault management throughout the entire stack.
- ***Optimized cooling design.*** Managing heat flow in the datacenter is a key capability with real ramifications for both system survival as well as energy costs. With extensive datacenter experience – from cabling, to power, to cooling – Oracle datacenter engineers approached the hardware team to ask for improvements to airflow and cooling of systems. The result has been changes to cooling design and fan control that improves overall datacenter heat dispersion.

- **Full stack testing.** Oracle Integrated Stack Testing (OIST) ensures the hardware and software components in an enterprise configuration interoperate and perform optimally throughout the system's lifetime. For IT managers planning to purchase a new system, reference configurations documented by Oracle provide a starting point for solution architecture discussions. Fully qualified by Oracle, these reference configurations reduce customer in-house testing, preparation, deployment, and maintenance times, thereby reducing overall operating costs. Key areas tested during OIST include upgrades, stress, faults, and interoperability.

OIST involves the building and configuration of several complete systems running volume enterprise software. The configurations are comprised of SPARC and x86 processor-based servers, Storage Area Network (SAN) and Network Attached Storage (NAS) based enterprise storage, and volume Oracle software packages.

The Oracle servers fall into one of just a few classes, in terms of architectural commonality. Oracle Sun SPARC Enterprise M-Series servers share common processors, as well as other hardware components for memory interconnect and I/O. This is also true for Oracle Sun SPARC T-Series servers, and the x86-based offerings. Although all SPARC processor-based systems run the Oracle Solaris OS, the x86-based servers run either Oracle Solaris or Oracle Enterprise Linux. By testing a relatively small number of representative systems, Oracle creates reference architectures that apply across their respective classes.

The reference architectures also span horizontal and vertical scaling dimensions, a critical consideration for meeting performance and capacity requirements. Large SMP systems running a single instance of the operating system support vertical scaling by adding on CPUs, RAM, and I/O devices. Oracle Real Application Cluster (RAC) technology enables horizontal scaling, by adding more systems or virtual machines to the cluster, each running its own instance of the operating system. Again, a myriad of options exist, in terms of the number and types of nodes used in cluster configurations, as well as other key components, such as the cluster interconnect.

The selected configurations enable the largest possible return on investment in terms of the broad applicability across a massive number of customer deployments.

OIST software includes the Oracle Database 11g R2 and R1, Java EE Application Server, Oracle WebLogic Application Server, Oracle VM Server, Oracle's PeopleSoft Enterprise Campus, and Siebel Customer Relationship Management software, as well as other popular Oracle packages. An important aspect of this testing is the inclusion of emerging products such as high-speed network interfaces and innovative storage technologies that many IT organizations are considering.

- **Patch system testing.** The OIST environment also enables incremental testing following each step of patch installations and software upgrades. By executing load and stress tests after each patch baseline/cluster installation or software upgrade, any variation of test results can be quickly identified, isolated, and fixed prior to the actual release of the modification. Integrated testing means that the entire stack, including patches and upgrades that have been previously applied, go through another round of load and stress tests to ensure the combinations of patches and upgrades work as expected.

Installing software upgrades and patches at all layers of the stack, validating quality and performance following each change including:

- The use of Oracle Solaris Live Upgrade for upgrading to Oracle Solaris update releases
- The installation of Oracle Solaris kernel and recommended patch clusters
- The installation of Oracle patches and minor and major upgrades to all the software layers on each system (database, middleware, application)
- The OIST environment enables incremental testing

Security

Security is increasingly vital as a function of application design, and developers and IT managers alike are driving an increase in the use of encryption and isolation in the datacenter to help reduce risks. At the same time, encryption is a compute-intensive process that can limit available computing resources for other applications, and physical system isolation quickly becomes cost and space prohibitive. Both Oracle hardware and the Oracle Solaris OS can make significant contributions to securing applications and the databases they depend on.

- ***On-board cryptographic acceleration.*** To enable the extended use of encryption in more and more pieces of the application stack, the SPARC T1, T2, T2Plus, and SPARC T3 processors all provide integral on-chip crypto acceleration for a wide variety of popular ciphers. The Oracle Solaris cryptography framework automatically offloads encryption to the on-board cryptographic engines in SPARC T-Series processors. Utilizing this on-board crypto acceleration improves WebLogic performance by a factor of two and increases throughput up to 25%.
- ***Isolation through Oracle Solaris Containers.*** Virtualization technology is increasingly popular, and vital to both consolidation efforts and maximizing utilization and flexibility for datacenter resources. Unfortunately, many virtualization solutions can quickly become costly with complex licensing schemes that can ultimately constrain use of this valuable technology. Oracle Solaris Containers technology is provided as a part of the Oracle Solaris OS – the only operating systems offering that offers this capability built-in. Organizations can create isolated and secure Oracle application deployment environments using Oracle Solaris Containers, without fear of licensing costs.
- ***Using Solaris Security Features to Harden Oracle Databases.*** The Oracle Solaris operating system contains a large ecosystem of security mechanisms, many of which can be highly effective in securing Oracle databases. Commodity Oracle Solaris operating system security features such as virtualization, role-based access, reliability and availability, and accountability through auditing can be used to lock down network-facing services in order to protect them against internal and external threats. (For more information, please see the Oracle white paper titled *Hardening Oracle Databases with Oracle Solaris Security Technologies* by Christoph Schuba at: www.oracle.com/technetwork/articles/servers-storage-admin/solsecurityhardendb-167809.pdf)

Management

Datacenter applications and their dependencies – middleware, virtualization technology, operating systems, systems, and storage – can be highly complex to manage. While many tools exist to manage the various levels of the stack, users need full stack provisioning and management. Oracle now has all of the management components required to manage the full stack, and integration efforts are underway.

- ***Manage the full stack with Oracle EM and Oracle Ops Center.*** Oracle understands that full-stack management is a distinct goal, and strongly desired. As a part of this effort, Oracle integrating Oracle Enterprise Manager and Oracle Ops Center with a new Oracle Ops Center 2.5 agent that is capable of sending alerts to Oracle Enterprise Manager, enabling Oracle EM to monitor hardware.
- ***Oracle EM Grid Control and Oracle's Sun Storage 7000 Unified Storage Systems.*** Oracle's Sun Storage 7000 Unified Storage Systems provide an excellent mechanism for adding both incremental storage as well as innovative Flash technology to applications. To move toward a unified management platform, Oracle EM Grid Control has been enhanced to control the Sun Storage 7000 Unified Storage Systems – allowing database, virtualization, and storage to be managed under a single application.
- ***Oracle Validated Configurations (OVC).*** Oracle Validated configurations are pre-tested, validated Linux-based architectures that include software, hardware, storage, and networking components with documented best practices for deployment. Oracle and its strategic partners offer and recommend these configurations to enable end-users to deploy fully-tested solutions to achieve standardization with high performance, scalability, and reliability while lowering infrastructure costs. As a part of the integration within Oracle, Sun systems are being added to OVC configurations.
- ***Convenient Bootable VM image for SPARC and x86.*** Organizations are always looking for ways to simplify deployment paths while reducing risk. Being able to deploy applications more quickly can have a direct relationship with the quality experiences by users. To this end, Oracle is providing bootable Oracle Solaris 10U7 OS images for both the SPARC and x86 architectures. These images are preconfigured with the Oracle Database 11g R2 within an Oracle Solaris Container. Simply booting a pre-defined image can save considerable time that would normally be required to install the operating system, install virtualization, configure a virtual machine, install the database, and install and test patches.

Conclusion

Mission-critical applications require an approach to infrastructure that emphasizes the entire technology stack. As a single company, Oracle can provide a complete product stack – integrating applications, middleware, virtualization, OS technology, hardware, storage, and management. Oracle is uniquely positioned to continue to develop best-of-breed technologies in these key areas. Moreover, Oracle has the opportunity to integrate those technologies to vastly improve performance, scalability, reliability, security, management and overall quality. While every organization is different, tightly

integrated infrastructure presents new opportunities for profitability and simplification – allowing organizations to prosper and thrive in even the most challenging times.

References

To learn more full-stack integration from Oracle, please visit the resources listed in Table 1.

TABLE 1. REFERENCES

| | |
|--|---|
| Hardware and Software. Engineered to Work Together | http://www.oracle.com/us/corporate/features/engineered-173370.html |
| Oracle's Optimized Solutions | http://www.oracle.com/us/solutions/optimized-solutions-171609.html |
| Article: "Oracle and Sun 101" | http://www.oracle.com/profit/features/071610_sun.html |
| Oracle's Strategy for Sun Servers, Storage, and Complete Systems | http://landingpad.oracle.com/webapps/dialogue/ns/dlqwelcome.jsp?p_ext=Y&p_dlg_id=9231501&src=7011672&Act=16 |
| John Fowler Interview: "Oracle and Sun, Engineering from Applications to Disk" | http://www.oracle.com/technology/oramag/oracle/10-may/o30interview.html |
| John Fowler Responses in: "A Bright Tomorrow" | http://www.oracle.com/profit/features/050110_fowler_ga.html |
| David Kelly Article: "Hardware, Software, Complete" | http://www.oracle.com/technology/oramag/oracle/10-may/o30sun.html |
| Oracle + Sun Strategy Webcasts | http://www.oracle.com/events/productstrategy/index.html |
| Hardening Oracle Databases with Oracle Solaris Security | http://www.oracle.com/technetwork/articles/servers-storage-admin/solsecurityhardendb-167809.pdf |
| Trust Your Enterprise Deployments to the Oracle Product Stack | http://www.oracle.com/technetwork/server-storage/solaris/documentation/stackintegration-167863.pdf |



Oracle Full-Stack Integration: Maximize the Value of IT Investments from Applications to Disk

October 2010

Author: Pierre Reynes

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200
oracle.com



Oracle is committed to developing practices and products that help protect the environment

Copyright © 2010, Oracle and/or its affiliates. All rights reserved. This document is provided for information purposes only and the contents hereof are subject to change without notice. This document is not warranted to be error-free, nor subject to any other warranties or conditions, whether expressed orally or implied in law, including implied warranties and conditions of merchantability or fitness for a particular purpose. We specifically disclaim any liability with respect to this document and no contractual obligations are formed either directly or indirectly by this document. This document may not be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without our prior written permission.

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

AMD, Opteron, the AMD logo, and the AMD Opteron logo are trademarks or registered trademarks of Advanced Micro Devices. Intel and Intel Xeon are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. UNIX is a registered trademark licensed through X/Open Company, Ltd. 0410

SOFTWARE. HARDWARE. COMPLETE.