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White Paper

Advantages of Oracle SPARC Servers Running Oracle Solaris over Commodity Alternatives

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Executive Summary

As enterprises accrue exponentially growing amounts of information, data center reliability and efficiency have become more important than ever. Trends toward higher system utilization (through virtualization) show no sign of slowing, making it imperative that enterprises have the IT solutions to capitalize on these trends and ensure that efficient, secure virtualization can be accomplished. While x86 architectures have long been considered safe and cost-effective for virtualization, the performance and value of Oracle's suite of SPARC processor-based servers, and the Oracle Solaris operating system and virtualization software should prompt enterprises to explore the Oracle stack. An investigation of Oracle stacks reveals them to be a unified data center solution engineered for efficiency and economy; a data center solution that reduces enterprise risk compared to x86 architectures.

With a track record of reliable, robust server virtualization, Oracle Solaris continues to gain notice for its performance, scalability, and value. Utilizing the SPARC family of servers, Oracle Solaris has demonstrated itself to be both agile and capable of managing complex workloads that would require comparatively more x86 systems to sustain. In a direct and rigorous comparison of Oracle SPARC and x86 systems, Edison analysts found the SPARC solution to possess advantages in performance, scale, dependability, and virtualization strength. These advantages will be cited throughout this examination of comparable networks of two-socket, VM-provisioned servers: SPARC T5 with Oracle's virtualization running Oracle Solaris, and a Hewlett Packard x86 server running Red Hat Enterprise Linux (RHEL) with VMware vSphere Enterprise Plus.

Three critical conclusions emerging from this white paper are:

- Oracle offers a sole-source solution for server virtualization—a single company manufactures and integrates the entire application-to-disk stack. This single party accountability has been found to be conducive to operational savings and to alleviate concerns of interoperability, operational consistency, and maintenance.
- Oracle's SPARC solution costs less than alternative solutions without compromising performance. Both the total cost of acquisition and ownership, excluding database, are lower than leading alternative solutions (34.0 percent and 29.8 percent, respectively). Both the reduced risk and increased data security afforded by an Oracle solution were determined by Edison to be among the advantages of an Oracle stack.
- Over the course of the analysis, Edison resolved that the performance, risk reduction, and financial savings offered by Oracle SPARC servers warrant their consideration by IT decision-makers and purchasing managers seeking a high-performing, cost-effective virtualization solution.

Performance, Scalability, Value

Virtualization

Oracle

Unlike commodity hardware with VMware virtualization, SPARC servers have virtualization built into their OS, and are engineered to take virtualization down to the processor. This translates to Oracle Solaris having both lower latency and lower overhead than RHEL solutions, which feature only non-integrated virtualization. Designed to work in concert, Oracle Solaris and Oracle VM Server for SPARC—a built-in, low-overhead hypervisor, and Oracle Solaris Zones—represent Oracle’s virtualization solution. Oracle Solaris has been calibrated over the course of 25 years to offer optimum virtualization, while Oracle Virtual Networking (not included in this study) virtualizes the SAN and LAN infrastructure. The majority of commodity virtualization solutions are not engineered to work in concert.

Virtualization Technologies

Oracle VM Server for SPARC is a hypervisor-based virtualization technology that supports secure live migration as virtual machines transit from server to server. This technology can improve resource utilization and simplify failover availability and achievement. Oracle Solaris Zones is a built-in OS virtualization technology that allows thousands of software-isolated instances to be deployed in a single instance of Oracle Solaris, while simultaneously enabling high levels of customization and control. Oracle Virtual Networking can further enhance the virtualization in an Oracle Solaris/SPARC system by providing a fabric-based infrastructure connecting all the virtualized resources in the network or storage devices, providing virtual I/O capabilities and software-defined networking between systems.

Oracle VM vs. VMware

Some comparative points regarding Oracle's virtualization offering and VMware:

- Oracle VM templates can be used to support applications like CRM and ERP, which reduces provisioning time. Provisioning with Oracle VM tools has been measured to be seven to 10 times faster than VMware.¹
- Fully integrated into the Oracle stack, Oracle VM Server for SPARC has the capability to manage and provision the components of that stack, whereas VMware's hypervisor does not.
- VMware's overheads have been shown to impair consolidation ratios — VMware demonstrated a 7-17 percent performance loss on simple I/O and network (VM vs. native)² and suffered a 12 percent performance loss on IBM WebSphere (VM vs. native)³. Oracle VM Server for SPARC and Oracle Solaris Zones on SPARC T5 servers showed a less than 1 percent difference, versus native, on CPU-intensive workloads.

Oracle Virtual Networking for Software Defined Networks

While not included in this study, the Oracle Virtual Networking product line can extend further advantages to Oracle clients. Networking products consist of a hardware fabric interconnect and several supporting software components. These products are able to virtualize SAN and LAN infrastructure by defining connectivity in software, giving enterprises the flexibility and agility needed for optimum virtualization.

The Benefits of an Integrated Solution

Enterprise-ready from the outset, Oracle Solaris was the first comprehensive OS for the cloud and has a demonstrated history of performance. Oracle SPARC stacks do not require the third-party add-ons that x86 architectures do, and, to match the capabilities of Oracle Solaris, RHEL requires add-on modules like high availability and file-system add-ons, among others. Integrating hardware, operating system, virtualization and

¹ The Evaluator Group, Independent Lab Validation: <http://tinyurl.com/l4xev8e>

² vSphere5: IBM x86 PerformanceCharacteristics-InfoSphereInformationServerVMware.pdf , vSphere4: <http://www.VMware.com/pdf/>

³ VMware & IBM: <http://www.slideshare.net/rjmcDougall/virtualization-primer-for-java-developers>

applications, the Oracle SPARC/Oracle Solaris Solution's interdependent nature is capable of heightening efficiency and lowering risk.

Consolidating management to allow for the simple, accelerated deployment of cloud infrastructures, Oracle Enterprise Manager Ops Center can serve as a fundamental technology for enterprises. Able to manage all Oracle systems in any environment—traditional, virtualized and cloud—Oracle Enterprise Manager Ops Center is outfitted to perform the job of multiple management tools including: discovery, inventory, monitoring, patching, configuration management, server provisioning, host management, storage management, virtualization management, network management, and cloud infrastructure management.

Some of key benefits of an Oracle solution include:

- The efficient placement of applications within the data center
- Management simplicity
- Increased uptime
- Reduced power/cooling and system administration costs

Operational Efficiency

SPARC servers and Oracle Solaris 11, designed to work in conjunction, promote operational efficiency and, in doing so, realize advantages most comparative solutions cannot. Due to the built-in virtualization support, Oracle Solaris 11 running on SPARC servers is able to deploy cloud-ready data center infrastructure. Additionally, automation protocols in Oracle Solaris 11 reduce the long intervals of boot and provisioning time generally needed for the deployment of hundreds of systems in a data center, so that greater system utilization can be achieved faster.

No Add-Ons

System consolidation, as found in the all-in-one design of the Oracle stack, is a fundamental way to improve efficiency in the data center. Where third-party add-ons required by x86 architectures actually heighten a system's complexity and require more IT oversight, the Oracle stack, configured for virtualization out of the box, requires no add-ons to provide simple, cost-effective system consolidation throughout the data center.

Guaranteed Application Compatibility

Guaranteed application compatible at both the processor instruction-set level and the operating system API level, SPARC-based Oracle Solaris solutions ensure that past investments are protected. Regardless of age, all compatible SPARC/Oracle Solaris applications can be operated on SPARC-based Oracle Solaris. This eliminates the need to rewrite applications within the SPARC environment and allows applications running on previous generations of Oracle Solaris to be deployed on the latest SPARC systems. SPARC-based Oracle Solaris systems allow customers to leverage custom applications and older ISV applications still in use.

Linear Pricing of SPARC Servers

A unique processor interconnect design and the utilization of nonproprietary memory components has enabled Oracle to alter conventional notions about the costs of "scaling up" with larger servers. While it has long been customary for vendors to charge high premiums for the expansion of larger servers, Oracle solutions offer a straight-line price for performance increase as processors are added. An Oracle SPARC/Oracle Solaris system with four processors is half the cost of eight processors, and twice as much as a system with two processors. Customarily, enterprises are forced to construct larger-scale deployments from ever-increasing quantities of smaller networked servers, increasing complexity and raising high-speed networking costs. Oracle's linear pricing allows customers to deploy any workload onto larger-scale servers for nearly the same price/performance cost as a deployment of smaller servers to obtain critical advantages including: higher performance, higher efficiency, higher system availability, and reduced complexity.

Risk Management

With a fully integrated application-to-disk stack, fewer servers required, and a single point of contact, Oracle solutions are designed to provide reliable, high-availability foundations for enterprise businesses. The overall RAS (reliability, availability, and serviceability) of Oracle stacks compares favorably with RAS features offered by x86 architectures, as Oracle solutions come equipped with failure detection and self-remediation both at the system level and with Oracle Solaris. Other RAS features and considerations that merit attention are discussed below.

Eliminating the Dangers of Migration

The constant migration necessitated by RHEL/x86 architectures can be problematic, risk-prone, and jeopardize operational stability. Oracle Solaris's guaranteed application compatibility allows enterprises to avoid the risk, repetition, and wasted resources that OS migrations can entail, like additional hardware/software, and personnel costs for developing and maintaining the parallel system for an intended migration. There is also the possibility that an OS migration may fail on a particular RHEL/x86 architecture, given those architectures' somewhat inconsistent migration histories. With Oracle Solaris' guaranteed application compatibility, Oracle stack allows to bypass migrations that otherwise invite risk and incur cost.

The Advantage of Single Party Accountability

One unique advantage of an Oracle solution is that all of its hardware and software components are engineered by a single company. Should any issue arise connected with—or pertaining to—an Oracle stack, SPARC servers have an embedded, dedicated processor for reporting support concerns automatically. And, if a support call is in order, Oracle is the single point of contact. Having consistent, single-party accountability allows for faster and more complete issue resolution.

SPARC/Oracle Solaris Requires Fewer Administrators⁴

The integrated simplicity of an Oracle SPARC/Oracle Solaris solution extends up to the management level. A feature unique to Oracle systems, the Enterprise Manager Ops Center for Oracle Solaris is designed to monitor, patch, provision, virtualize, and support operating systems, virtualization technologies, Oracle servers, storage, and networks, all from a single user interface. The Enterprise Manager lowers both administrative/IT personnel costs and risk by reducing the number and breadth of error-prone manual tasks.

⁴ ZDNet: <http://www.zdnet.com/blog/murphy/cost-comparison-solarissparc-vs-linuxx86/1020>

Isolated Workloads Ensure Safety

The RAS features, built in to every SPARC system, isolate individual workloads to ensure a safe and secure computing environment. Due to this isolation, if a single application should fail or encounter an error, it is prevented from causing downtime across the entire system. The isolation of workloads makes Oracle stacks a secure choice for hosting the Tier-1 applications critical to enterprise success.

Oracle Solaris Predictive Self Healing Technology

This feature, exclusive to Oracle Solaris, promotes uptime by proactively identifying and working to resolve pending faults that could lead to downtime in the data center. This Predictive Self Healing technology also maximally leverages availability in instances of software and hardware faults and promotes a simple, efficient experience for system administrators. Further, if any unforeseen downtime does somehow occur, Oracle Solaris' Predictive Self Healing ensures the expedient recovery of systems to limit service interruptions.

Superior Security

Security is also integrated in an Oracle SPARC solution. In a SPARC platform running Oracle Solaris, Oracle's built-in security provides a level of data center protection that even the most secure x86 server can have difficulty matching. Oracle Solaris Cluster works to create isolation and to inoculate both Oracle Solaris Zones and the Oracle SPARC hypervisor from outages stemming from hardware or software failure. Should circumstances call for disaster recovery, an Oracle solution offers aggressive reclamation capabilities that enable a swift return to optimum operability. Dynamic Domains provide rapid recovery support for I/O, memory, and processor resources. Oracle Solaris Cluster enables customers to fail over applications from a primary to a secondary site, if need arises. Oracle Virtual Networking provides security in a multi-tenant environment by creating isolated virtual private data centers without relying on VLAN. In addition to the protective measures woven throughout each element of an Oracle stack⁵, the features named above can help enterprises to move forward with confidence in their data center's security.

⁵ Oracle Solaris and Fujitsu SPARC Enterprise Systems — Integrated and Optimized for Enterprise Computing Fujitsu White Paper, May 2011. <http://tinyurl.com/ls3l53b>

Total Cost of Acquisition and Ownership

From a Total Cost of Acquisition (TCA) and Total Cost of Ownership (TCO) perspective, a data center equipped with Oracle SPARC servers is respectively 34.0 percent and 29.8 percent less expensive than one equipped with x86 alternatives, excluding database costs. The cost advantage exists primarily because superior hardware performance and software feature-sets allow the Oracle-equipped data center to purchase less hardware and software than with an x86-equipped data center to achieve the same performance levels. The full extent of the advantage is best seen by observing the results of comprehensive TCA and TCO analyses of competing systems.

Methodology of TCA and TCO Analysis

Total Cost models review the costs associated with the acquisition, installation, licensing, maintenance, and brick-and-mortar infrastructure needs of a server solution. Within this study, list prices are used throughout; no discounts are applied.

The cost components reviewed include:

- Hardware licensing and maintenance
- OS licensing and maintenance
- Virtualization licensing and maintenance
- Network licensing and maintenance
- System Management software licensing and maintenance
- Facility costs including space, power, and equipment
- Staffing costs

Total Cost of Acquisition are one-time costs, such as equipment purchase, software licenses, and equipment, plus the initial cost for the first term of any maintenance contracts, whether for one or three years: the out-of-pocket costs paid on day one. There is no accounting treatment, therefore no need to separate component costs into capital or operating categories. Rent, power, and personnel are not included as they are paid as a part of daily operations.

Total Cost of Operation includes all costs that are needed to sustain operations. These include all maintenance, power, space, and staffing costs, using a five-year horizon. All cost components are included as either capital costs or operating costs. Hardware is assumed to be refreshed every five years, so is not a factor in this analysis.

Systems Under Comparison

Given the relative performance of the Oracle and x86-based systems, this analysis considers two multi-server networks:

Oracle Solution

The Oracle solution runs on 20 SPARC T5-2 servers. Each server contains two 16-core 3.6GHz SPARC T-5 processors, 256GB of RAM, 600GB of storage and dual-redundant power supplies. Virtualization is handled by Oracle VM Server for SPARC. The operating system is Oracle Solaris 11.1, which is bundled with Oracle Enterprise Manager Ops Center, and Integrated Lights Out Manager. See the Appendix for a more detailed treatment of quantities and specific line items.

x86-Based Solution

The representative selected for x86 technology is an HP ProLiant DL380p Gen 8 system. A data center equivalent to the Oracle installation would require 49 such servers. Each machine is equipped with two Intel 8-core 2.7GHz Xeon E5-2697 V2 processors, 224GB of RAM, 600GB of storage and dual-redundant power supplies. Virtualization is handled by VMware vSphere Enterprise Plus, licensed per server, and VMware vCenter Server Standard, licensed per site. The operating system is Red Hat Enterprise Linux (RHEL) 2S. Additional licenses and/or maintenance contracts of Red Hat Load Balancer, Red Hat Scalable File System, Red Hat High Availability, HP iLO Advanced, and HP OneView bring this solution as close to the Oracle level of system management functionality as possible. HP x86 systems are connected by using appropriate quantities of Cisco Nexus virtual and rack mount network switches. See the Appendix for a more detailed treatment of quantities and specific line items.

Infrastructure and Personnel

Both solutions use similar rack mount hardware with equivalent cost per rack, with rack quantity dependent on number of servers. Both solutions assume rental of facility space in New York City, and staff with salaries based on New York City salaries for either Oracle- or Red Hat-experienced personnel. Power cost is based on custom power estimations for each server technology, scaled by a constant factor to account for server cooling and general facility HVAC consumption.

Environment Cost Scaling

For both TCA and TCO calculations, most costs scale in some way with the size of the installation. Because the Oracle solution runs with both fewer servers (20 servers to 49 servers) and physical cores (640 cores to 784 cores), it is dramatically less expensive, even in terms of components and services that have approximately equal unit prices in both systems. See Figures 1 and 2.

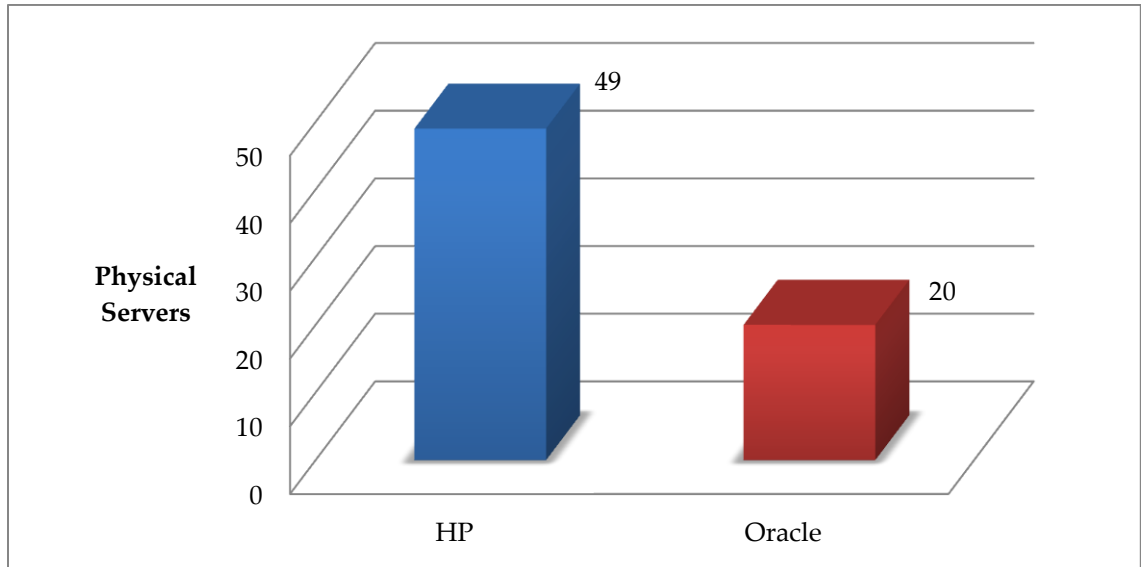


Figure 1: Server Count Workload Comparison

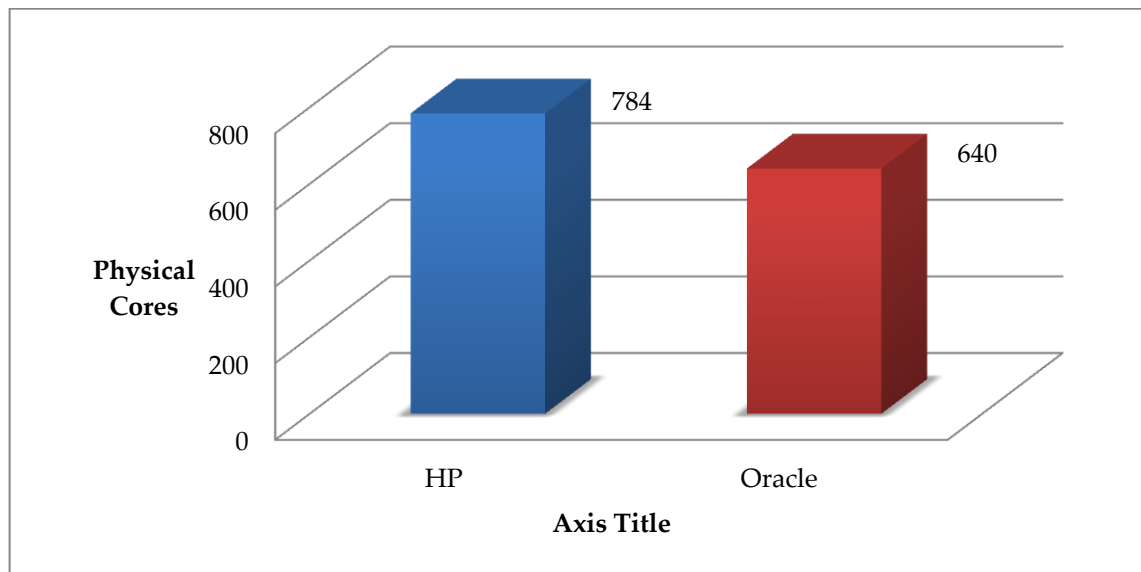


Figure 2: Core Count Workload Comparison

TCA Results

TCA includes costs which are paid or agreed-to at the time of purchase. It does not include any costs associated with daily operations.

Total Cost of Acquisition	Oracle	HP	Difference	
Acquisition Cost				
Hardware/Maintenance	\$1,365,190	\$937,329	\$427,862	45.6%
Network/Maintenance	\$88,891	\$207,330	\$(118,440)	-57.1%
Software/Maintenance	-	\$642,446	\$(642,446)	-100.0%
Virtualization/Maintenance	\$71,940	\$451,532	\$(379,592)	-84.1%
Database/Maintenance	\$18,544,000	\$22,716,400	\$(4,172,400)	-18.4%
System Mgt/Maintenance	-	\$71,932	\$(71,932)	-100.0%
Equipment	\$4,000	\$6,000	\$(2,000)	-33.3%
Total Cost of Acquisition	\$20,074,021	\$25,032,969	\$(4,958,948)	-19.8%
TCA (excl. DB)	\$1,530,021	\$2,316,569	\$(786,548)	-34.0%

Table 1: TCA

Total Cost of Acquisition, with up-front payment for one/three-year support plans is 34.0 percent (\$786,548) less with a system based on Oracle SPARC T5-2 hardware and Oracle VM Server for SPARC is than with a system based on HP ProLiant DL380p hardware and VMware vSphere 5.1 virtualization.

Oracle networking equipment is better tailored to the hardware and accomplishes connectivity with less components, leading to a lower expenditure on networking costs. The cost of a SPARC T5-2 based system, including Virtualization, Operating System and Management Software is comparable to the cost of HP DL380P hardware and VMware VSphere virtualization. However, to run, the commodity solution also needs an operating system from Red Hat, and to approximate the functionality of the Oracle bundled software, additional management software must be purchased from HP.

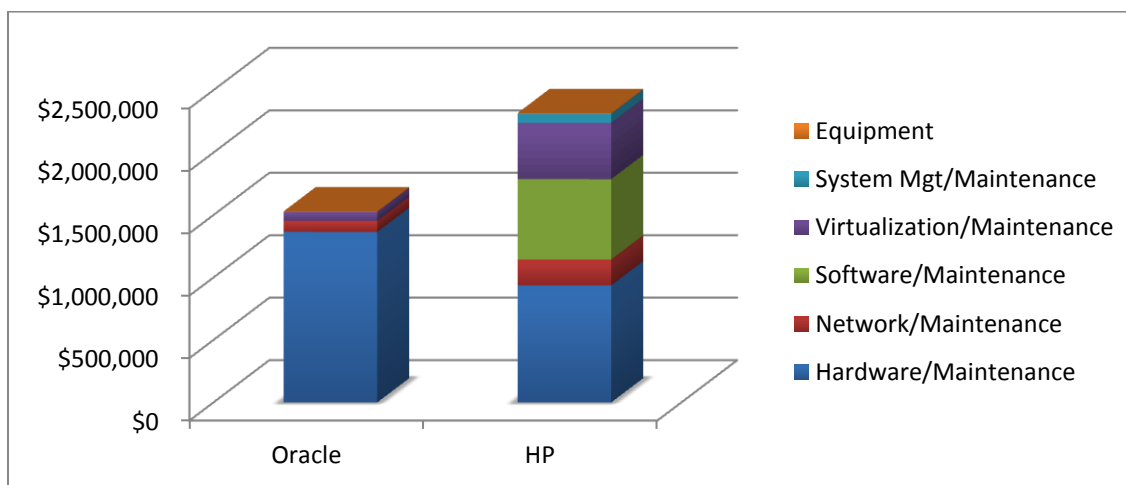


Figure 3: Systems TCA

Five Year TCO Results

This table represents both acquisition and operating costs for a five-year period.

Total Cost of Ownership	Oracle	HP	Difference	
Capital Cost				
Hardware	\$1,218,920	\$772,597	\$446,323	57.8%
Network	\$79,598	\$176,086	\$(96,488)	-54.8%
Software	-	-	-	n/a
Virtualization	-	\$347,505	\$(347,505)	-100.0%
Database	\$15,200,000	\$18,620,000	\$(3,420,000)	-18.4%
Equipment	\$4,000	\$6,000	\$(2,000)	-33.3%
Subtotal Capital Cost	\$16,502,518	\$19,922,188	\$(3,419,670)	-17.2%
Operating Cost				
Hardware	\$731,352	\$175,093	\$556,259	317.7%
Network	\$46,463	\$156,221	\$(109,758)	-70.3%
Software	-	\$1,070,744	\$(1,070,744)	-100.0%
Virtualization	\$119,900	\$434,505	\$(314,605)	-72.4%
Database	\$16,720,000	\$20,482,000	\$(3,762,000)	-18.4%
System Management	-	\$119,887	\$(119,887)	-100.0%
Power	\$277,771	\$191,075	\$86,696	45.4%
Space	\$129,600	\$194,400	\$(64,800)	-33.3%
Staffing	\$444,000	\$701,250	\$(257,250)	-36.7%
Subtotal Operating Cost	\$18,469,085	\$23,525,174	\$(5,056,088)	-21.5%
Total Cost of Ownership	\$34,971,603	\$43,447,362	\$(8,475,758)	-19.5%
TCO (excl. DB)	\$3,051,603	\$4,345,362	\$(1,293,758)	-29.8%

Table 2: TCO

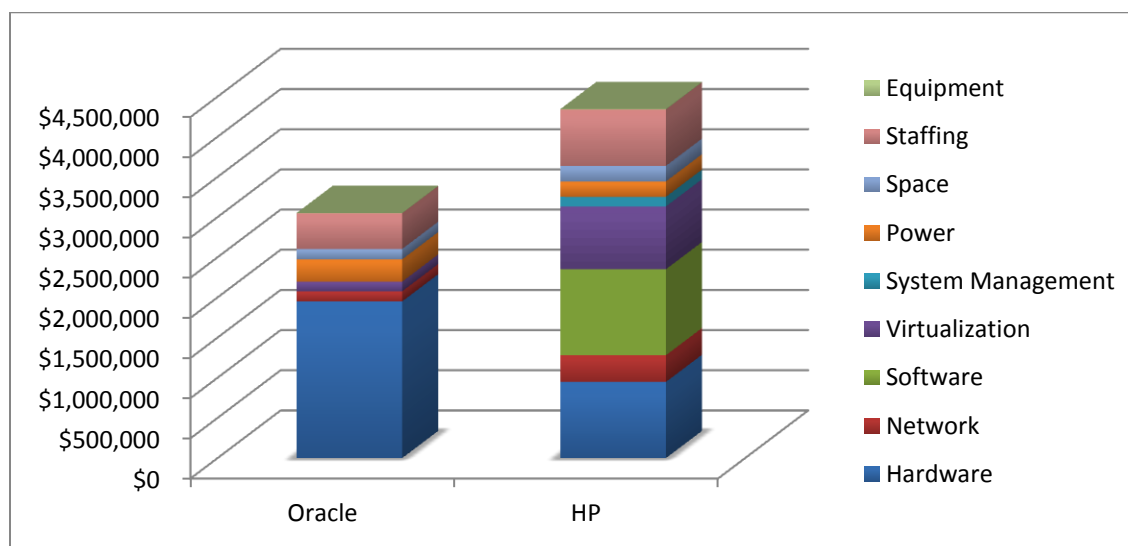


Figure 4: Systems TCO

Conclusion

Edison's analysis revealed that the Oracle SPARC T5-2, with Oracle Solaris 11 and Oracle VM Server for SPARC virtualization, is 29.8% percent more cost-effective than the competing x86, RHEL-based system. In the case outlined above, the comprehensive TCO savings equaled \$1,293,758. Edison's findings suggest that Oracle has succeeded in engineering a data center solution that melds heightened performance and reduced risk with significant value.

There is, perhaps, a new standard in enterprise computing.

Appendix – Detailed System Information

List costs are used for all components; there are no discounts. The configurations and networks of the systems compared in this paper are:

Table 3 – Oracle SPARC T5-2 Based System

Hardware		Per Server	Total Quantity
Oracle SPARC T5-2			20
Processor	3.6 GHz SPARC T5 16-core	2	40
RAM	8GB	32	640
Storage	300GB	2	40
Network Adapter	10 Gb FCoE	2	40
Power Connection	Power Cords	2	40
Power Supply	2x hot-swappable AC 2,000 W redundant power supplies	2	40
Network			
	Cisco Nexus 5548UP	N/A	2
	Cisco Nexus 2232PPFEX	N/A	2
Software			
OS	Oracle Solaris 11.1	1	20
VM	Oracle VM Server for SPARC	1	20
Database	Oracle Database 12c	16	320
Systems Management	Integrated Lights Out Manager	N/A	1
Systems Management	Enterprise Manager Ops Center	N/A	1

Table 4 – Commodity System (uses HP DL380P, RHEL and VMware VSphere)

Hardware		Per Server	Total Quantity
ProLiant DL380p Gen8			49
Processor	E5-2697v2 2.7 GHz 12-core 2P 32 GB-R	2	98
Encryption Accelerator	227933-B21	1	49
RAM	16 GB (1x16) Dual Rank x 4 PC 3L – 1060 OR (DDR-3 133)	14	686
DVD	HP Slim 12,7 mm SATA	1	49
Storage	300 GB	2	98
Network Adapter	HP CN1100E Dual Port Converged Network Adaptor	1	49
Power Connection	HP C 13	2	98
Power Supply	750 W Common Slot Gold Hot Plug Power Supply	2	98
Network			
	Cisco Nexus 5548UP	N/A	4
	Cisco Nexus 1000v		98
	Cisco Nexus 1110-X	N/A	1
	Cisco Nexus 2232PPFEX	N/A	2
Software			
OS	RHEL, 2 S, unlimited guests, 24x7	1	49
OS	Red Hat Smart Management	1	49
OS	HP Warranty Upgrade 24 x 7	1	49
OS	Red Hat Load Balancer	1	49
OS	Red Hat Scalable File System	1	49
OS	Red Hat High Availability	1	49
Virtualization	VMware vSphere Enterprise Plus, 24 x 7 SnS	1	49
Virtualization	VMware vCenter Server Standard, 24 x 7 SnS	N/A	1
Database	Oracle Database 12c	8	392
Systems Management	HP ILO	1	49
Systems Management	HP Insight Control Environment	1	49

Note for Database Licenses in the total solution:

When included, the database license cost does have a significant impact on the data center solution. This impact scales with the number of processor cores, and indicates a marked cost advantage to the Oracle solution’s lower number of more capable machines and smaller number of total cores.