White Paper

Oracle x86 Infrastructure

The Optimized Stack: Reducing Total Cost of Ownership through Vertical Integration

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Executive Summary

In July 2011, Edison published a white paper that demonstrated the total cost of ownership (TCO) advantages of Oracle's optimized x86 integrated stack. This white paper is version 2.0, created to reflect the changes in system from the three competing vendors and a change in the VMware licensing model. These changes had some effect on the results of the previous study, narrowing the Oracle advantage on occasion but also increasing it in others. Oracle has made changes in its licensing policies that also can have a TCO advantage. Oracle Enterprise Manager and Oracle Enterprise Manager Ops Center, previously extra-cost options, are now included with all Oracle servers.

These two no-charge additional products not only provide users with the ability to run a completely virtualized cloud infrastructure, but also provide unique disk to application control of business services within that cloud. However, as no single or multiple vendor products exist that can directly compare to these Oracle capabilities, they are not included in this study, although we judge their cost savings to be significant and relevant. Instead, we view these additional advantages as further enhancements to the TCO conclusions stated in this report. Integrating hardware and virtual machine management into a single console can greatly simplify the management of Oracle x86 servers. By offering the management tools at no additional charge, their value to the enterprise is even higher.

Regardless of the overall economic climate, organizations have keen interest in keeping costs of business in check. Historically, IT enabled the automation of expensive manual processes and made employees more productive, changing the entire cost model for doing business. Today, IT is really seen as a competitive weapon, with the Internet having opened up new revenue-generating paths to customers (whether B2C or B2B). However, driving down costs remains a critical role of the CIO.

Standardization is a proven strategy for reducing IT costs, and datacenters have widely adopted fast-maturing technologies, including power-saving innovations, enterprise-caliber x86 servers, and now virtualization. However, such technology often entails expenses of its own. Executives and IT professionals must proceed with caution lest, ironically, the solutions wind up contributing to the problem

Total cost of ownership — that is, the true cost of IT equipment and operations over time — is especially important to consider in this light. An organization prepared to make a sizeable investment in its data center today could overlook prohibitive ongoing operating expenses down the line. In a typical virtualized x86 enterprise infrastructure the largest cost factors are often from software licensing, and support costs for operating

systems and virtualization. On a two-socket system, these costs can represent as much as 67 percent of total TCO over a three-year period.

What sets Oracle's approach apart from that of other vendors is its ability to apply a holistic philosophy to the entire x86 environment, developing consolidation solutions as complete infrastructures specifically designed to optimize performance and lower TCO. These systems comprise the entire hardware and software stack, from application to disk, with every major component engineered, tested, certified, packaged, deployed, upgraded, managed, and supported as an integrated whole. Oracle claims the results are better performance and efficiency, easier deployment, streamlined administration and maintenance, and — as Edison Group examines here in some detail — lower TCO.

In this paper, Edison analyzes the cost structures across a range of system sizes and deployments for the core x86 system stack. Edison compared Oracle's complete infrastructure with alternative options from HP and IBM, deployed with Red Hat Enterprise Linux and VMware vSphere, either separately or together. Among other findings, Edison has documented that Oracle's TCO is as much as 61 percent lower than that of comparable deployments.

x86 Infrastructure Stack: Real-World Consideration of Total Cost of Ownership

As the ongoing costs of running data centers continue to rise against the backdrop of a challenging business environment, keeping total cost of ownership (TCO) in check has increasingly become an imperative. The economies of open standards x86-based computing have gained widespread attention among IT professionals. They see advances in x86 system design and operating systems, in addition to maturing virtualization technology, as paving the way to more cost-effective IT operations.

Assessing the true TCO for a fully deployed x86 environment with any accuracy is often somewhat involved, and comparisons between different vendor offerings is no easy matter. Even pared down to core essentials — servers, operating system, and (typically) virtualization software — the setups involve not only purchase costs but also costs for facilities, system maintenance, licensing, and support. In most cases, such x86 infrastructures comprise different types of best-of-breed components, provided by a federation of vendors.

Because it offers enterprise consolidation solutions as complete x86 infrastructures, Oracle stands out as an exception. The largest cost factors in a standard virtualized x86 enterprise infrastructure quite often arise from having multiple vendors, for instance, in the form of software licensing and support costs for Red Hat Enterprise Linux and VMware vSphere. On a two-socket system, these two expenses alone can represent as much as 71 percent of total TCO over a three-year period. Oracle states that its strategy — engineering hardware and software to work together throughout the stack – is designed to reduce the complexity that affects time to deploy and support the infrastructure. They contend it can also reduces the IT cost structure, and drives efficiencies that reduce TCO across the board. This paper shows how Oracle's complete x86 infrastructures deliver lower TCO than do equivalent infrastructures based on offerings from HP and IBM.

Oracle's Integrated Infrastructure Approach

Oracle is the only vendor offering enterprise consolidation solutions for x86-based infrastructures that include built-in virtualization technologies engineered, tested, and deployed together as a single system. Because it provides these technologies with high-quality servers, offering a choice of Oracle Linux or Oracle Solaris, and a unified service support contract, Oracle can deliver a predictable and easily quantifiable TCO.

The architectural approach Oracle takes for complete x86 infrastructures is to engineer the hardware and software together for enterprise workloads. Because these systems are tested, certified, packaged, deployed, upgraded, managed, and supported as an integrated whole, they are optimized to work together across and between the layers of the entire infrastructure stack, from application to disk. Oracle also maintains a commitment to open standards, which gives flexible options to its customers who have investments in other products.

Let us look at how system performance and the individual elements of the x86 infrastructure stack impact TCO.

Performance

A primary driver in Oracle's designing of full application-to-disk infrastructure, where the greatest control can be exercised in engineering, is to optimize performance. In dealing with an increasingly connected and demanding end-user community, superior performance is extremely important in its own right, accelerating the delivery of services to meet ever-changing business needs. However, it also plays a vital role in reducing TCO. Oracle incorporates highly scalable servers, with built-in enterprise-class virtualization, which can enable data centers to consolidate their existing applications into fewer, more powerful systems to improve efficiencies and reduce costs.

Spotlight on Server Performance [1]

A good example of the kind of server performance Oracle offers is its Sun Fire X4470 M2 server. It has set a world record as the fastest among all four-socket systems. In benchmark testing, it set a new standard for Java system performance,[1] allowing organizations to deploy fewer Java virtual machines with higher levels of efficiency and manageability than previously possible, helping to reduce data center complexity. In head-to-head comparisons (see footnote below), the Sun Fire X4470 M2 server outperformed IBM's comparable four-socket x3850 X5 system with the same Intel Xeon processor, and even outperformed the four-socket Power 7-based IBM Power 750 Express system by 34 percent.

Oracle uses x86 servers based on Intel's leading-edge Xeon processors, which have become an extremely effective choice for running a wide range of enterprise applications, particularly for deploying with virtualization, or in cloud environments, which are fast gaining widespread adoption.

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[1] Results from www.spec.org as of 4/6/2011. Sun Fire X4470 M2 (4x Intel Xeon E7-4870 CPU, MS Windows, Oracle Java 6 u25 VM) - 2,703,740 SPECjbb2005 bops, 675,935 SPECjbb2005 bops/JVM. IBM X3850 X5 (4x Intel Xeon E7-4870 CPU, CPU, MS Windows 2008, J9 VM) - 2,582,363 SPECjbb2005 bops and 129,118 SPECjbb2005 bops/JVM. IBM Power 750 Express (4x POWER7 3.55 GHz, AIX) – 2,478,929 SPECjbb2005 bops, 77,467 SPECjbb2005 bops/JVM. SPEC and SPECjbb2005 are registered trademarks of the Standard Performance Evaluation Corporation.

Virtualization

In Oracle's view, designing systems that truly deliver the greatest efficiency and performance requires a holistic approach to the entire datacenter stack infrastructure. Toward this end, it offers excellent quality servers, pre-loaded with its own well-received infrastructure software portfolio, including Oracle VM virtualization software. This server virtualization software fully supports both Oracle and non-Oracle applications on both SPARC and x86-based systems, and delivers highly efficient performance. It is a fully featured hypervisor with high availability and migration capabilities, along with a browser-based management console.

On select x86 systems, Oracle also pre-loads the Oracle Linux and Oracle Solaris operating systems and Oracle VM virtualization software. Other major vendors of x86 systems rely on third-party components for virtualization and operating systems. Because of this, these vendors do not have the same level of control over the entire infrastructure as Oracle does. With the backing of an established world-class support organization, data centers deploying Oracle now have a single point of enterprise-class support for their entire virtualization environments. This includes Oracle Database, Fusion Middleware, applications, Oracle Solaris or Oracle Linux, all of which are certified with Oracle VM. (For data centers virtualizing Oracle applications, Oracle VM Server is the only x86 server virtualization solution certified to run Oracle software products.)

Oracle's complete x86 infrastructure also support Oracle Solaris Containers, which isolate software applications and services using flexible, software-defined boundaries. Oracle Solaris Containers offer an innovative approach to virtualization and software partitioning, allowing many private execution environments to be created within a single instance of Oracle Solaris. Each environment has its own identity, separate from the underlying hardware, so it behaves as if it is running on its own system. That makes consolidation simple, safe, and secure, and is excellent for leveraging multithreading hardware. Oracle Solaris is supported on both SPARC and x86-based systems, using the same virtualization technology on either platform. It can also be combined with Oracle VM to provide highly granular control of your virtualized systems with the lowest overhead and the highest performance.

Operating Systems

In addition to virtualization technology, Oracle's high-quality x86 rack mount and blade servers can come with a choice of operating systems pre-loaded for user installation and configuration, including:

- **Oracle Linux** — Combined with Oracle's Unbreakable Enterprise Kernel, Oracle Linux brings the latest Linux innovations to market, delivering extreme performance, advanced scalability, and reliability for enterprise applications. Oracle Linux 5 is up to 75 percent faster than Red Hat Enterprise Linux 5, and also includes complete enterprise-quality support from Oracle. Oracle Linux helps lower TCO by enabling CPUs to stay in low-power state when the system is idle, reducing infrastructure costs. Another potentially cost-saving feature is automatic isolation of defective CPUs and memory, which can avert expensive system crashes and downtime.

- **Oracle Solaris** — This UNIX operating system enables excellent performance and return on investment through flexible resource sharing that can transparently utilize idle resources often found in consolidated environments. Solaris has built-in high-level pervasive security, and offers several features that reduce TCO, including power management via the Power Aware Dispatcher. It provides event-driven thread scheduling for power efficiency and leveraging of the power-saving features of the latest Intel chipsets, parallel patching for Solaris Containers (which saves management time for systems with many containers), and Solaris Binary Application Guarantee.

Spotlight on Oracle Linux

As part of the Linux mainline kernel community, Oracle's engineers contribute in advancing Linux for mission critical deployments. Oracle Linux is the culmination of work with the mainline community and Oracle's own product development teams. Oracle Linux is the only supported Enterprise Linux distribution that is available for free download and distribution.

Additionally, Oracle applies fixes to bugs found in the rigorous testing to which it subjects each version of Linux on its complete enterprise application stack configurations. The fixes are limited to those considered critical to such environments, and are dropped in subsequent versions coming from Red Hat once its developers have addressed the bug. Such extensive testing of Oracle Linux for the complete infrastructure plays a major role in its better performance.

To date, Oracle reports never receiving a support request on Linux compatibility issues.

Spotlight on Oracle Solaris Application Guarantee

The Solaris Application Guarantee reflects Oracle's confidence in the compatibility of applications from one release of Solaris to the next. It is designed to make re-qualification — let alone porting — a thing of the past, reducing application life cycle costs across OS releases. If an application runs on earlier versions of Solaris, including their initial release and updates, it will run on the latest version, including its initial release and all updates, even if the application has not been recompiled for Oracle Solaris. If an application experiences compatibility problems when running on the latest version of Solaris, Oracle will analyze and provide the appropriate remedy for the problem.

Support

Contributing to the lower TCO for Oracle's complete x86 infrastructures is a unified service support contract. Oracle's entire vertically-integrated stack is backed by Oracle Premier Support, an award-winning service and support plan. It includes proactive support tools and resources with embedded system diagnostics, enabling fast, in-depth troubleshooting and problem resolution by an organization's own IT staff or Oracle support engineers. With no socket, core, or memory limitations for operating systems or virtualization software, Premier Support eliminates additional, and sometime unpredictable, licensing and support fees. It makes 7x24x365 onsite support available, with two-hour response time. Its Auto Service Request automatically opens a service request for specific server faults and transports electronic fault telemetry to help expedite the diagnostic process, often even before an IT department is aware of the problem. This saves valuable time and speeds time-to-resolution.

By providing a single point of accountability for the entire system, Premier Support lowers administration costs and reduces costly downtime. This substantially reduces the risks associated with deploying and managing IT systems, as well as providing improved and easily quantified TCO. Standard support coverage includes the latest software releases. Product enhancements come out of a planned [$4.3B](#) in R&D investment for FY2011, as well as the efforts of 29,000 product development engineers. Oracle points out that lifetime support enables organizations to upgrade on their own schedule, as well.

Other TCO-Reducing Factors

In taking a holistic approach to the entire x86 infrastructure stack, an Oracle system can deliver even further TCO-related benefits. Full testing and integration across the entire software stack, for instance, fosters superior performance, reliability, and ease-of-management factors, which can all help reduce costs.

In addition to these more easily quantifiable factors, other aspects and features of Oracle's complete x86 infrastructures lower TCO in a number of ways:

- **Business-Driven IT Management** — In what appears to be the industry's first converged hardware management solution for Oracle's x86 environments, Oracle's Enterprise Manager and Enterprise Manager Ops Center combine management across servers, operating systems, firmware, virtual machines, storage, and network fabrics into a single console across physical and virtual environments for x86 and SPARC architectures. This eases management and helps enable business objectives

to drive IT. A multi-customer study [2] by Crimson Consulting Group found that use of Enterprise Manager improved annual staff productivity by as much as 75 percent and reduced annual server expenditures by as much as 20 percent.

- **Storage-Related Cost Reductions** — Oracle's ZFS Storage Appliance can be used to reduce energy consumption up to 80 percent and physical footprint by 70 percent [3]. Oracle's Sun Flash reduces energy consumption by up to 100 times, while improving storage transaction response time as much as tenfold.

- **Faster Application Deployments** — Oracle VM Templates provide an innovative approach to deploying a fully-configured software stack by offering pre-loaded and pre-configured software images. Use of Oracle VM Templates eliminates the installation and configuration costs and reduces the ongoing maintenance costs, helping organizations achieve faster time to market and lower cost of operations. Oracle VM Templates of many key Oracle products are available for download, including Oracle Linux, Oracle Solaris, Oracle Database, Fusion Middleware, and many more.

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[2] *Oracle Enterprise Manager: Real-World Insight into Business Impact and Return on IT Investment*, 2010, Crimson Consulting Group. See: oracle.com/enterprisemanager11g

[3] A 2010 study by Edison Group, [*Oracle ZFS Storage Appliance Comparative Management Costs Study*], found that Oracle ZFS storage appliance could reduce provisioning time by 34 percent, configuration change time by 31 percent, and time for troubleshooting by 44 percent.

TCO Comparisons

This section presents side-by-side TCO comparisons of Oracle's complete x86 infrastructures, based on a number of server offerings, with equivalent infrastructure stacks based on comparable HP and IBM servers.

Methodology

For the sake of simplicity, the comparisons that follow focus strictly on the compute infrastructure — server, OS, virtualization stack offerings and license schemas, and support levels. The impacts of additional TCO-reducing factors offered by any vendor (such as embedded system diagnostics, performance advantages, or management tools) have not been included.

For each comparison, TCO has been calculated over both three-year and five-year time periods. Industry research has indicated that the most common server refresh period is actually five years, though most organizations plan for three (the second-most common timeframe.) [4]

Because product discounts are unpredictable and vary widely, only list prices are used in this comparison. To compare the varying warranty and support levels of the different vendors, adjustments were made to equal the 24x7x365 with the two-hour response time standard with Oracle complete x86 infrastructures (although HP's website describes only a four-hour response time).

The offerings also vary in the stack and how they are priced. Oracle's system-based Premier Support includes the two-hour response time, as well as all licenses and support for the full OS and virtualization stack. HP and IBM's support comprises hardware maintenance, with separate costs for licenses, support and management for Red Hat Enterprise Linux (RHEL) and VMware vSphere. Oracle Premium Support allows for unlimited memory, processors, cores, and virtual machines. The corresponding RHEL and vSphere pricing were used to achieve a like-for-like license and support comparison at what would be the customer's more favorable list price. (For example, multi-year support agreements are used when they offer a customer discount.)

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[4] IDC, *Server Refresh: Meeting the Changing Needs of Enterprise IT with Hardware/Software Optimization*, Jean S. Bozman and Katherine Broderick, July 2010. Available at http://www.oracle.com/us/products/servers-storage/servers/x86/idc-server-refresh-170677.pdf.

Oracle Linux and Oracle Virtualization also include certain management capabilities that, in the case of RHEL and VMware, are optional; therefore, these have been added to their respective costs.

Finally, facilities costs were calculated to include rack space, power, and cooling. Because different vendors use differing assumption in their "peak" power consumption, and because differentials between the vendors turned out not to have been significant, the most conservative (largest) power estimate was used across all the comparable systems from all three vendors.
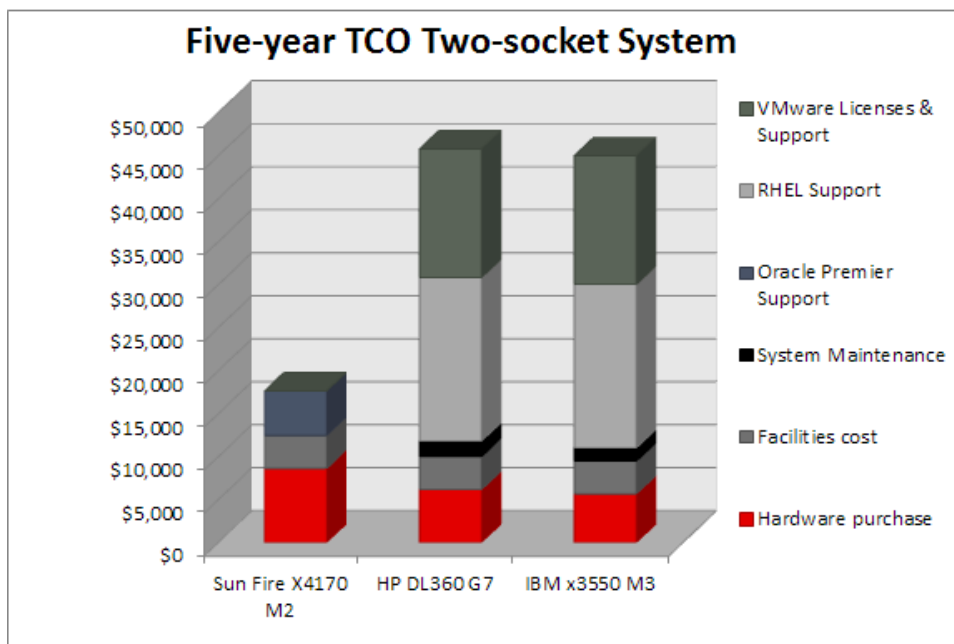
Comparison 1: Two-Socket System
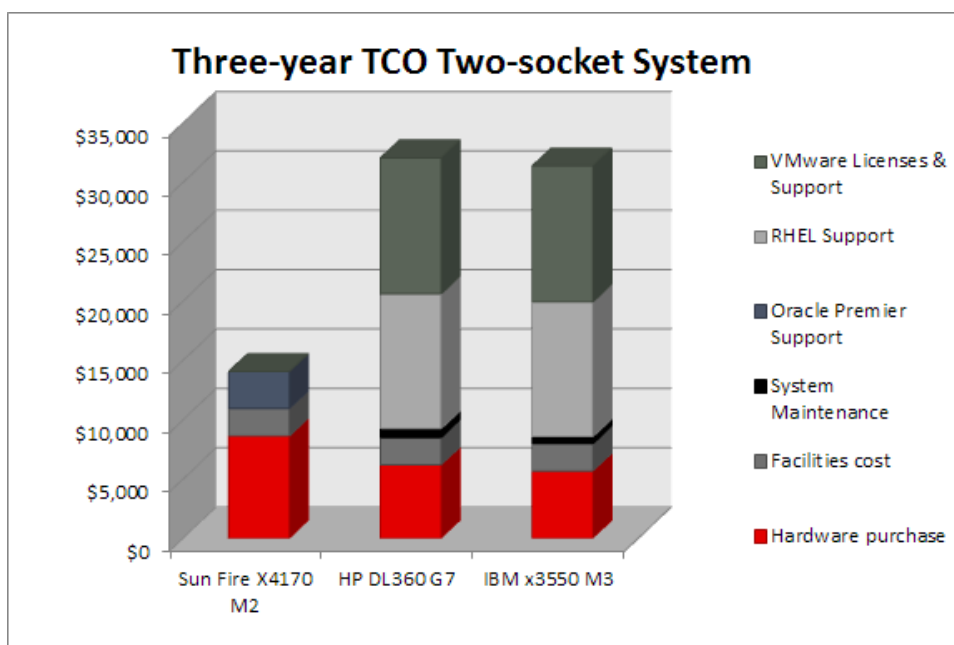
In this comparison of the Sun Fire X4170 M2 server with equivalent systems from HP and IBM over a three-year period, a few key points should be noted:

- TCO for both HP and IBM systems are more than double — 55-56 percent greater for both — than the TCO for the Oracle virtualized and supported stack.

- Even leaving virtualization out of the comparison, Oracle's fully virtualized and supported system is less expensive than HP or IBM with RHEL alone.

- Because HP does not offer a two-hour response time, the Oracle Premier Plan provides superior coverage. (In the case of IBM, the pricing used here reflects support that does include a two-hour response time.)
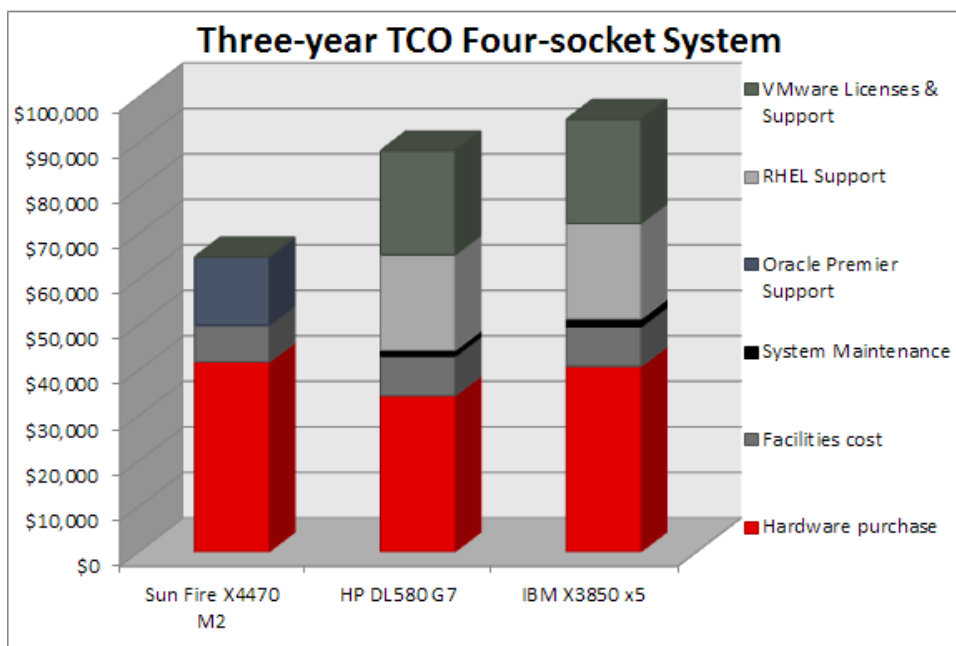
Three-Year TCO		Sun Fire X4170 M2	HP DL360 G7	IBM x3550 M3
1.	Hardware Purchase	$8,633	$6,186	$5,663
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$11,448	$11,448
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$750	$594
7.	Server OS Support	$0	$9,620	$9,620
8.	OS Management Support	$0	$1,728	$1,728
9.	Server Virtualization Support	$0	$0	$0
10	Oracle Premier Support	$3,484	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$1,636	$1,636	$1,636
13.	Floor Space Costs	$662	$662	$662
Total		$15,460	$31,449	$31,781
Percentage Oracle's TCO is lower			56%	55%

In this comparison of the Sun Fire X4170 M2 server with equivalent systems from HP and IBM over a five-year period, it should be noted that Oracle's TCO is even better for data centers on a five-year cycle, with the TCO for both HP and IBM being more than twice that for the Oracle system.
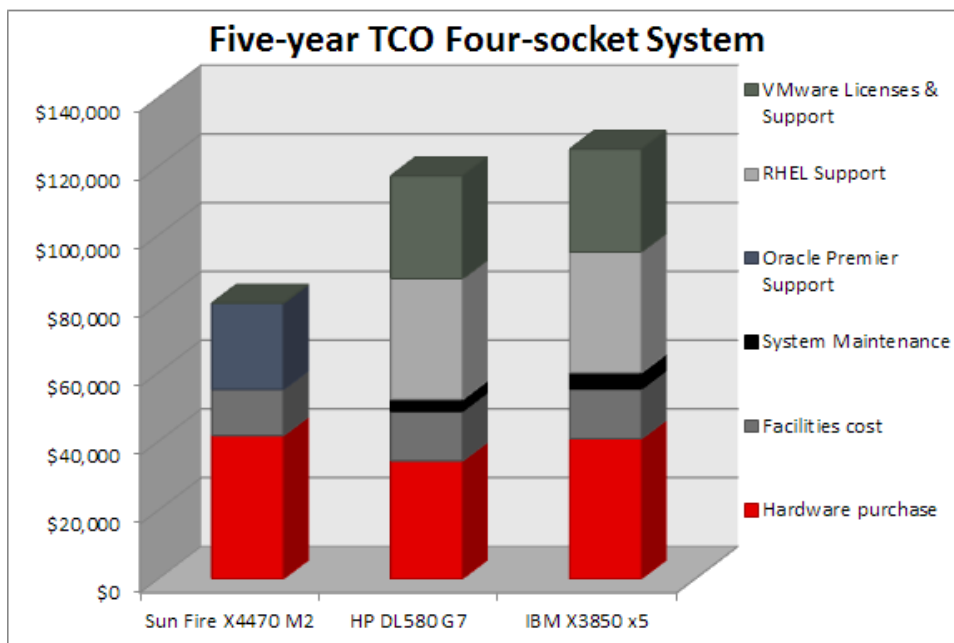
Five-Year TCO		Sun Fire X4170 M2	HP DL360 G7	IBM x3550 M3
1.	Hardware Purchase	$8,633	$6,186	$5,663
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$11,448	$11,448
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$1,810	$1,548
7.	Server OS Support	$0	$16,118	$16,118
8.	OS Management Support	$0	$2,880	$2,880
9.	Server Virtualization Support	$0	$3,496	$3,496
10.	Oracle Premier Support	$5,807	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$2,726	$2,726	$2,726
13.	Floor Space Costs	$1,104	$1,104	$1,104
Total		**$19,315**	**$45,187**	**$45,413**
Percentage Oracle's TCO is lower			**61%**	**61%**

Comparison 2: Four-Socket System

In this comparison of the Sun Fire X4470 M2 server with equivalent systems from HP and IBM over a three-year period, TCO for HP and IBM systems is 26-32 percent greater than with Oracle's system.

	Three-Year TCO	Sun Fire X4470 M2	HP DL580 G7	IBM x3850 X5
1.	Hardware Purchase	$41,742	$34,366	$40,799
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$22,896	$22,896
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$1,309	$1,750
7.	Server OS Support	$0	$19,240	$19,240
8.	OS Management Support	$0	$1,728	$1,728
9.	Server Virtualization Support	$0	$0	$0
10.	Oracle Premier Support	$15,027	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$6,063	$6,063	$6,063
13.	Floor Space Costs	$1,986	$2,592	$2,592
Total		**$64,819**	**$88,183**	**$95,067**
Percentage Oracle's TCO is lower			**26%**	**32%**

As in the earlier comparison, over a five-year period, the Sun Fire X4470 M2 server provides an even lower TCO, in this case up to 32-36 percent less than with equivalent systems from HP and IBM.

|	Five-Year TCO	Sun Fire X4470 M2	HP DL580 G7	IBM x3850 X5
1.	Hardware Purchase	$41,742	$34,356	$40,799
2.	Server OS Purchase	$0	$22,896	$22,896
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$0	$0
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$3,433	$4,770
7.	Server OS Support	$0	$32,236	$32,236
8.	OS Management Support	$0	$2,880	$2,880
9.	Server Virtualization Support	$0	$6,992	$6,992
10.	Oracle Premier Support	$25,045	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$10,104	$10,104	$10,104
13.	Floor Space Costs	$3,312	$4,320	$4,320
Total		**$80,203**	**$117,217**	**$124,997**
Percentage Oracle's TCO is lower			**32%**	**36%**

Comparison 3: Eight-Socket System
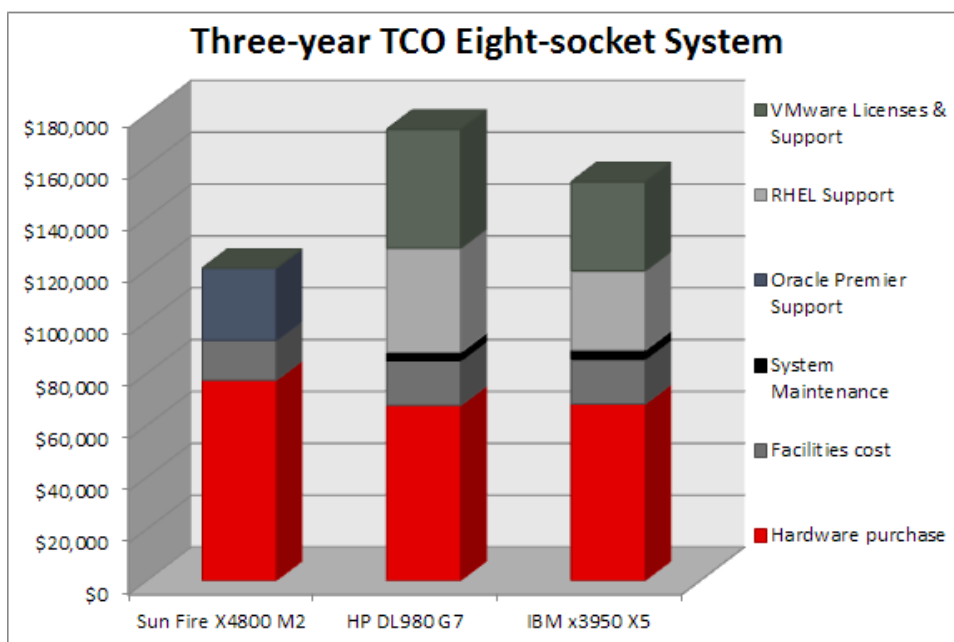
In this comparison of the Sun Fire X4800 M2 with equivalent systems from HP and IBM over a three-year period, the following key points should be noted:

- IBM's comparable system entails 22 percent greater TCO than the Sun Fire X4800 M2 server. The HP DL980 G7 server has a 31 percent greater TCO than the Sun Fire x4800 M2 server.

- Both the HP offering and the IBM offering used in this comparison — the HP Proliant DL980 G7 the IBM x3950 X5 server, respectively — actually consist of two 4-node x3850 X5 servers interconnected to appear as a single system. The HP server is delivered as a single chassis while the IBM system stacks two x3950 X5 servers using special cables and other hardware. The Oracle Sun Fire x4800 M2 server has been designed from the ground up as an eight socket machine with all eight sockets in a single chassis.

- Oracle's Sun Fire x4800 M2 server has a space advantage over both HP and IBM (5RU vs. 8RU for each competitor).

|	Three-Year TCO	Sun Fire X4800 M2	HP DL980 G7	IBM x3950 X5
1.	Hardware Purchase	$77,320	$67,618	$68,153
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$45,792	$34,344
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$3,205	$3,501
7.	Server OS Support	$0	38,480	$28,860
8.	OS Management Support	$0	$1,728	$1,728
9.	Server Virtualization Support	$0	$0	$0
10.	Oracle Premier Support	$27,835	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$12,033	$12,033	$12,033
13.	Floor Space Costs	$3,312	$5,184	$5,184
Total		**$129,022**	**$174,039**	**$153,802**
Percentage Oracle's TCO is lower			**31%**	**22%**

Five-year TCO Eight-socket System
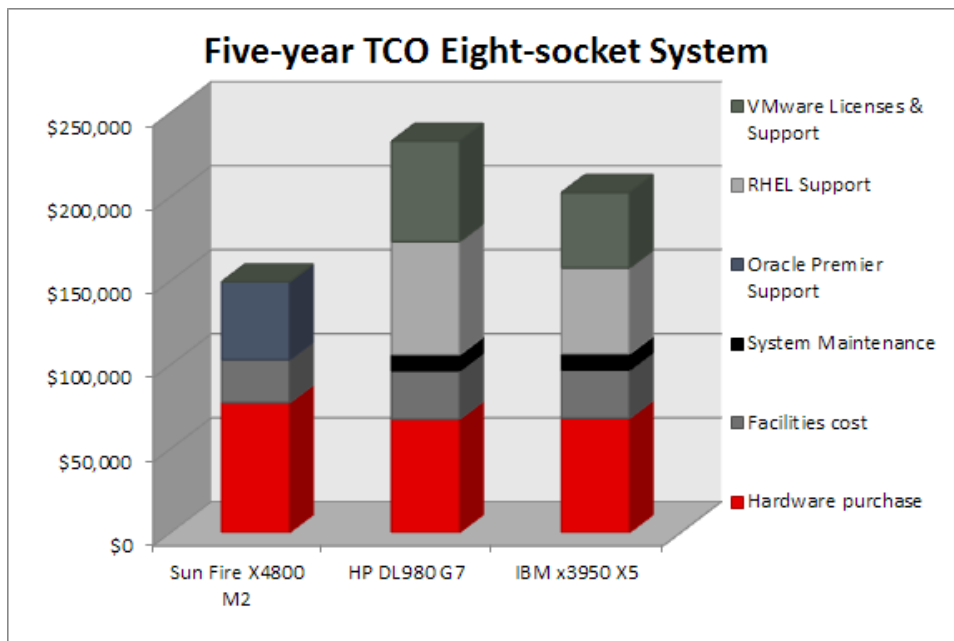
As in the comparisons shown earlier, over a five-year period, the Sun Fire X4800 M2 server results in still lower TCO for Oracle's offering than the equivalent system from IBM, in this case 26 percent lower. In comparison with the HP DL980 G7, the Oracle TCO is 36 percent lower.

|	Five-Year TCO	Sun Fire X4800 M2	HP DL980 G7	IBM x3950 X5
1.	Hardware Purchase	$83,587	$67,618	$68,183
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$45,792	$34,344
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$9,555	$9,541
7.	Server OS Support	$0	$64,472	$48,354
8.	OS Management Support	$0	$2,880	$2,880
9.	Server Virtualization Support	$0	$13,984	$10,488
10.	Oracle Premier Support	$50,152	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$20,055	$20,053	$20,053
13.	Floor Space Costs	$5,520	$5,520	$5,520
Total		**$159,314**	**$232,994**	**$202,453**
Percentage Oracle's TCO is lower			**36%**	**26%**

Comparison 4: Ten 2-Socket Blades with Networking

The two cases to follow compare an x86-based infrastructure stack using the Sun Blade X6270 M2 server module in a Sun Blade 6000 chassis with Sun Blade 6000 10GbE Switched NEM 24p against similar offerings from HP and IBM, projecting out both three and five years. (This represents a typical blade deployment.)
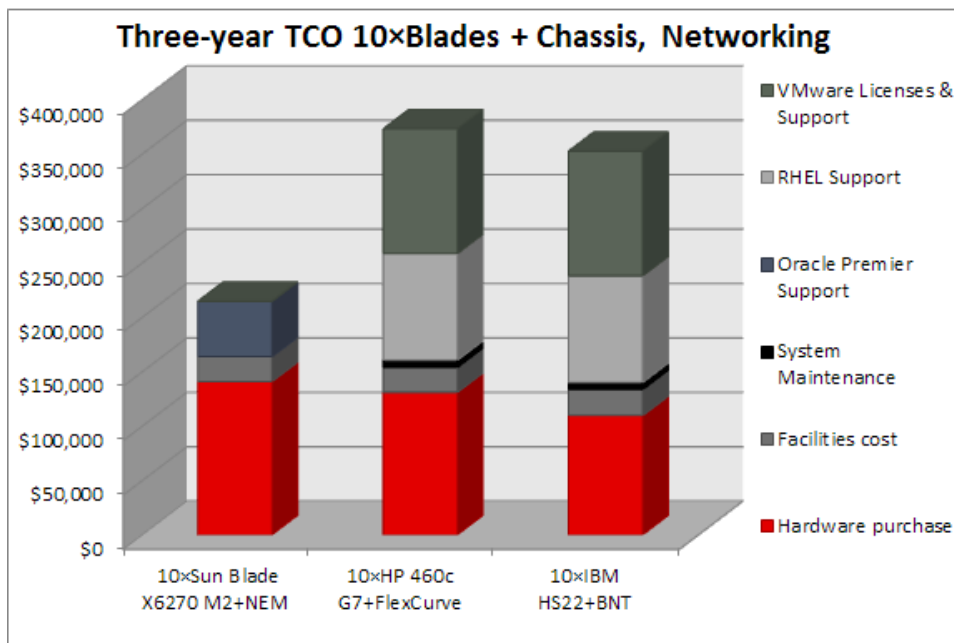
Comparing 10 Sun Blade X6270 M2 server modules in a Sun Blade 6000 chassis with Sun Blade 6000 10GbE Switched NEM 24p versus comparable systems from HP and IBM over three years, Oracle's system provides up to 39-42 percent lower TCO.

Three-Year TCO		10 × Sun Blade X6270 M2 + NEM	HP 10 × 460c G7 + FlexCurve	10 × IBM HS22 + BNT
1.	Hardware Purchase	$141,083	$131,212	$109,873
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$114,480	$114,480
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$6,674	$6,445
7.	Server OS Support	$0	$96,200	$96,200
8.	OS Management Support	$0	$1,178	$1,178
9.	Server Virtualization Support	$0	$0	$0
10.	Oracle Premier Support	$50,790	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$16,190	$16,190	$16,190
13.	Floor Space Costs	$6,624	$6,624	$6,624
Total		$214,687	$373,103	$352,660
Percentage Oracle's TCO is lower			42%	39%

Five-year TCO 10×Blades + Chassis, Networking
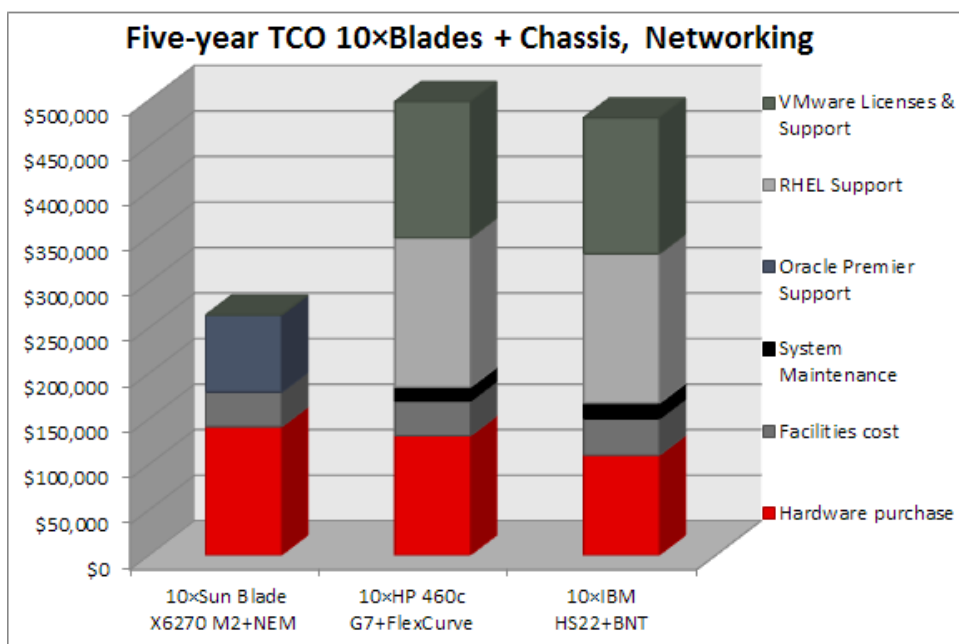
Comparing 10 Sun Blade X6270 M2 server modules in Sun Blade 6000 chassis with Sun Blade 6000 10GbE Switched NEM 24p versus the equivalent systems from HP and IBM over five years, Oracle's system provides up to 45-47 percent lower TCO.

	Five-Year TCO	10 × Sun Blade X6270 M2 + NEM	HP 10 × 460c G7 + FlexCurve	IBM 10 × IBM HS22 + BNT
1.	Hardware Purchase	$141,083	$131,212	$109,873
2.	Server OS Purchase	$0	$0	$0
3.	OS Management Purchase	$0	$0	$0
4.	Server Virtualization Purchase	$0	$114,480	$114,480
5.	Virtualization Management Purchase	Included	Additional	Additional
6.	HW Support Only	$0	$26,289	$17,165
7.	Server OS Support	$0	$161,180	$161,180
8.	OS Management Support	$0	$2,880	$2,880
9.	Server Virtualization Support	$0	$34,960	$34,960
10.	Oracle Premier Support	$84,650	$0	$0
11.	Virtualization Management Support	Included	Additional	Additional
12.	Power and Cooling Costs	$26,983	$26,983	$26,983
3.	Floor Space Costs	$11,040	$11,040	$11,040
Total		**$263,756**	**$498,017**	**$480,429**
Percentage Oracle's TCO is lower			**47%**	**45%**

Conclusions

For enterprise companies looking for the greatest value from their IT assets, total cost of ownership (TCO) is a vital consideration when planning x86 environments for the data center. Oracle has focused intensively on TCO as it applies to the entire x86 infrastructure stack, designing the major hardware and software components with optimizing performance, management, and TCO from the start. Because servers, operating systems, and virtualization software are created at Oracle by their own engineers, they are designed, tested, certified, packaged, deployed, upgraded, managed, and supported together.

Oracle's architectural vision is to deliver a complete stack of information technology from application to disk. Their fundamental concept is that engineering the separate components to work together delivers a better overall system in terms of reliability, performance, management, and security by engineering the entire infrastructure with service and support in mind. Oracle can deliver lower TCO in the design and operation of its system, in the ease of deployment enabled by VM Templates and Validated Configurations (eliminating costs for installation and configuration, reducing time to operation, and maintenance costs). In addition, the efficiency and effectiveness of its award-winning Premier Support package minimizes costly downtime. Customers have a single point of accountability and assistance for the entire IT stack which, in and of itself, can serve to dramatically lower TCO.