



WHITE PAPER

The Solaris™ 10 Advantage: Understanding the Real Cost of Ownership of Red Hat® Enterprise Linux®

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**A CRIMSON CONSULTING GROUP
BUSINESS WHITE PAPER**

This study was sponsored by Sun Microsystems but was designed and executed by Crimson Consulting Group as an independent, analytical evaluation with research participants screened to include comparable experience with deployments of both Solaris and Red Hat Enterprise Linux.

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EXECUTIVE SUMMARY

CIOs facing a decision on IT environment changes or upgrades are often presented with media accounts and various reports touting the cost of ownership benefits of the Linux operating system as compared to other Unix operating systems and Windows. In fact, a number of studies were published between 2001 and 2005 that cited evidence of cost advantages when comparing Linux to commercial, license-based alternatives running on carefully selected hardware platforms.

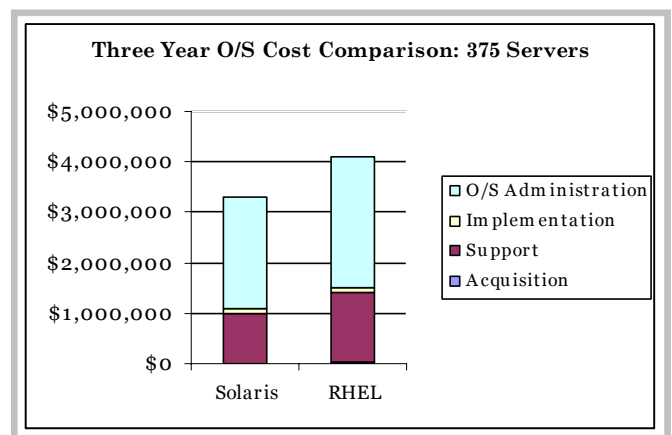
However, CIOs should be aware that innovation by other operating system providers such as Sun Microsystems, has created new cost of ownership dynamics. With the introduction of Solaris™ 10 in 2005, Sun embraced open source to deliver an operating system that offers a very compelling cost of ownership when compared to Red Hat® Enterprise Linux®.

In order to evaluate the impact of changing cost of ownership factors and provide an updated look at what CIOs can expect today, Crimson Consulting Group conducted detailed primary research with a dozen enterprise level companies representing over twenty unique and significant deployments of Solaris and Red Hat Enterprise Linux (RHEL). This study uncovered differences in the deployments and the implications for management and administration of the operating systems. The Crimson approach is unique in that the emphasis is on areas where there are substantive differences from a long-term cost of ownership perspective.

For example, Solaris 10 runs on a broad spectrum of hardware including both SPARC and x86/x64 platforms, which offers a broad spectrum of price/performance choices. Crimson chose to limit its cost analysis to the x86 platform type since both Solaris and Red Hat Enterprise Linux run on the same x86 systems. Therefore, it obviates the need to include hardware in a cost comparison model.

In analyzing a common deployment scenario based on primary research, Crimson identified differences in the following key areas of deployment cost:

- **Solaris has Lower Acquisition Costs:** Both Solaris and Red Hat Enterprise Linux are free, but Crimson research shows that Solaris has lower acquisition costs because it includes features, as part of the OS, that research participants were likely to purchase separately for use in a Linux environment.
- **Solaris Support is Cost-Effective:** Solaris provides a more affordable subscription-based support offering and presents cost savings, particularly when scaling to mission-critical production environments.
- **Implementation Costs are Equal:** Crimson research showed that Red Hat Enterprise Linux and Solaris are equal in terms of OS implementation cost.
- **Administration Costs are Lower for Solaris:** The primary research showed that there are several key areas of OS administration time and cost savings for Solaris as compared to Red Hat Enterprise Linux. The analysis also showed that as environments grow, the cost savings over Red Hat Enterprise Linux, increase exponentially and not in a linear fashion.



“What they say about Linux being cheaper is not true.”

Unix Architect/Crimson Study Participant running both Solaris and Red Hat Enterprise Linux

INTRODUCTION

Based in part on initial perceptions of Linux being free and available to run on inexpensive hardware, the Linux movement has experienced substantial growth in terms of community, customers, and inevitably, commercialization. Red Hat, which accounted for an estimated two thirds of Linux server shipments last year, is the leader in the commercial Linux world. Red Hat Enterprise Linux customers, now with the benefit of substantive deployment experience, are realizing a truer picture of the cost of ownership of running Linux in the enterprise. In many cases, the low cost perceptions do not match reality, particularly as it relates to evaluating the long-term cost of managing larger, production-level systems.

The market reality is that innovation by other operating system providers has shifted the dynamics of long-term cost of ownership. With the introduction of Solaris 10 in 2005, Sun embraced open source and delivers an operating system that offers a very compelling cost of ownership when compared to Red Hat Enterprise Linux. Further, Sun has built upon the advantages based on several decades of operational experience and corresponding innovations that have been proven in demanding data center environments.

CRIMSON'S APPROACH TO COST OF OWNERSHIP

Too often, IT purchases center on the initial acquisition cost of the hardware or software solution without fully contemplating long-term cost implications. For a more accurate picture of cost of ownership, Crimson employs a framework that evaluates costs related to business applications and systems over the lifecycle of the application. For this study, Crimson focused on evaluating operating system choice and how upfront decisions can impact cost over the long term.

Crimson's practical analysis seeks to highlight the major areas of cost, focusing in particular on those areas where there are substantive differences between operating system choices. Based on Crimson's past experience evaluating cost of ownership, the largest factor is typically the labor cost to manage and maintain production systems over time.

It is also important to note that the intent of Crimson's economic analysis is to help companies today evaluate the cost of ownership for both current deployments and deployments going forward. Looking back at past purchases, particularly for hardware and related support costs, provides little insight for a company contemplating an investment today. To that end, in the acquisition and support cost categories, the economic evaluation is based on currently available offerings rather than on past purchases.

The major categories of cost included in the Crimson research and analysis are as follows in Table 1.

Table 1: Description of Cost Categories Included in Research and Analysis

Category	Description
Initial Acquisition Costs	Both Solaris and Red Hat are "free" to use, so this cost category included quantifying the costs of any additional software required on each platform to provide the requisite, comparable functionality.
Implementation Costs	This includes the cost of initial installation and configuration of the operating system software.
Support Costs	These costs include annual subscription support contracts for the operating system software plus maintenance fees for any additional software required.
OS Administration Costs	This includes the ongoing cost (primarily labor) to manage, maintain, and monitor servers and respond to incidents generated by unplanned downtime. Specific labor costs included in this category include: problem analysis, security incident response, and patch management.
Performance-Related Costs*	This category includes costs directly attributable to the performance of the applications, particularly the cost of hardware added to the configuration and the systems administration costs that go along with managing additional hardware.

* While Crimson investigated performance-related costs during the study and interview process, the data gathered was anecdotal and qualitative in nature and was subsequently not included in the economic analysis.

Research Methodology

Crimson's research included structured, detailed interviews with system administrators at twelve large corporations spanning a broad spectrum of industries and representing twenty unique deployments of Solaris and Red Hat Enterprise Linux. Industry representation included: education, financial services, industrial supply, manufacturing, media & entertainment, retail, and telecommunications. The interviewees, primarily Unix/Linux system administrators, were screened and selected based on their operational experience with **both** the Solaris and Red Hat Linux operating systems, with nearly all of the participants having both deployed in their data center environments. An additional criterion for participation was that all deployments must support mission-critical applications.

The interviewees were posed a detailed set of questions covering both quantitative metrics and qualitative, experiential information. These questions were structured along the lines of the implementation lifecycle as outlined in the previous section and included:

- Detailed metrics regarding size of deployment, staffing, and operating system function
- Quantitative information related to acquisition, support, implementation and administration
- Qualitative information regarding the deployment and use of Solaris and Red Hat Enterprise Linux operating systems

In addition, the study also includes aggregated information from secondary research.

Defining a Typical Deployment

By averaging the data from the study participants, Crimson created a profile of a typical deployment to use for the cost analysis. Table 2 illustrates the high level inputs utilized in the cost analysis.

Table 2: Average Deployment Information for Cost Analysis

Server Deployment Information				
# of Servers	375	% of servers with > 2 sockets	% of servers virtualized	
% of Servers Mission Critical	30%	113	40%	0%
Non-mission Critical servers		262	30%	30%
General Environment Growth Rate (YOY)	10%			
Analysis Horizon	3 years			

- Average size of deployment was 375 servers, with a range from 25 to 1,000 servers
- Average company size was 29,950 employees, with a range from 4,500 to 81,900 employees
- Industry representation included education, financial services, industrial supply, manufacturing, media & entertainment, retail, and telecommunications
- Server workloads across participants included packaged and Web application servers

COST ANALYSIS RESULTS

Based on Crimson primary research as well as publicly-available data, the following analysis summarizes the quantitative and qualitative information for Solaris-based environments versus Red Hat Enterprise Linux-based environments. The goal of the economic analysis is to demonstrate cost expectations for a deployment based on the current acquisition and support costs at the time of deployment combined with an expectation of labor-related costs based on past, real world deployment history. For acquisition costs specifically, the economic analysis includes costs for additional third-party software based on the functionality required by the study participants.

INITIAL ACQUISITION COST

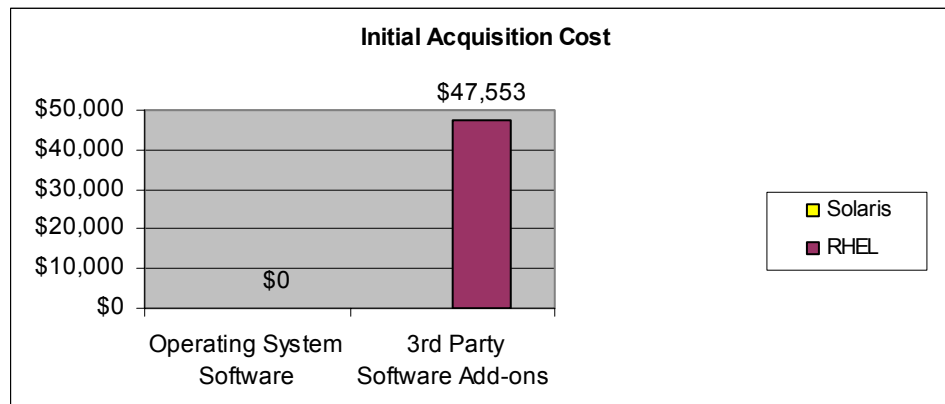


Figure 1: Initial Acquisition Cost

As illustrated in Figure 1, while the initial acquisition costs for the operating systems are effectively zero for both Solaris and Red Hat Enterprise Linux, the study data found additional software license costs typically associated with a Linux deployment. It should also be noted that while Solaris is licensed free of charge, RHEL users must pay for support in order to obtain a license. Solaris 10 is available for free to end users. Sun also makes available for free Solaris Express Developer Edition, which is based on the next release of Solaris under development via the open source OpenSolaris project.

While the usage of additional third-party software varied in the Red Hat Enterprise Linux environment (for example, some banking industry customers cited additional security software), Crimson found the usage of virtualization software to be consistent across research participants. Many of the survey participants cited use of VMware® for their Red Hat Enterprise Linux environments, whereas in most cases they took advantage of Solaris Containers in the Solaris environment. It should be noted that a few of the study participants did use VMware to provide virtualization capabilities for both Linux and Solaris environments because it was a company standard. In evaluating IT investments, organizations should obviously factor in corporate standards as well as the functionality provided natively in the operating system being evaluated.

Regarding hardware costs, Crimson explicitly did not include hardware in the cost model since the “go forward” emphasis of this analysis is based on running both operating systems on x86/x64 hardware. That being said, there is certainly potential for cost savings in a Solaris environment because of the inherent advantages of Solaris 10 running on both x86/x64 platforms

and Sun's SPARC-based hardware. These savings can be particularly significant in heavy transaction environments and where companies are seeking to consolidate servers and services.

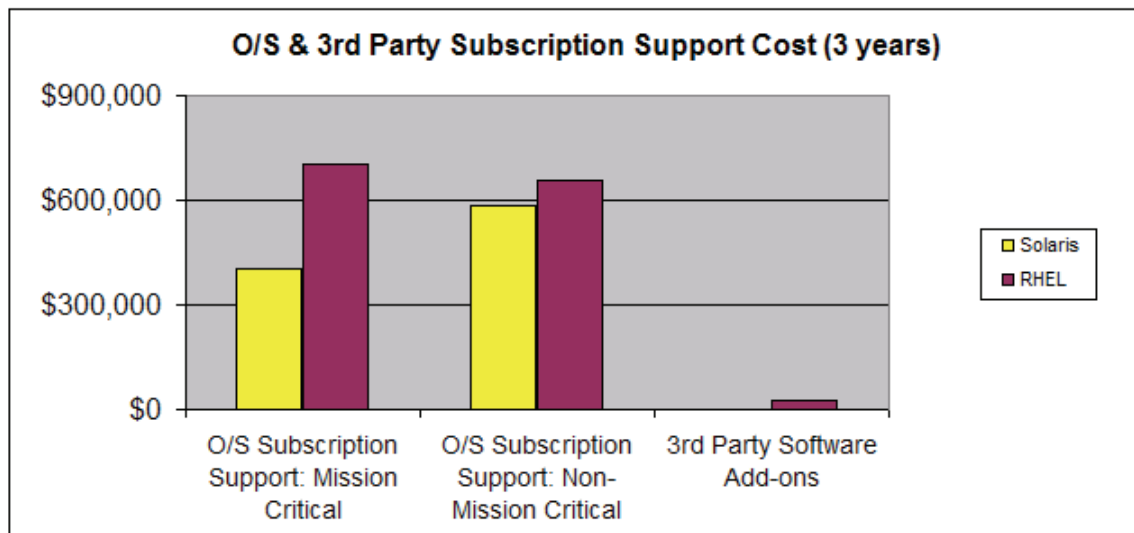
Table 3: Quantitative Comparison (Acquisition)

Solaris Environment	Red Hat Enterprise Linux Environment
There is no license fee for Solaris; it is available for download without restriction.	There is no license fee for Red Hat Enterprise Linux, however there is a requirement to pay the subscription support fee prior to acquiring the software.
Solaris 10 provides native features and support for virtualization, file management, and network adapters.	Based on Crimson's survey, in many cases additional software was required in the Red Hat Enterprise Linux environment including: ▪ VMware software to support virtualization ▪ Veritas Volume Manager to provide "ZFS-like" functionality ▪ Software for FibreChannel support The one consistent purchase required across study participants was for VMware.

"Linux used to be cheaper but the cost advantage is not there anymore."

Unix technical lead and study participant from a major communications and information technology company

OPERATING SYSTEM & THIRD-PARTY SUBSCRIPTION SUPPORT COST



Support Costs	Solaris	RHEL	Difference
O/S Subscription Support: Mission Critical	\$403,952	\$701,026	42%
O/S Subscription Support: Non-Mission Critical	\$585,374	\$656,269	11%
3rd Party Software Add-ons	\$0	\$26,017	
Total Support Costs	\$989,326	\$1,383,311	28%
Support Cost/Server/Year	\$879	\$1,230	

Figure 2: Operating System & Third-Party Subscription Support Cost

As illustrated in Figure 2, based on current subscription support list price information readily available online, Sun provides a more cost-effective subscription support offering, particularly compared to the Red Hat Enterprise Linux Advanced Platform offering which is used mostly for mission-critical servers. For the average deployment scenario in this analysis, Sun provides a 27% savings as compared to Red Hat Enterprise Linux. Note: The Crimson economic analysis factors in a 25% discount on support subscription costs offered by either Sun, Red Hat, or other support providers. Obviously, discounts offered tend to vary widely across industries, customers, and dollar value of the potential sales situation.

Table 4: Quantitative Comparison (Subscription Support)

Solaris	Red Hat Enterprise Linux
Solaris 10 provides the following subscription support plans (List price): Solaris 10 Basic Support: \$324 per year Standard Support: \$720 per year Premium Support (up to 2 sockets): \$1,080 per year (unlimited sockets): \$1,980 per year	Red Hat Enterprise Linux offers the following subscription support plans (List price): Red Hat Enterprise Linux Red Hat Enterprise Linux (up to 2 sockets) Basic Support: \$349 per year Standard Support: \$799 per year Premium Support: \$1,299 per year Red Hat Enterprise Linux AP (unlimited sockets) Standard Support: \$1,499 per year Premium Support: \$2,499 per year

Qualitative Information

The overall feedback from the majority of participants in Crimson's primary research was that Sun provided higher quality, more responsive support than Red Hat. Survey respondents did comment on the availability of good support for Red Hat Enterprise Linux within the open source community, but this often increased the time it took to resolve technical issues. Additionally, Crimson survey participants indicated that open source community support was not good for mission-critical environments where downtime costs are measured in minutes or seconds.

While not analyzed specifically as part of this study, downtime is a major concern with costs estimated by industry analysts to be anywhere between thousands to hundreds of thousands of dollars per hour depending on the application and the industry. For companies relying entirely on technology, such as online brokerages or e-commerce sites, downtime is an even greater concern.

Furthermore, some of the interviewees were unable to take advantage of open source support due to legal considerations, e.g. a potential lack of indemnification against intellectual property challenges to Linux.

Other survey respondents cited the dearth of support personnel for Red Hat compared to Sun, and a lack of true mission-critical support, with systems administrators noting half day or longer waits for support compared to less than two hours with Sun.

"Solaris is better tested and more stable than Red Hat."

Information security specialist and study participant at a financial services company

IMPLEMENTATION COSTS

Based on Crimson research data, the basic installation and configuration of servers for each operating system required roughly the same amount of effort, which ranged from several hours to 1.5 days. The mean server implementation time was roughly one day per server for both environments, with little to no difference in terms of the level of effort with both vendors' software.

Additionally, both Solaris and Red Hat Enterprise Linux users mentioned that with best practices they can reduce the amount of time it takes to get a server up and running to just a few hours. It is important to note that our research and analysis did not explicitly address the configuration of virtualized servers or services. As a result, assuming internal staff does the installation, implementation costs are the same. These costs are fairly insignificant when considered in the context of a three year cost analysis, representing only about 3% of the total cost.

Table 5: Quantitative Comparison (Implementation)

Solaris	Red Hat Linux
Solaris includes the Jumpstart capability for deploying servers, with an average implementation time of one day per server.	RHEL includes Kickstart capability, with an average implementation time of one day per server

OPERATING SYSTEM ADMINISTRATION COSTS

Crimson probed participants with detailed questions related to the ongoing administration and operation of production systems. The findings show that key features in Solaris 10 resulted in a substantial time savings as compared to the Red Hat Enterprise Linux environment.

Crimson analyzed administrative costs on two levels:

- a **macro-level** perspective where Crimson studied the number of servers that could be managed by administrators in each respective environment, and
- a **micro-level** perspective where specific administrative functions with anticipated quantitative or qualitative differences between the Solaris and Red Hat Enterprise Linux environment were evaluated.

Macro Analysis

First, Crimson gauged the administrative and operational costs at an aggregate level, stemming from detailed questions related specifically to the number of servers operating system administrators were able to manage across deployments. One key metric where Crimson sought increased visibility was the number of servers that can be managed and administered by an individual administrator. It's Crimson's belief that although both Solaris and Red Hat Enterprise Linux can support a wide variety of environments, the impact on savings in administration costs is greater with Solaris as the number of servers grows. Across all of the environments that were larger than 100 servers, (the average across all of the deployments was 375), Crimson found that the average number of servers managed by a single administrator was 51.

This is a valuable benchmark as to the order of magnitude of operating system administrative costs. When looking at the average deployment as it relates to the Crimson cost analysis, the number of FTE (full-time employee) administrators based on the 375 server environment is 7.4. This yields an annual administration cost of roughly \$670,000 per year (# of FTEs x average burdened annual salary). As a result, this represents the largest cost line item when analyzing cost over the long term and subsequently where there can be the largest differences.

Micro Analysis

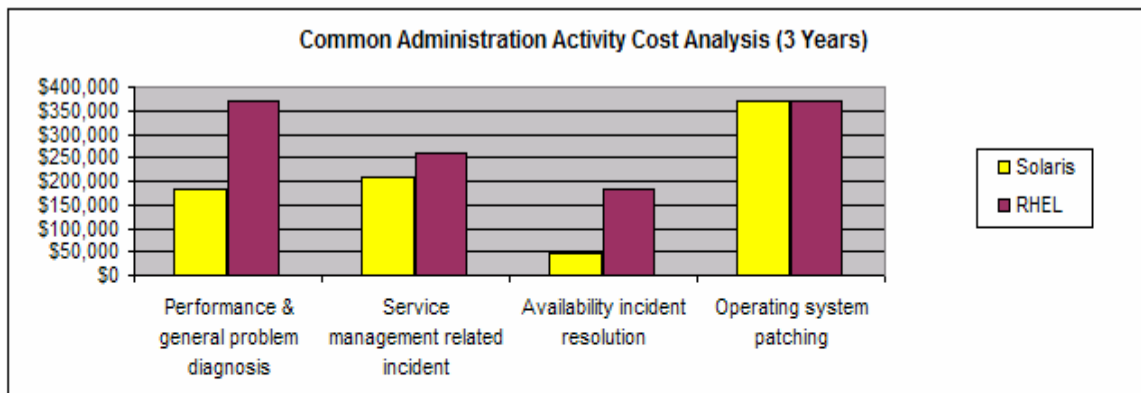
The micro-level analysis addressed common administrator functions and analyzed in detail the differences in terms of administrator time for both environments. For many of these functions, participants cited substantial time savings due to the mature feature set of the Solaris environment along with the general stability of the Solaris operating system in a production environment.

The following four administrative activity areas were analyzed during the study:

- Performance and general problem diagnostics – This includes responding to general server problems and diagnosing the cause of poor server performance. The economic analysis includes capturing the number of occurrences and duration to resolve the performance issues.
- Service management-related incidents – This includes responding to incidents related to services running on the respective servers and resolving issues specifically related to services.

- Availability incident diagnostics and resolution – Crimson evaluated server failure and the costs in terms of duration and resources associated with diagnosing and resolving availability related issues.
- Operating system patching – Crimson evaluated the frequency of patches as well as the duration and resources it takes to apply ongoing patches to both Solaris as well as Red Hat Enterprise Linux.

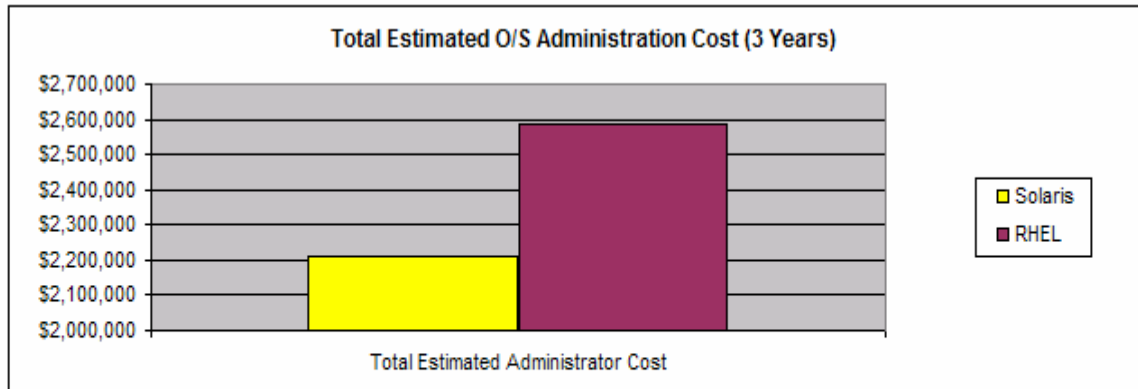
These differences are illustrated in Figure 3.



► Common Administration Activity Cost	Solaris	RHEL	Difference
Performance & general problem diagnosis	\$184,951	\$369,901	
Service management related incident	\$208,070	\$260,087	
Availability incident resolution	\$46,238	\$184,951	
Operating system patching	\$369,901	\$369,901	
Total Administration Activity Cost	\$809,159	\$1,184,841	32%

Figure 3: Common Administration Activity Cost

By combining these two analytical measurements, Crimson achieved a more accurate picture of what the cost differentials might be for Solaris and Red Hat Enterprise Linux in larger production deployment environments, as illustrated in Figure 4.



► O/S Administration Costs (Macro View)	Solaris	RHEL	Difference
Total Estimated Administrator Cost	\$2,211,043	\$2,586,724	
Total Administration Costs	\$2,211,043	\$2,586,724	15%
Admin Cost/Server/Year	\$1,965	\$2,299	

Figure 4: Aggregate Administration Cost

Crimson research indicated that specific features within Solaris 10 significantly contributed to increased effectiveness as well as savings for diagnosis and resolution of performance and availability issues. These features include, but are not limited to: ZFS, Containers/Zones, DTrace, and Predictive Self Healing.

- ZFS – Crimson research demonstrated that some customers are finding that this feature, bundled with Solaris, often eliminates the need for the Veritas Volume Manager on Sun Solaris. Red Hat Enterprise Linux does not have this built-in facility.
- Zones/Containers – The Crimson study indicated that using a new feature of Containers in Solaris 10 allows Sun customers to deploy more applications on a single server. As a result, customers are able to consolidate their servers and reduce their total hardware and software costs, as well as ongoing administration and operations costs.
- DTrace – Crimson research showed that customers save on costs to diagnose performance-related issues with servers by utilizing the DTrace feature within Solaris 10.
- Predictive Self Healing – Crimson research showed that customers save on costs related to server availability based on the automated monitoring and recovery capabilities based on the predictive self healing technology which includes Solaris Service Manager (SMF) and Solaris Fault Manager.
- SMF – With SMF, system administrators noted savings based on the ability to manage both the services provided by the system and the system itself.

Table 6: Quantitative Comparison (Administration)

Solaris	Red Hat Enterprise Linux
From an aggregate level, study data across all of the deployments showed the ability for system administrators to manage 36 servers in the Solaris-based environment. Interview respondents noted the following savings related to the functions and supporting tools: ▪ Diagnosing performance problems with DTrace resulted in an average of 50% time/effort savings per incident as compared to RHEL. ▪ Time savings via Predictive Self Healing (Fault Manager) resulted in a 75% time/effort savings per incident as compared to RHEL. ▪ Managing/diagnosing service-related issues with SMF yielded a 20% time/effort savings per incident as compared to RHEL. ▪ Applying Patches: Although applying patches was not a trivial process in the Solaris environment, the time it took was relatively comparable to RHEL according to Crimson survey participants.	From an aggregate level, study data across all of the deployments showed the ability for system administrators to manage 23 servers in the Red Hat Enterprise Linux-based environment. ▪ Applying patches in some cases resulted in more time savings in the Red Hat Enterprise Linux environment.

The qualitative feedback based on Crimson's primary research was that Solaris was generally more stable and provided effective tools for diagnosing and resolving problems.

"With Linux, there are a lot of software dependencies, for example, a particular version of the installed software depends on a particular version of the kernel. As a result, our operations costs are higher with Linux."

Unix architect/Crimson study participant at a major retailer

OTHER FACTORS IMPACTING LONG-TERM COST OF OWNERSHIP

There are additional, compelling qualitative factors that may ultimately have an impact on long-term cost of ownership:

- The Red Hat product lifecycle could present some downstream cost challenges, forcing companies to upgrade or lose support for their applications. According to industry estimates, nearly half of Red Hat Enterprise Linux deployments are running on Version 3, which entered the maintenance phase of support in July 2007. Red Hat plans to end full support for Red Hat Enterprise Linux Version 4 after May 15, 2008.
- On the other hand, Solaris offers guaranteed binary compatibility between different releases of its operating systems. While binary compatibility does not automatically result in certification by ISVs, it was a consideration mentioned by many of the survey participants, particularly with regard to custom in-house applications.
- Several of the interviewees noted Solaris is better integrated with Java and thus makes the transition for Java applications from one release of Solaris to another seamless.
- The complexity that comes with a rapidly growing Red Hat Enterprise Linux-based deployment has implications in terms of the agility and adaptability of the business.

INTERVIEW PARTICIPANT PROFILE: AN ONLINE RETAILER

An Internal Cost of Ownership Trial

This multi-billion dollar, multi-channel specialty retailer relies on its substantial online presence as well as retail stores throughout the U.S. to help it maintain its ranking as the world's largest direct marketer. The company is a Unix shop, running Solaris on 200 servers, as well as HP-UX and IBM AIX on additional servers. About two years ago, a Linux proponent within the company convinced management that Red Hat Enterprise Linux could deliver the enterprise capabilities the company needed at a lower cost of ownership than Unix. After deploying Red Hat Enterprise Linux in a limited production capacity, the company soon realized that reality didn't match expectations.

For instance, for a high profile proof-of-concept, eight sales and marketing applications were selected to be migrated from Solaris to Linux. These applications, the majority of which support the online store, were all written in Java in-house and represented some of the most mission-critical systems this company runs. Despite pulling out all of the stops to make the proof-of-concept work, the company had to hurriedly migrate seven of the eight applications back to Solaris because of performance problems. According to the architect participating in the proof-of-concept, "Linux simply could not provide the performance required to support 50,000 - 70,000 transactions per minute. One application even crashed the system. It did not crash Solaris, AIX, or HP-UX."

In addition to performance requirements, the retailer must also ensure compliance with the PCI (payment card industry) Data Security Standard. Any applications that process credit card transactions must be running in compliant environments. This means that the retailer must be compliant with patches from the OS vendor or the auditor won't certify PCI compliance. Yet, some applications or packages written for a certain kernel of Linux stop working when a patch is applied or they are written for an older kernel for which there are no longer official patches being created.

Despite two years of testing and using Linux, the retailer hasn't experienced the much-hyped cost of ownership savings. In fact, in many ways, particularly in administration, Linux has proven to be more expensive than Unix. The company shared the following insights with Crimson as part of the study:

Initial Acquisition Costs

Compared to RHEL, the company's acquisition costs for Solaris are lower because no additional OS extensions need be purchased. With Linux, the company needs to purchase third-party software, such as Veritas Volume Manager.

Implementation Costs

Generally speaking, using JumpStart on Solaris, it takes the retailer less than 30 minutes to get a server ready, compared to an hour for Red Hat Enterprise Linux. That said, the retailer did find it depended on the complexity of the configuration, particularly when using installation servers. Using an install server running Solaris, they were able to install 10-20 servers at a time without problem while with the same server hardware-wise, with Red Hat Enterprise Linux only 5-7 servers were able to be installed at a time before it become a problem.

Maintenance Costs

Solaris maintenance costs are one-third the maintenance costs of Linux. With Sun, the combined support for hardware and software is more cost-effective and streamlined. With Linux, companies have to get support for hardware separately.

Administration and Operations Costs

Currently the company has two administrators for 200 servers running Solaris. It has eight administrators managing 15-20 Linux servers. According to the company's Unix Architect, "With Linux, there's a lot of maintenance that needs to be done." For instance, with Java applications, the company notes that it takes weeks to diagnose an availability problem on Linux versus one week on Solaris. "There are a lot of software dependencies with Linux, for example, a particular version of the installed software depends on a particular version of the kernel. This is due to API changes made in the newer kernel version. As a result, our operations costs are higher with Linux."

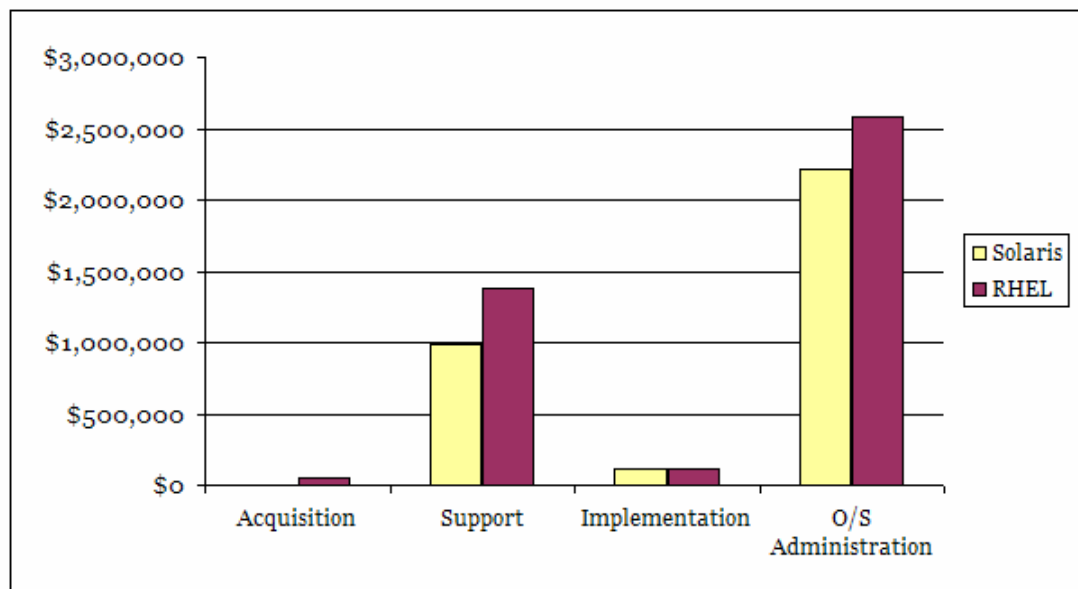
"In my opinion, Linux is just not ready for prime-time."

Unix architect/Crimson study participant at a major retailer

CONCLUSIONS

Long-term cost of ownership is a more accurate metric than acquisition cost in making an operating system decision. CIOs considering Linux should be aware that other Unix operating system providers, such as Sun Microsystems, may offer better long-term cost of ownership as compared to Linux.

From a cost of ownership perspective, this Crimson study demonstrates the advantage of application deployments based on Solaris 10 vis-à-vis Red Hat Enterprise Linux, with an emphasis on subscription support and administrative and operational support costs. Figure 5 illustrates this analysis, which is based on the average customer environment of 375 servers incorporated into the Crimson cost of ownership model.



Cost Category	Solaris 10	RHEL	
Acquisition Costs	\$0	\$47,553	
Subscription Support Costs	\$989,326	\$1,383,311	
O/S Implementation Costs	\$108,323	\$108,323	
Administration Costs	\$2,211,043	\$2,586,724	
Total Cost Over 3 years	\$3,308,691	\$4,125,911	20%

Figure 5: Cost of Ownership by Key Cost Category (over three years)

It is important to note that the cost differentials are not linear as the deployment environment grows, particularly with the introduction of additional percentages of mission critical servers. Based on the analysis and the economic model developed by Crimson, Figure 6 shows the cost of ownership, expressed in terms of per server per year grow with the deployment size.

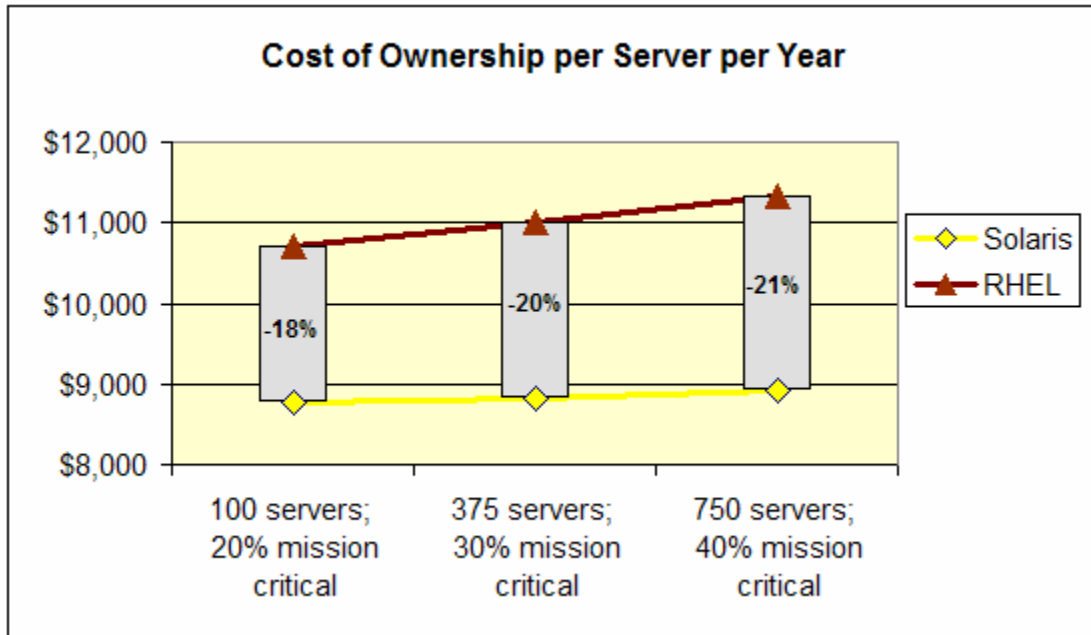


Figure 6: Three Year Cost of Ownership by Deployment size/type

Summarizing the findings of this study, Crimson found that:

- **Solaris has Lower Acquisition Costs:** Solaris 10 is available for free to end users. Crimson research indicated that in many of the Red Hat Enterprise Linux implementations, there were requirements for additional third-party software such as VMware for virtualization and Veritas Volume Manager for file system/storage management. Crimson research showed that significantly more RHEL implementations made use of external software for OS extensions than Solaris.
- **Solaris Support is Cost-Effective:** Sun's subscription support offerings are less costly across the board. Also, study participants identified additional annual maintenance fees for add-on products. In the average scenario based on our research, Solaris deployments result in a 28% cost savings over a three-year period.
- **Implementation Costs are Equal:** While a difference in terms of the initial implementation of the operating system was anticipated, the study results yielded no significant difference in the initial server deployment of Solaris and Red Hat Enterprise Linux. Both vendors offer tools and methods to install and deploy servers in an average of one day.
- **Administration Costs are Lower for Solaris:** Sun demonstrated a very considerable advantage compared to Red Hat Enterprise Linux in the macro-level metric of overall number of servers managed per administrator, which is supported in part by the micro-level analysis in the key areas of performance problem diagnosis, service management, and response to availability issues. For server patching, there was no significant difference between the two vendor solutions.

The assertion that Linux offers a lower total cost of ownership compared with other Unix operating systems such as Solaris is no longer an accurate assumption. In fact, depending on the number of servers deployed, this study shows that Solaris can offer a significantly lower long-term cost of ownership than Red Hat Enterprise Linux.

ABOUT CRIMSON CONSULTING

We help executives achieve market leadership.

Crimson is a leading provider of consulting services to the high technology industry. Our clients include Adobe, BEA, Cisco, HP, IBM, Intel, Microsoft, Oracle, Seagate, SAP, Sprint, Sun and Symantec.

Our clients gain significant value from our contributions in the following areas:

- Strategy Development
- Research Analysis
- Marketing Implementation

Unlike other firms, we combine consulting best practices with specialized knowledge from a database of experts. This combination results in deeper strategic insights and more pragmatic recommendations, delivering greater value than our competitors.

For more information, contact:

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APPENDIX: AN INTERACTIVE COST OF OWNERSHIP MODEL

(Requires Flash plug-in installed & enabled to view)

The model on the following page is intended for illustrative purposes only. Information in the model is provided without warranty of any kind from Crimson Consulting Group, as there may be factors that cause actual results to differ from information based on Crimson research and presented in this model.

