White Paper

Total Cost of Ownership for Intel® Itanium® 2-Based Systems:

A Case Study Based on Reuters' Experience

Reuters, the leading global provider of news, financial information and technology solutions to the world's media, financial institutions, businesses and individuals, recently undertook an initiative to determine the optimal platform upon which to run a new generic trading engine currently in development, known as a "structured negotiation capability" and referred to here as SNC. SNC is not product available for customers to purchase, but rather a core internal capability being developed by Reuters as part of their ongoing efforts to build and deploy richly functional, scalable and highly reusable capabilities across their infrastructure and product line. This strategy promises to improve their operational efficiencies and increase competitive advantages by bringing new products to market faster and lowering the overall cost structure.

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The system tests performed by Reuters compared a popular RISC-based architecture against an open standards architecture based on the Intel® Itanium® 2 processor. The comparison and performance testing indicated that when key factors of Total Cost of Ownership (TCO) were examined, the Intel® Itanium® 2-based platform demonstrated significant advantages in performance, overall cost and service requirements during the lifecycle of the equipment.

Executive Summary

According to the Standish Group, enterprises collectively spend over one trillion dollars per year on information technology (IT). As competitive pressures mount, companies seeking to increase the value of their IT investments have begun moving beyond straight-line comparisons of hardware costs to a more realistic examination of the full range of costs associated with operating a server. Analyses reveal that the factors that influence the costs of operation are frequently much more complex than hardware cost alone, consisting of a combination of tangible and intangible factors, all of which contribute to the total cost of ownership (TCO). TCO comparisons provide a real-world gauge to more accurately determine anticipated expenses associated with specific server platforms.

TCO studies typically focus on those factors that represent ongoing expenses during the life cycle of the server platform. For example, the cost of support and maintenance of a given platform represents a cradle-to-grave expense that can exceed the cost of the hardware by several times. Other factors that bear careful examination when assessing the TCO for a server platform include operating costs, expenses associated with upgrading firmware, application software costs, network hardware expenses and scalability costs. Cumulatively, these factors indicate that the actual hardware costs represent only a small part of the expense incurred by an organization following their selection of a server platform. By recognizing and addressing all the costs associated with a server purchase, IT budgets can be more effectively managed and considerable savings realized in a number of areas.

The comparison presented in this white paper stems from a series of evaluations conducted by Reuters to determine the most cost-effective platform for operating the SNC application. Using a flexible XML model, applications can be built atop SNC can be rapidly designed and deployed, and potentially support asset classes from foreign exchange

to energy instruments. Applying the principles of TCO evaluation, Reuters narrowed their focus to systems in the mid-range enterprise server category. To delineate the differences between platforms, this paper compares a leading RISC-based system and the Hewlett-Packard server rx5670, based on an architecture powered by the Intel® Itanium® 2 processor.

This white paper examines the various TCO factors involved and looks at the conclusions that Reuters reached in selecting the most suitable platform for the SNC system while lowering the TCO significantly. The Appendices provide the actual comparison costs, performance benchmarks, service expenses and other relevant data used in making this TCO evaluation. The overall results indicated that in this case, an Intel® Itanium® 2-based solution can deliver four (4) times the performance using one-half (1/2) as many processors at a cost of one-third (1/3) of a current RISC-based system that serves the same market segment. The cost savings for the higher-performing HP rx5670 system were $125,590 for the system itself and more than $6000 for typical support costs over a three-year span as compared to the RISC-based system. Refer to the Appendices for additional details of the test environment and a summary of the results.

The test results also illustrate that a well-designed 4-way server based on the Intel Itanium 2 system, such as the rx5670, can outperform an 8-way server such as the RISC-based system used in the comparison. The fact that multiple operating systems can be operated on the Intel® Itanium® 2 platforms adds to the considerable power and flexibility of any solution based on this architecture. The Intel® Itanium® 2-based platform uses Explicitly Parallel Instruction Computing (EPIC) technology, which was designed for highly efficient parallelism providing the ability to process multiple instructions or processes simultaneously for faster computation and improved application performance, especially with very large datasets. 64-bit EPIC architecture also allows the addressing of memory beyond the 4-Gigabyte limitation of the current 32-bit processors, introduces a powerful new instruction set and provides numerous new architectural features that enable the potential for very high speed computations with massive amounts of data. For details, visit: http://developer.intel.com/software/products/itc/architec/itanium/arch_mod/index.htm. With the Intel® Itanium® processor family, performance is dependent both on hardware characteristics, such as CPU clock speed plus bus and memory bandwidth, and on the ability of software to take advantage of the advanced architectural features of the underlying platform, such as speculation, predication, software pipelining and memory management.

The architecture of the Intel® Itanium® 2 processor, with EPIC, proved well-suited to the demands of delivering high performance while performing enterprise-caliber database transactions for Reuters. As demonstrated in this paper, the combination of Microsoft Windows Advanced Server operating system and SQL Server 2000 64-bit relational database provided a good match for the Intel® Architecture and EPIC capabilities.

Incorporating TCO considerations into evaluations of competing systems provides companies with a reliable means of assessing comparative costs in a number of areas, leading to potential savings when provisioning and supporting their IT infrastructure.

Overview of TCO Factors

Total cost of ownership for an enterprise application server includes cost factors that both directly and indirectly affect the bottom line. A realistic assessment of the actual expenses involved in purchasing, deploying, maintaining and upgrading the hardware and software required for a server platform should encompass these factors:

- Purchase price of the hardware
- Maintenance and service contract costs
- Network infrastructure costs
- Fixed operating costs
- Deployment costs, including database conversions and application migration
- Integration expenses to existing systems
- Ongoing operating costs, as affected by reliability, availability, serviceability and manageability of the platform

Refer to the section titled Evaluating TCO Factors for a more detailed examination of these expenses in relation to typical server architectures.

Case Study: Reuters SNC

This section of the paper examines the course of action that Reuters pursued to select a viable platform for a newly introduced slate of services. Subhra Bose, Senior Architect of the CTO Innovation Lab within Reuters, described the organization in these terms, "We have a wide variety of products in the information and trading sites of the world with approximately 600,000 professionals using different Reuters products. We also have about 17,000 employees."

Reuters' involvement in the trading markets of the world led to an initiative to develop a framework for supporting rapidly deployable applications for SNC. As Bose explained, "SNC is a generic backend framework intended for building trade negotiation applications. When we say trade negotiation applications, it can imply a lot of markets. For example, it includes foreign exchange trading, fixed income loans and energy markets-all of these different types of financial markets where negotiation between two or more traders is an integral element of the trading practice."

TCO Advantages in Implementing Structured Negotiations

As it has grown, Reuters has amassed a suite of products supporting a range of financial marketplaces over the years. Seeing an opportunity to create efficiencies while improving product quality, decision-makers within the organization sought to create a platform that could consolidate the functionality of these disparate systems into one designed to accommodate many different kinds of trading. Bose explained, "We have had an organic explosion of the number of systems within the company. Just over the last couple of years or so, while we were taking stock of the different systems, we began planning the new systems we needed to build because of the explosion of markets. We figured it would make sense to build a single, scalable, reliable, robust infrastructure with the latest and greatest technology. The goal was to be able to use this new system for doing all trade negotiations, rather than recreating the functionality again and again in each marketplace. Structured negotiations arose out of a need for an improved business perspective."

During the planning stage of this initiative, Reuters started out using platforms based on a RISC-based architecture and Intel® Xeon™ processor-based architectures. As the plans matured, and comparisons of the TCO factors began revealing the advantage inherent in specific system architectures, Reuters began incorporating Intel® Itanium® 2 processors into the framework of the SNC product. "We looked to the Intel® Itanium® [-based] platform," Bose said, "to get better scalability and performance."

The Web-based structured negotiations capability software is designed to be broadly adaptable to many different forms of trading. "In one sense, the application is structured negotiations; in another, it is a platform for building any-type trade negotiations over the Internet," Bose said, "To characterize it, structured negotiations is trade-data agnostic-it can perform negotiations with SGML documents or financial data types. We can use it with XML, either based on standard or custom data payloads for commodities and energy. We could even create our own XML framework for baseball card trading! The platform is fully generic. Structured negotiations provide you with the basics of trading, conducting negotiations between two or more counter parties."

Developing an Open Standards Framework on Intel® Architecture

The flexibility of XML makes it possible to produce a structure that can be modified with minimal effort to fit the requirements of different types of trading, relying on the appropriate industry business rules to guide the process. "The key for structured negotiations," Bose said, is being able to provide trade-negotiation business rules that correspond with the business process. Declaratively, as opposed to something that is embedded or hard-coded, as is the case in traditional systems. Let's say you want to build a system in the bond market. To change from one set of trading practices to another, you don't have to build, recompile and/or redeploy the entire system. I can just change the declarative specification, which is in an XML document, to change process description from one market to another. This fundamental feature lets me cater to any market. I can deploy structured negotiations once and reuse it for many markets."

From the perspective of Reuters, basing the infrastructure design for structured negotiations on Web services gives them considerable agility in launching new products tailored to diverse markets. As Bose explained, "First, you can create new products for new markets with less effort. Second, we had built the backend infrastructure as a Web Service available to different organizations. That is the business advantage in Web services. You can leverage your infrastructure and make money by selling it as Web services."

To clarify the point, Bose explained that if a financial institution wanted to create a trading system for a particular commodity, that company could build the system on top of the structured negotiations Web service. Even though the service would be offered through Reuters, it would be a fully branded company-specific trading system. Anyone using the service would have the impression that it is a service offered by that particular enterprise, rather than Reuters. In this manner, the infrastructure itself becomes a revenue channel for the company and the basis for any number of unique, customized product offerings. The exceptional scalability of an Intel® Itanium® 2-based system and EPIC technology coupled with the extended memory addressability for handling the very large databases in-memory proved an optimal framework for developing this infrastructure. Cost-versus-performance ratios were also an important consideration.

Launching specialized services of this type can be a very expensive proposition, which is all the more reason to investigate the TCO factors over the life cycle of the product. As Bose explained, "Using SNC's Web services infrastructure, we believe we can create new trading systems at one-fifth or less the cost compared to a traditional model, from a development perspective. That's not even including savings associated with deployment, production, rollout and other post-development processes."

Web services, through a reliance on modular software components working together effectively, deliver a number of benefits using open standards Internet communication protocols. Enterprise applications developed using Web services can deliver exceptional interoperability and seamless integration with existing software infrastructures, reduced time to market, simplified deployment and maintenance, as well as streamlining of business processes.

Improved Manageability through an Intel-Based Platform

During the final portion of the platform evaluation period, Reuters ran two systems side by side: an Intel® Itanium® 2-based HP rx5670 server and a comparable 8-way RISC-based system. Bose found the differences in manageability striking. "On a qualitative side, we encountered many problems working with the RISC-based system compared to the HP rx5670 based on Intel® Itanium® [micro]architecture. The difference was remarkable. We literally spent hours and hours getting the RISC-based server to work and more hours of installation and configuration time. One problem was that we needed very specialized skilled personnel in order to install and configure the RISC-based system. You need to pay a lot for that level of experience. In spite of that, it took many hours to get the system based on RISC architecture working."

"With the HP rx5670 server, an Intel® Itanium® 2-based system with Microsoft* components," Bose continued, "we installed the operating system, reconfigured the machine, installed the software, redeployed the box from one location to another location a number of times. We had no serious problems at all-it was very easy."

Deployment, initial configuration and installation represent significant factors that directly affect the TCO value, both in the time invested in implementing an enterprise application to the specialized service costs to configure the system. These factors are discussed in detail in the section titled Tangible Costs of Ownership.

Intel® Itanium® 2 Processor Memory Space Speeds Up High-Volume Transactions

The types of transactions involved in trade negotiation systems are well-suited to the Intel® Architecture platform, and Reuters has been able to also capitalize on the advantages of the larger memory space afforded by the Intel® Itanium® 2 processor.

"The time criticality of any transactions in a trading system is vital," Bose said. "Time criticality as well as the durability of the data. Going to the disk, fetching the trades, performing some operation on the data and then storing the data back to the disk takes a lot of time. We can improve that significantly if we can get all the trades-live trades, to be precise-in memory. Each of these trades is an XML document ranging from 1KB to 10KB. If I were to keep one million trades in memory, I need more than 10GB memory. That is one key rationale why I was looking for Intel® Itanium® architecture for improving performance. We found that caching the live trades in memory, we get five to ten times performance benefits, depending on the type of transaction. That is a really significant benefit for us."

The streamlined development times associated with Web services also contribute substantially to reducing the time to market for large-scale applications. Applications can be deployed, launched and tested on a limited access Web server, and once they have been approved for release, installed on a target Web server for customer and business access. These reduced development times provide one more benefit worth consideration when making TCO comparisons.

Comparison Summary

The primary servers considered in this TCO study are generally characterized as mid-range servers, suitable for data center applications, using symmetrical multi-processing (SMP) ranging from a 4-way Intel® Itanium® 2-based HP rx5670 server with to an 8-way RISC-based system architecture.

The equipment configurations and associated prices for the hardware tested for this study are based on values calculated on 11 October 2002. At that time, prices were as follows:

Server	Price as Tested
HP rx5670 server with 4-1 GHz Intel® Itanium® 2 processors. Configuration includes: 16GB RAM, 36GB hard drive, DVD-ROM, Graphics/USB card, mouse, keyboard, integrated network interface card, Microsoft Windows Advanced Server, Limited Edition, v1.2 license.	$90,205
RISC-based server CPU/MEM Board Bundle with four-way 900MHz processors. Configuration includes: 4 licenses, 4 x 1GB RAM, 4 x 8MB Ecache.	$101,000
Field Rack for RISC-based system Base package with 8-processor 900MHz processor. Configuration includes: 4 licenses, four-way CPU/Memory board, 4 x 1GB memory, 2 x PCI controllers, 1 system controller, 2 power supplies, 3 fan trays, 10/100Base-TX Ethernet controller, system cabinet.	$114,195
Expansion Kit for Expansion Cabinet, for use with system components	$600
Total RISC-based System Components:	$215,795

The Appendices provide additional details on this comparison. Based on the extensive testing performed by Reuters, the HP rx5670, operating with one-half the number of processors, had four times the performance of the RISC-based system, running comparable database operations at about one-third of the cost.

Financial Transaction Performance
Reuters Structured Negotiation Capability

Intel® Itanium® System compared to RISC-based System

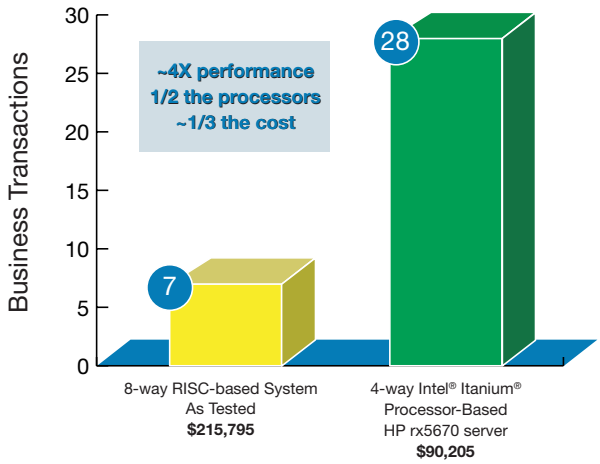

Figure 1. Financial Transaction Performance Comparison

Evaluating TCO Factors

Determining the total cost of ownership for an enterprise-capable server involves calculating both the tangible and intangible costs of ownership. Tangible costs translate easily into hard figures, such as the:

- purchase price of a server
- cost of a service contract to maintain the system
- network equipment required to support intranet or Internet access
- fixed operating costs, which factor in elements such as power consumption of the hardware, cooling requirements of the system and facility requirements including rack mounts, space required for the system and so on

In most cases, the tangible costs can be directly determined, based on invoices or estimates. The following section titled Tangible Costs of Ownership discusses these factors in more detail.

Intangible factors in any TCO evaluation impact the bottom line in a variety of ways, but by their nature they are more difficult to measure. Nonetheless, organizations can effectively address many of the intangible costs when evaluating comparable platforms, and by doing so they can contribute to long-term savings. Intangible factors include:

- conversion costs for database and application migration to a new platform
- risk mitigation costs to minimize service disruptions during platform deployments
- integration costs in connecting a platform with legacy systems and existing company infrastructure
- operation costs associated with the reliability, availability, serviceability and manageability of the server platform

These and other related factors are discussed in the section titled Intangible Costs of Ownership.

Tangible Costs of Ownership

Tangible costs of ownership provide the most accessible basis for comparing server platforms prior to launching a new initiative or deploying enterprise applications. As can be easily demonstrated, however, the purchase price alone serves as only an approximate starting point to what the overall TCO value will be. Only after both the tangible and intangible costs are evaluated can the full cost structure and long-term value be effectively analyzed.

Purchase Price of Server Equipment

Evaluating different server platforms can often be a difficult exercise. Non-standard features can affect the price, as well as the cost of essential external components required to carry out key tasks, including network interface components, hard disk storage, system memory and so on. At the heart of any evaluation of this type, the cost versus the performance ratio is a key consideration. Only by comparing systems of roughly equivalent performance can the actual value of the hardware components be accurately assessed. Inexpensive systems that lack adequate performance to handle mission-critical tasks clearly don't represent genuine value to an organization. High-end systems that are inordinately expensive also fare poorly in a TCO evaluation. Cost and performance cannot be separated in a rigorous TCO evaluation.

The two systems represented in Reuters Case Study were evaluated both for the price of the initial server configuration, as well as the performance when applied to performing the business transactions that would constitute the basis for the Reuters' structured negotiations capability application. In this instance, the cost versus performance results heavily favored the platform based on the Intel® Itanium® 2 processor, which cost approximately one-third as much as the RISC-based system, while delivering four times the performance.

Service and Support Costs

Service and support costs can be examined in a number of different ways. For example, depending on the complexity of the installation, support costs can vary widely. The cost of daily ongoing operations, usually covered in a service agreement, represent an aspect of the support costs that can be directly calculated and compared. Some system implementations have higher built-in costs than others. For example, systems that require supporting applications and upgrades be installed directly on client workstations typically have relatively higher support costs than Web-based systems. Systems that rely on Web services and browser-based interfaces can manage upgrades through simple changes on the application server. The cost of documentation for a system, both the installation expense and the ongoing operation, is one more tangible cost.

In general, systems based on open standards and widely available components fare better when considering service and support issues. Proprietary systems using specialized hardware and software typically require service skills that are more expensive in the open marketplace. Although service and support packages vary from manufacturer to manufacturer, there is a clear advantage for systems based on Intel® Architecture and the Microsoft Windows operating system. The section titled Service Comparison in the Appendix points out the key factors that favor service costs for the Intel®-based HP rx5670 over the leading RISC-based system. Service costs are considerably less expensive for the HP rx5670; for example, a three-year 24x7 service plan for the rx5670 costs $15,644 as compared to $22,212 for the RISC-based system. This is cost of service for only one server in the SNC data center.

Training and Routine Maintenance Costs

Some tangible costs require a bit more research and investigation to calculate accurately. For example, the cost of training personnel to perform routine tasks on a system and the expense associated with updating firmware contributes to the TCO. This is true whether the direct costs factor in the software expense or acquiring the necessary skills required to perform the upgrade. There are also hard costs (such as required licensing fees) associated with the operating system and applications selected to run on the platform. These can account for a sizeable percentage of the total investment. For specialized applications, software costs can sometimes exceed the cost of the hardware. When assessing database cost, some of the same factors that affect hardware cost come into play. During the course of their system comparisons, Reuters performed testing of both 2 recent versions of a leading relational database running on the RISC-based platform and the Microsoft SQL Server* 2000 database running on an Intel® Itanium® 2-based platform. Performance testing results demonstrated consistently faster response times under most conditions for the combination of Intel® Itanium® 2 processing and Microsoft SQL Server 2000 compared to the comparable database running on the RISC-based architecture.

Scalability Costs

Another very critical factor, particularly for enterprises operating in high-growth fields, is the cost of scalability. Systems that are designed to scale up and scale out inexpensively can benefit IT organizations during rapid growth periods, reducing the costs required to adapt to dynamic change. Scaling and clustering represent two different approaches to managing massive increases in transaction volume, and each of these approaches has a different set of costs attached to it. To maximize the bottom line and achieve optimal cost savings, the approach that delivers the appropriate level of price, performance and availability while increasing the load-handling capacity represents the best choice.

Other hardware costs to consider include the cost of integrating a server platform with an existing infrastructure and the overall interoperability cost. While this is not addressed in this study, it is an important factor to consider. Seamless integration with existing legacy systems is often an essential requirement in IT environments, since many organizations have a substantial investment in these systems and wholesale replacement is not immediately feasible. Those system architectures that demonstrate benefits and advantages in ease-of-integration can generate substantial cost savings. Interoperability also factors heavily in environments where, out of necessity, a complex mix of hardware and software platforms must be universally supported.

The testing performed by Reuters in their evaluation showed exceptional scalability for both the Intel® Itanium® and the Itanium® 2-based platforms, both supporting a higher level of business transaction workloads with lower response times than the RISC-based system. The HP rx5760 also includes the capability of scaling to 48GB of memory, providing exceptional handling of the very large memory spaces.

Intangible Costs of Ownership

Intangible costs also have a very real impact on the bottom line, but by their nature they are often more difficult to calculate and factor into a comparison. For this reason, they are sometimes referred to as "soft costs." The more effectively an organization deals with the range of intangible costs associated with a server platform, the more likely it is that extended cost savings and efficiency can be realized during the life of the server platform.

Conversion Costs

The actual costs associated with conversion depend on the level of consistency required with the earlier data and application functionality framework. Another key element of the initial conversion is the deployment cost, including the cost of putting the new platform into service, and training associated with providing personnel with new skills.

In addition, more tools may be required to complete the installation, perform setup operations and initiate backup and restore procedures. These costs, as well as the maintenance costs related to the upgrade and acquiring skilled personnel to assist in the conversion, factor significantly into the total cost equation.

Risk Mitigation Costs

Launching a new server platform is not a trivial exercise and the process of moving a substantial part of a business operation from one platform to another entails a certain degree of risk. The selection of a solution that lowers risk factors is a sound strategic measure and a means of moderating any potential infrastructure disruptions that may arise.

Investments that are tied to a sole vendor represent an identifiable risk. Solutions that favor multiple sourcing lessen the risk, providing a clear alternative path in the event that a primary vendor drops product support, fails to deliver on agreements or unduly raises the costs associated with product upgrades or maintenance.

Another measure of investment protection is the ease by which an existing system can be upgraded to the latest generation technology. The HP rx5670, for example, uses a design by which a new processor can be swapped with the earlier processor. This type of investment protection can factor heavily into extending the lifespan of equipment and help to lower the TCO

Integration costs can be significant when dealing with hardware and software components that are not designed for maximum interoperability. By selecting a standard solution designed for multi-operation system setup, unanticipated expenses can be avoided. A solution that has been tested and deployed under a wide range of conditions and situations can help minimize implementation difficulties.

The time-to-market (TTM) costs correlate directly to the degree of difficulty and the time involved in bringing a new platform to full serviceability. Open architectures tend to reduce TTM costs due to the ready availability of components to support the infrastructure and the prevalence of skilled practitioners to configure and deploy the components. Proprietary architectures are generally characterized by limited options and reduced availability of specialists trained to configure and deploy systems, leading to a less-competitive set of market choices at greater expense.

Operation Costs

Over the life cycle of an enterprise server platform, certain factors will have a prolonged impact on the intangible costs associated with that platform, but the combined effect of these operation costs can be considerable. The overall usability of a system affects everyone who makes use of the resources and accesses data residing on that system, but the direct financial costs aren't generally amenable to straight-line calculations.

Four other key factors speak to the overall utility of a system, factors that can influence operational costs in a number of different ways. These factors are sometimes referred to using the acronym RASM:

- Reliability
- Availability
- Serviceability
- Manageability

Organizations operating businesses where downtime will negatively impact profits consider RASM as an essential component of a viable application platform. In environments where a few minutes of downtime can cost an organization tens of thousands or hundreds of thousands of dollars, properly implemented RASM can mean the difference between a thriving business operation and failure.

Conclusion

By performing total cost of ownership comparisons, enterprises can factor real-world considerations and overall operating experiences into assessing the full range of expenses involved in launching a business product on a server platform. TCO costs include both tangible and intangible costs, and often the intangible costs can contribute significantly to the total expense of operating a platform.

Support costs represent a much higher percentage of the total expenses associated with a system than is often assumed. Under some circumstances, support costs over the life cycle of a server platform can exceed the original hardware cost by a factor of four or five times.

In a wide range of head-to-head comparisons, Intel® Architecture platforms based on the Intel® Itanium® 2 processor demonstrate exceptional TCO values, providing performance, reliability and manageability in a cost-effective package. These results are achieved while providing an exceptional price/performance ratio, a key factor in any TCO comparison.

Appendices

The following appendices cover the primary factors measured during the TCO comparison. Factors covered include:

- Performance comparison
- Service comparison
- Database comparison
- Independent tests and benchmark results

Performance Comparison

The following material describes the performance comparisons for the SNC software developed by Reuters. The experiments conducted by Reuters were designed to benchmark the most crucial areas of functionality. Reuters tested the performance of SNC using different database platforms, and application servers. Microsoft SQL Server was run on the Intel® Itanium® and Itanium® 2-based systems, while a leading relational database was run on the RISC-based system. During these experiments, Reuters tested the performance of the SNC application on three different Intel® Architecture platforms: Intel® Xeon™ processor MP, Intel® Itanium® processor and Intel® Itanium® 2 processor.

SNC provides the basis for forms-based negotiation, and several trade negotiation products being developed by Reuters use this framework. The core component of SNC is a COM+ server application that exposes a set of APIs to client applications. The two most frequently used attributes of SNC are the Initiate and Negotiate functions. The Initiate function begins a new trade negotiation process. Initiating involves in-memory processing, inserting a new negotiation instance into the database, and finally writing to a durable queue. The Negotiate function performs transitions according to the business logic during the negotiation process. Negotiating involves retrieving the negotiation instance from in-memory cache or the database, followed by in-memory processing, then an insert/update operation and finally write to a durable queue.

Performance Test Methodology

Reuters designed a test program that simulated multiple trade negotiation processes. Each process calls the SNC core component to perform transactions during the execution. During this experiment, the test team measured the average response time of the Initiate and Negotiate functions. Shorter response time indicates better system availability, leading to better overall performance.

When implementing the experiment, Reuters compiled SNC into both 32- and 64-bit executables using Microsoft Visual C++* 6.0 with Service Pack 5 and Microsoft SDK build 3590, respectively. Evaluations addressed SNC performance and scalability on both the Intel® Itanium® and Intel® Itanium® 2-based architectures as well as Intel® Xeon™ processor architecture. SNC can be configured to use either Microsoft SQL Server or other relational databases as the database server. SNC processes large numbers of XML documents during execution, and for this reason it requires a database server with good XML support. The performance of the database impacts the overall performance and scalability of SNC.

Performance Test Results

The response time while running SNC on the Intel® Itanium® 2-based platform using SQL Server is approximately two (2) times as fast (better) as running SNC on an Intel® Itanium®-based platform as expected and four (4) times faster than running SNC on the RISC-based system and database.

Reuters' test results demonstrate that the SNC application services performance while running on an Intel Xeon processor MP was on average better than the RISC-based system. Since the application demanded larger memory and all the other features that Intel Itanium 2 microarchitecture offers, Reuters' choice was Intel Itanium 2-based systems.

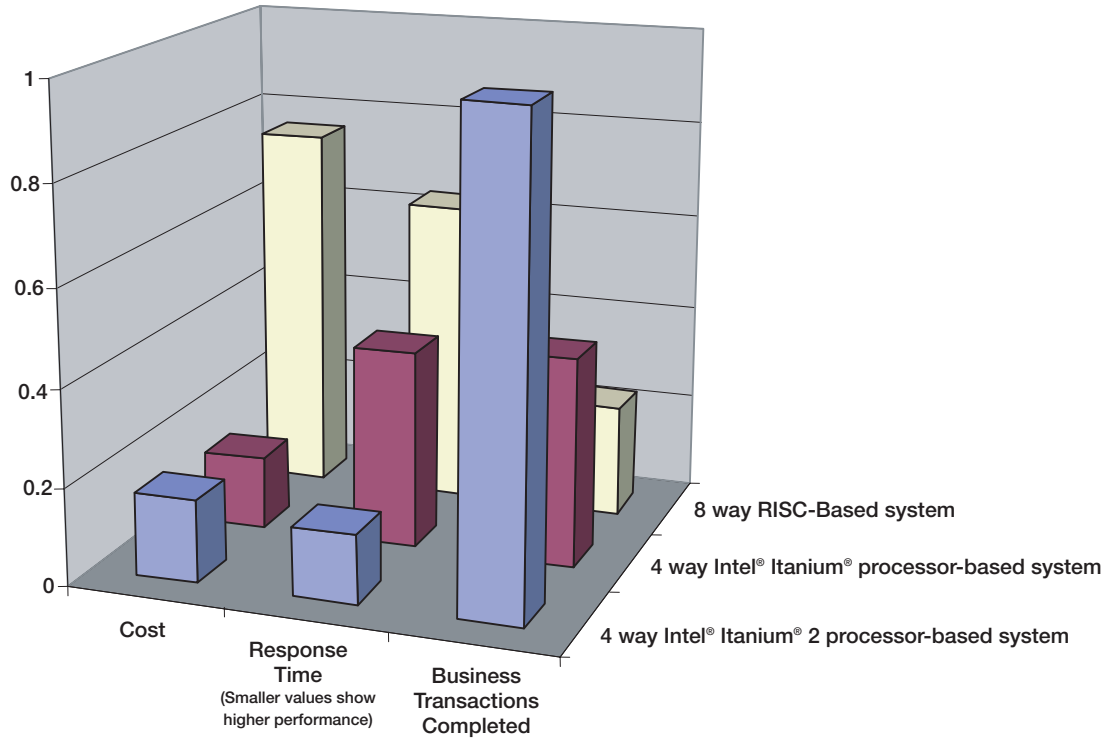

Figure 2. Comparison of Cost, Performance and Scalability

Service Comparison

Service practices and fees typically vary from company to company, making it difficult to equitably assess the relative value of services in a system-to-system comparison. One method that helps quantify service costs is to examine the service descriptions to determine what is included for a particular product. Often complimentary free services are included, which can add greatly to the value of the overall service offering.

The next section looks at service offerings, including costs, for the HP rx5670 and the leading RISC-based system.

Database Comparison

The following material describes the database platform comparison for the SNC software. The experiments conducted by Reuters were designed to benchmark databases handling the Initiate and Negotiate operations. The Initiate function focuses on initiating the trade negotiation process. The Negotiate function performs transitions according to the business logic during the negotiation process. Microsoft SQL Server was running on the Intel® Itanium® and Intel® Itanium® 2-based systems, while the 2 most recent versions of another leading relational database were running on a RISC-based system under UNIX.

Support Level: 3 years of 24x7

Server Name	HP rx5670*, 4 CPUs, Intel® Itanium® 2, 1 GHz, Windows	HP rx5670*, 4 CPUs, Intel® Itanium® 2, 900 MHz, Windows	HP rx4610*, 4 CPUs, Intel® Itanium®, 733 MHz, Windows	RISC System, 8 CPUs, 900 MHz, UNIX OS
Warranty coverage that is included as part of the server price	3 Year, 8x5 Next Day Onsite	3 Year, 8x5 Next Day Onsite	3 Year, 8x5 Next Day Onsite	1 Year, 8x5 Same Day Onsite
HW Support Warranty Upgrade– 3 years, 24x7 Same Day Onsite	$9,344	$9,344	$5,895	*See Note1*
SW Support Operating System– 3 years, 24x7, Unlimited	$6,300	$6,300	$6,300	*See Note1*
Total Cost of Support –3 years	**$15,644**	**$15,644**	**$12,195**	**$22,212** – *See Note 2, upgrade service coverage*

Notes:

1) To upgrade the standard warranty for the RISC-based system to a higher level, the monthly upgrade charge is calculated, then multiplied by the number of months the support is to last, then discounted by 40% when all 3 years are paid for at the time of initial purchase. Hardware and software support pricing is not separated, as is the case when purchasing HP support. In this case the upgrade is to the highest level.

2) This RISC-based manufacturer does not break-out HW and SW support in their warranty upgrade packages. The total amount shown is for both.

Support Level: 3 years of 8x5 Same Day

Server Name	HP rx5670*, 4 CPUs, Intel® Itanium® 2, 1 GHz, Windows	HP rx5670*, 4 CPUs, Intel® Itanium® 2, 900 MHz, Windows	HP rx4610*, 4 CPUs, Intel® Itanium®, 733 MHz, Windows	RISC System, 8 CPUs, 900 MHz, UNIX OS
Warranty coverage that is included as part of the server price	3 Year, 8x5 Next Day Onsite	3 Year, 8x5 Next Day Onsite	3 Year, 8x5 Next Day Onsite	1 Year, 8x5 Same Day Onsite
HW Support Warranty Upgrade– 3 years, 8x5 Same Day Onsite	$4,162	$4,162	$4,395	*See Note1*
SW Support Operating System– 3 years, 8x5, Unlimited	$4,800	$4,800	$4,800	*See Note1*
Total Cost of Support –3 years	**$8,962**	**$8,962**	**$9,195**	**$15,624** – *See Note 2, upgrade to higher service level*

Notes:

1) To upgrade the standard warranty for the RISC-based system to a higher level, the monthly upgrade charge is calculated, then multiplied by the number of months the support is to last, then discounted by 40% when all 3 years are paid for at the time of initial purchase. Hardware and software support pricing is not separated, as is the case when purchasing HP support. In this case the upgrade is to the highest level.

2) The RISC-based system manufacturer does not break-out HW and SW support in their warranty upgrade packages. The total amount above is for both.

Database Test Methodology

As described in the previous Performance Comparison section, the test methodology involves performing a comparison of SNC using different database servers. SNC processes a large amount of XML data during execution, and thus requires a database server that has good XML support. The performance of the selected database has great impact on the overall performance and scalability of SNC.

Hardware Profiles:

In this experiment, Reuters used a 32-bit version of SNC deployed on a four-way Intel® Xeon™ processor-based system running at 1.6 GHz, using 4GB RAM as the Application server.

Reuters testing utilized the following database servers:

- Intel® Itanium® 2-based system (1 GB): four Intel® Itanium® 2 processors, 1.0 GHz, 16GB RAM with MSSQL
- Intel® Itanium® 2-based system (900 MHz): four Intel® Itanium® 2 processors, 900 MHz 16GB RAM with MSSQL
- Intel® Itanium® -based system (733 MHz): four-processor Intel® Itanium® processors, 733 MHz, 16GB RAM with MSSQL.
- RISC-based system / relational database: eight-processor configuration, 900 MHz, 8GB RAM with UNIX OS
- RISC-based system / relational database: eight-processor configuration, 900 MHz, 8GB RAM with UNIX OS

On each platform, Reuters experimented with different numbers of concurrent negotiations (threads), ranging from 1 to 32 threads and measured the average response time of the Negotiate and Initiate calls. The test team used the same test methodology on each hardware platform.

Database Test Results

Database performance depends on a variety of factors. The comparison tests demonstrated that the Intel Architecture and Microsoft SQL Server 2000 64-bit solution provided 20 to 45 percent better response time than the RISC-based system. This evaluation also demonstrated similar and dramatic performance differences under very heavy workloads, illustrating that this combination of hardware and software scales effectively to extremely demanding enterprise levels. As Subhra Bose stated, "As we put greater and greater loads into the data center infrastructure, we'll be adding the 64-bit Windows Advanced Server, Limited Edition solution to handle the work. Quite simply, we believe it's the best solution to support our growth."

Independent Tests and Benchmark Results

Many benchmarks on Intel® Itanium® 2-based systems, as well as other performance proof points, clearly reinforce the Reuters' experience as described in this paper. For additional performance details, refer to: **www.hp.com/products1/itanium/performance/commercial/index.html**

For more information about Intel® Itanium® 2 processors and their world-class capability for targeted applications, refer to: **www.intel.com/products/server/processors/server/itanium2/index.htm**

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