Sun Fire V440 Raises Bar for four-way Workgroup Servers with Leading Price/Performance

UNIX Server Pricing and Configuration Monitor

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D.H. Brown Associates, Inc., (DHBA) is a leading research and consulting firm, concentrating on the strategic analysis, assessment and evaluations of technologies, products and market trends in the "Information Industry." DHBA concentrates on thoroughly understanding and continuously updating its knowledge of the core technologies and trends underlying current and future products. An acceleration in technological innovation has driven price/performance by over 30% annually for open systems since 1983. The technological explosion supports unprecedented opportunities for World Class corporations, but demands far greater discipline and attention to detail. DHBA provides its clients with the high level balanced perspective coupled with the technical depth required for tactical and strategic decisions to fully capitalize on existing and emerging technology. Our services enable our clientele to consistently fashion well-informed decisions adapted to their own unique needs. For additional information, please contact Marketing at marketing@dhbrown.com.

About the UNIX Server Pricing and Configuration Monitor

The Server Pricing and Configuration Monitor analyzes pricing trends in the UNIX server market. Comprehensive, up-to-date information on list prices and performance provides a clear picture of the competitive positions of the major vendors. Nine defined performance categories objectively compare configurations across vendor lines and arrive at a three-year cost of acquisition. All configurations specify machine features, performance data, and detailed hardware and software prices. All information is updated within two days of any major announcement, and is available to our subscribers in hardcopy form and through our website, at http://www.dhbrown.com.

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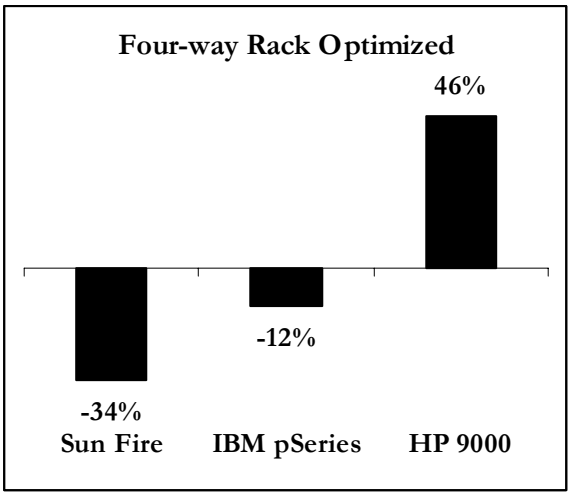
SUMMARY

Sun's recent announcement of the Sun Fire V440 resets customers' price/performance expectations of a four-way capable 64-bit UNIX server. Leveraging the UltraSPARC IIIi chip at up to 1.28 GHz with 1MB on-chip Level 2 (L2) cache and double data rate (DDR) memory interface, the Sun Fire V440 is able to arrive at $9,995 (U.S. List) for a dual CPU entry configuration and deliver leading price/performance.

DHBA Evaluation	
👍	Sun Fire V440 offers leading $/performance (based on TPC-H 100 GB database size results) for a 4-way server
👍	Aggressive entry pricing and competitive feature set positions Sun Fire V440 well against IA-based servers
👍	Sun Fire V440 strengthens Sun's position in the workgroup server market



Sun has achieved its design point for the Sun Fire V440 towards reducing the total cost of acquisition (lowest priced four-way RISC/UNIX server), as well as lower cost of ownership (Solaris 8, Advanced Lights Out Manager and System Configuration Card).

The rack-optimized (4U) Sun Fire V440 is expected to significantly bolster Sun's position in the four-way space by targeting even lower price points than its previous offerings (Sun Fire V480), and bridging the gap between existing dual-processor rack-optimized server products. Sun hopes to build upon the momentum achieved by its Sun Fire V480.

Sun has been widely successful with its price/performance formula to gain market momentum. Its astute choice of features within its servers (e.g., lack of hot-plug PCI support) guided by customer engagements have allowed it to price its systems well below the competition, yet retain the gross margins necessary to maintain a sustainable business. While the Intel-architecture based server OEMs benefit by significant economies of scale allowing them to be extremely price/performance competitive, amongst the UNIX vendors IBM has emerged as the strongest competitor to Sun. This was achieved by its Sun-focused aggressive

pricing (Express Configurations) strategy. In June 2002, IBM announced its own four-way eServer p630 within a week of Sun's Fire V480 announcement and cut prices on its p630 before general availability of the product to undercut Sun. IBM's p630 continues to match the Sun Fire V480 on key system configurations using its Express Configurations (accounting for the bulk of IBM's low-end business). IBM will probably not cut prices even further to match the new price points being offered by Sun for its Sun Fire V440. However, IBM's thrust will be its performance and features (dLPAR [requires additional I/O drawers], dynamic CPU deallocation, hot-plug PCI-X, etc.) capabilities over the Sun Fire V440 with its UltraSPARC IIIi processor. IBM certainly does offer a healthy feature set, however, most of the target market in the SMB requires only a subset of the functionality well served by the Sun Fire V440. Customers looking for a similar feature set from Sun should look at the higher-end midrange servers.

As expected, Sun has done its homework and is presenting performance data on the Transaction Processing Council's (TPC) TPC-H benchmark measuring system performance running complex *ad-hoc* queries. Sun has measured the Sun Fire V440 server on the TPC-H benchmark against a 100 GB database achieving a performance of 2,428.60 QphH (Query per Hour). The price/performance is even more impressive at $28/QphH, lower than any other four-way capable server. The price/performance of the Sun Fire V440 matches that of the best Intel Architecture (IA) based server, HP's ProLiant ML370-G3 configured with dual 3.06 GHz Intel Xeon processors achieving a 1,386 QphH result. HP's result is 43% lower than Sun, strengthening Sun's position as a viable and very cost-effective alternative to the IA-32/Windows solution with lower cost of acquisition (and possibly ownership). Comparatively, the price/performance of the Sun Fire V440 is 26% better than its closest four-way rival, HP's ProLiant DL580-G2 configured with quad 2.8 GHz Xeon MP processors with a slightly higher result of 2,605.6 QphH. The price/performance of the Sun Fire V440 is second only to Sun's own Sun Fire V250 server. Overall, the results are 13.5% higher than Sun's existing four-way, the Sun Fire V480 server, which falls in the same category. The Sun Fire V440 comes in more than 36% lower in price/performance than the Sun Fire V480. Note that the above price/performance differences are only based on the TPC-H benchmark and may not reflect differences seen in other workloads or individual customer environments. D.H. Brown Associates, Inc. (DHBA) encourages customers to ask Sun and indeed the other vendors for more benchmark references and if possible, test the system in their individual environment.

Besides IBM, Fujitsu also maintains a very aggressive pricing strategy and has emerged as a strong Sun alternative in the enterprise accounts, although its familiarity is considerably lower than Sun. Nevertheless, its ability to do multi-vendor maintenance, multiple platform offerings (PRIMERGY), and most importantly, SPARC compatible, Solaris supported PRIMEPOWER servers, makes it a strong competitor to Sun. However, Sun's large installed base in the SMB space combined with strong affinity with ISVs will make it rather difficult for the competition to displace or compete effectively with Sun in this space. Sun's toughest competitors lie on the other side of the fence from the IA-based server camp running Microsoft's Windows operating system.

This report evaluates the product features and performance of the Sun Fire V440 in greater detail and analyzes its strengths and weaknesses compared to its leading competitors in the 64-bit market.

SUN FIRE V440

Sun will gain significant ground on the competition with its Sun Fire V440 launch. While the availability of the UltraSPARC IIIi processor with support for one- to four-way SMP systems disclosed Sun's plans of a four-way server based on this CPU, Sun's target price point was the showstopper for the event. The Sun Fire V440 inherits the philosophy adopted by Sun for all its Volume Systems Products (VSP) of fulfilling the needs of a majority of its customers by a product that exceeds price/performance expectations on all accounts. For the rest of the customers with focus on higher single system availability, partitioning requirements and performance, Sun will continue to offer another product (or products) to meet their needs. While this typically exemplifies cannibalization (some of this is expected), Sun's product positioning with distinct feature sets aims to define new categories for its products and thereby broaden its market reach.

ULTRASPARC IIII PROCESSOR

The UltraSPARC IIIi chip has been available since April 2003, introduced with Sun's launch of the Fire V210 and Fire V240 servers. The UltraSPARC IIIi chip is squarely designed to address the market requirements for one-to-four-way SMP capable systems. Sun has a large cadre of systems from uni-processor to massively scalable 106-way SMP systems, but employing the same chip across the board adds immense expense particularly at the low-end where it is vital to keep the costs lower to maintain competitiveness. Sun has invested in the i-series line of SPARC microprocessors for limited scalability systems. The objective is to reduce the overhead associated with the chip and the additional circuitry needed to support massively scalable systems and achieve a lower cost point through integration of key components. It integrates the L2 cache and memory controller and features the JBus interconnect for CPU-CPU communication.

Table 1: UltraSPARC IIIi vs. UltraSPARC III Processor Comparison

	UltraSPARC IIIi	UltraSPARC III
Clock Frequency	1.0, 1.06, 1.28 GHz*	900, 1050, 1200 MHz
SPECint2000	553.0 @ 1002 MHz	626.0 @ 1.05 GHz
SPECfp2000	841.0 @ 1002 MHz	982.0 @ 1.05 GHz
Fabrication Process	0.13 micron	0.15 micron
Number of Transistors	87.4 million	29 million
Die Size	178.5 mm2	232 mm2
Power Consumption	46 Watts @ 1.06 GHz	65 Watts @ 900 MHz
Multiprocessor Capability	Yes, 1 – 4 SMP	Yes, 1 – 106 SMP
CPU – CPU Interconnect	JBus, 16 byte, operates at 120 – 200 MHz, peak bandwidth of 3.2 GB/sec.	Sun Fireplane, 128 bit, operates at 150 MHz, peak bandwidth of 2.4 GB/sec.
Level 2 Cache	On-chip, 1 MB, 4-way associative, operates at 50% clock frequency	Off-chip, 8 MB, 2-way associative, operates at 1/3rd clock frequency
Memory Controller	On-chip, 16 GB/CPU addresseability	On-chip, 16 GB/CPU addressability
Memory Interface	DDR1 @ 266MHz, peak bandwidth of 4.2 GB/sec.	SDR @ 133MHz, peak bandwidth of 2.4 GB/sec.

* 1.0GHz frequency is supported on Sun Fire V210 and Sun Fire V240 servers; 1.06 GHz and 1.28 GHz are supported on Sun Fire V250 and Sun Fire V440 servers; UltraSPARC IIIi results are for Sun Fire V210; UltraSPARC III results are for Sun Fire V880.

The UltraSPARC IIIi chip includes a large number of transistors due to the integration of the L2 cache. According to Sun, about 63 million transistors on the chip are used for the L2 cache. The advanced 0.13 micron fabrication process allows Sun (Texas Instruments) to pack more transistors in the same footprint and reduce the power consumption to only 46 watts, about 30% lower than Sun's UltraSPARC III chip as shown in the table earlier.

The UltraSPARC IIIi is limited to supporting up to four-way SMP systems. Sun has introduced a new JBus interconnect to replace the Sun Fireplane interconnect required to maintain cache coherency in traditional UltraSPARC III-based systems. The JBus is a 128-bit bus shared between the address and data paths. It operates at up to 200 MHz clock speed depending upon the type of system (maximum frequency supported is 183 MHz in the Sun Fire V440 server through the use of a Bell Repeater chip). The UltraSPARC IIIi chip also features the JIO chip for external I/O connections. There are two JIO chips in the Sun Fire V440 server, supporting six 64-bit PCI slots.

Additional changes in the UltraSPARC IIIi chip relevant to overall system performance include the on-chip 1MB L2 cache operating at 50% of the core clock frequency and faster DD1 memory interface. These enhancements are expected to compensate for the smaller cache compared to the UltraSPARC III CPU. The higher set associativity of the L2 cache on the UltraSPARC IIIi chip is typical of smaller cache designs and is done to increase the hit ratio.

Based on the SPEC CPU2000 benchmark, the UltraSPARC IIIi chip operating at 1.06 GHz offers a SPECint2000 (peak) result of 553 compared to a 626 by a 1.05 GHz UltraSPARC III chip (about 90% slower). Note that SPEC CPU2000 does not account for other factors affecting system performance, most notably memory and I/O bandwidth. Later sections compare application performance of the four-way Sun Fire V440 with the Sun Fire V480 server.

PRODUCT LINE COMPARISON

The Sun Fire V440 fits between Sun's existing dual-CPU capable and quad-CPU capable servers. While the Sun Fire V440 is also a quad-CPU capable system akin to the Sun Fire V480, the packaging with the UltraSPARC IIIi chip and targeted price/performance, makes the Sun Fire V440 attractive to both datacenter accounts and SMBs. It will be positioned in the SMB and enterprise accounts with a large number of transactions such as *ad-hoc* query databases, messaging, application server and file/print environments. The Sun Fire V480 will continue to serve the large data set market typical of ERP or midrange databases with its larger memory and L2 cache support. The following table compares the two systems on a feature and performance basis.

Table 2: Sun four-way Capable Rack-mount Systems Comparison

	Sun Fire V440	Sun Fire V480
Form Factor	4U	5U
Processor	UltraSPARC IIIi	UltraSPARC III Cu
Clock Speed	1.06, 1.28 GHz	1.05 GHz
L2 Cache	1 MB, on-chip	8 MB, off-chip
Maximum Memory	Up to 16 GB	Up to 32 GB
Number of 64-bit PCI Slots	6 PCI, 3x33/66MHz, 3x33MHz	6 PCI, 2x66MHz, 4x33MHz
Maximum Internal Disk (hot-plug)	292 GB (4 bays) Ultra320 SCSI	146 GB (2 bays) FC-AL
External Ports	2 x 10/100/1000Mbps, 1 serial, 1 Ultra320 SCSI, 4 USB, 10Base-T Ethernet, RJ45 serial for ALOM	2 x 10/100/1000Mbps, 1 FC-AL, 2 USB, RJ45 serial
Hot-Plug/ Redundant Power Supplies	Yes / Yes (hot-plug)	Yes / Yes (hot-swap)
Automatic System Recovery	Yes	Yes
Remote Monitoring / Power on/off	Yes (Advanced Lights Out Manager)	Yes (Remote System Control Card)
System Configuration Card	Yes	No
Power Consumption	650 Watts	1440 Watts
Operating System	Solaris 8 (7/03), Solaris 9	Solaris 8 (2/02), Solaris 9
Entry Configuration List Price	**$9,995** (2 CPUs, 4 GB RAM, 4x36 GB Disks)	**$19,995** (2 CPUs, 4 GB RAM, 2x73 GB Disks)

The most noticeable aspect of the Sun Fire V440 compared to its UltraSPARC III counterpart is the 50% lower entry price tag. Despite the 90% slower processor, the price/performance benefit is also in the 50% range (with equivalent disk configuration), yielding a substantially lower cost of acquisition compared to the Sun Fire V480. In addition, the power consumption requirements have dropped down by more than half, lowering power and cooling costs associated with the server.

The other differences include use of standard, widely available and faster DDR1 SDRAM memory and Ultra320 SCSI drives compared to slower SDRAM and expensive Fibre Channel disk drives on the Sun Fire V480. These elements play a significant role in system price especially for larger configurations. The Sun Fire V440 also features more disk bays supporting up to 292 GB of internal disk capacity through four 73 GB disk drives, compared to only two internal drives in the Sun Fire V480.

The Sun Fire V440 features the Advanced Lights Out Manager (ALOM) enabled by the embedded System Controller (SC) for remote management. The ALOM is the next-generation replacement to the existing Remote System Control (RSC) and Lights Out Management cards supported on other Sun Fire and Sun Netra servers. The ALOM support was introduced with the Sun Fire V210 and Fire V240 servers and offers features such as serial and Ethernet connectivity options (CLI), hardware monitoring, and event logging,

among others. Besides ALOM capability, the Sun Fire V440 also includes a System Configuration Card (SCC) that holds system information including ALOM and user configuration data, host ID, Ethernet and MAC addresses for the system to allow quick transition to another system. This saves a considerable amount of time for administrators freed from reconfiguring the new system. This card is unique in the industry.

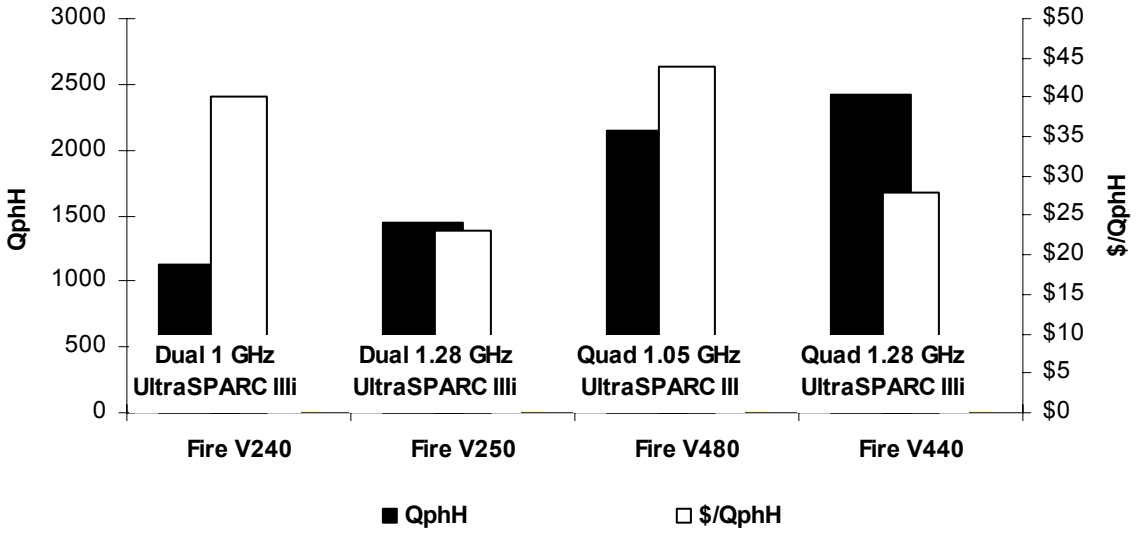
The Sun Fire V440 requires at least the Solaris 8 (7/03) release for proper functioning. It will soon support the latest Solaris 9 operating environment (OE), which includes additional components such as Solaris Resource Manager and Solaris Volume Manager integrated into the base OE functionality. The inclusion of these value-add features reduces the overall acquisition cost associated with procuring the necessary software components for managing the system.

PERFORMANCE

Sun has reported TPC-H benchmark results for the 100 GB database size for the Sun Fire V440 server. Most traditional RISC/UNIX vendors are judicious in their benchmark disclosures for their systems. It is worthwhile for the vendors to only disclose the results for their chosen benchmarks without engaging in an expensive and time-consuming process. However, this limits the ability to compare the system performance (not just CPU level benchmarks like SPEC, which are disclosed by a majority of the vendors) across multiple platforms. Sun has not yet released any SPEC CPU2000 results for the Sun Fire V440 but will likely release some in the coming weeks.

Back in July 1999, Sun was the first vendor to report results and continues its avid support for the TPC-H benchmark. The benchmark measures the performance of a system running *ad-hoc* queries against a set database size. Sun is the only RISC/UNIX vendor to report results for the 100 GB and 300 GB database sizes, with the rest of the vendors from the x86 camp. The following chart shows the TPC-H Queries per Hour (QphH) performance and price/QphH for the dual-CPU Sun Fire V240 and Sun Fire V250 servers, and the quad-CPU Sun Fire V440 and Sun Fire V480 servers.

Chart 1: TPC-H @ 100GB Results for Sun Fire V Series Servers



Notes: All results are from Transaction Processing Council (TPC) and current as of 9/17/03.

The Sun Fire V440 configured with four 1.28 GHz UltraSPARC IIIi processors achieved a result of 2,428.6 QphH at a price of $28/QphH. The result is more than 13% higher than that achieved by the Sun Fire V480 configured with four 1.05 GHz UltraSPARC III processors. The 1.28 GHz UltraSPARC IIIi processor has slightly higher (estimated) performance than the 1.05 GHz UltraSPARC III, so the Sun Fire V440 benefits with the quad horsepower of the faster chip. The results are pivotal to ensure customers that despite the smaller cache, the system continues to achieve strong performance compared to existing Sun Fire alternatives.

The 36% price/performance improvement is also very impressive. Most of the improvement came from a much smaller (273 GB) storage configuration for the Sun Fire V440 compared to the 819 GB used for the Sun Fire V480, saving over $12,000 (including maintenance) for the Sun Fire V440. In addition, the Sun Fire V440 server configuration itself is 65% of the Sun Fire V480 costs (after applying standard discounts) contributing to the bulk of the price/performance improvement.

COMPETITIVE POSITIONING

The Sun Fire V440 has raised the price/performance bar incrementally for four-way RISC/UNIX servers. While the Sun Fire V480 triggered a price war between IBM and Sun, IBM is unlikely to react to the Sun Fire V440 announcement with drastic price cuts on its eServer p630 to match Sun for mainstream configurations. The following sections look deeper into the leading competitive offerings in this space. Note that in the last PCM update with the Sun Fire V480, HP's AlphaServer ES series and SGI's Origin 300 (now replaced by Origin 350) were also included in the comparison. However, the price/performance characteristics of the Sun Fire V440 combined with its target market and customer affinity towards the Solaris (primarily), AIX, and HP-UX operating environments significantly reduces the possibility of direct competition with HP's AlphaServer ES series (raw performance driven system) and SGI's Origin 350 (NUMAflex shared memory multiprocessing design) servers.

Table 3: Leading four-way Rack-optimized UNIX Servers Comparison

	IBM p630-6C4	Sun Fire V440	Sun Fire V480	HP Server rp5405	Fujitsu Primepower 450
Form Factor	4U	4U	5U	8U	4U
Orderable CPUs	1, 2, 4	2, 4	2, 4	2, 4	1, 2, 4
Clock Speed / Processor	1.2, 1.45 GHz / POWER4+	1.06, 1.28 GHz / UltraSPARC IIIi	1.05 GHz / UltraSPARC III Cu	650 MHz PA-8700	1.1 GHz SPARC64 V
L2/L3 Cache	1.5 MB (shared) / 8 MB	1 MB / none	8 MB / none	None / none	1 MB / none
Maximum Memory	32 GB (ECC, Chipkill)	16 GB (ECC)	32 GB (ECC)	16 GB* (ECC)	16 GB (ECC)
Number of standard PCI slots	6 64-bit/133 MHz PCI-X (hot-plug)	3 64-bit/66 MHz; 3 64-bit/33 MHz	2 64-bit/ 66 MHz; 4 64-bit/33 MHz	10 64-bit/66 MHz (8 hot-plug)	2 64-bit/66 MHz; 4 64-bit/33MHz
Maximum Internal Disk	587.2 GB (hot-swap)	292 GB (hot-plug)	146 GB (hot-plug)	584.4 GB (hot-plug)	588.0 GB (hot-swap)
Storage Controller	Dual Channel Ultra3 SCSI	Ultra320 SCSI	FC-AL	Dual Channel Ultra2 SCSI	Ultra320/LVD SCSI
Network Controller	Dual 10/100 Ethernet	Dual 10/100/1000 Ethernet	Dual 10/100/1000 Ethernet	10/100 Ethernet	10/100 Ethernet, 10/100/1000 Ethernet
Remote Management**	Yes (Service Processor)	Yes (Advanced Lights Out Manager)	Yes (Remote System Control)	Yes (Extended fault management system)	Yes (XSCF)
Hot-Plug/ Redundant Power Supplies	Yes / Optional	Yes / Yes	Yes / Yes (hot-swap)	Hot-swap / Yes	Hot-swap / Yes
Hot-Plug/ Redundant Cooling Fans	Yes / Optional	No / No	No / No	Hot-swap / Yes	Hot-swap / Yes
Operating System	AIX 5L V5.1, AIX 5L V5.2, SuSE Linux Enterprise Server 8	Solaris 8 (7/03), Solaris 9	Solaris 8 (2/02), Solaris 9	HP-UX 11.0, HP-UX 11i	Solaris 8, Solaris 9
Standard Hardware Warranty	1 Yr. HW Next Business Day On-Site	3 Yr. HW 2nd Business Day On-Site or CRU	3 Yr. HW 2nd Business Day On-Site or CRU	3 Yr. HW Next Business Day On-Site	3 Yr. HW 2nd Business Day On-Site
Entry Configuration List Price w/UNIX OS	**$15,150** (1 CPU, 4 GB RAM, 2 x 36 GB HDs, CD-ROM)	**$9,995** (2 CPUs, 4 GB RAM, 4 x 36 GB HDs, DVD-ROM)	**$19,995** (2 CPUs, 4 GB RAM, 2 x 73 GB HDs, DVD-ROM)	**$29,026** (2 CPU, 4 GB RAM, 2 x 36 GB 15K HD, DVD)	**$14,046** (1 CPU, 1 GB RAM, 36 GB HD, DVD-ROM)

* Maximum memory capacity varies depending upon type of base configuration. ** Functionality between the offerings listed here varies drastically, detailed comparison of these offerings is beyond the scope of this report. CRU: Customer Replaceable Unit

The Sun Fire V440 fits well in the four-way competitive system comparison. The IBM p630 Model 6C4 with the 1.2 GHz POWER4+ processor is the closest competitor to the Sun server. Fujitsu's PRIMEPOWER 450 with the latest 1.1 GHz SPARC64 V processor follows

closely behind since it is also SPARC compatible and runs Solaris. The HP rp5405 is shown above for comparison purposes (cheapest four-way PA-RISC server) but it takes nearly twice as much rack space as compared to the leading alternatives and runs an old and slower 650 MHz PA-8700 processor.

The maximum memory capacity of the Sun Fire V440 is short compared to the leading alternatives, most notably Sun's own Fire V480 and IBM's p630, but bodes well for its positioning in Sun's product line as well as the competition. The six PCI slots are also within expected range, and while Sun does not support hot-plug PCI support, the majority of the target market in the SMB space is unlikely to take advantage of this capability. This does, however, put Sun at a disadvantage compared to IBM in larger enterprise accounts where hot-plug support for PCI is often a required checklist item irrespective of whether the capability is ever used. Sun does support redundant power supplies and hot-plug disk drives on the Sun Fire V440, both a must have in the space considering the higher failure rates associated with disk drives and faulty power supplies, although a redundant power supply is included with each Sun Fire V440 system.

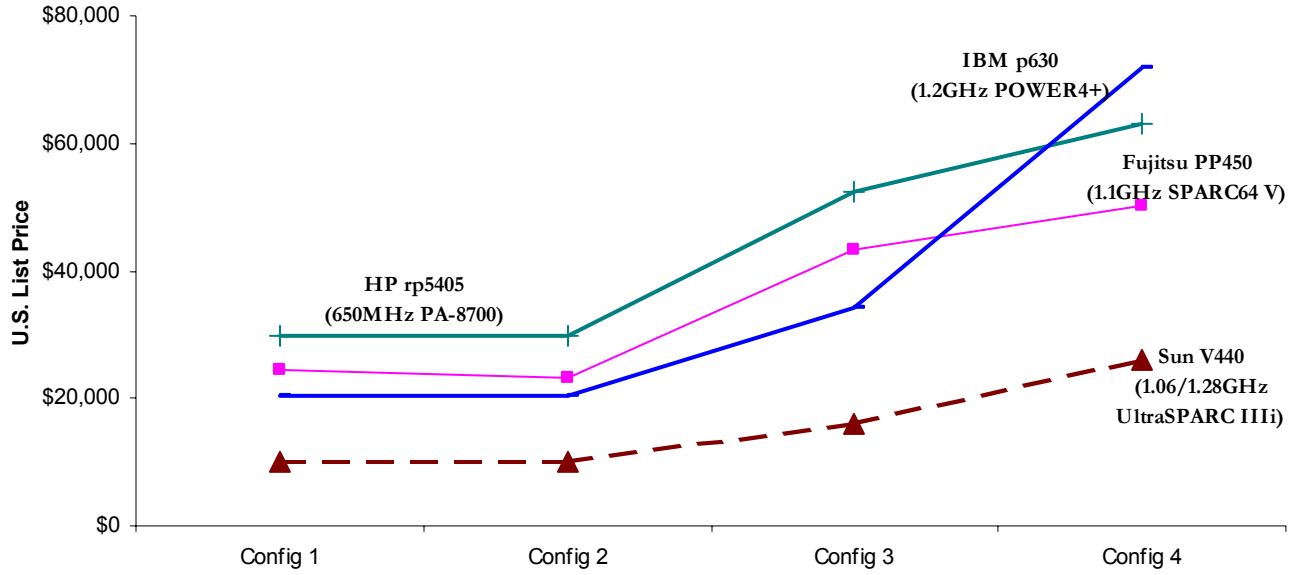
While Sun has not expended considerable energy around RAS beyond basic ECC and parity correction supported across all datapaths (some parity only) and the features discussed earlier, it has spent time improving the system manageability characteristics of the server. The system comes with the ALOM SC hardware and software for complete remote management with enhancements (beyond basic event logging and notification supported in the previous RSC card) supported in older Sun servers. The features found in ALOM are similar to the enhancements done by HP with its Event Monitoring Service for fault monitoring and notification, Fujitsu's Extended System Control Facility (XSCF) and IBM's First Failure Data Capture (FFDC) for thorough troubleshooting. The ALOM capability of the Sun Fire V440 gives administrators the ability to monitor and manage components such as fans, CPU, power, temperature, FRU ID, and LEDs, a feature not supported by the older generation RSC card. However, Sun no longer offers a GUI console interface for remote management with most of the operations to be done in command line interface (CLI). HP, IBM and Fujitsu offer a GUI interface for their remote management software.

The Sun Fire V440 also supports the SCC card that holds configuration data to allow administrators to simply insert the card into the new system to provide all the identity information necessary for that system to function in its environment. This is widely used in smaller rack-optimized systems where the availability rates of servers are much lower than typically seen in four-way rack optimized servers.

The chart below shows list pricing for the leading competitively priced servers, namely IBM's 1.2 GHz POWER4+ based p630, Sun's Fire V440, HP's 650 MHz PA-8700 based rp5405 and Fujitsu's 1.1 GHz SPARC64 V-based PRIMEPOWER450. The rest of the offerings from IBM, Sun and HP, along with Fujitsu are priced higher and compared separately.

Note that customers should take into account the system features (discussed earlier in table 3) and performance (discussed later in this section in table 4) before making their decision. The chart below shows only one aspect of system comparison.

Chart 3: List Price Comparison of Leading UNIX Servers on Select Configurations



The Sun Fire V440 handily beats the rest of the competition on configured list pricing. Its closest competitor (for configurations 1-3), IBM's 1.2 GHz POWER4+ based p630 Model 6C4 is at least twice as expensive. As the chart above shows, with a larger memory configuration, IBM pricing goes up significantly (doubling the price), compared to the marginal increase in price associated with Fujitsu's PRIMPOWER450 and HP's rp5405 since they absorb most of the increase to four CPUs in Configuration 3 itself. Note that Express Configuration bundles are used for the IBM p630 for the first three configurations, while the fourth configuration is set up to meet the specifications. All the other configurations are built off pre-configured systems with memory and disk drive pre-installed.

Configuration Details:

Configuration 1: 2 CPUs, 2 GB RAM, 2 x 36 GB HDs, DVD, operating system, 3 year Hardware Warranty

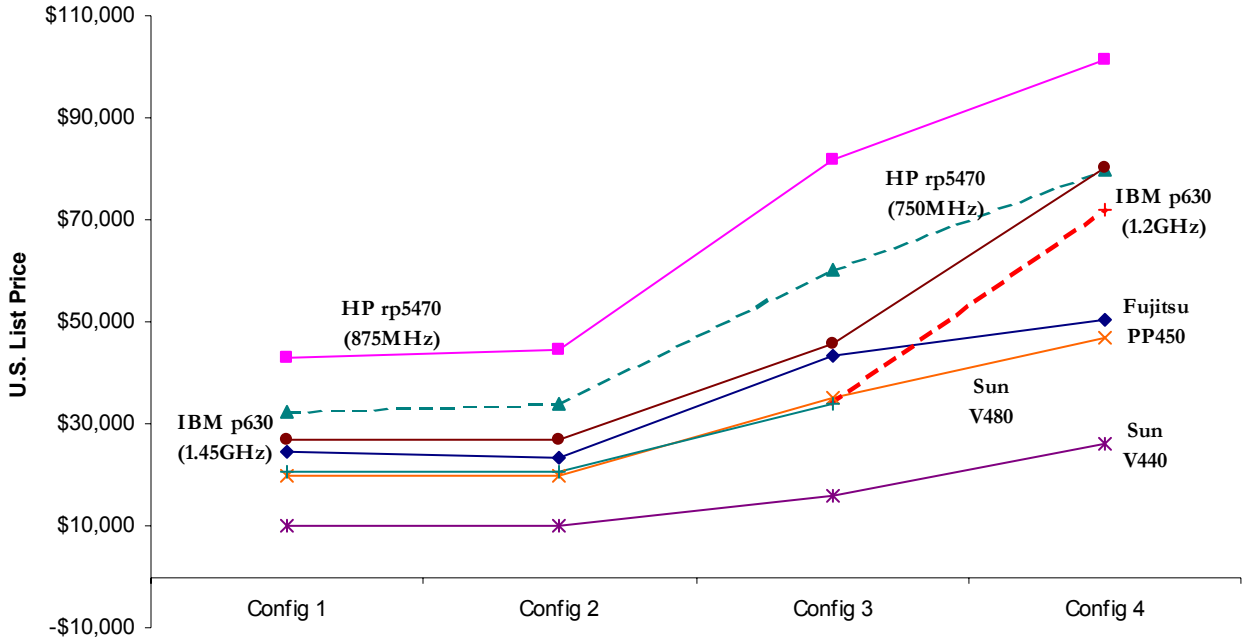
Configuration 2: 2 CPUs, 4 GB RAM, 2 x 36 GB HDs, DVD, operating system, 3 year Hardware Warranty

Configuration 3: 4 CPUs, 8 GB RAM, 2 x 36 GB HDs, DVD, operating system, 3 year Hardware Warranty

Configuration 4: 4 CPUs, 16 GB RAM, 2 x 36 GB HDs, DVD, operating system, 3 year Hardware Warranty

Note that Sun and Fujitsu only offer a three-year limited warranty with second business day response time compared to next business day response time (uplift added for IBM) offered by both IBM and HP for the servers configured in this report.

Chart 4: Performance Optimized Leading UNIX Servers List Price Comparison on Select Configurations



The Sun Fire V440 achieves a considerable price advantage compared to its "performance optimized" competitors. The HP rp5470 is up to four times as expensive and even with a significantly higher discount, will not be able to match the Sun Fire V440 on price/performance. IBM's p630 with the 1.45 GHz POWER4+ is also higher priced and is positioned above the Sun Fire V480. Notice that the IBM p630 with the 1.2 GHz POWER4+ processor is priced very similarly to the Sun Fire V480 server for the first three configurations (all Express), with a huge difference in the fourth configuration.

Besides the TPC-H performance results discussed earlier, Sun has not yet disclosed any additional performance results for the Sun Fire V440 server. The CPU performance of the Sun Fire V440 with the 1.28 GHz UltraSPARC IIIi is estimated to be higher than that for the Sun Fire V480 server.

Table 4: Leading four-way capable UNIX Servers Performance Comparison (Highest results are highlighted)

	IBM eServer p630	Sun Fire V440	Sun Fire V480	HP Server rp54xx	Fujitsu PRIMEPOWER 450
Processor	1.2 / 1.45 GHz POWER4+	1.28 GHz UltraSPARC IIIi	1.050 GHz UltraSPARC III Cu	650 / 750 / 875 MHz PA-8700	1.1 GHz SPARC64 V
Uni-CPU:					
SPECint2000	767 / 910	*696*	619	491 / 549 / NA	682
SPECfp2000	1014 / **1158**	*1021*	962	488 / 522 / NA	1037
Quad-CPU:					
SPECint_rate2000	31.4 / 37.0		28.20	20.8 / 24.5 / NA	30.5
SPECfp_rate2000	35.1 / 38.8		40.10	18.7 / 19.9 / NA	**41.4**
Web Serving:					
SPECweb99	NA / **6895**		900MHz: 4500	NA/ 4646 /NA	
SPECweb99_SSL	NA / **1988**		900MHz: 568	990 / 1066 / 1190	
SPECsfs97_R1 v3					
TCP v3 Result (ORT)	NA / **33,569** (1.48)			NA / 16,003 (2.04) / NA	
UDP v3 Result (ORT)	NA / **33,593** (1.46)			NA/ 17,979 (2.11) / NA	
Java Performance:					
SPECjbb2000 (ops/sec.)				NA/ 34,168 /NA	**58,212**

Notes: All performance numbers are current as of 09/17/03; Sun Fire V440 results are DHBA estimates.

Vendors are usually very selective in their benchmarking process. There are no application benchmarks shown above since only one vendor has reported results, e.g., TPC-H from Sun only, Oracle Applications from IBM only. The lack of sufficient benchmark evidence limits a customer's ability to do head-to-head system comparison. They have to rely on either relative performance of the new system compared to their existing installation, or do their own benchmarking (custom data), as industry-standard benchmark results and real world performance can vary drastically.

HP's PA-8700 processor is not as strong on CPU level metrics, but has demonstrated very strong performance on benchmarks such as SPECjbb2000. The only result available for the four-way 750MHz PA-8700 trails the Fujitsu PRIMEPOWER450 significantly. IBM has strong performance across the board including leading performance in SPECweb99, SPECweb99_SSL and SPECsfs97_R1 v3 benchmarks. While the performance of the Sun Fire V440 in the above benchmarks is not expected to be industry leading, it will be sufficiently close to the peak performance to make a compelling price/performance argument for the customer.

