IDEAS Research and Advisory Services

Dell Grabs Early Lead with Dual-Core Intel Xeon Announcement

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SERVICE NAME

» Enterprise Servers

CORE TOPICS

» Technology Lifecycles

KEY ISSUES

» Which new technologies should users consider for deployment in the next one to three years?

» What is the impact of the microprocessor on overall systems performance?

» How do new technologies impact customer purchase decisions?

RECOMMENDATIONS FOR USERS

» Existing Dell customers should work with Dell in identifying the performance benefits of dual-core for their respective workloads. Based on benchmark data, customers with single-core 3.2 GHz Intel Xeon processors (or lower clock speed) running integer and Java-based applications are ideal for an upgrade to dual-core. Actual performance may vary.

» In the transition period between single core and dual core, identify system features and requirements up front before comparing systems on sockets and cores. This will avoid improper comparisons that can lead to imbalanced servers with disproportionate memory and I/O resources.

» Evaluate software-licensing schemes for all existing and proposed applications before considering dual-core deployments.

» Add performance/watt as a relevant metric in making platform decisions.

» Although most applications rely on the operating system for multithreading benefits, consider working with the ISV/OEM in recompiling the software to exploit potential advantages. However, this may not be feasible in all scenarios, especially for legacy code.

Summary

Ideas International, Inc. (IDEAS) expects Dell to take an early lead in the x86 server market with its support for the first dual-core Intel Xeon DP processor on select dual-socket PowerEdge servers. The availability of the dual-core Xeon DP processor, codenamed "Paxville DP," is a major milestone for Intel, and indeed Dell, as the two companies gear to achieve parity with AMD[1] on high-performance server offerings. Although Dell has been offering dual-core processor chips on its single-socket PowerEdge[2] servers since July 2005, the availability of the dual-core Intel Xeon DP processor adds muscle to its highest volume servers – the PowerEdge 1850, the PowerEdge 2800, the PowerEdge 2850, and the PowerEdge 1855 blade server – promising a fast volume ramp up for Dell and laying the groundwork for the rest of its PowerEdge product line as it embraces more dual-core offerings from Intel in the coming months.

Dual-core processors are a natural evolution point for the x86 industry as fabrication technologies coupled with enterprise requirements (e.g. better performance/watt ratios) make multi-core offerings a necessity. Intel is taking a big bang approach to multi-core with over 17 multi-core projects underway. It has already announced that it will make the "Paxville MP" processor available for four-socket servers in the coming months, rounding out its portfolio of dual-core desktop and server offerings for the mainstream x86 market. Intel has been on the offensive in its transition to dual core; it pushed up the availability schedule for its "Paxville DP" and "Paxville MP" processors from early 2006 to the fourth quarter of 2005. It also plans to be more aggressive in standardizing on dual-core SMP offerings for the workstation and server markets with the availability of the "Bensley" platform with "Dempsey" dual-core processors in early 2006.

Dell's commitment to the Intel x86 architecture has paid off nicely with significant market share gains in the workstation and server markets. Dell expects to continue that trend as the industry transitions to dual-core processor chips. Intel's platform strategy – to innovate in areas beyond processors, such as chipsets and system management software interfaces – is a pivotal component of Dell's Scalable Enterprise strategy, which aims to leverage industry standards to address customer challenges around operational and deployment complexity. Dell's transition to dual core shares this focus; it is working to ensure seamless migration by enabling a single-system image between single-core and dual-core offerings across its mainstream dual-socket servers.

Dell PowerEdge Servers

Dell is offering the 2.8 GHz Intel Xeon dual-core processor with a 2 MB Level 2 (L2) cache per core on the aforementioned Dell PowerEdge servers. These PowerEdge servers account for more than half of Dell's shipments to the enterprise market. Dell is positioning the PowerEdge servers equipped with dual-core Xeon processors for CPU-intensive applications such as those in the high-performance technical computing market and for database, CRM, ERP, and Java applications among others. Servers equipped with virtualization software such as VMware ESX Server are also an ideal fit for dual-core processor servers, since more compute resources are available for the individual virtual machines.

Existing PowerEdge customers cannot field upgrade to the new dual-core processor chips because a different system board is required to accommodate these higher-power-consuming processor chips. However, the system software image for the new board is backward compatible with existing systems to ease the transition to dual core. As such, other Dell PowerEdge servers can also use the dual-core processor system image without making any platform changes. However, Dell wants to ensure that it positions the advantages of dual core for target applications that will see the most benefit. For example, even though the PowerEdge 1800 is a dual-socket tower server, it is primarily positioned for workloads such as file and print sharing, which do not see any significant benefit from dual-core processor chips. Note that low-end servers such as the PowerEdge SC430, the PowerEdge 830, and the PowerEdge 850 already offer a dual-core option employing the Intel Pentium D processor, but they are not targeted at the enterprise market. Dell will continue to offer single-core and dual-core options on such servers until it transitions to the next-generation Intel platform offering. Dell is also adding support for the single-core 3.8 GHz Intel Xeon with a 2 MB L2 cache. Table 1 below provides details on the PowerEdge servers included in the dual-core Intel Xeon DP announcement.

Table 1. Lineup of PowerEdge Servers Equipped with Dual-Core Intel Xeon DP Processors

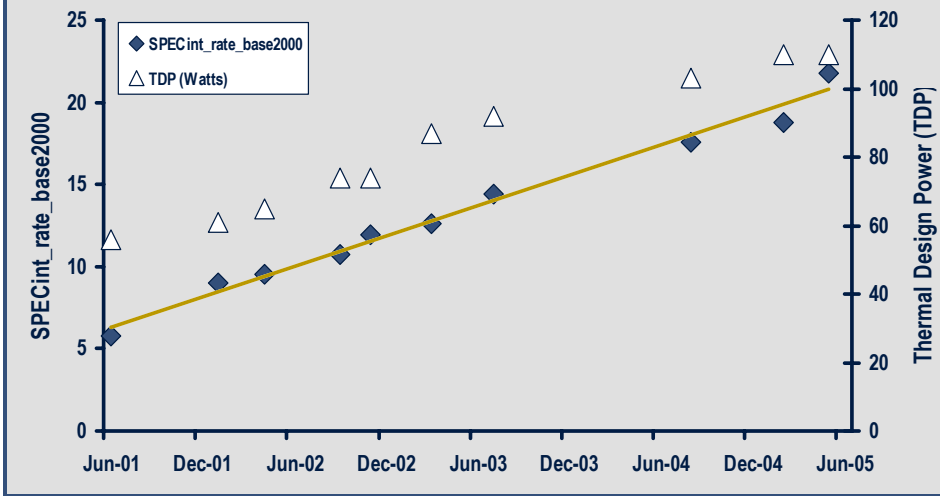
	PowerEdge 1850	PowerEdge 2800	PowerEdge 2850	PowerEdge 1855
Form Factor	1U rack mount	Tower	2U rack mount	7U rack-mount enclosure – 10 blade servers
Processors Supported	Up to 2 single-core Intel Xeon EM64T processors at up to 3.8 GHz / Up to 2 dual-core Intel Xeon EM64T processors at 2.8 GHz			
Maximum Memory	Up to 12 GB DDR2 / 400 SDRAM (up to 16 GB by 4Q05)			
Internal Disk Bays	2 Ultra320 hot-plug SCSI	8 + 2 Ultra320 hot-plug SCSI	6 Ultra320 hot-plug SCSI	2 Ultra320 hot-plug SCSI
Number of I/O Slots	2 PCI-X or 2 PCI-Express	4 PCI-X, 2 PCI-Express, 1 PCI	3 PCI-X or 2 PCI-Express and 1 PCI-X	1 daughtercard
Gigabit Ethernet Ports	Dual embedded Intel Gigabit NICs			
Remote Management	Baseboard Management Controller with IPMI 1.5 compliance			
Dual-Core Entry Price	$2,448	$2,448	$2,548	$2,748

Performance Benefits of Dual Core

Intel, much with Dell's support, has been driving toward enhancing the value of the entire platform, instead of just the processor. It has been investing heavily in upgrading memory technology with Fully Buffered DIMMs and already leads with support for the faster DDR2 memory modules. Further, Intel has also led the transition from PCI-X to PCI-Express in order to drive balanced system performance. However, despite the raw throughput increase in the supporting subsystem, the performance of the dual-core Intel Xeon processor is likely to be scrutinized. While dual-core processors are all the rage in the x86 market, they are not new to the technology industry. In fact, Intel's RISC rivals, led by IBM, have been offering dual-core processors since 2001 and have successfully transitioned their entire product lines. However, Intel is unique in the computing industry because of the sheer volume of processors it delivers to various server and workstation offerings.

Intel's focus for years, at least the most visible one, has been on clock speed improvements. Currently, the 3.8 GHz Intel Xeon DP processor is Intel's fastest available single-core processor for SMP workstations and servers. Keeping up with the core clock speed improvements, Intel has also subsequently improved the Front Side Bus (FSB) frequency to 800 MHz (Xeon DP), and has steadily increased the size of the on-chip L2 cache to 2 MB (Xeon DP). Figure 1 below shows the fourfold increase in SPECint_rate_base2000 performance for the Intel Xeon DP processor from June 2001 to June 2005. Comparatively, the clock speed improved from 1.4 GHz to 3.6 GHz during the same time frame. However, Thermal Design Power[3] (TDP) for the Intel Xeon processor (shown on the right axis) also increased at the same pace. The dual-core processors aim to deliver higher performance beyond the growing TDP envelope.

Figure 1. SPECint_rate_base2000 Performance and TDP Power Consumption Increase for Intel Xeon Processor



Notes: SPECint_rate_base2000 results from Standard Performance Evaluation Corporation (SPEC); TDP information from Intel; performance data is sorted based on the hardware availability date for the server configured with the Intel Xeon processor used in the above comparison.

Dell has disclosed the SPECint_rate2000 and SPECjbb2000 performance results for its PowerEdge servers equipped with the dual-core 2.8 GHz Intel Xeon processor with a 2 MB L2 cache per core. In the SPECint_rate2000 benchmark, the PowerEdge servers configured with two dual-core 2.8 GHz Intel Xeon processors with 2 MB L2 caches per each core show a 54% increase in peak throughput compared to the same PowerEdge servers configured with two single-core 3.6 GHz Intel Xeon processors with 2 MB L2 caches. In the case of the SPECjbb2000 benchmark, the dual-core configurations outperform their single-core counterparts by 44%. Table 2 below compares the new results with the existing results using the single-core 3.6 GHz Intel Xeon processor with a 2 MB L2 cache.

Table 2. Performance Comparison of Single-Core and Dual-Core PowerEdge Servers

	Server	Single-Core 3.6 GHz Intel Xeon w/2 MB L2 Cache	Dual-Core 2.8 GHz Intel Xeon w/2 MB L2 Cache per Core	% Increase
SPECint_rate2000 Benchmark	PowerEdge 1850	38.1	*58.5*	54%
	PowerEdge 1855	38.3	*58.9*	54%
	PowerEdge 2800	38.2	*58.5*	53%
	PowerEdge 2850	38.1	*58.7*	54%
SPECjbb2000 Benchmark	PowerEdge 1850	104,172	*149,801*	44%
	PowerEdge 1855	104,778	*151,061*	44%
	PowerEdge 2800	104,443	*150,700*	44%
	PowerEdge 2850	104,139	*150,151*	44%

Notes: The SPECint_rate2000 results for the single-core Dell PowerEdge servers are from the Standard Performance Evaluation Corporation (SPEC). The SPECint_rate2000 results for the dual-core Dell PowerEdge servers are Dell estimates that were submitted to SPEC for publication.

It is easy to recognize that the above comparison is between four-core configurations and two-core configurations. As such, on a per-core basis, the performance has actually dropped by up to 28% (SPECjbb2000 benchmark). In the past, Intel's RISC rivals have claimed they derived a 100% performance increase from doubling the number of cores in the newer configuration. However, for the most part, the new configurations also included elevated clock speeds. Note that the dual-core processors in the above configuration have a significantly lower clock speed than the single-core processors.

When we compare dual-core and single-core processors with similar clock speed options, the percentage change is more interesting. For example, if we compare the PowerEdge servers configured with two dual-core 2.8 GHz Intel Xeon processors with 2 MB L2 caches per each core against the PowerEdge 2650 (predecessor to the PowerEdge 2850) with two single-core 3.2 GHz Intel Xeon processors, each with a 512 KB L2 cache and a 2 MB L3 cache (using the faster clock speed to compensate for the FSB improvements), the overall improvement in the same SPECjbb2000 benchmark is 107%, or a 3% per-core improvement over the PowerEdge 2650 performance of 72,701 ops/sec. That is, the 2.8 GHz dual-core implementation offers a bit more than twice the SPECjbb2000 performance

compared to a 3.2 GHz single-core chip. The same holds true in the SPECint_rate2000 benchmark using similar clock speed options. Essentially, customers currently using the 3.2 GHz Intel Xeon processor with the 533 MHz FSB with up to a 2 MB L3 cache will double their existing performance on the new dual-core processors (if their workloads model these benchmarks). Intel will more than likely eventually get to the 3.6 GHz clock speed for the dual-core version and be able to demonstrate double the performance of the single-core version. Table 3 below summarizes the above comparison.

Table 3. Performance Comparison of Single-Core and Dual-Core PowerEdge Servers

SPECjbb2000 Benchmark	PowerEdge 2650 Single-Core 3.2 GHz Intel Xeon w/2 MB L3 Cache	PowerEdge 2850 Dual-Core 2.8 GHz Intel Xeon w/2 MB L2 Cache per Core	% Increase
Overall	72,701	*150,151*	107%
Per Core	36,350	*37,537*	3%

Based on Dell's internal estimates, the improvements in floating-point performance, such as those represented by the SPECfp_rate2000 benchmark, will be more modest, around 23%. Dell has published a TPC-C benchmark result of 38,622 tpmC at $0.99/tpmC for the PowerEdge 2800 using a single dual-core 2.8 GHz Intel Xeon processor with a 2 MB L2 cache per core with the Windows Server 2003 Standard x64 Edition operating system and the Microsoft SQL Server 2005 Standard x64 Edition database. Overall, based on Dell estimates, database performance will improve by approximately 37% on an overall throughput basis and database price/performance will increase by 29%. Clearly, the per-core reduction in performance for such workloads will be more severe. Again, it is necessary to estimate performance improvements based on similar clock speed Intel Xeon configurations to view the true impact of dual-core processor chips.

It is true that depending upon the existing configuration and application, performance improvements may not be convincing enough for customers to upgrade to the new platforms. There are, however, two very good reasons to consider upgrading to the dual-core processors:

- Improved performance/watt – This ratio represents the improvement in the server's delivered performance for each unit of consumed power. As shown in Figure 1 earlier, this metric has steadily improved (by twofold from June 2001 to August 2005) but not enough to overcome datacenter limitations. Increasingly, enterprise customers are being constrained by their power and cooling infrastructure's inability to effectively deploy newer generation servers with high-power-consuming processors. Based on Dell's estimates of the proportionate increase (approximately 8 to 10%) in the maximum power consumption of the new dual-core processors, projected performance/watt improvements can be up to 43% using the SPECint_rate2000 benchmark. This is a significant metric that has broader implications for enterprise customers, for which dual-core processors deliver material improvements.
- Potentially beneficial software licensing – Primarily, ISVs use three types of licensing algorithms to price their software: per server, per processor, and per user. Among these, the per-processor licensing approach has branched off into

two distinct models: per socket and per core. Customers using application software licensed per server, per user, or per socket benefit immensely from the introduction of dual-core processors, as they are able to reap the benefits of faster processors without worrying about increases in software licensing costs. Major ISVs like Microsoft and VMware have committed to license their application software by the number of sockets in the server, offering significant savings in software licensing costs for customers deploying servers with dual-core processors. On the other hand, ISVs licensing per core will charge twice as much (or some fraction thereof) for servers configured in this manner.

Dell Value Strategy

Dell's Scalable Enterprise focuses on addressing deployment and operational challenges for enterprise customers by providing them with necessary tools, and more importantly, choice and flexibility. Dell pioneered a unique business model for the computing industry and retains an edge with its direct selling model, online real estate, ease of use, and lean supply chain. Unlike rival vendors, Dell does not perceive value in adding premium software offerings gained through acquisition – besides increasing complexity and cost, the new offerings may require considerable time to become integrated into the existing portfolio. Instead, Dell has steadily focused its energy on providing value at the platform level by leveraging industry standards and partner software without adding complexity and cost. This approach allows customers to reap the benefits of industry standard server deployment; customers can deploy any third-party software (for higher provisioning, management, and monitoring tasks) or roll their own to provision and manage their servers. However, this approach may not work for customers looking to have a one-stop-shop for all their software needs.

Using common components between similarly classed (e.g. workgroup or departmental) servers is a de-facto requirement of enterprises deploying a large number of servers. Dell, like most other major x86 players, has standardized on common processor (add-on), memory, and hard disk drive options for its workgroup PowerEdge servers. For example, there is a nearly identical options template for the PowerEdge 1850, PowerEdge 2800, and PowerEdge 2850 servers. Dell has also standardized on the Baseboard Management Controller (BMC) with IPMI 1.5/2.0 compliance for remote management on all its eighth-generation PowerEdge servers. Customers can use the same tools and scripts to monitor and manage all their PowerEdge servers.

Dell is one of the more unique x86 vendors to offer common BIOS and drivers among its PowerEdge servers. The same high-volume servers – the PowerEdge 1850, the PowerEdge 2800, and the PowerEdge 2850 – also share the same system image so customers have fewer images to manage, saving deployment, provisioning, and maintenance costs associated with each OS image. In the past year (from August 2004), PowerEdge customers had to only manage four system images across these high volume servers, including the most recent change to support dual-core processors. Further, Dell is promising the same system image across both single- and dual-core processors, enabling an easier migration path to dual-core configurations. Table 3 below shows the commonality between Dell's highest volume PowerEdge servers. The form factor limits the number of options supported on the PowerEdge 1855 blade server.

Table 3. Commonality between High-Volume PowerEdge Servers

	PowerEdge 1855	PowerEdge 1850	PowerEdge 2800	PowerEdge 2850
Processor Options	100%	100%	90%	90%
Memory Options	40%	96%	100%	100%
Hard Disk Drive Options	100%	100%	100%	100%
BIOS	Yes	Yes	Yes	Yes
Drivers	Yes	Yes	Yes	Yes
System Image	Yes	Yes	Yes	Yes
Dual-Core Compatibility	Yes	Yes	Yes	Yes

Dell has also been aggressively promoting its OpenManage product family, specifically its ability to integrate with third-party software applications such as those from Microsoft (Systems Management Server) and Altiris (Altiris Server Management Suite). The integration enables Microsoft or Altiris customers to use a single tool and process to update hardware (BIOS, drivers, firmware) and software (application patch, security patch), which reduces the overhead of managing multiple consoles and simplifies the operational aspects of managing large datacenters.

The IDEAS Bottom Line

The availability of the dual-core Intel Xeon processor will strengthen the transition to dual-core-processor-based configurations. Intel's aggressive road map to deliver on dual-core and quad-core processors within a short timeframe will also pressure ISVs that are licensing by the core to reevaluate their strategy. Dell's ability to announce early support for this significant announcement positions it for early share gains among enterprise customers looking to squeeze additional performance out of their existing investments. Further, Dell is enabling an easier transition path with a common system image, which should benefit all customers.

The PowerEdge servers configured with the dual-core processors will be generally available by early October 2005. Dell's key rivals – HP and IBM – are also expected to follow suit. Dell historically has maintained an edge over its competition in certain sweet spot configurations. However, it is unclear as to how HP and IBM will price their dual-core configurations and customers should contact their suppliers to get early quotes.

[1] AMD announced its first dual-core AMD Opteron 800 series processor for four- to eight-way servers in April 2005. Its dual-core AMD Opteron 200 series processor for two-way servers became available in late May 2005.

[2] PowerEdge SC430 was announced on July 12, 2005; PowerEdge 830 and PowerEdge 850 were announced on August 9, 2005.

[3] Intel recommends that thermal solution designs for the systems use the TDP figures instead of the maximum processor power consumption figures.

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