



Dell Delivers Quad-Core for the Real World

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Management Summary

Outside of a home, the largest purchase most of us will ever make is a car. We take pride in our “wheels” and we want them to look good and to be comfortable. More important, however, they must be performant, economical, and safe, and not necessarily in that order. Performance is important to be able to merge onto the freeway and into high-speed traffic safely and easily, in any kind of weather or road condition. With the cost of gasoline hovering between \$2.00 and \$3.00, cars clearly have to have good fuel economy. Safety may be last, but it is by no means least. Cars must be able to hold the road and stop quickly to protect the valuable cargo inside. One configuration variable that can affect both the performance and the safety of your vehicle is the transmission, specifically the capability to select a car that has four-wheel drive. No driver wants to feel the tires slipping on wet pavement as he accelerates on to the highway. No driver wants to hit the brakes only to feel his car sliding sideways with no ability to control it. Having the capability to provide power to all four wheels gives the driver peace of mind.

A similar scenario holds true in the data center. Every CIO dreads the sound whenever their phone rings. Did the mission-critical server die? Is my OLTP platform out? Many data centers are driven by single- or dual-socket x86 platforms controlled by single core CPUs in a scale-out architecture. The recent advancement in processor technology has propagated the use of dual-core CPUs from AMD (*Opteron*) and Intel (*Xeon*), providing two processing engines in every socket for the execution of enterprise applications. Dual-core is especially useful in data centers that have implemented workload management techniques to balance server utilization and provide a safety net when one processor, or core, fails. Dual-core is also helpful to consolidate or virtualize an environment. Dual-core CPUs enable significant economies of scale in the energy they use and the system utilization that they enable. Well, one might ask, if dual-core processors enable such a significant improvement in performance, utilization, and reliability, what would be the impact of a quad-core engine? Intel has responded by introducing a quad-core version of their Xeon microprocessor, and Dell has responded to that announcement by integrating Intel’s quad-core *Xeon 5300* processor into their existing line of *PowerEdge (PE)* servers.

Recognizing the need to improve the performance and reliability of one- and two-socket servers for the SMB customer, and for departments and remote offices of larger enterprises, Dell has upgraded their PowerEdge family with quad-core Xeon 5300 processors for the *PE19x0* and *PE29x0* rack-mount and tower platforms. To see how quad-core platforms can improve your server performance and ROI, please read on.

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The Data Center Environment

There is a consistent theme running through the top ten list of headaches for every CIO, whether Fortune 500 or SMB. Prominent among the issues are meeting the enterprise processing needs resulting from continual growth, physical and logical consolidation of data center infrastructure, inefficient server utilization of resources, and excessive operational costs due to energy consumption and administrative staffing as a result of server proliferation. The total cost of ownership (TCO) for the data center is running out of control. The CIO needs to make changes to the basic infrastructure in order to reduce the amount of energy wasted every day and to improve the profitability picture of enterprise IT.

The typical data center consists of a vast array of mono- and dual-processor, rack-mounted x86 servers in a scale-out architecture. In an attempt to simplify the IT environment, data center management typically rolls out a new server for each new application to try to segregate the data access and improve IT security. Unfortunately, this results in extremely poor utilization of system resources, with each server using only 15-25% of available system CPU power. In order to correct this, CIOs are consolidating their application infrastructure onto fewer and more powerful platforms, sharing system resources between complementary applications. Over the past year, these servers have been configured with the latest x86-micro-processor technology from one of two companies, Intel with their dual-core *Xeon* processor or AMD with their *Opteron* CPU. Due to their reduced energy requirements¹ and the inclusion of virtualization technology into the chip design, the data center has been able to improve the basic performance per watt consumed to run the enterprise servers and to cool the environment from the heat generated.

The availability of new energy-efficient, dual-core servers² enabled the enterprise to lower its operating costs, consolidating applications from older servers with expired warranties onto the new technology, freeing the

budget from maintenance costs. Reducing energy requirements to operate the data center efficiently is of major importance, with the cost of electricity spiking. It has become necessary for every data center to increase the performance per watt in order to reduce the recurring costs of data center operation. With one eye on enterprise profitability and the other on future performance requirements, the CIO must protect the enterprise's investment with a flexible platform, capable of scaling processors and memory without the need to replace the entire platform. By addressing these issues, the CIO can retain control of the data center's operating expenses.

In an effort to assist all enterprises in achieving that goal, Intel has made a commitment to a 300% increase in performance per watt by the end of the decade. Intel has now reassumed the leadership mantle in taking the next step in improving both performance and performance per watt for x86 processors with the introduction of a quad-core Xeon processor for the high-volume, or two-socket, server.

The Transition to Quad-Core CPUs

In an effort to maximize energy efficiency along with performance density for the broadest possible segment, Intel has released the *Xeon Processor 5300*, a quad-core processor family, formerly known as *Clovertown*, for the execution of 32- and 64-bit applications. The Xeon 5300, the first x86 processor built on 65-nanometer technology, is the next evolution from the Xeon 5100 Series, originally called *Woodcrest*. Intel has merged two Woodcrest processors into one socket in order to reduce the energy drain on the data center while doubling the number of compute threads (to 16) and increasing the performance capability by 50%. By first introducing quad-core technology into the 5000 family, Intel is enabling system providers to integrate up to eight cores into a single two-socket platform, with a front side bus (FSB) of up to 1333MHz and a processor frequency of up to 2.66GHz, with a typical energy dissipation (TDP³) requirement of 80 Watts per four-core processor⁴. The Xeon 5300 allows each pair of cores to share 4MB of cache, for a total of 8MB. Intel originally announced four versions of the 5300,

¹ The typical dual-core CPU consumes the same or less energy than its single-core counterpart.

² See **The Clipper Group Navigator** dated September 29, 2006, entitled *Dell Delivers Improved PowerEdge 6800s with Latest Intel Technology*, available at <http://www.clipper.com/research/TCG2006083.pdf>.

³ Thermal Design Power

⁴ A high-performance Xeon processor 5355 has a TDP of 120W.

ranging in speed from 1.6GHz to 2.66 GHz, with a FSB of either 1.066GHz or 1.333GHz. Intel has recently announced a fifth version with a processor speed of 2.0GHz, a 1.333GHz FSB, and a TDP of 80W. Intel-based servers support two versions of the Intel 5000 Series chipset: the Intel 5000P chipset for performance and volume server platforms and the Intel 5000V chipset for value platforms. Both support up to 21GB per second throughput from processor to memory or I/O, and up to 64GB of FBDIMM⁵ memory.

This is an ideal compute environment for the consolidation of well-threaded applications, reducing the amount of data center space required to support the mission- and business-critical applications of the enterprise. They will benefit from a multi-core architecture with larger cache, higher throughput, and greater memory capacity. The Xeon 5300 also benefits from many of the advanced server technologies that Intel has developed, such as *Intel Virtualization Technology (Intel VT)* and *Intel I/O Acceleration Technology (Intel I/OAT)*. Intel VT provides hardware assistance for many new software-based virtual environments, for example, *VMware* and *Xen*, to support 64-bit O/S. Intel I/OAT provides hardware- and software-supported I/O acceleration to improve data throughput significantly.

It would be nice to compare Intel's four-core Xeon to other four-core x86 processors. Unfortunately, there are no others! AMD is scheduled to announce the availability of their four-core Opteron sometime during 1H07. Instead, let us look at how one server vendor, Dell, has employed the Xeon 5300 in a customer-ready solution.

The Dell Solution

Dell offers an extensive family of *PowerEdge (PE)* servers, encompassing rack-mount, tower, and blade-based platforms. These servers cover a wide-range of performance capabilities up to quad-socket, based upon a wide-range of Intel processors, including *Celeron D*, *Pentium D*, and *Xeon*. The PowerEdge servers have used both mono- and dual-core Xeon CPUs. Now Dell has extended the PowerEdge capabilities with quad-core processing and next generation performance features, remote management extensions, and new storage options, with the availability of the Xeon 5300 in its dual-socket

platforms: the rack-mounted *PE1950* and the *PE2950*, and the *PE1900* and *PE2900* towers. These platforms all provide up to 16 threads of parallel processing to any mission- or business-critical application, in the data center or at a remote location, utilizing two threads for each core. Configured with quad-core CPUs, the PowerEdge provides up to 63% better performance⁶ than with the dual-core Xeons installed, and up to 40% greater performance/watt.

PowerEdge platforms use a common design, utilize common components, and employ the same system drivers, firmware, operating system, and applications, helping to reduce the complexity of managing data for any size enterprise. PowerEdge servers also include Dell's *OpenManage* systems management facility, along with a *Baseboard Management Controller* with a complete set of tools that monitor various hardware components and alert the data center staff when a fault occurs. For those situations with no IT staff available, Dell offers the optional *Dell Remote Access Controller* that is controlled through a web-based graphical user interface to monitor, troubleshoot, and upgrade remote locations. Various iterations of Microsoft *Windows*, Red Hat *Linux*, and Novell *SuSE Linux* are supported.

The Dell PowerEdge Tower Servers

The PowerEdge 1900 and PowerEdge 2900 are available in a tower chassis and are an ideal server for the SMB and remote or branch office. At the entry level, the 1900 can serve as a principle file/print/messaging server or provide any other dedicated application support, while the 2900 has the scalability to support a large branch by itself, or perform as a node in a data center cluster. This makes the PE2900 more suitable for consolidation of departmental applications, perhaps in a database architecture, in addition to managing an email/messaging environment. The PE2900 also has the flexibility for rack mounting in a 5U space, as enterprise needs change.

Configurable with two Xeon 5100 dual-core or Xeon 5300 quad-core 64-bit processors, the PE1900 can access up to 8MB of cache and 16GB of fully buffered DIMM memory, enabling simultaneous reads and writes, and pro-

⁵ Fully Buffered Dual In-line Memory Module.

⁶ Based on the SPECint_rate2000 benchmark test performed by Dell Labs in May/October 2006 on a PE2950 with two quad-core processors.

viding three times the throughput of DDR2 memory. The PE2900 can access up to 48GB of DDR2 memory. Both have the scalability to support up to six I/O controllers, four of which are PCI Express and two PCI-X. This enables the data center to communicate with the towers via multiple high-performance interconnects.

The towers come with an integrated two-channel SAS-SATA controller or a Dell PERC RAID controller and multiple embedded Gigabit NICs. The PE1900 has support for up to eight 2.5" drives or six 3.5" drives, for a total of 3.0TB of internal data, while the PE2900 can support up to 4.6TB of internal storage over 10 bays.

The Dell PowerEdge Rack Servers

Alternatively, the Dell PE1950, 1U rack-mount server, and the PE2950, a 2U configuration, are ideally suited for ultra-dense data centers. With up to two dual-core or quad-core processors, the PE1950 is well suited for edge-of-network operation, enterprise infrastructure, SAN front-end, thin client-server, and HPC cluster applications. With the same CPU configurability, the PE2950 helps to implement a virtualized environment for a growing network infrastructure as well as providing a consolidation platform for web, messaging, database, and file/print applications.

The rack-mounted PowerEdge platform is ideal for the data center that requires a high-powered cluster node and is short on data center floor space and energy. The PE1950/PE2950 supports up to 32GB of fully buffered DIMM memory, twice the capability of its predecessors, or of the PE1900, and provides 8MB of cache for each four core CPU. This provides significant scalability in virtualized workloads where applications such as *VMWare* can take advantage of the additional memory. In addition, the quad-core PE1950 and PE2950 provide better performance per watt than the prior generation of dual-core processors. Combined with energy-efficient power supplies, both the PE1950 and PE2950 can reduce wasted power at lower workloads.

The PE1950 supports SAS and SATA drives with up to 1.5TB of storage available with embedded disk controllers. With additional bays, the PE2950 can support up to 4.5TB of SATA storage or up to eight 2.5" SAS drives. Both servers also support PCI Express I/O slots (two for the PE1950, three for the PE2950) enabling high performance Ethernet, RAID,

InfiniBand, and Fibre Channel controllers today, protecting enterprise investment for the future.

In addition to the internal storage scalability, Dell offers a variety of external storage arrays, including their own *PowerVault* series as well as a full line of *CLARiiON* arrays from EMC. Further, Dell has recently announced the *PowerVault MD3000* SAS Array capable of storing 4.5TBs and the *PowerVault NX1950* NAS solution to provide gateway access for a network of server platforms.

Conclusion

The continued evolution of the data center, along with the inexorable cost of energy, has forced the CIO of every enterprise, Fortune 500 or SMB, to rethink the total cost of ownership for the IT infrastructure. The cost to power an x86 server is now greater than the acquisition cost. Inefficient servers, once tolerated, are now replaced. Multi-core technology is the gateway to improved performance, consolidation and a virtualized environment, enabling the replacement of anywhere from four to ten mono-core platforms with a single quad-core x86 platform, a platform designed to operate in the same energy range as its predecessors.

As we enter a new year, there is only one x86 quad-core processor – the Xeon 5300. However, several vendors have incorporated this new technology into their product set. Dell is one who has chosen to propagate the 5300 throughout their two-socket platforms with upgraded configurability and systems management. Dell continues bring higher-end capabilities and more energy efficiency to mid-sized and smaller businesses, which share many of the same infrastructure pains and TCO requirements as their larger brethren. If your enterprise is trying to reduce the total cost of ownership of your IT infrastructure, take a look at the PowerEdge family. It may have the performance and the energy envelope necessary to improve the bottom line of your enterprise.



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