

Improving Energy Efficiency with Intel® Xeon® Processor-based Servers and VMware Virtualization Infrastructure



Helping Companies Meet Demands for Increasing Capacity While Keeping Their Data Centers Cool

Today's data centers consume a lot of electricity. A recent report by the Environmental Protection Agency states that data centers in the U.S. consume 4.5 billion kWh annually, or 1.5 percent of the country's total electrical consumption.¹ Perhaps more importantly, this figure has doubled from 2000 to 2006² and is likely to double again in the next few years.

And energy use translates into increased costs for organizations. According to Gartner, between 2007 and 2012, most U.S. enterprise data centers will spend as much on power and cooling as on the hardware itself. Gartner also predicts that energy costs for IT will only continue to rise and could double by 2012.³



Burning Money to Cool the Data Center

As x86-based servers have proliferated, energy costs have risen even as performance per watt has improved. Much of the problem lies in underutilized hardware. According to Gartner, an x86 server only uses between 5 - 10 percent of its capacity in a typical 24-hour period.⁴

VMware virtualization technology can substantially reduce power and cooling costs by consolidating multiple workloads onto the latest energy-efficient multi-core Intel®-based processors. By using Intel® Xeon® processor-based servers and VMware virtual infrastructure, you can consolidate resources and decrease your energy costs, while increasing asset utilization. You can also allocate spare capacity on-the-fly so that you can respond easily to changing workloads or business priorities.

VMware virtualization solutions allow businesses to run multiple application and OS workloads on the same server. Ten server workloads running on a single physical server is typical, but some companies are consolidating as many as 30 or 40 workloads onto one server.[†] Consolidation through virtualization reduces the number of physical servers required, helping to reduce your power and cooling costs, as well as providing more compute power in less space.

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In fact, the impact of virtualization on energy consumption is so significant that utilities in North America such as PG&E, Southern California Edison, SDG&E, BC Hydro and Austin Energy are heavily incenting customers for removing servers through consolidation.⁵

Intel and VMware: Driving Energy Efficiency Through Consolidation

Through silicon process, microarchitecture improvements, and the use of new materials, Intel is delivering increasing performance within the same power envelope. This allows you greater VM density so you can consolidate multiple environments onto a single server, greatly increasing utilization.

- Up to 40 percent better performance compared to previous-generation Intel® processors in a virtualized environment⁶ and up to a 10 percent power reduction⁷ with Intel® Xeon® processor 7400^A series.
- Up to 20 percent better performance and up to 38 percent better performance per watt with Intel® Xeon® processor 5400^A series compared to previous-generation Intel processors⁸.

Today's Intel Xeon processors are designed with built-in hardware assists for virtualization (Intel® Virtualization Technology,⁹ or Intel® VT) VMware has optimized their virtualization software to take advantage of Intel VT features and capabilities in the silicon. The resulting increases in efficiency allow higher VM density (more consolidation) greater application performance, and workload flexibility within the data center. This provides an infrastructure that delivers tangible benefits for both your business and IT organization, while also helping you reduce energy costs and consumption.

Through VMware virtualization solutions, IT infrastructure becomes dynamic and responsive to fluctuating capacity requirements, as well as sensitive to energy use. VMware® Distributed Resource Scheduler (DRS) monitors the utilization of a pool of servers and uses VMware® VMotion to dynamically rebalance virtual machines across an entire resource pool of physical servers on an ongoing basis. VMware Enhanced VMotion coupled with Intel VT FlexMigration allows live migration across different generations of Intel Xeon processor-based servers, giving IT managers the freedom to move workloads whenever necessary, helping ensure business continuity during unforeseen spikes in data center resources.



VMware DRS uses a feature called VMware® Distributed Power Management (DPM) to reduce power consumption by turning off servers when there is unneeded capacity. Servers are powered back on when the capacity is required. Since the virtual machines live migrated off the affected servers, this feature automatically shrinks or expands the pool of servers running at any given time, improving your energy efficiency without reducing service levels.

In addition to reducing costs and improving flexibility, the ability of businesses to dynamically manage their Intel Xeon processor-based infrastructure using VMware virtualization solutions directly helps the environment. Every server that is virtualized saves 7,000 kWh of electricity and four tons of carbon dioxide emissions per year. With more than a million workloads running on VMware® Infrastructure, the aggregate power savings are about 8 billion kWh, which is more than the heating, ventilation and cooling electricity consumed in New England in a year.¹⁰

Leveraging the innovations of Intel and VMware, companies can increase energy efficiency in their IT environments, as well as improve business flexibility, and power and cooling costs.

Improving Energy Efficiency by Refreshing Hardware and Consolidating Workloads

Let's look at an Intel and VMware customer, the Virginia Community College System, and how virtualization and a hardware refresh helped them improve energy efficiency and lower costs.

The Virginia Community College System oversees 23 colleges spread across 40 campuses. Serving more than 250,000 students per year, the college had reached maximum power and cooling capacity. Unless the IT department found a way to consolidate servers and improve efficiency, the organization would either have to revamp the existing facilities or move to a different building. And with limited resources, moving or retrofitting wasn't a plausible option.

The IT team for the college system addressed these challenges by refreshing, virtualizing and consolidating its servers. They chose powerful multi-core Intel Xeon processor-based servers and VMware Infrastructure 3 Enterprise which included VMware® ESX Server, VMotion, Distributed Resource Scheduler, as well as other components.

The Virginia Community College System achieved a 15:1 consolidation ratio and removed five racks from their data center, streamlining their data center real estate. In addition, the institution reduced heat output by 90,000 BTU/hour, which equals 7.5 tons less cooling each hour.

To learn how your company can take advantage of VMware virtualization running on Intel Xeon processor-based servers to improve energy-efficiency performance visit www.vmware.com/go/intel



⁴Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See www.intel.com/products/processor_number for details.

¹Dependent on workload and underlying physical servers/cpu.

¹http://www.eia.doe.gov/emeu/repse/enduse/er01_new-eng_tab1.html.

²Ibid.

³Kumar, Rakesh. "US Data Centers: The Calm Before the Storm". Gartner, Sept. 25, 2007.

⁴Kumar, Rakesh. "How IT Management Can "Green" the Data Center". Gartner, Jan. 22, 2008.

⁵<http://www.vmware.com/solutions/consolidation/green/pge.html>.

⁶Virtualization performance gain claim based on vConsolidate benchmark running Intel Xeon processor 7350 vs. Intel Xeon processor 7460 results September 2008; Intel Xeon processor X7460, platform details: 4U Intel® S7000FC4UR (Fox Cove) Qual Server with four Intel Xeon X7460 (6-core, 16 M cache, 2.66GHz, 1066FSB), 32 GB memory (16 2 GB FB-DIMM 667 MHz Kingston® KVR667D2D4F5/4G), Fibre Channel Adapter: 2* HBA Dual-Port QLE2462 PCIe* (one idle), storage configuration: EMC Clarion® CX3-40f 4Gb 15-slot array. Single RAID controller with 4 GB cache and a battery, dual PSMs with dual AC inputs. RAID 0, SAN: 10 Hitachi® 146 GB 15 K RAID 0 FC HDD, 2 DELTA® DSP-1570BB, Fans: 8, VMware® ESX Server 3.5 Update 2 RC (Build 94067).

⁷Reduced Platform power claim based on vConsolidate Benchmark on VMware ESX Server results; configuration details above. Comparison between Intel® Xeon® Processor 7400 and 7300 Series based on vConsolidate benchmark result measured on VMware ESX Server v3.5.0 by Intel Corporation in September 2008.

⁸Intel® Xeon® processor x5460 series delivers up to 20 percent (1.25x) higher performance when compared to Intel® Xeon® processor 5365 series as published/measured using SPECjbb2005* in November 12th, 2007. Intel® Xeon® processor 5450 series delivers up to 38% (1.38x) higher performance per watt when compared to Intel® Xeon® processor E5335 as published/measured using SPECjbb2005* in November 12th, 2007.

⁹Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain platform software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

¹⁰Gartner, Inc. "Gartner Says Agility Will Become the Primary Measure of Data Centre Excellence by 2012", 10/24/07.

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