

IT@Intel Brief

Intel Information Technology

Computer Manufacturing

Data Center Management

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Energy-Efficient Performance for the Data Center

To meet the demand for higher computing capacity without adding servers to the data center, Intel IT created a virtualization solution that provided high performance, energy efficiency, and lower operational costs. By consolidating four physical machines into one running four virtual machines (VMs), we calculated a reduction of USD 2,468 per year in direct operational costs.

IT engineers at Intel face the significant challenge of managing the cost and efficiency of our data centers. Servers continue to proliferate, but they are often underutilized, leading to higher capital, maintenance, power, cooling, and software costs, as shown in Figure 1.

To determine the potential for reducing data center total cost of ownership (TCO), we tested a virtualization solution, comparing new servers based on the Dual-Core Intel® Xeon® processor 5100 series with Intel® Virtualization Technology to earlier server versions. The new servers consistently outperformed earlier servers, achieving higher throughput and reduced power consumption. We realized increased energy efficient performance (EEP) and increased computing performance in the data center through server consolidation.

Profile: Reducing Data Center TCO

- 4:1 server consolidation strategy
- USD 2,468 cost reduction with each consolidation
- USD 6 million savings annually in a data center with 10,000 servers

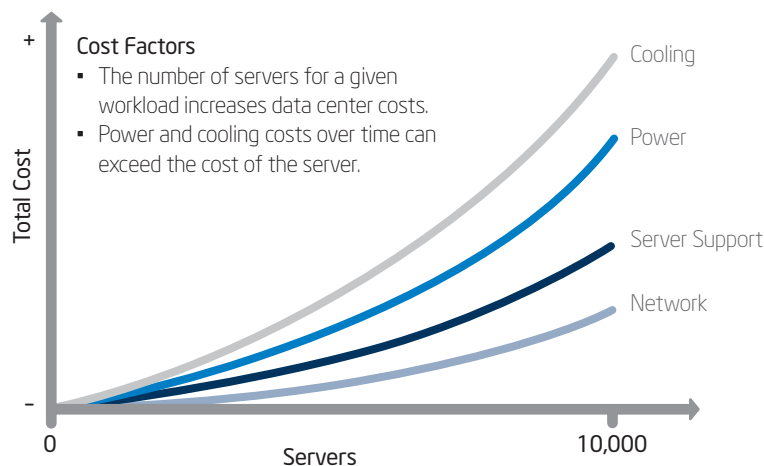


Figure 1. Data center cost factors. Servers are often underutilized, leading to higher capital, maintenance, power, cooling, and software costs.

Enterprise Data Center Challenges

Our enterprise data centers support several individual business applications in a heterogeneous 32- and 64-bit environment. To meet increasing application demands, Intel IT needed to improve data center computational capacity. As more systems increase complexity and costs—including hardware, software, maintenance, support, power, and cooling—we determined that adding systems was not the answer.

We needed a cost-effective solution that delivered the range of processing power our applications required that went beyond simply adding servers. To accomplish these goals, we

proposed a virtualization solution combining high performance, energy efficiency, and lower operational costs that relied on the new Dual-Core Intel Xeon processor 5160.

Test Methodology

To validate the proposed solution, we created usage models in two data center environments—the proposed virtual solution and a typical data center—as shown in Figure 2. The test evaluated four servers with Intel® Pentium® III processors running at 733 MHz, each running a data center workload, against one Dual-Core Intel Xeon processor 5160-based server with the Intel® 5000 series chipset, running all four workloads simultaneously in VMs.

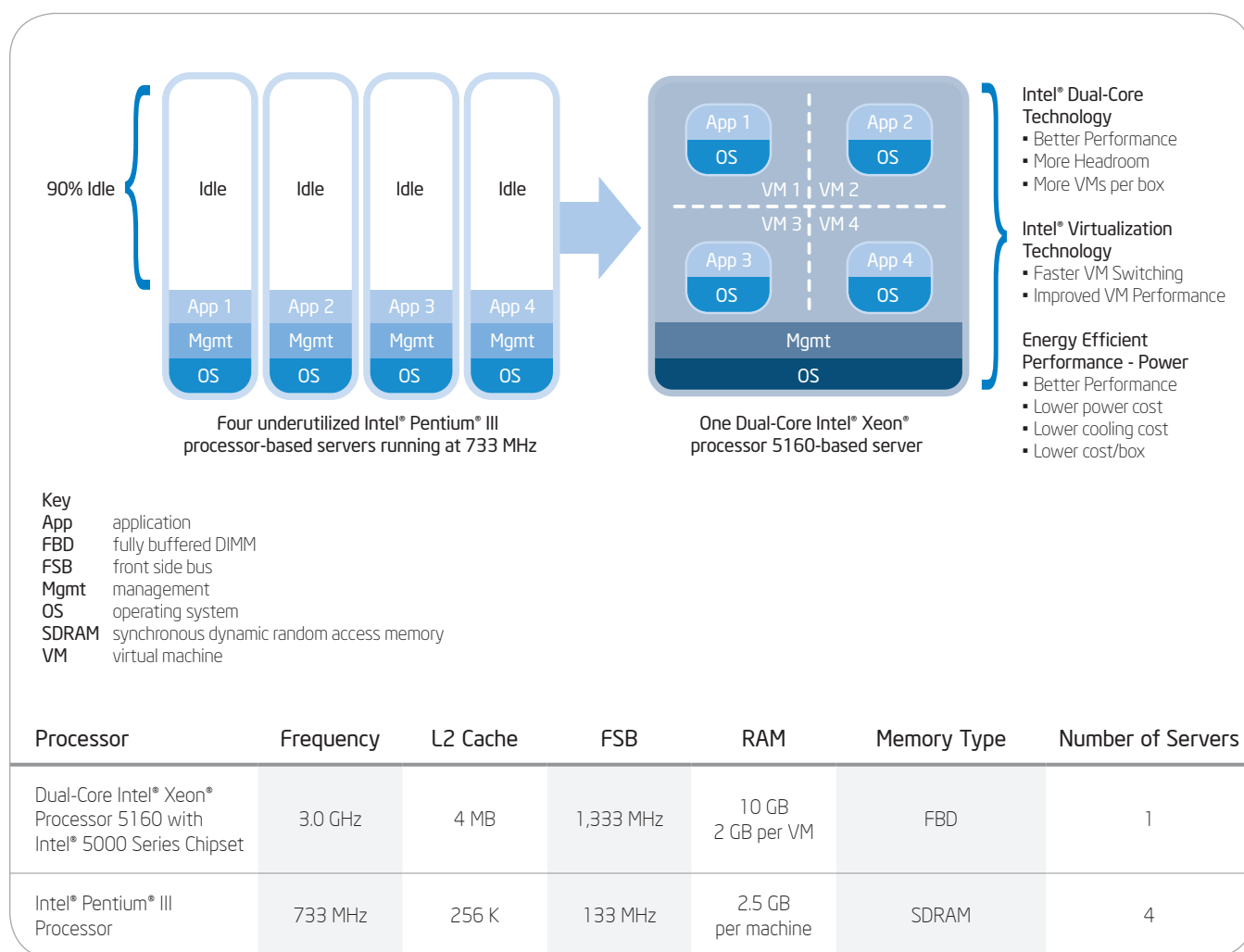
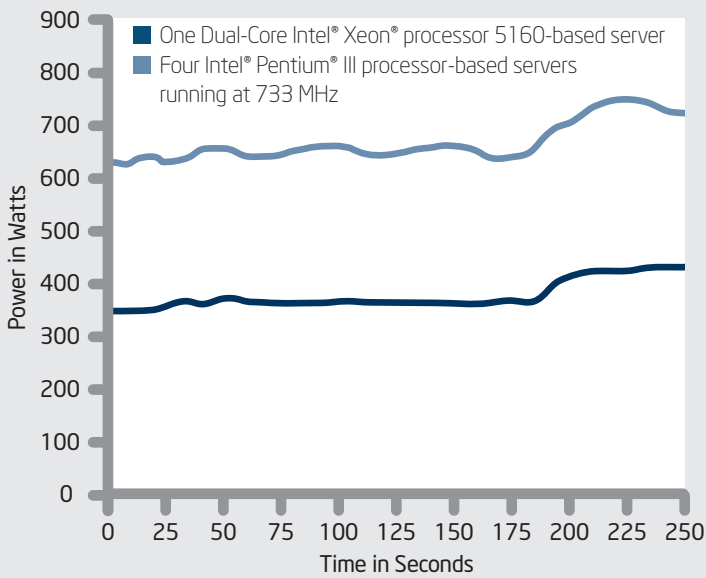


Figure 2. Consolidating servers 4:1. Virtualization solution replaces four older servers with improved performance and reduced power costs.

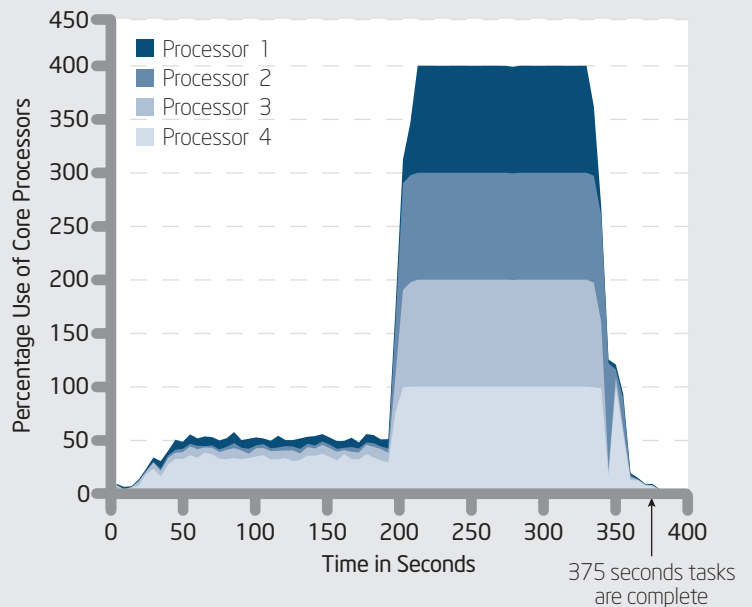
We constructed a database application that created a balance of I/O and CPU intensive application states. We gathered statistics on the operating system performance monitor at the hardware level. Figure 3 shows the CPU

utilization statistics reflecting the two states throughout the job. CPU-intensive application states represent approximately 30 percent of the job time.

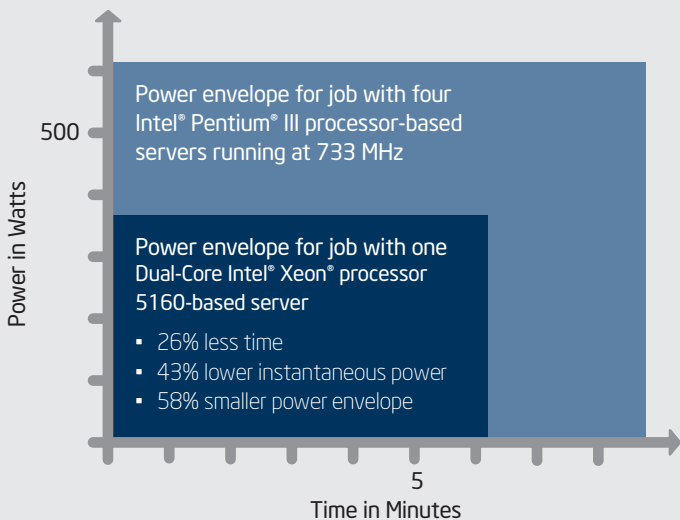
Instantaneous Power during Job



Dual-Core Intel® Xeon® Processor 5160 Processor Time Percentage during Job



Power Envelope Comparison



CPU and Power Utilization

Job Performance	Dual-Core Intel® Xeon® Processor 5160-based Server	Intel® Pentium® III Processor-based Servers Running at 733 MHz
Runtime	6.12	8.28
Average Power	359	631
Average CPU Utilization	28%	53%

Dual-Core Intel® Xeon® processor 5160 completes jobs in 26 percent less time, with 58 percent smaller power envelope

Figure 3. Results demonstrate performance and power savings. With average CPU usage at only 28 percent, we see the potential for higher levels of consolidation through more virtual machines.

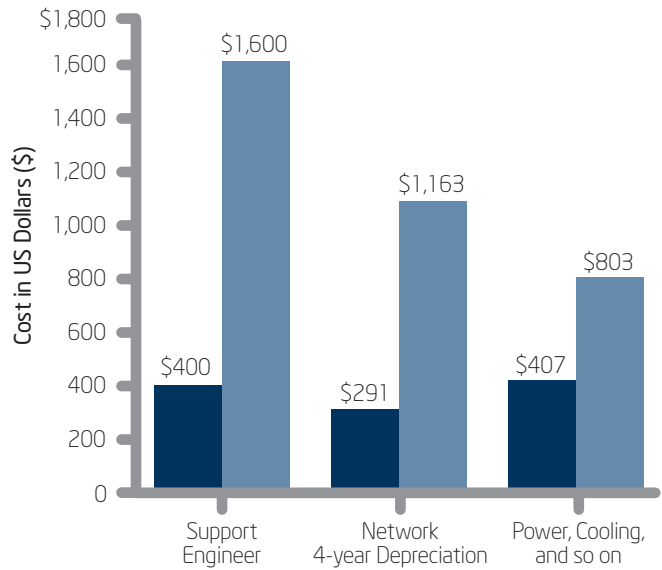
Results

The test demonstrated that the Dual-Core Intel Xeon processor 5160 delivered higher performance as measured by job completion time and better energy efficiency as measured by average power and power envelope. Figure 3, on the previous page, shows the percentages of savings:

- Job time: 26 percent
- Average power: 43 percent
- Power envelope: 58 percent

We projected financial savings based on reduced support, depreciation, and power and cooling costs, as shown in Figure 4. Our assumptions yielded USD 2,468 per year reduction in direct operational costs. This calculation is conservative and does not include costs such as reduced server room square footage, racks, network switches and routers, backup power supplies, and universal power supply (UPS).

Results confirm that the Dual-Core Intel Xeon processor 5160 delivers a virtualization solution that combines high performance, energy efficiency, and lower operational cost through a 4:1 server consolidation strategy. Through measured utilization statistics, we demonstrated the potential for higher levels of savings with more aggressive consolidation of physical machines to VMs in an enterprise data center.



- One Dual Core Intel® Xeon® processor 5160-based server
- Four Intel® Pentium® III processor-based servers running at 733 MHz

Figure 4. Cost comparison of 4:1 server consolidation.

Our results yielded USD 2,468 savings per year in direct data center operating costs. Based on our results, we see potential savings of more than USD 6 million annually in a 10,000-server data center.

Acronyms

EEP	energy efficient performance
TCO	total cost of ownership
UPS	universal power supply
VM	virtual machine

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