CASE STUDY
Intel® Xeon® processor 5500 and 5600 series
Intel® software development products
Performance: Data-Intensive Computing

Energy-efficient HPC

New Intel® processors help Duke University facilitate cutting-edge research while improving energy efficiency by up to 50 percent

Duke UNIVERSITY

"With better processing performance, researchers can tackle more complex problems or run more analyses in less time than before."

– John Pormann, Director, Scalable Computing Support Center, Duke University

Whether they are studying stock market volatility or exploring the human genome, researchers across Duke University turn to the Duke Shared Cluster Resource to access the high-performance computing (HPC) resources required to run large, complex workloads. The IT group that manages those resources needed ways to expand the cluster without growing out of its existing data center. By adding Dell PowerEdge* blade servers with the Intel® Xeon® processor 5500 series, the group enhanced performance while controlling power consumption. The organization is now saving approximately USD 100,000 per year in power costs and avoiding the costs of moving to a new facility.

CHALLENGES

- **Increase performance.** Provide the best possible computational performance for solving large-scale problems in a broad array of research fields.
- **Control energy consumption.** Adopt a dense, energy-efficient hardware platform to expand the HPC cluster without having to increase data center power, cooling, or real estate.

SOLUTION

- **Dell servers with Intel Xeon processors.** The IT group added Dell PowerEdge M610 blade servers with the Intel Xeon processor 5500 series to maximize energy-efficient performance. Intel® software development products help developers optimize code for the latest Intel processors.

IMPACT

- **Larger workloads, faster results.** With better processing performance, researchers can run larger, more complex workloads and achieve results faster than before.
- **Optimized code.** With Intel software development tools, software developers have achieved up to 50 percent performance improvements just by recompiling code.
- **Increased efficiency and reduced costs.** The new Intel processors helped reduce power consumption by up to 50 percent per server compared with previous-generation processors, potentially saving more than USD 100,000 per year in energy costs and avoiding expensive data center renovations.

The Duke Shared Cluster Resource enables more than 70 different groups across campus to produce breakthrough research, but the 50-year-old facility that houses the cluster is far from cutting-edge. "The building was definitely not designed to serve as a data center," says John Pormann, director of the Duke University Scalable Computing Support Center (SCSC), which is responsible for managing HPC resources. "With more than 700 servers in operation, we were nearing the limits of power and cooling. We need efficient technologies that will let us expand our resources and improve performance without requiring major facility renovations."

The SCSC group also must continuously incorporate the latest processors to deliver the greatest possible performance for research. "Our researchers need a combination of raw compute power and high memory capacity to run increasingly large and complex workloads," says Pormann. "Researchers use grant money to fund purchases, and it is our job to select hardware that will deliver the greatest performance for their investment."

Intel and Dell Help Duke Plan New Technology Investments

For several years, the SCSC group has selected Dell servers equipped with Intel processors for its HPC nodes. Teams from Dell and Intel play key roles in helping the Duke group plan for those new hardware purchases. "Both the Intel and Dell teams provide us with technology road maps so we can plan for future technology and spend wisely," says Pormann. "In some cases, waiting for the next technology release pays off. We can make sure professors are maximizing the value of their investments."

New Intel® Xeon® Processors Deliver Increased Workload Performance

For recent acquisitions, the SCSC group selected Dell PowerEdge M610 blade servers equipped with the Intel Xeon processor 5500 series. Besides providing outstanding raw compute power and eight processing cores for each blade server, the Intel processors support the increased memory capacity that researchers increasingly demand. "More and more of our researchers are asking for large memory configurations for their workloads," says Pormann. "With the new Intel Xeon processors, we can equip our servers with much larger memory capacity than before so researchers can see greater detail in engineering simulations, include more data in bioinformatics calculations, and study the interactions of more cells in each computational biology simulation."

Researchers immediately noticed the improved performance of the Intel Xeon processor 5500 series. "With better processing performance, researchers can tackle more complex problems or run more analyses in less time than before," says Pormann. "They also can do more with less. In some cases, each new server enables researchers to do the work of eight or more previous-generation servers. They are getting much greater performance for their money."

Intel® Xeon® processors deliver energy-efficient performance

Duke Reduces Energy Consumption Up to 50 Percent per Server

Moving to the Intel Xeon processor 5500 series has helped the IT group achieve that improved performance while controlling energy use. A study conducted by Pormann shows that the new Dell blade servers with the Intel Xeon processor 5500 series consume up to 45 percent less power than older 1U Dell rack servers with the Intel Xeon processor 5300 series. The study even shows a sizable reduction in power compared with the previous-generation Intel Xeon processor 5400 series. The Intel Xeon processor 5500 series uses 18 percent less power than the previous-generation processor, regardless of processor utilization levels.

"We have seen significant reductions in power consumption with each new generation of Intel processors," says Pormann. "With these new processors, we can deliver the performance our researchers need while staying inside our existing data center."

By purchasing more energy-efficient servers, the organization has seen considerable cost savings. "We estimate that we will save around USD 100,000 per year in power and cooling costs while also avoiding the higher costs of data center renovations," says Pormann. "With all of these savings, we are planning to launch new projects that will increase IT automation and improve the efficiency of our operations even more."

SPOTLIGHT ON THE DUKE SHARED CLUSTER RESOURCE

The Duke Shared Cluster Resource provides access to high-performance computing resources for Duke University research groups in a range of fields, from chemistry, physics, and engineering to biology, sociology, and economics. With more than 700 nodes and more than 4,000 cores, the cluster makes a strong contribution to the breakthrough research conducted at the university.

Intel® Compilers Enhance Application Performance by Up to 50 Percent

To help optimize applications for the latest Intel® processing architecture, the SCSC group has moved from open-source development tools to Intel® software development products, including the Intel® Compiler Suite. The group also is exploring the Intel® MPI Library for parallel programming.

The Intel tools are helping to deliver measurable improvements compared with open-source tools. "We have seen anywhere from 20 to 50 percent improvement in performance, just by recompiling, not even changing any line of code," says Pormann. "Using the Intel MPI Library with the Intel compilers should provide acceleration for message passing as well."

Duke Has a Foundation for Sustainable Growth

As the SCSC group continues to expand the cluster, it will incorporate servers with the Intel Xeon processor 5600 series to maximize the sustainability of growth. "With 50 percent more cores in each blade server, we could see a 50 percent performance improvement without any increase in energy consumption or real estate," Pormann says. "As a result, we can continue to sponsor more and better research at Duke without major overhauls of the data center."

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