CASE STUDY
Intel® Xeon® Processor E5 Family
Education
High-Performance Computing
Energy, Environment, and Performance

Enabling Innovative Research while Maximizing Energy Efficiency

Canadian HPC consortium SHARCNET generates impressive energy savings by investing in new servers based on the Intel® Xeon® processor E5 family

SHARCNET™

"By purchasing new servers with the Intel® Xeon® processor E5 family, we have reduced the data center footprint of these servers by about 95 percent while delivering the same overall level of total performance. We have freed up data center resources and reduced IT management burdens while maintaining high performance and capacity."

– John Morton
Technical Manager, SHARCNET

The Shared Hierarchical Academic Research Computing Network (SHARCNET)—a consortium of 17 Canadian universities, colleges, and research institutes—provides world-class high-performance computing (HPC) resources to researchers in a broad range of disciplines. To capitalize on energy-efficiency incentives from the local power distribution company, SHARCNET needed to reduce the energy its clusters consumed. By replacing aging AMD-based servers with new HP ProLiant* servers based on the Intel® Xeon® processor E5 family, the consortium can deliver up to 20 times better performance per server while using 95 percent fewer servers to achieve the same overall cluster performance. Energy cost savings are funding capital expenditures that support innovative research.

CHALLENGES

- **Reduce operating costs by capitalizing on energy-efficiency incentives.** Earn significant incentives from the local power distribution company and free funding for new capital expenditures by reducing power consumption of HPC clusters—without sacrificing capacity or performance.
- **Make room for growth.** Reduce the power, cooling, and real estate needed to support future expansion of HPC resources.

SOLUTION

- **HP servers based on the Intel Xeon processor E5 family.** SHARCNET replaced aging AMD-based servers with new HP ProLiant SL230 servers equipped with the Intel Xeon processor E5 family.

TECHNOLOGY RESULTS

- **Improved single-node performance by 20 times.** Better raw processing power plus greater core and socket density enable the new servers to deliver 20 times the performance per node of previous servers.
- **Increased cluster density by 95 percent.** Replacing 768 servers with just 40 based on the Intel Xeon processor E5 family, SHARCNET has gained significant data center space for future expansion.
- **Reduced energy consumption and costs.** By using fewer nodes to deliver the same performance, SHARCNET reduced energy demand, earned a CAD 137,000 incentive from the local power distribution company, and is saving over CAD 200,000 per year.

BUSINESS VALUE

- **Accelerated research.** Researchers using single nodes for workloads can capitalize on performance gains to speed results.
- **Freed funding for capital expenditures.** The member institutions can use energy cost savings to fund new capital investments that will help support additional, larger, and more complex research projects.

One of the largest HPC consortiums in Canada, SHARCNET supports researchers in fields ranging from astrophysics, computational chemistry, and bioinformatics to economics, finance, and most recently, the digital humanities. The consortium runs four primary clusters plus several specialty clusters that are dispersed across data centers in the province of Ontario. Through its centralized management structure, SHARCNET strives to make all of its resources available to all researchers, regardless of their specialty or location.

The Intel® Xeon® processor E5 family enables consolidation and energy savings by delivering outstanding performance

Though the universities pay the bulk of the operating costs for the clusters by covering the costs for space and power, the SHARCNET team is always looking for ways to reduce expenditures on their behalf. A new incentive program from the local power authority provided an opportunity to significantly cut costs. "The local power distribution company was offering substantial incentives if we could reduce power consumption and demand," says John Morton, technical manager at SHARCNET. "We presented the opportunity to the universities, explaining that if they could provide a little bit of capital for new HPC systems, we could save them a lot on operational costs."

Besides capitalizing on power company rebates, the SHARCNET team wanted to make room for future growth. "The machine room had reached its limits for power, cooling, and real estate," says Morton. "We knew that if we could increase the density of a cluster, we could free up resources for additional expansion down the road."

To earn the incentives and free up valuable data center resources, the SHARCNET team targeted a five-year-old, 768-node cluster named Whale for decommissioning. Whale used HP servers based on AMD processors. "The existing AMD-based systems were out of warranty and nearing the end of their useful lives," says Morton. "We might have been able to keep them running for another year, but the power company incentives provided a sufficient reason to make the change when we did. We decided to decommission Whale and add the equivalent capacity to another cluster—Orca."

Refreshing HPC Resources with the Intel Xeon Processor E5 Family

After selecting HP as the hardware vendor, the SHARCNET team began to evaluate processing architectures, including options from AMD and Intel. "We wanted the processor that could deliver the greatest compute performance at the best price," says Morton. "When we saw that the Intel Xeon processor E5 family could deliver 8 FLOP/s per cycle, we realized that we could match the total FLOP/s of the cluster we were replacing while using far fewer servers."

The memory bandwidth available with the Intel Xeon processor E5 family was another key factor in the decision. "With large-scale memory bandwidth, the Intel Xeon processor E5 family provides superior performance and scalability for certain codes compared with competing architectures," says Morton.

The SHARCNET team selected HP ProLiant SL230 servers equipped with the Intel Xeon processor E5-2670. The cluster runs a CentOS* operating system and supports applications for a wide range of research fields.

SHARCNET staff and researchers also use Intel® software development tools to help optimize code for Intel Xeon processor–based clusters. "We have benchmarked a number of different compilers, and we found that Intel® Compilers helped to deliver the overall best-performing applications," says Morton.

Boosting Individual Node Performance by 20 Times

The new servers offer significantly greater performance than the aging ones they are replacing. "With greater raw compute performance and larger core counts than the previous processors, the Intel Xeon processor E5 family enables the new servers to deliver 20 times the performance per server compared with the previous systems for particular codes," says Morton. "Researchers using single nodes will be able to generate results much faster than before. At the same time, by improving the performance of every node, we have been able to reduce the total number of nodes we need."

Increasing Infrastructure Density by 95 Percent

With the new servers, SHARCNET has increased the density of the cluster dramatically. "We replaced 768 nodes with just 40," says Morton. "By purchasing new servers with the Intel Xeon processor E5 family, we have reduced the data center footprint of these servers by about 95 percent while delivering the same overall level of total performance. We have freed up data center resources and reduced IT management burdens while maintaining high performance and capacity."

Saving over CAD 200,000 per Year in Energy Costs

With fewer servers running in the data center, SHARCNET reduced energy consumption by more than 200 kilowatts, which results in an annual savings of approximately two million kilowatt hours. That reduction helped SHARCNET earn substantial energy incentives from the local power distribution company and is enabling the consortium to drive down overall operating expenses. "We are saving the universities significant amounts of money per year on electricity costs," says Morton. "With these savings, we expect a return on investment in under two years."

The member universities intend to invest those savings in capital expenditures. "We are currently planning to add another 32 nodes to Orca, likely to be based on the Intel Xeon processor E5 family," says Morton. "As we add these and other new systems in the future, we can help researchers tackle larger, more complex problems than ever before."

LESSONS LEARNED

For the SHARCNET team, this refresh of HPC resources highlights the importance of considering the total cost of ownership when evaluating new investments. "Organizations often separate operating and capital costs," says John Morton, technical manager at SHARCNET. "Our recent refresh project shows that an investment in newer, higher-performance servers can actually help significantly reduce total costs in the long run."

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