CUSTOMER
SHARCNET
www.sharcnet.ca

INDUSTRIES
Higher Education
High Performance Computing (HPC)

CHALLENGES
- Academic research requires HPC systems with the most realistic modeling available
- Computational limitations restrict simulation quality
- Cutting-edge hardware is required to support computational research in fields including medicine, finance, and the environment

SOLUTION
System of HPC servers built with 12-core AMD Opteron™ 6100 Series processors ("Orca Cluster"). The AMD Opteron™ processor Model 6174 in the HP ProLiant servers run at 2.2 GHz.

RESULTS
- Expanded research design capabilities through expanded throughput
- Decreased time waiting for research jobs to be processed
- Global recognition of Canada for having world-class HPC access
- Advance research on disease control, environmental protection, and financial investment

TECHNOLOGY AT A GLANCE
- AMD Opteron™ 6100 Series processors
- HP ProLiant SL165z G7 servers

SHARCNET Consortium Builds High Performance Computing Cluster with AMD Opteron™ Processor Technology.

About SHARCNET

SHARCNET, the Shared Hierarchical Academic Research Computing Network, is a consortium of Canadian universities, colleges and research institutes that provide a network of high performance computers and software. In practical computing terms, SHARCNET is a cluster of clusters.

Three fundamental goals guide their operations:
- Accelerate production of research through cutting-edge computational expertise and hardware in HPC
- Join academic researchers and corporate partners to achieve business opportunities
- Attract the best students, researchers, and companies for successful collaboration.

SHARCNET's HPC models and simulations powered by AMD technology are addressing some of the world's most critical issues: the spread of highly infectious diseases; development of environmentally friendly cars; prevention of climate change; and financial portfolio investment.

SHARCNET provides the infrastructure, networks, and resources to provide facilities for world-class computational research. Their infrastructure includes 20,000 processors and dozens of visualization workstations, contributed systems, and specialty systems. SHARCNET also provides a set of six dedicated HPC systems, each built for a specific target utilization. One of those, the Orca Cluster, serves as a large MPI (Message Passing Interface) capacity cluster for parallel processing job submissions.

About Orca

The Orca Cluster is built on 7,680 AMD Opteron™ 6100 Series processor cores. Some 320 HP ProLiant SL165z G7 server nodes, with a total of 10TB of RAM, each contain two 12-core AMD Opteron™ processors Model 6174 running at 2.2 GHz with 12MB Level 3 cache. The equipment was funded by Compute Canada's National Platforms Fund, awarded by the Canada Foundation for Innovation.

AMD

Orca was designed so that users experience the best performance with jobs that use whole nodes. That is, threaded jobs should use 24 cores and MPI jobs should use multiples of 24 cores. With 67 Teraflops of peak compute power, Orca more than doubled SHARCNET's capacity for research when it launched in early 2011.

Dr. Robert Mercer is a professor of Computer Science at The University of Western Ontario and a SHARCNET user for the last five years. His research interests revolve around various aspects of artificial intelligence, with many applications in the area of human language processing. He was one of the first scientists to start using Orca.

"SHARCNET is always looking at enhancing, and Orca is their latest and greatest. In order for us to report the functionality of what we've done, we have to benchmark our problem-solving. Each of Orca's nodes is faster. The CPU is faster, so it has really helped us with our benchmarking because we can do it more quickly," says Mercer.

For more information on the AMD Opteron™ 6100 Series Platform, visit: http://www.amd.com/us/products/server/processors/6000-series-platform/

Seeking answers to complex problems

Dr. Mercer and his graduate students are working on a unique form of logic programming called Answer Set Programming, which allows the user to specify ways to solve problems in a rule-oriented format. "You describe the problem, and we build solvers to take this declarative representation and come up with solutions that match that declarative representation as quickly as possible. What we've discovered is that the problems get very complex very quickly and so we're interested in using distributed and multi-threaded program machines to solve these programs," says Mercer.

This type of language-based problem solving can help advance online security via encryption and verification programs, and medical and pharmaceutical breakthroughs through bio-informatics models. The processing capabilities enabled by the latest designs of HPC clusters are significant in this area of research.

One of Dr. Mercer's researchers, Jonathan Leaver explains, "Some of the benchmarks that we use to measure how well our software is performing were selected a number of years ago, and they were considered significant benchmarks at that time. It is almost trivial running them now on the new Orca Cluster in the sense that they don't scale because the problems are so simple, compared with what the cluster is capable of handling."

Earning global recognition

Access to a world-class resource like the Orca Cluster has also afforded the University of Western Ontario's Computer Science department status and recognition from colleagues in the international research community.

"This is a competitive advantage for us because in North America we have access to a lot of these large, multi-threaded nodes that our colleagues in Germany and England don't have. The capacity of the problems they can tackle are a little bit more limited," says Leaver.

"It's nice to be able to come to the table and say that we can run some of the tests that they can't run or potentially tackle some of the problems that they may not yet have equipment for. And it enables us to explore some possibilities that are sort of unique in our field, in terms of building a faster and more efficient system."

New frontiers in research that require the latest hardware

The leading-edge nature of their research requires Dr. Mercer and his team to use hardware technologies at the forefront of what's possible in the present moment. "It takes one to two years for us to design and build our software. Unless we're doing it on cutting-edge hardware, it wouldn't make any sense for us."

There's probably no hardware feature more critical for their specific purposes than the cluster's parallel and multi-threaded processing capabilities. "If we can get our hands on more parallelism, that's a good thing for our research," says Leaver.

Dr. Mercer's first-hand experience with AMD technology was also a factor when it came time to purchase a cluster for another research project. "We were pleased with what we were able to get on SHARCNET, and we transferred that confidence to our purchase of another cluster. Our experience with AMD convinced us when we were buying this cluster that AMD was one of the key suppliers that we wanted to look at."

For more information on AMD High Performance Computing (HPC), visit: http://sites.amd.com/us/business/it-solutions/compute-intensive-hpc/Pages/compute-intensive-hpc.aspx

"We really need to have resources that are dedicated to us so that we can push forward in a timely way. That's something that SHARCNET and the Orca Cluster can give us. Without it, we'd still be working on smaller clusters and not getting anywhere near the throughput, let alone the design architecture that we're now looking at."

DR. ROBERT MERCER
Professor of Computer Science, The University of Western Ontario

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