



“HP provides us with high performance computing technology that is critical to Canada’s competitiveness as a world-class research community. Such technology accelerates our ability to produce results that are beneficial to our economy, health, environment, scientific knowledge, and culture.”

—Hugh Couchman, Scientific Director, SHARCNET

Objective:

Expand high performance computing resources to academic researchers in areas such as genomics, weather prediction, planetary science, and nano-scale electronics.

Approach:

Architect an extremely high performance single system image of a physically distributed computing environment.

IT improvements:

- HP Cluster Platform 4000 systems based on HP ProLiant servers with AMD Opteron processors
- XC System Software
- HP StorageWorks Scalable File Share
- HP Scalable Visualization Array

Business benefits:

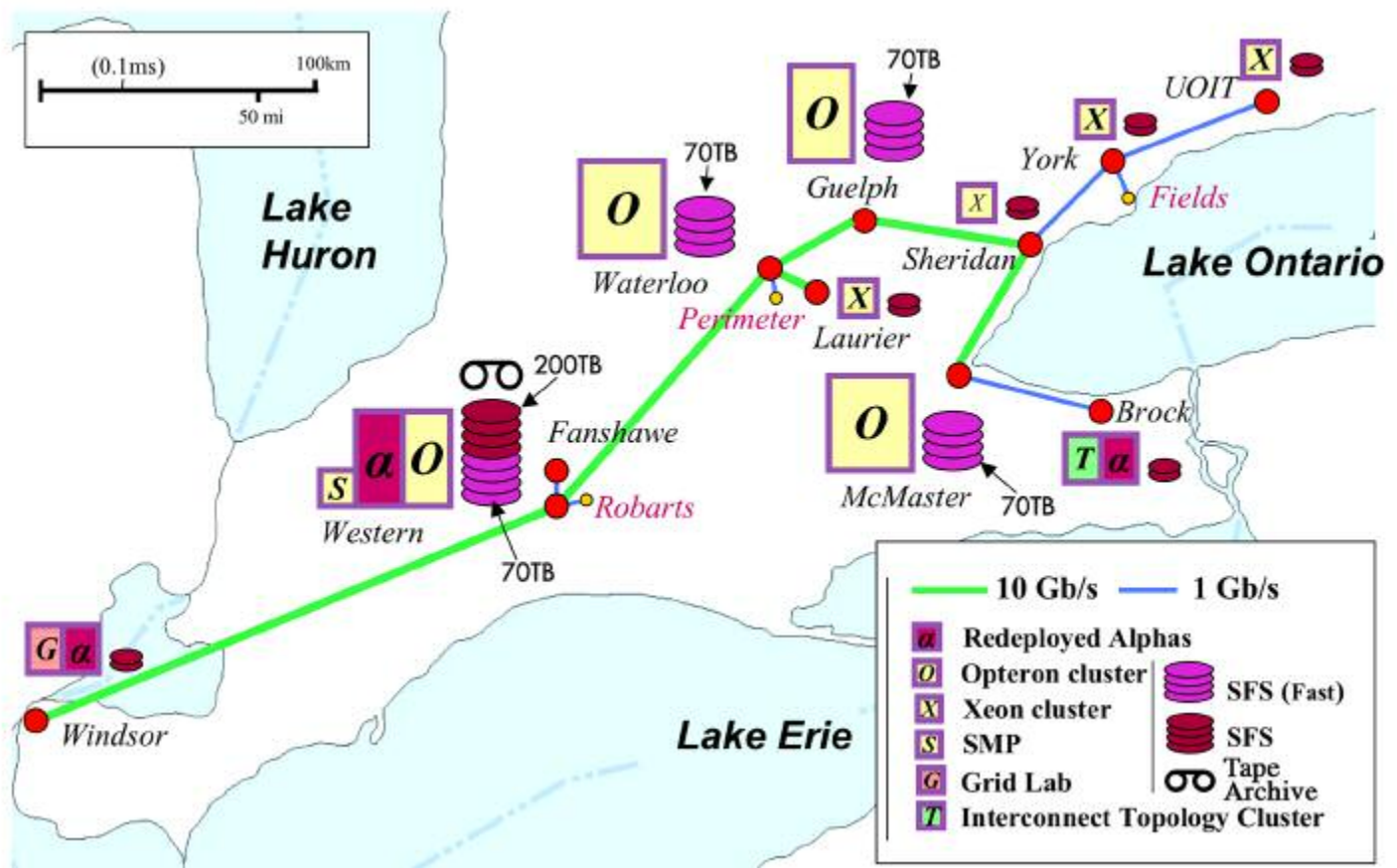
- More than 25 teraFLOP/S of performance in a distributed environment.
- XC System Software provides a single, supported user environment.
- Five sharable high-bandwidth file systems with a total of 500 terabytes of capacity distributed across four campuses. The storage system scales as computing capacity increases.
- Scientists and engineers now visualize and analyze complex sets of data more cost effectively.
- SHARCNET researches produce and analyze data faster, resulting in accelerated research.

Enabling World-class HPC Research

Canada’s Shared Hierarchical Academic Research Computing Network (SHARCNET) is a multi-institutional, high performance computing network that spans sixteen leading academic institutions in south western, central, and northern Ontario. Established in January 2001, SHARCNET is structured as a cluster of clusters. Each of the institutions in the group is connected over an optical network to the distributed compute and storage resources and has equal access to the technology.

SHARCNET’s mission is to meet the computational needs of researchers as they accelerate the production of world-class research results. The consortium also facilitates the development and testing of leading-edge tools for high performance computing grids.

In 2004 SHARCNET received a \$50 million grant from the government and other sponsors to expand its clustered computing network. Approximately \$20 million of the new grant was used to purchase four new parallel compute clusters from HP. These clusters, with a total of 1,900 servers, are housed at separate SHARCNET academic institutions throughout the consortium and deliver more than 25 teraFLOP/S of performance. SHARCNET’s HP Cluster Platform systems collectively form the most powerful supercomputer in Canada and achieve ranking on the Top500 supercomputer list.



A Balance of Computation, Storage, and Visualization

Like many HPC scientific and engineering organizations, SHARCNET needed a storage and visualization system that would scale commensurate with increases in computing capacity. The SHARCNET installation implements HP's Unified Cluster Portfolio, a comprehensive, modular package of tested and pre-configured hardware, software and services for scalable computation, data management, and visualization. The solution includes four components of portfolio: the HP Cluster Platform, the XC System Software, HP StorageWorks Scalable File Share (HP SFS) system, and HP Scalable Visualization Array (HP SVA).

"The HP Unified Cluster Portfolio provides us with an integrated, open-source based supercomputing utility to support distributed, high-performance computing, data management, and visualization."

"Our researchers throughout the consortium are able to use as much or as little of the processing and data capacity as they require and seamlessly access it from anywhere on the network."

Hugh Couchman, Scientific Director of SHARCNET

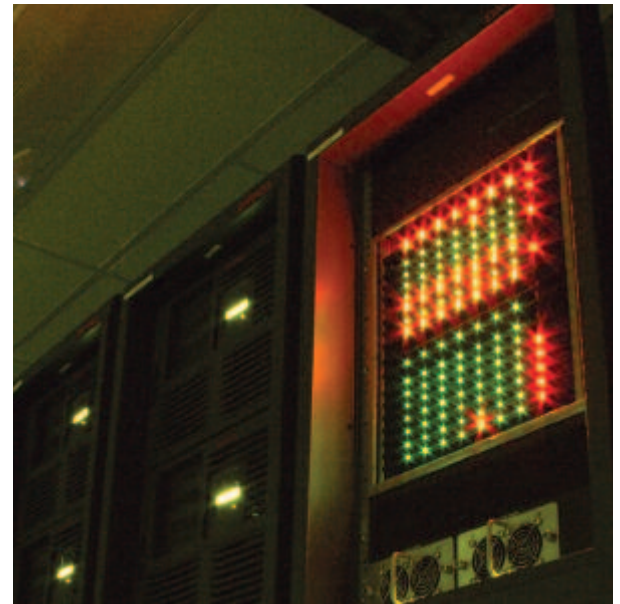
The HP clusters at SHARCNET consist of HP Cluster Platform 4000 systems based on HP ProLiant servers with AMD Opteron™ processors running HP's Linux-based XC System Software. The interconnect between the clusters includes Gigabit Ethernet, Quadrics Ltd. ELAN4, and Myrinet.

The XC System Software presents the user community with a single, supported environment, allowing management of a diverse and distributed workload across separate clusters—each having distinct design attributes. Using Platform Computing's Load Sharing Facility (LSF), the software gives users a full Linux operating system, workload management, and job scheduling environment. Administrative resources and costs are minimized through the comprehensive resource management functionality and scalability enhancements available in the software.

“Having a storage system that scales along with the increases in our computing capacity and demands is critical to SHARCNET’s increasingly complex scientific and engineering applications...”

Hugh Couchman

Scientific Director of SHARCNET



Robust Storage

SHARCNET integrated 500 terabytes of HP StorageWorks Scalable File Share systems into the distributed clusters—resulting in a single, sharable, high-bandwidth file system. The HP SFS is a self-contained file server that increases bandwidth by distributing files in parallel across clusters of industry-standard server and storage components. It is the first commercial product to leverage Lustre, a Linux clustering technology developed by Cluster Files Systems, HP, and the U.S. Department of Energy.

SHARCNET originally solicited bids from IBM, Sun Microsystems Inc., and Silicon Graphics Inc. before finally choosing the HP SFS. The selection group at SHARCNET had past experience with previous generations of parallel file systems and had encountered problems. “Sometimes a cluster would hang for twenty minutes just writing out a checkpoint file, so we were acutely aware of the need to pay attention to the file system. We felt HP SFS provided us with a much more robust solution,” Couchman said.

HP SFS can span dozens to thousands of clustered Linux servers, making it ideal to run distributed applications for data-intensive engineering and research projects. The low-cost, high performance and resilient StorageWorks SFS20 disk technology used in HP SFS appliances enables SHARCNET to economically expand their capacity to 500 terabytes of useable storage.

“Having a storage system that scales along with the increases in our computing capacity and demands is critical to SHARCNET’s increasingly complex scientific and engineering applications,” continued Couchman.

“HP SFS provides that scalability, along with very high bandwidth. Such technology helps us produce and analyze data much faster and dramatically accelerates research results.”

The selection group at SHARCNET also liked the fact that SFS is based on the Lustre file system. Price was another factor in choosing HP SFS over competing products. “In academic research we are extremely cost conscious; we don’t want to spend a lot on software,” explained Couchman. “And since HP SFS uses open source Linux code, we can modify the software as needed.”

High Performance Visualization

SHARCNET is using the HP SVA to deliver shared, high-performance, low-cost visualization across the clusters. The SVA uses industry-standard components and leverages advances in clustering, graphics, and networking technology to allow scientists and engineers to visualize and analyze complex sets of data. SVA technology can produce a vast, high-resolution display wall of 100 million pixels or more at approximately half the cost of competitive proprietary products.

“Our ability to generate large data sets has outstripped our ability to visualize them, both for deriving science and verifying correctness,” continued Couchman. “By integrating HP SVA with the HP Scalable File Share and XC software, we are now able to visualize and manipulate huge data sets in real time as an extension of computing and data management in the cluster.”

Pioneering Grid Computing

Grid technologies enable secure sharing of IT resources across geographic and organizational boundaries, helping HPC organizations do more with less and deploy resources rapidly for new projects. SHARCNET, a recognized pioneer in grid computing, is a test bed for innovative scalable HPC solutions over a distributed network. Using HP Cluster solutions, such as SFS and SVA, distributed data storage and visualization solutions are available to all researchers in the consortium.

SHARCNET's Innovative Research

The HP cluster is assisting SHARCNET researchers in numerous studies, such as exploring human genomics; containing infectious human and animal diseases; improving weather prediction; simulating the collapse and formation of planets; and developing nano-scale electronic devices.

Modeling Infectious Diseases in Animals

Researchers at the University of Guelph are using SHARCNET resources to model infectious diseases in animals. Foot-and-mouth disease (FMD) is a highly contagious and economically devastating disease that affects cattle, pigs, sheep and other cloven-hoofed ruminants. High performance computers can help researchers model how the disease is spread and how to better implement containment strategies.

"With high performance computing, researchers will be able test out increasingly more complex models, with improved speed and larger capacities for better understanding of how disease spread models work and how they relate to biological reality."

These results play a crucial role in helping animal health professionals design outbreak containment strategies. The opportunity to work with animal health researchers from Canada and the United States and to expose them to the potential of cluster computing is extremely exciting."

Dr Deborah Stacey, Professor of Computing and Information Science, University of Guelph

Predicting Weather Elements

SHARCNET researchers are also using the HP high performance systems for weather forecasting, environmental modeling, and prediction. Massive computing resources are needed to improve the accuracy of weather and climate models by improving space-time resolution, the representation of physical processes of models, and better quantifying modeling and forecast uncertainties.

Groundwater Flow and Transport Modeling

Researchers at the University of Waterloo are using SHARCNET's HPC resources to help protect ground and drinking water. Computational models describe fluid flow and the migration of contaminants in groundwater. Models developed by the group over the past twenty years are used worldwide at universities, research institutions, government agencies and in the private environmental consulting industry.

To learn more, visit www.hp.com

© 2006 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice. The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

4AA0-7843ENW, September 2006

