Case Study

Intel® Xeon® Processor
Intel® Virtualization Technology
Life Sciences
Bioinformatics

CENTRE FOR COMPARATIVE GENOMICS
Western Australia

Murdoch UNIVERSITY

Accelerating Core Competencies

The Centre for Comparative Genomics at Murdoch University accelerates research with 512-core Intel® Xeon® processor platform

The Western Australian Centre of Excellence in Comparative Genomics (CCG) represents a unique approach to research in Comparative Genomics drawing together biomedical and agricultural research and development, bioinformatics activities and expertise in comparative genomics.

At the heart of the Centre is the Bioinformatics Research Laboratory (BRL) which represents a unique scientific infrastructure for Australia. Comparing the unique genetic information, or genome, of living organisms encoded in their DNA between individuals within and across species, requires cutting-edge computational tools, and this is provided by a dedicated high performance computing capability, the iVEC Informatics Facility.

The Facility was recently upgraded from 30 cores to a 512-core cluster based on the latest Intel® Xeon® processors which are helping the Facility to significantly increase computational performance.

"The success of the system is working in our favour to promote our capabilities and helping us better service the community."

Adam Hunter
Associate Director,
CCG and Co-Director iVEC
Informatics Facility

Challenge

- **Enhance University's reputation in the life sciences.** Build up computing resources that enhance the University's research profile and academic standing.
- **Increase computing capacity.** Current system could not meet CCG's computational needs, and more performance is required to expand research capabilities
- **More efficient computing platform.** Improve significantly the computational performance to power usage ratio thereby increasing performance with minimal impact to the environment.

Solution

- **High-performance computing cluster.** Upgrade underlying platform at the iVEC Informatics Facility to a cost-effective High Performance Computing (HPC) platform based on the Intel® Xeon® 5400 processor series with quad-core processors.
- **Virtualization technology.** Employ a virtual server environment as the infrastructure to run the CCG by utilizing Xen Linux based virtualization on the Intel platform to attain maximum processor utilization while negating heat and power issues.

Impact

- **Accelerated computing.** Significant increase in time savings in running and interrogating genomic datasets more quickly.
- **Eco-friendly solution.** Increased Centre's compute performance capabilities with minimal heat and power consumption.

With the Intel® Xeon® processor platform, Murdoch University delivers value to the community by accelerating research into Comparative Genomics and services.

Core requirement

The Centre for Comparative Genomics' (CCG) vision is to become an international leader in the field of Comparative Genomics, integrating and utilizing world-class bioinformatics and information technology to provide tangible economic and social benefits for Australian communities in the fields of biomedical and agricultural science. Developing and engaging in these research activities not only enhances Murdoch University's reputation, it also enables the CCG to deliver value by testing their research techniques to real world problems. This in turn leads to attracting more students to the life sciences faculty of the University and attracts more grant money that can be used to further develop research.

Research and development efforts are led by the Bioinformatics Research Laboratory (BRL), which was established to support the Centre. The BRL offers leading edge capabilities for the development of computational tools; employs a vast range of data analysis and visualization strategies; and provides expertise in the development of integrated web-based applications.

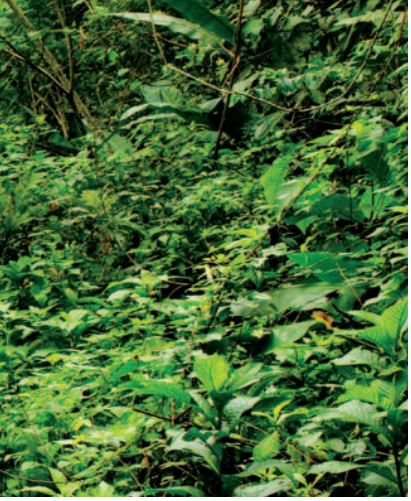
The key to supporting this research is the high-performance computing infrastructure at the iVEC Informatics Facility, located within the CCG. The Facility provides industry and academic researchers with access to state-of-the-art computing infrastructure and support. Maintaining the facility, keeping it updated and relevant is important for the CCG to maintain the effectiveness of its research—which is the reason the CCG decided to upgrade the platform. "We needed more cores. It was as simple as that," says Adam Hunter. "The previous infrastructure was only a 30-core system and we simply couldn't meet our computational needs."

Need for speed: performance, cost, & green IT

"We were looking for a more general purpose machine," says Hunter. "We wanted a high-speed, low latency solution giving us the ability to do a whole range of things we couldn't do before." Coupled with the need for a high performance platform was the need to ensure that the new platform was energy efficient and cost effective. Generally, as computing performance and capacity increases, so does the electricity bill as more cost is incurred running and cooling the system. Enhancing the energy efficiency of its facility was one of the key aspects of the upgrade. Being environmentally responsible was also tied to realistic issues such as budget and space in terms of housing equipment. Improving data center energy efficiency is becoming a fundamental requirement in most organizations, not only to contain operating costs, but also to support growth, extend the life of existing facilities, protect the environment, and address increasing regulatory requirements.

According to Gartner[1] research, "Going green is about more than just 'political correctness'; it also can have a tremendous, positive effect on business pressures to lower the overall cost of computing." Energy costs will become an increasingly significant component of IT budgets, and an increasingly tough challenge for organizations as they implement strategies to grow their computing capabilities and contain costs.

"Our strategy is based on virtualization," explains Hunter. "We have deployed a virtualized environment and it is driven towards providing the same service with less servers, less power and heat load, and the virtual server situation allows us to do this."



Virtually there

It was for these reasons—high performance, processor efficiencies, green IT and cost—that led the CCG to choose SGI* servers based on the Intel® Xeon® processor 5400 series. Upgrading the facility to a 512-core Intel Xeon processor-based cluster platform enabled CCG to incorporate high performance with a number of advanced energy-saving technologies to pack far more computing power into the facility. This gives the CCG access to increased computational performance with minimal increase in power and infrastructure cooling requirements "We are drawing more power, no question," Hunter admits, "but the amount of computational resource we have is improved by orders of magnitude."

The Intel processor-based 512-core SGI Linux cluster HPC deployment serves as a dedicated research machine for users of the iVEC Informatics Facility. The Intel platform was also suited for deployment as a virtual server infrastructure that runs the CCG.

The open, standard Intel® architecture processor allows the CCG to benefit from the wide freedom of choice within the Intel® ecosystem and take advantage of Open Source technologies such as the Xen* server virtualization running in a Linux environment. Xen supports Intel® Virtualization Technology (Intel® VT)2 that is built into the Intel® Xeon® processor. Hardware-assisted Intel® VT enhances software-based virtualization solutions like Xen to provide greater flexibility and maximum system utilization of the processors to run multiple virtual machines efficiently.

"Virtualization reduces the number of physical servers we have," Hunter further explains. This enables the CCG to simplify its server environment by consolidating more applications on fewer physical servers, avoiding costly facility expansion and lowering management costs.

Performing well

"The best benefit, in a nutshell, is having more computational capacity that is significantly more energy efficient," says Hunter. "With the [Intel Xeon processor] quad-core chip and having dual processor main boards, we can run eight threads on a single box giving us a significant increase in speed, and also negated our previous issue of not being able to run across different or multiple machines."

Hunter provided an example of the performance of the new system. "We had a project where it would have taken all our resources and about six months to compute. It was the first job we ran on the new machine and it took 24 to 36 hours."

The successful deployment has not only benefited the CCG in accelerating research computations, it is also enhancing the Centre's reputation among the community. Hunter explains that "we have a lot of external partners who use the machine and this improves our ability to service them as well. We have had nothing but positive feedback in relation to our system, especially in regards to other HPC deployments our clients have used.

Murdoch University's experience bodes well for other Universities looking towards upgrading their computing facilities. Hunter advises having a good team working closely with the vendor in fine tuning the installation. "There is a great deal of customization and if we didn't have our internal team, we wouldn't have been able to pull this off," he says. "We have a very good sense of what we have done; we have studied and worked through a solution which drew on our core competencies."

Summing up, Hunter says that "our success with deploying the HPC has given us confidence to grow and move forward towards new opportunities."

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About Intel® Xeon® processor-based servers: www.intel.com/products/processor/xeon5000/index.htm.

Spotlight: Centre for Comparative Genomics, Murdoch University

- The Centre for Comparative Genomics based at Murdoch University aims to draw together and enhance the activities of diverse, intensive pockets of research activity which extend from the agricultural sciences through to biomedical research to create bioinformatics solutions for the rapidly expanding task of integrating and analyzing large amounts of biological data..
- The Bioinformatics Research Laboratory (BRL) was established to support the Centre's research program and represents unique scientific infrastructure for Western Australia that develops and utilizes innovative techniques and tools to drive its core research program, as well as serve external clients on a fee-for-service basis.
- Murdoch University is an iVEC partner and has established the iVEC Informatics Facility within the CCG to provide a dedicated high performance computing capability to service the needs of the State's biomedical and agricultural community as well as the broader scientific community.

Solution provided by:

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[1]Source: Data Center Conference: Day 4 Highlights the 'Greening' of Data Centers, by John R. Phelps and Mike Chuba, November 30, 2007, Gartner, Inc., ID Number G00153658.

[2]Intel® Virtualization Technology (Intel® VT), Intel®® Trusted Execution Technology (Intel® TXT), and Intel® 64 architecture require a computer system with a processor, chipset, BIOS, enabling software and/or operating system, device drivers and applications designed for these features. Performance will vary depending on your configuration. Contact your vendor for more information

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