Southampton's £3M Supercomputer Goes Live

Fastest, Greenest Academic Supercomputer Cuts Data Processing Times from Years to Days

The University of Southampton is one of the UK's leading teaching and research institutions. It covers a wide range of subjects from engineering and science, to health, humanities and the social sciences.

A High Performance Computer (HPC system) built in 2004 was in use by the University's base of engineering and science researchers. It was generally regarded as 'passed its best' by the research community and the IT team and available processing power was insufficient to meet the demands of its users. The HPC system certainly could not meet future processing demands to take research to the 'next-level', i.e. more in-depth or more detailed research and analysis. It was also unable to support the increasingly multi and inter-disciplinary research teams located across the university.

With the aim of delivering high levels of processing power to potentially hundreds of academics and users, at the lowest deployment and running cost and with the greatest energy efficiency possible, the University of Southampton made the important decision to replace its 3-year old HPC system.

Solution

Custom-designed, built, rapidly implemented in just 1 week, tested and configured for the University by HPC and storage integrator OCF plc (www.ocf.co.uk), the University is now live with a new, much more powerful HPC system founded on IBM server and storage technology.

Named internally as Iridis III (replacing Iridis II), the HPC system has a capability equivalent to around 4,000 standard office computers, running simultaneously. It contains more than 8000 processors and is capable of over 74 trillion calculations per second.

Early performance test results submitted to the June 2009 Top 500 List found the HPC system ranked as the fastest academic HPC system in England and the fastest Windows based HPC in Europe. Separately, it was also ranked as the UK's 'greenest' academic HPC system in the 2009 Green500 List.

Technology

Servers

The HPC system design from OCF uses IBM System x™ iDataPlex™ servers (the first public sector use of iDataPlex in the UK). The innovative, half-depth form factor of iDataPlex reduces the airflow required across the components, lowering the power needed for cooling, whilst providing twice the number of servers in the same space as a standard 42u rack.

The rear door of iDataPlex has an in-built heat exchanger, which uses water to cool the expelled heat before it enters the data centre, making it more environmentally-friendly to use than standard air conditioning alone.

"Bringing 21st century technology into a 20th century, 30-year old data centre is really tough," says Oz Parchment, ICT Infrastructure Services Manager, University of Southampton. "Our key challenge was how to cool the HPC system. The iDataplex has a minimal heat footprint in the data centre, which enables us to *not* have a massive cooling infrastructure around the HPC system. Traditionally we have always banked on 30 per cent of capital expenditure being put towards data centre cooling and other enhancements, but in practice, it was less then 10 per cent. This meant we could invest more money into the HPC system."

Switching

The HPC system design uses 36 QLogic 12200 InfiniBand Edge switches. The switches deliver low-latency and high packet rates enabling the rapid transfer of data between computational units – improving overall performance of the HPC system. In fact, the switches can handle over 40 million packets per second, per port. Traditionally, efficiency of data transfer between such units can be around 70-80 per cent of peak possible usage. However, through the QLogic switches the data transfer is reaching over 90 per cent of peak possible usage. This is also assisted through the use of QLogic's FabricSuite allowing critical applications to finish faster through the use of adaptive routing; virtual fabrics and problem prevention.

Storage

The HPC system design also includes two IBM System Storage IBM DS4700 disk systems managed by IBM's General Parallel File System. The current capacity for that storage hardware is just over 100TBs – with 17TB already in use.

The IBM GPFS file system clusters the storage hardware so that researchers simply have to access one file, as if it was a local c-drive. GPFS also enables the IT team to upgrade and expand the storage hardware without downtime. This will become increasingly necessary as the University further expands use of the HPC to new departments and research areas.

Benefits and Results

The HPC system officially went live in February 2010. It is already in use by around 180 academics and 500 users from a range of departments, not just science and engineering - a fact simply impossible using the University's previous system.

Research projects include the design of quieter, cleaner aircraft, and advanced wind turbines, to drug discovery, tackling climate change, finding the origins of the universe, understanding new communication technologies and developing the next generation of nanotechnology.

The University is now able to 'attack' research related problems which were unsolvable on the previous HPC system, enabling more in-depth, valuable research to take place.

And, importantly, research problems which could take months or even years when processed on the University's previous HPC system, fleet of workstations or individual workstations can now be completed in significantly less time. For example:

- Dr Graeme Earl is using the new HPC system to render visualisations of ancient artifacts – such as a glass roman bottle. Using the previous HPC system such an visualisation would take around 48 hours to render, it is now taking just 2-3 minutes

- Similarly, to create a 'photo of the past', such as a computer graphic visualisation of an ancient site could take up to 4 weeks using a single workstation, it is now taking just a few hours

- Professor John Essex uses the new HPC system to model - in course-grain - the simulation of drugs, such as beta-blockers and how they enter the body. He has seen the time taken to process his research data reduced to just a few hours, down from one week using the previous HPC system and up to one month using a single workstation