



The Research Director
Environment and Resources Committee
Parliament House
George St
Brisbane QLD 4000

We are pleased to make a formal submission to the Queensland Government Environment and Resources Committee Inquiry into Energy Efficiency Improvements.

We have attached a full submission providing information on the key areas we believe we can comment on and taken the liberty of including details of relevant Australian Case Studies which we believe may be of assistance to the Queensland Government as reference sites.

In summary our focus has been the adoption of energy smart standards in the procurement of client and server hardware, optimization of the State's Data Centres, adoption of environmental standards in the procurement lifecycle.

Energy Smart Standards

EPEAT is the newest and most comprehensive standard sponsored by the US Environmental Protection Agency. It combines the best of all of the current standards including WEEE, ROHS and Energy Star. EPEAT is based on the IEEE 1680 standard. More detailed analysis can be found at www.epeat.net The US, Canadian and New Zealand Governments have made this a minimum standard for procurement. EPEAT is incorporated as a 501(c)(4) "social benefit" not-for-profit organization in Portland, Oregon, USA.

American National Standard IEEE 1680, which forms the basis of EPEAT, includes a criterion (4.5.1.1) that requires that every EPEAT registered product meet the current version of the applicable ENERGY STAR standard. Therefore, all EPEAT registered products are also ENERGY STAR qualified.

We would suggest that at minimum new Notebooks, Desktops, Monitors being purchased for Australian schools have an EPEAT Silver/Energy Star Rating of 4.0.

Taking advantage of the latest energy saving software is also vital for Government we recommend 1E nightwatchman which turns pcs's off at night and SMSWakeup to repower machines from a central command. More detail can be found at www.1e.com

Dell US has recently applied these technologies to its own fleet with expected savings of up to a 40% reduction in energy costs for our desktop and notebook computers. More detail can be found at http://www.dell.com/content/topics/global.aspx/casestudies/en/us/us/fy2008_q3_id688?c=us&cs=55&l=en&s=biz

Data Center Power Management

Common industry standards for measuring energy efficiency are Power Usage Effectiveness (PUE) and Data Center Infrastructure Efficiency (DciE). At Dell we believe a more effective measurement is Data Center Performance per Watt which captures not only power efficiency but also effectiveness of computing resources in doing the actual work.

Power and cooling is key. Dell has done significant work on the optimum temperature for DataCentres and found that 25c (77F) is the inflection point at which the combined air-conditioning

and server fan activity consume the least power. Optimised fan technology such as Dell's industry leading Low Flow/High efficiency on the latest servers is designed to operate in this environment.

Apart from specifying the most energy efficient hardware full utilisation of servers is the most effective way to reduce power consumption. Virtualisation is one of the most effective policies an organisation can adopt to improve utilisation.

Virtualisation will allow the Government to reduce the physical number of servers required in its data centers leading to increased data center performance per watt.

Dell recommends:

Decommissioning aging servers 3 years or more to take advantage of the significant advances in processor and power management technology in new generation servers.

Specifying Virtualisation in all servers.

Optimising Data Center temperature and best practice data center design to optimise for energy efficiency.

More detail can be found at

http://www.dell.com/content/topics/global.aspx/power/en/unleash_data_center_productivity?c=us&cs=NAHB&l=en&s=bsd

Flat Screen Monitors

In addition to being mercury-free and recyclable, light-emitting diode (LED) displays deliver significant energy savings compared to cold cathode fluorescent lamp (CCFL) technology. Dell's 15-inch LED displays, for example, consume an average of 43 percent less power at maximum brightness, resulting in extraordinary cost and carbon savings. LED displays are also thinner and lighter. Every flat panel monitor should meet the EPA's strict [Energy Star](#) 4.0 guidelines. Remove screen savers. They contribute to energy waste by preventing a monitor from entering stand-by mode.

Environmental Standards

Standards for "Green IT" should focus on the following areas:

- Power Consumption/Energy Efficiency
- The reduction of packaging and the option for customers to reduce their packaging requirements
- The use of materials in production that meet EPEAT standards
- A commitment by vendors to recycle old pc's and equipment in an environmentally sound manner.

More Detail can be found at www.dell.com/earth

Once again thank you for the opportunity to provide you with further detail, we would welcome the opportunity to work more closely with the Department. I hope the information provided will be of assistance as you consider setting guidelines for energy saving and environment impact. Please do not hesitate to contact me should you require further detail.

Yours Sincerely



Bernie Kelly
General Manager
Dell Australia



EXECUTIVE SUMMARY

The Environment and Resources Committee of the Queensland Government has a mandate to provide the Queensland Parliament with a report by 30 November 2009. This report will contain the Committee's findings surrounding potential energy efficiency improvements for households, communities, industry and government. In addition, the Committee has requested comments on how governments can make information on energy efficiencies more accessible.

Dell has a stated goal to become the greenest technology company on the planet. We recognise that Dell's impact on our climate extends beyond our own operations. We work to reduce our carbon footprint and are on track to be 100% carbon neutral in Australia by the end of 2009. We design and develop Information Technology solutions for our customers that, while taking advantage of the latest technological developments, more importantly, deliver tangible and measurable energy efficiencies and savings. Dell fully understands the distinction between energy efficiency and energy conservation, which are inextricably linked.

While the Committee's Paper Number 1 of June 2009 does not specifically mention energy efficiency for Information Technology, Dell has considerable experience delivering energy efficient solutions to governments and businesses around the globe. This experience, combined with our understanding of stringent environmental policies and global standards, will be of immediate benefit to the Queensland Government in the form of wide ranging insights based on actual case studies.

Melbourne City Council

"Each Dell OptiPlex GZ620 Desktop uses approximately 19% less power than the City of Melbourne's older machines. If we include the Dell LCD monitors in the calculation and compare against the CRT monitors we used to have here, we are using an estimated 39% less power with the Dell desktops."

Ashe Potter, Desktop Services Team Leader, City of Melbourne

Swinburne University Centre for Astrophysics

"We are routinely using seven to eight times more computational power than the old machine. If we had to use the old technology to achieve the same level of computing power, we would have to spend over \$1 million on new air conditioners just to keep the machines cool. Our annual power bill would have gone up by around \$300,000 a year."

With the new environment, we spent over \$100,000 on air conditioning in the new room and expect our annual power bills to also be less than \$100,000." Professor Matthew Bailes



State of California (USA)

California Integrated Waste Management Board and Department of General Services California's 2003 e-waste legislation, (SB20), required the state to develop purchasing guidelines to buy greener electronic products.

In June 2005, the California Integrated Waste Management Board adopted EPEAT as the state's official purchasing policy. The Department of General Services has since worked to incorporate the guidelines into an upcoming contract for IT equipment, and pressured vendors to provide EPEAT-registered products within their existing contracts. Since July 2006, the state has bought 3,756 desktops, 3,318 laptops, and 1,629 monitors.

Through its EPEAT purchasing, the state reduced energy use by 1,732,792 kWh -enough to power 153 households per year.

Approach

In responding to the Committee's request for submissions, Dell is focusing on four key areas it believes are of interest and benefit to Queensland Government and the community:

- providing substantive data to the Government on the costs and benefits which can be realised through energy efficiency improvements in IT
- providing an IT perspective on the types of initiatives which could play a significant role in encouraging energy efficiency – particularly for businesses and government departments
- providing an IT perspective on the types of policies Queensland government might consider implementing to encourage energy efficiency
- providing solutions on how governments can make information on energy efficiency improvements more readily accessible.



Committee request for comment:	Findings based on Global Standards Data and Dell Customer Experiences
Data on costs and benefits arising from energy efficiency improvements. <Dell providing for Information Technology infrastructure>	<p>As a minimum, all new laptops, desktops, monitors should have an EPEAT Gold classification. EPEAT is an international rating based on the IEEE1680 standard established by the US Environmental Protection Agency. In the US the Green Electronics Council estimates that 6 months sales of EPEAT registered PCs Saves 13.7 billion kWh of electricity, enough to power 1.2 million U.S. homes for a year.</p> <p>According to the IDC, US50¢ is spent to power and cool servers for every \$US1 in server spending today. This will increase to US66¢ by 2011. Power consumption is one of the biggest ongoing maintenance and management costs an organisation has and should be a major factor in considering total cost of ownership.</p> <p>Swinburne University increased its computing power by 7- 8 times when installing a new Dell rack-mounted server facility yet reduced its power consumption by more than 30%.</p> <p><i>The immediate benefit to governments and business alike is reduced operating costs as well as a significant reduction in the State's energy costs and footprint.</i></p>



Committee request for comment:	Recommendations based on Global Standards Data and Dell Customer Experiences
Understand what role Commonwealth Government initiatives could play in encouraging energy efficiency.	<p>The most important role of the Commonwealth Government is to set the example for all State and Territory Governments when it comes to the procurement and implementation of information technology.</p> <ul style="list-style-type: none"> – Introduce Virtualisation technology into data centres which focus on saving physical data centre space as well as the required power and cooling. – Introduce energy smart (EPEAT) desktop systems <p>All Government Departments that implement these initiatives can achieve these benefits:</p> <ul style="list-style-type: none"> – Reduction in computational energy costs – Overall reduction in hardware investment – Enhanced data security <p>Specifically, virtualisation can lead to up to 47% savings in annual energy costs without sacrificing computing power and performance.</p> <p>Adoption of EPEAT by Commonwealth Government Departments</p> <p>The Department of Environment, Water, Heritage and the Arts (DEWHA) last month appointed a new IT services provider in a bid to green up its IT. DEWHA claims to be the first department in the Australian Government to specify a green focus as part of its information technology services contract. “The successful tenderer has proposed products for us that meet at least the Silver requirements of the Electronic Product Environmental Assessment Tool (EPEAT) standard - in many cases the Gold standard.”</p> <p><i>Dell recommends that Any Government efforts to modernise Commonwealth and State data centres should be complemented by policies that encourage IT energy efficiency in the private sector. For example, accelerated depreciation for retro-fitting or replacing IT that improves energy efficiency by at least 25 percent and energy-efficiency investments for Small Businesses.</i></p>



Committee request for comment:	Recommendations based on Global Standards Data and Dell Customer Experiences
<p>What additional policies should the QLD Government implement to encourage energy efficiency improvements?</p>	<p>Governments should focus on setting procurement policies that encourage the purchase of products that adhere to stringent environmental standards:</p> <ul style="list-style-type: none"> – Client* products that lead in EPEAT-Gold offerings and Energy Star 4.0 configurability (for example Dell has the first EPEAT gold notebook). Product registration in EPEAT is based on a comprehensive set of 51 environmental criteria in eight environmental performance categories identified above. Manufacturers declare their product's conformance to each criterion and are periodically audited by EPEAT to assure the accuracy of the declarations – Client products that include Energy Smart power management settings to reduce PC energy consumption by up to 78 percent – Full utilisation of servers is the most effective way to reduce power consumption. Virtualisation is one of the most effective policies an organisation can adopt to improve utilisation – Virtualisation will enable the Queensland Government to reduce the physical number of servers required in its data centres leading to increased data centre performance per watt – Power and cooling is key. Dell has done significant work on the optimum temperature for Data Centres and found that 25C is the inflection point at which the combined air-conditioning and server fan activity consumes the least power – Flat Screen LED monitors are the new LCD technology consume up to 43% less than traditional cathode screens. They should be a standard specification for government – Energy Smart servers which are up to 28 percent more efficient than standard servers. Industry standard s measure data centre efficiency as Power Usage Efficiency (PUE). Dell recommends a more accurate measure which is Data Centre Performance per Watt (DciE) – Implementing software that helps conserve power. Dell recommends 1E Nightwatchman software which turns computers off at night and SMSWakeup to repower machines from a central command – Dell has implemented this technology in its own operations around the globe and estimates up to a 40% reduction in energy costs. This equated to a savings of US\$1.8 million in the US alone in the first year. <p><i>Early estimates have shown the use of Nightwatchman software should save City of Melbourne \$100,000 per year in energy costs.</i> Refer City of Melbourne Case Study attached to this Executive Summary.</p> <p>For Data Centres Dell recommends:</p> <ol style="list-style-type: none"> 1. Decommissioning aging servers of three years or more to take advantage of the significant advances in processor and power management technology in new generation servers. 2. Specifying Virtualisation in all servers. 3. Optimising Data Centre temperature and best practice data centre design to optimise for energy efficiency. <p><i>*client products are defined as end-user hardware, e.g. Desktop/notebook</i></p>



Desired outcome	Dell Solution
How can governments make information on energy efficiency improvements more accessible?	Dell has a number of energy efficiency calculators available online to both businesses and the public from our Dell Earth website. They fall into three distinct categories : <ol style="list-style-type: none">1. Client hardware2. Data centres3. Monitor power http://www.dell.com/earth

In conclusion, Dell believes there are many areas where Queensland Government can make a measurable improvement in energy efficiency. While the focus of this submission has been tailored around information technology hardware, Dell is committed to a holistic approach to Green IT:

Standards for Green IT should focus on the following areas:

- carbon footprint in manufacture
- power consumption / energy efficiency
- the reduction of packaging and the option for customers to reduce their packaging requirements
- the use of materials in production that meet EPEAT standards
- a commitment by vendors to recycle old PCs and equipment in an environmentally sound manner.

We would welcome the opportunity to work with Queensland Government on these initiatives and look forward to exploring these ideas with you in greater detail.



Additional Information




Links to Standards Certifications

http://www.dell.com/content/topics/global.aspx/corp/environment/en/prod_design?c=us&cs=555&l=en&s=biz&~section=004

<http://www.epeat.net>

Dell's Energy Calculators / Tools

Energy efficiency benefits the environment and lowers the total cost of equipment ownership by reducing power consumption. Dell offers energy calculators that help estimate power needs, potential emissions avoidance and potential cost savings.

Client Energy Savings Calculator	Data Centre Capacity Planner	Monitor Power Savings Calculator
Calculate energy savings using Dell's Client Energy Savings Calculator	Power, cooling and airflow estimates for servers centres	Calculate power saved by enabling monitor power management
 Go to the Calculator	 Go to the Planner	 Go to the Calculator

The following documents have been included as Appendices:

Case Study – City of Melbourne

Case Study – Swinburne University – Centre for Astrophysics

FAST AND SIMPLE

The City of Melbourne has now consolidated its entire desktop fleet with Dell, simplifying the ongoing management of the council’s desktop infrastructure.

“The services provided by the Dell team were exceptional,” said Potter. “They made the process of installation and ongoing support and maintenance easy.”

To speed up the installation process, Dell loaded most of the applications onto the machines at its factory. “Dell loaded standard operating environments onto the machines well within the required time frame,” said Potter.

“Once they hit the user’s desk, everything was spot-on. In addition, a Dell engineer is here at the latest by the next business day if we need some assistance.

“There has not been one single issue with Dell support in the two years that we have been dealing with them. I’ve worked on technology rollouts with many companies, and this is easily the smoothest I have ever experienced,” he said.

For more information on this case study or to read additional case studies, go to DELL.COM/CaseStudies



HOW IT WORKS

HARDWARE

- Dell OptiPlex GX620 desktop with Intel® Pentium® 4 processor
- Dell OptiPlex 755 desktop with Intel® Celeron® Processor

SOFTWARE

- Microsoft® Windows® XP Professional
- Microsoft Office

SERVICES

- Dell Managed Services to deploy the desktop fleet
- Dell Custom Factory Integration™

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TURNING DOWN THE HEAT WITH DELL'S GREEN DESKTOPS

The City of Melbourne council reduces power bills by approximately 39% annually using Dell OptiPlex™ desktops



City of Melbourne's Council House 2 or CH2 building that was awarded six Green Stars by the Council of Australia for its environmentally-friendly design.

“Although most vendors had efficient machines, Dell really came to the party in terms of cost and power savings.”

Ashe Potter, Desktop Services Team Leader, City of Melbourne



SOLUTIONS

- POWER AND COOLING



CUSTOMER PROFILE

Country: Australia
Industry: Government
Founded: 1847
Number of employees: 2,000
Web address: www.melbourne.vic.gov.au

CHALLENGE

The City of Melbourne required environmentally-friendly desktops for its Council House 2 building in order to achieve a six Green Star rating. The desktops had to adhere to council's green policies and be cost-effective and designed to reduce power consumption.

SOLUTION

City of Melbourne replaced HP and IBM desktops with Dell OptiPlex desktops inside its purpose-built and environmentally friendly Council House 2 building as well as other council locations around Melbourne.

BENEFITS

- Power consumption cut by approximately 39% using Dell OptiPlex desktops
- Estimated \$100,000 annual savings in power bills, provided by additional power management
- Significant cost savings on the initial purchase cost, compared to competing brands
- Building achieved its six Green Star rating
- Standardised on Dell OptiPlex desktops, reducing service and maintenance costs
- Speedy installation achieved by loading applications at the factory



Victoria's City of Melbourne council manages the central business district and several surrounding suburbs over an area of 36.5km² with a population of almost 77,000. It works with other local councils and the State Government of Victoria to ensure Melbourne is a safe, healthy and clean city and support its position as a cultural centre.

“ I’VE WORKED ON TECHNOLOGY ROLLOUTS WITH MANY COMPANIES, AND THIS IS EASILY THE SMOOTHEST I HAVE EVER EXPERIENCED ”

Ashe Potter, Desktop Services Team Leader, City of Melbourne

The City of Melbourne has also taken a lead in the fight to reduce greenhouse gas emissions. In August 2006, it officially opened Council House 2 or CH₂, a purpose-built office building constructed with the environment in mind. The Green Building Council of Australia awarded CH₂ six Green Stars, recognising the building as a world leader in design.

The 10-storey council building incorporates sustainable technologies such as a water-mining plant in the basement, windows that open automatically at night to let in cool air, and solar-powered louvres that follow the sun.

The CH₂ building conserves energy by focusing on cooling rather than heating. Fresh air is drawn from 17m above street level and cooled within ‘shower towers’ inside the building’s basement. This method replaces traditional cooling systems that employ fans to blow recycled air into a building.

THE NEED FOR GREEN PCS

The council needed some cool and cost-effective desktops that complied with its environmentally-friendly requirements.

“We had some pretty strict rules in relation to the desktops we could use inside the building. If we purchased the wrong devices, we wouldn’t have complied with the policies that were in place,” said Ashe Potter, Desktop Services Team Leader at the City of Melbourne.

In December 2005, Potter began his search for the most power-efficient desktops to replace existing IBM and HP systems that were expensive and time-consuming to support.

“We had to contact different vendors each time we needed a machine fixed. They were reaching end of life, and were out of warranty and expensive to service,” said Potter.

The new desktops also needed to be ENERGY STAR compliant. “To get the Green Star rating, you have to be a world leader in building design,” said Potter. “On the technical side, energy-efficient desktop computers certainly play a massive part in achieving that rating.

NO COMPROMISE ON QUALITY AND EFFICIENCY

I contacted all the major vendors and asked for the greenest desktop possible without compromising on quality and efficiency,” explained Potter.

Following weeks of rigorous testing, the Dell OptiPlex GX620 desktops won hands down and Potter subsequently ordered 600 units for the new CH₂ building.

The Dell Ultra Small Form Factor OptiPlex GX620 use 3.4GHz Intel® Pentium 4 processors, 1GB of RAM, 40GB SATA hard disk drives, DVD-ROM and CD burners and 17-inch Dell LCD monitors. The desktops run the Microsoft® Windows XP Professional operating system with Microsoft Office XP.

By the end of 2007, the council had added 600 next-generation Dell Ultra Small Form Factor OptiPlex 755 units with 17-inch monitors throughout the adjoining building CH₁, Town Hall and 20 remote sites. These included child care centres, Queen Victoria Market, Melbourne City Baths, North Melbourne Town Hall and public libraries.

“The Dell OptiPlex desktops won out on two fronts: the initial purchase cost and the green factor,” said Potter. “Although most vendors had efficient machines, Dell really came to the party in terms of cost and power savings.”

The City of Melbourne also saved a significant amount of money on the purchase cost of the Dell desktops. “We also base our tenders on cost-effectiveness, and Dell offered the best price,” said Potter.

POWER EFFICIENT MACHINES

Each Dell OptiPlex GX620 desktops uses approximately 19% less power than the City of Melbourne’s older machines, according to Potter.

“If we include the Dell LCD monitors in the calculation and compare them against the various CRT monitors we used to have here, we are using an estimated 39% less power with the Dell desktops,” he said.

Potter expects the newer Dell OptiPlex 755 desktops to provide additional energy savings in the future. “We will continue to achieve significant power savings with the latest model OptiPlex desktops,” Potter said.

Potter recently implemented the 1E NightWatchman power management solution that automatically saves files, closes applications and places the Dell OptiPlex desktops into sleep mode at night. “Early estimates have shown that this initiative alone should save City of Melbourne an estimated \$100,000 per year in energy costs.”

“ EARLY ESTIMATES HAVE SHOWN THAT THIS INITIATIVE ALONE SHOULD SAVE CITY OF MELBOURNE AN ESTIMATED \$100,000 PER YEAR IN ENERGY COSTS. ”

Ashe Potter, Desktop Services Team Leader, City of Melbourne



THE DELL OPTIPLEX RANGE

THE SUPER GREEN MACHINE

Swinburne University of Technology's supercomputer searches for the secrets of the universe while minimising its footprint on Earth



"We call the supercomputer the Green Machine. The combination of Intel's Clovertown processors and Dell's PowerEdge™ servers and a batch queue system that powers machines on and off according to demand has allowed us to give users the power they need to do their research while minimising our carbon footprint."

Professor Matthew Bailes, Director, Centre for Astrophysics and Supercomputing, Swinburne University of Technology

CUSTOMER PROFILE

The Centre for Astrophysics and Supercomputing is Australia's newest and fastest growing astronomy research centre. Located at Swinburne University of Technology, the Centre attracts scientists from around the world to search for new planets and stars, study supermassive black holes and simulate the formation of the universe. Visit astronomy.swinburne.edu.au for more information.

CHALLENGE

The Centre wanted to build a new supercomputer that could support large increases in the number of users and jobs, and process time-critical data from some of the largest radio telescopes in the Southern Hemisphere. In addition, it wanted to reduce rising power and airconditioning costs by switching to an energy efficient solution that would also minimise greenhouse gas emissions.

SOLUTION

Dell™ PowerEdge™ 1950 servers formed the building blocks of the supercomputer, dubbed the Green Machine for its powerful performance and low energy consumption. Dell's 'rack and stack' option allowed the Centre to build, test and launch the supercomputer in three weeks. Easy scalability is assured, as each new node takes an average of 10 minutes to deploy.

BENEFITS

The Centre enjoys up to 10 times the computational power of the previous system, but its power bill is less than twice what it was. A batch system that powers machines on and off according to demand provides users with the processing power they need while ensuring the Centre minimises its carbon footprint. Significant performance improvements have also been experienced, with one visiting scientist completing a problem in four days that would have taken four years at his institution. In the future, the Centre will be able to process data captured by radio telescopes in near real time.



Founded on the back of a supercomputer that is one of the largest in the country, Swinburne University's Centre for Astrophysics and Supercomputing remains one of the most rapidly growing research centres in Australia. It participates in local and international astronomy projects, including a Hubble Space Telescope Treasury Program and a research and development initiative in the Square Kilometre Array project, a massive radio telescope planned for construction in 2020.

“ALTHOUGH USERS HAVE A COMPUTER THEY CAN TYPICALLY GET UP TO 10 TIMES THE COMPUTATIONAL POWER OF THE PREVIOUS SYSTEM, THE POWER BILL IS LESS THAN TWICE WHAT IT WAS.” Professor Bailes

The Centre's supercomputer is in demand across campus, performing tasks that range from simulations of the universe to the microphysics of atoms and molecules. The machine is used by physicists and engineers for research, and is also in demand to render content for three-dimensional animations and movies and even online education.

An annual hardware budget meant the supercomputer was always evolving, from humble beginnings as a cluster of 16 Digital Alpha processors to three major teraflop-scale clusters of different generations of Intel® processors. The current supercomputer is based on 145 Dell™ PowerEdge™ 1950 servers with quad-core Intel® Xeon® processors.

BUILDING A NEXT-GENERATION SUPERCOMPUTER

Three years ago, Professor Matthew Bailes, the Director of the Centre for Astrophysics and Supercomputing, realised the facility was facing a problem that the laws of thermodynamics taught him he could not escape: heat.

The temperature in the machine room was continually climbing because 100 per cent of the computers were in use simultaneously. Despite designing the machine to fit within a given heat load, imperfections in airflow and some anomalies in power consumption figures meant the computers could not all operate at capacity simultaneously without overloading the airconditioning system.

Users were becoming frustrated with the heterogeneous nature of the system, and the efficient scheduling of jobs was next to impossible. Sub-clusters would lay idle while others were at capacity, and the patchy use of the system meant it only averaged about 50 per cent efficiency or 1 teraflop.

The nature of the Centre's work also requires a powerful machine that can process data sets from a variety of sources at high speed. The Centre regularly receives telescope time at the Anglo-Australian Observatory, Parkes Observatory, Australia Telescope Compact Array, W.M. Keck Observatory and Gemini Observatory. Data received from these facilities must be processed as quickly as possible to ensure scientists do not miss vital scientific information.

Cost was also an issue. The Intel® Pentium® 4 processors were not very energy efficient and the power bill over the previous machine's lifetime was comparable to the hardware cost. This led to spiralling power and airconditioning expenses. Management overheads were also significant.



DELL™ POWEREDGE™ 1950

DELL POWEREDGE™ SERVERS DELIVER OUTSTANDING PERFORMANCE

With a mandate from the Vice Chancellor to reinvest in hardware, Professor Bailes and the design team sought to build a new supercomputer that would service users for the next four years. The supercomputer had to meet the following criteria:

- The new machine should deliver at least 10 times the performance of the previous system to meet user demand.
- The machine should be 100 per cent homogeneous. This would facilitate more efficient job scheduling.
- The kilowatts/gigaflop must be three to five times better than the existing cluster to keep a lid on the power bill and airconditioning costs.

Swinburne also decided to construct a purpose-built machine room with 100 kW of heat load.

After going to tender, Swinburne selected Dell™ PowerEdge™ servers as the building blocks of the new supercomputer because of their computing power and low energy consumption.

The installation was a simple process with Dell's 'rack and stack' option.

"Once the servers were plugged in, it took about a week to finalise the installation as each node took about 10 minutes to add to the cluster," Professor Bailes said. "We then invited some early adopters to use the supercomputer for a couple of weeks to iron out any issues. All in all, it took about three weeks before the supercomputer was opened up for general use in May 2007."

The new 10.8-teraflop supercomputer comprises 145 identical dual-processor Intel® quad-core Dell 1950 servers with 16GB of RAM and 1TB of disk space. Although the theoretical peak performance is only approximately six times the previous cluster, in reality the greatly increased homogeneity makes more efficient scheduling easy to achieve, so that the new supercomputer is often achieving up to 10 times the performance of the previous machine.

According to Professor Bailes, the Dell PowerEdge™ servers are very energy efficient, and benchmarks performed by the Centre on real-world astronomy applications revealed good scaling with the number of processing cores on the servers. "We are delighted with the performance of the Dell servers across a variety of applications," he said.

ENERGY EFFICIENT SUPERCOMPUTING

In the past, because of the differing architectures, the Centre found some nodes were over-subscribed while others were underutilised. The batch queue and lights-out management systems feature APIs that enabled the Centre to program the supercomputer to turn off nodes that are not required by the batch queue. This ensures the machine only uses power that it really needs.

Although users have a computer they can typically get up to 10 times the computational power of the previous system, the power bill is less than twice what it was.

"We call the computer the Green Machine," said Professor Bailes. "The combination of Intel® Clovertown processors and Dell's PowerEdge™ servers and a batch queue system that powers machines on and off according to demand has allowed us to give users the power they need to do their research while minimising our carbon footprint."

He added: "In the future, the sort of power-saving features we are seeing in our laptops will migrate to servers, and supercomputers will need to respond to user demand while minimising power consumption when idle. I'd like to see more research done into how this might be achieved. Our analysis shows that there are still significant savings to be made, particularly in relation to storage."

Initial user response has been favourable. The homogeneity of the supercomputer means users can use any node on the cluster and enjoy many times the power they previously had.

"The previous system had a cap of 40 simultaneous processors for one job, and the different processor flavours and memory combinations made it difficult to schedule efficiently," explained Professor Bailes. "The new machine has up to 512 cores working on a single problem simultaneously while allowing users to run hundreds of massively parallel, but short jobs.

"One guest user who used to rob cycles on spare Linux boxes at his observatory said he'd completed a problem using the Green Machine in four days. At his facility, it would have taken him four years," said Professor Bailes.

Swinburne University of Technology will celebrate its centenary in 2008 and the Centre is planning to hold a Swinburne Centenary Simulation to mark the occasion. This involves using the supercomputer to perform 100 different simulations of the formation of the universe based on currently accepted theories. A catalogue of the simulations will be made available to interested scientists via the World Wide Web.

REDUCING POWER COSTS

Professor Bailes added that the Centre expects to keep power costs to a minimum. The rack-mounted units are housed in a purpose-built room with new cooling systems.

"We are routinely using seven to eight times more computational power than the old machine. If we had to use the old technology to achieve the same level of computing power, we would have to spend over \$1 million on new airconditioners just to keep the machines cool. Our annual power bill would have gone up by around \$300,000 a year.

"With the new environment, we spent over \$100,000 on airconditioning in the new room

and expect our annual power bills to also be less than \$100,000," Professor Bailes said. "We have enough airconditioning capacity now to cool the entire cluster even though it is several times more powerful than our previous machine."

The Centre has received a university grant to link the job scheduling system to the computing cluster's remote management interface. This allows the Centre to turn off nodes when they are not in use and turn them back on when required.

"We estimate that this will lead to a further 20–30 per cent reduction in power demands," said Professor Bailes. "It will also decrease the wear and tear on the machines."

HOW IT WORKS

HARDWARE

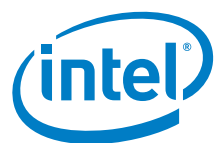
- Dell™ PowerEdge™ 1950 servers with quad-core Intel® Xeon® processors

SOFTWARE

- All custom applications

SERVICES

- Dell Server Installation services



EASY SCALABILITY CATERS FOR FUTURE GROWTH

As the fastest growing astronomy research centre in Australia, the easy scalability of the Dell servers ensures it can support increasing numbers of users and heavier workloads. The technology allows the Centre to simply add more nodes when it needs additional processing power. Such 'pay-as-you-grow' scalability helps keep costs low by maximising the use of existing resources.

"In astronomy, there are a lot of computations that do not require rapid communication between machines," added Professor Bailes. "The supercomputer was designed to run thousands of jobs on independent data sets, as opposed to one big job. On most of our benchmarks, we found the Dell machines scaled extremely well."

The Centre is now planning to link the supercomputer to Australia's radio telescopes so data can be transmitted and processed in near real time.

"In astronomy, when a star explodes we cannot afford to wait a few weeks to find out if we saw it," explained Professor Bailes. "We would miss out on a lot of opportunistic science. We're going to have telescopes spread over 500 kilometres piping data into the supercomputer over fibre-optic links. This will allow us to follow up any discovery almost instantaneously, rather than waiting weeks or months to process the data. In that time, the source we are interested in may have disappeared forever."

In the medium term, the Centre will explore using InfiniBand, a high speed, low latency interconnect, to link the nodes. It has also placed an order for additional nodes that will take the supercomputer from the current 10.8 teraflops to more than 15 teraflops.

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