

TIM Lecture Series

Energy Efficiency and Data Security in Modern Data Centres

Jerry Glowka, Jason van Gaal, Scott Moore,
Bill Bowerman, and Peter Smetny

“It's easy to come up with new ideas; the hard part is letting go of what worked for you two years ago, but will soon be out of date.”

Roger von Oech
Author and speaker on creativity and innovation

Overview

The first TIM lecture of 2013 was led by Jerry Glowka, Vice President of Solutions Architecture at IceBerg Networks (icebergnetworks.com), an Ottawa-based business that focuses on the provision of low-power technologies and innovative solutions for highly compact data centre solutions. To discuss innovation in energy efficiency and data security in data centres, Glowka was joined by Jason van Gaal (Granite Networks; granite-networks.ca), Scott Moore (Bell Canada; bell.ca/enterprise/), Bill Bowerman (FusionIO; fusionio.com), and Peter Smetny (Fortinet; fortinet.com).

The event was held at Carleton University in Ottawa, Canada, on January 17th, 2013, in collaboration with the IET Ottawa Local Network (iet-ottawanetwork.ca) and IEEE Ottawa Section (ieeottawa.ca). This lecture was the result of co-operation between Professor Michael Weiss (Carleton University) and David Mann (President of Ayrshireton Consulting Inc. and Committee Member of the IET Ottawa Local Network).

The TIM Lecture Series is hosted by the Technology Innovation Management program (carleton.ca/tim) at Carleton University. The lectures provide a forum to promote the transfer of knowledge from university research to technology company executives and entrepreneurs as well as research and development personnel. Readers are encouraged to share related insights or provide feedback on the presentation or the TIM Lecture Series, including recommendations of future speakers.

Summary

Glowka began the lecture by describing the current state of affairs in data centres, where increasing demand and power costs have created a challenging situation for data centre operators. There are currently over 50 billion devices in the world and projections indicate that these devices will be making over 1 trillion financial transactions per year by 2014. With every one of these transactions requiring "a little bit of power", Glowka underscored three reasons why data centres need to transition to green solutions. Although environmental concerns are a strong motivator, the need for this transition is driven as much by economics and resource demands.

Glowka explained that one of the underlying causes of the challenges facing data centres today relates to a "performance gap" in server technology. Advancements in CPU speed in recent years have outstripped growth in other technologies. Thus, fast CPUs cannot perform at optimal levels because they end up waiting for work to be completed upstream by other technology, and while they wait, they continue to consume power. The typical approach to solving this performance gap is to add more servers, however this is an inefficient approach that further increases power consumption in data centres.

Not only do increases in business demands directly increase the power demands of the servers themselves, but they also indirectly increase the power demands of cooling systems. Traditional data centres largely consist

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of blade servers that generate substantial heat. Power and cooling systems are reaching their limits, levels of carbon dioxide emissions are at historic levels, and the cost of power is increasing. In fact, power costs now dominate all other data centre costs.

The remainder of the lecture focused on key perspectives that affect energy efficiency and security in data centres and server technology, with an emphasis on innovations that will help the data centre industry "go green". The first part of lecture focused on the design and operation of the data centres. The speakers emphasized that efficiency gains could be realized through state-of-the-art technology and new approaches to data centre design. The second part of the lecture looked at green innovations at the level of server technology. Innovations are aimed at reducing the performance gap, maximizing efficiency, increasing the workload capacity of data centre IT equipment, increasing the use of virtualization, and providing higher-level security to deal with the challenges raised by increased reliance on "the cloud".

Designing and operating a green data centre

Jason van Gaal, COO of Granite Networks (granite-networks.ca), described the challenges faced when designing and operating a data centre that is both green and reliable. When Granite Networks were building their new Tier 3 data centre in Ottawa, they knew they needed to strike the right balance between performance, efficiency, reliability, and costs. Key design aspects included:

1. Lowering costs by choosing the "right-sized equipment" for a given need and ensuring that redundancies carried lower loads
2. Efficient placement of server racks for optimal cooling
3. Maximizing "free cooling hours" from cold Canadian weather
4. Optimizing air distribution via floor layout and aisle design

With annual power costs exceeding spending on IT equipment, the efficiencies resulting from a green data centre design have a real impact on the company's bottom line. Thus, green is a competitive advantage for Granite Networks.

A perspective from Bell Canada

Scott Moore, Project Manager at Bell Business Markets (bell.ca/enterprise/), offered insights from Bell Canada, which has been expanding its data centre portfolio. Bell's strategy is to increase their investment in infrastructure; acquire existing data centres and build additional new facilities; and enhance their certification program, all so that they can offer their customers greater security, performance, and availability.

Moore next described Bell's new data centre in Ottawa, which is a Tier 3 facility for public and private customers. The facility aims to combine industry-standard equipment with innovative design to achieve a low PUE (a ratio of facility-power to IT-equipment-power relative to cooling costs). Historically, a typical PUE was 2:1, but now a PUE around 1.5:1 is standard; Bell is targeting 1.3 or lower. To achieve this level of efficiency, this new facility takes advantage of the following green technologies and design innovations, among others:

1. Increased efficiency and decreased use of lead through flywheel technology instead of batteries for energy storage
2. Decreased use of copper through single-step electricity transformations
3. Reduced water consumption through air cooling (with A/C backup)
4. Reduced cooling costs by maximizing free cooling (90%) versus mixed cooling (10%) reserved for high-heat, high-demand days
5. Reduced heat demands in non-server areas of facility by retaining and redistributing heat generated by the servers
6. Reduced lighting costs with white server cabinets, which also creates a nicer working environment for employees

This new Bell facility has achieved Leadership in Energy and Environmental Design (LEED; tinyurl.com/2xqdggy) Gold certification. Also, Bell Canada and the facility's designers, Urbacon Architecture, were awarded the 2012 Green Enterprise IT Award (tinyurl.com/aqy6yfx) for facility design innovation.

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Enabling a greener data centre through fast storage

Bill Bowerman, Solutions Architect at FusionIO (fusionio.com), described how innovations in server technology are helping data centres become greener. FusionIO drives are designed to overcome the trap that many data centres fall into when faced with adding additional CPUs in an attempt to increase performance to keep up with customer demand. FusionIO drives use NAND Flash technology to reduce latency – which is the key when trying to maximize CPU utilization – to remove dependencies on intermediary technology for read/write access. From a green perspective, the key benefit of low latency and high performance is the efficient use of hardware and substantial reductions in power consumption. With much less equipment running in data centres, the power and cooling demands are also reduced, which lowers both the costs and carbon footprint of the facilities.

Beyond firewalls

Peter Smetny, Systems Engineer at Fortinet (fortinet.com), discussed the ever-increasing security challenges faced by modern data centres. Although virtualization and cloud-based technologies bring benefits in terms of business and financial performance, in addition to environmental benefits, they have changed the way data centres approach security. Data centres face similar types of security threats (e.g., attacks, disruptions, threats to data loss and confidentiality), but they now have less control over the infrastructure. A simple firewall is no longer sufficient because the concept of a secure perimeter no longer applies.

In response to more sophisticated threats – including botnets and underlying vulnerabilities in software on user devices – and a poorly defined perimeter, data centres seek a unified threat-management solution for their networks. However, traditional processors and memory are not fast enough to perform the inspections needed on incoming and outgoing data (at the data centre) to detect and prevent known and hypothesized threats. Smetny discussed key technologies – including ultra-fast application-specific integrated circuits (ASICs) and field-programmable gate arrays (FPGAs) – that not only protect against modern threats but also use power efficiently, to support the green advantage sought by data centres.

Lessons Learned

In the discussions that followed the first and second parts of the presentation, audience members shared the lessons they learned from the presentation and injected their own knowledge and experience into the conversation. The audience also identified the following key takeaways from the presentation:

1. Green adds to brand value and makes good economic sense.
2. There are many different approaches to cooling and reducing power consumption; lots of opportunities for innovation.
3. A lot of technology and efforts go into the mechanical design (e.g., server chimneys, plenum design, flywheels).
4. The geographical location of a data centre greatly affects power and cooling costs. Canada is a good place for data centres because cold winter weather provides free cooling.
5. Flywheels are still useful and innovative!
6. It is surprising to learn that power costs exceed IT equipment costs.
7. CPU improvements have exceeded advances in other areas (i.e., there is a "performance gap"), but there is still room for greater efficiency at the chip level.
8. Going green involves innovation even at the level of storage protocols.
9. Having more efficient hardware means you need less of it, which lowers equipment, power, and cooling costs.
10. Disks are now 22,000 times bigger but are only 16 times faster.
11. There is no longer such a thing as a secure perimeter; threat management is no longer about building walls.
12. A paradox: security needs to be rock-solid, yet flexible enough to handle future threats.

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About the Speaker

Jerry Glowka is the Vice President of Solutions Architecture at IceBerg Networks (icebergnetworks.com). Jerry has deeply developed skills in networking, security, and storage that allows him to combine best-of-breed technology to produce robust secure solutions for data centres as well as cloud computing. Jerry has been successful in identifying, working with, and bringing together world-leading technologies to address data centre exhaust and unmanageable power demands, and to overcome consumer fears related to the use of virtualized resources. Jerry is IceBerg's representative in the NSERC Strategic Network for Smart Applications on Virtual Infrastructure (SAVI), which is researching the evolution of today's Internet, its protocols, and its structure.

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