Sustainable Computing

REGISTER

Monthly newsletter of the IEEE Computer Society Special Technical Community on Sustainable Computing
Providing quick access to timely information on sustainable computing.

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Volume 1 Issue 6 June 2012

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From the Chair's Desk

May was a memorable month for our STC; we saw a resurgence in new memberships, and exceeded our short-term target of 100 members. Our intent is to continue to focus on membership growth in the short term. My co-chair and I have challenged each of the officers to recruit ten colleagues in the field to join up. We would greatly appreciate existing members inviting their colleagues in the field to join as well.

The June edition of the Register marks the sixth issue of our STC's newsletter. I would like to congratulate the editor, Christopher Stewart, and all of the contributors, on reaching the half year anniversary. Although each issue of the Register is only eight pages, it is surprising how much work is required to prepare them each month.

Our STC has been reaching out to a conferences and workshops in our field, both to promote our STC as well as to help publicize the venues and the best works that appear in them. For example, in May the IEEE ISSST conference allowed us to display a poster on our STC at their venue. In June, we will be promoting our STC at IGCC, GreenMetrics and SIGMETRICS. Lastly, if you have suggestions on how to improve our STC, please feel free to contact myself (martin.arlitt@hp.com) or any of the officers.

- Martin Arlitt

Letter from the Editor

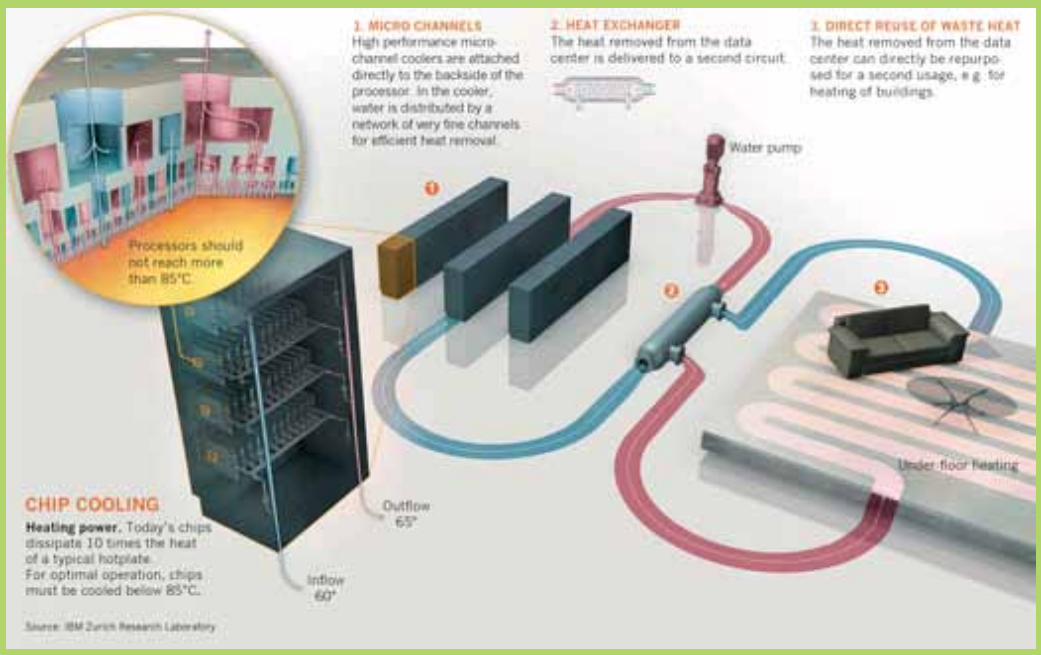
I am so excited about the Register's future. Since our first issue in January, we have added 4 regular-contributor columns (almost one a month) and we have several more in the pipeline. In particular, the Pick of the Month series, added in March, has been well received. We have an open, democratic voting process that is unlike award processes in other fields. Every month, our membership engages in a monthly conversation where community leaders proudly advocate on behalf of (what they see as) high impact research. Already, we are seeing signs of prestige in the Pick of the Month award. Each of our awardees has referenced the award on their public websites. I encourage everybody to join the STC and to vote for the Pick of the Month on our Facebook page.

This month, we will introduce another new column, Industry Highlights. Too often, people think that sustainability is only a concern of academics, disregarding the great work being done in industry. This new column, produced by Canturk Isci, will combat that notion. Whether its IBM's zero-emission data center or Microsoft's new carbon neutral pledge, Canturk will highlight great projects throughout industry and bring a short description to us directly. Hopefully, this article will make the Register a preferred forum for researchers and developers to publicize successful sustainable-computing products. Second, by providing contact information and references, we hope to facilitate academic and industry relationships.

Finally, last month, we introduced Energy-Efficient Architecture, a column written by Fan Dongrui. Fan is a member of the architecture community, publishing in MICRO, PPOPP, etc. His column will add a new dimension to the Register. Welcome on board Fan.

Industry Highlights: IBM's Zero-emission Data Center

A key approach for improving data center energy consumption is to use hot-water cooling. Hot water cooling eliminates the need for energy-hungry chillers used in air cooled data centers. Moreover, high-grade heat at the output can transferred for other uses, such as heating buildings. IBM Zurich Labs, in collaboration with ETH Zurich, has built a first-of-a-kind hot water-cooled supercomputer, dubbed Aquasar, which consumes up to 40 percent less energy than a comparable air-cooled machine. Furthermore, the waste heat is used for building heating, which decreased the carbon footprint of the entire system by up to 85 percent. The supercomputer consists of special water-cooled Servers, which feature microchannel coolers that are attached directly to the processors. Owing to this chip-level cooling, the thermal resistance between the processor and the water is reduced to the extent that even cooling water temperatures of up to 60°C ensure no overheating of the processors. This high input temperature of the water results in high-grade heat at the output, which in the case of Aquasar is up to 65°C. Aquasar demonstrates that it is possible to reduce the energy consumption of data centers while restraining costs and curtailing carbon emissions. Liquid cooling and deploying waste heat appear to become instrumental in the drive to improve the energy efficiency of data centers.



The 3PF SuperMUC scale-up was built based on Aquasar technology and 10'000 iDataPlex servers is currently (May 2012) the largest IBM system and the largest computer in Europe. It received the German Datacenter Prize as the most energy and resource efficient datacenter in Germany.

Contact: Bruno Michel, IBM Zurich Research Lab

Reference: Cooling Energy-Hungry Data Centers, Science 328, 316 (2010).

Website: http://www.lrz.de/services/compute/supermuc/
http://www.badw.de/aktuell/pressemitteilungen/archiv/2012/PM_2012_12/index.html

Sustainable Computing REGISTER

PICK OF THE MONTH JUNE 2012

Blink: Managing Server Clusters on Intermittent Power by Navin Sharma, Sean Barker, David Irwin, and Prashant Shenoy published in the Proceedings of the Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS).

A little over a year ago, I witnessed the far-reaching impact of this month's pick first hand. I was listening as my student gave a talk on our ongoing work on sustainable datacenters. The talk was part of a weekly group meeting attended by systems folk throughout my department. The talk was going well, many people were interested, even if the topic seemed "exotic." Then, unexpectedly, a senior colleague raised his hand and boldly asked, "Can your work compete with Blink?" That was it! Sustainable computing now has a benchmark. A system that lays out problems and grades solutions for the field. At its core, Blink is a server cluster designed and implemented on top of intermittent power, but it is also a Rosetta Stone, translating a sustainable computing problem into one well-received by researchers familiar with traditional, distributed systems problems. This month we were fortunate to interview all of the authors, to get the inside scoop on this definitive work.

Christopher Stewart: Congratulations! This paper was very popular among our membership. At least, in part because it is so well written. Personally, I love the title. Which author came up with Blink?

Authors: Since we were talking about “blinking” servers long before we ever thought about naming the system, the name Blink just came about naturally. In fact, by the time someone actually suggested the name out loud, another author had already written it into an initial paper draft. So the name really came about naturally, from multiple authors in parallel.

Christopher Stewart: When you submitted this paper, research on power-driven systems had not yet reached infancy. What led you to this area? Was there a specific experience? Was there an “aha” moment?

Authors: We had written a paper in 2010 on developing models for using weather forecasts to predict energy generation from renewables. While we had applied our models to sensing systems, that work first got us thinking about how to run clusters off renewables. Once we decided to explore that problem, the first challenge was to gracefully adapt the cluster to an intermittent energy supply. [Blink was] our first idea....

Christopher Stewart: In my experience, many computer scientists are still struggling with the concept of power-driven system management. Honestly, it is a huge paradigm shift. How receptive has the community been to this research?

Authors: We’ve found the community response to be somewhat bi-modal. Many people view power-driven management as an important paradigm shift, and are highly receptive to the new types of challenges the area introduces. Our paper was actually accepted on its first submission to ASPLOS.

Of course, there are also those who are less receptive to power-driven techniques, since they may be economically impractical for industry at today’s energy prices. However, we believe a longer-term view is warranted for sustainability research, given its importance to society.

Disclaimer: Comments in this article reflect the personal views of the interviewed author(s) only. These views may not reflect the views of other authors, affiliated institutions, or the publishing organization.

Nominations are Open!

Each issue of the Sustainable Computing Register features a Pick of the Month, a research publication or industry project that has significantly advanced the field of sustainable computing. The goal is to increase awareness within our community about high-impact, transformative research. Members can submit worthy papers and industry projects by emailing me. Submissions endorsed by 2 STC-SC officers will advance to public vote on Facebook. *By visiting our Facebook page, all members can vote for their favorite paper.* At the end of each month, the paper with the most votes will become a Pick of the Month (provided the authors agree to be interviewed).

Requirements for nominees:

- The paper must have been published in a peer-reviewed, research forum.
- The paper must be related to sustainable computing, e.g., energy efficiency, renewable-powered computing, smart grid, life cycle of ICT, smart buildings, etc.
- The paper must have been published in the last 2 years.
- Industry projects must have shown significant practical impact or intellectual contribution.

Christopher Stewart: OK, let's discuss some of the technical details within the paper. When Blink is deployed in the field with solar panels, what are the power efficiency losses observed?
Authors: For our solar panels, the maximum power we are actually able to harvest and use is typically about half the rated maximum for the panel. For the wind turbines, it's much less, since the turbines' maximum power occurs under steady and sustained 28mph winds, which hardly ever happens.

Christopher Stewart: You studied Blink under realistic, heavy-tail access patterns and designed Blink's memcached cluster to achieve "fairness", that is such that users received roughly the same response time for accesses in the tail. Can you discuss this feature, fairness, in the context of service level objectives?
Authors: Our paper looked at the fairness in response time for put/get requests to a distributed cache operating under intermittent power constraints. However, individual web pages for a service like Facebook may contain tens to hundreds of these put/get requests plus additional calls to other types of services. Thus, achieving per-page fairness in performance is another important research challenge.

Christopher Stewart: Active key migration is another nice feature to this work. As I understand it, you map objects to machines based on a popularity counter and the Blink rate of the machine, eschewing popularity-unaware consistent hashing. As a spurious though, do you think this approach has relevance for on chip caches, especially as we enter the dark silicon era?
Authors: It would definitely be interesting to see if a scaled-down version... for multiprocessors and on chip caches. Processors are definitely making strides in terms of energy efficiency and proportionality. However, one insight from Blink is that these techniques are not always applicable to power-driven management.

Christopher Stewart: What's next on the horizon?
Authors: We're definitely looking at how to apply the Blink abstraction to other types of applications beyond distributed caching. Hopefully, you'll see our work at a conference in the near future! We're also working on applying computer science techniques to improve the energy-efficiency of buildings. While data centers account for roughly 2% of U.S. electricity consumption, commercial and residential buildings account for 75%!

Christopher Stewart: Thank you all for your time and thoughtful answers. Also, congratulations to David Irwin on his new faculty post in the Electrical and Computer Engineering department at the University of Massachusetts Amherst. Best wishes on your future research, David.

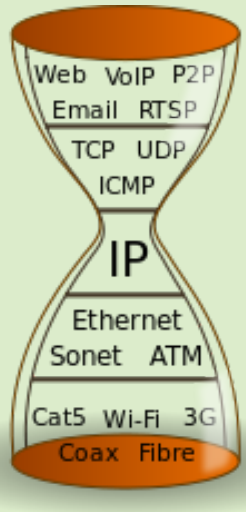
Networks & Distributed Systems

by Guillaume Jourjon, NICTA

Escape the heat spot

Network protocols are commonly depicted with an hourglass figure where the Internet Protocol (IP) sits at the waist. Intuitively, a greener Internet requires a greener IP and, more specifically, greener routing algorithms. Researchers in networking systems have long argued about the general use of BGP and the expanding BGP table. Take a look at Geoff Huston's Potaroo Blog for up-to date analysis of BGP table announcements and withdrawals.

In a green Internet, data transmission (and therefore IP routes) would consider the energy consumption of routers between the source and destination. However, today's routers are complex, comprising several line cards across multiple chassis which can be reconfigured. Their energy consumption depends on their configuration. In order to provide a green road for data transmission, we need to benchmark router configurations. In a very complete paper at Infocom 2008, Chabarek et al. proposed a power aware network design and routing. In their article the authors first proposed a generic method for benchmarking different network components. Then based on their investigation, the authors proposed a general model for router power consumption based on the different line card in use and the number of bits transmitted. This model is later used to perform a energy consumption optimization as a flow problem. While the authors acknowledged the limitation in their work (i.e. the number of routers benchmarked), the method and the resulting routing offers very interesting perspectives for the community.



Network protocols depicted in an hourglass figure by Olivier Mehani, CC-BY-SA-3.0-2.5-2.0-1.0. Distributed by Wikimedia Commons.

Industry Highlights: IBM's Measurement and Management Technologies

IBM's Measurement and Management Technologies (MMT) are a comprehensive set of technology solutions for managing physical infrastructure. MMT has been used successfully to managing data center infrastructure to optimize 1) floor space, 2) energy efficiency, and 3) power infrastructure. The technology, which was originally developed at the IBM T.J. Watson Research Center, combines advanced measurement technologies at high spatial density, measurement-driven models, and autonomous controls to enable optimal adjustments of a data center environment within a target envelope. The MMT technology was initially deployed world-wide internally in IBM's centers, where it is being used for daily operations such space planning, power management and closed-loop air conditioning unit control. MMT has provided significant savings to IBM but has also been deployed successfully at many IBM customers. Recently, the technology has been re-purposed to solve other sustainability-related problems. One of the pilot projects along these lines is performed jointly with the New York Metropolitan Museum of Art, where a wireless monitoring solution is deployed at The Cloisters exhibit for art preservation.

Contact: Hendrik Hamann, IBM TJ Watson Research Center (hendrikh@us.ibm.com)
Reference: Uncovering Energy Efficiency Opportunities in Data Centers, IBM J. Res. & Dev. 53, 19 (2009)
Website: http://www-03.ibm.com/systems/services/labservices/solutions/mmt/index.html

STC Updates

By Giuliano Casale, Imperial College

Membership: 198

Report from Secretary/Treasurer (Giuliano Casale):
- Collected officers' activity reports and prepared monthly STC report.

Report from Conferences Chair (Diwakar Krishnamurthy):
- Solicited collaborations from organizers of June conferences related to our STC (ICS 2012, USENIX ATC 2012, EESC 2012, HPDC 2012, WEED 2012, ERSS 2012, WETICE 2012, IWQoS 2012, ISCA 2012, Green Computing 2012, Green Networking Workshop 2012, and DSN 2012).
- Coordinated display of our STC poster at ISSST 2012 in Boston.

Report from Academic Chair (Niklas Carlsson):
- Working with the industry chair on a short-feature that will showcase academic and industry groups/ people, as well the proposal of a student award.

Report from Membership Chair (Anirban Mahanti):
- We currently have 198 members.
- Sergey Blagodurav (Simon Fraser U.) joined as vice chair to strengthen membership recruitment.

Report from Communications Chair (Abhishek Chandra):
- Continued to identify conferences, workshops and journals relevant to sustainable computing.
- Prepared a spreadsheet with information about upcoming call for papers and call for participation, for inclusion in the monthly newsletter and website.

Report from Policies and Procedures Chair (Stephen Dawson):
- Documenting implemented STC-SC processes and gathering requirements for future processes.

Report from Industry Chair (Canturk Isci):
- Finalized two of the industry features with their leads for publication in the newsletter.
- Prepared the initial draft for the industry/academy group picks and call for STC-SC student award.

Report from Information Officers (Danilo Ardagna, Guillaume Jourjon):
- Contributed material for newsletter and blogs.

Report from the Chief Editor (Christopher Stewart):
- Initiated the voting system for the pick of the month series.
- Brought in 2 more regular contributors.

Upcoming Events

By Abhishek Chandra, University of Minnesota

The following venues are all requesting submissions on subtopics related to sustainable computing or IT for sustainability.

Conference, Workshop & Symposium Call For Papers

Short Name	Main Topic	Location	Dates	Abstracts Due	Papers Due	Notification
SOCC'12	*Cloud Computing*	*San Jose, CA*	*Oct. 14-17, 2012*	*Jun. 8, 2012*	*Jun. 15, 2012*	*Sep. 3, 2012*
HotPower'12	Power-Aware Computing and Systems	Hollywood, CA	Oct. 7, 2012		Jul. 13, 2012	Aug. 24, 2012
ASPLOS 2013	Architectural Support for PL and OS	Houston, TX	Mar. 16-20, 2013	Jul. 16, 2012	Jul. 23, 2012	Nov. 9, 2012
INFOCOM 2013	Computer Communication	Turin, Italy	Apr. 14-19, 2013	Jul. 20, 2012	Jul. 27, 2012	Nov. 19, 2012

Journal and Special Issues

Sustainable Computing

Conference, Workshop & Symposium Call for Participation

Short Name	Main Topic	Location	Dates
IGCC'12	*Green Computing*	*San Jose, CA*	*Jun. 5-8, 2012*
Greenmetrics'12	*Sustainable computing*	*London, UK*	*Jun. 11, 2012*
Sigmetrics'12	*Measurement and Modeling*	*London, UK*	*Jun. 11-15, 2012*
IWQoS 2012	*Quality of Service*	*Coimbra, Portugal*	*Jun. 4-5, 2012*
ISCA'12	*Computer Architecture*	*Portland, OR*	*Jun. 9-13, 2012*
ICDCS'12	Distributed Computing Systems	Macau, China	Jun. 18-21, 2012
Cloud 2012	Cloud Computing	Honolulu, Hawaii	Jun. 24-29, 2012
USENIX ATC'12	Computer Systems	Boston, MA	Jun. 13-15, 2012
GCC'12	Green Communications and Networking	Ottawa, Canada	Jun. 15, 2012
HPDC'12	High Performance Distributed Computing	Delft, Netherlands	Jun. 18-22, 2012
CAGing	Collaborative and Autonomic Green computing	Toulouse, France	Jun. 25-27, 2012
MobiSys 2012	Mobile Systems	Low Wood Bay, UK	Jun. 25-29, 2012
GreenTech 2012	Conference on Eco-Technology and Green Computing	Chennai, India	Aug. 10-11, 2012
SIGCOMM 2012	Computer Communication	Helsinki, Finland	Aug. 13-17, 2012

Visit http://stc-sustainable-computing.ieee.net/venues for more information.

To advertise a relevant venue, email Abhishek Chandra at chandra@cs.umn.edu.
To purchase a printed copy of the Register visit http://www.magcloud.com/

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