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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The IEEE STC on Sustainable Computing

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Mission Statement

The STC on Sustainable Computing (STC-SC) is one of the initial set of IEEE Special Technical Committees (STC). We are a volunteer organization comprised of researchers and practitioners interested in sustainable information technology. We take a holistic view of IT. Any domain that uses or could potentially benefit from using IT is relevant to STC-SC.

The two primary goals of STC-SC are: (1) to promote the design and implementation of sustainable computing; and (2) to facilitate computing for sustainability. With respect to these goals, topics relevant to STC-SC include (but are not limited to):

- Energy efficient design and operation of IT equipment (servers, storage and networks).
- Sustainability across the life cycle of IT equipment and processes.
- Measurement and evaluation of the sustainability of existing IT infrastructures.
- Models that facilitate sustainable computing.
- Use of computing to systematically improve the sustainability of non-IT processes.

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Resource and Energy Management

by Danilo Ardagna, Politecnico di Milano

How clean is your cloud? A Summary of the Greenpeace Report (Part 2)

In July, I published the first of a 2-part series on the Greenpeace cloud computing report. In that article, I focused on the poor grades received by major IT companies. I also discussed a few brights spots from the report card. In this part, I will continue the review, starting with the debunking of a widely used metric for data center infrastructure: Power Utilization Efficiency (PUE).

Greenpeace noted that many cloud companies are working on improving the PUE associated with their newest data centers. However, the report explains why this practice may result in truly clean datacenter, "…unfortunately, PUE is now increasingly being misused by some companies to assert how green a particular data center is. The expected PUE is now increasingly included in company announcements of a new data center, offered as the numerical evidence of how green the new facility will be, often in the same way MPG (miles per gallon) is reported for automobiles, and this is increasingly misreported in the media as equivalent to MPG. However, while PUE can be a useful diagnostic tool for a data center operator, it is a poor metric for determining how green a data center is, as it does not account for how companies are managing computer resources inside the data center, and in some circumstances, it penalizes better performance."

At this point, we should provide some background for readers that are unfamiliar with data centers, their infrastructure, and the PUE metric. A data center is a building that houses servers. They are the factories that power Google, Yahoo!, and Facebook. To provide a hospitable home for servers, data center must provide two things: 1) electricity and 2) cool air. The former clearly makes the servers useful and the latter ensures that the Intel chips and Seagate disks inside of a server will not overheat. A very efficient data center would use as little energy on cooling and non-operational infrastructure as possible, much like an energy efficient home. Hence, the PUE metric was born. It divides the total power coming into the data center by the power used directly for compute tasks. Ideally, this metric is 1.0. A PUE of 2.0 would mean that for every 1 watt used by a server another watt is used in cooling.

PUE is easy to measure and has been the focus of a lot of data center improvements. For instance, a PUE of 2.0 would be totally unacceptable today. However, the Greenpeace report makes a great point. PUE, as an efficiency measure, may not always be a good indicator of sustainability. Consider a simple scenario. The workload at an Internet company decreases (e.g., there are often fewer people clicking "like" on Facebook at night). A very environmentally aware thing to do would be to turn off a few servers. There is no need to waste energy on idle servers, right? At the same time, even though we've turned off a few servers, it may not be enough to effect the data center's air conditioner, which must run continuously to keep all other servers cool. In this case, we have subtracted a constant amount of power from the numerator and denominator in PUE. This can actually increase the PUE, even though we are clearly using less energy in total. The report walks through a concrete example where this can happen.

In response to a growing desire to have a standardized method to report carbon intensity of data center operations, Greenpeace is in favor of the CUE (Carbon Usage Effectiveness) recently proposed by the Green Grid

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PICK OF THE MONTH
September 2012

Leveraging Stored Energy for Handling Power Emergencies in Aggressively Provisioned Datacenters by Sriram Govindan, Di Wang, Anand Sivasubramaniam, and Bhuvan Urgaonkar published in the Proceedings of the Seventeenth International Conference on Architectural Support for Programming Languages and Operating Systems.

Every month, our membership chooses (via Facebook vote) a standout paper or research project to highlight and expose to the whole community. This month, the pick of the month award goes to Leveraging Stored Energy for Handling Power Emergencies in Aggressively Provisioned Datacenters, an ASPLOS paper spawned from researchers at Penn State and Microsoft. Then in this article, Christopher Stewart, newsletter editor, interviews the paper's authors. The goal is to expose the author's personal sentiments regarding the work and its place in the broader community. Sentiments that may not be expressed in the paper itself. This month, we were able to sit with Sriram Govindan (lead author).

Christopher Stewart: First, let me provide a summary. This month's pick offers a radical but very sensible approach to survive the rare situations where a datacenter's servers need more power than the data center can bring in. Instead of turning off servers to reduce demand, "turn on" on-site batteries to increase the power supply. To appreciate this idea fully, readers should know that most datacenters already invest in on-site batteries that sit unused unless there is a power outage. Sriram and his colleagues (thoroughly) show that those batteries can be very useful in dealing with power emergencies. OK, let's move onto the interview. I am big fan of your work! I noticed that you had begun working at Microsoft for part of this work. How did that change your collaboration? Did the advisor-advisee relationship rule the day? Or were you empowered?

Sriram Govindan: First of all, I would like to thank the [STC membership] for honoring us with this award. It has been a year since I graduated from Penn State and joined Microsoft. Much of this work, including the initial submission for review, was done when I was a student. During the past year, I have been in constant touch with my advisors, collaborating on multiple research projects and looking forward to continuing this collaboration in coming years. My team in Microsoft is also very supportive of this collaboration.

Christopher Stewart: To say that the idea of leveraging stored energy to thwart power emergencies is “out of the box” is an understatement. I applaud your courage in tackling the problem in a fundamentally different way. Give us an idea on how you divided your time between refining such a novel idea and actually building it.

Sriram Govindan: We spent lot of time investigating the feasibility of energy storage before committing to building the infrastructure. Our ISCA paper last year looked at the possibility of op-ex savings using energy storage - which seemed like a more obvious use-case. Energy storage has always been considered as an expensive proposition... in other domains. But in the context of datacenters, which already invests several million dollars on power related cap-ex, we wondered if demand response can be achieved almost free of cost... At the same time, we wanted to ensure that this new use-case for batteries [would] not affect [their] intended purpose in today’s datacenters – transitioning to standby generators. We invested lot of [time] developing models to understand the charge/discharge, lifetime, availability and cost implications of using batteries... Encouraging results from our analysis... motivated us to build a prototype infrastructure.

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.

Selection Process:

1. Members can submit worthy papers and industry projects by emailing me.
2. Submissions endorsed by 2 STC-SC officers will advance to public vote on Facebook.
3. 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). Papers nominated but not selected for more than four (4) months will be removed.

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: One of the strengths of this paper is that you are able to combine supply-side (battery) and demand-side approaches together into a single model. I get the contribution. But I did find it ironic that Section 3.2 provides a really good classification of demand-side techniques, breaking them down into two categories, yet somehow I have far more than 2 papers on demand-side techniques. (*smile*) How did the community accept your classification? And given your unifying model, do you see any open research questions about the integration of stored energy and specific demand-side implementations?

Sriram Govindan: Though [our classifications] do not cover the entire spectrum of existing peak power management literature, they did allow us to capture the two broad functional behavior of demand-side implementations: (i) delaying peak demand to non-peak durations which include techniques like DVFS throttling, delay in scheduling batch job etc., and, (ii) moving peak to different part of the power network which includes techniques like request re-direction, live migration of workloads. There are a handful of disparate techniques that do not fall in to this classification include, advanced power-rerouting architecture, hardware improvements for energy proportionality, usage of other energy sources (generators/renewables) for demand-response. Many of these techniques are orthogonal and complementary, and are also more focused on energy rather than peak power related issues.

Christopher Stewart: Any ideas about using solar energy?

Sriram Govindan: Supply-demand mismatch due to vagaries in renewable energy source availability like solar, wind etc., can be handled using stored energy in a similar fashion as emergency handling, though the exact battery usage scenarios might vary. Energy storage can be used to address the temporal mismatch between supply and demand arising from variability. Further, in some cases, captive generation of greener energy (solar/wind/gas-turbines) can also be viewed as a ``virtual storage capacity'' within our broader framework to reduce peak demand from the utilities.

Christopher Stewart: Siriram, thank for you taking the time to do this interview. Best wishes on your future endeavors at Microsoft. And congratulations again on such a thought-provoking work.

How clean is your cloud? A Summary of the Greenpeace Report

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consortium, which provides a carbon per kilowatt hour intensity measurement. CUE has been a standard for more than one year, and yet only one of the companies evaluated by Greenpeace (Akamai) is publicly reporting its CUE.

Ultimately, the lack of CUE metrics was the main point of contention in the Greenpeace report. Companies were dinged for their lack of clean energy initiatives. "For all of the tremendous innovation contained in the development of the cloud and the devices that use it, most IT companies are currently choosing to buy their electricity off the rack, at the lowest possible price, with the focus on its quantity, not its quality.... By making better energy choices and demanding more from utility vendors, cloud companies have the opportunity to be a catalyst in driving utilities and governments toward the development of cleaner electricity generation that will ensure a truly green cloud for their long term sustainability, and a greener grid for us all."

The report did mention Google, Yahoo and Facebook in a positive light for their "Infrastructure siting" criteria. The key examples cited in the report are the following:

- Yahoo's decision to place a data center in Lockport, New York, was connected to its ability to secure a substantial (15MW) allotment of hydroelectric power from New York Power Authority.
- Facebook built its third major data center in Lulea, Sweden, a location chosen for the large amount of existing hydroelectric capacity at high availability. The data center can be fully powered with renewable energy.

The report mentions also GreenQloud located in Iceland, where nearly 100% of the electricity is 100% renewable from geothermal and hydropower energy sources. GreenQloud, is a cloud computing service that "…markets itself as a green compatible alternative to Amazon Web Services, and has established operations in a new data center built by Verne Global on a former NATO Air Force base…. With fast connection time to both Europe and the U.S. East Coast, Iceland's significant renewable energy resources are attracting interest from many IT brands, with Verne being the first to come online." These green hosts offer a unique promise for data centers that are profitable, in part, because they are sustainable.

Hydroelectric and geothermal energies are not the only green energy sources adopted by innovative data centers. "A growing number of IT companies have installed renewable energy on site to generate power for their own operations… companies are increasingly exploring onsite investments that can help provide better protection against electricity price volatility and, with onsite solar, can help shave electricity demand at the most expensive time of the day." The report mentions, as an example, the i/o Data Centers installation in Phoenix, where a large solar array (580,000 sq ft, with 5,000 panels) will generate a total 4.5MW at peak capacity. "Though just a fraction of the facility's total 100MW expected capacity, the solar panels will be married with thermal storage technology that will reduce the energy drain of cooling during the heat of the day."

Apple, as reported in New York Times "immediately disputed the report's findings, saying that the company planned to build two huge renewable energy projects at its recently opened data center in North Carolina that would eventually offset much of the coal-fired and nuclear energy use…In a statement issued in response to the report, Apple disclosed for the first time that the data center would consume about 20 million watts at full capacity — much lower than Greenpeace's estimate, which was 100 million watts.

The report conclusions are that additional investments in the development of grid infrastructure and energy storage technology are needed to enable much higher utilization of variable energy sources, such as wind and solar, and IT can have an important role and lead this pathway.

STC Updates

by Giuliano Casale, Imperial College

Membership: 267

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

Report from Conferences Chair (Diwakar Krishnamurthy):
- Solicited collaborations from SOCC 2012, HotPower 2012, ICUMT 2012, LCN 2012, and SustainIT 2012.

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

Report from Membership Chairs (Anirban Mahanti and Sergey Blagodurov):
- Total membership count is 267.
- Created a contact list from GreenMetrics to send invites to join STC-SC to people in the list.
- Next step is to prepare a contact list for E-Energy participants.

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

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

Report from Industry Chair (Canturk Isci):
- Worked with the Academic Chair on the STC-SC student award process.
- Continued working on the initial Community Highlights feature with the potential groups for the feature.

Report from the Chair

In the northern hemisphere, summer is nearing its conclusion for another year. As many of our officers return from vacation, we look forward to renewed efforts to grow our community as well as to increase the value we provide. Our STC now has 267 members, thanks to the continued efforts of our membership chairs. Our conferences chair continues to pursue opportunities to collaborate with related venues. We expect to see a series of “trip reports” from the pipeline of these venues that will start to occur in the fall. Our academic and industry chairs along with the secretary-treasurer are working on opportunities to provide greater value to students. And as always, we welcome suggestions from members on other ways that we can provide value to our STC.

- Martin Arlitt

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
NSDI '13	*Network Systems*	*Lombard, IL*	*Apr. 3-5, 2013*	*Sep. 12, 2012*	*Sep. 19*	*Dec. 10*
FAST'13	File and Storage Systems	San Jose, CA	Feb. 12-15, 2013	Sep. 18, 2012	Sep. 24	Dec. 6
SIGMETRICS'13	Performance Evaluation	Pittsburgh, PA	Jun. 17-21, 2013	Nov. 2, 2012	Nov. 9	Feb. 11
CCGrid	Cluster, Cloud and Grid Comp.	Delft, Netherlands	May 13-16, 2013		Nov. 12	Jan. 24
ICDCS	Distributed Computing Systems	Philadelphia, USA	Jul. 8-11, 2013		Nov. 12	Feb. 25

Journal and Special Issue Call For Papers	Papers Due (Open)	Notification
Sustainable Computing		

Conference, Workshop & Symposium Call for Participation

Short Name	Main Topic	Location	Dates
ICT-GLOW'12	ICT against Global Warming	Vienna, Austria	Sep. 3-7, 2012
EnA-HPC 2012	Energy-aware HPC	Hamburg, GE	Sep. 12-14 , 2012
Green Com	*Green Communications*	*Online*	*Sep. 25-28, 2012*
SustainIT	*Sustainable Internet*	*Pisa, Italy*	*Oct. 4-5, 2012*
HotPower'12	Power-Aware Computing and Systems	Hollywood, CA	Oct. 7, 2012
OSDI'12	Computer Systems	Hollywood, CA	Oct. 8-10, 2012
SOCC'12	Cloud Computing	San Jose, CA	Oct. 14-17, 2012
GreeNETS 2012	*Green Comm. and Networking*	*Gandia, Spain*	*Oct. 24-26, 2012*
SC'12	Supercomputing	Salt Lake City, UT	Nov. 10-16, 2012

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

To advertise a relevant venue, email Abhishek Chandra at chandra@cs.umn.edu.

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