

## Energy Efficient High Performance Computing Working Group 2/10/15 Meeting Report

### INTRODUCTION

The EE HPC WG held a meeting on 2/10/15. This Working Group is composed of members representing major Federal departments and independent agencies, private sector representatives, and members of the academic community. More information can be found at the working group's website, <http://eehpcwg.lbl.gov>.

*NEXT WEBINAR: Wednesday March 25<sup>th</sup>, 9:00-10:00AM Pacific Time  
Akhil Langer and Tapasya Patki will present their research on Power Management*

*NEXT MEETING: April 14th, 9:00-10:00AM Pacific Time*

### Introductions and Announcements: *Anna Maria Bailey, LLNL*

- John Gustafson from Ceranovo presented a webinar in January about computer arithmetic and energy efficiency. **He introduced the 'unum' (universal number), a superset of IEEE Floating Point, that contains extra metadata fields that actually save storage and energy, yet give more accurate answers that do not round, overflow, or underflow.** This topic generated a lot of positive feedback from the participants. Both the presentation and a recording of the talk are posted on the EE HPC WG website (<http://eehpcwg.lbl.gov/resources/discussions-and-webinars>).
- The EE HPC WG website will be getting a facelift. Andy Williams from LLNL will assume responsibility for the website and we expect great improvement soon!
- One of the founders for the EE HPC WG, Bill Tschudi, has announced his retirement in July 2015. His contributions have been wonderful and we will be working to replace the leadership he has been providing.
- Greg Rottman shared information about a low cost 3 phase wireless meter (under \$100) that should be coming out later this year.

### Conferences Sub-group Update: *Marriann Silveira, LLNL*

SC15:

The SC15 Workshop submission deadline had been extended by a week to the 14<sup>th</sup> of February. The EE HPC WG made a submission for the 6<sup>th</sup> Annual Workshop for the Energy Efficient HPC Working Group. The submission has not changed substantially from last year, but the organizing committee will include more participants from the system integrator vendor community.

Based on feedback from SC14, the SC15 Technical Committee is soliciting sessions that target System Administration. We're looking for people interested in helping to organize technical sessions that target energy efficiency and system administration. Let Natalie know if you are interested.

The next SC15 submission deadlines are the 3<sup>rd</sup> of April for Paper Abstracts with full Paper Submission due the 10<sup>th</sup> of April. The SC15 Panel Submission is due the 25<sup>th</sup> of April.

ISC2015:

The Power Measurement Methodology Team has submitted an abstract for an ISC15 paper and is trying to make the full paper deadline of February 15<sup>th</sup>. This same team will be making a BoF submission, also due February 15<sup>th</sup>. ISC' 15 High Performance Computing will be held July 12-16 in Frankfurt, Germany.

Other Conferences:

The National Laboratories IT Summit (NLIT) facilitates the exchange of best practices and ideas between IT professionals within the DOE complex, strengthens the IT infrastructure, and reduces costs within the DOE laboratory system. Speaker abstracts for NLIT are due the 18<sup>th</sup> of February. The summit will be held in early May in Seattle this year. Ralph Wescott announced that the Summit is being sponsored by PNNL this year. He has also made a submission to speak about PNNL's adiabatic and underwater systems.

Natalie Bates will be giving an invited talk at Supercomputing Frontiers 2015 on the EE HPC WG. Supercomputing Frontiers is Singapore's inaugural conference on trends and innovations in the world of high performance computing. It will be held in mid-March.

The EE HPC WG website lists many upcoming Conferences and Workshops that have an Energy Efficiency Focus (<http://eehpcwg.lbl.gov/resources/events-and-links> )

Other conferences mentioned by participants:

Dale Sartor will be speaking at the Data Center Energy Efficiency Best Practices Seminar (Technology Convergence Conference). 25 February. Santa Clara, CA USA.

Data Center World 19-23 April. Las Vegas, NV USA

Open Compute Project US Summit 2015. 11-12 March. San Jose, CA USA

**Infrastructure Sub-Group Update: *Bill Tschudi, LBNL, Marriann Silveira, LLNL and Dave Martinez, SNL***

### **LIQUID COOLED COMMISSIONING TEAM:**

Bill Tschudi reported on results from January 2015 ASHRAE TC9.9 meeting.

ASHRAE TC9.9 will work with us on our liquid cooling commissioning document. The next step is for Mike Patterson to edit the document and then submit it for TC9.9 Committee review.

They reported on research that has investigated the lower limit of humidity and its effects on ESD for recommended ASHRAE guidelines. The conclusion is that humidity doesn't need to be controlled for ESD purposes. So, there will be a revision to the guidelines which would essentially mean for most sites that no humidifiers are required. Now, they are turning their attention to high levels of humidity. They will study this and report results in the future.

ASHRAE is working on an energy standard 90.4 for Data Centers and Telcom Facilities. A draft will be out for review shortly and we can expect a standard w/in a year or two.

## **CONTROLS TEAM:**

There are lessons learned and best practices evolving from implementing and operating supercomputer centers with complex infrastructure systems and the highly variable demands placed upon these systems with today's supercomputers. This team will focus on sharing designs, challenges and best practices for integrated control systems in order to determine if there are universal learnings.

The Team has been meeting regularly with strong participation. We shared controls designs as well as issues and concerns. After writing an outline for a performance guideline whitepaper, we realized that the scope was too broad and we needed to focus more.

The team is currently focusing on understanding more about control system design considerations and trade-offs between having them located within the computer system verses within the building/infrastructure. The key problem is how facilities interface to platforms. Each has its own controls, so how can they be made to work together? Perhaps there ought to be some conceptual clarity on which aspects are controlled by the facility, and which ones by the platform. We are also planning on capturing case studies that illustrate the significance of this boundary question.

## **TUE TEAM:**

The TUE Team has developed two new metrics; iTUE and TUE that account for infrastructure elements that are a part of the HPC system (like cooling and power distribution). iTUE is not only a metric that is necessary for calculating TUE, but stands on its own as a metric for a site to use for improving infrastructure energy efficiency.

TUE is an improvement to PUE. PUE is easy to understand, and is comparatively easy to use. It is in common use, so extending its use is thought to be more practical than replacing it.

TUE is positioned to give a more accurate representation of the overall efficiency of the data center with its included IT processing equipment (servers). It primarily allows for consistent results even when moving the location of the air handling and energy storage devices around in the facility / IT chain like from row based to rack located or even directly to the server node itself.

The team is currently using test results from ORNL and LLNL to create better information on how to measure TUE. This information will be posted on the EE HPC WG website. It will also form the basis for a whitepaper.

We have been working with The Green Grid Metrics and Measurements WG about iTUE and TUE. They are interested in working with us on this.

## **ENERGY REUSE EFFECTIVENESS:**

The Energy Re-use Effectiveness Team in collaboration with The Green Grid has developed a standard metric for measuring the contribution of re-using heat generated by HPC systems for other useful purposes. Florent Parent, Calcul Quebec/Compute Canada is interested in testing this metric at his site.

Anyone else interested in sharing your experiences or testing the ERE metric should contact Natalie.

## **Systems Sub-group Update: *Natalie Bates, EE HPC WG***

### **SYSTEM WORKLOAD POWER MEASUREMENT METHODOLOGY:**

The EE HPC WG along with the Green500, Top500 and Green Grid have developed a standard methodology for measuring system power while running a workload. The ultimate goal is to have broad use of the highest quality energy and power measurement methodology for all of their system workload energy efficiency benchmarking activities.

This team has been focused on collecting data about node power variability while running a regular workload, like High Performance Linpack. Several sites have been participating in running tests, including LRZ, University of Dresden, Calcul Quebec, CEA, ORNL and University of Frankfurt. This information will help to inform the question of node sample size required for characterizing the power of an entire supercomputer. Jon Azose is a Research Assistant in Statistics at the University of Washington and has been leading the statistical analysis.

As mentioned earlier in the Conferences Update, this team has made an abstract submission for a paper at ISC15 on this topic. We will also make a birds of feather submission, on the topic of improving methodology, workloads and metrics for comparing system architecture with respect to power and energy. We have been hosting BoFs at both ISC and SC for the past 5 years.

### **HPC AND GRID INTEGRATION:**

The Demand Response Team is investigating how HPC centers have, can and should engage more actively with the Grid electricity providers. This is an investigative activity with the ultimate goal of educating the HPC DOE Facility and Operations Managers about HPC and grid integration opportunities and challenges.

The Team has written a paper analyzing data collected from 11 US-based Supercomputing Center sites that are on the Top100 list. The team has collected data from 9 European sites that are on the Top50 list and is now analyzing the data.

The team has developed another questionnaire that will be used to collect data from Electricity Service Providers in these countries. It focuses on their interests and involvements (both current and planned) in grid integration. This data will allow for comparing and contrasting electricity markets between countries in Europe and between the US and Europe. The questionnaire has been tested with friendly service providers, modified and is now ready for more general distribution.

One of the key learnings from this analysis is that some of the tools that are being developed to help with energy efficiency may also be used in the future for electricity grid integration. An example of such a tool is dynamic power management.

### **PROCUREMENT CONSIDERATIONS:**

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**SW UPDATE:**

Three efforts continue to develop momentum; these are 1) creating an on-line annotated list with links of energy efficiency workloads/benchmarks 2) promote development of a power measurement API, such as the work being led by Jim Laros from Sandia National Laboratory and 3) share best practices for dynamic power management.

***PARTICIPANTS INCLUDED***

Name	Organization
Anna Maria Bailey	LLNL
Natalie Bates	EE HPC WG
Bill Brantley	AMD
Anita Cocilova	LLNL
Wade Doll	Cray
Thomas Durbin	NCSA
Siddhartha Jana	University of Houston
David Grant	ORNL
Alan Marley	INL
Rodney Martin	NASA
Steven Martin	Cray
Dave Martinez	SNL
Scott Miliken	ORNL
Rick Pool	INL
Dale Sartor	LBNL
Andrew Riker	United Technologies, Sikorsky Aircraft
Greg Rottman	Army Corps of Engineers
Marriann Silveira	LLNL
Hinrich Tobaben	University of Hannover
Bill Tschudi	LBNL
Ralph Westcott	PNNL