

**Energy Efficient High Performance Computing Working Group**  
*2/11/14 Meeting Report*

**INTRODUCTION**

The EE HPC WG held a meeting on 2/11/14. 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 MEETING: April 8th, 9:00-10:00AM Pacific Time*

**Introductions and Announcements: Dale Sartor, LBNL**

- Steve Poole, ORNL has taken a stronger leadership role in the EE HPC WG. His strong background in advanced architecture, algorithms and applications will help expand the scope of the EE HPC WG to include a broader system and software focus.
- Marriann Silveira from Lawrence Livermore National Laboratory will provide technical leadership for the INTEGRATED LIQUID/AIR CONTROLS TEAM. This team arose out of the Liquid Cooling Infrastructure Commissioning Team.
- Steve Poole is working with Natalie to lead an effort to kick-off one or more SOFTWARE TEAM(S). If you are interested and have expertise in software and HPC energy efficiency, then contact Natalie.

**Conferences Sub-group Update: Anna Maria Bailey & Marriann Silveira, LLNL**

- **News on EE HPC WG participation in upcoming Conferences**
- The Power Methodology paper was accepted by the ACM/SPEC International Conference on Performance Engineering.
- Bill Tschudi presented on the liquid cooling commissioning effort at the ASHRAE TC9.9 Committee meeting during the ASHRAE annual meeting.
- The 5<sup>th</sup> Annual SC14 EE HPC WG workshop submission was completed on-time. This year, the only options for workshops are half and full day schedules. We chose a full day schedule. Notification of workshop acceptance is March 28<sup>th</sup>.
- Two EE HPC WG Teams made Birds of Feather submissions for ISC' 14. One is on the power measurement methodology for systems running a workload and the other is on TUE, a metric that addresses some of the weaknesses of PUE. Notification of BoF acceptance is March 21<sup>st</sup>.
- There is a 5<sup>th</sup> Annual European HPC Infrastructure Workshop in early April. Natalie Bates is scheduled to talk about the EE HPC WG and there may be other sites talking about the efforts of some of the Teams.
- NLIT 2014 – National Laboratories IT 2014 June 29th – July 2nd – San Francisco

➤ Ghaleb Abdulla of LLNL was asked by Chuck Wells of OSI Soft to be a guest speaker at the Western Electricity Coordinating Council (WECC) to discuss the effects of software compression on grid frequency data. He was addressing the following concerns:

1. How does compression change the characteristics of the signal?  
What is the frequency data mean in analytics?
2. What are the applications?
  - HPC Energy Efficiency
  - Microlevel energy scheduling
  - Demand response for HPC Facilities
  - Track and analyze distribution system events

The presentation was well received with a lot of heated discussions and they have asked him to come back to the meeting in June again to present on another topic. WECC typically meets twice a year and their topics are typically centered around electrical grid issues, equipment issues, downtimes, etc. This topic was a nice fit for them. The EE HPC WG would benefit from a Webinar on this topic as it ties to many of our areas that we are working on.

\*\*The EE HPC WG website Links and Events page lists many upcoming Conferences and Workshops that have an HPC Energy Efficiency Focus\*\*

**Future Conferences:** (more details at <http://eehpcwg.lbl.gov/events-and-links> )

**Infrastructure Sub-Group Update:** *William Tschudi, LBNL & Dave Martinez, SNL*

**LIQUID COOLED COMMISSIONING TEAM UPDATE:** The Liquid Cooling Commissioning Team has collected and reviewed best practices and lessons learned for commissioning of liquid cooling infrastructure. The ultimate goal is to improve the commissioning process for delivering a liquid cooling infrastructure that works when the HPC system is installed.

The Team has written a document that is intended to provide some general guidance and recommendations for those who are writing commissioning plans. The Team has five 'lessons learned' documents that help to illustrate the general guidance and recommendations. The goal is to have closer to 10 lessons learned- SO PLEASE LET NATALIE KNOW IF YOU ARE INTERESTED. The 'lessons learned' can be anonymous if necessary.

Since we last met, Bill Tschudi attended the ASHRAE TC9.9 Committee Meeting in mid-January. He was given a few minutes to talk about this team's work on liquid cooling commissioning. There were ~ 70-75 people in the room. He asked for a review of Liquid Cooling Commissioning document by the committee. He also asked them to publish it as part of the ASHRAE Liquid Cooling book or some other publication. They agreed to engage with us.

The Team is planning other venues to do outreach with the Liquid Cooling Commissioning document and lessons learned. It may also be possible to present at the NLIT Summit 2014 in late June and/or AFCOM in the Fall.

### **INTEGRATED CONTROLS TEAM LAUNCH:**

Members of the Liquid Cooling Commissioning Team will be launching another team called Integrated Controls.

This team will focus on sharing designs, challenges and best practices for integrated liquid and air system controls in order to determine if there are universal learnings that can be captured as a guideline. The team output will be a short report documenting their findings with an appendix containing the shared material.

Marriann Silveira from Lawrence Livermore National Laboratory will provide technical leadership for this team. She will draw upon LLNL's experiences as the initial basis for team. This team is especially looking for members who have had experience implementing and operating integrated liquid and air controls.

**TUE TEAM:** The TUE Team has developed a metric that improves PUE by accounting for infrastructure elements that are a part of the HPC system (like cooling and power distribution).

The February EE HPC WG webinar was a repeat of the SC13 TUE BoF with presentations from speakers Mike Patterson, Intel, Anna Maria Bailey, LLNL, Chung-Hsing Hsu, ORNL and Herbert Huber, LRZ.

There is interest in specifying a benchmark or suite of benchmarks to run while measuring TUE. TUE is intended to be like PUE – monitored over a period of one year, taking ongoing measurements to compensate for peak and nominal loading changes that occur within the data center. If it is not possible to monitor energy consumption over a full year, select a period of time not less than one month and verify that the loading within the data center during that time is typical for that particular environment. The benchmark or suite might simulate that typical load.

**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.

There is no new information to report on this activity. Anyone 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 team developed the standard, refined it through both alpha and beta testing and collaborated with the Green500 List to ensure adoption as the Green500 run rules. They are now developing outreach and other tools for broader adoption of the measurement methodology.

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.

As mentioned in the Conferences Update, this Team has a paper that was accepted by the SPEC/ACM International Conference on Performance Engineering. This is particularly exciting because of the cross-fertilization opportunities it may allow for with SPEC. For those who may not know, SPEC (Standard Performance Evaluation Corporation) is a non-profit corporation formed to establish, maintain and endorse a standardized set of relevant benchmarks that can be applied to the newest generation of high-performance computers. SPEC established SPECpower, an initiative to augment existing industry standard benchmarks with a power/energy measurement. The SPECpower committee currently has several focus areas:

- The Power and Performance Benchmark Methodology document
- The SPECpower\_ssj2008 benchmark (released)
- The PTDaemon power measurement harness
- The SERT tool (released)

The SPEC methodology does not yet scale to large-scale computing systems, like supercomputers, so perhaps SPEC can leverage the methodology developed by the EE HPC WG.

Again, as mentioned in the Conferences update, this Team made an ISC'14 BoF submission. The organizers are Wu Feng, Green500 and Virginia Tech, Erich Strohmaier, Top500 and LBNL and Natalie Bates, EE HPC WG.

Also, since we last met, the Team has heard input on recommended changes (mostly enhancements) to the methodology from CSCS, the Swiss National Supercomputing Center. These are being reviewed by the Team and both the recommendations and disposition will be captured as a change control document and posted on the EE HPC WG website.

**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. The Team has collected information from 11 US-based SC sites that are on the Top100 list. This includes LLNL, LANL, ORNL, LBNL, ANL, Purdue, SDSC, NCSA, NOAA, Intel and WPAFB. 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 SC13 workshop panel session on this topic was repeated as a webinar in January. It was moderated by Anna Maria Bailey with panelist Jim Rogers, ORNL, Josip Loncaric, LANL and Bob Conroy, OsiSoft. This Team had been planning on submitting a paper to ISC14, but is now planning on the State of the Practice track for SC'14. The EE HPC WG should expect to see a draft of this paper to review in mid-March.

**PROCUREMENT CONSIDERATIONS:** The RFP Team has a whitepaper that recommends procurement document requirements that target more energy efficient HPC systems. The intention is to raise the bar and extend the requirements with a yearly update of the whitepaper. The 2013 focus is on measurement capabilities.

The Team has been honing the measurement capability requirements based on feedback from the vendor webinars as well as input at SC13. This process is almost complete and the final document will be posted on the EE HPC WG website. From there, the Team will start to work on the 2014 update.

***PARTICIPANTS INCLUDED***

Name	Organization
Anna Maria Bailey	LLNL
Natalie Bates	EE HPC WG
Bill Brantley	AMD
Henry Coles	LBNL
Jacob Combs	Sonoma State University
David Grant	ORNL
Shankar Krishnan	Intel
Sunny Lam	Intel
Steve Martin	Cray
Mitesh Meswani	AMD
Bruce Myatt	Critical Facilities Round Table
Ram Naggapan	Intel
Joshua Ryan New	ORNL
Jean-Philippe Nomine	CEA
Greg Pautsch	Cray
Kevin Peterson	Cray
Barry Rountree	LLNL
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