

**Energy Efficient High Performance Computing Working Group  
6/12/18 Meeting Report**

**INTRODUCTION**

The EE HPC WG held a meeting on 6/12/18. 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, <https://eehpcwg.llnl.gov/>.

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

**Introductions and Announcements:** *Natalie Bates, EE HPC WG & Anna Maria Bailey, LLNL*

**Conferences Sub-group Update:** *Torsten Wilde, Leibniz Supercomputing Centre (LRZ, Germany) & Siddhartha Jana, Intel*

**ISC18**

- ISC18 will be held in Frankfurt from June 24<sup>th</sup> through the 28th.
- The Grid Integration has been invited to present a Special Event on Contracts and Relationships between Supercomputing Centers and Electricity Service Providers.
- We submitted two Bofs and both were accepted: One, our normal joint Green500, Top500 and EE HPC WG Birds of Feather BoF. The other one was submitted by the Energy and Power Aware Job Scheduling and Resource Management Team.
- Natalie Bates and John Shalf are co-chairing a technical session on Computing within Constraints: HPC and the Cloud. There are three speakers: Greg Koenig (KPMG), Dan Reed (University of Iowa) and Alison Kennedy (STFC). All three of the talks will discuss energy/power as one of the constraints requiring consideration.

**Data Center Dynamics**

- Dave Martinez and Dale Sartor are presenting at a panel on liquid cooling at the Data Center Dynamics' San Francisco conference on June 26th. It will include a discussion about the nascent liquid cooling standard specification that Dale is helping to lead.

**SRMPDS**

- The 14th International Workshop on Scheduling and Resource Management for Parallel and Distributed Systems to be held in conjunction w/ ICPP on Aug 14 in Eugene, Oregon and Sid Jana has been invited to present a talk on the JSRM results.

**IGSC**

- The Ninth International Green and Sustainable Computing Conference (IGSC'18) Co-sponsored by IEEE Computer Society and IEEE STC on Sustainable Computing October 21-24, 2018, Pittsburgh, PA, USA

### **7x24 conference**

- 7x24 Conference will be held in Phoenix October 21-24, 2018
- Dale Sartor will be moderating a panel on “Lessons Learned in Establishing Metrics, Setting Goals, and Achieving High Data Center Energy Performance”. A panel from Digital Realty Trust, Intel, and the Lawrence Livermore, Sandia, and Lawrence Berkeley National Laboratories will share their stories and lessons learned in improving efficiency and resiliency.

### **SC18**

- Our workshop submission was accepted. We have an organizing committee and will hold our first meeting in early July.
- There is an SC18 page on our website with content “coming soon”!
- Two papers were submitted to the State of the Practice Tract; one from the Grid Integration Team and the other from the Energy and Power Aware Job Scheduling and Resource Management Team.
- We submitted a panel submission – following last year’s panel on Software and Energy Efficiency.
- BoF submissions are due at the end of July and we are planning to make 5-6 submissions on a variety of topics.

### **Other Conferences**

The EE HPC WG website has a links and events page with many other conferences and workshops listed that have an HPC energy efficiency focus.

**Infrastructure Sub-Group Update: *David Grant, ORNL and Dave Martinez, SNL,***

### **LIQUID COOLING CONTROLS:**

The Liquid Cooling Controls Team is focused on improving the efficiency and decreasing the cost of liquid cooling systems. The Team is making it easier to build controls for liquid cooling by working with the HPC system vendor community to deliver the right sensors and telemetry with their IT systems. The Team has created a list of data inputs that are provided by the system vendors or the facility.

This Team is attempting to incorporate these data inputs into the Redfish specification. They are working through ASHRAE for those data inputs that are from the system vendors. **The Team is looking for a contact with The Green Grid – who could help with influencing Redfish for those data elements that are from the facility.**

### **LIQUID COOLING STANDARDS:**

As reported previously, the EE HPC WG is collaborating with a small team working on Liquid Cooling Standards. Specifically we are developing an open specification for a liquid cooled

rack. The goal is a specification that would yield a multivendor solution that could be harmonized across the open standards community (e.g. OCP, Open19, and Scorpio). An open specification for a multivendor supported liquid cooled rack could increase deployment of warm water liquid cooling in HPC clusters and other high power density compute environments. Last month LBNL hosted a conference call with LLNL, SNL, and NREL to seek input. These labs have experience deploying liquid cooling in small scale applications (vs. large homogeneous super computers) and provided valuable input. A progress report with draft specifications is expected soon and will be shared with the EE HPC WG for input.

#### **RAS AND MAINTAINABILITY:**

One of the biggest challenges facing HPC centers is maintenance of the facility equipment; better and smarter maintenance could lead to substantial energy savings in the long run if the right things are maintained at the right time. An investigative team was created to answer the question as to whether or not the EE HPC WG should create a RASM team and, if so, what would be the team's deliverables. The investigative team has reached closure. The recommendation is to create a RASM Team with a focus on physical plant equipment. The deliverables- broadly- are to share best practices. There hasn't been much progress with this team since the last time we met.

#### **DASHBOARD TEAM:**

The Dashboard team has been diving more deeply into energy/power data collection systems, analysis and dashboards at three sites; LBNL, LLNL and NREL. All three sites have sophisticated capabilities. LBNL and NREL both have capabilities that span both the facility and the HPC system to at least the node level. LLNL is still working to integrate two different systems; one that includes the facility and HPC system to the rack level and another that collects data of the HPC system at a finer granularity than the rack.

The team is currently focused on a deeper comparison of the three sites and is developing a more detailed questionnaire. This questionnaire will be used for better comparison of the three sites and then may be used for querying other sites that also have more sophisticated energy/power data collection systems, analysis and dashboards.

Dave Martinez at Sandia National Laboratory is working as a test site with the United State's Department of Energy's Office of the Chief Information Officer (DOE OCIO) on a data center infrastructure management (DCIM) system from Nlyte. We'll be learning more about Sandia's experiences as well as DOE OCIO's expectations for other DOE sites.

#### **LIQUID COOLING COMMISSIONING:**

No news on Liquid Cooling Commissioning Team.

#### **iTUE AND TUE:**

No news on iTUE and TUE Team.

#### **ASHRAE:**

TC 9.9 is planning a major white paper that will capture the latest updates, corrections, and trends - ultimately to be incorporated into the 3rd Edition Liquid Cooling Guidelines. The

Liquid Cooling white paper will be in its 1st full rev and will be review and discussed by TC9.9 at the upcoming ASHRAE meeting (Houston, June).

Anyone interested in participating or contributing to any of these teams should contact Natalie.

**Systems Sub-group Update: *Natalie Bates, EE HPC WG and Jim Laros, SNL***

### **ELECTRIC GRID INTEGRATION:**

This Team straddles the Systems and Infrastructure Sub-Groups more than almost any of the other EE HPC WG Teams. The Team's most recent work on electricity service contracts of supercomputing centers has been captured in a Special Interest presentation at ISC'18 as well as a paper that is under review for SC'18. This is an interesting and relevant topic for HPC right now. Ladina Gilley from the Swiss National Supercomputing Center has just completed a multi-year public tender for their electricity and reported on her experiences at the 9th European HPC Infrastructure Workshop last month. As the absolute power demands and the power fluctuations increase for supercomputer centers- especially for those sites who are planning for 40MW+ exascale class systems, this topic is expected to grow in importance and interest.

The Team is now focused on potential power engineering challenges with future supercomputers and the impacts and nature of voltage fluctuations, dynamic load conditions and grid stiffness.

### **POWER MEASUREMENT METHODOLOGY:**

The work of this Team is currently focused on encouraging the HPC community who make submissions to the various benchmark lists, like the Top500, to use a high quality power measurement methodology that captures the power of the entire system. Inside HPC has announced quite a few new submissions to the Top500 List for June'18 and, fingers crossed, we'll have some of them done with the high quality L2/L3 submissions.

### **ENERGY AND POWER AWARE JOB SCHEDULING AND RESOURCE MANAGEMENT:**

This Team is wrapping up the first phase of its work, which was to have done a survey of of all supercomputing sites with large scale production deployments of energy and/or power aware job scheduling and resource management capabilities. They have written two papers describing their work. One paper was presented and will be published as part of the High Performance Power Aware Computing Workshop held in conjunction with IPDPS in May. The other paper has been submitted to SC18 and is pending acceptance.

This Team is also preparing a Birds of Feather session for ISC'18 in two weeks.

Beyond that, the Team is still discussing next steps

## **PROCUREMENT CONSIDERATIONS:**

This team has collected recent procurements for best practices on energy efficiency and done a first pass at analysis of the data. They are now reaching out to a broader group of people for feedback on the analysis. The focus for 2018 will be to enhance the section on the interface between the system and the infrastructure. The team will also broaden the measurement section to include using the measured data/telemetry for monitoring, controls and management.

## **POWER API**

The committee is busy accepting new proposals to the standard and writing additional proposals to be considered. We have recently added new functionality that aids in reducing code complexity when choosing to interact with the API using device/node names. Members of the committee are actively working on a new proposal that will aid in gathering online statistics and enhancing performance of the implementation. Organizations continue to contribute to the Power API specification, with new plugins and enhancements to the implementation framework.

## ***PARTICIPANTS INCLUDED***

<b>Name</b>	<b>Organization</b>
Natalie Bates	EE HPC WG
Anita Cocilova	LLNL
Wade Doll	Cray
Ryan Grant	SNL
Sid Jana	Intel
Mukesh Khattar	EPRI
Jim Laros	SNL
Matthias Maiterth	Intel
Aniruddha Marathe	LLNL
Steve Martin	Cray Inc.
Dave Martinez	SNL
Benson Muite	Tartu Ülikool, Estonia
Ben Radhakrishnan	National University
Ivan Sapozhkov	RSC
Dale Sartor	LBL
Mike Stravel	LANL
Torsten Wilde	Leibniz Supercomputing Centre (LRZ, Germany)