



Improving HPC Software

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IESP the Need



- The largest scale systems are becoming more complex, with designs supported by large consortium
 - ▣ The software community has responded slowly
- Significant architectural changes arriving
 - ▣ Software must dramatically change
- Our ad hoc community coordinates poorly, both with other software components and with the vendors
 - ▣ Computational science could achieve more with improved development and coordination

Where We Are Today:

We are not prepared for the changes coming

- Hardware features are uncoordinated with software development
 - (power mgmt, multicore tools, math libraries, advanced memory models, etc)
- Only basic acceptance test software is delivered with platform
 - UPC, HPCToolkit, Optimized libraries, PAPI, can be YEARS late
- Vendors often “snapshot” key Open Source components and then deliver a stale code branch
 - Counterexample: A model that works – MPICH for BG/P
- Community codes unprepared for sea change in architectures
- Coordination via SOW/contract is poor and only involves 2 parties
- No global evaluation of key missing components

The IESP Workshops:



- Goal: Improve the world's simulation and modeling capability by improving the coordination and development of the HPC software environment.
 - Build a plan for how the international community can join together to improve software available for high-end systems over the next 2 to 10 years.
- The DOE (SC, NNSA), NSF, and EU have committed their support for the workshops.
- This is the first workshop in the series of three.

International Community Effort

- We believe this needs to be international collaboration for various reasons including:
 - ▣ The scale of investment
 - ▣ The need for international input on requirements
 - ▣ Europeans, Asians, and others are working on their own software that should be part of a larger vision for HPC.
- The process must be totally open

Executive Committee:

Co-Chair: Jack Dongarra, Univ, of Tennessee / ORNL, US

Co-Chair: Pete Beckman, Argonne National Laboratory, US

Franck Cappello, INRIA, FR

Thomas Lippert, Jülich Supercomputing Centre, DE

Satoshi Matsuoka, Tokyo Institute of Technology, JP

Paul Messina, Argonne National Laboratory, US

A Plan Could Include:



- Work with vendors to create the HPC equivalent to the ITRS (Int'l Tech Roadmap for Semiconductors)
 - Get community working on software before machine becomes available
- Community proposed unified roadmap for exascale software
- Identify missing components for future architectures and a plan to address them
- Develop models for working more closely with vendors
 - ▣ (support, acceptance tests, target features)
- Identify key application areas to drive development
- Community software development models
- Funding and organizational models

Achievable Outcomes



- Improve the capability of computational science
- Build and strengthen international collaborations and leadership; deliver more capable, productive HPC systems
- Build and improve R&D program developing new programming models and tools addressing extreme scale
- Open source HPC development guided by roadmap with better coordination and fewer missing components
- Joint programs in education and training for the next generation of computational scientists.
- Vendor engagement and coordination for more capable software supporting exascale science

Workshops and Report



- 3 workshops over the next year
 - 1: Santa Fe, April 7-8
 - 2: Paris France, June 28-29
 - 3: Japan in the early Fall
- Broad engagement by the community
- Initial reports in summer 2009
- Final report for first year at SC09
- Planning for *IMMEDIATE* payoff
 - Could begin ramping up next year



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The mission of the **International Exascale Software Project (IESP)** is to lay the foundation for exascale computing by mobilizing the global open source software community to combine and coordinate their collective efforts far more efficiently and effectively than ever before. The IESP will hold a series of three workshops to organize and structure this community wide effort. The first, invitation-only workshop will occur on April 7th and 8th in Sante Fe, New Mexico, US, with people arriving in time for a reception on April 6th. Attendees will include members from industry, academia, and government, with expertise in a range of critical areas.

Goals for the first meeting include the following:

- ▶ Assess the short-term, medium-term and long-term needs of applications for peta/exascale systems
- ▶ Explore how laboratories, universities, and vendors can work together on coordinated HPC software
- ▶ Understand existing R&D plans addressing new programming models and tools addressing extreme scale, multicore, heterogeneity and performance
- ▶ Start development of a roadmap for software on extreme-scale systems

Attendance at the workshop is by invitation only. Additional details on registration will be coming soon.

Workshop Information

[Workshop Location](#)
[Workshop Agenda \(draft\)](#)
[Executive Committee](#)
[Organizing Committee](#)
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IESP



- *Plan to build an international partnership that joins together **industry, the HPC community, and production HPC facilities** in a collective effort to design, coordinate, and integrate software for leadership-class machines.*
- Build an international plan for developing the next generation open source software for scientific high-performance computing

Engagement in the Following Activities

- *Build international collaborations in the areas of high-performance computing software and applications.*
- *Development of open source systems software, I/O, data management, visualization, and libraries of all forms targeting tera/peta/exascale computing platforms,*
- *R&D of new programming models and tools addressing extreme scale, multicore, heterogeneity and performance,*
- *Cooperation in large-scale systems deployments for attacking global challenges,*
- *Joint programs in education and training for the next generation of computational scientists.*
- *Vendor engagement to coordinate on how to deal with anticipated scale.*

Goals for this the workshop include



- Assess the short-term, medium-term and long-term needs of applications for peta/exascale systems
- Explore how laboratories, universities, and vendors can work together on coordinated HPC software
- Understand existing R&D plans addressing new programming models and tools addressing extreme scale, multicore, heterogeneity and performance
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Topics



- Purpose of the workshop series, desired outcome (international Research, Development, & Deployment efforts for open source system software and tools for exascale computers)
- Identify key technical areas on which to focus, e.g., file systems, message-passing and multi-threading sw, fundamental numerical sw, system management tools, debuggers, ...
- Begin to identify which groups would like to tackle what areas and which funding sources might support the work
- Begin to develop the open source model, cooperation and collaboration modes, project organization
- Goals for next two workshops, i.e., focus of their agendas

Plan



□ Day 1

- Overviews of architecture trends
- Current status of HPC systems and SW models
- Science Drivers in US, EU, and Japan
- Panel on SW Barriers for HPC, today and tomorrow
 - Three evolutionary SW items
 - Three revolutionary SW items
 - What are the community interaction models to address both evolutionary and revolutionary themes?

Plan Day 2



- Breakout 1: Technical Roadmap Discussion: What is feasible? What are the top challenges?
- Breakout 2: Collaboration model and funding: How can we work together?

- Goals and agenda for next workshop

Follow on Meetings



- Refine the ideas that emerged from the earlier meetings.
- Incorporate new ideas into the plan.
- Expose the IESP to a wider group of people.
- We would like to get buy in from as many people as possible. Some may not be able to attend the earlier meetings.

