



# The National Strategic Computing Initiative (and the ECP): Overview and Status



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September 2016

# The NSCI Is Born

## The Executive Order (July 29, 2015)



**Goal:** Sustain/enhance U.S. leadership in HPC technology and use

1. Use HPC for economic competitiveness and scientific discovery
2. Foster public-private collaboration (all industry, not just vendors)
3. Use a whole-of-government approach (inter-agency collaboration)
4. Move HPC research into production settings

# NSCI Strategic Objectives



1. Accelerating delivery of a capable exascale computing system across a range of applications representing government needs
2. Increasing coherence between modeling and simulation and that used for data analytic computing.
3. Establishing, over the next 15 years, a viable path forward for future HPC systems even after the limits of current semiconductor technology are reached
4. Increasing the capacity and capability of an enduring national HPC ecosystem.
5. Developing an enduring public-private collaboration

# Lead Agencies



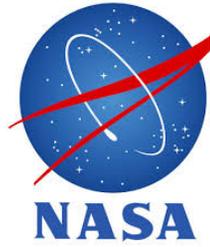
- **Department of Energy:** Office of Science and NNSA will collaborate on an exascale computing program to support their missions: simulation and analytics.
- **National Science Foundation:** focus on the HPC ecosystem for science, and on workforce development.
- **Department of Defense:** focus on advanced analytics to support its mission

# R&D Agencies



- **Intelligence Advanced Research Projects Agency (IARPA):** paradigms offering alternatives to standard semiconductor technologies.
- **NIST:** measurement science to support future computing technologies.

# Deployment Agencies



1. National Aeronautics and Space Administration
  2. Federal Bureau of Investigation
  3. National Institutes of Health
  4. Department of Homeland Security
  5. National Oceanic and Atmospheric Administration
- Participate in the co-design process on behalf of their missions
  - Participate in testing, workforce development and effective deployment

# First Public Forum on NSCI



## 57<sup>th</sup> HPC User Forum

September 8-10, 2015 – Broomfield, Colorado

Thursday, September 10, 2015

7:15am Networking Breakfast

8:00am Welcome: Paul Muzio, Rupak Biswas, Earl Joseph and Steve Conway

**Session Chair: Earl Joseph**

8:00am **Panel on US Plans for Advancing HPC: Potential Implications Of The White House Executive Order and NSCI**

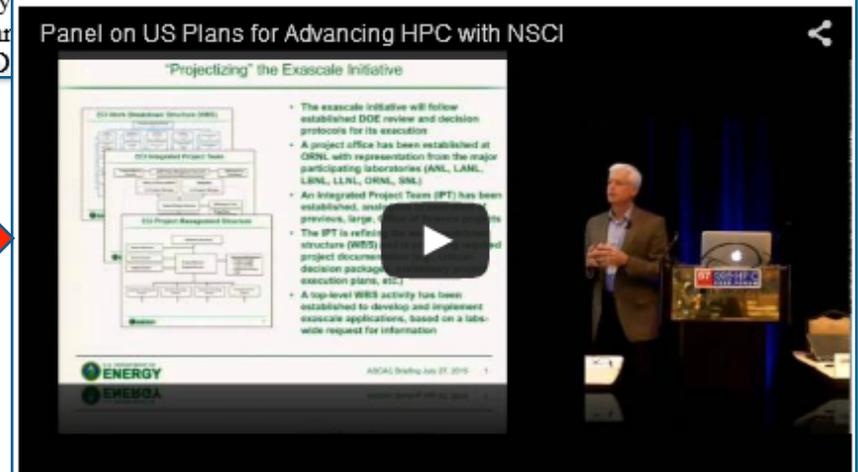
- Panel moderator: Bob Sorensen
- Panel members: Randy Bryant, OSTP, Irene Qualters, National DOE Office of Science, Will Koella, Department of Defense,

9:15am **Open Forum Discussion and Q&A of the NSCI Plans and Director's Intent**

- Panel members: Doug Kothe, Oak Ridge National Laboratory, Leland, Sandia National Laboratory, Bert Still, LLNL, Nathar Mehrotra, NASA Advanced Supercomputing Division, and D

## Video: Panel on US Plans for Advancing HPC with NSCI

September 14, 2015 by [Rich Brueckner](#) [Leave a Comment](#)



Panel on US Plans for Advancing HPC with NSCI

"Projectizing" the Exascale Initiative

- The exascale initiative will follow established DOE review and decision protocols for its execution
- A project office has been established at ORNL, with representation from the major participating laboratories (ANL, LAM, LLNL, LLNL, ORNL, SNL)
- An Integrated Project Team (IPT) has been established, consisting of representatives from participating laboratories
- The IPT is refining the project structure (WBS) and project documentation (project documents, decision packages, execution plans, etc.)
- A top-level WBS activity has been established to develop and implement exascale applications, based on a lab-wide request for information

DOE ENERGY EMEREA

ANL&C Broomfield July 27, 2015 1

Video: [insidehpc.com](http://insidehpc.com)

# Challenge: Government vs. Non-Government HPC Missions



- **Government Need:** Leadership-class supercomputers designed to support mission requirements of U.S. government agencies
- **Vendor Need:** Supercomputers designed to support mainstream market requirements

*“ASCI/ASC system requirements are sometimes so specific to the program's needs that systems developed for the program cannot be sold to any other organization.”*

(IDC 2008 evaluation for DOE of ASCI/ASC program)

# Challenge: Workforce Development



Ensure an adequate number of qualified job applicants and workers

- This is a major challenge for the global HPC community

*“The HPC community has only begun to address this labor shortage... but there is still a long way to go – especially in light of the challenges needed to harness the potential of petascale and exascale computers.” (IDC 2010 study for DOE)*

*“The European Commission and Member States should also collaborate to address the shortage of qualified HPC job applicants, especially by ensuring that HPC competency is required in university scientific and engineering curricula, and that students are aware from an early age of attractive, rewarding HPC careers.” (IDC 2015 report for the European Commission)*

# Challenge: Benefit Industry

- From industry=vendors to industry=entire private sector
- Recruiting industrial partners
- Understanding/addressing industrial/commercial needs
- Bridging the cultural gap
  - Obey tight product development schedules, continue work during academic holidays, handle non-US citizens, etc.



# Challenge: Funding



- NSCI extends beyond the Obama Administration.
- NSCI needs to prove it can address real national security concerns (defense and economic security) to ensure long-term funding.
  - February 9, 2016: **Pres. Obama's FY17 budget** includes \$318 million for NSCI (\$285M DOE + \$33M NSF) – subject to Congressional approval.
  - February 25, 2016: The **HPC4mfg program**, led by LLNL and including LBL and ORNL, has funding of \$3 million for 10 projects to advance HPC use in manufacturing. Separate from NSCI but aligned with NSCI goals.
  - **NCI's Precision Medicine Institute** has a pilot program on using HPC for cancer research that is also supporting NSCI.

# NSCI Will Have Limited Success If...



- Agencies do not get additional funds and instead are forced to re-label existing funding under the NSCI "brand."
- The lead agencies treat the NSCI as an intensification of the status quo instead of a deliberately disruptive mandate to serve industry as well as science.
- The agencies do not learn to collaborate well with each other.

# Which Brings Us to the Exascale Computing Project...

The U.S. Department of Energy's (DOE's) Exascale Computing Project (ECP):

- Accelerate delivery of an exascale computing system to deliver 50 to 100 times more performance than current high-end machines
- Maximize the benefits of high-performance computing for U.S. economic competitiveness, national security and scientific discovery.
- Address applications development, hardware, software, platforms and workforce development needs.
- This is DOE's NSCI project....*it's not a program.*

# Lots of Moving Parts

Collaborative effort:

- Directly involves six of DOE's major national labs
  - DOE-SC's Oak Ridge, Argonne, and Lawrence Berkeley national labs
  - NNSA's Lawrence Livermore, Los Alamos, and Sandia national labs.
- Support from all 17 DOE labs
- Partnerships with commercial and academic entities.

# The First Round of Funding

Just Announced:

- 15 application development proposals for full funding and seven proposals for seed funding, representing teams from 45 research and academic organizations.
- \$39.8 million for advanced M&S for key challenges supporting DOE missions in science, clean energy, and national security, etc.
- Additional funding to support HPC vendor R&D on node and systems better suited for such applications to roll out soon.

# Some Technical Details

- Support applications solving science problems at least 50× faster or more complex than today's 20 PF systems.
- Operate in a power envelope of 20–30 MW.
- Be sufficiently resilient with an average fault rate no worse than weekly.
- Explore at least two diverse system architectures.
- Possess a comprehensive software stack that meets the needs of a broad spectrum of applications.
- Adopt a holistic project approach that uses co-design to develop new platform, software, and computational science capabilities at heretofore unseen scale.

# Scheduling Details

## ECP phases

- 2016 – 2019
  - Develop applications, conduct R&D&D on software technologies
    - Use current systems, CORAL systems as testbeds
  - Vendor R&D on node and system designs that are better suited for HPC applications
- 2019
  - **ECP insights are used in formulation of RFP for exascale systems**
  - DOE and NNSA laboratories issue RFP for exascale systems, select offers, award build and NRE contracts
- 2019-2023
  - ECP Applications and software technologies are modified with knowledge of systems
  - Software technologies are “productized”
- 2023-2025
  - Exascale systems are in production, applications and software deal with actual system behavior

# A Few Takeaways

- This project that will not develop or acquire exascale HPCs, but rather be geared towards developing a wide base of capabilities that could ultimately feed into future DOE exascale HPC acquisitions made by individual DOE facilities.
- ECP leadership will need to walk a fine balance between advancing the state of the art and developing capabilities that will have immediate and positive benefit to a wide range of DOE lab mission requirements.
- Managing the ECP will require significant coordination among the many participants. Leadership issues will be complex, but key to the ultimate effectiveness of the project.

# Thanks



## Questions?

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