U.S. Department of Energy's
Office of Science

ASCR Joint Activities with other Agencies

Advanced Scientific Computing Advisory Committee

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High End Computing in FY 2004 President's Budget

- **Due to its impact on a wide range of federal agency missions ranging from national security and defense to basic science, high end computing—or supercomputing —capability is becoming increasingly critical. Through the course of 2003, agencies involved in developing or using high end computing will be engaged in planning activities to guide future investments in this area, coordinated through the NSTC. The activities will include the development of an interagency R&D roadmap for high-end computing core technologies, a federal high-end computing capacity and accessibility improvement plan, and a discussion of issues (along with recommendations where applicable) relating to federal procurement of high-end computing systems. The knowledge gained from this process will be used to guide future investments in this area. Research and software to support high end computing will provide a foundation for future federal R&D by improving the effectiveness of core technologies on which next-generation high-end computing systems will rely.**

http://www.whitehouse.gov/omb/budget/fy2004/pdf/spec.pdf

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Agency Coordination Overview Matrix

	Research Coordination	Development Coordination	Strategy Coordination
NNSA	X – $17M research funded at NNSA laboratories	X – Red Storm development	X – Formal coordination documents
DOD – DUSD Science and Technology			X – IHEC study
DARPA		X – HPCS review team	X – HPCS evaluation system plan
NSA	X – UPC	X – Cray SV2/X1 development	
All Agencies			X – HECCWG

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NNSA Details

	Research Coordination	Development Coordination	Strategy Coordination
NNSA	X – $17M research funded at NNSA laboratories, Light weight kernel, common component architecture, performance engineering, …	X – Red Storm development quarterly review meetings, open source software thrust, ASCI Q review, ASCI PSE review, SciDAC reviews, …	X – Formal coordination documents, joint funded NAS study, platform evaluation

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DOD and DARPA Details

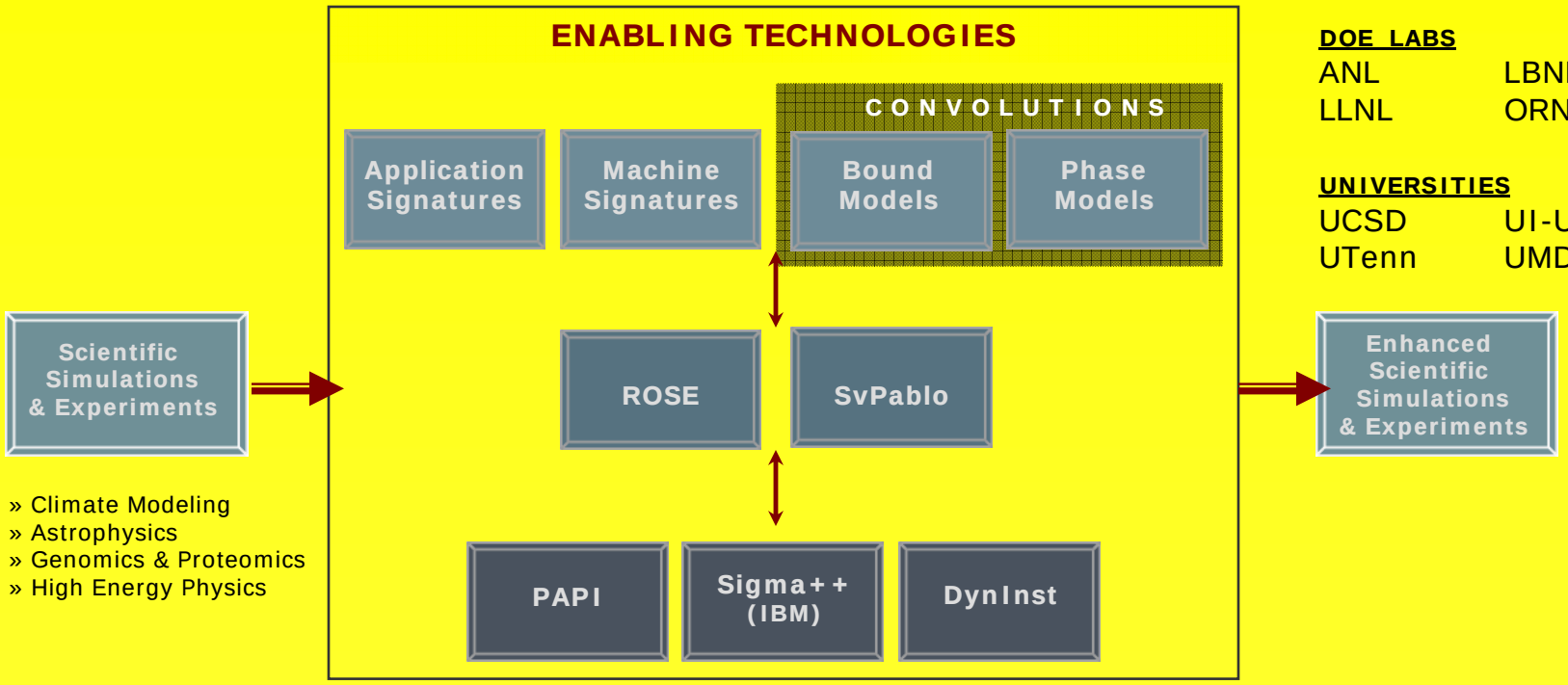
	Research Coordination	Development Coordination	Strategy Coordination
DOD – DUSD Science and Technology			X – IHEC study, agreement on SC role in IHEC
DARPA		X – HPCS review team – Phase I, Phase II and Phase II; Review Cray, IBM, HP, SUN and SGI projects	X – HPCS evaluation system plan, agreement on SC role as HPCS early evaluator at scale

NSA Details

	Research Coordination	Development Coordination	Strategy Coordination
NSA	X – UPC (Lauren Smith), Programming Models (Bill Carlson), Benchmarking (Candy Culhane)	X – Cray SV2/X1 development, Cray Black Widow development (quarterly review meetings)	

PERC PERFORMANCE EVALUATION RESEARCH CENTER

Developing a *science* for understanding performance of scientific applications on high-end computer systems, and *engineering* strategies for improving performance on these systems.



DOE LABS

ANL LBNL
LLNL ORNL

UNIVERSITIES

UCSD UI-UC
UTenn UMD

GOALS

- Optimize and Simplify
  - Profiling of real applications
  - Measurement of machine capabilities (emphasis on memory hierarchy)
  - Performance prediction
  - Performance monitoring
  - Informed tuning
- Understand the key factors in applications that affect performance
- Understand the key factors in computer systems that affect performance
- Develop models that accurately predict performance of applications on systems.
- Develop an enabling infrastructure of tools for performance monitoring, modeling and optimization.
- Validate these ideas and infrastructure via close collaboration with DOE SC and other application owners.
- Transfer the technology to end-users.

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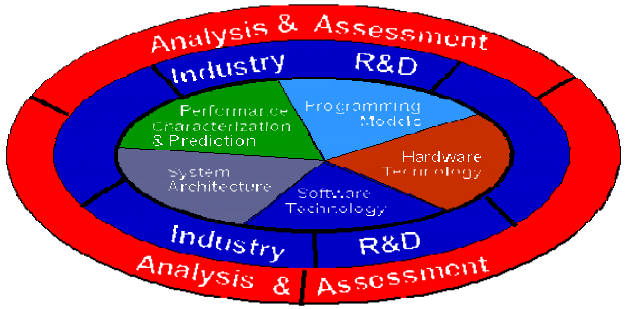
DARPA High Productivity Computing Systems Program (HPCS)

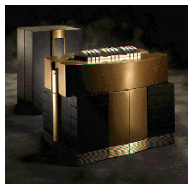
Goal:

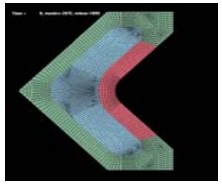
- Provide a new generation of economically viable high productivity computing systems for the national security and industrial user community (2007 – 2010)

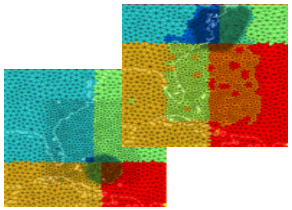
Impact:

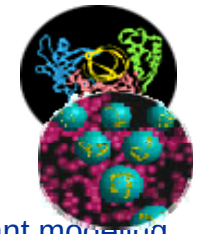
- **Performance** (efficiency): critical national security applications by a factor of 10X to 40X
- **Productivity** (time-to-solution)
- **Portability** (transparency): insulate research and operational application software from system
- **Robustness** (reliability): apply all known techniques to **protect against outside attacks**, hardware faults, & programming errors











Applications:

- Intelligence/surveillance, reconnaissance, cryptanalysis, weapons analysis, airborne contaminant modeling and biotechnology

Fill the Critical Technology and Capability Gap

Today (late 80's HPC technology).....*to*.....Future (Quantum/Bio Computing)

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Computing Metric Evolution

Early Computing Metrics

- Clock frequency
- Raw performance (flops)

GHz Race

Current Computing Metrics

- Clock frequency
- Point performance
- Acquisition Price

Tera-flop Race

(Top Ten HPC Centers)

HPCS "Value" Based Metrics

- System performance relative-to-application diversity
- Scalability (flops-to-petaflops)
- Idea-to-solution
- Time-to-solution
- Mean time-to-recovery
- Robustness (includes security)
- Evolvability
- Application life cycle costs
- Acquisition (facilities and equipment) costs
- Ownership (facilities, support staff, training) costs

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Phase I HPCS Industry Teams

- **Cray, Incorporated**
- **International Business Machines Corporation(IBM)**
- **Silicon Graphics, Inc. (SGI)**
- **Sun Microsystems, Inc.**
- **Hewlett-Packard Company**

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Next Generation Computer Architecture

- Goal: Identify and address major hardware and software architectural bottlenecks to the performance of existing and planned DOE science applications

- Activities
  - **Architecture impacts on application performance**
  - **OS/runtime research**
  - **HPC for science roadmap**
  - **Evaluation testbeds**

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Network and Middleware Joint Activities

- Joint Engineering Team: Linking Federal and Academic Research Nets.
- Network Research Team: Joint workshop on cybersecurity
- Middleware and Grid Infrastructure Coordination (MAGIC)
- PPDG ⇔ GryPhn