



Office of Science
Science for America's Future

High Performance Network Planning Workshop

“Networks for Science”

Reston, VA
August 13-15, 2002

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Mathematical, Information and
Computational Sciences

<http://www.science.doe.gov/ascr/mics/>



The Office of Science



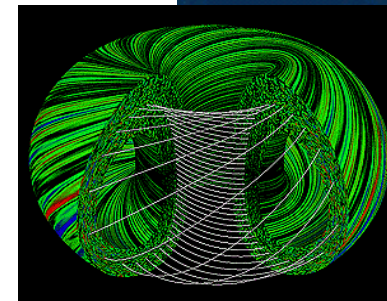
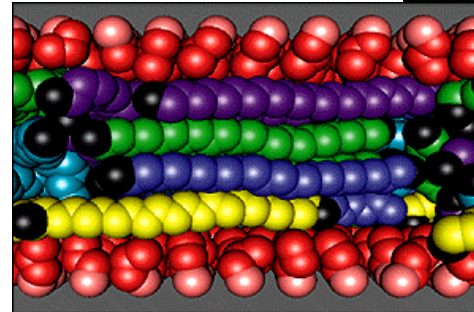
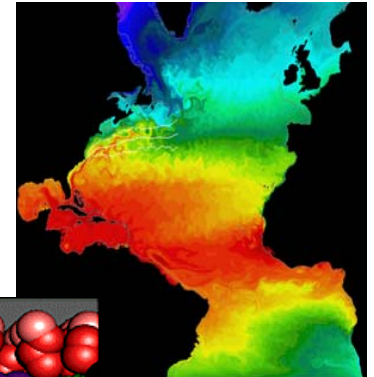
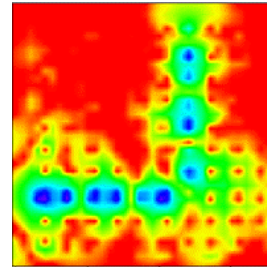
- Supports basic research that underpins DOE missions.
 - Provides over 40% of federal support to the physical sciences (including more than 90% of high energy and nuclear physics)
 - Provides sole support to select sub-fields (e.g. nuclear medicine, heavy element chemistry, magnetic fusion, etc.)
 - Supports the research of 15,000 PhDs and graduate students
- Constructs and operates large scientific facilities for the U.S. scientific community.
 - Accelerators, synchrotron light sources, neutron sources, etc.
 - Used by about 18,000 researchers every year
- Provides infrastructure support for the ten SC laboratories.



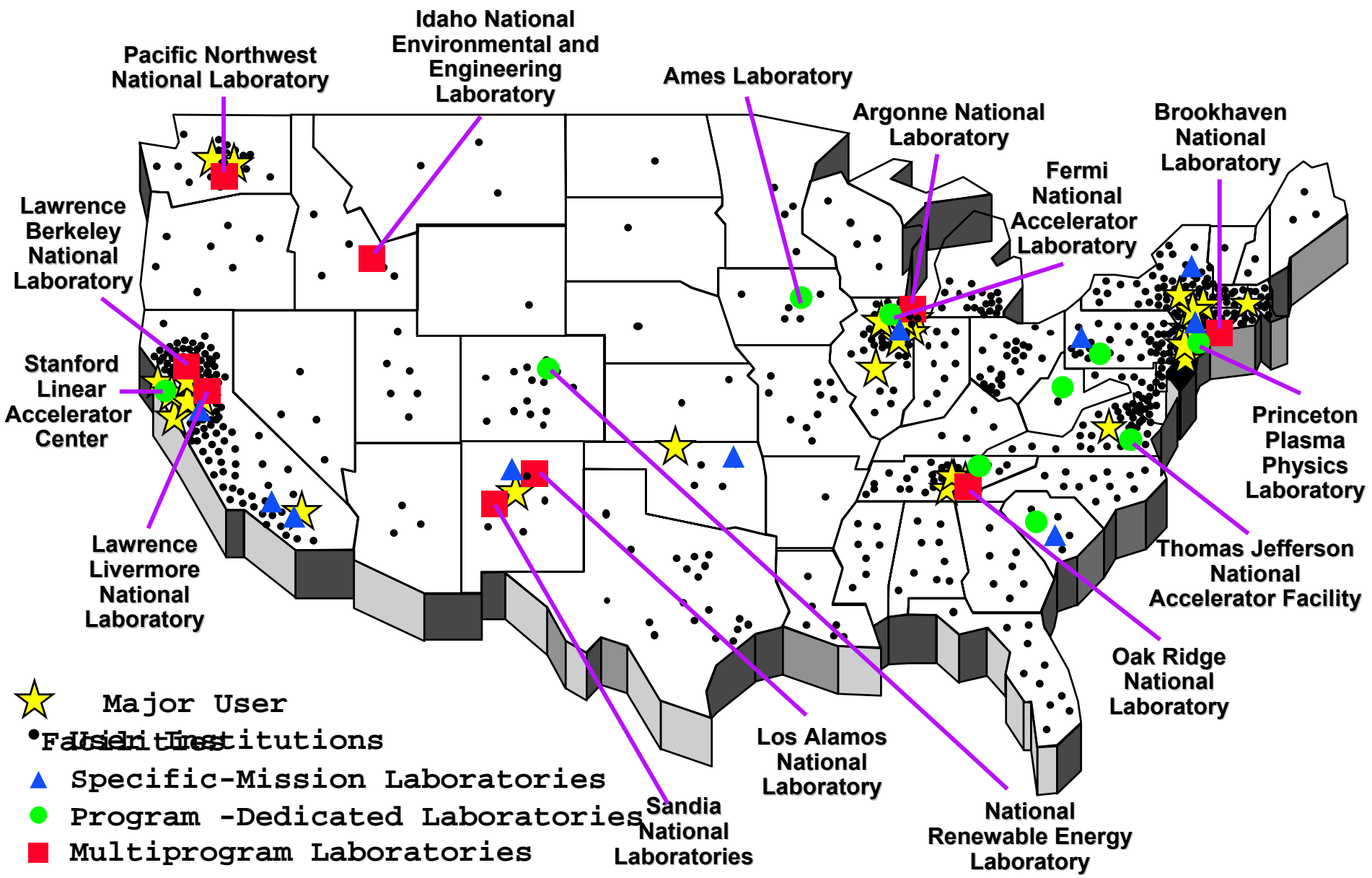
Scientific Discovery through Advanced Computing

Goals

- Create a new generation of scientific simulation codes that take full advantage of the extraordinary computing capabilities of terascale computers.
- Create the mathematical and systems software to enable the scientific simulation codes to effectively and efficiently use terascale computers.
- Create a collaboratory software environment to enable geographically separated scientists to effectively work together as a team and to facilitate remote access to both facilities and data.



Collaboration and Networks Critical for DOE Science



Oops !

6/02

| Rank | Manufacturer | Computer | Rmax | Installation Site | Country | Year | Area of Installation | # Processors | Rpeak | Nmax | N1/2 |
|------|-----------------|------------------------------------|-------|--|---------|------|----------------------|--------------|-------|---------|--------|
| 1 | NEC | Earth-Simulator | 35860 | Earth Simulator Center Kanazawa | Japan | 2002 | Research | 5120 | 40960 | 1075200 | 266240 |
| 2 | IBM | ASCI White, SP Power3 375 MHz | 7226 | Lawrence Livermore National Laboratory Livermore | USA | 2000 | Research Energy | 8192 | 12288 | 518096 | 179000 |
| 3 | Hewlett-Packard | AlphaServer SC ES45/1 GHz | 4463 | Pittsburgh Supercomputing Center Pittsburgh | USA | 2001 | Academic | 3016 | 6032 | 280000 | 85000 |
| 4 | Hewlett-Packard | AlphaServer SC ES45/1 GHz | 3980 | Commissariat a l'Energie Atomique (CEA) Bruyeres-le-Chatel | France | 2001 | Research | 2560 | 5120 | 360000 | 85000 |
| 5 | IBM | SP Power3 375 MHz 16 way | 3052 | NERSC/LBNL Berkeley | USA | 2001 | Research | 3328 | 4992 | 371712 | 102400 |
| 6 | Hewlett-Packard | AlphaServer SC ES45/1 GHz | 2916 | Los Alamos National Laboratory Los Alamos | USA | 2002 | Research | 2048 | 4096 | 272000 | . |
| 7 | Intel | ASCI Red | 2379 | Sandia National Laboratories Albuquerque | USA | 1999 | Research | 9632 | 3207 | 362880 | 75400 |
| 8 | IBM | pSeries 690 Turbo 1.3GHz | 2310 | Oak Ridge National Laboratory Oak Ridge | USA | 2002 | Research | 864 | 4493 | 275000 | 62000 |
| 9 | IBM | ASCI Blue-Pacific SST, IBM SP 604e | 2144 | Lawrence Livermore National Laboratory Livermore | USA | 1999 | Research Energy | 5808 | 3868 | 431344 | . |
| 10 | IBM | pSeries 690 Turbo 1.3GHz | 2002 | IBM/US Army Research Laboratory (ARL) Poughkeepsie | USA | 2002 | Vendor | 768 | 3994 | 252000 | . |
| | | SP Power3 375 MHz | | Atomic Weapons | | | | | | | |



“Networks for Science”

Why now?

- **Growing needs for high performance networking; resources are limited !**
- **End-to-end performance: merely increasing backbone bandwidth is not the answer**
- **Increased need for advanced services: grids being deployed**
- **Advances in optical networking and rapid sweeping changes in telecommunications industry**
 - **Alternative business models**
 - **Price/Performance**
- **Computational leadership being challenged (but, what about the network ?)**



VISION

- **Science applications and specialized experimental facilities: n-way interconnected.**
 - terascale computing
 - petascale storage
 - high end visualization
 - remote collaborators
- **Office of Science networking environment: move science, especially large scale science, to a new regime.**
 - seamless collaboration among scientists
 - seamless collaboration among scientists and experimental and computational resources
 - redundant efforts are discouraged
 - scientific progress fostered through the interplay of theory, simulation and experiment



Methodology

- Engage Office of Science program offices in network planning.
- Convene a workshop to bring together network visionaries.
 - Application representatives from high impact, high visibility initiatives
 - Network providers
 - Network and middleware researchers
- Report findings for opportunities and a path forward.
- Develop strategy for Office of Science networking driven by scientific applications.
- Develop a roadmap and program plan for networks.



Workshop Approach

- Focus on “What is possible in the realm of science?”
 - *Science unfettered by communications—scenarios*
- How do the high impact applications requirements impact network provisioning?
 - *Network research*
 - *Middleware research*
- Are there alternative business models that make sense in the context of the scenarios?



Workshop Objectives

- **Document requirements for representative high impact applications.**
- **Document how these requirements influence network provisioning, network research, and middleware research.**
- **Analyze the provisional strategy.**
 - **Strengths and weaknesses of the approach**
 - **External opportunities that support the approach**
 - **Risks of the approach**



Workshop Outline

- **Day 1 – Vision**
 - Provisional strategy
 - High impact applications
 - Advanced network vision
 - Science environment vision
- **Day 2 – Reality**
 - Business plan options
 - Network research possibilities
 - Middleware research possibilities
 - Matching application requirements to possibilities
- **Day 3 – Path Forward**