



U.S. DEPARTMENT OF
ENERGY

Office of Science Advanced Scientific Computing Research Division

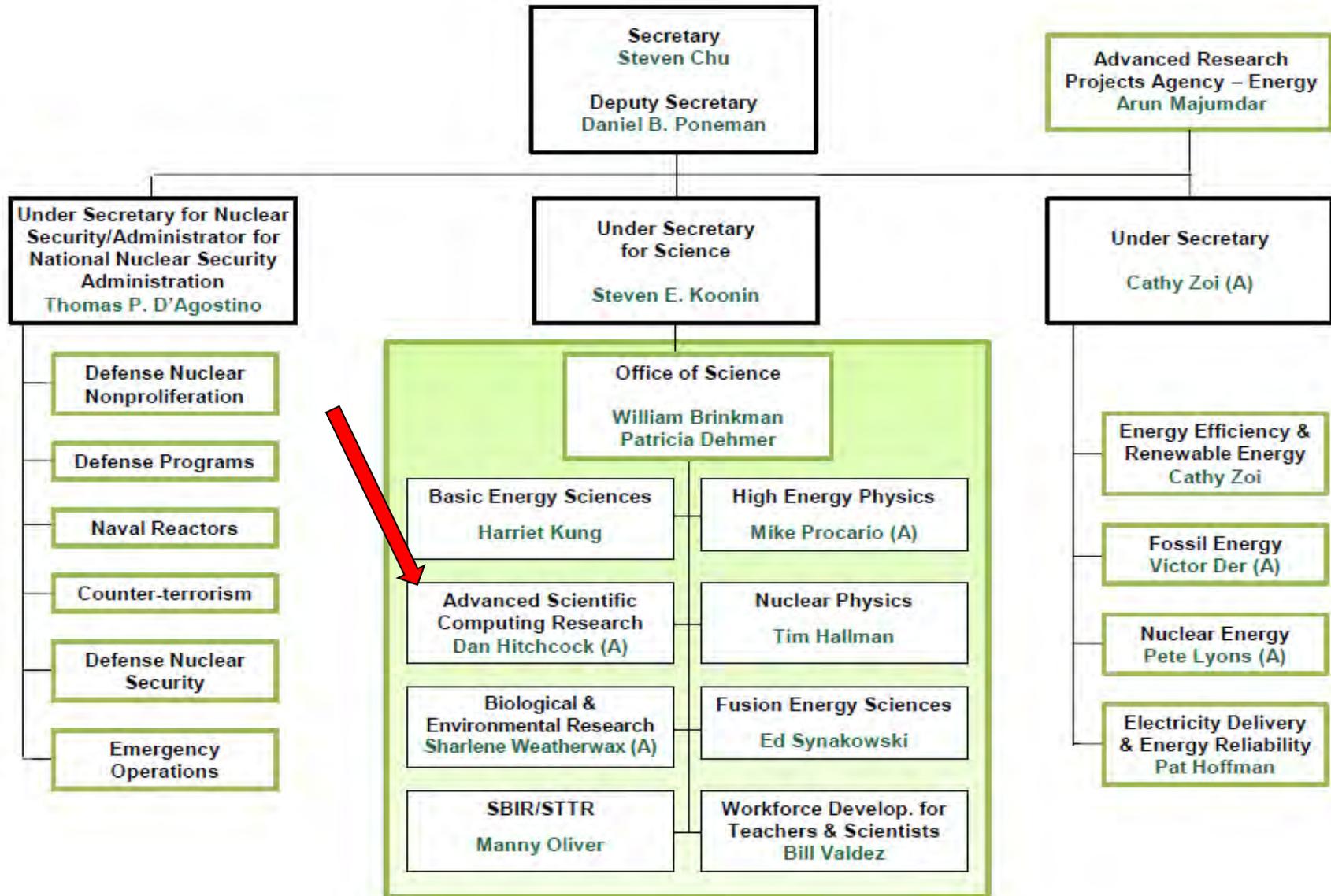
Next-Generation Networks for Science

Program managers

- Richard Carlson
- Thomas Ndousse, PhD



Where to find ASCR in DOE





Program Elements:

- High-Performance Networks – Research and development of advanced technologies which include technologies for rapid provisioning of hybrid packet/circuit-switched networks, ultra high-speed transport protocols, high-speed data distribution tools and services, secure and scalable technologies for bandwidth and circuits reservation and scheduling, secure and scalable tools and services for monitoring and managing of federated networks.
- High-Performance Middleware – research and development to support distributed high-end science applications and related distributed scientific research activities. These include advanced middleware to enable large-scale scientific collaborations; Secure and scalable software stacks to manage and distribute massive science data, software and services to seamlessly integrated science workflows to experiments and network infrastructures; cyber security systems and services to enable large-scale national and international scientific collaborations.

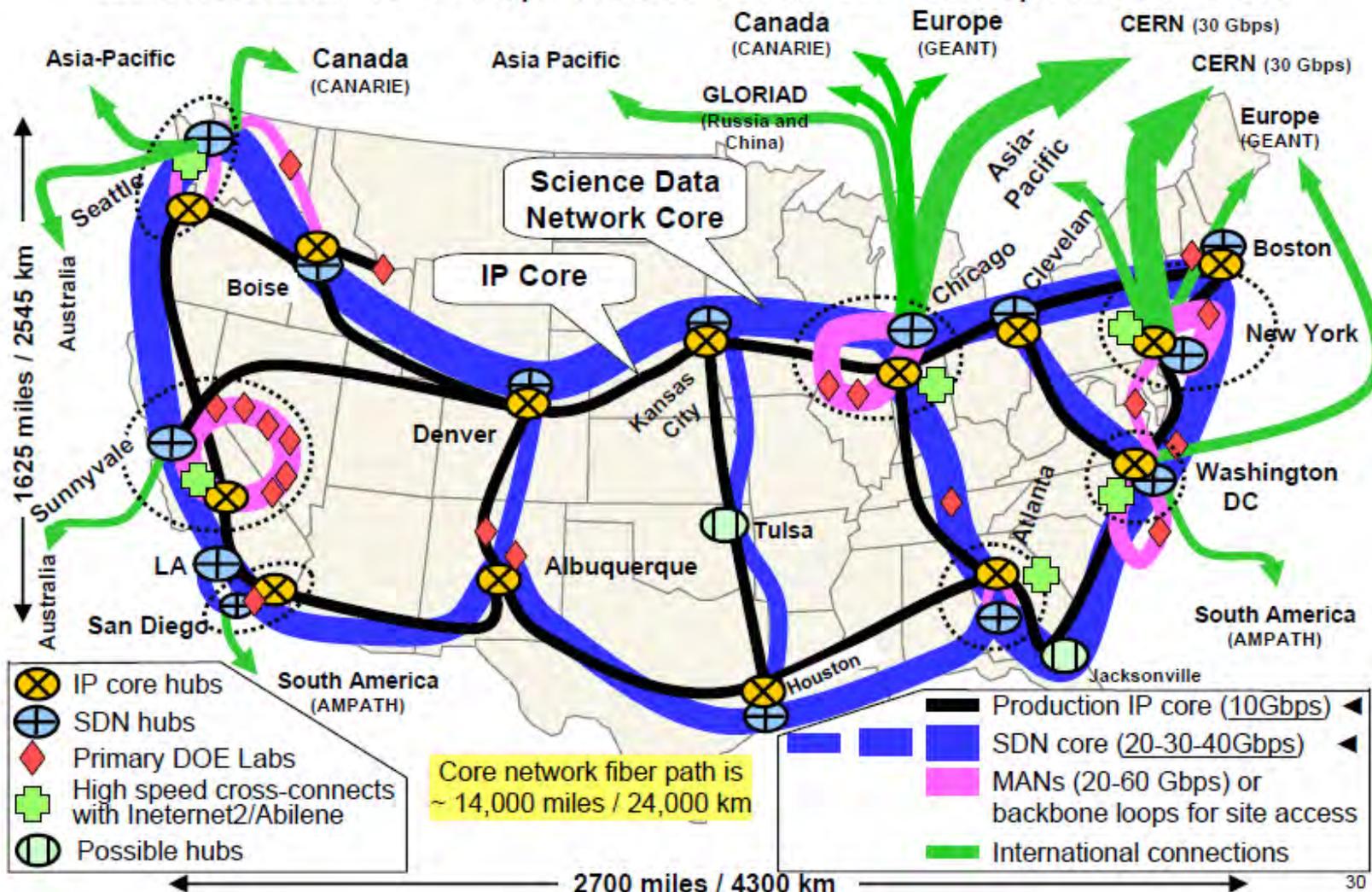


- Applied Mathematics
 - Supports basic research leading to fundamental mathematical advances and computational breakthroughs across DOE and Office of Science missions.
- Computer Science
 - Supports research of systems software, HPC systems architecture , and data management for scientific modeling and simulation at pet scale to exascale,
- ✓ Next Generation Networking for Science
- Computational Science
 - Supports research in pioneering science application codes for the next generations of high performance computers. Research topics include the development of transformative new science application software, techniques and methods.



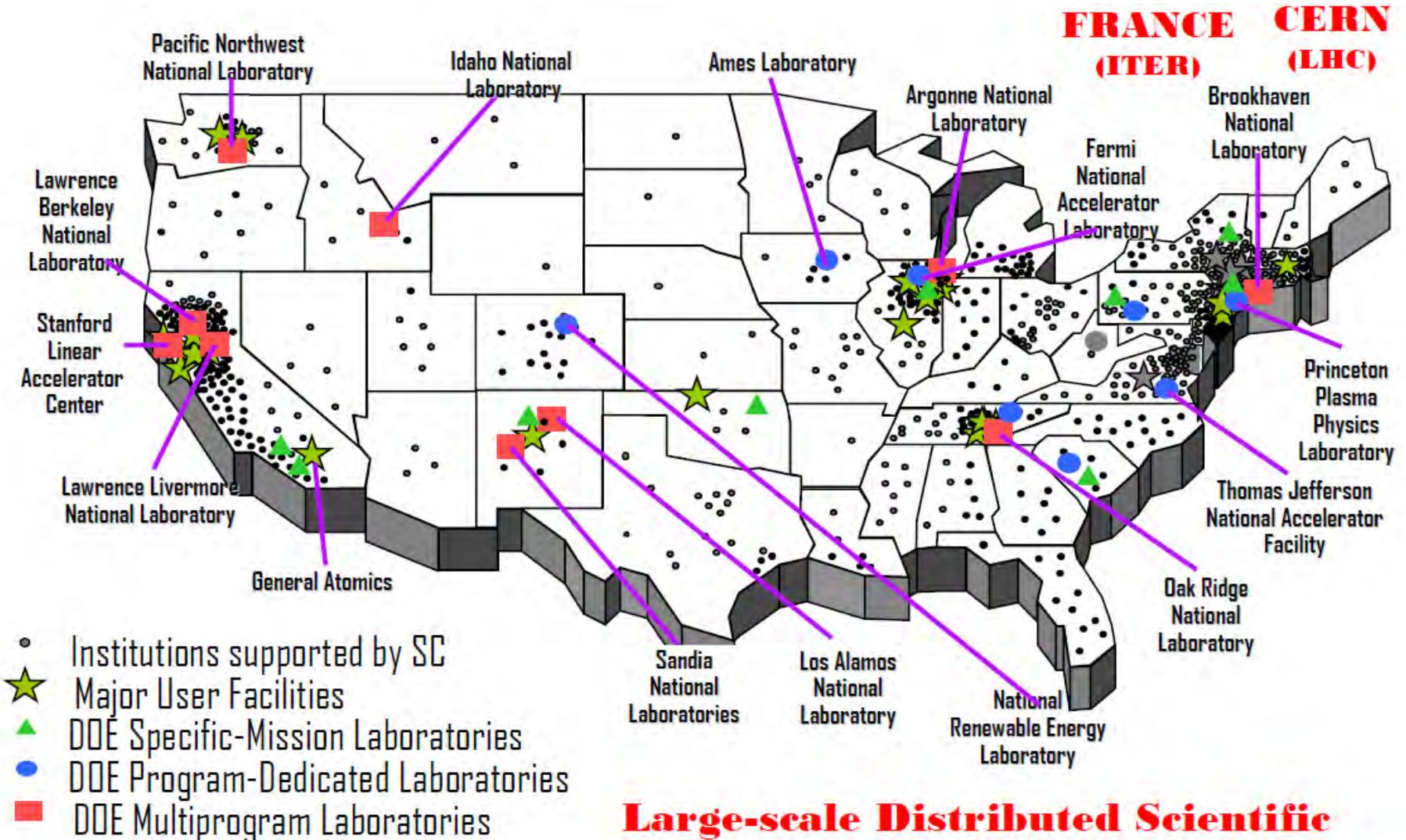
DOE Network R&D 1/4: DOE's ESnet Capability Projections

Core networks: 40-50 Gbps in 2009-2010, 160-400 Gbps in 2011-2012





DOE Network R&D 2/4: DOE Distributed Science Complex



Large-scale Distributed Scientific Collaborations



DOE Network R&D Drivers 3/4: Distributed Networking and computing



Argonne Leadership Computing Facility

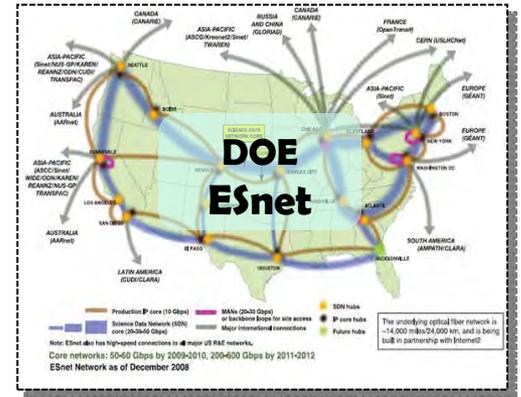
- Argonne Leadership Computing Facility's next-generation IBM Blue Gene/Q system. The 10 pet flops system will include more than .75 million cores and .75 pet bytes of memory



- The Oak Ridge Leadership Computing Facility (OLCF) was established at Oak Ridge National Laboratory in 2004 with the mission of standing up a supercomputer 100 times more powerful than the leading systems of the day.

- Networks with unprecedented agility and capabilities are needed to distribute massive simulation data and provide DOE scientists and their national and international collaborators with unfettered access to scientific instruments and supercomputing facilities.

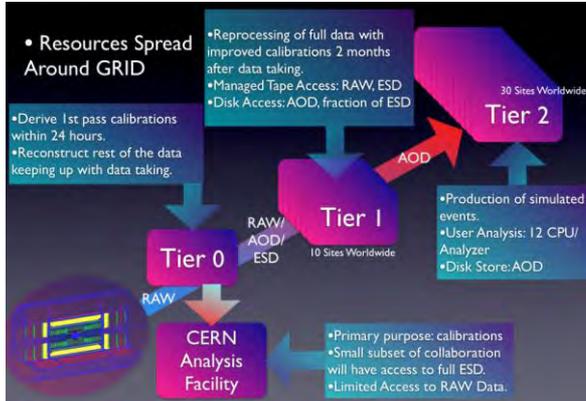
- ESnet provides the high-bandwidth, reliable connections that link scientists at national laboratories, universities and other research institutions, enabling them to collaborate on some of the world's most important scientific challenges including energy, climate science, and the origins of the universe



- More than 4,000 scientists use NERSC to perform basic scientific research across a wide range of disciplines, including climate modeling, research into new materials, simulations of the early universe, analysis of data from high energy physics experiments, investigations of protein structure, and a host of other scientific endeavors.



DOE Network R&D Drivers 4/4: Distributed Science Facilities

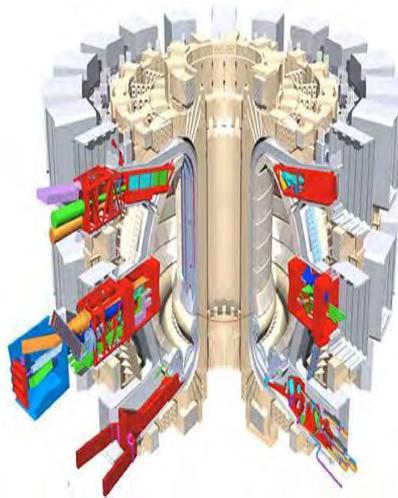


Large Hadrons Collider (LHC)

National Synchrotron Light Source II - NSLS-II



- Advanced networks provide DOE scientists and their national and international collaborators with unfettered access to scientific instruments and supercomputing facilities.



International ITER Project

Advanced Photon Source (APS)



LINAC Coherent Light Source (LCLS)





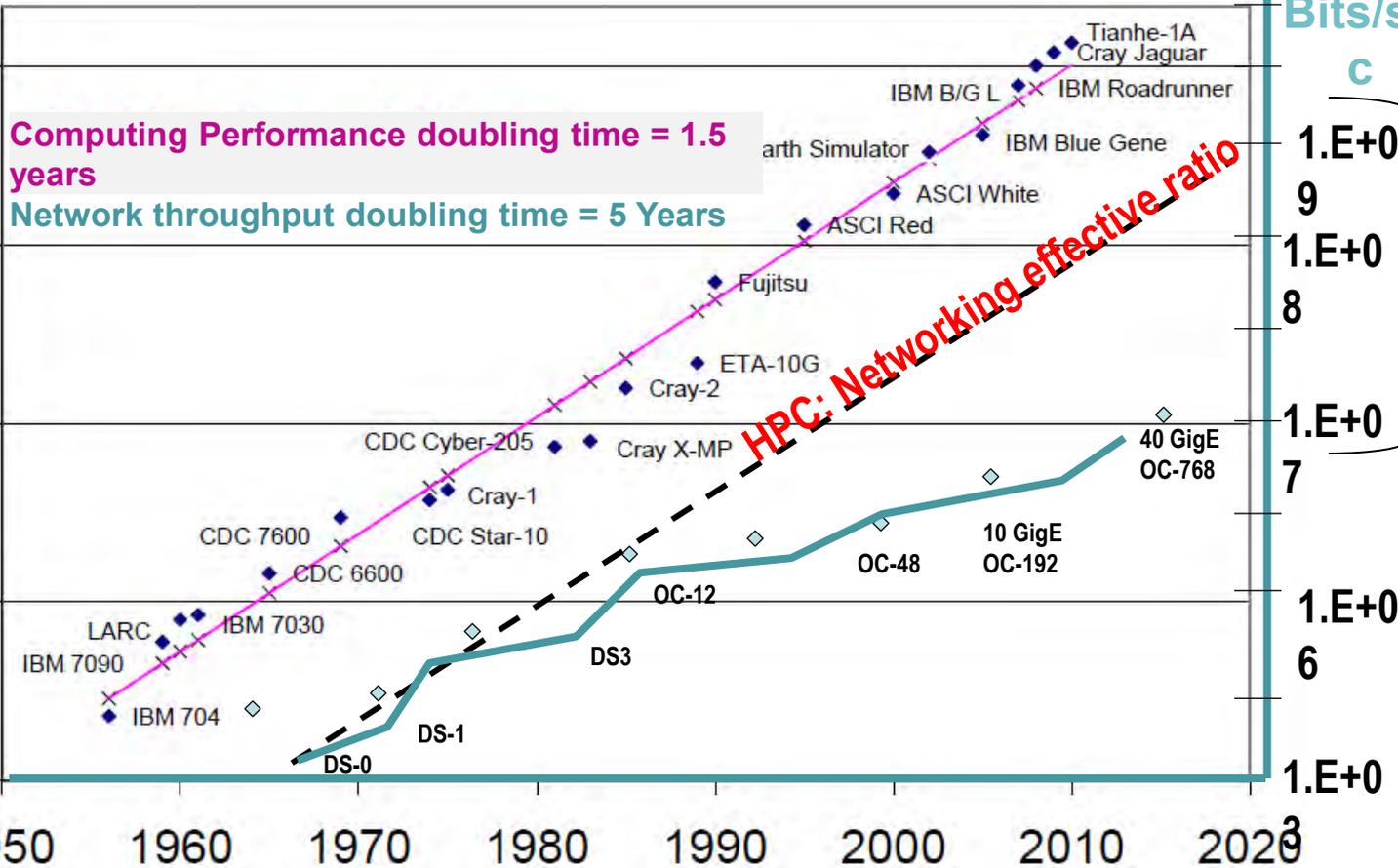
Data-Intensive Science

HPC & Networking Performance Gap

Flops

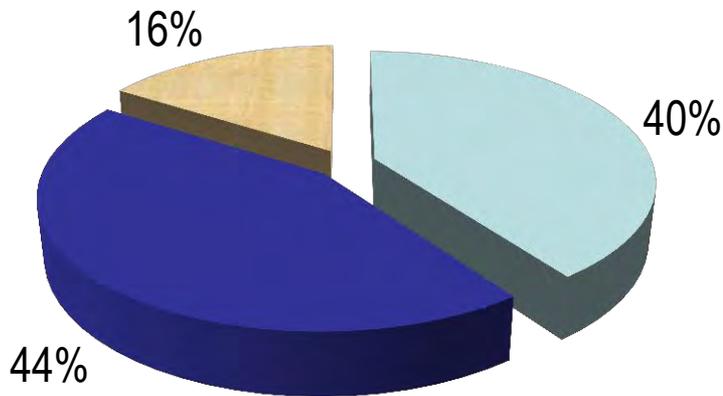
E2E
Bits/se

C





Affiliation of Our Researchers FY2010



■ National Labs ■ Universities ■ Industries

All Awards made through open solicitations

- **Collaborative research**
 - 2 or more PIs – 75%
 - Single PI – 25%

- **Affiliation of our Researchers**
 - National Lab – 39%
 - University – 42% in
 - Industry – 19%

- **Portfolio distribution**
 - Long-term R&D – 20%
 - Short – 60%
 - Testbed activities 20%

- **Research**
 - Successful technology transfer to DOE network infrastructure
 - Contribution to Internet technologies

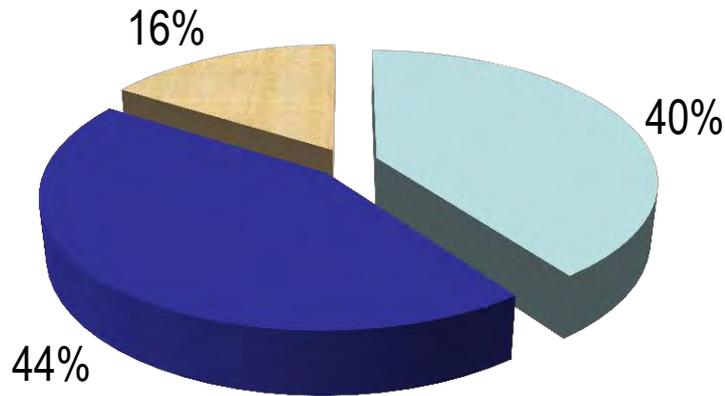
Networking attributes

- Leverage basic research in ASCR computer science, applied mathematic, computational science programs
- Transfer of successful R&D results to DOE's network infrastructures (ESnet, Lab LANs, Host systems)
- End-to-end means application to application
- Multi-domain and multilayer to Federation networking
- Competitive awards to national laboratories, industry, and universities
- Awards made in accordance with DOE/Office of Science peer-reviews process



Current Portfolio

- Affiliation of our Researchers
 - National Lab – 39%
 - University – 42% in
 - Industry – 19%
- Portfolio distribution
 - Long-term R&D – 20%
 - Short – 60%
 - Testbed activities 20%
- Project size
 - 3 large multi-institution
 - 15 single investigator



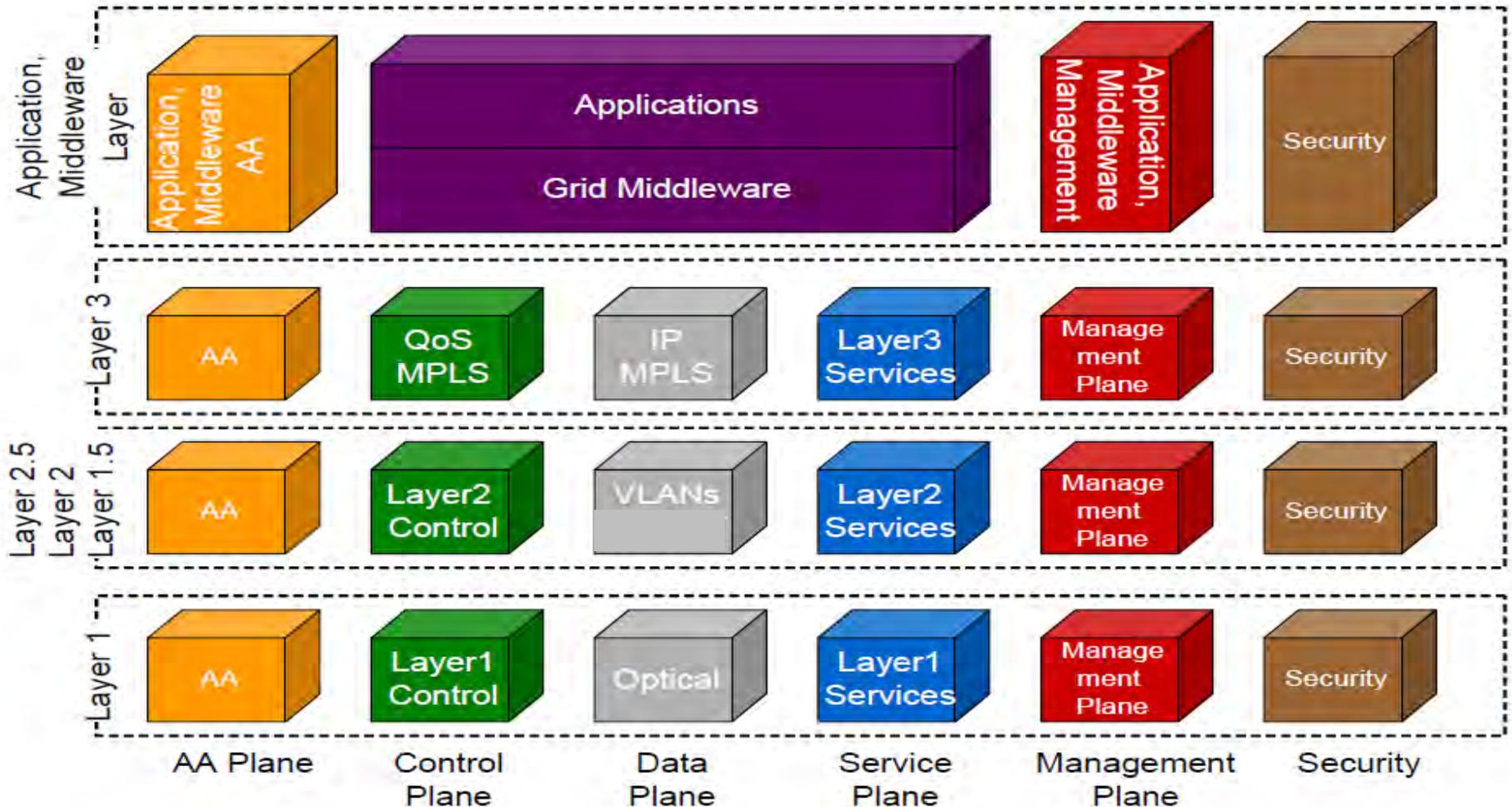
■ National Labs ■ Universities ■ Industries

All Awards made through open solicitations



Guiding Principles

1) Access, 2) Security, 3) controllability, 3) Observability, 4) Manageability





- Federated/ hybrid end-to-end network measurement and monitoring (PerfSonar-based framework)
- Development and testing of 100 GigE system-level network components and services
- End-to-end federated multi-layer dynamic provisioning (WAN provisioning, LAN provisioning, end host and application provisioning)
- Hybrid packet/circuit-switched networks traffic engineering
- 100 Gbps network technologies prototyping and testing
- Grid computing (Open Science Grid, Earth Systems Grid)
- Large-scale data movement toolkits, domain-science distributed data architecture and services



Solicitations

- [Terabit Networking for Extreme-Scale Science](#)
- [Continuation of Solicitation for the Office of Science Financial Assistance Program](#)
- [Annual Phase I SBIR/STTR FOA](#) (Closed)

[Office of Science Grants and Contracts Web Site](#)