



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

Networking and IT Research

U.S. Department of Energy
Office of Science

Federal Networking & IT
Research Opportunities FY 2004 Conference

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IT Research in DOE's Office of Science

Office of Science

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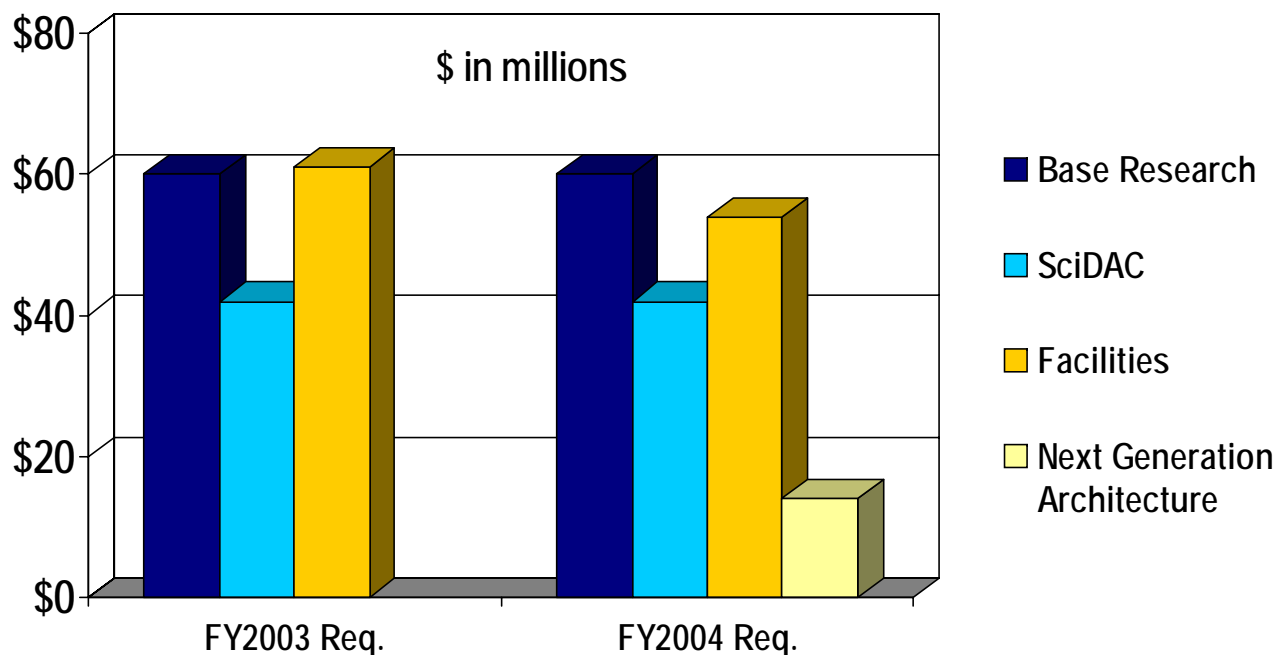
Advanced Scientific Computing Research (ASCR)

Mission:

- Deliver forefront computational and networking capabilities to scientists nationwide that enable them to extend the frontiers of science, answering critical questions that range from the function of living cells to the power of fusion energy.



ASCR Budget



<u>Fiscal Year</u>	<u>Request</u>	<u>Appropriation</u>
2002	\$156,170,000	\$147,159,000
2003	\$163,557,000	\$164,480,000*
2004	\$170,490,000	TBD

* Following General Reduction & Omnibus Rescission



ASCR Program Overview

Research

Research to enable...

...simulation of complex systems

...distributed teams, remote access to facilities

BES, BER, FES, HEP, NP

- Applied Mathematics
- Computer Science

- Network Environment
- Scientific Applications
- Genomes to Life

- Nanoscience
- Materials
- Chemistry
- Combustion
- Accelerator
- High energy Physics
- Nuclear physics
- Fusion
- Climate
- Astrophysics
- Biology



- Nanoscience
- Grid enabling research
- Integrated Software Infrastructure Centers

(Mathematicians, computer scientists, application scientists, and software engineers)

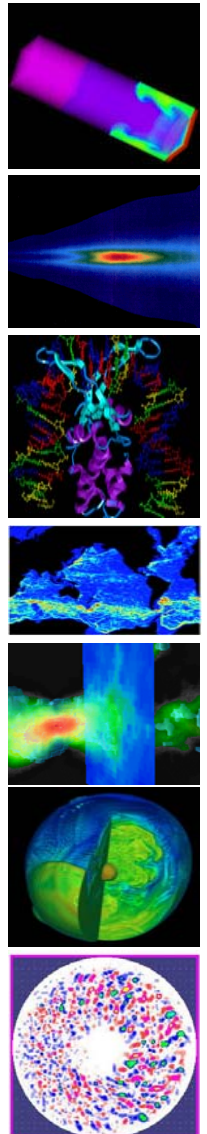
Next Generation Architecture

High Performance Computing and Network Facilities for Science

National Energy Research Scientific Computing Center (NERSC)

Advanced Computing Research Testbeds

Energy Sciences Network (ESnet)

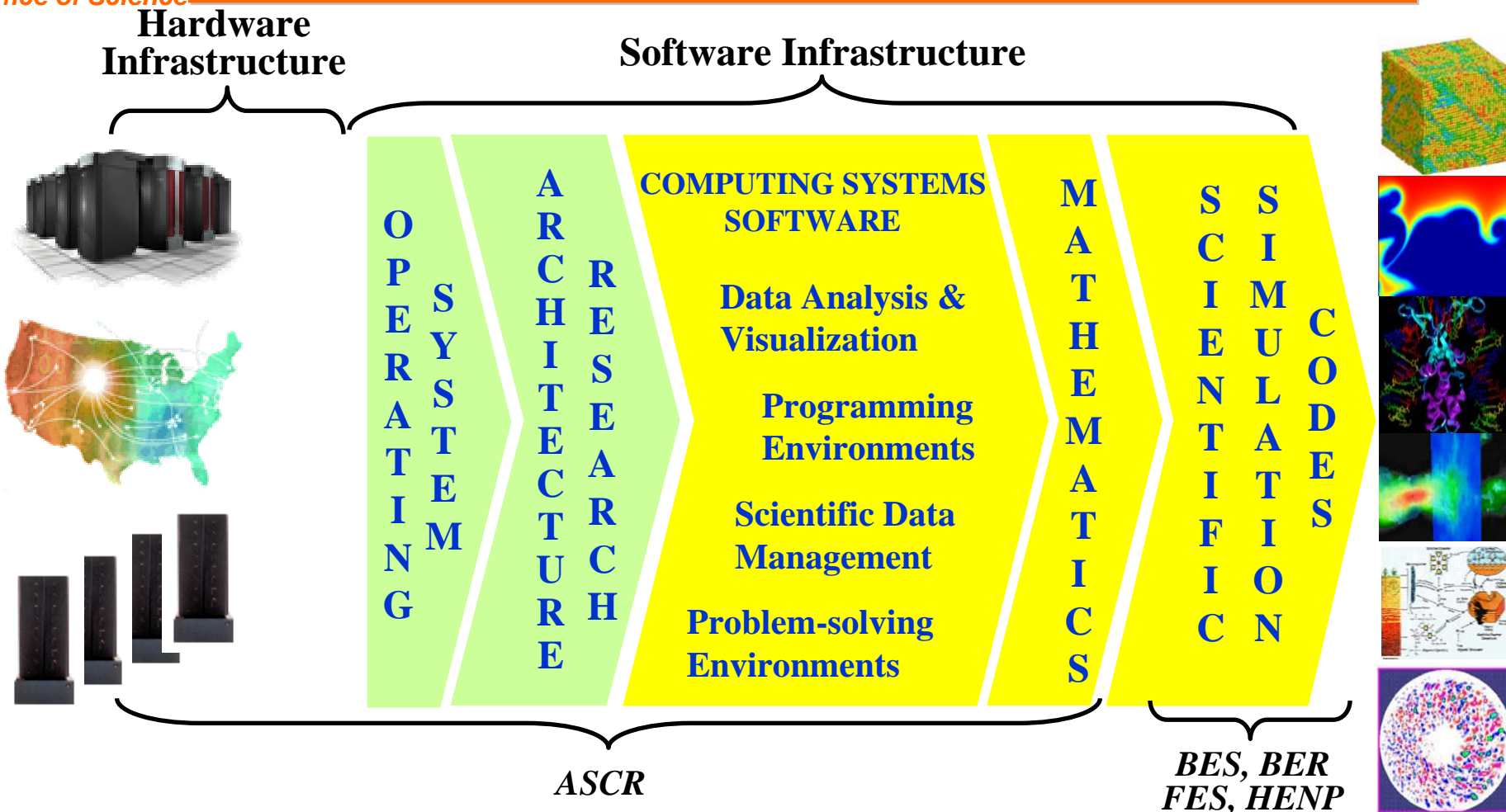




Scientific Discovery Through Advanced Computation (SciDAC)

Brings the power of terascale computing to science

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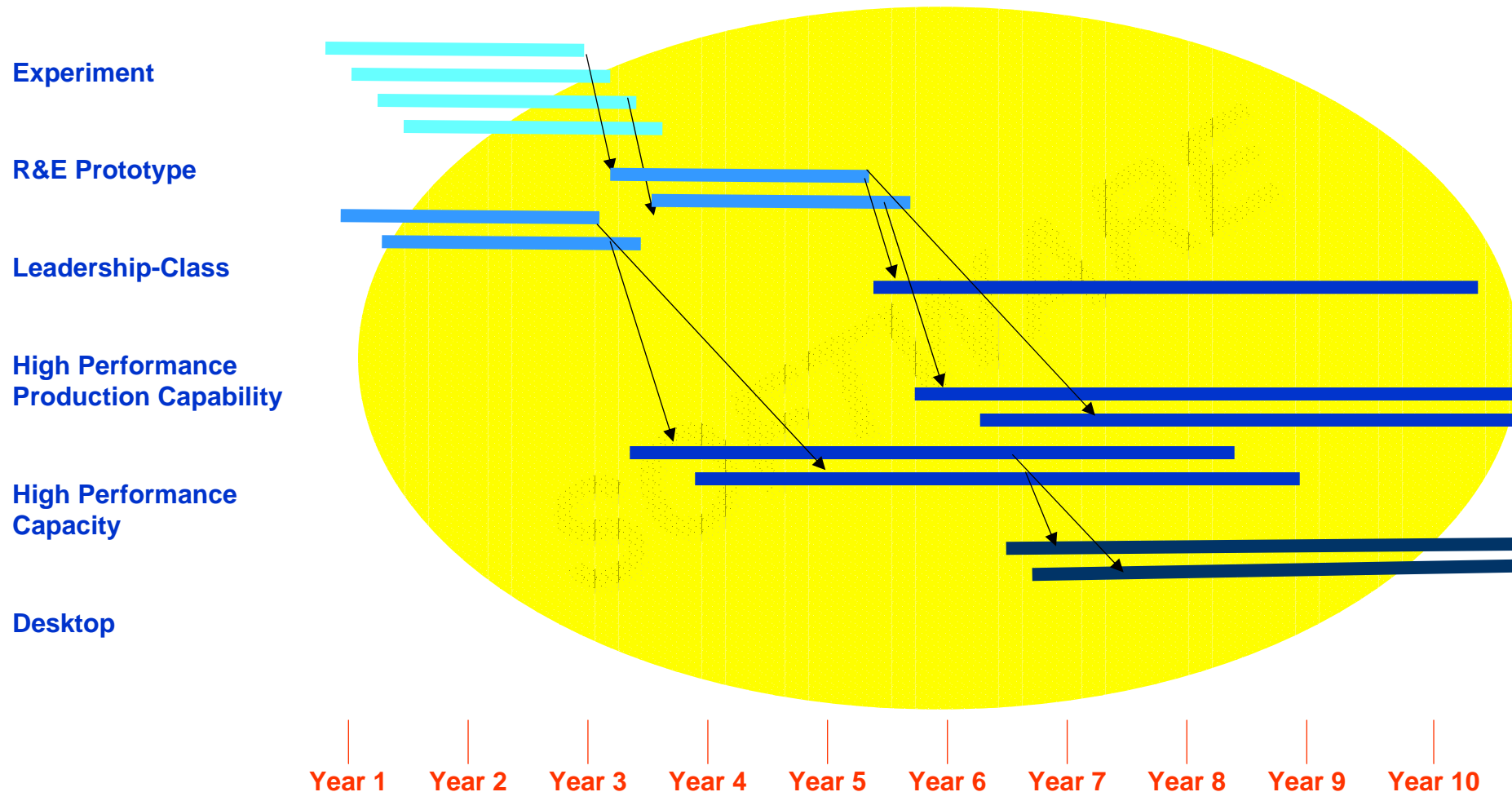


State-of-the-art electronic collaboration tools will facilitate access to these tools to bring simulation to a level of parity with theory and experiment in the scientific enterprise.



Compute Facilities and Testbeds Timeline

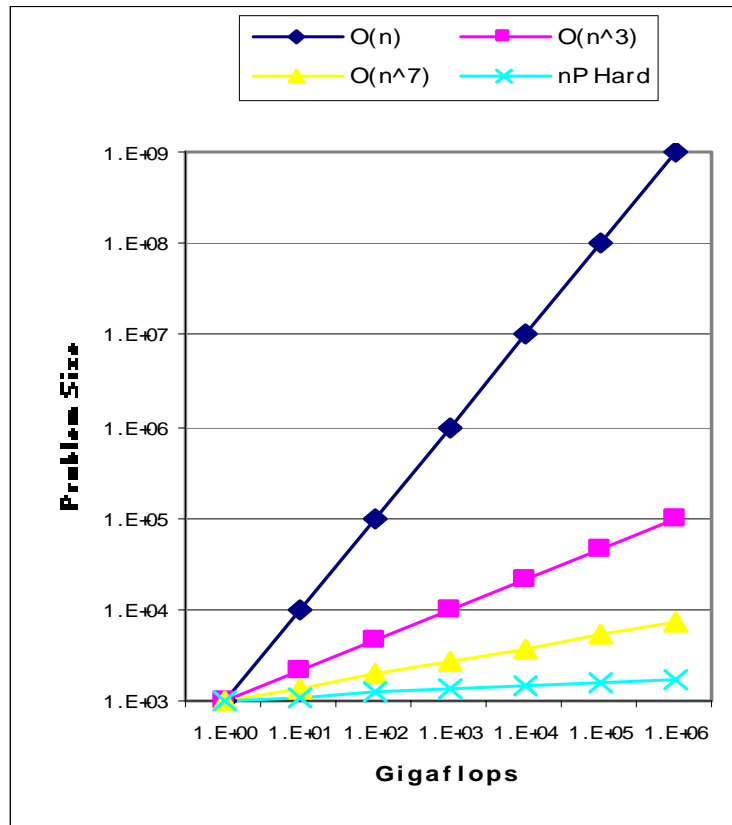
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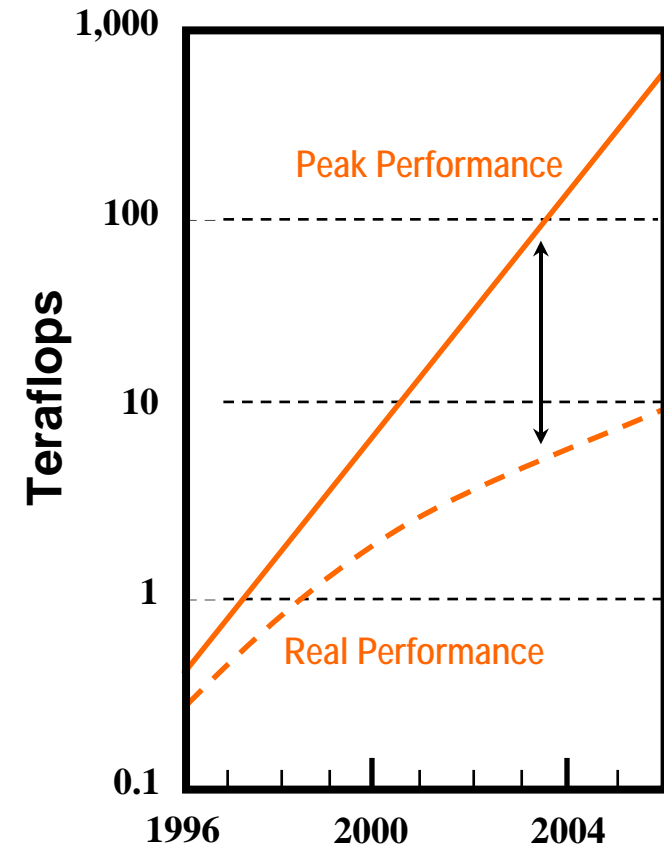


Applied Math Challenges

Algorithm Scaling with Problem Size
Determines the Size Problem that can
be Solved!



Algorithms determine what fraction of
peak performance is delivered to
science





Applied Mathematics

Contribution to ASCR Strategic Goal

- “Forefront computational capabilities” to “extend the frontiers of science” require
 - Well-posed mathematical models (e.g., PDEs)
 - Mathematical analysis of model behavior
 - Solvable discrete versions (grid generation and discretization)
 - Efficient algorithms for solving the discretized models
 - Predictability analysis and uncertainty quantification for model reduction and to determine levels of confidence in the results
 - Engineering design optimization, discrete optimization problems, constrained optimization problems
 - New areas (dynamical systems, multiresolution analysis, multiscale mathematics, scalable algorithms) dictated by need and opportunity

Basic
Research

SciDAC
ISIC

Deployment to
Facilities

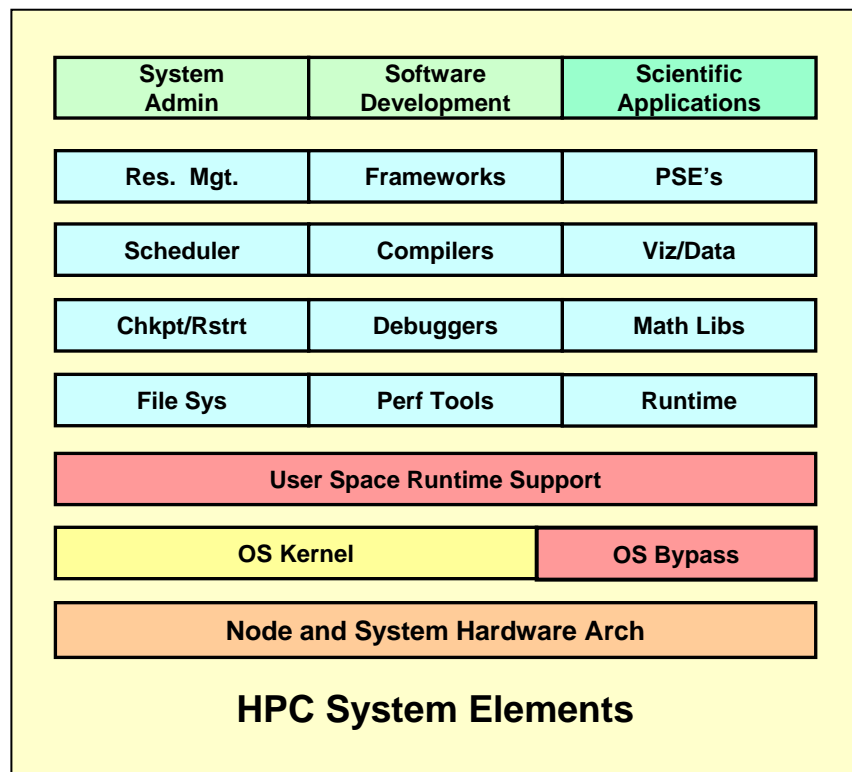
Deployment to
Users

Long Term
Support



Computer Science Research Systems Software & Tools

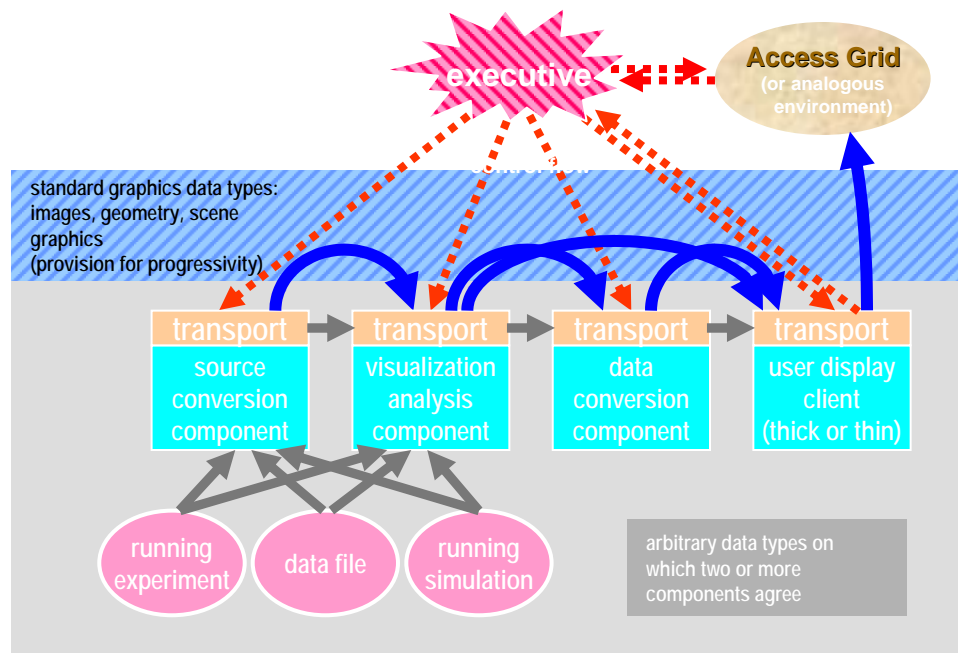
Opportunities



- Petascale systems by 2010 (100,000+ processors)
- Very challenging architecture diversity – X1, Red Storm, BG/L, DARPA HPC systems
- Reliability/fault management
- Software engineering
- CS Hardware Testbeds



Computer Science Research Data Management & Visualization



Opportunities

- SW framework (probably CCA-based) for visualization; research
- Appropriate research infrastructure;
- Petabyte-scale data;
- Complex data structures;
- Interaction with Network Environment Research



Network Environment Research





Network Environment Research

Opportunities

- End-to-end performance
 - Multi-domain
 - Ultra high-speed transport protocol
 - Network measurement and prediction
- Cyber security
 - scalable distributed authentication and authorization systems
 - Ultra high-speed network components
- High-Performance Middleware
 - Network caching and computing
 - Real-time collaborative control and data streams
 - Fault-tolerance, error detection/correction
- Integrated testbeds and networks
 - Network research to accelerate advanced technologies
 - Experimental deployment of high-impact applications



Workshops and Reports

- Blueprint for Future Science Middleware and Grid Research and Infrastructure, August 2002
 - <http://www.nsf-middleware.org/MAGIC/default.htm>
- DOE Science Network Meeting, June 2003
 - <http://gate.hep.anl.gov/may/ScienceNetworkingWorkshop/>
- DOE Science Computing Conference, June 2003
 - <http://www.doe-sci-comp.info>
- Science Case for Large Scale Simulation, June 2003
 - www.pnl.gov/scales/
- Workshop on the Road Map for the Revitalization of High End Computing
 - <http://www.cra.org/Activities/workshops/nitrd/>
- Cyberinfrastructure Report
 - <http://www.cise.nsf.gov/evnt/reports/toc.htm>
- ASCR Strategic Planning Workshop
 - <http://www.fp-mcs.anl.gov/ascr-july03spw>