Advanced Scientific Computing Research

An Integrated Program Across the Office of Science

The Advanced Scientific Computing Research (ASCR) program mission is to discover, develop, and deploy the computational and networking tools that enable scientific researchers to analyze, model, simulate, and predict complex phenomena important to the U.S. Department of Energy.

Historic Accomplishments

- CTSS, the first interactive operating system for supercomputers.

- The slow start algorithm for the Transmission Control Protocol (TCP) part of TCP/IP (Internet Protocol).

- Parallel Virtual Machine (PVM) and Message Passing Interface (MPI) parallel programming models.

- LINPACK, EISPACK, LAPACK, and ScaLAPACK, the most widely used numerical libraries in the world.

- Creation of the concept of a high-performance supercomputing center for scientific simulation in 1974—the Magnetic Fusion Energy Computing Center.

- Computational resources for the first reported scientific simulation to run in excess of 1 trillion floating point operations per second (teraflops).

Recent Scientific Achievements

- **Network-Enabled Optimization System (NEOS)**—increased scientific productivity through automated optimization.

- **Open Source Cluster Application Resources package (OSCAR)**—a collection of software tools for managing Linux-based computer clusters.

- **New Scientific Data Index**—100 times faster than commercial database systems.

- **Scientific Data Objects**—a common language for exchanging parallel data.

- **ParamBench** demonstrates the significant impact of concurrent memory accesses.

- **BOOMERANG**— "Balloon Observations of Millimetric Extragalactic Radiation and Geophysics" revealed that the Universe is flat.

- **Scientific Discovery through Advanced Computing (SciDAC)** is a research program with the goal to achieve breakthrough scientific advances through computer simulation. SciDAC establishes a new model for collaboration among the scientific disciplines, computer scientists, and mathematicians.
  www.sc.doe gov/ascr/mics/scidac/index.html

Software Infrastructure

Major User Facilities
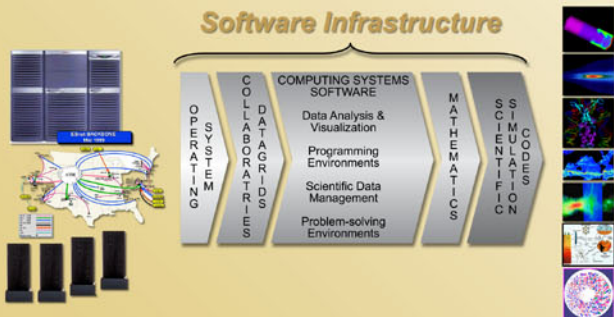
Advancing Computational Science of Scale-Producing Real Results
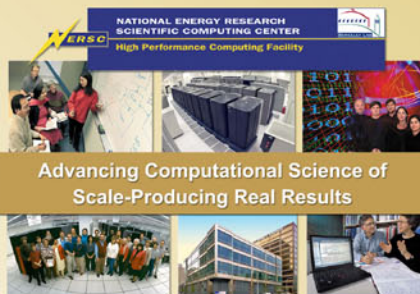
The National Energy Research Scientific Computing (NERSC) Center, managed and operated by Lawrence Berkeley National Laboratory, is a world leader in accelerating scientific discovery through computation.

Advanced Computing Research Testbeds evaluate new computing hardware and software. Argonne National Laboratory is testing the IBM/Intel Cluster. Oak Ridge National Laboratory is testing the IBM Power4 and Cray X1.

ORNL's IBM Power4—Cheetah

Energy Sciences Network (ESnet)
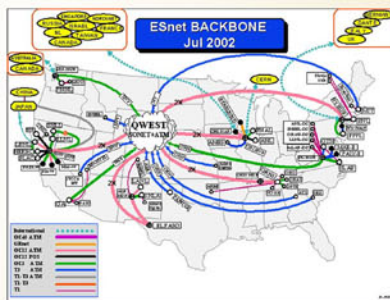
Energy Sciences Network (ESnet) has advanced network capabilities and services to enable seamless collaborations for DOE and its researchers.

Science Workforce Development

The Early Career Principal Investigator (ECPI) program supports research in applied mathematics, collaboratory research, computer science, and networks performed by exceptionally talented scientists and engineers early in their careers.
www.science.doe.gov/grants/grants/Fr03-11.html

The Computational Science Graduate Fellowship (CSGF) Program appoints about 20 new students annually to contribute to the next generation of leaders in computational science. www.krellinst.org/csgf/

The R&D Workforce Development program will support approximately 800 graduate students and post doctoral investigators in fiscal year 2004, of which 500 will be supported at Office of Science user facilities.

Office of Science
U.S. DEPARTMENT OF ENERGY

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