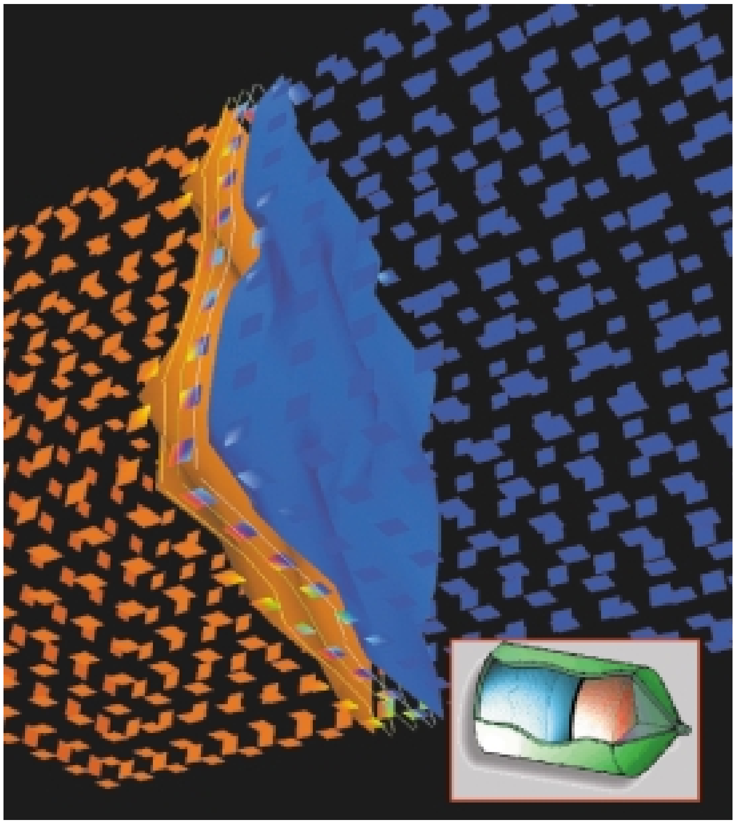
ASCI Simulation and Computer Science Program

History and Background

The Advanced Simulation and Computing program (which retains its historical name ASCI) creates simulation capabilities through the development of advanced weapons codes and high-performance computing that incorporate high-fidelity scientific models validated against experimental results, past tests, and theory. The goal is to meet the science-based simulation requirements of the Stockpile Stewardship Program (SSP) so that the National Nuclear Security Administration (NNSA) can complete its nuclear weapons responsibilities. This includes the means to assess and certify the safety, performance, and reliability of nuclear weapons.

The ASCI program actively addresses stockpile issues by developing and using simulations to study problems ranging from advanced design and manufacturing processes, to understanding accident scenarios, to weapons aging and to the resolution of Significant Finding Investigations (SFI). This spectrum of scientific inquiry demands a balanced system of hardware, software, and computer science solutions.

The Simulation and Computer Science Program develops the infrastructures that make ASCI platforms accessible to researchers. Such infrastructures include wide area networks that allow remote users to securely run applications, software tools, and applications tailored to supercomputer architectures.



A visualization of a shock wave propagating (from right to left) across the interface between two solid materials. Between the transmitted shock wave (blue) and the reflected shock wave (red) is a mixed region in which one solid interpenetrates the other. Understanding this process and being able to simulate the shock propagation through solid interfaces using the Caltech Virtual Test Facility (see inset) is highly relevant to ASCI applications as well as fields such as geophysics and planetary physics.

Problem Solving Environment (PSE)

ASCI's unprecedented code development efforts require robust computing and development environments that facilitate rapid progress. Through PSE, ASCI develops computational infrastructures that allow applications to execute efficiently on supercomputer platforms, to perform effective input/output (I/O) and archival data transfer, and to provide accessibility from the desktops of scientists and engineers.

Infrastructures encompass scalable software development tools, run-time libraries,

NNSA ASCI Advanced Simulation and Computing — Los Alamos, Sandia, Lawrence Livermore frameworks, solvers, archival storage, high-speed interconnects, scalable I/O, local area networks, distributed computing environments, security, software engineering, and software process improvement.

Visual Interactive Environment for Weapons Simulation (VIEWS)

VIEWS addresses the problem of seeing and understanding the results of multi-teraOPS weapons simulations. Researchers can compare results across simulations, between simulations and experiments, and can explore and understand multi-terabyte simulation datasets.

One element of such insight is the Data and Visualization Corridor (DVC) infrastructure, connecting supercomputers to offices and assessment theaters. A corridor is a wide path through which massive quantities of data flow and through which users explore data collaboratively. The corridor concept was defined through a collaboration of weapons scientists and engineers, researchers from academia and industry, and leaders of federal agencies.

Distance Computing and Communication (DisCom)

DisCom provides secure, ultra-high-speed remote access to ASCI supercomputers. Distance computing extends the environments required to support high-end computing to all sites. It partners with the National Security Agency (NSA) to develop the high-speed encryptors required to interconnect the NNSA national laboratories securely. These solutions will fit seamlessly into the secure ASCI computing environment.

PathForward

PathForward seeks to construct high-end computing systems and environments by scaling commercially available hardware and software building blocks. Program scientists collaborate with industry to accelerate future generations of balanced computer systems. These collaborations accelerate technologies in the vendors' current business plans, to make them available in the time frame and at the scale required by ASCI.

Since 1998, PathForward has focused on interconnect and data storage technologies, as well as systems software and tools for large-scale computing — technologies considered the most critical components of the 30-teraOPS-machine environment. Visualization and run-time system software were featured in FY2001. In FY2002, new projects in visualization, file systems, and optical interconnect technologies were approved.

Open Source Activities

ASCI makes strategic investments in system software that adapts quickly and easily to newer platforms. One strategy leverages Open Source-based systems. This strategy will be implemented with cooperation and the support of ASCI platform vendors and the Open Source high-end computing community, including other federal high-end computing user agencies (e.g., DOE Office of Science).

Open Source strategy should allow ASCI to move quickly from older to newer platforms, while retaining technical innovation, computing environments and program development tools. It will improve the ability to leverage developments from the Open Source community, while enabling easier reuse of software developed to meet ASCI programmatic requirements.

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