ASCI UPDATE

October 2000

Remarkable Mileposts and the Newest Ultracomputers

Hostile Environment Milepost Completed

In March, Sandia National Laboratories successfully completed a major milepost toward the goal of weapon certification without underground testing. This accomplishment demonstrates the National Nuclear Safety Administration's world-class computational capability through its Accelerated Strategic Computing Initiative (ASCI). To achieve this milepost, Sandia researchers produced, for the first time ever, three-dimensional computer simulations of a weapon system exposed to hostile radiation and blast environments. Specifically, researchers at Sandia simulated a weapon's response to blast and impulse loading and types of photon radiation transport that can result in both thermal-mechanical and electrical damage to the weapon system and components.

The Hostile Environment Code Review Panel, with members from academia, industry, and the national laboratories, met on May 23-24, to hear presentations from Sandia researchers on the key projects that contributed to meeting the milepost. The Panel stated, "Sandia has achieved the milepost, and has even exceeded it in several areas. The Panel is quite pleased with the review. It is clear to the Panel that ASCI is making a major contribution to Sandia's role in its Stockpile Stewardship mission. The work is relevant and much of it is world class. The Panel believes that the ASCI projects that were reviewed have fully embraced the principles of the ASCI mission."

Sandia National Laboratories is responsible for the design, engineering, testing, integration and production interface of all nonnuclear components, and the production of a specialty component called the neutron generator. Using the ASCI Red supercomputer, Sandia completed a series of three-dimensional simulations of the performance of the neutron generator in a radiation field as part of the milepost.

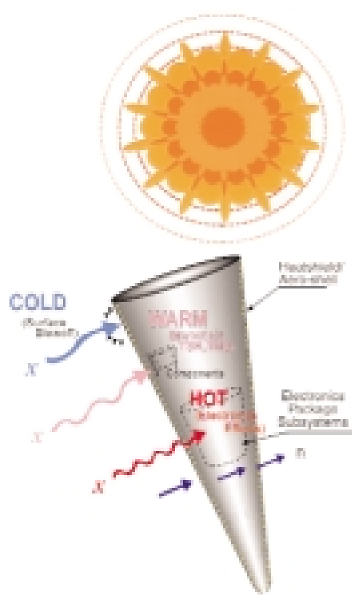

Image of a reentry vehicle receiving simulated radiation.

"This is the first time radiation transport throughout a reentry vehicle has been simulated three dimensionally," says Len Lorence, Manager of Simulation Technology Research Department at Sandia. "Modeling the complex environment inside a weapon required us to go many steps beyond where we were."

While three-dimensional computer simulations are necessary to capture physical features and the correct physics of a nuclear weapon, they are difficult because of large amounts of data that must be processed and analyzed. The recent weapon simulations at Sandia collectively required about 500,000 megabytes of random-access memory and used 2,000 computing processors for 45 days. Doing that much computing on a single desktop PC would take an estimated 250 years to complete.

In the News...

Stephen Attaway, a researcher at Sandia National Laboratories, wins the 2000 Sidney Fernbach Award from the IEEE Computer Society.

The U. S. Department of Energy's National Nuclear Security Administration announces that it has selected Compaq Corporation to build the world's fastest and most powerful supercomputer, a 30 teraOPS system name "Q."

The Sierra team successfully demonstrated the execution of the first version of Sierra on all ASCI platforms (Blue Mountain, Blue Pacific and ASCI Red).

More on these stories in future newsletters...

Who's Who in ASCI

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ASCI White

High-performance computing is critical to simulations that replace underground testing. Therefore, the NNSA is developing the next generation of computers, operating systems, and software applications as a part of its Stockpile Stewardship Program. The goal is to produce a system that will reach 100 teraOPS by 2004. Lawrence Livermore National Laboratory (LLNL) stepped toward this goal in June this year when it accepted ASCI White, an IBM-built machine that has risen to the classification of ultracomputer. ASCI White has 12.3 teraOPS (or 12 trillion calculations per second) peak computational capability and has already demonstrated a record computational capability of 3.9 tera-OPS on a hydrodynamics benchmark. This result is more than three times faster than the most powerful computer currently running as produced.

ASCI White covers an area the size of two basketball courts and is scheduled to be fully installed at LLNL in Livermore, California by the end of the year. Developed under the DOE's ASCI Partnership with IBM, the system is powered by 8,192 microprocessors. The computer's memory size of 6.2 terabytes is about 48,000 times that of a 128 MB desktop PC. It has 160 terabytes of storage space distributed over 7,000 disk drives. This is 16,000 times the amount of a PC with a 10 GB hard disk, and holds six times the contents of the Library of Congress.

"This level of computing power has never been achieved anywhere. It will open new horizons in scientific computing as we approach our goal to simulate the aging and operation of a nuclear weapon," according to David M. Cooper, Associate Director for Computations and Chief Information Officer at Lawrence Livermore.

Indeed, ASCI White is already hard at work, aiding completion of this year's Applications, Problem Solving Environment and Distance and Distributed Computing mileposts. In addition, White is being used for system testing and "full-system" science runs.

"There have been many more requests for full-system science runs on Frost (the unclassified portion of White) than in 1998 when the Blue-Pacific SST was delivered. This indicates that scalable simulation applications have progressed across a wide range of technology areas since then," says Mark Seager, ASCI platforms principal investigator at Lawrence Livermore. "What's more, we are already running over 15 scalable applications on White/ Frost and have achieved stunning scientific results in several areas."

In one impressive series of calculations, Francois Gygi of Lawrence Livermore has run several weeklong simulations on 2,640 processors and another run with 5,280 processors. These demonstrate for the first time, the macro-scale phenomena of a shock front moving through a material with first-principles simulation tools. This will allow researchers to measure with great precision, such basic properties as the shock width and energy transfer on the atomistic level.

Seager adds, "The support load carried by the system administration and IBM service teams was huge. Keeping other resources running in production while supporting milepost work on White and debugging the Frost system with science runs is a daunting task. My hat is off to them, they are one hard working and talented team of folks!"

Delivery of the ASCI White system from IBM facilities to its home in Livermore, California, required 28 tractor trailer trucks.

Secretary of Energy Bill Richardson called ASCI White a significant achievement and an important tool for stockpile stewardship.

The ASCI Update is written and published monthly by the Los Alamos, Sandia, and Lawrence Livermore Laboratories, with contributions from the Department of Energy. This newsletter, along with past editions, may be viewed on the web: www.sandia.gov/ASCI. Comments or inquires should be sent to ASCI@sandia.gov.   SAND 2000-2828.