NNSA's Sequoia supercomputer ranked as world's fastest

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From left to right in front of Sequoia: Bruce Goodwin, principal associate director for WCI, Dona Crawford, associate director for Computation, Michael Browne, IBM, Kim Cupps, leader of the Livermore Computing Division, and Michel McCoy, head of LLNL's Advanced Simulation and Computing program and deputy director for Computation.

Supercomputer at Lawrence Livermore National Lab passes 16 petaflops

WASHINGTON, D.C. - The National Nuclear Security Administration (NNSA) today announced that a supercomputer called Sequoia at Lawrence Livermore National Laboratory (LLNL) was ranked the world's most powerful computing system.
Clocking in at 16.32 sustained petaflops (quadrillion floating point operations per second), Sequoia earned the No. 1 ranking on the industry standard Top500 list of the world's fastest supercomputers released Monday, June 18, at the International Supercomputing Conference (ISC12) in Hamburg, Germany. Sequoia was built for NNSA by IBM.

A 96-rack IBM Blue Gene/Q system, Sequoia will enable simulations that explore phenomena at a level of detail never before possible. Sequoia is dedicated to NNSA's Advanced Simulation and Computing (ASC) program for stewardship of the nation's nuclear weapons stockpile, a joint effort from LLNL, Los Alamos National Laboratory and Sandia National Laboratories.

"Computing platforms like Sequoia help the United States keep its nuclear stockpile safe, secure and effective without the need for underground testing," NNSA Administrator Thomas D'Agostino said. "While Sequoia may be the fastest, the underlying computing capabilities it provides give us increased confidence in the nation's nuclear deterrent as the weapons stockpile changes under treaty agreements, a critical part of President Obama's nuclear security agenda. Sequoia also represents continued American leadership in high performance computing, key to the technology innovation that drives high-quality jobs and economic prosperity."

"Sequoia will provide a more complete understanding of weapons performance, notably hydrodynamics and properties of materials at extreme pressures and temperatures. In particular, the system will enable suites of highly resolved uncertainty quantification calculations to support the effort to extend the life of aging weapons systems; what we call a life extension program (LEP)," said Bob Meisner, NNSA director of the ASC program.

Uncertainty quantification, or "UQ," is the quantitative characterization and reduction of uncertainty in computer applications through running very large suites of calculations to characterize the effects of minor differences in the systems. Sources of uncertainty are rife in the natural sciences and engineering fields. UQ uses statistical methods to determine likely outcomes.

The machine will be an important tool used to support stockpile life extension programs, including the B61 and the W78. By reducing the time required for these studies, total costs also are reduced. In addition, the machine is expected to enhance NNSA's ability to sustain the stockpile by resolving any significant findings in weapons systems, bringing greater power to the annual assessment of the stockpile, and anticipating and avoiding future problems that inevitably result from aging. All of this helps to ensure that the nation will never have to return to nuclear testing.

Supercomputers such as Sequoia have allowed the United States to have confidence in its nuclear weapons stockpile over the 20 years since nuclear testing ended in 1992. The insight that comes from supercomputing simulations also is vital to addressing nonproliferation and counterterrorism issues as well as informing other national security decisions such as nuclear weapon policy and treaty agreements.

"Sequoia is an exciting achievement for the POWER architecture, not just for its speed and energy efficiency, but also for the important and complex work it can support to safeguard the nation's nuclear stockpile," said Colin Parris, general manager IBM Power Systems. "With supercomputers capable of 16 sustained petaflops, our ability to affect strategic change in areas like life sciences, public safety, energy and transportation that make our world smarter is greater than ever. The improvements in affordability, performance, efficiency and size that Sequoia delivers will also enable a broader set of commercial customers to implement HPC for their competitive advantage."

The NNSA/LLNL/IBM partnership has produced six HPC systems that have been ranked among the world's most powerful computers including: The Accelerated Strategic Computing Initiative (ASCI) Blue Pacific; ASCI White; the Advanced Simulation and Computing (ASC) Purple; Blue Gene/L; Blue Gene/P; and Blue Gene/Q, Sequoia. ASCI White, Blue Gene/L and now Sequoia all attained a No. 1 ranking on the Top500 list.

Sequoia is primarily water cooled and consists of 96 racks; 98,304 compute nodes; 1.6 million cores; and 1.6 petabytes of memory. Though orders of magnitude more powerful than such predecessor systems as ASC Purple and Blue Gene/L, Sequoia will be roughly 90 times more power efficient than Purple and about eight times more than BG/L relative to the peak speeds of these systems.

These videos explain a little more about how NNSA uses supercomputers to maintain the nation's nuclear weapons stockpile without the need for underground testing:

http://www.youtube.com/watch?v=DqOmBB5E_r8

http://www.youtube.com/watch?v=Rj4MjUA_G5I

http://www.youtube.com/watch?v=gZEOsNbkbsU

Established by Congress in 2000, NNSA is a semi-autonomous agency within the U.S. Department of Energy responsible for enhancing national security through the military application of nuclear science. NNSA maintains and enhances the safety, security, reliability and performance of the U.S. nuclear weapons stockpile without nuclear testing; works to reduce global danger from weapons of mass destruction; provides the U.S. Navy with safe and effective nuclear propulsion; and responds to nuclear and radiological emergencies in the U.S. and abroad. Visit the Web for more information.