# SCC The Strategic Computing Complex


The Strategic Computing Complex (SCC) at the Los Alamos National Laboratory (LANL) is a secured supercomputing facility that supports the calculation, modeling, simulation, and visualization of complex nuclear weapons data in support of the Stockpile Stewardship Program.

## National Security

The Advanced Simulation and Computing (ASC) program was established in 1995. ASC is a collaborative program among Lawrence Livermore, Los Alamos, and Sandia national laboratories, under the direction of the Department of Energy's (DOE) and National Nuclear Security Administration (NNSA). The ASC mission is to analyze and predict the safety, reliability, and performance of nuclear weapons and assess their functionality. At LANL, computer simulation capabilities, supported by a strong experimental suite, at the SCC have been developed to analyze and help predict the performance, safety, and reliability of nuclear weapons, and to assess their functionality.

## The SCC Facility

Dedicated in May 2002, the SCC is named the Nicholas C. Metropolis Center for Modeling and Simulation, in honor of Metropolis, a leading force the Laboratory during the Manhattan Project. The 300,000-square-foot, vault-type building features an unobstructed 43,500-square-foot computer room, which is an open room about three-fourths the size of a football field. This room houses all of the classified high-performance supercomputing resources at the Laboratory, including Roadrunner, Cielo, and Luna.

The SCC also has over three hundred office spaces for high-performance computing and weapons designers staff, as well as several conference rooms, classrooms, break areas, visualization theaters, and collaboration laboratories (or, collaboratories). All aspects of the SCC facility design were specifically aimed at providing the Laboratory with the latest technologies to support secure, high-performance computing.

To power the SCC, the facility depends on approximately 12 megawatts of power—more than the town of Los Alamos. The SCC utilizes rotary uninterruptible power supplies, or RUPS, which allow for efficient, uninterrupted power use and rapid recovery in cases of power loss. This power runs the facility and supercomputers, as well as the building's cooling system. The computer room is air-cooled, where 84 air-conditioning work push 1.5 million cubic feet of chilled air from the basement and to the computer room. Air enters the room at an approximate temperature of 55 degrees Fahrenheit, and after cooling the computers, it exists at 80-115 degrees Fahrenheit.

## Computing and Visualization Capabilities

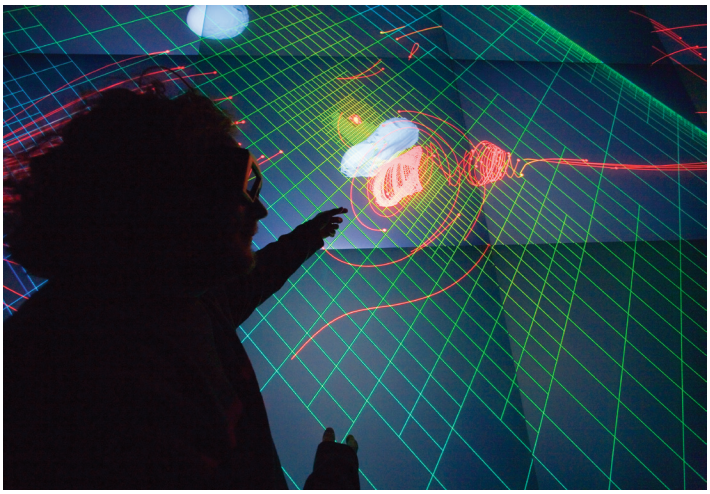
For over 60 years, advanced scientific computing has been a highly visible and indispensable part of the work at LANL. Today, the SCC hosts two interconnected capabilities: high-performance computing, and visualization technologies. The SCC is designed to scale with the increasingly powerful computer resources to deliver required services for users. Within the

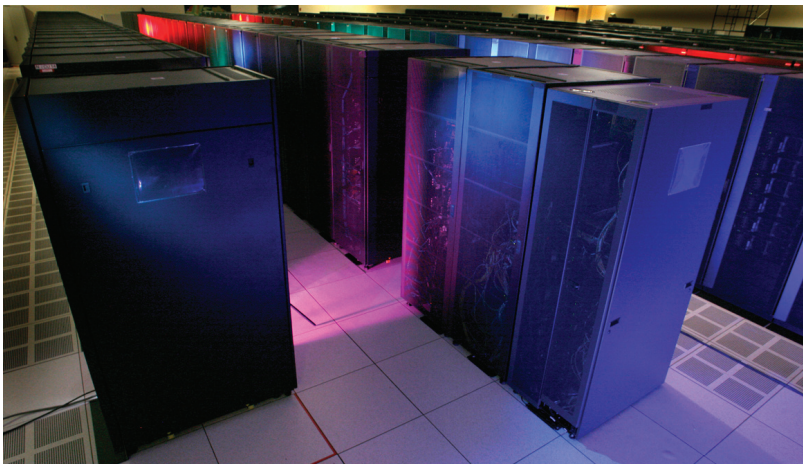

center are networking, archival storage, visualization servers, global file systems, and system software, all enhanced to support supercomputing and visualization.

The SCC's first supercomputer was the Q-Machine, a 25-teraflop computer that is now retired. Today, the SCC houses the Roadrunner, Cielo, and Luna supercomputers.

Roadrunner was the world's first computer to break the "petaflop" barrier, performing more than a thousand trillion operations per second, or petaflop/s, which made it the fastest computer in the world in 2008. One petaflop is 1,000 trillion operations per second. To put this into perspective, if each of the 6 billion people on earth had a hand calculator and worked together on a calculation 24 hours a day, 365 days a year, it would take 46 years to do what Roadrunner would do in one day. To accomplish this speed, Roadrunner features hybrid processing, which includes graphics processers and requires specialized programming developed at LANL.

Cielo, installed in 2011, is a capability-class advanced simulation and computing system. The Cielo computer has the capability of 1.37 petaflops, which allows scientists to address large-scale application problems at the edge of our understanding of weapons-related physics. Because of Cielo's computational power, ASC collaborators are solving problems never considered previously.





Luna, the newest supercomputer deployed at LANL, provides computer cycles for the Directed Stockpile Work (DSW) Program, which includes the B61 Life Extension Program. Luna has a total of 24,640 processors, for a combined peak capability of 539.1 teraflop/s. This capability is particularly advantageous for processing LANL weapons safety calculations.

To view models and simulations calculated by supercomputers, the SCC Data Visualization Corridor, or Vis Corridor, was developed to enable detailed visual inspection, analysis, verification and validation of terascale computing simulations. The Visualization Corridor features a PowerWall Theater and a five-sided CAVE Immersive Laboratory, as well as desktop visualization and collaborator capabilities.

The PowerWall is a stereoscopic theater featuring 24 synchronized projectors and screens that project high resolution, three-dimensional modeling for an audience of over 80 people. The CAVE, or La Cueva Grande, has five plexiglass sides with near-infrared tracking to allow viewers full immersion and interaction with 43 million pixels of data. Characteristics of weapons simulations, such as fluid dynamics, impact analysis, shock physics, and thermal exchange, may be applied to open science, or unclassified, national security simulations like climate modeling.

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