NETL-RUA
Regional University Alliance

U.S. DEPARTMENT OF ENERGY

R&D FACTS

Strategic Growth Area

NETL's Simulation-Based Engineering User Center

Introduction

The National Energy Technology Laboratory (NETL) is home to the Simulation-Based Engineering User Center (SBEUC), which hosts one of the world's largest high-performance computers along with advanced visualization centers serving the organization's research and development needs.

A unique and collaborative tool tailored for engineering calculations in support of fossil energy research, the SBEUC progresses NETL's mission by applying complex model simulations for advanced energy technology development; simulations like these will help overcome technical barriers in development quickly, reliably, and cost-efficiently.

The NETL teams responsible for designing the SBEUC have balanced computational requirements, efficiency, usability, and collaboration techniques to deliver a premier system to the Lab and its partners.

Computational Capabilities

At the heart of the SBEUC is a 503 TFlops (trillion floating-point operations per second) high-performance computer that enables the simulation of phenomena that are difficult or impossible to measure, such as coal jet penetration into a gasifier.

The Center also has capabilities for running modeling tools at various scales ranging from molecules, to devices, to entire power plants and natural fuel reservoirs. With these capabilities the SBEUC provides enhanced visualization, data analysis, and data storage capabilities that enable researchers to discover new materials, optimize designs, and predict operational characteristics.

Pictured are the computational nodes inside of modular datacenter.

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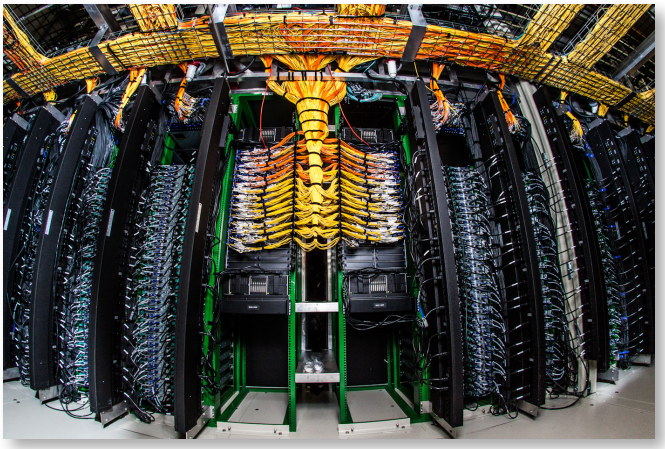

This image shows two of three Mellanox Infiniband 648-port switches, which are arranged in a Fat-Tree topology allowing for 40Gb/s non-blocking bandwidth between 1,512 computational nodes.

Visualization Centers: Improving Collaborative Efforts

The SBEUC facilities support effective collaboration among researchers and will improve interaction across NETL and its partnering NETL-Regional University Alliance (RUA) sites. In addition to secure desktop access for users, visualization centers—dedicated space for collaboration and simulation work—are installed at each of the three NETL sites: Morgantown, Pittsburgh, and Albany.

Additionally, a collaboration workstation is installed at each RUA site that includes high quality displays allowing group interaction and a more detailed exploration of simulation results. Users can also connect from off-site locations to monitor simulation progress outside of work and can share their simulation results with other SBEUC users.

Impacts and Benefits: Datacenter Efficiency

Recognized by Top 500 as one of the top 100 supercomputers in the world—currently ranked number 67—the computer is very energy efficient, using only 5.7 percent of its power for cooling versus 50 percent usage for traditional data centers. All of the computational, visualization, network hardware, and primary storage servers are installed in a high-efficiency modular datacenter. This approach leverages new free-air cooling technology and permits full operation of the computation systems with minimal cooling costs. This free-air cooling method operates by circulating filtered outside air through the datacenter and supplementing it with evaporative cooling, allowing for the very high power efficiency.

An external shot of the modular datacenter shows the filters for the free-cooling air technology. Using this technology the SBEUC is able to operate with a Power Utilization Effectiveness (PUE) of 1.06—for every kilowatt of power used for computation only 60 additional watts are required for cooling.

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