The Modular Supercomputing Facility (MSF) at NASA’s Ames Research Center is an innovative approach to meet our evolving high-end computing (HEC) requirements in an environmentally conscious way that also provides flexibility and power efficiency.

NAS Division experts worked with industry partners to design, build, and install the first prototype MSF system, named Electra, in 2016. Electra’s first module uses a combination of outdoor air and fan technology to remove the heat it generates, and consumes less than 10% of the energy used in traditional supercomputing facilities. The system’s 1.03 power usage effectiveness (PUE) rating—the ratio of energy used by the computing equipment to energy used to power the entire data center—falls well below the computing industry standard of 1.7 PUE.

A second MSF module was integrated with Electra in late summer 2017. This module can expand Electra with up to eight HPE E-Cells, able to house twice the nodes of the original module. Cooling is provided by circulating water from two adiabatic coolers on its roof down to the computer racks. With the addition of the first four E- Cells, Electra will deliver an additional 685 million computer hours per year to augment its sister system, Pleiades.

With modular supercomputing, containers can be added as needed to accommodate NASA’s ever-increasing demand for computing resources. Advantages of such a setup include reducing annual water usage by more than a million gallons of water, and saving over a million kilowatt-hours of energy each year—enough electricity to power at least 300 households per year. The resulting cost savings translate to purchasing power for additional hardware to deliver world-class supercomputing performance for more than 1,500 users across the U.S. who rely on HEC for their research supporting NASA missions.

The NAS Division is now moving ahead with plans for an expanded modular environment at Ames with up to eight times the capability of the current Electra configuration. As usage on Pleiades has increased more than 20% in the last two years alone, these plans for expansion will help keep up with the demands for supercomputing time to support NASA-sponsored engineers and researchers as they continue to study Earth systems, seek to invent the next breakthrough in aerospace technology, discover new planets, and explore the origin of the universe.

**Architecture Overview**

- 16 SGI Broadwell D-Racks; 4 HPE Skylake E-Cells
- 2,304 total nodes
- 78,336 cores, 368 terabytes total memory
- 3.33 petaflops sustained performance (Nov 2017)
- 4.79 petaflops theoretical peak performance

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www.nasa.nasa.gov/hecc/resources/electra.html