NASA System Used Across Agency for Multiple Applications and Research

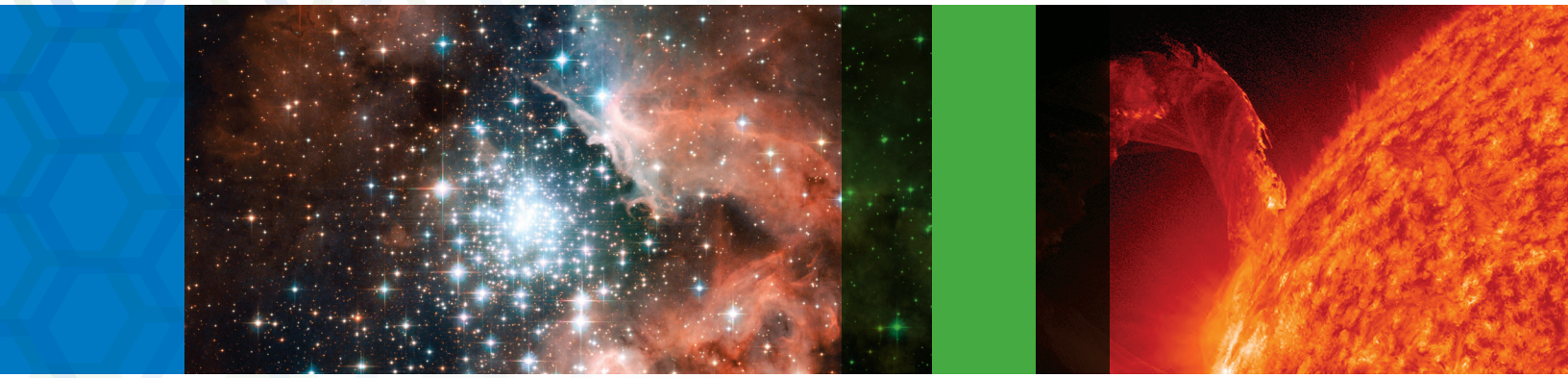
"Pleiades" Ranks High on Top 500 Supercomputers List

Key Facts

Organization:
NASA Advanced Supercomputing Division

Location:
Mountain View, California

Application:
Government Research



The National Aeronautics and Space Administration, more commonly known as NASA, is the U.S. government's space agency. NASA was the original Silicon Graphics, Inc.'s first customer, having been with the company from the 1980s through its current, post-acquisition phase. Through a 2008 technology refresh program, the NASA Advanced Supercomputing (NAS) facility at NASA Ames Research Center in Mountain View, California, purchased a new SGI® ICE cluster system, and has continually upgraded it since, resulting in a 1.3 petaflop system.

Implementing a Technology Refresh at NAS Division

The NAS Division first purchased an SGI ICE system in 2006. This system was a standalone system that led to the agency's decision to purchase an additional SGI ICE system in 2008 as part of an agency-wide technology refresh program. The 2008 system was installed "off-the-shelf," with no custom engineering required. Over time the system grew significantly in size, up to now 186 racks of compute capability. All of the system's components are standard, including Intel® processors, a Mellanox®-based dual InfiniBand™ backbone and SUSE® Linux® Enterprise Server operating system, all integrated by SGI. In fact, Pleiades, as the system is known, is currently ranked as the seventh most powerful supercomputer in the world.

Pleiades is the largest InfiniBand cluster to date, comprising over 63 miles of cabling, dual wired for failover support. It also has seven Lustre® file systems and one of the largest SGI InfiniteStorage Data Migration Facility (DMF) systems, at 26 petabytes of DMF archive with the capability of going to 40 petabytes.

Software support for Pleiades includes SGI Tempo Cluster Management Software and SGI Performance Suite.

Hundreds of Users in Dozens of Application Areas

Researchers have appreciated the ability to perform data analysis and visualization on the Pleiades system for many years. The system is available for mission projects throughout the space agency, all across the country. The system is being used by over 1,000 users, up to 300 at a time, in a variety of application areas including computational fluid dynamics (CFD) for air and space vehicle design, climate modeling, astrophysics, and other earth and space sciences. The system is being used to analyze data from the Kepler space telescope, which is looking for signs of life and new planets in the outer galaxies, and is also being used for solar flare research. The system was even an important resource during the Space Shuttle program, for real-time analysis of the rockets as well as the shuttle cab itself. Currently, Pleiades is at over 100% utilization.

"Pleiades has enabled science and engineering discoveries that just weren't possible prior to its deployment," said Bill Thigpen, NAS Division systems and engineering branch chief and deputy project manager for NASA's High-End Computing Capability Program. "The scale of the system has facilitated the execution of jobs spanning tens of thousands of cores, enabling high-fidelity simulations, providing new insight into solar weather and the origins of the universe, and improving the stewardship of our environment."

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Ease of Installation and a Heterogeneous Environment

Pleiades is a heterogeneous system from a processor standpoint, with three generations of Intel® Xeon® processors — from 5400 to 5600 series. The biggest application run to date has involved the use of 75,000 processor cores.

Photo Credit: NASA Ames Research Center

The NAS facility has received up to 32 racks of compute power in a single week, which SGI has been able to install with relative ease. Compared with other vendors' large HPC systems that require taking the existing system down for incremental installations, and then weekly for preventive maintenance, SGI has been able to add racks on-the-fly while the system remains operable — less than a week from receiving dock to production — and the system never needs to go offline for maintenance. This increased up-time enables researchers to do more and perform bigger jobs, and the system administration team at NAS really appreciates that.

The NAS Division has chosen to retain, on-site, two full time hardware experts from SGI, as well as three software professionals from SGI Professional Services.

According to SGI Principal Systems Engineer Jennifer Fung, "The key for a successful installation, implementation and use of SGI ICE is that the system administrators must be properly trained before their system is installed. While the system consists of standard components, and is thus generally easy to manage, customers can benefit greatly by having SGI show them how to maximize their productivity." The high-end computing team at NASA Ames really took this advice to heart and quickly became experts on how to most easily administer the ICE system.

About the NASA Advanced Supercomputing Division

For nearly 30 years, NAS has been associated with leadership and innovation throughout the high-end computing (HEC) community, playing a significant role in shaping HEC standards and paradigms, with a leading part in the development of large-scale, single-system image computers. As part of the Exploration Technology Directorate at NASA Ames Research Center, the division supplies some of the world's most powerful supercomputing resources to NASA and U.S. scientists. NAS provides an integrated high-end computing environment to accelerate NASA missions and make revolutionary advances in science. In addition to Pleiades, their integrated environment includes smaller test bed and next-generation systems, high-fidelity modeling and simulation, high-bandwidth local and wide area networking, parallel performance analysis and optimization, distributed information infrastructure, and advanced data analysis and visualization.

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