



The Computerworld Honors Program

Honoring those who use Information Technology to benefit society

Final Copy of Case Study

YEAR:
2012

STATUS:
Laureate

Organization:
SGI

Organization URL:
www.sgi.com

Project Name:
Pleiades Upgrade

What social/humanitarian issue was the project designed to address? What specific metrics did you use to measure the project's success?

The Pleiades (named after the astronomical open star cluster of the same name) supercomputer is part of the High-End Computing Capability (HECC) Project, which provides world-class high-end computing, storage, and associated services to enable scientists and engineers supporting NASA missions to broadly and productively employ large-scale modeling, simulation, and analysis to achieve successful mission outcomes. The mission of Pleiades is to accelerate and enhance NASA's mission of space exploration, scientific discovery, and aeronautics research by continually ensuring optimal use of the most productive high-end computing environment in the world.

Please describe the technologies used and how those technologies were deployed in an innovative way. Also, please include any technical or other challenges that were overcome for the successful implementation of the project.

At the NASA Advanced Supercomputing facility, the primary supercomputing center for the agency, HECC provides users with an integrated computing environment including both the computational resources and services supporting efficient use of the systems. Services provided include high-speed networking, data storage, scientific visualization, code porting and optimization, and 24x7 user support. Pleiades, which ranks 7th on the TOP500 list of the world's most powerful supercomputers, represents NASA's state-of-the-art technology for meeting the

agency's supercomputing requirements, enabling NASA scientists and engineers to conduct modeling and simulation for NASA missions. This distributed-memory SGI ICE cluster is connected with InfiniBand in a dual-plane hypercube technology. The system architecture is manufactured by SGI. Pleiades consists of 185 racks (11,776 nodes) with a performance rating of 1.34 petaflop/s peak cluster and 1.09 Pflop/s LINPACK rating (June 2011, using 11,648 nodes). Two racks (64 nodes total) are enhanced with NVIDIA graphics processing unit (GPU): 43 teraflops total. The system consists of 112,896 total cores (32,768 additional GPU cores), with a total memory of 191 terabytes. The system also contains Intel Xeon X5670 (Westmere), X5570 (Nehalem), and E5472 (Harpertown) processors. The newest generation of supercomputer, SGI ICE X, continues the heritage of previous ICE designs, including the SGI ICE 8400, in implementing hierarchical management and hypercube networking topologies. This allows easy system expansion over time, including over multiple generations, with no system downtime while the expansion is taking place. This feature saved NASA over two million hours of compute time during a previous system upgrade.

Please list the specific humanitarian benefits the project has yielded so far.

Here are a few examples of the real-world science accomplishments enabled by these supercomputing resources over the years. Space Shuttle Safety: Computational fluid dynamics (CFD) experts at Johnson Space Center and at the NASA Advanced Supercomputing (NAS) facility at Ames helped develop OVERFLOW, the primary CFD code used to predict space shuttle debris paths and damage. Hurricane Tracking & Prediction: Simulations of Cyclone Nargis (2008), produced using Pleiades and cutting-edge visualization techniques, were the first to show the genesis of this devastating tropical storm five days in advance. Research scientists supporting NASA's Earth Science Technology Office needed hundreds of thousands of processors for each simulation to improve the understanding of tropical storm genesis and intensification, and to extend prediction time for tropical storms to help save lives and property. Ocean & Sea Ice State: Scientists at NASA and MIT on the Estimating the Climate and Circulation of the Ocean 2 (ECCO2) project are using advanced computation to reconstruct the day-to-day state of the Earth's ocean and sea-ice system. In addition to helping develop core understanding of how the ocean and sea-ice system works, this information is being used to provide scientific input for real-world issues including: monitoring the ocean atmosphere exchange of carbon dioxide; forecasting the likely impact of pollutant plumes, such as the Deep Water horizon; and improving estimates of Antarctic glacial melting. Heart Assist Device: Simulations of blood flows within the human circulatory system were crucial to development of the NASA-DeBakey Ventricular Assist Device (VAD). Using knowledge gained from shuttle technology, CFD experts made improvements to the VAD design to increase blood flow circulation and reduce clotting, improving the lives of hundreds of heart-failure patients around the world.

Please provide the best example of how the project has benefited a specific individual, enterprise or organization. Feel free to include personal quotes from individuals who have directly benefited from the work.

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