success story

HP and Caltech embark on a mission to higher performance

"We are pleased with the progress we have seen during recent months with the Itanium™ architecture and with our interactions with the HP development groups. Our real-world experience with the Itanium architecture has shown performance improvements that help us advance the sophistication of our simulations and maintain a rapid pace in our research. Through our continued strong collaboration with Hewlett-Packard, we believe that are on the right path to provide our user community with competitive high-performance hardware and software."

Dr. James C. T. Pool
Executive Director, California Institute of Technology

The California Institute of Technology gets results from discovering anti-matter to determining the nature of the chemical bond, founding modern earthquake science to probing the secrets of the universe. As one of the world's preeminent institutions for engineering and scientific research and education, the term "pioneering" only begins to describe its work.

When it comes to computing needs, Caltech requires the latest and best technology. As such, it relies on its own Center for Advanced Computing Research (CACR). Founded in 1995 to ensure Caltech would stay at the forefront of computational science and engineering (CS&E), CACR simultaneously provides leading-edge capabilities for CS&E research and experiments with new technologies that help define the technical computing environment of the future.

In 1997, CACR began a collaborative relationship with Hewlett-Packard Company. HP committed early-access to its newest and largest computer system and, in return, CACR agreed to evaluate the HP systems and software, using large-scale scientific and engineering applications for complex experiments.

"We're not what you'd call a typical HP customer – we like to do things differently!" explains Dr. James C.T. Pool, executive director, California Institute of Technology. "We like to be on the leading edge, trying the newest and latest technology. That way, in the long haul, the servers developed by HP are better suited to the needs of scientific and computational applications."

unifying architecture

CACR currently has two different sets of Itanium architecture systems. One set, put in place in mid 2000, consists of three 4-CPU servers. Pool noted, "Our servers came as very pre-production units and still look that way even though they have been upgraded with the later versions of the Itanium processors!" Three additional, more finished-looking 4-CPU systems arrived in February/March 2001.

The Itanium Processor Family (IPF) is a highly scalable 64-bit architecture based on the Explicitly Parallel Instruction Computing (EPIC) that was co-developed by HP and Intel®. It allows new levels of Instruction Level Parallelism (ILP) for more instruction issues per cycle. Itanium architecture processors provide performance that easily outstrips what is possible with earlier processor families. With its advanced Itanium architecture, the HP rx 4610 processor-based servers are the essential platforms for the next generation of 64-bit computing, no matter whether HP-UX, Windows or Linux operating systems are used.

partners in development

Pool explained Caltech's interest in the IPF systems. "Any experience we can get with HP rx4610 systems, in terms of assessing their long term prospects, is valuable information to us. By investing our time and people, and with open access to HP's technical development team, we end up with production systems that are consistent in terms of their ability to handle very large computational loads."

CACR works hand in hand with HP to help develop and improve the Itanium servers. HP corrected the bugs that CACR uncovered, sending new software and drivers back to CACR, whereupon Pool's staff re-tested the servers and provided HP with code-accuracy and overall systems performance information.

CACR did the stress testing, using benchmarks like the MPI test suite, to test for things that would be typical in much larger codes. This stressed system software as well as hardware in a more contained and comparable environment.

Once through the benchmarks, CACR moved to a second phase of running codes that typically would run on the HP Superdome: chemistry, integrated physics codes – solid dynamics, fluid dynamics – both computationally demanding and data intensive codes.

Pool said, "Interacting in the development stage ensures that these systems can handle the scientific applications that we need them to. It has been worth our while and we are pleased with the way the Itanium architecture has progressed to meet our application needs."

industry

scientific computer-based modeling

challenge

- **maintain the latest and most progressive computer systems**

solution

- **3 HP rx4610 4-way servers**

results

- **increasing stability**
- **improving performance**

real-world findings

Mark Bartelt, systems manager at the California Institute of Technology, commented, "To evaluate system software, we have used increasingly complex applications recently culminating in the port of part of our Virtual Test Facility. CACR is responsible for software integration and performance in Caltech's Center for Simulation of the Dynamic Response of Materials, a center of excellence sponsored by the DOE Accelerated Strategic Computing Initiative (ASCI) (see http://www.cacr.caltech.edu/ASAP/). The goal of the center is the construction of a Virtual Test Facility (VTF) to simulate the response of materials under shock waves generated by high explosives. It is a coupled fluid dynamics and solid dynamics problem that is intrinsically three-dimensional."

Bartelt continued, "The finite element solid dynamics component of the application has been ported, and completed hundreds of time steps before successful termination. Solid meshes ranging in size from 100,000 to 400,000 elements were successfully pre-partitioned and prepared for the parallel version of the VTF. We are confident we will be able to port substantial portions of the VTF in the near term and ultimately run the entire VTF suite on the Itanium architecture systems. Initially, we have focused on validation of code correctness, stressing various compiler options within the context of our test applications, and exercising the MPI message-passing library."

"Itanium is a unifying architecture, giving us a choice of three operating systems: HP-UX, Windows, or Linux," Pool noted. "We also have ported IRIS Explorer, a modular visualization environment, to Linux in cooperation with the Numerical Algorithms Group (Downers Grove, IL and Oxford, England) and the University of Leeds in England. We have had excellent support from a variety of sources at HP and support from RedHat and nVidia."

Pool observed, "By running Linux in addition to HP-UX we are able to increase our overall scientific computational capabilities."

"HP-UX 11.20 is proving to be extremely stable and we've seen a continuing improvement in the Itanium HP rx 4610 systems' performance," said Bartelt. HP has upgraded our pre-production systems' hardware over the time that we've been testing it. Each of the CPU upgrades has not only addressed hardware issues, but had progressively higher clock speeds, so the production server performance has improved over that of the original pre-production units."

moving forward

HP and CACR will continue to work together towards the development of more powerful, high-performance systems. "We are extremely pleased with the progress we have seen during recent months with Itanium and with our interactions with the HP development groups," Pool stated.

He concluded, "Our real-world experience with Itanium has shown performance improvements that help us advance the sophistication of our simulations and maintain a rapid pace in our research. Through our continued strong collaboration with Hewlett-Packard, we believe that we are embarked on the right path to providing our user community with competitive high-performance hardware and software."

For more information on how working with Hewlett-Packard can benefit you, contact your local HP service representative, or visit us through the Internet at our
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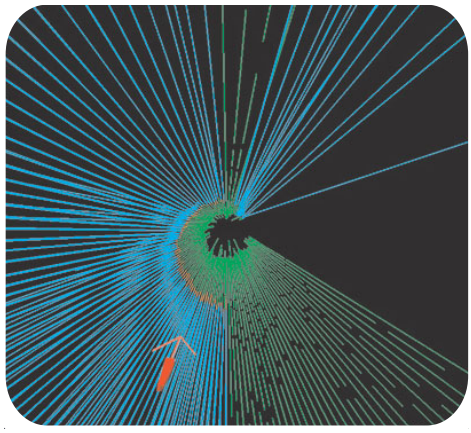

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CACR simultaneously provides leading-edge capabilities for computational science and engineering research and experiments with new technologies that help define the technical computing environment of the future.

Founded in 1891, Caltech has an enrollment of some 2,000 students, and a faculty of about 290 professorial members. The Institute has more than 19,000 alumni. Caltech employs a staff of more than 2,400 on campus and 4,800 at JPL. Over the years, 28 Nobel Prizes and four Crafoord Prizes have been awarded to faculty members and alumni. Forty-seven Caltech faculty members and alumni have received the National Medal of Science; and eight alumni (two of whom are also trustees), two additional trustees, and one faculty member have won the National Medal of Technology. Since 1958, 13 faculty members have received the annual California Scientist of the Year award. On the Caltech faculty there are 78 fellows of the American Academy of Arts and Sciences; and on the faculty and Board of Trustees, 70 members of the National Academy of Sciences and 46 members of the National Academy of Engineering.