Customizing supercomputers from the ground up

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(PhysOrg.com) -- Computer scientist Adolfy Hoisie has joined the Department of Energy's Pacific Northwest National Laboratory to lead PNNL's high performance computing activities. In one such activity, Hoisie will direct a group of scientists designing supercomputers and their software applications simultaneously — so all the components of a supercomputer can be optimized and focused on one kind of problem.

As director of PNNL's Center for Advanced Architectures for Extreme Scale Computing, Hoisie is planning on tackling the kind of problems that can be found in a variety of scientific fields, from studying biological systems to understanding the electrical power grid. Some of these applications rely on the sheer computational power of supercomputers in the process of scientific discovery. In other areas, researchers amass so much data — petabytes, a million billion times more bytes than in one character on a page — that their supercomputers need more than just fast processors, they need to be able to shuttle that data around rapidly.

Most supercomputers, such as Cray's Jaguar at Oak Ridge National Laboratory in Tennessee, gain their fame due to how fast they perform calculations — their processing speed. But a speedy processor won't matter if the computer can't move data between memory and the hard drive fast enough or if it can't handle rivers of data coming in from instruments taking measurements.

The data-intensive problems that PNNL researchers want to solve

require a different emphasis in computational resources. But rather than build supercomputers and write software separately, Hoisie and two other computer scientists — Darren Kerbyson and Kevin Barker — will design the supercomputers and the applications that will run on them at the same time. Because most computers and software are designed independently, the scientists will also need to develop the tools to allow this co-design.

"The complexity of extreme-scale supercomputing systems and applications is now comparable to that of the physical simulations they perform. The science of systems and applications designed for optimal performance is a grand challenge for high performance computing research," said Moe Khaleel, director of Computational Sciences and Mathematics at PNNL. "PNNL will now be at the forefront of these endeavors."

In addition, the bigger in scale, the more power they consume. The team will also be looking at how performance and power intersect, and how they trade off against one another on extreme-scale systems and workloads. As part of the center, Kerbyson and Barker will collaborate with researchers at other national laboratories and universities.

The researchers come to PNNL from DOE's Los Alamos National Laboratory in Los Alamos, N.M. There, Hoisie earned an international reputation in performance analysis and engineering of large-scale parallel computers. Hoisie won the Gordon Bell Award from the Association for Computing Machinery in 1996, an honor given for work in parallel computing.

Kerbyson will lead basic research at the center and will also be the chief scientist for the PNNL's Extreme Scale Computing Initiative, which will be exploring how to tackle analysis of extremely large data sets. He specializes in modeling and analysis of how well software performs. He

has a doctorate in computer science from the University of Warwick in the United Kingdom.

Barker has extensive experience developing tools for modeling software performance and for extreme scale hardware and software. He has also developed applications for parallel computing. He has a doctorate in computer science from the College of William and Mary in Williamsburg, Va.

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