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*Eric Polizzi
Assistant Professor, Department of
Electrical and Computer Engineering
University of Massachusetts, Amherst*

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Nanoelectronics researchers at the University of Massachusetts move up from a workstation to an Intel® Cluster Ready HPC system and gain scalable performance with simple management

Challenges

Improve performance. Scale up from workstation performance by moving to an HPC cluster equipped with the latest Intel® architecture.

Swift deployment and easy management. Stay focused on research by selecting a cluster that will deliver outstanding performance, right out of the box, without requiring excessive time for design, deployment, or management.

Solution

Certified Intel® Cluster Ready cluster with the latest Intel® Xeon® processors. With help from Intel and Silicon Mechanics, the research team designed and deployed a certified Intel Cluster Ready cluster equipped with the Intel Xeon processor 5500 series.

Impact

Scalable performance. The Intel Cluster Ready cluster helps researchers scale performance significantly, solving larger mathematical systems without having to rewrite code.

Fast deployment. The cluster was ready for research within one month—several months sooner than if researchers had acquired, tested, and integrated components on their own.

Simplified management. The Intel Cluster Ready program helps ensure that hardware and software components will work together over the life of the cluster.

Researchers in the Electrical and Computer Engineering Department at the University of Massachusetts (UMass) Amherst are developing software algorithms to help engineers solve complex mathematical systems. They use those algorithms themselves for modeling nanoelectronic components—ultra-small devices that will serve as the next generation of transistor. To solve larger systems and enhance the detail of models, the group decided to move up from a single computer workstation to a high-performance computing (HPC) cluster based on the latest Intel® processing architecture. Intel and Silicon Mechanics helped them select a certified Intel® Cluster Ready cluster equipped with the Intel® Xeon® processor 5500 series. After a rapid deployment, researchers are capitalizing on outstanding, scalable performance without complicated IT management.

UMass researchers were using a single workstation with a multi-core Intel® architecture to develop and run their parallel linear system solver (“Spike”) and eigenvalue solver (“Feast”). While the workstation’s performance was sufficient for many tasks, researchers encountered several limitations. For example, sharing this single computer restricted the number of researchers who could work simultaneously. The team also was unable to capitalize on all eight of the workstation’s processing cores. “Memory bandwidth limitations kept us from scaling beyond four cores,” says Eric Polizzi, assistant professor in the Department of Electrical and Computer Engineering. “We needed a system that would let us scale to eight cores and beyond so we could solve larger systems and improve our modeling.”

Polizzi’s group decided to move up to an HPC system, which could support more simultaneous work and provide greater scalability. In selecting the system, Polizzi’s primary requirement was performance. “We wanted a cluster that could provide outstanding raw compute power plus the memory capacity and bandwidth to allow us to take full advantage of multiple cores on a single node. We also needed fast communication between nodes so we would not face any bottlenecks as we scaled,” says Polizzi.

“ The increased compute performance and memory bandwidth provided by the new Intel® architecture...let us achieve ideal speed-ups for our algorithms without having to rewrite any of our code....We can solve larger mathematical systems, improve our nanoelectronics simulations, and complete projects faster than before.

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Spotlight on Nanoelectronics at UMass Amherst

Researchers in the Electrical and Computer Engineering Department at the University of Massachusetts, Amherst, are exploring the computation of large-scale physics and engineering problems in nanosciences. Professor Eric Polizzi and his team develop applied mathematics techniques and robust parallel algorithms for enabling realistic numerical simulations on HPC platforms.

Researchers wanted the performance benefits of HPC, but they did not want to increase their IT management responsibilities. “We do not have the resources to design a supercomputer, test all of the hardware and software components, and manage a complicated system,” says Polizzi. “We needed a reliable, high-performance system that could be deployed and managed easily.”

Intel® Cluster Ready helps accelerate deployment and simplify management

After consulting with a team from Intel, Polizzi’s group selected a certified Intel® Cluster Ready system. Certified Intel Cluster Ready clusters are built according to the Intel Cluster Ready Specification and rigorously tested for component interoperability.

With help from an Intel team, Polizzi used the configuration tool on the Silicon Mechanics Web site to design the cluster. Silicon Mechanics sales and engineering teams then worked with Polizzi to fine-tune the configuration. “The online configuration tool made it simple to customize each node while keeping the cluster within the Intel Cluster Ready certification,” says Polizzi. “In addition, the Silicon Mechanics team was a great help in finding configuration options that could accommodate all our computing needs and fit into our budget.”

The new cluster uses one Silicon Mechanics Rackform iServ R346* as a head node plus two Rackform iServ R4410 servers, which feature a new compact design that fits four compute nodes into each 2U server. The compute nodes include two processors from the Intel® Xeon® processor 5500 series and 48 GB of memory across 12 DDR3 DIMM slots. An InfiniBand* fabric helps ensure fast communication between nodes.

To prepare the cluster, Silicon Mechanics deployed Clustercorp Rocks+* middleware, which provides a complete software stack in a single installation. The UMass group selected a variety of “Rolls”—prepackaged software components such as the Intel® Developer Roll—for the cluster. The Silicon Mechanics team completed the hardware and software integration, shipped the integrated cluster to Polizzi, and then sent an engineer to the UMass lab to finish installation details. The engineer also provided a knowledge transfer service to help Polizzi’s team manage the cluster in-house.

“It might have taken us several months to design, test, and deploy an HPC system on our own,” says Polizzi. “By choosing an Intel Cluster Ready system through Silicon Mechanics, we were ready for research in less than one month.”

Increased memory bandwidth helps double scalability on each node

Using the Intel Xeon processor 5500 series in the HPC cluster, researchers now have the scalability they need to solve larger math and engineering problems much more rapidly. “The increased compute performance and memory bandwidth of the Intel Xeon processor 5500 series, along with the fast InfiniBand communication, let us achieve ideal speed-ups for our algorithms without having to rewrite any of our code,” says Polizzi. “With workstations using previous-generation processors, our algorithms could not scale beyond four cores. Now we can scale to eight cores on each node and achieve additional scalability using all the compute nodes. We can solve larger mathematical systems, improve our nanoelectronics simulations, and complete projects faster than before.”

Simplified management keeps researchers focused on their work

Polizzi’s team is reaping the rewards of HPC without having to spend more time managing or supporting this new infrastructure. “With an Intel Cluster Ready cluster, all the hardware and software components work together reliably,” says Polizzi. “If we ever have a problem, we can call Silicon Mechanics to resolve the issue fast. The Intel Cluster Ready cluster and support from Silicon Mechanics help us stay focused on our research.”

Fast access to HPC resources helps researchers explore new possibilities

“Our researchers now have easy access to state-of-the-art HPC resources,” says Polizzi. “Several users can run their workloads simultaneously without affecting one another, and they achieve better performance than if they had used other HPC facilities. With an Intel Cluster Ready system based on the latest Intel architecture, we anticipate breakthrough results for our research.”

Visit www.intel.com/go/cluster to read more about the Intel Cluster Ready program and to learn where you can buy a certified Intel Cluster Ready cluster. Visit any Silicon Mechanics product Web page at www.siliconmechanics.com to custom configure a server, storage, or cluster solution.

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