CASE STUDY
Intel® Xeon® Processor 5500 Series
Enterprise Server
High-Performance Computing

Intel® Technologies Deliver a Sunny Outcome

Intel® Xeon® processor 5500 series helps RENCI make weather forecasting faster and more reliable.

Seeking a flexible supercomputer to support a variety of research, North Carolina's Renaissance Computing Institute (RENCI) selected an Intel® Xeon® processor 5500 series-based Dell PowerEdge M610* blade server. It was a smart choice. Now jobs that used to take weeks or months are finished in hours or days—and RENCI scientists have demonstrated the viability of new weather modeling techniques with the potential to save millions of dollars next time a hurricane threatens the state.

Renci Renaissance Computing Institute Catalyst for Innovation

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– Brad Viviano
Infrastructure Manager
RENCI

CHALLENGE

- **Performance.** With its high-performance computing (HPC) systems showing their age, RENCI needed a platform that could better meet scientists' needs for high performance and scalability.
- **Flexibility.** RENCI's researchers tackle pressing problems in areas from bioscience and public health to the humanities and social sciences, so a flexible platform was essential.

SOLUTION

- **Performance technologies from Dell and Intel.** After evaluating competitive offerings, RENCI installed an 8-chassis Dell PowerEdge M610* cluster with 128 dual-socket Intel® Xeon® processors 5560, and both InfiniBand* and Gigabit Ethernet connectivity.

IMPACT

- **Application breakthroughs.** Applications run faster by an order of magnitude or more than on RENCI's Intel® Xeon® processor 5150-based cluster, enabling scientists to explore more alternatives and study problems in greater detail.
- **Data center savings.** The new system is just one-fourth the size of the older one, saving valuable floorspace and delivering much more performance per unit of power consumed.
- **Institutional flexibility.** With industry-standard hardware and dual-boot support for both Linux* and Windows* operating systems, the system is an easily managed workhorse supporting a broad array of workloads.

More Perfect Predictions

Weather forecasting—one of the key applications running on RENCI's new Intel Xeon processor 5500 series-based HPC cluster—is all about certainty. Combining the processor's outstanding performance with innovative forecasting techniques, RENCI researchers have made breakthroughs that are earning national attention for improving the certainty of their weather predictions.

Weather forecasters run groups, or an ensemble, of simulations to better understand the interplay of complex factors involved in weather systems. RENCI can run ensembles that use more simulations and that model conditions in eight times greater detail than the models used at the National Center for Environmental Prediction. While the RENCI models are research products at this time, the institute plans to offer them to the National Weather Service, where they could help researchers and forecasters gain a clearer picture of weather systems, including when and where a severe storm will make landfall

If a hurricane is bearing down, RENCI's work can help officials preserve life and property while avoiding unnecessary evacuations.

and with how much force. Using the Intel Xeon processor 5500 series, scientists can obtain results faster and explore more "what if" scenarios in a given time period. "Instead of one ensemble run, we can do 10 or 20, and with much greater precision," says Brian Etherton, senior atmospheric scientist.

Those results can affect much more than whether your picnic gets rained on. Disaster management experts use a rule-of-thumb figure of USD 1 million per mile when they estimate the costs of evacuating a given area, according to Rob Fowler, director of HPC research at RENCI. For instance, if a hurricane is bearing down on North Carolina, more precise weather models can potentially help emergency management officials make more accurate decisions about where and when to evacuate, preserving lives and property while avoiding unnecessary disruptions.

Performance Payoff

"The Intel Xeon processor 5560's high performance and memory bandwidth are what enable the speedups," says Brad Viviano, RENCI's manager of infrastructure. "We spent about the same amount per node for this system as we did for our Intel Xeon processor 5100 series-based cluster three years ago, but we get results eight or nine times faster and we're performing many more calculations in the same amount of time."

Node for node, the new Intel Xeon processor 5500 series-based workhorse also dramatically outperforms RENCI's aging IBM Blue Gene*/L system. A 500,000-point ADCIRC grid, a code RENCI scientists use to measure coastal storm surge, takes four hours and 26 minutes on 512 nodes of the Blue Gene system, two hours and 49 minutes on the 256-node Intel Xeon 5150 processor-based system, and less than 21 minutes on the new platform.

Best Value

RENCI chose the Intel Xeon processor 5500 series after a review of available alternatives. "To support the breadth of our research, we wanted something more flexible than the Blue Gene system, which is much more specialized," Viviano recalls. "The Intel Xeon processor 5560 boiled down to the best value over the expected life of the system. It represented quite a leap in performance over previous systems, and our early benchmarking confirmed that we would indeed get the fantastically increased memory bandwidth Intel was talking about. We knew it would continue to be a productive system for a long time."

RENCI gives the platform high marks for its manageability and ease of use. "It's a lot easier for IT to manage an Intel® processor-based system compared to a specialized supercomputer," says Viviano. "With a cluster of Intel® blades, whether it's one or a thousand, there's not the requirement for a lot of specialized skills."

The new machine also shows the increasing density of the new Intel® technologies. While RENCI's older Intel® based cluster has 40 dual-socket, dual-core nodes per rack, the new system packs 64 dual-socket, quad-core nodes into each rack. The jump from 160 to 512 cores per rack is much appreciated given RENCI's 1800 square foot data center. "We're wired for density, so the floor space savings are a big advantage," Viviano comments.

As for RENCI's scientists, they're excited about the opportunities the system affords to advance their research. "We're on the cutting edge, backing up forecasts with a degree of science that nobody's achieved before," says Etherton. "We're making probabilistic forecasts with a much higher degree of certainty."

Then he adds, with the joy of a scientist who loves his work and delights in a powerful new tool, "We're having a great deal more fun than we did with the older systems."

SPOTLIGHT ON THE RENAISSANCE COMPUTING INSTITUTE

RENCI was established in 2004 as an advanced cyberinfrastructure research and problem-solving collaboration involving the University of North Carolina at Chapel Hill, Duke University, North Carolina State University, and the state of North Carolina. RENCI applies high-end technology tools, including high-performance computing, in multidisciplinary research projects aimed at generating innovation and economic growth for the state. The institute also works to push the development of next-generation cybertools and infrastructure through technology research and prototyping.

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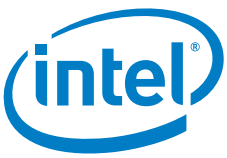

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