

CHALLENGE	SOLUTION	BENEFIT
Provide supercomputer-level performance in a scalable, cost-effective, and standards-based architectural solution	A Dell™ PowerEdge™ 7150 server with four Intel® Itanium® processors and 10 GB of shared memory (expandable to 64 GB)	Computing performance that rivals that of a traditional supercomputer but consumes much less data center space

From coast to COAS

Oregon State University’s College of Oceanic and Atmospheric Sciences (COAS) lowered its computing costs and expanded its data center for new business opportunities

The College of Oceanic and Atmospheric Sciences (COAS) at Oregon State University is one of the leading centers for ocean and atmosphere research in the United States. Researchers at COAS provide insights into the interaction between air and sea and its implications for everything from weather to commerce, defense to recreation.

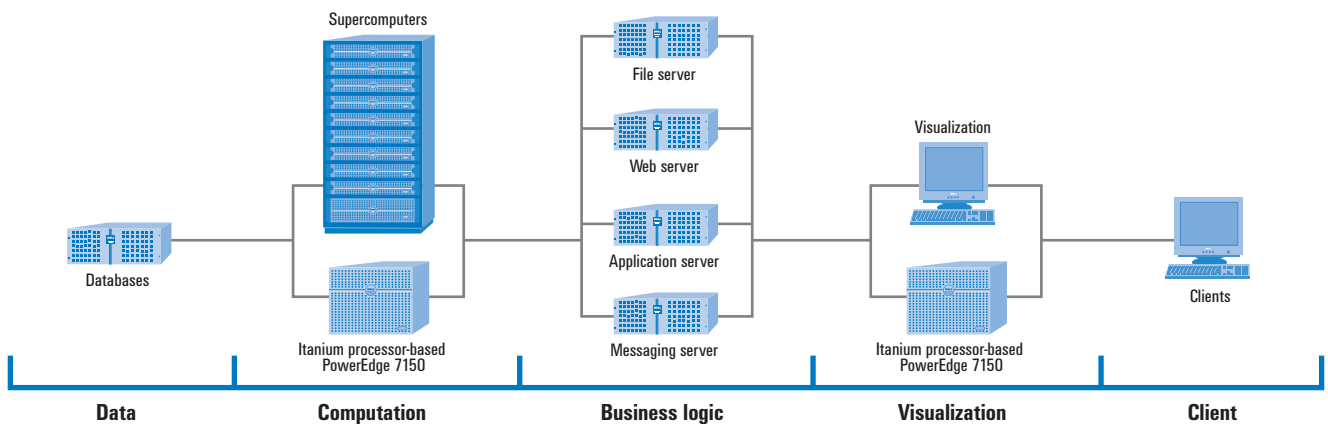
Whether crunching through massive amounts of data from satellites and research vessels or performing complex data modeling, the COAS research center has always required expensive supercomputers. But with the advent of the Intel® Itanium® processor-based Dell™ PowerEdge™ 7150 server, COAS sees a new day dawning in scientific research. This new computer architecture can

help scientists to tackle more deep-science problems, explore new business opportunities, and streamline the research workflow.

Research is business as usual

As one of the top five oceanic and atmospheric graduate institutes in the country, COAS offers graduate studies in atmospheric sciences, geophysics, marine resource management, and oceanography. More than 60 scientists explore topics such as how ocean currents affect coastal biology, the ongoing effects of El Niño, and the ocean’s role in global climate changes.

COAS operates more like a business entity than a research institution. With limited public funding, COAS must compete for



College of Oceanic and Atmospheric Sciences at Oregon State University uses Intel Itanium processor-based Dell servers to crunch massive amounts of data

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— **Chuck Sears**
Director of Research Computing Services
College of Oceanic and Atmospheric Sciences, Oregon State University

just about every dollar it spends. Today, the college’s biggest partners are the National Science Foundation, NASA, and the U.S. Navy, but COAS is eager to extend its research services to other government agencies and private industry.

This dollars-and-cents approach—and a desire to make its vast expertise in environmental sciences available to a broader audience—led COAS to re-examine its computing infrastructure.

Supercomputers have limits, too

Scientific computing involves moving massive amounts of data in and out of computers for various types of specialized processing, and using powerful visualization software to view that data on workstations. The data volumes are enormous: satellites and ocean-going research vessels send data by the gigabyte. To make sense of such huge data sets, COAS uses five supercomputers for the data modeling, management, and visualization cycle.

“Supercomputers have large memory, exceptional floating-point performance, and very good I/O,” says Chuck Sears, director of research computing services for COAS. “They’re great for scientific computing, but they’re too expensive and too specialized.” Supercomputers can cost millions of dollars, consume valuable space, and require a vast infrastructure.

“We have never been able to use the industry-standard server platforms that offer exceptional price/performance and to build integrated solutions to fit our workflow,” Sears explains. In the past, COAS had looked into building clusters with standards-based servers, but those servers simply did not have the memory, I/O, or scalability to handle problems that demand 32 GB of main memory. “We have desperately wanted a platform that provided an industry-standard architecture and could scale with evolving research needs, but yet follows the PC performance/price curve,” Sears says.

COAS dives in with Dell

COAS had been a long-time customer of Dell servers and workstations. The local Dell sales team spent years around the college’s supercomputer and visualization computing center and came to

understand the architectural requirements of oceanographic research. “Most people think of Dell as a click on a Web page, but the company has a strong enterprise vision,” Sears says. “They understand large-scale computing. They understand our orders of scale.”

Not only did Dell understand the computing challenges that COAS faced, but the Dell team also offered to solve them in a brand new way. “Dell stepped up to the challenge of matching super-computing power with an off-the-shelf server based on the Intel Itanium architecture,” Sears says.

Taking advantage of the Dell and Intel early adopter program for the Intel Itanium platform, COAS installed a preproduction Dell PowerEdge 7150 server, which had four Intel Itanium processors and ran the Red Hat® Linux® operating system. “On paper, the Dell and Intel people claimed that this tiny Itanium server, not much larger than a television set, had the same computing power as a supercomputer that fills a traditional computing center and requires specialized cooling and power conditioning,” Sears recalls. “We were skeptical at first.”

The Itanium architecture employs a well-balanced blend of high-speed compute performance, high-speed I/O, and high-capacity memory, heretofore unseen in off-the-shelf processors. It accommodates up to 16 TB of main memory—orders of magnitude more than the 1 GB to 4 GB offered by previous-generation processors. Its massive register resources (328 in all, including 128 integer and 128 floating-point resources) and Explicitly Parallel Instruction Computing (EPIC) technology enable multiple, simultaneous instruction execution, helping servers reach high levels of performance.

Itanium changes everything

After two months of testing the Itanium processor-based PowerEdge 7150 server,¹ Sears’ staff began to see performance ratings that made them both excited and nervous. “We have some very tough FORTRAN and C code, and we were seeing significant improvements in our grand challenge class of compute applications,” Sears says. “It was hard to believe, given Dell’s traditional market space.”

Sears was overwhelmed by the implications of Itanium architecture-based computing for the COAS Environmental Computing Center. “The Itanium architecture changes everything,” he says. “It will let us scale throughout the enterprise to the point where we can finally address the grand challenges of science. Moreover, it enables a whole new business model, allowing us to do more advanced research at lower costs. By speeding up research and lowering the cost, it will allow us to go after more customers with new data products.”

¹ The college’s initial testing used the first generation of the Itanium processor family, with follow-on activity planned for the second-generation Itanium processor (Itanium 2).

For example, COAS currently provides “data products” primarily to three customers—the National Science Foundation, NASA, and the U.S. Navy. These products consist of video/DVD, published papers, and visualizations demonstrating the effects of various ocean and weather phenomena. Creating these finished products requires days of crunching through terabytes of data and moving that data from supercomputer to supercomputer for specialized processing and refinement.

The Dell PowerEdge 7150 can slice through this data at a low cost and uses a fraction of the data center space. The COAS vision is to use Itanium processor-based Dell servers across the workflow—for everything from back-end processing and high-end visualization to distribution.

“The parallelism in this architecture is very good,” Sears says. “The Itanium processor’s multiply and add operations that deliver floating-point performance can map really well to the scientific world. The very large memory address space, rich register set, and parallelism make it a superb architecture for any high-performance computing environment.”

COAS maps out the future

The Intel Itanium architecture of the Dell PowerEdge 7150 allowed COAS to apply supercomputer levels of power to scientific problems, unify processing power across data centers to solve larger problems, and speed up the research workflow. COAS sees the 64-bit architecture of the Intel Itanium processor eventually replacing the 32-bit architecture (upon which the Intel Pentium® III and Intel Xeon™ processors are based) in some application areas and co-existing with the 32-bit architecture in others.

COAS currently has Gigabit Ethernet² connections all the way to the desktop, helping every workstation take advantage of Itanium processor speeds. Once it has acquired multiple Dell PowerEdge 7150 servers, COAS plans to cluster them over a high-speed I/O path such as InfiniBand™. This infrastructure will provide extremely fast connections that can keep up with the other 64-bit elements of an Itanium architecture-based system.

Dell and Intel also have been working with third-party manufacturers to bring to market Itanium architecture-compatible I/O adapters, graphics cards, RAID controllers, and other components critical to total system throughput. By using a consistent computer architecture across the organization, COAS should be able to process more data and produce more sophisticated data products.

The college is eager to deliver its environmental research to living rooms via real-time weather updates, numerical model predictions of oil spill trajectories, and other consumer-packaged renditions of its rich data stores. New customers

could include television stations, weather services, and even recreational organizations.

“Traditionally, COAS research has been delivered primarily to the scientific community and federal agencies. We will continue to do this type of data delivery, but the Itanium architecture will help us deliver this knowledge to a much broader community,” adds Mark Abbott, dean of the College of Oceanic and Atmospheric Sciences.



Itanium makes waves beyond COAS

Sears adds that Itanium processor-based servers will change organizations in more subtle and profound ways than simply speeding up processing and lowering costs. He says these servers will revise entire IT infrastructures and business workflows.

“The scalability of the Itanium architecture is so well balanced that it can handle just about every high-performance computing task imaginable,” explains Sears. “Organizations no longer need to invest in multiple architectures to handle specialized tasks, nor waste time integrating disparate infrastructure elements. When you spend all your time with integration, you lose your business focus. The Itanium architecture makes integrating extremely high-performance enterprise systems easy: organizations can use industry-standard products that can be deployed from the desktop to the data center.”

An ocean of opportunity

So are supercomputers a thing of the past? “We certainly can’t discard our multimillion-dollar investment overnight; we’ll continue to use the machines we have,” Sears says. “But the Itanium architecture and systems like the Dell PowerEdge 7150 have changed the rules. They could redefine the building blocks for large-scale supercomputers and grid computing.”

“The scientific community is no different from the business community in the challenges it faces,” concludes Sears. “Everyone has shrinking budgets and more competition, everyone wants to increase computing performance, and everyone wants to discover new ways to tackle the problems that cannot be addressed with current levels of computing power. The Itanium architecture takes us into a whole new dimension of computing, one that is truly smaller, cheaper, and better by every measure.”

FOR MORE INFORMATION

<http://www.dell.com/servers>

<http://www.intel.com/itanium>

² Gigabit Ethernet indicates compliance with IEEE® 802.3ab and does not connote speeds of 1 Gbps.