Intel® Itanium™ Architecture: High Performance Computing (HPC) Grid Fuels Genetic Research

The successful mapping of the human genome and other biotechnology breakthroughs have pushed genetics into the spotlight. But existing genetic databases already strain the processing limits of the world's most powerful computers. The vast quantities of new genetic data now becoming available only widen the gap between the ability of genetic researchers to capture this exciting new information and their power to analyze and reference it.

High Performance Computing (HPC) systems built using the Intel® Itanium™ architecture directly address this challenge. A consortium of Norwegian universities has developed an HPC grid connecting their total computer resources into a geographically distributed but virtually consolidated system. The grid is delivering expanded processing capabilities by incorporating scalable, flexible clusters of systems based in part on the Intel Itanium processor. As a commercial user of the grid, Sencel Bioinformatics* develops software that accelerates a key genetic research procedure. Sencel believes that the grid's Intel Itanium processors will allow Sencel software to process this procedure faster than any other processor, thereby accelerating possible biotechnology breakthroughs.

INTEL®-BASED SOLUTION

- Clustered HP* i2000* Intel® Itanium™-based (800 MHz) systems
- Linux*
- HP-UX*
- Microsoft* Windows XP* (planned)
- Open Cluster Group OSCAR* Linux cluster management tool
- Score* clustering software
- Message Passing Interface (MPI)

Seeking More Affordable Power

Scientists at Norway's leading universities are conducting large-scale research projects in genetics and biotechnology. To provide the computing power for these research projects while keeping costs tightly contained, researchers created the NOTUR* (Norwegian Supercomputing) grid. Sencel Bioinformatics, one of the grid's users, is developing PARALIGN* software to dramatically accelerate common but critical algorithms used for rigorous genome sequence database searching. The prohibitive cost of special-purpose hardware previously used for such procedures presented a significant obstacle to the widespread use of the most accurate search algorithms.

"Since we are publicly funded, getting real value for our money is critical. We cannot risk making the wrong choice on an architecture. This made the Itanium processor family very interesting to us."

Arne Laukholm, Director, Center for Information Technology Service, University of Oslo*

Running on Intel

NOTUR designed and built an HPC grid by connecting geographically dispersed systems, including clusters of IBM* and SGI* computers. NOTUR's HPC specialists determined that the superior flexibility, scalability, and performance of Intel Itanium-based systems would be the ideal match for their computing needs. Working closely with Hewlett-Packard* engineers, the consortium added the Intel Itanium-powered clusters to the grid. The advantages of the Intel architecture HPC strategy were immediately clear. The distributed HPC grid could deliver the power to run highly demanding and data-intensive applications.

"Because Intel® Itanium™ processors are widely supported by the HPC community, we believe that the product family will be very successful. We have invested in HPC clustering, and the Itanium processor family fits in well with that clustering model."

Arne Laukholm, Director, Center for Information Technology Service, University of Oslo*

Flexibility to Grow and Adapt

NOTUR sees great value in the Itanium processor's support for multiple operating systems. Researchers like the clustering capabilities of Linux and the performance of HP-UX. Using the industry-standard Message Passing Interface (MPI), they can consolidate on a single hardware architecture and create a unified environment despite the heterogeneous operating environments. NOTUR also has the flexibility to deploy applications that run on Microsoft Windows XP, and can continue to support existing RISC legacy applications.

"We expect to run 64-bit applications on Windows XP*; the Intel® Itanium™ processor gives us the opportunity to test these applications and their performance."

Lars Oftedal, Assistant Director, Center for Information Technology Services, University of Oslo*

Boosting Performance While Cutting Costs

Today, Intel® technology helps support NOTUR members in their efforts to enter into a new era of HPC that delivers extraordinary performance at a competitive price. Sencel provides a case in point. By taking advantage of the Itanium architecture's many execution units and multimedia technology to execute gene sequence comparison algorithms, Sencel expects to deliver software capable of analyzing gene sequences much faster than previously possible, at an affordable price.

"We expect the 800 MHz Intel® Itanium™ processor to perform in the range of 600 to 800 million symbol comparisons per second with the Smith-Waterman algorithm. Thus, even the first-generation processor in this family will probably be faster for this application than any other processor."

Torbjørn Rognes, Chief Technology Officer, Sencel Bioinformatics AS*

Bottom Line

Intel Itanium-based HPC systems—with outstanding performance, scalability, flexibility, and competitive prices—allow scientists to make advances in such areas as bioinformatics and genetic research that would have been impossible just a few years ago. Eventually, the Norwegian grid will also be used in research across a variety of disciplines, with future systems running second-generation Itanium family processors.

"We are starting with Itanium now to ensure that we have the clustering management software we need before the next generation of Itanium™ processors becomes available. I believe that this next-generation processor will be very important for us—early indications are that it is going to be a very good price-performer."

Arne Laukholm, Director, Center for Information Technology Service, University of Oslo*

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8-Way Intel®-Based Servers Deliver Back-End Performance for GuangDong Securities*

With the recent explosive growth of China's economy and stock market, the country's securities industry is also undergoing dramatic development. To keep pace in an industry where capacity, security, and reliability mean everything, China's securities companies are forced to strengthen their information management systems.

GuangDong Securities Company, Ltd.*, has capitalized on information technology— especially the Internet—to increase its reach and impact. Today, the company's Web-based applications and services run on powerful, reliable Intel® Pentium® III Xeon™ processor based platforms. Using the Intel®-based Legend* NS20000* cluster server in its innovative online transaction-management and headquarters-management systems, GuangDong is one of China's leading securities companies in information development and practices.

GUANGDONG SECURITIES' INTEL®-BASED SOLUTION

- Clustered Intel® architecture-based servers running Oracle* Parallel Server* are the basis of GuangDong's headquarters management system
- Dual hot-standby system serves online transactions and fund clearing
- Dual Legend* Wanquan* 8000r servers, each with 8 Intel® Pentium® III Xeon™ processors and 2 GB ECC SDRAM memory
- Two 18 GB hot-swappable hard disks
- Microsoft* Windows® 2000 Advanced Server, Chinese version
- Oracle8i* database
- MSCS dual hot-standby software
- SQL Server* 2000 corporate version
- Two sets of Clarion* FC5301-36 (K1) Fiber Disk Array Storage

Business Challenge

One of the first securities companies in China and the only specialized securities company in the GuangDong province, GuangDong Securities Company, Ltd.*, was established in November 1997. To succeed in an ever more competitive field, GuangDong needed to expand its online offerings and develop a headquarters management system that was not only highly scalable, but also highly secure. GuangDong wanted a powerful online transaction system so investors could conduct massive numbers of transactions with the company directly.

GuangDong Securities' headquarters management system would need to provide real-time data collection and monitoring in 50 departments nationwide, and meet stringent security and reliability demands. Additionally, the system would need to manage a high volume of data—daily average volume of more than 150 GB and steadily increasing.

Current stand-alone servers were facing a constant challenge at balancing the need to process large amounts of transactions quickly without sacrificing the performance and reliability of the system. GuangDong Securities needed an expandable architecture that could securely and reliably run its key business applications for both online transactions and large database processes.

Intel and China's premier PC manufacturer, Legend Computer Systems*, are working together to accelerate the development and delivery of high availability solutions. Legend has spearheaded several industry-wide e-Business initiatives in China.

Running on Intel® Architecture

GuangDong needed to scale its operations dynamically without compromising reliability. It turned to Legend* Computer Systems, China's premier PC manufacturer and a leading provider of high-powered enterprise computing servers, including clusters for high availability and scalability. Legend recommended 8-way Intel® architecture-based systems to run GuangDong's database.

Both GuangDong Securities' online transaction system and its headquarters-management system are based on the Intel Pentium III Xeon processor-based Legend NS20000 cluster server.

High Availability

Highly available systems are paramount to GuangDong. If a key server fails, the costs in lost productivity, sales, and even customers could be tremendous. The clustering capabilities of the NS20000, which strengthen the system's reliability, impressed GuangDong's management team. If one node fails, the workload transfers to other operating nodes, thus providing high system availability and reliability.

Legend's Intel®-based servers, with their advanced server management tools, met the company's reliability and availability needs. These tools include the Intel® Server Control (ISC), an application to monitor all hardware components and systems, and an Emergency Management Port that allows server management from a remote location.

In the rapidly changing business climate faced by China's securities industry, companies must expand their offerings and scale their systems quickly to succeed. Intel architecture-based systems provide a reliable, cost-effective foundation for these evolving e-Business systems.

Power and Performance

With its powerful 8-way Intel® Pentium® III Xeon™ processor-based servers, GuangDong Securities is well positioned to meet the rising demands on its information infrastructure. These systems are configured for multiple processors and larger cache sizes, increasing the response time of both enterprise and e-Business applications. By deploying fully populated 4-way and 8-way servers, institutions such as GuangDong gain the performance they need while consolidating systems, reducing management overhead and minimizing floor space.

Reduced Costs of Data Management

With high performance, less downtime and rapid recovery tools, clustered servers based on the Intel architecture are highly cost effective. According to Legend representatives, Intel Pentium III Xeon processor-based servers deliver outstanding performance, at a fraction of the price of comparable RISC-based servers. Intel® processors also provide cost-effective headroom to meet unpredictable spikes in workload demands. GuangDong's Intel-based system has enabled online transactions while considerably reducing their cost.

Security

Security and data integrity are critical in any securities transaction system. From user authentication to data encryption, a protected environment places additional demands on server performance. The performance and security features of Intel architecture-based servers with Intel Pentium III Xeon processors allow rapid and secure transaction processing. The Intel Pentium III Xeon-based system provides immediate, transparent security features—protecting customers while maintaining responsiveness.

The Bottom Line

Intel architecture and the high-performance Legend NS20000 server cluster system are an excellent choice for GuangDong Securities, since they can support key business applications, large database processing, and parallel computing. Moreover, the system provides high availability with a low total cost of ownership. Like GuangDong, more and more leading institutions are turning to Intel-based servers to deliver cutting-edge financial services.

HARDWARE SOLUTION:
LEGEND COMPUTER SYSTEMS

The Intel® e-Business Network is one of the world's largest cooperative business communities all working with Intel® products, technologies and services with a common goal of building better—more agile—e-Business solutions for you.

Find out more about an e-Business solution by contacting your Intel representative, or visit the Intel® e-Business Center Web site at: www.intel.com/ebusiness or its industry solutions specific sites: www.intel.com/go/retail, www.intel.com/go/manufacturing, www.intel.com/go/digitalmedia, www.intel.com/go/finance, www.intel.com/go/telco

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Intel® Itanium™ Architecture: Ensuring Smooth Sailing for Fluid Turbulence Research

Lighter and more fuel-efficient airplanes. Safer disposal of toxic waste. More reliable weather forecasts. Although a better understanding of turbulence will make these and other advances possible, simply getting access to enough computing power has always challenged scientists engaged in fluid dynamics research.

Just ask Paul Woodward, a professor of astronomy at the University of Minnesota, who has spent the last decade studying red giant stars and creating increasingly large computer simulations of convection and turbulence found in such stars. Woodward is almost as well known for his innovative use of High Performance Computing (HPC) systems as for his groundbreaking research. But by 1999, Woodward's stellar fluid dynamic simulations were straining the capabilities of the world's most powerful computers.

The Intel® Itanium™ architecture has given Woodward some breathing room. Powerful Itanium™ processor-based HPC clusters at National Center for Supercomputing Applications* (NCSA) in Champaign, Illinois, finally make it possible for Woodward to return to some intriguing turbulent modeling theories suggested by past simulations but never validated due to processing constraints.

"We need very high resolution to properly represent the behavior of turbulence," says Woodward. "Without the speed and memory addressing capability of the Intel Itanium processors, it would be impractical to even attempt these large simulations."

NCSA'S INTEL®-BASED SOLUTION

- 32 prototype IBM* Intel® Itanium™-based systems, each containing two "early release" Itanium processors
- 320 Intel Itanium-based systems using the second generation of Itanium processor code-named McKinley and delivering 6 Teraflops of power (planned)
- Red Hat* Linux*

A Constant Search for More Processing Power

Woodward's research team has been on the front lines of High Performance Computing for years. The group has successfully performed large-scale convection simulations that show how heat emanating from the center of a red giant star first disturbs, then violently agitates, the cooler and less dense gases found in the star's "envelope," or outer layer of gas. Using 3D visualization, Woodward graphically renders the way powerful waves of turbulence are created, and how they trigger sudden gas compressions—called shocks—before traveling outward to the surface of the star and dissipating.

In 1999, Woodward and his team won the prestigious Gordon Bell Award for a 1-billion-cell simulation completed on a massive 3,840-processor computer at Lawrence Livermore National Laboratory*. Despite a successful simulation that resulted in a rich and promising new dataset, computer processing limitations prevented Woodward from following up on the surprising new turbulence modeling theories suggested by the data.

Fluid turbulence is important for many areas of science and engineering. It is a factor in the design of aircraft engines, boats, and even cars. It influences the behavior of rivers, oceans, and the atmosphere. Our work should have an impact on a wide variety of disciplines.

Paul Woodward,
Professor of Astronomy
University of Minnesota*