Case Study
Intel® Xeon Phi™ Coprocessors
High-Performance Computing
Energy

Look Inside.™

Taking oil and gas exploration to the next level

DownUnder GeoSolutions harnesses the power of high-performance computing using a platform based on Intel® Xeon® processor E5-2600 v2 product family and Intel® Xeon Phi™ coprocessors to fast-track their clients' exploration

DownUnder GeoSolutions

With its head office located in West Perth, Australia, DownUnder GeoSolutions (DUG) is an innovative geosciences company offering a suite of geophysical processing solutions and services to global customers in the oil and gas industry. The company's products and services continue to be at the cutting edge of exploration and production services in the industry, with a core strength that is defined by an integrated approach across its comprehensive service offering, which includes seismic illumination studies, seismic data processing, depth imaging, petrophysical processing and interpretation, quantitative interpretation services, geostatistical depth conversation, and the complete range of DUG software. DUG is a global enterprise serving customers around the world through offices in Perth, Brisbane, Kuala Lumpur, Jakarta, Singapore, Houston, and London.

Looking to take its business to the next level, the company needed improved performance for its software solutions to better serve clients. DUG chose the Intel® Xeon Phi™ coprocessors, which deliver the compute performance to handle its highly parallel technical computing workloads.

Challenges

- **Increase compute performance.** Keep pace with rising business demand and increasingly complex seismic algorithms by enabling an increase of 5 to 10 times in compute performance to improve seismic processing, particularly Kirchhoff migrations, reverse time migrations, data interpolation and 3D surface-related multiple elimination (SRME).
- **Build on current Intel® architecture software investments.** Employ advanced compute solutions in seismic processing and imaging without sacrificing existing software investments.
- **Scale compute without scaling IT infrastructure costs.** Lower costs of maintaining IT infrastructure by having a platform that can scale compute resources utilizing existing IT investments.

Solution

- **Deploy SGI® Rackable® cluster powered by Intel® Xeon Phi™ coprocessors and Intel® Xeon® processor E5-2600 v2 product family.** Utilizing a platform based on Intel Xeon processor E5-2600 v2 product family and Intel Xeon Phi coprocessors, DUG was able to scale its software to the latest highly parallel architecture for faster seismic processing and imaging while enhancing algorithmic gains in existing software.

Technology Results

- **Utilized high-performance computing.** Amplify high-performance optimization techniques of the current software through the high scalability of the Intel Xeon Phi coprocessors.
- **Harnessed the common code base of Intel architecture.** Utilizing Intel Xeon Phi coprocessor-based platform allowed DUG to harness its existing sophisticated library infrastructure without changing the standard programming language.
- **Enabled transparent and efficient deployment.** Utilize the integrated compiler support and execution model to allow end-user processing staff to benefit from transparent deployment.

Business Value

- **Improved node-to-node performance.** Achieved an up to 8 times node-to-node performance improvement[1] that enabled faster seismic processing and imaging to meet growing business demands.
- **Reduced IT maintenance costs.** Utilizing highly parallel processing offered by multi-core, multi-threaded CPUs allowed DUG to maintain its existing software investments.
- **Delivered cost savings to customers.** Harnessing the latest in high-performance computing enabled DUG to provide higher-quality, faster seismic processing and imaging to their customers without added costs.

"Deploying SGI® Rackable® cluster based on Intel® Xeon Phi™ coprocessors and the Intel® Xeon® processor E5-2600 v2 product family allowed us to use the power of high-performance computing to achieve faster turnaround time in seismic processing while saving significantly on IT infrastructure costs and maintain our existing software investments."

– Dr. Matthew Lamont
Managing Director
DownUnder GeoSolutions

In pursuit of the next step in seismic processing performance

Having already spent significant time and resources on modernizing its code, DUG was on the lookout for advanced parallel hardware that could provide the next leap in performance for seismic processing and imaging services. This pursuit is driven by the company's continuous growth in the oil and gas exploration arena.

Utilizing a platform based on Intel® Xeon Phi™ coprocessors and Intel® Xeon® processor E5-2600 v2 product family significantly accelerates turnaround times for advanced seismic data processing

"Our company is growing, so we need more compute performance from our seismic processing systems. On top of that, we are also doing more intense studies for oil companies as the cost of drilling wells increases. We are also always faced with price pressures, so bang-for-buck computing is very important. To compete, we must be as efficient as possible because IT is one of our large costs," said Dr. Matthew Lamont, managing director at DUG.

The bulk of DUG's computer resources are being used for seismic processing. With its previous computing systems, the company's heavier workloads would take anywhere from days to months to run. "We want faster high-performance computing to help us deliver much, much higher-quality processing in a very, very short period of time. Our customers often have deadlines to meet, which if not met can cost them a lot of money," Dr. Lamont explained.

Seismic processing has long been at the forefront of high-performance computing. Production Kirchhoff migrations, which involve very large input/output datasets, have always been in the realm of out-of-core applications, where sophisticated data-locality-aware methods are required to remain on the right side of the compute-versus-I/O balance.

"The challenge for us is to find a high-performance computing solution that will allow us to scale production Kirchhoff migrations to the latest highly parallel architectures, while maintaining or even enhancing the algorithmic gains in our existing software," stated Dr. Lamont.

Improved seismic processing with the latest in high-performance computing

To address the demands of their highly parallel applications, DUG worked with Intel and SGI, one of the leading companies in high-performance computing solutions, to deploy a compute solution that will allow them to achieve faster turnaround for their seismic processing and imaging services.

DUG deployed the SGI Rackable clusters powered by Intel Xeon processor E5-2600 v2 product family and Intel Xeon Phi coprocessors.

"After looking at a number of different architectures, including graphics processing unit (GPU) technology, we chose to deploy a solution powered by Intel Xeon Phi coprocessors to help us deliver the next step in performance for our oil and gas software solutions," said Dr. Lamont.

DUG's customized high-performance computing environment includes 3,800 Intel Xeon Phi coprocessors that can scream through a migration in under 24 hours. Each node has dual-socket Intel Xeon processor E5-2600 v2 product family[2], coupled with four Intel Xeon Phi coprocessors 7120P with 16GB of onboard memory per coprocessor and 256 GB of system memory. Furthermore, each node is connected by a 10 GB non-blocking network. All of DUG's major software has been optimized to take full advantage of the processing power of the Intel Xeon Phi coprocessors.

Since deploying its new cluster, DUG has added compute capacity of six peak petaflops[3]. "We've already started seeing dramatic improvements in turnaround times when we compare our upgraded machines to those without coprocessors. Our time migration now runs more than 10 times faster[1], our depth migration runs six times faster[1]. We have also seen our reverse time migration (RTM) run significantly faster after utilizing this custom solution," added Dr. Lamont.

Bringing unrivaled seismic processing to the global market

Having built one of the most powerful geoprocessing production systems enables DUG to provide better seismic processing services to its customers around the world.

"Since we have significantly accelerated turnaround times for processing seismic data, this benefits our customers by helping them bring oil and gas projects online earlier, which in turn saves them millions of dollars," said Dr. Lamont.

Looking at the future, DUG hopes to be able to utilize this platform to further deliver cost-effective high-performance solutions to be more competitive in the global marketplace. The company also hopes the custom solution will be able to support their business expansion plans, including new service offerings such as cloud-based hosting.

Lessons Learned

- An effective high-performance computing solution should provide compatibility in scalability. The scalability of DUG codes already aligned well with the scalability of the Intel® Xeon Phi™ coprocessors, meeting DUG's demanding highly parallel applications.
- Depending on the application, each Intel Xeon Phi coprocessor delivers between 1.5 to 2 times the performance of the high-end hosts, which are typically equipped with two 10-core Intel® Xeon® processors E5-2600 v2 product family.

Find the solution that's right for your organization. Contact your Intel representative, visit Intel's **Business Success Stories for IT Managers**, and check out **IT Center**, Intel's resource for the IT industry.

Solution Providers:

All performance tests were performed and are being reported by DownUnder GeoSolutions. Please contact DownUnder GeoSolutions for more information on any performance test reported here.

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[1]Software and workloads used in performance tests may have been optimized for performance only on Intel® microprocessors. Performance tests, such as SYSmark* and MobileMark*, are measured using specific computer systems, components, software, operations, and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more information, go to www.intel.com/performance.

Results have been estimated or simulated using internal Intel® analysis or architecture simulation or modeling, and provided to you for informational purposes. Any differences in your system hardware, software or configuration may affect your actual performance.

[2]2-socket Intel® Xeon® processor E5-2600 product family server vs. Intel® Xeon Phi™ coprocessor (2.52x: Measured by Los Alamos Labs June 2012. 2-socket E5-2687 (8 core, 3.1 GHz) vs. 1 pre-production Intel® Xeon Phi™ coprocessor (60 cores, 1.0 GHz) on a molecular dynamics application. Workload completion time of 4 hours, 7 minutes, 10 seconds vs. 1 hour, 38 minutes, 16 seconds.). (2.53x: Measured by Sinopec October 2012. 2-socket E5-2680 (8 core, 2.7 GHz) server without a coprocessor vs. same server with 2 pre-production Intel® Xeon Phi™ coprocessors (61 cores, 1.091 GHz) on a seismic imaging application. Workload completion time of 1,342 seconds vs. 528.6 seconds.).

[3]Claim based on calculated theoretical peak double precision performance capability for a single coprocessor. 16 DP FLOPS/clock/core x 60 cores x 1.053 GHz = 1.0108 TeraFLOP/s.

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