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Parallelizing Oil and Gas Software with Intel® Software Development Tools

Schlumberger* increases performance for its PIPESIM* software by up to 10 times while streamlining the development process

Schlumberger* is the leading global supplier of technology, integrated project management, and information solutions to oil and gas organizations. The company's PIPESIM* Steady-State Multiphase Flow Simulator software enables production engineers to design and optimize oil and gas production systems, such as the systems that carry fluids from wells to production facilities. Software developers at Schlumberger adopted Intel® Software Development Tools to parallelize PIPESIM so customers could capitalize on the latest multi-core processing architectures to enhance simulation performance. With help from Intel tools, developers increased application performance up to 10 times while substantially accelerating the development process.

Challenges

- **Optimize software performance.** Enable oil and gas companies to capitalize on the latest multi-core processing architectures to run simulations faster, with greater accuracy, and explore more design alternatives.
- **Accelerate software development.** Speed up software development, optimization, and bug-detection tasks to produce better software and achieve a faster time to market for new software versions.

Solution

- **Intel Software Development Tools.** Schlumberger development teams used the Intel® Cluster Studio XE tool suite to parallelize code, optimize performance, and detect potential problems.

Technology Results

- **10x performance increase.** Developers increased PIPESIM performance by up to 10 times in its most demanding processes, enabling customers to run more simulations and examine more possibilities much quicker than before.
- **Streamlined development.** The Intel tools helped streamline tasks, saving developers weeks of time-consuming work. Schlumberger was able to produce better, more stable and reliable software faster than in the past.

Business Value

- **Time for new feature development.** By accelerating development tasks, such as pinpointing potential problems, Schlumberger can focus developers on creating new features.
- **Increased competitive edge.** Improving application performance and avoiding software problems helps improve Schlumberger's competitive edge.

Schlumberger

"By using Intel® Software Development Tools, we were able to improve PIPESIM* performance up to 10 times compared with the previous software version. That magnitude of performance increase provides tremendous benefits for our customers and helps us to maintain our competitive edge."

– Rodney Lessard, Senior Scientist, Schlumberger

Schlumberger's PIPESIM software has been helping oil and gas companies design and optimize systems for nearly 30 years. Recently, software developers undertook a large-scale project to parallelize the code to improve performance. "PIPESIM was initially developed for sequential systems," says Rodney Lessard, senior scientist at Schlumberger. "Today, our customers are running the software on PCs and workstations with modern, multi-core processing architectures that can deliver much greater performance for parallelized codes. We wanted to update PIPESIM so our customers could make the most out of today's processors."

Parallelizing PIPESIM would be no easy task, however. "Over the years, developers have introduced many new capabilities that have added code. Today, PIPESIM has nearly one million lines of code," says Lessard. "We needed ways to streamline the process of parallelizing code and optimizing it for new processors. We also wanted to identify any potential issues early in development, without having to go through console output and trying to use debuggers to capture errors."

Optimizing code and streamlining development with Intel Software Development Tools

Implementing a Comprehensive, Multifaceted Tool Suite

After evaluating a variety of software tools, the Schlumberger team selected Intel Cluster Studio XE to parallelize code, optimize software, and find potential problems. "We looked at other tools, but we like having one suite of tools from a single vendor cover all our needs," says Lessard. "With Intel Cluster Studio XE, we gain a compiler, tuner, analyzer, inspector, MPI library, and more, all in one solution."

The Intel® MPI Library, included with Intel Cluster Studio, played a key role in the decision-making process. "Once we decided on a multi-process approach instead of a multi-thread approach, we needed a message passing interface (MPI) library," says Lessard. "We tried Open MPI* with a prototype program our developers wrote, but Intel MPI Library better met our needs."

The Intel team helped Schlumberger developers find the right tools and implement them successfully for the PIPESIM project. "The Intel team presented the wide variety of Intel® technologies available and introduced us to expert engineers within Intel research and development centers who provided valuable input," says Lessard. "I don't think we would have been as successful if we hadn't had that kind of support."

Improving PIPESIM Performance by Up to 10 Times

Parallelizing and optimizing PIPESIM code with Intel tools has helped enhance application performance dramatically. "By using Intel Software Development Tools, we were able to improve PIPESIM performance up to 10 times compared with the previous software version," says Lessard. "That magnitude of performance increase provides tremendous benefits for our customers and helps us to maintain our competitive edge. Now our customers can explore many more pipeline production operation scenarios, and work with much larger networks than ever before."

Streamlining Development Tasks

For the PIPESIM project, the Intel tools are also helping streamline tasks that might have been time-consuming with such a large and complex base of code. For example, developers use Intel® VTune™ Amplifier XE to help pinpoint problem spots quickly. "PIPESIM is the result of 30 years of development. It's complex code with a million lines of code," says Lessard. "Intel VTune Amplifier XE analyzes the software, breaks it up into its main components, and helps us identify bottlenecks rapidly. It is a very important tool for us."

Other Intel tools help optimize code, simplify analysis, and accelerate problem solving. "Intel® Fortran Composer XE has a number of settings for helping us maximize resources, and the Intel® Trace Analyzer and Collector enables us to assess how much time each process is taking," says Lessard. "In addition, Intel® Inspector XE has provided a huge time benefit for us. We can run a multi-process simulation and have it pinpoint the exact spot of a memory overwrite in any of the running processes. The user interface makes it easy to see which line of code is causing errors. Instead of spending a week locating a problem, we can find it in minutes."

Accelerating High-Performance Computing (HPC) Software Development

Schlumberger uses additional tools for other software development efforts. For example, the company's HPC software developers are using Intel® Advisor XE to parallelize code. "Intel Advisor XE has been extremely helpful in identifying the best pieces of code for parallelization," says Carlos Boneti, HPC software eng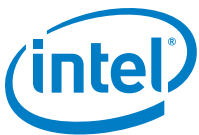ineer at Schlumberger. "We can save several days of manual work by targeting the right loops. At the same time, we can use Intel Advisor XE to find potential thread safety issues to help avoid problems later on."

Delivering Robust, Reliable Software Faster

Finding problems early is essential for producing reliable software. "When our customers are running large, complex simulations, a software crash could cost them a day's worth of work," says Lessard. "With the Intel tools, we can proactively analyze memory usage, allocation, and leaks so we can prevent bugs and eliminate problems later. As a result, we can deliver a more robust, stable, and higher-quality product."

The Intel tools enable Schlumberger developers to deliver products faster than before and spend more time on innovation. "We no longer have to spend months trying to track down bugs and bottlenecks," says Lessard. "We can resolve those issues quickly, ship this version, and start working on the next one."

Find the solution that's right for your organization. Contact your Intel representative, visit Intel's **Business Success Stories for IT Managers,** or explore the **Intel.com IT Center.**

Lessons Learned

Working with Intel® Software Development Tools has helped reinforce the value of capitalizing on technology to streamline processes. "Sometimes developers can be a little too quick to try to solve problems by brute force," says Rodney Lessard, senior scientist at Schlumberger*. "In the long run, it's a much better approach to spend the time and find tools that can help you increase productivity and efficiency. A little time investment up front can save you lots of time in the future."