CRAY®

Next-Generation Reservoir Simulation with Stone Ridge Technology's ECHELON Software and the Cray® CS-Storm™ Cluster Supercomputer

CS-Storm Cluster + Stone Ridge Technology ECHELON Software

Cray and Stone Ridge Technology offer a scalable, ultra-fast solution combining ECHELON, the industry's first GPU-targeted reservoir simulator, with Cray's CS-Storm cluster supercomputer using NVIDIA® Tesla® GPU accelerators.

Setting a New Standard for Reservoir Simulation:

- **Rapid Results:** Full SPE10 benchmark run in under one minute

- **High Resolution:** 243-million-cell model running out 45 years in 2.5 hours — on just 2 nodes

- **Improved Productivity:** 100 realizations of a 16-million-cell model in five hours on a single cluster node with eight GPUs

- **Small Footprint:** One to two nodes CS-Storm nodes can outperform 10 to 20 traditional compute nodes

## The Challenges of Reservoir Simulation

The landscape of the oil and gas industry is changing, and these changes are driving a need for scalable high-performance reservoir simulation. Higher-fidelity models which offer improved and often essential resolution to capture complex heterogeneity can improve recovery prediction. However, increased model size and the emerging requirements of Bayesian-based uncertainty quantifications have outpaced the ability of traditional hardware and software infrastructure to support them:

- Unconventional resources such as shale and tight gas/oil reservoirs require extremely high-resolution simulation models to capture interactions between multiple fractures, between the reservoir and fractures, and between wells.

- Risk mitigation and uncertainty quantification often require large ensembles of simulation runs.

The Solution: Cray CS-Storm Cluster and ECHELON Software

Combining the dense and efficient CS-Storm GPU platform with ECHELON, the industry's first reservoir simulator developed and optimized for GPU platforms, gives users a solution with proven performance at unparalleled resolution and scale.

Proven Results: Unconventional Resources in the Permian Basin
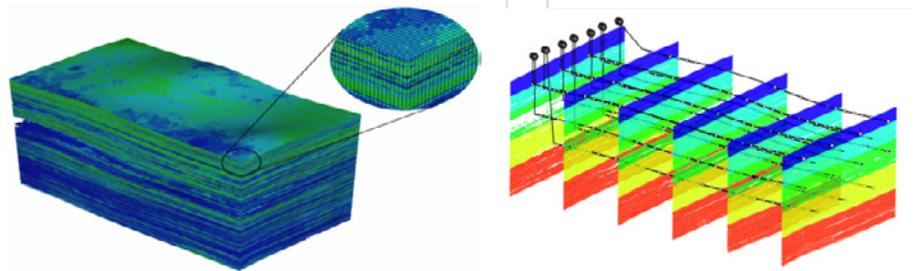
Fast turn-around for large models		
Model (16M cells)	Avg. time per job on 4 Tesla K40s / 2 K80s	Speedup w.r.t. standard simulator* 4 Tesla K40s / K80s
Dual Porosity	13.5 min / 12 min	25 / 28
Dual Permeability	16.8 / 13.8 min	40 / 48
Extreme ensemble throughput on a single node		
Model (16M cells)	Wall time for 100 runs on 2U node with 8 Tesla K40s	Wall time for 100 runs on 2U node with 8 Tesla K80s
Dual Porosity	11.3 hr	5.0 hr
Dual Permeability	14.0 hr	5.7 hr

(See SPE-173246-MS)

* Running on 12 cores, Xeon E5-2687W

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ECHELON Software – ECHELON is Stone Ridge Technology's technical software product for high-performance reservoir simulation, created and developed for fine-grained parallelism targeting GPUs. It is exceptionally fast, typically achieving runtimes that are 10 to 50+ times faster than leading commercial simulators. ECHELON has demonstrated scaling to very large systems with hundreds of millions of cells.

CS-Storm Cluster – Cray's CS-Storm system is a dense, accelerated cluster supercomputer that offers 250 GPU teraflops in a single rack — a space- and power-efficient solution for users who collect and process massive amounts of data from diverse sources such as satellite images, surveillance cameras, financial markets and seismic processing data. The CS-Storm cluster integrates seamlessly into Cray® CS400™ systems, enabling users to run a wide range of workloads on a single, easy-to-manage cluster supercomputer.

Turnkey Solution – Because its entire software and hardware stack has been validated and configured to address an organization's specific needs, the solution can go into production rapidly. This also helps organizations that are deploying GPU-based systems for the first time to avoid headaches such as performance issues and thermal problems.

> **Cray offers the highest performing GPU-packed compute infrastructure on the market. The ability to do more in a smaller hardware footprint brings significant and welcome cost savings and productivity improvements at a very competitive time in the energy industry.**
>
> **—Vincent Natoli, Founder/CEO, Stone Ridge Technology**

About Cray
Cray provides systems and solutions that help you solve your most difficult computing, storage and data analytics challenges. The company's comprehensive portfolio includes expertly optimized cluster systems, extremely scalable, powerful supercomputers, advanced storage systems and high performance data analytics and discovery platforms. Founded in 1972, Cray has focused exclusively on developing, building and supporting supercomputing technologies for over 40 years.

About Stone Ridge Technology
Stone Ridge Technology develops and markets ECHELON, the world's fastest commercial reservoir simulator built and optimized from inception for GPUs and massive fine-grained parallelism.

Getting Started
Learn more about optimizing your reservoir simulations with Cray and ECHELON:

- Request a briefing
- Learn more about the CS-Storm cluster
- Learn more about ECHELON
- Contact Cray