

Solution Brief:

Oil & Gas

Delivering Performance & Scalability to Energy Exploration & Simulation Applications



Contents

- The Oil & Gas Challenge** 1
- Today's Solution** 1
- A Better Way** 2
- Building High Performance Clusters** 3
 - High-performance InfiniBand Switches** 3
 - Fast Storage Access** 5
 - Visualization Solutions** 6
- Putting It All Together** 6
 - Key Features & Benefits** 6
 - Tested & Certified with Leading Applications** 7
- Customer Success Stories** 7
- About Voltaire** 8

Abstract

The Oil and Gas industry is facing new challenges as demand for natural resources continues to grow at a dramatic pace while exploration costs have skyrocketed amidst decreasing supplies. Competition is fierce and technology is a competitive advantage. Voltaire has proven success expediting the energy exploration process by accelerating simulation and analysis of potential sites.

The Oil & Gas Challenge

The market for oil and gas exploration and production is highly competitive. In today's world of tightening oil supplies and ever-increasing energy prices, the value of rapid discovery and decision-making is more important than ever. Oil reserves are becoming depleted and most reserves are now in locations that are difficult to access and explore, making 'every hole count'. Poor decisions can have disastrous physical and financial consequences. Efficient and accurate exploration is critical to achieving success and maintaining competitive advantage in this market. In addition, extractions from existing reservoirs must be highly efficient, making the depth and speed of simulations a critical success factor.

Oil & Gas exploration companies need to take advantage of technologies that help to streamline their business processes, ensure the most efficient and accurate exploration possible, and enable the most efficient extraction from existing reservoirs. This requires a high performance computing platform that enables deeper and faster simulations and provides higher precision visualization capabilities.

To support deeper and faster analysis and obtain the best performance possible from key upstream applications, large compute and storage infrastructure is required. The oil and gas industry has been one of the first to adopt the concept of building large clusters and grids based on commodity servers and storage. Clusters and grids are by far the most economical approach for delivering large-scale systems -- however, they create new challenges in scalability. Selecting an interconnect fabric that can deliver high bandwidth and low latency is critical to overcoming these challenges.

Today's Solution

Oil and gas companies typically deploy clustered computers that share data through a shared file system. Using Gigabit Ethernet to access NFS-based files, these compute islands quickly run into file I/O limitations.

NFS has limited bandwidth (~50MB/s) and high CPU overhead leading to major performance slow down and even potential system lock-ups as numerous clients (50 – 60) try to write simultaneously to the file system. To avoid congestion, two networks are often deployed: one for MPI traffic and another for NFS traffic. This

Solution Brief: Oil & Gas

somewhat defeats the purpose of constructing the cluster in the first place because it adds cost and complexity to the overall solution.

To address this problem, some organizations divide their clusters into smaller units that avoid lock ups, but limit scalability and application performance. Others employ unique architectures or exotic solutions, but this path can lead to interoperability and scalability problems.

A Better Way

Voltaire InfiniBand solutions make applications more scalable and perform faster. Voltaire offers high-performance (10, 20 and 40 Gbps), low-latency (< 2 microseconds) interconnect solutions for high performance data centers. Benchmark testing has found that Voltaire interconnect solutions reduce application runtime by as much as 50 to 300 percent.

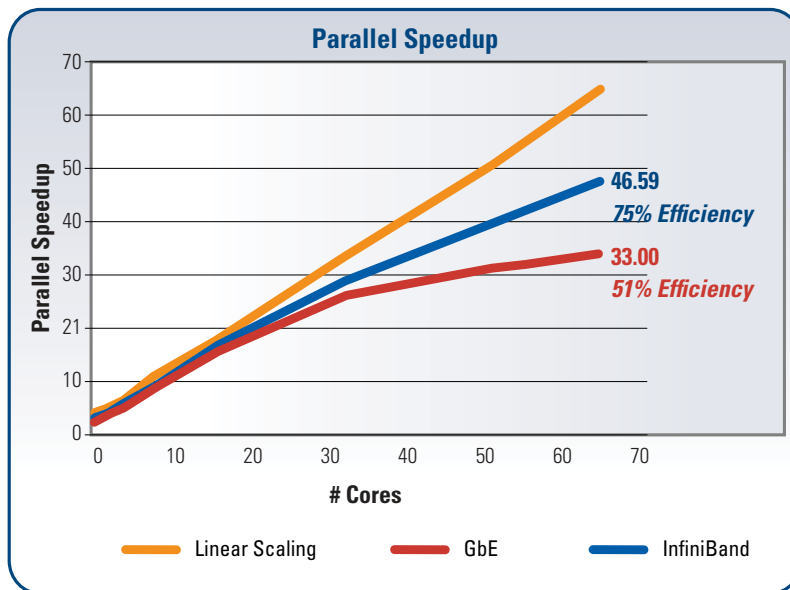


Figure 1. 75% Parallel Speed Up with Voltaire vs. only 50% with GbE

In addition to offering InfiniBand switch technology, Voltaire works directly with software and storage vendors to create the most efficient, fastest, and lowest-latency solutions available. By leveraging Voltaire InfiniBand-based solutions, organizations can now gain improved scalability and performance to perform simulations and analysis faster and more efficiently.

As today's price and performance leader in the industry, Voltaire builds its solutions using standards-based InfiniBand technology. InfiniBand is an industry-standard interconnect for high-performance computing (HPC) and enterprise applications. The combination of high bandwidth, low latency, and scalability with high performance storage makes InfiniBand the interconnect of choice to power many of the world's largest and fastest computer systems and commercial data centers. Voltaire solutions support most major server vendors, operating systems, storage solutions and chip manufacturers.

	1 Gb Ethernet	10 Gb Ethernet	Myrinet	InfiniBand
Bandwidth	1 Gb/sec	10 Gb/sec	2.5 Gb/sec	10, 20 & 40 Gb/sec
Latency		~10 us	2.5 - 5.5 us	< 2 us
Average Efficiency	53%	No Entries	68%	74%
Price Per Gig/Port	~\$350.00	>~\$700.00	~\$225.00	<\$100.00

Table 1. Price/performance advantages for InfiniBand

Building High Performance Clusters

Voltaire offers complete end-to-end server interconnect solutions for speeding Oil and Gas exploration applications. The two major elements of the solution include:

- High Speed, Low Latency InfiniBand switches
- Fast Storage Access and Scalable File Systems
- Visualization Solutions

High-performance InfiniBand Switches

Voltaire’s InfiniBand-based solutions deliver high performance and scalability to compute clusters. Voltaire offers a complete portfolio of products including a scalable line of InfiniBand switches, high performance I/O gateways (for seamless connectivity to Ethernet and Fibre Channel networks) and fabric management software. Voltaire solutions use the Open Fabric Alliance’s OFED drivers and the Open MPI (Message Passing Interface) libraries to optimize application performance for both MPI-based and socket-based applications.

For small-to-medium sized clusters, Voltaire offers the Voltaire Grid Director™ 9024. It is a 1U device with twenty-four 10 Gbps (SDR) or 20 Gbps (DDR) InfiniBand ports. The switch is a high performance, low latency, fully non-blocking edge or leaf-switch with a throughput of 480 Gbps.

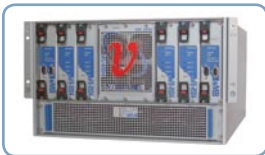
The Grid Director 9024 is well-suited for small InfiniBand fabrics with up to 24 nodes because it includes all of the necessary management capabilities to function as a stand-alone switch. It is internally managed and offers comprehensive device and fabric management capabilities. Designed for high-availability (high MBTF) and easy maintenance, the switch is simple to install and features straightforward initialization. The solution is scalable as additional switches can be added to support additional nodes.

For larger clusters ranging from 25–288 compute nodes, Voltaire offers the Grid Director™ 2004 and 2012 multi-service switch—the industry’s highest performing multi-service switches for medium-to-large clusters and grids. The switch enables high performance non-blocking configurations and features an enterprise-level, high availability design. The Grid Director 2004 supports up to 96 InfiniBand 4X ports (20 Gbps) and the Grid Director 2012 supports up to 288 InfiniBand 4X ports (20 Gbps). Voltaire Grid Director switches are scalable through the use of modular line boards and they feature 10 GbE and Fibre Channel capabilities so the solution can provide high-performance, integrated SAN and LAN connectivity.

Voltaire has defined scalable units for deploying large, scalable clusters for oil and gas exploration companies. Scalable units are ideal for constructing large clusters that deliver unparalleled performance to applications. The solution combines scalable compute and storage capabilities using scalable file systems.



Figure 2. Voltaire Grid Director switches for clusters from 24 up to 96 compute nodes



Solution Brief: Oil & Gas

At the heart of the solution is the Voltaire Grid Director 2012 multi-service switch. Voltaire's director-class, multi-service switches offer integrated InfiniBand, GbE and Fibre Channel connectivity in a single chassis. This enables MPI and storage traffic to run on the same network, a capability that is not available with Ethernet or proprietary fabrics. By enabling IPC and high performance storage on a single network, Voltaire solutions enable far greater scalability.

Scaling out is made easy by using Voltaire Grid Director switches as core switches to interconnect multiple scalable units. Such connectivity can be implemented as fully non-blocking or as partially blocking depending on application requirements or budget constraints.



Figure 3. A scalable unit of 200 nodes powered by a Voltaire Grid Director 2012

Scaling out further is made easy by using Voltaire Grid Director switches as core switches to interconnect multiple scalable units. Such connectivity can be implemented as fully non-blocking or as partially blocking depending on application requirements or budget constraints.

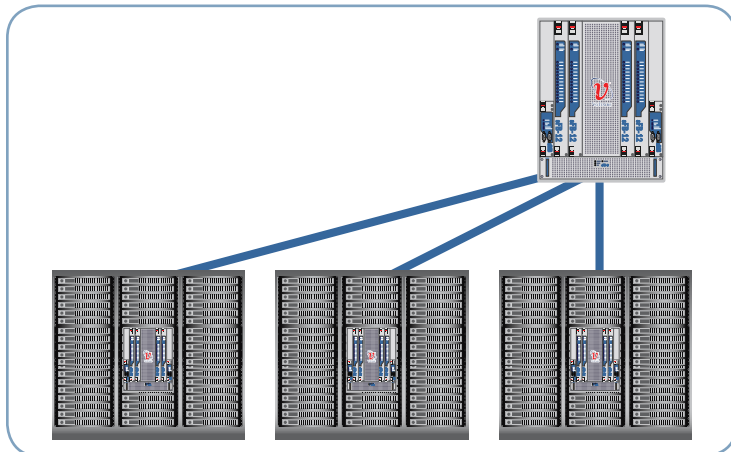


Figure 4. Multiple scalable units interconnected using a Voltaire Grid Director 2012

Fast Storage Access

For companies looking to incorporate storage into their InfiniBand cluster, Voltaire offers fast I/O capabilities for storage. Voltaire solutions combine scalable compute and storage capabilities with parallel file systems. By using InfiniBand with parallel file systems, the server's CPU overhead is reduced, freeing up CPU cycles for your application.

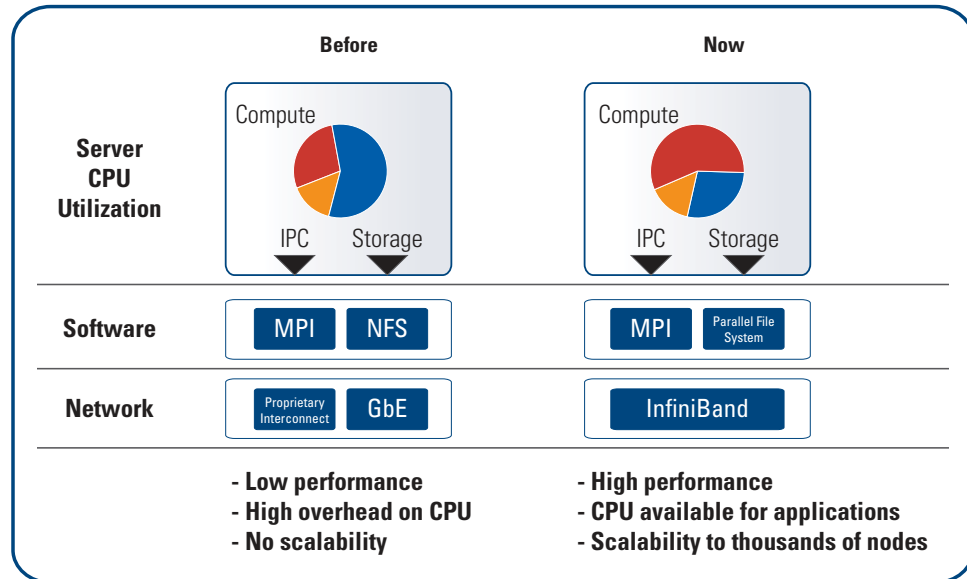


Figure 5. The advantages of combining IPC and File I/O with Voltaire Solutions.

At the heart of the solution is the Voltaire Grid Director 2004 multi-service switch (described above). Voltaire's director-class, multi-service switches offer seamless InfiniBand, GbE and Fibre Channel connectivity. This enables MPI and storage traffic to run on the same network, a capability Ethernet and proprietary fabrics do not offer. By enabling IPC and high-performance storage on a single network, Voltaire solutions allow companies to leave behind the limitations of network file systems (NFS) and move to parallel file systems over InfiniBand. This provides far-greater scalability.

Applications can now have effective file I/O rates of 350MB/s compared with the 50MB/s previously available by using NFS. Additionally, the size of compute clusters is no longer limited by the limitations imposed by NFS.

Scalable File Systems

Running scalable file systems over Voltaire InfiniBand solutions creates the most scalable solution in the industry with more than 1,000 nodes on a single name space, and delivers high performance connectivity for the storage and client nodes. Voltaire has significant experience and expertise in enabling large-scale parallel file system deployments. Such solutions include: Lustre, HP SFS, IBM GPFS, Panasas and PVFS. These solutions, when combined with InfiniBand, solve two critical problems that NFS creates: limited throughput and limited scalability.

The diagram (Figure 6) below outlines a Voltaire deployment with HP SFS (Lustre) with 1,100 nodes (2,200 cores) all accessing a single file system.

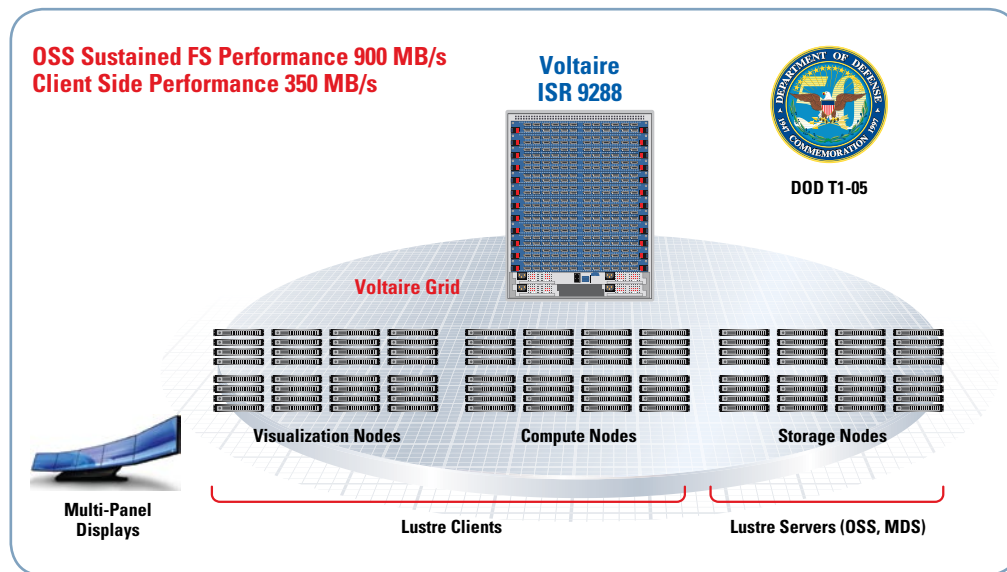


Figure 6. Voltaire's T1-05 installation at the D.O.D – 1,100 nodes on a single file system – InfiniBand is used for both MPI and Lustre over the same wires.

Visualization Solutions

Customers in a variety of industry sectors such as energy, automotive, aerospace, government and military use Voltaire solutions for visualization on clusters and grids ranging from dozens to hundreds of nodes.

Visualization clusters typically require very high bandwidth, and Voltaire's InfiniBand solutions with up to 20Gbps per host link are ideal for this. In addition, the low overhead on the CPU frees it to carry out the image processing faster. The result is a powerful solution that delivers higher levels of resolutions and faster image processing.

Putting It All Together

Key Features & Benefits

Voltaire solutions for oil and gas offer many compelling benefits to users.

- **Scalable Interconnect:** Voltaire InfiniBand solutions enable customers to build large clusters and grids that can process tasks concurrently on hundreds and thousands of CPUs. This provides network efficiency and enables faster and deeper calculations resulting in faster and more accurate results for exploration and simulation.
- **High Bandwidth:** Voltaire solutions provide bandwidth of 20 Gbps to allow for high resolution imagery and better 3D image manipulation for visualization applications.
- **Flexibility:** Grids and clusters that use Voltaire solutions can be built as a fully non-blocking 20 Gbps fabric or as a lower bandwidth fabric based on the needs of the application. Moreover, Voltaire switches are upgradeable in a non-disruptive, hot pluggable way.
- **Standards-Based:** Voltaire solutions are based on InfiniBand: the only industry standard, high-performance interconnects.



Figure 7. 3D visualization is commonly used in oil & gas exploration and production.

- Enables Scalable File Systems:** Scalable file systems over InfiniBand means unparalleled performance on both the clients and storage servers. With Voltaire, hundreds and thousands of nodes can rely on a single file system global name space. This is field proven. Voltaire has customers using Grid Director switches for fabrics including one system with 2,200 CPUs (1,100 nodes) on a single global name space.

Tested & Certified with Leading Applications

By working closely with leading server and software vendors on integration and testing, Voltaire offers the fastest and most efficient high-speed interconnect solutions. Voltaire solutions support leading applications, MPI offerings, management applications, operating systems and parallel file systems.

Applications	Schlumberger: ECLIPSE, Landmark: VIP, ParadigmGeophysical
MPI Support	OpenMPI, Scali MPI Connect, HP MPI, Intel MPI, MVAPICH, SGI MPT,ParaStation MPI, Microsoft MPI (MS CCS)
OS Support	Red Hat EL3/EL4, FedoraCore, SuSE 9, SuSE 10, SuSE SLES9, SuSE SLES10 and others.

Parallel File Systems Lustre, HP SFS, IBM GPFS, Panasas, IBRIX, TerraScale’s TeraGrid

Customer Success Stories

Oil and gas companies and service providers around the globe are incorporating Voltaire solutions into their infrastructure. They have selected Voltaire to bring greater performance and scalability to their technology environments.

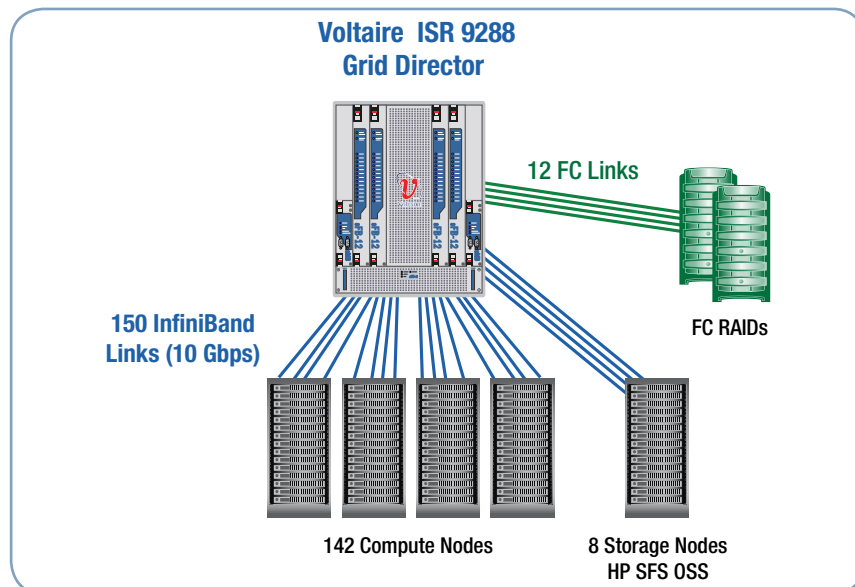


Figure 8: The system configuration as deployed by a leading Asian oil and gas company

Figure 8 describes a production configuration at a leading Asian oil and gas company. The customer selected a fully non-blocking configuration that combines IPC and Lustre (HP SFS) and also includes FC connectivity to legacy FC SAN storage systems.

Other oil & gas companies have used Voltaire solutions at HPC1, Europe's first on demand computing center. Located near Paris, HPC1 uses the latest industry standard technologies to offer services in scientific computing and open source by leasing CPU cycles to customers in industries ranging from oil and gas to manufacturing and bioinformatics. Voltaire solutions power the 240 CPU cluster that enables customers to run complex calculations and large-scale simulations faster and more efficiently than ever before.

About Voltaire

Voltaire (NASDAQ: VOLT) designs and develops server and storage switching and software solutions that enable high-performance grid computing within the data center. Voltaire refers to its server and storage switching and software solutions as the Voltaire Grid Backbone™. Voltaire's products leverage InfiniBand technology and include director-class switches, multi-service switches, fixed-port configuration switches, Ethernet and Fibre Channel routers and standards-based driver and management software. Voltaire's solutions have been sold to a wide range of end customers including governmental, research and educational organizations, as well as market-leading enterprises in the manufacturing, oil and gas, entertainment, life sciences and financial services industries. More information about Voltaire is available at www.voltaire.com or by calling 1-800-865-8247.

Notice

Reproduction of this publication in any form without prior written permission is not allowed. The information in this publication is subject to change without notice and is provided "AS IS" WITHOUT WARRANTY OF ANY KIND. THE ENTIRE RISK ARISING OUT OF THE USE OR INTERPRETATIONS OF THIS INFORMATION REMAINS WITH RECIPIENT. IN NO EVENT SHALL VOLTAIRE BE LIABLE FOR ANY DIRECT, SPECIAL, PUNITIVE OR OTHER DAMAGES.

Performance results will vary based upon a number of system factors. Some of these include: server configuration of the processor, chip set, memory size, firmware and driver release versions, MPI version and OS kernel version. The configuration or configurations tested or described may or may not be the only available solution. These tests are not a determination of product quality or correctness, nor does it ensure compliance with any federal state or local requirements.

Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies.



Contact Voltaire to Learn More

1.800.865.8247
info@voltaire.com
www.voltaire.com

©2008 Voltaire Inc. All rights reserved. Voltaire and the Voltaire logo are registered trademarks of Voltaire Inc. Grid Director is a trademark of Voltaire Inc. Other company, product, or service names are the property of their respective owners.