

High-Performance Computing Solution for the Energy Industry

Cisco InfiniBand and Ethernet Solutions for High-Performance Computing Clusters in the Energy Sector

Overview

Research and development in the energy industry depends heavily on simulation and computational analysis to explore new energy resources and to find innovative means to tap these resources. Many of these tasks require large amounts of raw computing power. The capability to perform simulations faster and more accurately is extremely important to the overall competitiveness of an organization. Speed and improved accuracy in simulation must be achieved while IT managers are being required to reduce the cost of the hardware and system maintenance. In the past, this computational power was delivered by large symmetric multiprocessing or vector supercomputers. With the proliferation of the x86 architecture, however, computational resources can be delivered using high-performance computing (HPC) clusters. The energy industry is adopting HPC clusters as the cost-effective and standards-based means to build computational capability.

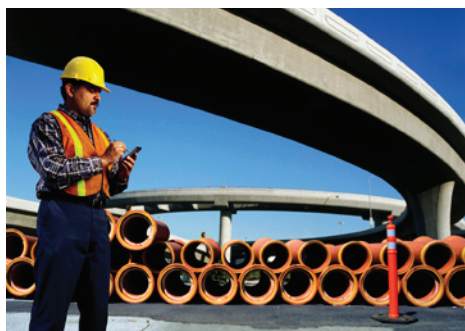
The demand for dependable computing power for oil and gas exploration continues to grow as ever more complex problems are addressed and high-performance computing resources become increasingly critical as tools for success. As the industry leader in networking, Cisco® delivers an unmatched HPC solution to address customer needs. The broad Cisco solution portfolio delivers high speeds, low latencies, open standards, and high system availability, allowing customers to deploy the right infrastructure for their applications.

Challenges

The primary HPC challenges in the energy sector are:

- Accurate exploration of reservoirs
- Oil and gas production from complex reservoirs
- Reduced cost of hardware and maintenance

The energy industry is faced with the challenge of supporting the world's needs for oil and natural gas, requiring the industry to explore for new resources of energy and to find competitive



means of production from these resources. The exploration of new reservoirs is performed using seismic processing techniques that require the use of large computational simulations. The reservoirs of natural resources are becoming increasingly structurally complex over time. The current state of the art in sensor technology allows geologists to collect petabytes of seismic data from the areas under exploration. Processing this huge amount of data requires large amounts of storage and powerful HPC resources.

Business Benefits

The main business benefits for the energy sector are:

- Increased competitiveness
- Faster discovery of energy resources
- Cost-effective infrastructure

Solution

HPC clusters offer a viable means of building a scalable and cost-effective computational resource for seismic processing and reservoir modeling. A scalable high-performance network is the lifeline of a HPC cluster. Application scalability is directly affected by the latency and bandwidth characteristics of the cluster network interconnect. As cluster resources sprawl across departments, there is also an increasing need to provide a consolidated general-purpose HPC resource in R&D organizations.

The main challenges addressed by Cisco HPC products are in the exploration and production spaces. Oil and gas exploration requires large numbers of servers to process seismic data. The main networking challenge is the effective delivery of large data sets to all server nodes from the storage and parallel file systems. Cisco Catalyst® Ethernet switches can be used to create a high-performance, scalable network for servers and to provide 10 Gigabit Ethernet connectivity to parallel file systems. Cisco InfiniBand multifabric switches can also be used to provide high throughput access to network-attached storage (NAS) over InfiniBand.

Reservoir modeling is required for production optimization. Reservoir modeling tasks are complex computational fluid dynamics problems that require an ultra-low-latency and high-bandwidth network to scale application performance. Cisco double-data-rate (DDR) InfiniBand server fabric switches (SFS) offer ultra-low latency on the order of hundreds of nanoseconds and very high bandwidth, which is required by such applications. Cisco InfiniBand products have been used to build the largest HPC clusters in the world today, and they are a primary building block of scalable HPC networking. Some of the largest energy corporations in the world today use Cisco InfiniBand switches for their HPC clusters.

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Table 1. Cisco HPC Solution for Energy

Reservoir Modeling	256 to 512–node DDR Clusters
Seismic Visualization	1000+ node clusters
Parallel File System Access	Cisco SFS 3000 Series Multifabric Server Switches Ethernet gateway for NAS access
InfiniBand Storage	Native InfiniBand storage

Table 2. HPC Solution Stack for Energy

Independent Software Vendors (ISVs)	CGG, Paradigm Geophysical and Schlumberger ECLIPSE
Storage and File Systems	DDN, IBM, Isilon, NetApp, and Panasas
Processor	AMD and Intel
Server	Dell, HP, IBM and Sun
Network	Cisco

Why Cisco High Performance Computing?

Cisco is the only vendor to offer a variety of standards-based fabric technologies: Gigabit Ethernet, 10 Gigabit Ethernet, InfiniBand, and Fibre Channel. Cisco offers a full portfolio of HPC networking products for HPC clustering. The Cisco SFS InfiniBand switching family can be used for low-latency interprocess communication networking, and the Cisco Catalyst Ethernet switches can provide a scalable management network. Cisco MDS 9000 family storage switches can be used to access block storage for parallel file systems. Customers can choose the most appropriate solution and mix of fabrics for their applications. By standardizing on the Cisco HPC solution, organizations can use Cisco technology leadership to simplify their HPC operations and reduce time to deployment for new application infrastructure, without compromising the availability, security, and predictable application performance needed in today’s business environment.

- Reliability
 - Highly reliable DDR products, proven by large deployments in critical environments
 - Robust, enterprise-class, end-to-end solution with proven performance and security
 - Rigorous hardware testing with all cable lengths and switches to help ensure high-quality products
- Scalability
 - Easy to scale the HPC infrastructure with Cisco products; choosing Cisco products provides investment protection
 - Broadest portfolio of technologies for all networking needs
 - Proven solution in the largest HPC and enterprise clusters in production
- Manageability
 - End-to-end management solution over multiple fabrics

- Unified management capabilities for Ethernet and InfiniBand
- Comprehensive ecosystem
 - Integrated HPC solution, through partnering with server vendors and ISVs
 - Mature processor, server, storage, OS, and ISV qualifications
 - Proven interoperability with server and storage solutions
 - Integrated switching and HCA cards with all major blade system switching chassis
- Service and support
 - Cisco support for complete networking solutions, including drivers and Message Passing Interface (MPI)
 - Cisco 24/7 services and support, available worldwide
- Experience
 - Cisco HPC implemented with customers in multiple industries
 - Cisco leadership in OpenFabric and OpenMPI standards efforts

At the Statoil facilities in Stavanger, Norway, Cisco InfiniBand technology is used to interconnect the largest supercomputer in Scandinavia, ranked number 151 in the top 500 and capable of executing 12-thousand billion (12 tera-floating-point-operations-per-second [TFLOPS]) calculations per second with a cluster of 256 interconnected servers with 1024 processors. The supercomputer is important for the realization of next-generation oil exploration, helping analyze many interpretations with different models to determine where the company should drill.

“Computing power plays a decisive role in providing better images of the geology several kilometers under the subsurface, especially in areas with demanding geological structures,” according to Arild Halsetrønning, project manager for the server cluster at Statoil. “We believe the combination of Cisco InfiniBand switches and HP servers provides a leading high-performance clustering solution today to help resolve our complex models in a timely and accurate manner.”

For More Information

Visit the Cisco Website at <http://www.cisco.com/go/hpc>.

