CASE STUDY

Intel® Enterprise Edition for Lustre* strengthens oil and gas exploration

Intel® Enterprise Edition for Lustre* software
Intel® Xeon® Processor E5- 2600 v3 Family
Intel® Ethernet Server Adapter X520 Product Family
Energy
Intelligent Storage

"Lustre* file system has met our current and future data service demands with its outstanding performance and enhanced scalability. The Intel® Enterprise Edition for Lustre software and its built-in graphical Intel® Manager for Lustre software has assisted us in simplifying system installation, configuration and monitoring, the convenient and intuitive management interface can help to set storage capacity quota for various project teams flexibly and a single storage cluster can provide data service for several computing clusters at the same time, which is really marvelous. "

Wang Yi
Director
Engineering Technology and Geophysical Prospecting Technology Research Institute, CNOOC

China National Offshore Oil Corporation (CNOOC) is China's largest offshore oil and gas producer searching for offshore large- and medium-sized oil and gas fields to ensure supply of national oil and gas resources. In the process of oil and gas exploration, efficiency of seismic data collevction, recording, processing and interpretation plays a decisive role. Deepening of exploration and increasing complexity and size of seismic data on exploration targets have added to the challenges of oil and gas resources exploration. CNOOC has adopted a solution based on Intel® Enterprise Edition for Lustre* software (Intel® EE for Lustre* software) to enhance seismic data processing efficiency, raise oil and gas exploration levels and capabilities.

CHALLENGES

- **To improve data transmission capability:** A single seismic prospecting project can involve more than 100 TB of data, and network throughput capabilities from storage to computing clusters served as the bottleneck affecting performance of the file system.
- **To optimize storage management:** CNOOC wanted to enhance storage operation and maintenance by creating storage clusters with the capability to consolidate data from multiple exploration projects, instead of storing them separately.
- **To strengthen system scalability:** Increasingly complex exploration projects is posting capacity and performance challenges to existing storage solution.

SOLUTIONS

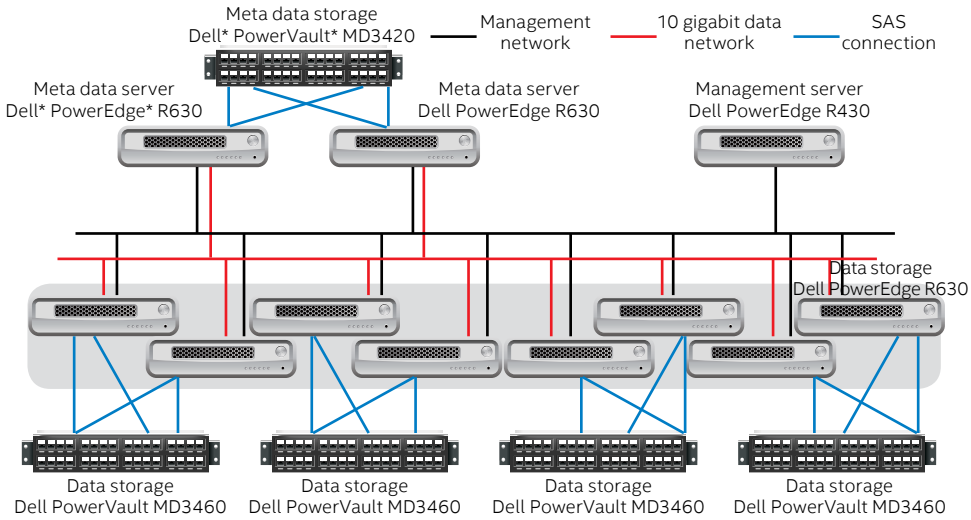
- **Lustre software-based storage solution:** CNOOC deployed a Lustre software-based storage cluster form by connecting high-density disc arrays to Intel® Xeon® Processor E5-2600 v3 family-based servers via a 10GB network connection using Intel® Server Adapter X520 family.
- **Intel® Enterprise Edition for Lustre* software:** Intel® Manager for Lustre* software is used to perform installation, configuration, monitoring, quota setting and management of Lustre storage system.

IMPACTS

- **Strengthened exploration capability:** CNOOC is achieving faster, larger-scale and more complicated seismic data interpretation, improving exploration efficiency and level, and gaining innovation superiority. Computing results that used to take 2 months can now come out a dozen days ahead.
- **Unified storage service:** The new solution provided a simplified, centralized and unified storage services for high-performance computing (HPC) projects and raised utilization rates of storage facilities and network bandwidth.
- **Enhanced scalability:** CNOOC can now flexibly scale its storage system to meet demands of its oil and gas exploration.

CNOOC relies heavily on seismic data in exploring new oil and gas resources. Seismic data are collected by offshore acquisition vessels through recording high resolution echo from sound waves bouncing from the sea floor. This data is used to help determine the hydrocarbon content and exploitation value of a given area by using HPC clusters and extremely complicated mathematic calculations, such as data noise removal, redundant data processing, migration imaging, etc.

Intel® Enterprise Edition for Lustre* software-based storage clusters significantly improves overall performance of high-performance computing clusters and enhances oil and gas exploration capabilities



High-performance Computing Cluster Storage Architecture at CNOOC

LESSONS LEARNED

- CNOOC found the deployment of Intel® Enterprise Edition for Lustre* software-based storage solution improved their storage performance by 4.4 times comparing to their pervious solution. Together with new 10 Gigabit Ethernet connection, computing results that used to come out in 2 months can now be obtained a dozen days in advance.
- Intel Enterprise Edition for Lustre software has a built-in Intel® Manager for Lustre* software, which includes simple, but powerful, management tools that provide a unified, consistent view of Lustre storage systems and simplify the installation, configuration, monitoring, and overall management of Lustre.
- Use of Intel® Ethernet Server Adapter X520 Family can help to deliver the optimal performance of Lustre file system and prevent network throughput from becoming a bottleneck affecting overall performance of the system.

Dependence on large capacity storage system

The seismic data volume of a single project generally reaches terabyte level. Wang Yi with CNOOC said, "For example, in the process of pre-stack time migration (PSTM), a single project involves 23TB of data, which together with intermediate data storage and backup in high-performance computing, will require 100TB or even larger storage capacity for the project. What is more, other projects, like pre-stack reverse-time depth migration (RTM) and full wave inversion (FWI), represent a larger data volume and greater computational complexity." Moreover, CNOOC had also found that its current storage clusters were facing high capacity expansion cost as a result of special storage protocol and device restrictions.

I/O and network bottlenecks

CNOOC's storage clusters used to be connected to the HPC platform via 1Gb Ethernet. Wang Yi said, "As restricted by data transmission capabilities, the high-performance computing platform could not access data quickly and thus failed to deliver full computing performance."

Lustre software-based storage cluster architecture delivers excellent performance and scalability

After evaluation of an Intel EE for Lustre software proof of concept including , performance tests, taking into consideration of Intel's technical and after-sales support, CNOOC has decided to introduce the Intel EE for Lustre software-based cluster storage solution.

The new storage cluster solution adopts Dell* PowerVault* MD3400 series of storage devices for object and meta data storage of Lustre file system, and uses Intel® Xeon® processor E2600 v3 product family in all servers, providing CNOOC improvements to overall performance of their high-performance computing clusters, improving seismic data analysis efficiency and enhancing scalability of storage clusters.

Wang Yi with CNOOC said, "Our decision to introduce the new storage system architecture is undoubtedly insightful, as the open source Lustre file system has been widely validated and well received in terms of its performance and scalability. Intel Enterprise Edition for Lustre* software has made many improvements based on Lustre, including Intel Manager for Lustre* software, which greatly facilitate Lustre deployment, expansion and management. More importantly, costs of performance and capacity expansion are much lower than those of the former storage system, making it especially suitable for enterprises demanding large-scale and high-bandwidth storage systems. Last but not least, we can count on Intel team's reliable support any time."

Prominent data throughout capabilities

Meanwhile, CNOOC has switched 1 Gigabit Ethernet connection between the storage system and high-performance computing to 10 Gigabit based on Intel® Ethernet Server Adapter X520 Family to remove I/O bottleneck.

In addition, Lustre software-based storage system provides hierarchical storage management strategies to store cold and hot data on magnetic tapes, low-speed hard discs, high-speed hard discs or SSD respectively, further enhancing overall performance of the storage system.

"With same hardware configurations, the Intel® Enterprise Edition for Lustre* software-based storage performance has been 4.4 times of that of the previous. Computing results that used to come out in 2 months can be obtained a dozen days earlier at present." Wang Yi with CNOOC said.

With Lustre software-based storage clusters supporting synchronous operation of CNOOC's multiple sets of HPC clusters, CNOOC needs to set capacity quota for each directory instead of for each user. Intel has assisted CNOOC in using the storage pool approach to realize flexibility of storage quota. "This has greatly facilitated CNOOC's storage management and raised storage utilization. For instance, members of a project team only access one storage pool, and their operation has no influence on other project teams," Wang Yi said.

Next, CNOOC will continue to work with Intel on Intel Solid-State Drives and 40Gb Intel® Ethernet Server Adapter to keep leveraging strengths of high-performance computing to improve oil and gas exploration efficiency and level.

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.

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