



e-GEOS takes one giant leap with Intel

Intel® Xeon® processor E5-2680 v2 product family reduces data processing time up to 10x for Italian geospatial intelligence specialists e-GEOS



e-geos

AN ASI / TELESPIAZIO COMPANY

“Together with E4 Computer Engineering, we have designed a new HPC cluster with 5x more processing cores than the previous one. This has enabled us to achieve a performance per watt ratio that is far more efficient, as well as a reduction in data processing time between 5x and 10x, depending on the type of process.”

*Dr Mario Costantini
Head of Algorithm and
Processing-System Engineering,
e-GEOS*

Using interferometric radar data collected by the COSMO-SkyMed* earth observation satellite system, e-GEOS analyzes millimetric deformations in the earth's surface due to landslides, subsidence, earthquakes, and volcanic phenomena. Processing this vast amount of data, sometimes against the clock in the case of emergency situations, requires huge amounts of computing power. To meet this challenge, e-GEOS recently rolled out a high-performance computing (HPC) cluster with 96 nodes, each with two Intel® Xeon® processors E5-2680 v2 product family. It has five times more processing cores than the previous cluster and has reduced raw data processing time between 5x and 10x, depending on the task.

Challenges

- **Increase performance.** e-GEOS wanted to improve the processing power of its HPC cluster, enabling it to analyze and interpret increasing amounts of raw data
- **Maintain energy consumption.** The new HPC cluster had to offer an increase in performance with no additional increase in energy consumption or operating costs

Solutions

- **New HPC cluster.** e-GEOS rolled out a new HPC cluster with 96 nodes, each with two Intel Xeon processors E5-2680 v2 product family and 128GB (50 percent of nodes) or 256GB (the remaining 50 percent) of total memory
- **Revamped storage.** 600TB of storage are now available with a throughput of 15GB/s. Storage is now protected by a RAID-6 chain and the Intel® Enterprise Edition for Lustre* software package

Impact

- **Greater efficiency.** The physical cores have increased from 512 to 1,920, while power consumption remains practically unchanged compared to the previous HPC cluster
- **Performance leap.** The new HPC cluster has 5x processing cores than the previous one, enabling e-GEOS to achieve a performance per watt ratio that is far more efficient, as well to cut raw data processing time between 5x and 10x
- **More responsive.** e-GEOS can interpret satellite radar data into meaningful information up to 10x faster, processing higher resolution information and covering larger areas, sometimes saving critical time in crisis and emergency situations

Monitoring the earth's crust

e-GEOS is a global leader in the geospatial information and earth observation services sector. The Italian Space Agency (ASI) owns a 20 percent stake in the business and Telespazio (Finmeccanica/Thales) owns the remaining 80 percent.

e-GEOS provides services to detect millimetric deformations in the earth's surface. The synthetic aperture radar (SAR) data coming from the COSMO-SkyMed earth observation satellite system, as well from other SAR systems, when processed by e-GEOS with the proprietary persistent scatterer pair (PSP) interferometric data analysis technique, can be used to detect and measure ground deformations due to landslides, subsidence, earthquakes, and volcanic phenomena. This information is then used to analyze and monitor critical situations, and to prevent natural disasters.

The high accuracy of e-GEOS's services also allows the monitoring of land uplift and subsidence in urban areas to support action to prevent the sinking and collapse of buildings and structures.

COSMO-SkyMed allows e-GEOS to carry out studies of specific areas of the earth's surface, day and night, and also under adverse weather conditions. It then shares the data collected with other organizations in charge of land risk management.

e-GEOS also offers continuous monitoring of the state of the coasts, seas and internal waterways, useful for the study of pollution and for the positioning of boats and accurate management of maritime traffic, particularly in tricky seas. Agriculture can also benefit from information from satellites to monitor crop growth cycles and optimize harvests. Finally, it contributes considerably to the functioning of geographic information systems (GIS) and 3-D mapping.



Raw data processing time is reduced by up to 10x

Time: a key factor in emergencies

The COSMO-SkyMed earth observation satellite system features a Space Segment and an Earth Segment. The first is composed of a constellation of four satellites equipped with high-resolution SAR sensors operating in the X Band and equipped with a data transmission and acquisition system. The second is composed of infrastructures for the management and control of the entire constellation and for the receipt, archiving, processing, and distribution of products.

Satellite data arrives in raw form at the Earth's surface in flows of at least 30 images. Each of these is formed by about one million pixels per km² with monitoring that can cover an area between 100 to 1,600 km². e-GEOS analyzes around 100,000 km² in one year, which is why it requires enormous amounts of processing power. Its computing system must be capable of analyzing, selecting, and comparing many billions of pixels—in the case of a crisis, as quickly as possible.

Intel® technology-powered HPC cluster

e-GEOS uses PSP-IFSAR, a processing chain that runs in parallel on its HPC cluster. Built in 2008, the cluster consisted of 64 nodes, each made up of two Intel Xeon processors E5450 with 16GB of RAM. Although the cluster was very powerful, e-GEOS wanted to upgrade it to improve performance and lower energy consumption. e-GEOS's new HPC system was designed, produced, configured, and installed by E4 Computer Engineering, an Italian company specializing in the supply of highly-efficient parallel computing systems. It has 96 nodes, each with two Intel Xeon processors E5-2680 v2 product family and 128GB (50 percent of nodes) or 256GB (the remaining 50 percent) of total memory. The physical cores have increased from 512 to 1,920, while power consumption remains practically unchanged compared to the previous HPC cluster.

Riccardo Zuco, engineer and head of IT, Environment, Health and Security (EHS) and quality at e-GEOS, points out how refrigerated racks have increased efficiency: "We initially conducted a series of tests with the latest processors available on the market to select the most suitable technology. We chose the latest generation of Intel Xeon processors. E4 Computer Engineering helped us to define the overall project and subsequently provided the hardware solution combined with a cooling solution. The cluster is installed in refrigerated racks, which ensure high efficiency and high reliability as well as silent operation."

With regard to storage, 600TB are now available with a throughput of 15GB/s, compared to the older cluster, which had 120TB with a throughput of 5GB/s. Storage is now protected by a RAID-6 chain and the Intel® Enterprise Edition for Lustre* software package.

Dr Mario Costantini, head of algorithm and processing-system engineering, at e-GEOS, points out how processing requirements have increased dramatically over recent years: "The amount of data that is collected with COSMO-SkyMed during a comparable period of observation and equal land area in square kilometers has increased by two orders of magnitude. Therefore, higher-performance computing clusters are now needed. Together with E4 Computer Engineering, we have designed a new cluster with 5x more processing cores than the previous one. This has enabled us to achieve a performance-per-watt ratio that is far more efficient, as well as a reduction in raw data processing time between 5x and 10x, depending on the type of process. This enables us to process higher resolution information covering larger areas."

Intel Enterprise Edition for Lustre software

The ability to process a greater amount of data results in higher accuracy, but puts even greater demand on the storage subsystem. e-GEOS chose Intel Enterprise Edition for Lustre software, an installation, configuration, and file management system adapted to support big data applications and HPC.

Lustre is the open source file system of reference in HPC, with a distribution in over 50 percent of big data processing clusters worldwide. Thanks to I/O parallelism and I/O virtualization for storage, the Lustre file system enables enterprises to achieve a maximum throughput of 1TB/s in more complex installations.

Intel Enterprise Edition for Lustre software incorporates 24/7 SLAs and technical support services, meeting the needs of the most demanding users and implementers of exascale computing solutions.

"The use of Intel Enterprise Edition for Lustre has enabled us to increase the I/O throughput between the servers that make up our HPC cluster and the storage units. In addition, we have been able to simplify installation, configuration, monitoring, and data archiving," said Dr Costantini.

Looking to the future

Andrea Luiselli, RCO platform specialist at Intel, said: "With proven experience in HPC,

Spotlight on e-GEOS

Utilizing the COSMO-SkyMed earth observation satellite system, e-GEOS offers an exclusive portfolio of application services, making it a leader in the European Programme for the establishment of a European capacity for Earth Observation (Copernicus). Using satellite, aerial and in situ data, e-GEOS offers near-real-time environmental monitoring, rapid mapping and interferometry in support of natural disaster management, analysis of ground subsidence and thematic mapping for agriculture and silviculture, as well as distribution of data from satellite missions.

E4 Computer Engineering has developed a product that combines the performance of Intel Xeon processors E5-2600 v2 product family, along with Intel® True Scale Fabric and a storage system based on Intel Enterprise Edition for Lustre software, in order to satisfy e-GEOS's need for reliability, high availability and performance."

Simone Tinti, HPC team leader at E4 Computer Engineering, said: "The excellent synergy established with Intel over the years has enabled us to create a highly reliable solution capable of sustaining the enormous workload e-GEOS must manage daily, sometimes in emergency situations. We are proud of our work and the results achieved."

Marcello Maranesi, engineer and CEO of e-GEOS, concluded: "The progress made over the years by Intel, together with the optimization of PSP algorithms for SAR interferometry carried out by our researchers, has enabled us to make a giant leap forward. This has benefited the companies that use this data in various forms and the community as a whole. This investment secures the future of almost all our applications and services that rely on the analysis of substantial amounts of data. It means we will be able to develop our business over the next three years to meet the demands of our growing market segment."

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