



Case Study
Intel® Itanium® Processor
High Performance Computing

Setting the Supercomputing Standard

Intel and HP empower CESGA to deliver industry-leading HPC facilities for researchers worldwide



As one of the world's leading high performance computing (HPC) centres, CESGA is dedicated to providing the academic community, both within Spain and internationally, with industry-leading facilities. In order to continue to lead the way in technological innovation and research, it developed the Finis Terrae HPC platform with support from Intel and HP. The new platform increased the number of computation hours available by a factor of ten. Even before the platform's official launch, researchers in disciplines ranging from electromagnetism to climate change were successfully completing complex projects with real-life applications.

“With HPC resources powered by Intel® technology, we can drive scientific innovation at a global level.”

Javier García Tobío,
Director of CESGA

Challenge

- **Continue strategic dedication** to technological innovation by providing scientists and researchers with fast, reliable high performance computing platform
- **Develop world-class reference platform** to position Spain as a leader in supercomputing technology projects and support research at a global level

Solution

- **Deployed 146 HP Integrity* RX7460 servers** powered by Intel® Itanium® processors 9000 series
 - **A total of 2,580 CPUs** provides 19,000GB of memory and 16,000 Gigaflops of processing speed
 - **Open source platform** allows use of Unix, Linux and Microsoft-based applications
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CESGA widens research community with powerful high performance computing underpinned by Intel® Itanium® processors 9000 series

Assessing the Situation

Based in Santiago de Compostella in north western Spain, the Supercomputing Centre of Galicia (CESGA) works with the government of Galicia and the National Research Council of Spain to deliver high performance computing (HPC) facilities to the scientific community. It is committed to promoting the use of its resources for R&D purposes by both Spanish and international organisations, and has tasked itself with acting as a global reference centre.

In keeping with this strategy for excellence, CESGA wanted to develop an HPC platform with performance to rival any others in Europe. Its plan was to meet four related aims:

- Provide the research community with a platform that would significantly improve their time-to-results without impacting quality of research
- Consequently enable researchers to gain higher productivity levels
- Facilitate the rate of technology transfer from research to industry through more efficient generation of results
- Contribute to raising the levels of social wellbeing in Spain and abroad by enabling these results to be reached faster

In order to build the most suitable platform to meet these requirements, CESGA embarked on a collaborative project with four other organisations. It worked with Xunta de Galicia, (the region's local government body) and the Spanish Superior Council for Scientific Investigations (CSIC) as well as HP and Intel. "We wanted to include Intel in this partnership for a number of reasons," said Javier García Tobio, Director of CESGA. "Firstly Intel® technology allowed scalability to a very high number of processors under a shared memory architecture. It was also important that – together with HP – it was the only architecture that would allow simultaneous running

of the three different operating systems required by our users: Unix, Linux and Windows. Added to this, Intel displayed the expertise and commitment to integrate its technology into our complex HPC environment."

The resulting supercomputer was named Finis Terrae, after a cape on the coast near the CESGA site. It consists of a total of 2,580 CPUs with Intel® Itanium® processors 9000 series. With 72 server towers, weighing a total of 32 tonnes and covering an area of 140m², Finis Terrae is one of the largest shared-memory supercomputers in the world, with one of the best GB:CPU ratios. It was also the largest HP-Intel supercomputer in the world at its launch.

Any researchers wishing to use the solution for a research project are able to book time and capacity. They can use their own bespoke applications thanks to the open source operating system, and can access the platform from a number of sites across Spain.

Spotlight: CESGA

- The Supercomputing Center of Galicia (CESGA) is a centre for high-performance computing, communications and advanced services
- It works with the Scientific Community of Galicia, the Consejo Superior de Investigaciones Científicas (CSIC) and the Galician regional government
- CESGA's strategic mission is to drive technological innovation and provide high performance computing resources to deliver results that improve people's quality of life



“With Finis Terrae, new research can improve quality of life with everything from healthcare to weather forecasting.”

Javier García Tobío,
Director of CESGA

Delivering the Solution

In the six months between the completion of the deployment of the platform and its official launch, it was enthusiastically adopted by over 200 research teams from a wide range of disciplines.

For example, MeteoGalicía is a weather research service based in north west Spain. It has used Finis Terrae to investigate ocean and atmospheric dynamics and climate change as well as to deliver daily weather forecasts for the region. These include forecasts tailored specifically for local business like wind power producers and the fishing industry and for key sporting events.

Meanwhile, a group of radio-physicists from around Spain has collaborated on a project to improve radiotherapy treatment for hospital patients. The high performance of the Finis Terrae platform enables multiple complex algorithms to be run simultaneously on real patient CAT scan images, delivering more comprehensive results faster. This means that the treatment programmes devised for each individual are more reliable and timely, resulting in better patient care.

As well as projects like these, which have an impact on the daily lives of thousands of people, Finis Terrae has been used for more theoretical – but just as exciting – initiatives. A team of researchers from the Universities of Extremadura and Vigo

worked with CESGA to break a world record within weeks of the platform’s launch. They succeeded in solving an electromagnetism problem with 150 million unknown quantities, completing the calculation in six hours. This is a significant improvement on the previous world record of 85 million unknowns, and will play an important role in improving the design of large structures equipped with radio devices, like boats and aeroplanes.

Finally, a research team from Barcelona used the Finis Terrae platform to solve the century-old ‘Fekete Points’ mathematical problem, which focuses on the distribution of particles on the surface of an object and the transmission of energy between them. Using Finis Terrae’s extremely high performance and high availability supercomputing resources, the mathematicians were quickly able to develop an algorithm that solved the problem of minimising the energy transfer between up to a million particles by identifying the most efficient way of arranging them. This calculation, which would have taken 40 years using a single CPU, was completed on Finis Terrae in a day and a half. As well as being a breakthrough for the scientific community, the resolution of the Fekete Points problem means that molecular stability can be improved in the chemical industry to bring benefits to numerous manufacturing and engineering processes.

Key Technologies

- Finis Terrae HPC platform consists of 146 HP Integrity* RX7640 servers with Intel® Itanium® processors 9000 series
- A total of 2,580 CPUs provide 19,000GB of memory – giving one of the best GB:CPU ratios in the world – and more than 16,000 GigaFlops processing speed
- Open source operating system enables use of Unix, Linux and Windows to suit a wide range of bespoke research applications

Integral Answers

- High performance supercomputing platform enables ten times more calculating hours than previously
- Quick processing speed and reliability of platform mean results are achieved faster
- Availability of platform for multiple operating systems means new types of research in new fields can be carried out using HPC tools

Ten-fold increase in computing hours makes CESGA a world-leading research facility for numerous diverse fields

Concluding

By introducing the Finis Terrae supercomputing platform to its facility, CESGA has increased the number of computing hours available to the scientific community by a factor of ten. This means that more projects can now be run concurrently, and more researchers can benefit from its industry-leading resources. García Tobio said: "We have so far attracted over 20 research groups that have never used CESGA before. The combination of more computing hours available through high performance and the open source platform has made this possible."

The Spanish government has recognised the unique value of Finis Terrae by classifying it a Singular Scientific and Technical Infrastructure, meaning it will benefit from continued grants to support further innovation in the future.

CESGA has been approached by universities and research bodies from across the world wanting to make use of the new supercomputing platform. "We're very pleased that Finis Terrae has already achieved the status of a world-class HPC resource," concluded García Tobio. "We are looking forward to seeing even more breakthroughs made in all aspects of science and industry, and are confident that the technology foundation from Intel and HP will support more discoveries for a long time to come."

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Return on Investment

- Increased calculating hours means more researchers can use the system at any one time – already 20 new research projects have been initiated
- Many research projects generated usable results right from the start, enabling improved radiotherapy treatment and faster weather forecasting
- Finis Terrae has confirmed CESGA's reputation as an industry-leading HPC facility, generating interest from researchers around the world.
- The Spanish government has classified it a Singular Scientific and Technical Infrastructure, guaranteeing continued grants to support ongoing innovation.



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