CASE STUDY

High Performance Computing (HPC)

Beauty and High Performance Computing Under Glass at Barcelona Supercomputing Center

Intel® Omni-Path Architecture and Intel® Xeon® Scalable Processor Family enable breakthrough European science using 13.7 petaFLOPS MareNostrum 4

MareNostrum 4

- Spain's 13.7 petaFLOPS supercomputer contributes to the Partnership for Advanced Computing in Europe (PRACE) and supports the Spanish Supercomputing Network (RES)
- 3,456 nodes of Intel® Xeon® Scalable Processors, plus 0.5 petaFLOPS cluster of Intel® Xeon Phi™ Processors (codenamed Knights Landing and Knights Hill)
- Intel® Omni-Path Architecture interconnects multiple clusters, including an Intel Xeon Scalable Processor system, a future IBM Power9/ Nvidia GPU cluster, an IBM storage system, and an Intel Xeon Phi Processor cluster
- Beautifully housed in the Torre Girona chapel in Barcelona inside a specially built glass box for all to see
- Designed to carry on key research in personalized medicine, astrophysics, biosciences, and many other fields, plus enable development of next-generation codes and tools for the Exascale computing era

Challenge

In publicly and privately funded computational science research, dollars (or Euros in this case) follow FLOPS. And when you're one of the leading computing centers in Europe with a reputation around the world of highly reliable, leading-edge technology resources, you look for the best in supercomputing in order to continue supporting breakthrough research. Thus, Barcelona Supercomputing Center (BSC), or Centro Nacional de Supercomputación, is driven to build leading supercomputing clusters for its research clients in the public and private sectors.

"We have the privilege of users coming back to us each year to run their projects," said Sergi Girona, BSC's Operations Department Director. "They return because we reliably provide the technology and services they need year after year, and because our systems are of the highest level."

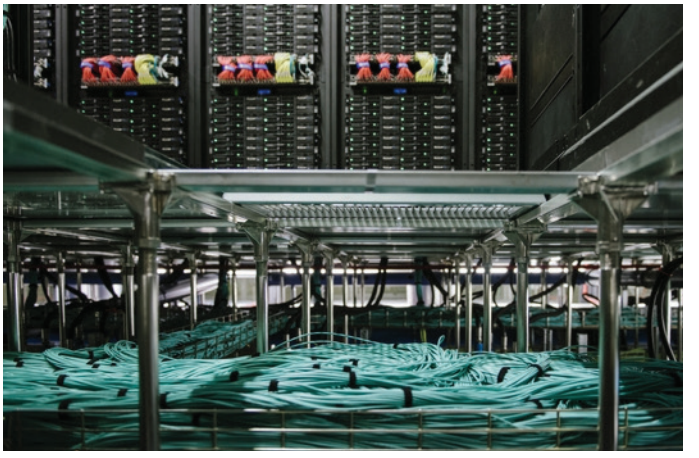
Supported by the Spanish and Catalan governments and funded by the Ministry of Economy and Competitiveness with €34 million in 2015, BSC sought to take its MareNostrum 3 system to the next-generation of computing capabilities. It specified multiple clusters for both general computational needs of ongoing research, and for development of next-generation codes for many integrated core (MIC) supercomputing and tools for the Exascale computing era. It fell to IBM, who partnered with Fujitsu and Lenovo, to design and build MareNostrum 4.

Solution

MareNostrum 4 is a multi-cluster system interconnected by the Intel® Omni-Path Architecture (Intel® OPA) fabric. A general-purpose compute cluster, with 3,456 nodes of Intel® Xeon® Scalable Processor Product Family (codenamed Skylake) will provide up to 13.7 petaFLOPS of computational capacity. A smaller cluster delivering up to 0.5 petaFLOPS is built on the Intel® Xeon Phi™ Processor 7250 (codenamed Knights Landing), which will be expanded with additional nodes of the next-generation of Intel Xeon Phi Processor (codename Knights Hill). A third small cluster will include Power 9 and Nvidia GPUs. And an IBM storage array will round out the system. All systems connecting to the storage cluster will use the Intel OPA fabric. MareNostrum 4 is designed to be ten times faster than its predecessor.

"From my point of view," stated Girona, "Intel had, at the time of the procurement, the best processor for general purpose systems. Intel is very good on specific domains, and they continue to innovate in other domains. That is why we chose Intel processors for the general-purpose cluster and Intel Xeon Phi Processor for one of the emerging technology clusters, on which we can explore new code development."

The system was in production by July 2017 and placed at number 13 in the June 2017 Top500 list and number 16 on the November 2017 list.



Results

"BSC is unique in that they have a very good methodology of putting together very effective teams by combining their own computational experts with the scientists that need the resources," stated Enrique Celma of Intel. "They have many seasoned developers that also know very well the framework and problem that the researcher is trying to solve. Thus, the jobs can run reliably, fast, and efficiently, returning results quickly."

BSC also boasts the only European scientist to receive the Seymour Cray Computer Engineering award, Mateo Valero, the center's director.

"With leading technology, seasoned expertise, and award-winning leadership, BSC is attracting both attention and investment from both public and private sectors," added Celma.

BSC research covers many fields, but they are especially known for their work in genomics and personalized medicine. MareNostrum 4 will continue to enable BSC scientists to explore the possibilities of creating personalized treatments for diseases using genomics and analytics powered by Intel Xeon Scalable Processor Family and other Intel technologies.

Additionally, there are many research projects currently under way at BSC, which could leverage the capabilities of MareNostrum 4 for computing.

Another unique aspect of MareNostrum 4 is that it is aesthetically pleasing to look at, and it is available for all to see. According to Girona, even the blue cables were selected to match the chapel's interior. BSC's largest machine is housed inside the Torre Girona chapel in Barcelona, surrounded by a glass room designed as the data center. The Torre Girona chapel receives over 10,000 visitors a year, just to see the institution's supercomputer.

"The Barcelona Supercomputing Center team is committed to maximizing MareNostrum in any way we can," concluded Girona. "But MareNostrum is not about us. Our purpose at BSC is to help others. We are successful when the scientists and engineers using MareNostrum's computing power get all the data they need to further their discoveries. It is always rewarding to know we help others to further cutting-edge scientific exploration."

Solution Summary

To remain competitive and to continue to service its long-standing research customers, BSC was awarded €34 million to build MareNostrum 4, a 13.7 petaFLOPS supercomputer comprising multiple clusters. The largest of the systems is built on Intel Xeon Scalable Processor Family with Intel OPA fabric and Intel SSD DC Product Family storage devices. This cluster will serve the majority of researchers with massive computing capacity. A 0.5 petaFLOPS cluster is powered by Intel Xeon Phi Processor 7250, and it will be used mainly for next-generation code development and exploration. Additional clusters include a GPU system and storage system, also interconnected to the main cluster by Intel OPA. MareNostrum 4 entered production in the summer of 2017, and placed #13 on the June 2017 Top500 list and number 16 on the November 2017 list.

Where to Get More Information

Learn more about the research projects potentially using MareNostrum 4.

Learn more about BCS and MareNostrum 4.

Learn more about Intel Omni-Path Architecture.