CASE STUDY

High Performance Computing (HPC)
2nd Generation Intel® Xeon Scalable Processor
Intel® SSDs

Universidad Politécnica de Madrid Deploys Magerit-3 for Advanced Research

With 2,920 cores, scientists expand research in new materials and effects of intense electronic excitation using lasers and X-rays

Magerit-3 Highlights:

- Built by Lenovo with 68 ThinkSystem SD530 two-socket servers with two GPU accelerator nodes
- Intel® Xeon® Gold 6230 processors with 20 cores each (2,920 cores total)
- 192 GB memory, 48 GB Intel® SSDs per node (13.056 PB total)
- 182.78 TFLOPS Rpeak performance

Executive Summary

The leading science and technology university in the Spanish-speaking world, the Universidad Politécnica de Madrid (UPM), needed next-generation supercomputer capabilities to support ongoing research by computational scientists at the institution. It's aging Magerit-2 supercomputer, built in 2011 on IBM Power architecture was replaced by Magerit-3, a 2,920-core cluster of Lenovo ThinkSystem servers using Intel® Xeon® Gold 6230 processors. The new supercomputer went into production in September 2019.

Challenge

The Universidad Politécnica de Madrid (UPM) (Technical University of Madrid) supports a wide range of schools in engineering, architecture, computers, and science with over 40,000 students in undergraduate, graduate, and Ph.D. programs. In 2004, UPM expanded resources available to researchers with the creation of the Centro de Supercomputación y Visualización de Madrid (CeSViMa) (Supercomputing and Visualization Center of Madrid), which offers High Performance Computing (HPC) and interactive visualization services using specialized software for engineering, energy, and the environment. According to Oscar Cubo Medina, Technical Director for CeSViMa, the center provides supercomputing services across all the schools at UPM, plus for scientists at associated research institutions such as Instituto de Fusión Nuclear, a center at UPM devoted to nuclear fusion and fission research and in high energy excitation; and Instituto de Energía Solar, where next-generation materials for lowest-cost and more efficient solar panels are studied.

CeSViMa hosts one of the most powerful supercomputers in Spain, named Magerit. Meaning 'place of many waters', Magerit is the ancient Arabic name for Madrid. Magerit has provided HPC and general computing services for over a decade through three phases. Magerit-1 was built in 2006 by IBM on their Power architecture. Magerit-2 expanded the supercomputer's capabilities in 2011. Magerit-3 went into production in September of 2019.

Since Magerit-2 was deployed, some researchers at UPM have advanced their methods and computational needs to where they have outgrown the capabilities of their HPC resources. Eduardo Oliva Gonzalo is a postdoctora researcher within the Instituto de Fusión Nuclear. He studies the interaction of lasers and plasmas and is specifically interested in the amplification of X-rays.

"You cannot do this kind of research on small clusters," said Oliva Gonzalo. He had been working on much smaller computational systems, including homemade Beowulf clusters. "The challenges I face are multi-scale. I need to simulate millimeters or centimeters of plasmas but at high resolution (up to tens of nanometers). You need HPC to do that."

Fellow scientists Antonio Rivera and Ovidio Peña Rodríguez use HPC simulation for research into plasmonic nanoparticles and the effects of intensive electronic excitation on materials, especially those used in nuclear environments. They use a range of physics and molecular dynamic codes that are computationally intensive.

"Historically, our supercomputing simulations could take a week to complete," stated Rivera.

"Some of the calculations we need to do could not be done on Magerit-2," added Peña Rodríguez.

Other researchers, such as Pablo Palacios and Pablo Sanchez-Palencia from the Instituto de Energía Solar, need supercomputing for theoretical modeling of new materials made from perovskites for photovoltaic solutions. Perovskites are considered the future of solar technology. Perovskite-based solar cells are cheaper and easier to manufacture than silicon-based materials, but they are less stable. Palacios and Sanchez-Palencia are working on the study of new combinations of perovskites with different metals to create photovoltaic materials with greater stability.

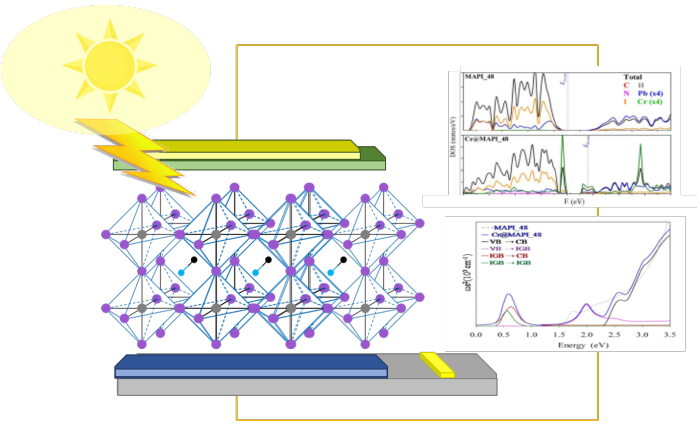
With advances in research areas, simulation codes, and processes, by 2018, it was time for a new Magerit.

Solution

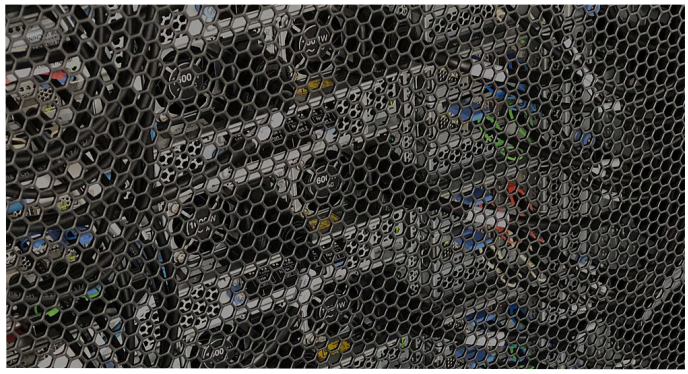
Magerit-3 was built by Lenovo using their ThinkSystem SD530 two-socket servers. A total of 68 ThinkSystem SD530s provides 2,920 cores from Intel Xeon Gold 6230 processors. Magerit-3 delivers 182.78 teraFLOPS of Rpeak performance.

"We are probably one of the largest users of Magerit," said José Manuel Perlado, Chair of Nuclear Physics and Director of Instituto Fusión Nuclear. "We mainly do work within nuclear fission and fusion, but many of our codes and research are applicable to other areas where high density physics must be studied."

According to Perlado, researchers run many very computationally demanding codes that require both large processing capability and large amounts of memory. Some codes cannot be parallelized. Magerit-3 is instrumental in advancing the research of scientists at the Institute, according to Perlado.



Perovskites analysis workflow: from crystal structure to optical properties. The first steps towards design of more efficient solar devices. (Photo courtesy IES group, UPM)



Magerit-3 Supercomputer managed by Supercomputing and Visualization Center of Madrid (CeSViMa). (Photo courtesy UPM)

Solution Summary

To support advanced research by scientists at UPM, including associated research institutions and other institutions in Spain, the University needed to deploy next-generation HPC capabilities. Magerit-3, a 2,920-core supercomputer built on Lenovo ThinkSystem SD530s with Intel Xeon Gold 6230 processors, was deployed and put into production in September of 2019. And according to the university, It provides nearly 183 teraFLOPS of supercomputing performance, accelerating codes by as much as 5X.[1]

Where to Get More Information

Find out more about the Intel® Xeon® Scalable Processor family.

Find out more about the Universidad Politécnica de Madrid and the two associated research centers, Instituto de Energía Solar and Instituto de Fusión Nuclear.

Learn more about Lenovo ThinkSystems SD530.

Solution Ingredients

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Lenovo and Intel are working together to accelerate the convergence of HPC and AI, creating solutions of all sizes, to unlock new levels of customer insight. Through collaboration on systems and solutions, software optimizations and ecosystem enablement, their goal is to speed discovery and outcomes for the world's most challenging problems in the exascale era and beyond. Lenovo servers, the leading system choice for the TOP500 fastest supercomputers, are powered by Intel Xeon Scalable processors and Intel's leading-edge technology for storage, memory and software, providing the innovative foundation to drive science and industry progress forward even faster.

[1] Results provided by Universidad Politécnica de Madrid.

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