Case Study
Intel® Xeon® Processor E5-2600 v2 Product Family
High-Performance Computing
Government/Public Sector

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High-performance weather forecasting

Intel® Xeon® processor E5-2600 v2 product family powers new supercomputers at Météo-France for faster, more precise weather and climate analysis

METEO FRANCE
Toujours un temps d'avance

"The numbers are impressive. Internal tests at Météo-France show that the Intel® Xeon® processor E5 family-powered bullx* supercomputers have already increased useful performance by a factor of 12 when compared to the previously installed configuration. Electricity consumption has also been reduced by 20 percent overall."

Alain Beuraud,
HPC Project Manager,
Météo-France

Météo-France, the national meteorological service for France and its overseas territories, has deployed new supercomputers from Bull, powered by the Intel® Xeon® processor E5 family. Already in the TOP500* list of the world's most powerful supercomputers, the new configuration at Météo-France, with its parallel processing capabilities, has delivered dramatically improved performance and reduced energy consumption.

Challenges

- **Performance demands.** Météo-France had to increase the power of its supercomputers to meet new demands for greater accuracy and precision in its short-term European and overseas weather forecasts
- **Reduce energy consumption.** To minimize the operating costs in its data centers, Météo-France needed to reduce energy consumption of computers and cooling systems
- **International standards.** As a leading player in the international community of meteorological and climate science, Météo-France needed computer power to remain on a par with those of peers

Solutions

- **High-performance computers.** Météo-France selected two 1008 bullx DLC B710* compute nodes, each equipped with two 12-core Intel Xeon processors E5-2600 v2 product family and 1866MHz memory DIMMs
- **Energy management.** Bull provides direct liquid cooling technology, while the Intel® Datacenter Manager: Energy Director power management solution stack provides power and thermal monitoring and management

Technology Results

- **Improved performance.** Internal assessments at Météo-France show performance has already improved by a factor of 12 (measured on real applications) over the previous configuration, with greater global reliability
- **Reduced energy consumption.** Météo-France's tests also show that energy consumption has reduced by 20 percent
- **TOP500 position.** The first of Météo-France's two new supercomputers was ranked number 61 in the most recent listing of the TOP500 most powerful supercomputers; the second will be added when the list is next published

Business Value

- **Improved service.** Météo-France can develop its climate and weather models and increase their resolution to deliver more accurate forecasting to government and citizens
- **Commercial activity.** With greater computational power and parallel processing, Météo-France can develop new services for clients in the aviation, energy, construction and tourism sectors

Safety, security and the science of climate and weather

From avalanche predictions to storm surge warnings, the chances of rain on a public holiday or the arrival of perfect picnic conditions, millions of people in France and its overseas departments and territories rely on daily weather bulletins produced by Météo-France, the country's national meteorological service.

Headquartered in Paris, with research and production facilities in Toulouse, Météo-France is tasked with protecting the security of life and property throughout the country. It provides essential information to both government departments and commercial interests. Météo-France is also responsible for collecting, processing and researching climatological data and developing climate projections.

Simulation modeling with supercomputers

Producing Météo-France's weather forecasts and climate analysis is the responsibility of dozens of physicists, atmospheric chemists, hydrologists and oceanographers. Underpinning their research is a series of powerful, proprietary computer models fed by millions of data points around the world.

Alain Beuraud, HPC project manager at Météo-France, explains the role of IT at the organization: "Weather simulation is an extremely complex calculation that depends on numerous long-term computer simulations of atmospheric conditions. Forecast quality depends on several factors including the number and quality of the observation points where data is collected, the methods for assimilating that data into models,

500 teraflops of high-performance computing for radically improved weather and climate modeling

the accuracy of the model itself, and the available computing power."

At Météo-France, short-term forecasts are mainly developed using two complementary models: ARPEGE*, which simulates and predicts phenomena such as large depressions, anticyclones or frontal systems around the world; and AROME*, which focuses on the French mainland and islands in Europe.

In addition, Météo-France uses results from the European Centre for Medium-Range Weather Forecasts' (ECMWF) Integrated Forecast System* (IFS*) models for 10-day forecasting and runs one of two French climate models used by the UN's Intergovernmental Panel on Climate Change (IPCC). Researchers also reconstruct past climatic conditions from archival observations or simulate future changes and also lead research into atmospheric phenomena.

High-performance forecasting

High-performance computing is a strategic element in Météo-France's operations, critical to remaining on par with peers in the rest of Europe, the U.S. and Japan. "This is a 24/7 business," says Beuraud. "We need reliability, accuracy and speed. There's no room for delays in delivering our reports: after 15 minutes, the result is considered missing. Our work simply cannot be done without very high levels of computational power."

When the French government issued a new contract for even more precise meteorological information for French territory in Europe, even more computational power was needed. Beuraud explains the changes needed: "To meet the new requirements, we needed to increase the resolution of the AROME model from 2.5 kilometers to 1.3 kilometers. In other words, we needed to dramatically increase the number of data points to be analyzed. To meet the new demands, we needed to increase our general processing power by a factor of at least 10."

Energy consumption was also a concern. In particular, Météo-France wanted to reduce the electricity consumption of its supercomputers and cooling systems.

The new requirements coincided with Météo-France's regular review of its computational capabilities. The contract with existing suppliers was coming up for renewal, so Météo-France decided to look at alternatives. Having assessed solutions from a number of vendors and subjected them to rigorous testing, Météo-France opted to work with Bull and Intel.

Powerful parallel processing

Météo-France chose to install two 1008 bullx DLC B710 compute nodes, each equipped with two 12-core Intel Xeon processors E5-2600 v2 product family and 1866MHz memory DIMMs, interconnected by a high-performance InfiniBand FDR* network. The innovative direct liquid cooling technology developed by Bull reduces energy consumption, while the Intel Datacenter Manager: Energy Director power management solution stack was also deployed to provide power and thermal monitoring and management.

The first of the Bull supercomputers was installed at Météo-France's site in Toulouse. The second was installed six months later in a data center 15 km away. The computers are the first fully installed supercomputers in Europe to be equipped with the Intel Xeon processor E5-2600 v2 product family based on the 22nm manufacturing process.

The adoption of the Bull supercomputers has enabled Météo-France to move from vector to scalar technology and achieve much higher levels of parallel processing power for minimal total cost of ownership.

"Most importantly, the new configuration will enable us to enhance the AROME model in line with our government contract. We have moved our existing models across to the new configuration and can now develop them," says Beuraud. "But it is also helping us to deliver new and exciting services both to the French government and to our numerous clients. We are developing models for airports, for example, that will improve our ability to predict and provide useful analysis of fog conditions. It has opened up a whole new range of possibilities and cements our position at the heart of international weather and climate research."

HPC in action

Beuraud continues: "The numbers are impressive. Internal tests at Météo-France show that the Intel Xeon processor E5 family-powered bullx supercomputers have already increased useful performance by a factor of 12 when compared to the previously installed configuration. Electricity consumption has also been reduced by 20 percent overall, since the new supercomputers adapt to load and reduce power consumption when not in use."

Maximizing the potential of the new Intel® architecture, each supercomputer in the Bull configuration has already achieved a Linpack performance of more than 460 teraflops. Total peak power is now one petaflop – or one million billion operations per second. A total performance of more than five petaflops is expected to be available by 2016.

The first supercomputer installed at Météo-France is currently ranked number 61 in the TOP500 most powerful non-distributed computer systems in the world. The second installation is due to appear in the next published edition of the list.

"The project as a whole has been very positive," concludes Beuraud. "The Bull and Intel task force is highly experienced in high-performance computing and parallel processing and was very supportive during our transition. We have also joined a large community of Intel users, which enables us to compare and exchange experiences. Those kinds of relationships are very important and help confirm that we made the right decision."

Spotlight

Météo-France is France's national meteorological and climate service. It is an agency depending on the Ministry of Ecology, Sustainable Development and Energy and has a budget of more than USD 480 million (EUR 350 million). Météo-France is a member of the European Centre for Medium-Range Weather Forecasts (ECMWF), Eumetsat, the operator of European weather satellites, and Eumetnet, the network of European meteorological services. It contributes to the World Meteorological Organization (WMO) and the UN Intergovernmental Panel on Climate Change (IPCC).

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