CASE STUDY

Intel® Xeon® Processor 5600 Series

Energy/Utilities
Energy Efficiency and Government/Public Sector
IT Efficiency, Environment, and Performance

Natural Resources

Scandinavian countries develop carbon-neutral, shared-resource HPC data center using Intel and HP technologies

Due to growing power consumption and soaring power costs, supercomputing costs are an increasing economic burden for researchers and their universities in Scandinavia. To address these challenges, the national academic research infrastructure organizations of Sweden, Denmark and Norway worked together to develop a green, low-cost data center to provide resources that could be remotely shared. Located in Reykjavik, the capital of Iceland, the Advania Thor Data Center (AT/DC) uses powerful natural resources and cost-efficient natural air cooling. Its high-performance computing (HPC) platform consists of 288 HP ProLiant* BL280c G6 servers powered by Intel® Xeon® processors 5600 series. This innovative facility provides a new model for shared, energy cheap and energy-efficient HPC resources, potentially changing the future delivery of computing services.

advania
Welcome to IT

"Cost-efficient HPC delivery and power and cooling were the criteria for the AT/DC. Intel® Xeon® processor 5600 series provides the dense, powerful HPC required by the data center and is also designed for energy efficiency."

Kolbeinn Einarsson
Business Development Manager
Advania Nordic

CHALLENGES

- **Cost-efficient HPC.** Scandinavian countries were paying high charges for HPC and, faced with spiraling energy costs, were concerned about diminishing returns for supercomputing investments
- **Working together.** Representatives from Norway, Denmark and Sweden aimed to develop an energy-efficient data center that provided HPC resources that researchers across the region could have shared access to

SOLUTIONS

- **Carbon-neutral.** Advania, one of the largest IT companies in the region, was charged with developing a carbon-neutral, energy-efficient data center
- **Natural resources.** The data center was located in Iceland, where natural power resources and free cooling mean much cheaper energy costs
- **Powerful platform.** HP and its reseller Opin Kerfi developed a 288-node cluster based on HP ProLiant 280c G6 servers and the Intel Xeon processor 5600 series

IMPACT

- **Low cost.** Lower energy costs could result in the total cost of ownership (TCO) falling by up to 50 percent
- **Shared resources.** Universities and research organizations from across the region are beginning to share the HPC resources, signaling a political shift in, and willingness to share, supercomputing resources
- **Elite benefits.** AT/DC provides high-performance computing with low TCO, low power usage and green power usage
- **Global reputation.** AT/DC is gaining a powerful reputation for industry-leading, carbon-neutral, low-cost operations with governments and enterprises around the world seeking to benefit from its use

Diminishing returns

Within the context of HPC, it's the norm to have supercomputing hardware physically close to the research institutes that use it. Yet the hosting and operational cost is becoming increasingly prohibitive as energy costs spiral upwards each year.

This problem was particularly acute in the European Nordic regions, where countries spend millions of Euros each year on supercomputers, yet often have weak accounting of energy costs.

Rene Belso, chief technical officer, Computing, Danish e-Infrastructure Cooperation (DeIC), said: "Research institutes across Scandinavia recognized the cost of HPC infrastructure operations, namely electricity supplies is not transparent. In the worst case, with the cost of electricity in key market segments rising annually, long-term costs could quickly spiral out of control, jeopardizing HPC in our region.

"In the best case we simply lose the significant electricity savings we could have made by placing our computer centers at a more favorable place. Savings we otherwise could have used to get a near doubling of our compute power".

This will result in universities and research organizations seeing ever diminishing returns from their HPC budgets, or in budgets increasing in size for lesser returns. Recognizing the implications, research and government organizations in Sweden, Denmark and Norway came together to explore the possibility of saving costs by jointly developing HPC resources that could be shared across the region.

Belso added: "Opening a supercomputer cluster is no longer rocket science, and ensuring high-level operations is quite straightforward today. Our aim was to see if we could bring down the TCO by getting organizations to share HPC resources."

Sustainable, low-cost energy powers a supercomputing platform that delivers 35 Tflop

"However, this was potentially fraught with difficulties." Belso added: "University computer centers understandably often do not want to share their resources with other centers. They argue that they need to have resources close by, even if the operational costs are significantly higher."

"While this is sometimes justified, we wanted to prove to universities operating these computer centers that they could benefit by letting their computer centers focus on more advanced operations and state-of-the-art user support, and not on hardware maintenance, often not amounting to more than on-location cabling and hardware replacements."

The reason that many computers maintain an old operational way is to retain control, influence, funding, and jobs. Only a few are ready to move from mostly cabling and hardware maintenance to advanced control of remote front-end servers in collaboration with colleagues placed remotely within other organizations and cultures.

However with electricity costs growing year-on-year and ever more advanced network connectivity, traditional computer centers face the same challenge to innovate as did wagon wheel makers with the arrival of rubber tires. There is certainly resistance to change from a hardware focus to remote operations, and local user support, but the need for change is clear and the potential advantages of doing so are compelling.

Hidden power

To prove this, and with an eye on developing joint national infrastructures for computational science that deliver high quality computational services, the trio of countries decided to develop a data center that would act as a proof of concept pilot.

Because of its unique climate and natural power resources Iceland, was chosen as the location. Geothermal energy lies just beneath the surface, while hydro power sources are easily tapped. This means the price of electricity, compared to the Scandinavian countries, is almost negligible. The prospect of reducing TCO up to 50 percent and using carbon-neutral sources was a compelling reason to locate the data center in Iceland.

Advania, the largest IT company in Iceland and the ninth largest in the Nordic regions, was tasked with developing a data center that made use of these natural resources to provide green compute services for Denmark, Sweden and Norway, as well as Iceland.

Kolbeinn Einarsson, business development manager for Advania Nordic, said: "Iceland has green energy in relative abundance, with low and stable power costs and plenty of free natural cooling. These factors are ideal for developing an energy-efficient data center, but we also needed to develop an HPC platform that would provide efficiency gains."

To meet these objectives, HP and its reseller Opin Kerfi developed a 288-node cluster based on HP ProLiant 280c G6 servers and the Intel Xeon processor 5600 series. The platform provides a compelling HPC theoretical peak performance of 35 Tflop, while also offering 6912GB of memory.

Industry-leading technology

Einarsson adds that the energy-efficiency and power provided by the platform were the ultimate deciding factors in the choice of hardware: "We are vendor agnostic, but people need to pack more and more computing power into smaller spaces. Cost-efficient HPC delivery and power and cooling were the criteria for the AT/DC. The Intel Xeon processor 5600 series provides the dense, powerful HPC required by the data center and is also designed for energy efficiency."

Energy prices in Iceland are extremely low but overall efficiency was important on several counts. Advania wanted to combine high-production quality with low TCO and dovetail these benefits with high power usage effectiveness (PUE) to deliver a globally elite data center on all counts.

The Intel Xeon processor 5600 series regulates power consumption and intelligently adjusts server performance according to application demand. By automatically shifting the CPU and memory into the lowest available power state, this maximizes both energy cost savings and performance. In the near future processor upgrades to the Intel® Xeon® processor E5 family, which is optimized for cloud operations, are likely to take place.

The HP ProLiant G6 line also includes advances in energy efficiency, virtualization and automation. For example, one of its features is the HP Sea of Sensors.* Thirty-two smart sensors automatically track thermal activity across the server and dynamically adjust system components such as fans, memory and input/output processing to optimize system cooling and increase efficiency.

Karl Hansen, business manager for HP, said: "From the HPC, political and environmental perspectives, the Thor data center is a landmark project. It's the first time that disparate organizations have come together to create a green operation that utilizes natural resources and shares HPC resources."

Transformation and collaboration

Ebba Thora Hvannberg, professor of computer sciences at the University of Iceland, says the AT/DC is set to transform collaborative projects between research centers across the region: "Evaluation of energy costs was one of the success criteria for all organizations involved in the project, and together we expect to save at least half of the costs we were previously paying.

"By moving equipment away from the University of Iceland, we gain access to more powerful and scalable HPC resources than we had on our own. Ultimately, we expect collaboration between centers to be very fruitful. This will also overcome the resistance to shared HPC resources displayed by some organizations."

Another advantage to locating the data center in Iceland is the existence of network (Internet) submarine cables strung across the Atlantic Ocean floor. Although at the moment the AT/DC is primarily being used by Scandinavian research organizations, there is plenty of spare computing and storage capacity and Advania has been receiving enquiries from organizations throughout Europe and America.

Kolbeinn Einarsson explains: "The infrastructure already exists to provide remote computing services to other countries beyond the Nordic regions. For example, computer services can be delivered to the UK from Iceland with only a 40 millisecond latency delay."

Einarsson says the data center will expand as and when it needs to, but for the present, the focus is on providing HPC resources to research organizations across Norway, Sweden, Denmark and Iceland. While the carbon-neutral energy sources available in Iceland are clearly the foundation for the AT/DC, the hardware provided by Intel and HP complements and galvanizes a data center model that could, in the future, become a template for compute services delivery.

Governments and large organizations are already enquiring about the services delivered by the data center and Karl Hansen believes that ultimately its carbon-neutral, geo-thermal, energy-efficient model could signal the beginning of new forms of compute power delivery in which compute power and storage are delivered remotely at a fraction of the cost paid today.

Find the solution that's right for your organization. Contact your Intel representative, visit Intel's Business Success Stories for IT Managers (**www.intel.co.uk/Itcasestudies**) or explore the Intel.com IT Center (**www.intel.com/itcenter**).

Spotlight on Thor Data Center

The AT/DC is a 28,000 square foot facility 10 minutes from Reykjavik, Iceland. It is one of the most energy efficient data centers in the world. Using free-cooling elements, power utilization is extremely efficient. The data center is powered by clean, renewable hydroelectric and geothermal energy sources and offers a unique value proposition for companies who require a reliant and cost effective hosting service in a 100 percent green, zero-carbon footprint environment.

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