CASE STUDY

GRC GREEN REVOLUTION COOLING

The Immersion Cooling Authority®

VSC VIENNA SCIENTIFIC CLUSTER

Vienna Scientific Cluster's Immersion Supercomputer: Extreme Efficiency, Needs No Water

Find Out How GRC's Technology Helped VSC Get More Compute for Less.

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Abstract

The Vienna Scientific Cluster (VSC), created to satisfy the demand for High Performance Computing (HPC) of a consortium of five Austrian universities, released a competitive tender to build the most powerful supercomputer in Austria. However, this was not your regular competitive bid process where systems that meet the minimum requirement compete purely on the bid price. The VSC took a long-term perspective towards cost and performance, they defined very specific targets and tests that reflected the long-term cost of the system. GRC came together with ClusterVision, Intel®, and Super-micro® to create a custom solution that came out well on top of the competition.

This paper will explore how GRC's technology helped dramatically reduce the upfront cost and energy consumption of the system. Thereby allowing reallocation of capital towards more computing power.

VIENNA SCIENTIFIC CLUSTER

VSC oversees High Performance Computing for a group of progressive Austrian universities

Introduction

When the five Austrian universities came together to create the VSC-3 their aim was to build the most powerful mainframe computer in Austria, while ensuring minimal cost of ownership. Getting the most computing power for a limited budget is something every data center planner strives for. However, the VSC went a step further and changed the very way in which systems are procured. Traditionally, organizations define a minimum level of computing power, they decide on a ballpark budget, and then invite bids from vendors to meet those requirements at the lowest possible cost.

VSC on the other hand created a procurement process that would reflect the total cost of ownership for the system over a longer period of time. They defined very specific metrics and tests for the systems and then compared their performance scores along with their upfront and operating costs. By measuring what they truly wanted, the VSC was able to get a system that was custom tailored to their needs. GRC (Green Revolution Cooling), in partnership with the leading European commercial HPC cluster specialist, ClusterVision, as well as Intel and Supermicro, created a solution that beat every other competitor, including big brand OEMs and other precision cooling solution providers.

Selection Criteria

VSC defined a point system on which each competing system would be tested. All entries were put through an acceptance test to ensure that they meet the minimum requirements for computing power, energy efficiency, network performance, and storage performance. The acceptance testing included a stability test followed by an endurance test.

Once accepted, each of the systems were tested on:

- Computing Power
- Energy Efficiency
- Price

Let's take a deeper look into how such a criteria reflects total cost of ownership of a system:

Description	Value	Units	Source
Upfront Cost	€6,000,000	Euro	Estimated
Computing Power	500kW	Kilo Watt	Estimated
Total PUE	1.15	-	Predicted Target
Cost of Power	€0.13	€/kW-hr	Average Cost of Industrial Electricity in Austria[1]

*Assumptions - Not reflective of final installation, these are GRC's estimates for a typical installation.

Results

Calculating the total cost of the system based on the above assumptions, over a five-year period shows that the cost of energy for even an extremely efficient system would be about 35% of the total cost of ownership.

Costs Over 5 Years

Energy	€3,274,050.00	(35% of Total Cost)
Ownership	€9,274,050.00	

Hence, including energy efficiency as a procurement criteria and giving it the appropriate weightage helped the VSC get a system that not just had a lower upfront cost but lower operating cost as well.

Further, the comprehensive testing on each of the metrics ensured that they confirmed the true cost of the system. For example, the test for energy efficiency measured the power drawn by the complete system, including that of the IT hardware. Additionally, the VSC estimated the power requirements of supplying any cold water that the cooling system may use. This power requirement was calculated based on the water temperature requirements of the cooling system, and is reflective of the cost of procuring and operating an appropriately sized chiller plant.

GRC's ICEraQ micro-modular, racked-based cooling solution's ability to operate with water as warm as 50°C gave it a considerable edge over most of the competition. This meant that the system would not require a chiller even in the peak of summer where water temperatures approach 43°C. Thereby, completely eliminating the capital and operating expenses related with a chiller plant. Let's take a deeper look into some of the other factors that helped GRC come out on top.

GRC's Winning Solution Solution

The winning solution, pictured above, was installed in its Vienna home in July 2014. The Cluster is made up of 2,020 nodes, each with 16 processor cores housed in the ICEraQ system. The more than 600 teraflops of computing power takes up a mere 540 kilowatts of power and is packed into a little over 1000 square feet of white space. Making it one of the most efficient non-GPU based supercomputers in the world, while ensuring extremely efficient white space utilization.

Area	1,104	Sq. ft.
Total Power	540	kW
Number of Nodes	2,020	16 processors /each
Computing Power	>600	TFLOPS
Efficiency	0.8[2]	kW/TFLOP
Power Density	490	W/Sq. ft.

Another key highlight of the deployment was how GRC's technology enabled server cost reductions through hardware optimization. This reduction in server costs coupled with infrastructure savings helped the VSC get more compute from their budget.

To put things into perspective, 600 TFLOPS of power means that the cluster can perform more than 600 trillion additions or multiplications in just one second.

For example, in one nanosecond, VSC-3 could take the speeds and ranges of every pass and shot in the entire FIFA World Cup 2014 tournament and calculate the corresponding launch angles.

Key Benefits of GRC's Solution

Here are some of the key benefits of GRC's technology that gave it the competitive edge:

Lower Energy Requirements

Lower Cooling Energy — The ElectroSafe® coolant used in the ICEraQ system enables extremely efficient cooling. The coolant is a dielectric mineral oil blend, does not conduct electricity but is a good conductor of heat, making it ideal for cooling of IT equipment. This superior heat conductivity, drastically improves the system's ability to both extract heat from the servers and subsequently to expel that heat out of the system.

It is this property of ElectroSafe that allows the ICEraQ system to maintain core temperatures well below conventional cooling methods even with water as warm as 50°C. The ICEraQ system boasts a PUE of 1.02-1.033, as was reported by Intel based on tests carried out for over one year.

Lower Server Energy

Besides reducing the energy required for cooling, the ICEraQ system also reduces the energy consumed by servers themselves. The system completely eliminates the need for many components such as server fans, as is explained in greater detail further in this paper, this reduction of components along with superior thermal management helps reduce the energy drawn by the IT load itself. The ElectroSafe coolant helps eliminate hot spots, and reduces current leakages from components. These savings added up to a 10-20% reduction in energy drawn by the cluster itself.

More for Less

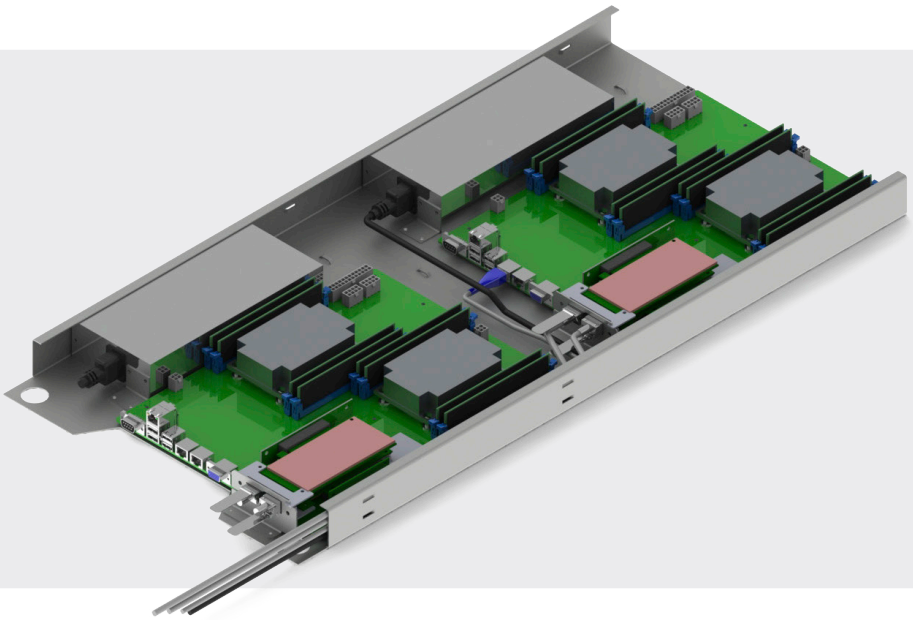
The price of a system is usually directly proportional to its computing power. So an increase in computing power would result in a higher priced system. However, GRC's technology enabled dramatic reductions in equipment and infrastructure costs, allowing a bigger portion of the budget to go towards computing power. Here's where these savings came from:

Simpler Infrastructure — Apart from eliminating the need for any kind of ambient cooling such as chillers, and air handlers, the lower power rating of the data center helps downsize the complete infrastructure, including backup generators, UPS batteries, and power distribution.

Optimized Hardware — The use of the ICEraQ system enables the optimization of hardware for cost and energy reductions. There are a few obvious ways wherein the hardware can be optimized to cut down the costs of the servers.

Most OEMs like Supermicro, in this case, give customers the option to customize hardware to their specific needs. Customizing hardware design and configuration can help further trim procurement and operating costs of equipment for use in the ICEraQ system.

Standard OEM systems are designed for a variety of applications and usually come with an abundance of expansion ports and/or memory channels on the motherboard. These are usually populated with additional and unnecessary components that use more power and therefore require more cooling as well.



Simplified Server:
Nothing is hidden from view
Savings of up to $300 per unit; $12,000 per rack

GRC's technology enables the removal of all these unnecessary components and channels on the mother board. This mixing and matching of hardware can help reduce both, the cost and power consumption of the system. The lower power rating also helps downsize the power supply, further reducing the cost of the hardware. An optimized power supply can save over $50 per power supply, while optimizing the motherboard itself can save over $100 per system. Additional savings are also available by picking memory without heat spreaders.

Overall, choosing the right combination, and size of optimized hardware can result in savings close to $300 per unit, adding up to a total of up to $12,000 per rack.

Besides the cost savings, the ICEraQ system allowed system designers to pick the optimal hardware for the application, without concerns regarding their form factor or thermal restraints.

Zero Water Consumption

Another key feature, of the installation was its ability to reduce water consumption to zero. The ICEraQ's ability to accept warm water, combined with the climate in Vienna allowed for the use of a dry-cooler instead of a cooling tower, thereby delivering water-free cooling around the year.

Conclusion

Performance and efficiency have always been seen as a trade-off for upfront costs. However, GRC's technology is changing that view, many customers like the VSC are realizing the true benefits of the ICEraQ system. Beyond the lower build and operating costs, the ICEraQ system is giving data center planners more flexibility to get more of what they want by making the whole system leaner, right from the data center architecture down to the servers, everything is optimized for performance and efficiency. GRC encourages innovation in hardware, and the ICEraQ system enables just that. For more information on how GRC can help design custom solutions for your next build, mail us at info@grcooling.com.

References

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