

IBM hot, water-cooled supercomputer goes live at ETH Zurich

Energy consumption is reduced by up to 40 percent and direct utilization of waste heat cuts carbon-dioxide emissions by up to 85 percent

Zurich, Switzerland, June, 2010, IBM (NYSE: IBM) has delivered a first-of-a-kind water-cooled supercomputer to the Swiss Federal Institute of Technology Zurich (ETH Zurich) marking a new era in energy-aware computing. Announced one year ago, the innovative system, dubbed Aquasar, consumes up to 40 percent less energy than a comparable air-cooled machine. Through the direct use of waste heat, which provides warmth to the university buildings, it decreases the carbon footprint of the system by up to 85 percent.

Making computing systems and data centers energy-efficient is a staggering undertaking. In fact, up to 50 percent of an average air-cooled data center's energy consumption and carbon footprint today is not caused by computing but by powering the necessary cooling systems to keep the processors from overheating – a situation that is far from optimal when looking at energy efficiency from a holistic perspective.

The development of Aquasar was part of IBM's First-Of-A-Kind (FOAK) program, which engages IBM's scientists with clients to explore and pilot emerging technologies that address business problems. The supercomputer consists of special water-cooled IBM BladeCenter® Servers*, which were designed and manufactured by IBM scientists in Zurich and Böblingen, Germany. For direct comparison with traditional systems, Aquasar also holds additional air-cooled IBM BladeCenter® servers. In total, the system achieves a performance of six Teraflops** and has an energy efficiency of about 450 Megaflops per Watt. In addition, nine kilowatts of thermal power are fed into the ETH Zurich's building heating system. With its innovative water-cooling system and direct utilization of waste heat, Aquasar is now fully operational at the Department of Mechanical and Process Engineering at ETH Zurich.

"With Aquasar we make an important contribution to the development of sustainable high performance computers and computer system. In the future it will be important to measure how efficiently a computer is per Watt and per gram of equivalent CO₂ production," said Prof. Dimos Poulidakos, head of the Laboratory of Thermodynamics in New Technologies, ETH Zurich.

Innovative water-cooling system

The processors and numerous other components in the new high performance computer are cooled with up to 60°C warm water. This is made possible by an innovative cooling system that comprises micro-channel liquid coolers which are attached directly to the processors, where most heat is generated. With this chip-level cooling the thermal resistance between the processor and the water is reduced to the extent that even cooling water temperatures of up to 60°C ensure that the operating temperatures of the processors remain well below the maximally allowed 85°C. The high input temperature of the coolant results in an even higher-grade heat at the output, which in this case is up to 65°C.

Dr. Bruno Michel, manager of Advanced Thermal Packaging at IBM Research - Zurich comments, "With Aquasar we achieved an important milestone on the way to CO₂ -neutral data centers. The next step in our research is to focus on the performance and characteristics of the cooling system which will be measured with an extensive system of sensors, in order to optimize it further."

Aquasar in the service of research

Aquasar is part of in the three-year, collaborative research program called "Direct use of waste heat from liquid-cooled supercomputers: the path to energy saving, emission-high performance computers and data centers." In addition to ETH Zurich and IBM Research - Zurich, the project also involves ETH Lausanne. It is supported by the Swiss Centre of Competence of support for Energy and Mobility (CCEM).

* The IBM BladeCenter Cluster is comprised of three IBM BladeCenter H chassis with a total of thirty-three IBM BladeCenter QS22 servers (two IBM PowerXCell 8i Processors each) and nine IBM BladeCenter HS22 servers (two Intel Nehalem EP Processors each). Water-cooled are two IBM BladeCenter H Chassis with in total twenty-two IBM BladeCenter QS22 and six IBM BladeCenter HS22 servers.

**Based on the High-Performance LINPACK Benchmark.

Further Information

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ETH Zurich

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