Furthering sustainability in high-performance computing

ABB and HPE implement technology to reduce energy consumption

Answers to some of society's most pressing challenges are buried in massive amounts of data. The world's top research centers use supercomputers as they try to solve some of the most complicated problems such as pandemic modeling, precision medicine, climate change and quantum mechanics.

To do this computational science, they process and analyze vast amounts of data, which requires a lot of compute capacity and a lot of power.

The next generation of supercomputers are about to surpass the one quintillion calculations per second barrier.

Hewlett Packard Enterprise (HPE) and ABB are partnering to implement technology to reduce energy consumption while increasing computing capacity.

Powering systems to save energy

One of the many challenges of sustainable computing is to increase compute capacity while meeting electricity parameters and innovating within the space limitations of today's highly advanced, densely built systems. Engineers working on HPE's Cray systems are constantly seeking ways to increase compute thresholds. Sacrificing computing capability for power is not an option in these high-performance machines, so ABB had to rethink how to provide the extra power.

The near-full footprint meant that there was little-to-no extra space to distribute electricity to the additional processors in a system. It also meant that there was limited free space for air-cooling of the power supplies, which is typically used in these set-ups.

The solution was an innovative liquid-cooled, 12.5-kilowatt, hot-swappable rectifier. A rectifier is a power supply that converts alternating current (AC) to direct current (DC).

The rectifier not only meets the power needs of the high-computing density, but also integrates directly with the supercomputer's liquid-cooled system with dripless connectors, which help protect the valuable electronics from becoming wet during installation or maintenance.

Each rectifier features a 96-percent energy efficiency. At the same time, the rectifiers can connect to, communicate and engage with the supercomputer. The system can "tell" the rectifiers when they need to ramp their power up or scale it down, depending on the computing load. That enables peak efficiency during light computing loads and when the system is fully loaded. In some situations, if the computer needs more than 100 percent power capacity, the rectifiers can also provide that.

"To get an idea how important power efficiency is for system energy savings, consider this: each power cabinet typically contains 24 rectifiers, and there can be anywhere from 50 to more than 100 cabinets in use for each supercomputer," said Peter Raadsen, Product Line Leader, ABB. "When you start multiplying rectifier efficiency by the number of cabinets and rectifiers per cabinet, the impact is quite significant."

In addition to the liquid-cooled rectifier, ABB also provided board-mounted DC/DC converter modules that help to ensure that the appropriate voltage level for the processors is applied at any given moment to meet demand needs – whether it is a light load or a heavy one.

The Cray computers use power supplies with a +/– 190-volt output instead of traditional 380-volt output levels, improving safety and placing the products in a lower safety hazard classification.

Sustainability benefits

The use of higher voltage direct current creates several sustainability benefits. The use of copper can be reduced by a factor of 14. Copper does not break down in the environment and potentially produces the equivalent of 5.5 – 9.5 t CO_2eq per ton extracted. Benefits also include material reduction in the distribution from pool to tray and the use of higher voltage direct current reduces the amount of power input conversions per tray.

Another environmental and efficiency benefit of higher voltage direct current is the vast reduction of power losses: by as much as 95 percent.

To realize the same benefits with a 12V distribution it would require over 1.000 times the amount of copper. This is something that would not be viable from both an environmental and cost perspective.

"We need to be able to do more computing with fewer resources and energy inputs," says HPE Chief Sustainability Officer, Christopher Wellise. "At HPE, we are committed to accelerating our path to a circular economy, and part of that is innovating technologies that overcome energy and resource constraints."

How system monitoring saves energy

Once a computer is up and running, it needs real-time monitoring of thermal and power aspects. HPE servers offer embedded power and thermal monitors on critical components with output data aggregated and reported through HPE Integrated Lights Out (iLO), a proprietary firmware management tool. iLO allows users to monitor equipment utilization, power consumption, and thermal output via tools, such as HPE OneView, HPE InfoSight, ABB Ability™ Data Center Automation, or 3rd party Data Center Infrastructure Management (DCIM).

"These insights allow users to increase utilization, avoid overprovisioning and minimize data center cooling to actual heat generation, preventing overcooling and the associated energy consumption," said Wellise.

"That is where integrating HPE's iLO and OneView software capabilities at the server level with ABB Ability™ Data Center Automation, ABB's industrial solution for on-premise and hybrid cloud environments, becomes interesting," he added.

By integrating both IT and OT solutions, HPE and ABB were able to automate the correlation between workload and CPU dynamics with cooling of the data centers. The result: a reduction of energy use of up to 30 percent, translating into 300.000 euros of annual savings per 1,000 m² on average. This integrated IT/OT system view, combined with the innovation at the material and electrical level, can bring a completely new paradigm into sustainability in computing.

Paving the way

HPE and ABB have been global, strategic partners since November 2017. The relationship combines the best of ABB's digital offerings with HPE's leading innovative connectivity, secure edge compute and hybrid information technology (IT) solutions, as well as new everything-as-a-service models.

Their combined expertise – ABB's roots and expertise in industries which go back more than 130 years, and HPE's excellence in IT solutions – enabled a unique perspective on how to increase the sustainability of high-performance computers.

ABB and HPE are paving the way for sustainable high-performance data centers so that humanity can find answers to existential problems such as predicting pandemics, fighting climate change and discovering new medicines.