

ZutaCore joins the startup crowd to surf the coming wave of liquid cooling

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Summary

Startup ZutaCore has emerged from stealth mode to mount a bid for the still nascent liquid cooling market in datacenters, where air cooling is still predominant. The company says its approach is different from those of others in that it combines the features of multiple techniques to achieve high-performance cooling without the cost and complexity. ZutaCore is working on initial deployments with at least one major datacenter provider and a manufacturer of prefabricated modular systems.

The 451 Take

ZutaCore's timing couldn't be much better – it is entering the race when it is about to actually start. 451 Research expects direct liquid cooling to finally enter the mainstream in the coming years, with some major datacenter operators leading the charge. Even though there are already numerous vendors in the area, ZutaCore managed to position itself differently with an approach that is easy to integrate into existing IT and facility practices without being prescriptive for the customer or technology partners. 451 Research views this as a major positive in a market where no two customers have identical requirements.

Context

ZutaCore was founded in 2016 in Israel with the objective to develop a direct liquid cooling (DLC) system that is less complex and not disruptive to established facility operations and maintenance practices. The company, funded by private individuals to the tune of about \$5m, currently employs about 20 and generated its first revenue in 2018. Most of its staff are engineers that have already filed for 14 patents on the DLC system developed.

DLC is a collection of various techniques that remove thermal energy from devices that generate heat (electronics in this case) with a fluid as the heat-transport medium, as opposed to using airflow. DLC is not new to datacenters; in fact, it has been around in various shapes and forms for decades,

including mainframes and high-performance computers. It is also widely present in high-performance workstations and gaming PCs.

Despite superior thermal conductivity of liquids compared with air, DLC has yet to become established for installations at facility scale – air cooling is still the standard in the overwhelming majority of datacenters. This may finally be changing due to a number of technological and market trends – such as escalating silicon power (processors and accelerators have hit or are approaching 300 watts), drive for lower capacity cost and growing concerns around sustainability – that challenge current IT and datacenters systems designed around the use of air cooling.

Technology

ZutaCore has created a DLC system called HyperCool2 that combines the precision delivery of cold-plate cooling and an evaporative (two-phase) coolant, which is a common type of engineered fluid in some full-immersion systems. Classical cold-plate systems circulate liquid, commonly water, in sealed metal 'heat sinks' with internal cavities that interface with the chip. Mechanically, the HyperCool2 is similar in that its heat sink is a sealed device that interfaces with the chip. However, unlike other cold-plate systems that capture heat via simply transferring it into a cooler liquid (such as water), HyperCool2 uses a latent heat phenomena where the dielectric refrigerant boils and evaporates rapidly.

This vaporization energy is where most of the thermal power from the processor is captured. ZutaCore currently uses 3M's Novec 7000 fluid, which exhibits a low boiling point and relatively high vaporization energy. The process removes heat from the chip and, by way of heat rejection, the gaseous coolant then flows to a condenser, cools and becomes liquid before being pumped back again at low pressure, typically under one bar gauge.

The net effect of this low-pressure, direct-contact vaporization is high cooling capacity for a little amount of coolant, unlike in a typical full-immersion system. ZutaCore says HyperCool2 needs a mere two liters of refrigerant per one kilowatt heat load. Furthermore, the company says HyperCool2 circulates less than 20 liters an hour, a fraction of many water-cooled cold-plate systems. Another feature of HyperCool2 is that it reacts in a self-regulatory fashion to changes in processor heat dissipation – when the processor is working hard and generates more thermal energy, the refrigerant heats up and evaporates faster and more refrigerant becomes available. This also allows the system to scale cooling capacity as higher-power server processors (2019 will likely see 250-300W models), GPUs and accelerators enter the market.

This level of control also allows the customer to choose the target temperature and level of cooling performance it wants to calibrate to by adjusting the condensation temperature. Lower pressure decreases the boiling point of the coolant, which means vaporization happens sooner. The company is developing software that allows users to monitor and control the cooling and is integrated with datacenter infrastructure management and IT services management suites, as well as a suite of software-defined-cooling functionality to be available down the road.

The direct-contact vaporization system shows very strong performance compared with air cooling. ZutaCore says its worst-case energy overhead is 6% of the IT load (partial power-usage effectiveness, pPUE, of 1.06), including the external heat exchanger on any climate. This compares with 15-40% design overhead – even in more recent, optimized air-cooled facility designs. On an annualized basis, HyperCool2 delivers a pPUE of 1.01-1.03. The total benefit is potentially even larger since DLC eliminates many server fans that amount to a nontrivial share of IT energy, typically in the region of 5-10% and up to 20%.

Strategy

A key point of HyperCool2 is that it can be integrated into existing infrastructure designs, supply chains and operational regimes without much disruption. ZutaCore manufactures and sells the components for HyperCool2 that go in a server, but doesn't bind the hands of customers for the rest of the infrastructure. Operators have a range of options for how they deploy HyperCool2 – from individual systems to datacenter-scale standardization. The company says it is simple enough to retrofit an existing server in minutes.

Even better for legacy operators, HyperCool2 does not necessarily mean major changes to the facility at the same time, since it can be installed in an air-cooled datacenter (using either air cooling or a water loop). ZutaCore is also offering an in-rack integrated condenser for tactical deployments targeted at specific high-performance applications, and to handle 'hotspots' in an air-cooled facility.

For larger, facility-scale installations, ZutaCore offers refrigerant-distribution units and outdoor condensers from datacenter equipment partners, but operators are free to source facility equipment as they see fit. Because ZutaCore's focus is on high-power electronics, such as server processors, accelerators and potentially high-speed optical network controllers, it doesn't capture all the heat in a server or the data hall. Facilities will still need air cooling, albeit much less of it, which helps with lowering costs and delivers a performance boost by helping processors sustain higher speeds.

ZutaCore is working with at least one major datacenter operator and a prefabricated modular datacenter provider to develop facility designs incorporating HyperCool2. It says it is also exploring the possibility of partnerships with datacenter equipment makers and major server suppliers, as well as with additional datacenter operators with sufficient buying power to steer their supply chains. The first production installations are scheduled sometime in 2019.

Competition

ZutaCore enters a market that counts many vendors, including some with the backing of major datacenter equipment makers. Launched in 2009, Iceotope is a UK-based supplier of immersion technology that has seen traction in recent years. Iceotope has an indirect technology partnership with Schneider Electric (via an investment from Aster Capital, which represents Schneider), and is already in extensive proof-of-concept testing with some major operators.

Asetek, a Danish vendor of various cold-plate systems, has formed a supplier relationship with some major server vendors, such as Fujitsu and Cray, as well as OCP-specialist Penguin. Canada-based CoolIT is a DLC technology supplier to high-end workstation component makers, as well as workstation and server system vendors. In 2016, it announced a partnership with (and investment from) German cooling specialist STULZ (via its US entity STULZ Air Technology Systems). Under the terms of the deal, STULZ is able to perform installations of CoolIT Systems. STULZ will also eventually manufacture and assemble certain components for CoolIT systems. There are also a number of major OEMs that have developed their own cold-plate systems for their customers, such as Dell, HPE and Lenovo.

Texas-based Green Revolution Cooling (GRC) was formed in 2008 and has been primarily serving HPC projects in the academic and government sectors in the US. On the back of that business, it has recently turned its attention to the more mainstream operator. Netherlands-based supplier Asperitas was founded in 2015, but had its official technology launch in 2017. Founder and CEO Rolf Brink originally planned to build a ruggedized IT system for ships, before realizing that the technology had wider applications. Spanish Submer is a recent entrant with an immersion cooling system that has won projects at CERN, the European particle physics research institute.

SWOT Analysis

Strengths	Weaknesses
ZutaCore's system offers high-performance cooling for processors and accelerators for little cost and no disruption to the supply chain or facilities operations.	Like any startup, ZutaCore needs to establish itself in what is a risk-averse market and is in the process of landing reference installations.
Opportunities	Threats
Datacenter infrastructure capacity is still growing fast, and cost pressure will only grow. At the same time, silicon power envelopes will escalate dictated by semiconductor trends and the economics of IT infrastructure for webscale cloud, engineering simulations, in-memory computing, big-data analytics, AI, and more.	The direct liquid cooling scene is getting crowded fast, although mainstream adoption is still some way off, and sizeable projects are sporadic. ZutaCore is up against some competition with years of operational experience and backing from major HVAC partners or server makers.

Source: 451 Research, LLC