



IMPACT REPORT

Immersion cooling firm Submer surfaces with breakthrough datacenter economics

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Barcelona-based startup Submer Technologies is one of the latest companies to try its luck in the increasingly busy (yet nascent) market for direct liquid cooling (DLC) with an immersion system. The company says it has managed to find a new sweet spot for immersion cooling that

delivers on both performance and cost. The company's technology has been in pilot production at some customers and is ready for prime time.

The 451 Take

Historically, the argument that DLC is both technically and economically superior to air systems has only convinced HPC users in any significant number – and probably IBM's mainframe users.

Submer is on the right track with its focus on affordability, compact footprint and ease of use.

However, the market for various datacenter immersion and other DLC systems counts probably a dozen active specialists, as well as some major server makers, which all compete for a limited number of deals. Comparisons are already difficult. Submer will need to find its own voice and articulate how it does things differently (and better) compared with more established DLC vendors. The timing is right:

Technology and market conditions have never been more favorable for the adoption of liquid cooling.

Context

Headquartered in Barcelona, Submer Technologies was founded in October 2015 to develop and market a new immersion cooling system that is high-performing and keeps costs low. Its management team has a track record in datacenter design, building and operation. The company recently received a grant from the European Commission under Horizon 2020, the EU's research and innovation framework program running from 2014-2020. The public funds will allow Submer to complete the development of the system (with additional features) and carry out pre-sales activities. Submer is also raising funds from venture capital firms to expand sales and marketing and to fund future manufacturing. In its submission to Horizon 2020, Submer has set an ambitious goal to reach €36.5m (\$44m) in revenue and to help create 92 skilled jobs by 2022. It currently employs about 20, most of whom are engineers.

Immersion cooling, also known as total liquid cooling, puts IT systems in a bath of dielectric fluid that captures the thermal power of processors, memory and all other

energized solid-state components. The value proposition is simple – immersion cooling fluids are orders of magnitude better at conducting and storing heat than air, and much less conducive to electricity. These properties make immersion cooling much more energy-efficient – particularly when the energy of IT system fans is accounted for, which can add up to 10-20% of the total IT load – and protect the IT equipment from corrosion, electrostatic discharges and fire better than air.

However, immersion cooling and other forms of DLC, such as cold plates in direct contact with chips, have yet to become mainstream. Even though DLC offers superior infrastructure economics, it is disruptive not only to facility design, build and operations, but also to IT procurement and practices. At the same time, air cooling hasn't hit hard technical limitations that would force the hand of most operators. Rack densities, the most often-cited driver for DLC, have remained moderate for the most part, while air cooling can handle the odd 20-30kW rack. Organizational inertia means that, outside the realm

of high-performance computing, operators and equipment vendors have largely carried on, and are still carrying on, optimizing air cooling designs.

There are signs of a looming shift, nonetheless. High-performance semiconductor technology is now producing chips that dissipate over 200W of thermal power from an area that is about the size of a thumbnail – some, such as NVIDIA's latest Tesla accelerator, reach 300W. The characteristics of existing semiconductor technology suggests future chips will become even more power-hungry to attain the highest possible performance, at which point air cooling becomes unviable, 451 Research believes. Air cooling already leads to marginal loss of peak performance (probably mid- to high-single-digit percentage on an application level). Recent Intel processor designs opportunistically boost speeds if more cooling capacity is available, as long as power and temperature remain under limits – limits which customers are able to set higher. Additionally, continued datacenter sprawl will only increase economic pressure,

which calls for denser and lower-cost facility infrastructure designs for next-generation builds. All this points in the direction of increased use of liquid cooling.

Technology

At the core, Submer's immersion system is a synthetic cooling liquid (as opposed to mineral-based) that the company has experimentally developed with a partner. Compared with some other engineered fluids, Submer's liquid is inexpensive at under €10 (about \$12) per liter, yet offers high cooling efficiency. Another key characteristic of the liquid Submer uses is the high optical performance (or low optical loss) for submerged fiber connections. The fluid is a single-phase coolant (it does not change state), which means it does not evaporate like two-phase fluids. In theory, two-phase coolants are more energy-efficient because of the evaporative cooling effect. However, the difference is marginal for the overall infrastructure, and the higher price of two-phase fluids and the system to contain the vapor will likely offset any savings in energy.

Submer also believes the baseline system it has developed is compact and highly efficient due to extensive optimization of the components – the units that will soon hit the market are third-generation designs. The commercialized product will likely be called SmartPod 3. In its standard configuration, the system offers 50kW cooling capacity for either 22 or 45 horizontal rack units of IT systems. The pods come in a highly water- and dust-resistant package (International Protection Marking 65) that makes them viable in unconditioned environments, such as office buildings, warehouses and factory floors. The pods can also be stacked two or three units high to save on footprint.

Strategy

Like most early-stage startups, Submer is actively courting prospective customers from all walks of life. Immersion cooling is relevant for virtually all application areas (e.g., hyperscale core sites, high-performance scientific and

technical computing, enterprise application acceleration, and remote edge locations). A key prospect is CERN, the European Organization for Nuclear Research.

Submer is working on a couple of development projects to appeal to specific types of customers. One example is its effort to develop an Open Compute Project (OCP) version of its pod that will sport electrical rails for OCP rack power distribution. It has also developed an OCP-compliant chassis for IT systems that is optimized for dense vertical installation in immersion cooling systems.

Another specific type of clientele that Submer claims is interested in its technology is crypto-miners. Keeping costs down is of utmost importance for individuals and organization that are mining cryptocurrencies such as bitcoin. Crypto-mining is fundamentally a money-making endeavor where miners want to maximize profit and minimize cost, so mining operations move to locations where electricity, hardware and operations are the cheapest. In an effort to create artificial scarcity, the bitcoin system, in particular, was designed to make

bitcoin harder to mine, resulting in increasing compute demand, which is triggering efficiency measures inside and outside of the datacenter. Since the beginning of 2018, with the sharp decline in the price of bitcoin and other cryptocurrencies (compared with December 2017), crypto-miners are looking at novel ways to keep their costs as low as possible.

To address such requirements, Submer has adapted its SmartPod for GPU- and ASIC-heavy use cases such as crypto-mining; it calls this CryptoPod. The CryptoPod has lower functional diversity and no redundancy of components, in order to keep costs down. It also lacks extras, such as a touchscreen control panel for on-site management.

Competition

Submer competes not only with myriad air cooling system vendors, but also a growing number of DLC suppliers, some of which have been on the market for over a decade, starting out by selling cooling systems for high-end PCs

and high-performance workstations. 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.

Vendors of immersion cooling systems offer a closer comparison with Submer. 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. 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). 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.

SWOT Analysis

Strengths

Submer has engineered a high-performing yet cost-effective product, and is backed by EU funds.

Weaknesses

Submer is a young startup with few reference installations and only limited operational record for its systems.

Opportunities

Demand for power-hungry silicon required for high-performance applications will only grow with engineering simulations, in-memory computing, big-data analytics, AI and more.

Threats

Numerous vendors of liquid cooling systems vie for still sporadic projects. Some have years of operational track record and backing from major HVAC partners or server makers.

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M&A ACTIVITY BY SECTOR

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Submer Technologies (/search?company=Submer+Technologies)

COMPANY MENTIONS (OTHER)

Asetek , Asperitas , Aster Capital , CoolIT Systems , Cray , Dell Technologies , European Commission , CERN , Fujitsu Ltd , Green Revolution Cooling , Hewlett Packard Enterprise , IBM , Iceotope ,

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