

**TECHNICAL ANALYSIS:**

# What Dell Technologies' study means for data center cooling

**A recent Dell Technologies study shows single-phase direct liquid cooling the most thermally effective compared to four other data center cooling methods.**

This highlights a potential pathway for better sustainability and increased efficiencies.

The study, titled "Performance Comparison of Five Data Center Server Thermal Management Technologies" by Dell technologists

tested thermal models of leading data center cooling technologies including:

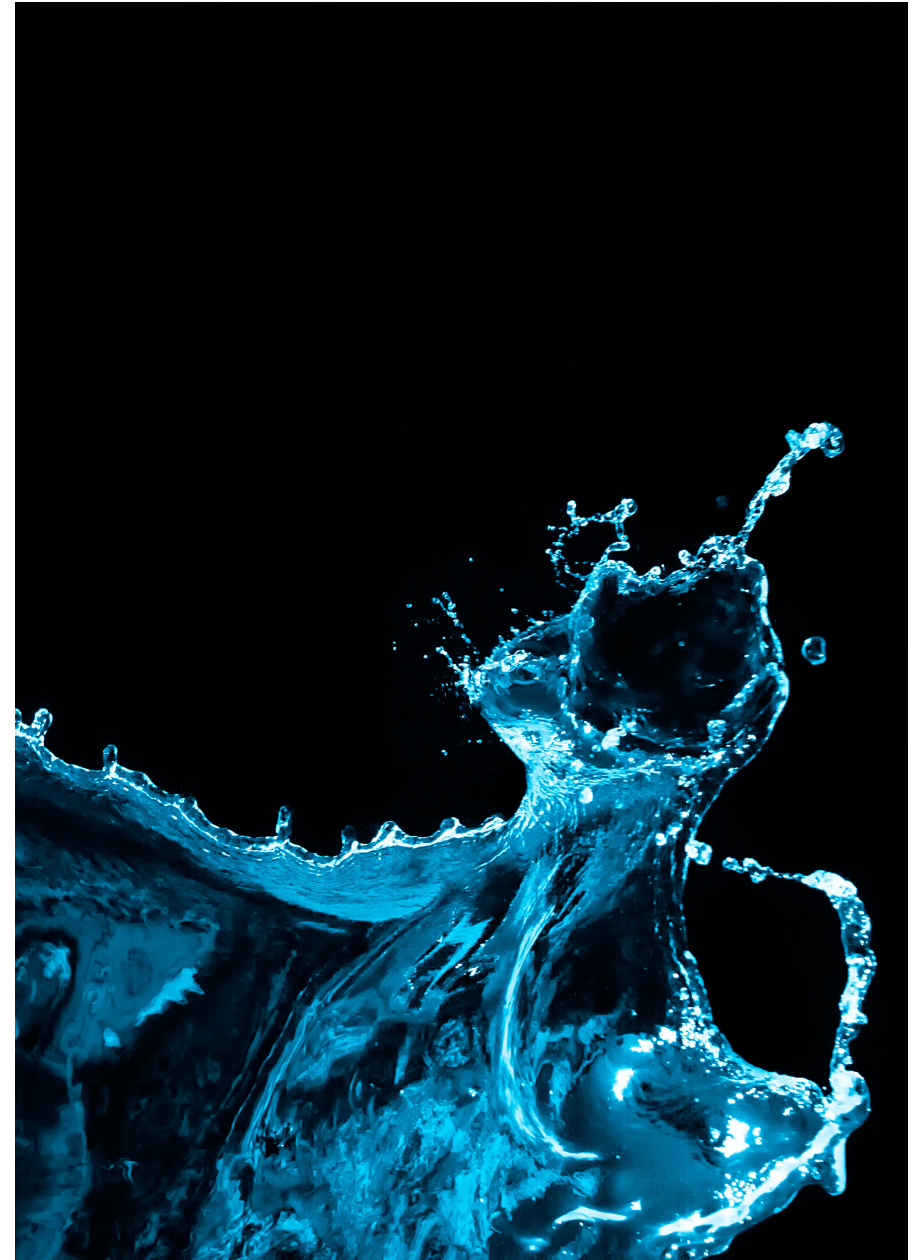
- Air cooling
- Single-phase immersion
- Two-phase immersion
- Two-phase direct liquid cooling
- Single-phase direct liquid cooling.

Here are three important takeaways for data center operators and engineers to consider:



## Over The Next Five Years We Could See Single-Phase Direct Liquid Cooling Emerge As The Most Commercially Viable Thermal Solution

- **Air Cooling:** Thermal management innovations will either extend air cooling at the expense of space or enable hybrid air and liquid cooling systems to support higher TDP processors or increase thermal solution efficiency.
- **Single-Phase Immersion:** With thermal effectiveness being similar or worse than air cooling, with available technology limited to 400 W processors, investing in non-traditional data center infrastructure that will likely become outdated in the near future requires careful consideration.
- **Two-Phase Immersion:** With the looming uncertainty of viable two-phase coolants due to PFAS regulations, the fluid selection is further limited by the saturation temperature of the coolant as the chip package temperatures continue to decrease. The technology is also shown to be approaching its limits with 500W packages.
- **Two-Phase Direct Liquid Cooling:** With performance on par with 25% PG-Water mixture 1-Phase DLC for up to 500W and at 0.5 lpm, the entire liquid cooling technology portfolio may need to be redesigned to support the future processor roadmap.



## Infrastructure Investments are Critical for Time-To-Market Deployments

- Liquid cooling infrastructure investments are critical for time-to-market deployments as these can be valued at millions or even billions of dollars. But with so many diverse choices for liquid cooling technology in a data center, a clear investment strategy hasn't emerged until now.
- Direct Liquid Cooling Technology utilizes infrastructure and products designed over the past four decades to provide reliable liquid cooling performance for the most demanding data centers. Direct Liquid Cooling Technology has the longest proven track record and the greatest performance opportunity to provide a clear infrastructure investment strategy for the next generation of high-performance IT demands.



### **Single-Phase Direct Liquid Cooling Technology's has Matured with the High-Performance Computing Market's Innovations**

- Single-Phase Direct Liquid Cooling technology has been in development by various IT suppliers for over 40 years. The computing industry has utilized a wide variety of Direct Liquid Cooling cold plates to cool the highest power silicon around.
- In that time a wide variety of vendors have established product lines and solutions to meet the growing need for Direct Liquid Cooling. The supply chain, reliability, and proven track record of Direct Liquid Cooling has prepared it to be the premier technology ready to take the IT market into the next generation of performance.

