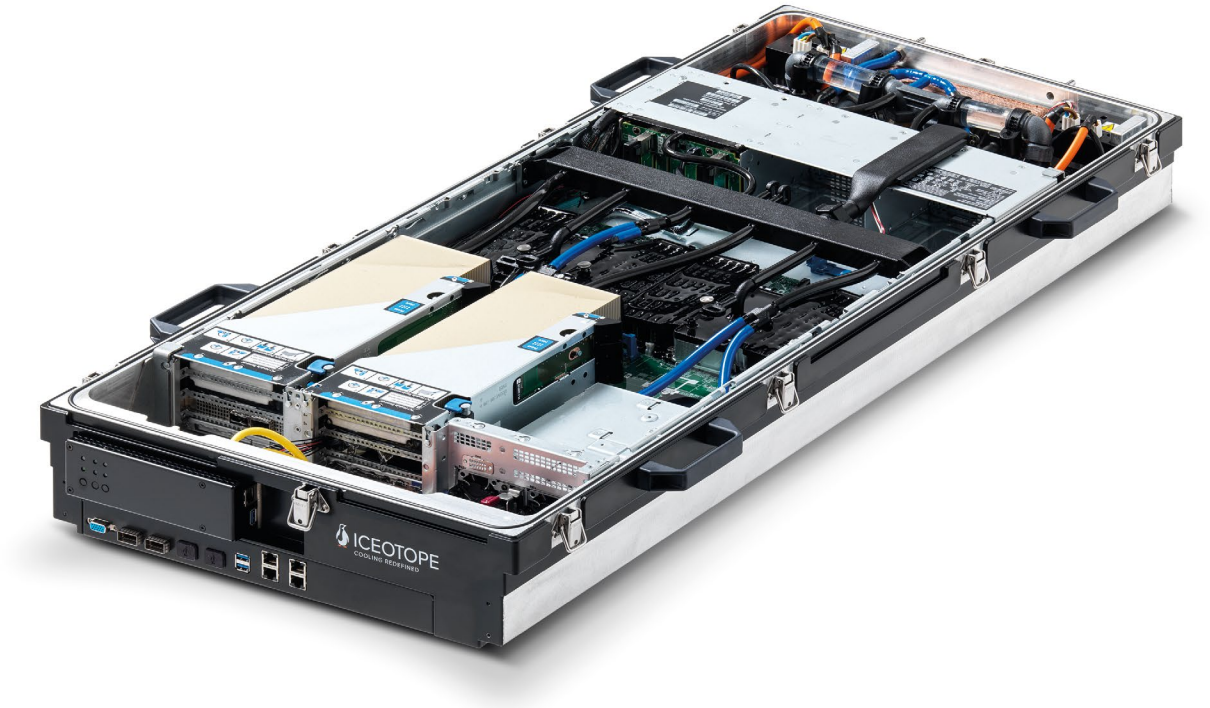
White Paper 312
Revision 1



HPE ProLiant DL380 Benchmark Analysis

Precision Liquid Cooling vs Air Cooling

Artificial intelligence and high-performance computing applications are having a transformative impact on industries from life science to healthcare to financial services. They are also transforming data center design as the processing requirements for these applications is creating a paradigm shift in the data center environment.

As compute densities increase, so too do the energy demands of individual servers and racks. Add to this growing pressure to lower carbon emissions, as well as the requirements of distributed edge locations, data center operators are at the center of a perfect storm. Legacy air-cooled data halls can no longer keep up with the demands of the technology.

To better understand the operational advantages of Precision Liquid Cooling vs air-cooled systems, Iceotope teamed up with Hewlett Packard Enterprise (HPE), Avnet Integrated and Intel to conduct a benchmarking test of the KUL Data Center solution. Iceotope has had an OEM agreement to offer liquid cooling with HPE ProLiant servers since 2021.

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Testing Environment

Iceotope's KUL Data Center solution was compared to a traditional air-cooled system using a 19.6kW load comprising 16x HPE ProLiant DL380 Gen10 servers under stress test conditions.

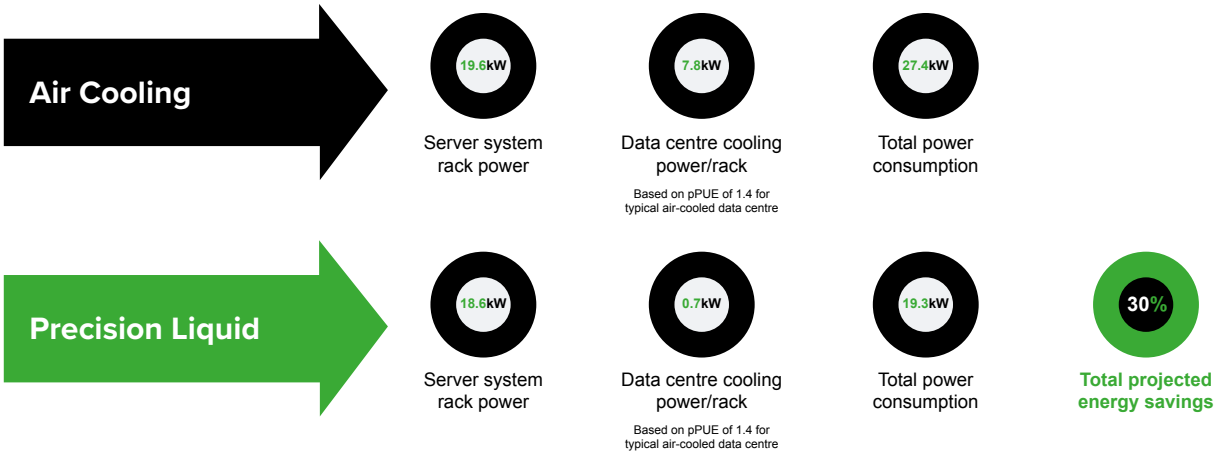
Air Cooling	Liquid Cooling
6250 CPU SKU (185W TDP) Low Tcase	6250 CPU SKU (185W TDP) Low Tcase
✓ 20 -30 degC air inlet temperature while running Linpack	✓ 20 -30 degC water inlet temperature while running Linpack
6246R CPU SKU (205W TDP)	6246R CPU SKU (205W TDP)
✓ 20 –30 degC air inlet temperature while running Linpack	✓ 20 -30 degC water inlet temperature while running Linpack

The systems were tested using Linpack High Performance Computing (HPC) benchmarking across a range of ambient temperatures. The tests measured rack and server component temperatures, as well as energy consumed by the pumps and servers, to identify performance benefits and energy savings of the KUL Data Center.

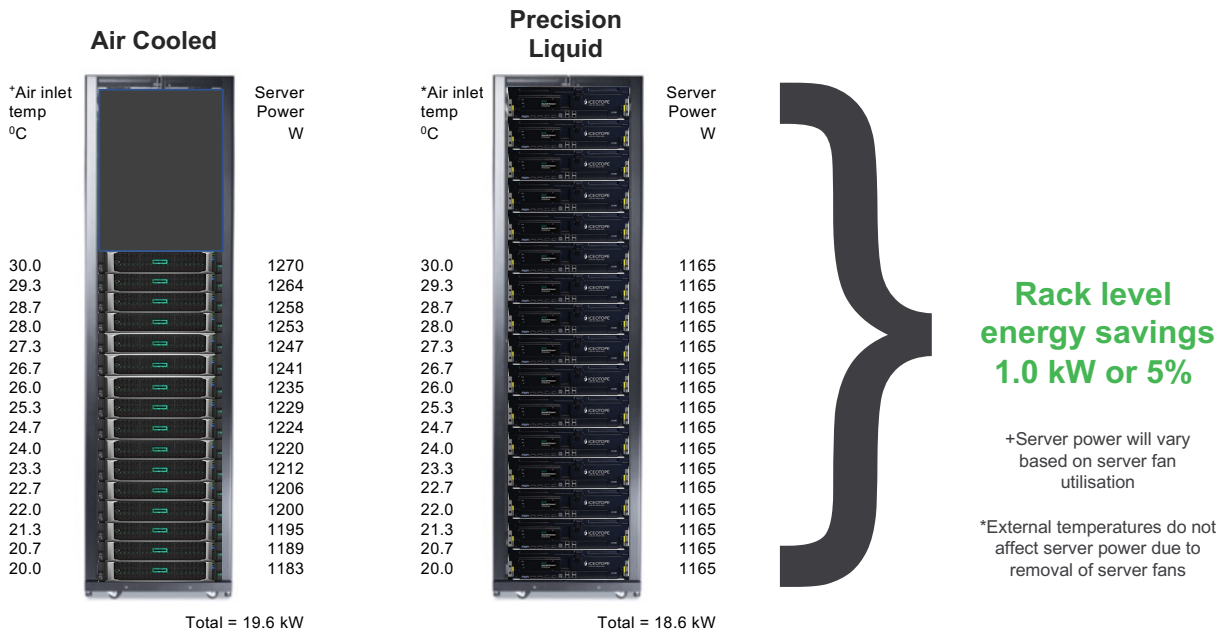
Performance Results

Performance Improvement and Energy Savings

The laboratory tests showed the Iceotope Precision Liquid Cooled system enabled a **4% increase in server performance** at elevated temperatures. The liquid cooling systems also consumed 1kW less energy at rack level than its air-cooled counterpart, representing a **5% energy savings in the IT Equipment alone**. Assuming a typical cooling power usage effectiveness (pPUE) of 1.4 in air and 1.04 in liquid cooled data centers, a can be projected. A breakdown of this savings is as follows:



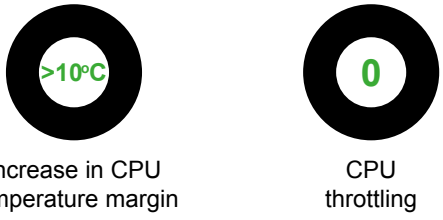
Assuming air-cooling infrastructure consumes, on a per rack basis, a pPUE of 1.4, a data center operator has to allocate about 7.8kW of cooling infrastructure power. Add that to the server system rack power of 19.6kW, total power consumption becomes 27.4kW. With liquid cooling, the server system rack power starts at 18.6kw. This is due to the removal of fans and other air-cooled infrastructure on the server. Assuming a pPUE of 1.04 for liquid, data center cooling power is now only 0.7kW – a figure one-tenth of the air-cooled system. Total power consumption is now 19.3kW, more than 8kW less than the air-cooled system, which translates to a projected 30% total energy savings.



If you multiply that 8kW savings across 20 rows of 20 racks in a data center environment, a substantial cost savings opportunity emerges for a data center operator. This is in addition to the sustainability benefits of reducing energy consumption overall with Precision Liquid Cooling. There is also no stranded power, due primarily to uncertain fan power demand in air-cooled servers. With liquid cooling, pump power is ~90% lower, enabling the racks to run more fully populated to facilitate more servers and storage devices, and/or denser IT loads.

CPU Temperature Margin

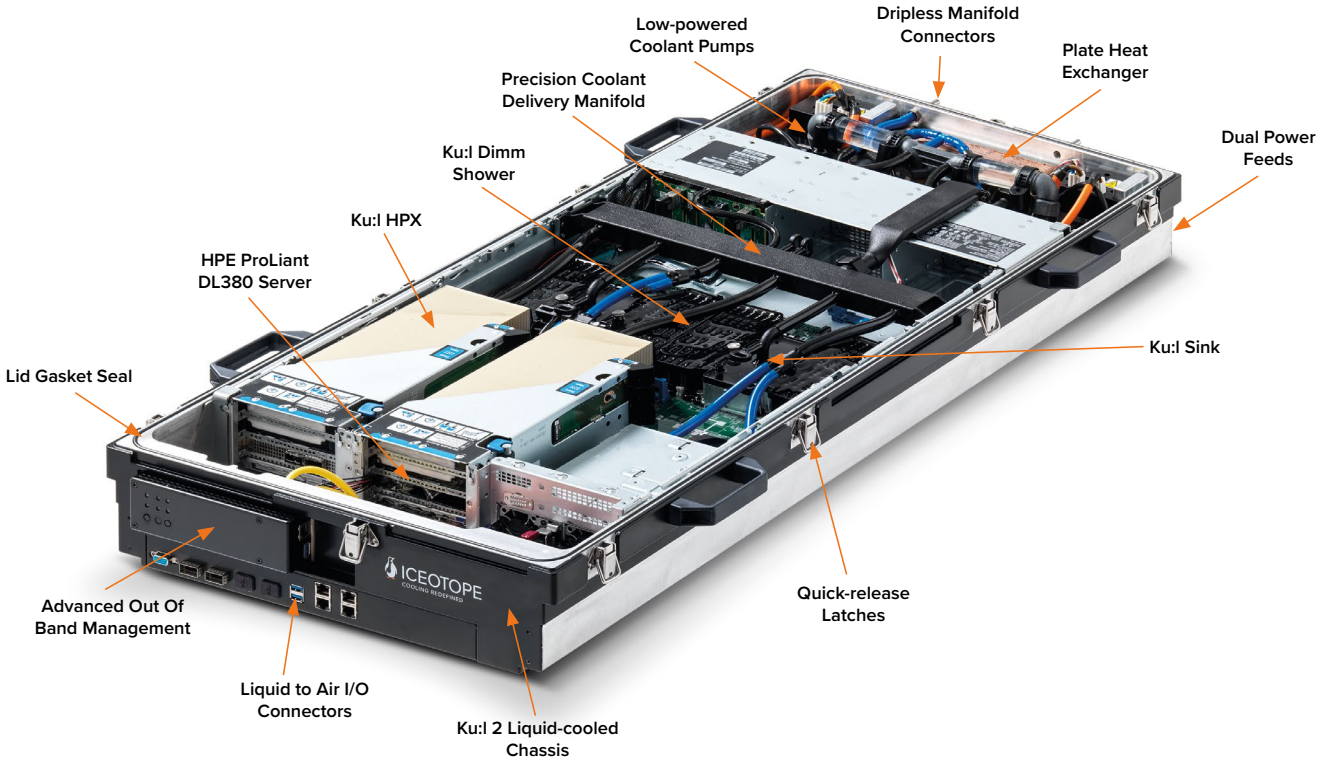
The benchmarking results showed a tighter temperature distribution and lower temperature overall with Precision Liquid Cooling than the air-cooled systems. Liquid cooling also had an increase in CPU temperature margin of greater than 10 degrees Celsius (degC) compared to air cooling on 6250 SKU with further margin on the 6246R SKU. No CPU throttling was encountered in higher ambient temperatures at the server level with liquid cooling, whereas throttle events occurred at 30 degC ambient for the air-cooled solution while using 6250 CPUs.



Platform Resiliency

The results also indicated greater platform resiliency for the Precision Liquid Cooling system. In order to avoid the throttling mentioned above, the air-cooled systems would have to limit configuration and/or ambient temperature to less than ~27degC. This was not the case for liquid cooling as it is less dependent on ambient temperature. Liquid cooled chassis are 100% sealed protecting the critical IT from the surrounding atmosphere – rendering it impervious to extreme temperatures, dust, gasses, and humidity – and creating a stable operating environment.

With the increased system demands from high performance computing applications, guaranteed performance is becoming critical to data center operators. Financial service organizations, for example, that are running high frequency trading applications cannot afford the split-second change in performance when throttling occurs. With air-cooling technology, when a CPU hits a certain internal temperature, the system throttles down until the temperature drops below its internal protection threshold. This cycling of power will continue to keep the system running, but to both a financial and performance cost to the trading applications.



Conclusion

The performance benefits and energy savings highlighted during the benchmark testing demonstrates that Precision Liquid Cooling technology delivers predictable data center cooling and reduced complexity at scale. Air cooling can no longer be used precisely or sustainably to cool high-power chips and processors. In fact, it is becoming increasingly likely air cooling will no longer be able to ensure an appropriate operating environment for energy dense IT equipment. As technology evolves, so too must data center cooling technology. The newest technology from chipsets to servers to rack density increasingly require liquid cooling solutions.