Oregon State University Leads the Way in Data Center Innovation with Liquid Cooling

Oregon State University (OSU) has a long-standing reputation for excellence in technology, research, and education. Among its standout facilities, the College of Earth, Ocean, and Atmospheric Sciences has embraced innovation to meet growing computational demands for AI, high-performance computing (HPC), and climate studies. In response to a broader challenge for the research community to consolidate data centers, enhance sustainability, and reuse heat generated by computer systems, the College adopted waterless, two-phase direct-to-chip liquid cooling technology.

Transforming Computational Performance and Sustainability

OSU’s focus on cutting-edge research required an infrastructure capable of handling sophisticated numerical modeling and AI workloads, such as those involved in the $220 million Ocean Observatory Initiative. However, scaling their data centers to meet performance needs came with significant challenges. Traditional air-cooling methods were already reaching their limits, and expanding capacity would have required massive energy consumption, additional space, and significant operational overhead.

By integrating waterless, two-phase direct-to-chip liquid cooling technology provided by ZutaCore®, OSU overcame these challenges while achieving unprecedented operational efficiencies. This innovative solution enabled the University to reduce processor temperatures by up to 30%, reclaim energy previously lost to inefficient cooling systems, and achieve a 20% improvement in compute performance.

Building a Heterogeneous Data Center Infrastructure

At the heart of OSU's College of Earth, Ocean, and Atmospheric Sciences is a heterogeneous data center infrastructure supporting servers from Dell, HP, and Supermicro and processors from NVIDIA and AMD. With network capabilities reaching up to 200G, this environment is designed to handle diverse workloads, ranging from HPC simulations to AI model training.

To prepare for the influx of data and increased demands posed by newer AI and HPC technologies, the University committed to modernizing its existing data centers. The objective was to ensure seamless compatibility with an upcoming $200 million supercomputing data center, one of the fastest in academia. This modernization effort was driven by a need to maximize energy efficiency, improve compute density, and lay the foundation for a resilient, unified network of high-performance, interconnected data centers.

Innovating for Maximum Energy Efficiency and Space-Saving Design

OSU's move to liquid cooling technology was a critical step toward meeting sustainability and performance goals. Traditional air-based cooling systems were inefficient, requiring 70 tons of cooling for their existing infrastructure with projections of an additional 240 tons to manage future demands. Scaling this approach would have been energy-intensive, expensive, and physically limiting due to space constraints.

ZutaCore's HyperCool® technology leverages a waterless design with a closed-loop pool-boiling circulation of dielectric heat transfer fluid, which directly absorbs and dissipates heat from CPUs and GPUs through a phase-change process. This design eliminates the need for water in the data center, thereby avoiding potential damage to server hardware while delivering 10 times more efficient heat removal compared to traditional methods.

The new cooling system enabled OSU to eliminate the need for four additional cooling systems, reclaiming critical power and allowing the University to meet its growing computational demands. CPU temperatures dropped from approximately 72°C to 66°C, significantly extending the lifespan of components and preventing performance throttling.

> **"Oregon State college of Earth, Ocean and Atmospheric sciences was able to retrofit many servers with the Zutacore 2 phase direct to chip liquid cooling technology to reduce data center heat load, increase processing and recapture of heat generated. This has allowed our group to take power that was going to be used for additional air based CRAC units and translate that into processing power for servers increasing our overall capacity with the same space."**
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> **– Christopher M. Sullivan,**
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> Director - Research and Academic Computing,
> College of Earth, Ocean, and Atmospheric Sciences

Retrofitting for the Future While Preserving Existing Equipment

One of the significant challenges OSU faced during its data center modernization was the need to retrofit existing servers and infrastructure without replacing them entirely. ZutaCore's HyperCool solution was designed to work seamlessly with existing racks, processors, and chilled water systems on campus. This retrofit approach not only saved OSU substantial costs but also minimized disruption to ongoing operations and enabled compatibility with a wide range of existing equipment.

The ability to retrofit servers with HyperCool also made the transition smoother for groups migrating from older, decommissioned data centers. These groups could connect directly into the liquid cooling system with minimal effort, maximizing resource utilization while meeting OSU's stringent energy efficiency standards.

Flexibility and Scalability with Chatsworth Products (CPI) ZetaFrame Cabinet System

The Chatsworth Products (CPI) ZetaFrameä cabinet system provided OSU with a scalable and adaptable solution for its data center upgrade. Features like removable back doors, space-saving designs, and simple installation allowed for efficient rack placement and better utilization of available space. The ZetaFrame system is designed to support high-density cooling needs, making it an ideal complement to ZutaCore's liquid cooling technology. Additionally, CPI's ability to customize its products to meet OSU's specific requirements showcased its commitment to flexibility and innovation, helping the University to scale its infrastructure effectively while staying ahead of future demands.

A Roadmap for AI and HPC Excellence

While the initial deployment of OSU's liquid cooling system focused on CPUs, plans are underway to extend the technology to GPUs, which are essential for powering advanced AI workloads. By retrofitting their infrastructure with scalable cooling solutions, OSU has laid the groundwork for advances in machine learning, AI model development, and climate computational research.

Additionally, OSU's liquid cooling system enables the reuse of heat, demonstrating a commitment to sustainability. Excess heat generated by the system is redirected to heat nearby buildings, contributing to the University's broader sustainability goals.