HeatSync Case Study

Advanced Direct-to-Chip Liquid Cooling Implementation in High-Density Data Centers

OVERVIEW

A leading cloud service provider aimed to retrofit its 4 MW data center to support direct-to-chip liquid cooling at 20 kW per rack. The objective was to enhance cooling efficiency, reduce energy consumption, and improve server reliability. HeatSync was engaged to develop a comprehensive solution encompassing detailed system-level modeling, AI-driven optimization, and performance validation.

1. CLIENT REQUIREMENTS

- **Direct-to-Chip Liquid Cooling Deployment:** Implement a cold plate design featuring microchannels (0.2 mm) and cooling fins (0.1 mm) to facilitate efficient heat transfer.
- **Coolant Evaluation:** Assess the performance of PG25, PG40, and 3M coolants to determine optimal thermal performance and compatibility.
- **System Optimization:** Design an efficient liquid cooling system by selecting appropriate pipes, pumps, valves, heat exchangers, and controllers to ensure adequate flow distribution to servers, storage units, and switches.
- **Energy and Water Consumption Reduction:** Develop an AI-driven optimization tool to adjust cooling component settings in real-time, aiming to minimize resource usage.
- **Enhanced Server Reliability:** Maintain lower operating temperatures to improve server longevity and performance.

2. LIQUID COOLING SYSTEM SIMULATION AND OPTIMIZATION

HeatSync utilized Simcenter Flomaster to create a detailed system-level model of the data center's liquid cooling loop. This simulation enabled accurate predictions of hydraulic and thermal performance at the chassis, rack, and data center levels. Key activities included:

- Component Sizing
- Design Scenario Evaluation
- Energy Consumption Estimation
- What-If Analyses

This comprehensive modeling approach facilitated early-stage design validation, ensuring the feasibility and efficiency of the proposed cooling system.

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3. AI-DRIVEN REAL-TIME OPTIMIZATION

In the project's second phase, HeatSync developed an AI-based optimization tool designed to:

- Continuously fine-tune operating settings of cooling components dynamically.
- Achieve significant decreases in energy and water usage through intelligent control strategies.
- Monitor system performance to anticipate maintenance needs, thereby reducing downtime and associated costs.
- Detect anomalies indicative of potential cyber threats, ensuring system integrity and security.

4. PERFORMANCE OUTCOMES

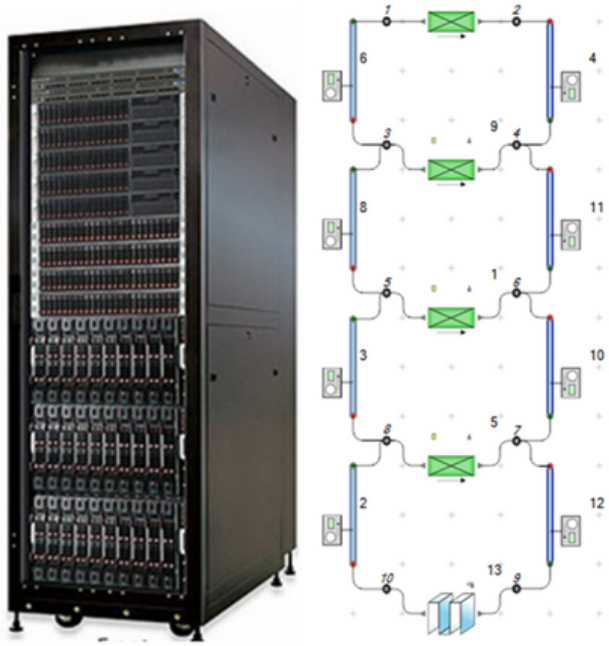
The implementation of the advanced cooling solution yielded significant improvements:

- **Energy Efficiency:** Achieved a 40% reduction in energy consumption compared to traditional air cooling methods.
- **Power Usage Effectiveness (PUE):** Improved PUE from 1.6 to 1.2.
- **Server Reliability:** Lowered operating temperatures contributed to enhanced server performance and longevity.
- **Operational Cost Savings:** Realized cost reductions through efficient thermal management and the implementation of AI-based predictive maintenance strategies.

5. CONCLUSION

HeatSync's integration of direct-to-chip liquid cooling with AI-driven optimization demonstrates a significant advancement in data center thermal management.

Contact HeatSync today to learn more about our advanced design, simulation, testing, and optimization solutions for data center cooling, enhancing energy efficiency, improving server reliability, and reducing operational costs through cutting-edge liquid cooling and AI-driven optimization.



HeatSync: Consortium of Thermal Management

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