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Design and CFD analysis of a tank solution for natural convection based single phase immersion cooling of servers.

By

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Microsoft Teams Link

Abstract

The issue of thermal management of data centers is becoming even more challenging with increasing chip power densities. This has been primarily driven by increasing demands in artificial intelligence and machine learning-based applications, increased usage of cloud-based services, and high-performance computing. The development of these applications has led to a corresponding increment in high performance and high power density CPUs and GPUs. Liquid cooling technologies are outperforming the traditional air cooling approach in dissipating high heat fluxes. Out of these technologies, single-phase immersion cooling offers advantages like substantially lower PUE values, simplified data center infrastructure, ease of deployment for edge data centers, improved reliability, and even temperature profile on the servers. This study focuses on the development of a natural convection-based single-phase immersion cooling solution for edge data centers. Eight servers were immersed in a tank filled with mineral oil were analyzed using CFD. The tank is directly cooled with integrated heat exchanging plates to cool down the hot fluid. The inlet flow rate and temperatures of the coolant in the plates were varied to determine the optimal value of the required flow rate. The baseline results of the air-cooled heat sink were also compared with the improved heat sink better suited for natural convection. The CPU temperatures and the temperatures of auxiliary components on the motherboard were also analyzed. Pumping power comparison of the baseline case where the entire tank is cooled using forced convection was also performed.