

Centralized vs. Distributed Pumping for Rack-based Direct Liquid Cooling

Superior performance and reliability has been realized in data centers that utilize centralized pumping systems. Centralized pumping assemblies offer multiple advantages over distributed pumping systems, and we've mapped out the comparisons to prove it.

Feature	CoolIT Systems Centralized Pumping	Distributed Pumping
Low-Profile Cold Plates	With a total height of 15.6mm, the CoolIT R3 Passive Cold Plate easily fits in all server and blade configurations.	Each cold plate has an integrated pump that renders it too high to fit into dense HPC server blade configurations.
Moving Parts	No moving parts, nothing to fail, never removed from server until the server itself is retired.	Each cold plate is a pump, a point of failure that must be monitored and removed from the server upon failure.
Points of Failure	A rack with 100 processors requires only 2 pumps and they are redundant.	A rack with 100 processors has 100 points of failure, each one on the server.
Ease of Maintenance	Pump maintenance is simple, less frequent and completed inside the heat exchanger not the servers.	Pump maintenance must be performed inside each server - time consuming and high chance of damaging other components.
Balancing Flow Through Servers	Centralized pumping through passive cold plates maintains appropriate flow distribution across all processors with minimal pressure changes from supply and return manifolds.	Multiple pumps increase pressure in the return manifold relative to the supply manifold. Because of this pressure differential: <ol style="list-style-type: none"> 1. A pump failure in a single pump loop will result in a reverse of coolant flow from return (warm) to supply (cool). 2. In a single pump failure within a dual pump loop scenario, the remaining operating pump will not have enough power to overcome the high pressure in the return manifold resulting in reduced coolant flow. 3. Heterogeneous processor environments struggle to overcome pressure challenges due to the mixture of single and dual pump loops. The single pump loops can be starved of flow.
Manifold Complexity	Only requires a single manifold to maintain appropriate flow to all servers.	A full rack requires three separate manifolds in order to counter the effect of over-pressurized return manifolds. This results in more connections, each being a failure point on the manifold.
High Pressure Facility Water	In the multiple rack scenario (CHx650), the higher pressure facility water stops at the CHx650 and is not brought to the racks. With the single rack (CHx40) scenario, the higher pressure facility water is brought to the rack and stops at the CHx40 Module heat exchange system.	In all scenarios of distributed pumping, the higher pressure facility water is brought directly to the rack and stops at the heat exchange system.
Cost of Cold Plates	Very low cost as no pump required.	Higher cost to pay for the pump in each cold plate.

Learn more about CoolIT's performance, efficiency and density benefits for data centers at www.coolitsystems.com.