Dell Smart Cooling Technology

INNOVATIVE COOLING
FOR MODERN IT

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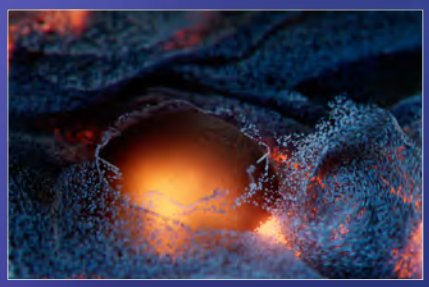

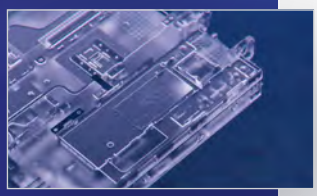

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THE NEXT GENERATION OF COOLING IS HERE

In these exciting times, **advanced technology** is fueling game-changing innovations that are furthering the role technology will play in shaping and enabling human potential. Equipped with the most powerful processors and accelerators to date, servers can create, mine, arrange and process ever-increasing amounts of data faster than we've ever historically imagined.

The sheer abundance of new data being produced globally is astounding. In only a year, the accumulated world data will grow to **44 zettabytes** (one zettabyte is 10007 or 30B 4K movies).

Organizations that embrace this **digital revolution** will undoubtedly grow their organization and reap the associated rewards.

To support this digital revolution, Dell Technology is incorporating more powerful components in every **PowerEdge server**. This is so company researchers, IT and business professionals, can accelerate new thoughts and pioneer innovations from this data like anticipating cancer, forecasting inclement weather or streamlining manufacturing through robotics, to name a few.

These new more powerful components consume larger amounts of energy and drive higher system heat. To get the most out of your servers **requires that your system be kept cool.**

SMART COOLING TECHNOLOGY

PowerEdge servers are designed with Smart Cooling which uses state-of-the-art thermal technologies with intelligent control systems to **ensure optimal cooling and sustained system performance.**

Smart Cooling consists of three primary cooling solution options: **Air Cooling, Direct Liquid Cooling (DLC) and Immersion Cooling**. These technologies provide PowerEdge customers with efficient cooling options that fit their IT and data center goals.

In addition, Dell OpenManage Power Manager complements each cooling option by giving customers powerful tools to **monitor and manage power and cooling** at the system, rack and data center level.

AIR COOLING

Air is cheap and readily available. To maximize the potential of air cooling, Dell invented Multi-Vector cooling. It is comprised of control algorithms, thermal and power sensors, component mapped fan zoning, and airflow channeling shrouds to balance and intelligently direct airflow across a symmetrically arranged group of key sub-systems.

Key sub-components include:

FANS • In addition to cost-effective standard fans, multiple tiers of high-performing, Dell-designed fans are supported to increase system cooling. The high-performance silver and gold fans can be configured into next-generation PowerEdge servers to support increased compute density.

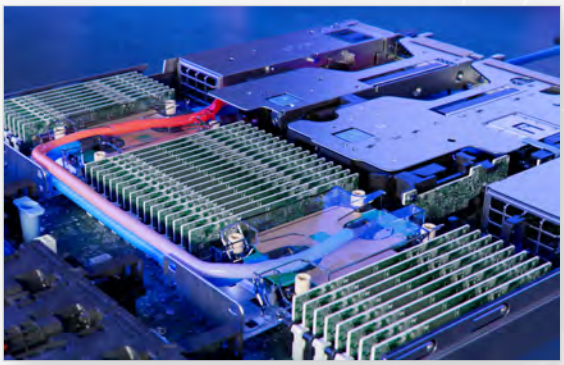
HEATSINKS • The improved Dell CPU heatsink design not only improves CPU cooling capability but also helps to streamline airflow and air temperature distribution across the chassis. Innovative heatsinks 'armed' with high-performance heat pipes and optimized fin spacing achieve this goal.

SYSTEM DESIGN • The T-shaped system motherboard layout, and PSUs that are located at each corner of the chassis allow for improved airflow balancing and system cooling, subsequently driving more efficient system cooling. This layout improves power supply unit (PSU) cooling due to reduced risk from high pre-heat coming from CPU heatsinks. The streamlined airflow helps with PCIe cooling as well, enabling support for PCIe Gen4 adapters. And finally, it creates a better cable routing experience on the PDU side of the racks where power cables are generally separated by grid assignments for redundancy.

KEY BENEFITS

- Air is inexpensive, plentiful, and easy to access.
- It is not a specific feature but a collection of key components that work harmoniously together to cool your servers.
- Dell custom-designed fans and advanced heatsinks double thermal and airflow management delivering powerful, sustained system performance.
- Dell Fans and heatsinks are qualified using mandated and extensive reliability and qualification processes to run at full speed for the life cycle of the server minimizing costly downtime.
- For customers whose workloads are more compute rather than storage-intensive, Dell's new "Low-Z" configurations have airflow channels that replace some of the storage to maximize the flow of air resulting in better-sustained performance over time.

DIRECT LIQUID COOLING (DLC)



Liquid cooling is an evolutionary step for data center cooling, offering significantly better effectiveness and efficiency compared to air. While it's not new, it's been the realm of supercomputing clusters or home enthusiasts for a number of years. The caveat is that projects required the owners to have technical expertise, and a comfort level with complexity and risk. Liquid cooling addresses internal components as they become even more powerful and hotter and is an effective way to cool extremely dense server solutions, based on the most powerful next-generation processors and accelerators. Dell's Direct Liquid Cooling offer is now a mainstream offer and available factory direct.

DIRECT LIQUID COOLING (DLC) uses the exceptional thermal capacity of liquid to absorb and remove the heat created by new high-power processors. Cold plates are attached directly to the processors and then coolant captures and removes the heat from the system to a heat exchanger located in the rack or row. This heat load is removed from the data center via a warm water loop, potentially bypassing the expensive chiller system. By replacing (or supplementing) conventional air-cooling with higher-efficient liquid cooling, the overall operational efficiency of the data center is improved.

LEAK SENSE TECHNOLOGY is a new feature now included with all Dell DLC solutions, providing customers with the knowledge that potential issues will be found and reported quickly. If a coolant leak occurs, the system's leak sensor will log an alert in the iDRAC system. Three errors can be reported: small leak (warning), large leak (critical), and leak sensor error (warning – indicates an issue with the leak detection board). These error detections can be configured to take meaningful actions, such as raising an alert or powering off a server.

KEY BENEFITS

- Increased System Cooling Capacity – DLC enables system configurations that cannot be cooled by only air, such as high TDP CPUs, dense storage, and/or add-in cards.
- Improved Energy Efficiency (PUE) – The DLC cold plate solution reduces energy costs by up to 45% relative to cooled air and helps extend the life of existing air infrastructure.
- Higher Compute Density – For the Dell PowerEdge C6520 server, DLC cooling supports up to 25% more cores per rack. For the Dell PowerEdge C6525 server (with backplane configuration supporting storage drives), DLC cooling enables 2x the core count over air-cooling alone.
- 3.11x ROI Within 4 Years – The cost of pairing DLC with existing PowerEdge cooling tower infrastructure typically breaks even within 1.3 years and yields a 3.1x payback within 4 years.
- Swift Serviceability – The CPU DLC cold plate solution attaches with four screws, making service quick and simple.

IMMERSION COOLING

Immersion Cooling is another option that uses liquid to cool servers for niche applications where conditioned air is scarce or not available. This approach completely submerges the system in a vat of liquid requiring no fans or air movement whatsoever to cool the system. Since no air is required to cool systems, it eliminates the need for any type of raised floor or air-handling equipment. Dell supports, through our OEM team, both single-phase and two-phase immersion projects.

SINGLE PHASE IMMERSION places systems in a fluid-filled tank that captures 100% of system heat to fluid (CPUs, memory, add-in cards, etc.). For fluid supply, it connects to the customer facility water CDU (same as DLC). The cooling threshold is limited to 400W TDP (comparable to air, less than DLC).

TWO PHASE IMMERSION uses dielectric fluid but uses a very similar approach to phase 1, except that the Phase 2 approach incorporating phase-change is a more powerful way to manage heat and enables up to 650W TDP cooling.

100% heat capture to these non-conductive fluids minimizes the cooling overhead for a rack of servers, although performance limitations mean these trail DLC in terms of potential performance. For certain customers, Immersion may be the best cooling option for a given environment and set of workloads.

KEY BENEFITS

- 100% heat capture to liquid. Air is not required.
- Manages high TDP com in dense server systems
- Uses non-conducive liquid

DELL TECHNOLOGIES OPENMANAGE POWER MANAGER

To orchestrate each of these cooling solutions and reduce the need for manual intervention, OpenManage Power Manager takes center stage. It intelligently monitors and adjusts various system sub-components to ensure optimum sustained performance in real-time. Power Manager is built with four primary objectives in mind.

PRIMARY OBJECTIVE

1. Help customers reduce power usage by automating policies that place power caps on racks/rows/rooms of servers.
2. Remediate by quickly identifying and fixing an issue before it creates a negative impact on current company SLAs.
3. Intelligently know who/what is consuming the most power, detailed in an easy to generate and readable format.
4. Reduce the carbon footprint of a data center by actively managing and adjusting power consumption to an "as needed" approach.

Fulfilling these objectives is important in helping customers prevent server downtime that is related to power and thermal threshold management. They also aid in decreasing overall carbon emissions which is quickly gaining the attention of most government agencies worldwide.

Ultimately, the best cooling solutions do their job in the most efficient manner, using the least amount of energy. This contributes to a lower wasted overhead to power and cool your IT, all part of having the smallest carbon footprint possible.

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LEARN MORE AT

https://www.dell.com/en-us/dt/servers/power-and-cooling.htm

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