DELL EMC

PowerEdge Product Group

Direct from Development

NEXT-GENERATION COOLING TECHNOLOGIES PROMOTE DATA CENTER EFFICIENCY

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SUMMARY

- Dell EMC expanded operating Environments research & development (R&D) kicked off in 2008 with Fresh Air Cooling:

  Addressed temperature and relative humidity; continuing advanced R&D on corrosion in poor air quality environments

- Dell EMC Enterprise products can be deployed in expanded environments – under warranty

- Expanded operating environment allows for reduced CAPEX & OPEX

- More Next generation cooling technologies are here Dell EMC is shipping (limited) configurations with Cold Plate (Direct Liquid Cooling)

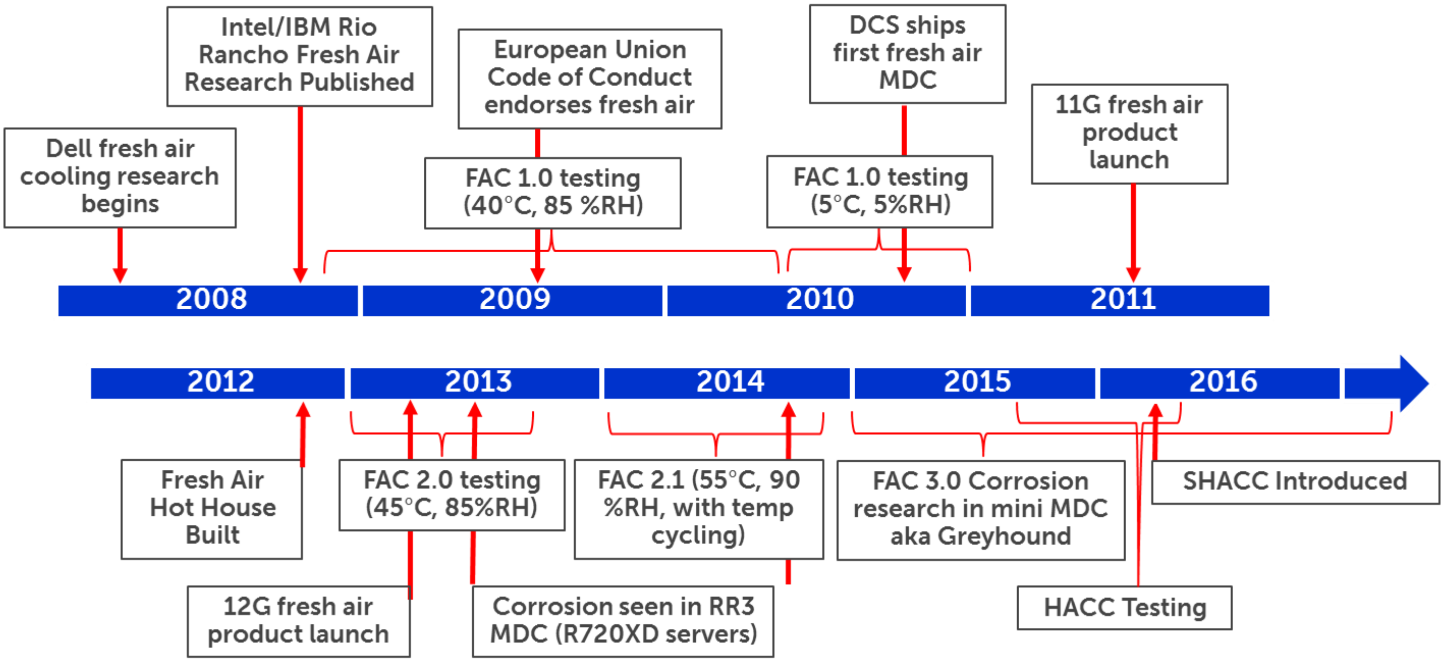
The worldwide demand for computing power is skyrocketing with cloud computing, IoT, and traditional application models all experiencing growth. In response the industry has responded by packing more power into successive generations of CPUs, faster RAM to feed them and greater storage density to house the information demanded by consumers. The increase in power has brought on increases in operating temperature necessitating new, more efficient cooling technologies for datacenters to dissipate the heat being generated and address corrosive elements in varied environments.

Dell EMC recognized these trends early, and in 2008 initiated the first iteration of its Fresh Air Cooling (FAC) research in anticipation of evolving energy demands. Fresh Air Cooling is the process of using outside air or mixing it with exhaust air (to generate desired inlet temperature), or passing it over an evaporative cooling mechanism (swamp cooler) and feeding it directly into the inlet side of the data center servers. A fresh air cooled datacenter replaces traditional cold room air conditioners with a much more efficient, cost saving cooling solution.

Power Usage Effectiveness (PUE) *is the ratio of the total energy consumed by a data center to the energy used for computing only. A lower PUE means a more efficient data center. Traditional data center PUE's range between 1.6 and 1.8, FAC datacenters generally deliver PUE's between 1.2 and 1.4. For example, a large data center in Arizona has a record low PUE of 1.015 using Dell EMC FAC*.

By 2009, when the EU Code of Conduct endorsed FAC, Dell EMC was well into Phase 1 of FAC R&D. Dell EMC demonstrated the operational robustness of its hardware in 40°C/85% relative humidity (RH) environments. Then Dell EMC validated the solution's operability in low temperature and humidity. In 2011, Dell EMC shipped its first Fresh Air Cooled Modular Data Center (MDC). MDCs are deployable in semi-knocked-down states for fast, easy assembly in situ. Dell EMC R&D successes bore FAC-ready products within 11th Generation PowerEdge.

In late 2012, Dell EMC progressed into FAC Phase 2 with a higher temperature and humidity tolerance (45-55°C, 85-90% RH). Concurrent with FAC 2.0, Dell EMC built and deployed a fresh air cooled MDC on its Round Rock, Texas campus to give personnel direct exposure to the technology and facilitate improvements in design and develop best practices. This 0.5 MW MDC runs real-world customer workloads (not simulated). During this time period, ASHRAE, ISA, iNEMI and other industry consortia began to investigate the unconditioned, frequently corrosive inlet air FAC allows into data centers. In parts of Asia, ASHRAE reports that 98% of AC-equipped datacenters have moderately high corrosive environments (ISA-71 G2).



In 2013, Dell EMC's MDC saw its first long-term corrosion-related issue. In response, Dell EMC kicked off the Fresh Air 3.0 initiative with a focus on corrosion and corrosive environments.

Lab environments, being less effective in replicating real-world conditions, drove Dell EMC's deployment of the Fresh-Air Hot House in 2012: a living R&D cell and showcase of the hardware's ability to survive Texas summers in an un-air-conditioned, kiosk-sized, tinted-window enclosure drawing in filtered air. Its cooling relies only on a central ceiling fan and the compute and storage internal fans. In this hot house, PowerEdge 11th to 13th generation hardware encounters high temperatures, humidity, and airborne contaminants from automotive/truck exhaust – as it's located in a parking lot near the intersection of two interstate highways.

The next step in corrosion research – Dell EMC's mini-MDC facility – became operational in 2014. It's a swamp-cooled PowerEdge R720XD-populated datacenter, injected with chlorine and sulfur corrosion accelerants. Here, Dell EMC R&D investigates corrosion; and robustness of hardware, surface finishes, and coatings. Importantly, it also supports the development of Dell EMC's environmental early warning IoT device, which is designed to alert data center operators of conditions that may be harmful to computing equipment.

In the selection of datacenter installation locales, or for the detection of problem areas within FAC datacenters, Dell EMC believes that prevention is key. To enable customers to detect and mitigate environmental threats, Dell EMC's IoT solution incorporates transducers and logic to sense, quantify and log environmental factors that contribute to corrosion. Dell EMC is in the second phase of development of this device, with improvements targeted in increased sensitivity, better time-domain logging, and a greater operating temperature/humidity envelope.

In parallel, Dell EMC collaborates with supplier partners to better understand the effects of corrosive environments on products that are co-developed. Progress on corrosion acceleration allows Dell EMC to simulate over five years of ISA.71-G3 exposure within six months. This has identified areas where Dell EMC and partners have strengthened materials, systems and components. Dell EMC's study of connector/contact robustness has provided ongoing feedback to the industry and is driving mitigation and hardware protection measures. Dell EMC is demonstrating and implementing design features to increase robustness to combat corrosive airflow.

FAC is an efficient, effective way to cool the datacenter, but cooling still remains a challenge within the system. As system power densities increase due to higher-wattage CPUs, it is becoming difficult to cool them with traditional forced-air methods. Two technologies have become front runners in overcoming this looming issue: oil immersion and cold-plate (direct liquid cooling). Oil immersion involves immersing servers in a recirculating oil bath with heat exchanged to external ambient. Dell EMC has developed and fully validated warrantable immersion cooled solutions. Dell EMC also offers cold-plate solutions for high-performance applications. Cold-plate not only cools better than a traditional solution, but also removes nearly all CPU heat from the system, easing the thermal burden on surrounding components.

Fresh Air HotHouse

Mini-MDC

MDC

Dell EMC is committed to bringing customers the best technology available, and discovering the best practices to maximize the value Dell EMC technology brings to the market. Dell EMC tests in the real world, under real conditions, with real product to ensure it addresses environmental factors that might affect customers. In summary, Dell EMC designs and warrants product solutions for deployment in efficient, expanded operating environments. Dell EMC anticipates new technologies, investigates intrinsic robustness and drives improvement to provide the best value and lowest TCO.