Next-Generation PowerEdge Servers: Thoughtful Thermal Design

Tech Note by

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Summary

Next-Generation Intel and AMD PowerEdge servers will support internal components with increased capabilities, such as higher CPU core counts and memory frequencies. These new features bring with them increased power consumption. Dell Technologies has refined its thermal design to optimize cooling of these enhanced hardware ingredients.

This DfD will explain what changes were made to the thermal architecture of next-generation Intel and AMD PowerEdge servers, as well as the key benefits each change will bring to the end user.

Introduction

The installment of 3rd Generation Intel and AMD processors will give next-generation PowerEdge servers ample computing capacity. The newest PowerEdge servers are packed full of dense heat-producing semiconductors that must be adequately managed to stay below the recommended operating temperatures. The Dell Technologies thermal engineering team has tailored new thermal solutions and designs to address these concerns.

Increased Power Means Increased Heat

The most significant driver for the thermal redesign is the increase in power (Watts) being consumed by internal components. For example, Intel Ice Lake processors can now support up to 40 cores of processing power, but this at the toll of consuming up to 270W. Additionally, Intel also has a 33% increase in memory channels that support 9% higher speeds, amongst other new heat-producing features below:

- 2x PCIe performance with Gen4
- 33% more I/O lanes
- NVMe HW RAID
- Hot-Plug BOSS (2x M.2) for boot

These features create a dense server that can consume more power than previous generations. To keep the system cool, the following thermal design changes have been made to next-generation (15G) PowerEdge servers:

Thoughtful Thermal Design Changes

High Performance Fans – New higher performance fans have been added to increase the amount of cool air pushed through the system, targeted at higher power semiconductors (CPUs, GPUs and NVMe drives). A 3-tier approach to fan performance is employed to address the trend of increasing total power. This includes standard fans and high performance silver and gold fans, which increase the airflow capability versus the previous-generation fans (see Figure 1).

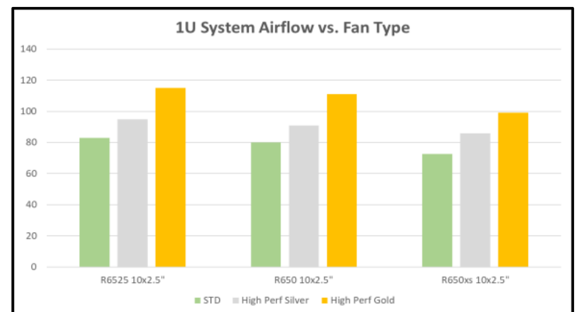

Figure 1 – Graph illustrating the increased fan airflow (in CFM) for high performance silver and gold fans compared to baseline fans

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In 2U systems, the gold fan features a dual rotor design in a larger form factor and spacers implemented for the standard and silver fans. Both Intel and AMD next-generation PowerEdge servers will support the silver and gold fans. The fan type is predetermined according to the server platform and hardware configuration.

Smaller PSU Form Factor and Location – To create space for a thermal architecture redesign, PSUs have been relocated to the outside edges of the 1U and 2U server chassis. This provides purposeful exhaust lanes for hot airflow from the CPUs to prevent overheating of downstream hardware components such as PCIe cards, OCP or PSUs. In the 1U systems a new, narrower, 60mm form factor PSU is implemented to further increase the exhaust path space. The new PSU layout and form factors are supported for both Intel and AMD next-generation PowerEdge servers. See Figure 2 below for illustrations of this new PSU layout.

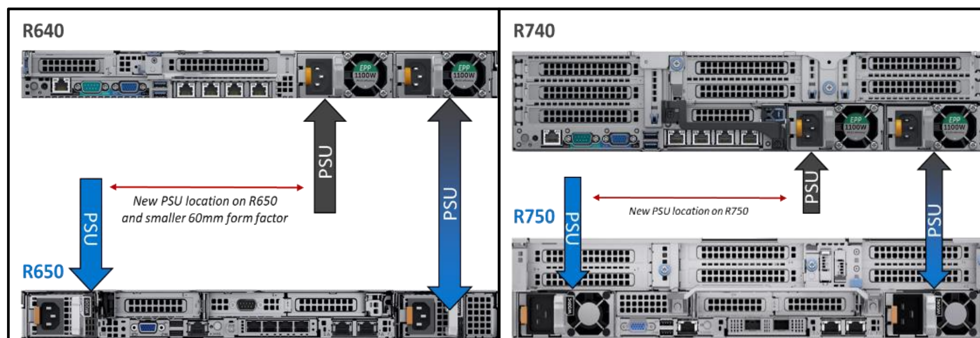


Figure 2 – PowerEdge R650/R750 PSU architecture compared to R640/R740

Balanced Airflow Design – Perhaps the most impactful change is having a more balanced airflow design. Figure 3 illustrates that the R650 motherboard layout is more symmetrical than the R640. The R640 layout was challenged due to PSU and PCIe cards located directly downstream of the CPU exhaust paths creating PSU and PCIe cooing challenges and an imbalance in airflow across the width of the system. The R650 virtually eliminates these bottlenecks by moving the PSUs out of the CPU exhaust path, balancing the airflow, and creating the purposeful paths for CPU exhaust airflow to the rear of the chassis. The R750 features the same split PSU layout and purposeful CPU exhaust paths in addition to a dedicated duct design that delivers fresh air to the rear PCIe slots for high power GPU configurations.

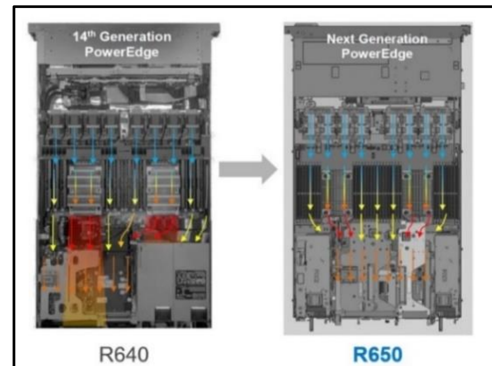
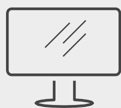


Figure 3 – The PowerEdge R650 has a more balanced airflow design compared to the PowerEdge R640

Conclusion

Dell Technologies PowerEdge servers with 3rd generation Intel® and AMD processors delivers a thoughtful total solution that accommodates semiconductor thermal requirements by improving the internal thermal design. By implementing higher performance fans, new PSUs and purposeful airflow pathways, PowerEdge customers can maximize their work output without having to worry about overheating their system.



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