Data Center Design Trends: New Challenges and Solutions

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Abstract: The following white paper is part of a quarterly series developed by Willdan Energy Solutions. The intent of the series is to provide the intelligence we have collected through implementation of data center energy efficiency programs nationally. We seek to identify technologies and strategies that can become actionable items in utility-run data center programs. This quarter's white paper focuses on the emerging trends in data center design. In particular, data center operators are now focusing on several key aspects: energy efficiency, automation, and density. These trends and their advantages are explored further in this article.

*Representative Blade Server

There can be no doubt that data center operators, like managers of all nascent industries, are shifting focus to solve new challenges as older ones come closer to resolution. Never-ending uptime and space for growth had been the key challenges as this industry grew up. Uptime will always remain a chief concern, but challenges facing constant reliability have been significantly mitigated. Operators are now faced with concerns over operational costs—namely energy—and how to become more efficient. Monitoring and automation technologies have emerged as one mechanism to increase operational efficiencies. And strategies such as increased density have made space less of a concern in data centers. However, density also presents new challenges for cooling.

Focus on Energy Efficiency

Three main drivers can be attributed to an increased focus on energy efficient designs in data centers: operational energy costs, stricter regulations, and a desire to be a "greener" company. For the purposes of this paper, we will focus on the first two drivers. In an IBM study of its customers' data centers[1], it was found that the costs to run a data center overcome the costs for design and construction in a relatively short period of time. IBM estimated that the average data center will cost five times more to run over 20 years that it cost to build. With energy costs being so significant, it is no wonder that operators are turning their

attention to designing and upgrading with more efficiency.

Stricter regulations are also playing a part in driving data centers to higher energy efficiencies. There have been clear signals from the White House that reductions in greenhouse gas emissions and waste are a priority. As the economy improves, stricter regulations will likely be more palatable to Congress, and data center operators should be ready for changes. While requirements may tighten, there are also incentives available in many areas for making energy efficiency improvements. Many states mandate that public utilities run programs to garner energy savings, and some of those utilities have programs designed specifically for data centers[2]. These incentive programs help offset the costs and lower the payback period of making improvements.

Building Automation and Monitoring

The pivotal trend in building automation and monitoring is integrating systems and moving from reactive to proactive management. This opportunity is just beginning to take hold in the industry and promises to be a game-changer in facilities management for data centers. Chasing hot spots and sending people around the data center to reset CRAC units would become unnecessary under an appropriately automated system. A self-healing data center is a more efficient and less costly data center.

Monitoring and automation also help protect against impending failures. Real-time monitoring of heat and server and disk events can provide clues that predict a negative event, and automation systems can self-correct for these events. The intersection of uptime and efficiency is where data centers are headed.

Increasing Density, Virtualization, and Optimizing Cooling Strategies

Over the past several years, typical server rack energy consumption has grown from 500 watts per rack to 20 kW per rack, and racks with densities approaching 40 kW are becoming more common[3]. The upside of density in servers is that it requires less space and comparatively lower cost[4] for operations. Virtualization also offers savings through decreased software licensing per processor.

However, cooling strategies have to be optimized for this new reality, and are largely dependent on the size and configuration of the data center. The fact is that higher density equals greater heat and an increased need for cooling. Cooling inefficiencies in dense environments can cause significant increases in operational costs.

Sources:

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