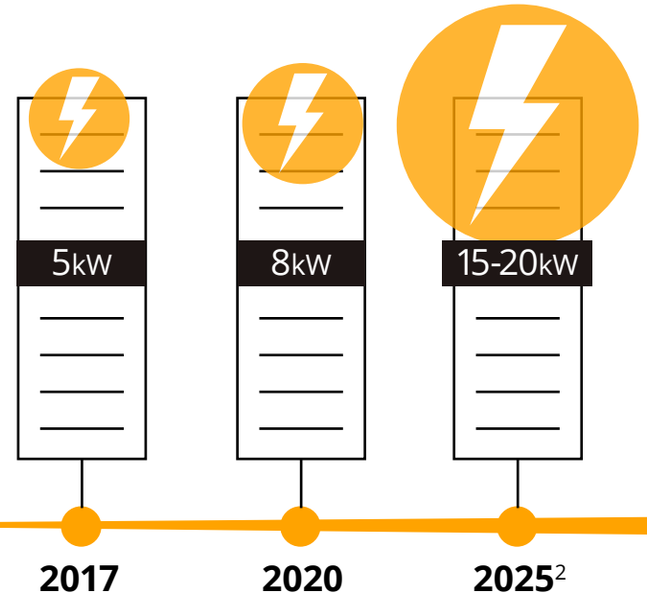
Avoid Risk: 4 Ways to Prepare Data Centers for Rising Rack Density

BLACK & VEATCH

Today's digital world and its promises of on-demand, real-time access and information are revolutionizing how companies conduct business and serve their customers. It's what's driving organizations to pack more computing power into their data centers to deliver the expected customer experience and evolve with powerful data analytics and automation. Higher computing power means higher-density servers. Therefore, the average amount of power needed per rack is increasing. Enterprise legacy data centers designed for 4 or 5kW per rack, for example, must now accommodate racks reaching 15kW or more — or in high computing scenarios, 40kW. This poses a major challenge.

Today, the average rack is up to 8kW/rack, by 2025 it will be predominantly between 15 to 20kW.[1]



[2]

Operators Beware: Avoid Risks from Rising Density

High-density racks are more efficient at crunching data, but they devour power and emit lots of heat. The biggest impact Black & Veatch engineers are seeing is the effect on our clients' cooling efficiency. Without adequate cooling or the right space to move air effectively, hot spots develop, and equipment can overheat, leading to a worst-case scenario: equipment shutdown.

Shutting down a mission critical data center can cause major business disruptions to essential operational, customer or trending data. For data center operations, overheating can trigger manufacturing settings throwing a system into disorder or voiding the warranty, adding administrative pressure and an increase in operational costs. Black & Veatch engineers help clients mitigate risk by preparing for best- and worst-case scenarios.

As rack density and heat output climb, so can utility costs and the labor required to maintain multiple cooling systems associated with higher-density systems. However, there are proactive actions companies can take to offset additional costs and maintenance before adding more cooling equipment.

[1] Source: Bifei, Yang. 2020. 5 year forecast: Huawei predicts 10 trends shaping data center facilities. DCD

[2] Source: Lawrence, Andy. 2020. Rack Density is Rising. Uptime Institute

4 Ways to Ready Your Data Center for Rising Rack Densities

1. Conduct a CFD analysis: Computational Fluid Dynamics (CFD) analyzes airflow patterns and models airflow distribution. It establishes a benchmark of the current operational environment and facilitates future IT planning. By modeling airflow, you can optimize temperature set points and air distribution to maximize cooling system efficiencies and minimize overall cooling costs. Examine the supply and return air and water temperatures. If the Delta T (ΔT), change in temperature, is too low, you're operating inefficiently. A low air ΔT across the server means too much air movement (and you could be paying too much in fan energy). The higher the ΔT, the more efficient and the less energy is consumed by the mechanical systems. However, a ΔT can also be too high, which means too little air movement. This creates recirculation problems within the racks and supplies colder-than-necessary air temperatures. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) TC 9.9 provides thermal guidelines for what is recommended versus allowable.

2. Optimize existing space: Reconfigure the floor design to accommodate higher density equipment and disperse heat efficiently. Higher loads should be distributed throughout the floor if possible, avoiding placing all high-density equipment in one area. It's important to work alongside IT and their cable plant designers to effectively disperse the heat load without overcomplicating the cable plant design and inadvertently paying too much for cabling, or blocking airflow.

3. Retrofit raised-floor environment: As equipment becomes higher in density, there are cooling strategies more efficient than raised floor, like liquid or precision air cooling. However, if retrofitting a raised floor environment, quick and easy fixes may include:

- Make the under-floor plenum space as open as possible, removing any unused cabling that may restrict airflow
- Move power and communications overhead where possible and to not restrict airflow
- Deploy hot and cold aisle containment systems
- Change out perforated airflow panels for maximum airflow

Implementing close-coupled cooling may be the best option in the short term. Rear-door or in-row cooling equipment can supplement raised-floor cooling and easily achieve higher densities. The typical raised access floor has an upper limit of about 11-12 kW per cabinet (assuming one high-flow floor grille per cabinet). Increasing power densities beyond this limit requires wider distribution of loads for significant increases in fan power. Alone, close-coupled cooling solutions are expensive and can add risk to a data center since cooling fluids need to be delivered within the aisles. Combining these solutions can limit risk and achieve the higher-density goal. Other solutions that effectively accommodate high-density environments include full hot-aisle containment systems, rear door heat exchangers, cold plate chip cooling, liquid cooling or liquid immersion cooling.

4. Deploy Effective Power Distribution: Higher density racks require more wattage and larger circuits to handle additional power. An analysis of the existing electrical system may be necessary to determine compatibility and options for closing this gap. Additionally, larger electrical distribution can lead to increased short circuit levels that may surpass the rating of the equipment. Depending upon the situation, these considerations may require a different approach to the electrical system. Energized work is difficult to perform with strict Occupational Safety and Health Administration (OSHA) guidelines. It requires extensive risk mitigation and should play a role in how future electrical distribution systems are designed.

In an enterprise environment where you may have mixed densities, power distribution needs to be considered and designed effectively. It's also important to understand your recovery procedures and back-up power system capabilities. Coordinate these capabilities with the mechanical team. It's possible a steep rise in temperature could occur in the data hall during generator startup. The data hall can overheat if it takes too long for power to restore the cooling system.

TIP:

Test power backup systems to see how long it takes generators to come back online and to transfer power to your cooling system. The transient recovery time may be as long as 30 to 40 seconds which is a lifetime for a room filled with 12 and 14kW racks. Too much heat may fill the space and temperatures can rise to 100 degrees in a manner of 10 to 20 seconds. Review priority 1 and priority 2 settings for critical systems to come back online.

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Work Across the Data Center Aisle

To successfully deploy these solutions, it's important for mechanical and electrical teams to work "across the data center aisle" alongside IT departments to understand the plans for cabinet loading and white-space placement. For instance, transitioning to higher-density racks may free up lots of expensive white space, but force all cooling into a few small areas. This is not how a raised floor cooling system was ever intended to work. So IT, facilities and third-party MEP teams need to work together to find a solution that balances IT, cooling and electrical requirements.

It's also crucial to understand the team's appetite for risk. The most common high-density cooling solutions used to supplement a raised floor involve cooling fluids piped directly into the server rows. Are they comfortable with water, glycol or refrigerant piped over or under your server equipment? Installing these types of systems over an active data center can be a nerve-racking experience but eased with the right partner experienced in live data center installations, like Black & Veatch.

Future Readiness

The market's appetite for computing power shows no signs of slowing down. For legacy data centers needing to keep up, knowing your future growth model is vital. Black & Veatch estimates a 12 to 36-month growth assessment should provide a good indicator of a facility's' power utilities. As your trusted advisor, engineer and builder of data center infrastructure, Black & Veatch has a holistic view of the mechanical, electrical and IT dependencies to help model these growth plans, as well as perform data center assessments, engineer and construct the ideal solution.

To realize the promises of AI and IoT, computing power and densities must increase. The data centers that can adapt quickly by designing and engineering their facilities to be future-proof for higher densities will be more agile and responsive to ever-evolving market demands.

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