EBOOK

The Role of DCIM Software in Managing High-Density Racks



Sunbird®

DCIM that's easy, fast, and complete

Introduction

As data centers evolve to support growing demand, rack densities are increasing.

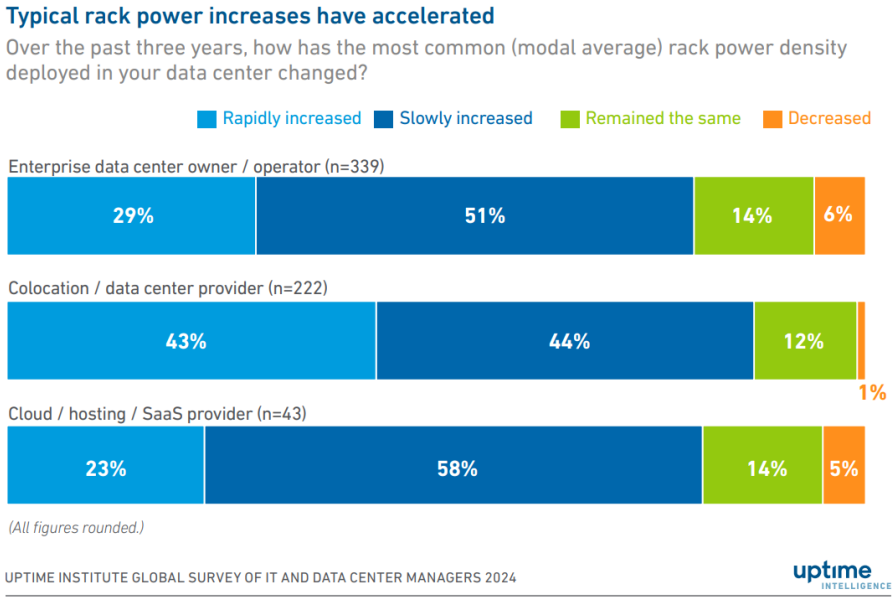
According to Uptime Institute, 80% of owner-operated data centers and 87% of colocation data centers are seeing their rack densities rise.

While a standard rack may operate at 3-5 kW, high-density racks typically run at 10 kW or more, with some exceeding 50 kW per rack in hyperscale and high-performance computing (HPC) environments.

In addition to having a greater energy demand requiring advanced power distribution strategies, high-density racks typically pack more equipment in a smaller footprint, have complex network and power cabling, and generate large amounts of heat, necessitating innovative cooling solutions.

While this approach enables the deployment of more compute resources in a smaller area, it also introduces new challenges that require advanced management solutions.

In this eBook, we will discuss the key challenges with high-density deployments, and why leading data center professionals are deploying Data Center Infrastructure Management (DCIM) software to manage their high-density racks.



Source: Uptime Institute

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What's Driving Increasing Rack Densities?

As data center professionals strive to keep up with the rapid growth of demand for digital services, one of the most significant trends is the move towards higher rack densities. Increasing rack density is not just a matter of adding more servers or power per rack; it is a response to changing technology needs, operational challenges, and growth opportunities.

Key Factors Contributing to Increasing Rack Densities

- **Growth in data-intensive applications.** Data centers are increasingly required to support workloads like artificial intelligence, machine learning, and big data analytics. These applications demand substantial processing power and memory. In response, operators must deploy more computing resources into limited footprints.
- **Increasing energy efficiency demands.** Data center managers are under growing pressure to reduce energy waste both for cost reasons and to meet environmental sustainability goals. Though power-hungry, high-density infrastructure often boasts significant energy efficiency improvements over traditional counterparts.
- **Space constraints and real estate costs.** Data center space now comes at a premium. Many organizations face high real estate costs and limited available space. Increasing rack density is a direct response to this challenge, as it enables operators to maximize computing resources without expanding the facility footprint.
- **Advances in hardware technology.** Ongoing improvements in server and storage hardware—such as higher performance per watt and smaller form factors—have made it possible to deploy more compute resources into the same physical space.



(continued)

What's Driving Increasing Rack Densities? (continued)

Benefits of Increasing Rack Densities

The move towards higher rack densities offers a host of benefits for data center managers, including:

- **Space optimization.** By deploying more equipment into the same space, high-density racks can help organizations maximize space utilization and potentially reduce their required floor area.
- **Cost savings.** Consolidating equipment into fewer, higher density racks can lead to lower operational costs.
- **Energy efficiency.** High-density racks can offer greater efficiency and contribute to more sustainable data center operations.
- **Improved performance.** With more compute resources per rack, high-density systems can deliver faster processing speeds and better performance for demanding workloads.

The trend towards high-density deployments in data centers is only expected to increase, bringing with it both challenges and opportunities. Effective management of these high-density environments is critical to ensuring operational efficiency, uptime, and cost-effectiveness.

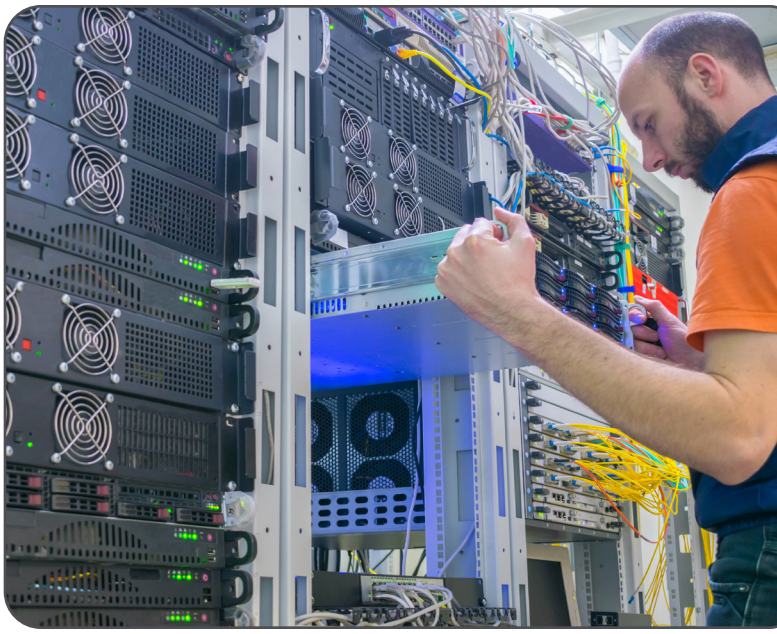


Common Challenges of Managing High-Density Deployments

According to Uptime Institute, accommodating significantly denser IT is among the top concerns for today's data center professionals, with 91% of survey respondents saying that they are at least slightly concerned about it. Almost one-quarter of data center professionals are very concerned about how they will manage denser IT going forward.

This is understandable because the massive power requirements and complexity of high-density racks present significant challenges, including:

- **Power distribution and capacity planning.** High-density racks require substantially more power than traditional racks. This increased power draw can strain existing electrical systems. Without careful monitoring and capacity planning, there is an elevated risk of tripping a circuit breaker and experiencing unplanned downtime.
- **Cooling management.** Concentrating more equipment in a rack leads to more heat, which can result in hot spots. Conventional cooling methods may be inadequate in dissipating the heat generated by densely packed servers, increasing the risk of equipment failure. Some organizations find that their cooling resources only allow them to put a minimal number of high-performance servers in a rack, even if they have the power capacity. This ends up wasting rack space capacity and necessitates deploying more cabinets.
- **Asset and connectivity tracking.** As equipment is deployed more tightly together, tracking individual assets and components becomes increasingly challenging. The density of cables and port connections complicates documentation, planning, and troubleshooting efforts.
- **Space and infrastructure limitations.** The compact arrangement of equipment in high-density racks restricts physical access for routine maintenance or troubleshooting issues.
- **Operational complexity and risk of downtime.** In high-density environments, the concentrated nature of the infrastructure means that even minor failures can have a cascading effect, potentially impacting multiple systems simultaneously. The increased operational complexity raises the overall risk of downtime.



An Introduction to DCIM Software

As data centers continue to scale with increasingly dense environments, managing high-density racks has become more complex and risk-prone.

High-density racks are often deployed in mission-critical environments where maximizing performance and efficiency is essential, and data center professionals need the right tools to help reduce the risk of downtime, inefficiencies, and stranded capacity.

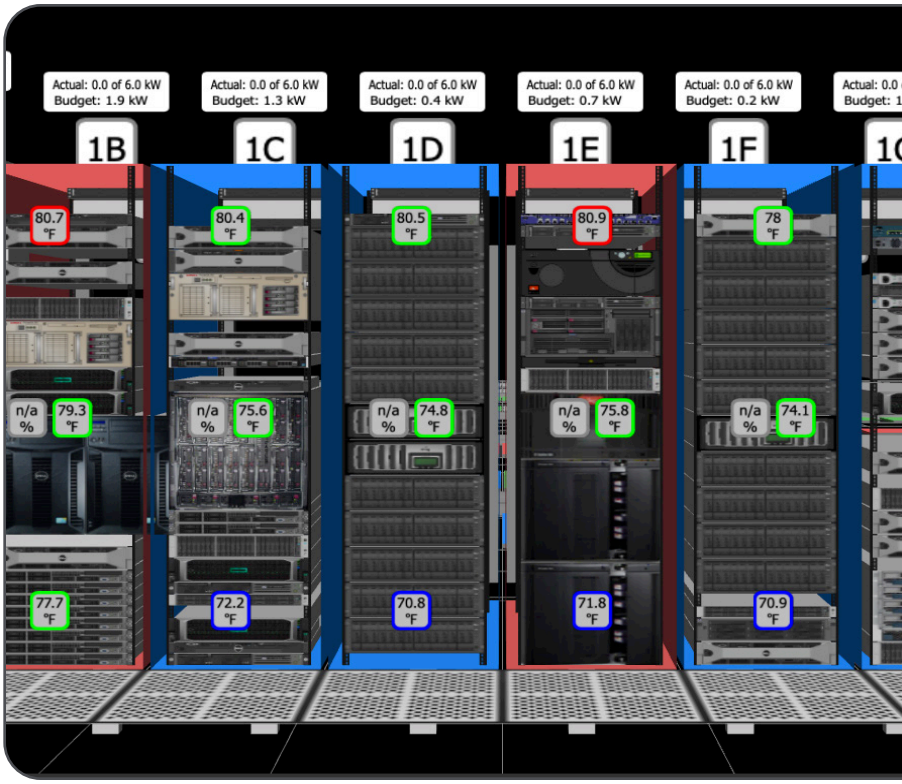
Data Center Infrastructure Management (DCIM) software is increasingly used to manage these high-density environments, providing a single pane of glass and digital twin that supports reliable and efficient operations.

DCIM software helps you plan, provision, model, and monitor all of your infrastructure across all of your sites. It typically replaces Excel, Visio, and homegrown databases, and bridges information across organizational domains such as data center operations, facilities, and IT to maximize utilization of the data center.

Benefits of Using DCIM in High-Density Environments

Leading data center professionals report that DCIM software enables:

- **Increased uptime.** By continuously monitoring power and environmental data, DCIM software helps you identify potential issues before they become larger problems.
- **Increased efficiency.** DCIM software helps in planning and deploying space, power, cooling, and port resources more effectively.
- **Increased productivity.** With less manual effort required to complete routine tasks, teams can be more efficient and have more time to focus on strategic initiatives.



Power Monitoring to Reduce Risk and Maintain Uptime

High-density racks often push power systems to their limits, leaving little room for error.

Without real-time monitoring, unexpected spikes and imbalances can lead to costly downtime. DCIM software gives you the visibility to stay ahead of these risks.

Power Management Challenges with High-Density Racks

- **Lack of information.** The power demand in high-density environments requires granular monitoring. Traditional, manual methods of tracking power data often fall short in detecting rapid fluctuations, making it challenging to respond quickly to anomalies and prevent potential issues.
- **Risk of tripping circuit breakers.** Deploying high-density racks can lead to tripped circuit breakers if they are not effectively managed. Understanding if power distribution systems can handle sudden spikes or sustained high loads is often difficult.
- **Load balancing across racks.** Uneven distribution of power among densely packed racks can result in some circuits being near tripping while others are underutilized. Achieving a balanced load distribution helps prevent tripping circuit breakers and enable optimal performance.

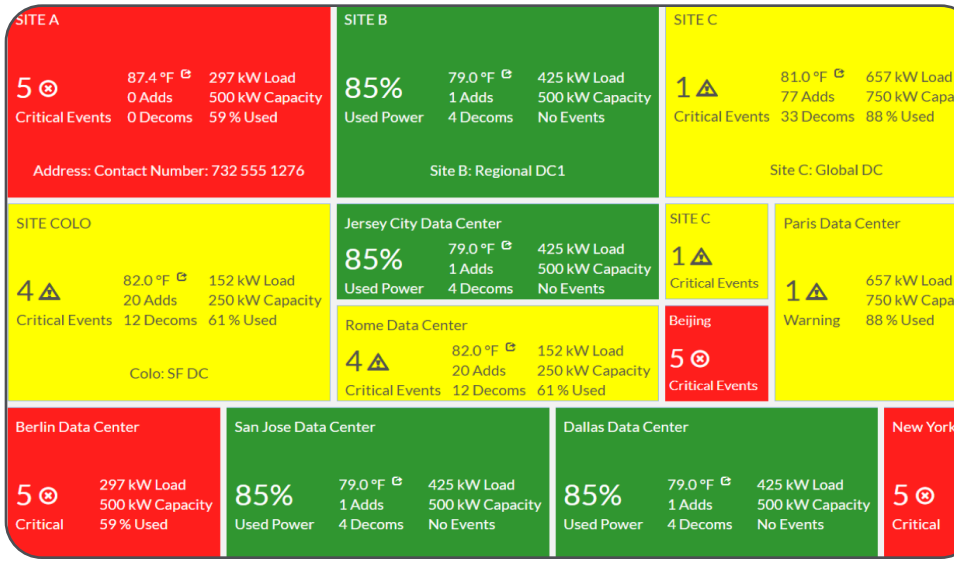


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Power Monitoring to Reduce Risk and Maintain Uptime (continued)

How DCIM Software Helps

- **Real-time power monitoring.** DCIM software continuously collects granular power consumption data from intelligent rack PDUs and other power meters in your data center. This real-time monitoring allows you to understand power usage at any level such as device, rack, or branch circuit.
- **Thresholds and alerts.** With some DCIM software vendors, you can set warning and critical power usage thresholds on rack, inlet, and circuit breaker loads and three-phase balance. When these thresholds are exceeded, an event can be generated and you can receive an alert. This lets you know about potential issues so you can investigate and resolve them before they escalate into serious problems that can result in downtime.
- **Redundancy monitoring and reporting.** DCIM software enables better power planning to maintain redundancy. For example, the ability to simulate failover scenarios lets you know which racks are outside of your redundancy requirements and at risk during an outage, and DCIM software with Load Shift Detection offers a tunable AI algorithm that detects and alerts when the load shifts from one power supply on an IT device to another, indicating a potential loss of redundancy.



"The ability to see all power usage at a facility and compare to the cooling capacity is an amazing feature."

FROM THE EXPERT:

MIDCO

Tony B.
Technical Facility Manager

Environment Monitoring to Optimize Cooling

As high-density racks generate more heat, managing cooling becomes a critical challenge. Without the right information, data center managers risk creating hot spots or overcooling systems, both of which present serious risks.

DCIM software empowers operators to maintain visibility into their environment, enabling optimal cooling performance across the data center.

Environment Management Challenges with High-Density Racks

- **Hot spots.** In traditional environments, where airflow and cooling systems are designed for lower densities, the heat from high-density racks can overwhelm cooling infrastructure, creating localized hot spots. If not properly managed, these hot spots can cause equipment failures and lead to unplanned downtime.
- **Overcooling.** Since high-density racks generate so much heat, some data center managers may be overly conservative and overcool them beyond industry or manufacturer guidelines. This practice wastes cooling resources, energy, and money, and offers no additional benefit. Without accurate monitoring, it can be difficult to optimally cool each rack.
- **Lack of information.** Without real-time data collected from temperature and humidity sensors, it is manual and time-consuming for data center professionals to know if high-density racks are appropriately cooled or not. Constant fluctuations in the environment can make data become unreliable very quickly.

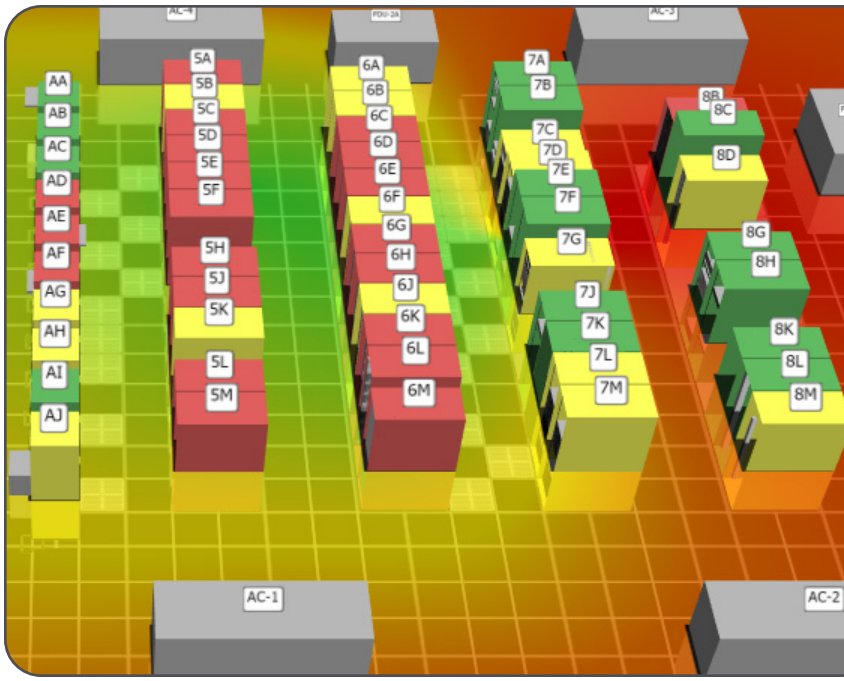


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Environment Monitoring to Optimize Cooling (continued)

How DCIM Software Helps

- **Real-time monitoring and alerts.** Some DCIM software systems collect, store, and report on data from environmental sensors such as temperature, humidity, and airflow. Warning and critical thresholds can be set on temperature and humidity so that, when thresholds are violated, you can be notified that a rack is outside of your standard cooling range so you can quickly remediate the issue.
- **Identifying hot spots.** In addition to thresholds and alerts, DCIM software offers multiple other ways to catch hot spots before they potentially cause equipment to fail, resulting in downtime. Thermal map time-lapse videos of a digital twin of your data center make it easy to analyze the formation of hot spots and perform forensic analysis to identify the root cause and racks can be color-coded by temperature to understand the temperature of all racks at a glance.
- **Avoiding overcooling.** DCIM software with a patented ASHRAE psychrometric cooling chart makes it easy to visualize if racks are within or outside of industry standard or custom ranges for temperature and humidity. This information enables you to correctly adjust temperature set points to optimize cooling resource utilization.



FROM THE EXPERT:

"Our data center team knows more about the rooms, climate, power consumption than our facility management."

WACKER

Dirk S.
System Engineer

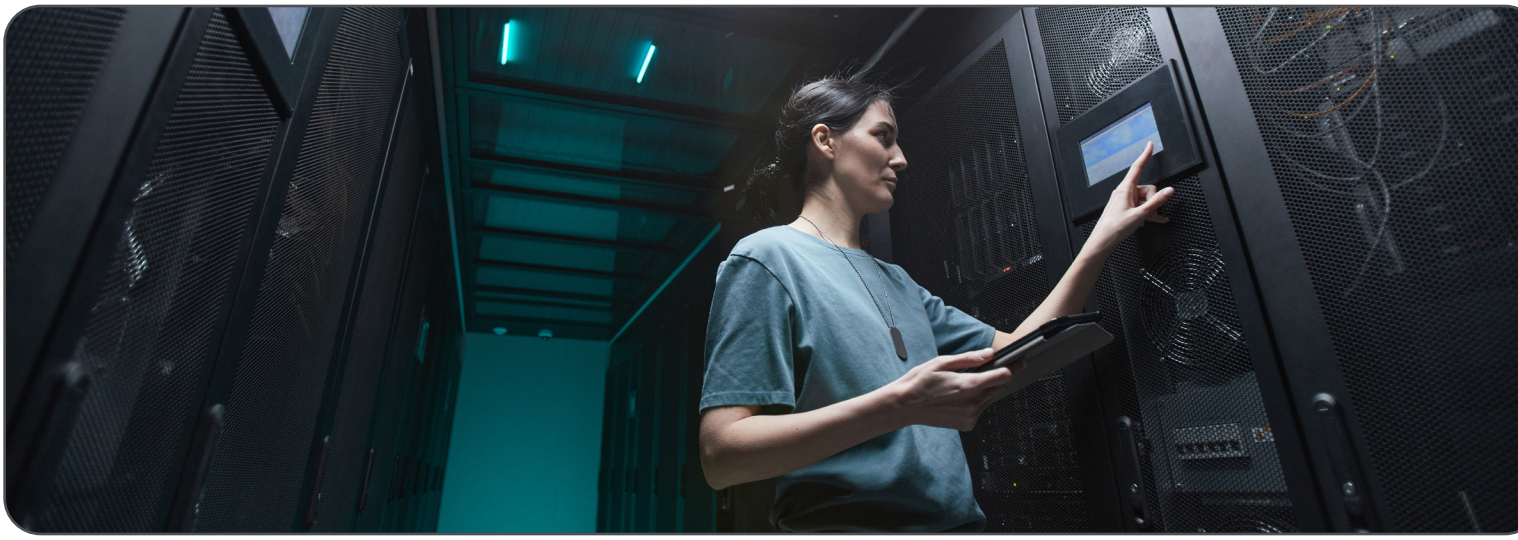
Capacity Planning to Optimize Resource Utilization

Packing power-hungry equipment into high-density racks can potentially maximize efficiency—but only if you have the capacity to support it. Without the right information, you risk overprovisioning or underprovisioning which can disrupt operations or increase costs.

DCIM software helps you know the capacity of all infrastructure resources at a click so you can make more informed planning decisions.

Capacity Planning Challenges with High-Density Racks

- **Power and cooling constraints.** High-density racks require much more power and cooling capacity than traditional racks, making it difficult to track and forecast resource needs accurately. Overestimating the power or cooling requirements can lead to wasted resources, while underestimating them can cause bottlenecks and potential overheating resulting in equipment failure.
- **Space management.** Managing space is particularly challenging in high-density environments. If racks are full of equipment, airflow and cooling may be impeded and require constant monitoring. On the other hand, if power or cooling resources cannot support many high-performance servers in a rack, costly rack space must be left empty and additional cabinets must be deployed for future projects.
- **Dynamic workloads and resource fluctuations.** In high-density environments, workloads and resource consumption can fluctuate rapidly. Changes in demand, seasonal load variations, and evolving business requirements can impact the resources required to maintain optimal performance. Forecasting and managing these changes can be difficult without intelligent capacity planning tools.

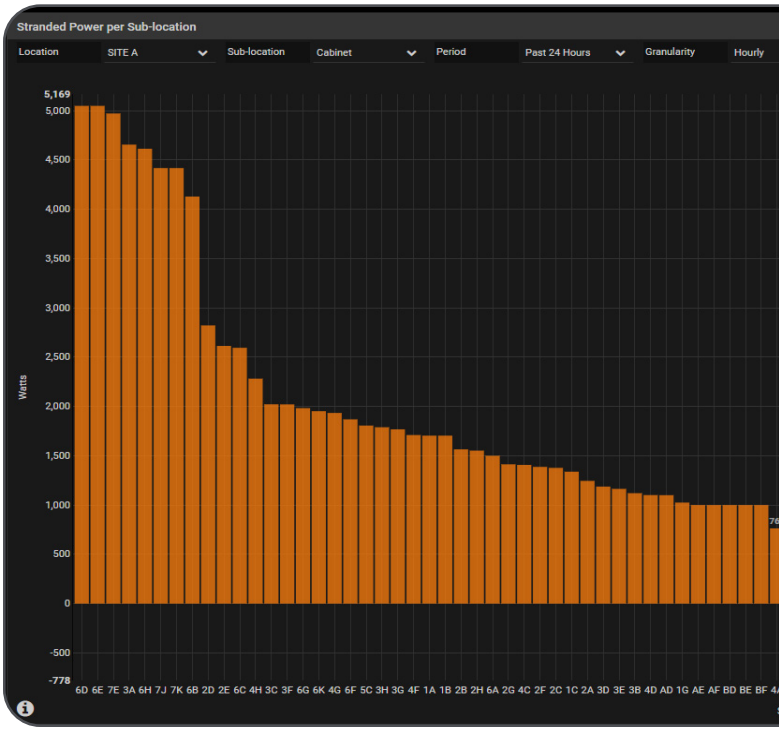


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Capacity Planning to Optimize Resource Utilization (continued)

How DCIM Software Helps

- **Understanding if your existing racks can support high-density deployments.** DCIM software helps determine if your existing facilities can accommodate high-density deployments by tracking your capacity and utilization of space, power, cooling, and network/power ports. With detailed and accurate information, you can perform what-if analysis to know if your existing facilities can handle increased loads. Additionally, weight is often overlooked parameter when deploying equipment, but some DCIM tools can even factor in the total weight and weight capacity of your high-density racks for a more complete understanding of capacity.
- **More informed power capacity management.** DCIM software models the power flow from the building down to server power supplies and can provide intelligence on the power capacity and usage at every hop in your power circuits. By monitoring and managing power loads, three-phase power distribution, and circuit breaker states while ensuring redundancy requirements are met at all levels of the data center, you can maximize power capacity utilization without introducing risk.
- **Easier and faster deployments.** Without the right tools and data, figuring out where you can deploy equipment in a high-density environment can be a manual and time-consuming process. With DCIM software, you can select the model and quantity you are deploying and instantly get a list of all the racks with the available space, power, and port capacity to support it. Then, you can reserve all those resources with a click.



FROM THE EXPERT:

"From an ROI perspective, it's massive for us. We're getting 40% more usage out of our facilities and power resources."

COMCAST

Michael Piers
Senior Manager DCIM/Tools

Digital Twin for Remote Planning and Troubleshooting

High-density racks leave little room for error—literally. With complex configurations, dense cabling, and limited physical access, even small planning mistakes or troubleshooting delays can lead to major disruptions. Without clear visibility into equipment placement, power distribution, and network connectivity, managing these environments becomes a challenge.

A 3D digital twin changes the game by providing a real-time, interactive view of your high-density infrastructure, allowing you to plan with precision, identify issues remotely, and troubleshoot faster—all without setting foot in the data center.

Planning and Troubleshooting Challenges with High-Density Racks

- **Complex rack configurations.** High-density racks introduce greater complexity when it comes to planning the placement of equipment. The tightly packed configurations can obstruct airflow, limit cooling efficiency, and create power or space constraints. Without clear visibility, even small changes can make significant impacts on rack health and capacity that can go unnoticed until an issue occurs.
- **Lack of visibility into power and network connectivity.** High-density racks involve complex power and network configurations, making it difficult to track port-to-port connections and track port capacity.
- **Troubleshooting without physical access.** Troubleshooting issues in high-density racks can be time-consuming and labor-intensive, particularly when physical access is difficult. Remote troubleshooting is often required to minimize downtime and quickly resolve issues. However, without real-time, visual data, identifying and addressing issues becomes more complex.

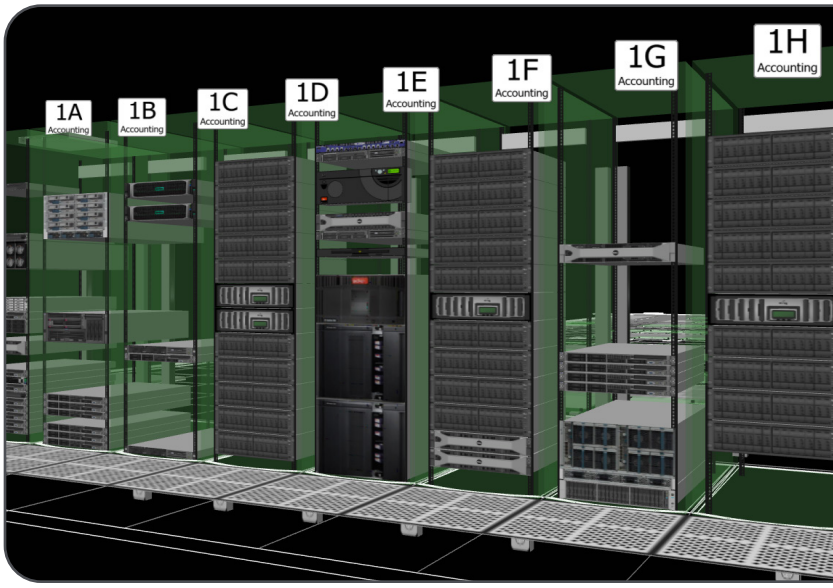


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Digital Twin for Remote Planning and Troubleshooting (continued)

How DCIM Software Helps

- **3D digital twin of all your sites.** DCIM software provides a real-time digital twin replica of your high-density deployments down to the port level. Automatically rendered rack elevations of single or multiple racks can be viewed at any angle with true-to-scale size and placement of rack contents. You can visualize connections between structured, patch, and high-density power distribution cabling including cables under the raised floor or in overhead cable trays. Overlay live measured readings from power meters and environmental sensors on your 3D floor map to gain augmented reality views of what is happening in any rack.
- **Power single-line diagram.** Because DCIM models relationships, it can generate single-line diagrams that allow you to easily navigate your high-density power circuits and drill down to see details of your utility feed, generators and fuel tanks, switchgears, transformers, load devices, UPS units, AC panels, floor PDUs, DC plants, and DC bays.
- **Network diagram.** Because DCIM tracks every physical connection, it can generate network diagrams of your high-density environment to visualize how devices are physically connected and include both active and passive components such as structured cabling and patch cabling.



FROM THE EXPERT:

"Being able to quickly and visually lay... information out dramatically improves both planning and troubleshooting."

Akamai

Michael Garito
Senior Data Center Program Manager

Conclusion

As data centers continue to evolve, high-density deployments are becoming more common. While they offer significant benefits—such as space optimization, cost savings, and improved performance—they also introduce new challenges that require a more strategic management approach. Without the right tools, power constraints, thermal issues, and operational complexities can put uptime and efficiency at risk.

DCIM software provides the visibility necessary to manage high-density environments effectively. From real-time power and environmental monitoring to capacity planning and asset management, a comprehensive DCIM solution ensures that data centers can maximize resource utilization while minimizing risk.

By leveraging DCIM software, you can confidently navigate the challenges of high-density deployments, ensuring operational reliability and efficiency in increasingly complex environments.

Other Resources You Might Be Interested In:

- NVIDIA H200 Power Requirements: Can Your Racks Support Them?
- Can Your Racks Support NVIDIA DGX H100 Systems?
- Is Your Data Center Ready for the NVIDIA GB200 NVL72?
- The Growing Importance of Load Optimization in High-Density Racks

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Get a test drive login

Explore a full-featured Sunbird DCIM demo system.

Try It Free



Download the data sheet

Get an overview of our modern DCIM solution.

Download



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See real product screenshots of Sunbird DCIM.

View Screenshots



Try an interactive tour

Get a self-guided demo of popular power management features.

Start Tour

Sources

https://uptimeinstitute.com/resources/research-and-reports/uptime-institute-global-data-center-survey-results-2024

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