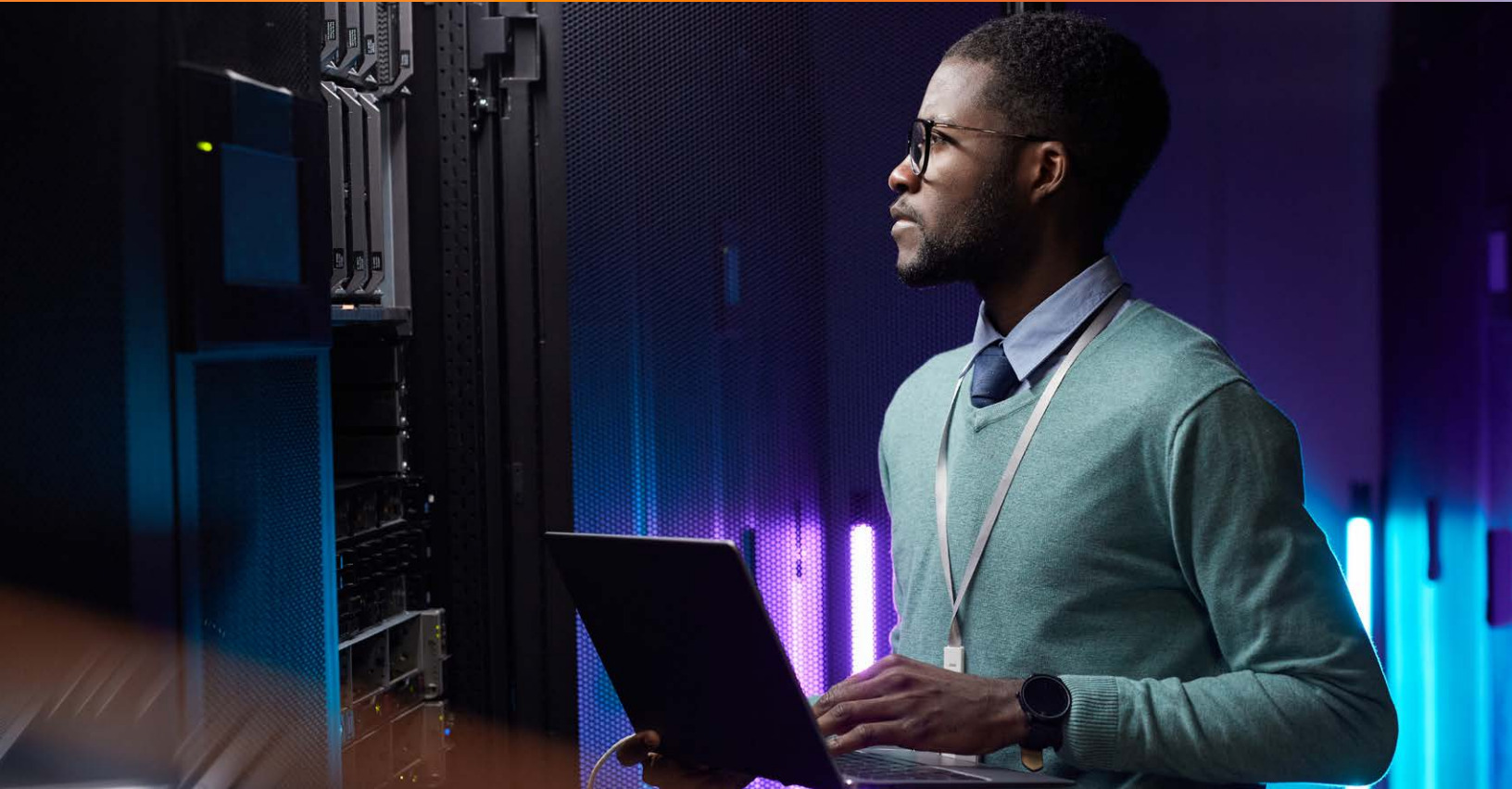
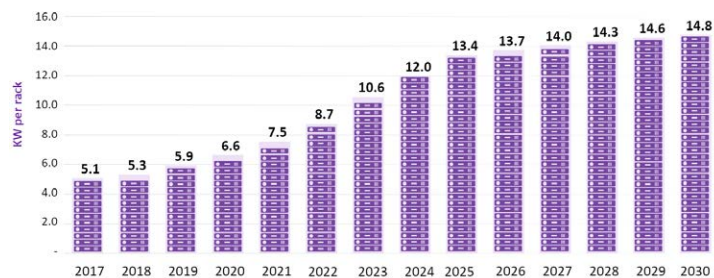


Rising Rack Densities: A Driver for High-Density Rack Power Distribution Units

Vertiv™ Geist™ Rack PDUs at a glance



The average power density of data center racks continues to rise to support AI and ML, crossing 10kW in 2023¹.



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The increase in rack density in data centers has been significant, driven by the growing demand for computational power and the rise of hyperscale cloud services. Over recent years, the average rack density has steadily risen, with hyperscale providers operating at higher densities².

Provider	Server Nodes per Rack	Power Consumption per Rack
Meta	Up to 128	12.5 - 15.8 kW
Microsoft	72 to 92	Up to 24.5 kW
Amazon	Average of 28	Around 17 kW

Table 1: Hyperscale cloud service provider densities were already high, with an average power consumption of 12-20 kW. Source: Omdia Data Center UPS Analyst Call - Aug 2023*

Moreover, server racks that train large AI models require even higher power, with some configurations reaching up to 50 kW per rack. As data centers evolve, configurations with densities of 25 kW or even 100 kW are becoming increasingly common, emphasizing the need for higher-density rack PDUs to manage power distribution and thermal management within these environments efficiently.

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The Significance of Three-Phase Power

Efficient power distribution is crucial in high-density computing environments. Three-phase power is a system that connects three voltage sources or loads to balance the power distribution. The two most commonly used three-phase power systems are the 208V Delta and the 240-415V WYE. Let's compare these two configurations.

	208V Delta	VS	240/415V WYE
Voltage Levels	Provides voltage levels ranging from 200-240V, with the most common being 208V.		Provides voltage range of 200-240/346-415V, with the most common being 240V (NAM) or 230V (EMEA) Line-to-Neutral output.
Configuration	Employs a triangular connection of three phases (AB, BC, and CA) without a neutral wire.		Three phases joined in a Y-shaped pattern and connected by a neutral wire.
Applications	Legacy servers, blade servers and micro servers.		High-performance servers, storage arrays, and networking equipment.
Advantages	<p>Power Efficiency: Well-suited for high-power applications due to its voltage range.</p> <p>Cost-Effectiveness: Existing installations can use it without major infrastructure changes.</p> <p>Compatibility with Legacy Equipment: In retrofit scenarios, where older equipment is still in use, the 208V Delta system provides continuity.</p>		<p>Global Availability: WYE power systems operating at 240/415V are more commonly used than 208V Delta systems. This widespread adoption standardizes components and simplifies maintenance and replacements, streamlining installation and upkeep.</p> <p>Scalable Power: Accommodates increased demands as a data center expands or adds new equipment.</p>

Key Considerations for High-Density Rack PDUs

When selecting high-density rack PDUs, several critical factors warrant attention:

- **Integration with IT Equipment:** Ensure seamless integration with high-power CPUs and GPUs, scaling to meet increasing power demands.
- **Scalability and Flexibility:** Opt for PDUs offering scalability and flexibility to adapt to evolving technology requirements, future-proofing your infrastructure.
- **Real-Time Monitoring and Management:** Prioritize PDUs with advanced monitoring and management capabilities for proactive maintenance and troubleshooting.
- **Outlet Configuration:** Customize outlet configurations to match the unique needs of your data center environment, optimizing power distribution and airflow.

Mitigating Common Pitfalls in High-Density Power Management

Avoiding common pitfalls is crucial for maintaining optimal performance in high-density environments. Here are a few critical mistakes to avoid:

- **Underestimating Power Requirements:** Anticipate future power needs and plan accordingly to avoid capacity constraints.
- **Neglecting Power Monitoring:** Implement robust power monitoring systems to track power utilization and identify potential issues proactively.
- **Overlooking Capacity Planning:** Allocate sufficient physical space for servers and power infrastructure to accommodate future growth and avoid costly downtime.

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Conclusion: Navigating the Complexities of High-Density Power Management

To effectively handle the increasing rack densities in modern data centers, it's crucial to adopt advanced power management strategies. The three-phase power system is a key solution, allowing efficient power distribution within high-density environments. By leveraging this technology, operators can optimize power delivery, enhance reliability, and effectively address the challenges posed by escalating rack densities.

Vertiv: Your Trusted Partner in High-Density rPDU Solutions

From seamless integration and energy efficiency to proactive monitoring and scalability, Vertiv Geist offers the expertise and solutions needed to unlock the full potential of data center infrastructure. With over a decade of experience serving hyperscale clients, Vertiv provides streamlined processes, superior quality assurance, and a customer-centric approach to product development.

Contact a Vertiv Expert today. Visit the rPDU Finder on Vertiv.com for a complete list of available models.

Enhanced Performance and Management of Dynamic IT Spaces

Power

Integrate



Monitor



Rising Rack Densities: A Driver for High-Density Rack Power Distribution Units



Vertiv™ Geist™ Rack PDUs at a glance

Smart Power Unleashed: High-Density Rack PDU System Overview

Outlet Control

Address unresponsive equipment or increase runtime of critical equipment upon power failure with outlet-level control.

Upgradable & Hot-Swappable

Easily update your rPDU's monitoring capabilities to adapt to latest technologies and changing business needs.

Environmental Monitoring

Proactively monitor environmental conditions within the cabinet to ensure optimal operating conditions. A variety of sensors are available to meet your needs including temperature, humidity, airflow, door position, flood detection and more.

Combination C13/C19 Outlet

C13 and C19 in one. Provides the flexibility to connect C14 and C20 plugs in the same outlet. High retention color coded outlets are P-Lock cable compatible.

U-Lock

Secure power cords and avoid accidental disconnections. Receptacles are color-coded by circuit for instant identification.

Vertiv™ Intelligence Director

Daisy-chain up to 50 devices on a single IP address. Reduce deployment time with self-configuration of downstream devices.

High Temperature Grade

Up to 60°C working ambient variants for high temperature environments.

Remote Connectivity

Access the rPDU remotely via the network interface or serial connection to monitor power consumption and configure user-defined alert notifications to prevent downtime.

Fault-Tolerant Daisy Chaining

Simplifies intelligent rPDU connectivity and ensures data is reported even when a break in the network chain occurs.

Small Footprint and Low Profile Breakers

Compact size to install in tight spaces.

Power Monitoring 1% accuracy

Allows data centre managers to accurately monitor input and outlet level power usage with 1% monitoring accuracy tested to ANSI and IEC standards.

Universal Input

A universal input with a pivoting connector simplifies IT power infrastructure deployments by enabling users to standardize on a single rPDU globally.

