# High Performance Computing Density Drives Up Demands on Rack-level Battery Backup


From process control to retail, businesses everywhere are using data-driven strategies to improve their product and service offerings. They are building Internet of Things (IoT) infrastructures that collect large volumes of data from edge devices for delivery to cloud-based servers for processing. However, with its population of 50 billion IoT edge devices, [1] the huge volumes of data the IoT generates creates considerable challenges as well as opportunities.

The most effective way of extracting actionable information from these high data volumes is to use data analytics technologies including Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL). These are no longer futuristic concepts, but rather practices that are here today and being integrated with and deployed into a variety of business.

## Compute Density Drives Battery Backup Requirements

This rapid adoption of analytics has created an explosion in workloads which are both compute and power intensive. For example, OpenAI—an artificial intelligence research laboratory—has released an analysis showing that since 2012, the amount of compute used in the largest AI training runs has grown by more than 300,000 times.[2] In other words, the computer resources consumed by AI has doubled every 100 days.

This rise of AI/ML/DL is driving future rack power densities that will far exceed those of today. Rack-based servers already contain multiple CPUs/GPUs (with hundreds of cores) that will exceed 300W each in the near future. [3]
They are integrated with terabytes of memory and multiple high-speed communication channels. There will also be DDR5 RAM memory power and channel number increases, PCIe Gen4/5 bus power and lane increases, 100G+ Ethernet, and increasing NVMe protocol adoption, which will only be moderately offset by efficiency gains. All this will lead to accelerating rack power densities.

**"The appetite for compute solutions associated with the global digital transformation, coupled with the rise of AI/ML/DL, suggests that future rack densities will far exceed those of today."**

— Dell 2020 Server Trends and Observations Brief

**As a new generation of AI-driven compute intensity is accelerating rack-level power density, backup battery solutions must keep up with rack-level power density expectations.**

[1] Dell EMC's 2020 Server Trends and Observations – 'Data is King', p2
[2] Programmer Info – 'An Exponential Law For AI Compute'
[3] Dell EMC's 2020 Server Trends and Observations – 'Data is King', p13

Together, this AI compute usage and compute density have created a turning point in power density requirements, which has implications for data centers, the server hardware within them, and, in turn, the batteries utilized for backup.

The massively increasing data center workload is gravitating to companies focused on vast cloud businesses, driven by industry leaders such as Amazon, Google and Microsoft. There are already over 500 hyperscale data centers operated by such firms.[4] While this is a minority of the total data center population, hyperscale data centers consumed 47 percent of servers in 2020.

Some of these data centers' operators are opting for power infrastructures with battery backup distributed out to individual racks, in architectures such as those defined by the Open Compute Project (OCP). However, within this scenario of sharply increasing rack power density, backup batteries must deliver more power while occupying less space; it's the compute hardware rather than the battery that earns the revenue for the data center.

**2x**

The Power Density

**½**

The Footprint

With twice the power density, NiZn batteries exhibit ½ the size and weight of comparable lead-acid batteries.

## Battery Power Density is the Key Factor

With these continuing space constraints on in-rack power backup, battery power density will be the key competitive factor. While lead-acid battery technology has been the workhorse for decades, newer technologies are introducing fresh opportunities to meet the challenges of increasing power density in server racks. Nickel-zinc (NiZn) technology, in particular, has specific advantages over lead-acid solutions - and lithium-ion chemistry as well - in terms of performance, reliability, safety, cost, and eco-friendliness.

In particular, ZincFive NiZn battery backup solutions offer dramatically higher power density than lead-acid batteries when measured by either weight (Watt hours per kilogram) or by volume (Watt hours per liter). The size of the NiZn battery is reduced to half that of a comparable lead-acid type. This means that NiZn batteries have two times the power density and half the weight of lead-acid batteries.

NiZn batteries are also simpler to use in a rack format. They do not require trickle charging to maintain capacity performance, which simplifies system design and is more energy efficient. Additionally, unlike lead-acid batteries, NiZn's alkaline chemistry does not sulfate over time and has a higher operating temperature range; another contributing factor to a significantly longer life with low maintenance. In fact, NiZn batteries have three times the product life compared to lead-acid batteries.

## The Safer, More Sustainable Choice

Placing battery backup in the rack, instead of a separate UPS facility, heightens the need for entirely safe operation to protect employees and equipment. Data center operators concerned about the possibility of thermal runaway in lithium-ion batteries will be interested to note that NiZn batteries have been rigorously tested to the UL 9540A test method at cell level, and they did not exhibit thermal runaway in any of the five arduous and destructive test types in that test method.

[4] ZincFive White Paper – Optimizing Data Center Operations with NiZn Backup Technology

Comparable lithium-ion battery systems require a Battery Management Systems (BMS) to manage safe battery operation during UL 9540A testing—a clear disadvantage.

NiZn batteries are also more reliable, in part due to their battery string behavior. When a lead-acid or lithium-ion battery cell fails, it creates a high impedance or an open circuit that halts string operation. By contrast, a weak or depleted cell in a NiZn battery remains conductive, allowing the string to continue operating. In addition, NiZn strings tolerate string imbalances to a greater degree than either lead-acid or lithium-ion systems. With rack-based battery storage being distributed by nature, this behavior serves to lessen maintenance activities and costs.

At the same time, increasing density and power levels of batteries in the data center can have implications for data center sustainability. In a recent Climate Impact Report, ZincFive's NiZn batteries achieved the best overall score of all surveyed technologies. [5]

*ZincFive Monobloc and SubC Cells*

**ZincFive NiZn batteries have been rigorously tested to the UL 9540A test method at cell level and they did not exhibit thermal runaway.**

## The High-density Batteries for High Density Compute

As rack-level compute density drives power density levels continuously upward, backup battery requirements rise accordingly. The high-power density of NiZn batteries makes them the ideal choice to keep up with the increased density requirements, with their smaller size and weight allowing easier integration into server racks. They also can reduce operating expenses by virtue of their superior safety, high reliability, wider operating temperature range, long life and simpler maintenance requirements. By simplifying the challenge of high density battery backup, NiZn batteries are the better choice for the data center operators chasing ever greater compute density.

[5] Boundless Climate Impact Profile August 2020

ZincFive

## Contact ZincFive today

Contact ZincFive today to learn more about its innovative batteries, UPS systems and battery cabinets that make it easy to optimize your data center with NiZn technology.

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