Support Rising Data Center Power Demands with Digital Electricity™

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There are three ways fault-managed power may transform power design and deployment in the portable and prefabricated data centers of the future.

Data centers aren't only the large, siloed facilities they used to be. Today, they're much more than physical structures that house compute power, storage, and networking connections. Data centers provide the foundation for how we work and play. And new types of data centers, such as containers, modular data centers, and micro-edge data centers, bring portability and the ability to achieve rapid expansion and improve operational efficiency.

As applications and technology demands increase, organizations of all kinds are expecting more from their data centers than ever before. Technological advances like artificial intelligence (AI), 5G, and IoT are only increasing data center workloads.

At the heart of conversations about data center demand and growth is power. While these future-forward advancements mentioned earlier enable greater strides in efficiency and collaboration, they also place tremendous pressure on infrastructure and power—especially for portable and prefabricated spaces like containers and micro-edge data centers.

For example, global asset and wealth manager Schroders estimates that energy use due to AI deployment alone could increase from approximately 1GW in 2023 to 7GW by 2026.

And while power usage surges, the cost of power is also rising. The 2023 Global Data Center Market Comparison by Cushman & Wakefield reports that the industry is seeing a median 16% growth in electricity costs for industrial and commercial purposes.

Managing a data center is becoming harder, not easier. What the industry thinks it knows about power design and deployment may no longer hold true. Do you want to be left behind?

An Improved Format of Electricity Is Here: Fault-Managed Power

At the core of this change to power design and deployment is an improved format of electricity called by many names: fault-managed power, Digital Electricity™ (DE), pulsed power, or Class 4.

Fault-managed power systems, such as Digital Electricity™, function much differently than traditional power distribution methods.

For example, Digital Electricity splits electricity into small, safe packets of energy. You can think of these energy packets just like the data packets that travel over a network to their destination.

Every second, hundreds of these energy packets are sent from a transmitter to a receiver over a network, similar to how data packets travel from one point to another over a data network.

To energize an application, it converts conventional analog electricity into Digital Electricity for distribution from a centralized source to many endpoint loads.

From there, Digital Electricity cables distribute the energy packets to wherever they need to go. These cables are flexible, small-gauge, and lightweight.

The remote VoltServer receivers "take in" the packets sent by the transmitter shelf and adapt Digital Electricity to a format appropriate for the locally powered loads, whether the loads use standard 48VDC or AC power. These receivers have a variety of input pairs and provide a range of electrical output formats and power levels.

Throughout this entire process, the energy packets are monitored for safety by the system itself. If a problem arises that could cause a safety issue, then the system immediately stops sending packets, preventing injury or damage.

These Class 4 systems were adopted by the National Electrical Code in 2023 and are supported by new safety standards published by UL and Alliance for Telecommunications Industry Solutions (ATIS).

How Fault-Managed Power Can Support Data Centers

From our point of view, there are three ways fault-managed power may transform power design and deployment in data centers of the future, such as micro-edge or container data centers.

It can accelerate sustainability and efficiency efforts.

Power usage in data centers has increased slowly over the last 20 years—but now it's picking up speed. According to McKinsey, for example, U.S. data center power consumption is expected to reach 35GW by 2030, up from 17GW in 2022. As consumption increases, it must be managed to control not only operational costs but also environmental impact.

Sustainability is also ranking higher on the priority list for data center operators who want to be proactive and make energy-efficiency improvements before mandates or directives require them to do so. These leaders will be ahead of the game instead of scrambling alongside many of their peers when anticipated changes surface in the future.

Fault-managed power can support sustainability in many ways.

As density requirements grow, the amount of available data center space is shrinking. Fault-managed power can help operators optimize space and reduce material use. It offers the ability to distribute more power and data within the same volume, increasing density and reducing physical materials. For example, fault-managed power offers an 18:1 cable reduction to achieve the same level of traditional 48VDC power delivery.

It also reduces the amount of steel required to create separate pathways. Fault-managed power cabling can be installed in data trays, for example, eliminating overhead busway, breakers, and PDUs. These systems enable data centers to do much more with much less, both in terms of physical space and the time required to create and maintain data.

Finally, fault-managed power can reduce the operating expenses associated with data center deployment. The technology features built-in intelligence that allows operators to:

- Monitor and control energy from any location with software for energy management decisions
- Audit power consumption in real-time
- Support real-time device telemetry through dashboards
- Track and document device history; local logging of power, events, and faults
- Offer policy control; pre-program actions based on input events or a schedule

And let's not forget about availability. A sustainable data center is one that not only minimizes environmental impact, but also provides reliable and secure data processing and storage.

These systems enable a centralized backup power architecture and uninterruptible power supply that is more economic and easier to manage than distributed models—all while ensuring data center uptime.

02 It makes high-voltage DC power safer and more efficient.

As trends like renewable energy and onsite DC power generation take hold, high-voltage DC power is becoming more viable for some data centers. It takes up less space, can cope with massive power increases, and makes it easier to integrate onsite and renewable energy sources.

It's estimated that up to 20% of power is lost simply in conversions. Creating an all-DC-powered data center can result in less energy usage by reducing inefficient AC-DC-AC conversions, which also decreases operating costs and carbon emissions.

As a result, data center architects are interested in designing with high-voltage DC power, but safety issues and/or technological limitations have prevented them from doing so in the past.

Fault-managed power can help data centers overcome this hurdle by supporting safe and efficient high-voltage DC power.

Many servers are already implementing high-voltage DC power capabilities, and switches are soon to follow. For data centers that want to pursue high-voltage DC power, fault-managed power can make it safer and more efficient. It safely distributes high-voltage DC power over long distances, supporting these systems and reducing AC-DC-AC conversions. An all-DC data center can increase energy efficiency by more than 5% while providing higher availability numbers.

Fault-managed power also minimizes the electrical hazards associated with traditional high-voltage

DC. With current electrical distribution approaches, several safety protections are needed to shield users. And even with these safeguards in place, electrical distribution is still dangerous. High voltages aren't safe to touch without protection. That's why safety technologies like circuit breakers, ground-fault circuit interrupters (GFCIs), and arc fault circuit interrupters (AFCIs) were developed. Conventional electricity can also an unintentional (and often dangerous) path to ground, which means it doesn't always go where it's expected. This can damage property and people.

By detecting, reacting to, and protecting against fault conditions, fault-managed power ensures safe operation and failure modes, eliminating the electrical hazards typically managed by breakers, GFCIs, and ACFIs in traditional distribution. They constantly monitor for faults and control the delivery of power current during an abnormal condition. This mitigates the risk of shock or fire that often occurs with conventional electricity.

Fault-managed power's approach makes high-voltage DC power safe to implement in data centers.

Support scalability and maintainability.

Trying to predict power needs in the future is nearly impossible. No one knows for sure where innovations like 5G, augmented and virtual reality, and AI will lead, or what's over the horizon that we don't know about yet.

In the past, operators have deployed full electrical infrastructure in an attempt to guess what's to come, but densities continue to increase well beyond expectations. This often leads to underbuilding, which can cause overloaded machines and large-scale failure. Guessing or making assumptions can just as easily result in costly overbuilding.

That's why the ability to intelligently add infrastructure and easily maintain it as data center requirements grow is critical.

To keep up with transformation, data center operators and technicians need to be able to perform moves, adds, and changes (MACs) on a regular basis quickly and easily, without lots of notice—and without having to schedule work in advance or bring in multiple trades. They must also be able to get power to wherever it's needed to support MACs (consider rack reconfiguration as an example).

Fault-managed power can support scalability and maintainability in many ways.

Class 4 systems allow a scale-on-demand approach that supports a linear buildout to address current capacity vs. overbuilding. When the time is right, it's then simple and straightforward to evolve data center space quickly so it's ready to adapt and grow. It's a modular, repeatable approach to power distribution in situations where a complete pod or cabinet is being deployed.

Because power is distributed through listed multi-conductor cabling instead of a bus bar, it's easy to move; simply run another cable in the tray. Installers and operators don't even have to know ahead of time where cabinets will go—cabling can be moved to wherever it's needed.

As power-hungry GPUs come on the scene to support AI, analytics, and augmented and virtual reality, current bus bars may not be rated to handle required power levels. Fault-managed power systems allow you to simply run another cable to bring in more power.

Because Class 4 systems support digital convergence, power and data lines don't need to be separated. This means that power can be installed and managed by any trade group. Over time, in-house teams can even be trained to complete the upgrades.

Your Fault-Managed Power Resources

Digital Electricity, invented by VoltServer, is a type of fault-managed power. It makes electricity easier to work with and safer to touch so the world can more quickly deploy new technology.

Our systems are faster to install and can be less expensive than conventional electricity, enabling a completely new way to distribute power.

Working closely with VoltServer, Belden designed Fault-Managed Power System (FMPS) Cables to support Digital Electricity and fault-managed power systems—the industry's first cables designed and UL listed for Class 4 cabling. They safely carry power at higher levels and across longer distances while reducing infrastructure costs.

Together, Belden and VoltSever can help you understand where to start, how simple and easy FMP is to implement and deploy in your data center, and how it can support your initiatives.

Learn more about Digital Electricity at www.voltserver.com.

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