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Optimizing rack power distribution in the multi-tenant data center

Executive summary

With information increasingly becoming the driving force behind many enterprises, the data center is now the foundation for successful business operations. More frequently than ever before, this function is outsourced to a multi-tenant data center provider... In the multi-tenant environment, peak operating efficiency and reliability are data center necessities; if the data center falters, the business suffers as a result. Consequently, these demands are changing the ways companies design and run data centers.

Increasingly, multi-tenant data centers (MTDCs) need to monitor every piece of power-drawing equipment in the data center, and do so with high accuracy and granularity. For the multi-tenant data center, the ability to stay up and running requires advanced rack power distribution units (PDUs) that can precisely monitor every aspect of power as well as enable the management of power distribution. Without advanced rack power distribution technologies, data centers are at risk of being unable to keep up with the ever-expanding business requirements. This white paper discusses the forces shaping today's data centers and describes the capabilities businesses should look for when selecting PDUs.

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Powering Business Worldwide

Factors influencing today's multi-tenant data center

The modern multi-tenant data center is under intense pressure on many fronts. While information is increasingly important to customer organizations in all industries – as witnessed by an exponential growth in data volume – data center operating budgets aren't keeping pace. As a result, customers have chosen to outsource, but in a competitive marketplace, price pressure has a trickle down effect of restricting operating budgets for providers. With more demands and stagnant budgets, multi-tenant data centers must operate more efficiently. In this environment, data centers face the dual mandates of operating to achieve peak energy efficiency while eliminating downtime as much as possible.

At the same time, virtualization – with its promise to deliver better utilization – is creating a heightened need for agility data centers. This agility mandate is further reinforced by the rising use of cloud-based solutions and data center colocation, which in turn is driving the need for higher accuracy in billing – often down to the single- outlet level in a rack. Measuring tenant power consumption for billing to this degree of accuracy is a key benefit for multi-tenant data centers. In addition, data centers are increasingly implementing converged infrastructure environments – pools of integrated storage, server and networking technologies made possible by virtualization. With converged infrastructure environments, multi-tenant data centers are equipped to offer a greater range of products and services to meet the on-demand computing challenges of today's businesses – provided they can manage the fluctuating power distribution requirements that meeting such challenges entails.

Taken together, all these demands are causing multi-tenant data centers to closely manage every facet of operations to ensure efficiency. On a high level, data centers can implement environmental technologies such as airflow management solutions, including aisle containment doors and ceilings, blanking panels, and data center cages for secure partitioning. Data centers are also deploying UPS solutions to improve efficiency and reduce power costs without compromising protection. Busways that offer multiple plug-in configurations can enable data centers to flexibly connect power to server cabinets with the capacity to meet high power demands.

Power distribution can be further enhanced with the use of cables and accessories that deliver outlet and section current information, and thereby improve both management and troubleshooting. With the addition of power management software, data centers can monitor operations to the outlet level, further optimizing operational efficiency. In conjunction with hardware and software solutions, multi-tenant data centers can keep operations efficiently running on behalf of their customers by utilizing comprehensive services that include technical expertise for all products that are designed to improve costs, uptime, reliability, and power quality as well as an expansive, 24x7 support network.

Qualities of a next-generation rack PDU in a multi-tenant environment

In effect, the modern data center functions much like a utility, providing computing capacity in response to customer growth and the changing demands of those customers. Certainly, high-level power distribution strategies are needed for peak efficiency, yet data centers must go beyond a big-picture view of operations. Data centers that are contending with a variety of pressure-inducing factors must keep a watchful eye on all aspects of power distribution at a granular level. A new generation of advanced rack PDUs – devices with monitoring and management capabilities – offers data centers comprehensive functionality that addresses their most pressing operational needs.

Let's start with cooling costs, which many of today's data centers struggle to contain as density increases. The modern hot-air containment solutions in many data centers have implemented require higher rack PDU operating temperatures. Consequently, rack PDUs that have the ability to function at high operating temperatures, (140°F/60°C) UL rated, can help data centers reduce overall costs. Adding temperature monitoring can also help data centers keep a lid on cooling costs by accurately identifying where heat and humidity are building in the data center, allowing operators to respond accordingly. Such environmental monitoring is particularly suited for containment or network closets where excessive heat can create reliability issues. Additionally, as data centers take advantage of outside air-cooling whenever possible to reduce costs, it becomes increasingly necessary to monitor temperature to mitigate heat and humidity concerns. Environmental monitoring also includes switch closure monitoring to connect door switches or water sensors.

> **Key differentiator to your customers:**
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> As a multi-tenant data center, you can offer your customers additional power monitoring and control capabilities. Customers see benefit in being able to know their power has not been interrupted and may require management capability to control outlets. If this is a feature your data center offers, it can be a key differentiator from competing multi-tenant data centers.
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> Example: Branch circuit monitoring can provide alarms when power is lost on a branch circuit. When a MTDC is selling their services, they can market rack PDU features like this as an advantage over a competitor that has no intelligent monitoring in the rack. The same is true for outlet management/switching. They can give their customers control to do reboot at the rack without needing to gain physical entrance to the MTDC. Some MTDC customers may like to maintain higher levels of control over their racks, so monitoring and control is important to them.

Reducing administrative costs

Given the budget and resource constraints faced by many multi-tenant data centers, administrative overhead is another critical area that requires constant diligence. Data center operations professionals in multi-tenant environments may have customer service and sales-assistance duties that their counterparts in private data centers may not.

Easing installation

Ease of installation is more than just a convenience and time saver; rack PDUs that are easy to install save on startup and provisioning costs. Consider tool-less button mounting options for rack PDUs so out-of-box to install time is minimized. This solution requires a rack enclosure with keyhole (tool-less) mounting capability. Utilizing the same vendor for rack PDUs and rack enclosures is one way to ensure compatibility and another is making sure the rack PDU has been designed for mounting flexibility. An ideal solution would have the tool-less buttons factory-installed on the PDU, would accommodate the rack metal thickness, and would have flexibility to be mounted on the side of the PDU – for 90- degree mounting in the rack. Other mounting options may be required, so further flexibility can be obtained if the rack PDU has bracket-mounting capability, such as a clip foot bracket. A rack PDU with a lightweight aluminum chassis – 30 percent lighter than a steel equivalent – is also easy to install, and can even reduce shipping costs while dissipating heat better and delivering improved electrical ground conductivity.

Increasing billing accuracy

Meter accuracy on next-generation rack PDUs has improved to within ±1% of actual value, which is known as billing grade accuracy. This is a significant improvement over legacy models, which primarily used meters for load balancing. With such a high level of accuracy and transparency, data centers are able to effectively measure power usage to all outlets, enabling department billing as well as the ability to track usage for local utility rebate programs. Billing grade accuracy may be especially important to colocated data centers, which can use these measurements for tenant power consumption billing. In addition, the meter on next-generation rack PDUs can still be used for load balancing and helps data center operators identify open capacity.

Increasing agility

With a wide range of customer requirements in a multi-tenant data center, agility is critical. The best way to facilitate agility? Make sure a vendor can provide both the rack and the PDU. Compatibility goes a long way to ensure ease of use and optimize the way the two components work together.

Figure 1. Rack PDUs with racks from the same vendor ensure compatibility, which enables agility in the data center.

Agility can be further enhanced by features on the rack PDU itself. The ability to set the IP address, rotate the display if the PDU is installed upside-down for busway, and read alarms locally are all features found on rack PDUs with an advanced pixel LCD display and interactive menu system. For rack PDUs with daisy-chain capability, the menu display also enables data center staff to quickly configure multiple rack PDUs from a single IP address and network port, facilitating the management of power suppliers on different feeds through a single interface. The ability to establish a daisy chain can reduce physical infrastructure installation costs by 75% – by reducing the number of network ports that cost anywhere from $200-$500 apiece. This reduction saves on expenses and simplifies management, both critical factors that can increase agility.

Figure 2. An advanced pixel LCD screen with pull-down interactive menu options on a rack PDU.

Of course, uptime is critical for a multi-tenant data center, and even the most agile environment is compromised if the prospect of downtime remains a persistent concern. Here, too, next-generation advanced-rack PDUs can have a significant impact. One drag on reliability is issues of IEC plug retention. It is not uncommon for plugs to get bumped loose in the rack, leading to server shutdown. A rack PDU with IEC plug retention prevents the accidental dislodgment of a plug and can greatly enhance reliability. There are several methods to secure the plug, but a solution integrated into the outlet is ideal to avoid the bulk of external clips or cable trays. It is also important to avoid solutions that require proprietary power cord solutions that involve additional expenses to the tune of 20-50%. On the other hand, an integrated IEC outlet grip reduces the total cost of ownership and improves reliability.

Figure 3. IEC outlet grips provide plug retention and eliminate the need for intrusive cable management that often blocks airflow and decreases serviceability.

Another advantage to minimize disruptions is a hot-swap network meter card. A serviceable rack PDU can accommodate a hot-swap module complete with a meter display, network ports, LCD interface and CPU, all of which data center staff can replace without losing power to servers connected to the PDU. This facilitates field service intervention without the associated downtime. This serviceability concept is similar to hot-swap fans and power supplies found in rackmount servers that aim to prevent downtime.

Figure 4. A hot-swap network meter card minimizes downtime on a rack PDU.

Criteria for rack PDU selection

The process of selecting a rack PDU should begin with the power rating of the PDU and the technologies the data center needs. When designing a data center, operators typically take into account the planned capacity of the rack to calculate power and cooling requirements. Rack capacity is then used to select the appropriate input plug for the rack PDU. Multi-tenant data centers today often want a PDU capable of carrying the full power load as well as accommodating the possibility for expansion, and thereby allow for extra capacity. When such future-proofing is pursued, any excess capacity that is being provisioned can be handled seamlessly simply by implementing a larger capacity PDU.

Once the power rating of the PDU is considered, data centers should next evaluate technologies when selecting a PDU. Typically, rack PDUs come in three categories: basic distribution, metered distribution, and managed or switched distribution. Moving up the stack from basic to metered will allow data centers the ability to locally measure current and load balance – not to mention the capability to remotely monitor branch circuits and facilitate capacity planning. With advanced meters, data centers gain the capability to meter power at the outlet level – advanced functionality needed for accurate Level 3 PUE calculations. Outlet-level metering also provides a level of granularity in reporting power usage that is often required in multi-tenant racks at co-located data centers. In addition, managed PDU facilitate outlet switching, an ideal capability for lights-out data centers or in situations where fast response

to remotely cycle power in the rack is needed. With outlet switching, data centers can also turn off outlets when not in use, thereby preventing accidental overloading of the rack PDU. Finally, outlet switching enables data centers to sequence power up and perform load shedding – advanced features that can be important elements of an overall power strategy.

Conclusion

As the computing demands of their customers continue to increase, multi-tenant data centers can no longer afford to examine power distribution solely at a high level. With virtualization and converged infrastructure, computing capacity is dynamic – workloads, applications and storage are moved around both within and among data centers as business needs dictate. To ensure peak operating efficiency – an absolute necessity given modern business demands – data centers must monitor and manage power distribution at a granular level. Advanced rack PDUs have the features and reliability today's data centers need to maintain their own operations, but more importantly to support the changing and accelerating demands of the business. Multi-tenant data centers would be wise to develop their power strategy by understanding the current rack environment and workload demands, followed by choosing an optimized rack PDU and then backing up the system with a UPS enabled with virtualized management software.

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About the author

Joe Skorjanec has over 15 years of experience in applications engineering and product development in the power distribution and data center markets. He holds a degree in electronic technology from St. Paul College and a bachelor's degree in management information systems from Dakota State University. He is named on patents for transfer switch and outlet retention technologies, and is currently a product manager at Eaton, responsible for Enclosure Power Distribution for IT and data center applications. He may be reached at JoeSkorjanec@eaton.com.

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