colovore

The Challenges of Multi-Circuit Power Distribution in Colocation Deployments

Primer

Contents

EXECUTIVE SUMMARY

The operation of modern IT infrastructure at maximum computing capacity often requires significantly more electrical power and cooling per rack unit than previous generations. The reason for this is simple.

The miniaturization and improved performance of server componentry has made converged, virtualized architectures more affordable and power-efficient. This has allowed disproportionately more computing power to be installed per server cabinet and has caused an increase in the total possible electrical power consumption per rack unit.

IT executives need more cost efficient ways to power their data centers servers to take advantage of the improved capabilities of modern equipment. Traditional power distribution in data center racks using multiple, low-powered circuits is inefficient and suboptimal for many reasons. IT executives looking to improve their operating efficiency should consider higher-amp, higher-voltage and multi-phased power distribution to optimize their IT deployments. This is true for both 400VAC and 480VAC 3-phase distribution designs.

This white paper explains why.

MODERN TRENDS IN IT INFRASTRUCTURE DEPLOYMENT AND MANAGEMENT

Miniaturization of IT infrastructure is a common theme in today's world; technology continues to grow smaller, more compact, and yet more powerful. The trend is guaranteed to continue because hardware commoditization, virtualization and converged infrastructure solutions from major OEMs including Cisco, Dell, HP, and SuperMicro enable corporations to decrease IT overhead and operational costs.

According to IDC, blade servers on average consume 40% less power than traditional rack servers and take up 37% less space. Given that power can consume up to 70% of a company's data center operating costs, efficiencies in electrical load management can yield considerable savings. With its Moonshot cartridge-based server, HP claims a 77% cost reduction per cartridge versus a traditional server and estimates that the savings in TCO for a company deploying a 16 cartridge server deployment versus a traditional 16 server rack system are $212,000, or nearly 50%, over a 3-year timeframe.

This means racks now require more power density (kW per rack) in order to operate modern servers effectively. New form factors consisting of 2U, 4U, and even 10U footprints incorporating multiple server nodes and increased CPU, RAM, and storage require considerably *more power per rack unit than ever before*. Power requirements of 250 – 500 watts per rack unit are now common in today's IT architectures, with racks routinely drawing between 10 - 15kW in aggregate power.

This increase in the power required per rack unit requires a new power distribution design for data center racks to handle greater total loads.

Typical Rack-Level Power Distribution

Traditional power distribution in a data center rack consists of multiple, lower-power circuits. Table 1.0 "Power Circuit Comparison" below summarizes typical electrical power circuits and the effective power delivered assuming industry-recommended operating guidelines.

Table 1.0 - Power Circuit Comparison

Receptacle Type	Circuit Type	Available kW at 80% Breaker Rating
NEMA 5-15	15A 120V	1.4 kW
L5-20	20A 120V	1.9 kW
L5-30	30A 120V	2.8 kW
L6-20	20A 208V	3.3 kW
L6-30	30A 208V	5.0 kW
L21-20	208V 20A 3 Phase	5.8 kW
IEC 60309	**208V 60A 3 Phase**	**17.3 kW**

Most data center operators and infrastructure deployments deliver usable rack power densities in the 3 to 5 kW per rack range. This is governed by the power and cooling design constraints of the building.

In this case, if high power density racks are required, then receptacles from adjacent racks are diverted to supply the additional load. This eliminates power from other areas of the data center, rendering those sections unleasable. High density customers will have to pay for this luxury in the form of a surcharge on their monthly invoice as the data center provider attempts to recoup what it has lost in terms of sellable power in those other sections.

Let’s look at this scenario in even more detail. A full rack containing a mix of high power servers, low power network gear and cable management units can typically achieve an average energy consumption of 250W per rack unit. This translates to over 11kW for a typical rack that is 45 rack units tall.

This means that IT professionals seeking to deploy full racks of gear will have to manage the operation of multiple power circuits. The likelihood of more circuits being required is increased if redundant power circuits (ie, B-side feeds) are needed or higher individual rack densities (ie, 12+ kW per rack) are desired.

There are many drawbacks to this scenario which will be covered in the next section.

DISADVANTAGES OF MULTIPLE-CIRCUIT POWER DISTRIBUTION

There are a number of meaningful shortcomings when you need to deploy and manage multiple power circuits per rack. Operating flexibility, scalability, and reliability are negatively impacted and operational costs therefore increase. Factors to consider include:

1. **Reduced Rack Space:** Each additional power circuit requires its own power distribution unit (PDU) or power strip. In some cases these PDUs occupy precious rack space that

servers could use. They also reduce air flow, require more in-rack cabling and increase the complexity of cable management.

2. **Delayed Growth:** Older data centers were designed for lower power densities per rack using smaller-sized power circuits. When more power capacity is required there can be delays in installing additional circuits and increasing the additional air conditioned cooling that will be needed. This additional time creates opportunity costs and real costs increase due to additional parts and labor involved for the provisioning.

3. **Impeded Long-term Scalability:** What happens if you want to deploy modern hardware and configurations driving rack densities above 10 kW per rack? How does your data center provider enable this with existing standard power circuitry? Older data center facilities designed for lower capacity circuits often cannot provide the wall to wall high density power that modern servers demand, which stymies your ability to compress IT infrastructure taking advantage of more dense hardware.

4. **Unpredictable Failure Domains:** Modern big data applications are designed to gracefully recover from complete rack failures. Partial failures, where some servers die, while others survive, can be troublesome. This scenario is more likely to occur where there are many low capacity, over-utilized circuits in a cabinet. A single high capacity circuit engineered to capably handle any predicted load not only improves uptime but also reduces the mean time to recover (MTTR) if there is a failure. Such high capacity circuits include the IEC 60309 used by high density lab and data center operators

5. **Greater Operational Risk:** Each power circuit is a potential point of failure. More power circuits therefore reduce operational reliability, especially lower amp circuits because of the corresponding lower power surge required to trip the circuit.

6. **Increased Power Cost:** Traditional retail colo pricing models price power per the circuit, not by the actual power consumed. The more circuits, the greater the cost-- whether you use them or not. Paying for potential usage is costly, especially if you never load a circuit at full capacity for fear of overloading it. As a result, your effective price per kW consumed ends up being much higher than you realize.

7. **Step-Function Power Cost Increases:** The likelihood of a small power circuit being overloaded is greater than that of a higher capacity circuit. When this occurs, a new circuit needs to be ordered, and it is typically underutilized initially. This means that you are paying for an additional underutilized circuit that costs the same as a fully-utilized one. This causes an inefficient "stair step" increase in cost that can be triggered by a need of just 1 KW of extra capacity.

Now let's review how more modern power distribution can be beneficial.

BENEFITS OF 60A, 208V, 3-PHASE DISTRIBUTION

Given the disadvantages described previously, it is clear that larger power circuits in data center racks have many benefits. At Colovore, for example, we provision every cabinet with a standard 60 amp, 208 volt, 3-phase electrical circuit for these very reasons. This type of circuit offers both more efficient higher voltages and greater capacity. This means that each cabinet comes pre-configured with 20 kW of power capacity (17.3 kW at 80% derated level).

This provides:

1. **More Equipment per Rack:** With more available outlets per rack, you can install more equipment per rack, therefore reducing your unit data center overhead costs. Your IT environment is more compact and easier to manage.

2. **Near Real-Time Provisioning:** Increase your IT load without requiring additional outlets. This allows you to grow vertically, not horizontally. Because of the higher power nature of this circuit, incremental capacity is readily available and this reduces the need to wait for third party electricians to install new circuits.

3. **Scale as Your Strategy Demands:** Closely match your provisioned power to the compute needs of your IT roadmap now and in the future. This acts as an insurance policy guarding your infrastructure deployment from unexpected power-induced bottlenecks.

4. **Improved Operational Efficiency:** Better airflow, rack and cable management, and fewer PDUs all simplify the management of your IT infrastructure.

5. **Improved Uptime, Graceful Failures:** Fewer power circuits reduce your risk of disaster. Larger power circuits reduce the likelihood of partial failures of subsystems due to electrical

faults. This allows you to design systems that fail in a predictable manner and thereby improve resiliency using standard failover schemes.

6. **More Balanced Loads:** The electrical design extends beyond the cabinet. It is possible to have multiple small single-phase circuits overload a single phase of the main PDU powering the entire computer suite. This increases the risk of a circuit breaker tripping that affects the entire suite. Three-phase power to the cabinet improves the load balancing of the main PDU, minimizing the trip risk and maximizing power delivery to the IT infrastructure.

Using 60A, 208V, 3-phase distribution has many advantages. These can be improved further by collocating in a data center that allows you to pay for what you use, not the potential of a circuit. This allows you to match expenses to actual operating use. The lack of “stair step” provisioning model adds even more to the cost savings.

CONCLUSION

IT executives looking to drive operating and costs efficiencies by deploying higher-density infrastructure need to consider power distribution in addition to the hardware and data center environment you are choosing. To optimize your compute, it is clear that provisioning with fewer, but higher-power circuits drives significant benefits. And with IT architectures only becoming more compact and powerful, this is the best way to ensure the long-term scalability and viability of your IT infrastructure.

Peter Harrison, CTO and Co-Founder
May 2015

About Colovore

Colovore is the Bay Area's leading provider of high-density colocation solutions. Located in Santa Clara, CA, Colovore's modern data center features wall-to-wall power densities of 20 kW per rack and power billed as you consume it, not based on circuit potential. This provides the most flexible, scalable, and cost-effective colocation solution in the marketplace. And with a team with decades of managing web infrastructure, not real estate, you'll be in great hands.

www.colovore.com