

Is power your weakest link in data center flexibility?

Key considerations for power systems in adaptive IT environments

Business was booming to the point that the company outgrew its enterprise resource planning (ERP) system. It was time to upgrade to new software, larger storage and faster processors. The VP of manufacturing had no trouble getting approval for the upgrade and planned a one-month rollout process. No problem.

Actually, it proved to be a big problem. Hardware upgrades, software installation and data conversion could be completed in a month, but that was just the start. Space limitations compelled the company to migrate to high-density servers and storage devices that required more power than the company's power system could handle.

The power system overhaul would have been so costly that the company ultimately decided it was faster and cheaper to deploy the new ERP system in an entirely new building with new power systems. The end result: a cost overrun of more than 100 percent, and a wastefully underutilized data center.

Sadly, this scenario is typical. Even where there is ample budget and space to support IT growth, is there enough power? Often the answer is "no." This essential commodity, once taken for granted, now factors into IT planning decisions in a big way, for several reasons.

Your IT, networking and telecom systems consume more power than ever.

A typical rack or wiring closet of equipment used to consume about 1.7 kW or 2 kW. A few years ago, that would have been high; it would be minimal today. For example, a rack full of Cisco Catalyst 6513 networking equipment consumes 8 kW. A rack of HP Proliant DL145 1U servers consumes 12 kW. Fill that rack with HP blade systems, and now power consumption more than doubles, to 26.5 kW.

Typical power consumption for a rack of IT or telecom equipment

HP Blade System P Series	26.5 kW
HP Proliant DL140 1U	13.4 kW
HP Proliant DL145 1U	12.0 kW
IBM DS6800 + 12 DS6000	7.1 kW
Cisco Catalyst 6513	8 kW

Source: Eaton

How are you going to distribute clean, manageable, reliable power at that scale?

The capacity of your power system is only as great as its weakest link, only as high as the lowest rating along the chain. For example, suppose you need 6 kVA downstream, and you have 208-volt power coming in at 30 amps, but downstream breakers are only rated for 20 amps. Effectively you only have 20-amp, 208-volt service, derated 80 percent to 16 amps, per the National Electrical Code®. If you sized every element of the power chain to avoid such bottlenecks, you would be wasting a lot of money. You would also sacrifice the flexibility to downsize, if necessary.

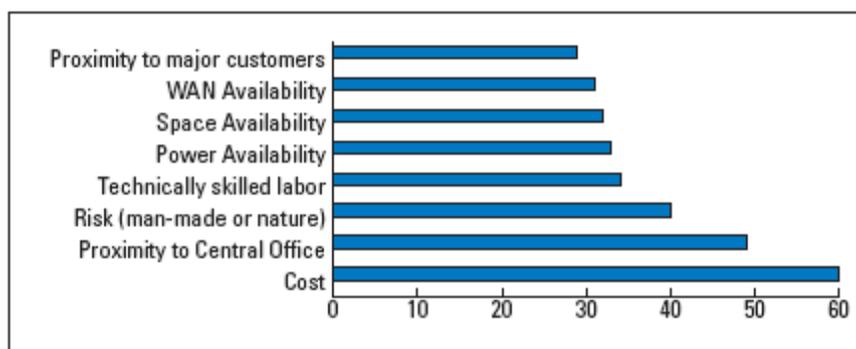
Power is proving to be a limiting factor in data center growth. For instance, while it is physically possible to put 42 1U servers in a single rack, that load would exceed all but the most ambitiously overbuilt power delivery systems and the rack would be as hot as an oven. Hot spots of power consumption or cooling requirements create a big strain on facility systems.

Some managers address this concern by spreading high-density equipment across several racks. Instead of attempting to pack 42 1U servers in a single rack, they might configure a rack with three or four 1U servers, interspersed with less demanding equipment, such as traditional 2U or 3U servers and networking equipment. This strategy levels the load on power and cooling systems, but it adds cost and complexity. Reliability may be compromised by the difficulty of maintaining widespread systems.

Your power requirements will inevitably change.

Business units within your organization are seeking to satisfy ever-changing business requirements, and they turn to their IT teams to provide the systems to make that work. They aren't expected to consider all the behind-the-scenes logistics of making that happen, and they don't. Power isn't even one of the top four worries on IT managers' minds, according to the Network Computing survey, "This Old Data Center" (2005). However, power systems can make or break the business case, now that power costs are approaching 50 percent of a typical enterprise IT budget.

Suppose the organization needs new servers to support new applications, plus redundancy to meet Sarbanes-Oxley requirements, plus disaster recovery provisions for critical systems and data. You could be adding components today and scrambling to find the cables and power outlets to serve all those different plug standards. Then, who knows? Next quarter the scenario could be reshaped by server consolidation, downsizing, corporate mergers, organizational upheaval or technology upgrades. Flux is the reality of IT today.



In spite of the looming power crisis in data centers, power isn't even one of the top four worries for IT managers.
Source: Network Computing survey, "This Old Data Center" (2005)

This flux brings unwanted complexity from a power perspective. How do you address this reality?

- Do you overbuild the capacity of the entire power system from main switchgear to individual power drops to be ready for future growth that may or may not happen? The entire power infrastructure would be severely under-utilized for now. Some components, such as traditional UPSs, are far less energy-efficient when operated at low loads. (An exception is the Eaton® BladeUPS®, which operates at greater than 95 percent efficiency even at low utilization.)
- Do you maintain a large inventory of diverse power distribution units in anticipation of changing power drop requirements? Or do you plan on keeping an electrician on retainer, to call in whenever the configuration changes? These are costly and cumbersome propositions.
- Do you run power cables in spaghetti fashion everywhere you could potentially need a power drop to support new equipment? Even the availability of a simple outlet can become a major restriction to IT flexibility.

Flexible. Adaptive.

These are the hottest buzzwords in IT infrastructures today.

The power infrastructure must be flexible and adaptable too.

In most cases, power was not a focal point in IT planning, so now the power chain is strained to meet large fluctuations in power demand.

What is the best strategy?

The data center— one of many at the telecom service provider – as a Utopian paradox.

The gleaming, top-of-the-line facility had expansive floor space, twin power utility feeds and the latest new equipment. Sitting in the middle of the vast data center, like lonely chess pieces, were six racks about four percent of the data center's potential utilization.

“Build it and they will come,” had been the philosophy for establishing the luxuriously over-sized data center, as well as the company's other data centers. But the people didn't come. Ultimately, the service provider joined the annals of good intentions that failed, and their data centers were sold for pennies on the dollar.

Overbuilding is still the norm, even though this approach is costly and risky. Constant change brings a cascade of complexity. Since power costs are not going to decline, and power requirements are not going to stabilize, what is the best strategy? How do you deliver power to IT equipment in dynamic organizations?

The answer is to seek flexibility and adaptability in the power infrastructure, just as you seek it in IT, networking and telecom systems. However, the chameleon nature of the power chain must preserve power quality, availability and reliability.

There are many theories about how to achieve flexibility and reliability; many organizations gain consistent results from the following strategies.

Strategy #1—

Standardize on a set of core attributes.

If you buy products that have consistent energy ratings, plug types and management interfaces, you can greatly reduce the complexity of the power chain. Simplicity always saves money.

For example, fewer plug types means less need for diversity in receptacles, power strips and power distribution units. Consistent energy ratings enable diverse equipment to be effectively served from a single UPS. Consistent management interfaces enable your system administrators to move easily from one system to another. Knowledge gained with one system can be applied to comparable systems across the enterprise.

Until recently, modular infrastructure solutions tended to focus on the needs of individual servers and networking appliances.

A more holistic approach – considering the bigger picture – does far more to reduce the complexity of the overall solution.

Strategy #2—

Deploy standardized, pre-engineered power solutions.

There has been a lot of focus in recent years on pre-engineered, modular infrastructures to house communication and IT systems in data centers and wiring closets. This approach provides a pre-tested, ready-to-install infrastructure that is naturally more robust and flexible than piece-part solutions assembled on-site, often in an ad-hoc fashion.

Why limit the benefits of structured solutions to servers, storage devices and communications gear? Pre-engineered infrastructure solutions can deliver equivalent benefits for your power system. Structured wiring enclosures are available to accommodate power quality, power monitoring and power distribution equipment as well.

Prefabricated wiring systems are engineered and tested at the factory, then shipped with all components in place within the enclosure. At your site, installation is easy, and your new wiring closet is a standardized part of the complete power chain. Structured wiring solutions address power needs in a cost-effective, energy-efficient manner.

Benefits of a structured wiring solution

For new or retrofit applications

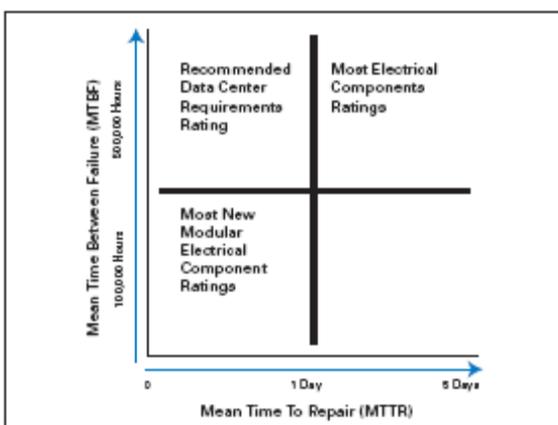
- Reduce space requirements by an average of 50 percent.
- Reduce construction cycles by one or two weeks.
- Mitigate job site risks with a pre-tested configuration.
- Deliver clean and reliable power on demand.

- Configure modular components for specific requirements, such as surge suppression, power quality and backup power, filtering and mitigating harmonics, emergency lighting, building management and rack-mounting IT equipment.

Strategy #3—

Look at both sides of the availability equation.

Mean time between failures (MTBF) is a good indicator of the robustness of power equipment, but the reality is that electro-mechanical devices, no matter how well made, will someday falter or fail, or at least require service. So, when evaluating equipment, it's important to consider mean time to repair (MTTR) as well as MTBF. Both metrics should be assessed, measured and optimized for the entire power system, not just for raised-floor equipment.



Source: Eaton

In a perfect world, all the components of your IT environment would be classified in the top left corner of this chart. They would run a long time without a hitch, and be quick to fix if there ever was a problem. In reality, most electrical and mechanical infrastructure for IT falls into the top right of this chart – engineered solutions that run trouble-free for a long time, but are troublesome to repair if the time comes.

Achieving good ratings on both measures, MTBF and MTTR, has been somewhat of a balancing act of conflicting forces. For instance, the industry moved toward modular components that could be easily swapped out for speedy repair. This approach often added complexity that made systems more prone to failure in the first place. Simpler designs with fewer components lead to greater reliability but can increase time to repair.

Eaton BladeUPS and Eaton 9140 UPS products optimize MTBF and MTTR through strategies such as these:

- Build self-diagnostics and predictive failure analysis into components and solutions.
- Reduce the number of components to reduce potential points of failure.
- Use standardized, off-the-shelf components wherever possible.

The result is a power backup solution that is highly reliable, gives advance warning of potential issues and can be quickly repaired with widely available replacement components.

Strategy #4—

Choose the most energy-efficient components you can find.

The more efficient the components of the power chain, the more real power available for your IT systems, to accommodate growth and change. For example, Eaton's BladeUPS power system operates at an industry-leading 97 percent efficiency in normal operation. Even at very nominal loads, where you would expect efficiency to be lower, this UPS is still more efficient than a leading competitor's product at full load. With best practices and the right choice of equipment, data center managers can reduce energy consumption by nearly 50 percent.

What is your power system trying to tell you?

Identifying and preventing the problems that tend to arise in shifting IT environments

Adaptive change in the IT environment could be stressing portions of your power systems and putting your critical applications at risk. Would you know? The clues to impending trouble, such as fast, transient aberrations in the waveform can appear and disappear in microseconds.

Harmonics, voltage fluctuations, transient over-voltage conditions and other power anomalies can wreak havoc on your equipment and processes. It is essential to fully understand the quality of the power that is being delivered throughout the facility. If you have detailed event information, you can pinpoint the root causes of problems or prevent them from occurring.

In the past, basic power monitors were used to identify existing conditions on an electrical distribution system or to evaluate past problems. If you wanted to detect fast voltage transients, you had to bring in portable power quality monitors that cost up to \$20,000 and usually required an outside consultant.

Eaton Power Xpert® next-generation meters address this issue in adaptive data centers. Thanks to recent technology advancements, we can now match the sampling rate of those high-end systems in compact, affordable devices. These permanently installed instruments monitor, record and analyze critical aspects of an electrical distribution system. With this knowledge, you can optimize energy utilization, process performance and cost, no matter how rapidly your IT architecture changes.

Closing thoughts

If you manage a data center – or you care about the profitability of an organization that has one – you know how critical flexibility and adaptability have become. But the IT infrastructure is only as flexible and adaptable as the power system that feeds it.

The good news is that technology solutions and best practices are available to mitigate the limitations of previous-generation power systems and substantially raise the bar for new installations. Either way, you just have to ensure that power considerations are included in the planning horizon.

About Eaton

Eaton is a global leader in electrical control, power distribution, power protection and industrial automation products and services. Eaton's Electrical division delivers a broad range of infrastructure solutions for data centers:

- **UPS products**—Rackmount and freestanding power protection systems for applications from the simplest desktop to the largest government, healthcare or industrial facilities
- **Enclosures**—Attractive, secure and functional enclosures for data centers, wiring closets, office environments and warehouse spaces
- **Power distribution**—Rackmount ePDU™s to streamline the distribution of power throughout a data center, rack or enclosure
- **Power reliability**—Generators and advanced battery technologies to provide backup power, paralleling gear to create redundant UPS configurations, power quality audits to assess and improve power conditions
- **Services**—Maintenance plans and extended warranties, 24x7 support, remote monitoring and diagnostic services, turnkey project management and electrical contracting and system integration—350+ customer support engineers in North America

For more information about Eaton's data center solutions:

800.356.5794 - www.Powerware.com/datacentersolutions

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