

MEETING THE DEMANDS OF

# Flexible Data Center Design



# EXECUTIVE SUMMARY

When designing a data center, a recognized set of principles is typically followed. Scalability, resiliency, reliability, and sustainability are all essential, but the most important common feature for data-center products may be flexibility. The equipment cabinet should likewise be flexible, but this has not always been the case. Certain well-known limitations and obstacles have befallen data centers in the past. Of late, this has prompted a rethinking of the way IT infrastructure, power, and cooling converge—and the data-center cabinet is starting to adapt. This white paper discusses the importance of understanding this convergence, and also takes a look at how racks are evolving to support flexibility.

## DATA CENTER DESIGN PRINCIPLES

As anyone who has lived through the last several waves of server-density increases and compute evolutions knows, designing a fixed physical infrastructure to support a constantly moving target is challenging at best. Data centers must be designed with both the past and the future in mind. They are tasked with delivering power and cooling to loads that are, to say the least, well beyond average for almost any other type of facility.

In addition to capacity challenges, load demand must be met with the utmost reliability: outages are never an option, not even for maintenance. Recognition that the data-center industry is responsible for operating more sustainably is increasing. The goal of consuming energy more efficiently has led to the pursuit of a lower PUE—which has in turn driven revolutionary changes in mechanical and electrical design, as well as efficiencies in system components like air handlers and uninterruptable power supplies.

Designing to the demands of the modern data center is no walk in the park, nor is the ongoing task of data-center operations. Once the design

and construction team have called it a day, there remains the ongoing task of delivering uptime in a continually evolving environment. Evolution is another word for change, and like it or not, the data center is no more immune to transformation and change than anything else in life. The physical infrastructure, the software, and the demands placed upon any given center all vary, moment by moment, and day by day.

## AND THE GREATEST OF THESE IS FLEXIBILITY

As stated above, scalability, resiliency, reliability, and sustainability are all core data center design principles, but none help to support the ongoing evolution of center operations as much as the center's ability to be flexible. Flexibility follows the flow of change, it integrates; in other words, the only way to adapt to change is through being fluid and flexible, rather than stagnant and rigid. Trees have strong trunks and branches, but they bend and sway with the wind and adjust to the seasons. Without the flexibility to sense and adjust to anticipated and unanticipated changes, a data center is on a sure path to failure.

Now, the IT manager who is standing in front of a 500-ton cooling tower or a 2MW diesel generator might take exception to that last statement. But while some of the major building blocks of data-center infrastructure may seem fixed and unmoving, the way in which they are designed and installed allows them to be at least scalable. In data-center design, opportunities for flexibility seem to increase the closer you move to the load, or in the direction of the cabinet on a one-line. For example, while a 2MW generator is inflexible, it could be feeding a busway that is the very definition of flexibility! Through a busway, the data-center manager could move electrical capacity

to the cabinet load without adding circuits to a distribution panel (and at the appropriate voltage, no less).

## FLEXIBLE INFRASTRUCTURE

Likewise, the cabinet PDU that is fed by the busway lends to the flexibility of the electrical design. In recent years, manufacturers of cabinet-mount PDUs have introduced products with features that support three-phase-power distribution—alternating phase outlet placement to support balancing three-phase loads—as well as outlets that can support multiple-plug configurations instead of just one. For example, a designer could specify a combination C13/C19 outlet that would accommodate both C14 and C20 plugs, giving the outlets the flexibility to support a variety of future IT-equipment refreshes. This flexibility lets operators populate racks one way today, yet still accommodate the changes of tomorrow with the greatest of ease.

## WHICH COMES FIRST: THE CABINET OR THE RACK MOUNT PDU?

Does the cabinet support the PDU, or does the PDU support the cabinet? Manufacturers of rack mount PDUs view the cabinet as an elaborate support mechanism for 42Us worth of power outlets. Cabinet manufacturers see the cabinet PDU as one of many accessories they are responsible for housing. We will not choose sides, but will let the reader decide.

Cabinet PDUs are also designed with varying degrees of “intelligence,” or software, that is built into onboard controllers. This gives the data-center operator the capability to reset power to the individual IT device via a single interface: whether that is a top-of-cabinet switch, a load balancer, a storage array, or a server bank. In the event of a main-power-source failure, cabinet PDUs support load shedding by shutting off noncritical devices in a predefined, prioritized order. Load shedding helps to ensure a controlled migration of IT workloads, so that the data center can continue to provide uninterrupted operation as well as workload flexibility.

In addition to rethinking the cabinet PDU, companies are rethinking the design of the cabinet itself. The equipment cabinet is home to the stars of the data center: the server, storage, and network appliances that create, process, and deliver the data that we rely on. The cabinet itself is a monolithic, yet otherwise unremarkable inhabitant of data-center real estate, whose purpose is primarily structural. It takes on the burden of housing all of the equipment and its weight, which is often thousands of pounds stacked in a relatively small footprint, sometimes as minimal as 24” by 42”.

## INFLEXIBLE INFRASTRUCTURE

When it comes to infrastructure, operators are accustomed to both the variety of available widths and heights, and to the almost endless list of accessories that can be used to support equipment. Cabinet manufacturers provide rails, doors, shelves for switches, cable-management solutions, and more. It is only after the accessory selections have been made and the equipment has been installed, however, that the equipment cabinet is configured for the present installation. It

is not uncommon for companies to replace racks during equipment-refresh cycles, when they realize that the present racks cannot accommodate the form factor of the new technology.

In addition to housing gear, the equipment cabinet serves another very important function. It is the stage for the cooling systems that support the data-center show. And while we are accustomed to working around the inflexibility of the standard data-center cabinet, there is little doubt that any data-center design would be improved and supported by racks that worked with operators through not only complimenting power and cooling delivery, but also by allowing for future-minded flexibility.

## WHERE POWER MEETS THE CABINET

In addition to supporting equipment, the average cabinet also has the responsibility for supporting the last leg of the data center’s most critical asset: redundant, reliable, conditioned power. The cabinet-mount PDU is attached to the rear of the cabinet and from there distributes single- and three-phase power to the loads inside the cabinet. The PDU is typically mounted by means of a support bracket that is affixed to the cabinet. Seemingly an innocuous detail, the PDU support bracket is an accessory that—if overlooked in the parts order—can bring an installation project to a screeching halt.

### CAN YOU LOSE YOUR JOB OVER A BRACKET?

At a recent cabinet installation at the University of Oregon, the project came to a standstill when the Dell team, already on the clock, realized that they could not

mount the cabinet PDUs to their racks. The project manager for the university had to track down the correct brackets and have them rushed to the job site from a couple states away. The Dell team was happy to have two paid days off work. To better understand the indispensability of this issue, let's take a look at five common cabinet configurations.

1. Single PDU, facing inside: could be mounted between the back support and rear equipment rail.
2. Double PDU, facing inside: could be mounted in the same position as the single PDU, but with less space.
3. Single PDU, facing outside: could be mounted between the cabinet side panel and rear equipment rail.
4. Double PDU, facing outside: could be mounted between the cabinet side panel and rear equipment rail, on both sides.
5. Quadruple PDUs, facing inside: could be mounted between the back support and rear equipment rail, on both sides.

The issue that commonly comes up in reference to the PDU-mounting bracket is that it falls into a no-man's-land of responsibility: Is it part of the cabinet? Or does it come with the cabinet PDU? Who is responsible for supplying and installing? To make matters even more complicated, some companies that manufacture both racks and cabinet PDUs will create a proprietary bracket that only mates their own components.

The bracket, as well as the cabinet PDU, can also contribute to an inflexible future. By definition, a bracket will support a certain PDU in a particular position within the cabinet. But cabinet PDUs are commonly mounted in a variety of configurations, depending on the application, which could change again during an equipment refresh. There can also be a limited number of positions available for affixing the PDU along the horizontal axis at the back of a standard cabinet.

## BUILDING A MORE FLEXIBLE FUTURE FOR RACKS

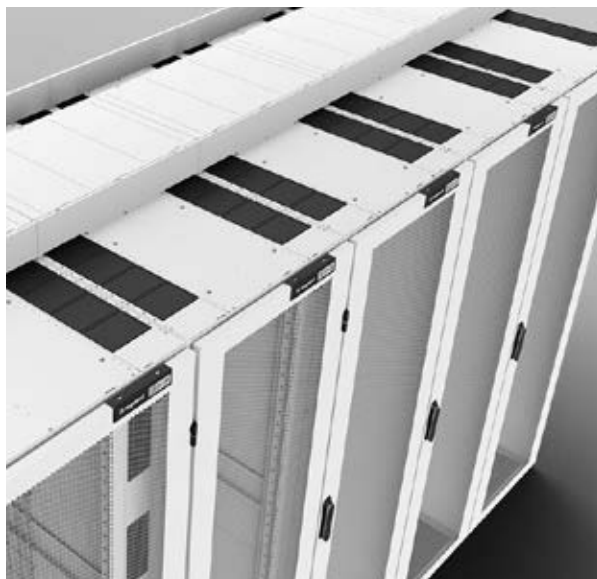
The restrictions and inflexibility that are part and parcel with maintaining a typical data-center cabinet are enough to induce design claustrophobia. But just as busways simplified power distribution by eliminating breakers and whips, a game-changing option in cabinet installation also exists. Known as toolless mounting, the Nexpanse cabinet platform has the versatility to infinitely adjust PDU location along the vertical axis of the frame, overcoming the challenges of PDU placement that are limited by pre-defined mounting locations.

When a rack PDU needs to be moved in a Nexpanse cabinet, adjustment is simply a matter of loosening four screws and sliding it into its new position. Picture sliding a rack PDU until

you find the correct position, stopping it there, and then tightening it into place. Not only does this eliminate the need for customized mounting brackets, but it provides the flexibility to mount your rack PDUs according to the current IT build. Likewise, toolless mounting means having the built-in adjustability to relocate a PDU to accommodate future move, add, and change projects.

Nexpand's flexibility is also designed into cable-management accessories such as cable rings. Mounting rings for routing bundles of cable are also infinitely adjustable on the cabinet frame, on rails, and on sheet-metal trays for further flexibility. Toolless mounting of cabling also provides the greatest opportunity to reduce overall cable length and overcome potential airflow issues, which can lead to increased heat loads, and higher energy consumption and operating costs.

All of this flexibility means that, with Nexpand, you can reasonably expect to reuse and recycle cabinet and power-distribution equipment in the future.



## CONCLUSION

The data-center cabinet has finally joined the ranks of many other data center building blocks by integrating flexible elements into its core design. The Nexpand custom cabinet line from Legrand includes key features such as toolless mounting, slide-in side rails, and adjustable airflow-management brackets. These features mean that you won't need to sweat the details of your next cabinet installation, and they also provide you with the ability to future proof your data-center cabinets against whatever may come your way.

## MINKELS

Minkels is a knowledge-driven producer and worldwide supplier of high-quality solutions for data center infrastructure (turn-key hot/cold aisle containment, cabinets, enclosures and row-based cooling solutions). Minkels products stand out for their innovativeness and flexibility. Customers can always be assured that they will get the very latest data center technology: modular solutions that respond to evolving, customer-specific business requirements. All our products are future-proof by nature. We see that as a 'must,' because the role of data centers is changing rapidly, driven by factors such as the cloud, the Internet of Things (IoT), Big Data and IT cost reduction. Minkels believes that modularity and complete integration are the key to a future-proof data center. Only this makes offering the right degree of flexibility and efficiency possible. These are not just buzzwords for Minkels - it's something we really stand for.

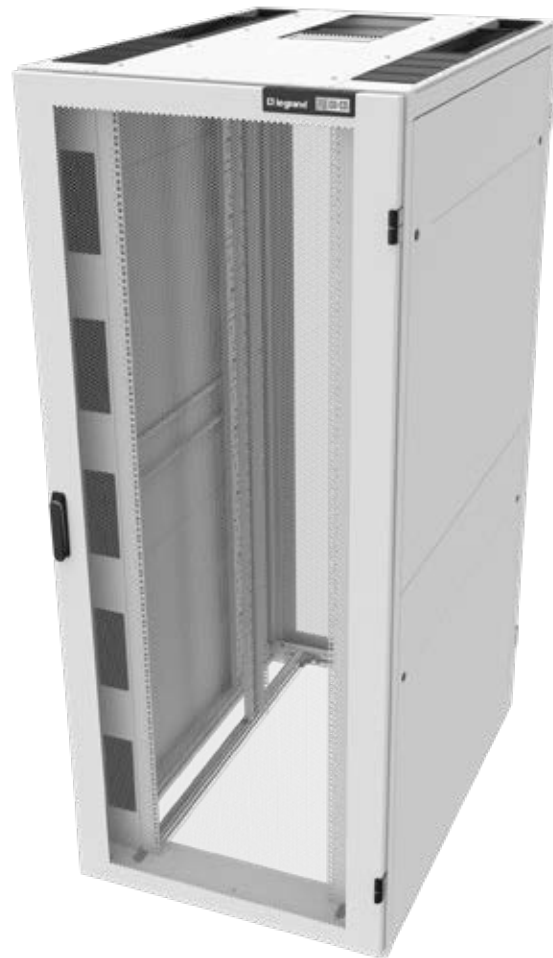


## SERVER TECHNOLOGY

Server Technology is proud to be a brand of Legrand in the Datacenter Power and Control Division, along with our sister company Raritan. We are the division of Legrand, leading the engineering and manufacture of customer-driven, innovative, and exceptionally reliable power, access, and control solutions—for monitoring and managing critical IT assets for continual availability.

## RARITAN

Raritan began developing KVM switches, for use by IT professionals managing servers remotely, in 1985. Today, as a brand of Legrand, we are a leading provider of intelligent cabinet PDUs. Our PDUs and other intelligent-power and energy-monitoring products are transforming how companies manage their data center power chains. Our solutions increase the reliability and intelligence of data centers of the top 10 Fortune 500 technology companies.





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