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ENHANCING ENERGY EFFICIENCY WITH DELL POWEREDGE 4220 RACK DESIGN

Taking advantage of the advanced features of the new Dell™ PowerEdge™ 4220 rack enclosure and following best practices can help IT organizations enhance hardware utilization, increase power and cooling efficiency, and reduce the server footprint in their data centers.

Organizations are constantly faced with the challenge of accommodating increasing amounts of data, increasing numbers of devices and users, and increasingly powerful servers to support critical applications—all while controlling data center costs for power, cooling, and other operations. How IT staff utilize and structure rack enclosures, power distribution units (PDUs), and other accessories can play a key role in helping meet these challenges.

The new Dell PowerEdge 4220 rack enclosure provides advanced features designed for optimal energy efficiency and manageability. Taking advantage of these features and following best practices when deploying this type of rack enclosure can help administrators enhance hardware utilization, create highly efficient power and cooling, and reduce the server footprint in their data centers.

ADVANCED RACK ENCLOSURE DESIGN

Selecting a tested rack enclosure design can be critically important. Racks are no longer simple cabinets that house servers; they have evolved to incorporate technologies designed to efficiently store, power, cool, manage, and secure hardware. Because these features enable each rack to function almost as its own small data center, rack enclosures can no longer be considered mere accessories.

Popular 42U rack enclosures such as the Dell PowerEdge 4210 have directly and indirectly driven

product design decisions from the chipset to the chassis, with each component optimized for use within the rack. Dell PowerEdge 1U, 2U, and 4U rack-mounted servers as well as energy-efficient uninterruptible power supplies, for example, are designed with rack features in mind.

Standard 42U racks have certain advantages compared with nonstandard racks—for example, they can typically pass through normal doorways and allow easy access to cables at the top of the rack. Racks taller than 42U can have an increased risk of tipping or bending if they exceed their weight capacity, and an increased risk of overheating equipment at the top of the rack. In addition, deviations from standard rack base dimensions (such as the 600 mm × 1,000 mm base of the PowerEdge 4210) typically work against the objectives of high-density server environments designed to maximize computing and storage capacity per square foot. Dell 42U racks are designed to accommodate the high power distributions and passive cooling requirements of these environments.

The Dell PowerEdge 4220 42U rack can support a weight capacity of 2,500 pounds, compared with the 2,000 pounds supported by the previous-generation PowerEdge 4210 rack. Other key features of Dell 42U racks include fully welded frames, dual-side panels in the PowerEdge 4220 model, removable and reversible doors that can open from the left or right, and fan kit accessories that can quickly remove heat from the top of the rack. A PowerEdge 2420 24U rack

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option is also available. (For more information, see the “Optimizing rack design” sidebar in this article.)

MANAGEMENT OF POWER DISTRIBUTION UNITS

To help manage data center space effectively, organizations typically enable power distribution by running power cables along the ceiling or below the floor. Rack enclosures should therefore be designed with sufficient cable entry paths at both the top and bottom. Dell rack enclosures have open floor space at the bottom and cable exit openings at the top and within the rear doors of the rack, and include a high-density rear-door kit with removal panels to create additional cable exit paths.

In addition to addressing room-level power cabling, rack enclosures must enable IT staff to optimally place PDUs for easy access to power outlets within the rack. To avoid the use of space designated for IT equipment, advanced racks should hold PDUs in the OU space, which is either along the sides of the rack or at the rear along the rear doors. Dell racks can hold compact PDUs in the OU space along the sides of the rack, a feature enhanced by tool-less mount PDUs available for both single- and three-phase power distribution.

The Dell PowerEdge 4220 rack includes additional space at the rear to hold large vertically mounted PDUs—often referred to as full-length PDUs—that are 1.7 m long and provide outlets close to servers and other IT equipment. Vertically mounted PDUs at the rear of the rack can also allow administrators to deploy shorter server power cables than they could otherwise.

The PowerEdge 4220 rack is also designed to place the full-length PDU outlets as far away from the back panel as possible, providing ample cable distribution space for a rack of its size. In addition, it can hold a total of four full-length PDUs, two on each side, providing the option to add PDUs to the rack enclosure on both sides or only along one side.

Organizations using Dell PowerEdge M1000e modular blade enclosures often

need to accommodate three-phase PDUs. Traditionally, Dell racks have enabled three-phase PDUs to reside in the OU space along the sides of the rack. Three-phase Dell PDUs are available in three outlet models, helping provide a form factor that offers

administrators multiple options for PDU placement. The PowerEdge 4220 rack is designed to allow more three-phase PDUs—including the full-length three-phase PDU—to fit in the rack than was possible with previous-generation Dell racks.

OPTIMIZING RACK DESIGN

The new Dell PowerEdge 4220 and PowerEdge 2420 rack enclosures include a variety of advanced features designed for optimized data center operations, including the following:

- Static load rating of 2,500 pounds for the PowerEdge 4220 and 1,500 pounds for the PowerEdge 2420
- Large open base for cable entry and exit
- Dual rear doors and split side panels, with locks
- Reversible front door that opens from the left or right, with lock
- Removable front and rear doors
- Adjustable mounting rails that slide forward or backward within the rack
- Eighty percent perforation of front and rear doors to aid thermal management in ultra-dense environments
- Rack-top cable exits with adjustable sliding door
- Reinforced frame to help provide stability
- Innovative side-rack power distribution unit (PDU) options for Dell PDUs
- Rotating rear casters to help easily position rack
- Standard base dimensions for two-tile placement in data center
- U-space numerical markings on both front server mounting posts
- Easily accessible leveling feet
- Standard height to enable movement through standard doorways
- Availability as a 42U frame only, 42U frame with front and rear doors, or 42U frame with front and rear doors and side panels
- A variety of available accessories, including Dell blanking panels (1U, 2U, 3U, and 6U), rack shelf, fan tray (120 V, 208 V, or 230 V), rack door kit (front and rear doors), side panel kit, ganging kits, stabilizer kit, PDUs, rack-mounted uninterruptible power supply, rack-mounted 17-inch 1U console, KVM (keyboard, video, mouse) switch consoles, and 1U keyboard tray



Dell PowerEdge 4220 (left) and PowerEdge 2420 rack enclosures are designed to efficiently store, power, cool, manage, and secure hardware

MAXIMIZING EFFICIENCY WITH DELL ONLINE TOOLS

Dell provides several online tools to help organizations plan optimized data center designs. The Dell Data Center Capacity Planner, available at DELL.COM/Calc, is designed to assess multiple aspects of power, cooling, and performance to help administrators understand how these variables affect energy efficiency in their environments.

The Dell M1000e Rack and Cable Advisor, available at DELL.COM/RackAdvisor, provides a reference tool administrators can use when setting up Dell PowerEdge M1000e modular blade enclosures in a Dell 42U rack. This tool guides administrators through a series of questions on the specific facility and blade enclosure to help them understand their specific configuration. Next, it provides graphics and information on strain relief bars (supplied with the Dell Blades Rail Kit), power distribution units, and blade enclosure stacking, along with recommendations on an alternative rear door for legacy Dell racks, if applicable. Administrators can also save their configuration and load it at another time.

For more information on energy efficiency and best practices for power and cooling optimization, see "The Energy Smart Data Center," by John Pflueger, Ph.D., and Albert Esser, Ph.D., in *Dell Power Solutions*, February 2008, DELL.COM/Downloads/Global/Power/ps1q08-20080179-CoverStory.pdf.

Because third-party PDUs can also easily fit in the OU space at the rear of the PowerEdge 4220 rack, organizations using PowerEdge blade servers should determine the three-phase PDU space requirements and the potential for interference with the space required to add or remove power modules from the blade enclosure. Managed, or *switched*, three-phase PDUs often incorporate bulky relays that can cause the PDU metal enclosure to protrude into the space directly behind the blade enclosure. In racks with one or two blade enclosures, administrators can plan the locations of the enclosures and managed PDU relays to help ensure that blocking does not occur. For racks with three or four blade enclosures, administrators using managed PDUs should typically use ones with a small form factor that sit in the OU space to the side of the blade enclosure.

EFFICIENT POWER AND COOLING

Cooling rising heat loads in a data center can present a significant challenge. Thermal management can be daunting, and cold air distribution (as opposed to heat removal) is not the only answer to thermal management problems, especially when taking the following factors into account:

- Obstructions under the raised floor that can create nonuniform airflow through floor tiles and into racks
- Recirculation of hot air from the rear of the rack to the front of the server air intakes
- Lack of a hot aisle/ cold aisle strategy, in which racks face the same direction to enable units to absorb heat exhaust from each other
- Stratification of air temperature across the front face of the racks, which can lead to failures in top-mounted network and server equipment

Eighty percent perforation of front and rear doors provides efficient airflow to aid thermal management in ultra-dense environments

In general, administrators should try to maximize the amount of cool air going directly to each server. The Dell PowerEdge 4220 rack enclosure includes 80 percent front- and rear-door perforation, essentially lowering the cold air restraint to the server to enhance efficiency. The hot air from the rear of the server can escape quickly with an equivalent 80 percent rear-door perforation. Within the rack, strategically placed air dams along the front of the servers help eliminate in-rack air recirculation, a common impediment to thermal efficiency.

At the front mounting posts of the PowerEdge 4220 rack, the air dams help prevent hot air at the back of the servers from leaking back to the front of the servers, which can increase the server inlet air temperatures. By blocking the hot air from the back of the rack, the servers receive air directly from the front, helping ensure a cold air inlet to all servers. Innovative in-rack air dams offer administrators the flexibility to configure the location of the mounting post inside the rack without losing the advantage of the air dams. Organizations using this rack can benefit from this dual advantage of efficient air dams and movable mounting posts within a single rack enclosure.



The amount of internal space within a rack is another critical factor affecting cooling and thermals. With a depth of 1,070 mm, the PowerEdge 4220 rack provides additional internal space to enhance overall rack thermals.

One of the simplest and most cost-effective ways to enhance airflow efficiency is to use blanking panels to fill unused rack positions. Without blanking panels installed in unused spaces, hot air from the back rack can flow directly to the front of the servers, which can lead to increased hot spots within the rack. If vertical space in a rack remains open, the gaps between rack-mounted equipment can cause a change in airflow through the rack and across the components. Dell rack accessories include blanking panels available in many sizes, from 1U to 6U. The increased cooling efficiency from this relatively small investment can help pay substantial dividends.



EFFECTIVE CABLE MANAGEMENT

Cable management is often an afterthought in server deployment, but can have a dramatic impact on data center thermals and serviceability. The Dell PowerEdge 4220 rack enclosure helps simplify the routing of power from servers to the PDU outlets by holding vertically mounted PDUs at the rear of the rack. The rack also includes adjustable cable rings mounted inside the rear of the rack, enabling administrators to route networking cables to one side of the rack and channel them upward and out the top of the rack. For high-density server environments in which cable rings may be insufficient, the PowerEdge 4220 rack features a removable tail bar to help eliminate obstructions to routing cables out the top of the rack while still maintaining sufficient space to close and lock the rack doors.

It can be critical to leave sufficient space at the back of the rack to route cables efficiently and help reduce or eliminate the blocking of warm air exiting the back of the rack. The 1,070 mm depth of the PowerEdge 4220 rack is designed to

Flexible PDU placement options and ample cable distribution space help efficiently manage data center space

provide optimal internal rack space while staying within the common two-tile data center footprint.

For more information on how Dell can help organizations plan optimized data center designs, see the “Maximizing efficiency with Dell online tools” sidebar in this article.

ENHANCED ENERGY EFFICIENCY THROUGH DELL RACK DESIGN

Rack design can play a key role in building an efficient, manageable data center. The advanced features of the new Dell PowerEdge 4220 rack enclosure can help organizations enhance hardware utilization, increase power and cooling efficiency, and reduce the server footprint in their data centers. [u](#)

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