Unleashing Stranded Power and Reducing Costs

Using Shared Zero-U Space with Siemon VersaPOD® Cabinets

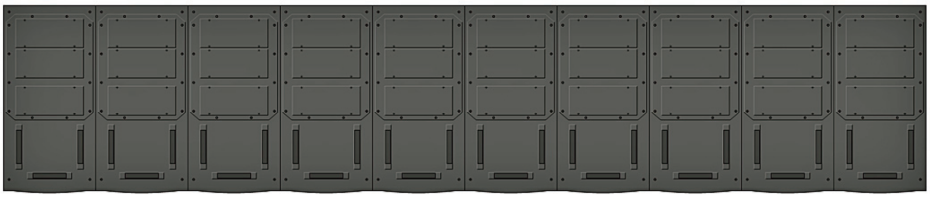
In modern data centers, servers account for the majority of equipment and perform most of the processing work. It therefore comes as no surprise that servers also present most of the power and thermal challenges and take up the most cabinet space in the data center.

Many data center managers prefer to use narrow 600mm (24 in.) server cabinets, assuming they can maximize space by accommodating more cabinets within the square footage of the data center. Not only is this a misconception, but deploying wider cabinets such as Siemon VersaPOD cabinets that share Zero-U space between bayed cabinets is proven to reduce stranded power and provide substantial cost savings without sacrificing space.

The Smaller Cabinet Misconception

When we consider the data center as a whole, it is important to understand that the total power of the space is allocated across all cabinets housing active equipment. Accordingly, regardless of whether a data center contains a greater number of smaller cabinets or fewer larger cabinets, the overall power load remains the same. As shown in Figure 1, whether a 50kW data center row houses 10 narrow 5kW cabinets or 8 wider 6.25kW cabinets, the total allocated power remains at 50kW per row. The same holds true for colocation facilities where power is generally allocated based on customer cages—total power of the cage is allocated across the cabinets housed within that cage.

10 Smaller-Width Cabinets at 5kW per Cabinet = 50kW of Available Power



8 Larger-Width Cabinets at 6.25kW per Cabinet = 50kW of Available Power

Figure 1: 10 narrow 5kW cabinets and 8 wider 6.25kW cabinets equal the same overall power allocation occupying approximately the same footprint.

The number of servers that can reside in a cabinet is limited based on power, weight and space. The international average amount of power supplied to a server cabinet ranges between 5.5 and 6kW with many colocation data centers setting a limit of 5kW per narrow 600mm (24 in.) cabinet. This means that on average a typical server cabinet can hold about 12 to 15 servers respectively. Using fewer wider cabinets such as the Siemon VersaPOD® cabinet, the power supplied to each cabinet can be increased, allowing the wider cabinet to support more servers. Using our above example for the 50kW row, the smaller 5kW cabinet can support 12 servers, while a larger 6.25kW cabinet can support 15. Simply put, wider cabinets do not mean less servers—they mean more servers placed vertically in fewer cabinets. With chimneys or containment systems and higher power, even greater vertical growth and cabinet utilization is achievable. Based on these factors, the belief that having a greater number of smaller footprint cabinets will maximize space is a misconception.

Furthermore, vertical growth is rapidly becoming a trend. In the past, data center and facilities managers believed that expanding the amount of floor space in the data center was the key to supporting future IT requirements. Now the idea of basing growth on floor space is going by the wayside as data centers strive to support higher power loads and optimize cabinet use through vertical growth.

In contrast to growing horizontally by adding additional cabinets in the space, growing vertically by placing more servers in fewer wider cabinets maximizes existing space while providing enhanced cable management within the cabinet. This is especially beneficial for data centers that simply do not have any more floor space available. In fact, many colocation environments are rewarding tenants for growing vertically where they have the power available to do so. It's easy to see why this makes sense from a colocation owner point of view—having tenants grow vertically within the confines of their leased space leaves more floor space available to accommodate additional tenants.

Delivering Power to the Cabinet

Power distribution units (PDUs) distribute power to active equipment. Sized based on the amount of power allocated to the cabinet, they are horizontally or vertically mounted in each cabinet and come in a variety of types, including standard, intelligent, monitored, switched and managed. They also come in a wide range of customizable configurations and number of receptacles.

For every PDU in a cabinet, there is also a connection to main power that includes an input power whip and a breaker or power bus connection in the main power panels. Excluding the actual cost of the PDU itself, some consultants place the cost to connect power to a PDU at roughly $565 for the whip, breaker and labor (note: power connection prices and labor rates may vary by location). Since most cabinets have two PDUs—one for primary power and one for secondary power—the cost to run power to PDUs in 200 cabinets would be approximately $226,000 (200 X $565 X 2). Cutting down on the number of cabinets and PDUs by deploying wider higher density cabinets saves on the expense of power runs. Since some power is lost in distribution from one point to another, fewer power runs also means overall less power loss. This helps improve Power Usage Effectiveness (PUE), which is used to measure data center efficiency and is calculated by the power input to a facility divided by the actual power used by the IT equipment.

The Stranded Power Conundrum

Once an amount of power is assigned to a cabinet, it cannot be used elsewhere. The power that is allocated to the cabinet stays allocated whether all of the power receptacles on the PDU consume the power or not. Whenever the power distributed to a cabinet exceeds the power actually consumed by the equipment the result is defined as stranded power. While having just a few unused receptacles per cabinet may seem minor, when multiplied across hundreds of cabinets, the amount of stranded power can reach a significant percentage of the total power available in the data center.

Not only does stranded power occur due to power being provisioned to a single cabinet that cannot be assigned elsewhere, it is also caused by servers being provisioned at higher than used ratings. Let's consider a data center cabinet where 24-outlet PDUs are used to power 12 servers that are expected to draw a maximum of 5.4kW total power based on each server's 450W nameplate rating. However, servers rarely ever reach their nameplate rating—experts estimate maximum power to be 65 to 70% of the nameplate rating. Whenever the servers consume less power than what is allocated to the cabinet, the result is stranded power (see Figure 2). For example, an actual load of 200W per server would result in a total of 3kW of stranded power (450W-200W X 12 = 3kW).

While data center designers have gotten better at provisioning based on estimates of actual power consumption rather than nameplate ratings, power remains a dominant contributor to capital expenditures (CapEX) and a significant contributor to operating expenses (OpEX). With power estimated at 50% of the total cost of ownership, today's data centers continue to look for ways to optimize power use.

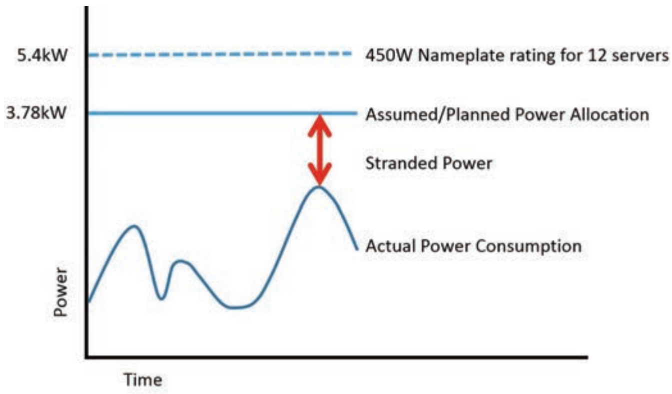


Figure 2: Whenever servers consume less than the allocated power, the result is stranded power.

Solution: VersaPOD® with Shared Zero-U Space

A unique way to solve the problem of stranded power in the data center is to deploy wider Siemon VersaPOD cabinets designed with recessed corner posts/mounting rails that create a vertical Zero-U space between bayed cabinets and at the end of row. The Zero-U space is nearly 178mm (7 in.) wide and provides 150mm (6 in.) of clearance between equipment mounting rails and doors at the front and rear. This vertical Zero-U space at the front and rear between bayed cabinets can be used for patching, cable management and power distribution. Not only does the VersaPOD Zero-U space free up horizontal equipment mounting space, it also allows PDUs to be shared between two cabinets. This increases the number of used power ports and reduces stranded power (see Figure 3).

Locating PDUs in the shared Zero-U space means that PDUs only need to be installed in the Zero-U space between every other cabinet. This cuts the required number of PDUs and upstream power connections (whips, breakers and installation) in half. For example, a data center with 200 VersaPOD cabinets would only require 100 PDUs for primary power and 100 for secondary power versus a data center with 200 self-contained cabinets that would require 200 PDUs for primary power and 200 for secondary. At $565 per upstream power connection, using VersaPOD cabinets in this scenario saves $113,000 on power runs alone.

Figure 3: VersaPOD Zero-U space with primary and secondary PDUs shared between two cabinets

Not only does sharing PDUs via Zero-U space offer significant savings on PDUs and power connections, it also helps reduce stranded power. For example, a self-contained cabinet with 12 servers would use 12 of the 24 outlets on each PDU and essentially abandon the remaining. In contrast, two VersaPOD cabinets with 15 servers that share two 30-outlet PDUs mounted in the Zero-U space would use all of the outlets. It's important to note that while 24 outlets is a common configuration for PDUs, higher receptacle port counts can be used to further maximize savings. The cost of a 30-outlet shared PDU in the VersaPOD is only slightly higher cost than a 24-outlet PDU, and it increases the usable vertical server space via higher power per PDU and additional usable outlets across the two cabinets.

The shared Zero-U space between bayed VersaPOD cabinets offers additional savings as well. Copper and fiber connections are located in the Zero-U space and therefore like the PDUs, they only need to be installed every other cabinet. Depending on the number of cabinets in a row, end of row patch panels or PDUs are available to round out the row (see Figure 4). In addition, because the shared patch panels are located in the Zero-U space directly to the side of the servers, shorter 1-meter copper patch cords and fiber jumpers can be used to make the connections and horizontal cable managers are replaced by vertical cable management fingers. With typical self-contained cabinets, patch panels are installed at the top of every cabinet, requiring longer 2 and 3-meter cords and jumpers to connect to all of the servers. Maintaining inventory of multiple longer cords and jumpers costs about 40% more, and can cost even more in data centers that use color coding.

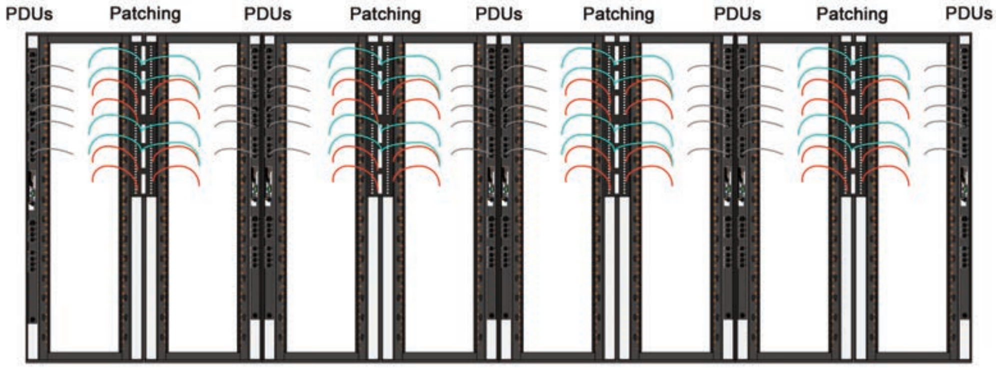


Figure 4: VersaPOD cabinets with shared Zero-U space between bayed cabinets allows PDUs and patch panels to be installed in every other cabinet, while enabling better PDU utilization and shorter patch cords and jumpers.

It's important to note that at a width of 762mm (30 in.) the VersaPOD cabinet is wider than the smaller 600 mm (24 in.) cabinets that some data center professionals believe will maximize space. However, as previously discussed, deploying fewer wider VersaPOD cabinets cuts down on the number of cabinets and increases the power load per cabinet, enabling vertical growth within a similar footprint and maintaining the same power load across the data center. Data centers should therefore not assume that floor space originally planned for smaller width cabinets will not accommodate wider VersaPOD cabinets. At 762mm (30 in), VersaPOD cabinets can also save space over wider (i.e. 800mm) self-contained cabinets. While some 800mm cabinets feature Zero-U space for vertical patching and power distribution, self-contained cabinets do not have the ability to easily share this space between two bayed cabinets like the VersaPOD. Siemon Design Services can help determine how many VersaPODs will fit into a specific space, provide analysis on the potential cost savings of shared Zero-U space, and adjust power and cabling plans accordingly.

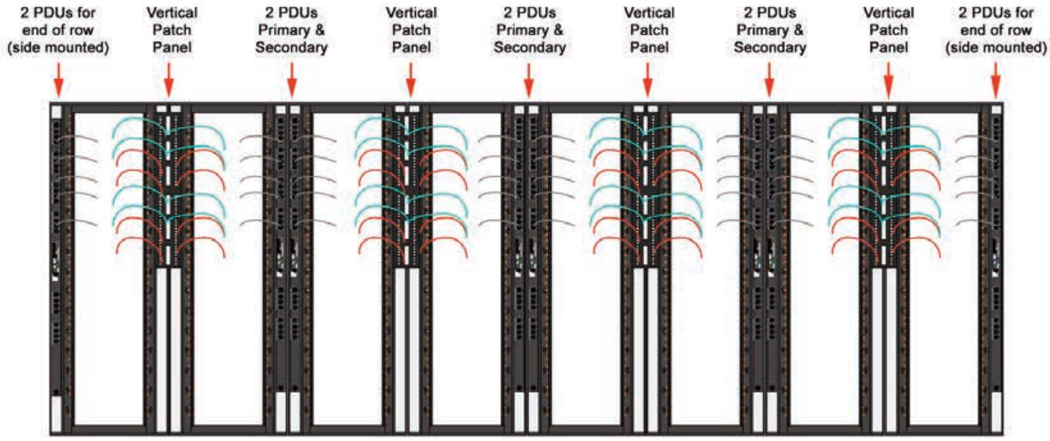
Cost Analysis of Using VersaPOD vs. Self-Contained Server Cabinets

To further illustrate the decrease in stranded power and cost savings of using VersaPOD cabinets with shared Zero-U space versus narrower self-contained cabinets, Siemon has conducted a cost analysis based on a 20-pod data center (see sidebar). Depending on the cabinet width, each pod contains 20 or 16 cabinets and fits within about 6.4 linear meters (21 linear feet). This analysis compares the following pod configurations (see Figure 5):

- Two rows of 8 wider 762mm (30 in.) VersaPOD cabinets with shared Zero-U space totaling 6.1m (19 ft. 8 in.) of linear feet
- Two rows of 10 narrow 600mm (24 in.) server cabinets without shared Zero-U space totaling 6m (20 ft.) of linear feet
- Two rows of 8 wider 800mm (31.5 in.) server cabinets without shared Zero-U space totaling 6.4m (20 ft. 11 in.) of linear feet

The VersaPOD and the 800mm (31.5 in.) cabinets contain 15 servers per cabinet at 6.25kW per cabinet, while the 600mm (24 in.) cabinets are utilizing 5kW per cabinet and therefore can only support 12 servers per cabinet. The VersaPOD shares two 30-outlet PDUs between every two cabinets, while the 600mm cabinets and 800mm cabinets use two 24-outlet PDUs per self-contained cabinet for primary and secondary power.

The analysis assumes two copper connections per server for primary and secondary networking, two fiber connections per server for primary and secondary SAN, and two power connections per server for primary and secondary power. The analysis takes into consideration the fact that PDUs and patching can be shared between two VersaPOD cabinets using the shared Zero-U space with two PDUs at the ends of the rows.



Eight 6.25kW VersaPOD Cabinets per Row (16 per Pod) with Shared Zero-U Space Between Cabinets
15 Servers Each, 30-Outlet PDUs and Vertical Patch Panels Installed Every other Cabinet.
Additional PDUs at End of Rows Only. Linear Feet = 6.1m (20 ft.)

Ten 5kW 600mm Cabinets per Row (20 per Pod) with No Shared Zero-U Space
12 Servers Each and 24-Outlet PDUs and Patch Panels Installed in Every Cabinet. Linear Feet = 6m (19 ft. 8 in.)

Eight 6.25kW 800mm Cabinets per Row (16 per Pod) with No Shared Zero-U Space
15 Servers Each and 24-Outlet PDUs and Patch Panels Installed in Every Cabinet. Linear Feet = 6.4m (20 ft. 11 in.)

Figure 5: Comparison of Cabinet Rows with VersaPOD 762mm (30 in.) with Shared Zero-U Space vs. 600mm (24 in.) and 800mm (31.5 in.) Self-Contained Cabinets

Price for the cost comparison is based on MSRP. The price for copper and fiber patching with the VersaPOD is based on Siemon's Vertical Patch Panels that mounts within the Zero-U space. With support for up to 96 copper ports and up to 288 duplex fiber connections per upper and lower section, the Vertical Patch Panel provides plenty of copper and fiber patching connections to support both adjacent VersaPOD cabinet connectivity requirements (See Figure 6).

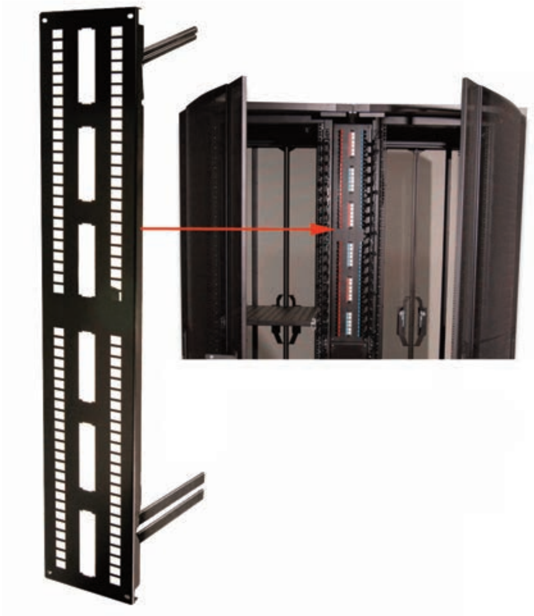
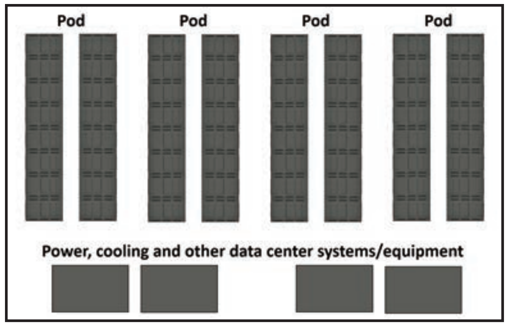


Figure 6: Siemon Vertical Patch Panels that reside in the Zero-U space between VersaPOD cabinets can support up to 96 copper ports and 288 duplex fiber ports per upper and lower section.

Pod-based Data Centers



Within a data center, pods are groups of cabinets that may be based on capacity, application or scalability. They are essentially compartmentalized areas of the data center, and sometimes referred to as data center halls or cells.

Pods often consist of two symmetrical rows of cabinets that are compatible with aisle containment systems (i.e., hot aisle or cold aisle containment). A data center may contain any number of pods, and they are typically repeated as the data center grows. This allows customers to scale the data center in a very predictable manner. Replicating cabinets and components from pod to pod during expansions provides predictable power, cooling and space consumption. Additional pods can be added with ease and confidence, rather than risky traditional design methods where growth is addressed on an as-needed basis and cabinets and components are piecemealed together based on an ad hoc design. With each pod using identical cabinets and components, there is also a common look to the data center with an organized floor layout that improves overall aesthetics.

To further support pod-based data center designs, Siemon V-Built™ Preconfigured Data Center Cabinets are custom kitted with preloaded Siemon components, including PDUs, fiber enclosures and copper patch panels, pre-terminated trunking cables, patch cords and jumpers, cable management and accessories. Assembled and packaged at one of Siemon's regional manufacturing facilities, V-Built cabinets arrive at the customer site ready to install the active equipment and finalize the connections. Each V-Built cabinet with its preloaded components is identified by a unique customer-specific part number for easy ordering of future identical cabinets.

As shown in Table 1, for a data center with 20 pods, the use of VersaPOD cabinets with shared Zero-U space saves a compelling 40% compared to 800mm and about 46% compared to 600mm self-contained cabinets. Even more compelling is the savings on stranded power connections. With VersaPOD cabinets sharing two 30-outlet PDUs shared between two bayed cabinets, they require half the number of PDUs of the 600mm and 800mm self-contained cabinets that both use two 24-outlet PDUs per cabinet. The result is only 120 unused PDU outlets per pod for the VersaPOD at the ends of each row, which can be used for future expansion if needed. In contrast, the 600mm cabinets results in 480 unused outlets and the 800mm cabinets results in 288 unused outlets. What is not shown in this cost analysis are the additional savings on the whip, breaker and labor for the upstream power runs. With half the number of PDUs for VersaPOD cabinets compared to 600mm cabinets, VersaPOD can save up to 50% or more on power runs. Taking all of these savings into consideration, it is clear that VersaPOD cabinets can cut data centers costs substantially for both CapEX and OpEX. In addition, having fewer power connections with VersaPOD cabinets results in reduced power loss and an increase in PUE.

Components Per Pod	VersaPOD 762	600 Wide	800 Wide
# Cabs Arranged in a Two-row Pod	16	20	16
Linear Dimension of Row	6.1 m (20 ft.)	6 m (19 ft. 8 in.)	6.4 m (20 ft. 11 in.)
# Available RU	1088	900	720
# Servers / Cab (240 servers per Pod)	15	12	15
Combo Vertical Copper/Fiber Panel	8	N/A	N/A
# Patch Panels	0	20	16
# Fiber Panels	0	20	16
# Horizontal Wire Managers	0	40	32
# PDUs	20	40	32
Total PDU outlets	600[1]	960	768
Stranded PDU ports	120	480	288
PDU Brackets	10[2]	40	32
1m Patch Cords/Jumpers[3]	960	0	0
2m Patch Cords/Jumpers3	0	480	480
3m Patch Cords/Jumpers3	0	480	480
Total Cost per Pod	$ 162,028	$ 300,722	$ 269,644
Cost per RU per Pod	$149	$334	$**375**
Cost per Server	$ 675	$ 1,253	$ 1,124
Total Cost per All 20 Pods	$ 3,240,560	$ 6,014,440	$ 5,392,860

Table 1: Cost comparison for a 20-Pod Data Center Using VersaPOD with Shared Zero-U Space vs. 600mm and 800mm Self-Contained Cabinets

1. Assumes two 30-outlet PDUs between two VersaPODs and at ends of rows and two 24-outlet PDUs for each 600mm and 800mm cabinet.
2. One PDU bracket can support two PDUs in the VersaPOD, while the self-contained cabinets require a bracket on both sides.
3. Assumes 30 patch cords and 30 jumpers (2 each per server) for VersaPOD and 800mm cabinets and 24 patch cords and 24 jumpers (2 each per server) for 600mm cabinets.

Conclusion

Often data center managers prefer less-expensive, smaller-width server cabinets, believing that they offer more useable space. Regardless, the amount of power load in the data center is divided by the number of cabinets. With fewer, wider cabinets such as Siemon's VersaPOD within the same space, the power per cabinet can be increased to support more servers per cabinet, enabling cost-effective vertical growth. It is therefore a misconception that smaller cabinets offer more usable space.

Rather than comparing cabinet to cabinet prices, it is crucial to look at the cabinets as a total solution. The ability of Siemon VersaPOD cabinets to share connectivity, patching and PDUs in the Zero-U space between bayed cabinets significantly reduces the number of PDUs, upstream power connections and stranded power. When comparing VersaPOD to 600mm cabinets as illustrated in Table 1, 46% savings can be realized due to the reduced number of cabinets, PDUs, mounting brackets and patch panels, as well as the ability to use shorter patch cords. Roughly a 40% savings can be realized using shorter 1m copper and fiber jumpers due to the vertical Zero-U patching orientation alone. In addition, stranded power outlets are reduced by 75%. All of these savings combined result in tremendous CapEX and OpEX savings.

Siemon Design Services can assist you with your data center design and perform a detailed custom cost analysis to determine how much you can save using VersaPOD cabinets. Siemon Design Services can provide 2D and 3D layouts, bills of material, thermal analysis and custom-configured and kitted V-Built™ cabinet part numbers.

For more information on Siemon cabinets and design services, please visit www.siemon.com or contact your local sales representative.

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