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Will Your Next Data Center Be Shipped To You In A Box?
What You Need To Know Before Purchasing A Containerized Data Center

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with Ben Echols, James Staten, and Christian Kane

EXECUTIVE SUMMARY

So far, when it comes to data-center shipping containers for the enterprise, there’s been a lot more talk than action. Many enterprises have expressed interest in the idea of modularly growing their data center footprint one container at a time, but most haven’t taken the first steps toward purchasing one. Why not? They can be deployed quickly, are extremely efficient, and are less expensive both on capital and operational expenditure fronts. One explanation is that there are few standards when it comes to containerized data centers: Each vendor offers something slightly different. This report helps to demystify the containerized data center and strategies of the eight vendors leading this charge.

WHY THE COMMOTION OVER CONTAINERIZED DATA CENTERS?

In case you’ve missed all the hype, containerized data centers are ISO-standard cargo shipping containers outfitted with racks for servers, storage, and networking gear, as well as the necessary power and cooling infrastructure. In general, containerized data centers support very high power density — around 25kW per rack, or up to 600kW for a 40x8 container. They can be quickly configured and delivered to any location that has power, coolant, and network connectivity, and are ready to plug in and run immediately. And some high-profile activities have highlighted the potential for this market:

• **Google and Microsoft have been showcase early adopters.** One of the first prominent customers to move on data center containers was Google, which earlier this year gave a YouTube peek into one of its data centers configured as a warehouse filled with containers. Microsoft added to the hype around containers when it announced that its Chicago-area data center would be configured specifically for shipping containers. Yahoo! has since confirmed its purchase of containers as well.

• **Sun and Rackable pioneered the concept as primary DC capacity.** Shipping containers were originally filled with IT equipment as disaster facilities that could be rolled into a war zone, hurricane-wrecked town, or other site to temporarily serve as command posts and communication centers. But earlier this past decade, Sun Microsystems and Rackable Systems (now Silicon Graphics International) focused a set of engineers on turning containers into high-density data centers for defense, high-performance computing, and scale-out Web service customers. While the customers were kept confidential, units started rolling out of the factories.

• **Other vendors have joined the fray to capitalize on a potentially lucrative market.** Due to the amount of technology that can be packed into a shipping container, just a handful of unit sales could make for a multi-million-dollar business. Thus all the major server vendors — HP, IBM, and Dell — as well as smaller vendors like Bull, Verari Systems, and American Power Conversion (APC) in conjunction with Australia-based Datapod, began offering containerized data centers.
CONTAINERIZED DATA CENTERS ARE NOT JUST FOR INTERNET COMPANIES

Google, Microsoft, and Yahoo! have found that containerized data centers are extremely efficient, partly because these companies purchase thousands of servers at one time. Receiving them already racked up in a container that just needs power, cold water, and network connectivity is extremely convenient. When the servers get old or break down, they can swap out the container for one with a new batch of servers. However, containerized data centers have other benefits that should appeal even to enterprises with less extraordinary compute and storage requirements:

- **Rapid availability.** In contrast to the multi-year lead times involved in building a data center facility, containerized data centers can be delivered, ready to operate, in as little as six to eight weeks. For many enterprises with overflowing data centers, containers are the fastest way to add capacity outside of colocation.4

- **Little disruption to existing data centers.** Even in cases where your organization could expand its current data center (or retrofit it for greater density and/or efficiency), the disruption to existing infrastructure that would result from the construction effort may be better avoided through use of a containerized data center. Running power, cooling, and network connectivity to a covered enclosure (depending on your planned usage, many vendors advise some sort of overhead cover) won’t jeopardize your current data center’s operations like a full-on retrofit. In addition, it may cost a disproportionate amount of money to increase the density of a data center that is simply too small.

- **High efficiency.** Containers are more efficient than the average enterprise data center facility. There’s nothing magical about putting servers in a cargo container instead of a building — but containerized data centers are carefully engineered and equipped with the latest cooling technologies, which isn’t true of many legacy data center buildings. By scrupulously engineering airflows and incorporating many data center facilities best practices, containerized data centers achieve power-usage effectiveness (PUE) ratios of around 1.3.5

- **Self-contained power and cooling infrastructure.** Some containerized data center manufacturers also offer an optional companion container that provides support systems like UPS, generators, and/or cooling infrastructure. For example, Dell’s containerized data center offering includes the option of adding completely self-contained air handlers, UPSes, and fire suppression equipment to the roof of the server container. This lets you run your containerized data center without depending on traditional data center infrastructure or supplement existing infrastructure that is overtaxed. If you’re considering a container that doesn’t have the option of a self-contained power and cooling infrastructure, there are products like Active Power’s PowerHouse, which is a containerized power and cooling solution for a data center. Both HP and Sun can provide their containers combined with a PowerHouse unit.
• **Security can be more easily enforced.** Container data centers are essentially walled off rows of compute. They can be configured with locking entrances, secure operations rooms physically separated from the compute environment, and can be fully populated with cameras and motion-sensing and intrusion-detection facilities. Such capabilities make workload isolation in a shared facility very easy.

• **Reduction of both capital and operational expense.** Due to their optimized construction, containerized data centers are often more efficient and thus cheaper to run than legacy data center facilities. While the potential for operational cost savings is clear, the capital expenditure (capex) savings are less obvious. By limiting the amount of unused infrastructure capacity, containerized data centers let organizations defer their facilities capex — instead of building a highly efficient data center that will last for 20 years, with capacity that won't be utilized for many years as it become more and more obsolete, containers let organizations only pay for the amount of infrastructure they need at the time.

• **Disaster recovery sites.** A recent article in *Computerworld* revealed that global cosmetics maker Revlon was using several strategically placed data center containers around the world as part of its disaster recovery plans. Rather than building parallel data center in various countries, Revlon preloaded five data center containers with vital data and shipped them to different parts of the world, which not only made them very resilient but also gave them a point of presence in foreign markets.

**NOT ALL CONTAINERIZED DATA CENTERS ARE THE SAME**

Despite sounding alike, there are significant differences between the vendor solutions we reviewed (see Figure 1). Furthermore, these products are highly customizable — from their capacity, cooling infrastructure, installed IT equipment, and more. If you're considering using a containerized data center for new or expansion capacity, you'll need to consider:

• **How is it cooled?** Containerized data centers usually require an external source of cooling. Options can include refrigerant, chilled water, or external air handlers, depending on the vendor and infrastructure package you choose.

• **What sizes does it come in?** Most full-size containers are 40 feet long and hold between 22 and 30 racks. Half-size containers are 20 feet and hold about 10 to 12 racks. Vendors like HP, SGI, and IBM make both full-size and half-size containers. Containers vary considerably due to the arrangement of the racks, support for full-depth equipment (or lack of support), and whether support systems like a UPS are located in the container or elsewhere.
• **Can it host any IT equipment?** While all the containers Forrester examined offer standard-width racks, don’t be too quick to assume you can fill any container with any IT you choose. Many vendors will want to supply a significant portion of the compute and storage load included in the container. In addition, while standard width, the depth of racks can vary even within one vendor’s container, so some of your equipment may be a tight fit.

• **How is the equipment serviced?** Service-level agreements (SLAs) vary widely between vendors. Given the immaturity of the market, there’s a great deal of flexibility, but expect to pay a premium for the shortest response times. Many of the larger vendors of data center containers, like Dell, HP, and IBM, offer additional services, starting with feasibility and capacity analyses, site preparation, and commissioning.

• **Can it be installed outdoors?** Although not necessary, the low cost and significant benefits of some minimal roof or enclosure for a container (lower temperatures, better efficiency, lower operating cost, and reduced risk) lead most vendors Forrester spoke with to recommend some form of cover or protected entryway. If that’s not possible, some vendors offer a rugged data center that should be able to withstand the elements better than the nonrugged containers.
Figure 1  Containerized Data Center Vendor Offerings

<table>
<thead>
<tr>
<th>Product</th>
<th>Length</th>
<th>Rack units available</th>
<th>Maximum power capacity</th>
<th>Includes UPS?</th>
<th>Can buy empty?</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APC/Datapod</td>
<td>20 ft.</td>
<td>—</td>
<td>—</td>
<td>Yes</td>
<td>Yes</td>
<td>Although APC was one of the first to the scene, with its InfraStruXure Express containerized data center, it is currently available as a custom build only. However, APC recently teamed up with Australia-based Datapod to offer containerized data centers in several different sizes that are meant to be added together as needed to create a modular data center.</td>
</tr>
<tr>
<td>Bull mobull</td>
<td>20 ft.</td>
<td>252U</td>
<td>240 kW</td>
<td>Yes</td>
<td>Yes</td>
<td>A new entrant into the market, Bull's mobull containerized data center claims the highest density of evaluated solutions, made possible by its unique water-cooled doors.</td>
</tr>
<tr>
<td></td>
<td>40 ft.</td>
<td>630U</td>
<td>550 kW</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Dell Enclosure-Based Data Center (EBDC)</td>
<td>40 ft.</td>
<td>1,296U</td>
<td>380 kW</td>
<td>Yes, in additional container</td>
<td>No</td>
<td>Dell's EBDC is a full-service offering in which Dell supplies the equipment and the installation of the EBDC. Dell's EBDC uses sliding centered racks that can be rolled out of one container into another. Dell also offers a container with self-contained air handlers, UPSes, and fire suppression equipment that can be stacked on the roof of the EBDC.</td>
</tr>
<tr>
<td>HP Performance Optimized Datacenter (POD)</td>
<td>20 ft.</td>
<td>500U</td>
<td>291 kW</td>
<td>Optional</td>
<td>Yes</td>
<td>HP's POD is currently shipping in several configurations: 40-ft. standard-density (max. 450 kW), 40-ft. high-density (max. 600 kW), and 20-ft. The hot aisle behind the servers is narrow so additional access is provided through exterior doors along the POD sidewall. Purchase of the POD can also be combined with additional services from HP and pre-installed HP hardware.</td>
</tr>
<tr>
<td></td>
<td>40 ft.</td>
<td>1,100U</td>
<td>450 kW</td>
<td>Optional</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>IBM Portable Modular Data Center (PMDC)</td>
<td>20 ft.</td>
<td>588U</td>
<td>240 kW</td>
<td>Optional</td>
<td>Yes</td>
<td>IBM's PMDC can be deployed in two different ways: 1) &quot;All-in-one,&quot; or multi-container solutions, which can include complete infrastructure (i.e., UPS, chiller, switchgear, fire systems, monitoring, cooling, etc.), or 2) as a multi-container solution with an IT equipment container that houses the IT equipment, cooling, and power distribution and a companion physical infrastructure container with the UPSes, chillers, and fire suppression. Like the other major server vendors, IBM's PMDC can be purchased with additional services and equipment, if desired.</td>
</tr>
<tr>
<td></td>
<td>40 ft.</td>
<td>714U</td>
<td>510 kW</td>
<td>Optional</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Source: Forrester Research, Inc.
**Figure 1** Containerized Data Center Vendor Offerings (Cont.)

<table>
<thead>
<tr>
<th>Product</th>
<th>Length</th>
<th>Rack units available</th>
<th>Maximum power capacity</th>
<th>Includes UPS?</th>
<th>Can buy empty?</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGI (formerly Rackable Systems) ICE Cube</td>
<td>20 ft.</td>
<td>624U</td>
<td>240 kW</td>
<td>Yes</td>
<td>No</td>
<td>The SGI ICE Cube is available in two primary designs, one that uses SGI's 19-inch half-depth Rackable servers to maximize density and another to support heterogeneous server and storage rackmount products. The half-depth design features a central-aisle layout with servers on each side, making the back of the server inaccessible, although there are no serviceable elements at the rear of SGI's half-depth Rackable servers. This design allows SGI to offer 1,800U of rack pace, fire suppression, heat exchangers and UPSes in a single solution.</td>
</tr>
<tr>
<td></td>
<td>40 ft.</td>
<td>1,800U</td>
<td>480 kW</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Sun Modular Datacenter (MD)</td>
<td>20 ft.</td>
<td>240U-280U</td>
<td>175 kW-200 kW</td>
<td>No</td>
<td>Yes</td>
<td>Sun was the first containerized data center provider on the scene, with its Blackbox, renamed MD. Sun's MD is also arranged with a central service aisle with rows of servers on each side; however, servers can be pulled into the service aisle while running to allow access to the back. Sun also offers a variety of services and includes installation in the cost of the MD.</td>
</tr>
<tr>
<td>Verari FOREST</td>
<td>40 ft.</td>
<td>1,520U</td>
<td>350 kW</td>
<td>Optional</td>
<td>Yes</td>
<td>Verari's focus with its FOREST container is on the green aspects; the company claims that the FOREST can maintain a PUE as low as 1.05 due to its highly efficient vertical cooling technology. The FOREST also contains 1,520U of available IT equipment space — the most of any evaluated vendor — while still allowing access to both the front and back of the racks via a central service aisle.</td>
</tr>
</tbody>
</table>

Source: Forrester Research, Inc.
RECOMMENDATIONS

CONTAINERS: THEY’RE NOT JUST FOR THE WEB GIANTS ANYMORE

Although enterprise use of containerized data centers is limited today, and mainly for niche purposes, Forrester expects adoption to climb over the next few years. As traditional data center space becomes harder and harder to come by, containers will become viable long-term replacements for traditional data center space. Not only are data center containers an ideal solution for companies in need of temporary or mobile data center space, but they also make sense for those that need additional space in their overtaxed data centers. Containers also make sense for firms that require areas of very dense floor space: The Bull mobull, HP POD, and SGI ICE Cube containerized data centers support more than 1,500 watts per square foot, density that is virtually unheard-of in a standard data center.

Before you make the leap, however, there are a few things to consider:

• **Local regulations could inhibit your use of containers.** Investigate the local regulations in the area where you will be locating your data center container, permits and taxation laws in particular. Is the container considered a temporary structure? Can it be declared an eyesore?

• **Site preparation may be necessary.** Containers are heavy and typically require a high-ceiling facility, so don’t expect to be able to simply roll one into your existing data center. Be prepared to have to accommodate cranes for moving the container into position. If the container will be parked adjacent to your data center you may have to run power, network, and water lines outside, and you will have to choose a location where delivery by truck can be accommodated.

• **Maintenance SLAs will vary.** Because of their newness, maintenance SLAs aren’t exactly established. Most vendors offer custom levels of support as an option, which may include 4-hour replacement of critical infrastructure. Determine your support, maintenance, and disaster recovery needs before you buy.

SUPPLEMENTAL MATERIAL

Companies Interviewed For This Document

Ascent
Dell
HP
IBM
Silicon Graphics International (formerly Rackable Systems)
Sun Microsystems
ENDNOTES

1. Some data center containers, such as the Sun solution, are water-cooled, thus also requiring access to a water source. Others use a glycol-based cooling system that simply needs to be replenished periodically.


4. After years of adding more server capacity and compute power to support new applications, data centers are busting at the seams — driving facilities, power, and cooling costs through the roof. Consider consolidation as a first step and be ready for growing future requirements before you reach crisis mode and literally run out of space, power, or money. See the October 5, 2007, “The IT Consolidation Imperative: Out Of Space, Out Of Power, Out Of Money” report.

5. Your data center’s efficiency can be measured by its power usage effectiveness (PUE), which is defined as the total amount of power coming into the facility divided by the IT equipment power. In a perfect world with no overhead from air conditioning and power conditioning inefficiencies, your PUE could be as low as 1, meaning that all the incoming power was being used for computing. In reality, 1.7 would be great, but if you’re running with a PUE above 2.5, you’re wasting a significant amount of your incoming electricity. See the October 29, 2008, “Retrofitting Your Data Center For Better Capacity” report.