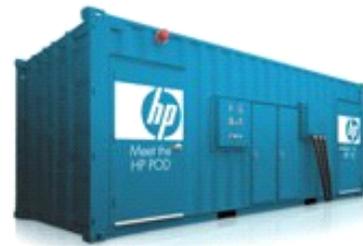


Data Center in a Box

July 2009

Gone may be the days of elaborate data centers in campus surroundings. Tomorrow's data centers may be stacked in boxes in the parking lot. Boxes? Well, cargo shipping containers, to be exact. The kind you see stacked up on huge freighters plying the oceans.

Google, the pioneer in so many things IT, started this trend in 2005. After some derision, its data-center packaging practices are now being followed by such industry leaders as HP, Sun, IBM, Dell, and Microsoft.



Why Would Anyone Want to Put a Data Center into a Shipping Container?

There are lots of reasons. They boil down to mobility, cost, schedule, and energy efficiency.

- If a company's data center is disabled by some disaster, and if they have no backup data center (shame on them), a new massive data center can be wheeled in within weeks.
- If a data center runs out of capacity while its new facilities are being constructed, the company can add additional capacity with a mobile data center. Maybe it doesn't need the additional construction – just put the data center containers in the parking lot.
- Data centers in a box do not require expensive facilities. They can be located in warehouses where space is cheap and where property taxes are low.
- Data center containers can be located in areas of cheap power.
- The confined construction of data centers means that cooling can be much more efficient, resulting in lower energy costs and a greener operation.

A containerized data center can be wheeled in and needs only three connections – power, water (for cooling), and networks. Ideally, it should have a concrete pad to rest on and a roof over its head; but these are not absolutely necessary.

Google, the Pioneer

Google began the containerization trend in 2005 when it started to deploy new data centers in containers. It had already developed its own line of DC-powered servers, each with its own backup battery to replace the less-efficient UPS (uninterrupted power supply) systems typically

used in data centers. To achieve even more space and energy efficiency, it conceived the containerized data center.

A Google container can house 1,160 of Google's dual-processor x86 servers. A container requires 250 KW of power. Each of Google's data centers comprises many containerized units.¹

Because the data center is so compact, great efficiencies can be made in cooling, a major energy consumer. Rather than having to move cold air across a large data center room and having it mix with warm air on its way, cold air only has to move a few feet and can be easily separated from the hot return air.



Inside a Google Data-Center Container

The energy efficiency of a data center (and other big power users) is measured by the Power Usage Effectiveness (PUE), which is a measure of how much additional power is needed over the basic power required to run the facility. A PUE of 1.5 means that the facility draws 50% more power than its basic needs, this additional power being used for lighting, cooling, and other peripheral uses. Typical PUEs for today's data centers are 2.0 to 3.0 – the data center requires more than twice the power required to run its servers, storage devices, and networks. Google, on the other hand, has achieved a PUE of 1.12, which meets the EPA (U.S. Environmental Protection Agency) goals set for 2011.

HP's POD – the Performance Optimized Datacenter

HP has announced its containerized data center, the Performance Optimized Datacenter, or POD (www.hp.com/go/pod) and gave walk-through tours of the POD at its recent HPTF (HP Technology Forum) 2009 conference in Las Vegas, Nevada, U.S.A. The POD is a 40 x 8 foot shipping container packed full with data center equipment. A 20-foot version is reported to be in the works for the fourth quarter of 2009.

Within the POD are twenty-two 19-inch standard 50U racks providing 1,100U of rack space. The racks can hold up to 160 servers each for a POD total of 3,520 servers. Being standard racks, any vendor's equipment designed for these racks may be used, including servers from IBM, Dell, and Sun and networking gear from Cisco. Alternatively, a POD can be configured with up to 12,000 hard drives, providing total storage of 12,000 petabytes. Any combination of servers, storage, and network equipment may



Inside the HP POD

¹ Stephen Shankland, [Google uncloaks once-secret server](#), *CNet News*; April 1, 2009.

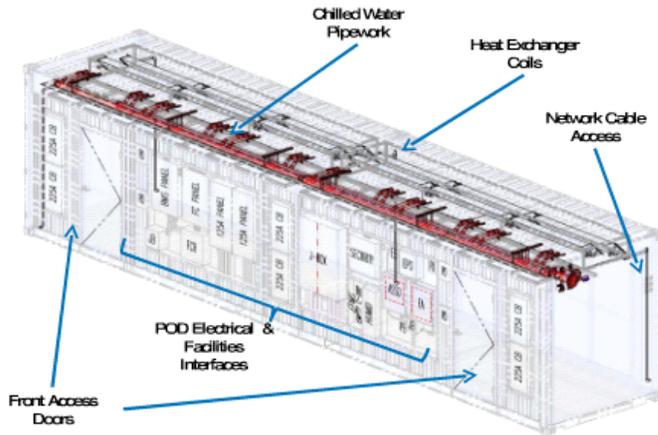
be provided. With this packing density, a 320 square-foot POD can provide the processing power of 4,000 square feet of data-center space.

The fronts of the racks are accessed from a 36"-wide aisle. The backs of the racks are accessible through outside double doors.

Each rack can provide up to 27 KW of power for a POD total of 670 KW and will operate with external ambient temperatures ranging from -20° to +120° Fahrenheit.

The cooling efficiency of the POD derives from its compact nature. The tall 50U racks form a barrier from floor to ceiling. The aisle in front of the racks is the "cold aisle." The space behind the

racks is the "hot aisle." Cold air is blown into the cold aisle from overhead blowers. From there, it flows through the rack-mounted equipment to the hot aisle in the rear of the racks, where it rises and enters water-cooled heat exchangers mounted above the racks. The cold air emerging from the heat exchangers is blown back down into the cold aisle. Because of the cooling efficiency of this system, cooling water need only be at a temperature of 65° F rather than the 45° F water temperature normally required, leading to further efficiencies.



The POD Exposed

The term "cold aisle" is relative. This is the aisle that operations personnel use for frontal access to the equipment. HP recommends that the cold aisle be maintained at a temperature of 90° F. However, for operator comfort, the temperature may be maintained at any lower temperature at the cost of cooling efficiency.

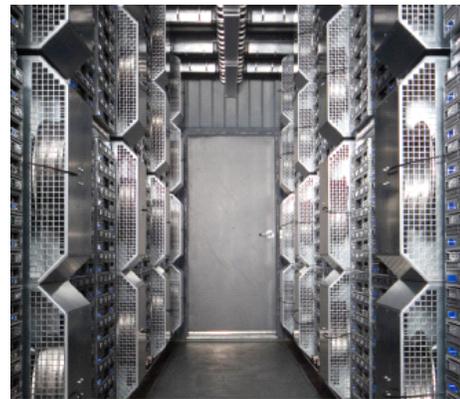
HP claims that their pods can be stacked but no more than two high.

The flexibility of the POD lies in the claim by HP that they can deliver a fully configured and functional POD within six weeks from date of order. This compares favorably with the one-to-two years required to build or extend a data-center facility. If unexpected increases in data center processing demands, loss of capacity due to a disaster of some sort, or management dictum for a backup data center should dictate a rapid increase in data-center capacity, a POD may be the answer, whether it provides temporary or permanent capacity.

A YouTube video of HP's POD may be viewed at http://www.youtube.com/watch?v=fJbCNB5Da_8.

Rackable's ICE Cube

Rackable System's ICE Cube (www.rackable.com) comes in a 20-foot or a 40-foot shipping container designed to house its half-depth server rack systems. As such, it is not compatible with equipment from other manufacturers. However, because of the half-depth form factor of Rackable servers, ICE Cube provides significantly more rack space.



Rackable's Central Aisle

Arranged in two rows with a 3-foot center aisle, a forty-foot ICE Cube provides 1,540U of rack space. Mounted in these racks can be servers containing 22,400 cores (Intel Xeon quad-core processors) or 11.8 petabytes of storage.

Rackable claims a PUE less than 1.2. An ICE Cube can be delivered with no external logo for security.

A YouTube video of Rackable's ICE Box can be viewed at <http://www.youtube.com/watch?v=oWJNpKx8iOU>.

Sun's Modular Datacenter

Code-named Blackbox, Sun Microsystem's Modular Datacenter (<http://www.sun.com/products/sunmd/s20/>) is offered in a 20-foot shipping container.²

Within the container can be seven 19" racks providing 25 KW of power each. The racks can contain up to 2,700 Sun servers running Solaris as well as compatible third-party equipment. An eighth rack is provided for network and control equipment.

A single Modular Datacenter can provide 18 teraflops of computing capacity or three petabytes of disk storage.

Microsoft's CBlox

Though not a vendor of containerized data centers, Microsoft plans to be a major user. It is building in Chicago a massive data center that will house up to 300,000 servers in 150 Microsoft CBlox containers.³

Microsoft needs this capacity. Its data-center requirements are growing at a rate of 10,000 servers per month, and this rate is projected to grow to 20,000 servers per month in the coming years.



Inside a Microsoft Data-Center Container

Microsoft claims that containers will form the basis of all of its future data-center designs.

Dell's Humidor

Dell is reported to be developing a data-center container.⁴ Code named Humidor, Dell's container data center will be a double-decker. It will comprise two containers, one on top of the other. The lower container will contain the data center proper – servers, storage, and networking. The upper container contains the power and cooling for the lower container.

The data center container will hold twenty-four 19" standard racks that can mount 2,400 servers. The servers may be any manufacturer's server from that fits into a 19" standard rack.

Dell claims that Microsoft is using some of its container data centers in its Chicago containerized data center.

² Sun Modular Datacenter: The World's First Virtualized Datacenter, *Sun Brochure*.

³ Microsoft: 300,000 Servers in Container Farm; *Data Center Knowledge*; May 7, 2008.

⁴ Dell Sees Double With Data Center in a Container, *The New York Times*; December 8, 2008.

Summary

Data-center containerization has a big potential for transforming the future look of the data center. It is already being embraced by the giants of the industry, Google and Microsoft. Who knows? Your next visit to a data center may be in the warehouse district.

