White Paper 01

The Optimum Data Center:

How

Modular Data Centers

Transcend

Containers

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Executive Summary

In the last few years, data center (DC) build-outs have seen a much needed transformation. The world's dependency on the Internet, the demand for agile computing and the pressures of decreasing time to market of product and service delivery have finally reached the data center infrastructure itself. Other driving factors forcing a change have been about the economics (both to build and operate), reliability, scalability and maintainability of the data center facility. Data center owners have noticed the need to standardize the data center components, so they can be built, tested and maintained easier and faster. These factors have pushed the industry to develop Container Data Centers, or the "data center in a box."

However, this solution has not lent itself to the flexibility and adaptability that has been demanded by the enterprise. The logical evolution of the Container DC was the Modular DC, which allowed for customized components to be built, integrated and tested offsite, then delivered and assembled on site.

Many emerging suppliers of Modular DCs are still using the same traditional data center design models as the brick and mortar build-outs, which do not realize the full potential benefits of a modular product. A fundamental change in data center design is necessary. Distinctively, NxGen Modular, with its innovative design concepts focused on modularity, has been successfully building and deploying mission critical Modular DCs which offer unparalleled scalability and efficiency.

Numerous papers have been written delineating the reasons and benefits of both Container and Modular DCs, which translate to saving time and money while increasing efficiency, scalability and maintainability. This paper is focused on the transformation of Container DCs to Modular DCs. Although there are some similarities in benefits between the two approaches, there are a number of elemental dissimilarities, which range from their structure to applicability and flexibility.



The Inevitable Evolutionary Process

The need for scalability and growth combined with the desire to simplify duplication of redundant components has driven many industries to change the way products are built or produced: moving from single one-offs or multi-purpose products to modular, specialized components. It is an evolutionary process, which has finally reached the business of data center build-outs.

The major driver of such transformations is economics. Standardized components, which are fabricated and tested at a factory then delivered and commissioned on site, provide efficiency, reliability and shorter time to market. Specialized modular components offer consistent redundancy, scalability and ease of field replacement and upgrades.

Computer Industry: The first computers were large mainframes, general multi-purpose expensive computers serving all applications. The evolutionary process of mainframes was the creation of server farms, specialized servers and "appliances." Next, blade servers were developed to accommodate redundancy and rapid extensibility.

Similarly, the disk industry has gone through an evolutionary process of single platter disk drives to multi-platter disk devices, to RAID to multi-LUN storage appliances.

Construction Industry: Large and small buildings have historically been built on site, a very lengthy and expensive process. The idea of pre-fabricating at the factory and assembling on site has become more and more widespread. Now structures such as bridges and large buildings can be built in a much shorter timeframe, with less overhead and greater precision. In addition, unexpected site issues can be eliminated, reducing project risks. According to the Freedonia Group, nonresidential prefabricated building system demand in the US is expected to increase 7.8% annually to $15.2 billion in 2015. Similarly, because of the success of rapid deployment, the Massachusetts Department of Transportation has issued a statement that precast elements and hybrid bridge systems will become "standard practice."

Data Centers: Until just recently, the basic physical infrastructure of the data center remained essentially the same since the mainframe era: a monolithic structure of power and cooling components, built for the sole purpose of supporting computers. Such build-outs typically take 18-24 months to complete. Among other considerations, a new design, construction methodologies and site customization is necessary each time. Because of these differences, there is little transfer of knowledge from previous, similar implementations to eliminate



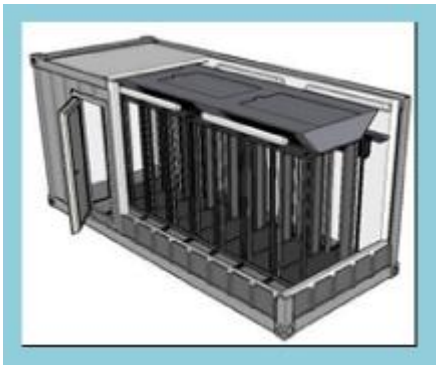
mistakes and improve construction. The complexity and lengthy process of these build-outs have forced organizations to build data centers over-capacity in order to allow for growth in future demand; a rather expensive undertaking in the capacity planning process, already rife with market and economic uncertainties.

Additionally, driven by our dependency on computers, the demand for data centers in remote locations or for temporary usage has also been increasing, including oil rigs and conflict zones. These environments require just-in-time deployment of the services. To build a data center in those areas the traditional way is just not practical.

The need to address such requirements led to the creation of the Container DC. A container offers a standard size, which can house the necessary data center components. The data center is now a product, which can be fully integrated and tested before being shipped to where it is needed.

Sample Pictures of Container Data Centers

ISO Container



Rack Configuration

Inside a Container

The Dawn of the Optimum Data Center: Modular DC

The Container DC was a groundbreaking idea. Although its external size is ISO restricted, the internal configuration has taken many forms, from a single container, which includes all the components, to specialized containers, each providing a specific function such as cooling or power, keeping the computer racks in a separate container.

Because of the standardized equipment, and how tightly they are integrated, the container solution offers better efficiency (power usage), streamlined maintenance and higher reliability in addition to being more cost effective in reducing time to operational readiness; mobility being its major strength.

Even though the Container DC has proven itself to be a useful solution for certain environments and purposes, it is not suitable for the enterprise. Containers are too rigid in their setup, impractical to customize, and do not provide adequate space for maintenance. Also, a data center build-out is one of the highest capital expenditures of an enterprise; therefore it is extremely important that it meets the organization's exact requirements. Some organizations also like to showcase their data center investment. A colony of containers is neither aesthetically pleasing nor impressive, lending a "construction site" air to its location.

The next logical step in the data center evolution is to break up the components into specialized modules: such as a power system module or a cooling system module, each configured to the exact specification and shipped to the site for assembly to create the optimum data center; much like pre-fabricated buildings.

The use of pre-fabricated modules redefines the concept of a data center, no longer requiring it to be built onsite. It is now a product or an IT appliance. Modules can be independently customized to provide the exact amount of power, cooling and rack space that is required. There is no need to over-build, because modules can be added as demand increases. Each module is constructed, tested and commissioned before it is shipped to the site for assembly. Because it is modular, the data center capacity can easily grow as IT requirements grow.



Sample Pictures of Modular Data Centers

Manufacturing

Shipping

Interior after Assembly

Electrical Room

The Modular DC offers the efficiency and cost effectiveness of the Container DC with the flexibility of the traditional data center

Modular DCs transcend Container DCs

The ideal solution to meet the growing demand for the delivery of flexible and extensible data centers is the Modular DC. It can be built, tested, delivered and assembled in a fraction of the time required by a traditional data center construction, with the exact necessary configuration; no overbuilding. Unlike Container DCs, it is customizable and extensible, which means any of the modules can be configured and sized to a specific configuration and modules can be replaced or added as requirements change.

Data Center Knowledge™ defines the two solutions as follows:

> **Container DC:** A data center container is a particular package that is engineered and delivered as such in an ISO shipping container.
>
> **Modular DC:** A modular data center references a deployment method and engineered solution for assembling a data center out of modular components in, many times, pre-fabricated solutions that enable scalability and rapid delivery schedule.

Similarities between Modular & Container DCs

The advantages of the Modular and Container DC over traditional brick and mortar data centers can be summarized as follows:

- Shorter time to operational readiness
- Less capital outlay
- Predictable cost to build and operate
- Improved uptime and reliability
- Energy efficient
- Less operational and maintenance costs
- Purpose-built for various uptime requirements
- Transportable

Although, these advantages have accelerated the acceptance of both solutions throughout various industries, the Modular DC is proving itself to be the ultimate solution for the enterprise.



Major differences between Modular & Container DCs

Feature	Container	Modular
Flexibility	♦ Must fit in an ISO container ♦ Limited density for cold/hot aisle configuration due to size constraints	♦ Modules can be built to suit ♦ Flexible in size and configuration ♦ Higher density hot/cold aisle configuration
On Site Customization	♦ Configuration cannot be changed after installation; container must be replaced with a new configuration	♦ After installation, modules can be tweaked and modified to fit changes in requirements
Serviceability	♦ Uncomfortable, limited space, if technician needs to spend long hours replacing hardware	♦ White space can be designed as needed for comfortable service access
Energy Efficiency	♦ Cannot redirect data center heat to office building to be energy efficient	♦ Can complement an existing office building with data center heat recovery used for comfort heating
Common Applications	♦ Military ♦ Oil rigs ♦ Temporary needs ♦ Remote sites	♦ Permanent solution ♦ Additional capacity to existing facility ♦ Re-purposing a building
Compliance	♦ Must be ISO compliant container ♦ Not ASHRAE compliant	♦ Manufactured in an ISO 9000 factory, no size limitation ♦ ASHRAE compliant
Enterprise Readiness	♦ Flexibility is a major issue ♦ Container appearance does not portray an enterprise class setting	♦ Customizable ♦ Aesthetically pleasing; inside and outside can be painted or siding applied ♦ White space can be defined ♦ Finished assembly can look just like a traditional data center

The Modular DC offers the efficiency and cost effectiveness of the Container DC with the flexibility of the traditional data center.



Conclusion

The demand for Modular DCs is growing rapidly. According to Uptime Institute's spring 2011 survey, almost 50% of large data center operators interviewed are considering "going modular." Furthermore, a number of experts in the mission critical field predict dramatic growth in the use of Modular DCs in the next five years. This demand has led to an increasing number of companies manufacturing modular systems. These companies are mostly either existing equipment vendors or traditional co-location operators, whose core competency is not building Modular DCs.

Because data center build-outs are not their main business focus, equipment providers such as HP, IBM, SGI, Epsilon Industries (HTS) and CISCO tend to build Modular and Container DCs mainly optimized for their own or their partners' equipment. Their solutions may not offer the flexibility to host multi-vendor servers or supplementary equipment.

Co-location operators, such as I/O Datacenter and Colt are using their data center know-how to offer modular solutions as well. However, these companies specialize in providing services rather than producing a product, which needs to be pre-fabricated, integrated, tested and packaged for shipment.

Uniquely among these vendors, NxGen Modular has emerged, specializing in manufacturing only Modular Data Centers and components. NxGen Modular is server/technology impartial with a focus on building, integrating and testing purpose-built Modular DCs. They have developed patent pending modular innovations which optimize performance while maximizing the economics of mission critical data centers.

Rising IT costs and an insatiable demand for data centers are forcing IT executives to re-think the conventional approach to growing data center capacity. Forward-thinking organizations embrace the new era of the Modular DC in order to create the optimum solution for a flexible data center.

Modular DCs signal the end of tying up capital years in advance by building data centers in large footprints before capacity is needed. Modular DCs can be scaled quickly and managed independently, freeing businesses from being locked into data center decisions made years ago.



About NxGen Modular

Founded in 2009, NxGen Modular is a provider of mission critical modular data centers, designed to improve operational performance and efficiency, lower overall costs, and facilitate seamless growth. Fueled by a commitment to innovation, NxGen Modular is pioneering new ways to meet the needs of the world's leading data center owners and operators by providing a faster, more efficient means of building data centers. For more information, please visit www.nxgenmodular.com

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