Preparing the Physical Infrastructure of Receiving Data Centers for Consolidation

White Paper 175

Revision 1

by Neil Rasmussen

> Executive summary

The consolidation of one or more data centers into an existing data center is a common occurrence. This paper gives examples of what is becoming a standard architecture for preparing the physical infrastructure in the receiving data center. This approach allows for shorter timelines and high efficiency while avoiding the commonly expected difficulties and complexities often experienced with consolidation projects.

Contents

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Introduction

Many data center consolidation efforts involve the consolidation of two or more data centers into a new, single data center. Consolidation into an existing data center is often considered impractical because the existing physical infrastructure is not considered compatible with current requirements, or the risk of disruption of the existing data center is not acceptable. However, a growing number of consolidation efforts have found success consolidating into an existing data center using the effective approach described in this paper.

The problems of consolidating into an existing data center include the following:

- The need to keep the existing data center operating during the consolidation project
- The desire to avoid installation of major equipment, plumbing, and wiring that might disrupt existing operations
- The low density capability of the existing infrastructure, typically 3kW per cabinet (100W / per square ft), when new equipment is most effectively deployed at 8-16kW per cabinet
- The attempt to push the existing cooling plant to support higher density results in hot spots and overcooling, resulting in gross inefficiency (PUE of 2.2 or more)
- The existing raised floor which is generally too short and clogged with wiring and plumbing to allow the required airflow

Piecemeal, unplanned consolidations that occur by slowly attempting to squeeze more equipment into an existing data center typically compound the problems of reliability, hot-spots, and inefficiency. Instead, many data center operators **have solved all of these problems by adopting the high-density pod overlay method described in this paper**.

High Density Pod Overlay Method

The high-density pod overlay method of data center upgrade is based on the concept of self contained "Pods" or units of data center infrastructure. A pod is a pre-designed collection of IT cabinets, power distribution, and dedicated cooling distribution that are deployed as a unit, almost always as a pair of rows of cabinets, such as shown in **Figure 1**:

Figure 1

High density pod installation at US Army Fort Bliss

In the high density overlay method, high density pods are added to an existing data center in order to raise efficiency, capacity, and density. Over time, the pods are added that displace the existing infrastructure. Eventually, the entire data center is converted to pods and the performance is nearly as good as a brand new data center. Each pod is like a self contained data center, with its own power and cooling distribution along with air containment technologies, so that it minimally affects the power and cooling environment it is dropped into. For example, a new pod requires no air from the existing raised floor because it has self-contained coolers. All of the heat generated by a new pod is captured and cooled within the pod, so it creates no additional hot spots or demand on the existing air conditioners.

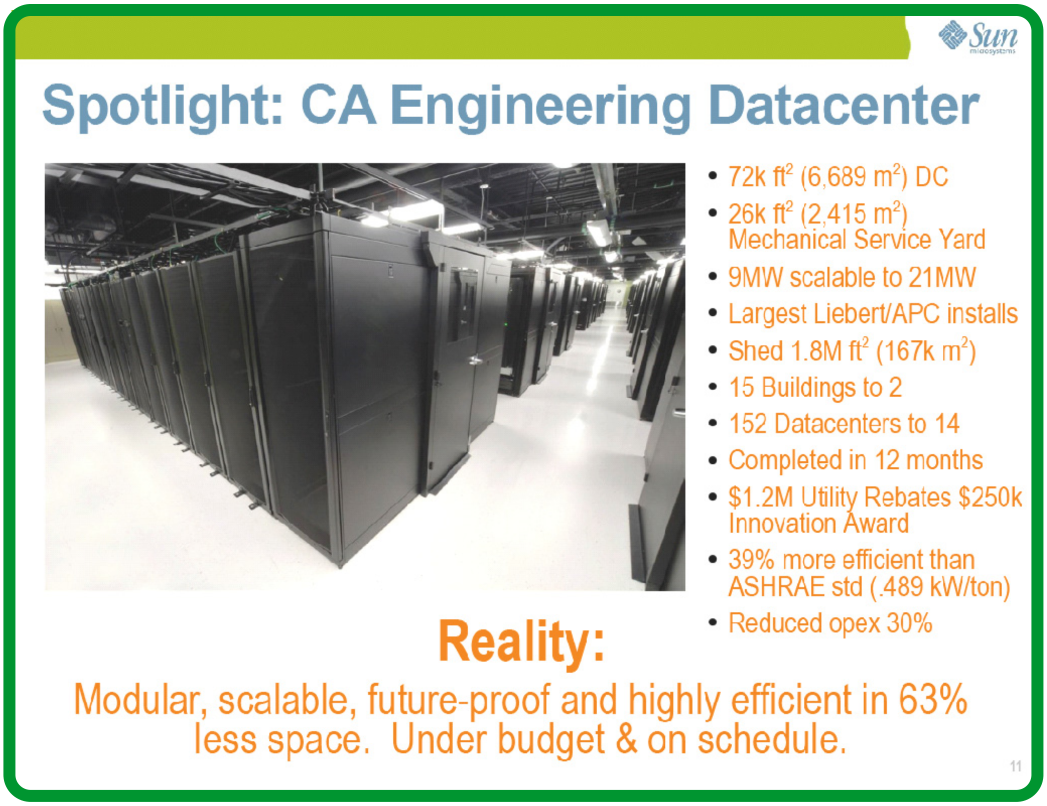


Figure 2

High density pod deployment at Sun Microsystems as part of a consolidation project

(presented by SUN at data center dynamics, July 2008)

In the example of **Figure 2**, a high density pod based approach was used in a new data center as part of a massive consolidation project of 152 data centers to 14 data centers. This project resulted in a PUE of less than 1.3. The pod approach simplified the design and accelerated the timeline of the project which was completed in 12 months.

The high density overlay method is particularly practical and effective during consolidation projects. Customers typically find that every added pod is 5-10 times more efficient in the use of floor space than the data center equipment that is consolidated into the pod. Therefore deploying pods quickly results in the net creation of free floor space, which then becomes available for additional pods. After the first few pods are deployed, the released floor space allows later pods to become much easier to deploy. When conversion is complete, the floor space eventually released can allow the overall capacity of the data center to be increased or that space can be repurposed. In the consolidation example of **Figure 2**, a net of 1.8 million square feet of space were released by the project.

A great advantage of the high density pod overlay method is that because pods are self-contained, the designs are off-the-shelf, and do not need to be custom or engineered to the specific limitations of each building or data center they are installed in.

Although high density pods are of a standardized design, they are readily adapted for the application as follows:

- The number of IT cabinets in a pod can be adjusted to make the pod fit better into existing room form factors.
- The IT cabinets in a pod are typically rack enclosures, but IT devices with custom enclosures such as storage devices are readily accommodated.
- Typical pod design values of 8 kW per cabinet are standard, but values up to 30 kW per cabinet are possible.
- The power redundancy of a pod is typically dual path, and the cooling redundancy is typically N+1, but other options are possible.
- Pods of different capacity, density, or redundancy are readily combined in an installation.

Meeting capacity requirements

In many consolidation projects it is desirable to increase the ultimate IT capacity of the infrastructure of the receiving data center. For example, the plan may be to consolidate into an existing 1 MW data center, with the objective of expanding the capacity of that data center to 2 MW to accommodate all of the desired consolidation. Furthermore, it may be difficult to anticipate whether 1 MW, 2 MW or some other capacity is really required due to uncertainties regarding virtualization and other factors. What is needed in this case is the ability to scale the data center when and if required. As pointed out earlier, the density increase achieved during real consolidation projects is so large that floor capacity is freed up and is almost never the capacity limit of a receiving data center. The limitation is always on the power and cooling capacities.

A high density pod overlay allows for scaling of capacity in the following ways:

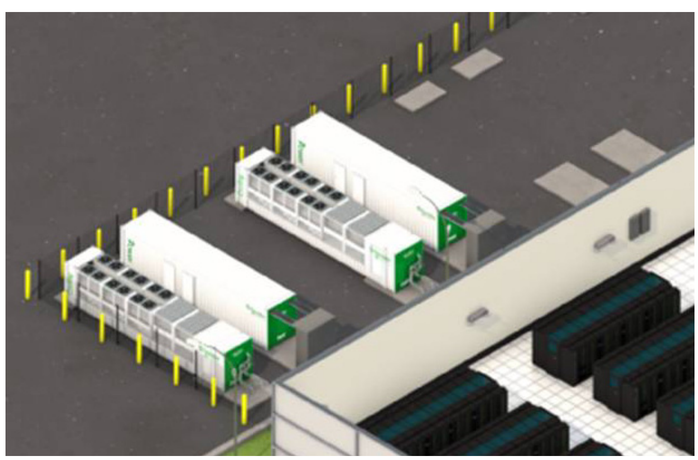
- New pods can utilize existing chiller plant, service entrance, and switchgear capacities until they are fully utilized.
- When an existing capacity is fully utilized, new pods supplied from new modular power and cooling plants can be added to the facility without disruption or replacement of the existing plants.

Link to resource
White Paper 163
Containerized Power and Cooling Modules for Data Centers

An example of the types of cooling and power plants (also referred to as facility modules) that can be added to an existing data center are shown in **Figure 3**. White paper 163, *Containerized Power and Cooling Modules for Data Centers*, describes these plants in further detail.

Figure 3

500 kW Cooling and power plant modules that can be added to scale the capacity of an existing data center



Preparing for consolidation

Link to resource
White Paper 177
Determining Power, Cooling, and Space Capacities when Consolidating Data Centers

Link to resource
White Paper 143
Data Center Projects: Growth Model

To prepare an existing facility for consolidation using the high density pod overlay method, the following approach is used:

- Assess the receiving data center to determine the capacities and capabilities of the existing physical infrastructure (see White Paper 177, *Determining Power, Cooling, and Space Capacities when Consolidating Data Centers*)
- Create a scaling plan to establish the ultimate scalable capacity of the data center
- Establish an IT growth plan, and reconcile this plan with the scaling plan (see White Paper 143, *Data Center Projects: Growth Model*)
- Select appropriate high density pod design(s)
- Establish a "carve out" area within the existing data center where the first pod can be installed
- Consolidate existing loads into the high density pod to release additional space if necessary
- Place pods over time and consolidate existing loads and loads from other data centers into the pods
- Add additional power and cooling plant capacity as necessary to support the growth plan

Figure 4 shows an example of a "carve out" area within an actual existing data center that was used to locate the first high density pod.

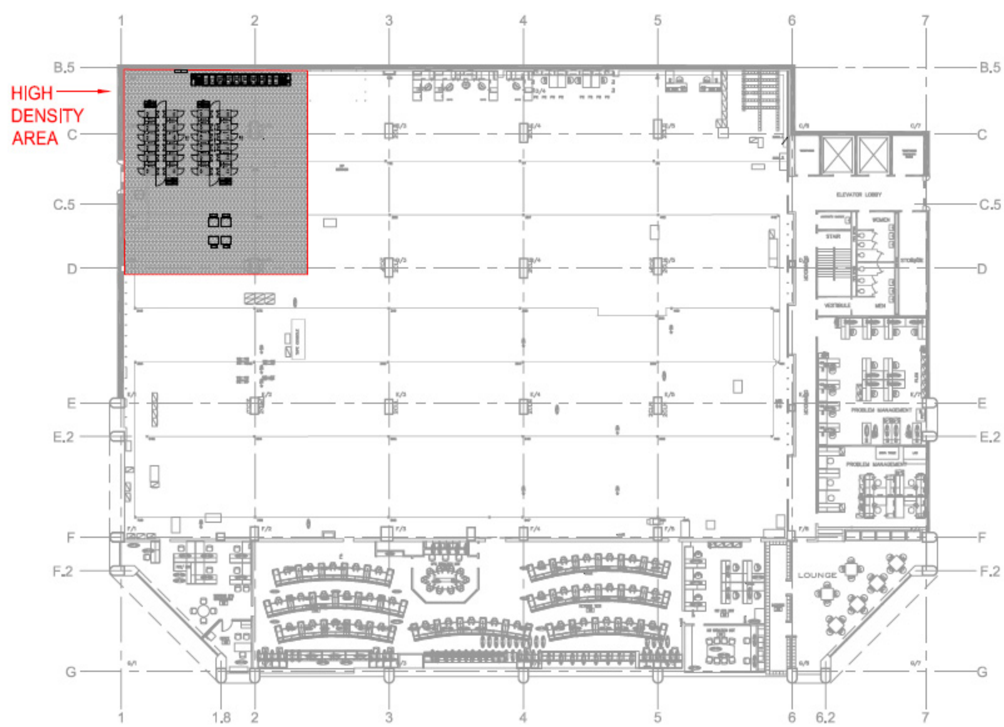


Figure 4

"Carve Out" area established in an existing data center for first high density pod deployment

Conclusion

Existing operating data centers can be effectively used as receiving data centers for data center consolidation projects. However, the common approach of "just trying to fit additional equipment in" typically results in hot spots, reliability problems, inefficiency, and running out of space. Instead, the use of the high density pod overlay method can allow an existing legacy data center to transform into a high density, high efficiency data center during a consolidation project.

The annual PUE of data centers that use the high density pod overlay approach can be expected to be on the order of 1.35 at full load, which is not quite as good as a 1.2 PUE that is possible with a new purpose built data center, but is much better than the typical 2.0 PUE observed before the pod overlay was deployed.

The self-contained nature of the pod means that minimal planning, design, or engineering is required to place a pod in any existing environment, allowing for a high degree of standardization and reduction of the deployment cycle time.

The high density pod overlay method has been used successfully in hundreds of commercial consolidation projects. It is an effective method for new facilities as well as for transforming existing legacy data centers into suitable receiving data centers for consolidation, even while they continue to operate.

About the author

Neil Rasmussen is Senior Neil Rasmussen is a Senior VP of Innovation for Schneider Electric. He establishes the technology direction for the world's largest R&D budget devoted to power, cooling, and rack infrastructure for critical networks.

Neil holds 19 patents related to high-efficiency and high-density data center power and cooling infrastructure, and has published over 50 white papers related to power and cooling systems, many published in more than 10 languages, most recently with a focus on the improvement of energy efficiency. He is an internationally recognized keynote speaker on the subject of high-efficiency data centers. Neil is currently working to advance the science of high-efficiency, high-density, scalable data center infrastructure solutions and is a principal architect of the APC InfraStruXure system.

Prior to founding APC in 1981, Neil received his bachelors and masters degrees from MIT in electrical engineering, where he did his thesis on the analysis of a 200MW power supply for a tokamak fusion reactor. From 1979 to 1981 he worked at MIT Lincoln Laboratories on flywheel energy storage systems and solar electric power systems.

Resources

Click on icon to link to resource

Deploying High-Density Pods in a Low-Density Data Center
White Paper 134

Data Center Projects: Growth Model
White Paper 143

Containerized Power and Cooling Modules for Data Centers
White Paper 163

Determining Power, Cooling, and Space Capacities when Consolidating Data Centers
White Paper 177

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