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Data Center Power Density Paradox

Balance infrastructure capabilities with core IT needs

Key Highlights

- *Driven by the constant need for delivering high performance and an always available IT infrastructure, data centers are working beyond normal capacities to support the burgeoning demands being placed on them.*
- *The decisions for resolving the power space and cooling issues in a data center are driven by what the analysts and vendors have to say without taking into account the legacy IT environment of the organization.*
- *Organizations deploy smaller denser servers and storage systems to increase capacity and avoid the need for data center relocation or constructing an entirely new data center.*
- *In order to gain efficiencies, your organization will have to balance between density of servers and other equipment and the availability of power, cooling and space in your data center.*

Author Profile

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Data centers are like beehives with constant activity going on at every moment of time.

Driven by the constant need for delivering high performance and an always-available IT infrastructure, data centers are working beyond normal capacities to support the burgeoning demands being placed on them. With the exponential growth in terms of number of servers, storage space and networking equipment, many business enterprises are facing shortage of power, cooling and space in their data centers.

Many times, the decisions for resolving the power space and cooling issues in a data center are driven by what the analysts and vendors have to say without taking into account the legacy IT environment of the organization. Strategic decisions like installing high density blade servers and storage, modular power systems, in-row cooling system, aisle contentment, virtualization and cloud computing to tackle power, cooling and space issues will only help if they are employed properly.

Many organizations are deploying smaller denser servers and storage systems to increase capacity and avoid the need for data center relocation or constructing an entirely new data center. Then again, you need to careful about what you deploy lest the 'Power Density Paradox' (PDP) overcomes your organization. PDP essentially means that by deploying more dense equipment in your data center, you will reach an inflection point where the need for data center space will increase, resulting into more CapEx, OpEx cost & substantial amount of re-engineering efforts for your organization. Deploying dense equipment would also require additional need for power, cooling and backup systems in the data center that will eventually lead to increased costs.

In order to gain efficiency, your organization will have to balance between density of servers and other equipment and the availability of power, cooling and space in your data center. Ignoring this would lead to increase in capital expenditure as well as operational expenditure (power and cooling) and higher incidences of downtime, thereby, putting your business at risk.

Root Cause of Power Density Paradox

Server technology has undergone a remarkable transformation since the mid 1990s when floor-mounted minicomputers like the IBM AS/400 (still available today as the System-i) were just beginning to be replaced with rack-mounted servers taking "only" 3-5U of rack space. That's essentially a 14-fold increase in server density. The year 2000 saw these rack-mounted servers shrink to 1U "pizza box" designs, only to be replaced in 2002 by blade servers. These devices put multiple server motherboards (each with their own processor, memory, I/O connections and sometimes even a disk drive) on a single blade.

This brought a remarkable change in the density of servers per rack – an 84X increase! Correspondingly, the computing power of these servers increased manifold, which, meant more processors in a given space and more power to run and cool them. Given this situation, managing the thermodynamics in the data center becomes a huge challenge and a limitation to growth and reliability. There can be greater chances of system downtime, thus, hampering the normal course of operations.

Power

The denser the server environment, the more electricity is required to power and cool the space. For example, it takes 60 to 100 watts of power per square foot to operate legacy minicomputers or full racks of 3-5U servers. The same space filled with smaller, 1U servers would require at least 200 watts per square foot, and the latest blade servers require as much as 400 watts per square foot.

Cooling

Each additional watt of power consumed by the computing environment must be offset with an equivalent amount of cooling. Denser data centers also require more air-moving capacity to deliver the colder air and remove warm air from the space efficiently.

Space

The need for more power and cooling inadvertently drives up the need for space in data centers. As higher-density servers require more power per square foot than lower-density servers, they also need more support equipment such as air conditioning, uninterrupted power supplies and backup generators.

Power, cooling and space are interdependent on each other. The denser the data center, the more requirement for power and cooling and rising pressure of increasing space on data center managers.

Data Center Allocation at Different Power Densities

The chart shows the relationship of support space to usable space at various levels of power density based on a facility with 2,000 square feet of raised floor. This example is limited to the support space required for the additional Computer Room Air Conditioning (CRAC) units, UPS (and related electrical) and backup generators, but does not include the additional space required for upgraded power cables, airflow, upgraded chillers and additional fuel storage required for the upgraded generator capacity.

Risks in Ignoring the Paradox

Wasted Heating and Cooling Costs

The first and most obvious risk of implementing high density servers without accounting for the power-density paradox is a rapid and unnecessary increase in power and cooling costs, as well as in maintenance of equipment such as CRAC units. If you have a limitation of available power, these extra heating and cooling demands can reduce the net power available for IT computers, storage and networking systems.

Unanticipated Equipment Expenditures

The second risk is unanticipated capital and operating expenses for solutions that attempt to keep a sub-optimal facility in operation. The use of specialized air handling equipment such as active tiles or portable/standalone CRACs (In-Row cooling System) are warning signs that a data center may be approaching the end of its useful life. Even if these systems extend the life of the data center, they add to your power consumption and maintenance expense while introducing additional points of potential failure.

Downtime

Servers deployed in a high-density environment are at much greater risk from unexpected downtime than those in lower-density environment. Even if the UPS continues to provide operational power to the devices during a loss of utility power, the facility will lose cooling and airflow until the generator kicks in, and the cooling system recycles.

The downtime caused by such a cooling failure could be minutes if the server detects a temperature spike and shuts down to prevent damage to the servers; or it could be much longer in the event the excess heat actually damages hardware.

Depending on the architecture used to assure application software resiliency, this could quickly lead to application downtime, reduced overall performance/throughput, and financial risk to the business.

Optimization of IT facilities is the key

Poor data center design and management practices can compound the issues associated with the power-density paradox. An example could be haphazard arrangement of equipment racks over the years because of the business need for more server capacity. As the new servers and racks were added without any planning for data center airflow and cooling, they cause hot spots, increase power consumption and lead to inefficient cooling.

In addition, older data centers often may have only 12” to 18” of space under their raised floors for cooling (likely shared with network and power cabling), rather than the 30” or more required for modern, high-density data centers. Reconfiguring the racks for hot aisle/cold aisle airflow will improve efficiency somewhat, but provide no real increase in overall capacity since the shallow raised floor limits the cold airflow.

Another poor practice that’s all too common is using the factory default settings for data center infrastructure equipment, even if those settings are not appropriate for your deployment. A good example of this can be found with the CRAC units. By default, CRAC systems run independently of one other and each unit will try to maintain the relative humidity and temperature around it in a specific range. This results in the CRAC units fighting against one another, with one unit cooling and another heating, one humidifying and another dehumidifying the same air. Besides wasting electricity, this causes extra wear and tear on the units, which leads to unnecessary (and expensive) downtime, maintenance and hardware replacement. A simple solution could be to install a single control unit for all the CRAC units so they don’t work against one another.

Getting the maximum computing capability at the lowest total cost requires weighing a variety of factors, ranging from real estate and power costs to the proper configuration of CRAC units and the right choice of humidification equipment. To maximize application uptime and minimize costs and risks, data center designers and facilities managers must understand the power-density paradox and act accordingly.

Optimize and Balance is the way out

The best way to approach the power-density paradox is to understand the impact it will have on your organization and develop a forward-looking plan based on an assessment involving your data center's computing power; electrical requirements and cooling facilities.

A cross-disciplinary team that includes IT, operations and facilities personnel should do this assessment; so they can all understand the effects of their choices on the overall data center environment.

No Siloed Approach

Many corporate departments operate in isolated islands, or "silos," that make decisions somewhat autonomously. This is fine for most day-to-day activities. But data centers by their nature are not autonomous. While IT equipment is purchased, installed and often maintained by IT, power and cooling are usually the responsibility of the facilities staff, which often doesn't understand the power and cooling needs of modern, high-density servers. Involving all the affected parties helps keep everyone focused on the organization's objectives to reduce costs, make the most of current assets and avoid unnecessary capital expenditures in today's recessionary environment.

TAKING HELP FROM AN EXPERT

The power density paradox makes seemingly simple decisions more complex than appears on the surface. Involving expert outside assistance can help in several ways:

- *An independent, third party perspective can balance the needs and challenges facing the IT, facilities and finance groups.*
- *Specialized expertise in high-density data center design and operations can save time and money while providing a flexible path to longer-term needs.*
- *Knowledge and experience with best practices tools, processes and efficient technologies to support modern, high density data centers may fill gaps in your staff 's experience or availability.*
- *Expertise in modern HVAC and MEP infrastructure alternatives can extend the life of current facilities or be leveraged in the design of a new, high-density facility.*
- *Qualifying for and obtaining utility reductions that can subsidize efficiency improvements in the data center, lowering capital costs and reducing operating expenses.*

Organizations facing severe cost, real estate and power constraints should not rush blindly into the use of ultra high-density servers and storage systems to save space and money in their data center. If this is done without proper planning, and a holistic analysis of business needs and the data center environment, the use of such equipment can actually increase costs and business risks.

As data center managers, conducting an overall assessment of the data center environment, can produce dramatic short-term cost savings and delay or even eliminate the need for costly data center construction or relocations.

About Netmagic (An NTT Communications Company)

Netmagic, an NTT Communications company, is India's leading Managed Hosting and Cloud Service Provider, with 9 carrier-neutral, state-of-the-art data centers and serving more than 2000 enterprises globally. A pioneer in the Indian IT Infrastructure services space - it was the first to launch services such as Cloud Computing, Managed Security, Disaster Recovery-as-a-Service and Software-Defined Storage. Netmagic also delivers Remote Infrastructure Management services to NTT Communications' customers across Americas, Europe and Asia-Pacific region.

Netmagic is India's only IT Infrastructure services provider to be PCI DSS certified for its entire suite of services. It is also the first cloud service provider in India and in the world, to receive the CSA STAR certification for Cloud Capability Maturity Model (CCM) version 3.0.1, an industry benchmark for the specific security requirements of multi-tenant service providers. Besides this, Netmagic is also empanelled as an IT Security Auditing Organization with CERT-In (Indian Computer Emergency Response Team).

Netmagic was chosen by India's CIO community for 6 awards at the recent CIO Choice Awards 2016, across categories for Data Center and Cloud services. Prior to that, it was awarded the 'Data Center Service Provider of the Year' and 'Infrastructure as a Service Provider of the Year' by Frost & Sullivan at India ICT Awards 2015. Netmagic was also mentioned in Gartner's 2015 Magic Quadrant Report for Cloud-Enabled Managed Hosting, Asia/Pacific, where NTT Communications was named in the Leader quadrant. The mention was a result of the analyst firm's assessment of NTT Communications' Cloud services portfolio, which included Netmagic's Cloud services.

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The 2015 Frost & Sullivan India ICT Awards

'Infrastructure as a Service Provider of the Year'
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