NEXSAN

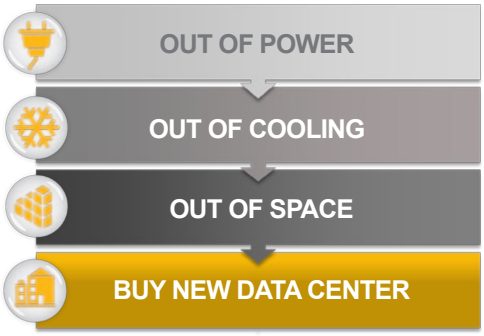
THE POWER/DENSITY PARADOX
THE RESULT OF HIGH DENSITY WITHOUT POWER EFFICIENCY

Growing demand for capacity in ever-shrinking data center space has motivated some storage vendors to cram as many disks as possible in a single space to help manage capacity needs without expanding the storage footprint.

However, the power/density paradox hinders end users from utilizing the very floor space that high density systems were intended to conserve.

WHITE PAPER

DENSE PACKAGING WITHOUT POWER MANAGEMENT RESULTS IN



Growing demand for capacity in ever-shrinking data center space has motivated some storage vendors to cram as many disks as possible into a single space to manage capacity needs without expanding the storage footprint. As much as some vendors call the problem solved, it's not that simple.

Without proper efficiencies and architecture, high density storage systems can create more problems than they solve and ultimately devastate your business. For some, that comes in the form of reliability issues with poorly constructed storage subsystems. For others, it comes in the form of the power/density paradox that hinders end users from utilizing the very floor space that high density systems were intended to conserve.

Let's examine. The total amount of power an equipment rack uses has grown with dense packaging, i.e., higher density = higher kWs per rack. Higher power densities per rack are posing substantial difficulties for data centers that were built at a time when 2-3kW per rack were common and more than enough power existed to support them.

However, the average power per rack has doubled to 6-8kWs and as high as 15kWs for very dense packaging. The issue for data centers compounds with inefficiencies in power distribution and the need for additional cooling. Buildings with infrastructures designed 10 years ago are now reaching their limits on what they can support as data continues to increase at exponential rates.

To illustrate the point, the EPA stated in a report to Congress that many data centers have already reached their power capacity limit:

- More than 10% of data centers (large medium and small) will be out of power capacity by the end of this year;
- 68% expect to be at their limit within the next three years;

The EPA report also states that power and cooling for storage represents 40% of total IT expense; and energy costs will increase by 19% CAGR from 2006 to 2011.

In a weak economy, data centers are increasingly motivated to extend the useful life of everything from technology to facilities. As such, vendors have responded with ever increasing amounts of capacity packed into a given amount of space.

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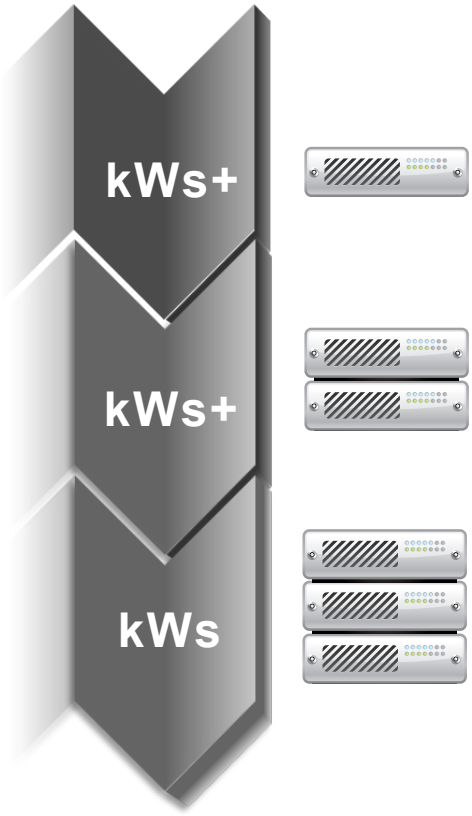

PROBLEM:
The Power Density Paradox

THE MORE POWER HUNGRY DEVICES YOU PUT IN A RACK... THE FEWER RACKS YOU CAN PLACE IN A ROOM

[1] Source: Emerson Network Power

What are the risks of high-density storage? What is the power density paradox? How does Nexsan help customers address both? This brief explores these important business and technology issues.

THE POWER DENSITY PARADOX ILLUSTRATED

With the costs associated with new data center construction, the allure of a high-density rack is attractive. However, without improvements to subsystem power efficiency, high-density storage leads to a problem known as the power/density paradox, as the following scenario illustrates.

Bearing this in mind, imagine a 4U storage subsystem with 60 drives. Without advanced power management to reduce the power consumption of a storage array, one could expect an average power draw of 1,750 watts with a peak load of 3,904 watts. A 4U subsystem would allow 10 subsystems in a rack which would produce a power draw of over 15.3kWs per rack.

That means only 30 racks could be put into a 10,000 square foot facility! By trying to solve a space problem, high density solutions end up creating an entirely new problem - power! As most facilities don't have enough available power to expand, organizations are left with few alternatives as they walk through a now spacious datacenter that is out of power. So what can IT professionals do to mitigate this paradox?

In a storage environment, each rack requires a certain amount of space for aisle room as well as heat load which must be removed from the data center through air conditioning.

Ten years ago, a rack that may have drawn a total of 1kW would have about 65% of the available floor space dedicated to aisles, cooling, UPS etc. That left 35% of the floor space available for racks.

Based on those numbers, a 10,000 square foot data center could have supported up to 500 racks on the data center floor. In a data center today, by increasing the power drawn to 10kWs, only 50 racks could be housed in 10,000 square feet[1].

Many data centers end up trading space for power resulting in more empty space without any real value achieved, thus, the paradox.

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AutoMAID 0

- Disk at full power
- 10ms response
- Energy efficient subsystem storage components

AutoMAID 1

- Heads parked
- Drive @ 7200 RPM
- Sub second response to first I/O; all subsequent I/Os at full speed
- 20% energy savings

AutoMAID 2

- Heads parked
- Drive @ 4000 RPM
- Up to 15 sec response to first I/O; all subsequent I/Os at full speed
- 40% energy savings

AutoMAID 3

- Heads parked
- Drive @ 0 RPM
- Up to 30 sec response to first I/O; all subsequent I/Os at full speed
- 60% energy savings

[1] Source: Emerson Network Power

THE POWER/DENSITY PARADOX COMPOUNDED: THE CASCADE EFFECT

It may come as a surprise to find out that for every 1 watt reduction at the component level (processor, memory, hard disk and so forth), there is an additional 1.84-watt savings on the energy bill. This is known as the cascade effect and is the result of inefficiencies, or loss of power, from power supplies, power distribution systems, UPS systems, cooling systems, building entrance switch gear, medium voltage transformers, etc.

Because of the cascade effect, when the power load is reduced by 1 watt, a total of 2.84 watts are saved[1]. What happens is that every attempt to save energy at the component level ends up become a cost reduction multiplier. For every watt saved by a subsystem, organizations get nearly 3 watts saved at the meter.

SOLVING THE POWER/DENSITY PARADOX: AUTOMAID

If the power/density paradox is the problem and the cascade effect compounds the problem, what is the solution?

The only solution to the paradox is to decrease the total amount of energy used for a given storage density. That can be done by limiting the number of components within a subsystem or by the subsystem itself being more power efficient.

Nexsan uniquely takes advantage of the cascade effect to change the outcome of the power/density paradox through an exclusive solution known as AutoMAID™. AutoMAID is the best solution to the paradox and your storage needs because only AutoMAID can significantly reduce the power consumption of a disk array without reducing storage performance - speed with green.

AUTOMATIC MASSIVE ARRAY OF IDLE DISKS (AUTOMAID®)

Automatic Massive array of idle disks (AutoMAID™) is a technology designed to manage power consumption through a policy system that saves significant amounts of power in the data center. By using Nexsan high density systems with AutoMAID, IT professionals can grow capacity without data center sprawl while reducing operating expenses.

AutoMAID doesn't suffer the limitations of the first generation of MAID that took an "on-off" approach to power efficiency. AutoMAID, or MAID 2.0, delivers the benefits of power efficiency without the performance limitations inherit to the MAID 1.0 "on-off" approach.

AutoMAID has the ability to spin down drives to lower energy consumption between data references. Whereas old MAID technology suffered from the inability to quickly recall data when needed, AutoMAID delivers sub second response times to the first I/O request and remains at full power for every subsequent I/O request until enough idle time has elapsed to activate AutoMAID energy savings once again. AutoMAID disks have four power management states:

- AutoMAID 0 - the disks are fully powered and run at peak performance without restrictions.
- AutoMAID 1 - parks the heads and powers them down by policy or command. However, the actual drive continues to spin at full speed. If a request for an I/O is received, the heads simply wake up and load data with sub-second response times and remain at full speed for every subsequent I/O request. The overall energy savings in level 1 is approximately 20%.
- AutoMAID 2 - parks the heads and slows the rotation speed of the disk from 7,200rpm to 4,000rpm. If a request for an I/O is received, the drive cycles up to full speed and loads the heads resulting in up to 15-second response times. The disk remains at full speed for every subsequent I/O request. The overall energy savings in level 2 is approximately 40%.
- AutoMAID 3 - parks the heads and turns the drive motor off. If an I/O request is received, the drive spins up and loads the heads resulting in up to 30-second response times. The disk remains at full speed for every subsequent I/O request. The overall energy savings in level 3 is approximately 60%.

	Ordinary Disk Array	Nexsan SATABeast	Difference
No AutoMAID Annual kWs	770,179	479,297	60.69%
Using AutoMAID 1&2 Annual kWhs	n/a	132,777	480.05%
Annual Cost @ $.12 kW (compares ordinary disk with Nexsan's AutoMAID 1&2)	$92,421	$15,933	480.05%

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With an estimated 40% of all data center power consumption going to storage, saving up to 60% on energy costs with AutoMAID has significant benefits. With AutoMAID, the key consideration and benefit is the ability to use high density storage with power efficient technology without impacting storage performance. The result is capacity growth without facility expansion while delivering overall cost reduction on a platform that doesn't compromise storage performance. It is the ultimate in storage efficiency — power, space and cost.

AUTOMAID IN ACTION

California Institute of Technology (Caltech) & NASA's JPL

Caltech hosts around 2.5PB of astronomy imaging data for the Jet Propulsion Laboratory for NASA, of which about 99% is on Nexsan's SATABeast according to Eugene Hacopians, a senior systems engineer at Caltech.

To cut energy costs on some 3,000 spinning disks, Hacopians noted, "...Caltech uses AutoMAID level one and two to maximize the performance versus savings tradeoffs."

Caltech uses their SATABeasts on AutoMAID level one and has set the policy to retract heads and power them down after five minutes of no activity. By doing so, Caltech saves 20% on their energy costs. Caltech also has a policy that after 2 hours of non-activity, AutoMAID level 2 is activated. With AutoMAID-2, in addition to the heads being retracted, the drive slows the rotation speed of the platters from 7,200 RPMs to 4,000 RPMs. This contributes to a 40% savings in energy. Combining the inherently energy efficient SATABeast with the savings of AutoMAID provides impressive energy consumption and cost savings[2].

[2] Source: Wikibon Peer Incite Webcast entitled, "Petabyte Explosion: How Caltech Manages to Manage Billions of Files

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AN IRONIC SUCCESS STORY

As much as Nexsan has helped organizations world-wide to cut costs and mitigate the power/density paradox, never did Nexsan foresee the irony that they might become the subject of their own success story.

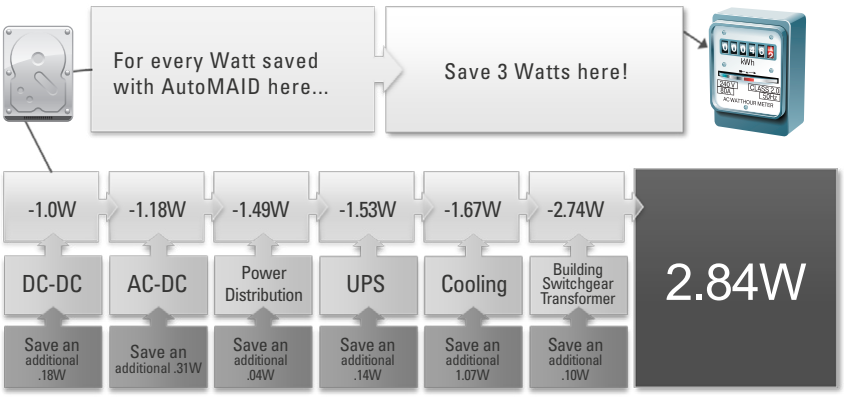
Each year, Nexsan holds a partner conference for North American partners in Las Vegas where some 6.6 Gigawatts of power is available from 8 power generating facilities in the region — not the least of which is the mighty Hoover Dam.

In 2009, Nexsan planned an experience room to demon- strate several storage systems resulting in 367TBs of capacity along with 14 servers.

The conference hotel delivered the ominous news that the 8.7kWs necessary to power all of the equipment was available, but the 29,000 BTUs of cooling necessary to remove the heat was not. The result was a power/density paradox and a storage conference without storage systems!

Based on the amount of power used at full load, the hotel required a dramatic reduction in the equipment used. Rather than accept the reduction in equipment, Nexsan looked into the benefit of its own power reduction technology. By leveraging AutoMAID level 3, total power consumption was reduced from 8.7kWs to 3.8kWs which ultimately reduced cooling from 29K BTUs to 13K BTUs.

With a 56% reduction in power and a 56% reduction in cooling, the conference hotel had no problem handling the power and cooling requirements.



SOLUTION: AutoMAID and the Cascade Effect

CONCLUSION

Whereas most might view high density storage as a way to free up facility space, there is a power/density paradox that must be addressed. Whereas other high density storage systems create a power/density paradox, AutoMAID is the clear solution to that risk.

By combining energy savings with high density, IT professionals get what they need most — more capacity while reducing floor space and costs. And with MAID 2.0, those cost savings can finally be achieved without reduction in storage performance.

In a new world of data expansion and economic contraction, storage efficiency is king. Nexsan's highly efficient storage line of products leads the industry in power efficiency, space efficiency and cost efficiency to help you mitigate the risks of new challenges while significantly lowering your total cost of ownership.

For more information on how a Nexsan product can meet your growing data needs while reducing costs, please visit **www.nexsan.com** or call **1.866.NEXSAN**.

ABOUT NEXSAN

Nexsan® is a leading provider of innovative data storage systems with over 10,000 customers worldwide. Nexsan's pioneering hybrid storage systems combine solid-state technologies, spinning disk storage and advanced software to deliver radical new levels of performance and capacity at lower cost. The company's advanced technologies enable organizations to optimize traditional, virtual and cloud computing environments for increased productivity and business agility. With more than 28,000 systems deployed since 1999, the company delivers its data storage systems through a worldwide network of solution providers, VARs and system integrators. Nexsan is based in Thousand Oaks, Calif. For more information, visit **www.nexsan.com.**

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