



NETAPP WHITE PAPER

REDUCING DATA CENTER POWER CONSUMPTION THROUGH EFFICIENT STORAGE

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AN EIGHT-POINT PLAN FOR FIGHTING POWER CONSUMPTION

The NetApp approach to fighting rapidly growing power consumption is simple: subtract machines and disks from the power equation by using storage more efficiently. This strategy has many corollary benefits: it lowers complexity, lowers people costs, lowers support and service costs, and improves network efficiency and performance. The NetApp eight-point strategy for reducing storage power consumption makes use of today's technology to halt growing power consumption at its source.

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1 HITTING THE LIMITS

Exponential data growth is a reality for most data centers. *IDC Worldwide Disk Storage Systems Forecast 2006–2010* predicts that worldwide data will grow at a compound annual growth rate of 50.6% through the decade. This growth is a huge concern for IT managers. Until recently, continuous improvements in price-performance and \$/GB have made it both easy and affordable to solve storage concerns simply by adding more disks to existing storage systems. However, IT executives are discovering that there are limits to that easy growth: floor space, weight loads, rack space, network drops, power connections, cooling infrastructure, and even power itself are finite resources. Hitting any one of these limits significantly jeopardizes the ability of IT to meet the demands of business.

A WATT IN MEANS A WATT OUT

“We’re at 100% of power capacity today. For every new watt I bring in, I’ve got to figure out how to take one out.”

IT exec

Global Financial Services Company

New York City

HITTING THE FAN

Cooling is inextricably linked to power consumption. Every watt of power that enters the data center generates heat that must be removed from the environment—and to do so takes more power. As the heat increases, systems become more unstable and component failure rates rise. The cost of power to cool a system often is as much as powering the system itself.

But cost is not the only issue. In some cases, rack densities generate more heat than existing cooling infrastructures can handle. Where there is no room for additional cooling infrastructure, there is no room for growth.

POWER HUNGRY

Storage companies have been steadily increasing storage density, inadvertently driving up data center power demands and cooling concerns. In the next 18 months, increases in average storage rack density are expected to drive average power consumption from 2kW per rack to 30kW per rack—and that’s only half the story. For each watt used by the server or storage, A/C, power supplies, and other related equipment together require nearly 1.5 times that amount.

PUTTING BUSINESS AT RISK

The combined effect of recent increases in the price of energy and the adoption of denser computing and storage architectures has driven energy costs for some data centers to 30% of their total operating budgets. If left unchecked, the cost to power IT equipment could exceed its acquisition cost in a matter of years. Without deliberate action, high energy costs will cripple an IT department’s ability to grow and change in support of the demands of the business.

THE GREENING OF STORAGE

Environmental issues are gaining serious commercial momentum and, fueled by the growing number of local and global green initiatives, they are rising ever more insistently up the corporate agenda. More power-efficient storage solutions provide for business growth while saving power. Every watt of energy saved in the data center is a watt that is removed from an organization’s carbon footprint and the global warming equation.

2 THE NETAPP EIGHT-POINT PLAN FOR FIGHTING POWER CONSUMPTION

The NetApp approach to fighting rapidly growing power consumption is simple: subtract machines and disks from the power equation by using storage more efficiently. This strategy has many corollary benefits: it lowers complexity, lowers people costs, lowers support and service costs, and improves network efficiency and performance. The NetApp eight-point strategy for reducing storage power consumption makes use of today's technology to halt growing power consumption at its source.

1. CONSOLIDATE SERVERS AND STORAGE

Servers alone can consume 50% of the power coming into the data center. The first step in reducing power consumption is to attack the power problem where you can reap the most gains—consolidating and virtualizing application servers.

Storage is the next largest consumer of energy after servers and cooling systems. In environments with lots of direct-attached storage, as much as 27% of the power going into the data center is being consumed by storage¹.

The dramatic growth of Windows® data has led to a proliferation of Windows file servers and direct-attached storage units. Not only are these server and storage assets poorly utilized, they are also difficult to manage, resulting in extremely high overhead costs.

Data centers that use lots of direct-attached storage can see significant power savings by implementing a storage network. Removing file servers immediately increases the total watts available in the data center. File server consolidation also increases your ability to scale in a power-efficient manner; instead of adding servers, you can scale by adding disks. Adding disks to an existing system has the additional advantage of allowing you to amortize operational costs over more drives.

In addition to reducing power loads, consolidating Windows data onto a highly available NetApp storage system dramatically simplifies the file-serving environment and creates valuable management, performance, and cost efficiencies.

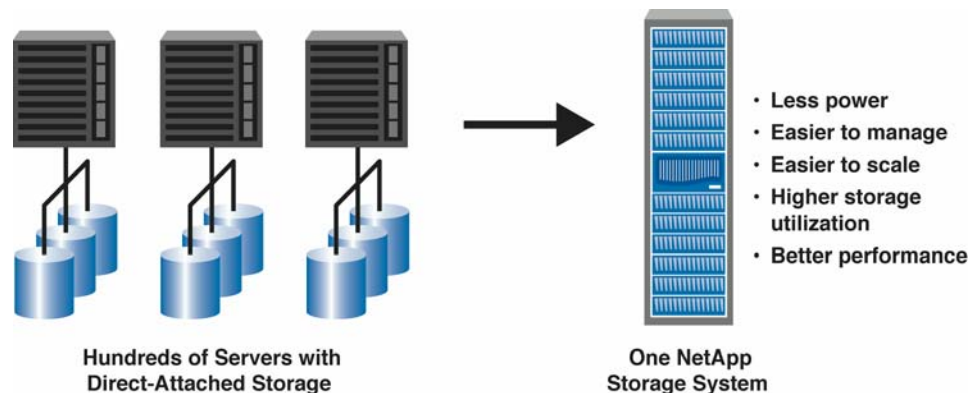


Figure 1) Storage Consolidation

2. USE HIGHER-CAPACITY DRIVES

Using higher-capacity drives can significantly alter the storage power equation. Typical SATA disk drives consume about 50% less power per TB than equivalent-capacity Fibre Channel drives. They also offer the highest available storage density per drive, further helping minimize power consumption. NetApp disk resiliency and data protection technologies have made SATA drives an increasingly viable alternative for many enterprise applications. Many companies are finding that SATA performance is good enough to support many more applications than they originally thought possible.

¹ "Power, Heat and Sledgehammer." Maximum Throughput, Inc. April 2002.

Dramatic Benefits of Higher-Capacity Drives

For example, if you replace 11 older systems with one modern, high-capacity system, you can increase capacity by 16% while consuming 81% less power and 93% less space than was required for the old systems. With this arithmetic, it doesn't take very long to achieve a significant return on your investment.

Table 1) Potential Savings from Higher-Capacity Drives.

	Old Systems	New Systems	Improvement
# of systems	11 Old Systems: 4 F880 3 F810 2 F820 1 F825 1 F840	1 FAS 3020 with 3 disk shelves	11:1
Power* (kW HRs) * Does not include power for cooling.	113,651	20,915	81% Decrease
Space (Cubic Feet)	63.0	4.3	93% Decrease
Capacity (GBs)	9,776	14,000	16% Increase

3. PROTECT AGAINST DISK FAILURES WITH FEWER DRIVES

When SATA drives are utilized for data storage, larger amounts of data are stored per drive when compared to smaller Fibre Channel primary disk drives. To insure that data reliability is not compromised, Network Appliance provides dual-parity RAID-DP™. When compared to RAID 10, data mirroring, RAID-DP offers 70% greater storage utilization². In addition, RAID-DP provides superior fault tolerance by recovering from the simultaneous failure of two drives, unlike other RAID levels that can tolerate only a single drive failure.

4. MIGRATE DATA TO MORE EFFICIENT STORAGE

To ensure the most efficient use of your storage resources, minimize the use of primary storage by migrating data to more efficient secondary storage where appropriate. The Network Appliance™ IS1200 information server automates migration of infrequently accessed data from primary storage to the more storage-efficient secondary storage of NearStore®.

5. INCREASE UTILIZATION

According to industry estimates, storage utilization rates average 25–40%. That means 60–75% of all storage capacity that is being powered goes unused. Not only is such a low utilization rate a waste of storage, it is a waste of power.

In most systems, storage administrators allocate and dedicate storage space to a particular volume or LUN at the time of its creation. This creates two significant administrative challenges: (1) once a volume is created on physical storage, its size is extremely difficult to change, and (2) once storage is allocated to a particular application, it is not available for another use. Since it is difficult to predict actual storage requirements, application administrators typically request much more space than they think they will need to protect themselves should they need more storage down the line. This common practice guarantees over-allocation. NetApp Flex Vol® technology enables thin provisioning, a technique that lets storage administrators quickly and dynamically resize flexible volumes, eliminating the need for over-allocation.

With NetApp FlexVol technology, utilization rates of 60% are the average³. By making all disks available to all datasets through a common pool of storage, both performance and capacity utilization are maximized. When disk space is no longer needed by a particular application, it can be returned to the free pool and made available to other applications as their storage needs grow. Increasing utilization 50% results in a corresponding reduction in the number of disks that are required.

² Network Appliance testing

³ Customer reported utilization data

6. BACKUP: DO MORE WITH LESS

NetApp Snapshot™ copies provide two significant efficiency advantages, making them unique in the industry. First, because only changes to the data are saved, Snapshot copies consume minimal storage space. Second, these copies also let you leverage a single copy of your data for multiple uses, reducing your reliance on special-purpose storage systems. With other vendors, backup, compliance, and disaster recovery may each require a dedicated system, putting huge additional demands on your storage infrastructure. With NetApp technology, a single copy of your data can be used for multiple uses so your backup system can be used for compliance *and* asynchronous disaster recovery. Reducing the number of special-purpose storage systems you use can radically reduce your power requirements.

Countless copies of data files consume vast amounts of storage. Deduplication technology can help you free up this capacity. Network Appliance NearStore includes A-SIS deduplication, a technology that eliminates duplicate data regardless of the amount of redundant data stored on the primary disk array. A-SIS deduplication reduces the need to continuously add more storage capacity for secondary data storage.

7. ELIMINATE STORAGE OVERHEAD FOR TESTING AND DEVELOPMENT

Testing and development require numerous copies of your data, putting huge additional demands on your storage infrastructure.

NetApp FlexClone™ technology lets you make multiple, instant virtual copies of your data with virtually no storage overhead. As with NetApp Snapshot technology, only data that changes between a parent volume and a clone is stored. Data volumes and datasets can be instantly cloned without requiring additional storage space at the time of creation. This capability makes it possible to allocate many individual, writable copies of data in a fraction of the space that would typically be required.

Additionally, with NetApp FlexClone technology, activities that once had to be performed sequentially—due to previous storage limitations—can now be done simultaneously, increasing the speed of testing and deploying new applications.

8. MEASURE YOUR POWER EFFICIENCY

Our last step is something that we encourage you to do on an ongoing basis to get a handle on your storage power consumption: measure the power efficiency of your storage systems.

One common measure of power consumption is watts per terabyte (W/TB). This measure can be misleading, however, when comparing machines that operate at different efficiency levels. A better way of evaluating storage power consumption is to measure watts per usable terabyte. This can be expressed with the following formula:

$$\frac{\text{Watts to power system}}{\text{Total system TB} \times \% \text{ System Utilization}} = \text{Watts per Usable TB}$$

To calculate the power efficiency of a particular storage system, divide the total watts per system by the total number of TBs in that system times the system utilization. System utilization is equal to the percent of your disks that are actually available for use. The figure below shows how this calculation reveals important differences between seemingly similar systems.

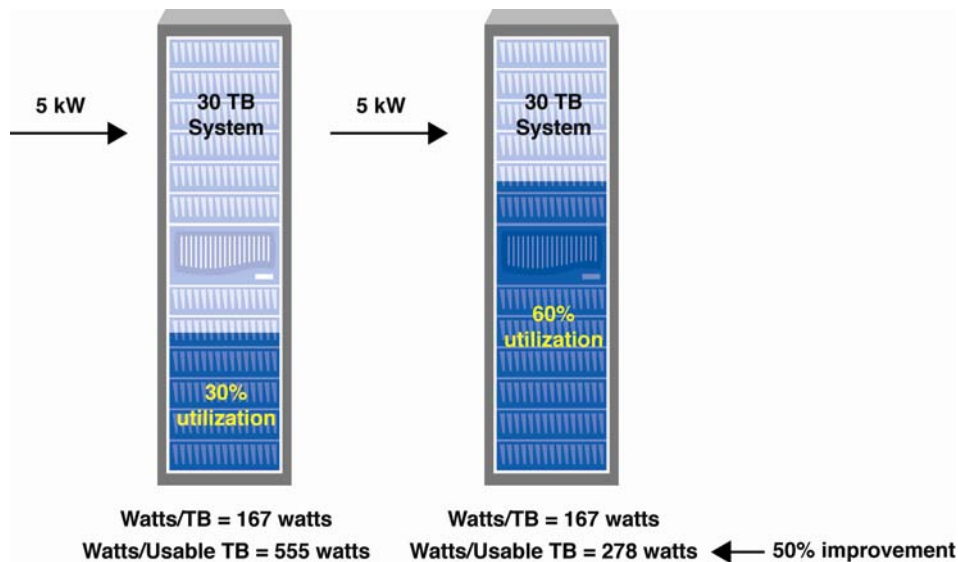


Figure 2) NetApp Storage Power Savings

3 LOOKING AHEAD

We believe that following these steps will return enough power and headroom for growth to your data center and protect the ability of your storage infrastructure to support the demands of your business for many years to come. In the meantime, however, we will continue to look for ways to improve the efficiency of storage systems at every level.

Here are some of the power-saving technologies that are being investigated by our industry: larger SATA drives, in-line hardware data compression, file deduplication, flash memory, improved power supply efficiency, energy-efficient CPUs, DC power, and intelligent control of the speed of individual drives in response to demand. Just as today there is no single solution for reducing storage power consumption, future reductions will be attained through a combination of efforts and by attacking the issue on all fronts.

4 THE NETAPP COMMITMENT

Runaway power consumption in the data center is an issue that storage vendors simply must address. At NetApp, we take this responsibility seriously and we will continue to devote our resources and talents to the development of data management and storage technologies that will help you overcome the challenges that power consumption realities pose to your success.

In our ongoing efforts to simplify data management, we will continue to reduce infrastructure complexity and cost and provide you the flexibility you need to stay competitive and meet your business challenges.

By focusing on data management and storage efficiency, not only can your organization realize substantial cost savings, you can do so while contributing to the health of our planet.

FURTHER READING

For more information, please check out these other papers at www.netapp.com:

- “NearStore Storage Efficiency,” TR-3539
- “Maximizing Storage Utilization” white paper, WP-7003-1106



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