

COMPELLENT'S GREEN ADVANTAGE

Extending the Life of Data Centers with an Energy-Efficient SAN

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EXECUTIVE SUMMARY

As IT departments work to keep pace with business growth, the cost of scaling and supporting a growing data center can be substantial. These costs extend far beyond the price of hardware and software. To meet rapidly changing business needs, IT departments need to do more than add equipment or expand functionality. Data center expansion requires planning for adequate floor space, power distribution, backup generators, cooling requirements and more. And that's no easy feat. According to analyst estimates, up to 50 percent of data centers will have insufficient power and cooling capacity by 2008.

This leaves many companies searching for more efficient solutions that reduce both the total cost of ownership and the environmental impact of running their data centers. By deploying a Compellent Storage Center™ SAN with Thin Provisioning and Automated Tiered Storage software, companies can maximize the efficiency of storage and consequently minimize the costs of power, cooling and real estate; decrease equipment expenditures; and produce a “greener” data center. At the same time, Compellent's storage virtualization helps companies create a virtualized data center with a significantly smaller footprint and enhanced IT flexibility.

Compellent's feature-rich SAN produces tangible “green” results: Compellent believes companies using a combination of Storage Center's unique energy-saving features can cut power and cooling costs up to 93 percent when compared to traditional storage solutions.

INTRODUCTION

For many companies, rapid data center growth will soon exceed their facilities' power, cooling and real estate capacity. A recent analyst report found that insufficient power and cooling are the #1 concern for data centers. To accommodate continued business growth, companies facing this problem will need to make major expenditures for data center improvements. Yet few organizations will likely want to invest heavily in improvement of leased facilities that house a corporate data center.

Companies that fail to address data center growth early could face serious consequences for their business. At the very least, organizations could be stuck with unplanned, unbudgeted expenditures. More importantly, the need to make major data center modifications could also prevent IT from taking on new, innovative projects and ultimately restrain corporate growth. Many companies will be looking for ways to extend the life of their data center with energy-efficient equipment.

Compellent's Green Advantage

Compellent's SAN can help companies enhance the efficiency of data storage and overcome the challenges created by rapid data center growth. With innovative technologies like Automated Tiered Storage, Thin Provisioning and Advanced Virtualization, Compellent can help organizations create a “greener” data center with a positive impact on both the environment and the bottom line. With a Compellent SAN, organizations can better utilize resources, decrease the need for equipment purchases and consequently minimize the costs of powering, cooling and housing equipment. As a result, Compellent believes companies can significantly reduce total data center costs while also reducing the environmental impact of running their data centers.

In fact, Compellent believes a fully-featured Storage Center SAN can save companies up to 93 percent of the power consumption and power costs of storage when compared to traditional storage solutions. According to the U.S. Department of Energy, commercial electrical costs within the United States as of June 2007 ranged from \$.0567/kWh to \$.2033/kWh. As shown in Figure 1, a typical 20 TB storage system configured with RAID 10 and utilized at 50 percent might require 274 enterprise-class disk drives. If a company selects 10,000 RPM 146 GB drives, those drives could consume 6,020 watts per year (52,740 kWh). Assuming the company pays \$.10 per kWh, powering the drives would cost \$26,370 over a typical five-year lifespan.

By comparison, a Compellent SAN with Thin Provisioning and Automated Tiered Storage might require only 14 of the same enterprise-class disks configured at RAID 10 and seven 7,200 RPM 750 GB SATA storage disks, configured at RAID 5. This total collection of disk drives would consume only 429 watts of power—or 3,758 kWh—for a total cost of only \$1,879 over five years, based on \$.10 per kWh – a substantial savings.

This paper will discuss the green advantages delivered by Compellent’s Thin Provisioning, Automated Tiered Storage and Advanced Virtualization technology.

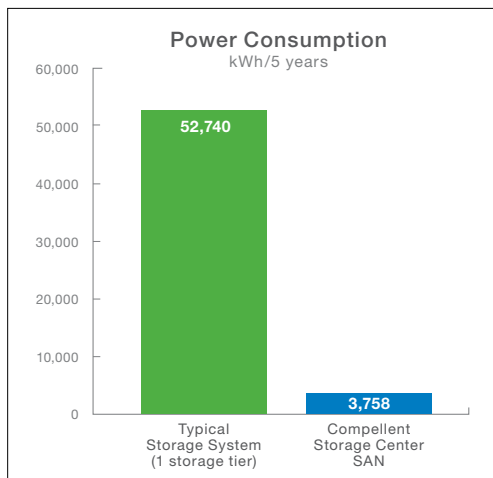


Figure 1. Compellent can reduce power consumption up to 93 percent. Compellent SAN configured with two storage tiers with Dynamic Capacity, Data Progression and SATA drives for lowest tier.

Thin Provisioning Delivers Ultra-Efficient Storage Utilization

Thin Provisioning is an essential building block for a cost-effective, green data center. Compellent’s Thin Provisioning software, called Dynamic Capacity™, can help significantly increase storage utilization, which lowers the number of overall drives required in a system. Dynamic Capacity allocates storage only when data is written to disk instead of pre-allocating storage capacity to volumes before that capacity is used. As a result, administrators no longer have to overprovision capacity in anticipation of future growth. This allows organizations to purchase, power and cool significantly less storage than they would need in a legacy storage environment.

In a typical storage environment, a company might purchase 20 TB of storage to provide

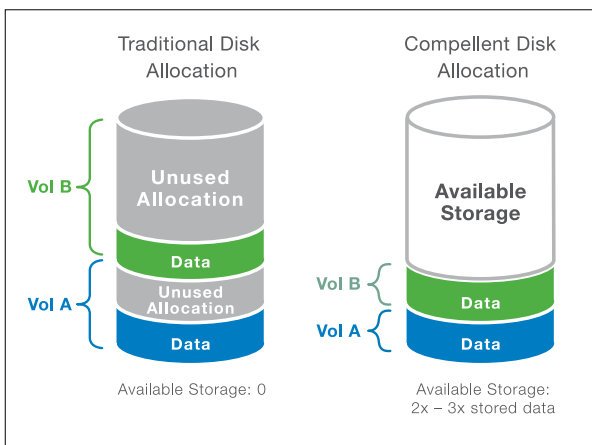


Figure 2. Compellent Dynamic Capacity eliminates the need to preallocate disk space.

1 TB of storage to each of 10 application servers (assuming RAID 10 volumes). With a Compellent SAN, administrators can create 10 virtual storage volumes of any size by using just 1 TB of physical storage. Each application still retains access to the full amount of storage it needs. If and when the enterprise actually requires more storage capacity, administrators can simply purchase that capacity and install it while the system is up and running.

COMPELLENT MINIMIZES ENVIRONMENTAL IMPACT OF ITS OWN BUILDING

Experiencing rapid corporate growth, Compellent needed a larger building to house its global headquarters in Eden Prairie, Minnesota. After finding a new property in 2006, the company capitalized on the opportunity to implement a wide range of “green” initiatives to reduce the costs of operating the new facility while also reducing its environmental impact. For example, the company used building materials from recycled products, enhanced the use of natural light for employee spaces to decrease the need for artificial lighting and deployed energy-efficient HVAC equipment.

Using Compellent’s technology has made an important contribution to cost savings and sustainability of the building. As a result of the company’s extensive efforts, the new building is Minnesota’s first certified “green” facility. The use of green policies reflects the corporate goal of helping customers reduce costs for acquiring, powering, cooling and managing storage. At the same time, the building has helped Compellent itself save money: The new building uses 12 percent less energy than the previous facility and just won the Green Advantage Environmental Certification Award.

Green Results: Compellent Decreases Disk Drive Counts by 75 Percent

The green advantages of Compellent Dynamic Capacity are clear: By purchasing and operating fewer disk drives, companies can significantly reduce power, cooling and real estate costs. In fact, using Dynamic Capacity alone, without any other energy-saving features, can help companies reduce disk drive counts on just a single tier of storage by 75 percent.

According to independent consulting firms, storage utilization rates for traditional storage systems have been estimated as low as 25 percent. A typical storage system—without Thin Provisioning—might require 274 146-GB disk drives to provide 10 TB of storage capacity (assuming 25 percent storage utilization). By contrast, a Compellent SAN using Thin Provisioning with the same type of drives would require only 69 disks to provide the same usable storage capacity.

Automated Tiered Storage Reduces the Impact of Inactive Data

Selecting the right disk drives for a storage system is essential for reducing both the costs and environmental impact of the data center. Many businesses simply deploy the fastest, and consequentially power-hungry, Fibre Channel disk drives in a single tier of storage. But creating a multi tiered system that employs both fast drives along with more economical, energy-efficient storage significantly decreases costs and minimizes environmental impact.

Selecting more economical disk drives for a second or third tier of storage cuts both hardware acquisition costs and power consumption. Compared with the 15,000 RPM drives often used for tier 1 storage, 10,000 RPM drives require less power with only a minor trade-off in performance, and are always suitable for tier 2 storage. In most cases, Compellent's customers can even use 10,000 RPM drives for tier 1 storage while maintaining excellent performance levels.

Most of the data within a typical volume is considered to be inactive. Industry analysts report that up to 80 percent of user data falls into this inactive category. Inactive data—from old e-mails to database tables that haven't been accessed recently—does not need to consume space on enterprise-class disk drives. Using Serial ATA (SATA) drives to store infrequently used data on a third storage tier can further reduce both acquisition costs and power consumption. SATA drives require significantly less energy than Fibre Channel drives. As an example, with 15,000 RPM, 300GB Fibre Channel drives, the total wattage for drives and enclosures would be 177. Compare that to 7,200 RPM, 1 TB SATA drives which require a total wattage for drives and enclosures of 38. And because SATA drives offer significantly greater capacity per drive than Fibre Channel drives, companies can use substantially fewer drives to reach the same storage capacity, thereby further reducing overall power consumption. Inclusion of a third tier with high-capacity 7200 RPM SATA drives enables companies to increase storage capacity while simultaneously decreasing drive, drive enclosure and power consumption costs.

Despite the clear benefits of deploying a multi-tier storage environment, managing such a system can be time-consuming and labor-intensive. Even companies that have multiple tiers may lack the ability to automatically migrate data to the appropriate tier. In many cases, administrators need to classify data and then manually transfer data between tiers. The alternative is to deploy an expensive and complicated information lifecycle management application.

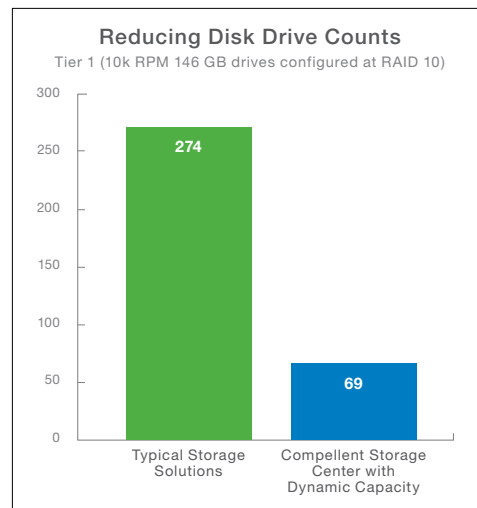


Figure 3. Dynamic Capacity can reduce tier 1 disk drive counts by up to 75 percent.

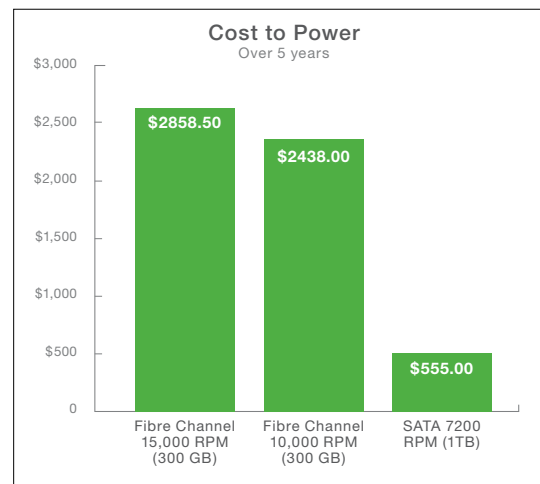


Figure 4. Storing inactive data on SATA drives can cut power consumption.

Compellent's Automated Tiered Storage software, called Data Progression™, can drastically reduce the complexity and costs of managing multi-tiered storage. Data Progression distributes data across a combination of disks by continually tracking data usage and automatically moving data between storage tiers based on predefined rules. Compellent's Dynamic Block Architecture records and tracks specific information about blocks of data, including the time written, time accessed, frequency of access, associated volume, and RAID level. Data Progression then uses all of this metadata to automatically migrate blocks of data (instead of entire files) to the preferred storage tier based on usage and performance. While frequently used data remains on high-performance storage, less frequently used data can reside on more economical storage, including SATA.

One of the challenges for many enterprises of incorporating SATA drives comes when determining the right amount of SATA to use. Compellent's block-level intelligence automatically determines inactive data and migrates it to SATA, eliminating the challenge of appropriate sizing. Compellent's use of SATA technology also complies with the drive manufacturers lighter duty cycle (desktop duty cycle) recommendations by recording inactive data on these devices automatically. When used according to the manufacturer's recommendation, the MTBF reliability of SATA drives almost reaches the reliability of enterprise devices. Enterprise level MTBF reliability is typically 1,400,000 hours while SATA (used at a light duty cycle) closely follows at 1,200,000 hours.

Adding a second or third tier of storage gives companies the ability to store read-only data such as snapshots on lower cost disk with a lower penalty RAID setting. With Compellent's Data Instant Replay software, when a snapshot or Replay is taken, the storage within that volume becomes read-only, meaning it does not need to be written again. Consequently, administrators can use a RAID 5 configuration for those Replays, which requires fewer disk drives and thereby less power and cooling than the RAID 10 configuration for active, read-write data. Utilizing Data Instant Replay in addition to Data Progression significantly enhances overall system efficiency.

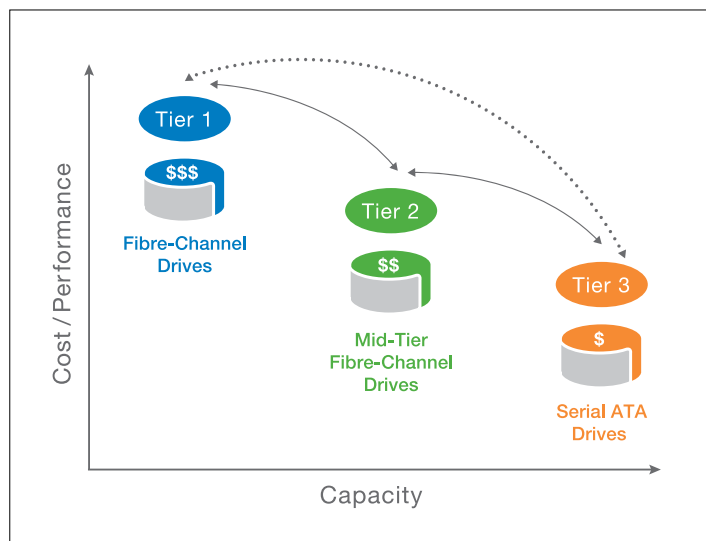


Figure 5. Compellent's Data Progression™ automates tiered storage.

THE OHIO STATE UNIVERSITY FISHER COLLEGE OF BUSINESS

A top 25 business school, The OSU must compete with IT services provided by leading business schools and free online services. A combination of Automated Tiered Storage and Thin Provisioning helped The OSU improve utilization and reduce disk expenditures by 50 percent.

“With Compellent's Thin Provisioning, we purchase only what we need when we need it. And Data Progression automatically moves old or infrequently accessed data to cheaper storage. We even realize cost savings within a single tier by moving from RAID 5-5 to RAID 5-9.”

CURTIS SMITH
Systems and Storage Administrator
The Ohio State University
Fisher College of Business

Green Results: Using High-Capacity SATA Drives in a Secondary Storage Tier Reduces Cost and CO₂ Emissions

Automated Tiered Storage provides important green advantages. By automatically moving infrequently used data to energy-efficient, higher-capacity SATA storage, organizations can dramatically reduce the number of power-hungry drives and thereby reduce the cost of powering their storage system. In addition, companies can reduce the amount of CO₂ emissions produced by their data centers.

While an enterprise-class 15,000 RPM 146 GB drive with a RAID 10 configuration might produce 32 tons of CO₂ emissions (includes data center overhead for cooling, humidification, UPS, power distribution etc.) over a typical five-year lifespan, a 7,200 RPM 1 TB drive with a RAID 5 configuration would produce just more than 2 tons over the same time period. Multiplying those reductions by the full number of SATA storage drives can produce tremendous CO₂ reductions especially considering that 80 percent of user data is typically inactive and ideally suited to SATA drive technology.

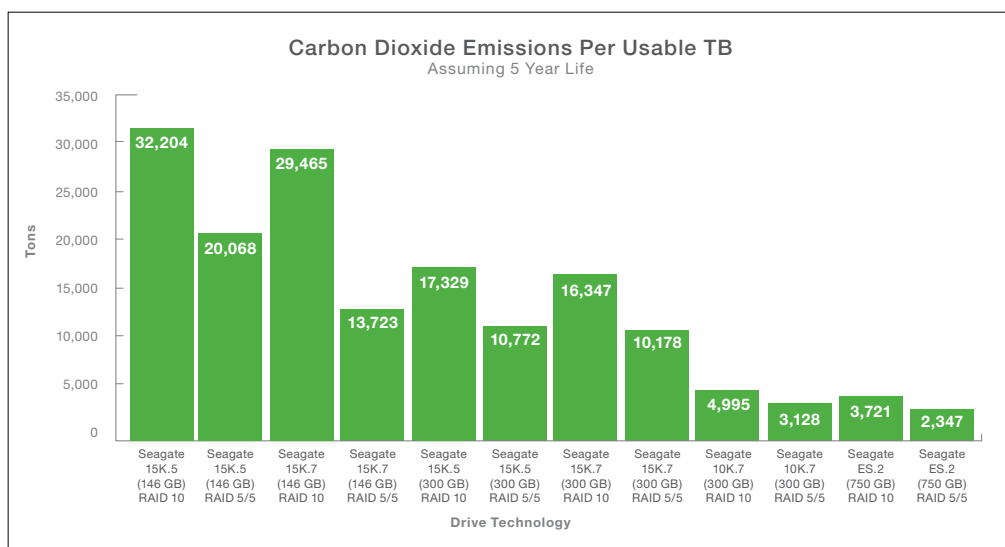


Figure 6. High-capacity SATA drives reduce data center CO₂ emissions over 90 percent.

The Optimal Storage Platform for Data Center Virtualization

By creating a virtualized data center that uses a Compellent SAN in conjunction with virtualized servers, organizations can create an extremely cost-effective and efficient data center.

Virtualized data centers help companies increase the utilization of resources, decrease the need for new equipment and minimize the costs associated with powering, cooling and housing equipment. With Compellent's ultra-efficient disk utilization, companies can delay or permanently defer huge data center upgrade costs related to backup generation, UPS, cooling, humidification, power distribution and footprint expansion.

Increasingly, organizations are realizing the potential benefits of server virtualization. By virtualizing servers using VMware®, Virtual Iron®, XenSource, Microsoft or solutions from other vendors, IT administrators can consolidate distinct applications onto fewer servers. Instead of running five applications on five separate servers, administrators can use virtualization software to run all five applications on the same physical server. Companies can reduce the costs of purchasing and maintaining production servers while improving resource utilization.

GM2 LOGISTICS

UK-based logistics and warehousing company gm2 Logistics delivers about 740 tons of paper products to more than 1350 customers every day. By virtualizing their environment, and booting blade servers from the Compellent SAN, gm2 Logistics has reduced its data center footprint by a third.

“Not only does booting from SAN bring our servers online instantly—we have also been able to eliminate a lot of hardware from our environment entirely. That means we’re consuming less power, which is great for both the environment and our pocketbook.”

JOHN BOYD
IT Manager
gm2 Logistics

To realize the full benefits of server virtualization, companies must virtualize storage as well. Employing a SAN, which enables multiple servers to share centralized storage resources, is the first step toward a virtualized data center. Still, traditional SAN solutions fail to deliver the potential of truly virtualized storage. Administrators using these traditional SANs are still forced to preallocate storage space to accommodate applications' performance requirements and a high level of redundancy. Consequently, many enterprises that choose SANs still need to purchase, power and cool more capacity than they actually use. In addition, typical SANs that use multi-tiered storage require administrators to manage the potentially complex process of data migration.

Compellent's Advanced Virtualization overcomes the limitations of traditional SANs to deliver true storage virtualization. Compellent's Advanced Virtualization technology merges all the disks into a single pool of storage, allowing any volume to use all disk drives simultaneously to access data. As a result, Compellent enables administrators to truly separate applications from physical storage devices and can deliver equivalent performance with fewer drives. IT administrators are free to change physical hardware—adding capacity or exchanging slow disks for fast ones—without adversely affecting application performance. Because applications are not allocated to specific storage devices, they can more effectively share storage, reducing the amount of capacity needed.

By helping to create a virtualized data center, Compellent provides important green advantages. The need for less storage capacity means fewer disk drives, a smaller data center footprint and lower power consumption. At the same time, the ability to use more energy-efficient SATA drives as part of a virtualized storage pool can help significantly reduce both power costs and CO2 emissions.

Green Results: Compellent Decreases Storage System Footprint by 92 Percent

Using fewer disks can also help reduce real estate costs by nearly the same ratio. By using a total of 21 disks instead of 274, a company can reduce its total storage system footprint by 92 percent. Beyond saving the potential cost of leasing space, a company using a Compellent SAN will have much greater physical space for future growth.

Compellent's Boot from SAN Solution Significantly Reduces Server Costs and Data Center Footprint

Compellent can further shrink data center power requirements by offering an integrated, automated Boot from SAN solution. By maintaining an operating system (OS) boot volume on a Compellent SAN rather than on the server, administrators can eliminate the need for server-attached disks. Without the need for internal server disk capacity, IT administrators can select diskless blade servers or other compact, energy-efficient server designs to save power, cooling, real estate and cabling costs. The total savings from going diskless could easily reach \$2,000 per server.

Compellent Server Instant Replay™, a complete Boot from SAN solution, can then help reduce the space required to store multiple copies of the same OS boot volume on the SAN. For example, storing independent server images for each distinct server can quickly consume significant quantities of storage space. But with Server Instant Replay, administrators can create a space-efficient Replay of an entire OS boot volume. The Replay contains only a pointer to the original boot volume along with the configuration information that is unique to the new server, such as its name and IP address. As a result, each Replay consumes only a few hundred megabytes of storage capacity—just a small fraction of the entire boot volume. This process can be used easily for 3 servers or over 300, allowing companies to purchase less storage capacity and minimize costs.

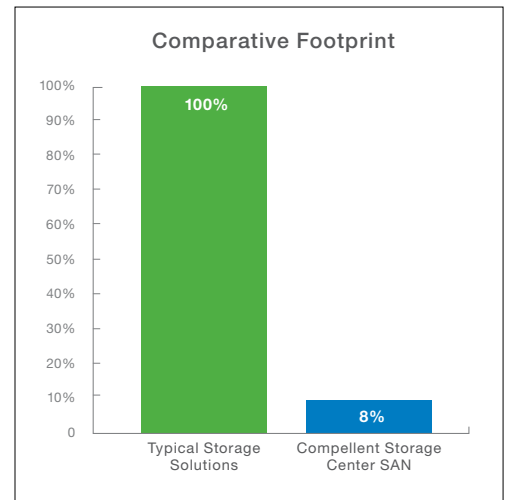


Figure 7. Compellent Decreases Footprint by 92 Percent. Compellent Storage Center SAN: two storage tiers with dynamic capacity, data progression, advanced virtualization and SATA drives for secondary tier.

EXTENDING THE LIFE OF THE DATA CENTER

The demand for deploying new software applications and increasing the storage capacity of data centers is unlikely to ebb any time soon. Companies need ways to accommodate that growth to avoid maxing out the power, cooling and real estate capacity of current facilities. Compellent can help companies avoid costly investments in IT facilities by extending the life of their data center.

By employing Automated Tiered Storage and Thin Provisioning software, Compellent can improve storage utilization, decrease the need for excessive storage capacity and minimize the power consumption of storage. Compellent can also help companies create a virtualized data center that requires fewer resources and increases IT flexibility.

While helping to curb unrestrained data center growth, Compellent also provides a modular hardware architecture that enables organizations to scale storage easily, without downtime, as a business grows. Organizations can add capacity, mixing and matching drives and drive enclosures, to match demand. With Compellent, companies can grow in a controlled fashion, without having to purchase unnecessary storage capacity up front.

This “design for persistence” approach offers Compellent customers unprecedented investment protection. Customers who choose Compellent won’t have to discard hardware or software investments to take their installed system to the next level or to add functionality to their system. Typical storage manufacturers exercise a “design for obsolescence” mentality, producing systems that impose an unnecessary environmental impact due to their relatively short lifespan.

By providing ways to reduce the overall number of disk drives required and by incorporating more energy-efficient, high-capacity drives into a multitiered storage system, Compellent presents numerous green advantages. Compellent reduces not only power consumption but also greenhouse emissions. Choosing Compellent’s SAN helps companies satisfy today’s and tomorrow’s data center needs while minimizing the environmental impact of doing business.

COMPELLENT

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