Lab White Paper

Dell Storage SC4020 TCO Analysis

Full-featured Value in a Cost-effective Solution for Smaller to Midsized Deployments

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ESG Lab Reports

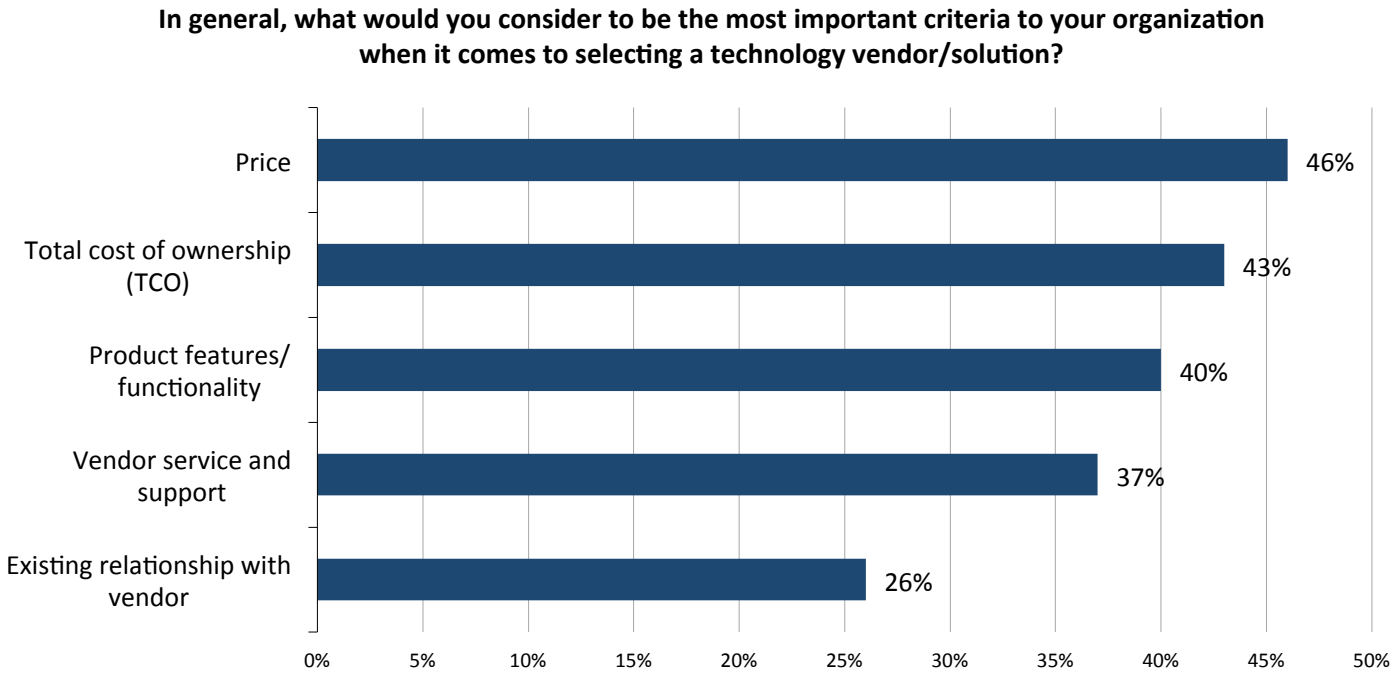
The goal of ESG Lab reports is to educate IT professionals about data center technology products for companies of all types and sizes. ESG Lab reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objective is to go over some of the more valuable feature/functions of products, show how they can be used to solve real customer problems and identify any areas needing improvement. ESG Lab's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments. This ESG Lab report was sponsored by Dell.

Challenges and Trends

IT organizations are under constant pressure to do more with less. It is no longer simply enough to identify the optimal technology that satisfies the technical requirements. The organization is under scrutiny to identify and justify the technology that best satisfies the requirements of the application at the lowest cost to the business. Not surprisingly, ESG research shows that the most important criteria reported by respondents when it comes to selecting a technology are price and total cost of ownership (TCO).[1]

To help balance these requirements from a storage perspective, it is important to identify more cost-effective storage technologies. This requires looking at the price tag of the equipment, examining the efficiencies built into the storage system, and understanding the total cost of ownership (TCO) of the storage investment.

Figure 1. Top Five Most Important Criteria When Selecting a Technology Vendor/Solution



Source: Enterprise Strategy Group, 2014.

Dell Storage SC4020

The Dell Storage SC4020 was designed to deliver the enterprise-class features and functionality of the Dell Compellent SC8000 storage system in a more cost-effective package that is optimized for small to midsized deployments. The SC4020 comes in a 2U dual controller enclosure with 24 integrated drive slots, 8 Fibre Channel (FC) or 4 iSCSI host ports, and 4 SAS disk expansion ports. SC200/220 disk enclosures can be added to scale the system up to 120 drives. The controllers are powered by a single quad-core 2.5GHz Intel processor with 32GB of memory.

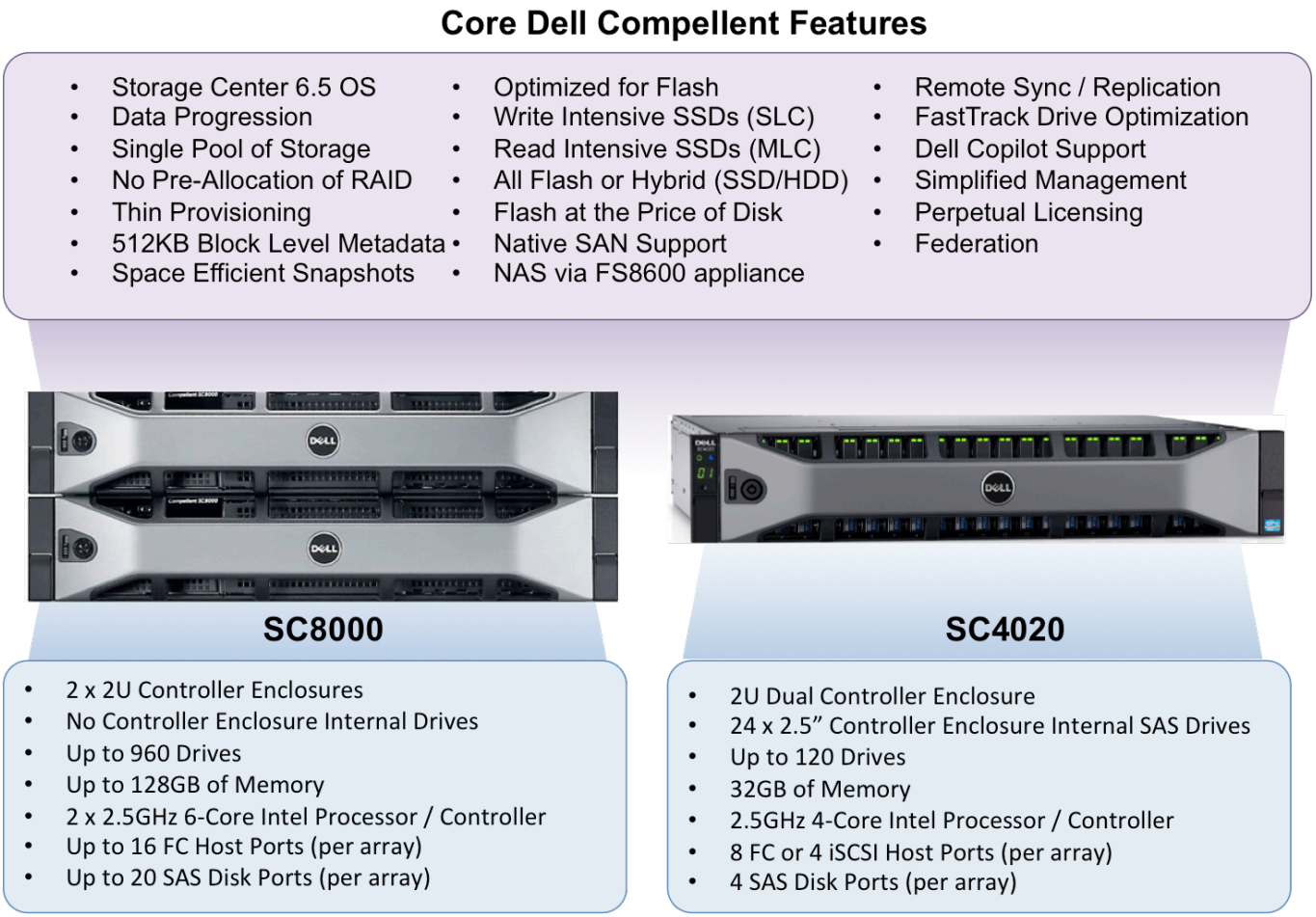
While the SC4020's hardware is a compact, scaled-down version of the more powerful SC8000, it contains all of the same enterprise-class features and functionality. The SC4020 runs the Storage Center 6.5 firmware with enterprise features such as Data Progression[2], thin provisioning, and space efficient snapshots. Like the SC8000, the SC4020 ensures investment protection with a Perpetual License software pricing model and Dell Copilot, which provides

[1] Source: ESG Research, *2014 IT Spending Intentions Survey*, January 2014.

[2] Data Progression provides advanced sub-LUN tiering based on block-level IO activity, including tiering across media types and RAID schemes

enterprise-class support for customers with entry-level budgets and requirements.[3] Figure 3 compares the similarities and differences between the highly scalable SC8000 and the cost-effective SC4020.

Figure 2. Feature Comparison of Dell Storage SC Series Models



Automation and Intelligence Reduce Administrative Costs

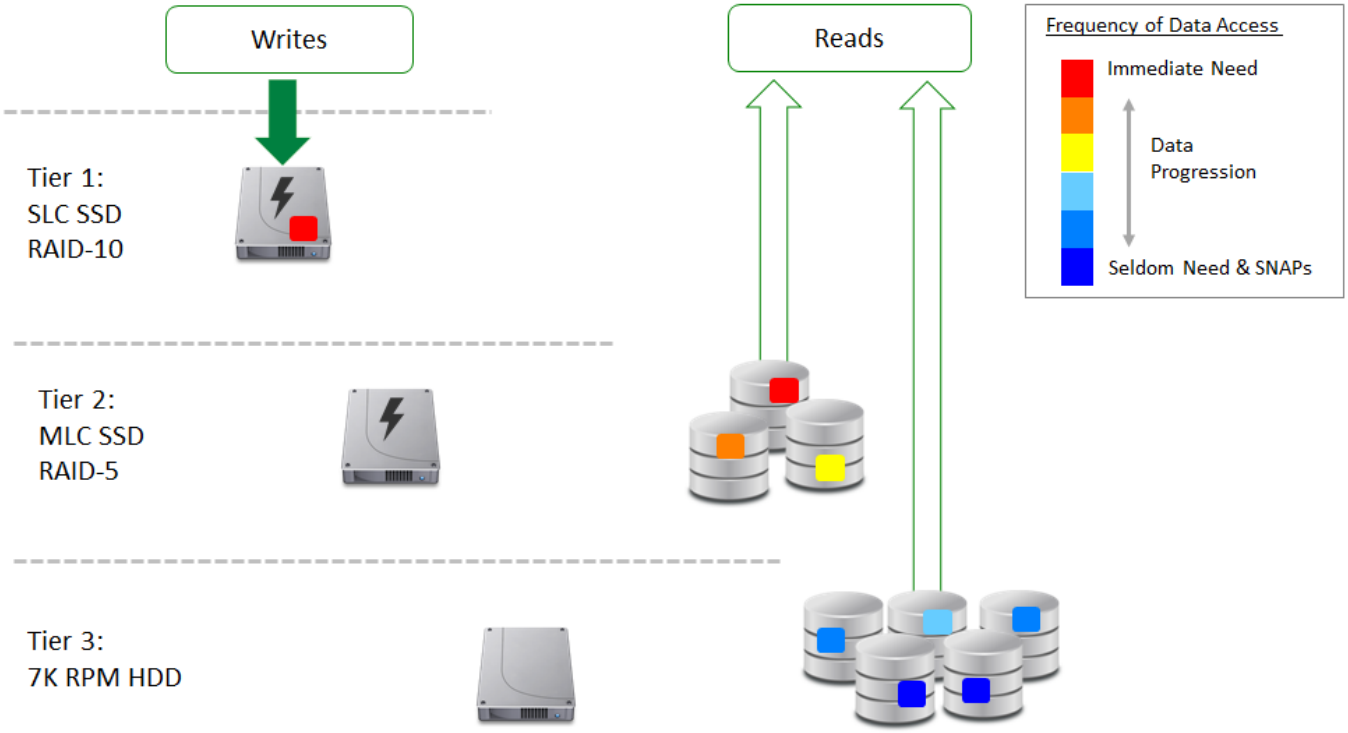
ESG Lab validated the automation and intelligence built in to the SC4020. All Dell systems based on SC Series (Compellent) technology leverage Data Progression to ensure that data is stored on the optimal storage media with the optimal RAID level at all times. As a result, Data Progression lowers TCO as it maintains performance while lowering the overall cost of storage. Where other vendors simply use high-cost SLC flash media as another tier of storage, Data Progression utilizes this tier to ensure the highest performance for incoming writes. After taking advantage of the high write performance of the SLCs, data is automatically progressed onto lower cost, high read performance MLC drives. ESG validated the ability to mix and match SLC, MLC, and spinning media in a single SC4020 storage system. By intelligently taking advantage of the strengths of both read and write intensive media, the SC4020 helps ensure that the organization's investment in flash technology is utilized in the most efficient manner at all times.

As data ages, it moves automatically to the lowest cost tier. The system will also choose the data protection level that is best suited for the data, at first taking advantage of high-performance RAID10 and moving down to higher capacity RAID5 or RAID6 protection schemes as data is less frequently accessed. Data Progression gives organizations the peace of mind that their data will be stored in the right place, at the right time, without the

[3] Perpetual software licenses are tied to the system rather than a specific controller. Customers can upgrade their components without rebuying the software they've already paid for. This provides a much lower TCO over the life of the storage system.

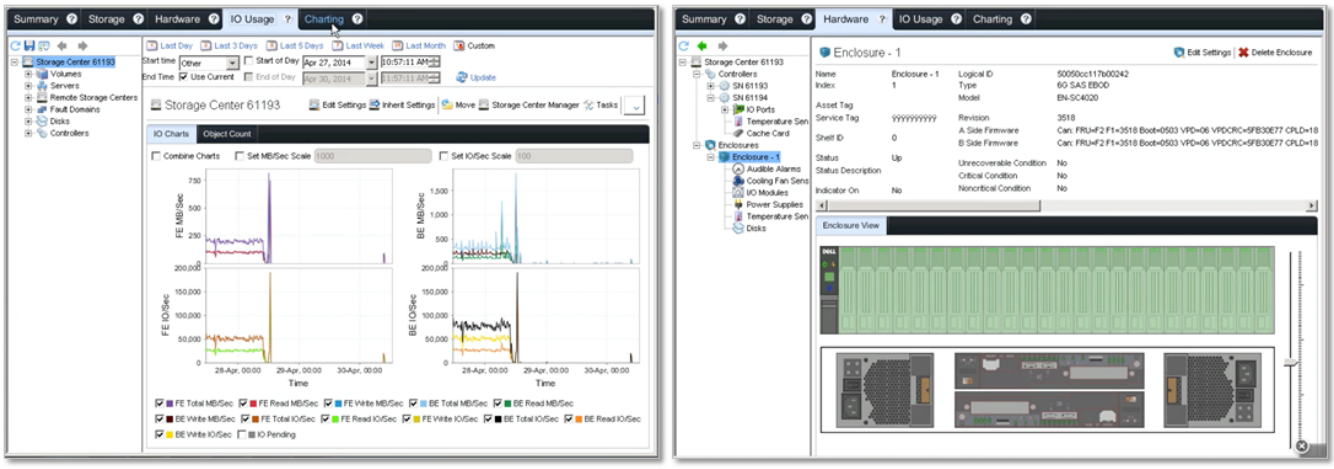
headaches of having to manually manage and move data between tiers of storage. Figure 3 shows the advanced functionality of Dell's Data Progression technology.

Figure 3. Automated and Optimized Tiering with Dell's Data Progression Technology



The SC4020 is simple to manage using Enterprise Manager to manage a single or multiple arrays. The interface is simple and familiar to administrators used to managing the SC8000. ESG Lab was able to easily use Enterprise Manager to manage the SC4020 in a single window as well as monitor system performance and wear leveling of the flash drives. We were able to easily set up synchronous and asynchronous replication schedules and quickly replicate between an SC4020 and an SC8000.The powerful yet intuitive management utility allows customers of all levels of storage expertise to quickly manage their system in minimal time. This dramatically reduces the recurring operating expenses (OPEX) associated with deploying and managing storage. Figure 4 shows some highlights of ESG Lab testing of the SC4020 using the Enterprise Manager graphical interface.

Figure 4. Intelligent Management of the SC4020 with Enterprise Manager



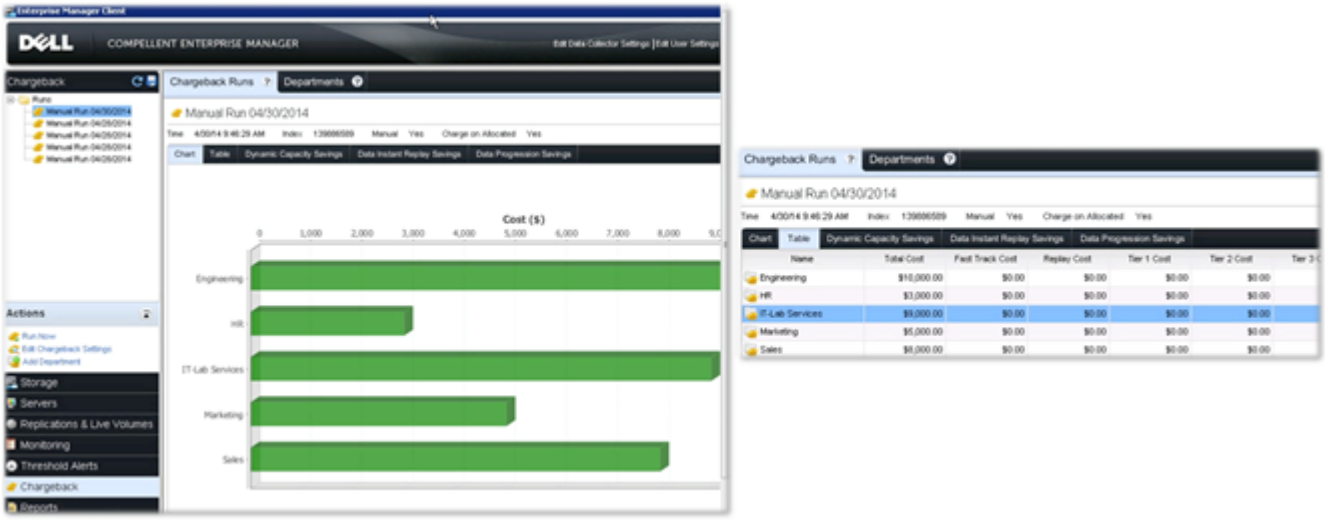
Virtualization and Efficiency Simplifies Management and Reduces Costs

ESG Lab validated that the SC4020 reduces costs with the same virtualization and efficiency features that are included in the enterprise-level SC8000 storage system. All data on the SC4020 is virtualized, freeing the administrator from traditional physical constraints with traditional HDD and SSD. RAID types and tiering can be achieved dynamically, all tracked by metadata managed by the SC4020. The built-in storage virtualization allows data to be stored, scaled, moved, tiered, delivered, and replicated in the most optimal and efficient manner possible, while minimizing the cost and management complexity associated with traditional multi-tiered storage environments. All data stored on the array is automatically placed on the storage technology and RAID level that allows organizations to deploy less storage to achieve the needs of the business.

The SC Series family of Dell storage solutions was one of the first storage systems in the market with thin provisioning. Leveraging more than ten years of field-proven innovation and maturity, SC Series thin provisioning lowers the cost of disk capacity without increasing the performance burden on disks.

Next, using Enterprise Manager, ESG Lab examined chargeback capabilities, which help identify and manage the costs associated with deploying and managing SC4020 storage from a system administrator's point of view. By first creating some simulated organizational departments and then entering in the hardware costs associated with the storage system and media providing the tiers of storage, we were able to quickly and easily understand the costs associated with storing all of the data on the storage system. Using this information, we identified the chargeback rates that can be billed or explained to each of the organization's departments. We were also able to easily identify and quantify the savings provided by using Dell Compellent technology over legacy storage systems—helping to better justify the efficiencies built into the system. Figure 5 shows the cost analysis and chargeback functionality included in Enterprise Manager.

Figure 5. Cost Analysis and Chargeback Feature of Enterprise Manager



Why This Matters

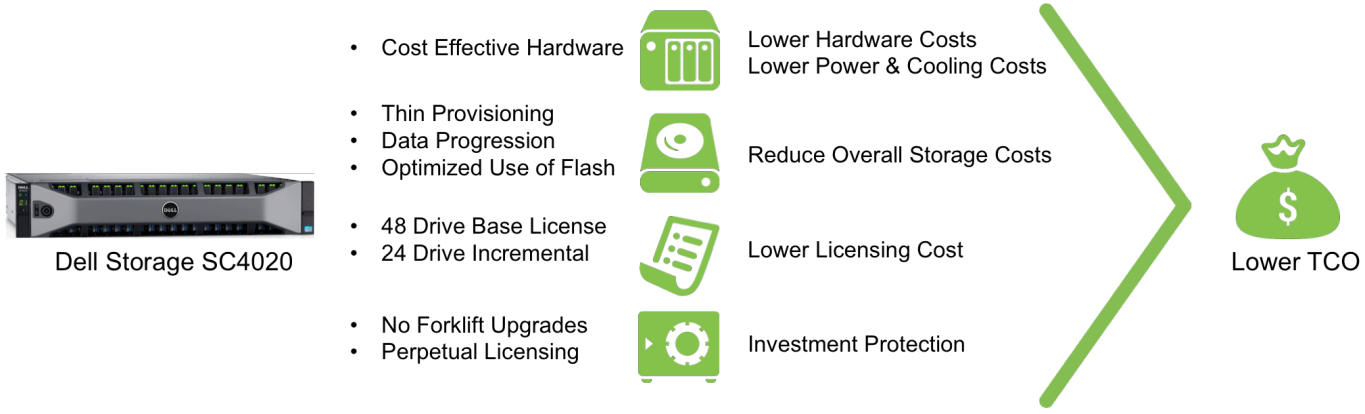
Traditionally, enterprise storage systems are expensive. While many smaller deployments can certainly make great use of enterprise-level features and functionality, these features come at too great a cost to smaller businesses and enterprise organizations looking to deploy departmental or branched strategies. These organizations tend to settle for less feature-rich technologies to limit cost, but ultimately pay higher operational expenses due to increased technical complexity and management overhead.

ESG Lab validated that the Dell Storage SC4020 provides enterprise-level technology, functionality, and support in a cost-effective package that is ideal for organizations looking to deploy smaller storage systems than previous Dell SC Series configurations. The SC4020 takes advantage of Dell's SC Series enterprise-grade virtualization technologies to help minimize capital and operational expenses for smaller organizations, while also providing investment protection for future growth.

Cost Efficiency Lowers TCO

The SC4020 was purpose-built to deliver the advanced, enterprise features of the SC8000 storage in a more cost-effective package for small to midsized deployments. The SC4020 utilizes cost-effective hardware in a smaller footprint that helps lower cost of acquisition while minimizing power and cooling costs. The SC Series architecture enables customers to purchase and deploy less capacity, while the fine-tuned SC4020 licensing model helps to lower licensing costs. All Dell SC Series storage arrays do not require forklift upgrades, and contain perpetual software licenses and full Copilot support, ensuring that today's investment can be leveraged for future growth. All of these features help to lower the total cost of ownership (TCO) of the SC4020, making it a very attractive choice for small to midsized deployments.

Figure 6. Key Features of the SC4020 Resulting in a Lower Total Cost of Ownership (TCO)



The SC4020 is designed and priced to lower the TCO for organizations of all sizes that are looking to deploy smaller storage systems than previous Dell Compellent SC8000 Series configurations, while taking full advantage of self-optimizing features. The SC4020 is ideal for cost-sensitive, read-intensive workloads such as highly virtualized environments, for business processing, email, collaboration, web applications, and VDI. Distributed enterprise environments can best optimize deployments by leveraging the SC4020 at remote or departmental locations, and the SC800 at a centralized data center. The SC4020 can be leveraged to lower the TCO for organizations looking to deploy smaller configurations, and the SC8000 for organizations looking to scale to larger configurations.

ESG Lab TCO Analysis

ESG Lab analyzed the total cost of storage ownership over eight years for two theoretical customers at the small and large ends of the "medium-sized business" segment. Hands-on testing and financial analysis were performed with a goal of quantifying the savings that can be achieved with the Dell SC-Series compared with modular storage solutions from industry-leading storage vendors in the same market. The model demonstrates how the Dell SC Series uses a combination of innovative technology (e.g., virtualization, tiering, flash, and thin provisioning) and an equally innovative business model (e.g., perpetual licensing, and future-proof support for new technologies) to lower initial acquisition costs and significantly lower long term TCO.

The smaller company was modeled initially requiring approximately 20TB of Fibre Channel attached block-based storage capacity to meet the needs of common business applications, and the larger company was modeled with an initial requirement of approximately 24TB. The capacity and performance needs for each model started lower and gradually increased over eight years. The final storage capacity at the end of the eight-year analysis period was roughly 40TB for the small configuration and around 110TB and for the large configuration.

The small company began with a mix of SAS and NL-SAS drives and added the performance advantage of SSDs in Year 4, while the large company model began with a mix of SSD and NL-SAS drives in Year 1 and added SSD, SAS, and NL-SAS spindles as the performance and capacity requirements dictated. The estimated spindle requirements to handle both the capacity and performance of a typical OLTP workload consisting of 70% reads and 8KB block size were normalized and calculated for each of three vendors' solutions. Where applicable, the advantages of the system design including any automated tiering and flash acceleration technologies available to each solution were taken into account. The ratios of drive types required for each configuration is listed in the Appendix.

In both scenarios, the companies eventually had a remote site to support remote replication for disaster recovery (DR). The small company added asynchronous replication in Year 6, while the large company replicated at initial deployment. The DR site required a minimum of 85% of the capacity on the primary site at all times. To reduce costs, the DR configuration was allowed to deploy a lower performing storage system, required less software, and did not require the use of any flash or auto-tier capability.

The ESG Lab analysis was quantitative in that it compared the cost of acquisition (hardware and software), support, management (including manpower), and power and cooling over eight years. ESG compared a Dell Storage SC4020 series-based solution with modular storage solutions from two other industry-leading storage vendors in the same market. The SC4020 used during ESG Lab hands-on testing formed the basis for the comparison. The eight-year models each included the need for equipment upgrades or additional systems due to an unanticipated spike in capacity and performance requirements.[4]

Figures 7 and 8 compare Dell with two other leading storage vendors for a small and a large storage solution. ESG Lab used a modeled street price including a normalized discount, as opposed to a list price, because the street price better represents what a customer would actually pay based on common discounts and savings opportunities.

[4] For more details, please refer to the Appendix.

Figure 7. Small Storage Solution – Street Price Comparison

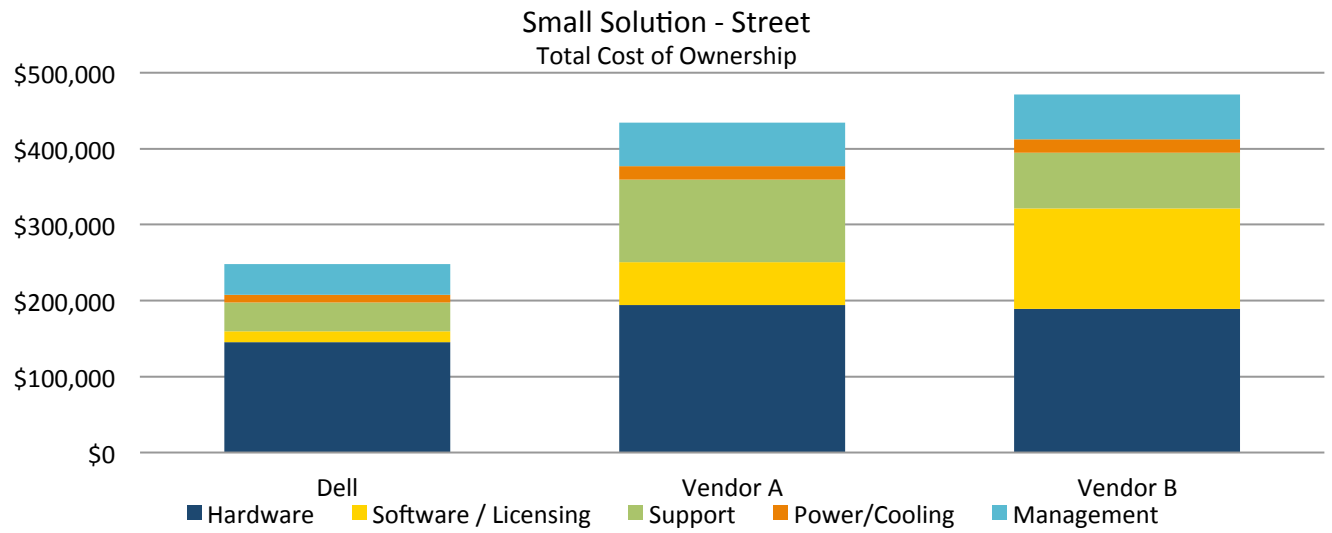
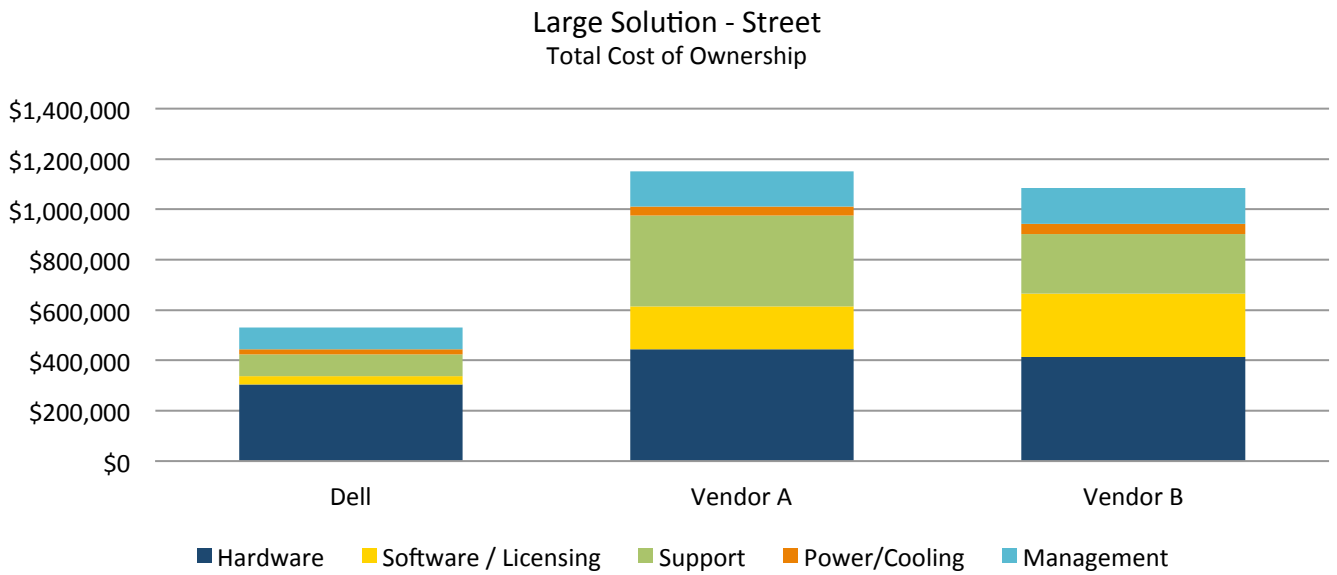


Figure 8. Large Storage Solution – Street Price Comparison



The Dell total cost of ownership is impressively lower over an eight-year period than its competitors. The price difference can be attributed to a combination of cost savings in hardware, software, support, and management. The SC4020 was designed and priced specifically to better accommodate budgets for smaller to medium-sized deployments and the results of the eight-year TCO model clearly validate this strategy.

Hardware costs were significantly lower for Dell SC4020. The system hardware was designed and sized to cost-effectively support deployments that are ideally suited for the SC4020, which has a smaller entry-level capacity than previous Dell SC Series models. The smaller footprint and ability to mix drive types in the same enclosure resulted in a significant reduction in power and cooling costs. Dell leverages the latest storage technology in innovative ways with a goal of maximizing performance while concurrently using less storage. An innovative two-tier approach that provides the high performance of flash at the price of disk and capacity optimization of thin provisioning and Data Progression meant that the SC4020 was able to meet both capacity and performance goals using less hardware. The SC4020 hardware offers excellent investment protection and eliminates the need for

forklift upgrades by supporting storage system federation with Live Volume and seamlessly integrating with the larger Dell Compellent SC8000.

Software costs were also much lower for the SC4020. The base license for the SC4020 covers the first 48 drives in the system regardless of each drive's capacity or performance. Additional software licenses are acquired in increments of 24 drives. In contrast, licensing capacity on the other vendors' systems was quite high, especially for SSD drives. The SC4020 runs the same operating system as the SC8000 (Storage Center OS), and includes the same full complement of enterprise-level software (including remote data protection) at a price point that is ideal for midsized and growing enterprises. This resulted in a very large software pricing advantage over the competitors. The competitors' systems also required purchasing new software when the system was upgraded at a very high cost, but software purchased for the SC4020 is protected with a perpetual license, meaning it will not have to be repurchased if and when the system hardware is upgraded.

The cost of maintaining hardware and software support was much lower for Dell SC4020. The SC4020 included full Copilot support, the same level of support given to SC8000 customers, at a reduced cost. Hardware and software support contracts, especially covering expensive SSD drives, were significantly more expensive for the other vendors. The price of maintaining service contracts increased substantially for the other vendors in the later years, where the price of SC4020 renewal contracts did not increase in the later years of the model.

Finally the intelligent design of Dell Storage Center management software helped minimize management costs in the TCO model for the SC4020. Multiple SC4020 systems could be managed from a single interface, and live volume support allowed easy migration of data between systems. Data Progression helped minimize the time needed to plan and manage storage by fully automating the task of balancing workloads and placing data on the optimal storage media. Replication management and configuration, including policies, scheduling, and performance monitoring, was quick and easy with the SC4020. The advanced virtualization capabilities along with no forklift upgrades eliminated some complex tasks that require vendor-specific storage specialists or the intervention of professional services to provision, manage, and configure the storage infrastructure, further helping to minimize management costs for the SC4020.

Table 1. TCO Eight-year Cost Breakdown for Small Configuration

Small Configuration	Dell SC-Series	Vendor A	Vendor B
Hardware	$145,148	$194,176	$189,135
Software and Licenses	$14,300	$56,168	$131,849
Support	$38,177	$109,059	$73,746
Power and Cooling	$9,772	$17,561	$17,623
Management and Service	$40,896	$57,526	$59,246
Total	**$248,292**	**$434,490**	**$471,599**

Table 2. TCO Eight-year Cost Breakdown for Large Configuration

Small Configuration	Dell SC-Series	Vendor A	Vendor B
Hardware	$305,339	$444,490	$413,244
Software and Licenses	$30,914	$170,412	$252,413
Support	$87,500	$360,863	$235,103
Power and Cooling	$21,133	$35,864	$41,279
Management and Service	$84,726	$138,073	$141,673
Total	**$529,612**	**$1,149,702**	**$1,083,711**

What the Numbers Mean

- Dell SC4020 has the lowest total cost of ownership, which includes the initial acquisition cost (hardware and software) along with all of the long-term costs over the useful life of the product (support, power and cooing, management, and service).
- In the small storage solution, Dell ($248,292) costs 43% and 47% less than nearly identical offerings from Vendor A ($434,490) and Vendor B ($471,599).
- In the large storage solution, Dell ($529,612) costs 54% and 51% less than nearly identical offerings from Vendor A ($1,149,702) and Vendor B ($1,083,711).
- The cost-effective design of the SC4020 hardware coupled with a large $/GB advantage for SSD capacity resulted in hardware costs that were between 23% to 31% lower, and power and cooling costs that were around 45% lower than the competing vendors.
- Software and licensing costs are significantly lower on the SC4020 (between 3.9 times and 9.2 times lower than the other vendors). The amazingly low software cost of the SC4020 included all of the SC Series enterprise-class software (including replication) and licensing for up to 48 drives regardless of drive capacity or type.
- The management costs associated with Vendor A and Vendor B can be up to 67% higher than with Dell SC Series. This includes the cost of migrating old data, system forklift upgrades, and manpower.
- With lower hardware and software costs, Dell SC4020 also provides full Copilot support at a cost that is significantly lower (up to 76% lower) than those of both competing vendors.

The Bigger Truth

Starting off small is difficult to do. Small offices, branch offices, and distributed virtualized environments must constantly make tradeoffs between minimizing price and maximizing functionality. With no clear picture of where and when future capacity, performance, and data protection requirements will suddenly arise, the decisions that organizations make in the early stages of deployment to save thousands of dollars can cost them hundreds of thousands of dollars down the road in unavoidable capital and operational expenditures. Many organizations choose to limit initial spending on the hardware that meets their needs today, but may not provide the flexibility to meet the needs of an unpredictable future.

The Dell Compellent SC8000 storage system remains one of the most feature-rich storage systems on the market. By virtualizing the data, Dell has freed the administrator from having to independently manage multiple storage media tiers and make RAID-level configuration decisions to optimize the balance between performance and capacity. The SC8000 has proven itself time and time again in enterprise environments for more than a decade. The design of the hardware and pricing model was targeted toward larger enterprises, and thus, it was previously difficult for customers with smaller environments or budgets to acquire this level of advanced functionality.

Through hands-on testing, ESG Lab confirmed that the SC4020 storage system offers most of the advanced features and functionality of the enterprise-class SC8000 storage system in a form factor and pricing model that makes it ideal for smaller deployments. ESG Lab used Enterprise Manager, the same simple interface that is familiar to SC8000 admins, to manage, monitor, and configure the SC4020. We were easily able to set up replication between SC4020 and SC8000 storage systems, and validated how easy it was to mix and match MLC, SLC, and spinning disks in the same enclosure.

With this testing in mind, ESG Lab confirmed over an eight-year period, that the Dell Storage SC4020 storage system has the lowest TCO for small and large-sized configurations when compared with storage solutions from two other leading IT vendors. The cost of acquisition was significantly lower than the competition, but more important for many organizations, the ongoing management and operational costs were lower. By providing a simpler way to manage, maintain, and upgrade a continuously growing infrastructure, SC4020 storage can save organizations hundreds of thousands of dollars in operational costs over a system's lifetime. For smaller configurations, the SC4020 truly delivers "more bang for the buck" when compared even with the SC8000 TCO. And thanks to perpetual licensing and the ability to federate and grow storage systems without forklift upgrades, organizations can rest easy knowing that their investment is protected against unforeseen growing pains in the future.

The storage market is full of vendors that claim similar features to Dell Compellent, however, these vendors have either software licensing costs, feature limitations, or other barriers that do not deliver the value provided by the SC Series architecture. Through hands-on testing and quantitative financial analysis, ESG Lab has confirmed that the Dell SC Series uses a unique and competitive combination of innovative technology (e.g., flash at the price of disk) and an innovative business model (e.g., perpetual licensing) to efficiently meet customer requirements with lower initial acquisition costs and significantly lower costs over the long term.

With the release of the SC4020 storage system, Dell has pioneered the push to provide feature-rich enterprise-class solutions and support for organizations with less than enterprise-class budgets and requirements. If your organization is looking beyond simply comparing price tags, and wisely making storage purchasing decisions based on the total cost of ownership, ESG Lab recommends considering the Dell Storage SC4020.

Appendix

TCO Assumptions

A modeled eight-year TCO of a small and large organization (primary site and DR site) was created by ESG Lab comparing the Dell Storage SC4020 with two other leading storage vendors in the same market.

The small configuration model assumes that a growing company makes a cost-effective purchase in the first year without knowledge of future growth requirements. The small company's performance requirements were based on a typical consolidated environment hosting a small database, a small exchange server, and a small number of virtualized servers. The company's capacity requirements grew by roughly 47% in the second year. In the fourth year, the growing company addressed performance issues with the addition of SSD drives and if necessary, hardware upgrades. The model assumes that, where supported, the flash was deployed to be used in both a caching and auto-tiered functionality. Finally, in the sixth year, the company added asynchronous replication and a DR site.

At the DR Site, approximately 85% of the total primary site performance storage capacity (SSD+10K SAS) is required. All primary site SSD performance capacity is protected at the DR site on 10K SAS disks—no flash is required at the DR site. NL-SAS capacity at the DR site protects both SAS and NL-SAS capacity at approximately 85% of the primary site.

The capacity and drive technology mix for the small configuration is shown in Table 3. Actual capacities and drive mix varied between vendors based on configuration and purchasing limitations, optimization technologies, known advantages, and known limitations.

Table 3. TCO Modeled Primary Site Storage Requirements: Small Configuration

Site Size	Year of Ownership	Total Managed Storage Capacity	Percent of Total Storage Capacity		
			SSD	10K SAS	7.2K NL-SAS
Primary Site	1	19TB	0%	37-55%	45-63%
Primary Site	2	28TB	5%	37-64%	66-63%
Primary Site	4	40TB	26-30%	26-47%	25-44%
Primary Site	6	40TB	26-30%	26-47%	25-44%
DR Site	1	N/A	N/A	N/A	N/A
DR Site	2	N/A	N/A	N/A	N/A
DR Site	4	N/A	N/A	N/A	N/A
DR Site	6	34TB	0%	31%	69%

The large configuration model assumes that a midsized IT department makes a cost-effective purchase designed to leverage an SSD tier for performance and NL-SAS tier for capacity. The small company's performance requirements were based on a typical consolidated environment hosting a midsized performance-sensitive database, a midsized exchange server, and medium number of virtualized servers. The company addressed performance and capacity needs in Year 3 by adding a mix of 10krpm SAS and 7.2k NL-SAS drives. In the fourth year, the growing company addressed performance and capacity issues with the addition of SSD and NL-SAS drives. The increase in the number of SSDs required either an expensive forklift upgrade (Vendor A) or a more cost effective addition of a second system (Dell / Vendor B) to scale to meet the new performance demands. In the sixth year, the company added additional capacity in the form of 10k SAS and NL-SAS drives.

The large model required asynchronous replication to a DR site at the initial deployment. At the DR Site, approximately 85% of the total primary site performance storage capacity (SSD+10K SAS) is required. All primary site SSD performance capacity was protected at the DR site on 10K SAS disks—no flash was required at the DR site. NL-SAS capacity at the DR site protects both SAS and NL-SAS capacity at approximately 85% of the primary site.

The capacity and drive technology mix for the large configuration is shown in Table 4. Like the small model, actual capacities and drive mix varied between vendors based on configuration and purchasing limitations, optimization technologies, known advantages, and known limitations.

Table 4. TCO Modeled Primary Site Storage Requirements: Small Configuration

Site Size	Year of Ownership	Total Managed Storage Capacity	Percent of Total Storage Capacity		
			SSD	10K SAS	7.2K NL-SAS
Primary Site	1	24TB	50-55%	0%	45-50%
Primary Site	3	56TB	21-24%	13-26%	51-65%
Primary Site	4	80TB	30-34%	9-18%	52-61%
Primary Site	6	110TB	21-24%	13-26%	51-65%
DR Site	1	20TB	0%	52%	48%
DR Site	2	45TB	0%	24%	76%
DR Site	4	67TB	0%	30%	70%
DR Site	6	90TB	0%	22%	78%

The large model assumes that a larger established organization demands more predictable and scalable performance. Aside from hardware, software, and support costs for both, the model also took into account power and cooling and management expenses. Power and cooling costs were estimated to be 9.84 cents per kWh based on the average retail cost of electricity in the U.S. in December 2012 as documented by the U.S. Energy Information Administration (http://www.eia.gov/electricity/state/).

Pricing data was gathered from publicly available sources and reseller supplied quotes.

Management costs were calculated based on average salaries and common tasks associated with the management of an IT infrastructure. It was assumed that three levels of users perform management tasks:

- Dedicated storage administrators or professional services to perform complex system administration ($55/hour).
- Experienced IT administrators to perform basic storage functions and VMWare and MS integrated administration ($45/hour).
- Basic IT staff to perform application integrated tasks and repetitive storage functions ($40/hour).

Average salaries were calculated by comparing a number of related IT roles across various IT organizations. (http://www.salarydom.com).

ESG modeled the expected management contribution from each level of user based on knowledge of each storage vendor's current software portfolio. The tasks ESG Lab modeled were: monitor, plan, provision, expand, tier, snap setup, snap recover, DR setup, DR test, and network configuration. Two other larger tasks included in the management costs were the migration of old data to the newly deployed infrastructure and the addition of a new system to an existing infrastructure. Each task was assigned an amount of time to complete (in minutes) and a monthly frequency.

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