

Enterprise Storage: Tough Criteria for Today's Digital Business Demands



Dell Storage SC Series delivers on the six key requirements that organizations, large and small, have for modern storage solutions

For some time, enterprise storage systems have been about much more than just “storage.” Yes, organizations continue to need high-capacity storage platforms, and the required capacities are skyrocketing. But storing lots of data economically is now only a starting point on a long list of business and technical requirements.

Within data-centric businesses—essentially all businesses in today's world—multifaceted, enterprise-grade storage arrays have become digital solution linchpins. High-performance servers and networks, along with the real-time applications they support, are doomed to fail if the data that fuels them isn't instantly and always available. Equally critical is the ability of storage solutions to easily and cost-effectively evolve and adapt to ever-changing business needs and challenges.

CIOs (and, increasingly, chief data officers) have grown much more sophisticated and demanding when evaluating and selecting storage solutions. When it comes to matching storage features and capabilities with application and business needs, smart IT pros must consider six key parameters:

1. Storage platform hardware and architecture
2. Storage performance and efficiency
3. Storage scalability
4. Storage availability
5. Storage management
6. Storage economics

It's important to understand that these six evaluation categories aren't mutually exclusive. For example, all of the first five categories have elements that directly affect the last category, storage economics. That said, each category still warrants its own consideration, depending on the required functionality of any given storage solution, the objectives and constraints of the purchasing organization, and a host of other variables. As detailed in this paper, the Dell Storage Center (SC) Series portfolio, powered by Intel® Xeon® processors, is delivering compelling storage platforms that excel across the board in each of these critical evaluation categories.

Storage Platform Hardware: Looking Beyond Storage Capacity

In today's rapidly evolving IT landscape, it's an accepted fact that software-driven capabilities—including deeply architected storage virtualization—are the key elements needed to create a workload-optimized data center for the future. Still, when choosing storage solutions, organizations can't afford to overlook the impact hardware can have on availability, scalability, and deployment flexibility. If a storage system's hardware and its architectural design are subpar, they can easily hobble even the most sophisticated software.

Historically, storage systems were compared largely in terms of their maximum capacity, the storage media used, and the cost per unit of storage. But storage media themselves have grown more capable and diverse over the years, with tape and hard disk drive (HDD) storage rapidly increasing in capacity and with solid-state storage (SSD) flash media joining the enterprise storage lineup. Indeed, the emergence of economical, enterprise-grade, all-flash and hybrid flash arrays is driving huge advances and disruptions in the once-staid storage sector.

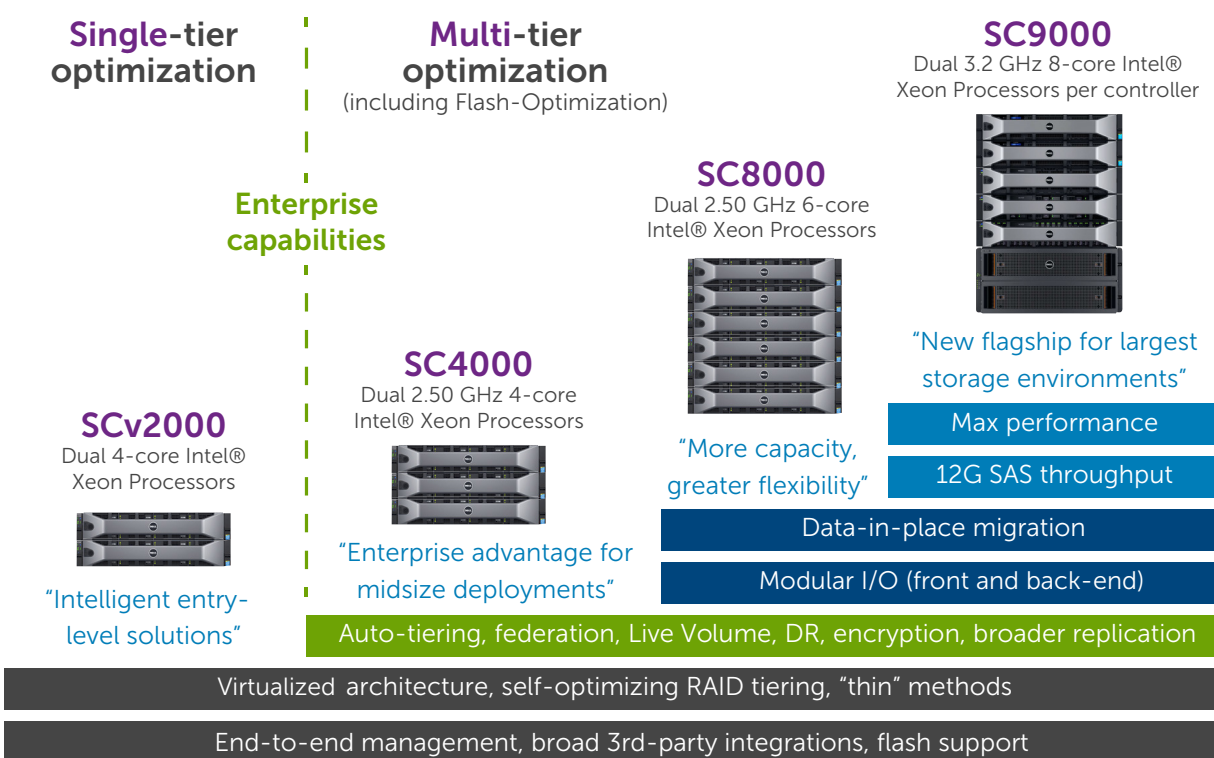
Using more and more industry-standard components in storage arrays is one way to hold down costs and ensure that storage products don't hit dead ends in technological advancement. But the quality and capabilities of those

standard components, the way they're architected, and the ease of interchanging them directly affect everything from overall storage performance and reliability to cost-effectiveness and the avoidance of forklift upgrades as next-generation components and systems appear. The storage controller or controllers act as the array's engine and house several critical subsystems. Those subsystems include system memory, with larger memory capacities directly boosting overall storage performance. The controller's microprocessor or microprocessors orchestrate all these subsystems and provide the power for the array's software operations.

The speed, functionality, and reliability of the processors have a direct impact on the array's higher-level capabilities and characteristics. Two key components of a processor—its memory and cache—along with its frequency directly affect workload optimization and advanced virtualization capabilities. The Dell Storage SC Series array family leverages different members of the powerful Intel Xeon processor line to serve as the “brains” of its storage controllers.

The types and speeds of the controller's back-end expansion connections affect overall array throughput. And the controller's I/O connection options determine the types of network connectivity the array supports and have an impact on its ability to easily expand and federate with other storage systems.

Figure 1. Dell Storage Center Arrays



The Dell Storage SC Series array portfolio contains four family members, ranging from the entry-level SCv2000 Series to the flagship SC9000 array, as shown in **Figure 1**. The SC Series offers these key hardware advantages:

- Powerful Intel Xeon processors
- Quality, best-of-breed internal components, selected and integrated to work seamlessly together
- Enterprise-class design redundancy for high availability with active/active controller pairs
- Modular “building block” portfolio architecture (maximum deployment flexibility, plus maximum hardware reuse/investment protection in an ever-changing environment)

With these and other features, the SC Series arrays provide a broad range of media options and various price/performance levels, along with flexible architectures that can easily accommodate future technological advances. Additionally, most SC Series products enable customers to mix and match capacity enclosures to create unique solutions that meet their business needs—either within a single data center or across distributed enterprise environments.

- The **Dell Storage SCv2000 Series** is a feature-rich, entry-level storage array in the Storage Center family of products that offers a compelling blend of high-performance and high-quality data storage at an affordable price.¹ The SCv2000 Series offers single or dual 2U controller and 5U controller arrays with drive slots included within the array, along with different capacity expansion options.

- The **Dell Storage SC4020** is an intelligent, self-optimizing array with a cost-efficient, all-in-one form factor designed to meet the needs of midsize organizations or remote offices. With its controller and drive slots integrated into a single 2U chassis, the SC4020’s compact footprint helps lower total cost of ownership (TCO) while providing expansion enclosure options for additional capacity.
- The **Dell Storage SC8000** offers more capacity and flexibility for midsize to large deployments. With high density, enterprise processing power, excellent memory, and fast performance, the 2U SC8000 can dynamically scale to meet a wide range of business requirements.
- At the high end, the **Dell Storage SC9000** can easily support large-scale systems, mission-critical workloads, and private or hybrid cloud environments. As Dell’s latest flagship array, the 2U SC9000 leverages Dell’s 13G server platform to offer exceptional processing power and 12Gb SAS expansion bandwidth for faster throughput in a highly scalable system. To address mission-critical applications, the SC9000 can achieve more than 360K IOPS with less than 1 ms latency.²
- The **Dell Storage FS8600** NAS gateway appliance enables customers to host block and file storage from a single pool with the SC9000, SC8000, SC4020, and SCv2080 arrays. With next-generation Dell Fluid File System version 5 (FluidFS v5), the enterprise-class FS8600 is one of the most competitive price/performance scale-out NAS solutions available, cost-effectively delivering high-count file operations per second (OPS).



Storage Performance and Efficiency: Optimizing Your Data Center

Clearly, a storage system's ultimate performance is partly tied to the power of its foundational hardware elements. But it takes sophisticated software to exploit and optimize the hardware's potential while also ensuring that the available storage is used as efficiently and cost-effectively as possible. The Dell Storage SC Series software begins this task by virtualizing and abstracting data from the underlying hardware to create a unified storage pool that applications can tap regardless of the physical storage locations or media types.

One of the most powerful and consequential software capabilities Dell provides with its SC Series arrays is RAID tiering and Data Progression. This auto-tiering solution distributes volumes not only across media types but also across flexible "RAID tiers" within a physical tier. Data Progression automatically classifies and migrates data to the optimum tier and RAID level, based on actual use and application performance requirements.

Dell's auto-tiering is intensely flash-aware, in that Dell is uniquely able to combine read- and write-intensive flash SSD types (SLC, MLC, and TLC) in the same storage array. As a result, customers can leverage price/performance differences among SSDs to boost IOPS in ways that would otherwise be cost-prohibitive. In fact, Dell can offer all-flash arrays or hybrid arrays for the lowest effective \$/GB of flash capacity.³

To further boost storage performance and efficiency, SC Series array volumes are "thin-provisioned" by default. Unlike with other storage solutions, there is no accompanying performance penalty or feature loss associated with this operation. Thin methods are fundamental to many key SC Series architectural advantages, including thin replication, thin snapshots, thin writes, and thin clones.

Coupled with the platform efficiency that comes with RAID tiering and Data Progression, Dell Storage SC Series also offers intelligent data reduction with deduplication and compression. For a flash optimized solution, Dell reports costs as low as \$0.45/GB for flash and \$0.10/GB⁴ for spinning disks. Depending on the workload type, deduplication and compression is able to achieve 10:1 capacity savings.⁵ In aggregate, these SC Series features help customers achieve optimal storage performance and efficiency—delivering the fastest drives and RAID levels without breaking the storage budget. These intelligent, self-optimizing, multilayer software-driven functions enable organizations to avoid overprovisioning—and overpaying—for peak storage demands while still being able to easily meet peak demands and future storage requirements as needed.

“Utilizing deduplication on an all-flash array with Dell Storage SCOS 7.0 allows us to pack more data into our storage arrays while maintaining the performance our customers expect on our cloud platform.”

Kevin Meyer
Storage Architect
Expedient

Storage Scalability: Scaling Up, Scaling Out

All SC Series standalone or "all-in-one" controllers support modular expansion enclosures to meet growing storage demands. For example, the top-of-the-line SC9000, powered by advanced Intel Xeon eight-core processors, can expand to as many as 960 drives, delivering more than 3 petabytes of raw SAN and/or NAS storage.

Beyond this per-array scale-up capability, multiple SC arrays can be combined non-disruptively with other SC Series arrays to build larger federated systems that all operate under unified management. The new Live Migrate feature⁶ offers a "storage hypervisor" capability that abstracts host mappings and makes it easy to move live data across multi-array federations. Volume Advisor proactively monitors clustered arrays to determine the best volume movement and placement, based on customizable performance and capacity usage policies. Data volumes can be moved transparently among the federated arrays to allow for maximum utilization of their combined capacity and performance. Permitting host-transparent volume movement between federated arrays improves performance and capacity utilization for growing workloads.

The firmware moves volumes effortlessly around the data center without interrupting workloads, balancing their environment for optimal performance and resource utilization without purchasing a separate virtualization appliance or software. For cloud and multi-tenancy applications, new policy-based Quality of Service (QoS) controls let you map resources to match business priorities. Plus, VVol virtualization support allows server-side administrators to easily target SC services on a per-VM basis, benefiting fully from Dell's growing relationship and integration with VMware.⁷

Another SC Series federation benefit: Because the Dell Storage SC Series arrays permit data encryption to be blended into each array, there is no requirement to place a dedicated encryption array into a federated storage network.

The SC Series' scale-up capabilities, combined with the arrays' scale-out storage federation capabilities, deliver more than just expanded storage capacity benefits. The multifaceted, flexible scalability features help organizations avoid storage solution obsolescence, enabling them to meet existing and future demands with minimal disruption.

Storage Availability: Dynamic Business Continuity

The most powerful storage solutions are of little value if they're not instantly and always available when needed. Storage availability depends on a combination of factors, from hardware component reliability such as cutting-edge Intel Xeon processors and redundancy up through software-driven data distribution and backup capabilities to system failover and recovery functionality. Dell Storage SC Series arrays achieve "5 nines" hardware availability⁸ by leveraging their redundant components and hot-swappable technologies and by virtualizing storage and storage management features across entire SANs, tracking metadata.

The Storage Center Live Volume feature is also a central player, helping ensure that data stored on SC Series arrays is always available. Because Live Volume provides transparent auto-failover to synchronized standby volumes on another array, workloads continue to run even during unplanned outages, with zero downtime or administrative intervention and no need for extra external software or hardware.⁹

Storage essentially "follows the application," as migrated volumes automatically map to associated hosts, regardless of physical location. Data center administrators can tap Live Volume to stretch with vSphere Metro Storage Cluster volume(s) between geographically dispersed locations. With auto-failover between fully synchronized volumes on local and remote arrays, organizations can establish recovery

point objectives (RPOs) and recovery time objectives (RTOs) of zero, maintaining full operations during natural disasters, power outages, hardware/ software failures, or other unplanned events. No administrative intervention is required for seamless failover—and when the downed array comes back online, the high-availability environment is efficiently and automatically repaired.

Live Volume can also guarantee uninterrupted replication to a third disaster recovery site if one of the primary arrays fails. Managed third-site replication uses the virtualized Live Volume as its source, tracking either underlying array, depending on its current availability. Synchronous and asynchronous modes are supported, as is the ability to change availability SLAs on the fly. These capabilities enable rich replication strategies for easily and efficiently meeting the most-complex business continuity needs.

A sometimes overlooked element of storage availability is the need to protect data from physical security breaches. This is where data-at-rest encryption can play a critical role. The SC9000, like the previously introduced SC4020 and SC8000, offers a complete range of FIPS 140-2–certified self-encrypting drives (SEDs) in both SSD and HDD formats, plus support for leading third-party key managers.

Storage Management: Automating and Simplifying Operations

Although organizations increasingly need the advanced operational characteristics the SC Series array family provides, they don't want to pay for them with increased operational complexity. Fortunately, SC Series arrays not only automate many core functions but also include a unified point-and-click interface that cuts administration time and eliminates the need for specialized skills, ultimately helping reduce overall costs.

The storage family's Dell Storage Manager (DSM) software simplifies storage resource management, providing comprehensive monitoring and management of all local and remote SC Series systems. DSM provides a range of functionality such as volume management as illustrated in **Figure 2**, as well as reporting and alerting, capacity planning, and a standardized API.

DSM streamlines management and administration and helps reduce operating costs, with advanced features such as departmental "charge-back" reporting, allowing instant visibility and control of a multi-petabyte, multi-location environment.

The management software also plays a key role in system and data availability. Activating auto-failover protection is a single-click operation for existing Live Volumes, and the feature can be easily turned on or off as needed. DSM's "tiebreaker" service keeps each array aware of the others' status and ensures that arrays synchronize fully during

“Live Volume auto-failover is the next level of redundancy.... The software has intelligence that can make decisions more quickly than we can, so it adds a level of safety to your enterprise data. I think the Live Volume auto-failover capability is part of the future of the protected enterprise.”

Scott Read
Network Systems Analyst – Storage Specialist
Montana Department of Transportation

recovery. The DSM tiebreaker runs on a virtual machine in a public or private cloud at a third location, providing additional fault tolerance for the overall system. In addition, the SC Series features a vast array of integration points with VMware®, Microsoft, Oracle, OpenStack, IBM-AIX, CommVault, Symantec, Foglight, Docker, and more. The VMware vSphere® plug-in, vCenter™ SRM adapter, and vStorage API for Array Integration (VAAI) support help you manage storage and virtual machines together.

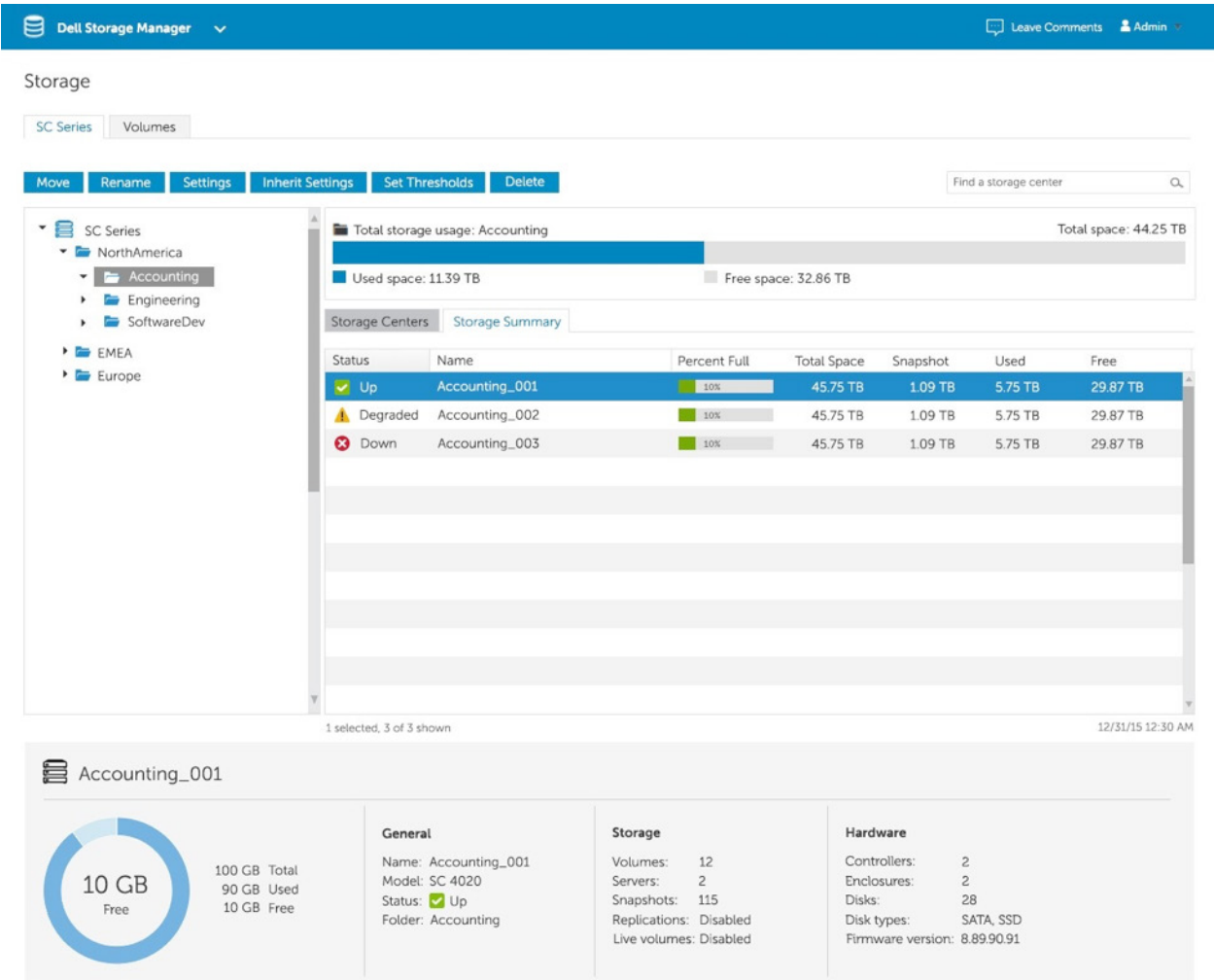
Of great importance to many organizations is the ability to replicate across PS Series (EqualLogic) arrays and SC Series arrays and perform day-to-day tasks from a single interface. DSM can initiate volume replication between PS Series and SC Series with a point-and-click interface and easily configure and monitor replication tasks.¹⁰ In addition, organizations can simplify migration from the PS Series to the SC Series, using a thin import feature within the SC Series operating system.

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With Dell Storage Manager and SCOS 7.0, I like the fact that I finally have my Dell Storage PS Series and my Dell Storage SC Series arrays on one environment, with a single pane of management.”

Hans de Jongh
Director /Owner
IT Creation

Figure 2. Dell Storage Manager for Centralized Monitoring and Management



Storage Economics: Delivering High Business Value

With their ability to deliver lightning-fast performance, rock-solid reliability and availability, optimized storage-tier selection, and advanced data compression, SC Series arrays with Intel Xeon processors offer compelling TCO economics. This paper has already noted several SC Series array features—including the storage efficiencies permitted by auto-tiering and intelligent data reduction—that directly decrease TCO. In addition, the ability of organizations to avoid “forklift” upgrades with data-in-place migrations, perpetual licensing of its value-added software features, and the SC Series family arrays’ long life spans (66 percent longer productive life spans than non-Dell storage solutions¹¹) also help organizations stretch their budget dollars.

Among the many other cost-saving features is Remote Instant Replay. This capability leverages space-efficient snapshots to deliver a cost-effective disaster recovery solution between local and remote sites. After initial site synchronization, only incremental changes in data need to be replicated. Thin replication cuts hardware, bandwidth, and administration costs. Customers can choose between synchronous or asynchronous modes and can use Fibre Channel or native IP connections between the local and remote arrays, depending on their existing network infrastructure or other business requirements.

Dell’s ability to replace hard-disk drives with cost-effective flash SSD alternatives can also drive significant savings while supercharging performance. Dell explored these benefits in tests of its midrange SC4020 array. The results: The Dell Storage SC4020 all-flash array not only provided up to a 4x reduction in query time and a 50 percent reduction in rack space compared to similarly provisioned 15K HDD solutions for data warehousing applications, but it did so at a 31 percent lower cost.¹²

Dell’s strong warranty programs as well as its enterprise-grade service and support portfolio also help organizations

keep storage costs in check. The company offers a lifetime SSD warranty with comprehensive coverage against wear-out¹³ as well as simplified perpetual software licenses. Dell’s award-winning Copilot and ProSupport installation and support options work to ensure that deployments go right the first time, and they deliver ongoing proactive services to resolve most issues before they become costly problems.

Dell Rises to the Enterprise Storage Challenge

The demands facing competitive, real-time businesses mean that no element of the IT infrastructure can coast on its past accomplishments. Each element, storage included, must push the performance, reliability, and scalability envelope and must do so in an efficient and cost-effective fashion. Just as importantly, storage and other IT subsystems must facilitate and expedite business evolution, rather than undermine it.

The days of grading storage on little more than its cost per gigabyte are long gone. Organizations today require enterprise-class storage that delivers the best combination of hardware and software features possible. No matter the speed and density of a storage array, if it isn’t highly scalable, always available, and extremely easy to manage, it has no place in the data center. And the most-compelling features and capabilities mean little if storage solutions punch big holes into tight IT budgets.

With its SC Series portfolio, Dell is facing the demands of enterprise storage head-on. For further information about Intel-powered Dell Storage SC Series arrays, go to www.dell.com/scseries.



1 The SCv2000 Series provides intelligent software capabilities at an affordable price. The SCv2000 Series offers RAID tiering, virtualization, and data protection options. As you require more-advanced features of the SC Series line such as multi-level tiering and Live Volume data movement, you can easily migrate your data to a SC4020, SC8000, or SC9000 array. For more information, visit dell.com/scv2000.

2 Internal test performed by Dell in August 2015 with Storage Center 6.7 on dual SC9000 controllers, using Iometer with 100 percent sequential reads and 8k sector transfer size. Actual performance will vary, based on configuration, usage, and manufacturing variability.

3 Net usable capacity of Dell array with 5 years of support, after 4:1 data reduction, vs. major competitors net of data reduction. Street price analysis is based on a variety of sources including analyst data, price sheets when available, and public information as of May 2016.

4 Source: Dell internal analysis, March 2016. Net effective capacity after applying a 4:1 compression and dedupe ratio. Customer's price may vary based on a variety of circumstances and data should be used for comparison purposes.

5 Source: Dell internal testing, March, 2016. Results may vary depending on application and configuration.

6 Live Migrate is available as a free upgrade on SC9000, SC8000 and SC4020 in Q3 2016 for customers with an active service contract. Similar capability is available now for SC arrays (including S40) running previous firmware versions, via the optional Live Volume feature.

7 QoS and WvI support is available as a free upgrade on SC9000, SC8000 and SC4020 for customers with an active service contract.

8 Results based on June 2015 internal Dell testing using SC8000 and previous-generation array studies with actual MTBF calculated from a runtime total of 67.3 million+ hours (accumulated by 16,123 systems). Runtime and availability influencing failures for a six-month period from 8/14 through 1/15. Estimated weighted average MTTR of 8.16 hours for 12-hour part SLA. Actual performance will vary, based on configuration, usage, and manufacturing variability. A minimum four-hour support option is required; other support options are available.

9 Requires optional Live Volume feature and 6.7-level firmware.

10 New Dell Storage Manager (DSM) enables day-to-day management of SC and PS Series arrays from a single interface. DSM is available now as a free upgrade for SC9000, SC8000, SC4020 and SCv2000 arrays in Q3, with a current support contract. DSM supports PS6xxx, PS-M4110 and PS4xxx arrays running PS 8.0 firmware or above. Cross-platform replication is available on SC9000, SC8000, SC4020, PS6xxx, PS-M4110 and PS4xxx arrays running SCOS 7.0 / PS 9.0 firmware or above as a free upgrade with a current support contract.

11 Based on Dell Storage (SC Series and PS Series) customer interviews from the January 2015 Dell-sponsored "IDC White Paper: Driving Business Value with Flash-Optimized Dell Storage Solutions."

12 Source: Internal tests performed by Dell in December 2014 with Storage Center v6.5.20 running data-warehousing-type applications on SC4020 configured with flash versus hard disk drives. Actual performance will vary, based on configuration, usage, and manufacturing variability.

13 Requires an active support agreement. For a copy of the Limited Hardware Warranty, write Dell USA LP, Attn: Warranties, One Dell Way, Round Rock, TX 78682 or see www.dell.com/warranty.