Reference Code: TA001917STG

Publication Date: June 2010

Author: Tim Stammers

TECHNOLOGY AUDIT

# Compellent Storage Center 5

Compellent Technologies

## SUMMARY

### IMPACT

Storage Center is a very competitive storage system that combines disk with optional flash storage. It uses advanced virtualization techniques to boost performance and reduce purchase costs and power consumption, and to allow management by staff without specialist storage skills.

- Deployments scale from a few TB to several hundred TB per system, and multiple systems spanning multiple PBs can be managed using a single interface
- Storage Center is a block-level device, with optional support for file-level data
- Storage Center can be attached to servers directly, via an iSCSI or Fibre Channel storage network (SAN), or via Ethernet for shared file storage.

### KEY FINDINGS

| | |
|---|---|
| **Strengths:** | ✓ Automated fine-grained migration of data between storage tiers increases efficiency.<br>✓ Highly automated and simple management.<br>✓ Thin provisioning and virtualization increase capacity utilization. |
| **Weaknesses:** | ✗ Optional file-level storage is via a separate NAS head. |
| **Key Facts:** | i Founded in 2002 Compellent is growing very fast and operates worldwide.<br>i An entry-level configuration of Storage Center costs around $21,000 for 10TB SAS disk capacity. |

## OVUM VIEW

During the last decade, a handful of start-up suppliers pioneered the development of storage systems that were highly virtualized, and automated many management tasks. During that period the storage market was consolidating around a handful of large suppliers, but this new wave of vendors bucked that trend and established itself as a major competitive force. It did this by offering storage products that provide clear advantages over incumbent technology.

Compellent is one of the highest profile of those companies, and sales of Storage Center, its flagship product, are continuing to grow. Other suppliers have attempted to reproduce some of the features of Storage Center, but often have not matched the depth of Compellent's implementation of virtualization techniques such as thin provisioning, or automatic migration of data across storage tiers.

Storage Center also offers sophisticated storage-management features, such as snapshot or replication software that allows off-site disaster-recovery systems to be built without requiring expensive network bandwidth. These qualities combined with a simple but flexible management interface make Storage Center a very competitive product in terms of cost of ownership and price for performance, with the potential to meet the needs of both mid-sized and large installations.

### Recommendation

Storage Center should be considered for any installation requiring flexible modular storage with advanced functionality.

## FUNCTIONALITY

Launched in 2004, Storage Center is now used by about 2,000 organizations. At the entry level, a list price of $21,000 buys a Storage Center configured with 10TB of mid-range SAS disk-drive capacity, together with important software features such as snapshot tools and thin provisioning.

The system is powered by up to two controllers linked for fail-over, and scales to a theoretical maximum capacity of 1,000 disk drives, or 2PB using the highest capacity disk drives currently available. In practice, the largest configurations currently run about 600 drives. To achieve greater capacities, customers can install multiple Storage Centers administered using a single management screen.

Storage Center operates at the block level, with optional support for storage of file-level data. Storage Center can be connected to servers directly, via Ethernet-based iSCSI and Fibre Channel SANs or via Ethernet for shared file access or all methods simultaneously. The device can be fitted with a range of Flash, Fibre Channel, SAS, and SATA disk drives.

High-availability features include redundant and hot-swappable power supplies, fans, and controllers, mirrored write cache, and battery backup for cache memory.

## SOLUTION ANALYSIS

### Ease of Management

Over the last few years the ease of management of storage devices has become a major area of competition between vendors. The rapid and continuing growth in the volume of data stored by businesses has increased the workload of administering storage systems, making any simplification of day to day storage tasks very welcome to customers – especially small to mid-sized enterprises that cannot afford to hire IT staff with specialist storage skills.

Storage Center can be maintained and managed by staff with no specialist storage skills. Tasks such as the creation and allocation of a storage volume to an application can be completed in less than five minutes, and require only very general knowledge about the nature of the application. The configuration of automatic scheduled snapshots for disaster recovery between data centers in two locations can be completed in even less time.

These and other tasks are completed using graphical interfaces that only require administrators to make top-level decisions, for example by offering a choice of storage profiles that provide defaults for parameters such as RAID levels and the way that snapshots will be handled. However Storage Center also offers a command-line interface for use by experienced storage administrators, and the ability to over-ride defaults for custom configuration. The graphical interface also provides a range of detail data, such as the real-time rate of data throughput to servers, and worldwide names of SAN network cards.

Each Storage Center is managed using an individual interface. Multiple devices are administered using central-management software that provides a single view of a group of devices.

### Virtualization

The degree of virtualization offered by storage devices varies considerably. Strictly speaking, even a disk array with simple RAID striping of data across groups of disks is providing a form of virtualization. However, the purpose of advanced storage virtualization is to improve disk utilization and performance by abstracting data volumes from the physical media on which they are stored.

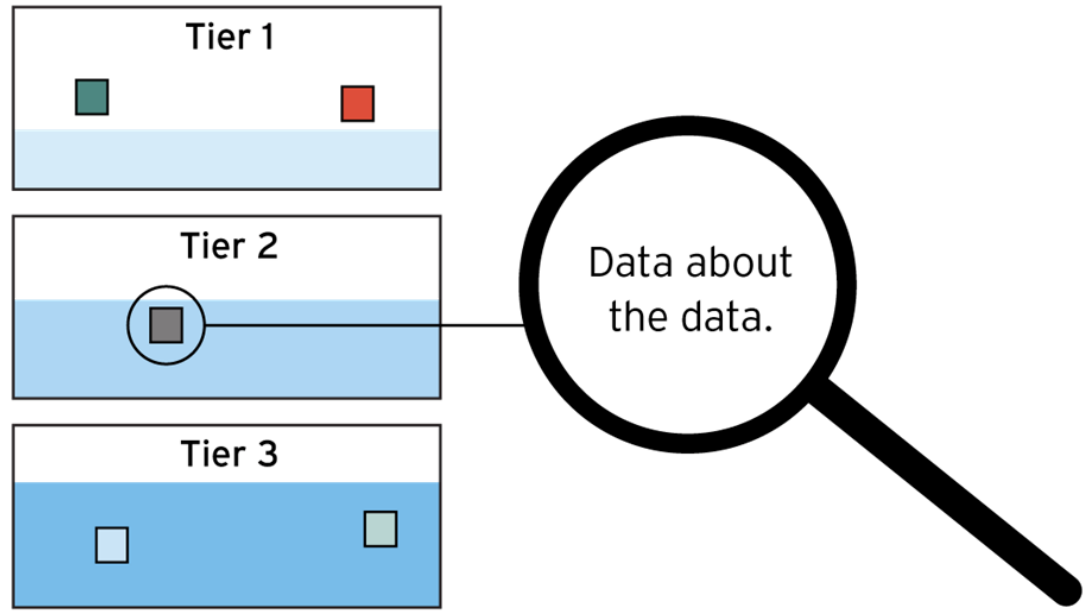
The level of abstraction and the freedom of movement of data across physical drives varies. Some storage devices only allow data to spread over a choice of subsets or groups of drives that were established when the disk array was first configured.

In contrast, Compellent's Storage Center includes a virtualization layer that is able to store any data volume, or part of a data volume, on any of the drives and RAID levels that are configured in the system. This improves utilization and performance, and underpins two other very important features of the device: smart placement of data on disk drive platters, and automatic migration of data across storage tiers.

Storage Center's virtualization software also enables so-called thin provisioning of data volumes, which dramatically reduces the amount of unused storage capacity within a device. For devices without thin provisioning, typically only about 25% of storage capacity allocated to applications is used to store data. Compellent's customers, however, can safely reach utilization rates of 80% or more. Storage Center is able to convert existing data volumes copied from other devices to thin-provisioned volumes.

Another way Storage Center improves utilization is by enabling administrators to reuse “white space”, which is typically reported by the OS to be unavailable even when files have been deleted from Windows volumes. This is enabled through the Free Space Recovery feature.

**Figure 1: Storage Center Architecture**




Source: Compellent

OVUM

### Smart Placement of Data on Drive Platters

Because of the speed at which data passes under a read-write head, the throughput of data stored at the edge of a disk-drive platter is 30% to 40% greater than for data stored further towards the middle of the platter. Storage Center is one of only a very few storage products that takes advantage of this fact, by automatically placing active data blocks at the outside of disk-drive platters. By ensuring that this prime real estate is not wasted on infrequently accessed data, this reduces the need for fast but expensive Fibre Channel or SAS 15K RPM disk drives, , and allows customers to use a greater proportion of low-cost SAS or SATA 7200 RPM drives.

Compellent claims that its customers replace older disk arrays in which up to 80% of disk drives are Fibre Channel, with Storage Centers in which about 80% of drives are SATA or low-cost SAS 7200 RPM. Depending on capacity and rotational speed, the per-GB purchase price of the slower drives can be more than 10 times cheaper than the fastest drives. Because of their lower spindle speeds and greater capacities, SAS or SATA 7200 RPM drives also consume less electricity and physical space, and generate less heat per GB of capacity than high performance drives.

### Automatic Migration of Data Across Storage Tiers

Fast Track is not the only reason why Storage Center needs fewer high performance drives than other boxes. Another is that the Compellent device is aware of the differences between tiers of storage, and ensures that the top tiers of high-speed disk drives are only used to store the data that is most likely to require high performance.

The software automatically moves data between tiers in both directions (up and down) according to the frequency with which it is accessed. The most frequently accessed data is stored on the fastest drives, which can include flash memory drives. The least frequently accessed data is stored on the slowest disk drives.

Migration of data across tiers underpins the storage concepts of hierarchical storage management (HSM) and the successor to HSM, information lifecycle management (ILM). Compellent was one of the very first storage suppliers to automate the migration process for non-mainframe storage, and claims it was actually the very first to do so.

Automated storage-tiering is still not a common feature of storage devices. Compared to some devices that have recently gained the feature, Compellent's implementation is sophisticated. Storage Center moves data in very small-sized chunks or pages that have a default size of only 2MB, rather than moving entire data volumes as some other tiering systems do. Compellent's software also takes account of RAID levels when deciding a hierarchy of storage tiers, and works with data from thin-provisioned volumes.

Customers can override the automated tiering for certain data such as database log tables that they wish to lock in place. The processing cycles required to complete data movements are consumed only when the controllers of a Storage Center are idling.

### Unified Storage

The proportion of data that businesses store at the file level rather than block level has been growing very quickly for several years. File-level data, which includes end-user-generated content such as documents, presentations, and videos, now comprises the majority of data stored by businesses.

However, storage of data at the block level typically provides higher performance, and for this reason Storage Center stores data at the block level. In 2007 Compellent added the ability to store data at the file level by launching a diskless NAS head that could be attached to Storage Center. That was a Windows-based NAS head, which Compellent will continue to sell. However, in May of 2010 the company launched an alternative NAS head, branded as zNAS.

Compared with Compellent's Windows-powered NAS head, zNAS is more deeply integrated with Storage Center, and offers better performance, especially when using the Unix-based NFS protocol to handle files, although it also supports Windows data using the CIFS protocol.

The improved performance is a consequence of the use of the open-source Zettabyte File System (ZFS) in zNAS. One of the many applications that use NFS is VMware's server-virtualization software when storing virtual machine images at the file level.

Administrators use a new zNAS interface to create and expand file systems, set up file level snapshots and set file access permissions. and Storage Center automatically provisions the required storage on the backend. The file-level data is stored and handled by Storage Center in the same way as block-level data, using features such as automatic tiering, thin provisioning, and intelligent placement of data on disks. Many other storage suppliers also ship NAS heads as a means of adding file-level support to block-level devices. Customers however have been reluctant to attach NAS heads to relatively expensive block-level storage simply to allow storage of low-value file-level data. But when using NAS heads with Storage Center, the least frequently accessed data is automatically located on the cheapest tier of high-capacity SATA or SAS disk drives.

### Snapshots and Disaster Recovery

Storage Center includes a snapshot tool that can be used to create space-efficient backup copies of data. The snapshots are incremental and record only the changes made to data rather than an entire copy of a data volume. They are instantly mountable and writable, and unlike other storage systems there is no limit to the number of snapshots that can be created. Storage Center can be configured to create snapshots of data automatically at time intervals chosen by customers.

For disaster recovery, snapshots can be copied between Storage Center in different locations, over Ethernet or Fibre Channel links. When using Ethernet, customers do not need to install any specialized networking hardware. Configuring remote replication of a snapshot takes about three minutes, and simply requires administrators to define parameters such as the times of day when replication is to happen, and network bandwidth allocation. Snapshots of thin-provisioned volumes can be replicated, and bandwidth consumption is minimized by replicating only the data that has changed since the last snapshot was taken, and by de-duplication of repetitive blocks of data.

The majority of Compellent's customers choose to replicate data asynchronously over Ethernet, but Storage Center also supports synchronous replication using fatter and more expensive network connections.

## PRODUCT STRATEGY

Since Storage Center was launched in 2004, Compellent has continued to refine the product through software development. Storage Center is based on low-cost commodity server hardware rather than specialized storage silicon and, for example, handles RAID striping in software rather than in PCI adapters . . The advantage is greater integration of features built on on top of the RAID engine, together", which speeds the process of adopting and bringing to market new new technologies such as SAS and flash drives.. Software RAID is far from unique, and any performance disadvantages caused by not using specialized silicon are offset at least in part by the performance-boosting effects of Compellent's storage virtualization, automatic data tiering and smart placement of data in disk drives.

Compellent's long-term plans are based around the existing architecture of Storage Center. Ovum expects this architecture to remain competitive for some years yet because of its advanced virtualization features. However, the storage technology is evolving, and vendors need to continually develop their products. At the beginning of 2010, Compellent updated Storage Center by adding features that included:

- **Virtualized ports** – Compellent says that this reduces the number of physical ports needed in storage networks and on Storage Center by 50%.
- **Support for SAS drives** – Serial Attached SCSI disk drives offer higher performance than SATA drives, but are cheaper than Fibre Channel drives, and can be fitted to the same Storage Center enclosures as SATA drives.
- **Automatic tiering to RAID 6** – Compellent's automatic data migration now encompasses RAID 6, allowing writes to occur in RAID 10 before data is migrated to RAID 6, and eliminating the write performance penalty of RAID 6
- **Snapshot consistency groups** – database and other applications can be backed up with time consistent snapshots that protect the integrity of linked transactions that span multiple data volumes.

- **Portable data volumes** – use external disk drives to ship large volumes of data to a remote site when setting up disaster recovery systems, saving time and expensive network bandwidth.
- **Server mapping** – automated provisioning of multiple data volumes with identical configurations, which is especially useful when deploying virtual servers.

The popularity of Storage Center has allowed Compellent to grow rapidly as a business. In 2005 the company saw revenue of only $10 million, but by 2009 total revenue had grown to $125m. Even during the global economic slump of 2009, Compellent's revenue grew by 39%, and the company gained over 500 new customers.

Storage Center is sold exclusively by channel partners, ranging from global resellers such as worldwide supplier Insight Enterprises, North American integrators SoftChoice and PC Connection, and British integrator Fordway, as well as boutique storage integrators. Compellent is based in the US, but during 2009 17% of its revenue came from other countries.

Customers of Compellent include London Borough of Hillingdon (UK public sector), Comic Relief (UK charity), IMG (global entertainment), Ares Management (global financial), Van Ameyde Group (Dutch insurance), DiscoverReady (US legal), Slumberland (US retail), and University of North Texas (US higher education).

Compellent has also sold Storage Center to hosting service providers including global service provider Savvis. These are significant endorsements of the scalability of Storage Center, the ease of managing a large number of the devices through a single management console, and the effect of automatic tiering on the cost of storage.

## IMPLEMENTATION

Implementation can be completed using either Compellent or third-party reseller staff, or a combination of the two. Resellers that install Storage Center are certified annually by Compellent. Compellent claims that Storage Center can be installed in four to eight hours, with the involvement of only one IT administrator. Although Storage Center can be administered by existing IT staff with no specialist storage skills, Compellent offers basic and advanced training courses in the management and maintenance of the device. The courses are hosted at multiple locations worldwide.

24x7 technical support is based on a "no call-back" policy, under which Compellent promises that customers will always receive immediate attention when calling, and will never be asked to wait for Compellent support staff to call back. Storage Center can be attached directly to servers, but is commonly connected using either an Ethernet-based iSCSI or Fibre Channel storage area network or SAN. To speed resolution of technical problems that might involve third-party components such as servers or SAN gear, Compellent is a member of the Technical Support Alliance Network. TSANet's members use pre-arranged mechanisms for swapping information when resolving mutual customers' technical issues, and include SAN specialists Cisco, Brocade, and QLogic, server makers Dell, HP, and IBM as well as server virtualization software from VMware, Microsoft and Citrix.

Alongside the implementation, training and support services, Compellent also offers professional services, including monitoring services, data migration services and services designed to help optimize capacity utilization and system performance.

Storage Center Core (virtualization) and thin-provisioning software (Dynamic Capacity) are shipped with the product. Optional modules include automated tiered storage (Data Progression with Fast Track), continuous snapshots (Data Instant Replay), thin replication (Remote Instant Replay), and Enterprise Manager Suite (Foundation, Reporter, and Chargeback). Also optional are a second controller and a diskless network-attached storage server for file-level management.

**Deployment example** – Established in 2001, Credit Market Analysis provides data-processing services related to the financial credit market from offices in London, New York, and Singapore. In 2008 the company installed Compellent storage as a part of an overall rework of its IT infrastructure, which also saw the company virtualize many of its servers. CMA says it chose Storage Center because of its flexibility, scalability, and performance. The company's credit-pricing services see it handle around 70 million calls to its web servers per day, and parse 1 million email messages per day.

The company runs a 14TB Storage Center as part of its production infrastructure, and a 19TB Storage Center to support disaster recovery and applications such as Microsoft Exchange. About 60% of data is frequently accessed and remains on the fastest Fibre Channel disk drives. VM images for about 100 virtual servers are on the next physical tier down, and historical data is held on the lowest tier of SATA disk drives.

**Deployment example** – The borough of Hillingdon in London has a population of almost a quarter of a million people, making it one of the largest local authorities in London. Hillingdon has responsibility for running schools, social services, waste collection and roads.

In 2008, data volumes at Hillingdon were doubling every year, and the authority's existing storage system was nearing its capacity limit. Hillingdon replaced those systems with two 30TB Storage Centers at separate locations, and replicated data between the two for disaster recovery. The authority had considered systems from Hitachi, HP, Dell, Pillar, and Sun. Hillingdon says that the Compellent storage was the best in multiple categories including ease of management, total cost of ownership, energy consumption, and disaster recovery.

Hillingdon had expected to need to hire extra staff to manage its storage system, but the Compellent systems eliminated that need, saving the authority about $75,000 per year in salaries. Thin provisioning of data volumes imported into the Storage Centers reduced disk usage by 45%, and the increased use of low speed disk reduced power costs by about $10,000 per year. Recovery of Novell GroupWise mailboxes from disk-based snapshots now takes less than 30 minutes, compared to up to 36 hours previously from tape.

**Deployment example** – Civica UK is part of Civica Group, a provider of services to more than 1,800 public-sector organizations worldwide. Civica UK provides services to 90% of UK councils and 50% of the UK's police forces, as well as to other bodies ranging from HM Revenue and Customs to libraries and academic institutions. Last year Civica UK installed four Compellent Storage Centers, two of which were configured with 54TB storage capacity.

The installation coincided with a VMware-based server virtualization project for applications ranging from number-plate recognition to local authority revenue, benefits, and planning application management. Civica says the Compellent storage used an 80/20 percentage split between cheap but slow SATA drives and fast but expensive Fibre Channel drives, and was 75% cheaper than a pure Fibre Channel system. It also says the systems were far simpler to manage than previous storage gear, eliminating the need for a full-time storage administrator.

**Table 1: Contact Details**

**Compellent Technologies Inc.**
7625 Smetana Lane
Eden Prairie
MN 55344-3712
USA
Tel: +1 (925) 294 3300
Fax: +1 (925) 294 3333
E-mail: support@compellent.com
www.compellent.com

**Compellent International**
St. Mary's Court, The Broadway
Old Amersham, Buckinghamshire
HP7 0UT
UK
Tel: +44 (0)1494 582041

**Headquarters**
Shirethorn House,
37/43 Prospect Street,
Kingston upon Hull,
HU2 8PX, UK
Tel: +44 (0)1482 586149
Fax: +44 (0)1482 323577

**Australian Sales Office**
Level 46, Citigroup Building,
2 Park Street, Sydney,
NSW, 2000,
Australia
Tel: + 61 (02) 8705 6960
Fax: + 61 (02) 8705 6961

**End-user Sales Office (USA)**
245 Fifth Avenue,
4th Floor, New York,
NY 10016,
USA
Tel: +1 212 652 5302
Fax: +1 212 202 4684



For more information on Ovum's Subscription Services please contact one of the local offices above.