DESIGNING A PERSISTENT HARDWARE ARCHITECTURE

Include Modularity, Flexibility and Scalability for Long-Term Usability

WHITE PAPER | MAY 2009

EXECUTIVE SUMMARY

Many enterprises looking to increase the flexibility, improve the scalability, enhance the availability and reduce the costs of data storage have turned to storage area networks (SANs). Yet traditional hardware vendors have failed to deliver on the promise of SANs. By relying on proprietary hardware designs, imposing restrictions on the types of technology that can be used and prohibiting customers from mixing and matching different drive and interconnect technologies, these vendors doom their products to early obsolescence and force their customers into costly forklift upgrades.

In contrast, the Compellent® Storage Center™ SAN is designed for persistence, not obsolescence. Using an open, nonproprietary hardware architecture, the Compellent SAN enables businesses to continuously integrate new disk drive, switch and network interface technologies without having to replace existing hardware or software. Enterprises can use any combination of Compellent's persistent hardware architecture, which is designed for flexibility, scalability and availability.

Compellent's Five Hardware Distinctions

1. Technology Independence

The Compellent Storage Center SAN protects infrastructure investments by supporting technology independence. With the Compellent SAN, enterprises can mix and match server interface technologies and disk drive types. Companies can use a variety of disk drive types simultaneously—including solid state disk (SSD), Fibre Channel, and Serial ATA (SATA) disk drives—to achieve the right balance between cost and performance. They can also choose iSCSI server connections for affordable connectivity over existing IP networks or Fibre Channel connectivity for higher performance and reliability. Compellent's technology independence gives enterprises the choice of drive and connectivity technologies for today's IT infrastructure and the flexibility to change technologies as business needs evolve.
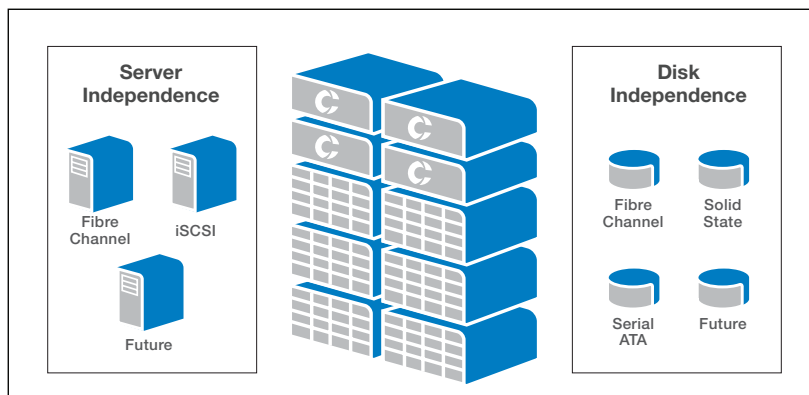

Figure 1: *Technology independence protects current assets and allows flexibility for future infrastructure changes.*

2. Single SAN Platform

Unlike other vendors, Compellent does not force its customers to undertake costly upgrades or product migrations to expand the capabilities or scalability of the SAN. Compellent offers a single, highly scalable SAN platform: the Compellent Storage Center SAN. Although new controllers are released every 12 to 18 months, all controllers are backward-compatible and field-upgradable. Companies can easily move data to the latest controller or integrate a new controller with an existing one to expand the functionality of the SAN. For example, a customer with a Series 10 controller can replicate data from a Series 10 SAN to a Series 30, or create a high-availability cluster using the two systems. With the Compellent SAN, companies can make changes without major capital expenditures.
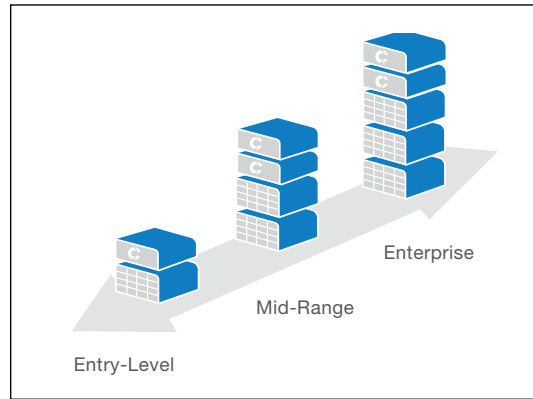
Figure 2: *Scale on demand, on a single platform.*

By choosing a Compellent SAN, customers also don't have to worry about buying the wrong system. When businesses select a SAN from another vendor, they frequently have to decide between one of several different models. If they discover it is not the right fit for their current business needs, they might have to start over from scratch, buying a completely new system and spending additional resources to learn how to use it. With Compellent's single SAN solution, businesses can easily expand their SAN or seamlessly transition from one SAN to another.

3. Modular Hardware Architecture, Designed to Scale

Unlike other SANs, which offer only dead-end growth paths, the Compellent Storage Center SAN offers a modular architecture that is built to scale easily from one terabyte of storage to hundreds, all on a single platform. Enterprises can start small and then scale a Compellent SAN online, adding capacity or functionality without causing any service disruption or downtime. They can also add Fibre Channel or iSCSI ports to modify an existing system.

This ease of scalability helps companies avoid making difficult technology choices at the time of the initial purchase. Companies can save money and buy with confidence, knowing that they can add capacity or connectivity to match demand without throwing away previously purchased components or having to purchase all of the resources up front that they may never use.

4. Highly Available, Clustered Architecture

The Compellent Storage Center SAN is designed for high availability with fully redundant hardware components and advanced failover features that provide uninterrupted data access. Controllers feature fully active, dual paths from servers to disk drives; fully redundant power supplies and cooling fans; mirrored, battery-backed cache; and failover support using a dual or quad port host bus adapter. In a clustered controller configuration, the controllers operate in unison to deliver high availability, but they are connected independently to ensure that there is no single point of hardware failure.

The Compellent SAN provides several high-availability advantages over competing systems. For example, the Compellent SAN architecture avoids the shared backplane of traditional SANs and consequently avoids sharing a point of failure. In addition, while other SANs require custom path failover software, Compellent multipath I/O failover requires no special software (in a Microsoft Windows environment). And while other SANs typically require downtime for software upgrades, Compellent software upgrades can be performed without disrupting availability.

5. Combined Block- and File-Level Storage

The Compellent Storage Center SAN with NAS (network attached storage) offers a fully integrated storage solution that enables companies to combine block- and file-level storage while gaining all the benefits of storage consolidation across the enterprise. Businesses with file-level storage requirements can access all the enterprise features of the Compellent SAN, including continuous snapshots, Automated Tiered Storage, Thin Provisioning, Boot from SAN and Remote Replication. This unified SAN and NAS solution delivers the high availability, scalability and end-to-end, single-vendor support that customers expect from a Compellent SAN.
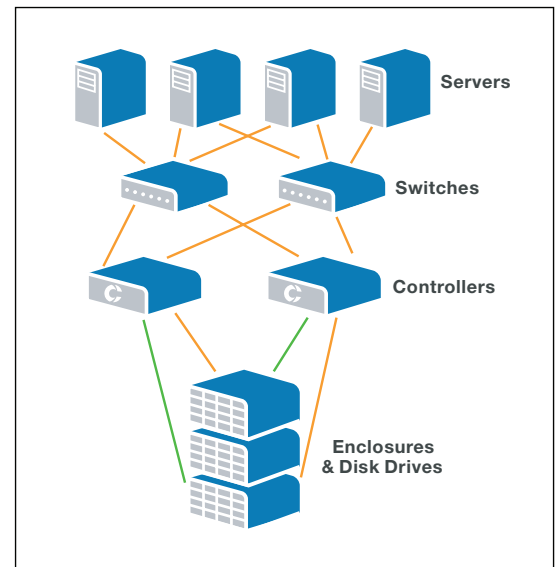
Figure 3: *Storage Center was architected to provide continuous availability for today's enterprise computing environments.*

The Building Blocks of Compellent Technology

Drives

The Compellent Storage Center SAN enables enterprises to use SATA, Fibre Channel and SSD disk drives within the same system, with a variety of capacities and speeds, to fully optimize the balance between performance and cost. Many SANs limit the available capacity of disks to the lowest common denominator. By contrast, the Compellent SAN uses disk drives to their full capacity—an enterprise can mix and match 300 GB and 450 GB Fibre Channel drives without any capacity or performance penalties.

Disk Drive Product Comparison			
	SSD	**Fibre Channel**	**SATA**
Capacity	73 GB 146 GB	300 & 450 GB, 15K 300 & 400 GB, 10K	500 & 1000 GB, 7.2K
Reliability	1,600,000 MTBF 24 x 7 x 365 days/year power on	1,600,000 MTBF 24 x 7 x 365 days/year power on	1,200,000 MTBF 24 x 7 x 365 days/year power on
Interface	Fibre Channel dual-port	Fibre Channel dual-port	Fibre Channel dual-port bridged to SATA
Power/TB	Medium	High	Low
Footprint/TB	Low	High	Low
Cost/TB	High	Medium	Low
Performance	Highest <1.0 ms R/W access	Very high 15K, 10K RPM 3.5–4.0 ms R/W access	Medium 7.2K RPM 8.0–9.0 ms R/W access

Enclosures

The Compellent SAN disk drive enclosures offer extensive flexibility and scalability. Businesses can mix and match disk drive types, capacities and speeds, housing those drives in SBOD (switched) Fibre Channel or JBOD SATA enclosures. They can add disks and then enclosures to increase storage capacity. The Storage Center SAN accommodates up to 1,008 disk drives and 720 TB of raw capacity within a single system. Redundant and hot-swappable power supplies and disks plus support for multiple RAID levels help ensure data protection.

Back-End (Enclosure Interface)	
Disk enclosure interface	Fibre Channel arbitrated loop (2 Gbps and/or 4 Gbps)
Maximum number of back-end ports	18
Maximum number of back-end loops	9

Enclosures per loop
    SBOD Fibre Channel
    JBOD SATA
	7
	5

Disk Drive Enclosures	
Enclosure support	SBOD Fibre Channel (2 Gbps and/or 4 Gbps) JBOD SATA
Disk drive support	15 K Fibre Channel (2 Gbps and/or 4 Gbps) 10 K Fibre Channel 7 K SATA
Intermixed disk drive capacities	Yes
Maximum number of disk drives per enclosure	16
Maximum number of disk drives	1,008
Maximum raw capacity	720 TB*

Disk drive capacity
    Fibre Channel (4 Gbps)
 	
    SATA
	15,000 RPM: 300 GB, 450 GB
	10,000 RPM: 400 GB, 300 GB
	
	7,200 RPM: 500 GB, 1 TB

RAID-level support	RAID 5/5, 5/9, and 10
Power supplies redundant and hot-swappable	Yes
Disk drives redundant and hot-swappable	Yes
Automatic drive failover	Yes
Automatic drive rebuild	Yes
Maximum number of hot spares	Configurable

Using 1 TB SATA hard drives

Controllers

The Compellent Storage Center SAN controllers are designed to deliver high availability. Redundant and hot-swappable power supplies and cooling fans help ensure nonstop operation whether a small or large problem arises. The controllers themselves are hot-swappable when customers use two controllers in a clustered configuration. By creating a cluster, customers can also take advantage of automatic failover capabilities.

The Compellent SAN controllers also offer the flexibility to meet changing enterprise requirements. Customers can select either one or two controllers per SAN, and then use Fibre Channel and/or iSCSI connections to servers. The controllers connect to any open-system servers without the need for dedicated server agents.

Controller	Series 20	Series 30
Number of controllers	1 or 2	1 or 2
PCI expansion slots	PCI - X = 4, PCI - E = 1	PCI - X = 1, PCI - E = 4
Expansion slot adapters	Fibre Channel, iSCSI or both	Fibre Channel, iSCSI or both
Maximum number of ports	20	20
Modular architecture	Yes	Yes
Processor speed	3.2 GHz	3.0 GHz dual-core
Active/Active cluster	Yes	Yes
Disk Drives redundant and hot-swappable	Yes	Yes
Power supplies redundant and hot-swappable	Yes	Yes
Cooling fans redundant and hot-swappable	Yes	Yes
Controllers redundant and hot-swappable	Yes, with clustered controllers	Yes, with clustered controllers
Controller-cluster distance	300 meters*	300 meters*

Fibre Channel direct connect limitation

CONCLUSION

The Compellent Storage Center SAN offers a standards-based hardware architecture designed to deliver the cost-effective flexibility, scalability and availability that enterprises need in a storage solution. Unlike SANs from other vendors, the Compellent SAN enables companies to mix and match technologies, increase storage capacity and integrate new technologies as they become available without a forklift upgrade. While other SANs are destined for obsolescence, the Compellent SAN is designed to provide a persistent hardware architecture that can meet the changing needs of businesses.