

DESIGNING A PERSISTENT HARDWARE ARCHITECTURE

Include Modularity, Flexibility and Scalability for Long-Term Usability

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compellent

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.

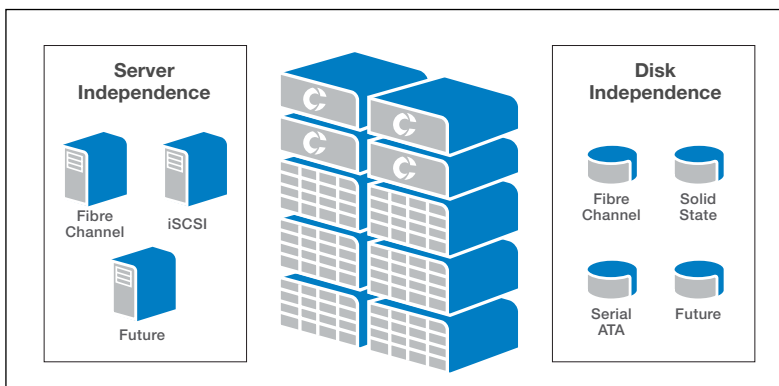


Figure 1: *Technology independence protects current assets and allows flexibility for future infrastructure changes.*

COMPELLENT STORAGE CENTER SAN DELIVERS MODULAR SCALABILITY

Furniture retailer Slumberland capitalized on the flexibility and modular scalability of the Compellent Storage Center SAN to expand and enhance its original system more than 20 times using the same software license since the original deployment in 2004. Initially, the IT group selected a small, 1 TB Compellent SAN for the company’s retail information system to demonstrate the benefits of the Compellent solution to management. Those benefits became clear soon after deployment: the SAN helped improve the performance and availability of the retail information system while saving 60 percent of disk costs through the use of Compellent’s Thin Provisioning capabilities.

The IT group subsequently added storage enclosures with mixed disk technologies to capitalize on Compellent’s Automated Tiered Storage functionality. They then added faster switches and an additional SAN for Remote Replication over IP. Without having to hire more administrators or spend too much on hardware and software, the IT group now manages more than 25 TB of usable storage.

“We chose Compellent because we needed a system that would let us start small and then grow to a much larger system once we could demonstrate success to the business units.”

SETH MITCHELL
Infrastructure Team Manager
Slumberland

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.

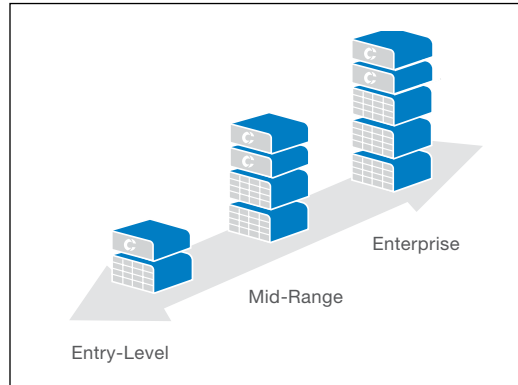


Figure 2: Scale on demand, on a single platform.

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.

CUSTOMERS AND PARTNERS PRAISE COMPELLENT'S INTEGRATION OF ISCSI AND FIBRE CHANNEL

"The ability to mix and match iSCSI and Fibre Channel server access in a single SAN drives down networking costs and ensures we are not locked into any single technology."

ROB KINNEY
Network Administrator
Fisher College of Business
Ohio State University

"Anyone planning on growing a company shouldn't be looking at iSCSI-only point solutions. Compellent allows me to scale my system in multiple ways without forfeiting my initial investment."

DON HIMSL
IT Manager
CNS

"Storage technologies change so rapidly, we had to make sure that whatever platform we selected had a clear path to the future for us, including iSCSI and asynchronous replication."

DAVE CHACON
Technical Services Group Manager
PING

"With Compellent, we have the best of both worlds without being locked into any given technology."

JOHN BOYD
IT Manager
gm2 Logistics

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.

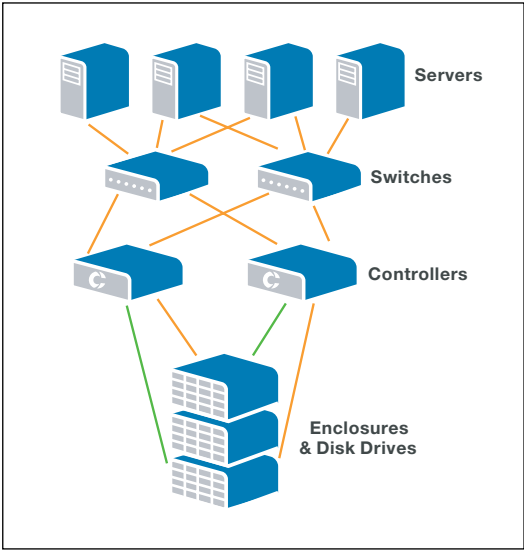


Figure 3: Storage Center was architected to provide continuous availability for today's enterprise computing environments.

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 | 7 |
| JBOD SATA | 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) | 15,000 RPM: 300 GB, 450 GB 10,000 RPM: 400 GB, 300 GB |
| SATA | 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.

COMPELLENT

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