

# LEVERAGING A PERSISTENT HARDWARE ARCHITECTURE

How an Open, Modular Storage Platform Gives Enterprises the Agility to Scale On Demand and Adapt to Constant Change.

## EXECUTIVE OVERVIEW

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.

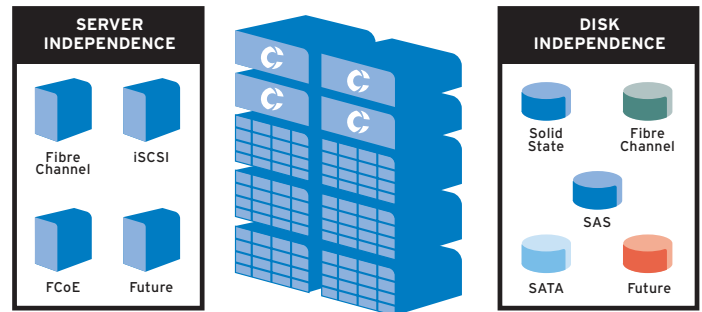
In contrast, Compellent Fluid Data™ storage is designed for persistence, not obsolescence. Using an open, non-proprietary hardware architecture, the Compellent SAN enables businesses to continuously integrate new disk drive, switch and network interface technologies without having to replace existing hardware or software. This persistent hardware architecture only from Compellent also allows administrators to configure storage systems using a combination of select industry-standard components for optimum flexibility, scalability and availability.

### Five Compellent Hardware Distinctions

1. Technology Independence
2. Single Storage Platform
3. Modular, Highly Scalable Architecture
4. Highly Available, Clustered Architecture
5. Unified Block- and File-Level Storage

#### 1. Technology Independence

The Compellent SAN protects infrastructure investments by supporting technology independence. With Compellent Fluid Data storage, enterprises can mix and match server interface technologies and disk drive types. Organizations can use a variety of disk drive types simultaneously – including solid state disk (SSD), Fibre Channel, Serial Attached SCSI (SAS) and Serial ATA (SATA) – 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. This technology independence gives enterprises the ability to choose the drives and interconnects that meet the needs of today’s IT infrastructure and the flexibility to make changes or adopt new technologies as business needs evolve.



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

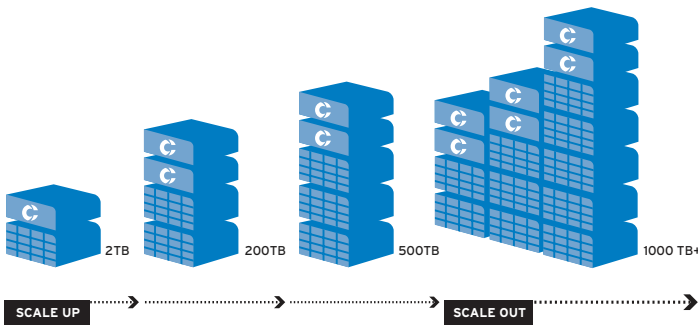
#### 2. Single Storage Platform

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, modular storage platform that scales without limit – and without the need to rip and replace technologies. Although new controllers are released every 18 to 24 months, all controllers are backward-compatible and field-upgradable. Administrators can easily migrate data to the latest controller – and utilize existing interconnects, if desired – or add a second controller for increased availability. This flexibility enables organizations to make changes as needed without major capital expenditures.

“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

By choosing a Compellent SAN, customers also don’t have to worry about buying the wrong system. When organizations select a SAN from another vendor, they frequently have to decide between one of several different models designed for a particular size and type of environment. Often times, they later discover the model is not the right fit for their current business needs, will not scale beyond a certain point determined by the vendor or is not compatible with new technologies as they become available. Such limitations force organizations to start over from scratch, buying a completely new system and spending additional resources to learn how to use it.



**Figure 2:** A single, modular hardware platform enables organizations to scale on demand without limits.

Compellent Fluid Data storage features a single, modular hardware platform. Businesses can start with any size system and easily expand on demand without having to replace existing infrastructure or networking components. In addition, administrators can take advantage of all Compellent enterprise-level functionality – from Thin Provisioning to Automated Tiered Storage – regardless of the system size.

“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

### 3. Modular, Highly Scalable Architecture

Unlike other SANs, which offer only dead-end growth paths, the Compellent SAN offers a modular architecture that is built to scale easily from two to hundreds of terabytes, 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 system downtime. They can also add Fibre Channel or iSCSI ports to modify an existing system on the fly.

This ease of scalability helps organizations 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.

## COMPELLENT SAN DELIVERS MODULAR SCALABILITY

Furniture retailer Slumberland capitalized on the flexibility and modular scalability of the Compellent 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, 1TB Compellent SAN for the company’s retail information system to demonstrate the benefits of the Fluid Data 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 Thin Provisioning. The IT group subsequently added storage enclosures with mixed disk technologies to leverage Compellent Automated Tiered Storage. 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 60TB 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 Mitchel  
Infrastructure Team Manager  
Slumberland

### 4. Highly Available, Clustered Architecture

The Compellent 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. Virtual ports increase port capacity, disk bandwidth, I/O connectivity and port failover. 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.

Compellent Fluid Data storage provides several high-availability advantages over competing systems. For example, the Compellent hardware 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 (MPIO) 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.

“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

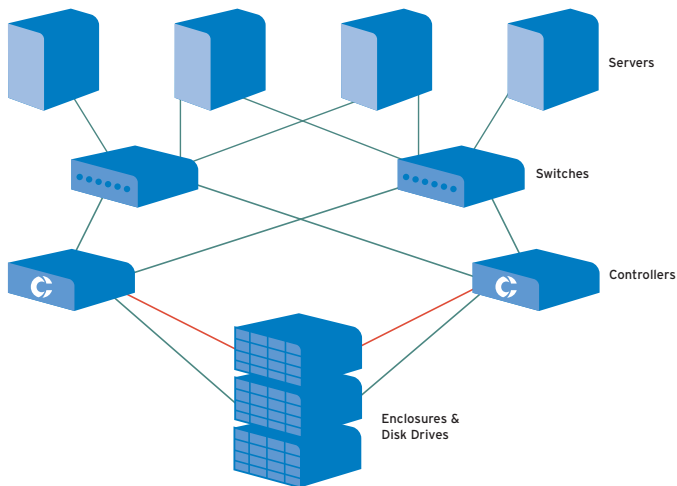


Figure 3: Compellent storage was architected to provide continuous availability for today's enterprise computing environments.

### 5. Unified Block- and File-Level Storage

Compellent offers two fully integrated storage solutions that enable organizations 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 Compellent Fluid Data storage, including Replays (continuous snapshots), Automated Tiered Storage, Thin Provisioning, Boot from SAN and Remote Replication.

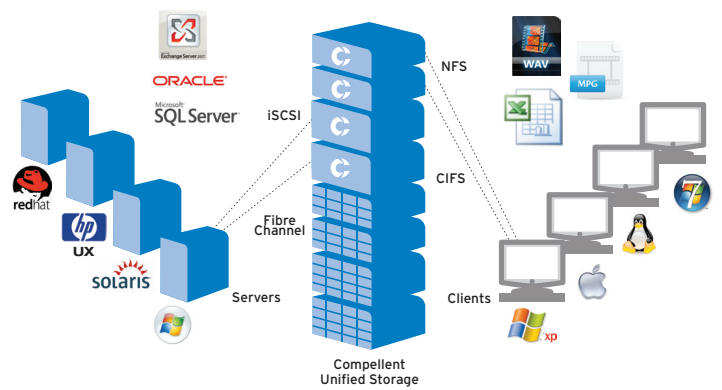


Figure 4: Compellent unified storage solutions allow organizations to consolidate data onto a single platform that combines file-level control with block-level efficiency.

Both unified SAN/NAS solutions – Compellent zNAS and Storage Center with NAS – deliver the high availability, scalability and end-to-end, single-vendor support that customers expect from Compellent. Compellent zNAS combines the highly scalable ZFS file system with a Fluid Data architecture, making it ideal for enterprises with mixed UNIX, Linux and Windows CIFS/ NFS environments. Storage Center with NAS, which runs on a Microsoft Windows Storage Server 2008 platform, provides a highly effective unified storage solution for Windows CIFS environments.

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

JOHN BOYD  
 IT Manager  
 gm2 Logistics

## The Building Blocks of Compellent Technology

### Drives

Compellent Fluid Data storage enables enterprises to use SSD, Fibre Channel, SAS and SATA drives within the same system, with a variety of capacities and rotational speeds, to fully optimize the balance between performance and cost. In addition, administrators can mix SAS drives with different capacities and rotational speeds within the same enclosure, which is especially

useful when configuring a disaster recovery (DR) site. 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 – and enterprise can mix and match 300GB, 450GB and 600GB Fibre Channel drives without any capacity or performance penalties.

Disk Drive Product Comparison				
	SSD	Fibre Channel	SAS	SATA
Capacity	146GB	300, 450 & 600GB, 15K 450GB, 10K	450 & 600GB, 15K 1 & 2TB, 7.2K	1 & 2TB, 7.2K
Reliability	1,500,000 MTBF 24 x 7 x 365 days/year power on	1,600,000 MTBF 24 x 7 x 365 days/year power on	1,600,000 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	SAS dual-port	Fibre Channel dual-port bridged to SATA
Power/TB	Medium	High	Low/High	Low
Footprint/TB	Low	High	Low/High	Low
Cost/TB	High	Medium	Low/High	Low
Performance	Highest <1.0 ms R/W access	Very high 15K, 10K RPM 3.5 – 4.0 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	Medium 7.2K RPM 8.0 – 9.0 ms R/W access

## Enclosures

Compellent storage enclosures offer extensive flexibility and scalability. Businesses can mix and match drive types, capacities and speeds, housing those drives in SBOD (switched) Fibre Channel, EBOD SAS or JBOD SATA enclosures. As business needs change, administrators can add disks and then enclosures on demand to increase storage capacity without downtime or

disruption. The Compellent SAN accommodates hundreds of SSD, Fibre Channel, SAS and/or SATA drives in a single system, with a maximum raw capacity of 1,280TB. Redundant, hot-swappable power supplies and disks, support for multiple RAID levels and automatic drive failover help ensure data protection.

Back-End (Enclosure Interface)	
Disk enclosure interface	Fibre Channel (4Gbps), SAS (3Gbps), SATA (2Gbps)
Maximum number of back-end ports	16
Maximum number of back-end loops	8
Enclosures per loop/chain	
SBOD Fibre Channel	7
JBOD SATA	5
EBOD SAS	4
Disk Drive Enclosures	
Enclosure support	SBOD Fibre Channel, JBOD SATA, EBOD SAS
Disk drive support	15K Fibre Channel, 10K Fibre Channel, 7.2K SATA, 15K SAS, 7.2K SAS
Intermixed disk drive capacities	Yes
Maximum number of disk drives per enclosure	16 SSD, 16 Fibre Channel, 16 SATA, 12 SAS
Maximum number of disk drives*	896 Fibre Channel, 640 SATA, 384 SAS
Maximum raw capacity*	538TB Fibre Channel, 1,280TB SATA, 768TB SAS
Disk drive capacity	
SSD	146GB
Fibre Channel	15K RPM: 300GB, 450GB, 600GB; 10K RPM: 450GB
SATA	7.2K RPM: 1TB, 2TB
SAS	7.2K RPM: 1TB, 2TB; 15K RPM: 450GB, 600GB
RAID-level support	RAID 5/5, 5/9, 6 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 Series 30 controller

## Controllers

Compellent storage controllers are designed to deliver high availability. Redundant and hot-swappable power supplies and cooling fans help ensure non-stop 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.

Compellent 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, including the latest 10Gbps iSCSI interconnects. 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
PCI data transfer rate	Fibre Channel: 4 & 8Gbps, iSCSI: 1Gbps	Fibre Channel: 4 & 8Gbps, iSCSI: 1 & 10Gbps
Maximum number of ports	18	18
Modular architecture	Yes	Yes
SAS support	No	Yes
Processor speed	3.2GHz	3.0GHz 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

Compellent Fluid Data storage offers a single, modular storage platform with a persistent hardware architecture that delivers the flexibility, scalability and availability needed to keep pace with constant change. Unlike other storage solutions, the Compellent SAN enables enterprises to mix and match popular drive types and interconnects, increase storage capacity on demand and integrate emerging technologies as they become available – all

without having to rip and replace hardware or undergo a costly forklift upgrade. Administrators can change system configuration at any time, and upgrading to the latest controller or drive type does not require purchasing a new base software license. While other SANs are destined for obsolescence, the Compellent SAN is designed for persistence, with the ability to scale up and out without limits.

**Compellent Technologies**

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