

Engineered for Efficiency

Accelerate Applications, Protect Data, and Empower IT with Nimble Storage

Storage plays a critical role in the datacenter, driving the consolidation and optimization of IT silos by providing a common location for application and user data. To keep up with the performance, capacity, availability, and efficiency needs of the virtual datacenter, storage is undergoing a transformation by leveraging flash, high-capacity disks, and integrated data management. This paper discusses how Nimble Storage's flash-optimized architecture is engineered to accelerate applications, scale performance and capacity, protect data and applications, and make IT more productive and empowered.

Executive Summary

Storage systems and IT resources are being strained by an increasingly virtualized, dynamic application environment and ever-growing capacity and performance requirements. Flash alone is not the answer, but when implemented in the right architecture it can help address some of these challenges. Nimble Storage has engineered the industry's most efficient storage system from the ground up, leveraging innovative technologies and a broad network of ecosystem partnerships.

Built on Cache Accelerated Sequential Layout (CASL™) hybrid storage architecture, Nimble Storage CS-Series arrays:

- Accelerate the performance of all applications by using flash SSDs as read cache to speed up reads, and a write-optimized layout to speed storage performance by orders of magnitude over traditional storage.
- Deliver measureable storage efficiency through features that include: in-line, universal compression of 30 to 75 percent with no added latency; redirect-on-write snapshots with no performance penalty; zero-copy cloning based on snapshots; and thin provisioning that allocates blocks of storage on demand.
- Scale to fit IT's changing applications needs by non-disruptively and independently scaling performance (compute or cache) and capacity (disk storage) without the up front cost.
- Protect data with integrated data protection based on instantaneous space-efficient snapshots; allowing customers to take application consistent backups and restore data in minutes from months worth of backups maintained online—all without the need for separate backup solutions.
- Enable efficient data replication locally or over the WAN for simple, affordable and application aware disaster recovery without the complexity of traditional solutions.
- Empower IT with push-button simple provisioning, non-disruptive upgrades, and deep-data analytics based proactive alerting and support, detailed reporting, and storage planning.

Nimble Storage delivers more storage performance, capacity, and functionality per rack unit than any other storage solution on the market. Nimble Storage customers routinely benefit from ten-fold improvements in application and VDI performance, dramatically simplified operations, greater usable capacity, and instant backups and restores for uninterrupted business operations.

Nimble Storage InfoSight leverages the power of data sciences to deliver true operational efficiency across all storage lifecycle activities. Delivered through the cloud, this “deep data” approach includes functionality such as proactive and granular alerting and support, capacity planning and performance analysis, and detailed reporting in areas of data protection and system health.

Nimble Storage's SmartStack solutions build on the rich partner ecosystem, which assures tight integration with virtualization and VDI solutions; this extends to core business applications such as Microsoft Exchange and SQL Server; and management tools such as VMware vCenter.

The Need to Optimize Storage

IT environments large and small are being reshaped by an increasingly virtualized, dynamic application environment and ever-growing data sets and performance requirements. As a result, storage systems—and IT resources—are being strained to deliver higher capacity and performance, protect more data and reduce operational overhead.

Virtualization and today's business applications place unique demands on network storage. As enterprises virtualize more applications and implement virtual desktop infrastructure (VDI), these demands must be balanced with the diverse I/O and data

“Nimble Storage provides all of the performance and operating metrics we demand to maintain our competitive advantage in the exploding cloud services market, delivering highly efficient hybrid services at extremely cost-effective price points.”

Phill Lawson-Shanks
CTO
Virtacore



Nimble Storage is built on the CASL hybrid storage architecture

protection needs of Microsoft Exchange, Microsoft SQL Server, Oracle, and other business-critical applications.

Flash-based solid-state disks (SSDs) help address some of these challenges. They have excellent read and random I/O performance and low latency, which are crucial for business applications, server virtualization, and VDI. However, due to high cost and write endurance issues, using flash-only arrays is only practical for a very limited set of applications. Consequently, data storage vendors have been promoting various hybrid combinations involving flash and hard drives. Some vendors have taken a bolt-on approach, which simply layers flash on top of disk as an additional tier. This approach fails to leverage flash in a cost-effective way; and does not maximize disk utilization. It does little to simplify IT administrators' jobs as they now have to contend with management and data migration between multiple tiers of storage.

What IT organizations of all sizes need is an efficient flash-optimized network storage solution. Specifically, IT should be looking for storage that marries the best characteristics of flash and hard disk drives to accelerate performance, maximize data capacity, protect data and applications, simplify management, and let IT easily and affordably scale performance and capacity as their business needs change.

Nimble Storage has architected such a solution from the ground up, combining flash technology, high-capacity disks, and high performance computing to deliver the industry's most efficient and affordable storage systems. Nimble Storage's flash-optimized hybrid arrays cost effectively accelerate applications, protect data, and empower IT to take on new initiatives while meeting ever-changing business needs.

Built on Solid Foundations

Since delivering its first product in 2010, Nimble Storage has become the fastest-growing storage company in industry history, thanks to innovative technology, people, and partnerships. Nimble's team of industry veterans has a deep understanding of customers' storage needs and backup challenges, groundbreaking technical expertise, and a track record for successful companies.

Nimble Storage's focus on an efficient flash-optimized storage solution led to the development of the Cache Accelerated Sequential Layout architecture and the Nimble Storage CS-Series. This high-performance solution combines primary and secondary data on a single flash-optimized hybrid storage system. This eliminates the expense and inefficiency of maintaining multiple separate systems or tiers within a storage system. The CS-Series also includes integrated snapshot and replication capabilities that streamlines data protection and offsite replication, which makes disaster recovery fast and affordable.

This approach has attracted thousands of customers across a spectrum of industries, including manufacturing, retail, financial services, high technology and internet, as well as the public sector. In addition, Nimble Storage's products and CASL architecture have garnered accolades from the Gartner Group, IDC, The Wall Street Journal, Dow Jones VentureWire, InfoWorld, Storage Newsletter, InfoStor, and others.

Nimble Storage's focus on building a strong solution partner ecosystem has also added to the company's momentum. With certifications from leading vendors such as Microsoft, VMware, Cisco, Citrix, and CommVault, customers are assured of tight integration with their existing virtualization and VDI solutions; core business applications such as Microsoft Exchange, SQL Server, SharePoint, and Oracle; and management tools, including VMware vCenter and vSphere, and Microsoft VSS. Nimble Storage has also released a series of converged infrastructure solutions called SmartStack leveraging best-of-breed building blocks such as Cisco UCS and VMware vSphere with Nimble Storage arrays for specific workloads such as VDI and data protection.

“There is no way we could accommodate the growth and expansion we do today with virtualization and Nimble under our previous storage architecture without heavily investing in support and services.”

Jeff Winter
Information Systems Director
City of Hot Springs and Garland
County

Architected from the Ground Up

Among Nimble Storage's technology breakthroughs is its Cache Accelerated Sequential Layout (CASL) architecture. CASL is key to delivering high performance and capacity savings, integrated data protection that maximizes uptime, and simplified lifecycle management. CASL features include:

- Flash-based cache that accelerates read access to application data by caching active "hot" data in flash
- Write-optimized data layout where data written by the host is first aggregated or coalesced in NVRAM, then is always written sequentially as full stripes to a pool of disk
- Inline variable-length data compression of 30 to 75 percent with no added latency
- Intelligent tracking of stored data, which enables instant caching of hot data to speed application performance and supports point-in-time snapshots and clones without copying data
- Integrated backup based on point-in-time, space-efficient snapshots that can be taken at pre-configured intervals and potentially replicated to a secondary site, allowing for frequent recovery points with no performance impact
- Flexible and non-disruptive scale-to-fit capabilities based on scaling compute and cache for higher performance, storage for capacity, or both without a forklift upgrade
- Integrated checksums, transparent data scrubbing and optimized dual parity (RAID-6) for ensuring reliability and availability of data.

Here is how Nimble Storage leverages the CASL architecture to accelerate applications, maximize storage capacity, protect data, and empower IT with the time and resources to invest in high value areas.

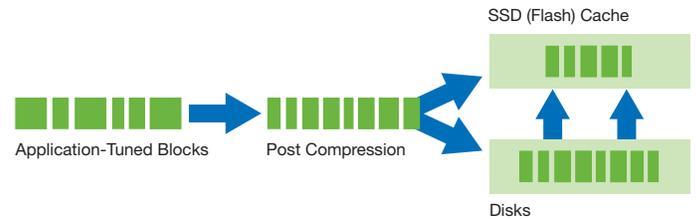
Accelerate Applications

Historically, IT has had to decide up front whether to optimize their storage for application performance or to meet capacity needs cost-effectively. Each of these approaches are at odds with each other and often results in independent storage silos that are inefficiently utilized, difficult to scale, and create significant management overhead. With Nimble Storage, there's no trade off between high performance and capacity, and customers can scale both easily based on the workloads they are running.

High Performance

Nimble Storage boosts the performance of all applications, from Microsoft Exchange and SQL Server to VDI, by accelerating reads and writes. Using flash SSDs as cache, Nimble Storage accelerates reads by an order of magnitude over disks. A survey of Nimble Storage's installed base found that servers average sub-millisecond latencies for reads and writes. Because flash is integrated into Nimble Storage arrays rather than implemented as a separate tier, there is no data migration overhead.

Likewise, CASL's write-optimized data layout enables substantially faster write performance than other storage architectures. CASL compresses incoming data and then aggregates, or coalesces, random writes into a stripe, writing them to disk sequentially. This eliminates disk latencies as the bottleneck in random writes to storage. Working with whole stripes also enables CASL to support a variable block length, including application-tuned block sizes on a per-volume basis. And CASL's efficient sweeping algorithm runs in the background without any performance impact, maintaining consistent performance as the array's capacity utilization increases.



CASL: Data is compressed, cached, coalesced, and written to disk, resulting in exceptional random read and write performance.

“Performance is absolutely critical for us. The performance we’re achieving with the Nimble Storage has proven game-changing for our development team. Today, code compilation takes a fraction of the time it once did, so idle time for developers has plummeted and productivity is at a new high.”

Ethan Erchinger
Vice President of Operations
Plaxo

Efficient Capacity

Customers save significantly on disk capacity because Nimble Storage's CASL delivers more usable storage capacity compared to traditional storage architectures. Apart from being able to deliver sustained performance even at high level of storage utilization, Nimble Storage customers benefit from a variety of storage efficiency features including in-line compression, redirect-on-write snapshots, zero-copy clones, and thin provisioning. The in-line compression capability is proven by data collected from Nimble Storage's install base to reduce the data footprint by 30 to 75 percent, depending on the workload, without any performance impact.

CASL's intelligent indexing allows for space-efficient snapshots and zero-copy clones while maintaining data in its compressed form. Rather than copying entire data sets, CASL keeps an index of where data is stored and tracks the incremental changes. As a result, Nimble Storage's redirect-on-write snapshots consume one to two orders of magnitude less space than full copies and have no performance penalty.

Nimble Storage zero-copy clones leverage the same snapshot architecture to create a new, cloned read/write volume, eliminating the lengthy process of copying data off of an active volume. Customers can create snapshots and clones in seconds and potentially save hundreds of gigabytes in disk capacity. Thin provisioning further maximizes storage capacity by only allocating storage for data on demand from CASL's optimized disk pool.

Flexible Scaling

Nimble Storage CS-Series can independently and non-disruptive scale to accommodate rapidly changing workloads. Customers can easily scale performance and capacity based on specific application needs:

- Scale up performance for greater throughput and IOPS and lower latency, via an in-box upgrade to faster controllers, upgrading to larger SSDs, or both non-disruptively
- Scale storage capacity by attaching external storage shelves without any down time.
- Nimble Storage InfoSight provides administrators with the ability to proactively plan storage capacity and performance through easy-to-understand graphical dashboards. This enables informed decision making around scaling storage including upgrading controllers, scaling cache, and adding capacity.

Protect Data

The administration of primary storage, separate backup, and separate disaster recovery (DR) storage is complex and time consuming. In contrast, Nimble Storage's integrated data protection reduces the number of separate storage solutions needed for primary and secondary data as well as backup, and greatly simplifies data replication for offsite disaster recovery and archiving. As a result, customers can backup and restore data in minutes, enabling IT to protect more applications, maximize uptime, and improve recovery time objectives (RTOs) and recovery point objectives (RPOs)—without needing separate backup storage.

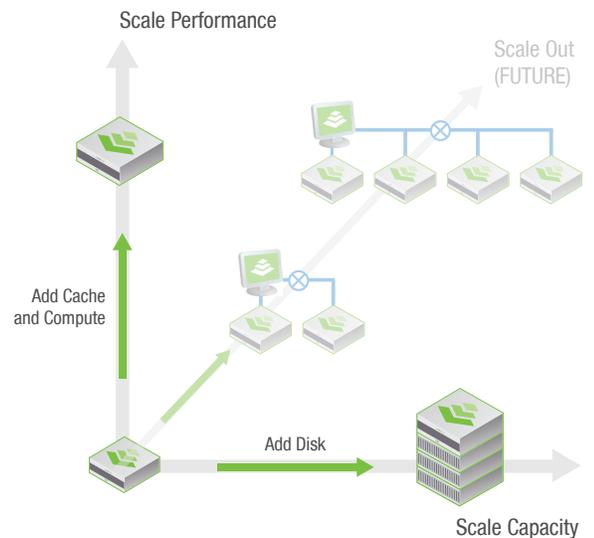
Nimble Storage resiliency and data protection features include:

Built-in Redundancy and Failover Capabilities

Nimble Storage arrays are designed for high availability with hot swappable active-standby controllers as well as redundant power supplies, cooling fans and drives. Nimble Storage's data layout enables an optimized implementation of RAID-6, which protects against dual-disk failure and avoids the performance penalty and disk re-build times seen with traditional implementations.

“[Nimble Storage’s] compression has been remarkable — and especially on VDIs, where today we are seeing compression of between 60 and 80 percent. Now, we have literally four times the space and our expansion options are seemingly limitless.”

Tony Banken
Network Administrator
Central Minnesota Jobs & Training Services



Scale-to-fit by non-disruptively and independently scaling performance and capacity

Instantaneous Snapshot-Based Backup and Restores

Nimble Storage's highly efficient redirect-on-writes snapshot technology and universal compression ensure that snapshots consume minimal storage capacity. As a result, customers can take and storage months' worth of frequent snapshots on a single system, leading to improved RPO.

With Nimble Storage, Florida Blood Services now backs up its virtual machines (VMs) every 15 minutes, whereas only 10 percent of VMs could be backed up daily with the previous SAN solution. EU Services, a direct mail marketing company, cut its nightly backup window from 10+ hours to 10 seconds, a reduction of 99 percent. Their SQL server database recovery on Nimble Storage array now takes less than five minutes; a task that would normally take hours. Similarly, Nimble Storage customer First Choice Health was able to restore 1.5TB of file data in less than 10 minutes, something that would have taken the entire afternoon with an external disk-to-disk or tape backup solution.

With Nimble Storage, restoring data from locally kept snapshot backups is equally fast and easy, for low RTO. Because snapshots are captured on the same array as primary storage without any data being copied, backup windows are a thing of the past. Snapshots can be taken in minutes and seconds and do not impact application or storage performance. Analysis of Nimble Storage's installed base found that almost half of all the deployed arrays are configured to retain snapshots for more than one month.

Nimble Storage also supports integration with Commvault Simpana, allowing CommVault to leverage Nimble's native snapshot capabilities. This integration allows IT to leverage Commvault's rich data protection capabilities along with Nimble Storage's efficient snapshot capabilities.

WAN-Efficient Replication

Nimble Storage replication is an order of magnitude more efficient and cost effective than traditional storage replication, speeding and simplifying disaster recovery. With Nimble's "thin" replication technology, compressed block-level changes are quickly copied to a remote array. The secondary system can be a different model than the primary array. Analysis of the Nimble Storage installed base found that half all of the workloads stored on the arrays are being replicated to a secondary system or site, compared to the industry average of 10 percent as reported by IDC.

Application/Virtualization Backup Integration

Through its integration with different protection frameworks, Nimble Storage provides application- and virtual machine-consistent backup and recovery for Microsoft and VMware environments, including backups of Microsoft Exchange, SQL Server, and SharePoint. Customers benefit from simplified backup and rapid virtual machine and application recovery.

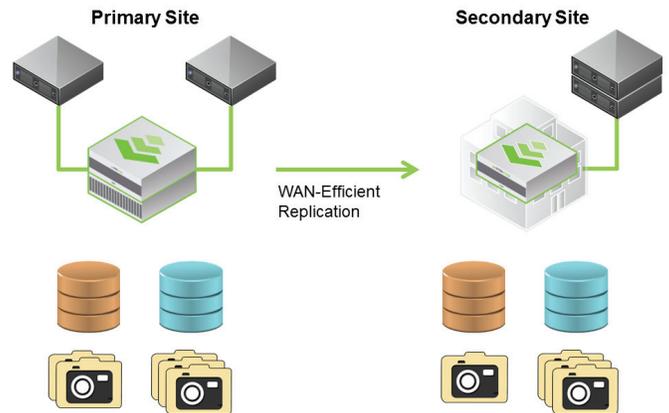
Administrators can also keep tabs on the state of their data protection through Nimble Storage InfoSight with detailed reports and automatic alerts on specific events such as replication failure.

Empower IT

Traditional storage systems are time consuming to deploy and manage. Taking a lifecycle-based approach, Nimble Storage makes it easy to purchase, set up, upgrade, and support its storage systems. By reducing the cost and complexity of the overall storage environment, Nimble Storage frees up IT resources for more value-added

“We can go wild with replication and snapshots because it costs us so little in terms of capacity. As a result, our RPOs have improved significantly.”

Chris Fricke
IT Administrator
Clackamas County, Oregon



Protect against disruptions with snapshots and WAN-efficient replication

“We love Nimble's seamless integration with VMware, not to mention with SQL and Exchange. This makes it easy to move between the two operating environments, and it greatly simplifies backing up virtual servers. Backup of file servers, which used to take as much as three hours, is now accomplished in seconds. The same is true for other workloads.”

Jozef Cabaj
Head of Infrastructure
Thomas Concrete Group AB

activities. Berkeley Research Group, for example, estimates that Nimble Storage arrays will save the company \$500,000 in support costs alone over five years compared to their previous storage solution.

Nimble Storage empowers customers by providing:

All-Inclusive Solutions

Nimble Storage products are all inclusive, with no hidden costs. A single SKU includes all flash and disk as well as snapshot and replication capabilities, application integration, and other software functionality. There is no need to purchase separate feature licenses, or host/ guest agents.

Push-Button Simple Deployment and Operations

Nimble Storage streamlines storage provisioning with its intuitive user interface, automated capabilities, and integration with leading hypervisor and application solutions. Application profiles automatically tune arrays for maximum performance and configure data protection policies for various workload types, eliminating the need for manual configuration or tuning.

Likewise, zero-copy cloning allows administrators to create clones of volumes in just three steps. For customers deploying virtual machines and virtual desktops, volume cloning can save hours of configuration and substantial storage capacity.

Data Sciences-Based Approach to the Storage Lifecycle

Nimble Storage has developed an innovative approach called InfoSight to realize substantial operational efficiencies across the entire the storage lifecycle.

InfoSight consists of the following components:

- **InfoSight Engine:** A data collection and analysis engine comprised of powerful deep data analytics that includes system modeling capabilities, and predictive algorithms
- **InfoSight Portal:** A secure online portal which serves as a window for administrators into the InfoSight Engine
- **Proactive Wellness:** A monitoring and alerting extension of the InfoSight Engine using statistical analysis for system health, performance, and protection gaps

The InfoSight Engine collects and analyzes a wide range of telemetry data from Nimble Storage systems deployed around the globe, leveraging deep-data analytics to diagnose and resolve issues that are too complex for traditional storage management and analysis tools. It provides system health checks, including application and workload analysis, to spot and remedy potential issues. Customers receive alerts about system health, performance, capacity, and errors such as storage network misconfiguration or failed replication.

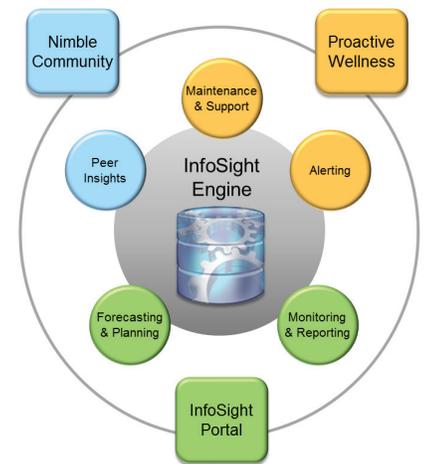
The InfoSight Portal is a window into the Engine, which administrators can use to:

- Get an overview of their storage environment
- Set triggers for automatic case creation, as well as opening and tracking support cases
- See historical capacity usage and predictions on when more capacity will be needed
- Drill down into detailed metrics on a per-volume basis to analyze and troubleshoot issues
- Understand different methods to improve performance including adding cache or upgrading controllers

Nimble Storage's support team can also perform secure remote troubleshooting, configuration, and problem resolution; provide peer insights; and offer customized guidance leveraging the InfoSight Engine.

“Our first VDI project scheduled later this year will be very taxing on our infrastructure. With InfoSight, I’m confident I can not only pinpoint storage performance bottlenecks, but know exactly what is necessary to resolve them to ensure this implementation goes smoothly.”

Anthony Perish
Systems Administrator
MulvannyG2 Architecture



The Nimble Storage Approach to the Storage Lifecycle

NimbleConnect Community

Nimble Storage has created a vibrant online community, called NimbleConnect, where IT professional, partners, and experts share best practices, tips and tricks, technical discussions, scripts, and other valuable information. NimbleConnect leverages the power of insight and data gained from InfoSight's deep-data analytics capabilities.

Application and Virtualization Integration

In addition to backup software integration, Nimble Storage makes it easy for customers to manage their storage infrastructure using tools they already know. With Nimble's vCenter plug-in, for example, IT administrators can use the VMware console to create data stores, set snapshot and replication schedules, review capacity and performance, create groups of clones in a single operation, and restore data from snapshots. Integration with VMware enables customers running vSphere to offload storage operations to Nimble Storage arrays, boosting vSphere's performance while optimizing CPU, memory, and storage resources.

Realtime, Non-Disruptive Upgrades

IT can deploy new Nimble Storage features and software releases with no downtime. When Kenneth Libeson at Meritage Group LP, an investment firm, ran a Nimble Storage firmware update, he noted that it "could not have possibly gone smoother. One click to download, one click to update. I watched a live virtual machine during the eight-minute process, which never disconnected."

Summary

With its flash-optimized storage arrays and lifecycle-based management approach, Nimble Storage delivers more storage performance and capacity per rack unit than any other storage solution on the market. Nimble Storage customers routinely benefit from ten-fold improvements in application and VDI performance, low support costs, greater usable capacity, and instant backups for uninterrupted business operations.

Next Steps

Get started with a briefing to explore how Nimble Storage can help accelerate applications and improve efficiency, protect more data, and empower IT. For more information contact Nimble Storage by email at info@nimblestorage.com or visit www.nimblestorage.com. Also visit the NimbleConnect community (connect.nimblestorage.com) and follow us on Twitter ([@nimblestorage](https://twitter.com/nimblestorage)).

"InfoSight lets me export reports so I don't have to manually create them anymore. With a few mouse clicks, I can generate either a detailed drill-down report on volumes to troubleshoot an issue, or an executive level report to keep my management team informed."

Farhan Ahmad
Systems Administrator
Gardiner Roberts LLP



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