Hewlett Packard Enterprise

# HPE Nimble Storage All Flash Arrays

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**Technical white paper**

HPE Nimble Storage All Flash Arrays provide high performance and consistent low-latency storage with advanced data reduction technology, along with rich storage management functionality for radically simple operation—even for the most demanding applications.

The HPE Nimble Storage unified product family allows enterprise customers a wide range of choices, such as using all-flash and hybrid flash for production applications, and secondary flash for backup and disaster recovery (DR) purposes.

All-flash arrays leverage groundbreaking storage innovations including:

1. HPE NimbleOS—a unique and highly-efficient flash-optimized storage architecture
2. HPE InfoSight predictive analytics—a cloud-connected management system to proactively predict and prevent issues
3. HPE Multicloud Flash Fabric—to seamlessly and transparently move data on-premises or the public cloud

This technology overview focuses on all-flash arrays and provides details on two key innovations:

- How all-flash arrays leverage HPE NimbleOS to accelerate read and write performance, optimize capacity, protect data, and scale seamlessly to meet the changing demands of diverse enterprise workloads
- Tight integration with HPE InfoSight, as well as how customers rely on the powerful data sciences from HPE InfoSight to guide scaling and ensure peak storage health

## Log-structured data layout

HPE NimbleOS uses log-structured file system technology to optimize data layout on the SSDs. As data is written or updated on the array, the changes are processed for data reduction and then written to disk in large stripes. This approach opens up numerous advantages, including variable block-size compression, efficient inline deduplication, and Triple+ Parity RAID. Log-structured layouts have their own challenges, including efficient management of write caches, indexes, and free space. The unique ability of HPE NimbleOS to efficiently manage a log-structured data layout is a key to its innovative design.

This style of data layout minimizes the wear on the flash in SSDs, allowing HPE Nimble Storage to offer an industry-leading 7-year warranty on SSDs.

### Write caches

HPE Nimble Storage arrays have two storage controllers, each with a multi-gigabyte non-volatile memory store (NVDIMM). NVDIMMs are attached to the controller's main memory bus, providing unmatched write-cache performance. The contents of NVDIMM memory is mirrored between the two controllers using a high-performance PCI bridge, ensuring no possibility of data loss on hardware failure, and minimizing the performance impact of mirroring the data.

### Inline deduplication

All-flash arrays deduplicate data in real-time, as data is received. The deduplication process uses a two-level fingerprint system, with short fingerprints for speed of detection and long cryptographically secure fingerprints to ensure reliability. The deduplication process optimizes for "flocks" of duplicate data, consecutive runs of blocks that are duplicated. This multi-layer deduplication process allows for near-perfect duplication detection, while dramatically reducing the amount of main memory required to efficiently deduplicate large capacity SSDs.

### Inline compression

After deduplication, HPE NimbleOS uses fast, inline, variable-block compression to substantially decrease the footprint of inbound write data. The highly optimized compression algorithms are fast enough that virtually all HPE Nimble Storage arrays are run with compression enabled for all data volumes.

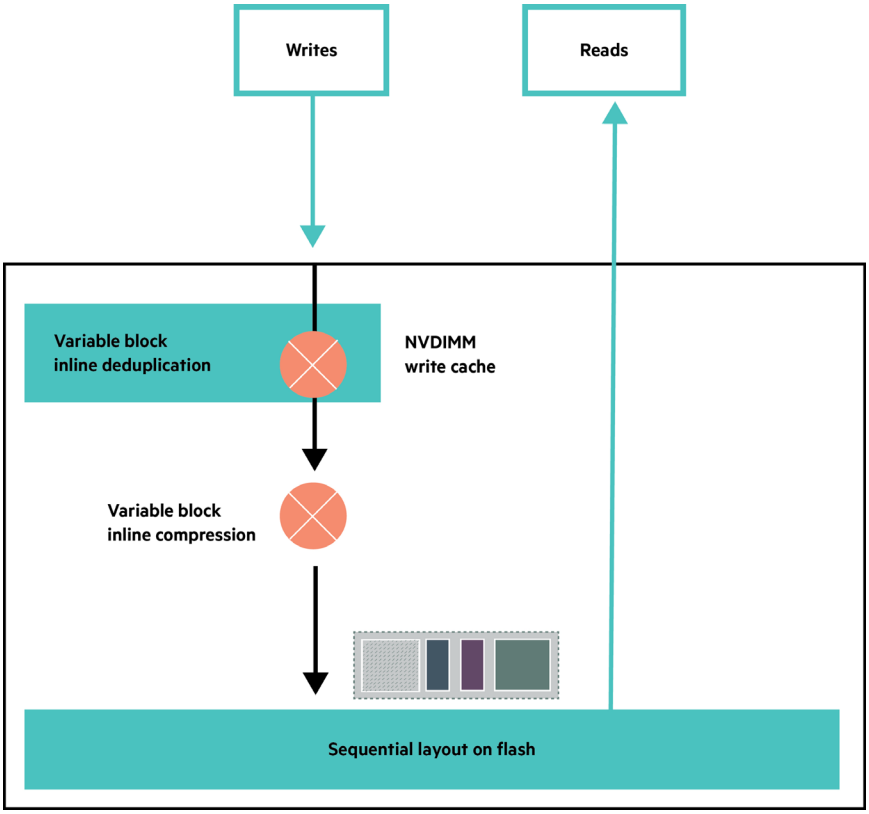


**Figure 1.** Inline deduplication and compression; caching and sequential data layout in HPE NimbleOS

## Encryption

When encryption of data-at-rest is enabled, compressed data is encrypted prior to writing it to the SSDs. Encryption is performed by the array controllers using a unique key per volume. Avoiding self-encrypting disks enables HPE NimbleOS to provide encryption on all available SSDs at no incremental cost to the customer. Use of per-volume keys allows volumes to be crypto-shredded without impact to other volumes. Because Intel® CPUs provide special instructions to accelerate modern encryption algorithms, the performance impact of enabling encryption is quite modest for most workloads.

## Thin provisioning and efficient capacity utilization

Capacity is only consumed as data is written. HPE NimbleOS efficiently reclaims free space on an ongoing basis, preserving write performance while maintaining high-capacity utilization. This avoids fragmentation and the write-amplification issues that hamper other architectures.

## Efficient, fully integrated data protection

All-inclusive snapshot-based data protection is built into every all-flash array. HPE NimbleOS can manage up to one thousand snapshots per volume. This enables users to create a complete point-in-time backup, replication, and archiving strategy around HPE NimbleOS snapshots.

### Thin, redirect-on-write snapshots

Point-in-time volume snapshots efficiently capture changed data only. This allows HPE NimbleOS to manage hundreds of thousands of snapshots with minimal performance impact. Furthermore, data can be instantly restored as snapshots reside on the same array as primary data. Restoring an older snapshot on an array does not destroy newer snapshots.

### Efficient replication

The all-flash array provides snapshot-based asynchronous replication. Because only compressed, changed data blocks are sent over the network, replication and recovery are simple and WAN-efficient. Data is always protected as encrypted data blocks are replicated without decrypting, for complete protection “on-the-wire”.

### Consistency groups

HPE NimbleOS provides volume collections. Snapshots and replication of a volume collection are done as a consistent process, enabling crash-consistent application recovery for applications that are spread across multiple volumes.

### Zero copy clones

Volume snapshots allow for fully functional copies or clones to be quickly created. Instant space-efficient clones deliver the same performance and functionality as the source volume, which is beneficial for virtualization, virtual desktop infrastructure (VDI), and dev/test workloads.

### Application consistent snapshots

HPE Nimble Storage arrays are fully integrated into the VMware® environment with a full-featured VMware® vCenter™ plug-in. The plug-in ensures that snapshots are VM-consistent. VSS integration ensures that snapshots are coordinated with Microsoft® Hyper-V, SQL Server, and Microsoft Exchange. Additionally, HPE Nimble Storage offers an Oracle App Data Manager tool to manage application consistent snapshots and clones of Oracle database applications.

## Simple and seamless scalability

HPE Nimble Storage arrays deliver flexible and independent scaling of both performance and capacity. Customers can start with a basic array as a building block and precisely scale their all-flash array infrastructure to support the changing demands, increasing capacities, and the diverse workloads of business-critical applications—without any downtime. HPE InfoSight also takes the guesswork out of scaling for the future, offering highly accurate projections for capacity growth, optimal cache, and compute sizing.

### Capacity scaling

All-flash arrays can support up to two flash expansion shelves that are easily added without disruption.

### Performance scaling

Array controllers can also be non-disruptively upgraded to controllers with more CPU cores and memory to enhance overall performance and throughput.

### Scale-out

The HPE NimbleOS scale-out architecture allows performance and capacity to be seamlessly scaled beyond the physical limitations of a single array—up to a 4-node storage cluster managed as one. This scalability can be used to eliminate performance hotspots and capacity silos. Also, to consolidate array management and protect storage investments.

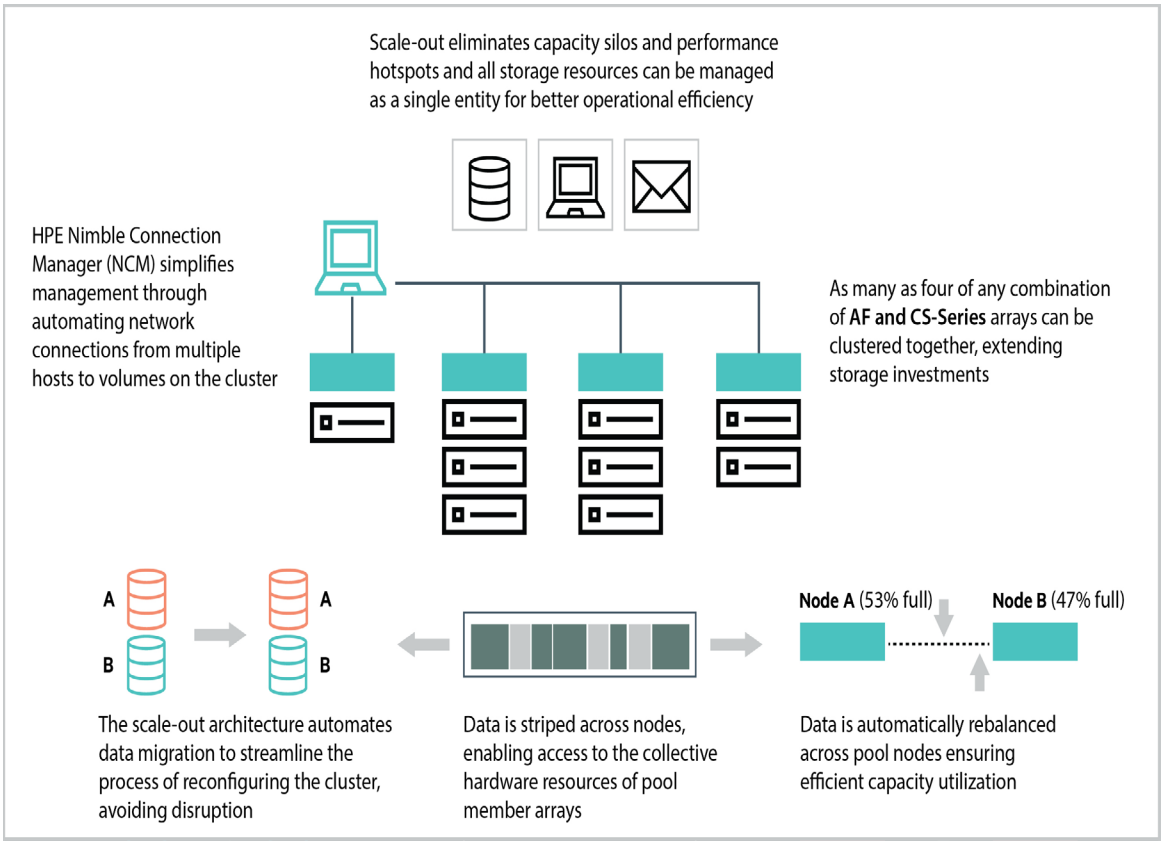


**Figure 2.** The HPE NimbleOS scale-out architecture

## HPE InfoSight

HPE InfoSight is the innovative HPE Nimble Storage analytics-based approach to the storage lifecycle. Through powerful data sciences, HPE InfoSight completely transforms the reactive, error-prone support and management experience into a proactive process for maintaining peak storage health.

HPE InfoSight monitors flash arrays, collectively and individually from the cloud. It gathers tens of millions of sensor data points daily per array and automatically makes sense of the data in real-time.

HPE InfoSight consists of:

### The HPE InfoSight engine

A data collection and analysis engine comprising sophisticated analytics, system modeling capabilities, and predictive algorithms.

- **Performance correlation analytics**
  This quickly identifies leading factors contributing to performance or latency issues, eliminating what used to take up to several days of manual data collection and analysis.
- **Detailed systems modeling**
  This activity helps identify performance bottlenecks and indicates whether increasing cache or upgrading controllers would improve the performance of deployed workloads.
- **Powerful, predictive algorithms**
  This enables administrators to visualize organic data growth and identifies when the array will approach capacity limits.

### The HPE InfoSight portal

A secure online portal that serves as a window into the HPE InfoSight engine. It consolidates and presents complex storage health and performance information into an easy-to-understand, graphical format.

The portal presents a single view of all storage assets, along with detailed information about storage performance, capacity, volumes, snapshots and replication, user-defined alerts, and support cases.

- **Proactive Wellness**
  Proactive alerts for system health, performance, and protection gaps. HPE InfoSight automatically predicts and resolves 86% of problems before issues are known.[1]

## Learn more at

hpe.com/storage/nimble

[1] Redefining the standard for system availability



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