The Insider's Guide to Evaluating All-Flash Arrays

DCIG

2017-18 ALL-FLASH ARRAY BUYER'S GUIDE

By Chuck Cook and Ken Clipperton

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Introduction

Enterprises are aggressively adopting all-flash arrays, and for good reason. The current generation of all-flash arrays address critical business priorities and deliver a return on investment of well under eighteen months in most cases. Indeed, many organizations have discovered that the transition to all-flash is self-funding, even when just the IT budget is considered.

However, the greatest value of the transition to all-flash is not IT budget savings. The greatest value of all-flash is the fact that it enables organizations to move faster. As Eric Pearson, the CIO of InterContinental Hotels Group has said, *"It's no longer the big beating the small. It's the fast beating the slow."*[1]

All-Flash, All the Time

Efficiency is the ability to accomplish a task with the least waste of time and effort. All-flash arrays (AFAs) help businesses increase efficiency by accelerating applications, eliminating storage management headaches, and automating routine processes. All-flash arrays now provide as much capacity as any organization requires, with the data services enterprises expect, and at price points that make sense to more and more businesses. Consequently, many businesses are turning to AFAs to accelerate all active workloads.

Flash is fast. Various metrics are used to evaluate all-flash array performance including latency, throughput and IOPS. In the typical highly-virtualized data center, flash offers dramatically better performance on all three metrics compared to legacy storage. Digitization initiatives are driving data volume and velocity beyond the capabilities of legacy storage. All-flash arrays can keep up with these requirements.

Flash is friendly. Datacenter friendly that is. Datacenters are expensive to operate; real estate, power and cooling are ever increasing costs. Flash eases the burden in each of those areas, consuming as little as one-tenth the data center resources of the legacy storage systems they replace. In fact, seven of the products in this Buyer's Guide can provide more than 100 TB/RU of raw flash capacity.

An AFA can also dramatically reduce storage management overhead, with storage troubleshooting nearly eliminated and routine tasks automated or simply integrated into server management tasks.

Flash is free. Well technically not free, but the return on investment is rapid. Many organizations have reported that the cost of their all-flash deployment was lower than the maintenance costs on their legacy storage system. Other organizations have eliminated whole data centers and achieved a nearly instantaneous ROI.

Competition among all-flash array vendors is fierce. Vendors continually add or enhance features and adopt the latest hardware improvements to gain an edge. As soon as products from vendors 'A' and 'B' achieve parity, Vendor 'C' leapfrogs them both and the scramble is on to catch up with the latest improvements. Yes, this is capitalism at its finest; and when vendors compete, you win.

DCIG is pleased to present this fresh snapshot of the dynamic all-flash array (AFA) marketplace. The *DCIG 2017-18 All-Flash Array Buyer's Guide* helps businesses accelerate the all-flash array selection process. This Buyer's Guide includes data sheets for twenty-five (25) enterprise-class all-flash arrays that achieved rankings of *Recommended*, *Excellent* or *Good*.

1. Pat Gelsinger on Stage at VMworld 2015, 15:50. YouTube. YouTube, 01 Sept. 2015. <https://www.youtube.com/watch?v=U6aFO0M0bZA&list=PLeFlCmVOq6yt484cUB6N4LhXZnOso5VC7&index=3>.

Introduction (continued)

These products come from twelve (12) vendors including Dell EMC, Fujitsu, Hitachi Data Systems, HPE, Huawei, NEC, IBM, NetApp, Nimble Storage, Pivot3, Pure Storage and Tegile.

The Value This DCIG Buyer's Guide Creates for Buyers

As in the development of all prior DCIG Buyer's Guides, DCIG's analysts have already done the heavy lifting for enterprise technology buyers by:

- Identifying a common technology need with many competing solutions but with little comparative data available to technology purchasers
- Scanning the environment to identify available products in the marketplace
- Gathering normalized data about the features each product supports
- Providing an objective, third-party evaluation of those features from an end-user perspective
- Describing key product considerations and important changes in the marketplace
- Presenting DCIG's opinions and product feature data in a way that facilitates rapid feature-based comparisons

The end result is that the *DCIG 2017-18 All-Flash Array Buyer's Guide* drives time and cost out of the product selection process by enabling prospective buyers to more quickly identify a shortlist of products that meet their specific needs. Thus, prospective purchasers can focus their product evaluation energies and move more quickly to the competitive bid process.

Each DCIG Buyer's Guide provides a valuable point-in-time snapshot of a marketplace. Vendors, of course, continuously release new products and feature enhancements. DCIG routinely incorporates these product updates into its bodies of research. The data DCIG collects is made available through subscription to the DCIG Competitive Intelligence Portal.

As a supplement to the downloadable Buyer's Guide, end users registering to access this report via the DCIG Competitive Intelligence Portal also gain access to the DCIG Interactive Buyer's Guide (IBG). The IBG enables organizations take the next step in the product selection process by generating custom reports, including comprehensive side-by-side feature comparisons of the products in which the organization is most interested. See **www.dcig.com** to learn more about the DCIG Competitive Intelligence Portal.

Note that this Buyer's Guide is not intended to be a substitute for bringing individual products in-house for testing. In-house testing or proof-of-concept implementations should still be done, if possible, since each product will perform differently under different application workloads and data center environments. We hope you find that this Buyer's Guide meets its intended purpose in your environment.

Chuck and Ken

Executive Summary

The marketplace for all-flash arrays is both rapidly growing and highly competitive. Many changes have taken place in the all-flash array marketplace in the 16 months since the release of the *DCIG 2015-16 All-Flash Array Buyer's Guide.* We have witnessed substantial increases in AFA capacity, storage density and performance. We have also observed some market consolidation through significant acquisitions and exits.

In a sense, the AFA marketplace is becoming simply the storage array marketplace. All significant product lines are now offered in AFA configurations, with various flash optimizations implemented including options specific to the all-flash configurations.

DCIG researched the features of more than 80 all-flash arrays for its Storage Array Body of Research. Recognizing that there are multiple market segments for these products, we grouped the products into midmarket, small and midsize enterprise, and enterprise classifications. The *DCIG 2017-18 All-Flash Array Buyer's Guide* includes the products that ranked *Recommended, Excellent* or *Good* among the enterprise grouping of arrays. Most of the products in this guide are part of a series that extend into the High End Storage Array classification as well as the SME and/or midmarket. Other products are the most robust model in a series.

Vendors are Exploring New Ways to Increase Their Value Proposition

As all-flash arrays rapidly transition from niche deployments to running general purpose all-day/every-day workloads, customer expectations for all-flash arrays have grown. Comprehensive data services are now considered table stakes. In this highly competitive marketplace, vendors are exploring new offerings to sway purchasers, including:

- **All-inclusive Licensing.** Since our last review of AFA products, multiple vendors switched to an all-inclusive approach to licensing, including HPE and NEC.This simplifies the purchasing process, encourages feature utilization and eliminates ongoing administrative overhead.
- **Utility-style Pricing.** Companies looking to reduce expenses often evaluate cloud-based IT services as an alternative to on-premise infrastructure. Cloud services can reduce CAPEX expenditures by offering a $/GB/month pricing model. Multiple AFA vendors now offer similar utility-style pricing options, including HPE and Tegile.
- **"Free" Hardware.** Who doesn't love free? Vendors are now offering "free" hardware upgrades to entice purchasers. Customers maintaining an active maintenance agreement can receive free hardware refreshes every 3-5 years. Most of these programs are quite new so there may not be much, if any, track record. Caveats may arise. As always, read the fine print.
- **Cloud-based Analytics.** Nimble Storage is generally credited with creating this new expectation in storage systems—the availability of proactive remediation based on cloud-based analytics. In most cases, both the vendor and the IT staff have access to the data as an aid to remediating problems, increasing performance and uptime, and simplifying capacity planning.

Executive Summary (continued)

- **Unified Storage.** Maintaining separate SAN (Fibre Channel and iSCSI) and NAS (NFS, CIFS and SMB3) infrastructures is inefficient and for many enterprises is becoming unnecessary. Consolidating workloads on a single array capable of running both SAN and NAS protocols increases business value by eliminating redundant hardware and its associated costs, including: administration, data center space and maintenance contracts. Some products still require a separate appliance (filer head) to provide file protocol support, but multiple vendors have recently integrated file protocol support into their primary controllers, including HPE 3PAR, NEC and Dell EMC.

Features that Enable Consolidation are Key to Creating Business Value

In addition to the considerations given above, all-flash arrays can create value by enabling significant reductions in overall data center costs. Consolidation is one of the primary means of reducing costs. This consolidation extends beyond storage to server and even data center consolidation. Fundamental hardware features that enable consolidation are described below and will be expanded on in the DCIG Comments.

Hardware Evolution Creates Consolidation Opportunities

- Average flash capacity increased 2x to 3x. Compared with the arrays in the DCIG 2015-16 AFA Buyer's Guide edition, the average raw flash capacity nearly doubled from 445 TB to 880 TB. The maximum raw flash capacity nearly tripled to 10 PB.
- Average flash density increased 3x to 4x. Average raw storage density rose nearly 4x to 80 TB/RU (terabytes per rack unit). The maximum density achieved by any array in this Buyer's Guide is an impressive 192 TB/RU.
- New models featuring updated Intel CPUs with more cores and larger DRAM caches.
- Substantial adoption of 12 Gb SAS back-end connections to SSDs, doubling the bandwidth to each flash memory device.
- Substantial adoption of 16 Gb FC, doubling the front-end bandwidth to hosts.

All-Flash Array Marketplace Consolidation and Disruption

Several acquisitions and exits have created significant disruption in the storage industry. Acquisitions include Dell purchasing EMC, NetApp acquiring SolidFire and Pivot3 buying NexGen. Another disruption occurred when AFA pioneer Violin Memory filed for bankruptcy. DCIG expects additional consolidation in the storage array marketplace.

The Purpose of this Buyer's Guide Edition

The *DCIG 2017-18 All-Flash Array Buyer's Guide* contains fresh information that will accelerate the research process for organizations and increase their confidence in the results of that research.

As prior Buyer's Guides have done, this Buyer's Guide puts at the fingertips of organizations a comprehensive list of all-flash arrays and standardized data sheets that can assist them in this important buying decision. The use of this DCIG Buyer's Guide will enable an organization to formulate an informed opinion on features that are most important to them, then generate a short list of products to research further and/or acquire.

Executive Summary (continued)

This *DCIG 2017-18 All-flash Array Buyer's Guide* accomplishes the following objectives:

- Collects and standardizes data about the features of available AFA models
- Provides an objective, third party evaluation of features from an end user's viewpoint
- Provides insight into the current state of the marketplace and product features that may warrant particular attention
- Scores and ranks the features on each model based upon the criteria that matter most to end users so they can quickly know which models are the most appropriate for them to use and under what conditions
- Provides standardized data sheets for twenty-five (25) all-flash storage arrays from twelve (12) storage providers so end users can do quick comparisons of more than 50 features that are supported or not supported on each model
- Gives any organization the ability to request competitive bids from different storage providers that are *apples-to-apples* comparisons

How to Use this Buyer's Guide

This Buyer's Guide is intended to help users accelerate their product research and selection process—driving cost out of the research process while simultaneously increasing confidence in the results. The purpose of this Buyer's Guide is NOT to tell users exactly which product(s) to purchase. Rather, it is to guide them in coming up with a list of competitive products that have comparable features that meet their specific needs.

To help in that decision, this Buyer's Guide gives organizations a sense of how products compare with each other, and provides insight into what other product offerings are available on the market and the specific features they offer. Features, as displayed on each product data sheet, represent the opinion of DCIG. DCIG encourages and strongly recommends every organization verify the functionality of the features that are of particular interest to them before making a buying decision.

DCIG recommends that companies use this Buyer's Guide in the following seven ways:

1. ***Eliminate the painstaking research normally associated with identifying a shortlist of products that meet their needs.*** This Buyer's Guide evaluates twenty-five (25) storage arrays from twelve (12) storage providers. Each product is ranked *Recommended, Excellent* or *Good* based on standard deviation ranges. More than 100 different features were evaluated, so organizations only need to look at the rankings and features to come up with a short list for consideration.
2. ***Do apples-to-apples comparisons of products from different vendors.*** It behooves an organization to get competitive bids from multiple vendors. After all, *when they compete, you win!* But that tactic only works well when organizations know that they are receiving competitive bids on products that are roughly comparable. Using this Buyer's Guide, organizations can do a better job of accomplishing that objective.
3. ***Separate the apples from the oranges.*** Just as important as doing apples-to-apples comparisons is identifying when an orange is thrown into the mix. Sometimes it is very difficult for an organization to know if it is truly getting a good deal when bids come in from vendors that include different products. Now organizations can refer to the rankings of each product on this guide so they know when they are getting a good deal, a great deal or just a *"so-so"* one.
4. ***Gain perspective on how products from less well-known vendors compare against established and better-known brands.*** There's a built-in level of comfort when buying products from well-known vendors. There's also a built-in resistance to buying products from vendors that are perceived as unknown quantities. This Buyer's Guide helps to remove some of that apprehension. Using this Buyer's Guide, organizations can see how these products stack up.
5. ***Normalize complex terminology.*** Every segment across industries has a proclivity to adopt acronyms and jargon that is specific to it. This Buyer's Guide sifts through the acronyms and jargon and then normalizes these terms, providing a foundation for meaningful comparisons. Definitions for these normalized terms are provided in the Glossary in this Guide.
6. ***Take advantage of standardized data sheets to quickly compare products side-by-side.*** The product data sheets available from the different vendors are rarely laid out in the same way or contain the same information. Some vendors even have data sheet formats that vary from product to product within their own portfolio. This Buyer's Guide tackles this problem by creating a standard, easy-to-read data sheet for every product. In this way, product data sheets for individual products can be printed out and laid down side by side so that the features on them can be quickly compared.
7. ***Help justify buying recommendations to business teams.*** An overall ranking of *Recommended*, *Excellent* or *Good* is included at the top of every product data sheet. This overall ranking summarizes in a single word how feature rich a product is compared to the other products in the Buyer's Guide.

Disclosures

Over the last few years the general trend in the US has been for both large and boutique analyst firms to receive some or all of their revenue from vendors.

DCIG is no different in this respect as it also receives payment for the different services it performs for vendors. The services that DCIG provides include blogging, battle cards, competitive advantage reports, customer validations,

product reviews, executive white papers, white papers and special reports.

In the interest of transparency, a number of the vendors included in this DCIG Buyer's Guide are or have been DCIG clients. This is not to imply that their products were given preferential treatment in the Buyer's Guide. All it means is that DCIG had more knowledge of their products so that DCIG could consider their product for inclusion in this Buyer's Guide.

In that vein, there are a number of important facts to keep in mind when considering the information contained in this Buyer's Guide and its merit.

- No vendor paid DCIG any fee to research this topic or arrive at pre-determined conclusions.
- DCIG did not guarantee any vendor that its product would be included in this Buyer's Guide
- DCIG did not imply or guarantee that a specific product would receive a preferential ranking in this Buyer's Guide, before or after completion of research
- All research was based upon publicly available information, information provided by the vendor, and/or the expertise of those evaluating the information
- No negative inferences can be drawn against any vendor or product not included in the Buyer's Guide
- It is a misuse of the Buyer's Guide to make comparisons between any vendor or product not ranked in the Buyer's Guide versus any vendor or product ranked in the Buyer's Guide

Because of the number of features analyzed and weighed, there was no way for DCIG to accurately predict at the outset how individual products would end up ranking. DCIG wants to emphasize that no vendor was privy to how DCIG weighed individual features. In every case the vendor only found out the rankings of its product(s) after the analysis was complete.

Inclusion and Exclusion Criteria

The inclusion and exclusion of specific array models in this Buyer's Guide is based on the follow criteria:

- Must be available as an appliance that is available as a single SKU and includes its own hardware and software.
- Must be marketed as an all-flash array (AFA). The best evidence of meeting this criterion is the existence of a specific all-flash SKU.
- Must use flash memory as primary storage, not merely as an extended cache.
- May permit storage expansion with disk shelves that contain HDDs or the virtualization of external disk-based arrays—essentially converting the all-flash array into a hybrid storage array.
- Must support one or more of the following storage networking protocols: iSCSI, Fibre Channel, InfiniBand, NFS.
- Must not be classified by DCIG as a High End Storage Array. Those products are a separate market and are covered in the DCIG High End Storage Array Buyer's Guide.
- There must be sufficient information available to DCIG to make meaningful decisions. DCIG makes a good faith effort to reach out and obtain information from as many storage providers as possible. However, products may be excluded because of a lack of sufficient reliable data.
- Must be formally announced and/or generally available for purchase as of February 28, 2017. A cut-off date had to be put in place or this Buyer's Guide would never be published.

Ultimately, it is the professional judgment of the analysts working on each DCIG Buyer's Guide whether or not a particular model meets the inclusion criteria.

The Eight-Step Process Used to Rank the Products

To rank each product included in this Buyer's Guide, DCIG went through an eight-step process to come to the most objective conclusion possible.

1. *DCIG established which features would be evaluated and which ones would not.* Prior to selecting the features which would be evaluated, DCIG quantified, then "normalized" the list of available features such that a common name for each feature was established. In cases where a feature could not be objectively defined or understood, it was excluded from consideration.
2. *The features were grouped into four (4) general categories.* The features to be evaluated were grouped into four broad categories: Management & Software, Hardware, Virtualization and Support.

3. *DCIG developed a survey to capture the feature data and completed a survey for each vendor's product(s). DCIG then sent the survey(s) to each vendor for verification. Each vendor was invited to review their data and respond with any corrections or edits to the DCIG-completed survey(s).* In every case, every vendor had the opportunity to review and respond to any DCIG-completed survey.

4. *DCIG identified a list of products that met the DCIG definition for "All-Flash Array" based on the inclusion/exclusion criteria.*

5. *DCIG weighted each feature to establish a scoring rubric.* The weighting of each feature was done by a team of DCIG research analysts. The weightings were used to reflect if a feature was supported and potentially how useful and/or important the feature was to end users.

6. *Each product's features were scores based on information gathered in the surveys.* Features were marked as either *"supported"* or *"unsupported/undetermined"* and then scored accordingly. Rankings were finalized after any updates from vendors had been entered and the review period had expired.

7. *Products were ranked using standard scoring techniques.* One of the goals of this Buyer's Guide is to establish clear lines of differentiation with conclusions that are arrived at objectively. To accomplish this goal, the mean score for all products was first determined and then the standard deviation. DCIG developed an overall ranking for each product based on where that product's overall score fit into standard deviation ranges.

8. *Product feature data review worksheets were created and sent to the vendors for review before publication.* Each data sheet included in this published version of the Buyer's Guide is derived from a feature data review worksheet that was sent to the vendor for its review and feedback. In every case, each vendor had an opportunity to review and update the content included on its respective data sheet(s).

Due to the large number of product features that DCIG evaluated, only a subset of the collected data could be included on the data sheets. The feature data on the data sheets was selected based on the following criteria: 1) the most variability, 2) the greatest scoring weight, and 3) of the greatest interest to prospective array purchasers. The full set of product feature data may be accessed in the DCIG Competitive Intelligence Portal available through DCIG's website: **www.dcig.com**.

DCIG Comments

Mark Twain wrote to a concerned relative, "...the report of my death was an exaggeration." Likewise, the death of legacy arrays (HDD based) may be an exaggeration, but the transition to all-flash is clearly accelerating. The business value proposition of AFAs is far too great to be ignored. From green field deployments to enterprises refreshing storage infrastructure, all-flash storage offers a compelling story.

AFAs have been the obvious option for a number of years in cases where ultra-low latency for high-value applications matters more than general purpose storage features. Happily, this trade-off is a thing of the past. AFA vendors have added data services to their AFA product lines. Established enterprise storage vendors have added AFAs to their general purpose product lines or acquired an AFA startup and integrated it into their offerings.

Enterprises now have many products to choose from that will deliver the performance benefits of an AFA without forcing them to compromise on data services. Many mainstream organizations are now seeking to replace legacy enterprise storage arrays with AFAs. As such, this Buyer's Guide evaluates arrays on the breadth of features required of an organization's primary storage array.

The Business Value of Flash

For many organizations considering a storage refresh today the key reasons to transition to all-flash storage include the opportunity to accelerate all current applications rather than a select few, and to gain performance headroom to add more applications and handle growing amounts data. Another factor driving AFA adoption is simplification, including the ability to integrate with automation frameworks via REST API support and with hypervisor management consoles.

Consolidation and Simplification are Keys to Creating Business Value

Consolidating many workloads onto an all-flash array can enable significant reductions in overall data center costs. AFA-enabled consolidation extends beyond storage consolidation to include server and even data center consolidation.

Since the current generation of all-flash arrays have the capacity and performance to potentially handle many workloads concurrently, features that enable consolidation are a reasonable focus for evaluation.

Features that Enable Consolidation

- Sufficient storage capacity
- Storage density much higher than the density of the legacy storage system
- Performance – Latency, IOPS, Bandwidth
- Multi-protocol (unified SAN and NAS) support
- High-speed Fibre Channel (FC) and Ethernet connectivity to application servers
- Quality of Service features (QoS)
- Multi-tenancy
- Non-disruptive Upgrades (NDU) & redundancy features that maximize uptime availability.
- Certified support for Enterprise Applications

Features that enable simplification can significantly improve IT agility, and therefore also deserve careful consideration. As noted in the introduction, *"It is no longer the big beating the small. It's the fast beating the slow."*

Features that Enable Simplification

- Automated intelligent caching and/or storage tiering
- Automated/policy-based provisioning
- Hypervisor management console integration empowering administrators to quickly allocate and assign storage to new virtual machines
- Proactive intervention based on storage analytics
- Proactive remediation based on fault data
- QoS based on predefined service levels enabling an administrator to quickly and easily assign each application or volume to a priority classification
- REST API to enable integration into automation frameworks that are the foundation for self-service ITaaS

Organizational Considerations

There are staffing and organizational implications associated with consolidating and simplifying storage. These will need to be addressed if an organization is to derive full value from its all-flash transition.

Capacity and Density

As noted in the Executive Summary, average AFA flash density of the products in this Buyer's Guide is 80 TB/RU with some arrays achieving 192 TB/RU. The combination of all-flash performance and high storage density means that an AFA may be able to meet an organization's performance and capacity requirements in 1/10th the space of legacy storage systems, creating an opportunity to realize significant data center cost reductions.

Quality of Service (QoS)

Managing storage performance can be complicated. The raw performance of an AFA may initially enable it to service all applications adequately. However, if enough applications are consolidated on the AFA, contention for finite resources will inevitably surface. Quality of service (QoS) features enable confident consolidation by ensuring critical applications receive appropriate performance resources. Most AFAs now support QoS features. The simpler these are to implement, the better.

QoS Feature	% of Arrays Supporting Feature
User assigns to predefined service levels	64%
User-defined Maximums	84%
User-defined Minimums	56%
User-defined Targets	44%

Management Integration and Automation

Workflow automation is increasingly important as enterprises strive to streamline their business processes. Storage vendors understand this challenge and are continually adding management flexibility to the arrays. By supporting multiple management interfaces, AFA's can be deployed more quickly and incorporated into existing workflows. VMware vCenter is universally supported. Management integrations with Microsoft and open standards are now widely supported.

Management Method	2017-18
VMware vCenter	100%
OpenStack Cinder	88%
REST API	84%
SMI-S	88%
SCVMM SMAPI	76%

Best Practices

Mind the failure domain. Consolidation can yield dramatic savings, but it is prudent to consider the failure domain, and how much of an organization's infrastructure should depend on any one component--including an all-flash array.

Focus on accelerating apps. Eliminating storage bottlenecks may reveal other bottlenecks in the application path. Getting the maximum performance benefit from an AFA may require more or faster network connections to application servers and/or the storage system, more server DRAM, adjusting cache sizes and adjusting other server and network configuration details. Some AFAs include utilities that will help identify the bottlenecks wherever they occur along the data path.

Leverage multi-tenancy features. Explore using multi-tenancy to limit the percentage of AFA resources any server administrator or software developer can allocate.

Pursue automation. Automation can dramatically reduce the amount of time spent on routine storage management and enable new levels of IT agility. This is another place where multi-tenancy and/or robust QoS capabilities add a layer of safety.

Conduct a proof of concept implementation. This can validate AFA feature claims and uncover performance-limiting bottlenecks elsewhere in the infrastructure.

Feature Areas Where DCIG Expects to See Improvement

PCIe, NVMe and NVDIMM Adoption

The amount of bandwidth to the individual flash device is a significant barrier to overall array performance. This limitation grows in importance as the capacity of an individual SSD increases. The next leap forward in AFA performance will occur as PCIe-attached media addressed via the NVMe protocol is adopted in AFA storage systems. DCIG expects this transition will occur in 2017 and 2018.

NVDIMM provides the next level of performance beyond PCIe/NVMe and will also play a discernible role by the end of 2018. Whether addressed as a block storage device or as persistent memory, the resulting performance enhancements will enable another wave of consolidation in the data center and perhaps provide the foundation for a new generation of analytics applications..

Data Governance/Security

Data security is an increasingly important concern affecting every enterprise. Data loss, theft or compromise can ruin a career or a business. A logical step would include adding data governance capabilities.

Data Fabrics and Seamless Tiering to the Cloud

Data access rates decline precipitously as data ages. Studies indicate that most data more than a few weeks old is rarely, if ever, accessed. The majority of data in most enterprises is cold. Maintaining such data on the highest performance flash media is inefficient. Leveraging "limitless" cloud capacity for this cold data should reduce storage costs. Less than 25% of the arrays that were surveyed currently support native tiering to the cloud. DCIG expects more vendors to add hybrid-cloud/cloud-tiering capabilities to their arrays.

Performance and Pricing

Two factors that strongly influence buying decisions are performance and cost. Therefore, it may come as a surprise to those who look at this *DCIG 2017-18 All-Flash Array Buyer's Guide* to see no performance benchmarks and no pricing information. There are two core reasons why performance and pricing information are not included in this Buyer's Guide.

First, performance results vary according to data center environments, the data being stored, and implementation decisions. Introducing any type of performance metric would only result in the analysis in this Buyer's Guide becoming more subjective, not less.

Second, this Buyer's Guide is intended to provide a point-in-time snapshot of the high end storage array marketplace. If DCIG had tried to test and establish performance benchmarks for all of these arrays, the next generation of arrays could well be available before the testing was completed,

making this Buyer's Guide obsolete before it ever saw the light of day.

As for pricing, many factors influence final price including capacity purchased, services, extended warranties, negotiations, etc. These factors differ for every vendor and for every enterprise.

DCIG recognizes that price and performance are relevant and often key considerations when buying a storage array. However, it is almost impossible for a third party like DCIG to objectively measure these features on a large scale. Therefore, evaluating these factors is a part of the buying process that is still best left to end users.

DCIG Observations

Recommended Ranking

Observations

Consolidating workloads on an all-flash array increases business value by accelerating more applications while eliminating redundant hardware and its associated costs. Those costs include administration, maintenance contracts and data center power, cooling and rack space. Many features contribute to the ability of an array to consolidate many workloads.

The following products earned the *Recommended* ranking: HPE 3PAR StoreServ 8450, 8440, 8400, Dell Storage SC9000, Hitachi Data Systems VSP F800, F600, F400, Huawei OceanStor 5800, 5600, 5500, 5300 V3, and NetApp AFF A300. DCIG observed that the following characteristics and features generally distinguish *Recommended* arrays from other arrays.

- Unified storage (Concurrent SAN & NAS), most without requiring a separate filer head
- Multi-tenancy
- Scale-out architecture
- PB of Flash
- Hardware-accelerated deduplication
- Comprehensive virtualization support
- Comprehensive management integrations including OpenStack, REST API, Microsoft SCVMM, SMI-S and VMware vCenter
- Extensive quality of service (QoS) options
- More self-healing capabilities
- Synchronous replication

HPE 3PAR StoreServ 8000 Series

HPE 3PAR StoreServ 8000 Series arrays enable workload consolidation in many ways. An 8450-based four-controller Mesh Active cluster provides up to 40 CPU cores, 384 GiB of DRAM cache and 736 TB of raw all-flash capacity in just four (4) rack units. Capacity can be scaled up to nearly 2 PB with storage enclosures and 15.36 TB SSDs, achieving an impressive storage density of 184 TB/RU (terabyte per rack unit).

HPE 3PAR StoreServ arrays also enable workload consolidation through concurrent support for SAN and NAS protocols within a single array. A four-controller cluster provides up to 16 1GbE or 8 10GbE ports for iSCSI or NAS connections and 24 16Gb Fibre Channel (FC) ports to accelerate most any workload.

The HPE 3PAR Gen5 Thin Express ASIC (Application Specific Integrated Circuit) enhances raw capacity/density with hardware-accelerated zero block detect and in-line block-level deduplication. The ASIC also provides management of thin provisioning, thin persistence, automated space reclamation, metadata operations, and of the PCIe cluster-interconnect.

Rich QoS options enable confident consolidation by guaranteeing the performance of critical applications through bandwidth, IOPS and latency thresholds. Management APIs and an SDK enable integration with 3rd party automation and infrastructure management frameworks; freeing IT staff to focus on other business priorities.

Dell Storage SC9000

The Dell Storage SC9000 array is the top model in the SC series of arrays. A cluster can include up to 8 controllers providing up to 6 PB of raw all-flash capacity. Each SC9000 controller provides 16 processor cores (dual 8-core processors) and 256GB DRAM cache. File protocol support can be added through the purchase of Dell Compellent FS8600 filer heads. The Compellent Storage Center OS provides extensive automated storage tiering and snapshot features.

The SC arrays support 15.3 TB SSDs, self-encrypting drives and can achieve a storage density of 136 TB/RU. The Dell Storage SC9000 leverages two SSD tiers (write and read intensive) to optimize performance, SSD endur-

ance and cost. The SC9000 initially writes all data to the write-intensive SSD tier. Deduplication occurs later, when the array's automated data tiering process moves data to the read-intensive SSD tier.

Hitachi Data Systems VSP F400, F600 and F800

The Hitachi Data Systems VSP F400, F600 and F800 arrays utilize Hitachi-engineered flash module devices (FMD DC2) to deliver highly granular QoS management and other benefits. Each FMD incorporates an ASIC to provide hardware accelerated in-line compression and decompression with T10 DIF to ensure end-to-end data integrity. Hitachi's flash translation layer implements proprietary flash management technology that increases the performance and endurance of the underlying flash memory.

The HDS VSP F-Series arrays are the only *Recommended* arrays which supports VM-level replication. The array also supports data migration to the cloud, including: Amazon S3, Microsoft Azure and the Hitachi Cloud Platform.

Hitachi offers a 100% data availability guarantee which provides a credit for replacement equipment if there is a loss of data availability caused by a malfunction of the storage array.

Huawei OceanStor 5000 V3 Series

The Huawei OceanStor 5300/5500/5600/5800 V3 arrays scale from 1.8 PB to over 5 PB of raw all-flash capacity. A fully scaled-out cluster consists of 4 pairs of controllers. Controllers in each pair are interconnected via an 8-lane PCIe 3.0 high-speed mirroring channel, and to other controller pairs via 10 Gb Ethernet.

The arrays optimize resource utilization for mission critical applications through LUN-specific SmartQoS policies which ensure that the required IOPS, bandwidth or latency requirements are achieved. The OceanStor V3 arrays streamline storage infrastructure via the SmartVirtualization feature which consolidates and centralizes heterogeneous storage systems. SmartVirtualization eliminates data silos, simplifying storage management, data migrations and disaster recovery procedures.

Huawei has operations worldwide, with its strongest brand recognition in the APAC region. Although relatively unknown in the Americas for its storage products, the company is expanding its R&D and operations in North America.

NetApp AFF A300

The NetApp AFF A300 was announced in September 2016, refreshing the all-flash FAS products. It utilizes the 15.3 TB SSD and scales to nearly 6 PB of raw all-flash capacity per dual controller pair. A fully scaled-out A300 cluster consists of 12 high-availability (HA) pairs with a maximum raw capacity of over 70 PB. The cluster interconnect is 10 Gb Ethernet. The A300 is the only product in the Buyer's Guide that supports 32Gb FC and 40 GbE connectivity.

NetApp arrays provide a unified storage infrastructure supporting SAN and NAS protocols in a single appliance. The AFF A300 can be clustered with hybrid NetApp FAS systems, enabling workloads to move between high-performance all-flash tiers and lower-cost higher capacity HDD tiers.

NetApp has been pursuing a hybrid-cloud data fabric vision for a number of years, an effort that appears to be bearing fruit. The AFF A300 runs Clustered ONTAP 9.1, which now includes ONTAP Cloud support for Microsoft Azure (in addition to AWS).

Excellent Ranking

The following products earned the *Excellent* ranking: Dell EMC Unity 600F All-Flash, Dell Storage SC8000, FUJITSU Storage ETERNUS AF650, NEC M710F All Flash Array, Pivot3 N5-6000 PCIe All Flash Array, Pure Storage FlashArray //m70, Tegile IntelliFlash HD T10KHD-300 and T10KHD-200.

Dell EMC Unity 600F All-Flash

The Dell EMC Unity products were released in May 2016, replacing the VNX line. Unity provides unified storage in a single appliance. Support for 15.3 TB SSD drives enables the Unity 600F to provide up to 384 TB in just 2U. Maximum capacity reaches nearly 10 PB. This impressive raw capacity is further enhanced through in-line compression.

Dell EMC CloudIQ is a no-cost, cloud-based software offering that provides a web-based monitoring interface for Unity environments. CloudIQ storage analytics compares collected system data (alerts, performance, capacity and configuration) against Dell EMC best practices to determine a Proactive Health Score for each array. Issues are presented along with recommended remedial actions.

Dell Storage SC8000

The Dell Storage SC8000 utilizes the same architecture as the SC9000, although with slightly less performance resources. These arrays support concurrent iSCSI, Fibre Channel (FC) and Fibre Channel over Ethernet (FCoE). Unified storage capabilities can be added through the purchase of Dell Compellent FS8600 filer heads.

FUJITSU Storage ETERNUS AF650

The FUJITSU Storage ETERNUS AF650 is based on the ETERNUS DX architecture.

The ETERNUS AF650 supports many of the data protection features surveyed and is one of two vendors ranked *Excellent* that support the T10 PI standard for ensuring end-to-end data integrity. Automated QoS policies can be set based on maximum IOPS or by using predefined service levels.

NEC M710F All Flash Array

The NEC M710F dual-controller array provides native SAN protocol support and uses a NAS gateway appliance for unified storage capabilities. The array does not support deduplication or compression, but scales up to 960 drives and a maximum raw flash capacity of 3.6 PB. Host connectivity is robust, with up to 48 16Gb FC and 24 10GbE ports. Maximum density is 45 TB/RU.

NEC arrays ensure data integrity through support for T10 PI, and protect data from theft by using self-encrypting drives (SED) and DoD-compliant data erasure technology. NEC also simplifies M-Series deployments through a new all-inclusive approach to licensing.

Pivot3 N5-6000 PCIe All Flash Array

In February 2016, Pivot3 acquired NexGen Storage and rebranded NexGen's NVMe-ready PCIe all-flash arrays. The Ethernet-only array provides a maximum raw flash capacity of 240 TB and density of 20 TB/RU.

The Pivot3 array combines multi-level flash tiering, dynamic QoS and active caching to prioritize workloads according to business needs. Comprehensive QoS features include five pre-defined QoS policies to assign performance characteristics to each volume. The Pivot3 array supports extensive automation and provisioning options, including VMware Virtual Volumes (VVol) support that exposes these same QoS policies on a per-VM basis within vCenter Server.

Pure Storage FlashArray //m70

The Pure Storage FlashArray//m70 array utilizes a chassis-based design allowing for modular expansion and upgrades for multiple hardware generations. The FlashArray supports 80 CPU cores and 24 storage networking ports. The FlashArray//m70 array integrates the latest innovations in NVDIMM and is NVMe-ready.

Pure Storage arrays run the designed-for-flash Purity operating environment. According to the Pure Storage "Flash Reduce Ticker" their customers are achieving an average in-line data reduction rate of 5:1. Pure Storage offers Evergreen Storage which provides includes upgraded controllers with each 3-year maintenance and support renewal, and proactive support based on storage analytics.

Tegile IntelliFlash HD T10KHD-300 and T10KHD-200

The IntelliFlash HD arrays team Tegile's IntelliFlash Metadata Accelerated active-active dual-controller unified storage architecture with Western Digital Corporation's SanDisk InfiniFlash dense flash enclosures to provide up to 522 TB of raw flash capacity in 5 RU, achieving a raw density of 104 TB/RU.

IntelliFlash arrays separate metadata from the primary data path, storing the metadata on high-performance memory devices. This separation of data optimizes functions such as in-line deduplication, in-line compression and snapshots, while simultaneously accelerating all I/O. Tegile also offers utility-based pricing, cloud-based analytics and a lifetime storage refresh program.

Good Ranking

The following products earned the *Good* ranking: IBM FlashSystem A9000, IBM FlashSystem A9000R, IBM FlashSystem V9000, NetApp SolidFire SF19210 and Nimble Storage AF9000.

IBM FlashSystem A9000, A9000R and V9000

IBM FlashSystem A9000, A9000R and V9000 all utilize the FlashSystem 900 hardware to provide data storage capacity. IBM now offers a FlashCore™ Forever program which includes new controllers with a 3 year maintenance extension.

IBM FlashSystem A9000 and A9000R controllers run IBM Spectrum Accelerate (formerly XIV) software in a flash storage grid architecture. Grid controllers and flash enclosures

are interconnected over redundant 56 Gb InfiniBand links. Hardware cards inside each controller perform compression. Pattern removal and deduplication are also supported. IOPS and bandwidth may be restricted via QoS policies.

The IBM FlashSystem A9000 is a fixed 8U configuration of three grid controllers plus one flash enclosure. Each of the grid controllers contains two 8-core processors and 192 GB of DRAM, for a total of 48 cores, 576 GB of DRAM, and a maximum raw flash capacity of 106 TB at 11.4 TB/RU.

The IBM FlashSystem A9000R consists of two to six grid elements, delivered in an IBM rack. Each 6U grid element contains two grid controllers plus one flash enclosure. A maxed out A9000R provides 240 CPU cores, 4608 GB of DRAM, and a maximum raw flash capacity of 634 TB.

The IBM FlashSystem V9000 utilizes the FlashSystem 900 hardware with the IBM Spectrum Virtualize (formerly SAN Volume Controller) software providing virtualization and data services. V9000 scales up and out providing 128 CPU cores, 2048 GB of DRAM, and a maximum raw flash capacity of 844 TB.

NetApp SolidFire SF19210

The NetApp SolidFire SF-Series block storage system that scales out to 100 nodes. Single-node scaling allows organizations to expand gradually as business needs require. SolidFire automates storage administration via API's and ensures performance with guaranteed minimum, maximum, and burst IOPS settings. SolidFire's rich automation and QoS features reflect a focus on cloud service providers and enterprises adopting an ITaaS approach.

Nimble Storage AF9000

The Nimble Storage AF9000 array continues with Nimble's legacy of scale-up and scale-out capabilities, now in an all-flash configuration. The AF9000 optimizes capacity via in-line data services. Nimble's cloud-based InfoSight predictive storage analytics service continually monitors Nimble Storage arrays. InfoSight raised the bar regarding proactive support for the entire storage industry.

ALL-FLASH ARRAY RANKINGS

OVERALL RANKINGS

RANKING	PRODUCT
RECOMMENDED	HPE 3PAR StoreServ 8450*
	HPE 3PAR StoreServ 8440*
	HPE 3PAR StoreServ 8400*
	Dell Storage SC9000
	Hitachi Data Systems VSP F800
	Hitachi Data Systems VSP F600
	Hitachi Data Systems VSP F400
	Huawei OceanStor 5800 V3
	Huawei OceanStor 5600 V3
	Huawei OceanStor 5500 V3
	Huawei OceanStor 5300 V3
	NetApp AFF A300
EXCELLENT	Dell EMC Unity 600F All-Flash
	Dell Storage SC8000
	FUJITSU Storage ETERNUS AF650
	NEC M710F All Flash Array
	Pivot3 N5-6000 PCIe All Flash Array
	Pure Storage FlashArray //m70
	Tegile IntelliFlash HD T10KHD-300
	Tegile IntelliFlash HD T10KHD-200
GOOD	IBM FlashSystem A9000
	IBM FlashSystem A9000R
	IBM FlashSystem V9000
	NetApp SolidFire SF19210
	Nimble Storage AF9000

* The licensing provider is listed at the beginning of each ranking category in which its products are included. One should not draw any negative inferences about any other products included in that ranking.

ALL-FLASH ARRAY PRODUCTS

Dell EMC Unity 600F All-Flash Storage

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	●
In-line Deduplication / In-line Compression	● / ✓
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	4
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	●
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	✓
T10 PI / FIPS 140-2	● / ✓

HARDWARE

3rd Party Storage Array Virtualization	●
Raw Flash Capacity per Array ***MAX***	10,000 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	192 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	256 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	24
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	24
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	20 / 24
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	● / 20 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ●
vMSC / VASRM	● / ✓
Virtual Volumes / vRealize Operations	✓ / ●

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	7

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NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Dell Storage SC8000

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	●
In-line Deduplication / In-line Compression	● / ●
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	5
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	● / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	3,000 TB
Raw Flash Capacity per Cluster ***MAX***	3,000 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	92 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	256 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	24
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	✓ / ●
Storage Networking Ports ***MAX, 2 CONTROLLERS***	48
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	24 / 24
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	48 / 24 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	●
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

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✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Dell Storage SC9000

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	●
In-line Deduplication / In-line Compression	● / ●
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	5
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	● / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	3,000 TB
Raw Flash Capacity per Cluster ***MAX***	6,000 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	136 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	512 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	4
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	✓ / ●
Storage Networking Ports ***MAX, 2 CONTROLLERS***	40
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	20 / 20
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	40 / 20 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	●
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

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✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

FUJITSU Storage ETERNUS AF650

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	○ / ○
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	○
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ○
QoS Options: User-defined Guaranteed Minimums	○
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	○
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	✓ / ○

HARDWARE

3rd Party Storage Array Virtualization	○
Raw Flash Capacity per Array ***MAX***	368 TB
Raw Flash Capacity per Cluster ***MAX***	○
NVMe SSD	○
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	33 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	256 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	20
Scale-out Controllers ***MAX***	○
Concurrent SAN & NAS / without Separate Head	○ / ○
Storage Networking Ports ***MAX, 2 CONTROLLERS***	32
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	○ / 16
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / 32 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ○
vMSC / VASRM	○ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	○
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

Hitachi Data Systems VSP F400

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	● / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	9
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	✓
T10 PI / FIPS 140-2	✓ / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	2,680 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	75 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	128 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	8
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	64
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	● / 32
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	64 / 64 / 64

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Hitachi Data Systems VSP F600

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	○ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	9
Automated Storage Tiering (Dynamic)	○
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	○
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	✓
T10 PI / FIPS 140-2	✓ / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	4,032 TB
Raw Flash Capacity per Cluster ***MAX***	○
NVMe SSD	○
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	76 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	128 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	16
Scale-out Controllers ***MAX***	○
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	64
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	○ / 32
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	64 / 64 / 64

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

Hitachi Data Systems VSP F800

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	● / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	9
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	✓
T10 PI / FIPS 140-2	✓ / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	8,064 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	81 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	512 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	80
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	● / 40
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	80 / 80 / 80

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

HPE 3PAR StoreServ 8400

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	10
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ✓
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	✓ / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	1,200 TB
Raw Flash Capacity per Cluster ***MAX***	2,400 TB
NVMe SSD	○
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	184 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	128 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	12
Scale-out Controllers ***MAX***	4
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	12
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	8 / 4
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / 12 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	5

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

HPE 3PAR StoreServ 8440

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	10
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ✓
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	✓ / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	1,843 TB
Raw Flash Capacity per Cluster ***MAX***	1,843 TB
NVMe SSD	○
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	184 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	192 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	20
Scale-out Controllers ***MAX***	4
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	12
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	8 / 4
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / 12 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	5

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

HPE 3PAR StoreServ 8450

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	10
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ✓
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	✓ / ✓

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	1,843 TB
Raw Flash Capacity per Cluster ***MAX***	1,843 TB
NVMe SSD	○
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	184 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	192 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	20
Scale-out Controllers ***MAX***	4
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	12
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	8 / 4
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / 12 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	5

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

Huawei OceanStor 5300 V3

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	✓ / ●

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	1,800 TB
Raw Flash Capacity per Cluster ***MAX***	1,800 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	45 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	64 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	8
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	32
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	16 / 16
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	32 / 16 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Huawei OceanStor 5500 V3

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	✓ / ●

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	2,700 TB
Raw Flash Capacity per Cluster ***MAX***	2,700 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	45 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	128 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	12
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	32
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	16 / 16
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	32 / 16 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

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NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Huawei OceanStor 5600 V3

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	✓ / ●

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	3,600 TB
Raw Flash Capacity per Cluster ***MAX***	3,600 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	43 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	128 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	12
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	36
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	28 / 28
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	36 / 28 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

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NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Huawei OceanStor 5800 V3

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	✓ / ●

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	5,400 TB
Raw Flash Capacity per Cluster ***MAX***	5,400 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	43 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	256 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	24
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	36
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	28 / 28
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	36 / 28 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

IBM FlashSystem A9000

OVERALL RANK **GOOD**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	● / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	●
Management Methods: IPMI / OpenStack / REST API	● / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	● / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	● / ●

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	105.6 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	●
Raw Flash Density ***MAX***	11.4 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	576 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	48
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	● / ●
Storage Networking Ports ***MAX, 2 CONTROLLERS***	18
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	● / 12
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	● / 12 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	● / ●
Virtual Volumes / vRealize Operations	✓ / ●

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	●
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

IBM FlashSystem A9000R

OVERALL RANK **GOOD**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ○
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	○ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	○
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ○
QoS Options: User-defined Guaranteed Minimums	○
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	○
Management Methods: IPMI / OpenStack / REST API	○ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	○ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	○ / ○

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	105.6 TB
Raw Flash Capacity per Cluster ***MAX***	633 TB
NVMe SSD	○
12 Gb SAS SSD	○
Raw Flash Density ***MAX***	11.4 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	768 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	40
Scale-out Controllers ***MAX***	12
Concurrent SAN & NAS / without Separate Head	○ / ○
Storage Networking Ports ***MAX, 2 CONTROLLERS***	12
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	○ / 8
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / 8 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	○ / ○
Virtual Volumes / vRealize Operations	✓ / ○

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	○
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

IBM FlashSystem V9000

OVERALL RANK **GOOD**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ○
Zero Block Detect	✓
In-line Deduplication / In-line Compression	○ / ✓
Hardware-accelerated Deduplication / Compression	○ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ○
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	○
Management Methods: IPMI / OpenStack / REST API	○ / ✓ / ○
Management Methods: SCVMM / SMI-S / vCenter	○ / ✓ / ✓
Multi-tenancy	○
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	○ / ○

HARDWARE

3rd Party Storage Array Virtualization	✓
Raw Flash Capacity per Array ***MAX***	528 TB
Raw Flash Capacity per Cluster ***MAX***	844 TB
NVMe SSD	○
12 Gb SAS SSD	○
Raw Flash Density ***MAX***	37.5 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	512 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	○ / ○
Storage Networking Ports ***MAX, 2 CONTROLLERS***	16
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	○ / 8
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	16 / 16 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	○ / ✓
Virtual Volumes / vRealize Operations	✓ / ○

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	○
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

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NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

NEC M710F All Flash Array

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ✓
Zero Block Detect	●
In-line Deduplication / In-line Compression	● / ●
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	3
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	●
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ●
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	✓ / ●

HARDWARE

3rd Party Storage Array Virtualization	●
Raw Flash Capacity per Array ***MAX***	3,686 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	45 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	192 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	●
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	✓ / ●
Storage Networking Ports ***MAX, 2 CONTROLLERS***	48
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	● / 24
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	48 / 48 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	● / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

NetApp AFF A300

OVERALL RANK **RECOMMENDED**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ●
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	● / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	✓
T10 PI / FIPS 140-2	● / ✓

HARDWARE

3rd Party Storage Array Virtualization	●
Raw Flash Capacity per Array ***MAX***	5,900 TB
Raw Flash Capacity per Cluster ***MAX***	70,500 TB
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	168 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	256 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	16 GB
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	24
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	32
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	● / 32
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / 8
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	16 / 24 / 8

VIRTUALIZATION

Microsoft ODX	●
VAAI	✓
VASA / VADP	✓ / ●
vMSC / VASRM	✓ / ✓
Virtual Volumes / vRealize Operations	✓ / ●

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	3

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

NetApp SolidFire SF19210

OVERALL RANK **GOOD**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	✓ / ●
Zero Block Detect	●
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	6
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	● / ● / ✓
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	● / ● / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	✓
T10 PI / FIPS 140-2	● / ●

HARDWARE

3rd Party Storage Array Virtualization	●
Raw Flash Capacity per Array ***MAX***	19.2 TB
Raw Flash Capacity per Cluster ***MAX***	1,920 TB
NVMe SSD	●
12 Gb SAS SSD	●
Raw Flash Density ***MAX***	19.2 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	384 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	8 GB
CPU Cores ***MAX, 2 CONTROLLERS***	20
Scale-out Controllers ***MAX***	100
Concurrent SAN & NAS / without Separate Head	● / ●
Storage Networking Ports ***MAX, 2 CONTROLLERS***	2
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	● / 2
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	4 / 4 / ●

VIRTUALIZATION

Microsoft ODX	●
VAAI	✓
VASA / VADP	✓ / ●
vMSC / VASRM	● / ✓
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	1
Standard Flash Media Warranty ***YEARS***	7+

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NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Nimble Storage AF9000

OVERALL RANK **GOOD**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	○ / ○
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	○ / ○
Automated/Policy-based Provisioning ***TOTAL # OF 10***	6
Automated Storage Tiering (Dynamic)	○
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ✓
QoS Options: User-defined Guaranteed Minimums	○
QoS Options: User-defined Guaranteed Maximums	○
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	○ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	○ / ✓

HARDWARE

3rd Party Storage Array Virtualization	○
Raw Flash Capacity per Array ***MAX***	553 TB
Raw Flash Capacity per Cluster ***MAX***	2,212 TB
NVMe SSD	○
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	46 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	256 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	80
Scale-out Controllers ***MAX***	8
Concurrent SAN & NAS / without Separate Head	○ / ○
Storage Networking Ports ***MAX, 2 CONTROLLERS***	24
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	○ / 12
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	24 / 24 / ○

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	✓ / ○
vMSC / VASRM	○ / ✓
Virtual Volumes / vRealize Operations	✓ / ○

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	○
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	1
Standard Flash Media Warranty ***YEARS***	7

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

NO FEEDBACK WAS RECEIVED FROM THE PROVIDER. ALL INFORMATION WAS SOLELY SOURCED BY DCIG.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

Pivot3 N5-6000 PCIe All-Flash Array

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	○ / ✓
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	○ / ○
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	✓
Metadata Stored Separately in DRAM / NVRAM / Flash	○ / ○ / ○
QoS Options: User-defined Guaranteed Minimums	✓
QoS Options: User-defined Guaranteed Maximums	✓
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	○ / ○ / ✓
Multi-tenancy	✓
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	○ / ○

HARDWARE

3rd Party Storage Array Virtualization	○
Raw Flash Capacity per Array ***MAX***	240 TB
Raw Flash Capacity per Cluster ***MAX***	○
NVMe SSD	✓
12 Gb SAS SSD	○
Raw Flash Density ***MAX***	20 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	192 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	○
CPU Cores ***MAX, 2 CONTROLLERS***	24
Scale-out Controllers ***MAX***	○
Concurrent SAN & NAS / without Separate Head	✓ / ○
Storage Networking Ports ***MAX, 2 CONTROLLERS***	8
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	8 / 8
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / ○
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / ○ / ○

VIRTUALIZATION

Microsoft ODX	○
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	○ / ○
Virtual Volumes / vRealize Operations	✓ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	90 Days
Standard Flash Media Warranty ***YEARS***	90 Days

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

Pure Storage FlashArray //m70

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	○ / ○
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	✓ / ✓
Automated/Policy-based Provisioning ***TOTAL # OF 10***	8
Automated Storage Tiering (Dynamic)	○
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	○
QoS Options: User-defined Guaranteed Maximums	○
QoS Options: Predefined Service Levels	○
Management Methods: IPMI / OpenStack / REST API	○ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	○
Native Data Tiering to Cloud	○
T10 PI / FIPS 140-2	○ / ✓

HARDWARE

3rd Party Storage Array Virtualization	○
Raw Flash Capacity per Array ***MAX***	512 TB
Raw Flash Capacity per Cluster ***MAX***	○
NVMe SSD	✓
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	73.1 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	2,000 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	32 GB
CPU Cores ***MAX, 2 CONTROLLERS***	80
Scale-out Controllers ***MAX***	○
Concurrent SAN & NAS / without Separate Head	○ / ○
Storage Networking Ports ***MAX, 2 CONTROLLERS***	24
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	○ / 16
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	○ / 12
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	○ / 20 / ○

VIRTUALIZATION

Microsoft ODX	○
VAAI	✓
VASA / VADP	✓ / ✓
vMSC / VASRM	○ / ✓
Virtual Volumes / vRealize Operations	○ / ✓

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	3
Standard Flash Media Warranty ***YEARS***	7+

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✓ SUPPORTED ○ UNDETERMINED / UNSUPPORTED

Tegile IntelliFlash HD T10KHD-200

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	● / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	6
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	●
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	●
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	● / ●

HARDWARE

3rd Party Storage Array Virtualization	●
Raw Flash Capacity per Array ***MAX***	366 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	73.2 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	192 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	✓
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	24
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	24 / 24
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	12 / 12 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	● / ●
vMSC / VASRM	● / ●
Virtual Volumes / vRealize Operations	● / ●

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	90 Days
Standard Flash Media Warranty ***YEARS***	7

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

Tegile IntelliFlash HD T10KHD-300

OVERALL RANK **EXCELLENT**

MANAGEMENT & SOFTWARE

Synchronous Replication / VM-level Replication	● / ●
Zero Block Detect	✓
In-line Deduplication / In-line Compression	✓ / ✓
Hardware-accelerated Deduplication / Compression	● / ●
Automated/Policy-based Provisioning ***TOTAL # OF 10***	6
Automated Storage Tiering (Dynamic)	●
Metadata Stored Separately in DRAM / NVRAM / Flash	✓ / ✓ / ✓
QoS Options: User-defined Guaranteed Minimums	●
QoS Options: User-defined Guaranteed Maximums	●
QoS Options: Predefined Service Levels	✓
Management Methods: IPMI / OpenStack / REST API	✓ / ✓ / ✓
Management Methods: SCVMM / SMI-S / vCenter	✓ / ✓ / ✓
Multi-tenancy	●
Native Data Tiering to Cloud	●
T10 PI / FIPS 140-2	● / ●

HARDWARE

3rd Party Storage Array Virtualization	●
Raw Flash Capacity per Array ***MAX***	542 TB
Raw Flash Capacity per Cluster ***MAX***	●
NVMe SSD	●
12 Gb SAS SSD	✓
Raw Flash Density ***MAX***	108 TB/RU
DRAM Cache ***MAX, 2 CONTROLLERS***	192 GB
NVDIMM Cache ***MAX, 2 CONTROLLERS***	✓
CPU Cores ***MAX, 2 CONTROLLERS***	32
Scale-out Controllers ***MAX***	●
Concurrent SAN & NAS / without Separate Head	✓ / ✓
Storage Networking Ports ***MAX, 2 CONTROLLERS***	24
Ethernet: 1 / 10 Gb ***MAX, 2 CONTROLLERS***	24 / 24
Ethernet: 25 / 40 Gb ***MAX, 2 CONTROLLERS***	● / ●
FC: 8 / 16 / 32 Gb ***MAX, 2 CONTROLLERS***	12 / 12 / ●

VIRTUALIZATION

Microsoft ODX	✓
VAAI	✓
VASA / VADP	● / ●
vMSC / VASRM	● / ●
Virtual Volumes / vRealize Operations	● / ●

SUPPORT

Technician Onsite with 4-hour Guaranteed Response	✓
Proactive Remediation Based on Fault Data	✓
Proactive Intervention Based on Analytics	✓
Standard Hardware Warranty ***YEARS***	90 Days
Standard Flash Media Warranty ***YEARS***	7

The DCIG Competitive Intelligence Portal contains additional data elements that are reflected in the overall ranking, but which are not shown on this data sheet.

✓ SUPPORTED ● UNDETERMINED / UNSUPPORTED

APPENDICES

Definitions, Explanations and Terminology

This section contains brief definitions and/or explanations of the terms used and assumptions made when developing the data sheets found in the *DCIG 2017-18 All-Flash Array Buyer's Guide.* These terms are in the same order as they appear on the individual data sheets.

MANAGEMENT & SOFTWARE

Synchronous Replication

Indicates if the array can synchronously replicate data to another array from the same storage provider. Write I/Os need to be received at the primary or source array and then copied and written to the secondary, or target array, with the write confirmed by both as complete before processing can continue.

VM-level Replication

Indicates if the array can replicate individual VM's (virtual machines).

Zero Block Detect

Indicates if the array is capable of detecting zero blocks on incoming writes and does not allocate space to write the zero block.

In-line Deduplication

Deduplication saves space by storing a pointer to an existing identical file or block of data rather than storing a second instance of the data. In-line deduplication is performed on data ingress.

In-line Compression

Compression is a feature that condenses data as it is written to storage systems. In-line compression is performed on data ingress.

Hardware-accelerated Deduplication

Indicates if the array utilizes a dedicated processor to perform deduplication operations.

Hardware-accelerated Compression

Indicates if the array utilizes a dedicated processor to perform compression operations.

Automated/Policy-based Provisioning *TOTAL # OF 10*

The ability to provision storage by using pre-defined policies that are carried out automatically without requiring manual intervention. The specific elements supported for each product are available by accessing the DCIG Competitive Intelligence Portal.

Automated Storage Tiering (Dynamic)

Automated tiering places data on the appropriate tier of storage within the array based upon policies that are either built into the storage array (system), set by the storage administrator (user-defined), or some combination of both. Indicates the array monitors and adjusts tiering in real-time or near real-time to optimize performance.

Metadata Stored Separately in DRAM / NVRAM / Flash

Indicates if the array stores metadata separate from the data and if so, which high-performance memory device (DRAM / NVRAM / Flash) is it stored. This data separation optimizes functions such as in-line deduplication, in-line compression and zero overhead snapshots.

QoS Options: User-defined Guaranteed Minimums

Indicates if the array supports a user-defined guaranteed minimum as a QoS option.

QoS: User-defined Guaranteed Maximums

Indicates if the array supports a user-defined guaranteed maximum as a QoS option.

QoS: Predefined Service Levels

Indicates if the array supports the assignment of LUN/VM/Volumes to predefined service levels (gold, silver, bronze) as a QoS option.

Management Methods: IPMI / OpenStack / REST API

Indicates if the array supports an Intelligent Platform Management Interface (IPMI), OpenStack Cinder and/or REST API's to manage storage resources.

Management Methods: SCVMM / SMI-S / vCenter

Indicates if the array supports System Center Virtual Machine Manager (SCVMM), Storage Management Initiative Specification (SMI-S) and/or vCenter to centrally manage storage resources.

Multi-tenancy

Indicates if the array has the capability to provide discrete storage, management, and functionality to multiple user-groups (tenants).

Appendix A—Definitions, Explanations and Terminology (continued)

Native Data Tiering to Cloud

Indicates the array's ability to natively attach, integrate and/or tier data to public or private cloud storage providers.

T10 PI

T10 Protection Information (PI) validates data as it moves across a data path, which ensures the end-to-end integrity of the data. The storage array confirms the checksum that is passed to it when data is received. The array stores the data plus the checksum. On a read, the checksum will be checked by the storage array and by the receiving HBA.

FIPS 140-2

The Federal Information Processing Standards (FIPS) Publication 140-2 is a U.S. government computer security standard that accredits cryptographic modules. Compliance with FIPS 140-2 provides enhanced assurance of the confidentiality and integrity of data.

VIRTUALIZATION

Microsoft ODX

The array supports Microsoft ODX (offloaded data transfer), a technology which enables direct data transfers within or between storage devices, avoiding the need to send data back and forth to a host.

VAAI

VAAI is a group of proprietary application programming interfaces (APIs) provided by VMWare's vSphere platform which allows certain I/O tasks to be offloaded to array hardware. VAAI first appeared in vSphere 4.1 and was expanded in 5.0.

VASA

vSphere Storage APIs for Storage Awareness (VASA) is a set of APIs that permit storage products to integrate with vCenter for management functionality. Storage Awareness collects configuration, capability and storage health information from storage products, allowing the administrator to build storage profiles based on capabilities.

VADP

vStorage APIs for Data Protection (VADP) is a data protection framework introduced in vSphere 4.0. VADP which enables centralized, off-host LAN free backup of vSphere virtual machines, reduces ESX host resources to do backup processing, and enables flexible backup windows.

vMSC

VMware vSphere Metro Storage Cluster (VMware vMSC) is a configuration option to use stretched clusters across a geographic area. Organizations can use vMSC to perform load balancing and non-disruptive data migrations between active data centers.

VASRM

VMware Site Recovery Manager (VASRM) is an automation software that integrates with an underlying replication technology to provide policy-based management, non-disruptive testing, and automated orchestration of recovery plans.

Virtual Volumes

Indicates if the array supports VMware Virtual Volumes. Virtual Volumes is an integration and management framework giving precise control of external storage resources down to the virtual machine level. Virtual Volumes enables policy-driven automation of VMware environments.

vRealize Operations

Indicates if the array supports VMware vRealize Operations which delivers integrated performance, capacity, and configuration management capabilities for VMware vSphere and cloud environments.

HARDWARE

3rd Party Storage Array Virtualization

Indicates whether the array supports virtualization of third party storage arrays, bringing the 3rd party storage arrays under the management of the primary array.

Raw Flash Capacity per Array (Max)

The number indicates the maximum amount of raw flash memory storage capacity in terabytes (TBs) that the array can have under its management. This number only includes the array's footprint and not the storage capacity of other systems it may have virtualized.

Raw Flash Capacity per Cluster (Max)

The number indicates the maximum amount of raw flash memory storage capacity in terabytes (TB) that a fully configured cluster (scale-out) of arrays can have under its management. This number only includes the cluster's footprint and not the storage capacity of other systems it may have virtualized.

Appendix A—Definitions, Explanations and Terminology (continued)

NVMe SSD
Indicates if the array supports NVMe SSDs. NVMe is the industry standard interface for PCI Express solid-state devices that offers improved bandwidth, IOPS and latency compared to SATA and SAS protocols. NVMe achieves these benefits through a streamlined protocol and command set that requires fewer clock cycles per I/O.

12 Gb SAS SSD
Indicates if the array supports a 12 Gb SAS interface to connect to SSDs.

Raw Flash Density *MAX*
The number indicates the maximum amount of flash memory that this product can provide per standard EIA rack unit. This measure of storage density is presented in terms of terabytes (TB) per rack unit (TB/RU).

DRAM Cache *MAX, 2 CONTROLLERS*
Indicates the maximum amount of DRAM cache that the model supports in a two controller configuration.

NVDIMM Cache *MAX, 2 CONTROLLERS*
Indicates the maximum amount of NVDIMM (non-volatile dual in-line memory module) cache that the model supports in a two controller configuration.

CPU Cores *MAX, 2 CONTROLLERS*
Indicates the maximum number of central processing unit (CPU) cores the model supports in a two controller configuration.

Scale-out Controllers *MAX*
The maximum number of controllers that the model can support in a scale-out configuration. A controller appliance may contain 1, 2 or more controllers.

Concurrent SAN & NAS
Indicates if this model has the ability to communicate with applications using both block (SAN) and network file system (NAS) protocols at the same time.

"/ Without Separate Head" indicates if this model supports block (SAN) and file (NAS) protocols without the need for additional hardware (filer heads).

Storage Networking Ports *MAX, 2 CONTROLLERS*
Indicates the maximum number of storage networking interfaces supported by the model in a two controller configuration regardless of the type of port.

Ethernet: 1 / 10 Gb *MAX, 2 CONTROLLERS*
Indicates the maximum number of 1 Gb and 10 Gb Ethernet storage networking ports supported by the model in a two controller configuration.

Ethernet: 25 / 40 Gb *MAX, 2 CONTROLLERS*
Indicates the maximum number of 25 Gb and 40 Gb Ethernet storage networking ports supported by the model in a two controller configuration.

FC: 8 / 16 / 32 Gb *MAX, 2 CONTROLLERS*
Indicates the maximum number of 8 Gb, 16 Gb and 32 Gb Fibre Channel storage networking ports supported by the model in a two controller configuration.

SUPPORT

Technician Onsite with 4-hour Guaranteed Response
Indicates if a technician is guaranteed to be onsite within 4-hours.

Proactive Remediation Based on Fault Data
Indicates if the vendor monitors fault data to proactively address faults in order to avoid or minimize down time.

Proactive Intervention Based on Analytics
Indicates if the vendor performs storage analytics based on data collected from arrays in order to intervene directly or provide proactive guidance to address potential problems, enable optimal performance and uptime, and facilitate capacity planning.

Standard Hardware Warranty
Indicates the length in years of the standard hardware warranty included with the purchase. A software support contract may still be required.

Standard Flash Media Warranty
Indicates the length in years of the standard flash media warranty included with the purchase. Flash media may have a different warranty length than the rest of the hardware. A software support contract may still be required.

Appendix B—Vendor Contact Information

Vendor Contact Information

Dell Technologies
1 Dell Way
Round Rock, TX 78682
+1.800.671.3355
www.dellemc.com

FUJITSU Limited
1250 East Arques Avenue
Sunnyvale, CA 94085
+1.800.831.3183
www.fujitsu.com/us/

Hewlett-Packard Enterprise (HPE)
3000 Hanover Street
Palo Alto, CA 94304
+1.866.625.0242
www.hpe.com

Hitachi Data Systems Corporation (HDS)
2845 Lafayette Street
Santa Clara, California 95050
+1.408.970.1000
www.hds.com

Huawei
5700 Tennyson Pkwy., Ste. 500
Plano, TX 75024
+1.214.919.6000
www.huawei.com/us/

IBM Corporation
1 New Orchard Rd
Armonk, NY 10504
+1.800.426.4968
www.ibm.com/storage

NEC Corporation of America
2880 Scott Boulevard
Santa Clara, CA 95050
+1.408.844.1475
www.necam.com

NetApp
495 East Java Drive
Sunnyvale, CA 94089
+1.877.263.8277
www.netapp.com

Nimble Storage, Inc.
2740 Zanker Road
San Jose, CA 95134
+1.877.364.6253
www.nimblestorage.com

Pivot3
221 W. Sixth Street, Ste. 750
Austin, Texas 78701
+1.512.807.2666
www.pivot3.com

Pure Storage
650 Castro Street, Suite #260
Mountain View, CA 94041
+1.800.379.7873
www.purestorage.com

Tegile Systems, Inc.
7999 Gateway Blvd., #120
Newark, CA 94560
+1.510.791.7900
www.tegile.com

DCIG Contact Information

AUTHORS
Chuck Cook
Senior Analyst
chuck.cook@dcig.com

Ken Clipperton
Managing Analyst
ken.clipperton@dcig.com

MEDIA CONTACT
Kari Schoen
Vice President, Operations
kari.schoen@dcig.com

DCIG, LLC
7511 Madison Street
Omaha, NE 68127
+1.844.324.4552
www.dcig.com

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