

DCIG TOP 5

High-End Storage Arrays

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HIGH-END STORAGE ARRAY INCLUSION CRITERIA:

- Be identified by the vendor as a high-end storage array
- Must support high availability through multiple controllers in an Active-Active configuration
- Must provide synchronous replication for non-disruptive operations across at least two data centers
- Must be able to provide at least three (3) petabytes of raw capacity
- Must offer support options to include:
 - Automated case creation based on fault data
 - Proactive support based on fault data
 - Technician onsite with 4-hour GTD response

SOLUTIONS FROM FOLLOWING VENDORS EVALUATED:

- Dell EMC
- FUJITSU
- Hitachi Vantara
- HPE
- Huawei
- IBM
- Infinidat
- NEC
- NetApp

MOST SUITABLE ENVIRONMENTS INCLUDE:

- Organizations requiring uninterrupted high-performance access to critical data
- Multi-petabyte storage requirements
- Multi-vendor storage environments

The Critical Need for High-end Storage Arrays

Organizations that provide critical infrastructure to the rest of society must provide uninterrupted service availability—even in the event of a disaster. In hospitals, an interruption in service could mean life or death for a patient. In financial institutions, a brief outage could easily have multimillion-dollar ramifications; and an extended outage could have a measurable impact on a nation's economy as a whole. Organizations in these and other critical industries—such as telecommunications, energy utilities, and transportation—depend on high-end storage arrays to provide uninterrupted access to the world's most essential data.

Reimagining High-End Storage

If your mental image of a high-end storage array is rack after rack full of blinking lights, you would be right only 30% of the time. Today, nearly half of all high-end storage arrays, including some of the TOP 5 products in this report, support configurations that fit into less than 8RU—that is just fourteen inches of rack space. Thus, huge floor space requirements no longer define high-end storage.

A high-end storage array must meet a wide array of enterprise requirements. Key attributes include high-performance with high-availability. High-end storage must also integrate into data center management and automation practices, and with critical software applications to secure and protect the data.

TOP 5 High-end Storage Arrays

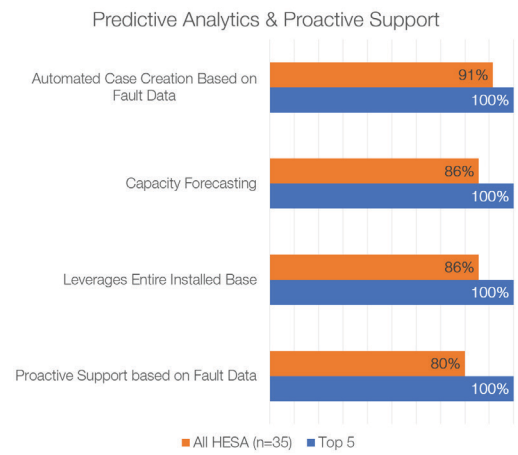
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| Dell EMC PowerMAX Series (8000) |
| Hitachi Vantara VSP 5000 Series (5500/5500H) |
| Huawei OceanStor Dorado V6 Series (18000 V6) |
| IBM FlashSystem 9000 Series (9200) |
| NetApp AFF & FAS Series (AFF400/FAS8700) |

* Listed in Alphabetical Order

Similarities among the TOP 5 High-end Storage Arrays

Beyond meeting the criteria for inclusion, the TOP 5 High-end Storage Arrays share the following characteristics:

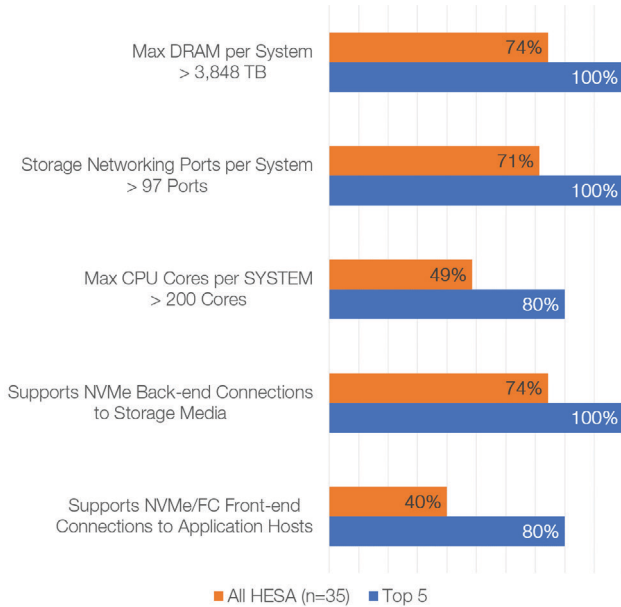
- Scale-out to at least eight (8) controllers for high availability and scalability
- Quality-of-service (QoS) options that facilitate confident consolidation of many workloads
- Support NVMe media to enable consistent low-latency
- Data efficiency features including compression and inline deduplication
- Robust virtualization integrations
- Predictive analytics, including capacity planning, and proactive support to maximize uptime
- Available on-premises as-a-Service



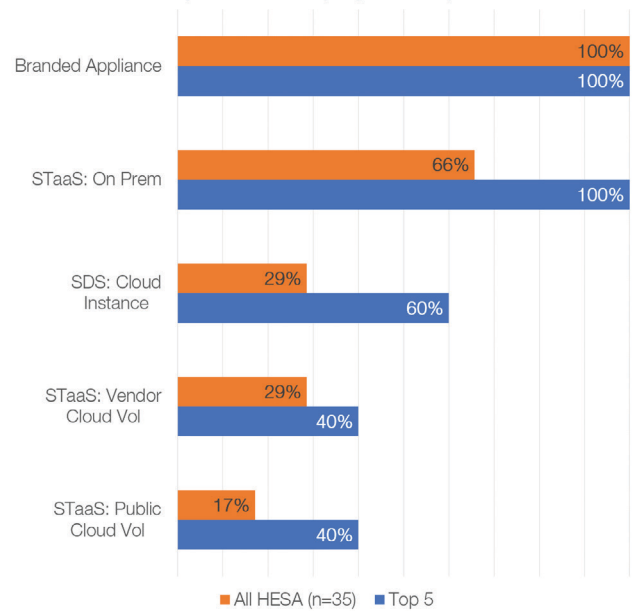
What Differentiates the TOP 5 High-end Storage Arrays

Performance resources. The TOP 5 High-end Storage Arrays generally provide more performance resources than other arrays, from CPU cores to DRAM caches and storage network connectivity. All TOP 5 arrays support NVMe back-end connections to storage media. All but one extend NVMe to application hosts across the Fibre Channel fabric via NVMe/FC. The reduced protocol overhead of NVMe frees up CPU cycles on the host while also reducing storage latency.

Performance Resources

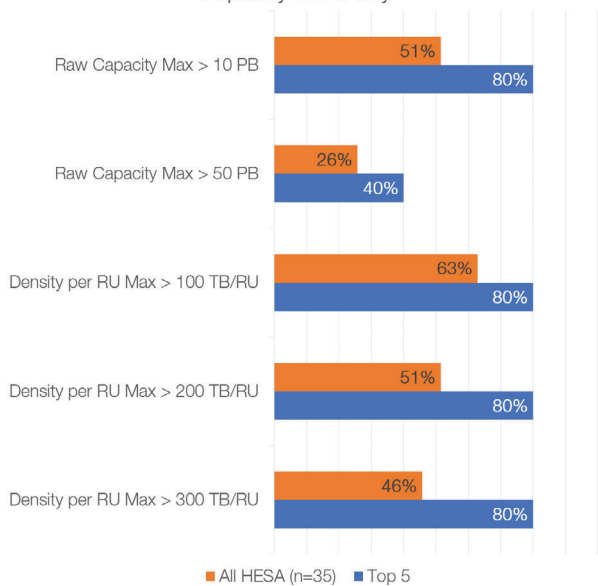


Acquisition & Deployment Options

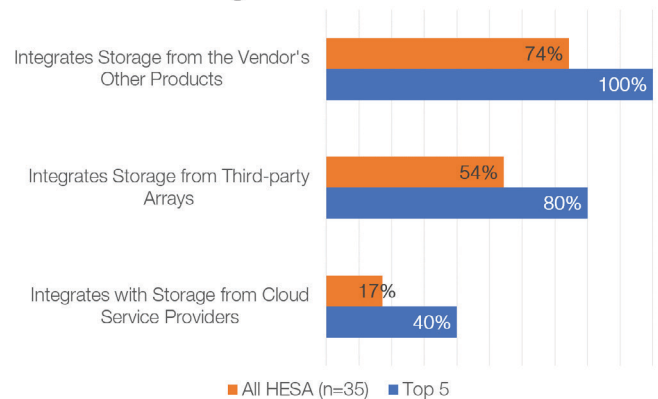


Capacity and density. The TOP 5 also distinguish themselves from other arrays—and among themselves—by the scalable capacity and storage density they deliver. These features complement the performance resources of the array, providing dramatically more performance per floor tile and increasing the amount of work any data center can provide.

Capacity & Density



Storage Virtualization



Other Differentiators Between the TOP 5 High-end Storage Arrays

- Performance claims around latency and throughput
- NVMe/FC support
- Hybrid cloud capabilities
- Quality-of-service options
- Support for both block and file (SAN and NAS) protocols
- Public cloud integrations

TOP 5 High-end Storage Array Solution Profiles

Dell EMC PowerMAX Series (8000)

PowerMAX is the current name for what was once called Symmetrix, arguably the most successful enterprise storage system in history. Dell announced the PowerMAX brand when it released the product as an all-NVMe array.

Similarly, **acquisition and deployment options** distinguish the TOP 5. While all offer on-premises storage-as-a-service options, only two of the five provide similar capabilities in the public cloud.

Storage virtualization. Four of the TOP 5 can integrate and manage the storage capacity of other vendor's arrays. This extends new capabilities to old storage and reduces storage management overhead. The extent of this capability varies significantly, even among the TOP 5, but generally includes tiering, compression, and deduplication.

The product provides end-to-end NVMe/FC connectivity and supports only NVMe-attached storage, including standard SSDs plus storage class memory (SCM) drives of 750 GB or 1.5 TB. The PowerMAX uses SCM as a storage tier and can be configured entirely with SCM. It is the only TOP 5 array that does not support SAS-attached media. Dell EMC rewrote the HYPERMAX OS to optimize it for NVMe, rebranding it as PowerMaxOS.

The PowerMAX 8000 scales to 4.4 PB of NVMe storage capacity. The system scales out to a maximum of 16 controllers which are sold as dual-controller “bricks.” A fully scaled-out 8-brick system supports up to 256 storage networking ports and 16 TB of DRAM. Like prior generations of the product, it uses DRAM as a write cache that it de-stages to NVMe flash as needed.

PowerMAX is available in two models, the PowerMAX 2000 and the PowerMAX 8000. The PowerMAX 2000 scales to a total of four controllers in two bricks.

Dell EMC has simplified software licensing for its PowerMAX arrays. Although retaining some a-la-carte elements, it has moved toward all-inclusive licensing by offering two software bundles for open systems and two bundles for mainframe environments. DCIG evaluated the products based on the extended “Pro” bundle.

Hitachi Vantara VSP 5000 Series (5500/5500H)

The Hitachi Vantara VSP 5000 Series is the new high-end of the Hitachi VSP product line. Hitachi Vantara supports up to 12 controllers in a scale-out cluster; and claims up to 21 million IOPS, 149 GB/s of throughput and latency of 70 microseconds for the product. The VSP 5500 scales to 69 PB of raw flash capacity at up to 319 TB per rack unit.

All VSP arrays run the Hitachi Storage Virtualization Operating System (SVOS RF), which has now been optimized for the parallelism of NVMe. As this name implies, the VSP can integrate storage from nearly any third-party array, incorporating those arrays into its sophisticated management and data services environment. Licensing is based on bundles plus a la carte features.

The Hitachi Ops Center goes beyond traditional storage management functions to include the Ops Center Analyzer, Automator, and Protector. Ops Center Analyzer provides AI and ML assisted cross-stack root cause analysis and recommended remediations, plus “What if” forecasting capabilities. Analyzer runs on-premises as a VM or on a dedicated host. The Hitachi Ops Center Automator software supports automated workflows, including provisioning and online data migrations. It offers an open API to integrated with existing data center automation tools.

Automation is a journey that many businesses want to pursue; yet they lack the experience, skills and resources to get started. To overcome these barriers to innovation, Hitachi Vantara is now offering a low cost “Automator Starter Pack”. This service helps businesses implement the Automator software and automate two workflows. As part of the engagement, which typically occurs across a 90-day window, IT staff learn how to apply Automator to their workflows. The benefits of automating the workflows are quantified for the customer.

Hitachi Vantara’s cloud-like pay-per-use offering is called EverFlex Consumption. It ranges from basic utility pricing to full “Storage-as-a-Service” on-premises or in a Hitachi-managed data center.

Huawei OceanStor Dorado V6 Series (18000 V6)

The Huawei OceanStor Dorado V6 Series is end-to-end NVMe based. Up to eight (8) 4RU quad-controller enclosures can be interconnected to form a 32-node SmartMatrix full-mesh cluster supporting 100GE NVMe over RoCE interconnection. This resilient architecture permits an 8-controller cluster to lose 7 controllers and still serve data.

The OceanStor Dorado V6 series features Huawei’s own Kunpeng 920 ARM-based 48-core 2.6 GHz processors. Each quad-CPU controller adds 192 cores and up to 1,024 GB of DRAM to the cluster. The OceanStor Dorado 8000 V6 and 18000 V6 support the Huawei-developed smart disk enclosure and Huawei-developed SSDs. The smart disk enclosure has its own CPU and memory that are used to offload tasks from the main CPUs, such as data reconstruction upon a disk failure. FlashLink® associates controller CPUs with SSD CPUs to coordinate flash media optimizations and SSD algorithms between these CPUs.

The OceanStor Dorado V6 offers the highest raw storage density among the TOP 5 at up to 553 TB per rack unit to a total of 32.8 PB. This unified storage capacity is accessed via up to 768 ports of host connectivity, including 8/16/32 Gbit/s FC/FC-NVMe, 10/25/40/100 Gbit/s Ethernet, and 25/40/100 NVMe over RoCE.

Huawei’s SmartQoS provides comprehensive quality of service capabilities. SmartQoS ensures that the required IOPS, bandwidth or latency requirements are met. Huawei SmartVirtualization integrates the storage from heterogeneous storage systems. SmartVirtualization eliminates data silos, simplifying storage management, data migrations, and disaster recovery procedures. In addition, OceanStor Dorado 8000 V6 and Dorado 18000 V6 storage systems incorporate dedicated Ascend AI chips that dynamically optimize the performance of many applications.

Huawei offers proactive support and predictive analytics via its eService Intelligent Cloud Management System, which relies on periodic collection and uploads of operations data including alarms, configuration data, performance data, system logs, and disk information.

Huawei offers the OceanStor Dorado V6 Series arrays as branded on-premises arrays. Licensing can be all-inclusive or based on feature bundles plus a-la-carte licenses for premium features. Huawei also offers flexible capacity through an on-premises storage-as-a-service option.

IBM FlashSystem Series (9200)

The IBM FlashSystem 9000 Series provides end-to-end NVMe data transfers through support for both NVMe SSDs and NVMe/FC. IBM claims it can deliver more IOPS (2.2 million) and bandwidth (22.5 GB/s) through each of its FlashSystem 9200 controllers than any other product in this report.

The FlashSystem 9200 is based on a 2RU, dual-controller enclosure that supports up to 24 industry-standard NVMe drives or IBM FlashCore Modules (FCM). It also supports up to four NVMe SCM drives per enclosure. These SCM drives are based on Intel Optane or Samsung zSSD in capacities ranging from 375 GB to 1.6 TB each.

IBM FlashCore Modules provide inline hardware compression, data protection, and specialized flash management features. IBM’s 38.4 TB FCM is the largest SSD supported by any array in this report; which helps explain the high storage densities (461 TB/RU) the array can provide.

IBM recently simplified its storage line, eliminating the Storwize brand. The FlashSystem product line all run the IBM Spectrum Virtualize storage operating system. Some features are only available on the more powerful models, including support for NVMe drives, SCM, and external storage virtualization.

IBM FlashSystem can virtualize more than 500 third-party storage systems. This brings legacy storage into the FlashSystem management domain and extends its comprehensive enterprise class data services to those arrays. This capability facilitates data migration to the FlashSystem. Longer term, IBM's integrated Easy Tier AI-driven automated tiering can use legacy third-party systems as a tier of storage.

IBM's combination of hybrid cloud capabilities and external storage virtualization of 500+ arrays is unique among products in this report. This enables the FlashSystem to bring hybrid cloud capabilities to nearly any existing storage array.

IBM offers much flexibility in acquisition and deployment of these systems, including storage-as-a-service on-premises, in IBM's cloud, and in the public cloud.

IBM offers all-inclusive and "bundles plus a la carte" licensing options on the FlashSystem 9000 Series.

NetApp AFF & FAS Series (AFF400/FAS8700)

The NetApp FAS & AFF arrays provide highly scalable storage. NetApp offers the highest raw capacity of any system in this report at 140 PB when fully scaled out in a 24-node federated cluster. The A400 can provide up to 360 TB/RU of dense all-flash storage. The AFF series utilizes an NVDIMM write cache to accelerate performance. NetApp claims latencies of under 100 microseconds, 300 GB/s of throughput and 11.4 million IOPS from a fully scaled-out cluster.

NetApp was the first mainstream enterprise storage vendor to release end-to-end NVMe support via NVMe/FC. It supports the full range of connectivity options including 16/32 Gb FC and 10/25/40/100 Gb Ethernet for connection to application hosts.

Netapp offers the most extensive set of acquisition and deployment options of any product in this report. It runs on the ONTAP storage operating system, which can also be deployed as software-defined-storage on-premises or in the cloud, with some limitations in capacity and features compared to the AFF A400 appliance.

ONTAP can virtualize some third-party storage arrays, including arrays from Dell EMC, Hitachi Vantara, HPE and IBM. This allows capacity from the legacy storage system to be incorporated into the ONTAP storage environment.

NetApp provides pre-built integrations into all the automation frameworks that DCIG included in its research. This facilitates rapid integration into the operations of the data center. ONTAP provides a wide range of quality of service features that facilitate workload consolidation.

DCIG Disclosures

Vendors of some of the solutions covered in this DCIG TOP 5 report are or have been DCIG clients. This is not to imply that their solution was given preferential treatment in this report.

In that vein, there are some important facts to keep in mind when considering the information contained in this TOP 5 report and its merit.

- No vendor paid DCIG any fee to research this topic or arrive at predetermined conclusions.
- DCIG did not guarantee any vendor that its solution would be included in this TOP 5 report.
- DCIG did not imply or guarantee that a specific solution would receive a TOP 5 designation.
- All research is based upon publicly available information, information provided by the vendor, and/or the expertise of those evaluating the information. DCIG conducted no hands-on product testing to validate how or if the features worked as described.
- No negative inferences should be drawn against any vendor or product not covered in this TOP 5 report.
- It is a misuse of this TOP 5 report to compare products included in it against solutions not included in it.

DCIG wants to emphasize that no vendor was privy to how DCIG weighed individual features. In every case, the vendor only found out the TOP 5 selection of its solution after the analysis was complete.

To arrive at the TOP 5 solutions included in this report, DCIG went through a seven-step process to come to the most objective conclusions possible.

1. DCIG established which features would be evaluated.
2. The features were grouped into six (6) general categories.
3. A DCIG analyst examined the feature data for each product and completed a survey for it based upon the analyst's own knowledge of the product and publicly available information.
4. DCIG identified solutions that met DCIG's definition for a High-end Storage Array based on the inclusion criteria.
5. DCIG weighted each feature to establish a scoring rubric.
6. Each solution was scored based on information gathered in the surveys.
7. DCIG identified the five highest-scoring solutions.

DCIG Inclusion and Evaluation Criteria

In this report, DCIG specifically focused on high-end storage solutions that possessed the following characteristics:

- Identified by the vendor as a high-end storage array
- Must support high availability through multiple controllers in an Active-Active configuration
- Must provide synchronous replication for non-disruptive operations across at least two data centers
- Must be able to provide at least three (3) petabytes of raw capacity
- Must offer support options to include:
 - Automated case creation based on fault data
 - Proactive support based on fault data
 - Technician onsite with 4-hour GTD response
- Information is available for DCIG to make an informed, defensible decision
- Must be formally announced or generally available for purchase as of June 1, 2020

DCIG identified thirty-five different solutions that met these inclusion criteria. The products come from nine different vendors:

Dell EMC
FUJITSU
Hitachi Vantara
HPE
Huawei
IBM
Infinidat
NEC
NetApp

To determine the TOP 5, DCIG evaluated each of these solutions across a wide range of enterprise storage capabilities including:

- Performance resources
- Capacity and density
- Availability and data protection features
- Hypervisor and container integrations
- Storage virtualization capabilities
- Acquisition and deployment options
- Predictive analytics and proactive support ■

About DCIG

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