

2024-25 **DCIG** TOP 5

MIDRANGE HYBRID CLOUD STORAGE SOLUTIONS // GLOBAL EDITION



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Hitachi Vantara VSP One Block

IBM Storage FlashSystem 9500

Lenovo ThinkSystem DM7100 AFA

NetApp AFF A400

StorONE S1/Seagate Exos AP 5U84

**Products listed in alphabetical order*

SOLUTIONS EVALUATED

1. Dell Technologies PowerStore 9200T
2. Dell Technologies Unity XT 880
3. Hitachi Vantara VSP One Block
4. IBM Storage FlashSystem 9500
5. iXsystems TrueNAS
6. Lenovo ThinkSystem DM7100F AFA
7. NetApp AFF A400
8. OpenDrives Ultra Ultimate 25
9. Pure Storage FlashArray//X90 R4
10. StorONE S1/Seagate Exos AP 5U84
11. Tintri VMstore T7080
12. VAST Data Universal Storage

MIDRANGE HYBRID CLOUD STORAGE SOLUTION FEATURES EVALUATED

- Data protection and cyber resilience.
- Deployment options.
- Licensing and pricing.
- Product and performance management.
- Software options
- Storage optimization.
- Technical support.

Hybrid Cloud Capabilities Now a Must-have Feature

On-premises, cloud, or hybrid cloud? That's a question few organizations ponder any longer as they acquire new enterprise technologies. Rather, most organizations already know the answer to it. They expect new enterprise technologies they acquire to possess hybrid cloud capabilities.

Corporate strategies drive this mindset to acquire enterprise technologies that possess hybrid cloud capabilities. Over 80 percent of organizations have a hybrid cloud strategy with about 90 percent using both on-premises and cloud services. Further, IT leaders often view hybrid cloud functionality as critical to future success as this feature facilitates corporate digital transformation initiatives.¹

However, in the quest to choose enterprise technologies that possess hybrid cloud capabilities, organizations must exercise caution. They cannot and should not assume hybrid cloud capabilities constitute a simple check box item on any product feature list.

The ways in which providers deliver and support hybrid cloud functionality in their products can and do differ significantly. Nowhere can one observe these differences more than in midrange storage solutions that possess hybrid cloud capabilities.

At least two levels of midrange hybrid cloud storage solutions exist. Using hybrid cloud technology, a Level 1 midrange storage solution can minimally store data on-premises, in the cloud, or both.

It also offers various techniques and technologies to manage data placement. These may include default and user-defined policies, artificial intelligence/machine learning, storing data in different clouds, or a combination of these.

This DCIG TOP 5 report only examined Level 2 midrange hybrid cloud storage solutions. All these midrange storage solutions also offer the flexibility to more freely host and move applications between on-premises and the cloud.

To facilitate this movement, the Level 2 midrange storage solution provider must offer software-defined storage (SDS). This feature permits the use of the midrange storage solution's other data services such as replication and snapshots in the cloud. Organizations may then often manage the midrange storage solution in a similar manner both in the cloud and on-premises.

Two Levels of Midrange Hybrid Cloud Storage Solutions Capabilities

DCIG classifies a midrange hybrid cloud storage solution as either Level 1 or Level 2. DCIG defines these two levels as follows:

Level #1: Data Tiering to the Cloud.

Data tiering to the cloud represents Level 1 of hybrid cloud functionality. This represents the baseline functionality that DCIG expects a midrange storage solution to possess to obtain a "hybrid cloud" classification.

However, nuances exist to this Level 1 cloud tiering classification. At an entry level, a midrange storage solution stores data on-premises and then tiers aging or selected data to cloud storage. This cloud storage tier often consists of using S3 or S3-compatible storage targets.

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The flexibility to move production applications and data between on-premises and the cloud represents Level 2 of hybrid cloud functionality.

The subtleties of Level 1 midrange hybrid cloud storage solutions include:

- Some midrange storage solutions offer policies (default or user-defined) that define the time for when aging or selected data gets moved to the cloud.
- Others employ more sophisticated algorithms, to include artificial intelligence and machine learning, that identify which data gets moved to the cloud and when.
- Some can simultaneously store data to cloud storage on multiple different cloud providers, be they general-purpose or purpose-built.
- Still others give organizations the ability to mix and match these different cloud tiering capabilities.

This Level 1 classification and its distinctions represent a basic implementation of hybrid cloud capabilities on midrange storage solutions.

Level 2: Flexibility to Move Applications between On-premises and the Cloud

The flexibility to also move production applications and data between on-premises and the cloud represents Level 2 of hybrid cloud functionality. Achieving Level 2 almost demands that a midrange storage solution provider offers SDS as an option. This often becomes a necessity for two reasons.

First, an on-premises application, when moved to the cloud, may not function if it must rely upon data tiered to S3 storage. Granted, an organization can theoretically restore tiered data to production cloud block or file storage. However, the application may not have sufficient time to restore data in this way. Even if restored, the application may not run, or run as expected, when hosted on the cloud provider's storage.

Second, few, if any, cloud providers permit a storage provider to deploy its physical storage solution in their cloud. While a few exceptions exist, if an organization wants to recover an application with a cloud provider, it must use the cloud provider's storage.

To meet this cloud provider requirement, some midrange storage solution providers offer SDS. Using SDS, they can virtualize the cloud provider's block, file, and perhaps even object storage. Once virtualized, the midrange storage solution provider can then re-present the cloud provider's storage to the application as its storage.

This serves a few purposes. Many, if not all, storage software data services available in the midrange storage solution now become available in the cloud. This permits use of the midrange storage solution's data services such as replication, snapshots, and others. Organizations may then even largely manage the midrange storage solution the same way in the cloud as they do on-premises.

This functionality gives organizations the flexibility to run their applications in a similar manner both in the cloud and on-premises. They may even support failing applications over to the cloud and back again with minimal or no disruption.

State of Midrange Hybrid Cloud Storage Solutions: Three Configurations

Organizations may obtain Level 2 midrange hybrid cloud storage solutions from multiple storage providers in one or more of the following configurations.

Configuration #1 – Sole Hardware Provider. In this configuration, a hardware provider delivers both the midrange array's hardware and its SDS feature. This configuration represents how most midrange storage solution providers deliver their midrange hybrid cloud storage solution.

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The sole hardware provider option represents how most providers deliver their midrange hybrid cloud storage solution.

For the on-premises component, the hardware provider delivers its own midrange storage hardware. For the cloud component, the hardware provider decouples its storage operating system from the hardware and delivers it as SDS.

This configuration minimally benefits organizations in the following two ways.

- First, organizations may manage both their on-premises and storage midrange hybrid cloud deployments in the same way. This can extend to using a centralized management console to manage both the on-premises and cloud deployments.
- Second, a single provider delivers all the hardware and software support whether deployed on-premises or in the cloud. This eliminates the finger-pointing that can occur when using hardware and software from different providers.

In this configuration, organizations should keep the following in mind. The hardware provider delivers both the hardware and software. It will likely own, maintain, and deliver the storage software. However, the provider likely does not manufacture the underlying midrange storage solution hardware components. It will often rely upon a third party to manufacture them.

Configuration #2 – Hardware/Software Provider Partnership. In this configuration, a software SDS provider partners with a hardware provider to deliver a pre-integrated midrange hybrid cloud storage solution. Delivering in this manner positions both providers to focus on their respective core hardware and software competencies.

This hardware/software provider configuration option results in a flexible, feature-rich mix of hardware and software. On the hardware side, DCIG observes that these midrange solutions offer high levels of storage capacity density and power efficiency. On the software side, the providers better optimize their solution to run on multiple hardware platforms and in multiple clouds.

The primary concern that may surface here concerns technical support for this configuration. Should a technical support issue arise, an organization must clarify which provider will own the issue through problem resolution.

Configuration #3 – Hardware/Hardware Provider Partnership. The hardware/hardware provider partnership represents the latest midrange hybrid cloud storage solution configuration to emerge. In this configuration, a hardware provider makes its SDS available on another hardware provider's platform.

Hardware providers possess at least two motivations to pursue this option. First, some hardware providers do not have a significant market presence or face barriers in entering certain countries. By delivering their SDS on another hardware provider's platform that does operate in those countries, they may enter them.

Second, some organizations already have long-standing relationships with specific hardware providers. In these instances, they want to continue to use the hardware from their current provider. However, they want to use the other hardware provider's SDS. This hardware/hardware provider partnership enables organizations to get both the hardware and software they want.

Since this represents a newer configuration, the same concerns may surface here as with the software/hardware provider partnership. Should a technical support issue arise, an organization must clarify which provider will own the issue through problem resolution.

Most evaluated midrange hybrid cloud storage solutions fall under the sole hardware provider configuration. However, DCIG gave a TOP 5 award to at least one midrange hybrid cloud storage solution from each configuration.

Each provider makes its on-premises midrange storage solution available as a pre-integrated storage appliance.

Common Features across All Midrange Hybrid Cloud Storage Solutions

DCIG evaluated over 45 different midrange storage solutions of which twelve met DCIG's inclusion criteria for a midrange hybrid cloud storage solution. DCIG evaluated over 325 features across these twelve midrange hybrid cloud storage solutions. These twelve share the following core features:

1. **Provider-branded, pre-integrated storage appliance.** Each provider makes its on-premises midrange storage solution available as a pre-integrated storage appliance. The appliance arrives at an organization's site with all hardware and software components pre-installed, configured, and ready for deployment. An organization often still needs to provide power, floor space, networking, and baseline configurations for deploying it into its environment.
2. **SDS option for deployment in general-purpose clouds.** Each solution provides organizations with an SDS option to deploy in one or more general-purpose clouds. Examples of general-purpose cloud providers include Amazon Web Services (AWS), Google Cloud Platform (GCP), and Microsoft Azure, among others. They minimally offer cloud services such as computing, networking, and storage to which organizations may subscribe. The SDS option typically consists of a virtual appliance that gets deployed in a cloud. It then uses the cloud's computing, network, and storage services to present a storage interface like its on-premises appliance.
3. **At least two storage controllers.** Each midrange storage solution's support of at least two storage controllers supports its deployment as a highly available solution. Supporting at least two controllers also represents the minimum number required for DCIG to classify a midrange array as "enterprise." However, most midrange hybrid cloud storage solutions now offer scale-out configurations and support more than two controllers.
4. **In-place controller upgrades and replacements.** The support of at least two controllers ensures uninterrupted access to the midrange hybrid cloud solution during routine maintenance. Routine maintenance typically includes regularly scheduled controller software upgrades as well as possible replacements.
5. **All-inclusive software licensing.** Each provider offers an all-inclusive software licensing option for its midrange hybrid cloud storage solution. Organizations should note that the exact features and number of features included in such a license will vary by provider.
6. **Scale to at least 500 TBs of raw storage capacity and 256 GBs of DRAM.** Supporting high levels of storage capacity and DRAM has become commonplace among midrange storage solutions. Many support storage and DRAM capacities that far exceed the 500TB and 256GB baselines referenced here.
7. **Periodic asynchronous replication.** Replication in some form becomes a requirement to support the failover of workloads from on-premises to the cloud and back again. Each of these solutions offers periodic asynchronous replication. Using this technology, each solution queues up writes on the primary system for a time (1 – 15 minutes.) At the end of that period, it then replicates the accumulated writes to the secondary system.
8. **Two data center (2DC) asynchronous.** 2DC asynchronous replication offers the same baseline functionality as periodic asynchronous replication. The main difference is that either of the midrange hybrid cloud storage solutions may function as both the primary and secondary system in a replication pair. Further, each midrange hybrid cloud storage solution in this replication pair may perform both functions at the same time.

Nothing better illustrates flash's pervasiveness than the availability of any of these midrange storage solutions in an AFA configuration.

9. **Management REST API.** Supporting a management REST API provides a means for third-party software solutions to manage a midrange hybrid cloud storage solution. Each midrange hybrid cloud storage solution offers such a management REST API for this purpose. However, organizations must still verify which, if any, third-party management software solutions support and manage specific midrange storage solutions.
10. **Technical Support via Email.** Every provider of midrange hybrid cloud storage solutions offers multiple means of providing technical support, of which email is one. However, obtaining technical support using email represents the only technical support option that they all share.
11. **24x7x365 availability of technical support staff.** Each provider makes its technical support available around the clock every day of the year.
12. **4-hour Response time of technical support staff.** While all providers make their technical support available around the clock, they all only guarantee 4-hour response times.

Similarities between the DCIG TOP 5 Midrange Hybrid Cloud Storage Solutions

In addition to supporting all the features listed above, all DCIG TOP 5 Midrange Hybrid Cloud Storage Solutions also support the additional following features. These include support for:

- **32Gb FC and 10 Gb Ethernet (iSCSI) block storage networking protocols.** Support for block storage protocols such as FC or iSCSI once represented the standard for measuring midrange storage solutions. While no longer true, the TOP 5 midrange hybrid cloud storage solutions still support these two block storage protocols.
- **All-flash array (AFA) configurations.** Nothing better illustrates flash's pervasiveness than the availability of any of these midrange storage solutions in an AFA configuration. Flash's availability, reliability, and performance has resulted in it often being the preferred storage media even in midrange storage solutions.
- **Array-based encryption.** Encryption once represented a feature only occasionally found on midrange storage solutions. Now organizations have become much more sensitive about the security of their data. This need for array-based encryption perhaps becomes heightened on midrange storage solutions. Organizations may deploy them at locations with lower levels of physical security. This makes them potentially more vulnerable to theft. Array-based encryption helps protect data residing on their drives should the midrange storage solution get stolen.
- **Immutable snapshots.** Ransomware and insider threats represent another set of concerns for which organizations must account. Organizations must assume they are always at risk of an attack and take steps to protect their production data. Immutable snapshots help secure their data from these threats. They first store data in an unchangeable format while providing organizations with the means to rapidly access and restore it.
- **Multiple high-end replication options.** Continuous asynchronous, synchronous, and synchronous replication across a metro cluster highlight the replication features that differentiate the TOP 5 solutions. Organizations typically only find these replication features on high-end storage systems. Now they may obtain these replication features on any of the TOP 5 midrange hybrid cloud storage solutions.
- **Multiple in-depth technical support options.** A combination of in-depth technical support options often contributes to separating the best from the rest. This adage holds true here as well. The providers for each of these TOP 5 providers offer onsite support, remote login and problem resolution, and remote monitoring. They also

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By requiring additional approvals for some administrative actions, organizations can better mitigate accidental or malicious activities. Each TOP 5 midrange hybrid cloud storage solutions supports these additional administrative checks.

provide same-day delivery of replacement parts with the option to obtain a guaranteed 4-hour onsite response. While every organization may not need this level of technical support, these providers can deliver it for those that do.

- **More uninterrupted system availability options.** Replacing midrange storage solution controllers and updating them represent only two aspects of storage system maintenance. These TOP 5 solutions do a better job of accounting for the other components that may need maintenance. These include firmware upgrades of hard disk drives (HDDs), network ports, and solid-state drives (SSDs). They facilitate data migrations, replacing old hardware with new hardware, and storage shelf and node additions. Organizations may perform any of these tasks on any TOP 5 midrange storage solution while it remains available and online.
- **On-premises storage-as-a-service (STaaS).** The TOP 5 midrange storage solutions better anticipate the modern demands of some organizations. The option to obtain storage-as-a-service on-premises illustrates this principle. Each TOP 5 midrange storage solution provider gives organizations the option to obtain and consume storage on-premises in this fashion.
- **Additional approvals needed for some administrative activities.** Organizations have rightfully come to recognize some administrative activities performed on storage systems should not be done unchecked. These may include copying, moving, or deleting data or setting up replication pairs. By requiring additional approvals for these types of activities, organizations can better mitigate accidental or malicious activities. Each of these five midrange hybrid cloud storage solutions supports these additional administrative checks.
- **VAAI block and thin provisioning primitives.** Many organizations have already begun the process of exploring a move off VMware software due to recent software licensing and pricing changes. However, organizations accustomed to using VMware's vSphere APIs for Array Integration (VAAI) will find they cannot move so quickly. Those organizations planning to use the VAAI primitives to optimize storage array management still need storage systems that support them. All TOP 5 midrange hybrid cloud storage solutions check these two important boxes.

In addition to supporting the above features, all TOP 5 solutions also support the following features and options:

- Additional management interface options include a command line interface, VMware vSphere/vCenter integration, and a web-based GUI.
- Automated policy-based storage provisioning.
- Integration with the Active Directory and LDAP directory services.
- Multi-tenancy.
- Network optimization for Ethernet, InfiniBand, RDMA, and/or NVMe-oF protocols.
- Reference architectures and white papers explaining their support for Microsoft SQL Server and Oracle Database.
- Scale to at least 1PB of raw storage capacity and 1TB of DRAM.
- Use SNMP traps and Syslog for alerting and reporting.

Differences between the TOP 5 Midrange Hybrid Cloud Storage Solutions

Despite the many similarities between the DCIG TOP 5 Midrange Hybrid Cloud Storage Solutions, they do differ in features they support. These differences demand that organizations identify and prioritize specific features a solution should possess to meet their requirements.

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Each TOP 5 midrange hybrid cloud storage solution supports multiple general-purpose clouds, though not the same ones. It therefore behooves organizations to select a TOP 5 product that supports the specific general-purpose clouds they want to use.

The differences between the DCIG TOP 5 Midrange Hybrid Cloud Storage Solutions primarily surface in three broad areas: Consider:

- **Support for general-purpose clouds.** Organizations may already have existing relationships with specific general-purpose cloud providers. Alternatively, they may anticipate using a specific one as they implement their hybrid cloud strategy. In both cases, organizations must verify the midrange hybrid cloud storage solution supports the general-purpose cloud they want to use.

For instance, each midrange storage solution supports different general-purpose clouds when using them as part of a tiered storage configuration. This behooves organizations to verify the TOP 5 product supports the general-purpose cloud providers they want to use.

This situation potentially becomes even more complicated for the TOP 5 midrange hybrid cloud storage solutions. Not all TOP 5 providers support the deployment of its SDS option in every general-purpose cloud. This mixed support for general-purpose clouds dictates that organizations proceed carefully in their choice of a midrange storage solution.

- **Support for mixed storage types and storage networking protocols.** Organizations wanting an on-premises midrange all-flash block storage solution using FC or iSCSI may theoretically select any TOP 5 product. This decision becomes more difficult, however, if the midrange storage solution must support other storage media types or storage networking protocols.

On the storage media side, three TOP 5 midrange hybrid cloud storage solutions support both disk and flash media.

On the storage networking side, three midrange storage solutions offer a choice between unified (block and file) or universal (block, file, and object) storage. If going down this path, organizations must then establish which Ethernet speeds they need the midrange storage solution to support. Support for 25, 40, 100, and 200Gb Ethernet varies between the TOP 5 products.

- **Data protection and security features.** Most, if not all, organizations have put in place initiatives to better protect their infrastructure from cyberattacks. Whether these incidents originate from outside an organization or from within, organizations must protect themselves against attacks. As such, organizations must obtain midrange hybrid cloud storage solutions that offer the appropriate data protection and security features.

In this area, midrange storage solutions vary in their cyber security capabilities. For instance, each midrange storage solution handles user and administrative logins differently if not using AD or LDAP. Four offer a Storage Administrator role, three support a Security Administrator role, and one supports Security Auditor and Storage Auditor roles.

If using Security Information and Event Management (SIEM) software to monitor activity, currently three integrate with an SIEM solution. Two of these products also now offer file analytics and file auditing to proactively detect and alert on anomalous activity on the storage solution.

TOP 5 Midrange Hybrid Cloud Storage Solution Profiles

Each of the following DCIG TOP 5 Midrange Hybrid Cloud Storage solution profiles highlight at least three ways they differentiate themselves from one another. These differentiators represent some of the primary reasons that an enterprise may want to consider one solution over another as a midrange hybrid cloud storage solution. Within each solution, an organization may find features that better meet its specific needs.

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Hitachi Vantara offers a 4:1 “No Questions Asked” data reduction guarantee for the VSP One Block. Its patented Adaptive Data Reduction (ADR) automatically switches between real-time and deferred processing to provide optimal performance and energy efficiency.

Hitachi Vantara VSP One Block

Hitachi tailors its Vantara Virtual Storage Platform (VSP) One Block storage system to the storage needs of midsize enterprises. It delivers up to 1.8 PBe of NVMe all-flash storage in a 2U rack-mountable enclosure. Enterprises may add up to two NVMe expansion shelves per appliance and scale it out to 65 nodes per cluster.

Combining it with the VSP One SDS Cloud creates the Virtual Storage Platform One hybrid cloud data platform. This hybrid cloud data platform offers one data fabric, control plane, and data plane that supports multiple protocols and clouds.

The VSP One Block utilizes the same Hitachi Vantara Storage Virtualization Operating System (SVOS) technology that powers Hitachi Vantara’s high-end storage arrays. To make SVOS more easily manageable by IT generalists, Hitachi Vantara took steps to simplify the VSP One Block’s deployment and operation.

Additional features the Hitachi Vantara VSP One Block offers that help differentiate it from other TOP 5 Hybrid Cloud Storage Solutions include:

- **Rapid, simplified deployments.** A VSP One Block midrange array can install in about 30 minutes. Hitachi Vantara preconfigures the arrays based on Hitachi Vantara’s recommended best practices. For instance, the VSP One Block midrange array utilizes Dynamic Drive Protection (DDP) groups. DDP groups provide RAID 6 resilience though DDP offers greater efficiency and faster recovery from drive failures than RAID 6. The VSP One Block midrange arrays also automatically enable FIPS 140-3 data-at-rest encryption and harden network management access to Block Administrator.
- **Simplified ongoing management.** The VSP One Block Administrator runs in dedicated hardware on the controller, not on a separately managed workstation, VM, or cloud. It then connects to Hitachi Remote Ops that enables Hitachi Vantara to monitor the system. As part of this service, it provides proactive support for the VSP One Block to include installing cryptographically validated microcode updates.

Enterprises may also use the AIOps management capabilities of the Hitachi Ops Center Suite to manage VSP One Block. This cloud-based SaaS option provides proactive monitoring, up-to-date asset inventories, health status, risk management, copy data management, and capacity planning. It complements those features with AI-driven insights and automations to further reduce management time and effort.

- **Smart, sustainable storage.** Hitachi offers a 4:1 “No Questions Asked” data reduction guarantee for the VSP One Block. Hitachi Vantara’s patented Adaptive Data Reduction (ADR) first continuously analyzes data as writes occur. It automatically switches between real-time and deferred processing to provide optimal performance and energy efficiency.

HV’s patented Dynamic Carbon Reduction (DCR) technology also optimizes power consumption. It switches controller CPUs into their low-power ECO mode during periods of low activity.

These intelligent data lifecycle management features contribute to Hitachi Vantara delivering solutions that optimize available array resources. Its use of CO2 reduction technologies has enabled the VSP One Block to achieve the Carbon Footprint of Products (CFP) approval.

The FlashSystem 9500's FlashCore Module 4 (FCM4) continuously monitors statistics gathered from every I/O. It then uses machine learning models to detect anomalies like ransomware in potentially a minute or less.

IBM FlashSystem 9500

The IBM FlashSystem 9500 distinguishes itself through its comprehensive support for NVMe to include NVMe/FC, NVMe/TCP, and NVMe-oF. IBM pairs these with 100Gb Ethernet and 64Gb Fibre Channel connectivity to deliver sub-millisecond access in a 4U dual-controller enclosure. The FlashSystem 9500 enclosure offers options to scale out to four controllers, scale up via expansion chassis, or both.²

The FlashSystem 9500 integrates with and manages 500+ third-party storage systems and multiple clouds. It also offers pre-built integrations for Ansible and automated policy-based storage provisioning.

Additional features the IBM FlashSystem 9500 offers that help differentiate it from other TOP 5 Midrange Hybrid Cloud Storage Solutions include:

- **AI-enabled cyber monitoring and recovery.** The FlashSystem 9500's FlashCore Module 4 (FCM4) continuously monitors statistics gathered from every I/O. It then uses machine learning models to detect anomalies like ransomware in potentially a minute or less.

IBM's Cyber Vault feature then accelerates cyber incident detection, response, and recovery. Cyber Vault runs continuously and monitors snapshots as they are created. Cyber Vault uses standard database tools and automation software to check snapshots for changes. If Cyber Vault finds such changes, this may indicate an attack is occurring and notifies system administrators.

Cyber Vault then keeps track of the last unchanged snapshot to speed up responses to a cyber-attack. Its knowledge of the last "good" snapshot to use for restores helps enterprises quickly identify one to use. Since snapshots reside on the same FlashSystem as production data, recoveries occur quickly. IBM guarantees a restore within 60 seconds or less using its immutable SafeGuarded Copy snapshot.

- **Broad colocation and cloud alliances.** IBM offers multiple global alliances with colocation providers, including China Telecom/Unicom and Global Switch. IBM also partners with Equinix® to provide a dedicated interconnection to the IBM Cloud® and other major cloud providers.

IBM makes its Spectrum Virtualize software that powers IBM FlashSystem Storage available in multiple clouds. These include the IBM Cloud, AWS, and Microsoft Azure. Spectrum Virtualize's availability in the cloud and on-premises positions enterprises to manage a hybrid cloud environment in a consistent manner.

- **IBM Storage-as-a-Service.** IBM FlashSystem all-flash array technology is the basis for IBM's Storage as a Service (StaaS) offering. IBM offers multiple pricing options based on performance, capacity, and contract duration.

Enterprises may choose from four FlashSystem performance tiers and up to 100% guaranteed availability. IBM installs the FlashSystems needed to meet the StaaS contract commitment. It also provides storage beyond the committed capacity for instant capacity growth or workload bursting.³

SVMs provide a virtualized view of the physical assets in the ThinkSystem DM storage cluster to create multiple independent sets of storage.

Lenovo ThinkSystem DM

The Lenovo ThinkSystem DM distinguishes itself from other midrange hybrid cloud storage solutions with its distinctive go-to-market model. Lenovo utilizes the proven NetApp ONTAP operating system (OS) to power the ThinkSystem DM. The ONTAP OS offers the hybrid cloud functionality, storage networking protocols, and storage management features that enterprises expect.

Lenovo then hosts NetApp ONTAP OS on storage hardware that it manufactures. Lenovo represents one of the few providers that offers end-to-end manufacturing. This end-to-end model has come into vogue due, in part, to rising global tensions and supply chain disruptions. Lenovo manufactures everything from the individual hardware components to assembling the ThinkSystem DM storage array.

Additional features the Lenovo ThinkSystem DM offers that help differentiate it from other TOP 5 Hybrid Cloud Storage Solutions include:

- **Storage virtual machines (SVMs).** SVMs provide a virtualized view of the physical assets in the ThinkSystem DM storage cluster. Using SVMs, an enterprise may create multiple independent sets of storage that serve at least two important roles.

For instance, SVMs permit multiple departments or organizations to securely use and share the same ThinkSystem DM's physical resources. Each department or organization may only access the ThinkSystem DM's resources assigned to its SVM. Each SVM also then isolates its data and management from other SVMs on the ThinkSystem DM.

SVMs also play a key role in ensuring a ThinkSystem DM remains available during hardware and software upgrades. During these upgrades, an organization may move an SVM and its data to different hardware resources in a ThinkSystem DM cluster. This permits continuous operations of the applications hosted on the SVM while also enabling organizations to keep the ThinkSystem DM storage up-to-date with the latest security and feature upgrades.

- **Centralized server and storage management using XClarity Administrator.** Lenovo uses the same hardware foundation for both its ThinkSystem server systems and storage solutions. To manage them, Lenovo offers XClarity™ Administrator. It runs as a virtual appliance, uses no agents, and can manage up to 1,000 devices. Using XClarity Administrator, enterprises may automate the discovery, inventory, tracking, updates, monitoring, and provisioning of their Lenovo server and storage systems.⁵
- **Monitors and predicts storage capacity usage.** Identifying current storage trends and forecasting issues before they impact production applications represents a challenge for many organizations. Lenovo's ThinkSystem Intelligent Monitoring helps enterprises get in front of this challenge. Intelligent Monitoring monitors and predicts capacity usage as well as helps detect risk factors before they escalate to impact operations.⁶

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NetApp has significantly matured ONTAP's hybrid cloud functionality to interoperate with multiple general-purpose clouds (AWS, Azure, GCP). This support includes deploying, migrating, and managing applications whether they run on-premises or in the cloud.

NetApp AFF A400

The NetApp AFF A400 distinguishes itself from other midrange hybrid cloud storage solutions with its ONTAP operating system (OS). NetApp makes ONTAP available on all its AFF and FAS high-end and midrange storage systems. This gives enterprises access to NetApp ONTAP even on midrange storage systems such as the NetApp AFF A400.

NetApp originally designed ONTAP to deliver file services such as CIFS, NFS, and SMB. Since then, NetApp has introduced support for object (Amazon S3) and block (FC/iSCSI) storage networking protocols into ONTAP. As a result, enterprises may use the AFF A400 to host mixed workloads using different storage networking protocols.

NetApp first formally started announcing support for hybrid cloud functionality at least ten years ago.⁷ Since then, NetApp has significantly matured ONTAP's hybrid cloud functionality to interoperate with multiple general-purpose clouds (AWS, Azure, GCP).⁸ This support includes deploying, migrating, and managing applications whether they run on-premises or in the cloud.

Additional features the NetApp AFF A400 offers that help differentiate it from other TOP 5 Midrange Hybrid Cloud Storage Solutions include:

- **Cloud Insights.** The flexibility to store data or run applications either on-premises or in the cloud on-demand sounds great on the surface. However, capacity, performance, and other issues inevitably arise. Further, the complexity associated with troubleshooting issues in hybrid cloud environments increases significantly even as resolving these issues becomes amplified.

NetApp delivers Cloud Insights as a cloud-based SaaS service. It provides enterprises with a means to monitor the application, server, and storage resources in their hybrid cloud environments. Cloud Insights discovers, visualizes, and monitors all elements (applications, containers, VMs, network switches, storage, etc.) in an application stack. Should an issue arise in that stack, Cloud Insights can help identify those elements contributing to or causing the issue. Specifically, it can identify correlated, degraded, or "greedy" resources that may be causing the issue in the hybrid cloud environment. This rapid identification permits enterprises to quickly focus their efforts on the most likely causes of the issue.⁹

- **NetApp BlueXP.** NetApp BlueXP provides enterprises running file services a central control plane to manage their storage and data. BlueXP offers some of the same features as Cloud Insights, such as discovery, visualization, and monitoring of the infrastructure.

However, BlueXP gives enterprises additional capabilities to classify data, perform back-ups and replication, and tier data. Enterprises may use BlueXP to manage file and object data on-premises and in the cloud. BlueXP even offers its own APIs for those enterprises that want to programmatically manage their hybrid cloud NetApp infrastructure.¹⁰

- **Offers a Ransomware Recovery Assurance Guarantee.** Ransomware has emerged as a scourge for all size organizations. However, bad actors and hackers often specifically target enterprises because of the outsized ransoms they can potentially obtain. To counter these threats, NetApp offers its Ransomware Recovery Assurance Service for new ONTAP AFF, ASA, and FAS systems.

To obtain this guarantee, enterprises must follow a prescribed set of steps and services to validate the environment. This process minimally involves using SnapLock Compliance, setting retention time, validating SnapLock Compliance volumes, and data recovery testing. Further, an enterprise must agree to follow NetApp's recommendations and requirements or risk voiding the Guarantee.¹¹

StorONE's auto-tiering algorithm constantly monitors the upper layer (usually SSDs) for moments of less I/O activity. It is during these times of lower I/O activity that StorONE moves data from the upper to lower storage tiers.

StorONE S1/Seagate Exos AP 5U84

The Seagate Exos AP 5U84 distinguishes itself by using the StorONE Data Storage Platform as its storage operating system (OS). The base Seagate Exos AP 5U84 unit offers 84 drive slots with dual controllers and a highly available hardware design.

The Exos AP 5U serves as a building block for constructing larger storage systems. It permits adding more Exos AP 5U84 units to the first one deployed. The StorONE Data Storage Platform then capitalizes on and enhances the Seagate Exos AP 5U84's available hardware resources. For instance, StorONE utilizes the Exos AP 5U84's two controllers to create an active-active, hot-swappable storage controller architecture.

Additional features the Seagate Exos AP 5U84 offers that help differentiate it from other TOP 5 Midrange Hybrid Cloud Storage Solutions include:

- ***StorONE Virtual Storage Containers create use case-specific media pools.***

Using StorONE's Virtual Storage Container™ feature enterprises may create a media pool from the Exos AP 5U84's SSDs, HDDs, or both. Assigning specific drives to individual media pools facilitates creating pools with use case-specific performance characteristics. Performance-intensive applications may be assigned to media pools consisting of SSDs. Conversely, lower-performing applications may be assigned to media pools consisting of HDDs.

Since application performance characteristics can and do change over time, StorONE media pools can flex with these changes. Enterprises may dynamically add and remove HDDs and/or SSDs from a media pool to meet changing application needs. They may also dynamically increase the media pool's size to meet increasing storage capacity demands.

- ***Utilizes intelligent auto-tiering.*** Storage systems that offer auto-tiering may use one of any number of algorithms to tier data on different storage types. Algorithms may rely upon either a "first-in-first-out" approach or wait until the SSD tier fills up. StorONE specifically chose a more sophisticated option to implement this feature.

StorONE's auto-tiering algorithm constantly monitors the upper layer (usually SSDs) for moments of less I/O activity. It is during these times of lower I/O activity that StorONE moves data from the upper to lower storage tiers. StorONE then also takes steps to optimize transfer speeds by moving as much data as possible as quickly as possible.

- ***Recover in the Microsoft Azure Cloud.*** StorONE's availability in the Microsoft Azure cloud provides options to perform cloud-based disaster recoveries. Enterprises may migrate on-premises applications to Azure using StorONE's vReplicate. Once hosted in Azure, enterprises may perform business continuity and DR activities. They may also explore using StorONE in Azure for hosting burstable workloads and data mining.¹²

Midrange Hybrid Cloud Storage Solutions Inclusion Criteria

In considering solutions for inclusion in this report, a solution must meet the following criteria:

- Must concurrently manage and store data both on-premises and in at least one general-purpose cloud environment.
- Must offer an SDS option to permit running hosting applications, data, and workloads in a general-purpose cloud environment.
- Must offer a pre-integrated appliance for on-premises deployment that includes all the needed hardware and software.
- Be shipping and available by July 1, 2024.
- Sufficient information available for DCIG to make an informed, defensible decision.

DCIG Disclosures

Providers of some of the midrange hybrid cloud storage solutions covered in this DCIG TOP 5 report are or have been DCIG clients. In that vein, there are some important facts to keep in mind when considering the information contained in this TOP 5 report:

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

No provider was privy to how DCIG weighted individual features. In every case the provider only found out the rankings of its solution after the analysis was complete. To arrive at the TOP 5 midrange hybrid cloud storage 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 seven general categories.
3. DCIG assigned a weight to each feature to establish a scoring rubric.
4. DCIG identified midrange storage solutions that met DCIG's definition for a midrange hybrid cloud storage solution.
5. A survey was completed for each midrange hybrid cloud storage solution.
6. DCIG evaluated each midrange hybrid cloud storage solution based on information gathered in the product's survey.
7. Solutions were ranked using standard scoring techniques. ■

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