Competitive Intelligence Report

DCIG

HPE Alletra Storage MP B10000 Competitive Differentiators Versus Pure Storage FlashArray

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COMPETITIVE INTELLIGENCE REPORT

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PRODUCT

HPE Alletra Storage MP B10000

COMPANY

Hewlett Packard Enterprise Development LP

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Spring, TX 77389

(888) 342-2156

https://www.hpe.com/us/en/alletra-storage-mp-b10000.html

PRODUCT

Pure Storage FlashArray

COMPANY

Pure Storage, Inc.

2555 Augustine Dr.

Santa Clara, CA 95054

(800) 979-7873

https://www.purestorage.com/products/unified-block-file-storage.html

The New Need for Enterprise Storage Systems to Address Today's Non-storage IT Challenges

Cybersecurity threats. Anywhere, anytime data availability. Hybrid cloud adoption and growth. VMware software licensing changes and VMware hypervisor alternatives. Complex IT infrastructures. These represent many of the concerns for which enterprises must account as they manage their modern IT infrastructures.

Adding to the dilemma, enterprises rarely have the luxury of deploying point solutions to respond to each challenge. Rather, enterprises must identify and deploy solutions that position them to comprehensively address and respond to these challenges.

These solutions ideally will include features that equip enterprises to:

- ***Improve and strengthen their cybersecurity posture.*** Enterprises now recognize that it is not "if" but "when" they have a cybersecurity event. Further, a cybersecurity event may take many forms that may include an internal breach, malware, phishing, or ransomware. Modern technology solutions must include features that improve and strengthen an enterprise's cybersecurity posture.
- ***Maximize their current VMware software licenses while positioning them to use VMware alternatives.*** Broadcom's VMware software licensing changes have prompted enterprises to re-evaluate how they use VMware going forward. While many will continue using VMware in some capacity, most now consider using VMware alternatives. These alternatives may include other on-premises hypervisors, general-purpose clouds, and containers and Kubernetes technologies. New solutions must account for these VMware alternatives.
- ***Meet ever-increasing application and workload capacity and performance demands.*** Delivering ever more capacity and performance to meet increasing application and workload demands remains a constant for any new technology solution being considered.
- ***Remain online indefinitely across hybrid multi-cloud environments.*** Today's world demands that IT infrastructures remain online 24x7x365 with no time for downtime. Any new solution must offer features that deliver on this requirement.
- ***Minimize the cost, time, and effort required to effectively manage ever-evolving and increasingly complex IT infrastructures.*** The demands placed on and threats faced by enterprise IT infrastructures equate to increasing amounts of complexity in those environments. These solutions must include artificial intelligence (AI) and machine learning (ML) features that automatically and pro-actively identify and resolve issues.

Enterprise storage solutions exemplify a core component of enterprise IT infrastructures that now offer features to meet these various challenges. As such, enterprises must scrutinize how well these solutions position them to address these challenges.

HPE Alletra Storage MP B10000 and Pure Storage FlashArray represent two storage solutions that enterprises often consider. How well these two solutions address these market forces depends upon, in part, on how each of them delivers on the following features and capabilities:

- Product architecture.
- Management of current and future storage investments.
- Data availability capabilities.
- Use of AIOps to ease management complexities.
- Anomaly detection capabilities.
- Support for various server virtualization platform technologies.

Product Architecture

Capacity and performance features remain the backbone of enterprise storage solutions. As such, enterprises still expect modern enterprise storage solutions to possess both the capacity and performance characteristics that they need.

However, enterprises want storage solutions to do more than meet their current storage capacity and performance requirements. The product's architecture should account for either planned or unplanned capacity growth, performance growth, or both. This requirement demands that modern storage solutions can scale capacity and performance independently of one another.

The product's architecture should account for either planned or unplanned capacity growth, performance growth, or both.

To meet these expectations, the solution will ideally:

- Scale its capacity or performance resources granularly and independently of the other resource.
- Scale both up and out.
- Minimize or eliminate hardware obsolescence associated with making these changes.
- Monitor resources for utilization and allocate and balance performance as needed.

Pure Storage FlashArray

Pure Storage offers three FlashArray model families, the //XL, //X, and //C models for different enterprise use cases. All FlashArray models use a modified "active/passive" dual-controller architecture where both controllers accept I/O during normal operations. A FlashArray then manages operations so only one controller moves data to and from attached storage system devices.[1]

Each family differs in maximum capacities and performance with Pure Storage positioning each model family as follows:

- ***The FlashArray//XL models prioritize performance over capacity.*** The //XL170 may achieve latencies as low as 150 microseconds (µs) and supports up to 1.4PB of all-flash raw storage capacity.[2]
- ***The FlashArray//X models seek to balance capacity and performance.*** The //X90 offers up to 915TB of all-flash raw storage capacity and may achieve latencies as low as 250µs.[3]
- ***The FlashArray//C models emphasize capacity over performance.*** The //C90 model scales up to 2.5PB of all-flash raw storage capacity and may achieve latencies as low as 2 milliseconds (ms).[4]

To scale up capacity and performance, each FlashArray model family offers different options. To increase capacity, enterprises may add more flash until the respective model reaches its maximum capacity. The //XL and //X models also support connectivity to a Direct Flash Shelf for more flash capacity with the //XL supporting connectivity for up to two Direct Flash Shelves.

To increase performance, Pure Storage offers two options. One may potentially swap out the controllers on an existing FlashArray model for more powerful controllers. The other option involves introducing a new FlashArray.

FlashArray DirectFlash Modules

Rather than using solid state drives (SSDs) in its storage systems, Pure Storage uses DirectFlash Modules (DFM). Designed by Pure Storage, DFMs connect directly to a FlashArray. Pure Storage's Purity software interfaces directly with the raw NAND in each

DFM using the NVMe protocol. The Purity software then maps, presents, and manages the flash media in each DFM.[5]

The type of flash memory used in a DFM varies depending on the FlashArray model. The FlashArray//XL and //X models currently support DFMs with up to 36TB TLC memory. These DFMs capitalize on TLC's higher performance and better reliability.

In contrast, the FlashArray //C models currently support DFMs with up to 75 TBs QLC memory. These DFMs capitalize on QLC's higher capacity and lower per-terabyte costs.[6]

The HPE Alletra Storage MP B10000 ships as a single model with a composable, disaggregated, scale-out architecture.

Managing FlashArray Performance

Every FlashArray model offers two Quality of Service (QoS) options to control, manage, and optimize its performance. By default, every FlashArray has its QoS Fairness setting turned on that administrators cannot turn off. This array-wide setting ensures that FlashArray itself cannot be overrun by the hosts and initiators attached to it.

Each FlashArray also offers a QoS Rate Limiting setting. Administrators can enable and configure this setting for individual volumes or volume groups. They may set restrictions on these volumes or volume groups based on bandwidth or IOPs limits.[7]

HPE Alletra Storage MP B10000

HPE offers HPE Alletra Storage MP B10000 as a single model. The B10000, does, however, consist of a composable, disaggregated, scale-out architecture. Using this architecture enterprises may configure the B10000 to meet different use cases.

A Composable, Disaggregated, Scale-out Architecture

The B10000's composable, disaggregated, scale-out architecture possesses characteristics that differentiate it from dual-controller storage architectures. By separating capacity and performance resources into independent components, the B10000 can scale these resources individually.

For instance, the B10000's composable infrastructure offers both compute and storage nodes. Enterprises may start out with an initial, entry-level configuration as small as two compute nodes. These two nodes must each contain at least eight (8) NVMe SSDs of the same capacity.

Once deployed, the B10000 may introduce additional performance or capacity in the following ways. They may:

- ***Add more performance.*** The B10000 currently scales out to a maximum of four compute nodes. Compute nodes may be added one at a time. Enterprises may also choose from either an AMD EPYC™ embedded 16-core processor or an AMD EPYC™ embedded 32-core processor for added performance.
- ***Add more storage capacity to each compute node.*** Each compute node scales up to 24 internal NVMe SSD drives. Additional NVMe SSD drives may be added to each compute node in two drive increments.
- ***Add flash storage expansion shelves.*** The B10000 supports from zero to sixteen external flash storage expansion shelves.

Regardless of where enterprises add more capacity, no B10000 controller "owns" any specific SSD. Rather, all B10000 controllers can see all SSDs. This visibility of and access to all SSDs reduces storage system inflexibility and the potential of creating capacity or performance silos.

It can also help enterprises avoid the hidden costs associated with stranded resources and overprovisioning. HPE uncovered in internal case studies that the total cost of ownership (TCO) savings using a disaggregated scale-out architecture can approach 40%.[8]

Once deployed, enterprises may see even greater savings operationally using the B10000 versus many FlashArray models. In two recently published Energy Star reports, the B10000 achieved up to a 10X higher IOPS/watt rating than a Pure Storage FlashArray //XL. Notably, the B10000 achieved a 387.48 IOPS/W rating. In contrast, a Pure Storage //XL model achieved a 40.56 IOPS/W rating.[9]

In two recently published Energy Star reports, the B10000 achieved up to a 10X higher IOPS/watt rating than a Pure Storage FlashArray //XL.

Performance Management

The B10000 uses various techniques to deliver on the performance that SSDs offer. It first utilizes system-wide striping which harnesses all the controllers' hardware resources available in the B10000's scale-out architecture.

By creating a single unified cluster, as opposed to a federated architecture, all the nodes participate in the front- and back-end I/O. The B10000's wide striping also negates the need to employ physical partitioning to control and manage performance.

To further control and manage performance, the B10000 also offers its Block Storage Priority Optimization software. Using this QoS software, enterprises may assign:

- Latency goals for specific tenants or applications.
- Minimum I/O goals per second and bandwidth for mission-critical applications.
- Maximum performance limits on workloads with lower SLAs.
- Service-level agreements (SLAs) as low as 50 microseconds.

The B10000 also enables enterprises to improve and maintain flash performance within the same system. For instance, enterprises may currently only add another controller or storage expansion unit of the same type to the existing deployment. However, the near-term roadmap includes permiting the B10000 to mix and match different controllers and storage types.

This ability to mix-and-match different controller and storage types works well in the B10000's scale-out architecture. Enterprises may then non-disruptively replace aging or maxed-out controllers or storage expansion units with ones offering higher performance or capacity.

Resiliency

A higher level of resiliency represents a significant benefit that a disaggregated, scale-out architecture offers over a dual controller architecture. This advantage specifically becomes apparent once the solution scales out to three or more controllers.

The B10000 may lose one or more controllers and still maintain system availability. It may also lose access up to two external drive shelves without losing access to any data.

The HPE Alletra Storage MP architecture also moved all write cache resiliency out of the controllers. Now losing a controller does not reduce write cache integrity. It does, however, eliminate the need for batteries or supercapacitors to protect write cache.[10] This approach provides the B10000 with extra write integrity resiliency without sacrificing performance.

HPE stands so firmly behind its commitment to non-disruptive system availability that it offers a 100% Data Availability SLA. If downtime occurs, HPE is willing to make concessions to its customers and pay penalties.

HPE Alletra Storage MP B10000 Competitive Differentiators Versus Pure Storage FlashArray

Table 1: Product Architecture Comparison Summary

	HPE Alletra Storage MP B10000	Pure Storage FlashArray

Models	8-core
	16-core
	32-core
		//C
		//X
		//XL

Controller Architecture	Disaggregated Scale-out	Modified Dual Controller Pair
Min/Max Number Controller Nodes	2/4	2/2

Min/Max Number of Storage Expansion Shelves	0/16	//C – 0/0
		//X – 0/1
		//XL – 0/2

Lowest Published Latency	SLA as low as 50 microseconds	As low as 150 microseconds
Flash Storage	NVMe SSDs	DFMs
QoS Software	Priority Optimization	QoS Fairness QoS Rate Limiting
Data Availability	100% Data Availability Guarantee	99.9999% Availability *(Evergreen//Forever)*
Storage Networking Ports	10Gb, 25Gb Ethernet 32GB FC	10Gb, 25Gb, 40Gb, 100Gb Ethernet 32Gb, 64Gb FC
Block Storage Networking Protocols	FC, iSCSI NVMe/FC, NVMe/TCP	FC, iSCSI NVMe/FC, NVMe/TCP
CPU Technology	AMD EPYC™ embedded 7003 Series 8/16/32 Core Processors[11]	Intel Xeon Processors[12]
ENERGY STAR IOPS/W Rating	B10140 Disk Set Online 4 387.48	//XL NVSS Disk Set Online 4 40.56

Key Questions to Ask:

- Do you want or need all storage systems resources available to maximize performance?
- Do you want Tier-0 mission-critical resiliency, with the ability to lose a lot of the infrastructure yet still suffer zero outage?
- Do you want to eliminate wasted capacity or performance?
- Do you want or need a storage solution that permits you to incrementally scale capacity, performance, or both as needed?
- Do you want or need the flexibility to control the amount of performance that specific applications or workloads consume and when?
- How important is it to manage costs when introducing additional performance?

Optimizing and Future Proofing Storage Investments

Enterprises frequently must address unexpected changes to their IT infrastructure that require introducing more capacity, more performance, or both. To avoid prematurely replacing hardware in their existing IT infrastructure, they want to optimize and future proof their hardware investments.

Storage solutions can be particularly sensitive to both planned and unplanned capacity or performance changes in the IT infrastructure. Enterprises often find they reach the capacity and performance limits of a storage array before it reaches its planned end-of-life (EOL). This may require enterprises to prematurely replace existing storage solutions.

Storage solutions can be particularly sensitive to both planned and unplanned capacity or performance changes in the IT infrastructure.

To address this situation, Pure Storage and HPE offer options for enterprises to optimize and future proof investments in their respective storage solutions.

Pure Storage Evergreen

Every Pure Storage FlashArray runs on the Purity storage operating system that includes storage optimization features. The Purity OS automatically turns on compression, deduplication, and thin provisioning optimization features in every FlashArray.[13]

To future proof its FlashArray solutions, Pure Storage offers its EverGreen subscription. Using Evergreen, as enterprise storage needs grow or Pure Storage offers new services, enterprises may upgrade their existing storage array.

Pure Storage offers three Evergreen subscription options.[14] Each of these subscriptions comes with common guarantees. Each subscription guarantees that enterprises will:

- Experience zero data loss.
- Not have to perform any data migration.
- Provide increased power and space efficiency.[15]

Evergreen//One

Pure Storage structures its first offering, Evergreen//One, for storage-as-a-service (STaaS) IT environments. Enterprises only pay for the Pure Storage capacity that they use on-premises, co-location, or in public general-purpose clouds. Pure Storage prices Evergreen//One for at least eleven different use cases.[16]

Evergreen//Flex

Pure Storage structures Evergreen//Flex for enterprises that own or control their storage solutions. Enterprises pay a subscription based on utilization of purchased storage capacity. This subscription includes hardware upgrades and SaaS-delivered software updates.[17]

Evergreen//Flex also offers two other options with a subscription commitment. The Ever Modern option provides for upgraded controllers for the FlashArray. Enterprises may also opt in for the Ever Agile option available with the purchase of qualifying amounts of storage capacity. Those enterprises that choose this option receive a trade-in credit for swapping existing controllers for new, upgraded ones.

Evergreen//Forever

Pure Storage structures Evergreen//Forever for enterprises that continue with traditional storage ownership. Like the //Flex offering, //Forever offers the Ever Modern and Ever Agile options.

Unlike the other two Evergreen offerings, //Forever includes four additional guarantees. These include a/an:

- All-inclusive software subscripton.
- Love Your Storage Guarantee™ where an enterprise may return a Pure Storage system within 30 days for a full refund.
- Non-disruptive hardware and software upgrades.
- Power and space efficiency guarantee.[18]

Evergreen Subscription Caveats

EverGreen //Flex and //Forever subscriptions do come with some caveats. Enterprises typically must stay within a FlashArray model family to perform non-disruptive controller upgrades. For instance, Pure Storage does not offer non-disruptive controller upgrades from the FlashArray//C models to the FlashArray//X or //XL models.

The HPE Timeless Program includes a 100% data availability guarantee.

One exception to this rule does exist. Pure Storage EverGreen//Flex and //Forever subscriptions do support non-disruptive controller upgrades from the FlashArray//X to //XL family.

However, these subscriptions do not cover all incremental hardware costs.[19] Further, enterprises should expect to pay more for these two options and to commit for longer subscription periods.

HPE Timeless Program

The HPE Timeless Program for HPE Alletra Storage MP B10000 compares most favorably with the Pure Storage Evergreen//Forever subscription. The HPE Timeless Program includes the following features:

- A nondisruptive controller upgrade if enterprises acquire a B10000 with sixteen or more cores, 46TB+ of raw storage capacity, and an eight year commitment. The 8-year commitment incurs no extra cost aside from purchasing eight years of SaaS and support.
- AI-driven cloud operations in the HPE GreenLake cloud.
- All-inclusive software subscription.[20]

Independently of the HPE Timeless Program, every HPE Alletra Storage MP B10000 solution includes the HPE StoreMore Guarantee, the 100% data availability guarantee, and the 30-day satisfaction guarantee. The B10000 offers multiple, always-on data reduction technologies to achieve a total savings guarantee of at least 4:1 across all reducible data.

These always-on technologies include:

- ***Compression*** technology that balances space savings with CPU utilization.
- ***Deduplication with Express Indexing*** that provides for fast detection of duplicate write requests.
- ***Data Packing*** that helps eliminate unused white space and creates larger, more media-efficient write sizes.[21]

Many enterprises now expect storage systems to remain online and perform well even during storage system controller refreshes and upgrades.

Table 2: Optimize and Future Proof Storage Investment Feature Summary

	HPE Alletra Storage MP B10000	Pure Storage FlashArray
Incl. Storage Optimization Features	• Compression • Data Packing • Deduplication • Thin Provisioning • Virtual Copy	• Compression • Deduplication • Thin Provisioning
Future Proof Feature Name(s)	HPE Timeless Program	Evergreen//One Evergreen//Flex Evergreen//Forever
Key Benefits	• All-inclusive software • HPE Greenlake AI-driven cloud operations • No-cost nondisruptive controller upgrade	• All-inclusive software subscription • Nondisruptive controller upgrade at extra cost.
Guarantees	• 100% data availability • 30-day satisfaction • 4:1 capacity savings	• No data migration • Nondisruptive HW/SW upgrade • Power & space Efficiency • Zero Data Loss

Key Questions to Ask:

- Do you want confidence the provider's future proof program accounts for all possible future hardware costs?
- What guarantees do you want the provider's future proof program to offer?
- How much do the extra options—if available, desired, and needed—in the provider's future proof program cost?
- What commitment do you have to make to the future proof program to realize the benefits that it offers?

Data Availability

Storage array uptime often goes hand-in-hand with data availability. If a storage array goes offline for any reason, it often impacts applications that rely upon the data it hosts. However, data availability now goes well beyond simple storage array uptime.

Enterprises must also evaluate how well the storage system performs during normal operations and when storage system maintenance activities occur. Maintenance activities minimally include storage system software patches and updates. However, many enterprises now expect storage systems to remain online and perform well even during storage system controller patches, refreshes, and upgrades.

Pure Storage FlashArray

Pure Storage offers 99.9999% (Six 9's) of uptime for any of its FlashArrays covered by its EverGreen//Forever subscription.[22] To deliver uninterrupted high levels of availability and performance, Pure Storage offers a modified dual active/passive controller configuration.

The HPE Alletra Storage MP B10000 utilizes software-defined storage (SDS) that makes all its controllers appear as one logical target to each attached host.

Delivered this way the two FlashArray controllers possess some attributes of active-active implementations. For example, all storage networking ports remain active on both contollers. However, the secondary or "passive" controller routes all storage traffic to the primary or "active" controller that processes it.

In this configuration, if the primary controller fails or goes offline for maintenance, the secondary controller takes over as primary. In these scenarios, the Purity OS moves the IP addresses or FC WWPNs to the secondary controller's ports to avoid path disruption.[23]

Pure Storage's modified active/passive architecture also addresses another common challenge in active/passive and dual active controller architectures. In dual controller architectures, each controller owns specific storage volumes so enterprises must employ multipathing software or configure the host to manage and prioritize storage traffic.

Pure Storage avoids this common drawback by decoupling its Purity OS software from its controller hardware. In this way, the array's "identity" – its IP addresses, fibre channel (FC) world wide port names (WWPNs), array configuration, etc. – remain in the software. Now, should the primary controller go offline, the Purity OS software still contains its identity. This identity fails over to the other controller so processing may continue uninterrupted.[24]

Upsides and Considerations

Uninterrupted performance should the primary controller go offline or fail represents a key upside of the FlashArray controller architecture. Since the secondary controller possesses the same hardware as the primary, processing continues as normal. This architecture also facilitates performing nondisruptive controller upgrades and refreshes within same FlashArray model family.

However, enterprises need to consider whether a storage solution with a second idle controller best meets their needs. Enterprises must potentially acquire a more powerful FlashArray system to compensate for a FlashArray controller sitting idle. They must weigh whether this approach justifies for the infrequent times a controller fails or goes offline.

Enterprises with dynamic IT environments must also weigh whether Pure Storage can adequately meet their needs to upgrade. It does offer nondisruptive operations during hardware refreshes and upgrades to more powerful FlashArray models and model families.

However, enterprises must subscribe to Evergreen//Forever to have a controller upgrade within the same FlashArray model family covered. If they must upgrade to another FlashArray model family, they will likely incur extra costs.

Even then, upgrading to controllers on a more powerful FlashArray model or model family may not suffice. Enterprises may need to acquire a second FlashArray and use Pure Storage ActiveCluster synchronous replication to distribute workloads across two FlashArrays.

HPE Alletra Storage MP B10000

Any HPE Alletra Storage MP B10000 with a minimum 3-year support agreement includes a 100 percent data availability guarantee. Additionally, the B10000's all-active, disaggregated, scale-out controller configuration utilizes the performance in each of its two to four controllers.

Two features make this possible.

- ***First, every B10000 controller in the scale-out configuration can access all back-end storage.*** This enables any host to go through any controller to access data stored on the B10000. It also has the net effect of making the performance resources on each controller available for use.
- ***Second, the B10000 utilizes software-defined storage (SDS).*** The SDS software makes all the controllers appear as one logical target to each attached host. Each host's I/O may go through any controller to access its data without requiring multi-pathing software.

Upsides and Considerations

The B10000's ability to use each controller to process I/O may free enterprises to use less powerful controllers. Since the performance on each B10000 controller gets used, enterprises can still achieve the performance they seek more economically.

If they later need more performance, they may replace or add more higher performance controllers or add expansion storage units without disruption or downtime. This ability to add, replace, or remove controllers or expansion storage units facilitates nondisruptive product upgrades and refreshes.

The B10000 offers various optimization features that can minimize any potential application performance hits.

However, since the B10000 utilizes all its controllers, the B10000's performance may decrease when one goes offline or experiences an outage. However, applications will only notice the B10000's performance decrease if it drops below their utilization of it.

To avoid this scenario, the B10000 offers various optimization features that can minimize any potential application performance hits. For instance, enterprises may introduce an extra controller to provide extra performance to account for a controller outage. The B10000 also offers wide striping that utilizes all array resources, I/O load balancing, and QoS to prioritize the I/O traffic of latency-sensitive applications.

Table 3: Data Availability Comparison Summary

	HPE Alletra Storage MP B10000	Pure Storage FlashArray
Data Availablity Guarantee	100% Data Availability Guarantee with support contract	Six 9's Uptime Guarantee 99.9999% with Evergreen//Forever
Controller Configuration	All 2-4 Controllers Always Active & Processing	Both Controllers Active; Only One Handles All I/O Traffic
Controller Replacement Process	• Introduce New Controller • Decommission Old Controller	• Decommission Existing Controller • Introduce Replacement Controller
Controller Upgrade—Same Family Model	• Introduce New Controller • Decommission Old Controller	• Decommission Existing Controller • Introduce Replacement Controller
Controller Upgrade—Higher Family Model	• Introduce New Controller • Decommission Old Controller	Various options
Controller Failure	Can lose more than one controller and remain online.	Can only lose one controller

Key Questions to Ask:

- Do you want confidence you can nondisruptively upgrade the system's controllers?
- Are you confident that the storage system can scale to meet your capacity and performance needs into the foreseeable future?
- Do you want to utilize all the available resources on each storage controller node?

AIOps for Hybrid Cloud Management

Enterprises already grapple with the complexity associated with managing their on-premises IT environments. Now the demands of computing in today's world almost compels them to implement hybrid cloud computing. For better or worse, hybrid environments serve to only exacerbate the complexity associated with IT management.

To address this complexity, artificial intelligence for IT operations (AIOps) has emerged to help enterprises manage their hybrid IT infrastructures. Both HPE and Pure Storage offer AIOps solutions that enterprises may use in this capacity.

AIOps has emerged to help enterprises manage their hybrid IT infrastructures.

Pure Storage Pure1

Pure Storage delivers its AIOps software, Pure1, as a cloud-based as-a-service data management platform. Pure1 assists enterprises in managing their hybrid IT environments in at least the following three ways.

Stack Analysis

Pure1 first gathers key information about the health and functioning of the application stack. The stack starts at the application level and extends down into various Pure Storage offerings.

Pure1 also provides predictive fault analysis and alerting as well as auditing for vulnerabilities in the environment. Pure1 currently supports FlashArray on-premises, Pure Cloud Block Storage hosted in Azure or AWS, or Pure Storage's Portworx container storage.

Workload Planner

Second, Pure1's Workload Planner utilizes the insights it gains from an enterprise's hybrid IT environment to identify optimization opportunities. For instance, using information gathered, Workload Planner can predict array capacity and performance as well as model existing and new workloads.

Pure1 also comes pre-loaded with ten common application profiles that enterprises may use in planning for deploying new applications. Using these profiles, Pure1 can model how these changes to help enterprises preview and understand their impact to environment. Workload Planner can also make upgrade recommendations if it determines the environment cannot handle them.

Service Assistant

Pure1's Service Assistant feature pools data from across Pure's worldwide customer base. Using this aggregated data, it pinpoints potential hardware, software, and environmental challenges.

For instance, it compares the software versions being used by the enterprise to the most current versions. It also analyzes the hardware in use for degradation or unusual behavior in the data for possible ransomware activity. Its insight also extends into the volumes and VMs used in VMware environments to both optimize and troubleshoot them.[25]

HPE AIOps

The HPE GreenLake cloud manages the HPE Alletra Storage MP B10000 using HPE GreenLake AIOps. It integrates with and enhances the AIOps analytics, cross-stack visibility, and performance insight capabilities of HPE InfoSight. HPE GreenLake AIOps also gathers and examines telemetry data from across the HPE infrastructure stack consisting of compute, networking, and storage.

HPE GreenLake AIOps provides complete cross stack analytics with topology insights. HPE GreenLake AIOps' signature-based wellness automation facilitates quick resolution to issues and the creation of support cases, if needed.

HPE AIOps can identify and prioritize problems across different layers of an enterprise's IT environment.

For example, HPE AIOps can identify and prioritize problems across different layers of an enterprise's IT environment. Using collected data, HPE AIOps develops unique signatures based upon workloads and enterprise requirements. These signatures perform root cause analysis with proactive remediation to optimize the IT stack.[26]

The B10000 also provides a new, enhanced on-array sensor and metric telemetry metadata collection framework. This framework better equips HPE GreenLake AIOps to first monitor and then proactively manage and support it.

The new telemetry data displays comprehensive VM and Volume topology views. Using collected data, it details dependencies between B10000 systems and their volumes, datastores, hosts and VMs.

These views identify issues such as how much latency originates from the network versus the array or servers. These details also help enterprises identify performance bottlenecks, optimize resource allocation, and troubleshoot issues beyond just storage.

These detailed dependencies also help to document, identify, and understand workload drift. Due to the dynamic nature of enterprise IT infrastructures, an application's original configuration rarely looks the same as months and years pass. By HPE AIOps monitoring this workload drift over time, enterprises can identify and correct potential issues before they cause an impact.

Table 4: AIOps Feature Comparison Summary

	HPE GreenLake AIOps	Pure Storage Pure1
Cloud-based SaaS	✓	✓
Collects telemetry data		
Clients	✓	✓
Network devices	✓	○
Storage systems	✓	✓
Cross stack analytics	✓	○
Full stack analytics	✓	✓
Hybrid cloud optimization	✓	○
Latency factors	✓	✓
Model existing workloads	✓	✓
Model new workloads	○	✓
Optimizes infrastructure	✓	✓
Predict impact of proposed changes to IT environment	✓	✓
Recommends fixes/resolution	✓	✓
Recommends upgrades	✓	✓
Resource contention insights	✓	✓

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✓ SUPPORTED ○ NOT SUPPORTED / UNDETERMINED

Enterprises must also deal with new strains of ransomware that have been designed to avoid existing storage- and network-based detection methods.

Table 4: AIOps Feature Comparison Summary (continued)

	HPE GreenLake AIOps	Pure Storage Pure1
Root cause analysis	✓	✓
Schedule software updates	✓	✓
Software update schedule recommendations	✓	●
Topology insights	✓	✓
Unique signatures	✓	●
Workload Drift	✓	●

✓ SUPPORTED ● NOT SUPPORTED / UNDETERMINED

Key Questions to Ask:

- From what client, network, and storage devices does the AIOps solution collect telemetry data?
- How mature is the AIOps solution?

Anomaly Detection

Ransomware still attacks by encrypting, exfiltrating, and/or deleting data. Thankfully, enterprise cybersecurity software can often detect these common types of ransomware attacks. However, enterprises must also deal with new strains of ransomware that have been designed to avoid existing storage- and network-based detection methods.

Hackers have created new strains of ransomware that encrypt data at very granular levels. This type of ransomware uses an attack methodology referred to as intermittent encryption. Rather than encrypting an entire file, it encrypts components of a file as small as 16 bytes.[26]

This technique has the same net effect of encrypting an entire file as it makes the file unreadable and unusable. However, intermittent encryption incurs less system overhead since it only encrypts small chunks of each file. In so doing, intermittent encryption may evade common methods used by many algorithms to detect ransomware.

This has led to an increase in software that specifically performs anomaly detection. Rather than trying to identify ransomware's presence, this software looks for anomalies in the data. Both Pure Storage and HPE currently offer software that analyzes data stored on their systems for anomalies.

Pure Storage Pure1 Assessments

Pure Storage Pure1 includes two options for performing data protection and security assessments.

Data Protection Assessment

Pure1's Data Protection Assessment provides two options enterprises may use to secure FlashArrays against ransomware. It first examines how enterprises set up their FlashArrays at

every level down to the hardware configurations. It then compares the FlashArray's existing configurations to Pure Storage's best practices. Finally, Pure1 makes recommendations on how to bring the current configurations into alignment with Pure Storage's best practices.

Enterprises may also use the Data Protection Assessment to configure FlashArrays for higher resiliency. The Data Protection Assessment features examine ongoing activity inside a FlashArray and perform anomaly detection. If they detect an anomaly, they display a 'Lightning Bolt' icon in the Pure1 console.

To perform anomaly detection, the Data Protection Assessment primarily looks for large changes in data stored on a FlashArray. To make this determination, it monitors the Data Reduction Ratio (DRR) of all compressed and deduplicated data on the FlashArray. Should the DDR experience an anomalous drop of 30% or more, Pure1 generates an alert.[27]

The B10000 leverages Zerto continuous data protection (CDP) to perform real-time, adaptive anomaly detection.

Security Assessment

The Pure1 Security Assessment scans FlashArrays for potential vulnerabilities. For instance, it scans the system for the use of default passwords or running end-of-life (EOL) versions of Purity.

It also detects unexpected changes in permissions, changes in volume and snapshot counts, and increases in alert notifications. Any of these could serve as precursors to data exfiltration or ransomware activity.[28]

Pure1 also leverages machine learning (ML) to determine if significant deletion or encryption changes occur. Should significant changes occur, it identifies a snapshot with an appropriate recovery point that precedes these changes.[29]

HPE Alletra Storage MP B10000

HPE Alletra Storage MP B10000 equips enterprises to protect data stored on it from ransomware events using its immutable snapshot feature. It also utilizes an AMD EPYC™ embedded CPU that includes AMD Infinity Guard with security features that server OEMs and/or Cloud Service Providers must enable. This AMD EPYC™ secures the B10000 in two ways.

- First, it includes Secure Encrypted Virtualization (SEV) that securely isolates hypervisors and VMs in virtualized storage environments.
- Second, its Secure Memory Encryption (SME) defends against unauthorized memory access.[30]

The B10000 also leverages Zerto continuous data protection (CDP) to perform real-time, adaptive anomaly detection as data flows onto it. Zerto first utilizes CDP functionality to back up and perform data recoveries if a ransomware event occurs. This real-time data tracking and analysis facilitates real-time alerting to any changes in the data. Zerto specifically monitors and analyzes data at a granular level.

Zerto's entropy detection and statistical analysis can detect and identify different ransomware attack methods. These include intermittent encryption, ransomware hiding behind filter drivers, or even encryption that does not look like encryption. However, this encryption technique results in compressible data as modern ransomware may use encoding to defeat standard entropy-based encryption detectors.

Should a ransomware attack occur, the B10000 will generate alerts as an attack takes place since Zerto offers open REST APIs based on Swagger. If Zerto detects a threat, it can generate and stream alerts to an enterprise's Security Incident and Event Management (SIEM) or Security Orchestration, Automation, and Response (SOAR) solution.[31]

Table 5: Anomaly Detection Feature Comparison Summary

	HPE Alletra Storage MP B10000	Pure Storage FlashArray
Feature Name(s)	Zerto	Data Protection Assessment Security Assessment
Detection method	Continuously monitors all data flows.	Monitors for anomalous drops in DRR ratios.
Manageability	REST APIs	Pure1
Other metrics measured	Real-time monitoring and detection of encoded data even if the encoding does not make it look encrypted	Network latency Changes in volume counts Changes in snapshot counts

Key Questions to Ask:

- Can the solution detect current and past forms of ransomware?
- Can the solutions detect ransomware that does not increase entropy in the IT environment and only encodes tiny percentages of each file?
- Are data copies (snapshots, clones, etc.) secure?
- How does the solution validate the recoverability and viability of snapshots and clones?
- At what granularity can the solution detect anomalies in the data?

VMware APIs and Storage Management Features

VMware offers multiple APIs and features that facilitate managing virtual machine (VM) data protection, external storage systems, and performing storage management. Available VMware APIs and storage management features include, but are not limited to:

- Storage DRS (SDRS)
- Storage I/O Control (SIOC)
- Storage Policy Based Management (SPBM)
- VMware APIs for Array Integration (VAAI)
- VMware APIs for Multipathing—Pluggable Storage Architecture (PSA)
- VMware APIs for Storage Awareness (VASA)
- VMware Native Multipathing Plug-In (NMP)
- VMware vSphere Storage APIs—Data Protection (VADP)
- VMware vSphere Virtual Volumes (vVols)

The availability of these APIs and features have prompted many enterprises to use them to manage and optimize their virtual IT infrastructure. Enterprises that use these features will find that few VMware alternatives yet offer comparable options.

Server Virtualization Platform Support

Broadcom's software licensing changes since it acquired VMware have prompted many enterprises to explore alternative hypervisor solutions. While enterprises will unlikely abandon VMware anytime soon, many have already begun evaluating competitive hypervisors.

This evaluation of competitive solutions has prompted the introduction of multiple VMware alternatives, including HPE VM Essentials *(HPE's own hypervisor).* As enterprises evaluate these alternatives, storage providers must continue to demonstrate support for VMware vSphere along with other hypervisors. Both Pure Storage and HPE have taken steps to address these current dynamics in the virtualization marketplace.

As enterprises evaluate VMware alternatives, storage providers must continue to demonstrate support for VMware vSphere along with other hypervisors.

Pure Storage FlashArray

Like most enterprise storage systems, Pure Storage integrates with multiple VMware vSphere APIs and storage features. The Pure Storage FlashArray supports multiple VMware APIs and features that include VAAI, VASA, vVols, NMP, and SPBM.

Pure Storage FlashArray also formally supports hosting and interacting with Citrix XenServer, Microsoft Hyper-V, and KVM-based hypervisors.[32] However, the level of API and feature support that it offers for these hypervisors pales when compared to VMware. This typically stems from the limited number of APIs and storage features available that each of these hypervisors offers.

To help address this, Pure Storage released its new Pure1 REST APIs. If an alternative hypervisor utilizes these APIs, it could potentially perform more storage functions on a FlashArray. However, the Pure 1 REST APIs are read-only for now.[33]

HPE Alletra Storage MP B10000

As an enterprise storage solution, the B10000 integrates with and supports VMware's multiple API and storage features.[34] The B10000 also supports Microsoft Hyper-V and HPE VME hypervisors.[35] HPE plans to support more storage APIs and features from other hypervisors as they become available, and as appropriate.

To manage VMs on the B10000, enterprises may utilize HPE Private Cloud Business Edition (PCBE). HPE PCBE grants enterprises access to its HPE VME Essentials (VME) Software that manages kernel-based virtual machines (KVMs) and VMware-based VMs. The HPE VME Software also includes the KVM-based HPE VME hypervisor.

Enterprises can access HPE PCBE at no extra cost and manage VMs across their hybrid cloud environment. The included HPE VME Software can provision and manage VMs both in the cloud and on-premises. In the cloud, it can manage VMs in both AWS and Azure. On-premises it can manage HPE VME and VMware vSphere hypervisors.[36]

Enterprises may also use HPE PCBE to centrally orchestrate and manage device firmware and hypervisor upgrades. HPE PCBE automatically handles these upgrades which avoids manually upgrading each device after manually checking compatibility matrices.

The HPE Alletra Storage MP B10000 offers enterprises a new, powerful, flexible all-flash alternative to Pure Storage FlashArray.

Table 6: Virtualization Platform Support Feature Comparison Summary

	HPE Alletra Storage MP B10000	Pure Storage FlashArray
Supported Hypervisors	VMware vSphere Microsoft Hyper-V HPE VME Hypervisor	VMware vSphere Microsoft Hyper-V Citrix XenServer KVM-based hypervisors
Array Mgmt	HPE GreenLake Data Services Cloud Console & APIs	Pure1 Pure1 REST APIs
VM Mgmt Software	HPE PCBE (Azure, AWS, HPE VME, & VMware vSphere)	No Current Offering

Key Questions to Ask:

- How well is the storage solution positioned to handle hosting other hypervisors?
- What software options does the provider offer, if any, to manage and optimize VMs across a multi-hypervisor, hybrid cloud environment?
- How does the solution orchestrate software and firmware updates across the entire infrastructure, including servers and hypervisors? Or is it only focused on the storage arrays?

Multiple Competitive Features on the HPE Alletra Storage MP B10000 Stand Out Versus Pure Storage FlashArray

Modern storage solutions must do more than simply, quickly, and efficiently provide storage. They must now address issues that enterprises routinely encounter in their IT infrastructures.

These include adapting to unexpected changes, controlling costs, detecting and responding to ransomware, managing IT complexity, and the rise of multi-hypervisor environments. To their credit, both HPE and Pure Storage recognize these issues and deliver storage solutions designed to address them.

However, the HPE Alletra Storage MP B10000 offers enterprises a new, powerful, flexible all-flash alternative to Pure Storage FlashArray. More importantly, it addresses these key challenges that enterprises currently face as they manage multi-hypervisor, hybrid cloud environments.

The B10000's architectural flexibility, how it manages VMs, and its anomaly detection functionality stand out from a competitive perspective.

The B10000's disaggregated architecture gives enterprises the freedom to focus on the specific features they need. They can start with a small footprint, lots of capacity or performance, or any combination thereof.

Further, they can dynamically and non-disruptively change the B10000's configuration without needing to replace it with a new model. These capabilities serve to lower the B10000's total cost of ownership while minimizing management time and hardware replacement costs.

Since many enterprises use the B10000 to host VMware VMs, it provides the core features that they need to achieve that objective. More importantly, HPE includes and makes its PCBE and VME software available to enterprises to manage VMs across their multi-hypervisor, hybrid cloud environment. This flexibility to both host and manage VMs across multiple hypervisors positions enterprises for the new multi-hypervisor world that most expect to arise.

The B10000's leveraging of Zerto software well-positions enterprises to detect even the newest ransomware strains.

Finally, every enterprise routinely deals with ransomware threats and wants to secure every component of their IT infrastructure. The latest ransomware strains may only modify small amounts of data leaving traditional entropy detection schemes unable to detect them.

The B10000's leveraging of Zerto software well-positions enterprises to detect even these latest ransomware strains. Zerto's ability to identify anomalies, even at granular levels, puts enterprises at the forefront of ransomware detection and data recovery. ■

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