NAND RESEARCH

Tackling IT Complexity with Simplified Enterprise Storage

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TACKLING IT COMPLEXITY WITH SIMPLIFIED ENTERPRISE STORAGE

THE COMPLEXITY OF IT

Enterprise IT is complex. There are endless options for deploying new infrastructure, spanning traditional on-prem, cloud, and consumption-based services. Workloads such as generative AI and advanced analytics are rapidly changing how we think about performance for compute and storage. Managing the vast amounts of data flooding into the enterprise taxes how we utilize storage – especially how we manage for growth while not falling behind the performance curve. Additionally, sustainability has become a top-level concern for CIOs across nearly every industry.

IT organizations are chartered with advancing digital transformation efforts, but those efforts are often thwarted by the complexity of underlying IT infrastructure. This often requires taking a different approach. It requires modernizing an enterprise's data infrastructure.

Choosing the right infrastructure solutions can take time and effort. Living with those choices can be just as challenging. A recently published survey[1] quantifies this challenge, showing that 90% of respondents feel pressured to buy technology their infrastructure can't support.

A further 74% of those IT practitioners say that their organizations cannot deploy new technology to leadership's full expectations. The causes of this vary, but it is often the result of technical debt that results in an infrastructure that's unable to support the required technology. It's nearly impossible to modernize enterprise data without overcoming this technical debt and reducing the complexity of managing the infrastructure.

[1] Pure Storage. "IT Leader Insights: The State of IT Modernization Priorities and Challenges Amid Economic Headwinds"

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CHALLENGES OF ENTERPRISE STORAGE

Data is the lifeblood of the modern enterprise, yet that data is often distributed across disparate data storage systems from multiple vendors. As a result, this critical resource becomes hard to manage, increasing costs and reducing the IT organization's efficiency. Storage administrators face a long list of challenges, including:

- **Manageability**: Every storage system has a distinct management interface. Further, most legacy storage vendors have a disjointed portfolio of storage solutions, requiring different skills to deploy and manage the various products.
- **Emergent Workloads**: New requirements to support everything from AI to cloud-native applications and everything in between require multi-dimensional performance from storage systems. But only some storage systems can easily support this kind of performance across a consistent portfolio.
- **Sustainability**: IT infrastructure accounts for over 1% of global consumption of energy.[2] A significant amount of data continues to exist on energy-hungry, low-density mechanical hard disk drives (HDD).
- **Longevity & Technical Debt**: Storage systems tend to exist unchanged for many years, ultimately becoming hard-to-manage legacy systems and a key contributor to technical debt for IT organizations. Keeping those systems performing over time is a challenge traditionally faced by storage administrators.
- **Data Protection & Availability**: Ransomware, malware, and disasters all slow down the speed of IT and threaten the business's momentum. Ensuring availability while protecting an enterprise's data is a crucial challenge for every storage administrator.

[2]Masanet, Shehabi, Lei et al. Recalibrating Global Data Center Energy-Use Statistics

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MODERNIZING THE STORAGE EXPERIENCE

Taming the complexities of enterprise storage begins with simplifying and modernizing the experience for the storage administrator. Such a streamlined storage experience requires delivering a long list of demanding attributes, including:

- **Consistent Manageability**: Enterprise storage should deliver a consistent management experience across storage tiers and platforms.
- **Adaptive Performance**: Storage solutions must adapt to the shifting needs of business-critical workloads, such as performance-demanding AI. Moving up a storage tier, let alone adding performance, capacity, or features, shouldn't require a new platform and learning a new management interface.
- **Planned Longevity**: Keeping storage systems current is critical for agility and eliminating technical debt. A simplified storage experience provides tools to be prepared for shifting workload demands while also providing updated software, hardware, and refreshed storage media over time without incurring downtime or migrating data from one system to another.
- **Increased Sustainability**: NAND flash enables high-density storage that is less expensive than traditional HDDs, especially when not limited by commodity SSD design. The emergence of QLC NAND offers a compelling alternative for the less-demanding nearline storage that today resides primarily on HDD-based solutions. The right kind of flash storage that offers high density and energy efficiency without sacrificing performance and that can scale economically is much more sustainable.
- **Integrated Data Protection**: The optimal place to mitigate the risks posed to your data from ransomware and other malware is within the storage system. Storage systems that help speed the detection of anomalies and ensure that data can be restored quickly from incorruptible backups will simplify data protection and make the enterprise more secure.
- **Flexible Business Model**: Business priorities shift, often impacting the IT infrastructure supporting business-critical applications. Flexible consumption-based models offer IT organizations a cloud-like economic model delivered with the control and performance of an on-prem solution. This approach also has significant sustainability benefits since over-provisioning storage is reduced or eliminated.

Surveying the range of storage solutions available across enterprise storage vendors reveals that only some can consistently deliver each element. Pure Storage, however, stands out as a prime example of a technology company that offers a scalable range of solutions, along with a culture of customer focus, that reduces operational complexity while simplifying life for the storage administrator. Rather than seeing data storage as a commodity, Pure innovates and takes a modern, customer-centric approach to enterprise storage that solves many of the complexities inherent in more traditional storage architectures.

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PURE STORAGE'S ALL-FLASH ARCHITECTURE

Pure Storage, founded in 2009, led the storage industry into the era of all-flash, and the rapid success of the company caught many of its larger competitors off-guard. Pure Storage found success in delivering high-performance all-flash storage systems that also dramatically simplified storage management. Legacy storage providers responded by introducing a range of flash-storage solutions that, while functional, were usually incompatible with other products from those same vendors – a heterogeneity and complexity that continues to exist today.

Pure Storage, in contrast, has developed a highly consistent storage portfolio based on a common architecture (with consistent Purity software, custom flash, and management tools shared across it) and two platforms, one scale-up, and one scale-out.

FLASH STORAGE'S SUSTAINABLE BENEFIT

Data centers account for between 1-2% of global energy consumption[3], with storage accounting for about 25% of data center energy use. The bulk of enterprise storage, an estimated 80%, remains based on legacy mechanical HDDs. This has a significant energy impact.

The storage density that flash enables and its lower power and cooling footprint give flash storage solutions a significant sustainability benefit. Flash storage, for example, consumes about 80% less power[4] than comparable HDD-based solutions.

Pure Storage did not want to introduce the inherent inefficiencies of off-the-shelf solid-state flash drives (SSDs) into its systems, so the company took a "clean sheet" approach in designing its custom flash architecture, DirectFlash™. Pure's DirectFlash software and hardware technology removes many of the bottlenecks and redundancies of traditional SSDs by moving control directly into Purity, the operating system controlling the FlashArray and FlashBlade products. This way, the software "talks" directly to the custom DirectFlash™ Modules (DFMs) instead of through the SSD translation layers.

The integrated hardware/software approach of DirectFlash allows Pure Storage to ship very high-density drives while still providing high performance. As a result, Pure Storage expects that its rate of capacity improvement will dramatically exceed the rate of solid-state disk and hard disk capacity, leading to devices of up to several hundred terabytes (Figure 1). That's a significant advancement.

[3] Masanet, Shehabi, Lei et al. Recalibrating Global Data Center Energy-Use Statistics

[4] Hepsiruthar, Priyankasharma (2020). *Comparative Analysis Study on SSD, HDD, and SSHD*. Turkish Journal of Computer and Mathematics Education

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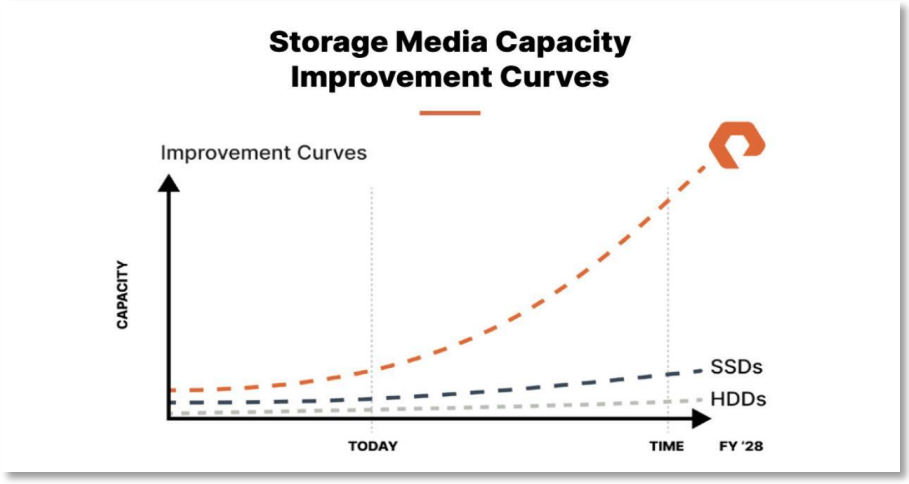
FIGURE 1: PURE STORAGE FLASH DENSITY PROJECTIONS



Source: Pure Storage

The density that Pure Storage delivers with its DirectFlash technology also contributes to the company's compelling sustainability story. Shipping the same capacity as competing systems, but with fewer drives, makes the Pure Storage products up to 5x more energy-efficient in 5x less space.

Beyond the benefits of its DirectFlash technology, Pure Storage delivers increased density and energy efficiency with its always-on data reduction. Pure Storage products show 2-3x better reduction[5] than competing all-flash storage systems, with no performance compromise.

EXPANDING THE REACH OF FLASH WITH QLC

Before exploring Pure Storage's approach to delivering storage solutions, it's essential to understand a few basics about flash memory technology. This will help in understanding the segmentation of Pure's flash storage solutions.

Flash memory is built on semiconductor logic called NAND. Two basic types of NAND are used to build flash storage systems: Triple-Level Cell (TLC) and Quad-Level Cell (QLC) NAND. TLC NAND, which stores three bits of data within each storage cell, is the type of flash memory historically used in enterprise storage systems. It's fast, and it has the endurance required for enterprise business-critical applications.

QLC NAND, on the other hand, stores four bits of data within each cell. This gives QLC a better density story than TLC, allowing more data to be stored within the same physical form factor as TLC. QLC NAND is also less expensive. The downside, however, is that QLC NAND has less write endurance and is less performant than TLC NAND. These characteristics make storage systems that use QLC ideal for "read

[5] Statistic provided by Pure Storage

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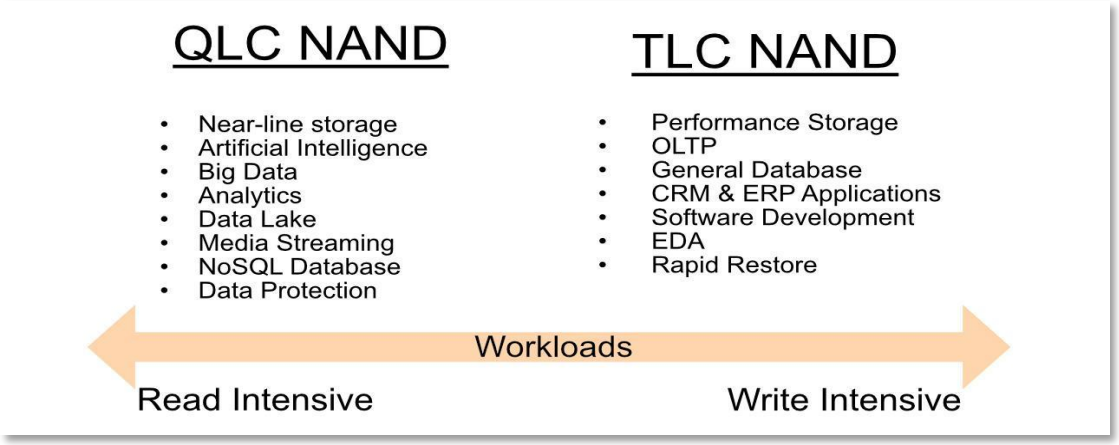
mostly" workloads where high performance isn't a critical requirement, such as those that traditionally utilize HDD-backed nearline storage.

Figure 2 illustrates the type of enterprise workloads where TLC and QLC NAND are each most appropriate.

FIGURE 2: QLC AND TLC FLASH WORKLOADS



It's not enough to insert QLC flash storage into an existing storage product. The performance and endurance characteristics of QLC require that support for the technology be engineered into any enterprise-class storage solution using the technology.

Pure Storage undertook that effort, becoming one of the first technology companies to deliver a robust QLC-based flash solution with its FlashArray//C. Pure Storage has now extended the possibilities of QLC to economically replace traditional HDD workloads, such as backup and other "bulk" data use cases, with their FlashArray//E and FlashBlade//E products.

PURE STORAGE'S UNIFIED STORAGE PORTFOLIO

Pure Storage's solutions, as noted above, share a common software, flash, and management architecture and can be grouped into two platforms: FlashArray (a scale-up platform) and FlashBlade (a scale-out platform). Each of these product lines is available in various configurations designed to address different needs within enterprise IT, all while providing a consistent platform and management experience. As noted above, both the FlashArray and FlashBlade families also support QLC flash to handle workloads more traditionally handled by HDDs.

FLASHARRAY

FlashArray is Pure Storage's solution for mainstream block and file storage. FlashArray was Pure's first offering, and the company continues to evolve its portfolio of FlashArray products. FlashArray models can service the needs of traditionally HDD-centric bulk data use cases (with the capacity-optimized, QLC-based FlashArray//E), nearline storage applications (with the high-performing yet still QLC-based FlashArray//C),

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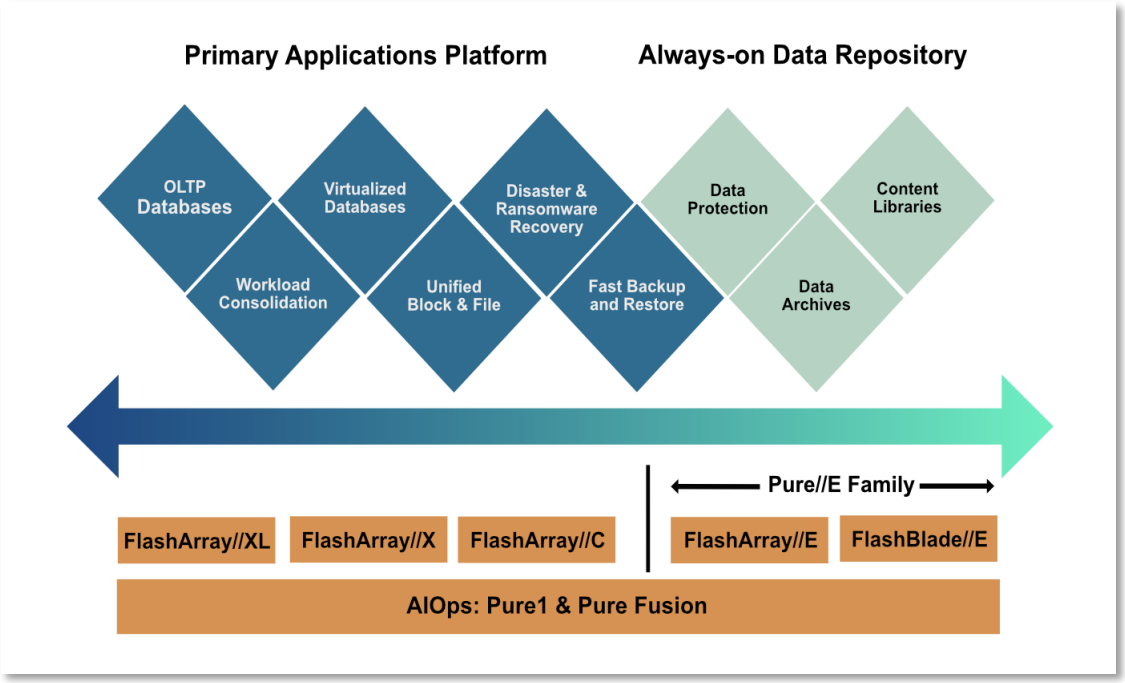
all the way to the extreme performance required by high-performance databases (with FlashArray//X and FlashArray//XL, see Figure 3).

FIGURE 3: PURE STORAGE FLASHARRAY OFFERINGS



FLASHBLADE

Pure Storage's FlashBlade family, on the other hand, is a highly performant and scalable unified fast file and object (UFFO) solution designed for unstructured data workloads. Such workloads either require greater performance and capacity than the Pure Storage FlashArray can deliver or are ones that FlashArray doesn't support (such as object data). Pure Storage offers FlashBlade models to service the needs of high-capacity/low-to-moderate-performance bulk data use cases and applications (with FlashBlade//E and FlashBlade//S200, respectively) to extreme-performance applications, such as deep learning and AI (with FlashBlade//S500, see Figure 4). And uniquely for a scale-out platform, customers can upgrade existing systems to move between these application and data use profiles, offering excellent agility.

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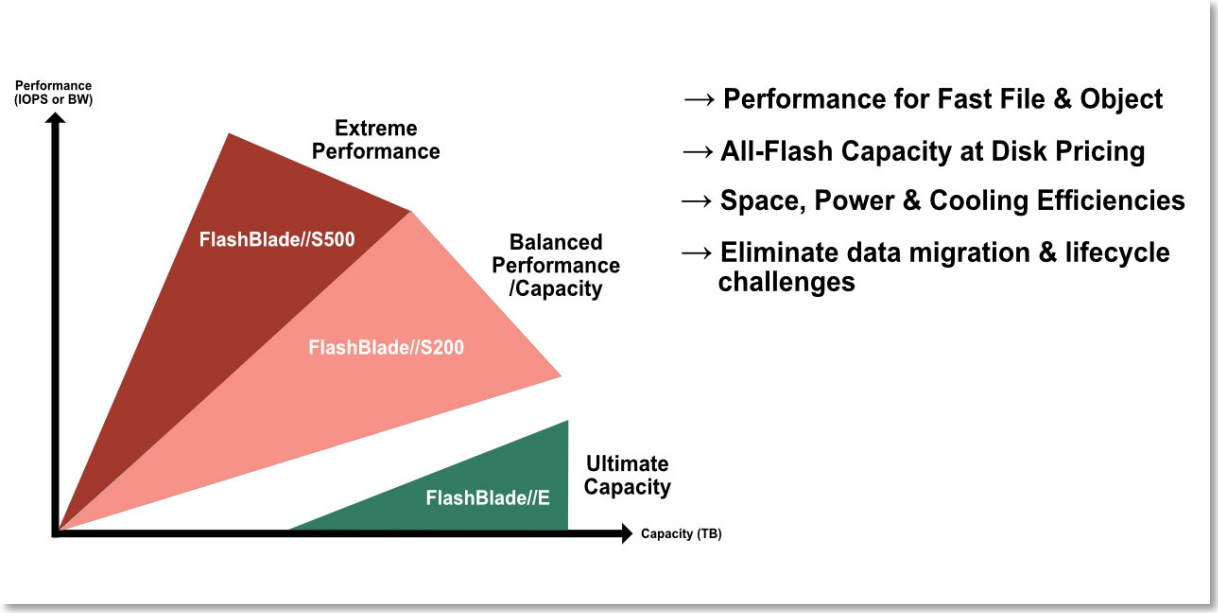
FIGURE 4: PURE STORAGE FLASHBLADE OFFERINGS



AN EVERGREEN STORAGE EXPERIENCE

Modernizing the enterprise storage experience goes beyond simply delivering a range of interoperable products that can meet today's IT challenges. It requires agility to respond to the changing needs of enterprise IT organizations. This requires having storage designed to adapt and grow over time rather than inflexible storage that sees its best performance in the first year of use.

Keeping hardware up to date means that a vendor should not only offer a program for refreshing storage controllers and guaranteeing storage media. A storage solution should be built on an architecture that allows such modernization without taking the systems offline, providing modular upgrades. Data should stay in place, even through multiple generations and upgrade cycles. And for those that would rather not purchase their storage, it should include a cloud-like consumption-based delivery model that can deliver storage on-premises, in the public cloud, and in hybrid clouds. A modern storage experience demands that vendors provide the tools required for everything from capacity planning to monitoring against sustainability goals.

Absent these capabilities, IT organizations find themselves facing the same complexity that has plagued the storage industry for decades:

- An inability to scale out-of-date hardware, while IT falls behind and accumulates technical debt.
- Expensive and complicated processes to lift-and-shift to new storage systems.
- Operational outages as equipment is upgraded.

Pure Storage addresses these needs with its Evergreen architecture and subscriptions (Figure 5). Pure Storage's portfolio of Evergreen offerings promises:

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- Non-disruptive hardware and software upgrades for all its products, scale-up and scale-out, with zero downtime and uninterrupted access to data as systems are upgraded, regardless of how storage is consumed.
- A proven, “always evolving” infrastructure, where the storage solution never becomes obsolete, is designed with a 10-plus-year lifespan in mind, and upgrades are included in the subscription to protect investments.
- Complete as-a-service consumption with service-level agreements, guaranteeing key criteria such as performance, data protection, and even energy efficiency.

FIGURE 5: PURE STORAGE EVERGREEN OFFERINGS

Source: Pure Storage

Pure Storage has an unrivaled track record for delivering on these promises. Customers have successfully completed over 10,000 controller upgrades on their arrays. In fact, Pure Storage claims that it is so simple for customers to keep their arrays modern that 97% of all its arrays that have ever been sold are still in service today, looking and performing like new arrays.

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IN SUMMARY

There is no question that IT storage administrators struggle daily with the complexities of their storage solutions. Taming those complexities begins with modernizing the experience for the storage administrator, a foundational goal for Pure Storage. The company has built a portfolio of industry-leading storage solutions around the idea that storage can be simple. With its Pure Evergreen offerings, Pure Storage simplifies the entire storage lifecycle.

This paper began with a list of the challenges facing storage administrators and described many of the ways in which Pure Storage addresses those same challenges with its modern approach to data storage.

Challenge	Pure Storage
Consistent Manageability	The FlashBlade and FlashArray families deliver a consistent management experience across a broad range of capabilities based on the Purity operating environment and the Pure1 management tool.
Adaptive Performance	FlashBlade and FlashArray serve different classes of workloads with a range of adaptive capabilities, all built using a common architecture that includes Purity software, DirectFlash modules (DFMs), and even dense QLC flash for HDD replacement applications.
Planned Longevity	Pure's Evergreen architecture and subscriptions allow for always-current solutions, with non-disruptive upgrades over ten-plus years, investment protection, and as-a-service consumption.
Increased Sustainability	Pure Storage provides a demonstrably better TCO and sustainability story, one made better with Pure's use of DirectFlash instead of commodity SSDs and the adoption of even-denser QLC-based flash solutions.
Integrated Data Protection	Pure Storage delivers robust, integrated data protection capabilities with its SafeMode technology, enabling immutable and delete-proof snapshots. Pure also offers a ransomware recovery SLA for its Evergreen//One as-a-service offering, unique within the storage industry.
Flexible Business Model	The options available with Pure Storage Evergreen Subscriptions allow IT organizations to consume and deploy storage on-premises, in the cloud, via traditional purchase, with a flexible consumption-based procurement model, or fully as-a-service.

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Any IT organization looking to modernize its storage infrastructure should evaluate Pure Storage's offerings. Simplicity is built into everything that Pure Storage delivers, enabling one of the easiest-to-deploy and manage storage solutions on the market – and, no matter which offerings you choose, it remains current with Pure's Evergreen architecture and upgrade programs. It's a powerful story.

To learn more, visit Pure Storage's dedicated page that explains how Pure does storage differently.

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