



White Paper

Evergreen Storage Is Changing Customer Experience Expectations in Enterprise Storage

Sponsored by: Pure Storage

Eric Burgener
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IDC OPINION

Managing technology refreshes is not a popular task among enterprise storage administrators, although it is a necessary task for successful businesses. As a business evolves, managing more data and adding new applications in the process, enterprise storage infrastructure inevitably needs to grow in performance and capacity. Enterprise storage solutions have traditionally imposed limitations in terms of their ability to easily accommodate technology refreshes that keep infrastructure current and operating reliably and most cost effectively. In 2015, Pure Storage introduced a new technology refresh model that has driven strong change in the enterprise storage industry by addressing the major pain points of legacy models and provided overall a much more cost-effective life-cycle management approach. In conjunction with other aspects of Pure Storage's enterprise storage product and services offerings, the company's "Evergreen Storage" technology refresh model has contributed to this all-flash array (AFA) vendor's ability to maintain an extremely positive customer experience as measured by the industry-standard Net Promoter Score (NPS). In brief, Evergreen Storage offers the following:

- **Technology acquisition and ongoing management.** With an assortment of guarantees, covering inclusive software packaging, data reduction ratios, flash endurance, and predictable maintenance, Pure Storage ensures customers get what they need and know what they will get up front for their money and caps this with a unique 30-day money-back guarantee on its enterprise storage products.
- **Technology refresh.** Pure Storage provides an ability unique in the industry to nondisruptively upgrade the *entire* system to next-generation technologies that leverage formalized trade-in credits for existing hardware and software, extending the normal enterprise life cycle from 3-5 years to as much as 10 years without performance and/or scalability limitations and reducing capital costs by as much as one-half relative to existing competitors over that period.

Evergreen Storage is available on all of Pure Storage's AFA offerings (the FlashArray//m and the FlashBlade) and provides a significant added incentive for prospects to consider them. According to IDC's research, Pure Storage is among the leaders in market share by revenue among AFA vendors (see *Worldwide All-Flash Array Market Shares, 1Q16: Established Storage Vendors Dominate* [IDC #US41556316, July 2016]), and the company's Evergreen Storage program is just one of several key ways in which Pure Storage is transforming the way business is done in enterprise storage.

IN THIS WHITE PAPER

Purchasers of enterprise storage have historically dealt with an upgrade cycle that was expensive, disruptive, inherently risky, and time consuming and occurred roughly every three to five years. In June 2015, Pure Storage challenged customer preconceptions about the enterprise storage upgrade cycle with the announcement of its Evergreen Storage. Evergreen Storage has been tremendously popular with customers and driven targeted responses from all of the other major enterprise storage players. In 2016, Pure Storage enhanced Evergreen Storage with new features that have increased its already extremely high customer experience performance. This White Paper assesses the impact Evergreen Storage has had on the enterprise storage industry and discusses the technical, financial, and business implications of the program from a customer point of view.

SITUATION OVERVIEW

The legacy enterprise storage upgrade cycle is familiar to most storage administrators. An enterprise purchases a new storage array, which includes a given storage capacity that may be expanded over the life of the product, but the maximum storage performance achievable by the system is fixed based on the capabilities of the controllers and the internal array bandwidth at the time the product is shipped. Regardless of how much capacity may be added over time, the maximum performance potential in terms of storage latency, throughput, and bandwidth does not increase.

Successful enterprises tend to grow their businesses over time, requiring additional performance from their IT infrastructure. A typical enterprise storage life cycle varies but is generally somewhere in the range of three to five years. Ultimately, the fixed storage performance of this system no longer meets requirements, and the business is forced to perform a forklift upgrade to gain access to the newer technologies in storage controllers and storage media necessary to meet its requirements more cost effectively. Even if a business is not outgrowing the performance of its storage, media density, power consumption, and maintenance costs on older products may become sufficiently onerous to also drive a company to want to upgrade to newer technology. This cycle repeats over time.

Frankly, this technology refresh model is inflexible, disruptive, time consuming, and expensive:

- **The model locks customers into older technology.** When a legacy enterprise storage array is developed, it can be designed to include the latest in controller and storage media technology. Firmware and software upgrades over the life cycle of the product can provide incremental performance improvements, but customers are locked into the limitations of that technology for the life of the product. Although capacity can be added, often all drives can be only of the type available when the system was first purchased. Customers do not necessarily have access to major advancements that provide order-of-magnitude improvements in performance, storage density, or cost.
- **Forklift upgrades are disruptive.** Moving to the next generation in controller and storage media technology requires a completely redesigned array with typically much higher internal bandwidth to take full advantage of performance and density advancements. This means that a completely new array must be brought in to replace the existing array, and that means downtime as well as data migration.
- **Technology migrations are time consuming and risky.** During the upgrade, all of the data in the old array must be migrated to the new array. Today, even the smallest enterprises are dealing with generally at least tens of terabytes (TB) of data, and most enterprises are dealing with hundreds of TB and looking at managing petabytes (PB) of data in the next several years (if they

are not already). Even if that data is migrated over high-performance local area networks like Fibre Channel (FC), migrating that much data can easily take days for many enterprises. Customers may also have extensive snapshot trees and replica libraries that will be lost if they cannot be migrated to the new system. Often, newer systems use a new, higher-performance or more efficient on-disk format, so customers can incur conversion risk during the migration as well. How long the upgrade will take and what sort of impact it will have on application services are key questions that must be answered as enterprises plan for the migration.

- **Upgrades are extremely costly.** First, a customer must buy the new hardware and any required software. None of the hardware and software from the older array can be transferred to the new array, so all of the capital expenditure must be repeated even if the customer wants just the same basic features (*x* amount of capacity, snapshot and replication software, etc.). Second, maintenance and support costs will increase based on the price of the new solution. Third, to help this inherently risky process go more smoothly, many enterprises hire outside professional services firms to plan and execute the technology refresh, a decision that can easily add anywhere from tens of thousands to several hundred thousand dollars in cost to what is already considerable expense.

IDC refers to this legacy approach as Model 1. Some enterprise storage suppliers, looking to minimize the impact of technology refresh, have introduced an overarching software layer that allows storage to be more completely virtualized across multiple arrays. With this enhancement, systems of disparate types can be combined into loosely coupled groups, sometimes referred to as "clusters." This allows newer and older systems to be combined so that their resources can be more flexibly allocated in logical pools that are less restricted by hardware limitations, providing an easier way to incorporate new technology into clusters (rather than systems). Storage virtualization can allow data to be migrated online, significantly minimizing the disruption associated with the data movement required when replacement systems are deployed. IDC refers to this approach as Model 2.

While Model 2 addresses some of Model 1's issues, it still suffers from significant problems from a customer's point of view. While new arrays can be added to the IT infrastructure, customers are still locked into old technologies with the existing systems. Many customers use the online data migration to move the newer array into production and, once the new array is serving production data, retire the older array. Data migrations still take time and often impose performance degradation on production applications during the migration process, which will generally occur more slowly than it would if the data was migrated between two nonproduction systems. Snapshot trees and replica libraries may or may not be lost, depending on vendor implementation. Any risks incurred by a conversion to newer on-disk formats are still present. And customers still have to repeat their hardware and software purchases when buying the new system, losing their capital investment on the original array, and are forced to accept the maintenance and support cost increases associated with the newer array.

Pure Storage and the Evergreen Storage Program

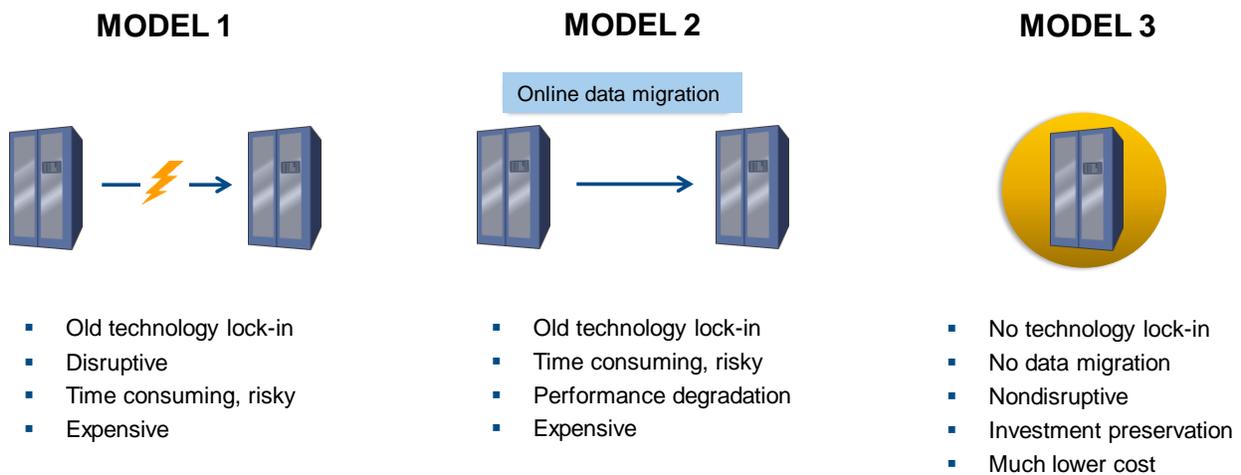
Pure Storage is an enterprise AFA vendor with offerings in both the primary flash market (FlashArray//m) and the big data flash (FlashBlade) market. Over the past five years, Pure Storage has introduced many features and programs that have differentiated its offerings from those of the legacy enterprise storage providers and driven real change in the industry:

- Early on in the growth of the AFA market, Pure Storage popularized the use of inline storage efficiency technologies with its AFAs, a move that led to inline data reduction being a baseline requirement for any AFA targeted for use as a general-purpose primary storage platform.

- After shipping the FlashArray//m product to the primary flash market for four years and establishing itself as a market share leader by revenue, Pure Storage introduced the industry's first enterprise-class, customer-ready big data flash platform with FlashBlade in 2016. Since then, other vendors have entered this emerging market, which promises to cost effectively bring the benefits of flash technology to workloads that have not historically been considered "primary."
- The customer-focused Pure Storage culture generates extremely high customer experience ratings that resulted in one of the highest Net Promoter Score¹ ratings ever published by an enterprise storage vendor. Pure Storage has maintained the quality customer experience even as it has grown to well over \$0.5 billion in revenue and continues to improve its NPS over time (in 3Q16, Pure Storage released its highest NPS ever of 83.5 on a scale that goes from -100 to +100). The work Pure Storage has done in this area has set a new bar for the enterprise storage industry and is driving change among the company's competitors, which is benefiting AFA customers across the board.
- Pure Storage's introduction of the Evergreen Storage program forever changed customer expectations around enterprise storage life-cycle management and technology refresh, driving direct responses from the company's competitors, which is again benefiting AFA customers across the board. IDC refers to this new approach as Model 3 (see Figure 1).

FIGURE 1

Enterprise Storage Upgrade Models



Source: IDC, 2016

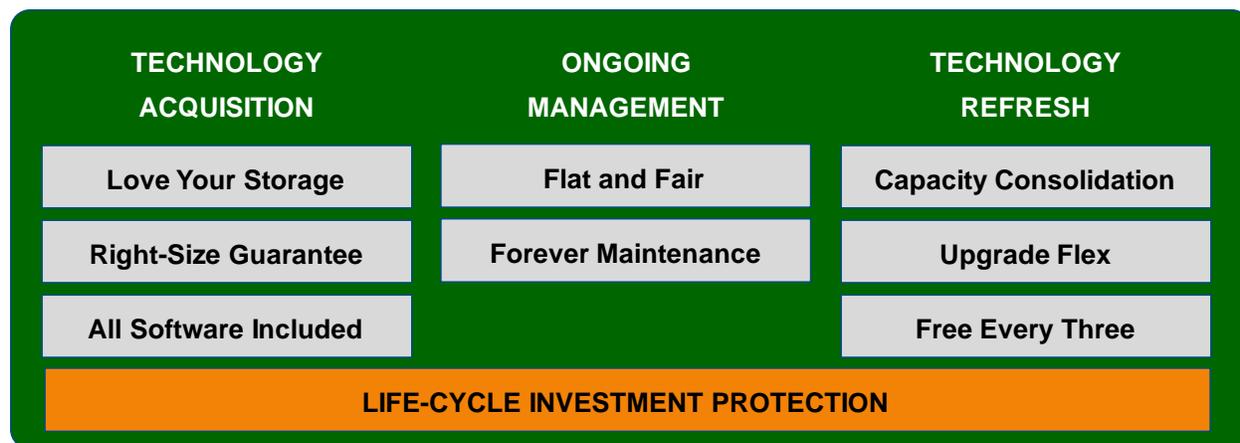
¹ The Net Promoter Score is a standardized measure of customer satisfaction, which is broadly used across 220+ industries to provide an independent rating, based on customer response, of the quality of experience a vendor delivers to its customers. For further information about NPS, see *Why Enterprise Storage Managers Need to Understand the Net Promoter Score* (IDC #US41185416, April 2016).

The Evergreen Storage Program

Evergreen Storage is a comprehensive life-cycle investment program that impacts customers positively during technology acquisition, ongoing management, and technology refresh (see Figure 2).

FIGURE 2

Evergreen Storage Program



Source: IDC, 2016

For technology acquisition, Pure Storage is the only vendor in the industry with a formalized, 30-day money-back guarantee on new system purchases, which it calls Love Your Storage. Customers are also guaranteed a data reduction ratio they will achieve against their workload prior to purchase (Right-Size Guarantee). Pure Storage evaluates customers' specified workloads with predictive tools and will guarantee an effective capacity based on this evaluation. The capacity can be evolved over time as workloads change to ensure that customers always get what is promised up front. Pure Storage also includes all data services software (snapshots, clones, encryption, quality of service, replication, etc.) with every system purchase.

For ongoing management, Pure Storage guarantees that maintenance rates on a per-device basis will not increase over the life of the system – which under Evergreen Storage may well be in the range of 8-10 years – and may go down in some cases (Flat and Fair). Under Forever Maintenance, any failed components are replaced free of charge by Pure Storage over the life of the array (including any solid state disk [SSD] wear-out conditions).

For technology refresh, Pure Storage has specially architected the hardware of its systems to support in-place upgrades of every component – flash devices (SSDs in the FlashArray//m and custom flash modules in the FlashBlade), controllers, internal array bandwidth, and host connections. Under Capacity Consolidation, data in older devices and shelves can be consolidated into new, expanded, and denser capacity media while getting trade-in credits against the hardware being upgraded. Pure Storage's Upgrade Flex allows customers to upgrade their controllers as often as desired while getting trade-in credit against the controllers being upgraded. And Free Every Three provides a new set of current controllers at no additional charge with each three-year maintenance and support renewal. Pure Storage is still unique in the industry in allowing customers to upgrade internal array bandwidth

so that upgraded systems can get the full performance benefit of new technology in controller and flash media. The company has proven this across well over 600 6-12GB SAS upgrades within its installed base, and these systems are fully compatible with NVMe technology upgrades slated for 2017 and beyond.

Analysis and Implications

With Evergreen Storage, Pure Storage has combined architectural capabilities with programs to drive a new technology refresh model. Pure Storage offers in its systems the ability to upgrade performance and/or capacity independently; mix and match flash geometries so that newer, higher-performance, and more dense storage devices can be added (or consolidated onto) as they become available; nondisruptively upgrade performance by moving to a higher model or next-generation controllers; enhance host connectivity by either adding or upgrading ports to higher bandwidth options; and move already-licensed software to newly upgraded systems without additional cost. The flexibility across these five areas allows Pure Storage customers to take advantage of the annual innovation cycle driven by newer Intel processors (for faster controllers), newer flash technologies (for higher densities and lower cost per gigabyte), and transparent, online firmware and software upgrades to keep their array current.

Note that all of these upgrades can be done nondisruptively, but this requires some explanation of Pure Storage's design. Although Pure Storage's FlashArrays have always been built around a dual controller architecture, they do not use the typical active/passive controller design. During normal operation, both controllers are in use, accepting I/O from the host side, while all I/O to SSDs internal to the array is handled through only a single controller. The controllers are designed so that a single controller can deliver the maximum performance at which the array is rated, which means that during normal operation, each controller would be no more than 50% loaded on the host side. In the event of a controller failure, all I/O on both the host side and the array side is handled by the single remaining controller, with no impact on performance. Pure Storage uses a dual-parity RAID implementation in the FlashArray//m; any failed SSDs can be hot plug replaced and any needed data will be rebuilt onto the new device as a background process, which does not impact application performance. When capacity from older devices is consolidated onto newer, denser flash media, the new shelf is added to an existing system; data is migrated as a background process, with no impact on application performance; and then the older shelf can be removed without shutting the system down. Note, however, that flash geometries can be mixed so that data does not have to be migrated off older drives as newer drives are added.

With Models 1 and 2, on-disk format changes that require data conversions can introduce risk, often require downtime, and consume time and effort on the part of a customer. Pure Storage systems use an adaptive metadata structure that is scalable, versioned, and hierarchical. When any major metadata updates occur, the old metadata structures can be left intact and referenced by the new metadata. The natural background optimization processes of the array migrate the older metadata to the new format over time, without the need for any explicit data migration tasks and without any application downtime or performance impact. The use of variable-sized data segments allows segment structures to be updated to add additional features transparently, without any data migration or application downtime. This is not a theoretical argument – Pure Storage has enhanced its metadata structures and data layout segments in every major release since its initial GA product, without requiring downtime or data migration. Fixed metadata structures and segment sizes in competitive AFAs introduce limitations that generally preclude the ability to make these types of major changes without data migration, introducing risk, effort, and downtime.

The unique ability of Pure Storage to perform an entire array upgrade in place without downtime drives key advantages to Model 3. First, data never has to be migrated during the process, reducing risk and saving time and money, although customers *can* choose to do this for capacity consolidation purposes in a nondisruptive manner. Second, customers preserve any capital investments they have made even as they migrate to newer technologies. They never need to buy another frame, rebuy storage capacity, or relicense any snapshot, replication, or other software that they have already licensed on a Pure Storage AFA, and they continue to pay the same maintenance and support at a device level that they were paying on the original system. Third, there is no downtime or performance degradation associated with the technology refresh process. Fourth, because of the simplicity of this technology refresh model, customers don't need to look outside their organization for resources to manage a multimonh array migration.

With the ability to completely upgrade the array in place without downtime, Pure Storage is expecting to extend the enterprise storage life cycle, which can be as little as 3 years, to as much as 10 years while still allowing customers to take advantage of newer, faster, more cost-effective technologies as they become available. Although Pure Storage will never require a frame swap, the company expects that customers will decide of their own accord when they want to do this based on the nature of storage technology advancements. In the interim, however, Pure Storage customers can get the benefits of nondisruptive technology refreshes on demand, without impacting their businesses.

The cost implications of Evergreen Storage are significant. Relative to the other two models where arrays must be replaced as often as every three years, hardware and software must be repurchased, maintenance and support costs significantly increase, and data must be migrated in a disruptive and time-consuming manner, Pure Storage's model dispenses with all of that. The actual cost savings will vary significantly based on the size of the system, but even assuming only one technology refresh over a six-year life cycle, capital costs will be one-half to one-third as much, while maintenance costs will be roughly half as much. The costs with Evergreen Storage are front loaded – the big savings in lower costs occurs at each technology refresh – but even then those up-front costs are comparable to the initial purchase costs of other AFAs, with some being lower and some being higher.

One other benefit needs to be taken into account. Upgrade Flex gives customers the option to perform technology refreshes more often while preserving their existing investments and without impacting application services. Over the past five years, Pure Storage has released new, faster controllers once a year based on the latest Intel chipsets. It is the company's product strategy to continue to innovate at this rate going forward, in effect allowing customers to ride the Intel processor technology curve very closely. Maintenance customers will still get their Free Every Three controller upgrades, but they also have the option to upgrade to next-generation controllers more often with trade-in credits, which preserve their existing controller investment. This is not the occasional trade-in credit program some vendors put in place when quarterly revenue is down; this is a formal program that is always available to Pure Storage customers when they need it, and it gives customers the flexibility to determine their own upgrade schedules.

Challenges

With Evergreen Storage changing the planning horizon on enterprise storage life cycles, the performance and capacity scalability of configurations will need to be increased. Given storage efficiency technologies, the effective capability of today's FlashArray//m well exceeds 1 million IOPS (assuming 100% reads at 4,000 block sizes) and 500TB of usable capacity, but as more customers move to all-flash configurations for all of their primary storage needs, larger systems will be needed over time. Pure Storage does not yet support clustering multiple systems together to scale throughput and bandwidth, and the ability to

"performance cluster" systems would provide another dimension to performance scalability, which is likely to be of interest in systems with a life cycle of 6-10 years. This capability should also include the ability to nondisruptively migrate data between systems in the cluster as well. This does not take anything away from the value that Evergreen Storage provides to customers, today and in the foreseeable future, but would certainly improve the value that Pure Storage's upgrade strategy provides to customers across a life cycle that includes multiple technology refreshes.

CONCLUSION

With the introduction of the Evergreen Storage program in 2015, Pure Storage addressed a key pain point enterprise customers have been complaining about for years – the expense and difficulty associated with performing a technology refresh. The Evergreen Storage program was initially dismissed by competitors as just another program, but within a year of its introduction, all of the key AFA vendors have incorporated components of Evergreen Storage into their own product portfolios. Most vendors now provide data reduction ratio guarantees, flash endurance warranties that exceed the useful life of a system, and inclusive software packaging, and some vendors offer maintenance cost guarantees of some form. Occasionally, AFA vendors offer upgrade trade-in credits as a sales incentive. None of the vendors, however, outside of Pure Storage offer an unconditional 30-day money-back guarantee, formalized programs for capacity consolidation, a formalized trade-in credit program for flash media and controllers that preserves investment, or the ability to nondisruptively perform the comprehensive technology refresh of which Pure Storage's systems are capable. Evergreen Storage is proving to be a sustainable advantage, and as more AFA vendors understand the nature of the changes Pure Storage has introduced to the technology refresh model, IDC expects that future AFA system designs from competitors will evolve to provide similar capabilities. This will clearly resonate well and benefit enterprise storage customers and may result in improvements to the Net Promoter Scores (which most vendors track and few vendors publish externally and are often in the range of 20-35) of other AFA vendors in the future.

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Global Headquarters

5 Speen Street
Framingham, MA 01701
USA
508.872.8200
Twitter: @IDC
idc-community.com
www.idc.com

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