Hyper ISE

Performance Driven Storage

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Hyper ISE: Performance-Driven Storage

Hyper ISE creates a new class of storage system, focused on performance-driven applications. It is the only storage system that is a true amalgamation of solid-state drive (SSD) and hard disk drive (HDD) technologies into a single pool of capacity. The X-IO Continuous Adaptive Data Placement (CADP) algorithm, native to the Hyper ISE, identifies hotspot data and places it on the SSD and keeps all other data on the HDD. By only utilizing Enterprise SAS HDDs, high performance levels are maintained, even for the data being serviced from the HDD capacity. The Hyper ISE architecture ensures that the SSD resources are never wasted, performance is never compromised, and capacity is always cost effective. This results in the best price, performance, and capacity ratios in the industry with unmatched reliability.

Hyper ISE provides the ideal balance of four fundamental elements of storage—price, performance, capacity, and reliability. All four elements are inextricably bound together to provide a unique solution to real-world problems in the datacenter. Balancing them leads to lower costs, improved reliability and data integrity, and increased application performance. This changes the economics of IT and enables users to do far more with their storage than ever before.

- Hyper ISE significantly improves database application performance transparently, enabling customers to avoid huge infrastructure investments. Query times are being reduced by up to 20 times.
- Hyper ISE enables virtual desktop implementations; supporting thousands of virtual desktops in a single storage system, surpassing performance requirements, making virtual desktop environments work seamlessly, and fitting well within budgetary constraints.
- Hyper ISE extends the consolidation benefits of server virtualization, achieving up to 50:1 virtual-to-physical ratios.
- High performance cloud storage requires predictability in both performance and cost. While it is easy to determine capacity growth rates, traditional storage systems are unable to predict the price of performance. This creates a major risk that either impacts the cost of the service or does not provide the required performance back to the user. Hyper ISE uniquely solves this core issue, providing predictability in performance and cost.

Figure 1 - Hyper ISE Storage System

The Hyper ISE Advantage

Hyper ISE is a new class of storage system that balances price, performance, capacity, and reliability. In order to understand how this is achieved, it is important to first understand how Hyper ISE was designed from the ground up. It is relatively easy to integrate SSD into a storage system; the hard part is using those drives effectively.

CADP: Combining SSD and HDD Technologies

Continuous Adaptive Data Placement (CADP) is the patented method that the ISE uses to manage the placement of data between SSD and HDD devices. Traditionally, storage systems have utilized SSD in two ways for hybrid architectures: traditional tiering based upon the Information Life Cycle Management (ILM) methodology and using SSD as cache. While each approach will allow for SSD devices to be incorporated with HDD devices, both have significant disadvantages.

SSD as a 2nd stage controller "cache" has the advantage of quickly reacting by moving "hot" data to the SSD devices. When data is expired out of the controller non-volatile random-access memory (NVRAM), the SSD devices act as a secondary holding area for this "hot data." The main problem with this approach is that valuable controller NVRAM must be used to address the amount of SSD space that is included in this 2nd stage cache. This severely limits the amount of SSD that can be used, as the controller NVRAM is used for the storage controller operating systems functions (snaps/clones/metadata management/1st stage caching), and there is a limited amount of this system RAM than can be allocated for addressing this SSD capacity. The result is that traditional storage controllers can only accommodate a small amount of SSD (just a few terabytes, max) for the cache acceleration of an entire array. This becomes a large problem when there are hundreds of HDDs in the system that need the SSD acceleration. As HDD capacity is added to these systems, the amount of SSD in the controllers cannot be increased (due to the NVRAM limitations). This results in a dramatically decreasing SSD/HDD ratio as the system is grown, fundamentally limiting how much capacity these systems can accommodate before the limited SSD space is consumed and the HDDs have to handle the high performance workloads.

Another alternative came with tiering the data between SSD and HDD, during the ILM days. This is the same method that was used to move data between slow serial advanced technology attachment (SATA) and faster HDD devices. The controller would monitor the activity of the "blocks" on the volume, and SSD assignment was prioritized for the blocks with the highest activity. The advantage of this approach is that there is no limit to the amount of SSD that can be used by the tiering software. The storage controller is addressing SSD like a regular disk, so there is no limitation of SSD capacity as with caching. The main disadvantage of this method is that data movement (re-balancing) is done in an atomic fashion. The software monitors for a large period of time (a day), then moves the data all at once. This interval was fine when moving data to SATA disks, but is not nearly responsive enough when SSD performance is needed. This method will allow for the incorporation of SSD with HDD storage, but its effectiveness will be limited as the data that is hot today will not be the data that is hot tomorrow.

CADP has the benefits of caching (five-second-movement intervals), the benefits of tiering (SSD capacity not limited by the controller), with none of the penalties that would be experienced using the ILM methodology or SSD as cache. The Hyper ISE delivers SSD performance with HDD economics by analyzing application I/O workloads, in near real-time, to accelerate hot data with SSD performance. Utilizing X-IO's patented CADP algorithm, application data is migrated between SSDs and HDDs continuously and automatically every five seconds. As data workloads change throughout the days, weeks, and years, CADP continuously manages hot data for ongoing performance improvements that today's enterprise applications require—without IT staff needing to manage the storage.

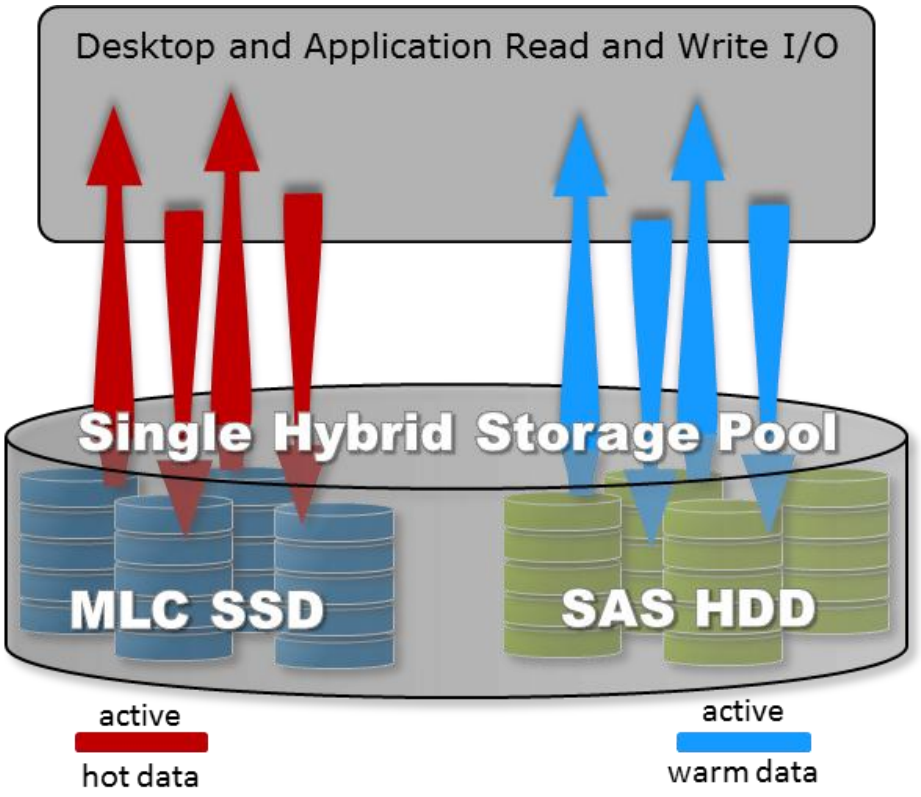

Figure 2 - Continuous Adaptive Data Placement

Fast Forever

One of the biggest issues with any storage system is sustaining performance over its entire lifetime. A storage system can initially perform very well, but as utilization increases, performance can fall off dramatically. IT professionals find themselves spending increasing amounts of time trying to tune their systems to squeeze out better performance, often with very little success.

Most storage systems begin to hit a performance wall as utilization reaches 50-70% of its storage capacity. The ISE technology enables better than 90% capacity utilization without the performance drop of traditional storage systems. This enables X-IO customers to achieve the value they rely upon, while reducing the amount of equipment they have to purchase. One customer had to keep storage capacity at approximately 25% with their old storage systems in order to maintain optimal performance. That meant they had to acquire and manage four times the amount of storage capacity needed to store their data, in order to provide the requisite application performance.

All of the design elements of Hyper ISE, including the way it handles vibration, heat dissipation, data placement, drive reliability, and the intelligence of Continuous Adaptive Data Placement (CADP), result in sustainable and self-optimizing performance. Additionally, the disk drives within Hyper ISE are not treated as individual and disposable components, but rather as a single element. As such, they work congruently, resulting in higher performance and reliability.

Price, Performance, Capacity, and Reliability

Enterprise customers have some of the fastest storage in the world but they pay a high price to achieve high performance. For more performance, they add more disk drives and create wide stripes across them, increasing cost per IOPS and cost per gigabyte. Another alternative is to implement SSD as its price per IOPS may be attractive—its price per gigabyte, however, is very high.

If performance is a requirement, a wide range of storage systems are immediately eliminated as options since they just can't provide the levels of performance needed. At this point, it is necessary to remember that performance is impacted by a number of elements:

- Capacity Utilization: Most storage systems experience degraded performance as capacity is consumed, often loosing up to half of the original performance when the array is just 60% full.
- Mixed Workloads: Some storage systems perform well with certain workloads but falter when different applications, with varying I/O behavior, access them.
- Drive Failures and RAID Rebuilds: These common occurrences can slow performance significantly for many storage systems.
- Data Migrations and Mirroring: Moving and mirroring data often utilize the same resources as user applications, slowing performance.
- Vibration and Heat: Two major issues that slow performance and impact reliability, especially over time.

It is also essential to consider pricing and budgetary constraints. This also requires more than a superficial analysis, extending to considerations of pricing per IOPS and per gigabyte, as well as all of the issues described above.

Reliability also plays a major role in these decisions. Though it is a priority for everyone, it is often overlooked in favor of price/performance and the cost of capacity. The reliability of Hyper ISE starts at the infrastructure level and therefore directly impacts price, performance, and capacity.

Price, performance, capacity, and reliability are linked; Hyper ISE was designed to provide an ideal balance of all four over time and through its entire lifecycle. It is the harmony of these elements that makes Hyper ISE a performance-driven storage system that maintains high performance throughout its entire lifecycle.

Application Acceleration/Business Enablement

Advances in server performance have been eclipsing advances in storage performance, and as a result, application performance is negatively affected. Since 1987, CPU performance has increased 2,000,000 times and disk performance a mere 11 times. The imbalance between servers and storage is only going to increase as processors continue to get faster and add more and more cores. Business intelligence, data warehousing, server virtualization, VDI, and cloud computing implementations are all impacted by the bottleneck, created by traditional storage systems.

Hyper ISE significantly changes the economics of storage through an ideal balance of price, performance, capacity, and reliability. This truly results in business enablement, freeing up capital to invest back into the organization. Database application query times are reduced by up to 20 times, without expending enormous amounts of money, resources, or time. Virtualized server ratios can far exceed the average of 10:1 with the potential to achieve 50:1 or higher. VDI implementations are often staggered and stalled with storage as the bottleneck. Hyper ISE can get virtual desktop initiatives to be great successes.

Hyper ISE—Transforming Performance into Business Value

Performance can be directly related to the bottom line for businesses. Companies are taking the terabytes of data they have and transforming that into monetary value and performance is the key to this effort. Data warehousing and business intelligence operations are unlocking the value from data at ever increasing rates, but limited storage performance hinders this process greatly. Virtual desktop claims the promise of lower cost of ownership by consolidating computing resources onto enterprise hardware (to increase reliability, make day-to-day management easier, and reduce the cost of deploying new desktops). The problem is that with typical VDI deployments, the performance demands are so high that the storage equipment can comprise up to 50% or more of the initial solution cost (just for the number of HDDs that are required). Other high-performance-requiring applications experience this high percentage of solution cost, attributable to storage, for the same reason.

The ISE has a unique value proposition for these high performance applications by delivering 2x to 10x the performance of traditional storage solutions. The result is less equipment to purchase and manage. This provides X-IO customers with unmatched value in Price/Performance for the most demanding applications. If you want to do cloud computing, getting 3x the number of users on the environment, increasing revenue, running database reports that complete in 1/10th the time, moving gigabytes of data constantly through the data warehouse, or supporting thousands of VDI sessions, then X-IO has technology that can unlock the value from data that enables business to win in today's economy.

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