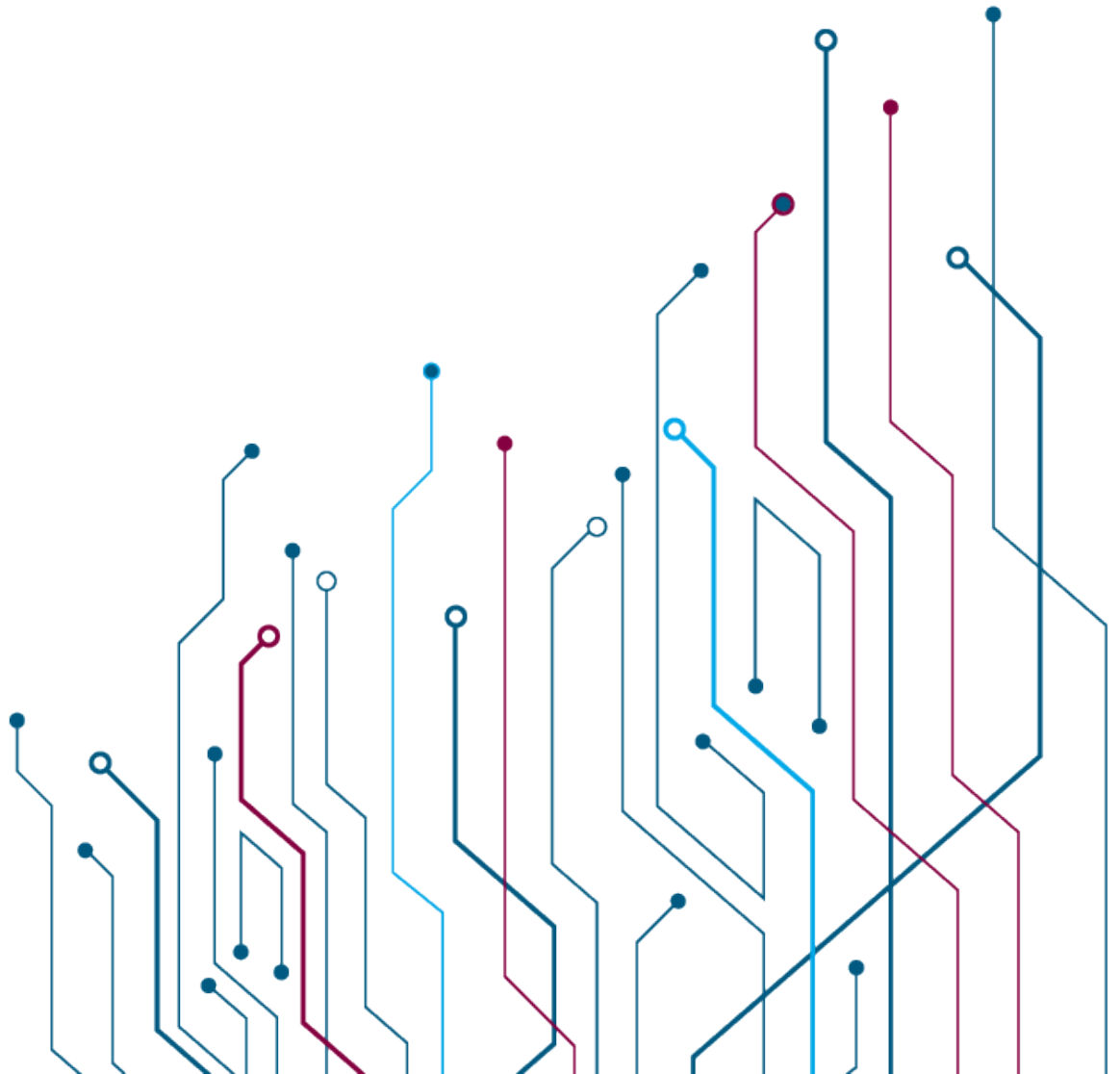




Nyriad UltraIO Storage System – The Economics of Technology for Storage

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Introduction

Organizations have come to depend on technology developments to provide continued improvements in the economics for storing and managing information. Information Technology professionals expect new storage systems to store more data, provide faster access, consume less power, and take up less space with each new generation. Watched closely are the new technologies that continue to deliver improvements. While economics for storing and managing information are the final measure used by executives in understanding the value from technology developments, IT decision makers have a more detailed evaluation process. They will look at current challenges and how a technology applies for improving the current situation.

The challenges for organizations charged with protecting and providing access to information assets are ever-present and increasing with new ones such as ransomware and the need to show movement for greater sustainability from operations. While the infrastructure and operations groups tend to get very specific as they attempt to find solutions, the challenges seen in a broader sense are executive concerns:

- Assurances that the information asset has integrity – the data stored is the same as the data accessed – unconditionally – is a basic requirement. This requires confidence in the processes for handling information and relies on the storage systems in use.
- Consistency for applications accessing information is required to get predictability in application execution. Variability in an application becomes evident quickly and results in dissatisfaction and impacts to business.
- Continuing operations and new business drive demands to store and manage more data. Meeting the demands for increasing amounts is not optional. Organizations are expected to have plans for the continuing increase as part of an overall strategy for operation.
- Optimizing operations from an economic standpoint is about getting the required services at the lowest cost and without jeopardizing business now or in the future.

The challenges for organizations continue but now there are strategies in place to address them. However, changes and problems still occur, raising awareness about the issues and an urgency for a solution. How leaders choose to manage these issues strategically can be critical for an organization's competitive viability.

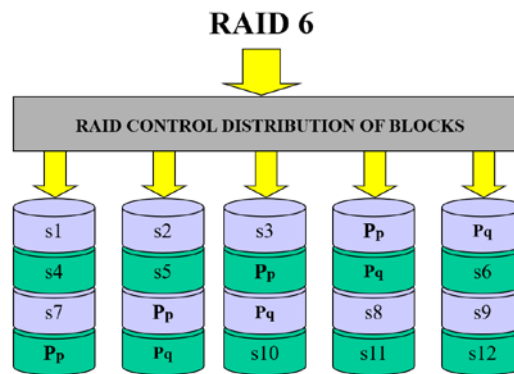
- Included in a strategy for meeting challenges is ongoing investment in integrating new technologies. New technologies in the area of storing and managing information are not only seen as necessary for deriving greater value from operations but are viewed as competitive as well. Investing to keep up with competitors or achieve an advantage is part of an overall business plan. Lack of investments in new technology is also understood to be the cause of technical debt resulting in falling behind peer organizations and inability to address new challenges.
- The axiom that "change is constant" is true in operations that must make changes to meet and move beyond their current challenges. The difficulty is in making judgements about balancing change (how much, how fast) against disruption and risk to current operations.
- Understanding the value from different approaches to addressing challenges is part of the complexity of setting direction for the organization. An evaluation about the economics of new technology must also consider what the investment means when implemented: impacts on

administration, usability in operation, and the long-term impacts of decisions regarding information that has a long lifespan. Addressing the challenges must consider the long-term implications.

One company that The Futurum Group sees as bringing new approaches to address challenges is Nyriad. Nyriad has delivered technology specifically to address challenges in storing and managing information. As a relatively new company providing products to Information Technology, Nyriad would be expected to bring something new to market to provide value. The Nyriad technology provides economic benefit while meeting critical requirements for availability and consistency. The lifespan of data and the cost to make transitions with storage systems are two additional areas that Nyriad has addressed with their new offering, the UltraIO Storage System.

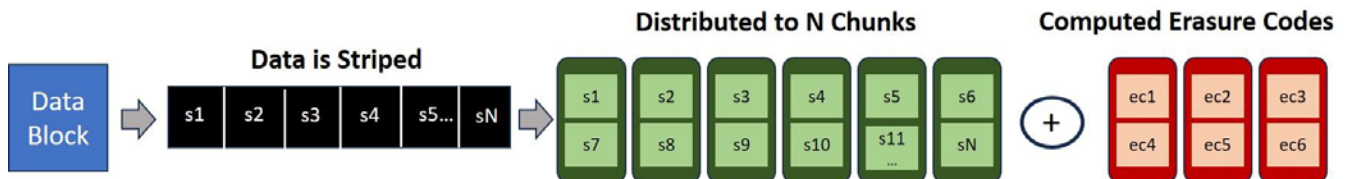
Value of the Nyriad UltraIO Storage System

The combination of advantages delivered by Nyriad's UltraIO storage derives from technology applied in the storage system. UltraIO is a block storage system with devices attached to an HA pair of controllers executing storage functions on the CPU. The unique technology that UltraIO storage delivers is the use of GPUs to perform calculations necessary for protecting from device failures with erasure codes and enabling wide stripes of data written across devices, which is termed Intelligent Data Placement. Erasure code calculations are more complex and compute intensive than RAID calculations but yield a number of advantages.



Data striped across data disks
Dual Parity – Pp and Pq protection distributed with data

Erasure Coding



The intensive calculations required for erasure codes, if done by the processor that is also processing host I/Os and managing data placement, could impact performance during write operations. Using GPUs dedicated to erasure code calculations is a unique application of technology by Nyriad. Let's review several of the advantages delivered by the UltraIO storage system that will help customers store, manage, and access data.

Global Array Protection with Erasure Codes

The Nyriad implementation using GPUs for erasure codes, calculates the protection across an entire stripe of 102 devices with a default of 10 devices for protection. In this case, any 10 drives could fail and the data would still be available. This should be contrasted with RAID protection schemes such as RAID 6 where the protection is across a RAID Group. A common implementation for RAID 6 is to have two parity devices across a small group of devices, usually a maximum of eight, which in this example would be 6+2 – 6 data devices and two parity devices. Dual parity allows for two device failures within a group. After a third failure, there is data loss. Larger RAID groups increase the probability of data loss when more than two failures occur within the group. The Nyriad implementation provides a breadth of protection across the entire array.

Greater Capacity Utilization

With erasure codes, the stripe width, meaning the number of devices across which the recovery code is calculated, can be much greater (across more devices) than with typical RAID protected devices. The large width amortizes the protection data across the larger set of devices in the protection group. This results in more usable capacity available. Stripes of data are accumulated in non-volatile memory and written across all devices in the array, accelerating performance as a sequential stream write – effectively parallel writes across the 102 devices in a typical array. Nyriad terms this Intelligent Data Placement. The greater capacity utilization possible gives an economic advantage for UltraIO storage compared to systems using the more traditional RAID data protection. A simple comparison calculation illustrates this value:

Effect of Using Erasure Code with Larger Stripe Width

Traditional RAID 6 6+2 protection	Raw Capacity for 104 18TB devices 1,872 TB	Usable Capacity At 6+2 RAID 1,404 TB	Efficiency 75%
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Erasure Code 92 + 10 protection	Raw Capacity for 102 18TB devices 1,836 TB	Usable Capacity Erasure Codes 1,656 TB	Efficiency 90.2%
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Consistent Performance with Required Protection

The potential impact in write performance during calculations required for device failure protection is avoided with the Nyriad UltraIO storage system use of GPUs for erasure codes. A challenge noted earlier was the need to have consistent performance for applications to store and read information. With the offload of the intensive calculations to GPUs, the performance during write operations does not suffer. Consistent performance is addressed with Nyriad technology.

Ability to Grow Capacity and Maintain Efficiency

The challenge of meeting the increasing capacity demands with continuing operations and additional workloads is met by adding more capacity. For individual storage systems, expanding capacity can be done a number of ways, but with RAID protected storage, the granularity of increment cannot improve the efficiency because of the implementation for protection in a RAID group. With Nyriad erasure code protection, the useful capacity efficiency is maintained as additional arrays of devices are added. For customers, the aggregate benefit increases when capacity is increased in larger arrays.

Increased Longevity – Utilize the Storage System Longer

Another economic gain that the technology of the UltraIO storage system delivers is the ability to utilize the system for a longer period of time than has been expected previously. In addition to getting more value from the investment in the UltraIO storage system by using it longer, there is a sustainability gain. When using components longer, especially when there are a large number of devices, there is less physical waste generated over time. The characteristics of Nyriad technology that enables the economics of using the system longer and greater sustainability are described below:

- With erasure codes, UltraIO storage is able to tolerate more device failures. The current implementation for UltraIO storage allows for configuration where ten devices in an array can fail with no loss of access to data or a performance impact. Devices that can be in service for a greater length of time provide continued value (and less waste) compared to a short replacement strategy.
- Maintenance for replacing failed devices can be deferred, which is beneficial in reducing the number of times that a service person is required. Overall, this reduces risks for continued operations.
- By using the system longer, the need to migrate data is deferred as well. Migration of data is a major cost factor both in the use of tools and the administrative monitoring required. Migration is also a risk element with potential issues occurring during the operation.

Overall Value from Nyriad UltraIO Storage System

In making decisions about systems to store and manage information, once basic functionality has been met, the economics of the solution becomes a key decision point. Nyriad UltraIO storage brings technology that delivers functionality resulting in economic benefit. Cited to this point are economic and technical gains from:

- Greater capacity utilization
- Higher level of data protection due to global level of array protection compared to use of RAID groups.
- Performance optimization with use of a sequential stream write of a full stripe, achieving parallel device operations.
- Providing consistent performance between read and write operations, even in the event of device failures within the array.
- Sustaining the lifespan of devices for longer periods compared to planned replacement based on limitations of dealing with predicted device failures.

In addition to these economics there is one more capability that can be a major benefit: lowering the acquisition cost of storage by using large capacity hard disk drives. With the technology provided with Nyriad UltraIO storage system, the device level protection with erasure codes enables the economics of less expensive hard disk drives and still delivers protection and longevity features. The full stripe sequential writes from Nyriad's Intelligent Data Placement exploit the write performance capabilities of hard disk drives.

Conclusions

Solving challenges is a primary task for most executives and professionals in organizations that depend on technology. The challenges for storing and managing information assets falls to a select group that must understand the business or organization goals, their current environment, and technologies that can be utilized to address the challenges.

The primary high-level challenges identified were assuring integrity of the information asset, delivering consistent, predictable application execution, meeting the increasing demands for storing information and optimizing operations for economics while meeting requirements now and in the future. Nyriad has delivered technology with UltraIO storage to help address these challenges.

The focus on economics, in initial costs and in operations, ultimately is a decision point for choosing the systems to store and manage information. The UltraIO storage system delivers technology to enable greater economic gain.

The Futurum Group has investigated the value proposition from the Nyriad UltraIO storage system and sees the potential for customers. Importantly, the economic benefits outlined above can be achieved with practicality. The technology Nyriad brings is the enablement for these gains, which are critical for IT operations. We expect further advances with the applicability of the technology providing a larger set of solutions for customers.