STORAGE POC
FACTS AND FINDINGS REPORT

Document Information

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Executive Summary

Our organization is currently in need of a new storage system for our new location. The current storage system in use, a 7-year-old Dell Isilon, is no longer able to meet the demands of our new editing workflows. The Isilon system is not designed to handle the increased data storage and processing needs of our new high-resolution video projects and the increasing number of editing stations. As a result, we have been experiencing slow performance and frustration from our users. In addition, the aging system is becoming increasingly difficult and costly to maintain. We require a new storage system that can provide faster performance, improved data protection, and the ability to scale as our organization grows. The new system should also be easy to manage, reliable, and cost-effective, in order to support our editing workflows and to ensure smooth operation of our new location.

In order to determine the best storage provider for our needs, we conducted a thorough evaluation of four different options: Qumulo, Dell Isilon, OpenDrives, and Nyriad Ultra.io. Each provider was tested for a variety of factors, including performance, scalability, and reliability, in order to determine which one would be the most suitable for our organization. The results of these tests will be analyzed and used to inform our decision on which provider to ultimately select.

In order to simulate a real-world scenario, we set up a lab environment that consisted of the following equipment: 5 high-end editing stations, each equipped with either a 10GB, 40GB, or 100GB NIC, 8 video playback/ingest machines, each with 1GB NICs, and 16 channels of ToolsOnAir writing simultaneously to the storage system. This configuration will allow us to thoroughly test the performance and capabilities of the storage providers under consideration and ensure that the chosen solution will meet the needs of our entire organization.

In addition to testing the storage providers in a standalone lab environment, we also attached each of the providers to our media asset manager, Curator, in order to evaluate their performance and compatibility with our existing workflow. This allowed us to not only measure the raw performance of the providers but also how well they integrated into our existing ecosystem, and how it would affect our overall workflow. We also evaluated the performance of the workflows on an existing editing bay on a different VLAN. This allowed us to simulate real-world usage conditions and to see how well the storage providers would perform in a production environment, and how well it would integrate with our existing network infrastructure. This provided us with a more comprehensive understanding of the storage providers' capabilities and suitability for our organization.

The main tests conducted on the storage providers included:

- Caption extraction time on a POC editing system
- Caption extraction time on an existing editing bay
- 2x Playback rating
- Power-up time
- Recovery time from power loss
- Redundancy from failing nodes or disks
- Write speeds under different types of loads
- Virtual environment performance

In addition to evaluating the performance and reliability of the storage providers, we also considered other factors such as ease of installation and scalability. This included assessing the complexity of setting up the storage solutions, as well as their ability to adapt and grow with the organization's changing needs. Qumulo required the least amount of technical expertise and troubleshooting, while OpenDrives required some level of technical expertise for certain parts of the installation process. Dell required a higher level of expertise and troubleshooting, particularly with the closed caption extractions. Nyriad Ultra.io required the most technical expertise and troubleshooting, as the system is custom built with a custom interface that DigitalGlue has written.

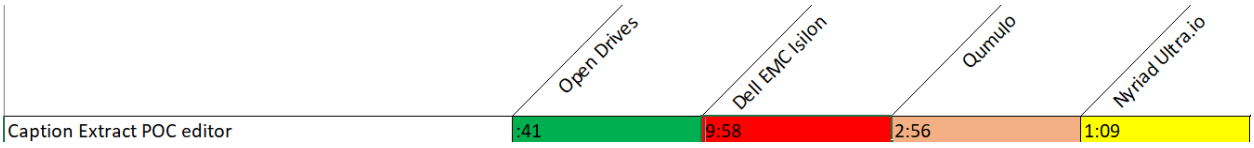
Despite the varying throughput speeds of the network cards used in our testing, we consistently observed a total bandwidth usage of approximately 2 GB/s to each machine. This suggests that the storage providers were able to effectively utilize the available bandwidth and that network card speed was not a bottleneck in the performance of the storage solutions. This is an important consideration for our organization as we move forward with our selection process.

In this report, we will be analyzing the results of these tests more in depth to determine which storage provider performed the best across all metrics. This will help us to make an informed decision on which provider to select for our organization.

Test Results and Evaluations

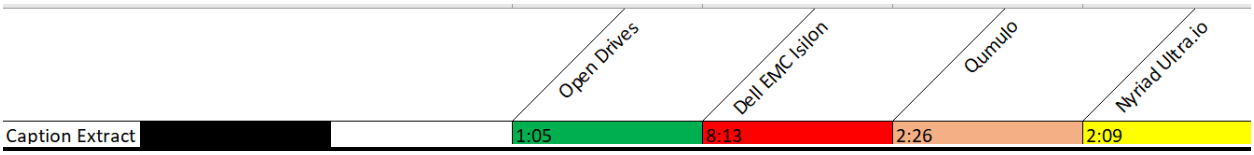
1. Caption extraction time on a POC editing system

The caption extraction time on a POC editing system test revealed some interesting results. On average, Dell Isilon took 9:58 minutes, Qumulo took 2:56 minutes, Nyriad 1:09 minutes, and OpenDrives had the best performance with a time of 0:41 seconds to complete the test. These results show a clear difference in performance among the storage providers and will be an important factor in our decision making process.



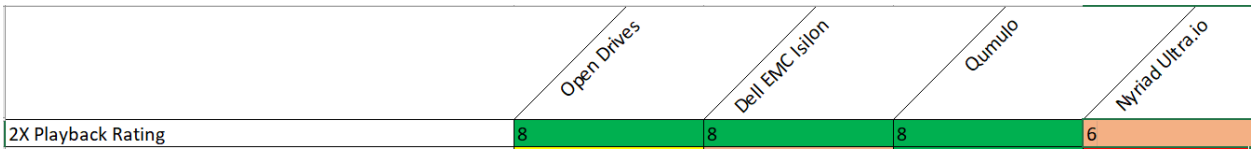
2. Caption extraction time on existing editing bay.

The caption extraction time on an existing editing machine test provided further insight into the performance of the storage providers. On average, OpenDrives had the best performance with 1:05 minutes, Dell took 8:13 minutes, Qumulo took 2:26 minutes, and Nyriad Ultra.io took 2:09 minutes. These results indicate that while some providers performed well on the POC editing systems, their performance may differ on an existing editing machine. This highlights the importance of evaluating the storage providers across different environments and scenarios to determine which one will be the best fit for our organization.



3. 2x Playback Rating

In addition to the caption extraction time tests, we also evaluated the storage providers' performance in terms of 2x playback speeds in Adobe Premiere. Jenna, our evaluator, rated the providers on a scale of 1-10, with 10 being the best. OpenDrives, Dell Isilon, and Qumulo received a rating of 8, indicating that they performed well in this test. Nyriad Ultra.io, however, received a rating of 6, indicating that it performed below the other three providers in this particular test.



4. **Power-up time.**

The power-up time test provided valuable information about the recovery time of the storage providers after a clean reboot. The results of this test indicate that most of the systems required a remount of the share in order to access the media. OpenDrives took 4:10 minutes to regain network connectivity, and 6:10 minutes to regain media access. Dell Isilon took 10 minutes to regain network connectivity and 14:50 minutes to regain media access. Qumulo took 2:45 minutes to regain network connectivity and 3:50 minutes to regain media access. Nyriad took 5 minutes to regain network connectivity and 20 minutes to regain media access.

	Open Drives	Dell EMC Isilon	Qumulo	Nyriad Ultra.io
Power up time	4:10 till ping 6:10 till media access 1/2 systems remount needed	10 min till ping 14:50 till media access but required a remount or reboot	2:45 till ping 3:50 till media access 1/2 systems remount needed	5 mins til ping 20 mins til media access.

5. Recovery time after power loss.

The power loss recovery time test provided important insights into the recovery time of the storage providers after a power loss. The results of this test indicate that OpenDrives took 4:40 minutes to regain network connectivity and 5:40 minutes to regain media access. Dell Isilon took 9:45 minutes to regain network connectivity and 10:30 minutes to regain media access. Qumulo took 2:45 minutes to regain network connectivity and 3:50 minutes to regain media access. Nyriad Ultra.io took 3:55 minutes to regain network connectivity, but after 30 minutes, the media was still not mountable. Furthermore, Nyriad Ultra.io required intervention from DigitalGlue to be restored after an hour.

	Open Drives	Dell EMC Isilon	Qumulo	Nyriad Ultra.io
Power up from power loss	4:40 till ping 5:40 till media access	9:45 till Ping 10:30 till mount	2:45 till ping 3:50 till media	3:55 Ping After 30 min still not

6. Redundancy from failing nodes or disks

In order to evaluate the redundancy of the storage providers, we conducted tests to simulate node and disk failures. The results of these tests show that OpenDrives took an average of 3 minutes for the HA switch to the passive controller before media was accessible again. Dell was able to tolerate one node failure before data was no longer accessible. Qumulo was also able to tolerate one node failure before data was not accessible. Nyriad Ultra.io was able to stay completely online with their active-active configuration, meaning that it can tolerate multiple node failures before data is no longer accessible. These results are important to consider when evaluating the overall reliability and availability of the storage providers and will be taken into account when making a final decision.

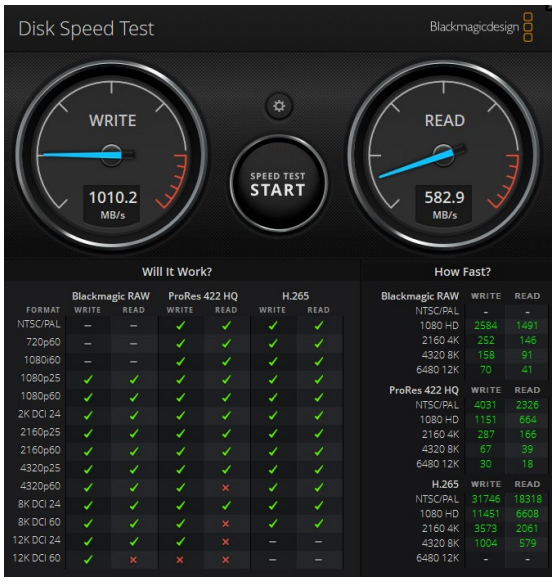
	Open Drives	Dell EMC Isilon	Qumulo	Nyriad Ultra.io
Redundancy Test	HA switch over to passive controller took 3 mins before medial was available.	2 nodes down still on line but media did not play back	power off two nodes and systme totally offline.	power off one CS server all clients could still play media.

7. **Read/Write Speed Tests**

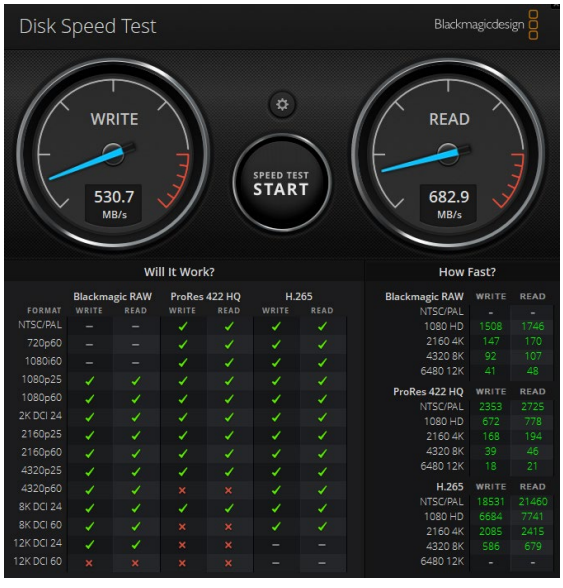
In order to evaluate the read and write speeds of the storage providers under different workloads and scenarios where nodes were offline, we decided to use the Blackmagic Disk Speed Test tool for read and write speeds and the AJA Disk Speed Test tool for frame rate speed values. This was done in order to keep the testing consistent and fair across the board. The results of these tests were important in assessing how the storage providers performed under varying loads and to evaluate their ability to maintain high speeds even when there is degradation, such as nodes being offline.

In order to establish a baseline for the storage providers' performance, we tested read and write speeds with no load on the system. The results of these tests were recorded in MB/s. OpenDrives had a read speed of 1010MB/s and a write speed of 582MB/s, Dell Isilon had a read speed of 530MB/s and a write speed of 682MB/s, Qumulo had a read speed of 532MB/s and a write speed of 685MB/s, Nyriad Ultra.io had a read speed of 788MB/s and a write speed of 522MB/s. These results provide a baseline for the storage providers' performance and will be used as a reference point when evaluating the performance under different loads and scenarios.

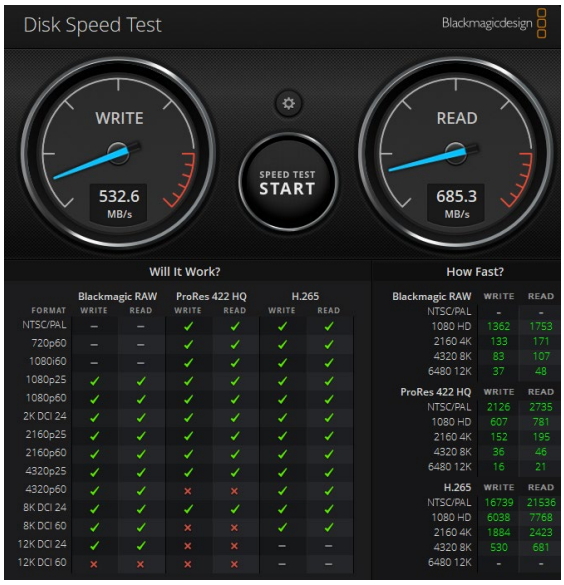
OpenDrives



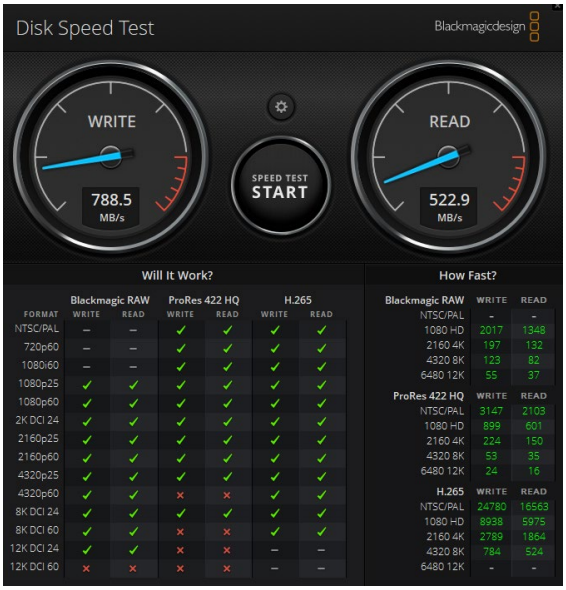
Dell Isilon



Qumulo



Nyriad Ultra.io

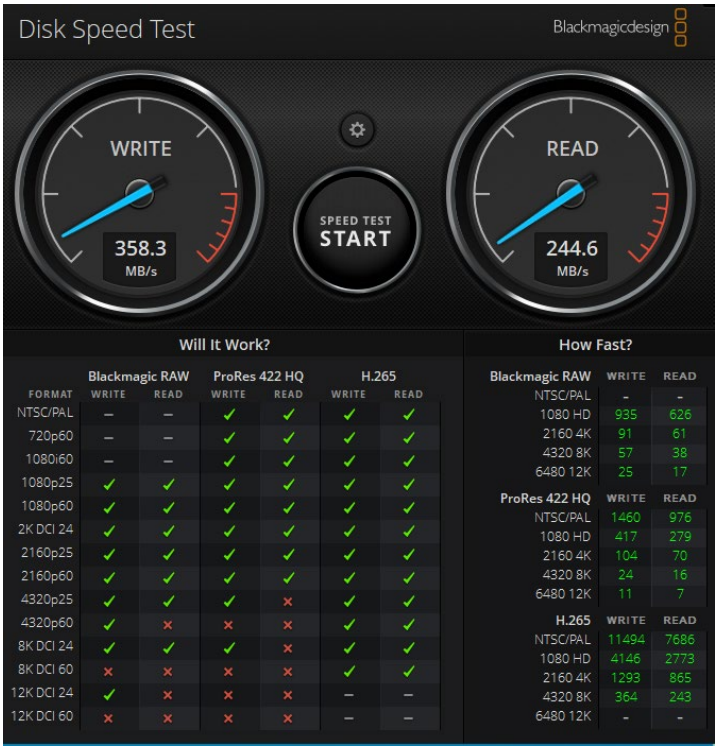


To simulate a heavy load, we designed a test scenario where 8 ingest machines were generating network traffic while simultaneously writing and reading 4gb files at a rate of 100Mbps from the storage providers. Additionally, we had 3 of the POC editing machines running 22 camera Better Together Adobe Premiere projects that were encoded in AVCi codec, which requires 100Mbps per stream, and 2 POC editing machines were running 9 camera Yippee projects encoded in UHD XAVCi, which require 400Mps per stream, all at the same time. This test scenario simulated a heavy load on the storage providers and provided a comprehensive insight into how they performed under such conditions. We observed that loading the high-definition content using Dell Isilon and Qumulo took significantly longer than expected, causing delays in the workflow, and raising concerns about the performance of these storage providers under heavy loads.

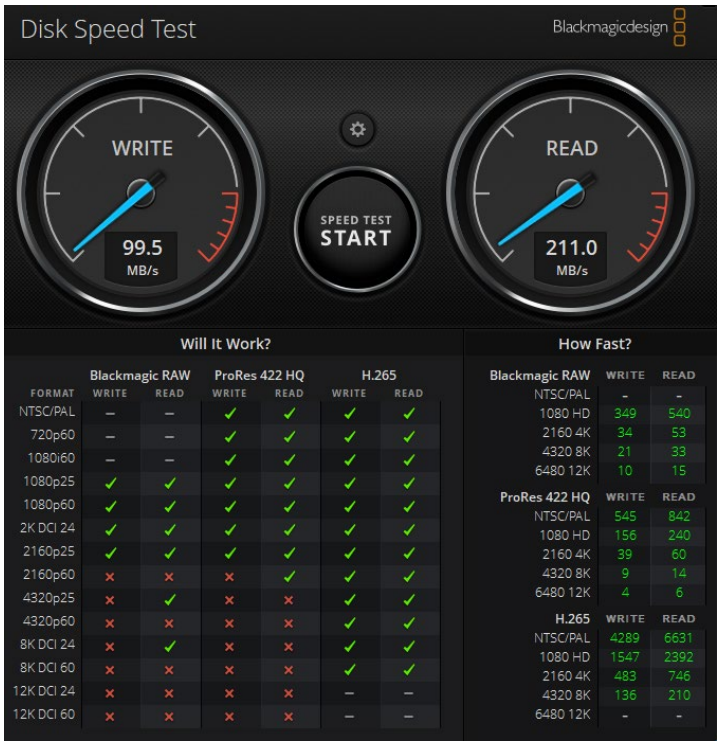
We immediately observed a major degradation in read and write speeds specifically with Qumulo, once the projects were loaded but not actively playing. This degradation was particularly noticeable when the system was idle, and no heavy loads were applied. This suggests that Qumulo may not be able to maintain optimal performance under normal usage conditions and may have issues with handling idle loads..

	Open Drives	Dell EMC Isilon	Qumulo	Nyriad Ultra.io
BM Speed test - Heavy load test	W-1154 R-517 stop W-365 R-245 play	W-594 R-680 stop W-120 R-175 play	W-278 R-266 stop W-170 R-503 play	W-445 R-534 stop W-278 R-266 play

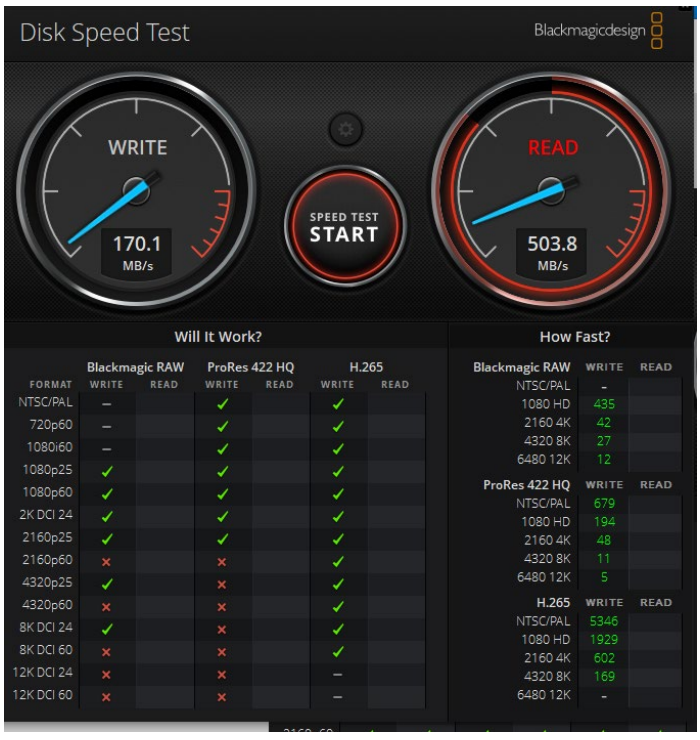
OpenDrives Heavy Load Test



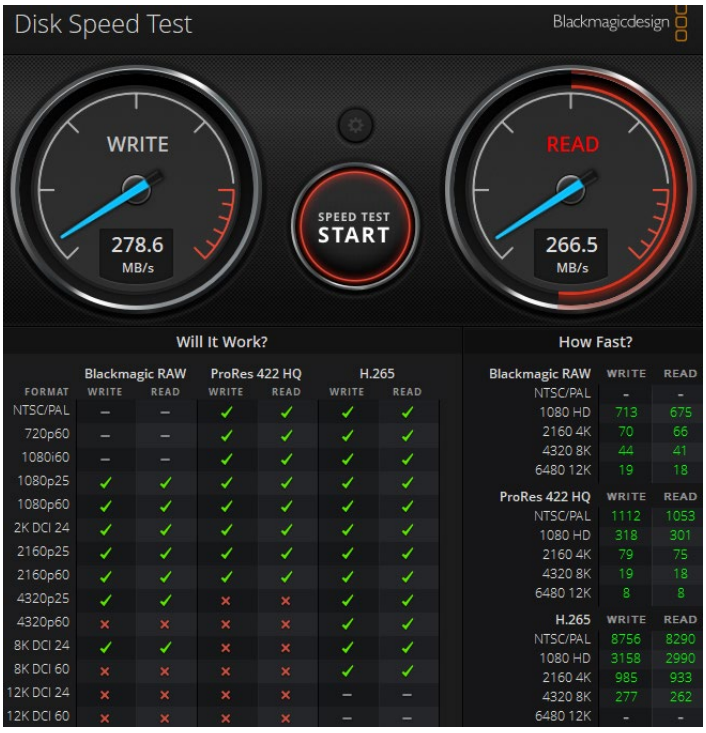
Dell Isilon Heavy Load Test



Qumulo Heavy Load Test



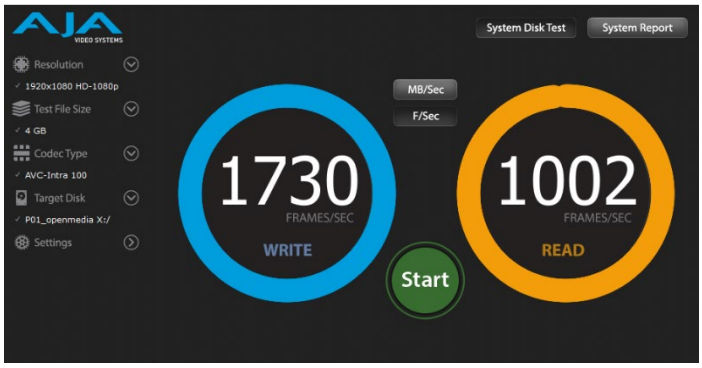
Nyriad Ultra.io Heavy Load Test



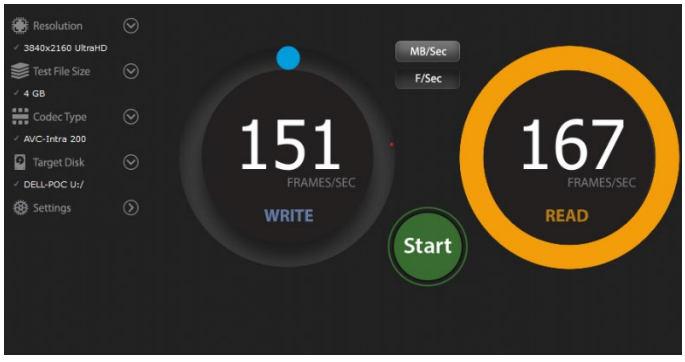
8. **Frame Rate Speed Test**

In addition to the read and write speeds tests, we also ran frame tests using the AJA Speed Test tool for HD and UHD content. These frame tests were designed to evaluate the storage providers' ability to handle high-resolution video and ensure smooth playback. The AJA Speed Test tool allowed us to simulate real-world scenarios such as multiple streams of high-resolution video playback and recording. We ran the tests on different codecs such as AVCIntra and ProRes, to evaluate the storage providers' ability to handle different codecs and compression methods. The frame test results provided insight into the storage providers' performance in terms of frame rate, dropped frames, and overall video quality. We also took into account the system's ability to handle multiple streams of high-resolution video playback and recording to see how they scale under heavy workloads.

OpedDrives Frame Test HD/UHD



Dell Isilon Frame Test HD/UHD



Qumulo Frame Test HD/UHD **Nyriad Ultra.io Frame Test HD/UHD**

9. **Virtual Environment: Speed Test**

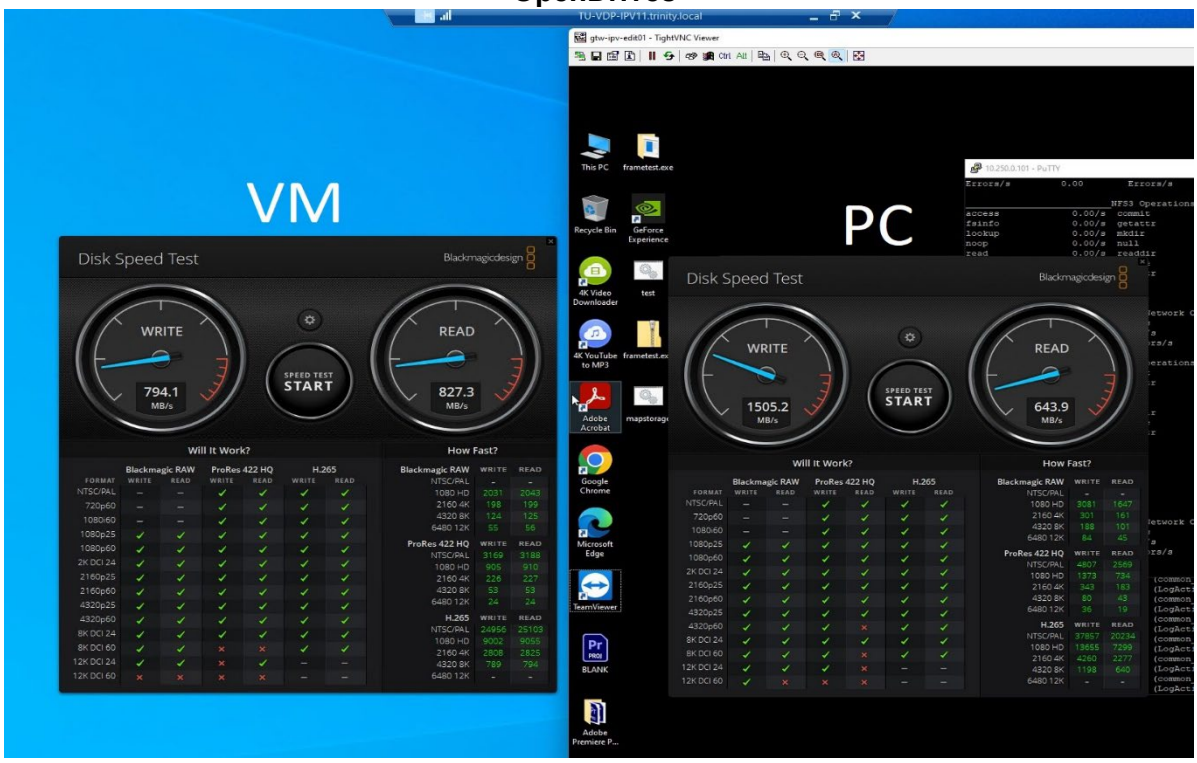
In addition to testing the storage platforms in a physical environment, we also conducted tests in a virtual environment to evaluate the performance of the storage platforms in comparison to a physical machine environment. This was done to ensure that the storage platforms are able to provide optimal performance in both physical and virtual environments. We used a combination of virtual machines and containers to simulate the same workloads and conditions as we did in the physical environment tests. This allowed us to evaluate the performance of the storage platforms in terms of I/O operations, network latency, and data transfer speeds in a virtual environment. This was important as our new environment will heavily rely on virtualized editing machines and we wanted to ensure that the storage platforms we are considering can provide optimal performance in these environments as well.

We observed a significant difference in performance when comparing the results of our tests in virtual and physical environments. Specifically, we saw about a 20% degradation of performance in the virtual environment, specifically with Nyriad Ultra.io. The read speeds were drastically affected in the virtual environment, the read speeds were about 80% slower than the physical environment which can be attributed to the overhead of virtualization on the storage platform as well as the network configuration. The virtual environment test results showed that network configuration may also have played a factor in the degradation of the write speeds. This is crucial to consider as virtualization is becoming increasingly common in today's media production environments and the ability of the storage platform to perform well in virtualized environments with proper network configuration is an important factor to consider.

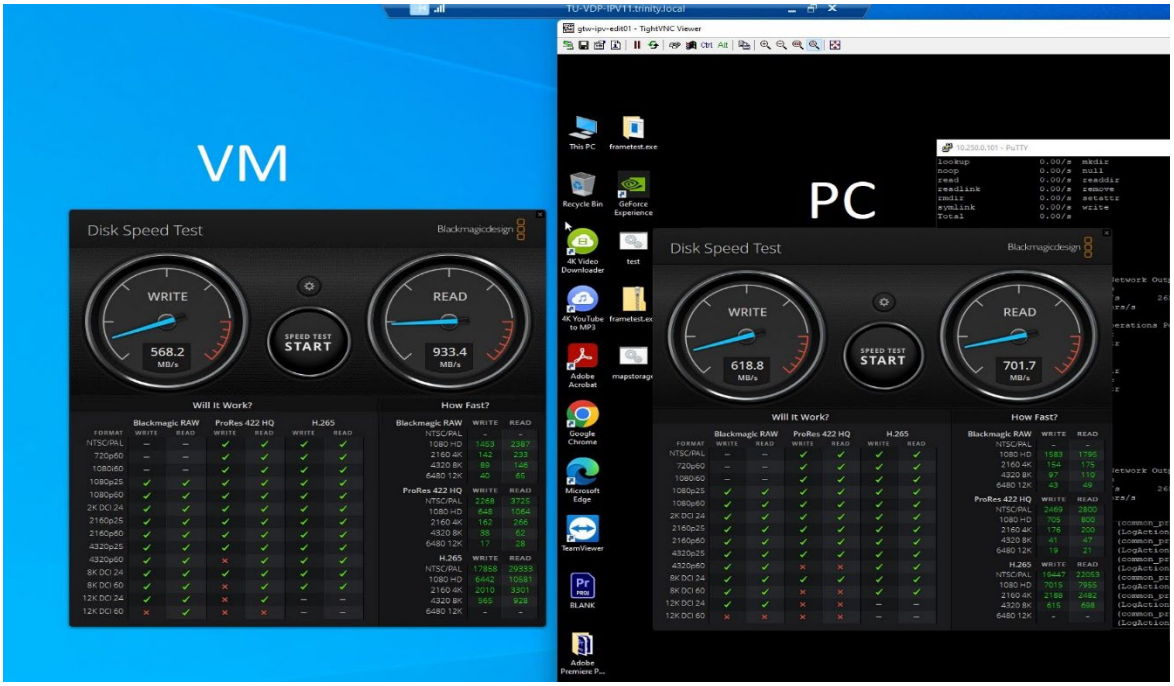
In order to verify the results of our tests, we also conducted a side-by-side comparison of read and write speed tests in both virtual and physical environments. We used the same test configurations and conditions for both environments, and the results were compared to ensure accuracy and consistency.

The side-by-side comparison allowed us to verify the results of our tests and confirm the observed performance degradation in the virtual environment specifically with Nyriad Ultra.io. This comparison was important to ensure that the results were not affected by any external factors and that the degradation in performance was in fact related to virtualization and network configuration.

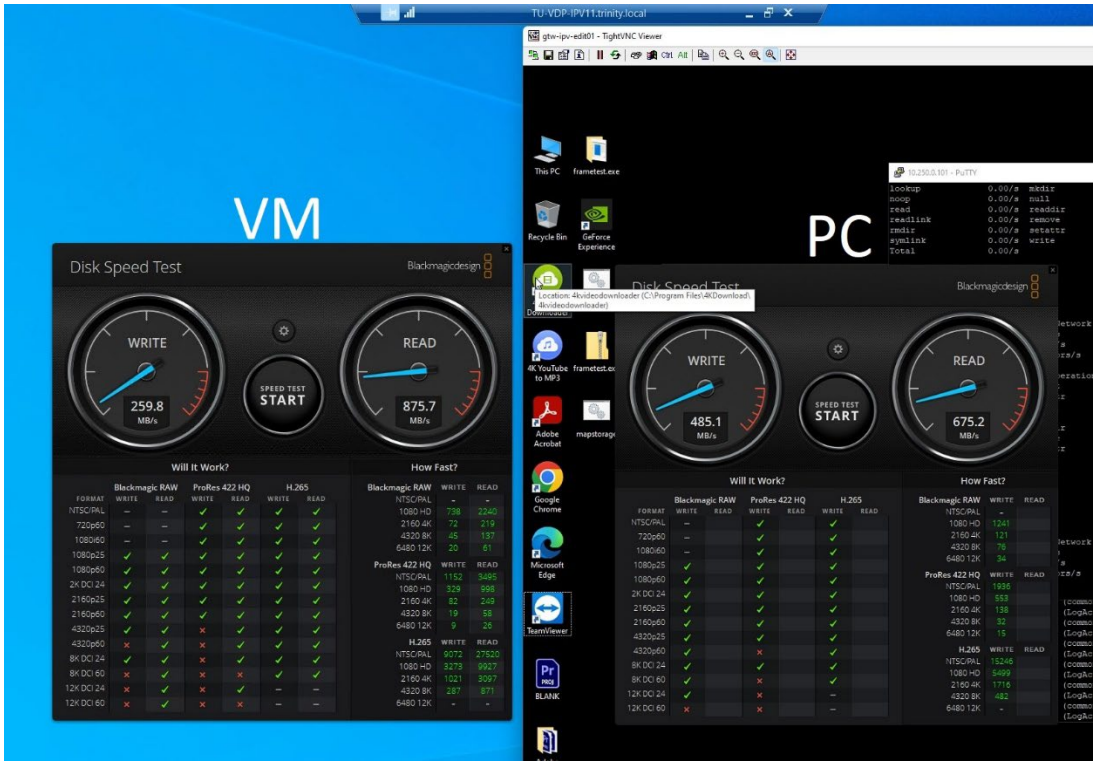
OpenDrives



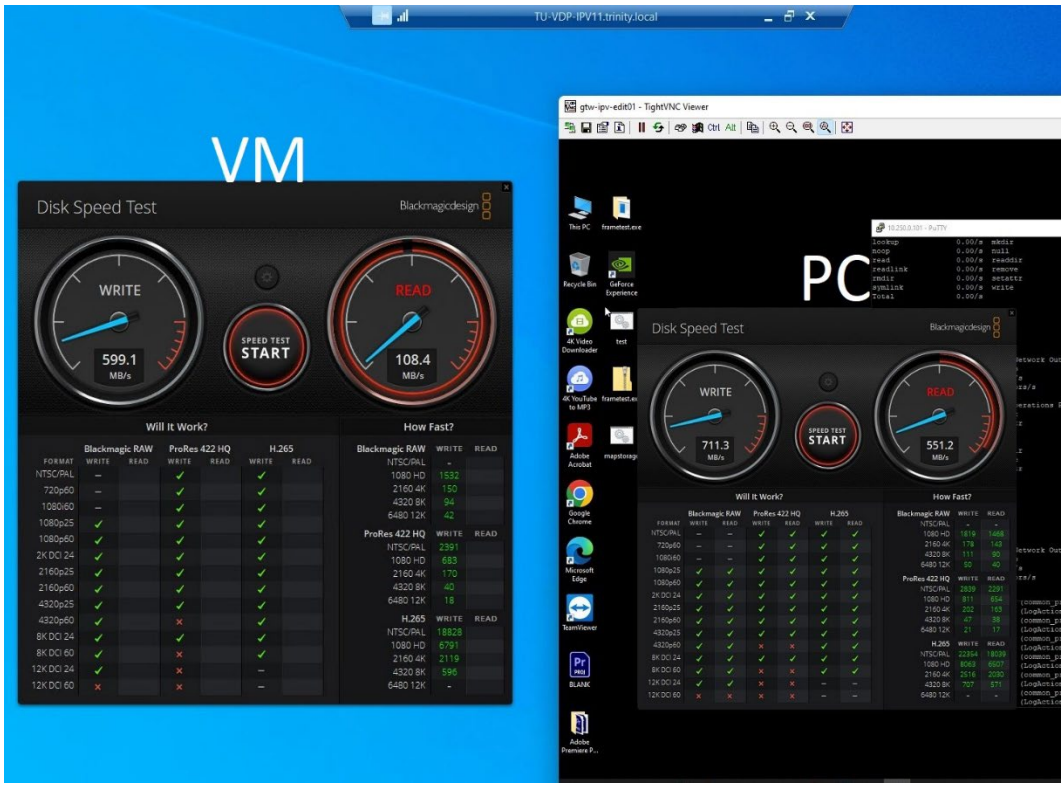
Dell Isilon



Qumulo



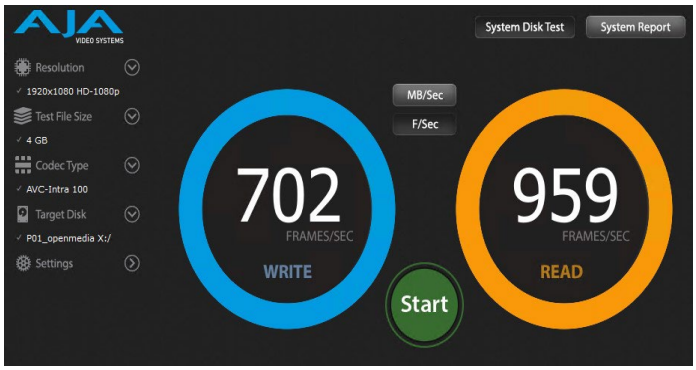
Nyriad Ultra.io



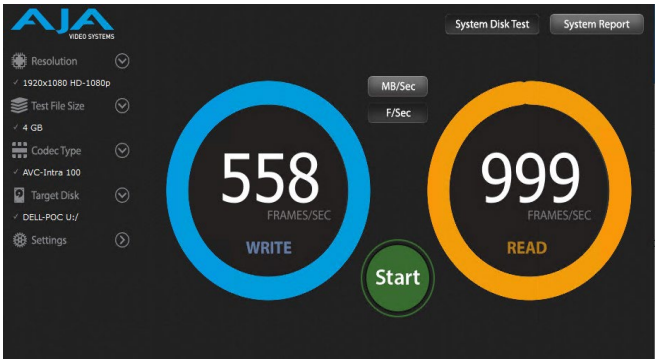
10. **Virtual Environment: Frame Speed Test**

In addition to the read and write speeds tests, we also evaluated the frame rates on the virtual machines. We ran the frame rate tests using the AJA Speed Test tool for HD and UHD content and the results were compared to those obtained in the physical environment. The results of the frame rate tests showed a similar degradation in performance as observed in the read and write speed tests. Specifically, we saw a decrease in frame rates of about 20% in the virtual environment, specifically with Nyriad Ultra.io. This degradation in frame rate performance is a significant concern as it can directly impact the smoothness of video playback and affect the quality of the final product. These results further reinforced the importance of considering the storage platform's performance in virtualized environments and the need for proper network configuration to ensure optimal performance.

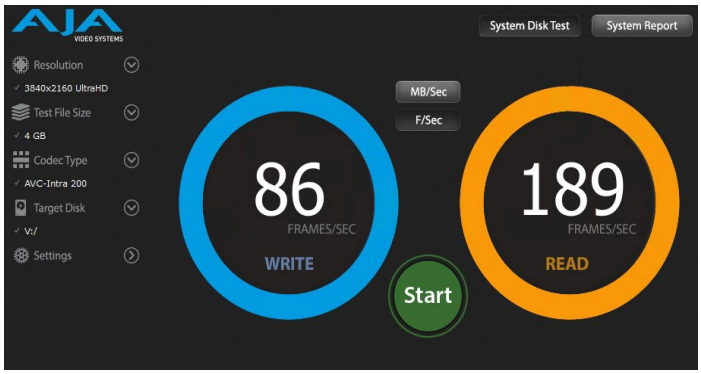
OpenDrives FT HD/UHD



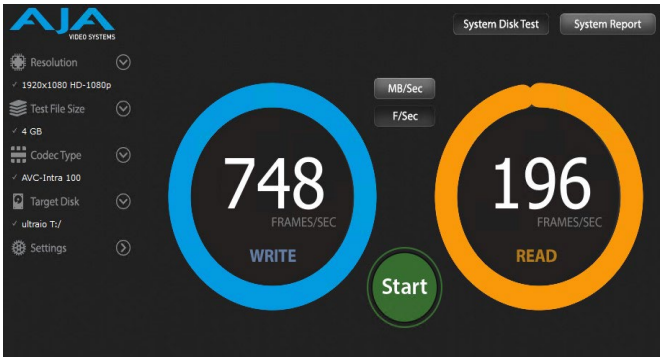
Dell Isilon FT HD/UHD



Qumulo FT HD/UHD



Nyriad Ultra.io



11. Virtual Environment: Caption Extraction

We also tested caption extraction in virtual machines in order to evaluate the performance of the storage platforms in this regard in a virtualized environment. The results were consistent with the tests conducted in physical environment, with similar performance across most storage platforms. However, Qumulo took twice the time to complete caption extraction in the virtual environment, while Dell Isilon took half the time compared to the other platforms. This indicates that while virtualization does have an impact on the storage platform's performance, it does not affect caption extraction performance significantly. However, it is important to note that Qumulo had a significant performance hit in the virtual environment which should be taken into consideration when evaluating the storage platform.

	Open Drives	Dell EMC Isilon	Qumulo	Digital Glue
Caption Extract VM	1:10	5:30	4:04	2:30

12. **Environmental: Power & Heat**

Apart from performance and technical criteria, we also took into consideration environmental factors such as heat, power, and operational costs when evaluating the storage providers. We noticed that heat output was consistently over 105°F with Dell Isilon and this could potentially become an issue for long-term operation and maintenance of the storage system. On the other hand, Nyriad Ultra.io required a vast amount of 220v power for each node, which could have a significant impact on the overall energy consumption and operating costs of the storage system. These environmental factors will also play a role in decision making, as they have the potential to affect the long-term operation and maintenance of the storage system.

	Open Drives	Dell EMC Isilon	Qumulo	Nyriad Ultra.io
Temperatures	83F	105F	95F	Controlers 85F Drives at 99F

13. **Graphical User Interface (GUI)**

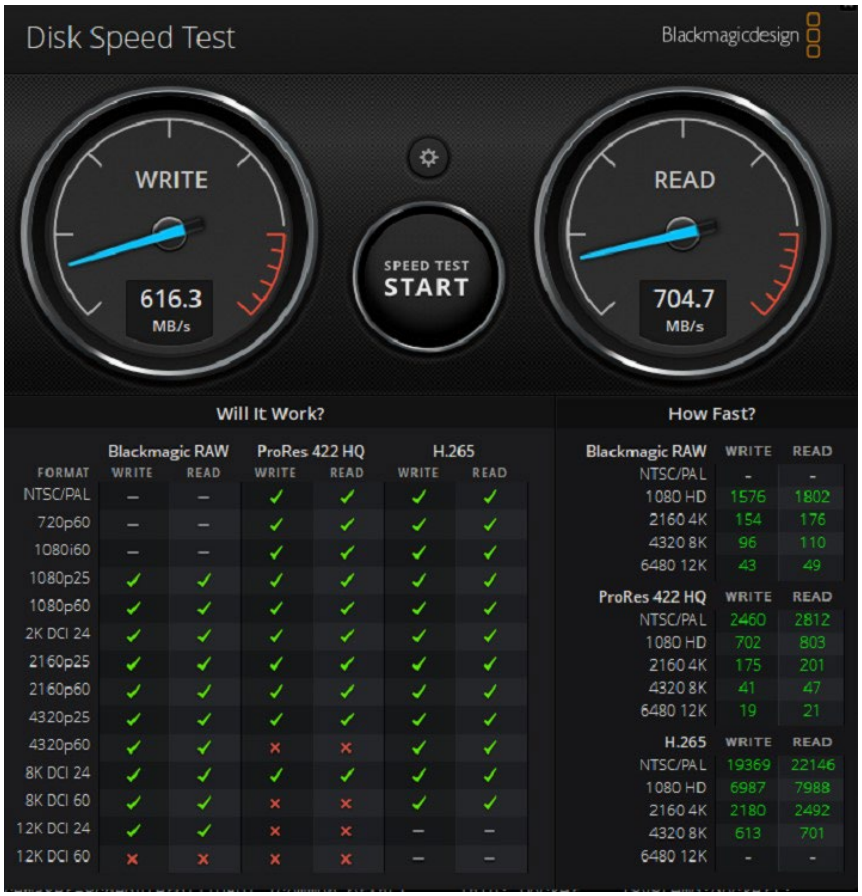
Finally, we also evaluated the graphic interface for reporting and management for each system. One of the main considerations was the ability to do most of the management in-house without requiring constant support from the manufacturer. Additionally, we evaluated the ease of use and readability of the reports, as well as the complexity of managing the system. Based on our testing and evaluation, we found that Qumulo had the simplest and most manageable interface. The interface was easy to navigate and provided clear, concise reports. OpenDrives was the next in line in terms of simplicity and manageability. The interface was easy to use and provided useful reports, however, not as simple as Qumulo. Nyriad had a more complex interface than Qumulo and OpenDrives, but still manageable although no real configuration settings were ab. Lastly, Dell had the most complex GUI, not only to manage but also to configure. It required a higher level of technical expertise and troubleshooting, which could be a challenge for in-house management. These results will be taken into consideration when evaluating the overall performance of the storage providers and determining the best option for the organization.

Addendum to POC: Dell Flash Tier

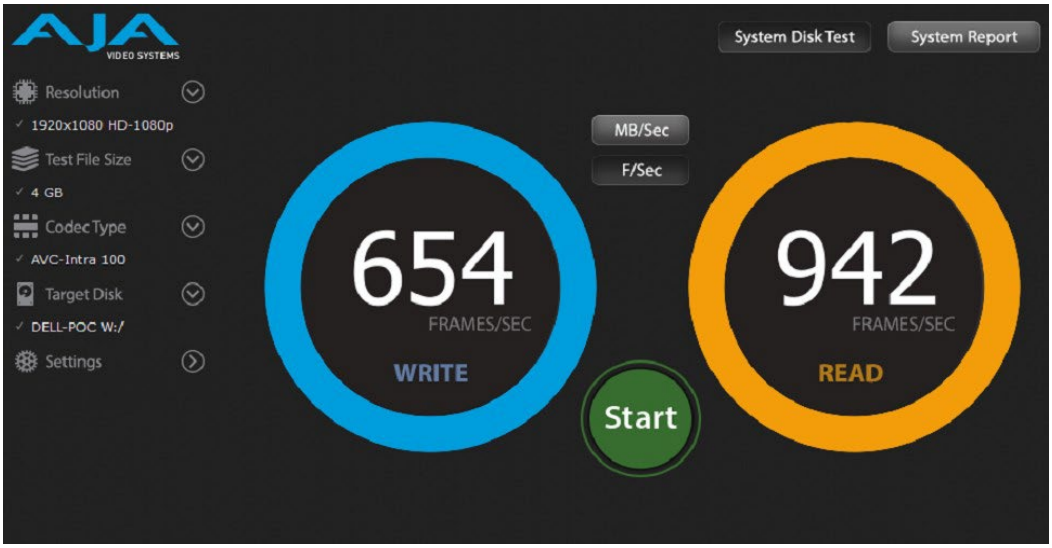
During the course of our tests, we encountered an issue with Dell Isilon's caption extraction performance which was taking significantly longer compared to other storage platforms. In order to address this issue, we contacted Dell and they proposed adding a flash tier to the storage. We modified our Proof of Concept (POC) to include this possibility and retested Dell Isilon's caption extraction performance. The results showed a significant improvement in caption extraction performance with the addition of the flash tier. This solution brought Dell Isilon's caption extraction time down to 2 minutes and 30 seconds which is closer to that of the other storage platforms and made it a more viable option for our organization. However, it is important to note that the inclusion of a flash tier does come with additional costs and considerations such as power and cooling.

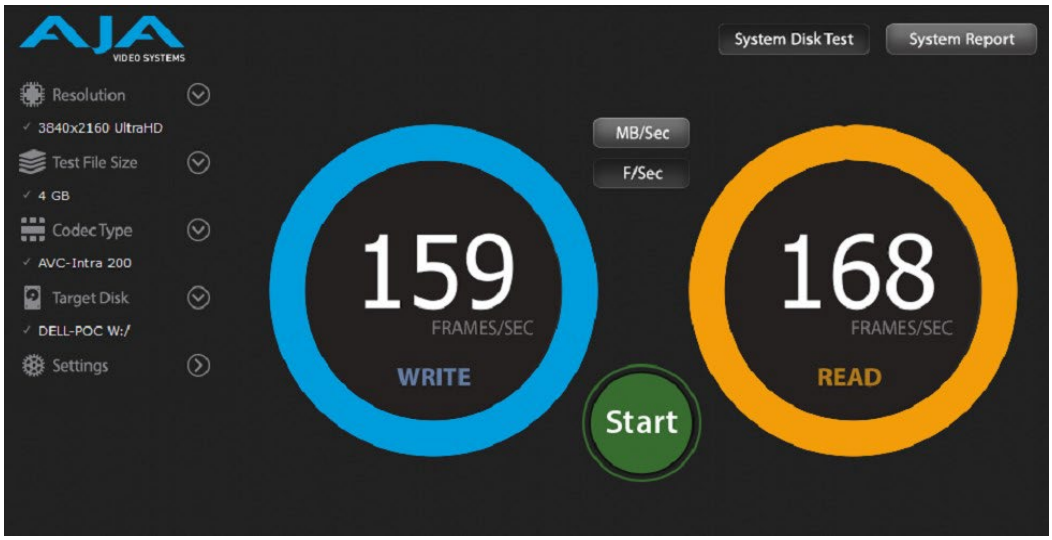
While the inclusion of a flash tier did improve caption extraction performance for Dell Isilon, we did not observe a significant increase in performance for other read and write and frame tests. We ran a series of read and write speed tests and frame tests using the Blackmagic Disk Speed Test tool and AJA Speed Test tool for different codec values. We compared the results of these tests before and after the inclusion of the flash tier and found that the performance increase was minimal, if any. This suggests that while the flash tier may be beneficial for certain specific use cases, it may not necessarily provide a significant overall performance boost for our organization's workflow and requirements.

Dell Isilon Flash Speed Test



Dell Isilon Flash Frame Test HD/UHD





Our final decision will take into account the overall performance and cost of each storage platform including this modification.

Pricing

When comparing the cost to performance, we took into account the various tests we ran including caption extraction, power up time, recovery time from power loss, redundancy, write speeds under different types of loads in both physical and virtual environments, and environmental factors such as power and heat.

In evaluating the cost to performance ratio, we analyzed the test results in conjunction with the costs for each storage platform. OpenDrives had the lowest cost at $932,053 and also performed well in our tests, particularly in terms of caption extraction and power up time. Dell Isilon had a higher cost at $1,250,785 and while it performed well in caption extraction with the addition of the flash tier, it had longer power up and recovery times and the flash tier would add a significant additional cost. Qumulo had a cost of $1,341,030 and performed well in caption extraction and recovery time and had the quickest power up time. Nyriad Ultra.io had the highest cost at $3,150,450 and while it performed well in terms of remaining online during redundancy testing, it had longer caption extraction times and required a significant amount of power. Based on these results, OpenDrives appears to offer the best value in terms of cost and performance.

OpenDrives	$932,053
Dell Isilon	$1,250,785
Qumulo	$1,341,030
Nyriad Ultra.io	$2,725,760

Conclusion

In conclusion, we have conducted extensive testing and evaluations on four storage providers: Qumulo, Dell Isilon, OpenDrives, and Nyriad Ultra.io. We have considered a wide range of factors such as performance, technical capabilities, environmental factors, ease of use, and scalability when evaluating each storage provider. We have also considered the results of our tests and evaluations, including caption extraction time on POC editing system, power up time, recovery time from power loss, redundancy from failing nodes or disks, write speeds under different types of loads, and environmental factors like power and heat, and ease of installation and scalability. All of these factors will be taken into account when making the final decision on which storage provider will be chosen for our new location. We will also consider the results of our tests and evaluations on the interface for reporting and management of each system.

Furthermore, we are considering future-proofing our environment with this decision. We want to make sure that the storage provider we choose can grow and adapt to our future needs, this means that the storage provider we choose should have the capability to scale up and accommodate for increasing data storage and processing needs. We also want to make sure that the storage provider is designed to handle new technologies and advancements in media production and editing workflows. In summary, this will provide a detailed report on the performance of each storage provider, taking into account the specific needs and requirements of the organization, and make recommendations on the best option for the organization that will future proof our environment.