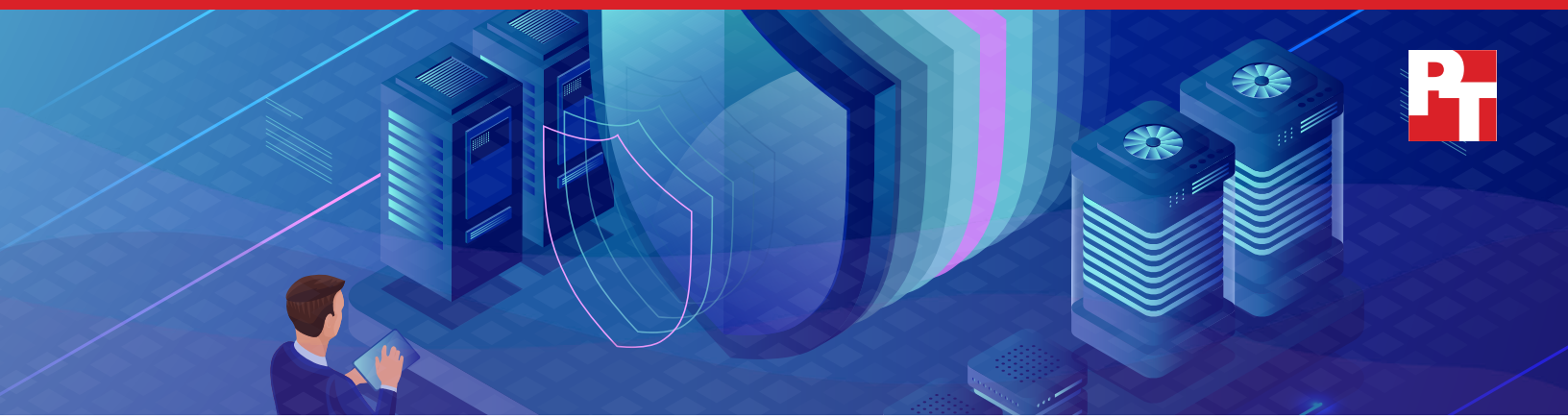


Achieve up to 80% better throughput and increase storage efficiency with the Dell PowerMax 8500

Compared to a competing array, Dell's high-end PowerMax 8500 storage array offered better I/O performance for simulated OLTP and data workloads, saved more space through more efficient data reduction, and performed snapshots with no performance impact

Critical database applications require fast input/output (I/O) performance, high throughput, reduced latencies, and modern security features to keep up with ever-changing demands. In a business landscape where 94 percent of companies that suffered a catastrophic data loss did not survive more than two years,[1] a powerful storage solution can make an important difference for your organization. The Dell PowerMax 8500 could bring significant advantages to help you keep up with database demands.

At Principled Technologies, we ran multiple tests on two all-NVMe® storage arrays, each with 90 TB of usable capacity: one of the newest arrays from Dell, the PowerMax 8500, and the most current array from another company we'll refer to as Vendor E. Compared to Vendor E array, the PowerMax 8500 used less storage capacity to store 62.5 TB of data and handled more input/output operations per second (IOPS) with lower storage latency for a simulated database online transaction processing (OLTP) workload. In addition, the PowerMax 8500 supported higher throughput (in MB/s) with lower storage latency during the extraction phase of a simulated extract, transform, and load (ETL) workload. With the Dell PowerMax 8500 storage array, enterprise-level organizations can maximize storage capacity and increase storage performance while maintaining fast response times.

We also tested the impact of taking storage snapshots on the two arrays. Capturing storage snapshots is a highly important and recurring operational process that brings several benefits, but doing so can affect the performance of production applications. The Dell PowerMax 8500 had a better response time while capturing snapshots and did not impact the performance of the steady state workload the solution.

Maximize storage efficiency
31% less storage used

Handle more database activity during simulated data extraction
80% greater throughput

Capture storage snapshots with no performance impact
94% lower storage latency

Get more cloud-based management features
Dell CloudIQ integration and proactive analytics

About the Dell PowerMax 8500 array

Aimed at enterprises, the Dell PowerMax 8500 storage array is an all-NVMe storage offering that Dell calls "the world's most secure, mission-critical storage."[2] According to Dell, the PowerMax 8500 offers increased efficiency, advancements in cyber resiliency, and a variety of automated storage operations, among other new features and capabilities.[3] Learn more at https://www.dell.com/en-us/dt/storage/powermax.htm.

How we tested

During our testing, both the Dell PowerMax 8500 array and the Vendor E array were located in an offsite data center lab. We performed all testing remotely after traveling to the lab to inspect the server clients, the network implementation, and the storage arrays. During testing, we had full control over and unfettered access to the testbeds.

We began our test setup by creating 64 1TB volumes on each array and mapped them to four Linux® servers connected to the arrays. We tuned the storage and hosts according to each storage vendor's published best practices.

We tested each array in four phases and ran each test separately three times. We chose the median results for each phase for this report.

Phase 1: **Data reduction**. We started the test with each array containing empty volumes. Using Vdbench, we simulated a data migration into the arrays. The 62.5TB dataset, which Vdbench created, had a sequential write input/output (I/O) profile using 128KB blocks, 4:1 compression ratio, and a single thread per volume. We collected capacity and data reduction information before and immediately after each test iteration to assess the data reduction capabilities of both storage arrays.

Phase 2: **Simulated OLTP performance.** We used Vdbench to pre-allocate data to all logical space on the volumes with a sequential write I/O workload, a 2:1 compression ratio, and a 2:1 deduplication ratio (the goal of that ratio was to simulate real-world database datasets). We then performed a long, fixed-rate OLTP simulation to precondition the arrays. Finally, we ran a simulated OLTP workload to collect IOPS and latency data from the two storage solutions.

Phase 3: **Data extraction by simulated ETL process.** To simulate the data extraction from a transactional database by an ETL process, we used Vdbench with a read-heavy workload. We ran the test to achieve maximum performance, collecting IOPS and latency data from both storage solutions.

Phase 4: **Storage snapshot performance.** To evaluate the performance impacts of creating and splitting snapshots in a simulated database environment, we set up both arrays to run a simulated fixed-rate database workload targeting 50K IOPS. We ran the steady state workload for five hours. At the five-hour mark, we performed snapshot operations and collected latency data from both storage solutions to show the performance impact on the workload while taking snapshots.

We unmapped and deleted volumes between testing phases 1 and 2. After deleting the volumes, we let the storage arrays sit idle so they could reclaim space, and then we restarted the process of creating volumes and mapping LUNs. Testing phases 2, 3, and 4 used the same volumes and LUNs. We did not delete and recreate the LUNs for testing phase 4. For more configuration and testing details, see the science behind this report.

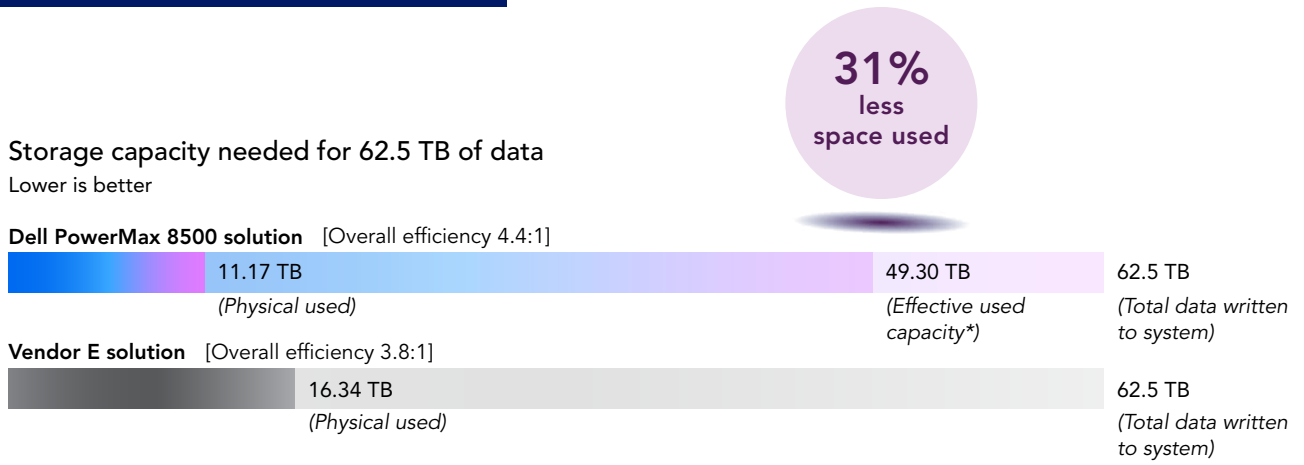
About Vdbench

Vdbench is an open-source benchmarking tool that generates input/output loads to stress storage arrays and simulate real-world workloads. It shows the maximum rate of IOPS a solution can handle, as well as the latency and bandwidth a solution delivers while processing those IOPS. For details on the workloads that we configured and used in our testing, see the science behind the report.

Store data more efficiently

With efficient compression, storage arrays offer more usable space, which can allow organizations to store more data and get more from their investment. The ability to store more data could also potentially delay a new hardware purchase.

Using inline compression, the PowerMax 8500 solution needed 11.17 TB of space to store 62.5 TB of data. The Vendor E solution also used its data reduction technology but needed 16.34 TB of space (over 5 TB more than the PowerMax solution) to store the same 62.5 TB of data. The data reduction ratio for the Dell solution was 4.4:1; the Vendor E solution offered a data reduction ratio of 3.8:1. PowerMax uses three figures to calculate its data reduction rate: total data written to the system, effective used capacity, and physical used capacity. However, Vendor E uses only the total data written to the system and the physical used capacity. Figure 1 shows the results from our data reduction testing.



**The PowerMax 8500 calculates its data reduction ratio by taking the reported effective used capacity and dividing it by the physical used capacity. The Vendor E solution calculates its data reduction ratio by dividing the total data written to system by the used physical capacity.*

Figure 1: Data reduction results after the Dell PowerMax 8500 and Vendor E storage array solutions stored 62.5 TB of data. Lower is better. Source: Principled Technologies.

The PowerMax 8500 calculates its data reduction ratio by taking the reported effective used capacity and dividing it by the physical used capacity. In our testing, those capacities were 49.3 and 11.17 TB, respectively. Effective capacity is "the amount of data stored on a storage system, plus the amount of unused formatted capacity in that system."[4] The Vendor E array calculates data reduction by dividing the amount of data written or presented to the systems by allocated physical capacity—62.5 and 16.34 TB, respectively, in our testing.

Process more transactional database operations with better response times

OLTP databases handle critical operations for many organizations, including those in the retail and financial sectors, and can affect the wait times of employees and customers. A storage array that can keep up with the demands of high-performing OLTP databases can help your business grow, while slowdowns in those databases risk frustrating delays, potentially affecting your organizational operations or bottom line.

Running a simulated OLTP workload with Vdbench, the Dell PowerMax 8500 solution processed 325,946 IOPS with 0.593 millisecond latency. The Vendor E solution processed 140K fewer IOPS with over 1 millisecond latency running the same workload. Figure 2 shows the IOPS results from that test, and Figure 3 shows the latency results.

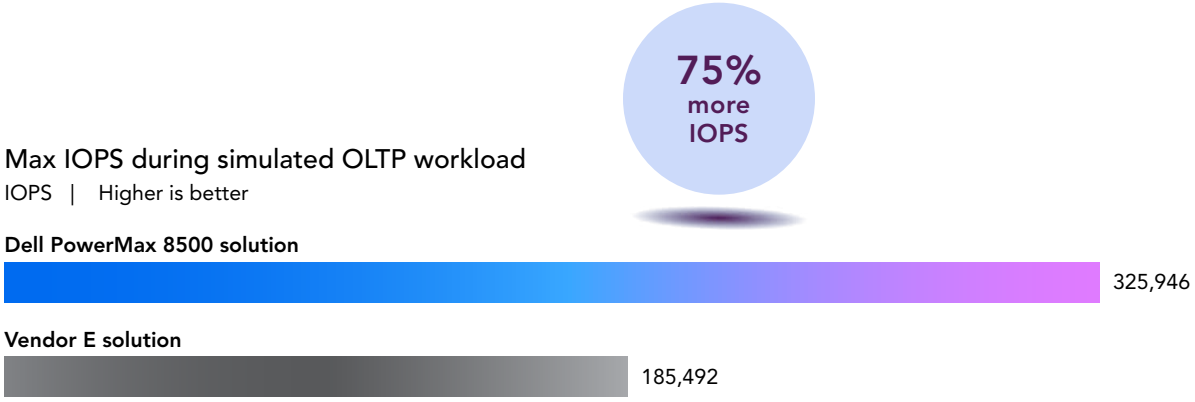


Figure 2: IOPS results for the Dell PowerMax 8500 and Vendor E storage array solutions running our simulated OLTP workload. Higher is better. Source: Principled Technologies.

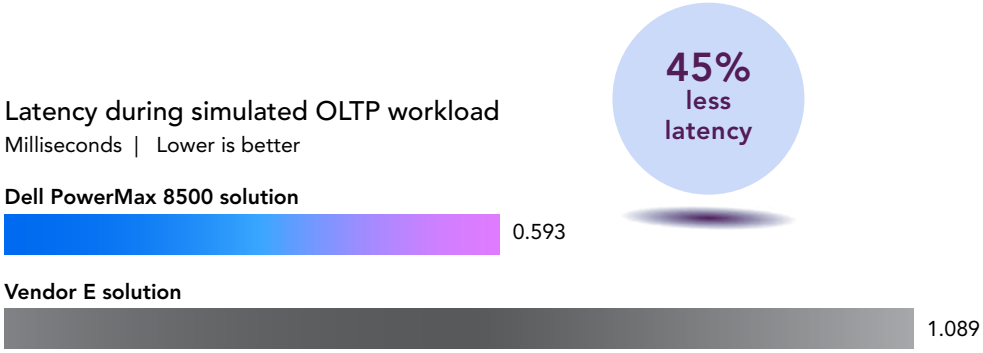


Figure 3: Latency, in milliseconds, for the Dell PowerMax 8500 and Vendor E storage array solutions running our simulated OLTP workload. Lower is better. Source: Principled Technologies.

Extract data faster to deliver analysis sooner

When it's time for stakeholders to analyze data, the output of ETL workflows is essential. Faster data access or extraction can speed the process, leading to more timely decision making—which could help businesses gain or keep a competitive edge.

We simulated the extraction phase of an ETL workflow by running a read-heavy Vdbench workload. The Dell solution achieved 80 percent more throughput than the Vendor E solution with 34 percent less latency. Figure 4 shows the throughput (in MB/s) during that workload, and Figure 5 shows the latency.

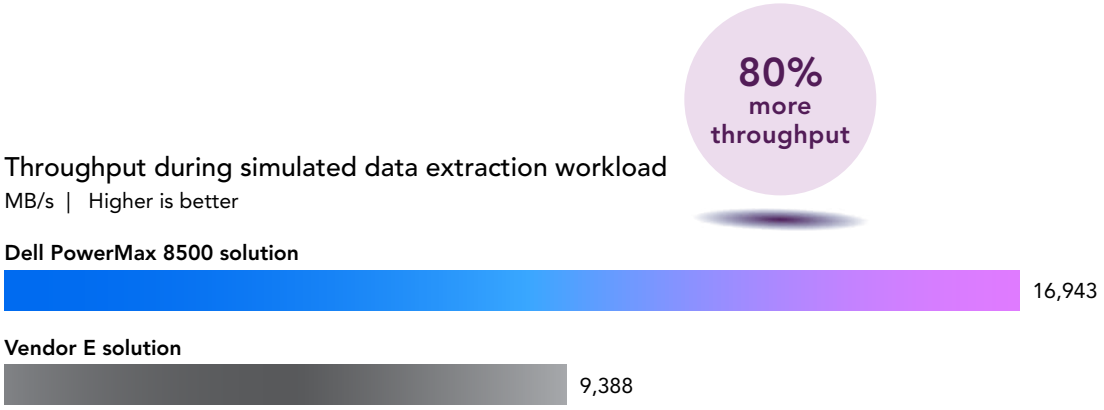


Figure 4: MB/s results for the Dell PowerMax 8500 and Vendor E storage array solutions running a simulated data extraction phase of an ETL workload. Higher is better. Source: Principled Technologies.

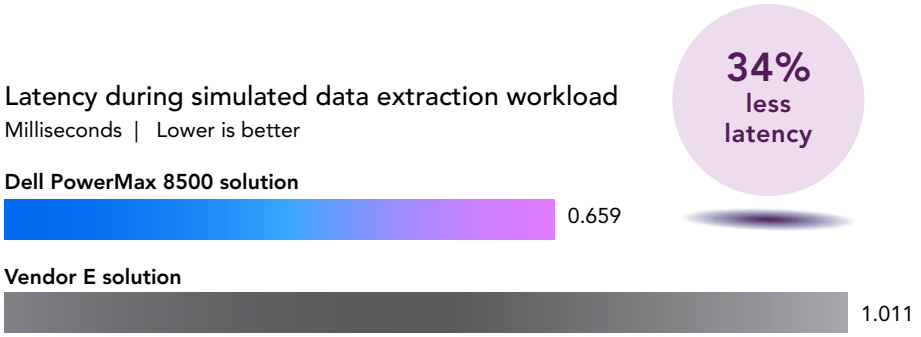


Figure 5: Latency, in milliseconds, for the Dell PowerMax 8500 and Vendor E storage array solutions running a simulated data extraction phase of an ETL workload. Lower is better. Source: Principled Technologies.

Minimize performance impacts during storage snapshot operations

Organizations that aim to keep their data secure, reduce risk, and maintain service-level agreements (SLAs) often use snapshots to back up their data regularly. Whether as part of routine workflows or for the sake of disaster recovery, efficiently capturing snapshots could mean fewer performance impacts for critical applications that require microsecond response times.

We set up both arrays that we tested to run a simulated fixed-rate database workload targeting 50K IOPS. We measured IOPS and average storage latency of both solutions during storage snapshot operations.

Taking snapshots with the Dell PowerMax solution had no negative effect on the I/O rate or storage latency, and the solution consistently delivered 50K IOPS with sub-millisecond average latencies (0.271) while taking the snapshots.

When we initiated the snapshots on the Vendor E array, the solution reduced the amount of IOPS it could support by temporarily dropping the I/O rate from 50K to around 10K and pushing storage latency to 24 milliseconds. The solution needed about 20 minutes to recover to 50K IOPS and had an average latency of 4.837 milliseconds during recovery.

Compared to the Vendor E solution average latency, the PowerMax decreased latency by 94.4 percent during the steady-state workload. Figures 6 and 7 show IOPS and latency data while capturing the snapshots.

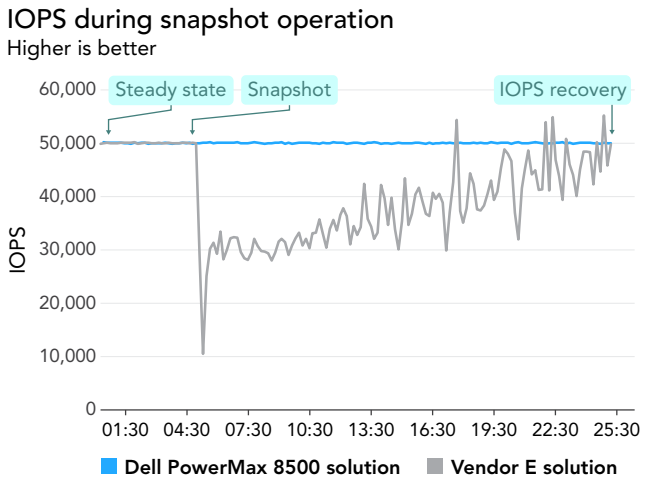


Figure 6: IOPS for the Dell PowerMax 8500 and Vendor E storage array solutions before, during, and after capturing snapshots. Source: Principled Technologies.

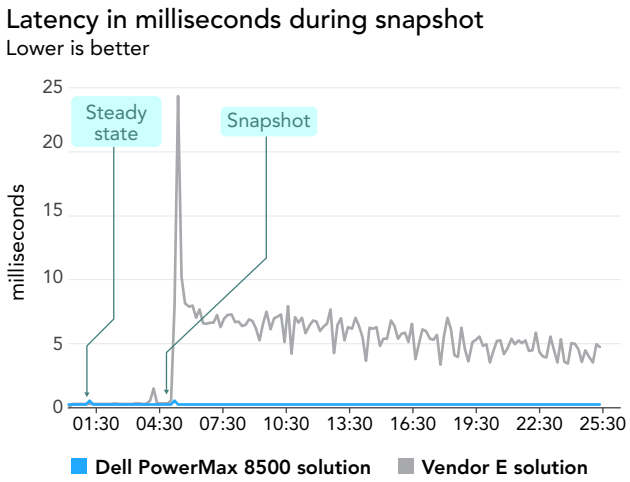


Figure 7: Average latency, in milliseconds, for the Dell PowerMax 8500 and Vendor E storage array solutions while capturing snapshots. Lower is better. Source: Principled Technologies.

Get modern security features and better manageability and usability

In addition to the data reduction and performance advantages we saw, the Dell PowerMax 8500 provided proactive health monitoring, multi-factor authentication (MFA), and deep integration with the cloud-native application Dell CloudIQ. This section presents an overview of our experiences with some management and security features from both solutions.

Multi-factor authentication (MFA)

To reduce the likelihood of unauthorized access to the system and cyberattacks, we enabled MFA to provide token-based two-factor authentication when accessing Unisphere management. MFA worked as expected in our testing, assigning randomly generated tokens required for logging into the PowerMax 8500. In contrast, the Vendor E array provided only local-based authentication and could not implement the more modern security measure, MFA.

Unisphere for PowerMax

Assessing the performance of any system can be a daily priority for storage administrators. During our testing, we managed and assessed the performance of the storage array by using the embedded, HTML5-based Unisphere for PowerMax tool. We found the information presented by the tool was easy to access, clear to understand, and contained all the necessary information to assess the health and performance of the PowerMax 8500 storage array. In comparison, the Vendor E array offered a Java-based tool for management and monitoring that we considered to be outdated and was cumbersome to use. Assessing overall system performance required multiple steps and lacked the functionality that we expected from enterprise-grade monitoring tools.

Dell CloudIQ

Additionally, the Dell PowerMax 8500 integrates with CloudIQ, a cloud-based management, monitoring, and analytics application that users can remotely access through web browsers or mobile devices at no charge. According to Dell Technologies, "As a Software-as-a-Service solution, CloudIQ delivers frequent, dynamic, nondisruptive content updates for the user." Dell also claims that CloudIQ is "built in a secure multitenant platform" to help ensure isolation for each tenant.[5] Based on our research, CloudIQ has potential advantages over the Vendor E cloud-based management solution. (Note: We did not test the capabilities of either remote management application.) Table 1 shows how the two cloud-based remote management offerings compare, based on publicly available information:

Table 1: A comparison of cloud-based remote management functionality for the two storage solutions we tested. Source: Principled Technologies.

	Dell CloudIQ	Vendor E cloud-based management solution
Proactive health reporting with system health score	☑	☒
Capacity usage monitoring	☑	☑
Performance monitoring	☑	☑
VMware® integration	☑	☒
Cybersecurity monitoring	☑	☒
Monitoring for servers, network, and data protection	☑	☒

Conclusion

In our data-driven world, storage arrays can play an important role in securing your organization's day-to-day operations and storing data for continued use and growth. While there are many enterprise-grade solutions that could meet your storage needs, they offer varied data reduction capabilities and levels of performance. In our testing, the Dell PowerMax 8500 solution delivered better data reduction rates compared to a similarly sized solution from Vendor E. It also supported better simulated OLTP database performance and simulated ETL performance than the Vendor E solution, including up to 80 percent more throughput during data extraction.

The PowerMax 8500 solution captured storage snapshots with no impact on the performance of the database workload. The Dell solution also supports Dell CloudIQ, so storage teams can closely monitor the array, analyze its usage, and watch for security threats. Choosing the Dell PowerMax 8500 solution could allow your organization to make better use of its storage and better support ecommerce and similar transactional database workloads.

1. Campbell, Mark, "What Are the Consequences of Data Loss?," accessed June 10, 2022, https://www.unitrends.com/blog/what-are-the-consequences-of-data-loss.
2. Dell Technologies, "Dell Technologies Storage Software Innovations Power New Levels of Automation, Security and Multi-Cloud Flexibility," accessed June 14, 2022, https://www.dell.com/en-us/dt/corporate/newsroom/announcements/detail-page.press-releases~usa~2022~05~03052022-dell-technologies-storage-software-innovations-power-new-levels-of-automation-security-and-multi-cloud-flexibility.htm#/filter-on/Country:en-us.
3. Dell Technologies, "Dell Technologies Storage Software Innovations Power New Levels of Automation, Security and Multi-Cloud Flexibility."
4. Storage Networking Industry Association, "SNIA Dictionary: Effective capacity," accessed July 8, 2022, https://www.snia.org/education/online-dictionary/term/effective-capacity.
5. "Dell CloudIQ: A Detailed Review," accessed June 14, 2022, https://www.delltechnologies.com/asset/nl-be/products/storage/industry-market/h15691-emc-cloudiq-overview.pdf.

Read the science behind this report at https://facts.pt/2GnqL1z ▶

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