Enable greater data reduction, storage performance, and manageability with Dell EMC PowerStore storage arrays

Dell EMC PowerStore arrays outperformed a competitor array in areas including data reduction, performance, and out-of-the-box VM deployment

Organizations face different challenges for storing and accessing data. Some need powerful arrays to maximize performance, and some want the flexibility of an infrastructure that combines both storage and compute into a single system. New all-flash, NVMe™-based Dell EMC™ PowerStore™ storage arrays help organizations meet these needs. PowerStore arrays deliver high data reduction and speed in a 2U form factor, and a hypervisor-enabled PowerStore array can internally host VMware ESXi™ VMs while also providing storage resources to external hosts.

We tested two Dell EMC PowerStore arrays against the equivalent NVMe-based array of a competitor ("Vendor A") across a range of performance and usability metrics. The Dell EMC PowerStore arrays had higher data reduction ratios, supported more input/output operations per second (IOPS), responded in less time, and provided higher bandwidth than the array from Vendor A. In addition, the hypervisor-enabled PowerStore array allowed our admins to start deploying a VM right out of the box. With Dell EMC PowerStore storage arrays, organizations can maximize storage capacity, increase storage performance, and cut management overhead time.

Up to 3x the data reduction*
Maximize storage efficiency
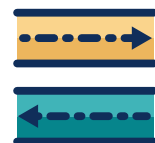
Up to 125% more bandwidth**
Minimize bottlenecks during periods of high user traffic

Up to 53% more IOPS**
Satisfy more users with faster storage performance

Up to 10.6x faster out-of-the-box VM deployment†
Save IT time and effort

Note: The standard PowerStore model is the 9000T, and the hypervisor-enabled model is the 9000X.

*Dell EMC PowerStore 9000T and 9000X vs. Vendor A array
**Dell EMC PowerStore 9000T vs. Vendor A array
†Dell EMC PowerStore 9000X vs. Vendor A array

Introducing the Dell EMC PowerStore storage arrays

In addition to outperforming the solution from Vendor A in our hands-on testing, Dell EMC PowerStore arrays can provide the following crucial features:

- **Intelligent automation** with array provisioning and cluster capacity balancing
- **Always-on data reduction** for storage efficiency
- **Block, file, and VMware vSphere® Virtual Volumes™ support** in a single array
- **Dell EMC PowerStore (hypervisor enabled) AppsON technology** for VMware-compatible application hosting
- **PowerStore Manager**, an HTML5 graphical user interface for local management, monitoring (including VMware clients), and analysis
- **NVMe-based architecture** for high levels of performance and improved response times

Dell EMC PowerStore (9000T model)

The latest storage offering from Dell EMC, the PowerStore 9000T presents an all-flash NVMe storage solution for organizations. The Intel® Xeon® Scalable processor-powered array takes up just 2U of rack space, enabling enterprises to save on data center costs by delaying the need to expand to new rooms or even buildings. Organizations can scale up and out by clustering PowerStore 9000T arrays together and augmenting storage performance and capacity without increasing the management workload.

Dell EMC hypervisor-enabled PowerStore (9000X model)

With this offering, Dell EMC has combined all-flash storage with VMware-hosted AppsON application support in a single array. Organizations could gain a completely virtualized environment ready to host VMs and applications with minimal configuration. These capabilities could decrease hardware requirements (reducing the need to buy additional servers and switches), lower capital, operational, and licensing costs, and simplify deployment and management.

Dell EMC PowerStore array

Testing performance and usability on the Dell EMC PowerStore solutions

We used default configuration settings for all testing and followed recommendations from each vendor's published best practices. Testing fell into two broad categories: performance and usability.

Performance testing

PowerStore 9000T

We used an input/output benchmarking tool called Vdbench to measure block storage performance and data reduction on the Dell EMC systems and the Vendor A array. Pages 4-6 present the results of performance testing on the Dell EMC PowerStore 9000T and the Vendor A array. For detailed results of our testing, see the science behind the report.

PowerStore 9000X

We configured the hypervisor-enabled PowerStore 9000X to host internal VMs running a MongoDB database workload while delivering storage to external hosts, and captured the database operations per second, bandwidth, and latency that it delivered (see page 7). The array from Vendor A, by contrast, cannot host internal VMs.

Usability testing

PowerStore 9000T

We measured how quickly we could provision storage to a virtualized ESXi environment on two clustered PowerStore 9000T arrays versus two clustered arrays from Vendor A.

PowerStore 9000X

We tested out-of-the-box VM deployment on the PowerStore 9000X versus the Vendor A array (which required separately configured VMware servers), capturing the time required to deploy a VM.

About the metrics we used to measure storage performance

Our Vdbench testing offers insight into storage performance by showing:

- The number of **input/output operations per second (IOPS)** a solution can handle, indicating whether it can process a high volume of user requests
- The speed at which a solution can respond (**latency**), protecting users and applications from experiencing long wait times
- The amount of information a solution can process per second (**bandwidth**), indicating how well it can process a high volume of data

Performance testing

Dell EMC PowerStore 9000T vs. Vendor A array

Gain more usable storage capacity with more efficient data reduction

Typically, storage administrators group storage resources into Logical Unit Number (LUNS), and present those to end users using a block-level storage protocol—we used Fibre Channel in our testing with the PowerStore 9000T and Vendor A array. To gauge the data reduction ability of the arrays, we provisioned 64 storage LUNs and filled them with 32 TB of data. We used Vdbench to create a 3:1 compressible and 3:1 dedupable data set.[1]

Next, we measured how well each solution deduplicated and compressed the data; that is, how much duplicate data it recognized and eliminated, and how much data it compressed. We did this by running a 256KB 100% write test on the data set. (Tests using write operations indicate how well an array's disks commit or save new information to storage, as opposed to tests using read operations, which show how well each solution's disks retrieve information.) The Dell EMC PowerStore 9000T solution offered an overall 9.6:1 data reduction ratio compared to the 3.1:1 ratio of the array from Vendor A, meaning that it offered three times the data reduction of the Vendor A array (see Figure 1). If your organization is heavily utilizing storage, you need a solution that can keep up with demands. As our testing demonstrated, the Dell EMC PowerStore 9000T array reduced data more efficiently, providing more usable storage capacity.
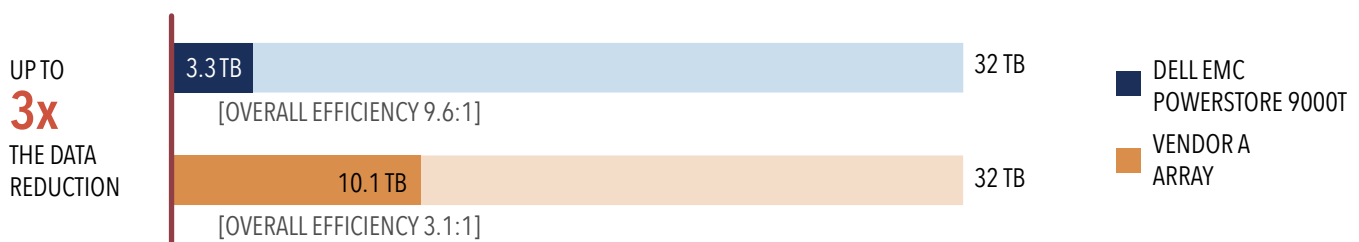
UP TO

3x

THE DATA
REDUCTION

3.3 TB
[OVERALL EFFICIENCY 9.6:1]
32 TB

10.1 TB
[OVERALL EFFICIENCY 3.1:1]
32 TB

■ DELL EMC
POWERSTORE 9000T

■ VENDOR A
ARRAY

Figure 1: Amount of storage required, after data reduction, while running a 256KB 100% write test. Lower is better. Source: Principled Technologies.

Support more IOPS

To determine each solution's ability to handle a high volume of user requests, we ran several workloads on the Dell EMC PowerStore 9000T and the array from Vendor A:

- A 4KB random 100% write workload, which indicates how quickly the arrays could commit or save data to the disks

- A 32KB random 100% read workload and a simulated Decision Support System (DSS) workload, both of which show how quickly each solution could retrieve information from their disks

- A 32KB mixed 80/20 read/write workload, representative of the online transaction processing (OLTP) database profiles that storage arrays commonly handle (e.g., processing customer orders)

The Dell EMC PowerStore 9000T outperformed the Vendor A array on all four tests, delivering up to 53 percent more IOPS (see Figure 2). On the 32KB random read workload, the Dell EMC PowerStore 9000T produced an impressive 566,145 IOPS. Taken together, this testing shows that the Dell EMC PowerStore 9000T solution outperformed the Vendor A array on an OLTP workload and also maintained superior performance on more data-intensive 100% read and 100% write workloads. Overall, these wins indicate that the Dell EMC PowerStore 9000T could better support periods of mixed-use or heavy activity than the Vendor A array.

██ DELL EMC POWERSTORE 9000T
██ VENDOR A ARRAY

566,145
370,983
218,054
142,042
130,374
86,090
294,793
218,890

IOPS ON A 100% WRITE WORKLOAD
UP TO
53%
MORE

IOPS ON A 100% READ WORKLOAD
UP TO
52%
MORE

IOPS ON A SIMULATED DSS WORKLOAD
UP TO
51%
MORE

IOPS ON AN 80/20 READ/WRITE WORKLOAD
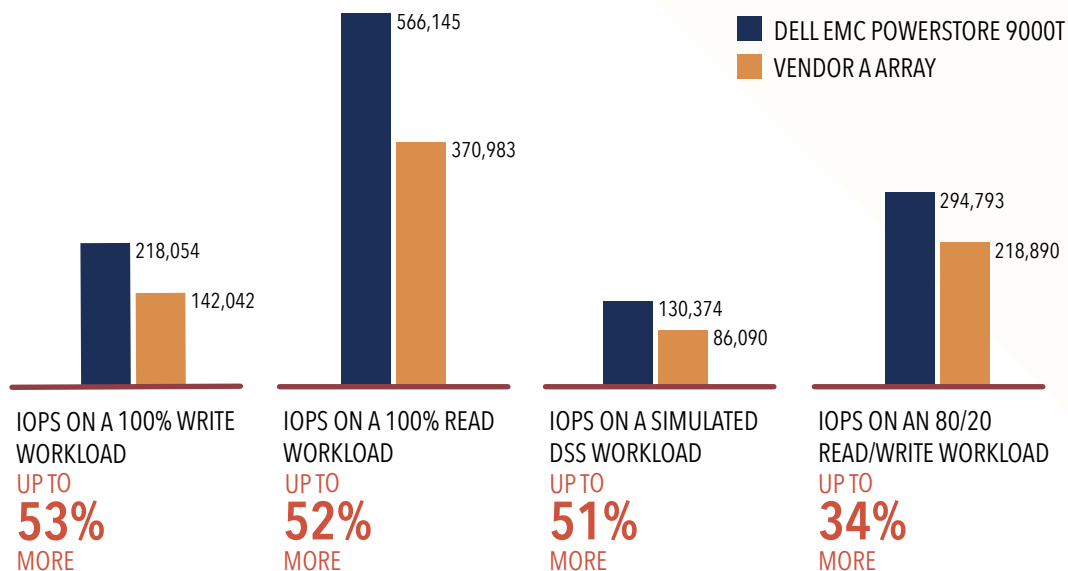UP TO
34%
MORE

Figure 2: Number of input/output operations per second (IOPS) supported while running four different workloads on the Vdbench benchmark. Higher is better. Source: Principled Technologies.

Process more data with higher bandwidth

To test how much data each array can transfer per second, we ran two Vdbench workloads with large 256KB blocks of data—one using random reads and one using sequential reads. The Dell EMC PowerStore 9000T outperformed the Vendor A array on both workloads, supporting up to 125 percent more bandwidth by processing up to 25,612 MB/s (see Figure 3). An array with high bandwidth capabilities helps process more data for large data requests such as streaming video or big data applications.

MB/s ON A RANDOM
READ WORKLOAD
UP TO
125%
MORE

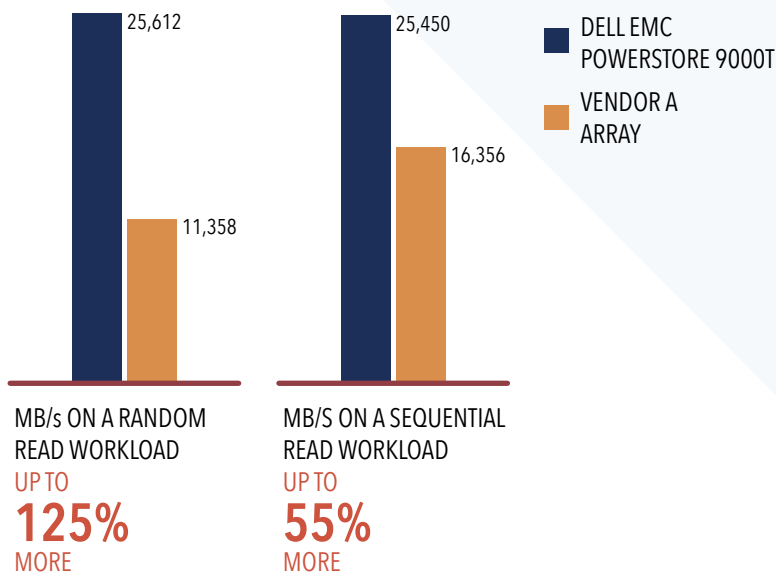MB/S ON A SEQUENTIAL
READ WORKLOAD
UP TO
55%
MORE

Figure 3: Amount of bandwidth (MB/s) provided while running two Vdbench workloads with 256KB blocks of data. Higher is better. Source: Principled Technologies.

What is the difference between random and sequential reads?

Our bandwidth testing used random and sequential read workloads, which use different access patterns for reading data. A task like streaming video requires an array to read data in a single continuous stream, a process known as sequential reading. By contrast, a user clicking different web links at random would require an array to pull data from multiple sources, a process known as random reading. Running both types of access patterns provides insight into how an array might handle a variety of routine tasks involving accessing and retrieving data.

Deliver faster response times

To measure response times, we applied a load of 360,000 32KB random read IOPS—a number indicative of a heavy storage workload. The Dell EMC PowerStore 9000T reached the target IOPS while reporting submillisecond latencies. The Vendor A array reported latencies at 1.48 milliseconds, more than double the time reported by the Dell EMC PowerStore 9000T (see Figure 4). These results indicate that the Dell EMC PowerStore 9000T could process heavy user request loads while still delivering fast response times, potentially improving application user experience.
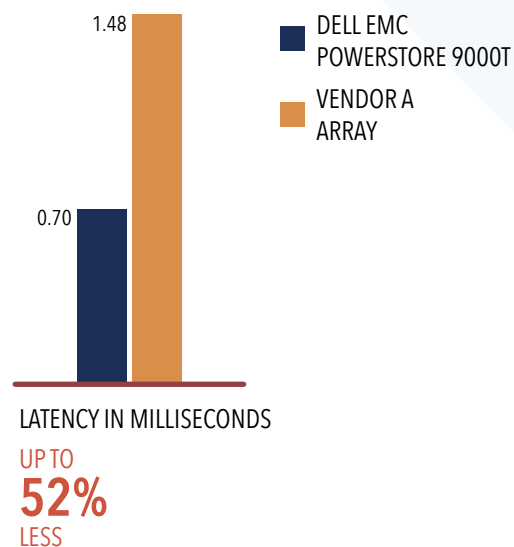

LATENCY IN MILLISECONDS
UP TO
52%
LESS

Figure 4: Response time (milliseconds) delivered while producing 360,000 IOPS. Lower is better. Source: Principled Technologies.

Dell EMC PowerStore 9000X vs. Vendor A array

Provide storage resources to external hosts while hosting database VMs internally

In addition to providing storage, the Dell EMC PowerStore 9000X has a hypervisor layer that enables users to deploy, host, and manage VMs. This unique capability reduces the need to acquire separate solutions for storage and compute, because the Dell EMC PowerStore 9000X does both. Businesses using the array from Vendor A, by contrast, wouldn't be able to do this without additional servers and Fibre Channel switches. With less hardware to manage, organizations could simplify deployment and management, potentially decreasing capital, operational, and licensing costs.

We set out to measure what the Dell EMC PowerStore 9000X could achieve while supporting two tasks simultaneously:

1. Host three internal database VMs running a Yahoo Cloud Serving Benchmark (YCSB) workload against MongoDB VMs. (YCSB is a benchmark that simulates analytics workloads, while MongoDB is a document-based database.)

2. Deliver storage to external hosts running a Vdbench workload

UP TO
208,178
OPERATIONS PER
SECOND

VENDOR A CANNOT HOST INTERNAL VMS, SO WE COULD NOT MAKE A COMPARISON

We found that the Dell EMC PowerStore 9000X supported 208,178 database operations per second while maintaining submillisecond read and update (write) database application latencies (see Figure 5). Simultaneously, the Dell EMC PowerStore 9000X supported 38 percent greater bandwidth for the external workloads (see Figure 6). This win is particularly striking when you consider that the array from Vendor A does not have the capability to host internal VMs or support internal workloads. These results demonstrate that the Dell EMC PowerStore 9000X can sustain strong storage performance while also hosting internal VMs and supporting database workloads.

READ
APPLICATION
DATABASE LATENCY (MS)
0.76

UPDATE
(WRITE) APPLICATION
DATABASE LATENCY (MS)
0.86

■ DELL EMC POWERSTORE 9000X

Figure 5: Application latency (ms) delivered by the Dell EMC PowerStore 9000X while hosting internal VMs and simultaneously delivering storage to internal hosts. Vendor A cannot host internal VMs, so we could not make a comparison. Lower is better. Source: Principled Technologies.

BANDWIDTH
(MB/S)
16,339

UP TO
38%
MORE
11,758

■ DELL EMC POWERSTORE 9000X
■ VENDOR A ARRAY

Figure 6: Amount of bandwidth (MB/s) provided to external hosts running a Vdbench workload. The PowerStore 9000T achieved these results while running Vdbench and MongoDB simultaneously. The Vendor A array was only running Vdbench. Higher is better. Source: Principled Technologies.

8U

2U

- Dell EMC PowerStore 9000X
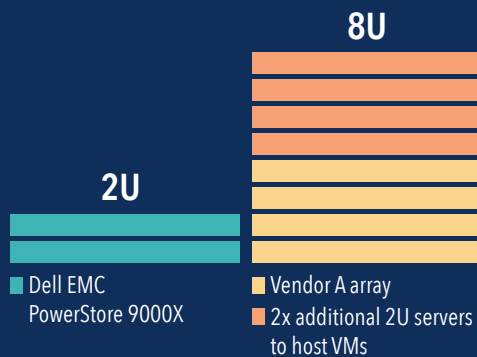- Vendor A array
- 2x additional 2U servers to host VMs

Figure 7: Amount of space taken up by storage array plus any servers necessary to provide storage resources while hosting database VMs. Source: Principled Technologies.

More versatility with a smaller data center footprint

The Dell EMC PowerStore 9000X ran compute and storage simultaneously while occupying just 2U of rack space. If businesses using a Vendor A array wanted to host VMs in a highly available (HA) environment, they would need to invest in additional servers, increasing the total footprint of the array from Vendor A to 8U (the array alone takes up 4U, and our test bed used two 2U servers). With its compact form factor, the Dell EMC PowerStore 9000X could help organizations save on data center costs by delaying the need to expand to new rooms or even buildings—all while enjoying the flexibility of an AppsON infrastructure.

Usability testing

Dell EMC PowerStore 9000T cluster vs. Vendor A array cluster

Provision storage on clustered systems in less time

Clustering storage arrays allows organizations to pool resources and reduce routine management tasks. Clustering also increases scalability: businesses can start with a small configuration and add capacity or performance as demand increases—clustering up to four arrays, in the case of the Dell EMC PowerStore 9000T. Each array in the cluster shares a single pool of compute and storage, simplifying management. The Dell EMC PowerStore 9000T also features auto-balancing, meaning that the system automatically chooses the array on which to create storage LUNs. By contrast, clustering arrays from Vendor A requires admins to manually navigate multiple layers of aggregates, volumes, and LUNs.

For ongoing management on the Dell EMC PowerStore 9000T, the Assisted Migration feature provides migration recommendations based on drive wear, array capacity, and health to better balance system resources. Migration starts automatically if the user accepts these recommendations.

Thanks to these features, a Dell EMC PowerStore 9000T cluster can streamline common tasks that are normally time-consuming, multi-step processes, such as creating storage for virtualized environments. We created clusters with two Dell EMC PowerStore 9000T arrays and two Vendor A arrays. Provisioning eight storage LUNs on the Dell EMC cluster took 1 minute and 25 seconds, compared to almost 9 minutes on the Vendor A cluster (see Figure 8).

■ DELL EMC POWERSTORE 9000T CLUSTER
■ VENDOR A ARRAY CLUSTER

🕐 1m 25s
🕐 8m 57s

STORAGE LUN PROVISIONING
TO VIRTUALIZED ESXI ENVIRONMENTS
UP TO
5.3x
FASTER

Figure 8: Time to provision eight storage LUNs on clustered systems to ESXi environments. Lower is better. Source: Principled Technologies.

Dell EMC PowerStore 9000X vs. Vendor A array

Spend less time on out-of-the-box VM deployment

Traditionally, storage systems haven't been able to support applications and serve as storage targets at the same time. The PowerStore 9000X enables both capabilities, offering a fully virtualized VMware-based environment out of the box that allows admins to provision storage to VMs with a few clicks. To save time and effort and allow admins to deploy VMs faster, the Dell EMC solution also automatically provisions Tier 1 storage to the VMware environment.

By contrast, deploying a VM on the Vendor A array required us to add physical cable connections, configure the Fibre Channel switch, map to the host, deploy storage LUNs, and create a VMware datastore. This expanded VM deployment time to 10 minutes and 21 seconds, versus just 53 seconds on the Dell EMC PowerStore 9000X—less than one tenth of the time (see Figure 9). With these time savings, admins could redirect their efforts to more strategic IT initiatives.

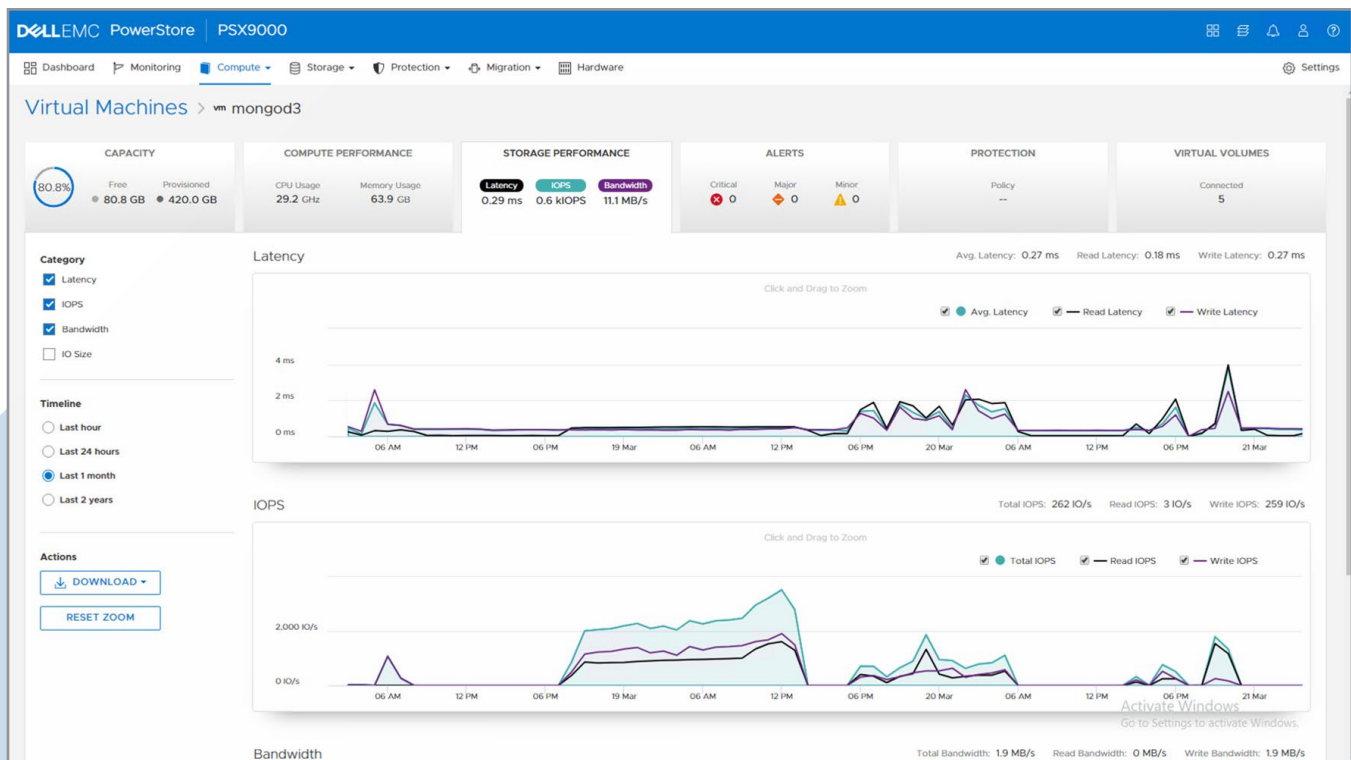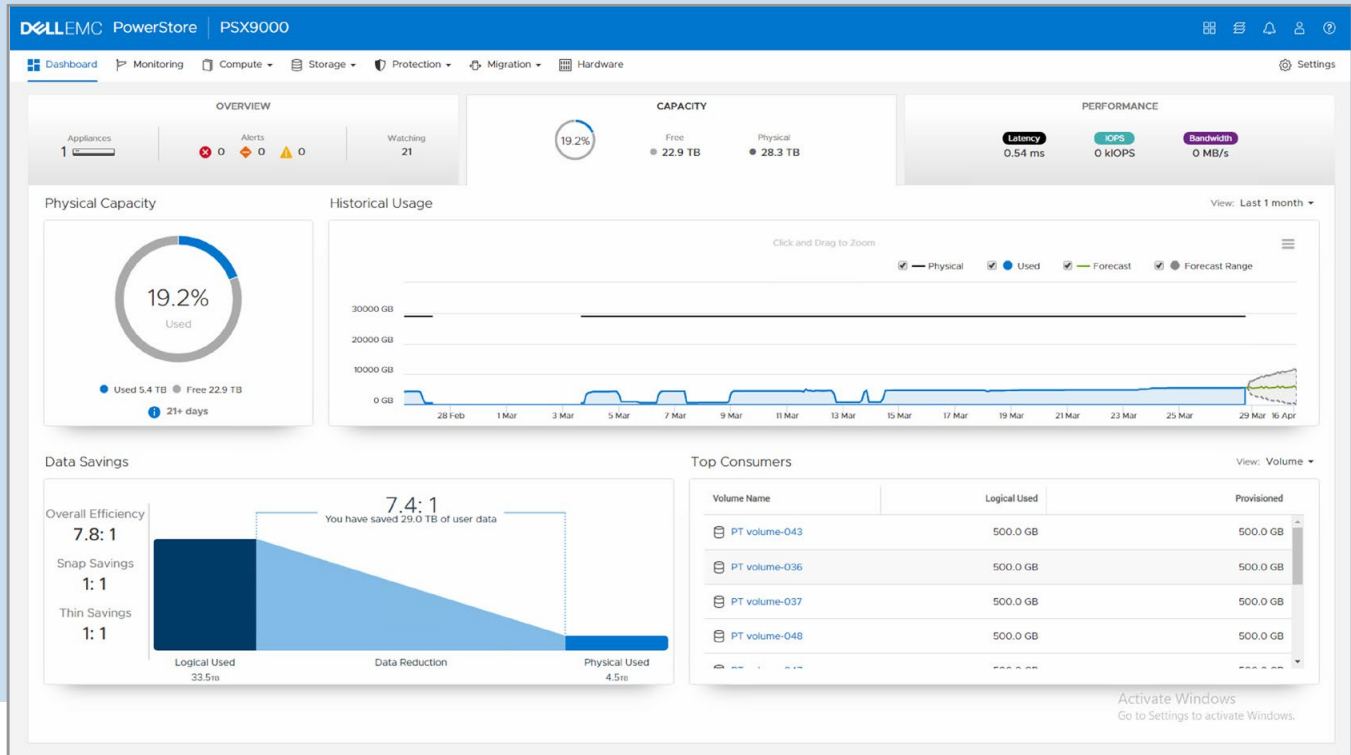■ DELL EMC POWERSTORE 9000X
■ VENDOR A ARRAY

🕐 53s
🕐 10m 21s

OUT-OF-THE-BOX
VM DEPLOYMENT
UP TO
10.6x
FASTER

Figure 9: Time to provision a VM out of the box. Lower is better. Source: Principled Technologies.

About Dell EMC PowerStore Manager

PowerStore Manager is a modern graphical user interface that enables management, monitoring, and analysis. The main dashboard screen presents a complete view of essential storage information on a single pane, while the Overview, Capacity, and Performance tabs can simplify administration. With a single click, administrators can access information such as alerts, capacity, historical usage and forecasting, data reduction rates, latency, IOPS, and bandwidth. Admins can also view and download data for anywhere from one hour to two years ago. (The below screenshots feature the GUI from the PowerStore 9000X.)
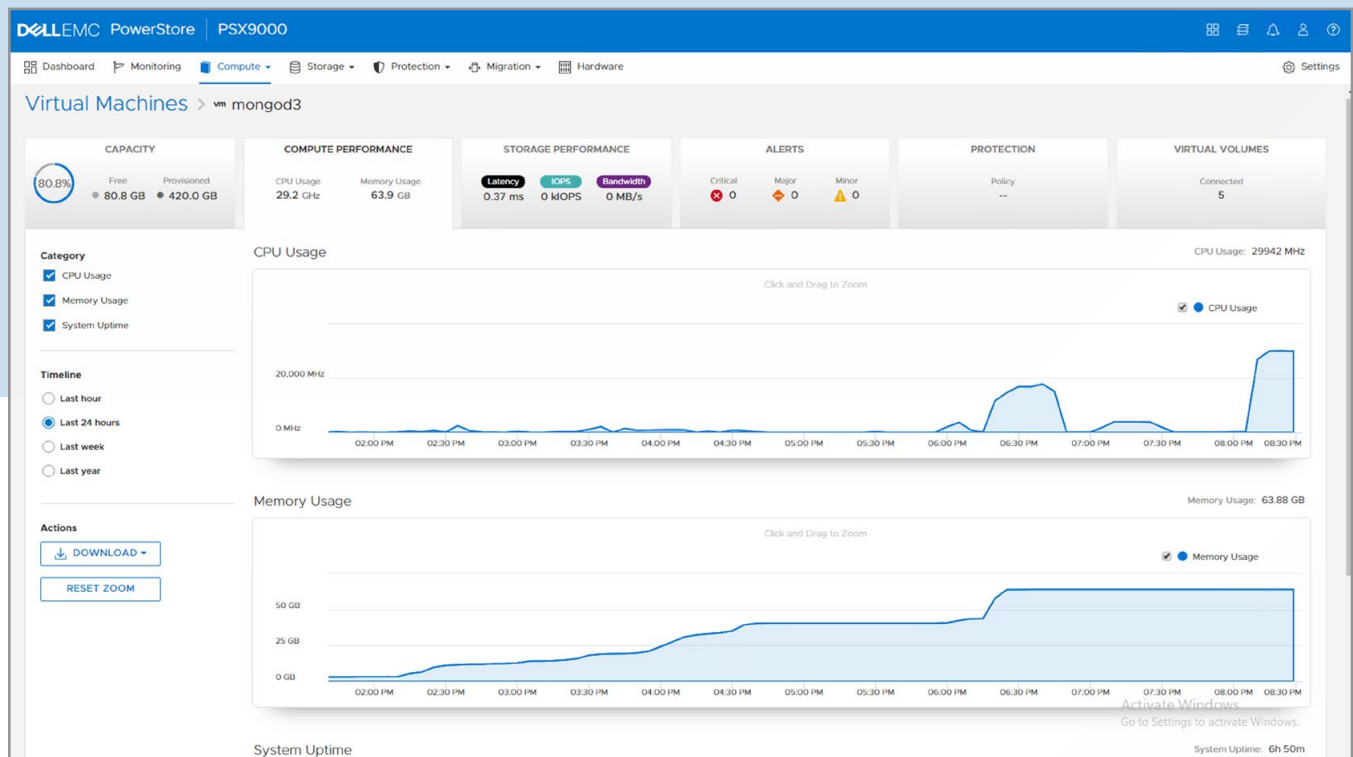

*User interface dashboard for illustrative purposes only.*

Monitoring and managing VMs from PowerStore Manager

The Dell EMC PowerStore 9000T and 9000X share some VM capabilities and integration with VMware. As we explored on page 9, the Dell EMC PowerStore 9000X supports out-of-the-box VM deployment; admins can also enable VM features on the Dell EMC PowerStore 9000T, such as Virtual Volumes (vVols), by registering a Vvols storage provider (known as the VASA provider) and connecting to VMware vCenter. Admins can then conduct monitoring and management tasks from PowerStore Manager, such as:

- Creating VM snapshots within PowerStore Manager or VMware vSphere. From within PowerStore Manager, admins can choose to create snapshots manually or use the PowerStore protection policy with a snapshot rule, employing a similar user interface to the one used for managing other storage objects such as volumes.

- Assessing virtual environment health and performance from a centralized location: Admins can access capacity, compute performance, storage performance, alerts, virtual volumes details, and historical usage on a single screen and on a per-VM basis.

- Viewing and downloading performance data from the past two years, one month, 24 hours, or one hour. (The below screenshot shows this capability on the PowerStore 9000X, but it is available on both systems.)

User interface dashboard for illustrative purposes only.
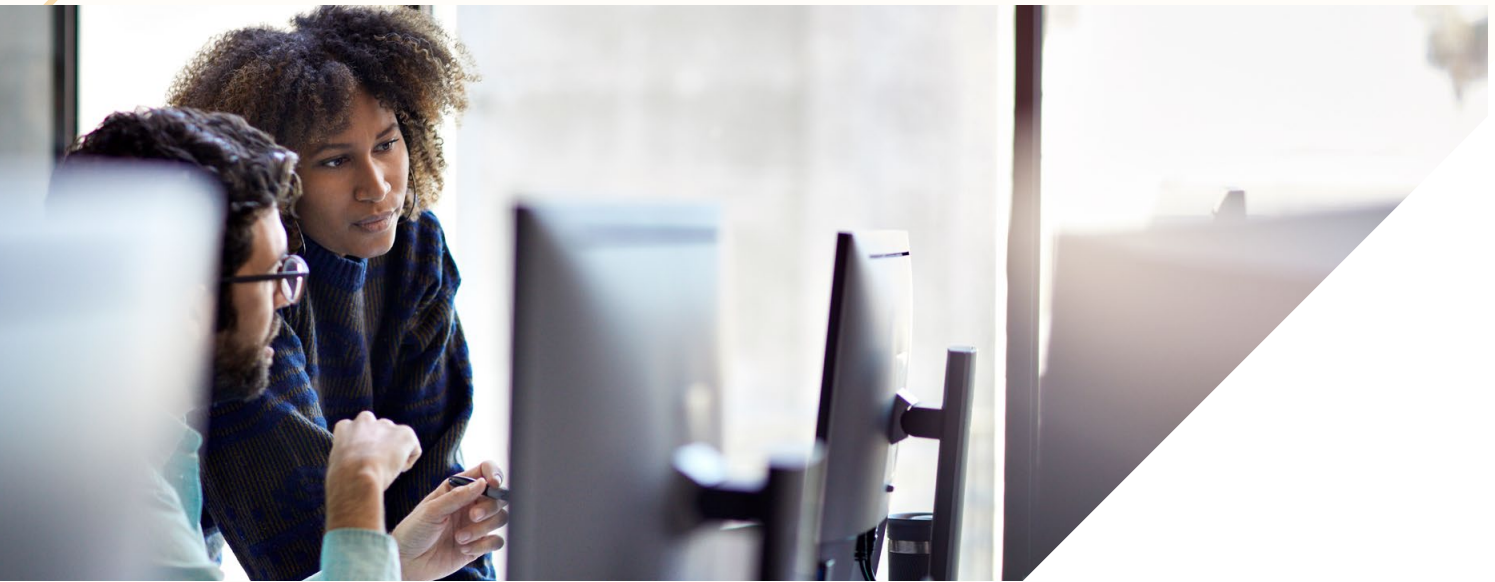
Conclusion

We tested two all-flash PowerStore arrays from Dell EMC against an array from Vendor A. In hands-on testing, we determined that both Dell EMC PowerStore arrays reduced data more efficiently and offered greater storage performance, as measured by IOPS, bandwidth, and latency. The hypervisor-enabled PowerStore array also saved time and hardware on out-of-the-box VM deployment compared to the Vendor A array. With Dell EMC PowerStore arrays, organizations could get more out of their storage.

To learn more about Dell EMC PowerStore arrays, visit DellEMC.com/PowerStore

1   Vdbench uses the LZJB compression algorithm, however Dell EMC PowerStore arrays use a different compression algorithm, which may result in different savings.

Read the science behind this report at http://facts.pt/c2r1z29 ▶

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