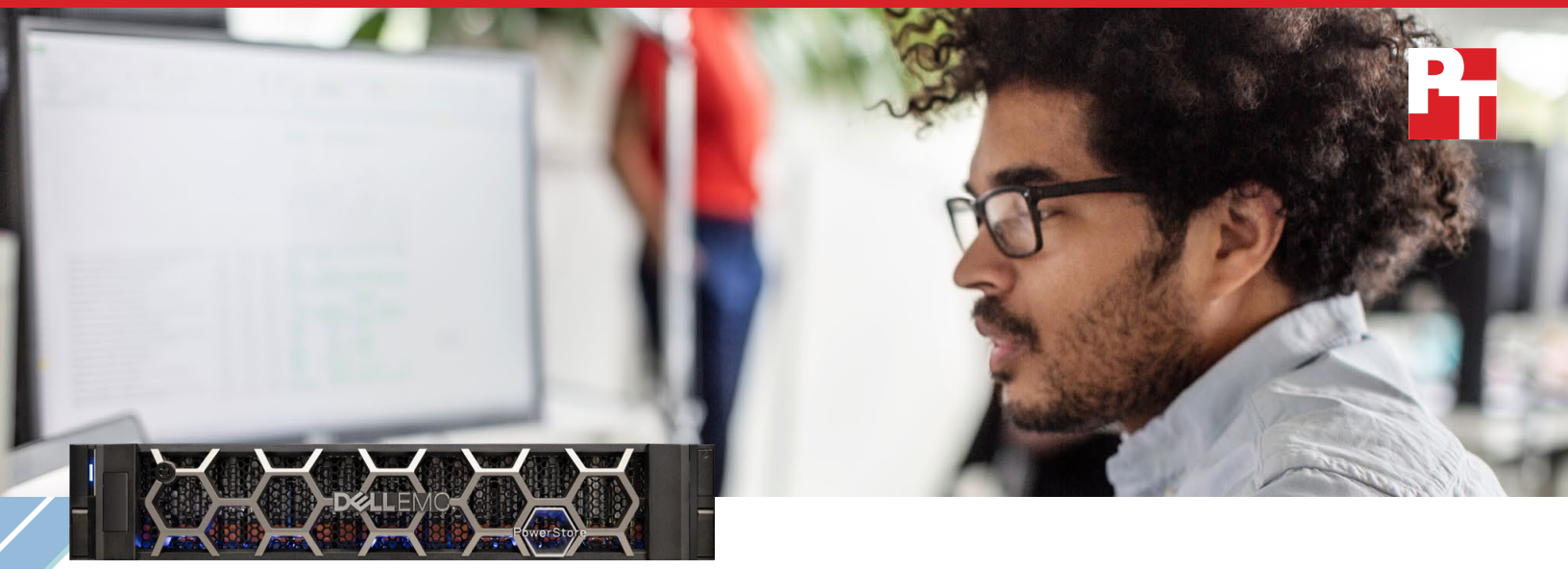


Up to 3.5x the data reduction*
Maximize storage efficiency

Up to 135% more bandwidth**
Minimize bottlenecks during periods of high user traffic

Up to 209% more IOPS**
Satisfy more users with faster storage performance

9x faster out-of-the-box VM deployment†
Save IT time and effort

Enable greater data reduction and storage performance with Dell EMC PowerStore 7000 series storage arrays

Dell EMC PowerStore 7000 series arrays outperformed the HPE Primera A670 in data reduction, performance, out-of-the-box VM deployment, and more

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 storage and compute in a single system. New all-flash, NVMe™-based Dell EMC™ PowerStore™ 7000 series 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 7000 series arrays against an HPE Primera A670 storage array across a range of performance and usability metrics. The Dell EMC PowerStore 7000 series arrays had higher data reduction ratios, supported more input/output operations per second (IOPS), had lower latency, and provided greater bandwidth than the HPE Primera A670. In addition, the hypervisor-enabled PowerStore array allowed our admins to start deploying a VM right out of the box. With Dell EMC PowerStore 7000 series storage arrays, organizations can maximize storage capacity and increase storage performance.

Note: The standard PowerStore model is the 7000T, and the hypervisor-enabled model is the 7000X.

**Dell EMC PowerStore 7000T and 7000X vs. HPE Primera A670 array*
***Dell EMC PowerStore 7000T vs. HPE Primera A670 array*
†Dell EMC PowerStore 7000X vs. HPE Primera A670 array

Introducing the Dell EMC PowerStore 7000 series storage arrays

In addition to outperforming the HPE Primera A670 in our hands-on testing, Dell EMC PowerStore 7000 series storage arrays can provide the following features:

- **Intelligent automation** with array provisioning and cluster capacity balancing
- **Always-on data reduction** for storage efficiency without compromising performance
- **Block, file, and VMware vSphere® Virtual Volumes™ support** in a single array
- **Dell EMC PowerStore (hypervisor enabled) AppsON technology** for VMware-compatible application hosting (this feature applies to the PowerStore X models only)
- **PowerStore Manager**, an HTML5 graphical user interface for local management, monitoring (including VMware environments), and analysis
- **NVMe-based architecture** for high levels of performance and improved storage response times

Dell EMC PowerStore (7000T model)

The latest storage offering from Dell EMC, the PowerStore 7000T presents a two-node, 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 7000T arrays together and augmenting storage performance and capacity without increasing the management workload.

Dell EMC hypervisor-enabled PowerStore (7000X model)

With this two-node offering, Dell EMC has combined all-flash storage with VMware-hosted AppsON application support in a single 2U 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 data reduction, performance, and usability on the Dell EMC and HPE solutions

We used default configuration settings for all testing and followed recommendations from each vendor's published best practices. Both models in the Dell EMC PowerStore 7000 series are two-node arrays; for consistency, we also used a two-node HPE Primera A670 array for our testing. Below, we outline how we tested data reduction, performance, and usability on the three arrays. For detailed results of all our testing, see the science behind the report.

Data reduction testing

Dell EMC PowerStore 7000T and 7000X vs. HPE Primera A670

We used a storage benchmarking tool called Vdbench to measure data reduction on the Dell EMC PowerStore arrays and the HPE Primera A670. Both Dell EMC PowerStore arrays achieved the same data reduction ratio.

Performance testing

Dell EMC PowerStore 7000T vs. HPE Primera A670

Using Vdbench, we measured block storage performance on both arrays under different I/O workloads. In this report, we present the results of performance testing on the Dell EMC PowerStore 7000T and HPE Primera A670.

Dell EMC PowerStore 7000X vs. HPE Primera A670

We configured the hypervisor-enabled Dell EMC PowerStore 7000X to host internal VMs running Vdbench and compared its storage performance to that of the HPE Primera A670 running Vdbench on externally hosted VMs. Next, we ran a MongoDB workload on VMs that the PowerStore 7000X hosted internally. Simultaneously, we ran a Vdbench workload on externally hosted VMs on both solutions. We captured several performance indicators:

- The IOPS that both solutions supported while running Vdbench on internally hosted VMs (on the Dell EMC PowerStore 7000X) and externally hosted VMs (on the HPE Primera A670).
- The database operations per second and database application latency that the Dell EMC PowerStore 7000X delivered while running a MongoDB workload on internally hosted VMs. Because the HPE Primera A670 lacks the capability to host VMs internally, we could not make a comparison for this test.
- The bandwidth and IOPS that both solutions supported while running Vdbench on externally hosted VMs. Note that for this and the above scenario, the Dell EMC PowerStore 7000X was simultaneously running workloads on internal and external VMs, while the HPE Primera A670 was only running a workload on externally hosted VMs.

Usability testing

Dell EMC PowerStore 7000X vs. HPE Primera A670

We tested out-of-the-box VM deployment on the PowerStore 7000X versus the HPE Primera A670 (which required separately configured VM hosts), capturing the time required to deploy a VM in a VMware environment.

Dell EMC PowerStore 7000T vs. HPE Primera A670

We measured how quickly we could access restored data on 10 storage volumes on the PowerStore 7000T versus the HPE Primera A670.

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 requests
- The speed with which a storage solution can respond (**storage latency**), minimizing the chance that users and applications will experience long wait times
- The amount of data a storage solution can process per second (**bandwidth**), indicating how well it can process a high volume of data

Data reduction testing

Dell EMC PowerStore 7000T and 7000X vs. HPE Primera A670

Gain more usable storage capacity with more efficient data reduction

Typically, storage administrators group storage resources into logical unit numbers (LUNs) and present them to end users using a block storage protocol. For all of our tests, we used the Fibre Channel storage protocol. Using Vdbench, we provisioned four 200GB LUNs and filled them with a 3:1 compressible and 2:1 dedupable 800GB 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 write test, which contained an equal number of 128KB and 256KB blocks, on the data set. The Dell EMC PowerStore 7000 series arrays offered an overall 7.1:1 data reduction ratio compared to the 2.0:1 ratio of the HPE Primera A670, meaning that the Dell arrays offered about three and a half times the data reduction of the HPE Primera A670 (see Figure 1).

If your organization is heavily utilizing storage, you need a solution that can keep up with capacity demands. As our testing demonstrated, the Dell EMC PowerStore 7000T and 7000X arrays reduced data more efficiently than the HPE Primera A670, providing more usable storage capacity.

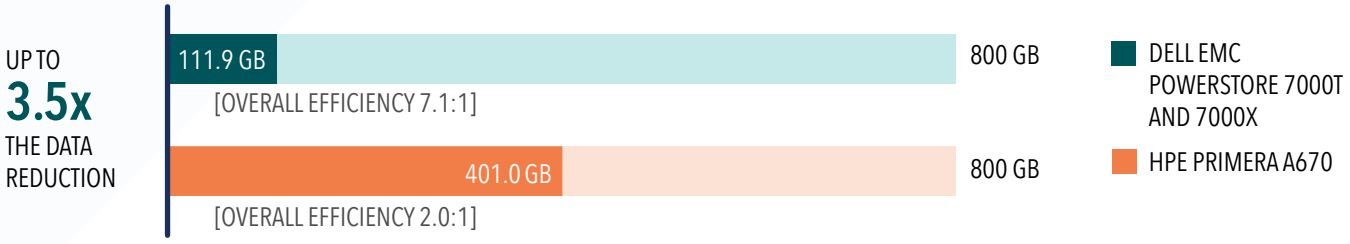


Figure 1: Amount of physical storage used, after data reduction, while running a 50% 128KB, 50% 256KB write test. Lower is better. Source: Principled Technologies.

Performance testing

Dell EMC PowerStore 7000T vs. HPE Primera A670

Support more IOPS

Storage arrays employ data reduction, a feature that cuts down on overall storage utilization by reducing incoming data in real time. On the HPE Primera A670, users must make the choice of whether to turn data reduction on (to free storage space) or off (to improve storage performance). On the Dell EMC PowerStore arrays, users do not need to make this choice, since the arrays offer always-on data reduction. We explored how enabling and disabling data reduction might affect performance on the HPE Primera A670, and how it compared to the performance of the Dell EMC PowerStore 7000T array.

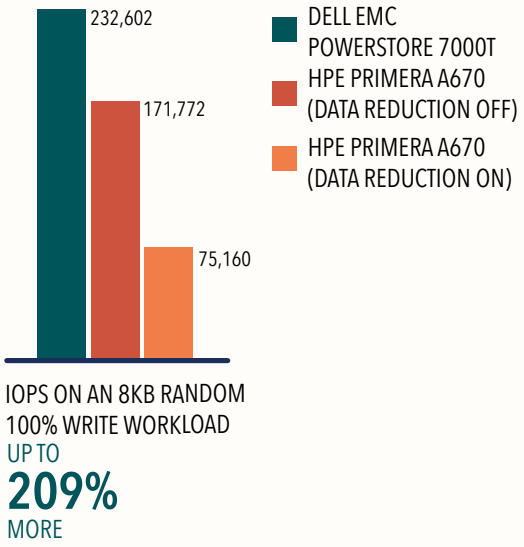


Figure 2: IOPS supported while running a Vdbench workload, with data reduction enabled and disabled on the HPE Primera A670. The data reduction feature on the Dell EMC PowerStore arrays is always on. Higher is better. Source: Principled Technologies.

First, we ran an 8KB random 100% write workload on the Dell EMC PowerStore 7000T. While using always-on data reduction, the array achieved 232,602 IOPS (see Figure 2). Next, we ran the same workload on the HPE Primera A670 with data reduction turned off. The HPE array produced 171,772 IOPS. When we enabled data reduction on the HPE Primera A670 and ran the workload again, the array produced 75,160 IOPS—less than half of what it had produced with data reduction disabled. These results indicate that businesses using the HPE array with data reduction turned on (as is standard, to free capacity) would see a 53 percent performance reduction compared to running the same workload with data reduction turned off. The HPE Primera A670 produced 35 percent fewer IOPS than the Dell EMC PowerStore 7000T with data reduction disabled—a mode that also risks the array using and running out of storage space sooner. Note that, after running this test, we enabled data reduction on the HPE Primera A670 for the remainder of our testing.

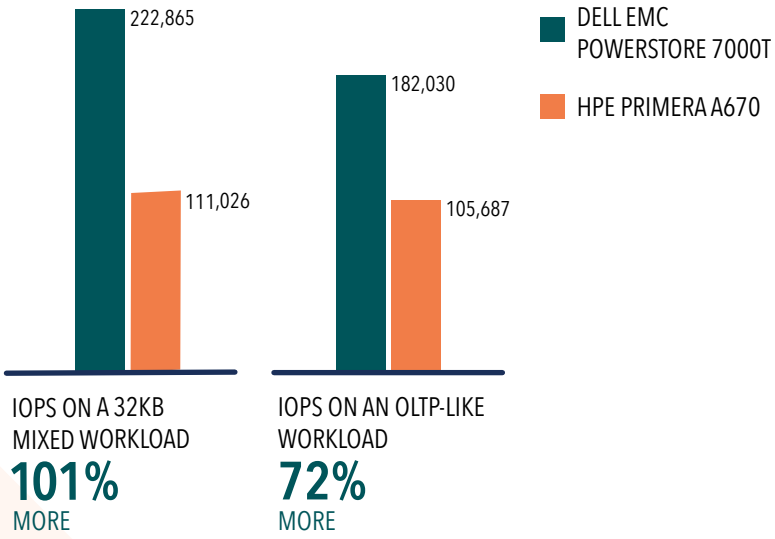


Figure 3: IOPS supported while running two different workloads using the Vdbench benchmark. Higher is better.
Source: Principled Technologies.

Next, we wanted to determine each solution's ability to handle a high volume of user requests. We ran two tests: (1) a 32KB 70/30 read/write workload, and (2) an OLTP-like mixed read/write workload, which emulates the database I/O requests a server would handle. The OLTP-like workload comprised 8KB and 128KB block sizes and a variety of random and sequential reads and writes. (For more details about the workloads we used, see "How we tested" in the science behind the report.) The Dell EMC PowerStore 7000T outperformed the HPE Primera A670 on both tests, delivering 101 percent more IOPS on the first workload and 67 percent more on the second (see Figure 3).

Process more data with higher bandwidth

To test how much data each array could process per second, we ran two Vdbench workloads with large 256KB blocks of data—one using random reads and one using sequential reads. Running both types of access patterns provides insight into how an array might handle large random and sequential block I/O. The Dell EMC PowerStore 7000T outperformed the HPE Primera A670 on both workloads, supporting up to 135 percent more bandwidth (see Figure 4). An array with high bandwidth capabilities helps process more data for large data requests such as streaming video or big data applications.

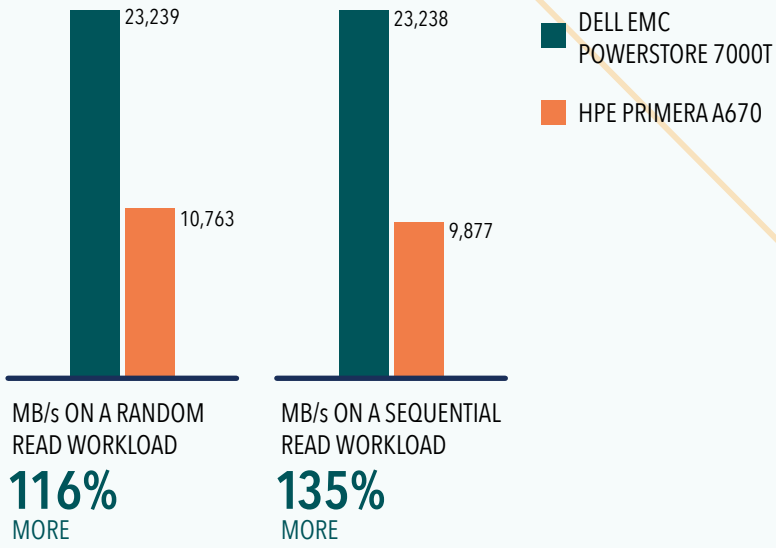


Figure 4: Bandwidth (MB/s) provided while running two Vdbench workloads with 256KB data blocks. Higher is better.
Source: Principled Technologies.

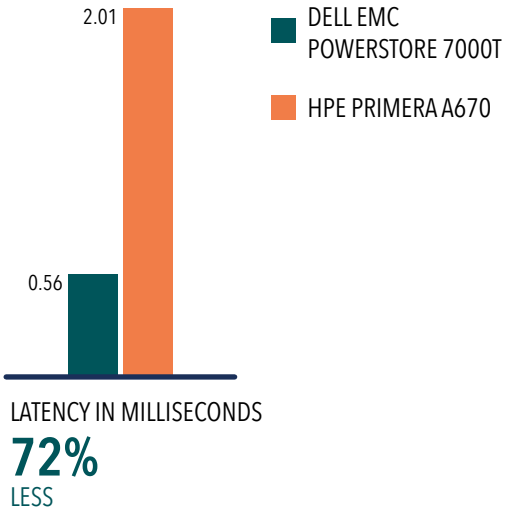


Figure 5: Response time (milliseconds) delivered while producing 107,000 IOPS. Lower is better.
Source: Principled Technologies.

Deliver faster response times

Sub-millisecond latencies under a significant I/O load indicate that your storage is performing optimally. Starting with the Dell EMC PowerStore 7000T, we configured a Vdbench I/O scenario (an OLTP-like mixed read/write workload comprised of 8KB and 128KB block sizes and a variety of read/write ratios at a fixed IOPS rate) to deliver a latency of approximately half a millisecond. We then ran the same parameters and workload on the HPE Primera A670, which delivered a latency of 2.01 milliseconds (see Figure 5). These results indicate that the Dell EMC PowerStore 7000T could process OLTP-like workloads while still delivering fast response times, potentially improving application and user experience.

Dell EMC PowerStore 7000X vs. HPE Primera A670

Host database VMs internally while providing storage resources to external hosts

In addition to providing storage, the Dell EMC PowerStore 7000X has an embedded hypervisor that enables users to deploy, host, and manage VMs on the array itself—a capability that could reduce the initial need to acquire separate servers for storage and compute.

We ran four scenarios to test various aspects of storage performance on both arrays.

- In Scenario 1, we ran a simple Vdbench simulation with internal Vdbench VMs hosted inside the Dell EMC PowerStore 7000X array, versus external Vdbench VMs hosted on two-socket servers connected to the HPE Primera A670 array.
- In Scenarios 2-4, we ran a MongoDB database workload with internal VMs hosted inside the PowerStore 7000X array as the array externally ran other Vdbench simulations simultaneously. We ran the same external Vdbench simulations on servers connected to the HPE Primera A670. Table 1 explains this scenario in more detail.

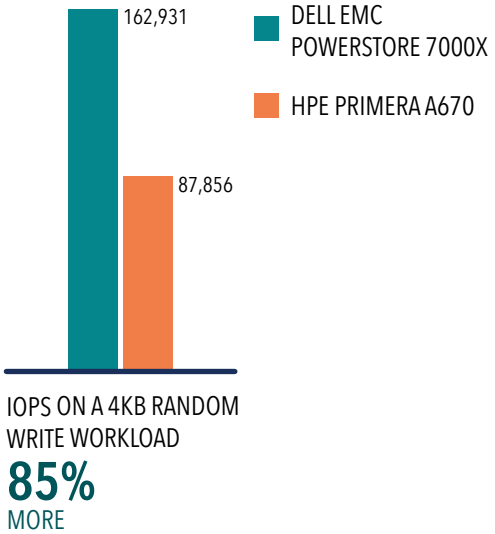


Figure 6: IOPS supported while running a Vdbench workload on VMs hosted internally (on the PowerStore 7000X) or externally (on the HPE Primera A670, which cannot host VMs internally). Higher is better. Source: Principled Technologies.

Scenario 1: Testing storage performance on the Dell EMC PowerStore 7000X (hosting Vdbench VMs internally) vs. the HPE Primera A670 (hosting Vdbench VMs externally)

When we ran a 4KB random write Vdbench workload on VMs hosted internally on the Dell EMC PowerStore 7000X and externally on the HPE Primera A670, the Dell EMC PowerStore 7000X produced 85 percent more IOPS than the HPE Primera A670 (see Figure 6).

Scenarios 2-4: Testing database performance on the Dell EMC PowerStore 7000X (simultaneously hosting database VMs internally and VMs running Vdbench simulations externally) vs. the HPE Primera A670 (hosting only VMs running Vdbench simulations externally)

For these scenarios, we ran two types of workloads simultaneously: (1) Yahoo Cloud Serving Benchmark (YCSB), which simulates analytics workloads, on internal database VMs, and (2) Vdbench on external VMs. This second workload type included two variations throughout the test window, which we describe in Table 1 as Scenarios 3 and 4.

Table 1: Testing database performance on the Dell EMC PowerStore 7000X (simultaneously hosting database VMs internally and VMs running Vdbench simulations externally) vs. the HPE Primera A670 (hosting only VMs running Vdbench simulations externally).

Scenario	Workload	Metric	VM location on the Dell EMC PowerStore 7000X	VM location on the HPE Primera A670
2: On the Dell EMC PowerStore 7000X, we ran YCSB on VMs running the document-based database MongoDB and measured database operations per second (OPS) and application latency. Simultaneously, we performed Scenarios 2 and 3.	YCSB on VMs running MongoDB	Database OPS and application latency	Internal	N/A: The HPE Primera A670 cannot host VMs internally
3: Simultaneously to performing Scenario 2, we ran a 256KB sequential read Vdbench workload on VMs that each array hosted externally, measuring bandwidth.	Vdbench	Bandwidth	External	External
4: After Scenario 3 completed, but while Scenario 2 was still running on the Dell EMC PowerStore 7000X, we ran an 8KB random write Vdbench workload on VMs that each array hosted externally, this time measuring IOPS.	Vdbench	IOPS	External	External

Scenario 2: Dell EMC PowerStore 7000X internally hosting MongoDB VMs running a YCSB workload

The Dell EMC PowerStore 7000X supported 188,320 database operations per second.

While doing so, the array maintained submillisecond read and update (write) database application latencies (see Figure 7).

188,320
DATABASE OPERATIONS PER SECOND

HPE PRIMERA A670 CANNOT HOST INTERNAL VMS, SO WE COULD NOT MAKE A COMPARISON

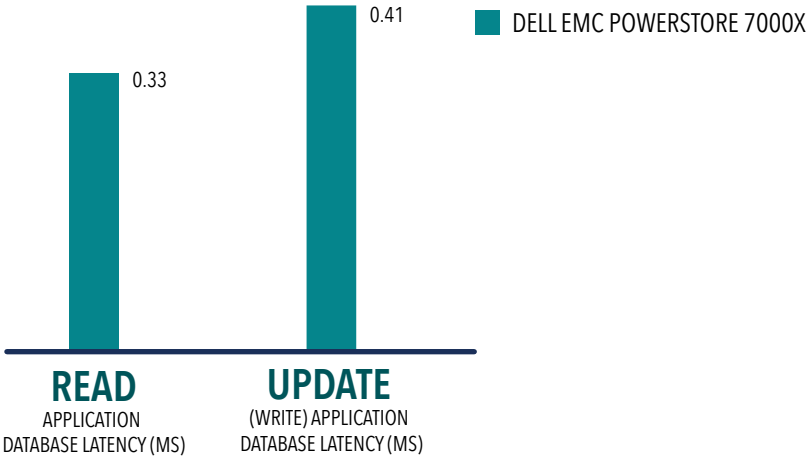
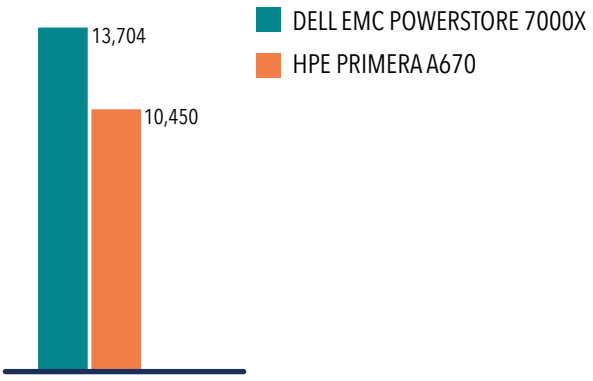


Figure 7: Database application latency (ms) delivered by the Dell EMC PowerStore 7000X while hosting internal VMs and simultaneously delivering storage to external hosts. The HPE Primera A670 cannot host internal VMs, so we could not make a comparison. Source: Principled Technologies.

Scenario 3: Dell EMC PowerStore 7000X and HPE Primera A670 externally hosting VMs running a Vdbench workload (bandwidth)

Simultaneous to running Scenario 2, the Dell EMC PowerStore 7000X also supported 31 percent greater bandwidth for the Vdbench workloads it hosted externally than the HPE Primera A670 did (see Figure 8).



31%
MORE

Figure 8: Bandwidth (MB/s) provided to external hosts running a Vdbench workload. The PowerStore 7000X achieved these results while running Vdbench and MongoDB simultaneously. The HPE Primera A670 was running only Vdbench. Higher is better. Source: Principled Technologies.

Scenario 4: Dell EMC PowerStore 7000X and HPE Primera A670 externally hosting VMs running a Vdbench workload (IOPS)

In addition to providing greater bandwidth, the Dell EMC PowerStore 7000X produced 65 percent more IOPS than the HPE Primera A670 (see Figure 9), even as it was simultaneously hosting MongoDB VMs internally in Scenario 2.

The wins in Scenarios 2-4 are particularly striking when you consider that the HPE Primera A670 lacks the capability to host internal VMs and support internal workloads. Even with applications consuming internal compute and storage resources on the Dell EMC PowerStore 7000X, the performance this Dell EMC array delivered to externally based VMs was not just adequate, but greater than that of the HPE array.

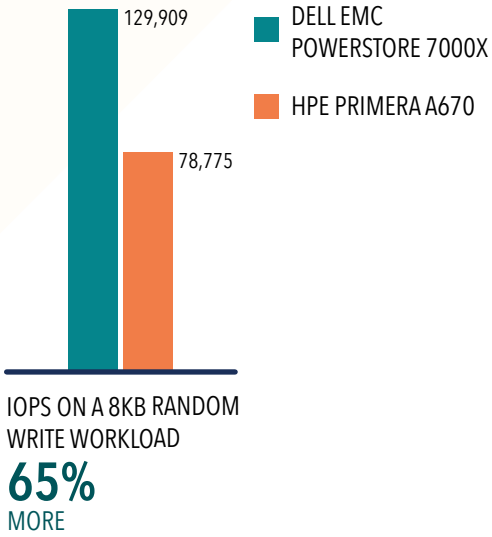


Figure 9: IOPS provided to external hosts running a Vdbench workload. The PowerStore 7000X achieved these results while running Vdbench and MongoDB simultaneously. The HPE Primera A670 was running only Vdbench. Higher is better. Source: Principled Technologies.

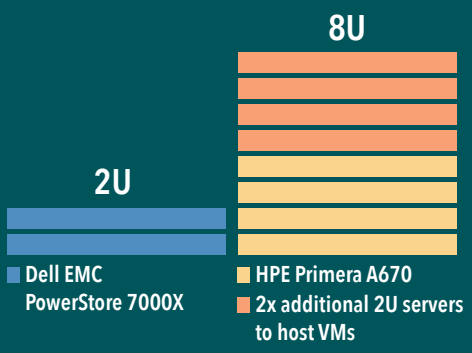


Figure 10: Amount of space taken up by storage array plus any servers necessary to provide storage resources while hosting database VMs. Lower is better. Source: Principled Technologies.

Greater versatility with a smaller data center footprint

The Dell EMC PowerStore 7000X ran compute and storage simultaneously while occupying just 2U of rack space. If businesses using the HPE Primera A670 wanted to host VMs in a highly available (HA) environment, they would need to purchase additional servers, increasing the total footprint of the HPE Primera A670 array to 8U (the two-node array takes up 4U, and our testbed used two 2U servers). With its compact form factor, the Dell EMC PowerStore 7000X could help organizations save on data center costs by delaying the need to expand—all while enjoying the flexibility of an AppsON infrastructure.

Usability testing

Dell EMC PowerStore 7000X vs. HPE Primera A670 array

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

Traditionally, storage systems haven't been able to support embedded virtual machines and serve as storage targets at the same time. The Dell EMC PowerStore 7000X offers a virtualized VMware-based environment out of the box that allows admins to provision storage to VMs residing on the array itself with a few clicks. The Dell EMC PowerStore array also automatically provisions Tier 1 storage to the embedded VMware environment.

Deploying a VM that could access the HPE Primera A670 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 8 minutes and 15 seconds, versus 53 seconds on the Dell EMC PowerStore 7000X (see Figure 11).

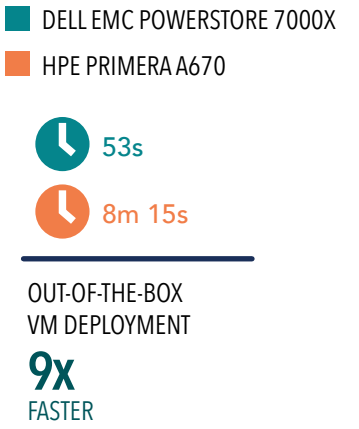


Figure 11: Time to provision a VM out of the box (minutes and seconds). Lower is better. Source: Principled Technologies.

Dell EMC PowerStore 7000T vs. HPE Primera A670

Access snapshot restore data faster

Taking snapshots of storage LUNs is a common task for storage administrators. Depending on the needs and policies of their data centers, admins might be taking snapshots on a weekly, daily, or even hourly basis. When data corruption or loss occurs, the admins can then use the snapshots they have taken to restore data to the system. Businesses typically deploy and manage large numbers of LUNs—making these snapshot restores a potentially time-consuming task.

We tested how long the Dell EMC PowerStore 7000T and HPE Primera A670 took to conduct a snapshot restore of 10 LUNs mounted as raw device mappings (RDM) onto a single VM. The Dell EMC PowerStore 7000T accomplished this task in a little over a minute, requiring just 16 steps. The HPE Primera A670 array, by contrast, required administrators to un-export the volumes from the application VM and host.[2] It took over 20 minutes (see Figure 13) and 31 steps to complete this task. For more details about our testing, see the science behind the report. With faster access to snapshot restore data, admins could get operations up and running sooner.

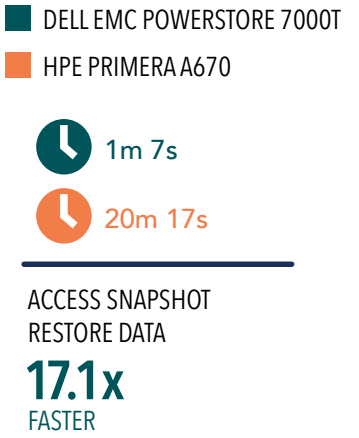


Figure 12: Time to access snapshot restore data (minutes and seconds). Lower is better. Source: Principled Technologies.

Conclusion

We tested two all-flash Dell EMC PowerStore 7000 series arrays against an HPE Primera A670 array. In hands-on testing, both Dell EMC PowerStore 7000 series 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 HPE Primera A670. With Dell EMC PowerStore 7000 series 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. We set the deduplication unit for the HPE Primera A670 to 16 KB to follow the best practices from HPE found here: https://h20195.www2.hpe.com/v2/getdocument.aspx?docname=a50000209enw. We set the deduplication unit for the Dell EMC PowerStore arrays to 4 KB.

2 HPE, "HPE SSMC 3.6 User Guide1SSMC," accessed July 10, 2020, https://support.hpe.com/hpesc/public/docDisplay?docLocale=en_US&docId=emr_na-a00085217en_us.

Read the science behind this report at http://facts.pt/7nslqfq ►

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