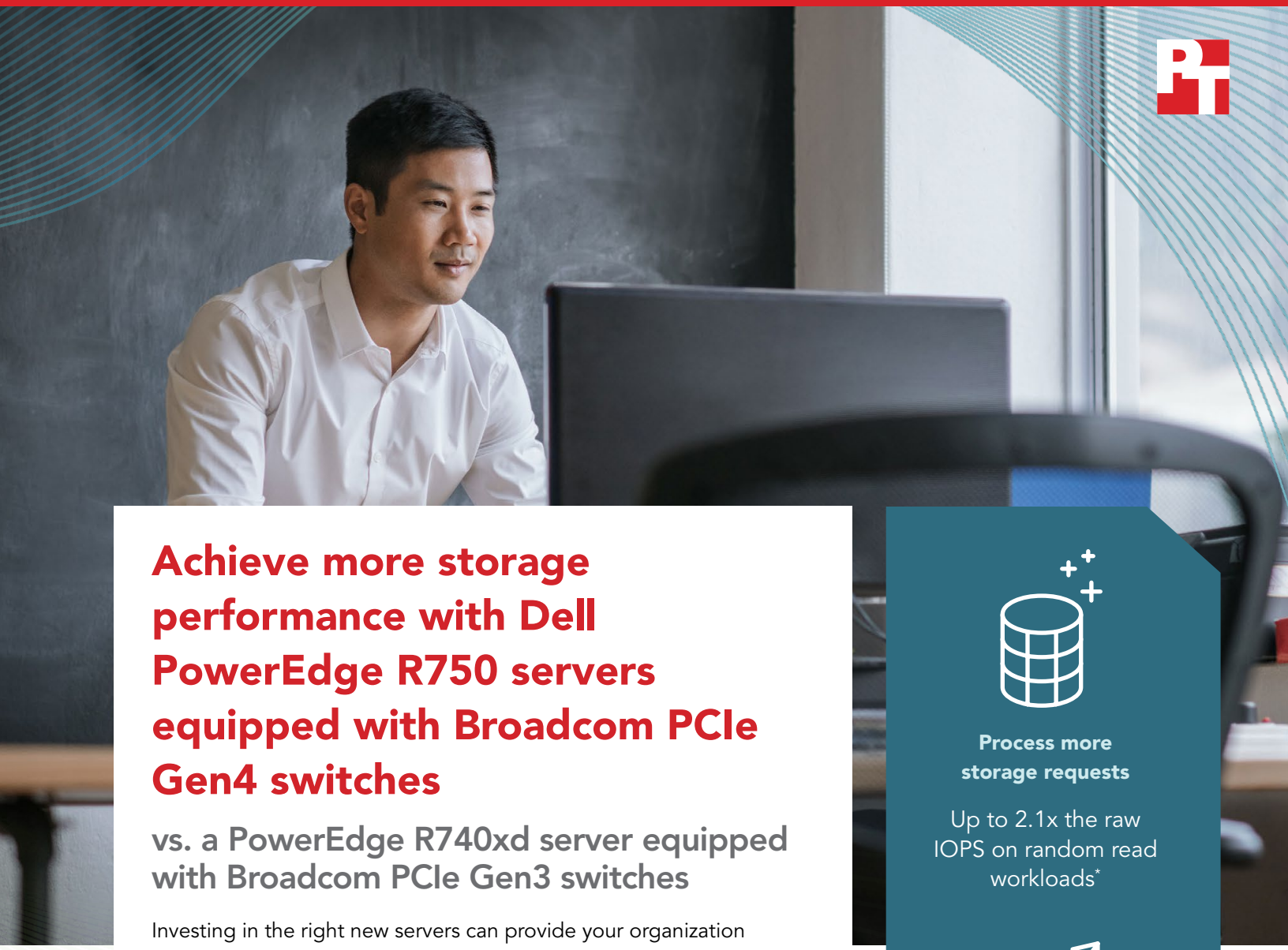


Achieve more storage performance with Dell PowerEdge R750 servers equipped with Broadcom PCIe Gen4 switches

vs. a PowerEdge R740xd server equipped with Broadcom PCIe Gen3 switches

Investing in the right new servers can provide your organization with the resources it needs to grow business and keep customers happy. The Dell PowerEdge™ R750 server comes equipped with the Broadcom PCIe® Gen 4.0 ExpressFabric Platform, which delivers latest-gen features and benefits that have the potential to help you accelerate data transfer speeds.

To understand the data transfer speed advantages of the 15G Dell PowerEdge R750 server with PCIe Gen4 switches, we compared its input/output operations per second (IOPS) and throughput to those of a previous-gen Dell PowerEdge R740xd server with Broadcom PCIe Gen3 switches.

In our tests, the Dell PowerEdge R750 server with PCIe Gen4 switches processed over 6.5M more random read IOPS and sustained over twice the gibibytes per second (GiB/s) on a 1MB sequential read workload compared to a previous-generation PowerEdge R740xd server with PCIe Gen3 switches.

Process more storage requests

Up to 2.1x the raw IOPS on random read workloads*

Sustain more concurrent throughput

Up to 2.2x the GiB/s on sequential read workloads*

Up to 1.9x the GiB/s on sequential write workloads*

*compared to a PowerEdge R740xd server with Broadcom PCIe Gen3 switches

About the Dell PowerEdge R750 server

The Dell PowerEdge R750 is a full-featured, general purpose 2U rack server powered by 3rd Gen Intel® Xeon® Scalable processors. According to Dell, the PowerEdge R750 is purpose-built to optimize application performance and acceleration with PCIe Gen 4.0 compatibility, eight channels of memory per CPU, and up to 24 NVMe™ drives. It also includes "improved air-cooling features and optional Direct Liquid Cooling to support increasing power and thermal requirements."[1]

About Broadcom PCIe Gen4 technology in Dell PowerEdge servers

According to Dell, the new PEX88000 PCIe Gen 4.0 series of switches on the motherboard of new Dell PowerEdge R750 servers "allow customers to build systems from simple PCIe connectivity inside the box to high performance, low latency, scalable, cost-effective PCIe fabrics for composable hyper-scale compute systems."[2]

How we tested

We compared the server and storage switch performance of a Dell PowerEdge R750 equipped with the new Dell PEX88000 series switch, which is a Broadcom PCIe Gen4 switched topology storage adapter, to that of a Dell PowerEdge R740xd, equipped with a Broadcom PCIe Gen3 switch (Dell PEX 9733). Both solutions were dual-processor, and each processor controlled a single switch. To measure each solution's block storage performance, we captured Flexible input/output (FIO) benchmark performance metrics, which offer insight into server and storage adapter performance by showing:

- The number of IOPS a solution can handle, indicating whether it can process a high volume of storage requests at once.
- The amount of information (in GiB) a solution can process per second (throughput), indicating how well it can process a high volume of data.

We tested with 8, 12, and 24 NVMe drives, evenly splitting the drives between the switches—and we used the NVMe Command Line Interface (NVMe-CLI) software to manage interrupts on the NVMe SSDs on the PowerEdge R750.

To make sure that the performance differences we note on the following pages were the result of the PCIe switches and not a bottleneck on the drives, we performed single drive tests to validate performance and calculated the theoretical maximum performance NVMe drives could deliver (NVMe max) by multiplying these numbers by 8, 12, and 24. If the performance was less than the calculated maximum for the number of drives, then we could infer that the drives were not the bottleneck.

We used the BIOS to limit the available cores per processor and measure scalability. We tested with 8, 16, 36 (2 x 18 core CPUs on the R740xd), and 56 (2 x 28 core CPUs on the R750). If performance improved as we added cores, we knew that the processor was limiting performance. If there was no difference in performance as we added cores, that told us that the processor was not limiting performance.

To show how much data each server solution could process per second on the above-mentioned drive and core configurations, we ran a FIO workload with small blocks (4 KB) of data—once using random reads and again using random writes. These are our IOPS results. Then, we repeated the process on large blocks of data (1 MB)—once using sequential reads and again using sequential writes. These are our GiB/s results.

For detailed system configuration information, benchmark parameters, and a step-by-step testing methodology, see the science behind the report.

How upgrading to 15G Dell PowerEdge servers can help your business

The world is more connected and data-driven than ever before. And legacy infrastructure can have a hard time keeping up in this new and exciting digital territory. 15G Dell PowerEdge servers with NVMe have the potential to help your company keep pace with evolving demands. The PCIe 4.0 capabilities in the Dell PowerEdge R750 server we tested double the throughput rate per lane from 8GT/s to 16GT/s over previous-generation 3.0 capabilities.[3]

Some estimates forecast that worldwide retail commerce sales are estimated "to grow by 50 percent over the next four years, reaching about 7.4 trillion dollars by 2025."[4] In this evolving landscape, the speed at which your infrastructure responds to queries can make the difference between discarded shopping carts and successful sales.

The need to constantly improve the customer experience is driving innovation and change in the financial market as well. PwC reports that 63 percent of insurance company CEOs think Internet of things (IoT) is important in their business strategy. And Tipalti predicts that AI will power 95 percent of all customer interactions in the next decade.[5]

Additionally, the global edge computing market size for "industries relying on IoT devices, sensors through edge nodes, devices, and localized data centers […] telehealth services […] autonomous vehicles and connected car infrastructure […]" is projected to reach $55,930 million by 2028.[6] The PCIe 4.0 capabilities (doubled bandwidth per lane) in the Dell PowerEdge R750 server can enable these industries to handle more or heavier traffic from the devices already present.

What is the difference between random and sequential workloads?

Our FIO benchmark testing incorporated random and sequential workloads, which use different patterns for accessing and storing data. For example, a user who browses multiple web pages in an online store before making a purchase represents a read-heavy random workload because the application may have to pull data from multiple drives. By contrast, streaming video necessitates that a server read that data sequentially in a single continuous stream. The same rule applies to storing data. Running both types of workloads provides insight into how the server solution handles the access, retrieval, and saving of data.

Performance and scalability

Running 4KB random read and write workloads as well as 1MB sequential read and write workloads provides an overarching view of how each solution handles the transfer of different data types and sizes.

To determine each solution's scalability, we also gathered 8, 16, and 36 (plus 56 for the PowerEdge R750) core performance metrics for both server solutions in these three NVMe drive configurations.

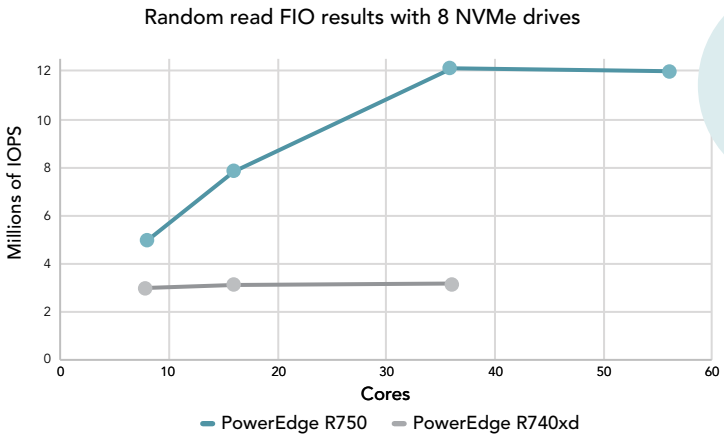
We found that the Dell PowerEdge R750 server with PCIe Gen4 switches processed significantly more storage requests and sustained more concurrent throughput both to and from storage than the Dell PowerEdge R740xd server with PCIe Gen3 switches.

Process more outgoing storage requests

Up to 2.1x the raw IOPS

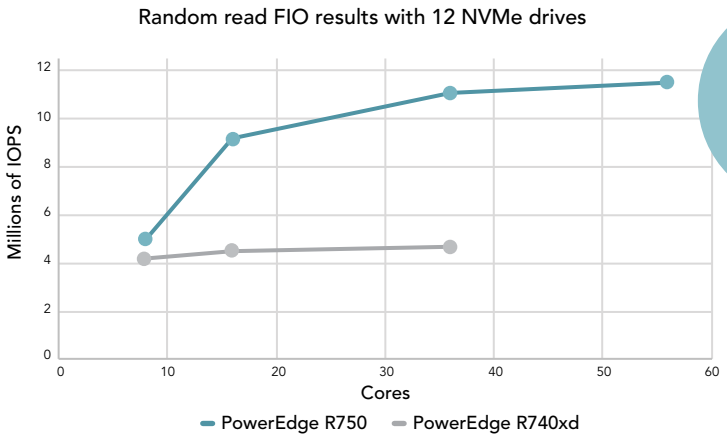
Random read testing results

Based on the raw IOPS output we saw in FIO benchmark testing, upgrading from previous-generation Dell PowerEdge R740xd servers to the latest-generation Dell PowerEdge R750 servers could help your organization expand its user base or deliver performance gains for I/O-intensive applications.



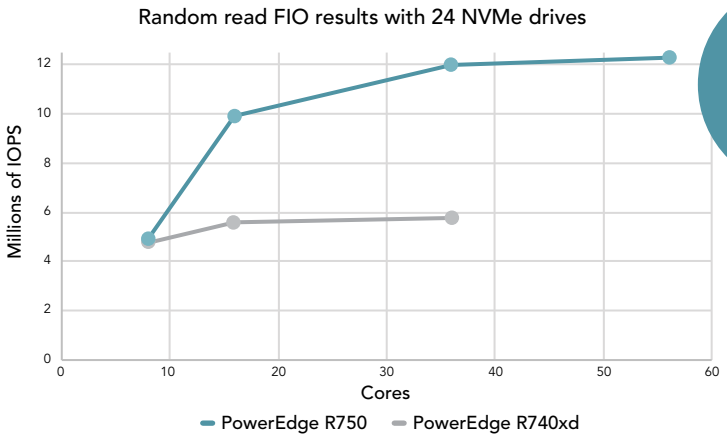
Up to 12 million IOPS with 8 drives

Figure 1: Random read FIO benchmark results with 8 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 11.4 million IOPS with 12 drives

Figure 2: Random read FIO benchmark results with 12 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 12.3 million IOPS with 24 drives

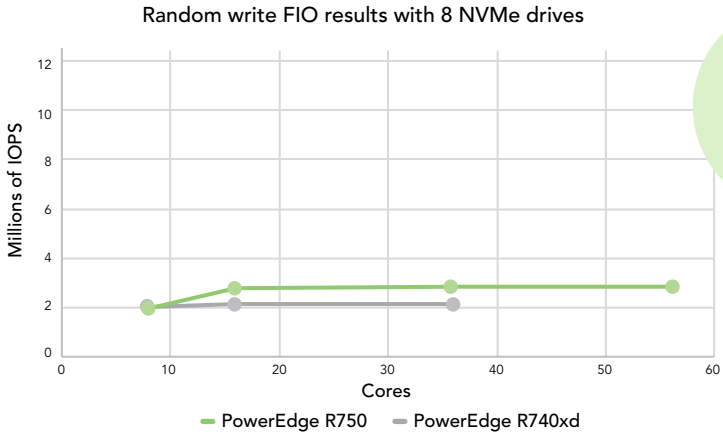
Figure 3: Random read FIO benchmark results with 24 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.

Random write testing results

In the random write comparison, we found that the NVMe drives, not the Broadcom switch or processors, were a bottleneck. While adding cores slightly increased performance across the board, both solutions topped out with IOPS numbers that were similar to those we predicted based on our NVMe max calculations. For random write testing results, see the science behind the report.

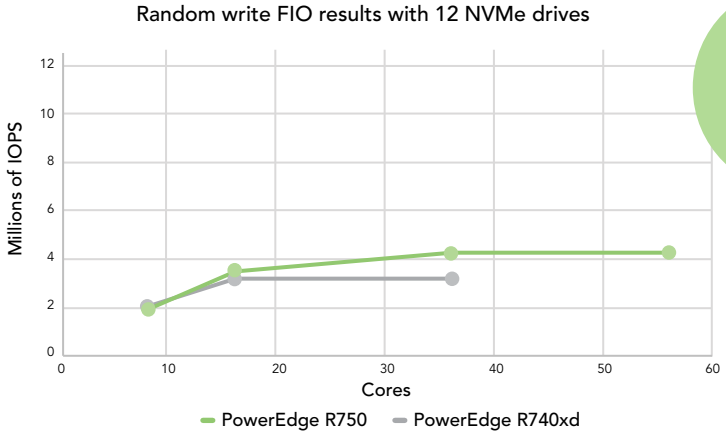
Process more incoming storage requests

Up to 1.1x the raw IOPS



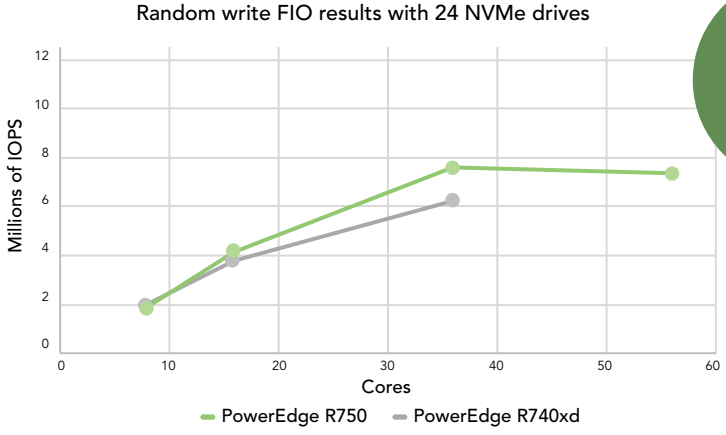
Up to 2.8 million IOPS with 8 drives

Figure 4: Random write FIO benchmark results with 8 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 4.2 million IOPS with 12 drives

Figure 5: Random write FIO benchmark results with 12 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 7.3 million IOPS with 24 drives

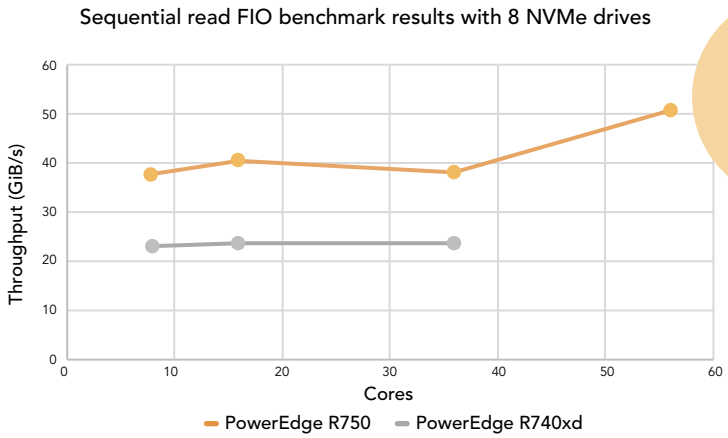
Figure 6: Random write FIO benchmark results with 24 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.

Sequential read testing results

The higher volume of outgoing large blocks of data (1 MB) processed by the Dell PowerEdge R750 solution could benefit applications that stream video, allow users to import large amounts of data in less time, and enable employees to access large files more quickly.

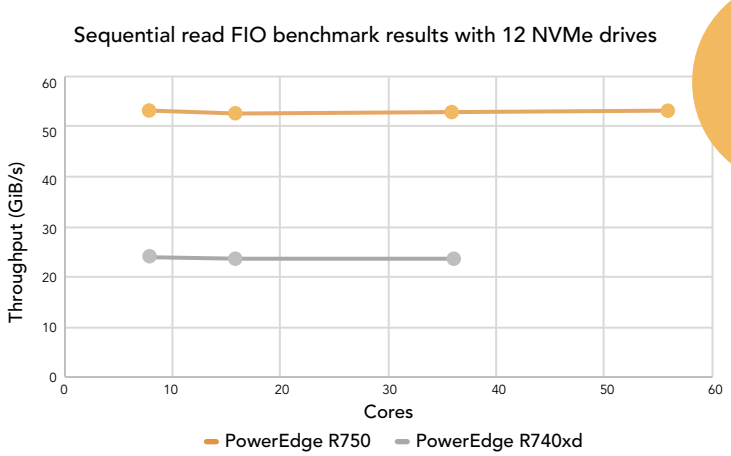
Sustain more outgoing concurrent throughput

Up to 2.2x the GiB/s



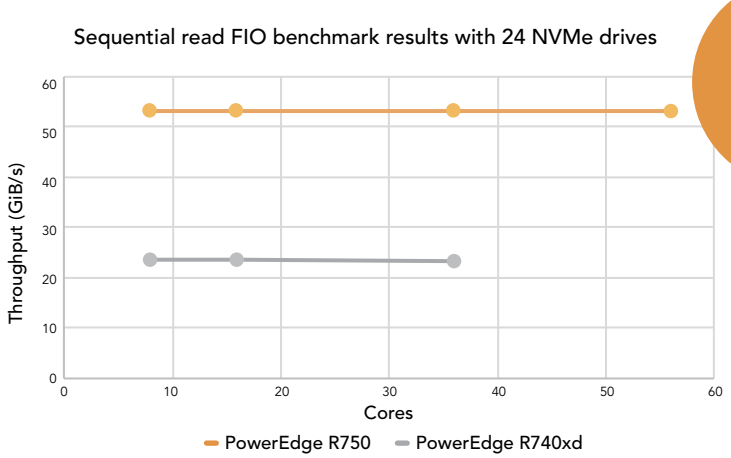
Up to 50.9 GiB/s with 8 drives

Figure 7: Sequential read FIO benchmark results with 8 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 53.2 GiB/s with 12 drives

Figure 8: Sequential read FIO benchmark results with 12 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 53.2 GiB/s with 24 drives

Figure 9: Sequential read FIO benchmark results with 24 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.

The importance of throughput

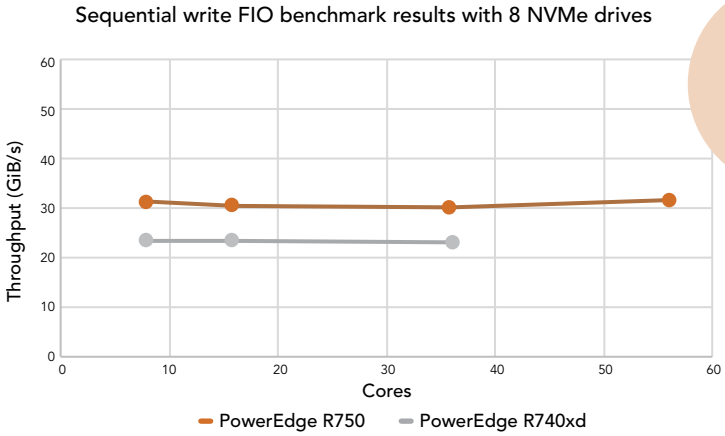
Investing in a solution with high throughput and IOPS could have a direct impact on a company's bottom line. According to Data Center Knowledge, "Throughput is the result of IOPS, and the block size for each I/O being sent or received. Since a 256KB block has 64 times the amount of data as a 4K block, size impacts throughput. In addition, the size and quantity of blocks impacts bandwidth on the fabric and the amount of processing required on the servers, network and storage environments. All of these items have a big impact on application performance."[7]

Sequential write testing results

The higher volume of incoming large blocks of data processed by the Dell PowerEdge R750 solution could benefit applications that render video, allow users to export large amounts of data in less time, and enable employees to copy information from one file to another more quickly.

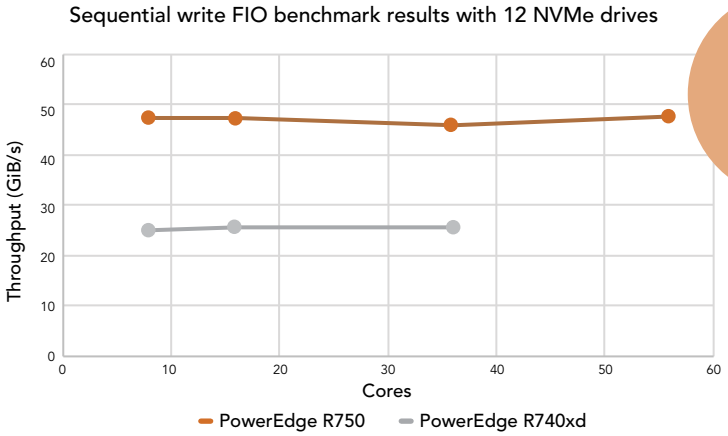
Sustain more incoming concurrent throughput

Up to 1.9x the GiB/s



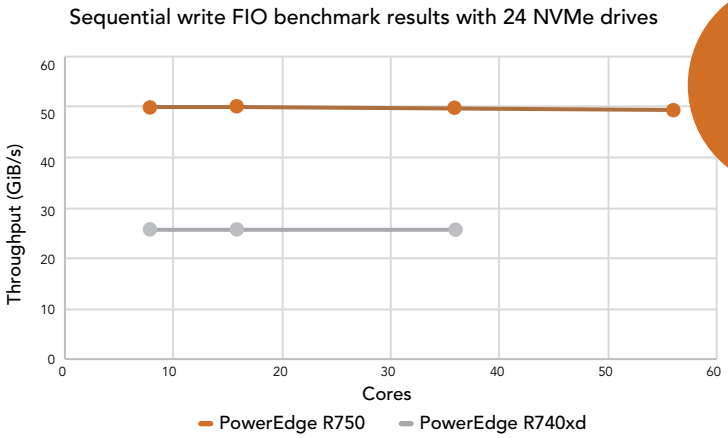
Up to 31.6 GiB/s with 8 drives

Figure 10: Sequential write FIO benchmark results with 8 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



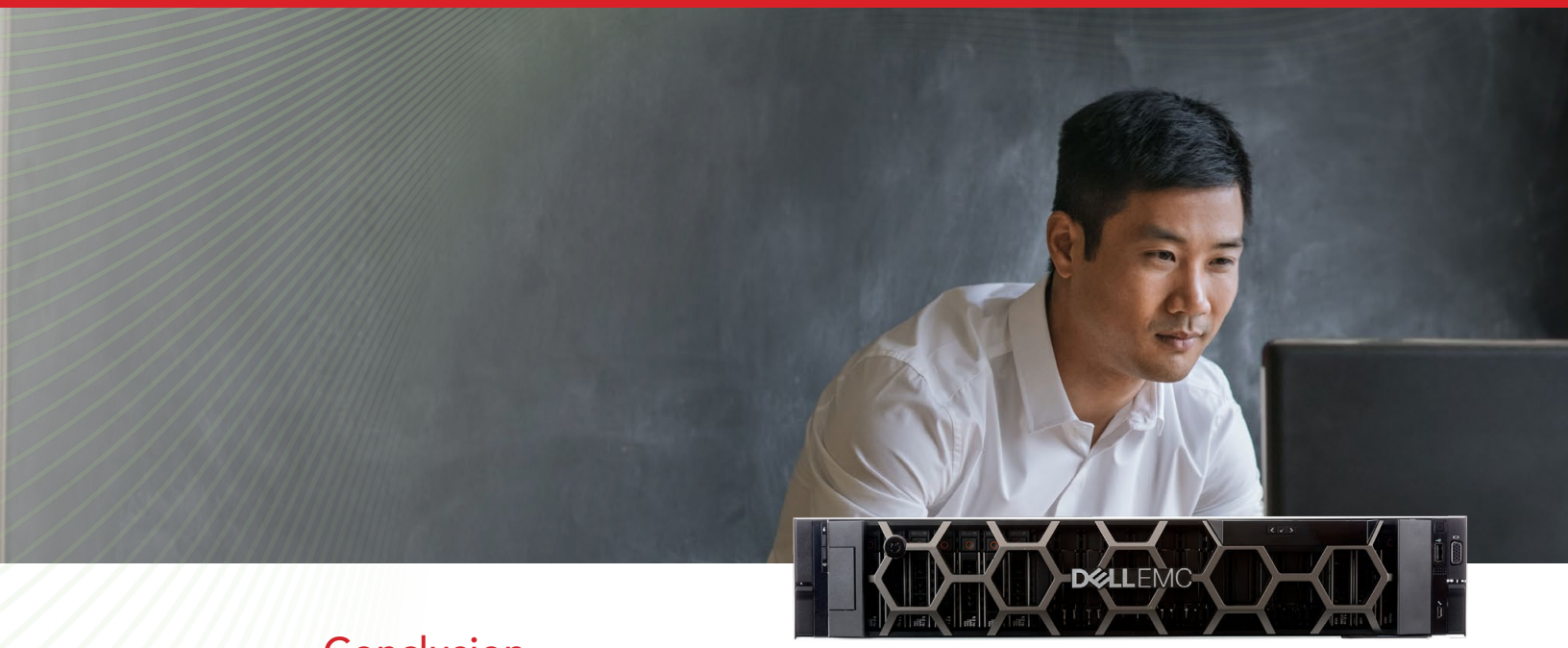
Up to 47.5 GiB/s with 12 drives

Figure 11: Sequential write FIO benchmark results with 12 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Up to 49.3 GiB/s with 24 drives

Figure 12: Sequential write FIO benchmark results with 24 NVMe drives and increasing cores. Higher is better. Source: Principled Technologies.



Conclusion

Investing in the right new servers can help you grow your business and keep customers happy. We found that Dell PowerEdge R750 servers equipped with Broadcom PCIe Gen4 switches improved data transfer speeds over a previous-gen PowerEdge R740xd. In our FIO benchmark tests, this 15G Dell PowerEdge server processed significantly more storage requests and sustained more concurrent throughput both to and from storage than a Dell PowerEdge R740xd server with PCIe Gen3 switches.

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Read the science behind this report at https://facts.pt/KwE4FeA ▶

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This project was commissioned by Dell Technologies.