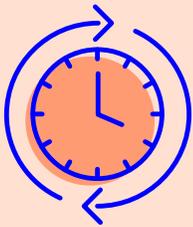## Speed up your transactional database performance

Up to 71% more transactions per second

Value SAS SSDs
vs. enterprise SATA SSDs

Up to 115% more transactions per second

Data center NVMe SSDs
vs. enterprise SATA SSDs

Get better performance for less

Up to 109% more transactions per second for every dollar

Data center NVMe SSDs
vs. enterprise SATA SSDs

Get significantly better transactional database performance for less from a Dell EMC PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA

A PowerEdge R740xd server with drives from KIOXIA achieved better transactional database performance at a lower cost than the same server with enterprise SATA SSDs

Dell EMC PowerEdge R740xd server running a transactional database workload

For years, businesses looking for lower-cost, flash-level performance have defaulted to SATA SSDs. But with SATA SSD connection speeds limited to 6Gb/s, businesses are increasingly seeking cost-effective ways to improve performance. Now KIOXIA has introduced the RM5 Series value SAS SSDs and CD5 Series data center NVMe™ SSDs, both of which offer faster transfer speeds than SATA SSDs. Together with the Dell EMC™ PowerEdge™ R740xd server we tested, these drives from KIOXIA also provided a better performance-to-cost ratio than the SATA SSDs we tested.[1]

We configured a Dell EMC PowerEdge R740xd server with three types of drives: enterprise SATA SSDs, value SAS SSDs, and data center NVMe SSDs. Using a read-intensive transactional database workload, we tested the drives. The value SAS drive configuration boosted transactions per second (TPS) by up to 71 percent over the configuration with enterprise SATA drives. Data center NVMe drives pushed performance even further, delivering up to 115 percent more TPS than the SATA-based configuration. We also found that value SAS and data center NVMe drives delivered, respectively, up to 73 percent and 109 percent better transactional database performance per dollar than enterprise SATA drives.

With value SAS and data center NVMe SSDs from KIOXIA, your business might not have to choose between performance and affordability. Welcome to life after SATA.

Get significantly better transactional database performance for less from a Dell EMC PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA

October 2019 (Revised)

How do value SAS and data center NVMe SSDs compare to SATA SSDs?

Consider the loyal manual car buyer. Twenty years ago, driving a stick shift made sense: manual cars were often cheaper and got better gas mileage. But now that automatic car technology has caught up, manual car sales are dwindling.[2] When looking for a new car, the manual car driver might catch themselves eyeing an automatic that's just as affordable, with superior gas mileage to boot. They might start to wonder: Am I limiting myself with a technology that could become obsolete?

Data center technology evolves even more rapidly. What made sense financially five years ago or even two years ago may no longer be the best option today. Take SATA SSDs, which have had the same transfer speeds of 6Gb/s since 2008.[3]

RM5 Series value SAS SSDs deliver a 12Gb/s connection, and CD5 Series data center NVMe SSDs push transfer speeds to 32 gigatransfers per second (GT/s).[4] In our testing, both drives from KIOXIA delivered better transactional database performance per dollar than the enterprise SATA SSDs we tested.

SATA SSDs may have served your business well in the past. But your needs have changed, and so has data center technology. Like the manual car owner switching to automatic, it's time to consider what lies beyond SATA.

About the Dell EMC PowerEdge R740xd

The Dell EMC PowerEdge R740xd offers strong database performance with a variety of storage configuration options, and can support up to 24 SATA, SAS, or NVMe drives.[5]

RM5 Series value SAS SSD from KIOXIA

Get significantly better transactional database performance for less from a Dell EMC PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA

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Taking the drives for a test run

We wanted to learn about the performance improvements companies could experience by configuring new servers with new drives from KIOXIA versus enterprise SATA drives. We tested a single-node Dell EMC PowerEdge R740xd server with three different SSD types:
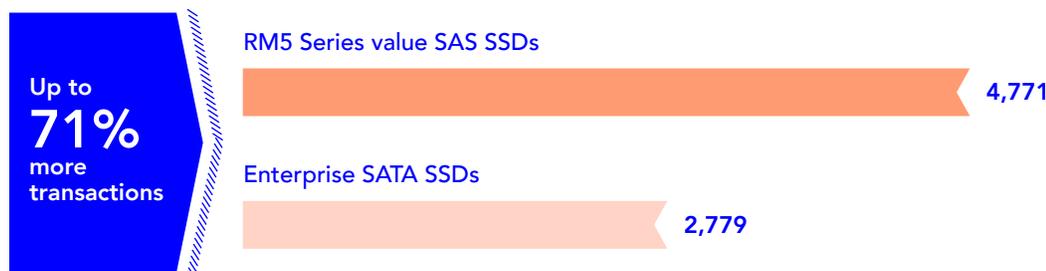
- Intel® D3-S4510 SATA SSDs (RAID 10 and no RAID)
- RM5 Series value SAS SSDs (RAID 10 and no RAID)
- CD5 Series data center NVMe SSDs (no RAID)

On each, we ran a read-intensive transactional database workload from Benchmark Factory for Databases® 8.0.1, which simulated purchases and sales at a brokerage firm. We tested the configurations with enterprise SATA and value SAS SSDs with hardware RAID 10 enabled. For the configuration with data center NVMe SSDs, we did not use hardware RAID because it is not available for NVMe drives in the current test configuration. (For more details about this approach, see Comparing apples to apples on page 4.)

About Benchmark Factory for Databases

According to Quest software, Benchmark Factory allows you to "easily conduct database workload capture and replay, industry-standard benchmark testing and scalability testing."[6] For more information about Benchmark Factory for Databases, visit https://www.quest.com/products/benchmark-factory/.
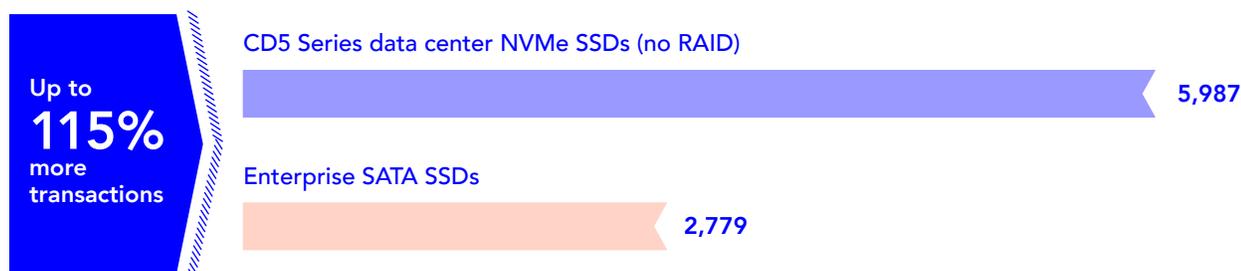
What we learned

The charts below show the results of our testing. With RAID 10 enabled on the enterprise SATA and value SAS SSDs, the Dell EMC PowerEdge R740xd server configured with SATA SSDs achieved 2,779 database transactions per second. The server configured with value SAS SSDs from KIOXIA boosted that number of transactions to 4,771, a performance improvement of 71 percent. The Dell EMC PowerEdge R740xd server configured with data center NVMe SSDs, meanwhile, produced 5,987 transactions per second—115 percent more than the configuration with enterprise SATA SSDs. With RM5 Series value SAS and CD5 Series data center NVMe SSDs, your business could run far more transactions per second, letting you serve more customers on the same server.

Total transactions per second   *higher is better*

Up to **71%** more transactions

RM5 Series value SAS SSDs
4,771

Enterprise SATA SSDs
2,779

Total transactions per second   *higher is better*

Up to **115%** more transactions

CD5 Series data center NVMe SSDs (no RAID)
5,987

Enterprise SATA SSDs
2,779

Get significantly better transactional database performance for less from a Dell EMC
PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA

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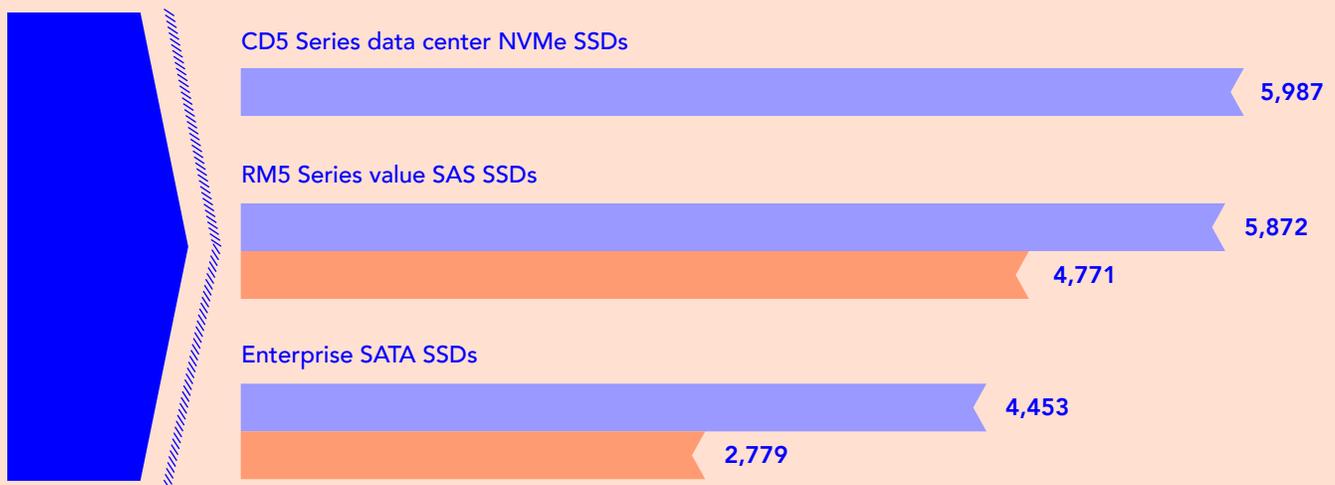
Comparing apples to apples

RAID 10 (Redundant Array of Independent Disks) technology helps protect data by writing multiple copies of the same data on different drives. The extra work data redundancy requires ties up some of the available performance capabilities of the drives. To reflect real-world configurations, we used hardware RAID 10 for both the enterprise SATA SSDs and the RM5 Series value SAS SSDs. The CD5 Series data center NVMe SSDs ran without hardware RAID because it is not available for NVMe drives in the current test configuration.

To explore the performance of the enterprise SATA and value SAS drives without RAID, we conducted the tests a second time without using a RAID configuration for any of the drives. In the chart below, the lower two blue-shaded bars represent these additional data points. The SATA drive performance improved but fell well short of that achieved by the RM5 Series value SAS and CD5 Series data center NVMe SSDs.

Despite the fact that our server used top-of-line processors, our transactional database workload running on value SAS and data center NVMe SSDs without RAID fully utilized the CPUs before we hit the performance ceiling of these drives. This explains why the performance of the two drives without RAID is so similar. Unlike the enterprise SATA SSDs, RM5 Series value SAS and CD5 Series data center NVMe storage options can help fully utilize the compute potential of each server.

Total transactions per second *higher is better*

■ No RAID   ■ RAID 10

CD5 Series data center NVMe SSDs

5,987

RM5 Series value SAS SSDs

5,872

4,771

Enterprise SATA SSDs

4,453

2,779

Get significantly better transactional database performance for less from a Dell EMC
PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA
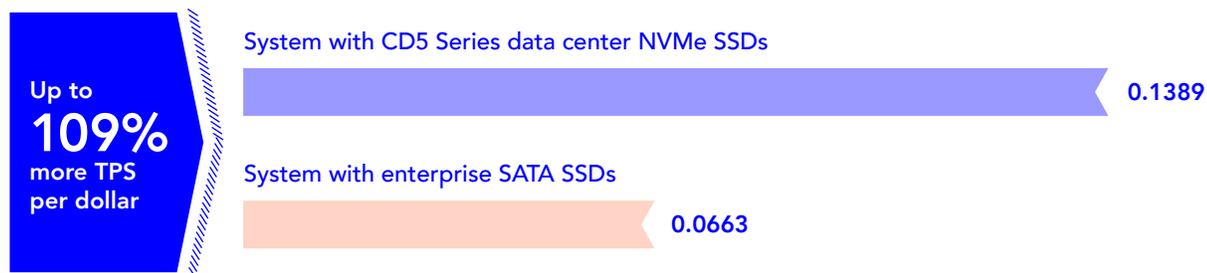
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Value SAS and data center NVMe SSDs provided better transactional database performance per dollar

To calculate performance per dollar, we divided the total TPS by the total solution cost of each configuration. (For more information on how we arrived at our cost analysis results, see the science behind the report.) With RAID 10 enabled on the SATA and SAS SSDs, the Dell EMC PowerEdge R740xd server with RM5 Series SAS SSDs provided 0.1150 TPS per dollar, whereas the configuration with enterprise SATA SSDs delivered 0.0663 TPS per dollar—meaning the configuration with value SAS SSDs produced 73 percent more TPS per dollar.

TPS per dollar   *higher is better*

Up to
73%
more TPS
per dollar

System with RM5 Series value SAS SSDs
0.1150

System with enterprise SATA SSDs
0.0663

TPS per dollar   *higher is better*

Up to
109%
more TPS
per dollar

System with CD5 Series data center NVMe SSDs
0.1389

System with enterprise SATA SSDs
0.0663

CD5 Series data center NVMe SSDs increased value for money even further, delivering 109 percent more TPS per dollar than the RAID-enabled enterprise SATA SSDs we tested. Without RAID enabled on the SATA and SAS SSDs, RM5 Series value SAS SSDs and data center NVMe SSDs still delivered 33 percent and 30 percent better performance per dollar, respectively. For both of these configurations, a fully utilized CPU impacted the TPS-per-dollar metrics (as we explain in more detail on page 4). However, both the value SAS and data center NVMe SSD configurations demonstrated significant potential performance-per-dollar savings compared to the enterprise SATA drives we tested.

System	Percent win
vs. Dell EMC PowerEdge R740xd with enterprise SATA SSDs (RAID)	
Dell EMC PowerEdge R740xd with RM5 Series value SAS SSDs (RAID)	73.45%
Dell EMC PowerEdge R740xd with CD5 Series data center NVMe SSDs (no RAID)	109.50%
vs. Dell EMC PowerEdge R740xd with enterprise SATA SSDs (no RAID)	
Dell EMC PowerEdge R740xd with RM5 Series value SAS SSDs (no RAID)	33.11%
Dell EMC PowerEdge R740xd with CD5 Series data center NVMe SSDs (no RAID)	30.66%

Get significantly better transactional database performance for less from a Dell EMC
PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA

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Conclusion: Serve more customers and get more transactional database performance per dollar

No one wants to be forced to choose between performance and cost when upgrading their flash storage. With RM5 Series value SAS and CD5 Series data center NVMe SSDs, you might not have to.

In our hands-on testing, a Dell EMC PowerEdge R740xd server with value SAS SSDs outperformed the same server with enterprise SATA SSDs. Data center NVMe SSDs boosted performance even further. In addition, the KIOXIA drives we tested delivered more transactional database performance per dollar than enterprise SATA SSDs. If your business is asking, "What does life after SATA look like?", value SAS and data center NVMe SSDs from KIOXIA provide an answer.

1 See our cost comparison results on page 5. According to our testing, RM5 Series value SAS and CD5 Series data center NVMe SSDs delivered, respectively, 73 percent and 109 percent better transactional database performance per dollar than the enterprise SATA SSDs we tested.

2 Eric Evarts, "Why Are Manual Transmissions Disappearing?", accessed October 4, 2019, https://cars.usnews.com/cars-trucks/best-cars-blog/2016/09/why-are-manual-transmissions-disappearing.

3 The Serial ATA International Organization (SATA-IO), which describes itself as "an independent, non-profit organization developed by and for leading industry companies" ("About SATA-IO," accessed October 4, 2019, https://sata-io.org/about-sata-io), last announced a dou-bling of maximum transfer speeds on SATA (from 3Gp/s to 6Gp/s) in August 2008. "New SATA Spec Will Double Data Transfer Speeds to 6 Gb/s," accessed October 4, 2019, https://sata-io.org/system/files/member-downloads/SATA_6Gb_Phy_PR_Finalv2.pdf.

4 KIOXIA, "Life After SATA," accessed October 4, 2019, https://business.kioxia.com/en-us/ssd/life-after-sata.html#value-sas.

5 Dell EMC, "Dell EMC R740xd spec sheet," accessed October 4, 2019, http://i.dell.com/sites/doccontent/shared-content/data-sheets/en/Documents/poweredge-r740xd-spec-sheet.pdf?newtab=true.

6 Benchmark Factory for Databases, accessed October 4, 2019, https://www.quest.com/products/benchmark-factory/.

Read the science behind this report at http://facts.pt/ku114o5 ▶

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This project was commissioned by KIOXIA

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PowerEdge R740xd server with value SAS and data center NVMe SSDs from KIOXIA

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