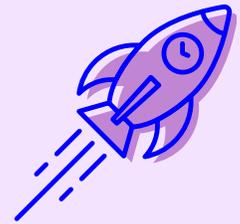




Analyze more data



106% more operations per second

Value SAS SSDs vs. enterprise SATA SSDs



137% more operations per second

Data center NVMe SSDs vs. enterprise SATA SSDs

Stretch your dollar further



Up to 132% more operations per second for every dollar

Data center NVMe SSDs vs. enterprise SATA SSDs

Get better database analytics performance at a lower cost with Dell EMC PowerEdge R840 servers equipped with value SAS and data center NVMe SSDs from Toshiba Memory

A PowerEdge R840 server with RM5 Series value SAS and CD5 Series data center NVMe SSDs processed more operations per second and delivered better performance per dollar than the same server with enterprise SATA SSDs

Dell EMC PowerEdge R840 server running a database analytics workload

Business moves at a lightning-fast pace. Shouldn't the drives in your data center do the same? SATA SSDs, once embraced as an affordable flash storage option, haven't increased their transfer speeds in over ten years.¹ For a faster storage option, Toshiba Memory has introduced the RM5 Series of value SAS SSDs and the CD5 Series of data center NVMe™ SSDs. Can these drives compete with enterprise SATA drives on performance as well as cost?

We set up a Dell EMC™ PowerEdge™ R840 server with three different drive configurations: current-generation enterprise SATA SSDs, value SAS SSDs, and data center NVMe SSDs. To measure database performance, we ran a 100% read workload on MongoDB®, a popular document-based database used to access and analyze unstructured data. The configuration with value SAS drives from Toshiba Memory provided 106 percent more operations per second (OPS) than the configuration with SATA drives. Data center NVMe drives improved performance even further, producing 137 percent more OPS than the SATA-based configuration. Value SAS and data center NVMe SSDs also offered up to 57 percent better response times and provided up to 132 percent better database performance per dollar than the enterprise SATA SSDs we tested.

Value SAS and data center NVMe SSDs from Toshiba Memory offer storage options that can keep up with the pace of business. Welcome to life after SATA.

Value SAS and data center NVMe SSDs offer higher transfer speeds

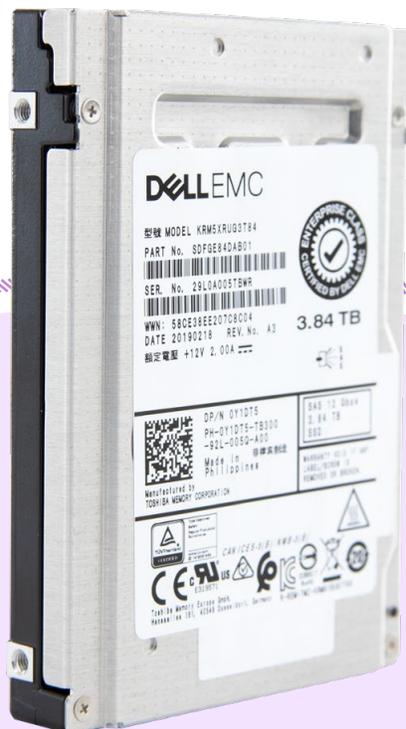
SATA transfer speeds have stayed at 6Gb/s since 2008.² According to the Serial ATA International Organization (SATA-IO), “there are no plans to extend SATA bandwidth beyond the current 6Gb/s transfer rate.”³ By contrast, the roadmap for SAS SSDs extends into 2029 and includes plans for faster speeds.⁴ IDC predicts that NVMe SSD revenues will continue to climb, making NVMe “the mainstream foundation technology for enterprise storage by 2020.”⁵

RM5 Series value SAS SSDs from Toshiba Memory offer a 12Gb/s connection, double that of enterprise SATA SSDs.⁶ CD5 data center NVMe SSDs, meanwhile, push transfer speeds to 32 gigatransfers per second (GT/s), boosting your data center’s ability to handle even more data.⁷ These drives from Toshiba Memory offer up to 7.68 TB of storage per drive, a PCIe® Gen3 x4 lane interface, and a 64-layer BiCS FLASH™ 3D TLC memory.⁸

About the PowerEdge R840

According to Dell EMC, the PowerEdge R840 rack server can “turbocharge your data analytics.”⁹ The server boasts space for up to 48 DIMMs, up to 6 TB of RAM, and 24 SAS or NVMe drives. The Dell EMC PowerEdge R840 also delivers integrated security features and options for task automation, such as OpenManage Enterprise management software.

To learn more, visit <https://www.dell.com/en-us/work/shop/poww/poweredge-r840>.



RM5 Series value SAS SSD from Toshiba Memory

About MongoDB

MongoDB is a document-based database that uses ad hoc queries, indexing, and real-time aggregation to access and analyze unstructured data like web pages, emails, and videos. According to MongoDB, the vast majority of the data created today (over 95 percent) is unstructured.¹⁰

To learn more, visit <https://www.mongodb.com/what-is-mongodb>.

How we tested

We set up a Dell EMC PowerEdge R840 server with three different drive configurations:

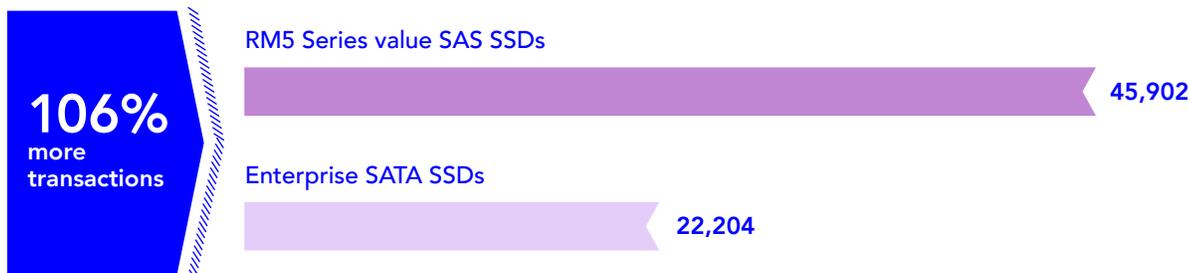
- Intel® D3-S4510 SATA SSDs
- RM5 Series value SAS SSDs from Toshiba Memory
- CD5 Series data center NVMe SSDs from Toshiba Memory

We used Yahoo! Cloud Serving Benchmark (YCSB) to run a 100% read workload on a MongoDB database. YCSB simulates analytics workloads that read large amounts of data and generate a result, represented as operations per second (OPS). Higher OPS indicate a solution's ability to ingest and analyze data more efficiently. Our YCSB workload running on a MongoDB database is representative of an enterprise environment performing big data analytics. For more details on the configurations and how we performed testing, see the [science behind the report](#).

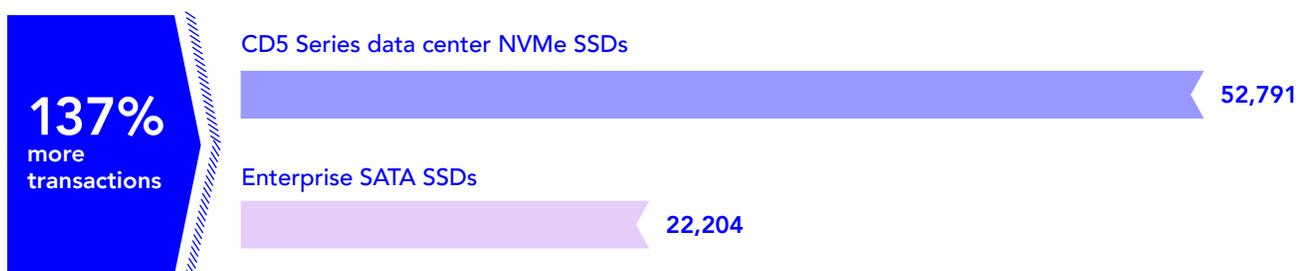
Increase your ability to analyze data

Value SAS and data center NVMe SSDs from Toshiba Memory both processed more OPS than the enterprise SATA SSDs we tested. While the SATA-based configuration delivered 22,204 OPS, the SAS-based configuration handled nearly 46,000 OPS, more than doubling performance. The solution with data center NVMe SSDs boosted performance even further, processing 52,791 OPS—an increase of 137 percent over the SATA-based configuration. These results showcase the ability of the SAS- and NVMe-based solutions to run read-heavy workloads, such as online searches and photo tagging.

Total operations per second *higher is better*



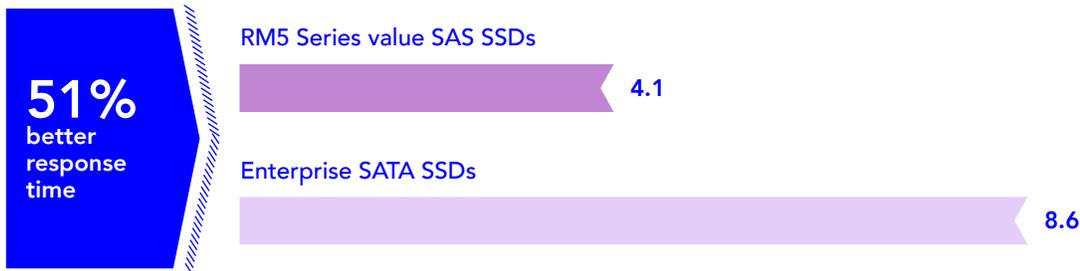
Total operations per second *higher is better*



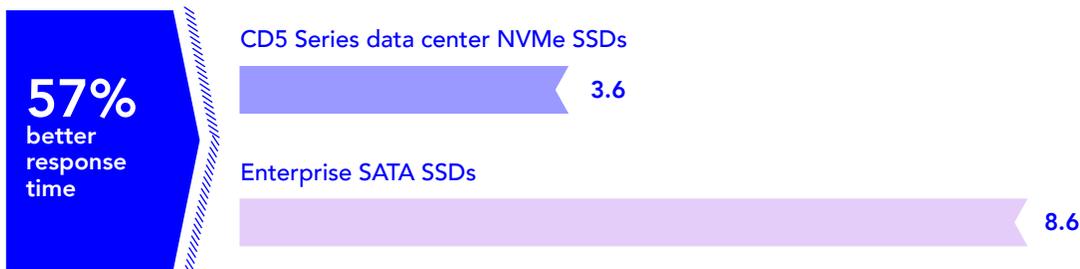
Keep user wait times to a minimum

For a smooth user experience, you need a system that provides low latency—that is, a system that responds quickly to your users' demands. On our read-heavy workload, the SAS-based configuration cut response times by just over 50 percent compared to the SATA-based configuration. NVMe drives lowered response times even further, enabling the configuration to respond in 57 percent less time than the configuration with enterprise SATA SSDs.

Total latency (ms) *lower is better*



Total latency (ms) *lower is better*



About the Yahoo! Cloud Serving Benchmark

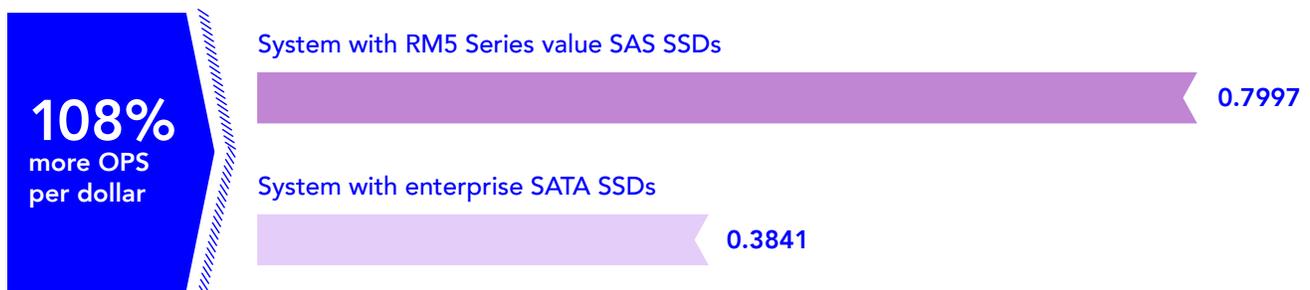
According to Yahoo!, "the goal of the Yahoo Cloud Serving Benchmark (YCSB) project is to develop a framework and common set of workloads for evaluating the performance of different 'key-value' and 'cloud' serving stores."¹¹ The benchmark supports MongoDB in addition to Apache HBase® and Apache Cassandra®, both NoSQL databases capable of handling large datasets. Administrators can benchmark their preferred database by writing a new interface layer.

To learn more about YCSB, visit <https://research.yahoo.com/news/yahoo-cloud-serving-benchmark>.

Value SAS and data center NVMe SSDs provided better analytics performance per dollar

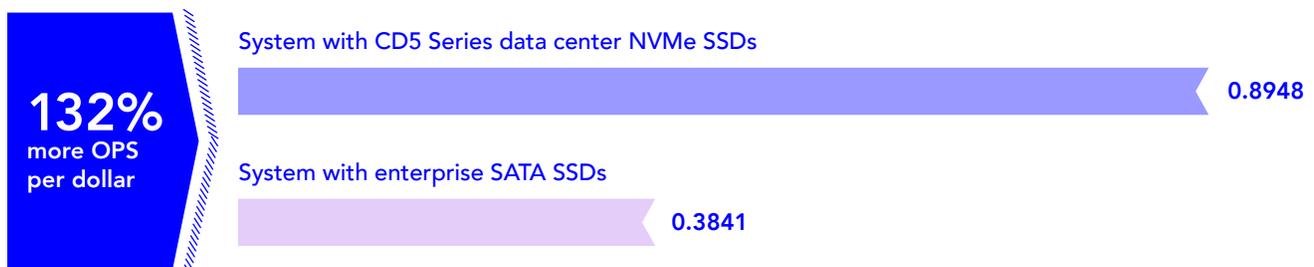
To calculate performance per dollar, we divided the total OPS by the total solution cost of each configuration. (For more information on how we arrived at our cost analysis results, see the science behind the report.) As the graph below shows, the Dell EMC PowerEdge R840 server with RM5 Series SAS SSDs provided 0.7997 OPS per dollar, whereas the configuration with enterprise SATA SSDs delivered 0.3841 OPS per dollar—meaning the configuration with value SAS SSDs produced 108 percent more OPS per dollar.

OPS per dollar *higher is better*



CD5 Series data center NVMe SSDs increased value for money even further, delivering 132 percent more OPS per dollar than the enterprise SATA SSDs we tested. With a solution that produces a better return on database analytics performance, your organization could satisfy more customers or invest in initiatives that grow your business.

OPS per dollar *higher is better*





Conclusion: Process more operations per second with lower latency and higher per-dollar analytics performance

In our hands-on testing, a Dell EMC PowerEdge R840 server with RM5 Series value SAS and CD5 Series data center NVMe SSDs outperformed a configuration with enterprise SATA SSDs. The solution with value SAS SSDs delivered 106 percent more operations per second and just over 50 percent lower latency than the SATA-based configuration. Data center NVMe SSDs boosted this performance even further, producing 137 percent more OPS and 57 percent better response times than the configuration with SATA drives. Value SAS and data center NVMe SSDs also provided up to 132 percent higher analytics performance per dollar than the enterprise SATA SSDs we tested.

With value SAS and data center NVMe SSDs from Toshiba Memory, your business can consider a future beyond SATA.

- 1 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 April 5, 2019, <https://sata-io.org/about-sata-io>), last announced a doubling 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 April 5, 2019, https://sata-io.org/system/files/member-downloads/SATA_6Gb_Phy_PR_Finalv2.pdf.
- 2 SATA-IO, “New SATA Spec Will Double Data Transfer Speeds to 6 Gb/s,” accessed April 5, 2019, https://sata-io.org/system/files/member-downloads/SATA_6Gb_Phy_PR_Finalv2.pdf.
- 3 SATA-IO, “SATA-IO Frequently Asked Questions,” accessed April 5, 2019, <https://sata-io.org/sata-io-frequently-asked-questions>.
- 4 SCSI Trade Association (STA), “Serial Attached SCSI Technology Roadmap,” accessed April 5, 2019, http://www.scsita.org/content/library/serial_attached_scsi_technology_roadmap/.
- 5 Eric Burgener, “NVMe in Enterprise Storage Systems,” accessed April 8, 2019, https://www.flashmemorysummit.com/English/Collaterals/Proceedings/2018/20180808_MRES-201B-1_Burgener.pdf.
- 6 Toshiba Memory, “Toshiba Memory America First to Deliver Value SAS SSDs Targeting SATA Applications,” accessed April 3, 2019, <https://business.toshiba-memory.com/en-us/company/tma/news/2018/06/storage-20180619-1.html>.
- 7 Toshiba, “Data Center SSD,” accessed March 22, 2019, <https://business.toshiba-memory.com/en-emea/product/storage-products/data-center-ssd/cd5.html>.
- 8 Toshiba, “Data Center SSD,” accessed March 22, 2019.
- 9 Dell EMC, accessed April 18, 2019, <https://www.dell.com/en-us/work/shop/povw/poweredge-r840>.
- 10 MongoDB, “Unstructured Data In Big Data,” accessed April 8, 2019, <https://www.mongodb.com/scale/unstructured-data-in-big-data>.
- 11 Yahoo, “Yahoo Cloud Serving Benchmark,” accessed April 8, 2019, <https://research.yahoo.com/news/yahoo-cloud-serving-benchmark>.

Read the science behind this report at <http://facts.pt/aaxoggq> ►



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For additional information, review the science behind this report.