High-Performance SSD Capacity is Finally Compelling

Micron's 9200 SSDs (NVMe™ Interface) Take Fast Storage Mainstream

Micron® 9200 series of NVMe™ SSDs

Performance

IOPS and GB/s for workloads that must work loads

High Capacity

1.6TB to 11TB
U.2 form factor, factory tuned

Simple

Reduce rack sprawl, share NVMe for bottom line value and efficiency

Overview

Data center planners, data managers, system designers and users all look to SSDs for the best in IOPS and GB/s performance[1] — far outpacing legacy storage options.

PCIe (later NVMe) SSDs brought the true potential of flash-based storage to mainstream IT with IOPS and GB/s capabilities previously unimagined.[2]

These capabilities came at a price: A single PCIe SSD was too small to drive broad adoption. We limited their use, reserving them for small portions of only the most mission-critical workloads, accelerating small slivers of the enterprise.

In 2015[3] improvements in media (NAND) coupled with faster storage protocols (NVMe)[4] and higher bandwidth busses (PCIe) enabled broader availability of larger SSDs with greater capacity and enhanced delivery.

In 2017 our introduction of the 9200 series of NVMe SSDs brings high-capacity, high-performance storage technology for pervasive business benefits such as:

Store and Accelerate: Store and accelerate entire data set I/O instead of just small slivers[5] with a single 9200 SSD

Consolidate and Simplify: Make sprawling racks and huge, growing clusters of slow storage yesterday's infrastructure — store more with fewer systems and lower power and cooling costs. Tame complexity with fewer platforms for easier management[5]

Share for Efficiency: Share NVMe storage across high-bandwidth, low-latency fabrics. Unlock the value of NVMe, unleash pent-up IOPS and capacity.

1. Performance defined as IOPS or GB/s, read or write as per product data sheets.
2. *Micron Announces World's Fastest Enterprise Solid-State Storage System Featuring PCI Express*, Micron Technology, Inc. Press release, June 2, 2011
3. *Micron Accelerates Data Center Storage with New NVMe PCIe SSD Portfolio*, Micron Technology, Inc. Press release, April 12, 2016
4. See the NVM Express (NVMe) Working Group website for details.
5. Analysis based on estimates and calculations., your results will vary (not a performance or manageability guarantee).

We Are In the Middle of a Data Generation and Demand Revolution

No one questions that data is growing and that the growth rates are phenomenal (possibly faster than anyone can accurately predict). In March of 2017, Seagate published the IDC Paper "Data Age 2025: The Evolution of Data to Life-Critical"[6] in which IDC forecasts that "by 2025 the global datasphere will grow to 163 zettabytes." This incoming deluge is on the horizon to be sure, but if IDC is correct — the horizon is near and getting nearer.

In a blog post in May 2016, Northeastern University stated that we are producing 2.5 Exabytes of data every day[7] — an amount equivalent to 90 years of HD video or a quarter million Libraries of Congress.

We aren't just generating enormous amounts of data, we are using it, consuming it, relying on it — each and every day in new and innovative ways: worldwide conferencing, genetics, medication research and development, higher-definition entertainment streaming services, hybrid and all cloud business applications and real time consumption by mobile users everywhere.

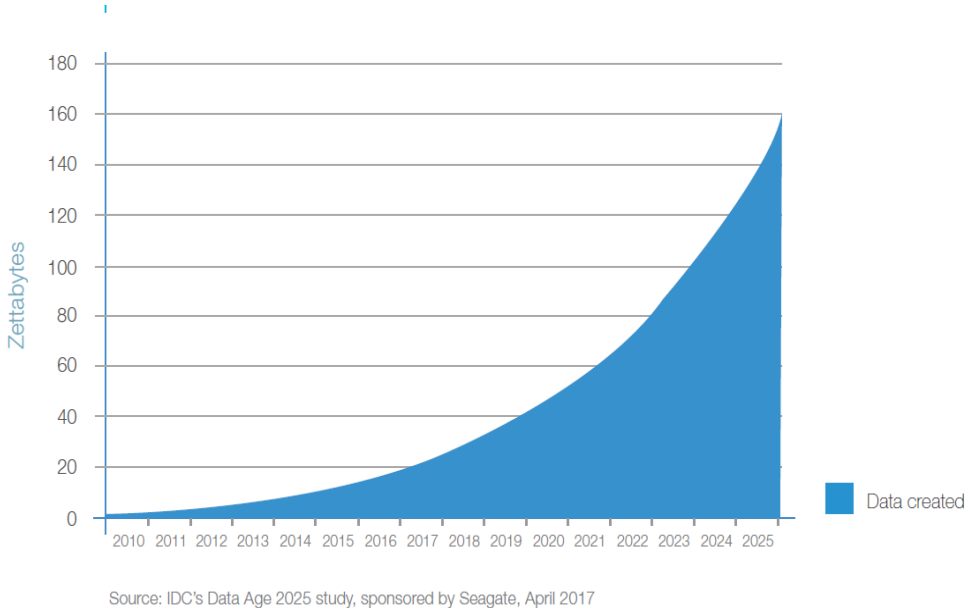


Figure 1: Annual Size of Global Datasphere (source: IDC)

Figure 1 shows the size of the global datasphere (from the IDC report).

Storing the global datasphere is important. Providing fast, reliable and power-efficient access to it is imperative.

PCIe (and later NVMe) SSDs have long been the drivers for fast data access, but until recently their capacity was limited to a few TB. This, combined with systems supporting just a few of these SSDs, relegated them to the corners of IT — accelerating a few applications and a few smaller data sets making it nearly impossible for them to keep pace with data creation.

With Micron's introduction of our 9200 series of NVMe SSDs, that's changed.

A Capacity Revolution

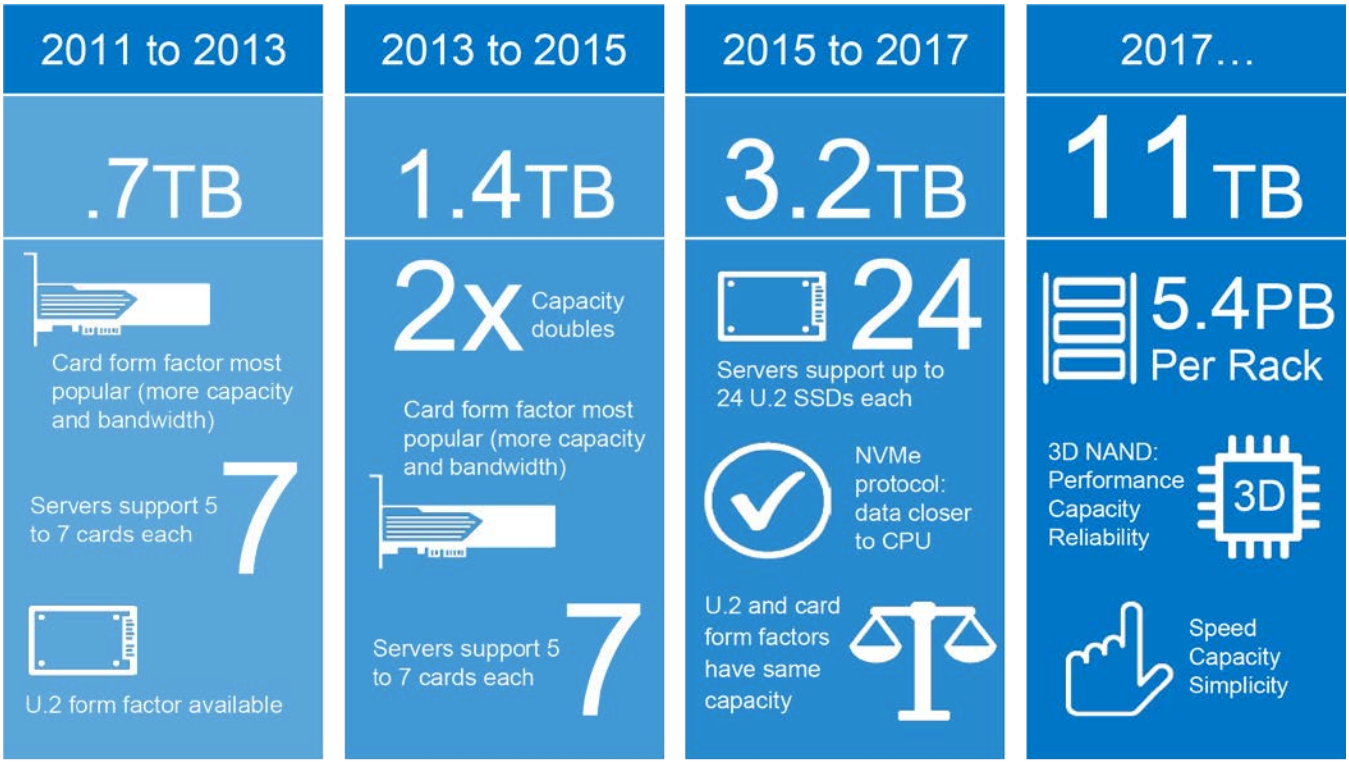
From 2011 through 2015 we saw a PCIe SSD capacity evolution. Over three generations of high-performance SSDs, capacity roughly doubled with each generation. Starting at 700GB (about 0.7TB) in 2011, growing to 1.4TB in 2013 and to 3.2TB in 2015. Form factors also changed. Prior to 2015, card form factors offered the highest capacity. In 2015, card and U.2 (2.5-inch) form factors offered similar capacity and performance.[8]

When we introduced our 9200 series of NVMe SSDs in the middle of 2017, that evolution became a revolution. Combining our high-density 3D NAND with architecture innovations to take full advantage of the NVMe protocol, our 9200 single SSD maximum capacity jumped to 11TB (U.2) with blazing fast performance and low latency.

6. IDC Whitepaper, Sponsored by Seagate, Data Age 2025, April 2017
7. "How Much Data is Produced Every Day," Northeastern University
8. Micron 9100 data sheet, Micron Technology.

The high-performance, high-capacity, hot swap capable U.2 form factor was quickly adopted for standard servers. From 2011–2015 standard 2U servers accommodated about seven card form factor devices (some more, some fewer). By 2015 server platforms stored up to twenty-four U.2 form factor SSDs.

PCIe/NVMe SSDs Capacities: Evolution Becomes Revolution



Real Benefits

A single NVMe U.2 SSD storing 11TB is impressive, but what can that mean in our data centers today? Tomorrow?

Large NVMe SSDs like the 11TB 9200 enable amazing per-rack density, enabling you to store more data in less space: smaller, simpler, easier.

As an example of how the 9200 series can reduce data center footprints, suppose you have a very large data set, say 50PB. Suppose you want to store it and access it very quickly (so a high-density archive may not be optimal).

How could 9200 series SSDs help? Through footprint (rack out) and power savings.

Reduced Footprint

Using a 50PB example data set, we can calculate how many 42U racks we'd need to store it based on drive capacity and common server designs by timeframe.

We'll assume a 2011–2015 standard 2U server accommodated about seven card form factor SSDs. From 2015 on, we'll assume a standard 2U server with 24 U.2 form factor SSDs. We'll base our calculations on a 42U rack and assume we can devote the entire rack to servers and SSDs. Figure 2 shows about how many racks we'd need to store 50PB.

Two factors drove the enormous reduction in rack count from 2011 to 2017. From 2011 through 2013 the largest PCIe SSD (NVMe wasn't yet available) was just 700GB (about 0.7TB). In August, 2017 the largest Micron SSD with NVMe is our 11TB 9200.

From 2015 to the present, standard servers easily support 24 U.2 NVMe SSDs in a 2U design.

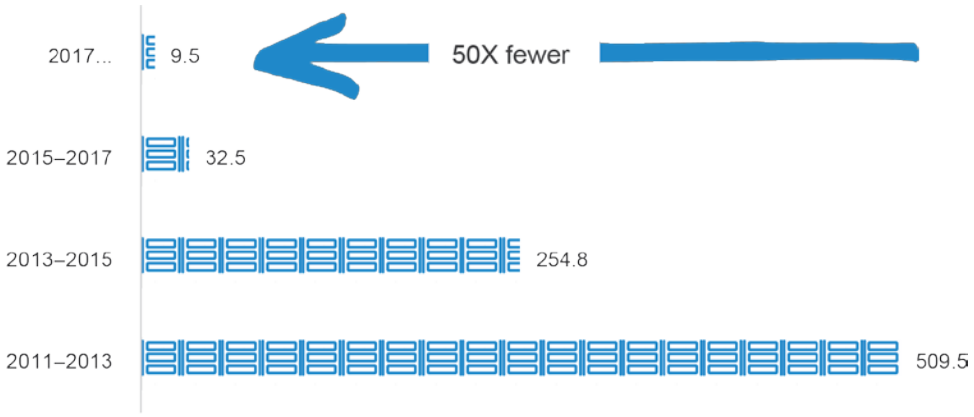


Figure 2: Racks needed to store 50PB of data

With the highest capacity PCIe SSD in 2011–2013, we'd need about 510 racks. Using our 11TB Micron 9200 SSD, that decreases to nine and a half racks — a 50X reduction.

Reduced Power

Because we need far fewer SSDs to store 50PB, we also need less power to drive them[9]. We can estimate power consumption using product datasheets from each era. Figure 3 shows calculated power (in kW) we need to store and access 50PB.

Figure 3 shows the SSD power to store 50PB.

Two factors drive the power reduction from 2011 to 2017. From 2011-2015, power per SSD was rated at 25 watts. That increased to 30 watts from 2015 to our 11TB 9200 SSD in 2017. Although power per SSD increase slightly, the substantial capacity per SSD increase reduced total number of SSDs we need to store 50PB.

Figure 3 does not include additional power reduction due to fewer systems. If we factor that in, the *potential* reduction could be even greater:

Fewer 9200 NVMe SSDs to store 50PB
+
Fewer platforms (24X 9200/platform)
= Additional Potential Savings

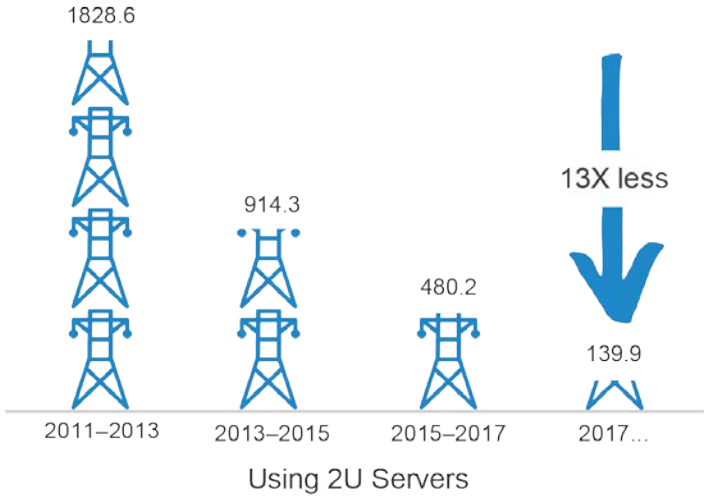


Figure 3: Power (kW) needed to store 50PB of data

9. Power consumption estimated based on SSDs alone for the example 50PB data set. Total power values calculated from data sheet power values and total number of SSDs used. Chassis power varies widely and is not factored.

Store and Accelerate to Modernize Legacy IT

When large enterprise organizations, public institutions and cloud service providers look to modernize their traditional IT — their racks and racks of 10K and 15K HDDs, accelerated by small caches — our 9200 series of NVMe SSDs provide a future-focused platform to meet the combined demands of data growth and real-time access with enterprise-class reliability.

Growing workload diversity, data set complexity and data center demand have pushed IT to look beyond accelerating small slivers of data through traditional caching. The Micron 9200's extreme capacity, real-time performance and ability to process entire data sets should help data center managers find positive ROI quickly for fast storage investment.

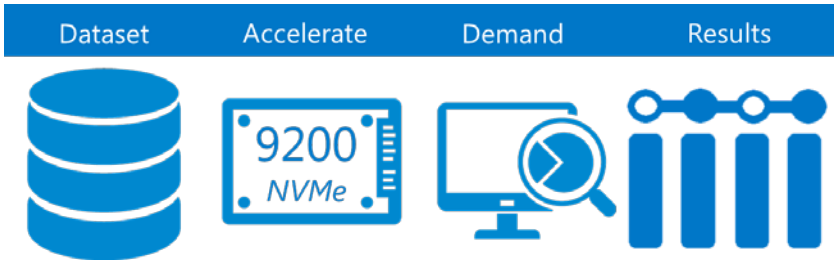


Figure 4: The 9200 NVMe SSDs accelerate entire data sets

The Micron 9200 series of NVMe SSDs have the capacity and speed to transform data into value. Accelerating applications and data delivery builds a better bottom line.

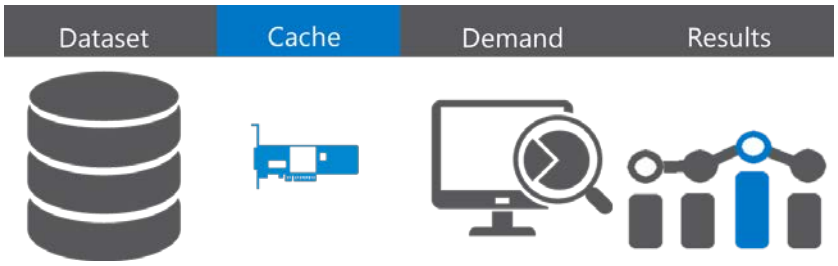


Figure 5: Traditional caching accelerates small slivers of data

Traditional caching (placing small capacity, higher speed storage in front of massive data sets) can improve results with a cache hit; cache misses do not. Cache hit rate depends on access patterns.

Consolidate and Simplify Your In-Server Storage

Unstructured data growth and increased demand for precision analytics has organizations scrambling for a method to easily implement distributed applications and maximize density while minimizing overhead.

Huge, sprawling deployments of legacy storage are a resource drain, squander precious IT talent on upkeep instead of freeing them for mission critical projects.

The Micron 9200 series of NVMe SSDs simplify these deployments with the density to consolidate and the capability to deliver.

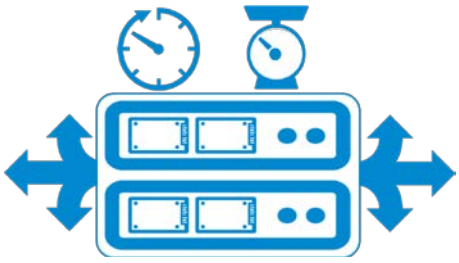
Figure 6: Simplify and consolidate disaggregated storage

Disaggregate storage with fewer tiles and platforms. Simplify deployments to free IT resources to focus on growth

Share NVMe Storage for Efficiency

A growing number of companies are moving to new IT design and deployment models to achieve quicker data delivery, extremely high throughput and faster time to results that they can also share among multiple workloads, applications and servers through shared NVMe.

Platforms that share NVMe extend its performance and agility across multiple systems: deploying applications faster with the ability to scale out quickly and easily, the infrastructure to unleash the pent-up IOPS and the capacity of server-local NVMe with the ease of centralized, pooled storage management.



Shared NVMe platform architecture improves resource use, releasing pent-up IOPS and capacity

Figure 7: Shared NVMe Platforms, Released IOPS and Capacity

Conclusion

With Micron's 9200 SSDs, capacity is finally compelling. At up to 11TB per U.2, our 9200 drive has the capacity to store and accelerate more data in high-performance storage, enabling you to consolidate and simplify disaggregated storage or share NVMe for efficiency and scale.

Adopting fast storage (initially PCIe and later NVMe SSDs) relieved some of IT's performance pressure, but capacity limitations kept fast storage out of the mainstream, relegating it to caching slivers of large data sets. IT had to carefully pick and choose where they used fast storage. It simply wasn't large enough for mainstream use.

Now, that's changed.

We used to build data lakes. Now we are filling data oceans. We create enormous amounts of data every day. These data oceans represent business solutions, concrete actions and valuable content — if we can get to it fast enough.

The Micron 9200 series of NVMe SSDs store and accelerate more data, modernizing legacy IT, consolidating and simplifying in-server storage and enabling the sharing of NVMe capacity and IOPS across multiple systems through shared NVMe architecture with smaller footprints and lower power consumption.

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