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Samsung SSD PM1743

A PCIe® 5.0 Storage Solution for the Data-Centric Era

Introduction

The volume of enterprise data is rising and the ways organizations use that data to engage customers and build a competitive advantage are evolving rapidly. The need to support large-scale, increasingly complex data operations, often in real time, means the enterprise servers that power these operations must evolve to meet on-premise, Cloud and Edge application demands.

Data management is at the center of this evolution. Enterprise servers must be able to more reliably handle a greater amount of data at unprecedented speeds. As a long-time leader in the high-performance solid-state drive (SSD) market, Samsung has a deep understanding of the challenges related to delivering high-volume, high-performance, highly reliable storage for enterprise servers of all kinds. As interface standards raise the ceiling for data-transfer bandwidth and efficiency, it's critical that storage vendors keep pace. Samsung's PM1743 is designed to take full advantage of these capabilities to deliver for datacenters and service providers adapting to the evolving demands of a rapidly changing marketplace.

Server Storage for the Data Revolution

Across the globe, datacenters are building capacity for more data and filling it rapidly. CBRE reports that even as datacenter inventory has grown across key markets, vacancy rates have declined. At the same time, the methods enterprises use to gain valuable insights from their data have become more sophisticated.

For datacenters and the enterprise servers they deploy, this combination of trends demands advancements in both capacity and performance. As artificial intelligence and real-time data analysis inform end uses across industries, enterprises need more than simple storage. They need fast, reliable access to data so they can analyze it, develop insights and act as quickly as possible.
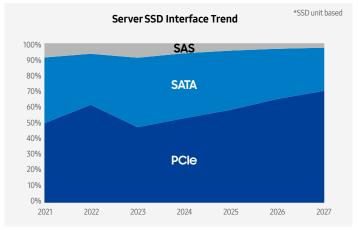
These trends are also changing the way enterprises approach data architecture. To optimize performance, data and analytics operations have been migrating toward Edge computing environments. Gartner estimates that more than half of enterprise-critical data will be created and manipulated for Edge applications by 2025.
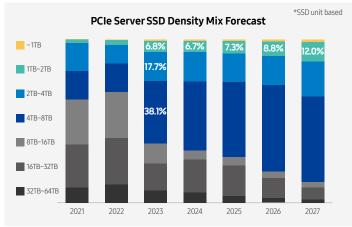
Evolution of SSD technology

These demands have generated major changes in how datacenters choose to store and retrieve their data. For nearly 20 years, SSDs have served as a high-speed storage solution, using integrated circuit assemblies to store data persistently on flash memory. Having no moving parts, SSDs have always been faster, more durable and more reliable than traditional hard drives — and significant progress has been made in increasing capacity at a reasonable cost.

Advancements in memory technology, such as Samsung's pioneering of vertical NAND (V-NAND), continue pushing SSD storage solutions forward, with today's drives being faster and more reliable than ever before. And changes to the interface between SSDs and the devices on which they run have yielded additional improvements; using the Non-Volatile Memory Express (NVMe) protocol to move data across a PCI Express (PCIe) interface allows SSDs to achieve much higher data transfer speeds. The benefits of higher-capacity drives and greater speeds are reflected in server SSD trends, which show strong uptake for the PCIe interface and higher-capacity drives.

Server SSD Interface Trend *SSD unit based

Source : Forward Insight 2023.3Q

PCIe Server SSD Density Mix Forecast *SSD unit based

Source : Forward Insight 2023.3Q

SSDs also provide this speed and performance in a flexible form factor, allowing datacenters to attach more of them to a single server unit. Increases in the efficiency of chips also reduce power consumption for an equivalent amount of space, reducing ongoing operating costs. Looking to the future, PCIe-based SSDs will become even more attractive to datacenter operators seeking greater scalability, reliability and energy efficiency.

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Speed

The fifth-generation PCIe interface does the following:

- Doubles the **transfer speed** of the previous generation, enabling systems to process more data in less time.
- Allows enterprises that can take advantage of these speeds to have more efficient access to data — especially real-time data — which in turn will give them a competitive edge as they analyze and act on valuable insights derived from that information.
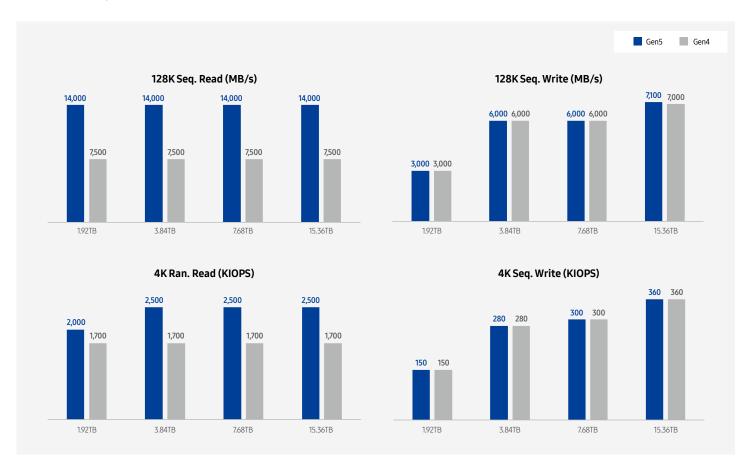
Performance

While the interface allows for high-speed data transfer, the actual bandwidth SSDs can achieve is limited by the controller they use.

- Controllers move data to and from NAND chips via channels — physical paths between the controller and each chip.
- The more channels a controller can handle, the more data it can move simultaneously. Performance-oriented applications generally use four, eight, or 16 channels. However, having more channels has historically meant more complexity, greater expense and greater power consumption. As a result, eight-channel SSDs have become the most common for performance-oriented SSD segments across all applications.

Here are the technical specifications of the proprietary controller in the PM1743:

- Supports **16 channels**, which gives datacenters access to more speed without compromising on power consumption.
- **Sequential read speeds** of up to 14,000 megabytes per second (MB/s) and **random read speeds** of up to 2,500K input/output operations per second (IOPS), which allow the PM1743 to reach speeds 1.9x and 1.7x faster than those provided by products designed for fourth-generation PCIe interfaces.
- **Sequential write speeds** of up to 7,100 MB/s and **random write speeds** of up to 360K IOPS, which deliver 1.7x and 2.1x faster performance than the previous generation.
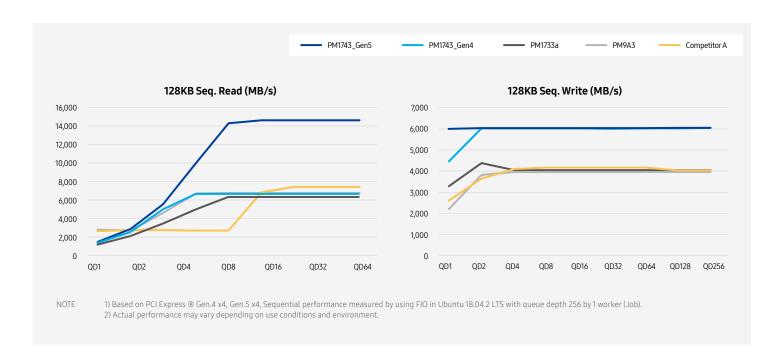
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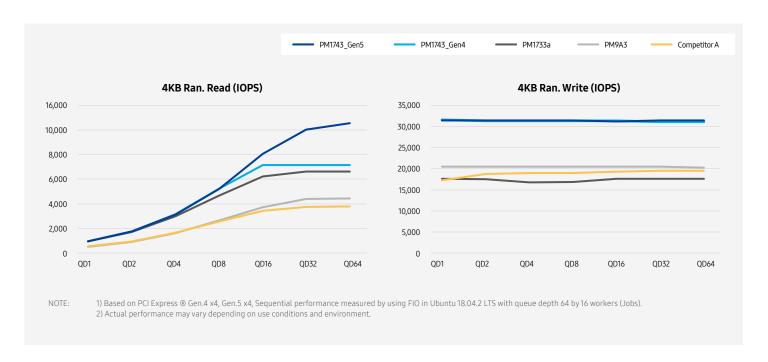| Product	Gen4 Performances											
	PM1743				PM1733a				PM1733			
Interface	PCIe Gen4											
Form Factor	2.5" 15mmT											
Capacity	1.92TB	3.84TB	7.68TB	15.36TB	1.92TB	3.84TB	7.68TB	15.36TB	1.92TB	3.84TB	7.68TB	15.36TB
128K Seq. Read (Mbps)	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,000	7,000	7,000	7,000
128K Seq. Write (Mbps)	3,000	6,000	6,000	7,000	2,500	4,100	4,100	4,100	2,400	3,800	3,800	3,800
4K Ran. Read (KIOPS)	1,000	1,700	1,700	1,700	1,400	1,550	1,550	1,550	800	1,500	1,450	1,450
4K Ran. Write (KIOPS)	150	280	300	360	110	135	135	135	100	135	135	135
Endurance	1 DWPD											
Reliability	2.5M Hours MTBF											

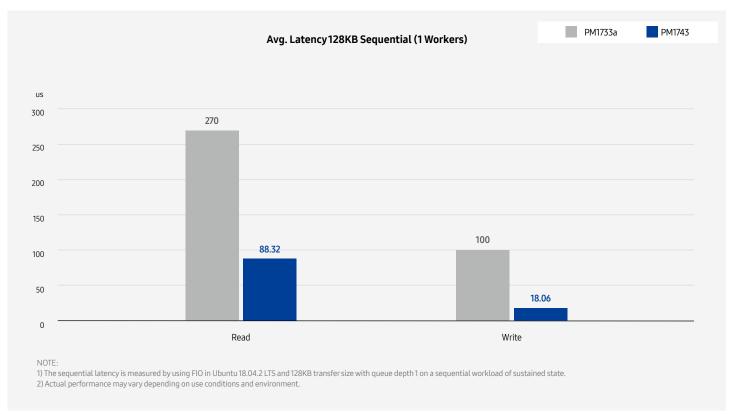* This information is subject to change without notice.

The PM1743 is designed to Open Compute Project specifications and is backwards compatible, so it offers speed advantages even across previous-generation PCIe interfaces. The flexibility to deploy a new generation of SSDs wherever they can meet evolving customer needs could help support the growing demand for high-performance computing servers that offer artificial intelligence and machine learning (AI/ML) capabilities, as well as hyperscale and Edge-to-Cloud solutions.

The PM1743's performance compared to other available products

The PM1743 demonstrates superior performance across fourth-generation PCIe interfaces compared to both its predecessor, the PM9A3, and a competing 16-channel based SSD. Across fifth-generation PCIe interfaces, write performance remains at the maximum limit of NAND capability achieved across fourth-generation interfaces. Marked improvements in read performance and latency across fifth-generation interfaces demonstrate the PM1743's advanced capabilities in high-end systems for which no comparable products exist to date.

NOTE
1) Based on PCI Express ® Gen.4 x4, Gen.5 x4, Sequential performance measured by using FIO in Ubuntu 18.04.2 LTS with queue depth 256 by 1 worker (Job).
2) Actual performance may vary depending on use conditions and environment.

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4KB Ran. Read (IOPS)

Legend: PM1743_Gen5 · PM1743_Gen4 · PM1733a · PM9A3 · Competitor A

4KB Ran. Write (IOPS)

NOTE:
1) Based on PCI Express ® Gen.4 x4, Gen.5 x4, Sequential performance measured by using FIO in Ubuntu 18.04.2 LTS with queue depth 64 by 16 workers (Jobs).
2) Actual performance may vary depending on use conditions and environment.

Avg. Latency 128KB Sequential (1 Workers)

Legend: PM1733a · PM1743

	Read	Write
PM1733a	270	100
PM1743	88.32	18.06

NOTE:
1) The sequential latency is measured by using FIO in Ubuntu 18.04.2 LTS and 128KB transfer size with queue depth 1 on a sequential workload of sustained state.
2) Actual performance may vary depending on use conditions and environment.

The 16-terabyte PM1743 demonstrates excellent performance across all metrics, setting a new baseline for a market category that has gone unserved until now.

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A league of its own: PM1743 Gen5 16TB performance metrics

Legend: ■ QD1 ■ QD64 ■ QD128

Chart: **Avg. Latency 4KB Ran. Read** (Mixed, 1 Workers) — us

R/W	QD1	QD64	QD128
100/0	70.19	87.23	176.99
70/30	71.13	146.66	399.14
50/50	72.56	179.19	291.61
30/70	74.56	194.79	185.07

Chart: **Avg. Latency 4KB Ran. Write** (Mixed, 1 Workers) — us

R/W	QD1	QD64	QD128
70/30	7.83	12.38	307.83
50/50	8.29	60.29	291.17
30/70	8.40	128.09	332.81
0/100	7.08	177.85	388.92

Chart: **QoS 99% 4KB Ran. Read** (Mixed, 1 Workers) — us

R/W	QD1	QD64	QD128
100/0	83	141	231
70/30	96	424	594
50/50	112	441	603
30/70	133	441	429

Chart: **QoS 99% 4KB Ran. Write** (Mixed, 1 Workers) — us

R/W	QD1	QD64	QD128
70/30	9	29	334
50/50	9	115	355
30/70	9	167	367
0/100	7	208	416

Chart: **QoS 99.99% 4KB Ran. Read** (Mixed, 1 Workers) — us

R/W	QD1	QD64	QD128
100/0	122	217	306
70/30	251	832	848
50/50	269	791	889
30/70	314	701	701

Chart: **QoS 99.99% 4KB Ran. Write** (Mixed, 1 Workers) — us

R/W	QD1	QD64	QD128
70/30	10	44	359
50/50	10	269	2,835
30/70	9	1,123	2,089
0/100	9	1,647	2,638

Reliability

Samsung's PM1743 ensures **reliability** of data operations by

- **Supporting dual port operations.** PM1743 is the first 16-channel SSD to do so and as such, provides enterprise users with an unparalleled combination of speed and reliability. Dual port operation also expands availability in the event of a failure.
- **Providing datacenters with early warning.** Through the utilization of dual ports, datacenters can be notified about issues to manage, long before they have a discernible effect on customers.
- **Including enhanced telemetry.** This capability collects and automatically transmits drive data in an encrypted format — including lifetime writes, capacitor health and workload over time — enabling preemptive diagnosis of potential failures. With this information, customers can take steps to reduce the risk of drive failure and maintain a high level of reliability
- and provides quicker resolutions. The customer can receive the initial resolution in two steps: first by running the SSD Toolkit and second by sending the debug information back to Samsung and effectively getting the resolution.

The result is fast, easy and automated control that offers a better experience across analytics servers.

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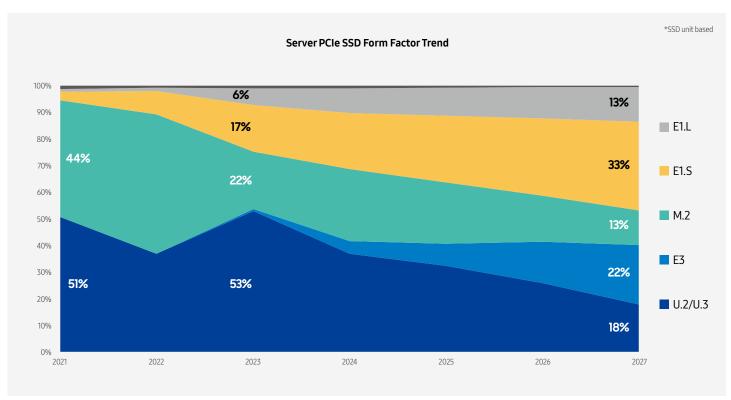
Efficiency

More storage and better performance have historically had an impact on operating costs. As datacenters add more devices, those devices consume more power and emit more heat. Increasing capacity efficiently is a primary concern.

Because SSDs rely on silicon chips mounted to integrated circuit boards rather than the bulkier magnetic media used in traditional HDDs, they can be manufactured in a wider variety of form factors. As SSDs have overtaken HDDs in servers, the industry has begun to gravitate toward more efficient form factors that maximize both the number of devices that can fit in a server unit and the arrangement of those devices to maximize airflow and reduce heat.

The PM1743 represents a 40% gain in efficiency over previous generations of devices, which allows it to deliver unparalleled performance and reliability without a major impact on operating overhead.

The PM1743 will be available in a variety of form factors:

- The drive dynamically supports **both conventional 2.5-inch form factors (U.2 and U.3).**
- It is also available in an **EDSFF form factor model,** designed to meet Enterprise and Datacenter Standard Form Factor (EDSFF) specifications. The E3.S form factor is expected to become more popular in next-generation enterprise servers and datacenters, due to their design's maximizing of storage density, signal integrity and thermal efficiency. EDSFF SSDs will allow customers to provide twice as much storage on a single rack unit as they could with the traditional 2.5-inch form factor.

Server PCIe SSD Form Factor Trend

*SSD unit based

Legend: E1.L, E1.S, M.2, E3, U.2/U.3

Source : Forward Insight 2023.3Q

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Samsung's PM1743
meets a dynamic market at a critical moment

The PM1743 represents an evolution in SSD technology that is driven by the fast-changing needs of enterprise customers. These are the target applications for the PM1743:

- **High-end computing servers.** The PM1743 is suitable for analysis functions driven by AI/ML needs, as well as core computing.
- **Compute servers from Edge to Cloud.** As the internet of things (IoT) and host or real-time data operations become more prevalent, there is an increase in demand for servers capable of this level of performance.
- **Mixed workload services.** These are made up of application servers and file servers and utilize PCIe Gen.5 speed in streaming services, as well as in application stores/

Enterprise servers must deliver more performance and storage capacity than ever before. That trend is unlikely to change: AI/ML operations continue to mature. Generative AI is in its early stages. Data-driven enterprises have only just begun to investigate the potential insights they can uncover with the growing combination of first-party and third-party data becoming available to them.

Conclusion

The need for data storage will continue to rise, as will the need for more powerful data processing in real time. These trends will continue to push against the boundaries of what datacenters and enterprise servers can provide. To keep up with this evolution, enterprise datacenters require powerful, consistent performance. They must take a proactive approach to deliver more than what customers are demanding today so that they can maintain the capacity to deliver what they will need tomorrow.

Every evolution in data volume, speed and performance has sparked changes in enterprise servers and datacenters. Most recently, the move toward disaggregated computing, where the constituent parts of a traditional computer become resources throughout a datacenter, has pushed the boundaries of performance and scalability even further. In that environment, high-performance SSD storage will help reduce a key bottleneck.

The fifth generation of PCIe interfaces is ushering in a new era of faster workload processing, less server downtime and better efficiency. As new architectures and emerging SSD capabilities advance, speed and performance requirements could jump unpredictably. When they do, early adopters will have secured a key advantage.

For more information

For more information about the Samsung Semiconductor products, visit **semiconductor.samsung.com.**

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