Ultra-Low Latency with Samsung Z-NAND SSD

Breakthrough storage for a new generation of enterprise and data center infrastructure

A Technology Brief by Samsung Memory Solutions Lab

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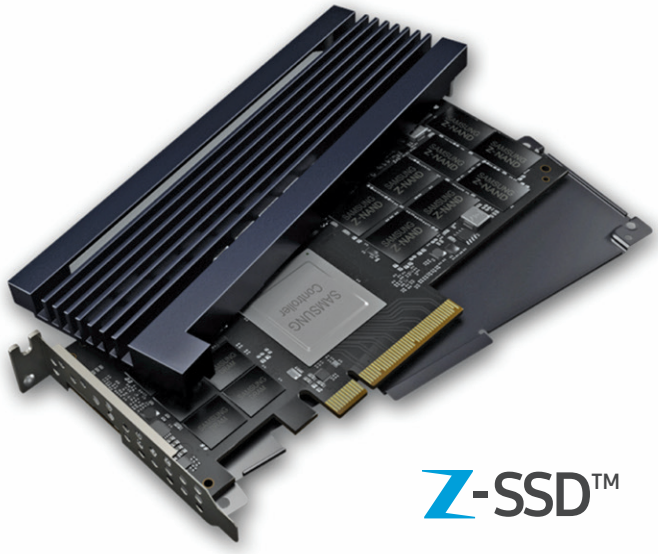
Introduction

The rapid adoption of flash in the data center and the enterprise has contributed to significant improvements in the storage infrastructure and the applications that run on top of it. Meanwhile, rapidly growing demand has driven all suppliers to offer comparable flash storage devices. While IOPS, capacity and bandwidth remain important storage criteria, the latency in flash devices can become a significant bottleneck hampering system optimization. To address the performance gaps resulting from unacceptably low latency, Samsung has developed a disruptive new tier of NAND technology called Z-NAND™, which is set to give enterprise architects new highly-efficient storage options for their data-intensive workloads. It is expected to be in demand almost overnight in a wide range of industries, for use cases such as high capacity caching, NoSQL databases, data stores and business analytics.



Z-SSD: Samsung Z-NAND SSD

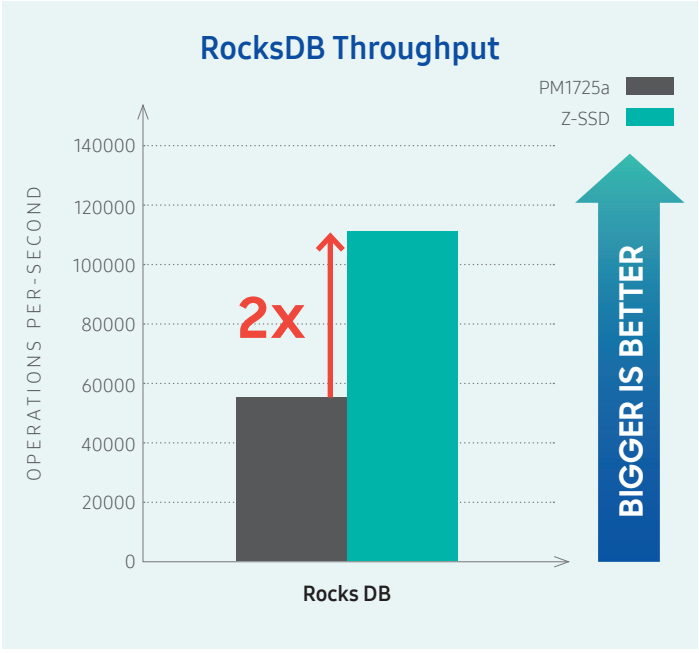
The first storage device based on Samsung's Z-NAND technology is the SZ985 — an "ultra-low latency" flash storage drive. The Samsung SZ985 Z-NAND SSD shares the fundamental structure of Samsung's V-NAND — the industry's leading 3D flash production technology. It offers a unique circuit design and controller, which together serve to maximize performance. The SZ985 provides 5.5 times lower latency than today's leading NVMe SSDs. Available in an 800GB capacity, the drive has been designed with proven NAND technology for improved reliability, exceptional scalability and greater cost-efficiency. This pioneering generation of Z-SSD's can easily be considered the optimal storage solution for latency-sensitive, I/O-intensive applications.

Samsung SZ985 Z-NAND SSD	
Form Factor	HHHL
Interface	PCIe Gen3 x4
NAND	Z-NAND Technology
Port	Single
Data Transfer Rate (128KB data size)	
Sequential Read / Write (GB/s)	3.2 / 3.2
Data I/O Speed (4KB data Size, sustained)	
Random Read / Write (IOPs)	750K/ 170K
Latency (sustained random workload)	
Random Read	12 - 20µs
Random Write (Typical)	16µs
DWPD	30
Capacity	800GB

Unprecedented Storage Performance for Data-Intensive Workloads

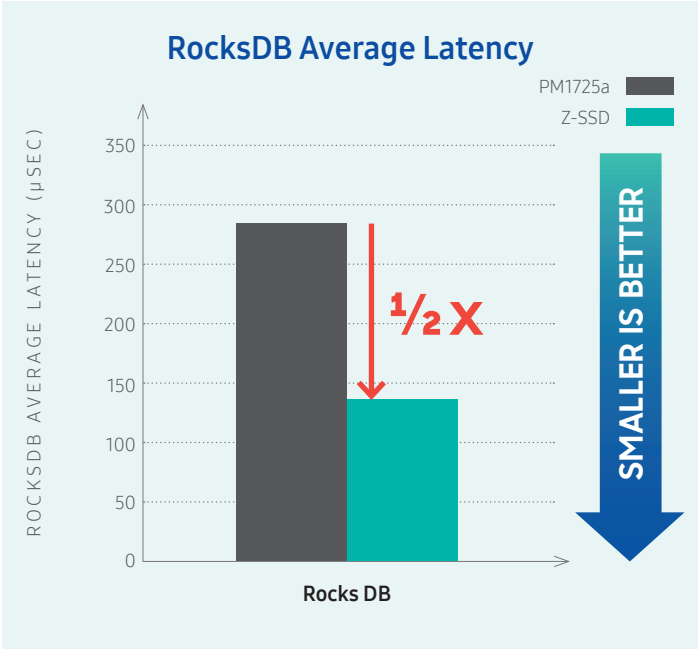
Latency, speed, scalability, capacity and attractive pricing all factor into the viability of the SZ985 for big data applications. A comparison of application-specific benchmarks for massive data workloads clearly demonstrates the superiority of the Samsung Z-NAND SSD over the highest-performing NVMe SSD, when running mission-critical applications. Moreover, the SZ985 is a feature-rich storage solution that can be applied to a host of data-intensive applications right out of the box. As the I/O storage stack continues to improve, applications can expect to gain substantial additional performance when deploying Samsung Z-NAND SSD.

Application performance is characterized by an increase in throughput, a decrease in latency or both concurrently. Our performance testing demonstrates that the raw latency speed-ups of the Z-SSD™ device are passed on to the application level, delivering tangible user-level performance acceleration in a diverse set of use-cases.



Impact of RocksDB

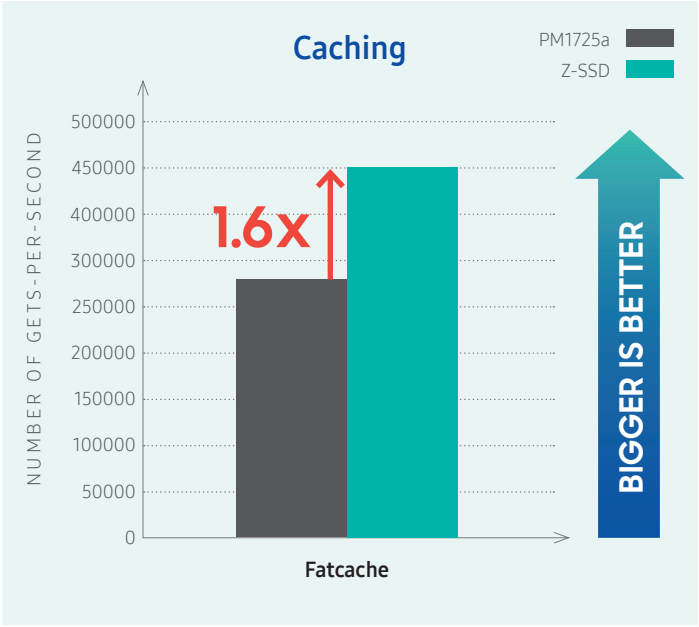
RocksDB is a popular "key value" store that serves as a back end to other applications and databases (e.g. MongoDB, Redis, MySQL, etc.) and is prevalent in many data center productions stacks. Our RocksDB performance benchmarking illustrates a large increase in throughput as a result of the decrease in Z-SSD device latency. A deployment of Samsung SZ985 Z-NAND SSD compared to that of the popular PM1725a NVMe SSD demonstrates that databases can expect to see their throughput double and their latency cut in half.



Unprecedented Storage Performance for Data-Intensive Workloads (continued)

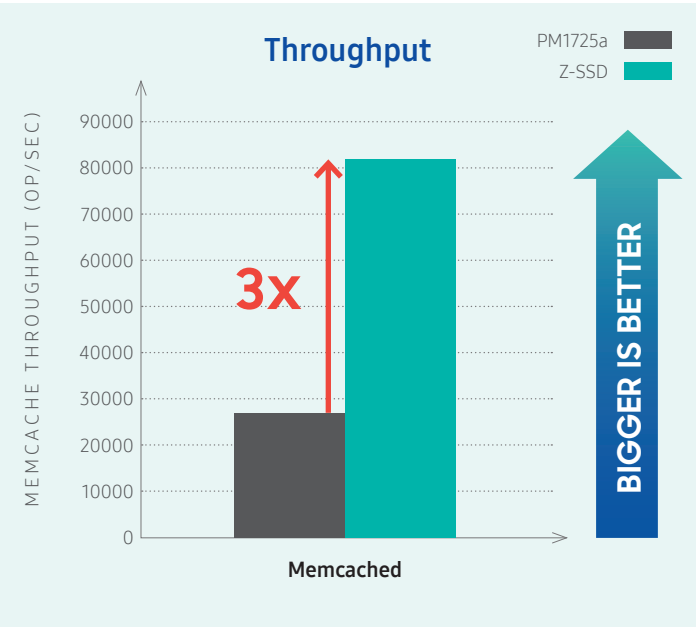
Caching

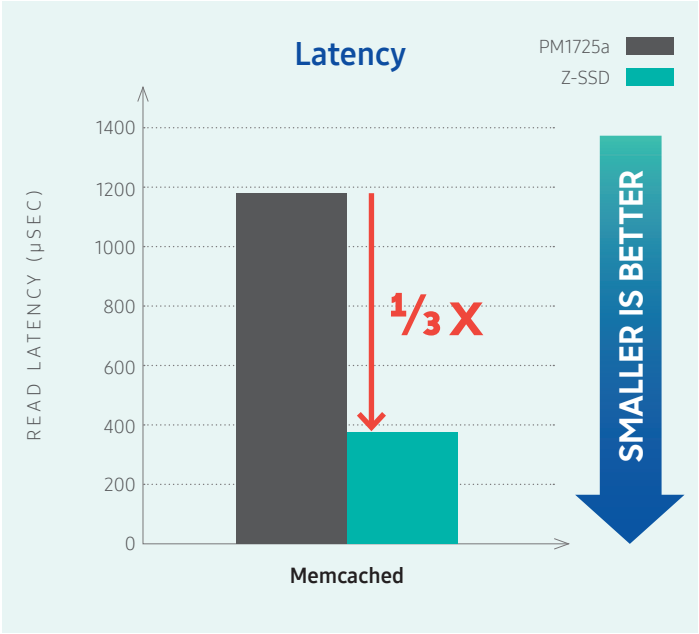
Another important application is caching. Memcached is a distributed memory caching system. It is typically used to speed up database-driven websites by caching data in RAM to reduce the number of times the database must be accessed. Fatcache extends the Memcached system to advanced SSDs, to provide a much larger caching capacity. Our tests using fatcache show a 1.6x throughput increase with Z-SSD compared to the PM1725a, reaffirming that Z-SSD is well-suited for caching purposes.



Operating System Paging

Paging performance can also be critical. Page swapping happens when the accumulated working set size exceeds the capacity of the server's physical memory. Due to the dynamic nature of data center workloads, swapping cannot be completely avoided. However, given the large latency gap between memory and storage, OS paging can be detrimental to application performance and to the user experience. We evaluated OS paging performance with Z-SSD using Memcached as a test case. Our results show that Z-SSD is a superior choice as a swap space target — it provides 3x the performance at a third of the latency, compared to the PM1725a, thus successfully mitigating user-level performance degradation.





To summarize, these three test examples demonstrate Z-NAND SSD's high degree of effectiveness in increasing throughput and lowering latency, across diverse domains. They show that the exceptional device-level performance of Z-NAND carries through to the application level, delivering an overall user-level performance increase and simplifying integration of the storage device in virtually any application.

Conclusion

New benchmark testing shows conclusively that the SZ985 Z-NAND SSD enables a new tier of storage with the highest throughput and lowest latency of any flash storage on the market today. This gives enterprise architects a compelling reason to consider Z-NAND when optimizing current and future workloads. The SZ985 combines extreme performance, durability, low latency and high capacity into a single, ready-to-install storage device suitable for most data centers today.

For more information contact Samsung at:
msl-inquiry@ssi.samsung.com.

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