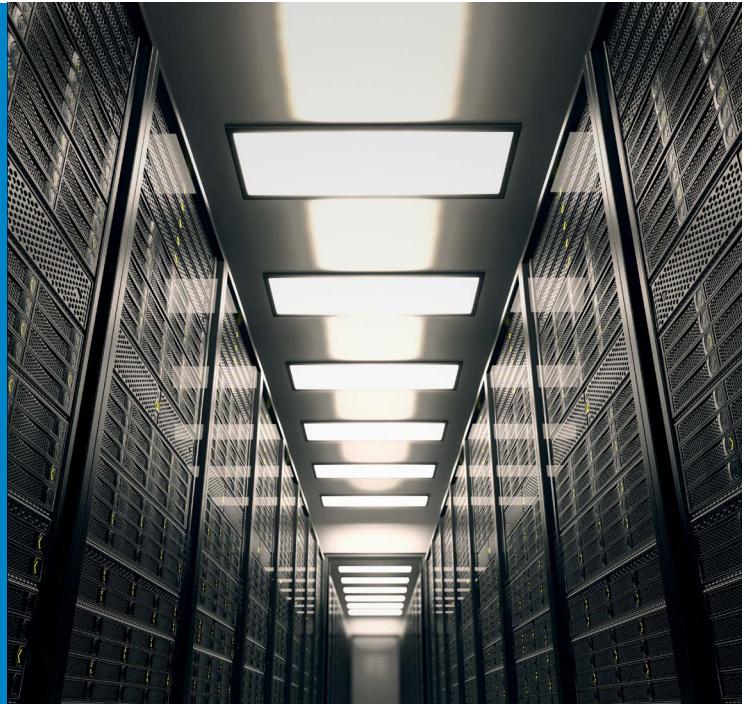


Multi-stream technology

Experience up to nine times faster throughput performance with endurance that lasts up to three times longer



Overview

NAND flash SSDs are increasingly deployed within enterprise data centers due to their high performance and low power consumption. The lower TCO (total cost of ownership) of NAND flash is also accelerating SSD adoption to replace HDDs in storage applications.

One SSD drawback is that, as a device continually writes data, valid data can be fragmented across the NAND flash medium.

To reclaim free space, the garbage collection process copies user data to new storage blocks and erases invalid data storage blocks, thereby allowing the media to store new write data.

Garbage collection processing decreases SSD read and write performance. In addition, garbage collection increases write amplification because individual host data write requests can result in multiple internal SSD writes to the NAND medium.

Valid data is first read from a media block that is about to be erased, and then rewritten to another media storage block, before the new host data write. Consequently, write amplification decreases SSD lifetime because each NAND chip can only endure a certain number of writes before it begins to fail.

Innovative multi-stream technology is standardized in T10 and implemented in the Samsung PM953 NVMe SSD. This new technology reduces or eliminates the garbage collection process by storing associated or similar lifetime data in the same erase block.

The process helps avoid NAND erase block fragmentation for data with the same lifetime. As a result of the decreased write amplification, storage systems exhibit improved read/write performance and a longer SSD device lifetime.

What is a stream?

Streams are host hints that indicate when data writes are associated with one another or have a similar lifetime. A group of individual data writes form a collective stream, and each stream is given a unique ID. For example, “hot” data can be assigned a unique stream ID, and all the data for that stream ID goes to the same erase block.

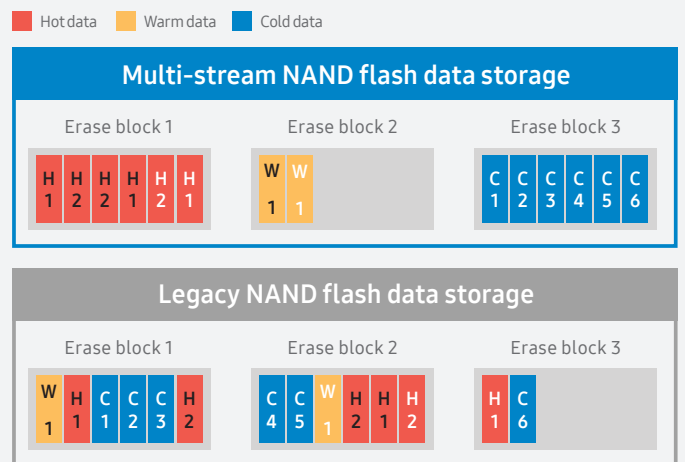


Figure 1. Multi-stream vs. legacy storage

Make your data center more efficient with multi-stream technology

System configuration	Fio configuration
<ul style="list-style-type: none"> Hardware system Quad Core Intel i7-4790 CPU 3.60GHz 16GB memory Software - Ubuntu 14.04 LTS, v4.03 Kernel with multi-stream patch - Fio 2.2.5 with multi-stream patch Device PM953 960 GB M.2 SSD* 	<ul style="list-style-type: none"> I/O workload: 70% read/100% write 4 sequential write jobs with different data lifetimes (e.g., 1x, 10x, 33x, 55x)

Figure 2. System and Fio configuration

* PM953 is used as a POC (proof of concept) for multi-stream technology to demonstrate its feasibility and potential for use. Note that a proof of concept is typically small and may or may not be complete.

Reduce garbage collection with multi-stream

Data within an erase block is associated with the other data or has a similar lifetime. This association increases the chance of freeing an entire erase block when data is deleted by a host system. Thus, when garbage is collected, significantly less data (or no data) must be moved.

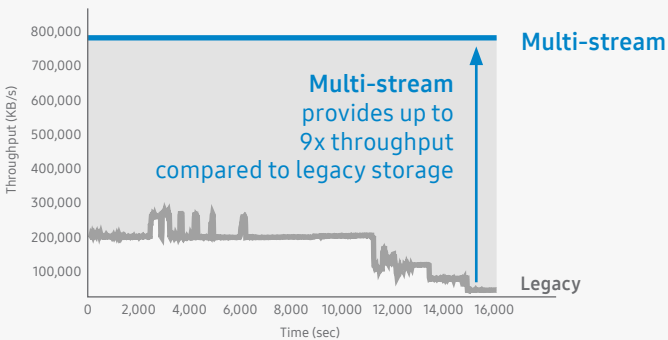


Figure 3. Write IOPS throughput comparison between multi-stream and legacy storage

Get up to nine times the throughput and three times the endurance with multi-stream

Performance measurements of Samsung NVMe SSDs with multi-stream technology are based on the Fio benchmark tool.

As shown in the Figure 3 Fio benchmark measurement results, a multi-stream SSD improves write throughput up to nine times over a legacy SSD. A multi-stream SSD's lifetime can be more than three times as long as a legacy SSD's lifetime.

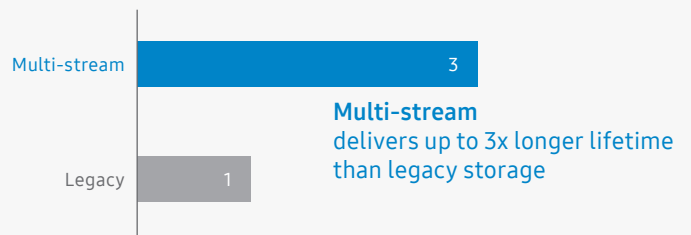


Figure 4. Lifetime comparison between multi-stream and legacy SSD

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