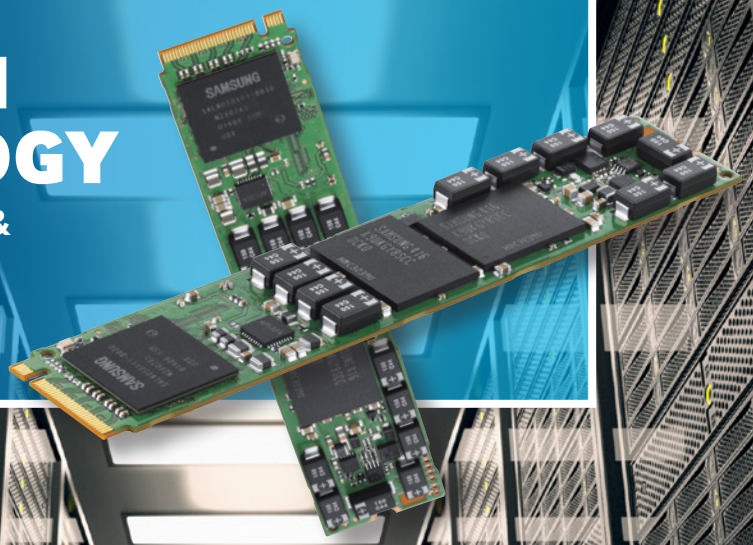
SAMSUNG

MULTI-STREAM SSD TECHNOLOGY

UP TO 9x READ PERFORMANCE & 3x WRITE ENDURANCE

T10 SCSI STANDARD



NAND flash solid-state drives (SSDs) are increasingly deployed within enterprise datacenters thanks to their high performance and low power consumption. Decreasing NAND flash cost-per-gigabyte is also accelerating SSD adoption to replace hard disk drives (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 (See Figure 1). To reclaim free space, *garbage collection* activity copies user data to new storage blocks and erases invalid data storage blocks, thereby allowing the media to store new write data. However, garbage collection processing decreases both 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. Here, valid data is first read from a media block about to be erased, then rewritten to another media storage block, accompanied by the write to store new host data. Consequently, write amplification decreases SSD lifetime because each NAND chip can endure a certain number of writes before it begins to fail.

MULTI-STREAM SSD TECHNOLOGY

With multi-stream technology, an innovative new technology standardized in T10, implemented in Samsung PM953S NVMe SSD, garbage collection can be eliminated or reduced by storing associated or similar lifetime data in the same erase block. This 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. That is, a group of individual data writes are a collective stream and each stream is given a stream ID. For example, “hot” data can be assigned a unique stream ID and the data for that stream ID would go to the same erase block (Figure 1).

How does multi-stream eliminate or reduce garbage collection?

Because the data within an erase block has a similar lifetime or is associated with one another, there is a greater chance that an entire erase block is freed when data is deleted by a host system. The FIO benchmark tool is used for the performance measurements on Samsung PM953S M.2 NVMe SSDs. This SSD implements the NVMe interface of the multi-stream technology as standardized in T10 on May 2015. Figure 2 shows the performance measurement system and SIO configuration.

Achieve up to 9x throughput and 3x endurance with a multi-stream SSD!

As seen in Figure 3, FIO performance benchmark measurement results show that a multi-stream SSD improves Write throughput up to 9x over a legacy SSD. Importantly, the legacy SSD endurance can be potentially be more than 3x of a legacy SSD (See Figure 4).

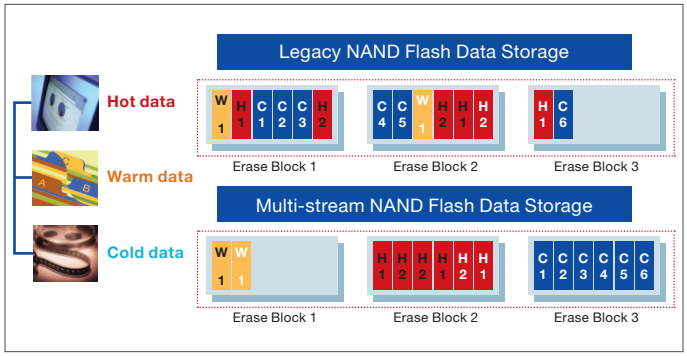


Figure 1. Legacy vs Multi-Stream Storage

System Configuration	FIO Configuration
• **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** PM953S 960GB M.2 SSD	• I/O workload: 70% Read/ 100% Write • 4 sequential write jobs with different data lifetimes (e.g., 1x, 10x, 33x, 55x) * *Higher performance dependent on applications*

Figure 2. System and FIO configuration

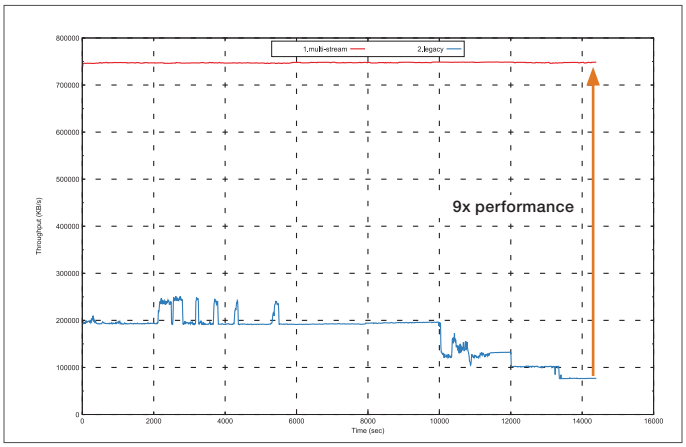


Figure 3. Read IOPs throughput

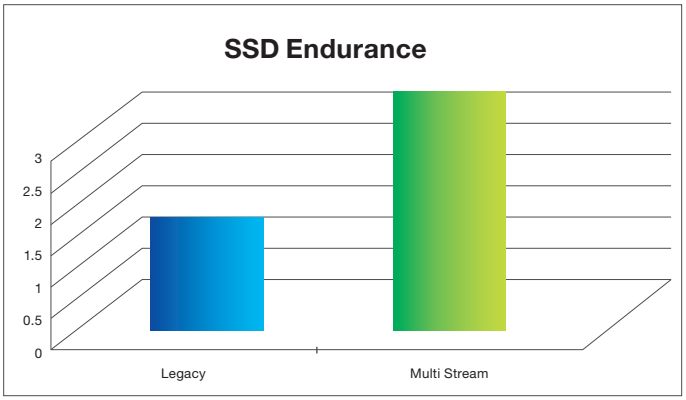


Figure 4. SSD Endurance

Samsung SSD activated

For more information, visit: www.samsung.com/flash-ssd
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