Samsung Multi-stream Technology

Achieve up to 9x throughput and 3x endurance with Multi-stream SSD

Solution Brief

Highlights

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

■ Hot data ■ Warm data ■ Cold data

Multi-stream NAND flash data storage

Erase block 1	Erase block 2	Erase block 3
H1 H2 H1 H1 H2 H1	W1 W1	C1 C2 C3 C4 C5 C6

Legacy NAND flash data storage

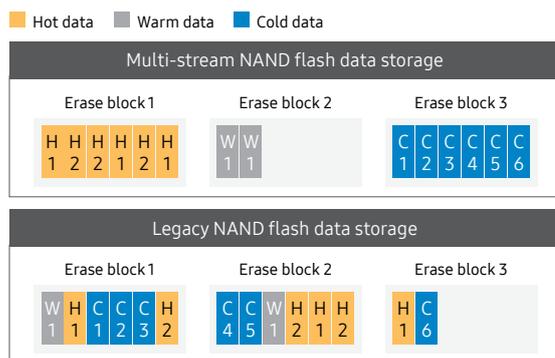| Erase block 1	Erase block 2	Erase block 3
W1 H1 C1 C2 C3 H2	C4 C5 W1 H1 H2 H2	H1 C6

Figure 1. Multi-stream vs. legacy storage

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 write new 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.

In case of SSD read process, 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 data center SSDs. 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 of 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 data writes 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.

SAMSUNG

Make your data center more efficient with multi-stream technology

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** PM953 960 GB M.2 SSD*	• 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.

Get up to nine times faster throughput and three times longer 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.
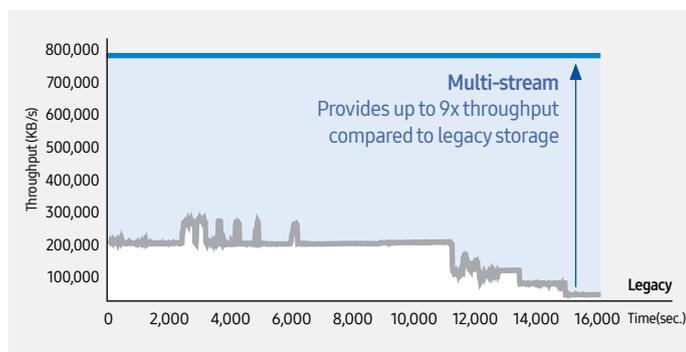

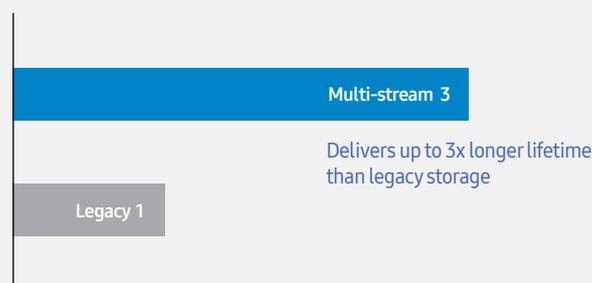Figure 3. Write IOPS throughput comparison between multi-stream and legacy storage

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

For more information

For more information about the Samsung multi-stream technology, visit **www.samsung.com/semiconductor**.

About Samsung Electronics Co., Ltd.

Samsung inspires the world and shapes the future with transformative ideas and technologies. The company is redefining the worlds of TVs, smartphones, wearable devices, tablets, digital appliances, network systems, and memory, system LSI and LED solutions. For the latest news, please visit the Samsung Newsroom at **news.samsung.com.**

SAMSUNG