Performance Analysis of SSD write using TRIM in NTFS and EXT4

Giryoung Kim, Dongkun Shin
Mobile Communication Engineering,
Sungkyunkwan University
Suwon, Korea
Anti09@skku.edu
dongkun@skku.edu

***Abstract*- The NAND flash memory based SSDs are considered to replace the existing HDDs. But the disadvantage of SSD is degradation of write performance. Because a write in flash memory should be preceded by an erase operation, a write performance is reduced. To maximize the write performance, SSD is used with the TRIM command. NTFS and EXT4 are known to support TRIM. This paper is compared by a write performance for TRIM on each file system.**

Keyword – SSD, TRIM, NAND-flash, NTFS, EXT4

I. Introduction

Recent improvement of NAND-flash based solid-state disks (SSD) is expected to change considerably on the future of storage market. The superior Flash memory storage has reduced in price, increased in per-unit extent, improved in reliability, and addressed the random write performance handicap, which is traditionally associated with the technology, by various creative methods. These benefits enable SSDs to be widely used in almost every side of modern computing systems, from low-end PCs to high-end servers in supercomputing, thus making the performance and permanence issues of solid-state storage system increasingly attractive to both academia and industry [1,3].

However, because SSD is based NAND flash memories, it has a characteristic that make difficult straightforward replacement of HDD. A write in SSD should be preceded by an erase operation, which takes an order of magnitude longer than a write operation[2]. A write performance in SSD is slower than that in HDD. To compensate for this defect, it is used to command called a TRIM.

Not all file systems make use of TRIM. NTFS and Ext4 are known to support it. So we analyze how to improve TRIM write performance for different file system

The remainder of this paper is organized as follows. In Section 2, we describe TRIM in SSD. Section 3 evaluates TRIM write in NTFS and EXT4. Section 4 concludes this work.

II. Related Works

A TRIM command allows an operating system to inform a solid-state drive (SSD) which blocks of data are no longer considered in use and can be wiped internally. While TRIM is frequently spelled in capital letters, it is not an acronym; it is merely a command name [4]

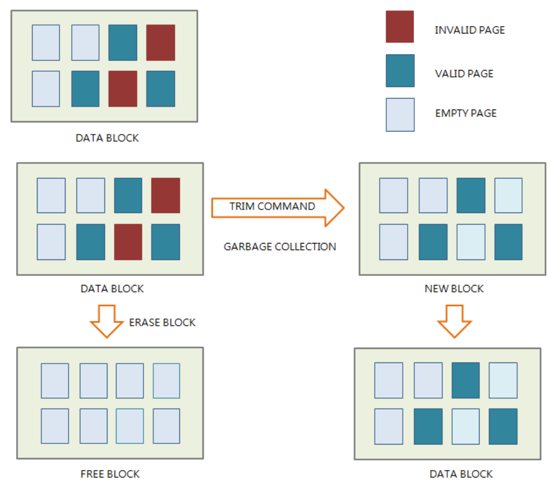

Figure 1 : Principle of TRIM

Figure 1 shows the Principle of TRIM[5]. The TRIM command is designed to enable the operating system to notify the SSD of which pages of data are now invalid due to erases by the user or operating system itself. During a delete operation the OS will not only mark the sectors as free for new data, but it will also send a TRIM command to the SSD with the associated LBAs to be marked as no longer valid. After that point the SSD knows not to relocate the data in those LBAs during garbage collection. This will result in fewer writes to the flash enabling a lower write amplification and longer endurance. Different SSDs will act on the TRIM command somewhat differently so the final performance can also be different between different SSDs.

As the command completely removes the data it affects, typical data recovery is made impossible.

III. Perormance Evaluation

We compared NTFS to EXT4 using the "iozone" benchmark program. The measurement computer had a Core i3-2100 3.10GHz CPU, 2-Gbyte of memory, and Samsung 470 series SSD with 64-Gbyte and SATA connection. The Linux kernel version was 2.6.38.

The measurement carried out in two kinds of file system, NTFS and EXT4. When TRIM operates and does not, we are compared by measuring the value of throughput. For operating TRIM, the journaling function is disabled on ext4 file system. For measuring the performance of TRIM, we fill in the target SSD with data fully. We erase some amount of data under TRIM operates and does not. And then we measure throughput by benchmark program.

NTFS

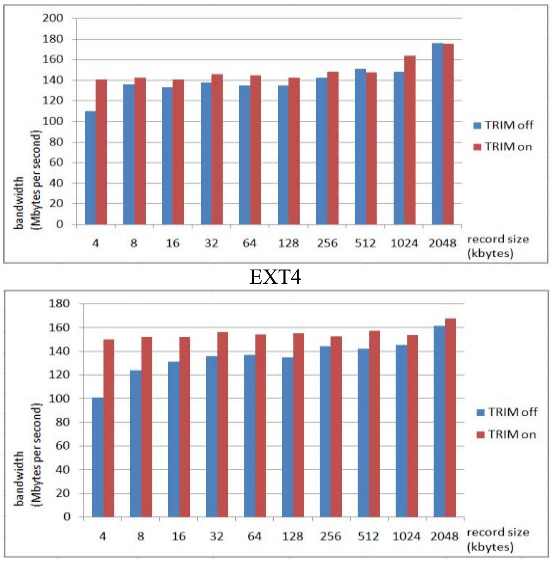

Figure 2 : Comparision of Write performance

Figure 2 shows the measurement results for writing. In write operation, enabling TRIM shows better performance than disabling TRIM. In particular, EXT4 shows higher performance.

NTFS

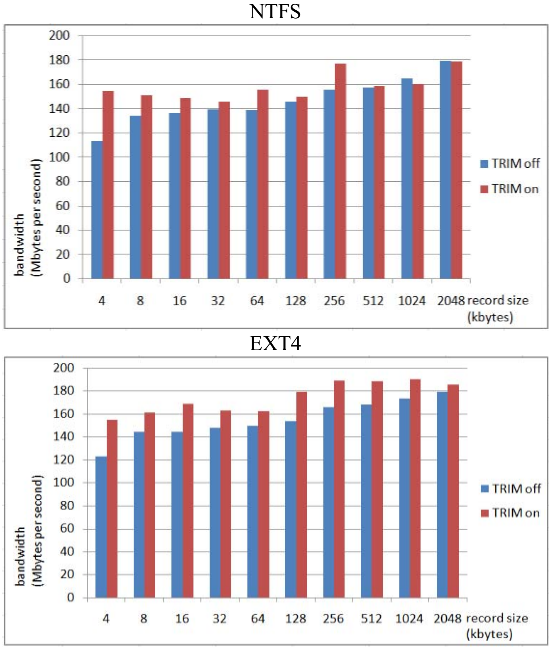

Figure 3 : Comparision of Re-write performance

Figure 3 shows the measurement results for Re-writing. In re-write operation, EXT4 shows higher performance. NTFS does not have a big difference, but it shows a better performance.

NTFS

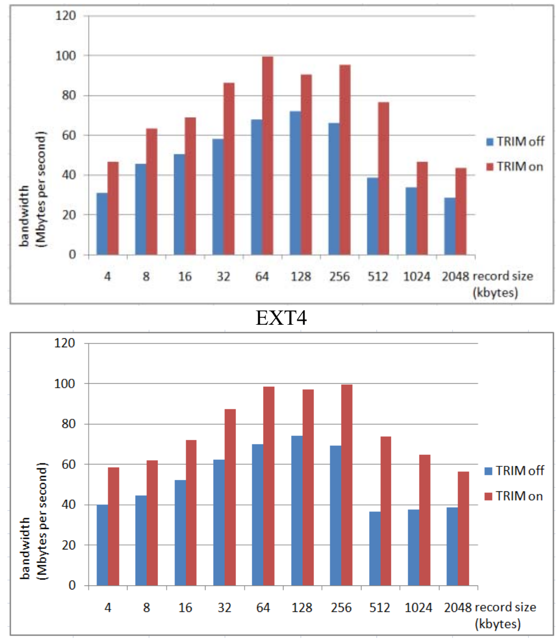

Figure 4 : Comparision of Random write performance

Figure 4 shows the measurement results for random writing. In random write operation, enabling TRIM shows better performance than disabling TRIM. Regardless of file system, random write appeared to be very effective in the TRIM.

IV. Conclusion

This paper presents TRIM to improve the SSD write performance in NTFS and EXT4. In particular, EXT4 showed more stable performance. TRIM also shows very high performance in random write. In future we are expecting that make file system using TRIM for SSD.

References

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