



# *Erasing an SSD is Easy and Fast!*

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*... then why is it so hard to eliminate one file?*

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## Keeping your data from prying eyes...

- Some data are so sensitive, they must be *verifiably* “destroyed” or “sanitized”
  - *Without having to scrap the whole storage device!!*
- Forensically, it may be possible to recover “deleted” files from SSD
- **Difficult!** but we cannot say “impossible”

## The Problem

- Page writes and Block erases cause SSD designers to delay the actual erase of deleted or “invalidated” data
- Deterministic TRIM helps
  - Returned data from an interface read of an invalidated LBA results in 0 over the interface.
  - Physical mode reads could reveal the “deleted” bits.



## SANITIZE: Securely Erasing Data



Fast, Easy and Inexpensive method for  
SSD repurpose/retirement

SATA & SAS  
SANITIZE  
commands  
for your  
SSD

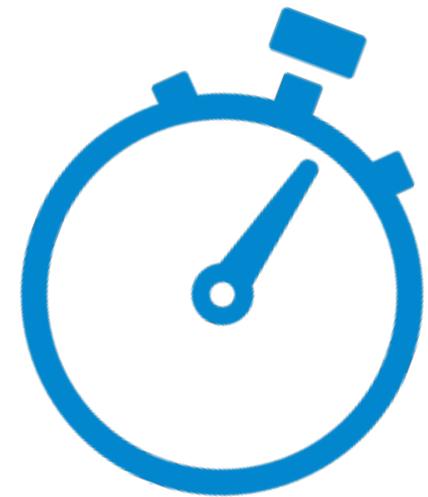
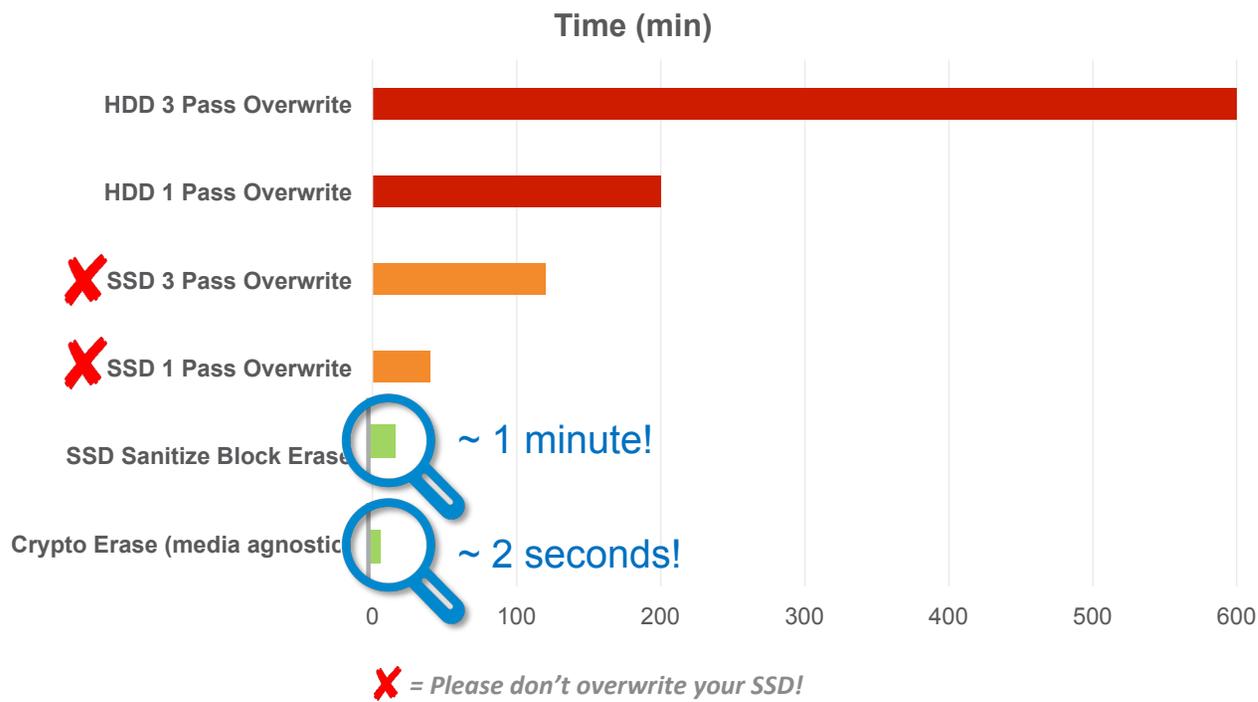
- **SANITIZE CRYPTO ERASE \***
  - “Instant Scramble Erase” for rapid data destruction by deleting and generating a new encryption key
- **SANITIZE BLOCK ERASE \***
  - All NAND blocks containing user data will be erased
  - Includes Over-provision & bad blocks

Sanitize  
supported by:



\* SANITIZE now accepted as a data “purge” method under [NIST Special Publication 800-88 – Revision 1](#)

## How long does it take to “Sanitize” a 1TB Drive?



*“Time is Money!”*

# Garbage Collection (GC) on a Hypothetical SSD

**1** We start with a full NAND block containing 8 pages of valid user data.



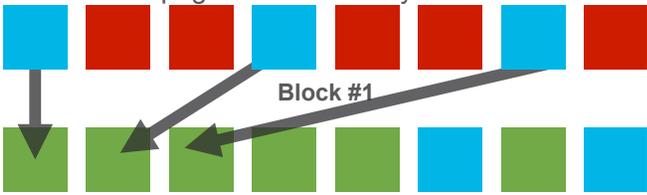
Block #1

**2** Over time, the user deletes files; the OS/FS tell the SSD that some blocks are invalid.



Block #1 (With Invalid Data)

**3** Garbage Collection algorithm copies valid data from Block #1 into a separate block (Block #2) that has erased pages that are ready for new data.



Block #1

Block #n

**4** Block #1 now contains only invalid data, although the bits are still there. Block #2 now contains the valid data originally stored in Block #1.



Block #1 (All Pages Contain Invalid Data)



Block #n

**5** The SSD needs space for new data, and erases Block #1, leaving it in an erased state, ready to receive new data. The bits are permanently

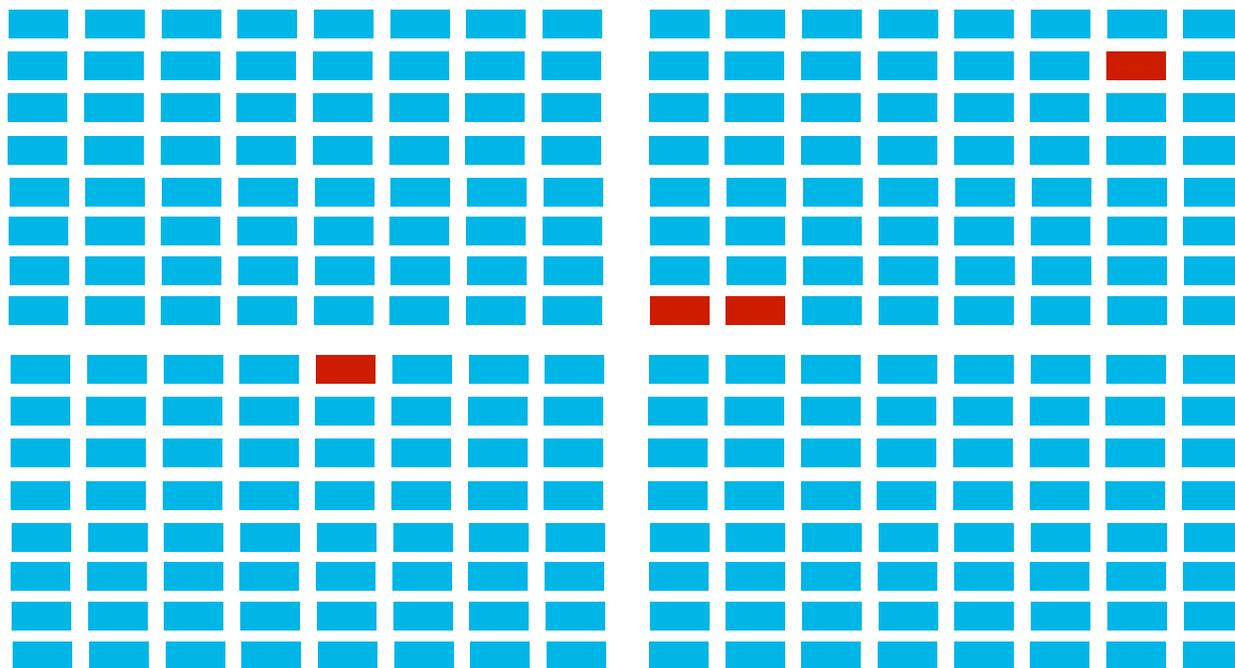


Block #1

■ NAND page w/data still in use    
 ■ NAND page with invalid data    
 ■ Erased NAND page, ready for new data



## Now, what if you REALLY want to delete a file?



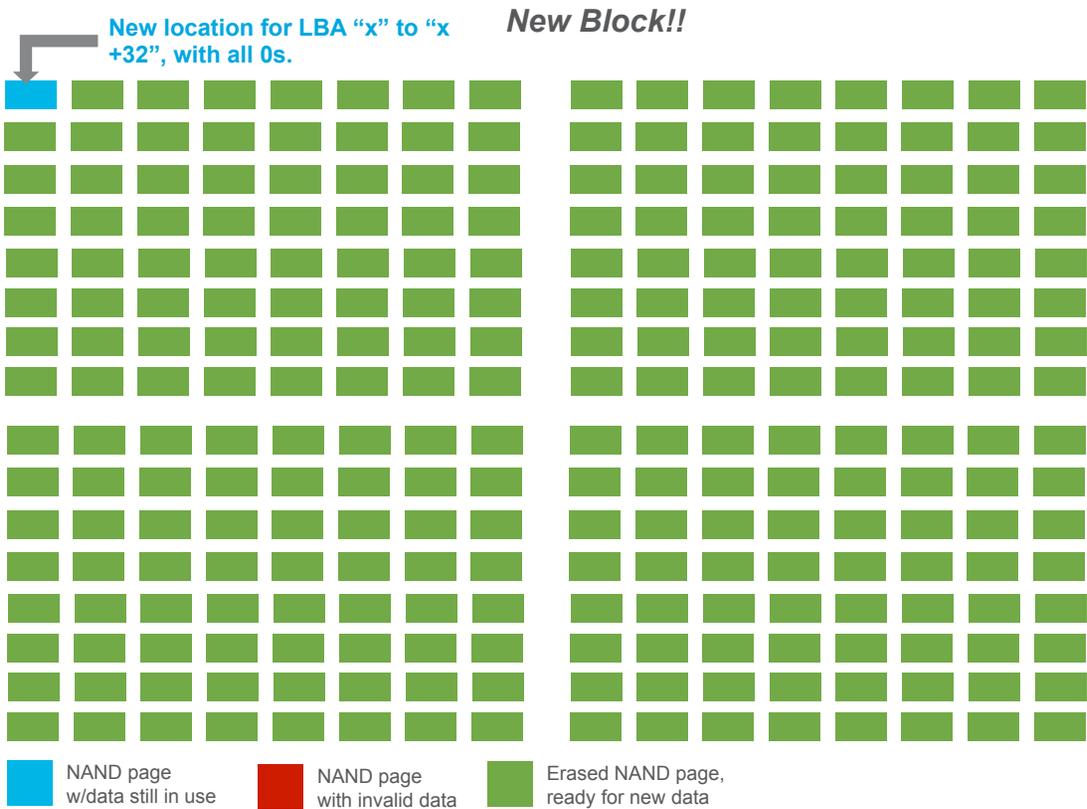
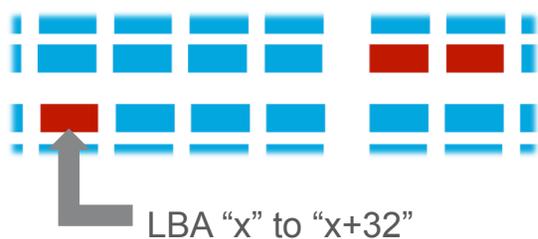
A more realistic NAND block contains 256 pages of 16kiB, total 4 MiB.

- In a full block, the user has deleted a file which is 64 MiB, and the user wants it securely erased.
- Normally, these pages would be invalidated, and stay unaddressed, but unerased, until GC is needed.
- Moving the valid pages prematurely could negatively affect "Write Amplification"!

■ NAND page w/data still in use   ■ NAND page with invalid data   ■ Erased NAND page, ready for new data



# Can't I over-write the LBAs?



A: Yes, you can try!

However, LBAs are dissociated from the physical location.

- You issue command, "Write all 0s to LBA x to x +32"
- SSD invalidates the old location
- SSD picks a new location for "all 0s"
- **Leaves the old bits in place, but unaddressed**

## So, what the heck do we do?

- For gov't agencies like NSA, for today, the answer is The Grinder
- What if we could do a “Forced Trim”?
  - Performance penalty
  - Write Amplification penalty
  - What about older copies of data?
  - *Certain agencies might be willing to pay!*
- ACS-4 has a new command, “ZERO EXT”
  - Investigating how we can apply this new command
- Can TCG Opal/Enterprise SEDs help?
  - Contain “data spills” to certain ranges/bands
  - Crypto Erase when needed





## Your Presenter



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Jon is a Sr. Technical Marketing Engineer in Micron's Storage Business Unit in Boise, Idaho. Jon facilitates new product integration and customer qualifications for notebook and desktop applications, as well as SSD in the data center. Jon is a creator of Micron's technical documentation, such as white papers and tech notes, and a blogger at [Micron's Storage Blogs](#). Jon plays a key role in product planning and development, bringing the voice of the customer directly to the development team.

Jon has more than 25 years of experience in the data storage industry, working with both magnetic media and solid state technologies.

Jon earned his Bachelor of Science degree in Electrical and Computer Engineering from the University of Colorado at Boulder.

