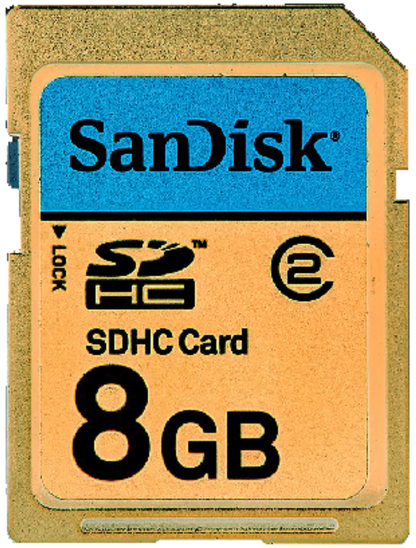
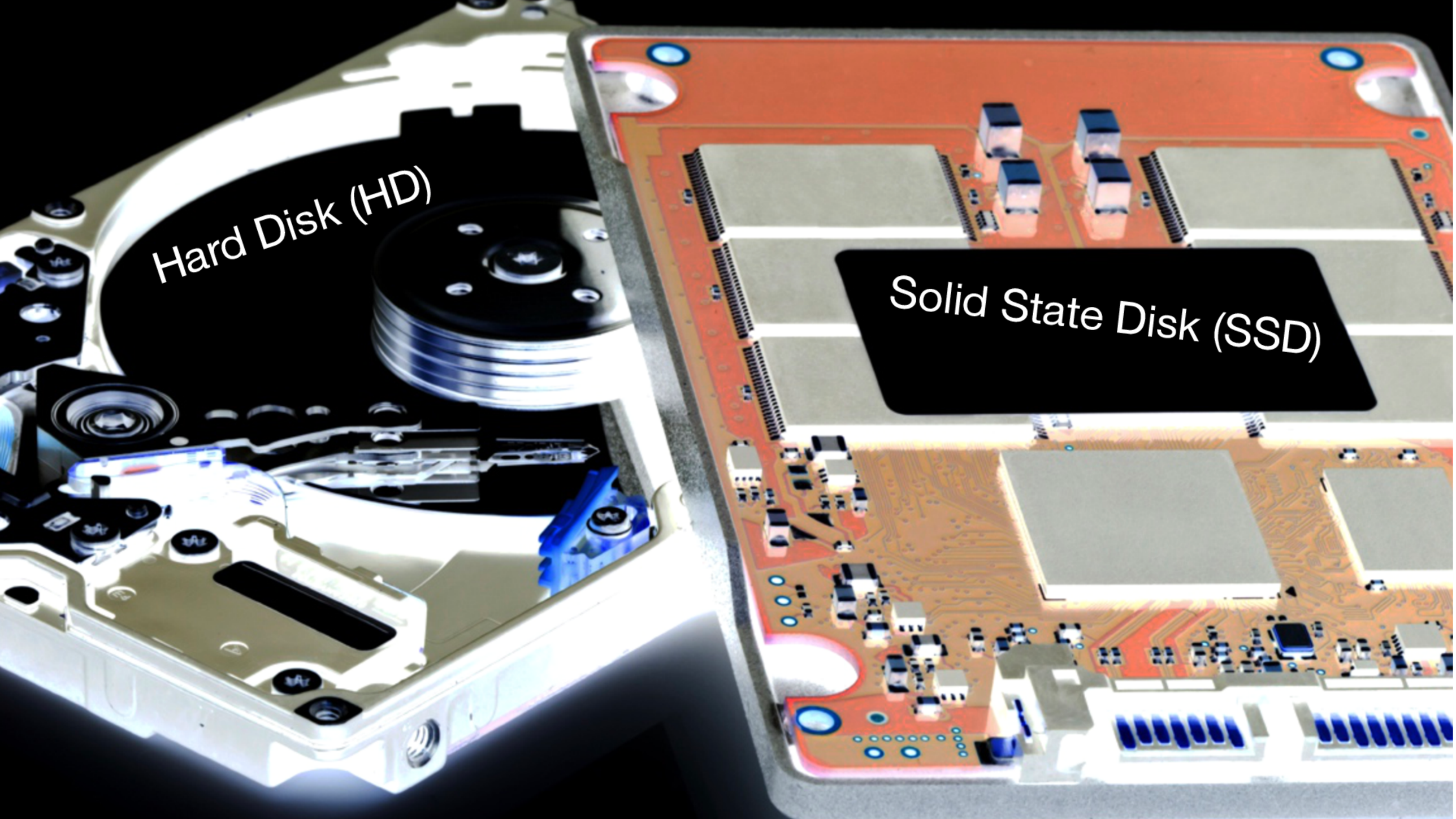
Flash Memory




Hard Disk (HD)
Solid State Disk (SSD)

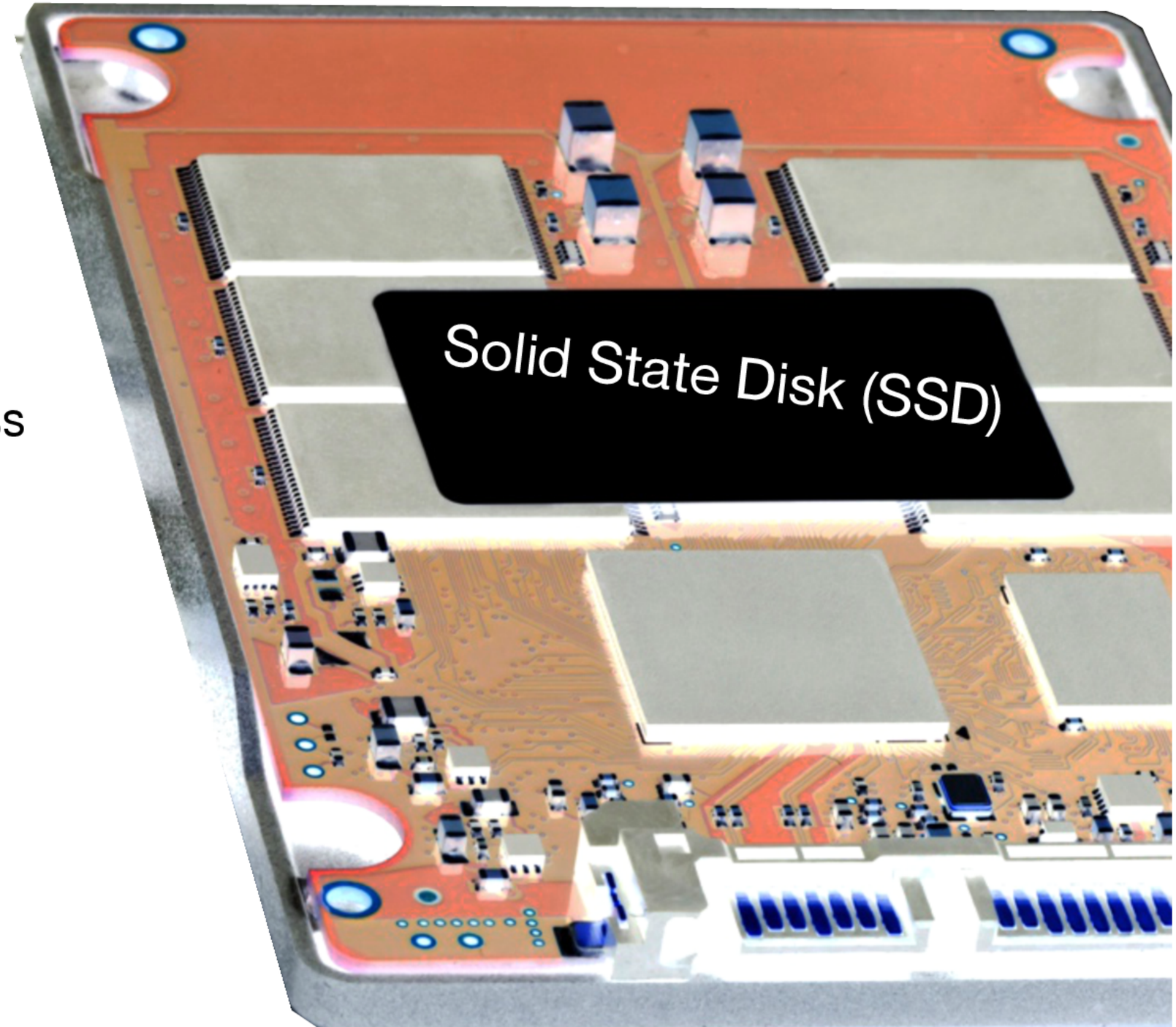
Major Properties

non-volatile

robust, no moving parts

~100x faster random access

plus: parallel accesses

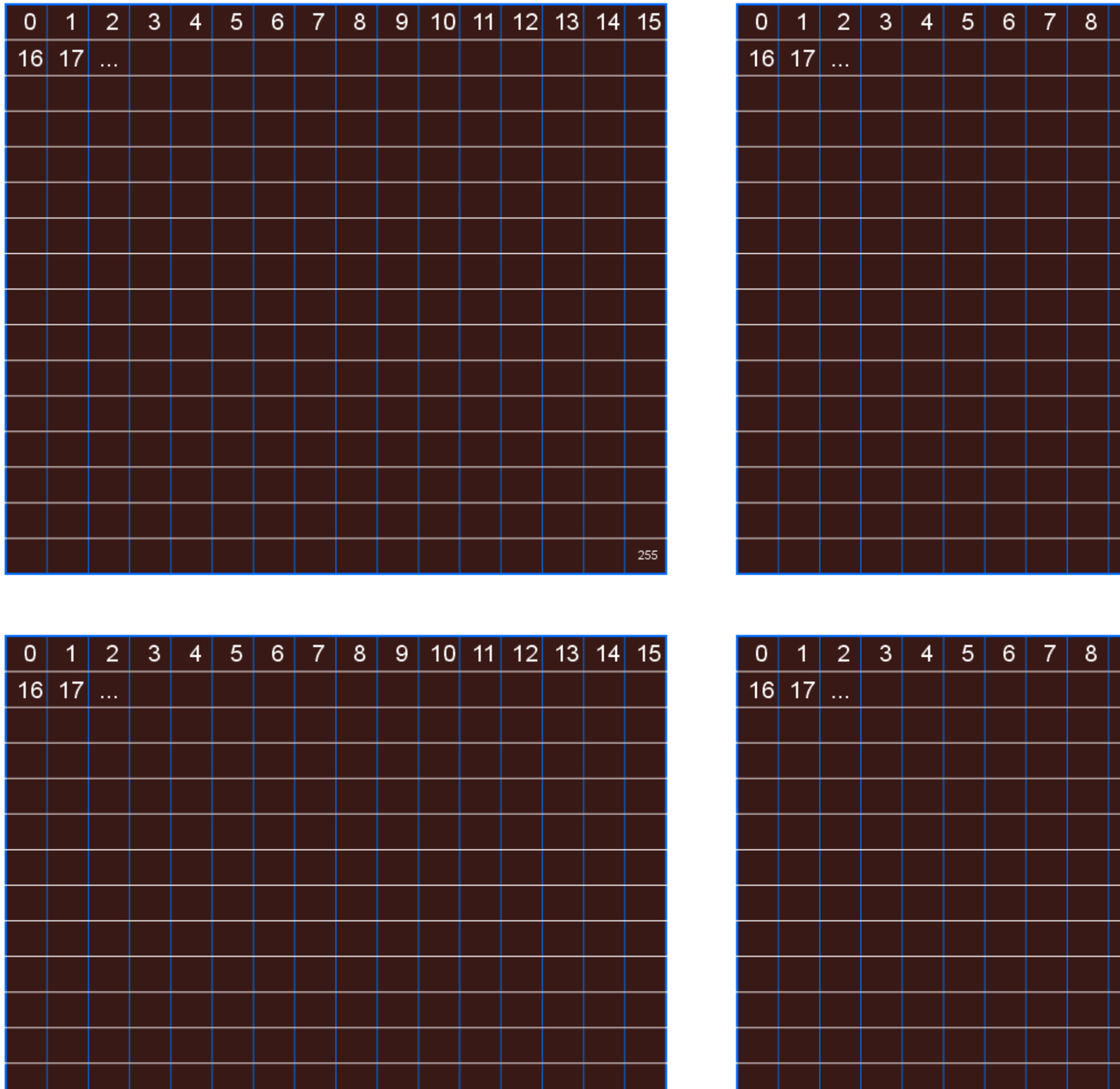


Blocks vs Superblocks

Super block

block := 8KB

superblock := set of blocks



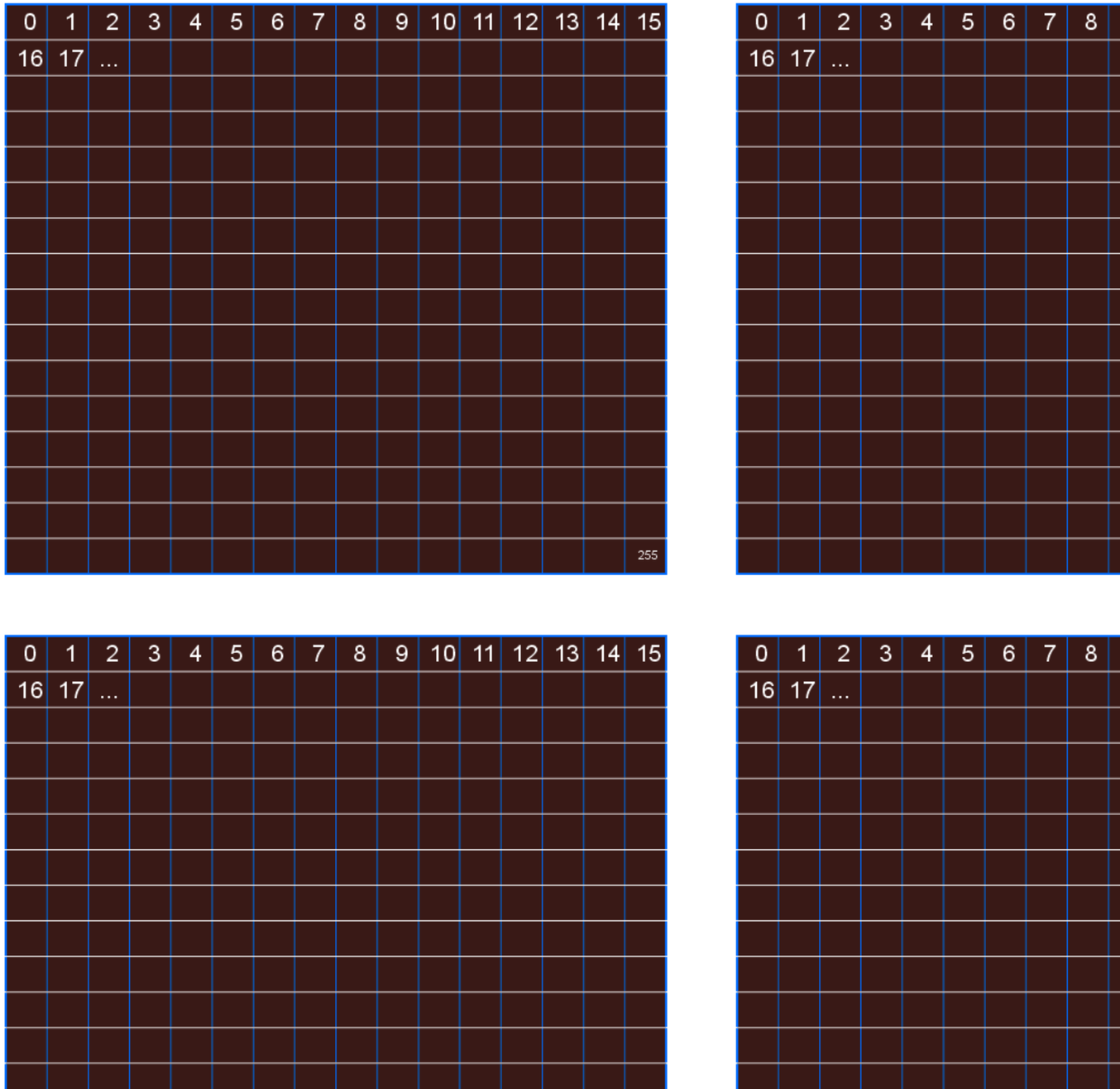
Blocks vs Superblocks

block := 8KB

superblock := set of blocks

can only write to **empty**, freshly erased blocks

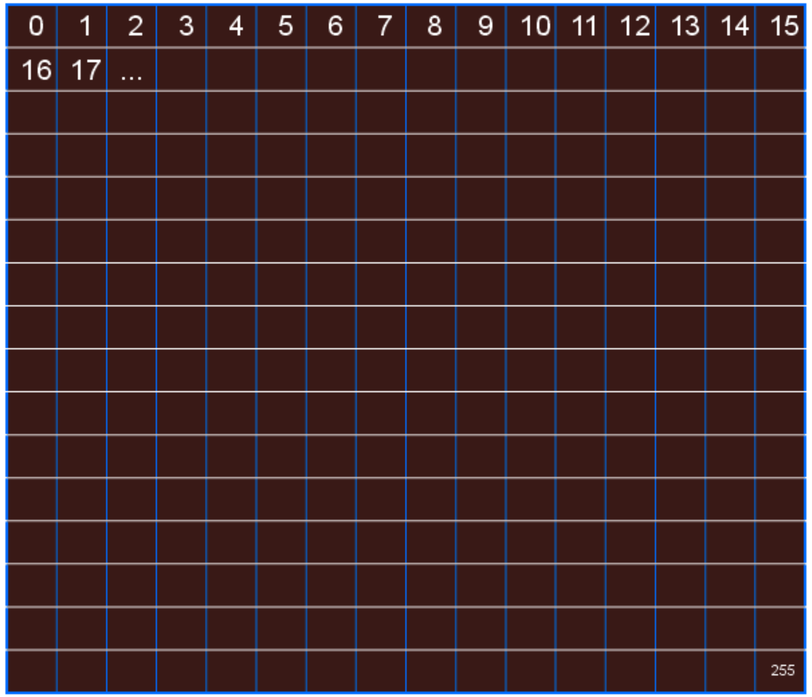
erase happens at the level of superblocks, **not blocks**



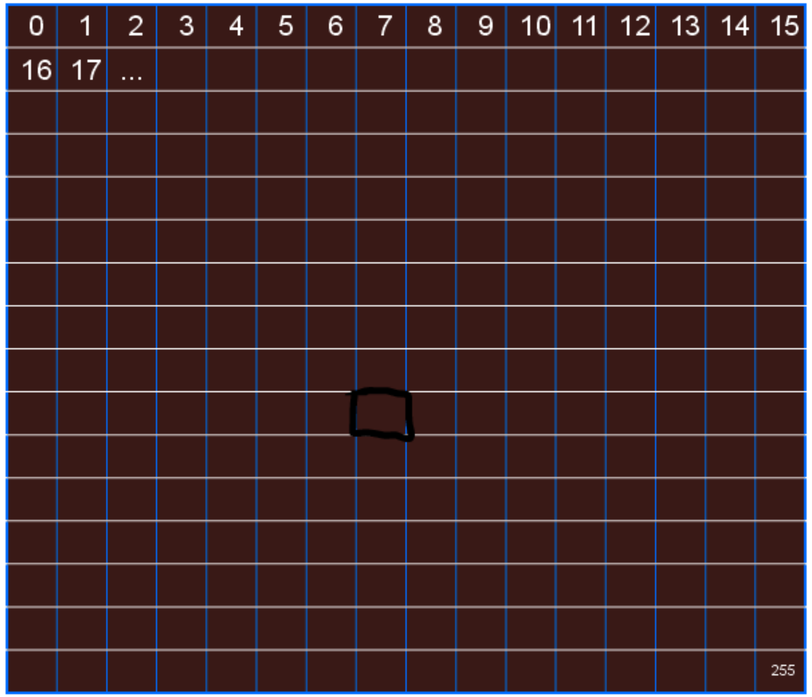
Example: Writing a Block

① erase superblock
② write block

SB 1



SB 2



Writing a Block

```
if empty block available:
    write data to block
else:
    possibly reshuffle/garbage collect
    erase superblock
    write data to block
```

Write Amplification

$$\text{write amplification} = \frac{\text{data physically written}}{\text{data logically written}} \geq 1$$

8KB

factors in:

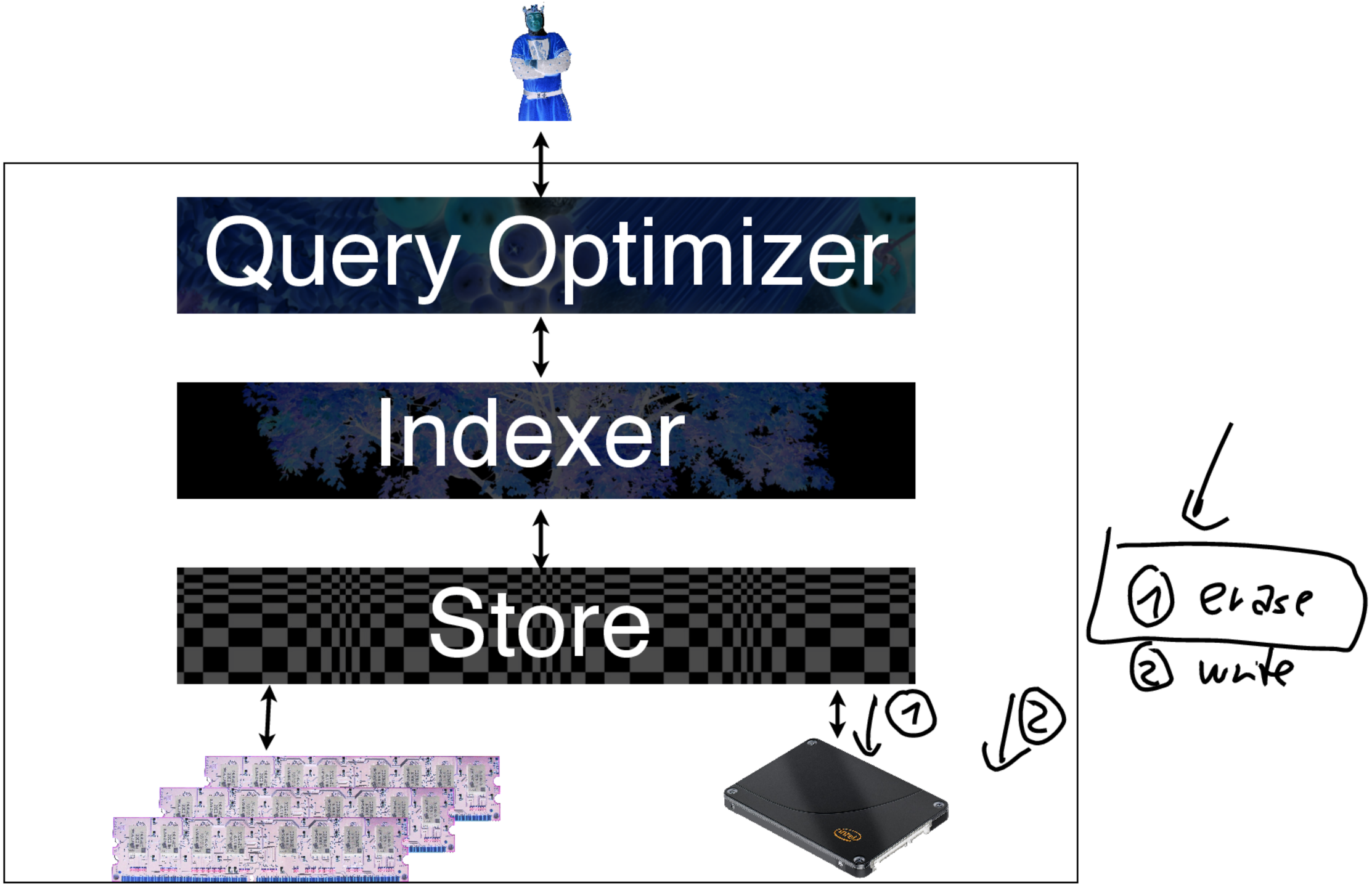
super block erasure

garbage collection

wear leveling costs

internal RAID

Trim



SSD Controller

similar tasks as the HD controller:

mapping of logical addresses to physical addresses

caching (128-512 MB)

flush() → flash

SSD Controller

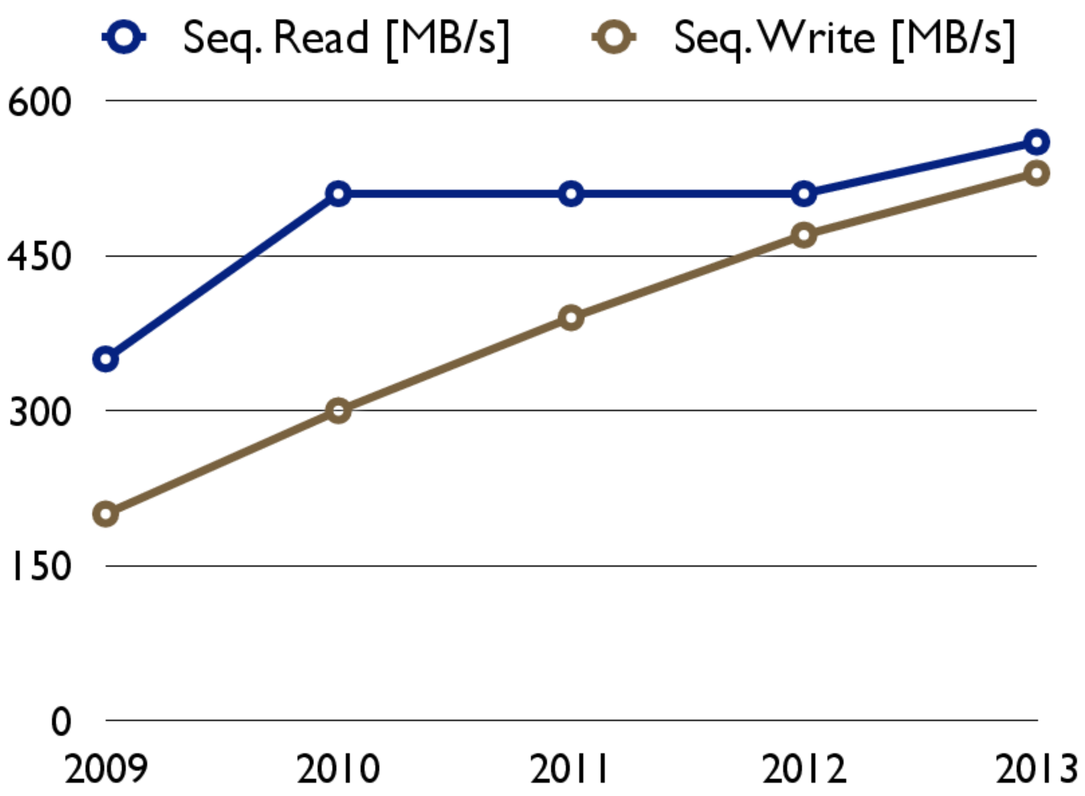
similar tasks as the HD controller:

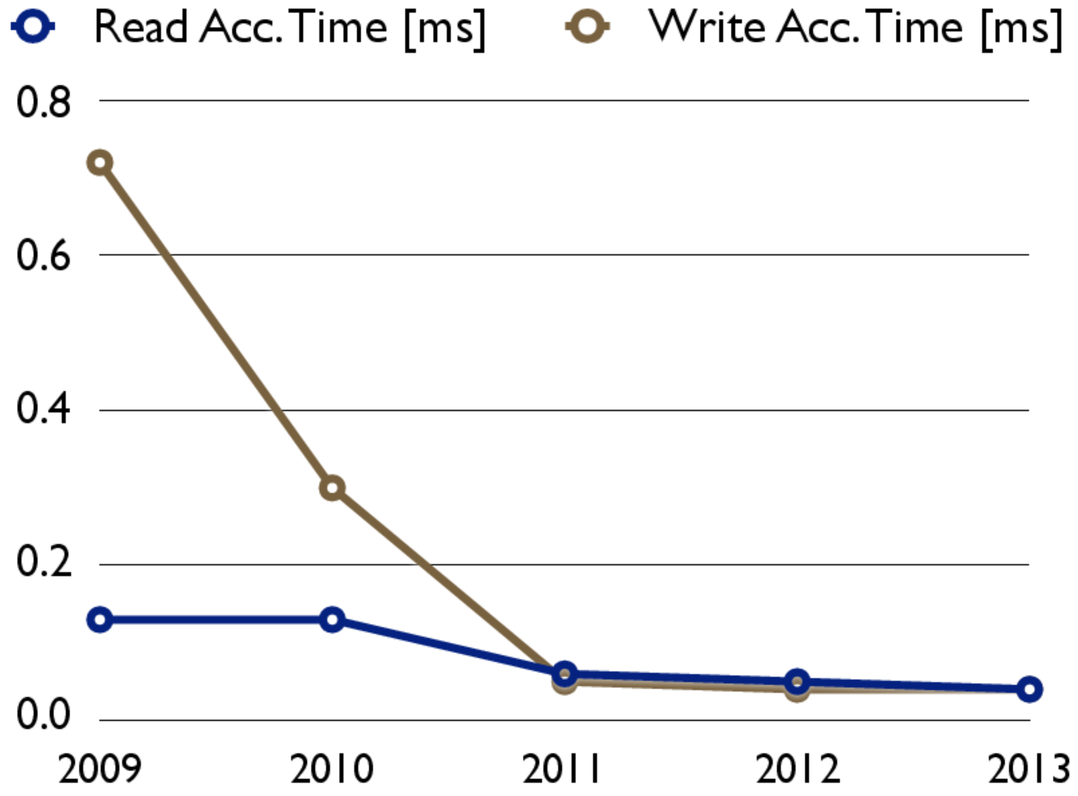
- mapping of logical addresses to physical addresses
- caching (128-512 MB)
- remapping of erroneous blocks

in addition:

- RAID-like storage of data cross different chips in the drive
- -> yet in conflict with erase-problem
- garbage collection

Sequential and Random Speed Evolution





Killing it with iron

0.05 ms
= 50 μs

Credits and Copyrights

SSD speed evolution mined from:
http://ssd-comparison.whoratesit.com [November 2013]