

1 Flash-Based SSDs

Vocabularies

1. Flash Solid-State Storage

- Is a type of non-volatile computer storage that stores and retrieves digital information using only electronic circuits, without any involvement of moving mechanical parts

2. NAND-Based Flash

- Is an electronic non-volatile computer memory storage medium using NAND-gate that can be electrically erased and reprogrammed.

3. Flash Page

- Is the smallest unit that can be programmed into flash

4. Flash Block

- Is a group of pages and the smallest unit that can be erased.

Physical Block Addresses											
Block 0						Block 1					
Page n	Page 1	Page 0	Page n	Page 1	Page 0	Page n	Page 1	Page 0	Page n	Page 1	Page 0
Sector n	Sector 1	Sector 0	Sector n	Sector 1	Sector 0	Sector n	Sector 1	Sector 0	Sector n	Sector 1	Sector 0



5. Wear Out

- Is similar to going past **expiration date**
- Means it has exceeded their endurance rating

6. Single-Level Cell

- Is a type of cell in solid-state storage that stores one bit of data per transistor (0 or 1)

7. Multi-Level Cell

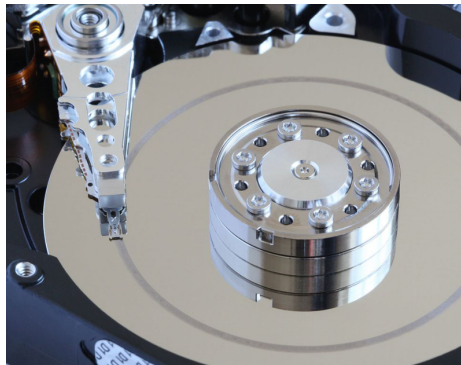
- Is a type of cell in solid-state storage that stores two bits of data (i.e 00, 01, 10, 11) per cell using two different levels of charge

8. Triple-Level Cell

- Is a type of cell in solid-state storage that stores three bits of data per cell (i.e 000, 001, 010, 011, 100, 101, 110, 111)

9. Head Crash

- Is a condition where the drive head makes contact with the recording surface

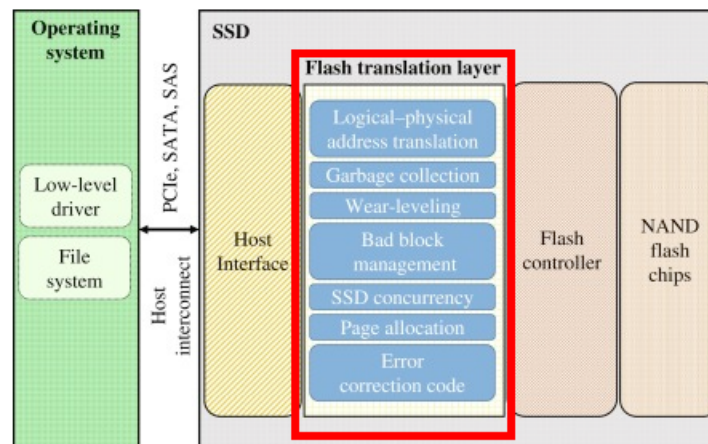


10. Disturbance

- Is also known as **read disturbance** or **program disturbance**
- Is a condition where accessing a bit in a page causes some bits to get flipped in neighboring pages

11. Flash Transition Layer

- Is an intermediate system made up software and hardware that manages SSD operations



12. Wear Leveling

- Is a technique for prolonging the service life of some kinds of erasable computer storage media, such as flash memory, which is used in solid-state drives (SSDs)

13. Direct Mapped

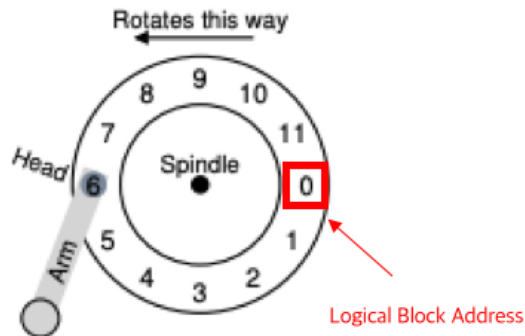
- Is a simplest organization of an **Flash Transition Layer** that maps read of logical page N directly to read of physical page N .

14. Logging

- Is a concept in **log-structured file system** that buffer all writes (data + metadata) using an in-memory segment; once the segment is full, write the segment to a log

15. Logical Block Address

- Is a common scheme used for specifying the location of blocks of data stored on computer storage devices, generally in secondary storage system



16. In-Memory Mapping Table

- Is a table inside the memory of the secondary storage device (is persistent in some form) that stores the physical address of each logical block in the system

17. Garbage Block

- Is also called **Dead Block**
- Is old version of block in secondary storage, such as solid state drive

18. Garbage Collection

- Is the process of finding garbage blocks and reclaiming them for future use

19. Cache Flush

- Is the process of clearing out sections of memory to ensure writes have actually been persisted in solid state drive

20. Trim

- Is an operation that takes an address (and possibly a length) and informs the device that the block(s) specified by the address (and length) have been deleted



21. Overprovision

- Is an extra amount of flash space used to reduce the cost of **garbage collection**, increase the longevity of flash drive, and prevents the device from slowing down



22. Page-Level FTL

- Is an intermediate system made of software and hardware that manages SSD operations at page-level.
 - It does not write a full block
 - Only writes the necessary page(s) of data along with the FTL metadata that must be written to track of the new position of the data

23. Hybrid Mapping

- Is a mapping technique used in **Flash Transition Layer** that enables flexible writing but also reduce mapping costs

24. Log Blocks

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25. Switch Merge

26. Partial Merge

27. Full Merge

1.1 Storing a Single Bit

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1.2 From Bits to Banks / Planes

1.3 Basic Flash Operations

1.4 From Raw Flash to Flash-Based SSDs

1.5 FTL Organization: A Bad Approach

1.6 A Log Structured FTL

1.7 Garbage Collection

1.8 Mapping Table Size

1.9 Hybrid Mapping

1.10 Wear Leveling

1.11 SSD Performance And Cost