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.

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 transister (0 or 1)
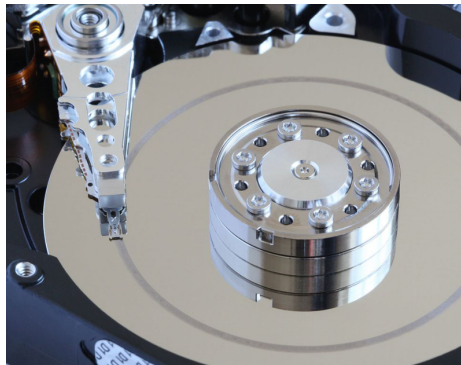
7. **Multi-Level Cell**

   - 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**

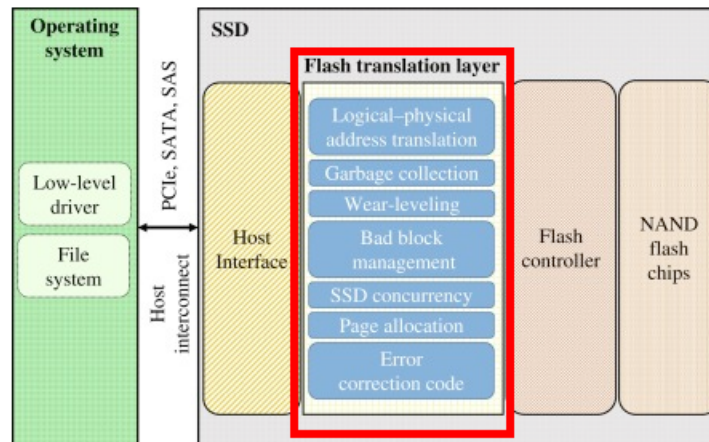   - Is a condition where the drive head makes contact with the recording surface

10. **Disturbance**

    - Is also known as **read disturbance** or **program disturbance**
    - Is a condition where accesing 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 playsical 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

Trimmed or
marked as rmoved

21. **Overprovision**

   • Is an extra amount of flash space used to reduce the cost of **garbage collection**, increase the logitivity 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 utilizes both block-based mapping and page-based mapping to enable flexible writing but also reduce mapping costs

24. **Log Blocks**

    - Are blocks in solid state storage where contents are erased and all writes are directed

25. **Switch Merge**

    - This will be revisited once when reading related section

26. **Partial Merge**

    - This will be revisited once when reading related section

27. **Full Merge**

    - This will be revisited once when reading related section

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