

# 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.

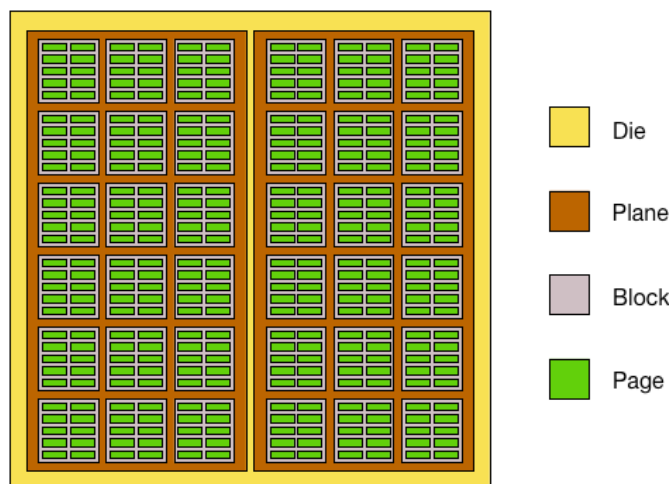
### 3. Flash Page

- 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 0	Sector 1	Sector n	Sector 0	Sector 1	Sector n	Sector 0	Sector 1	Sector n	Sector 0	Sector 1	Sector n



### 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**

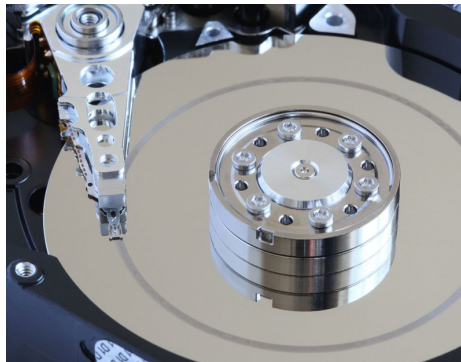
- Is a type of cell in solid-state storage that stores two bits of data (i.e 00, 01, 10, 11) per cell using two different levels of charge

#### 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

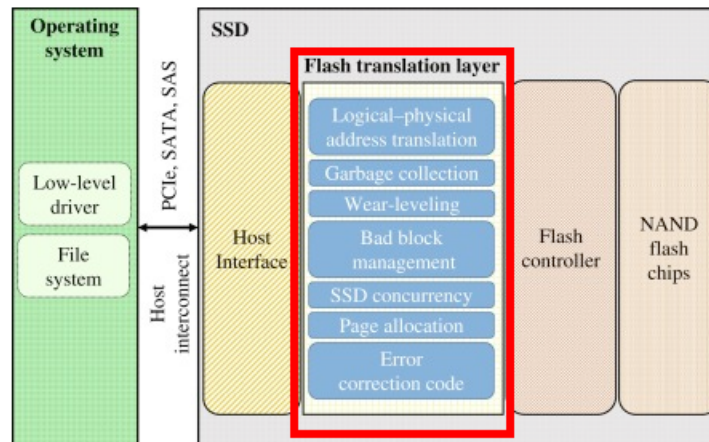


#### 10. **Disturbance**

- 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

#### 20. Trim

#### 21. Overprovision

#### 22. Background

#### 23. Page-Level FTL

#### 24. Hybrid Mapping

#### 25. Log Blocks

#### 26. Switch Merge

#### 27. Partial Merge

#### 28. 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