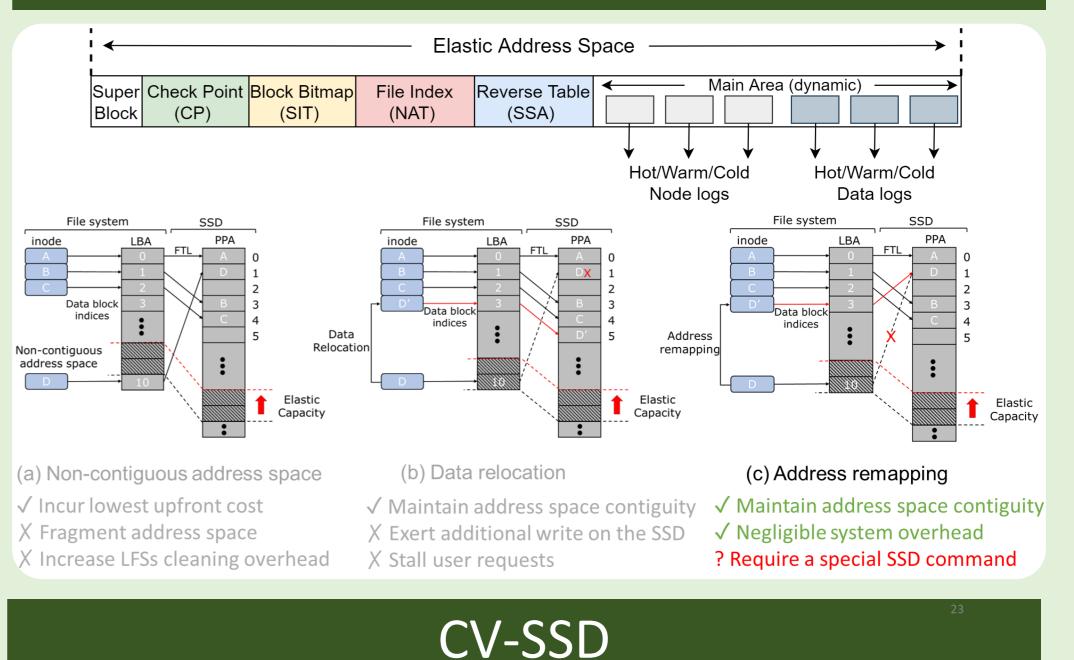
#### Syracuse University College of Engineering The Design and Implementation of Xiangqun Zhang & Computer Science 단국대학교 a Capacity-Variant Storage System Jongmoo Choi Bryan S. Kim

#### Abstract

- Modern storage systems and their ecosystem are built around hard disk drives (HDDs), which assumes that the capacity of a storage device does not change. This fundamentally negates the advantages of solidstate drives (SSDs) and causes fail-slow symptoms.
- A capacity-variant storage system maintains consistent performance by relaxing the fixed-capacity assumption.
  - > CV-FS, a log-structured file system for an elastic logical partition;
  - > CV-SSD, a capacity-variant SSD that gracefully reduces its exported capacity as it ages;
  - > CV-manager, a capacity management interface that orchestrates system components.

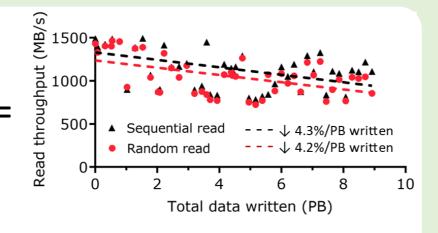
#### CV-FS



• WL presents unstable behavior in conventional SSDs

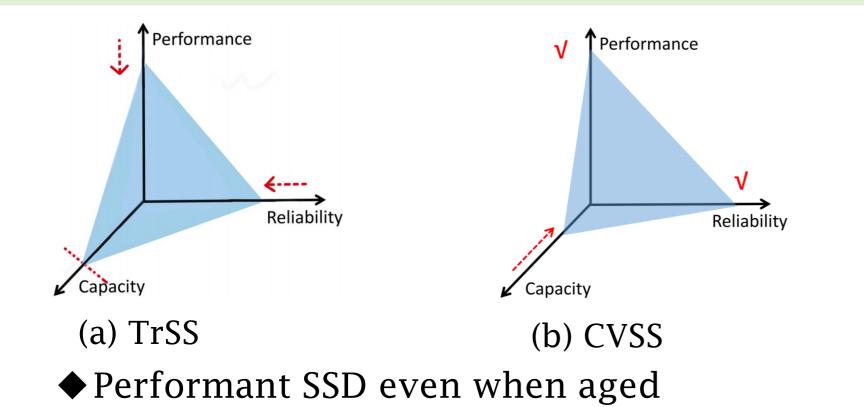
## Tax from the fixed-capacity abstraction

# The fixed logical capacity The decreased physical capacity



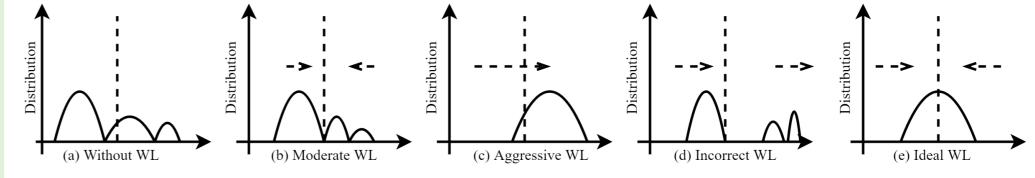
Wear leveling & OP are required	<ul> <li>Maintain an illusion of a fixed-capacity device</li> </ul>
Complicated error-handling (ECC, data re-read, redundancy)	<ul> <li>Manifest the fail-slow symptom</li> </ul>
Lifetime ends early	<ul> <li>When exported capacity can't be maintained</li> </ul>

#### Design principles



- Extended lifetime for SSD-based storage
- ◆ Streamlined SSD design.

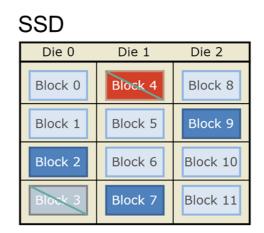
#### **CVSS** overview



• Forgo WL and adopt wear focusing to keep most inused blocks at peak performance and exclude underperforming and aged blocks.

 $\rightarrow$ 

SSD					
	Die 0	Die 1	Die 2		
Young	Block 0	Block 4	Block 8		
Middle aged	Block 1	Block 5	Block 9		
Retired high RBER	Block 2	Block 6	Block 10		
Retired worn out	Block 3	Block 7	Block 11		



(2) Not performing wear leveling

SSD					
	Die 0	Die 1	Die 2		
	Block 0	Block 4	Block 8		
	Block 1	Block 5	Block 9		
	Block 2	Block 6	Block 10		
	Block 3	Block 7	Block 11		

Ziyang Jiao

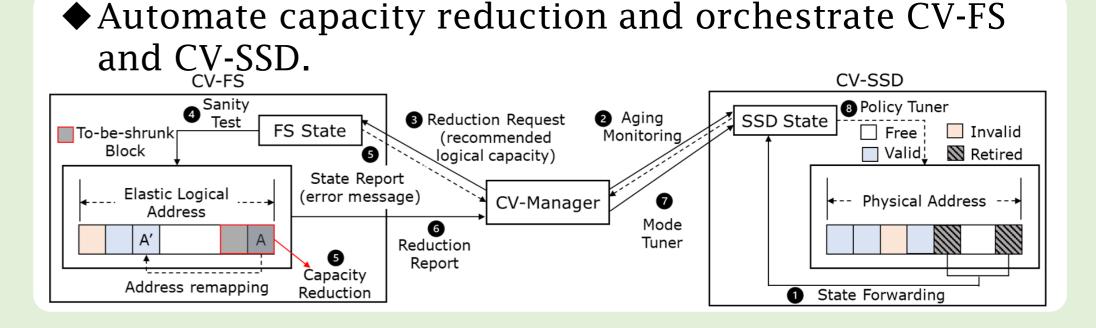
**Hojin Shin** 

(1) Ideal wear leveling

(3) Wear focusing

 $\rightarrow$ 

## **CV-manager**



## **Evaluation**

#### ◆ Synthetic workloads:

