Reliability in the Enterprise

How to Ensure Flash-Based SSDs Make the Grade

SMART® Modular Technologies

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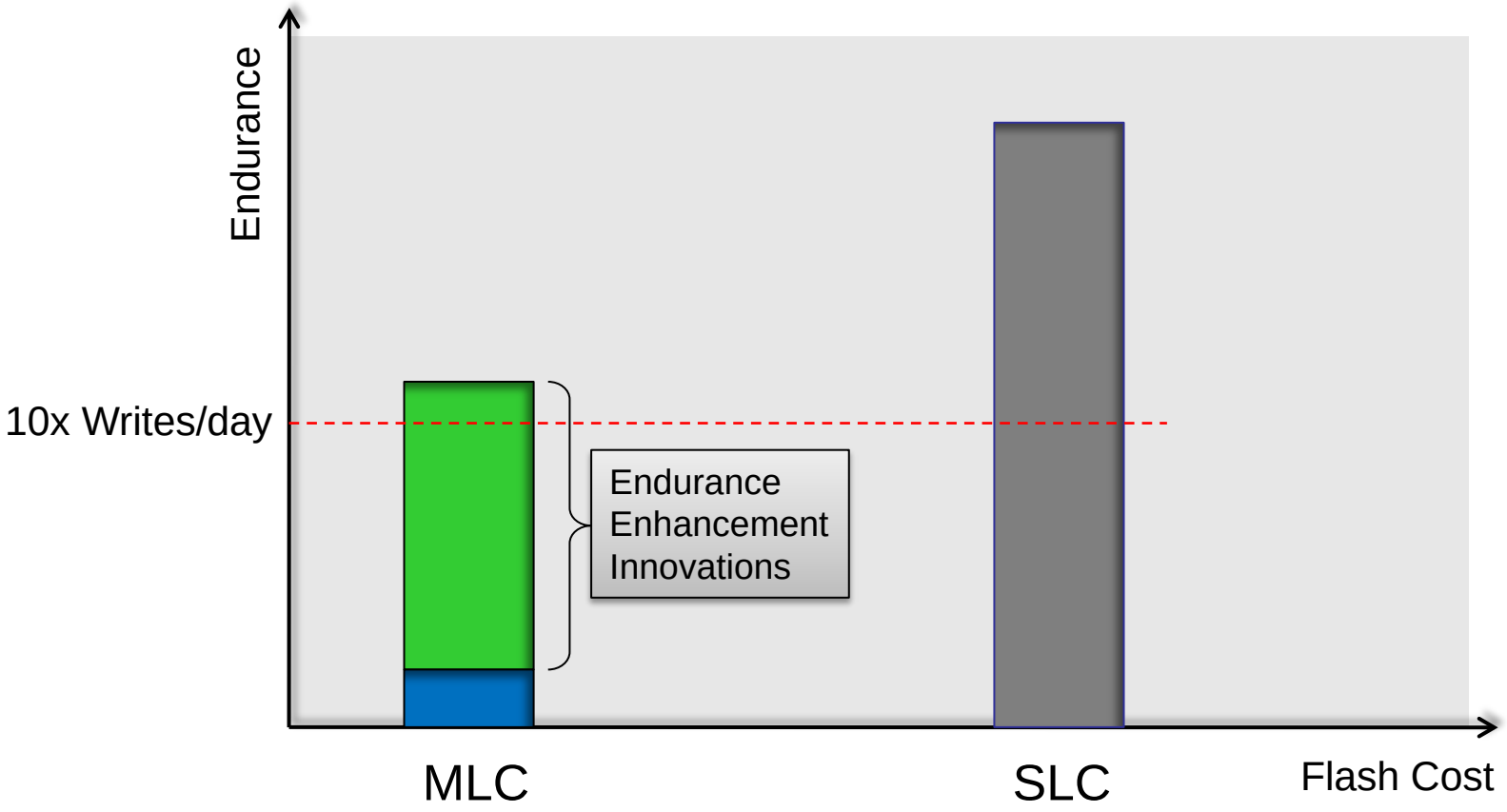
Enterprise SSD



Endurance Enhancement

- Flash must be used beyond its “rated” specifications
- SSD vendor has to assume ownership of flash reliability
  - SSD vendor must have flash characterization capability
  - SSD design is tailored to flash properties and features
  - The SSD vendor must have the ability to demonstrate SSD end of life

Enterprise Endurance

- Design Goal:
  - Write 10x logical capacity of the drive with random 4kB, incompressible data every day for 5 years

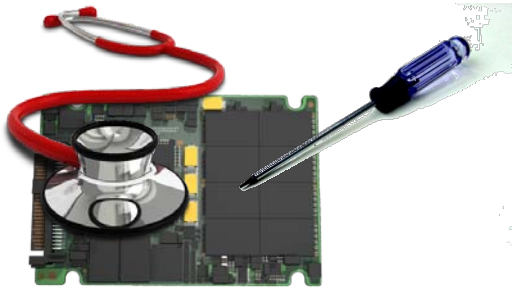
- Results in 40K PE requirement
  - 28% over provisioning
  - WA = 2.8
  - Current 2x nm MLC specs are between 1K & 5K

Drive Endurance Innovations

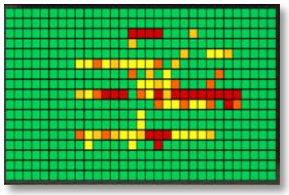
- Powerful ECC

- Cross page redundancy

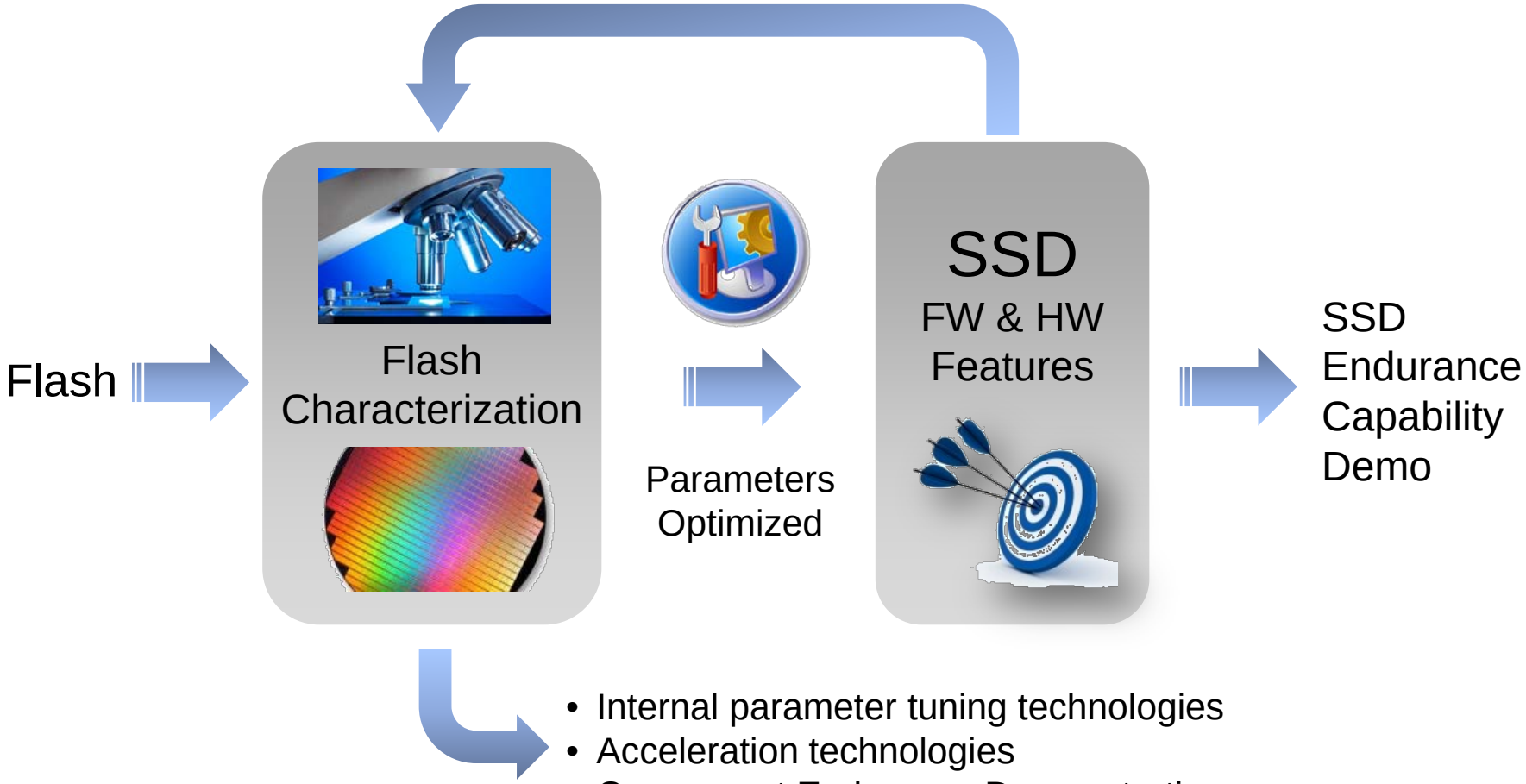
- Flash parameters monitored and adjusted over the life of the SSD



- Mapping weak block capability

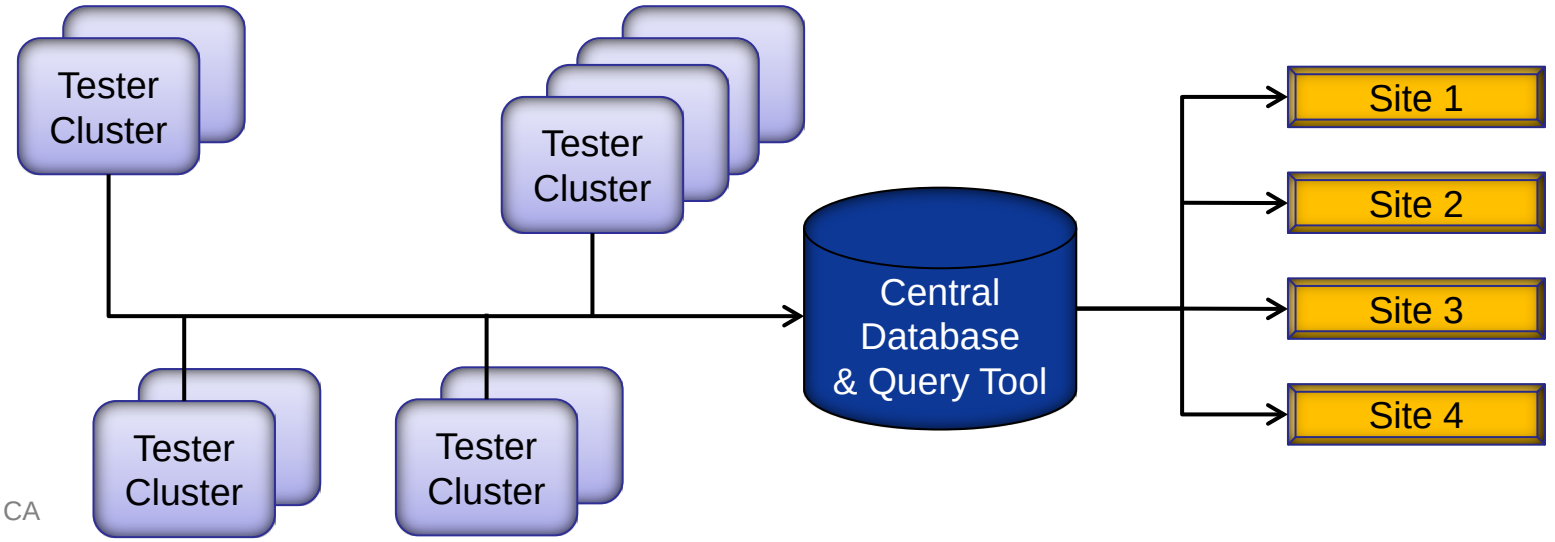


SSD Design Development

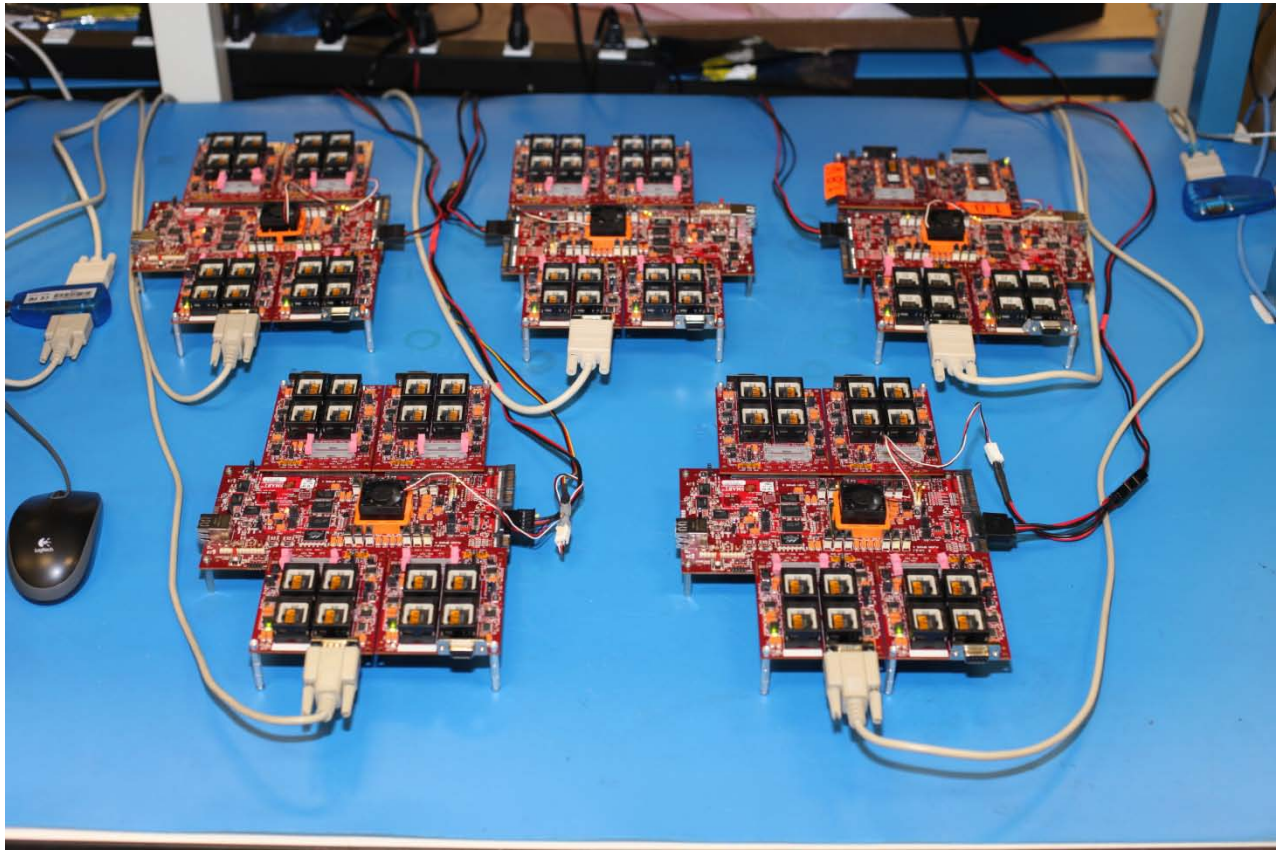


Component Testing Requirements

- High volume test capability
  - Sufficient quantities for reliability analysis
- Multiple testers for parallel studies
- Data warehouse and analysis infrastructure
- Ability to program internal flash parameters



Example Test Platform



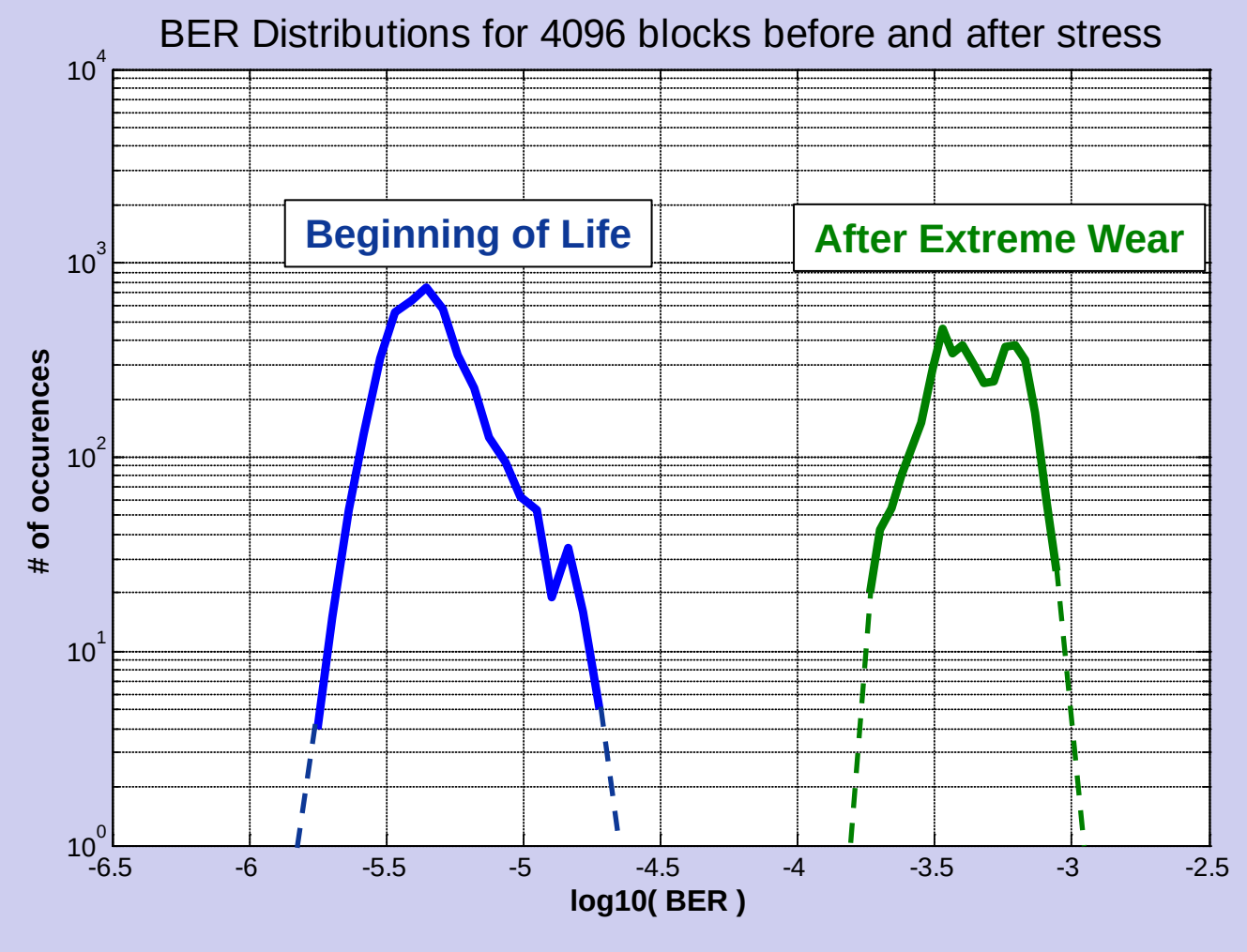
Easily Replicated

Flexible

Programmable

- Emulate drive algorithms
- HW flexibility to emulate drive

Statistics on Large Populations



Example

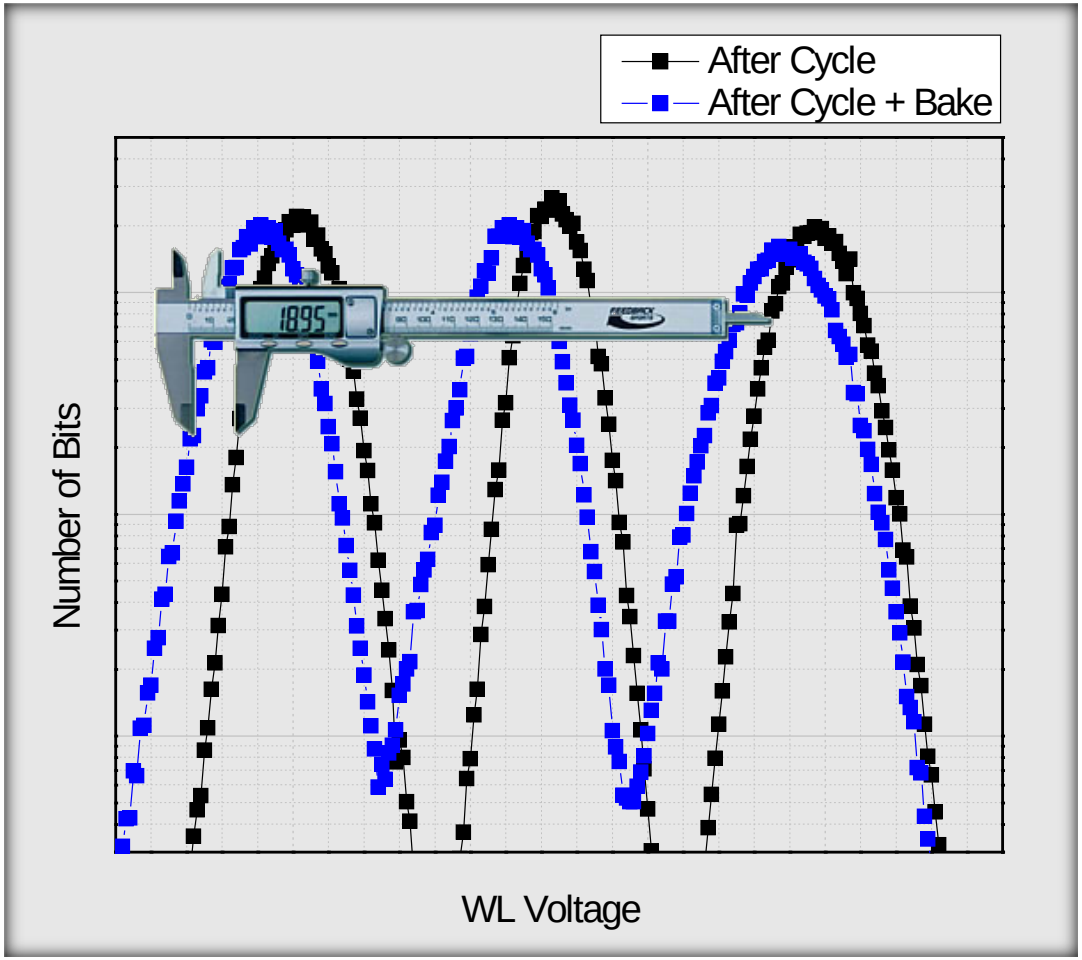
- Single Tester
- 4,096 blocks
- 16 package
- 64 die

Critical to be able to gather and manage large data sets

Large Complex Data Sets

- Testing Produces vast amount of Complex Data
  - 10's of GBs
  - Multiple experiments run in parallel
  - Revisions of flash
  - Firmware / tester evolution
- Sophisticated Data Management Tools
  - Access from multiple sites
  - Accessible to non database experts
  - Track experiment purpose, material, and tester revision

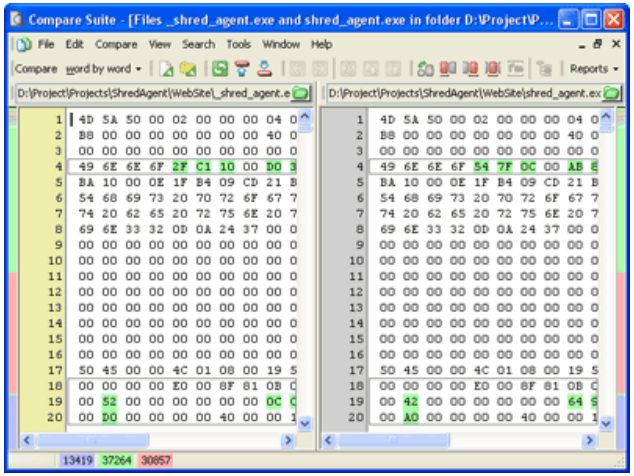
Internal Flash Features



Testers must be able to measure and control internal flash registers

Drive Emulation

- Adjust internal parameters over flash life in the flash characterization tester
- Characterize large numbers of parts
- Demonstrate an acceptably small percentage of blocks fail under operating conditions
- Use accelerants
  - For example, short dwell, high temp bake, etc



Drive Testing at End of Life

- Brute force wearing a drive to end of life is not practical
- Use acceleration methods to reach EOL rapidly
  - Bench data to support methodology
- Testing to demonstrate EOL behavior is critical
  - Essential to show that system manages the inevitable wear of flash smoothly at EOL
  - Meeting life time warranty must be demonstrated

Summary

- Market demands require MLC flash to be used beyond component specs

- Essential Elements of SSD Design
  - Flash characterization
  - Powerful test capability
  - Infrastructure to support constant evolution

Thank You!

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