Data Recovery from SSD

Advances & Challenges in the Lab

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Topics for Discussion

- Recognize the gains & challenges in SSD reliability and data recovery
- Motivate the discussion of enabling data recovery technologies in SSD

The Reality of Reliability

- It's Not a Question of "If, but When"
  - All electronic and mechanical components have a failure rate
  - Failure can be environmentally or user driven
  - When you least expect it…expect it!

NAND Issues & Limitations

- Reducing Process Size, Reducing Reliability
  - Increasing levels per cell
  - More ECC needed
  - Write Endurance limits
  - Disturb Errors
  - Endurance & Retention trade offs

Reliability Via the Controller

- Intelligent Controller Defines the Device
  - Utilizing MLC in SLC applications
  - ECC, CRC, Wear Leveling, Compression
  - Endurance solutions via write amplification
  - Security via Encryption

Why Data Recovery on SSD?

- NAND failure
  - Individual package or die failure
  - ECC, bad media, disturb errors
- Controller as the Culprit
  - Firmware corrupt
  - Defect tables or LBA translators corrupt
  - More code in silicon, more IP to manage
- Electrical damage
- Environmental damage
  - Fire, flood, impact
- User error

Data Recovery Challenges

- The Good News is…
  - Traditional failure of mechanical issues are gone
- The Bad News Is…
  - Many potential issues yet to be discovered!
- Encryption
  - Controllers now encrypting data
    - Individual package or die recovery very difficult
- TRIM & Garbage Collection
  - Undelete still possible?
    - Depending when the cleanup occurs

Data Recovery Solutions

- Advanced Technology Required in Lab
  - Fewer opportunities than with HDD
  - Competing technologies advancing quickly
    - Current data recovery solutions become obsolete
    - New tools and techniques being developed
- Technological Alliances Critical
  - Each OEM has proprietary implementations
  - Lab must work with industry leaders
    - Providing FA back to the dev teams
    - Identifying unique and new failures
    - Helping to prevent future issues in the field

Data Recovery Moving Forward

- Enabling Data Recovery on SSD
  - Possible future design implementations
  - Security will be of primary concern
  - Non-destructive diagnostics
  - Safety mechanisms to prevent catastrophic failure