Topics for Discussion

- Recognize the gains & challenges in SSD reliability and data recovery

- Motivate the discussion of enabling data recovery technologies in SSD
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
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