HOW TO MAKE A RUGGEDIZED SSD

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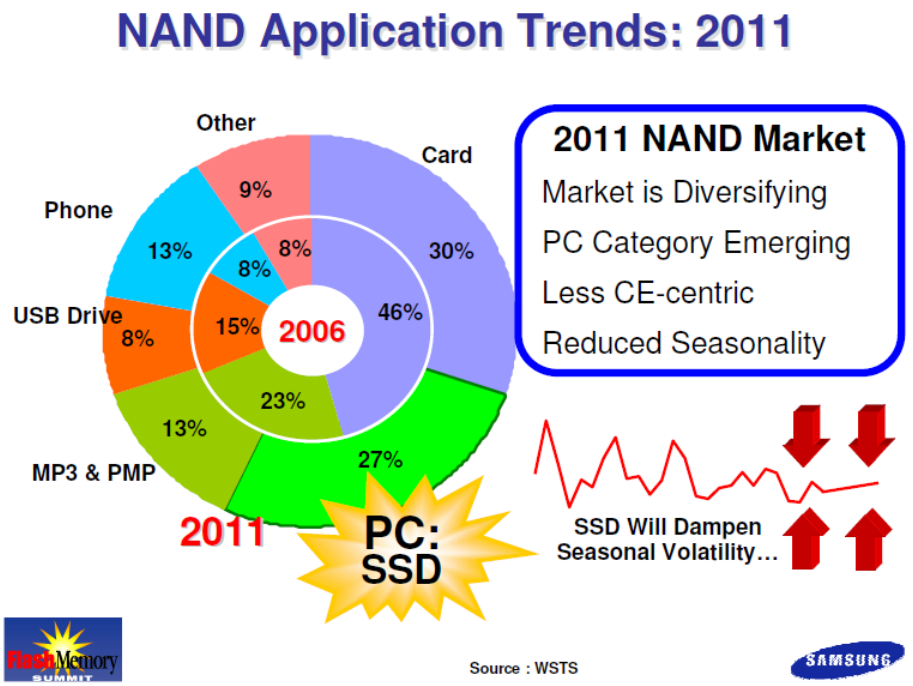
SMART High Reliability Solutions

Introduction

- In one decade SSDs went from existing only in expensive, rugged environments, to existing in all environments.



From 2007 FMS presentation “SSD: The Next Killer App” by Jim Elliot.

Introduction

- Today most SSDs cannot survive in the rugged environments of their ancestors.
  - Solid-State components with no moving parts is not enough.
- What are the problems with designing a ruggedized SSD?
- What can be done to solve those problems?

What is a rugged SSD?

- Able to survive extreme temperature
- Able to survive extreme shock and vibration
- Good start, but need to be more precise

What is a rugged SSD?

- Able to survive MIL-STD-810G
- Need to define specific tests and parameters
  - Operating temperature: -40°to +85°C
  - Operating shock: 50G based on half-sine shock pulse of 11ms
  - Operating vibration: 10Grms random 20-2000Hz (jet)

What is a rugged SSD?

- No temp-controlled, 19” rack with UPS able to send ATA flush command to the SSD
- Power cannot be guaranteed
- Also cartridge may be ejected at any time

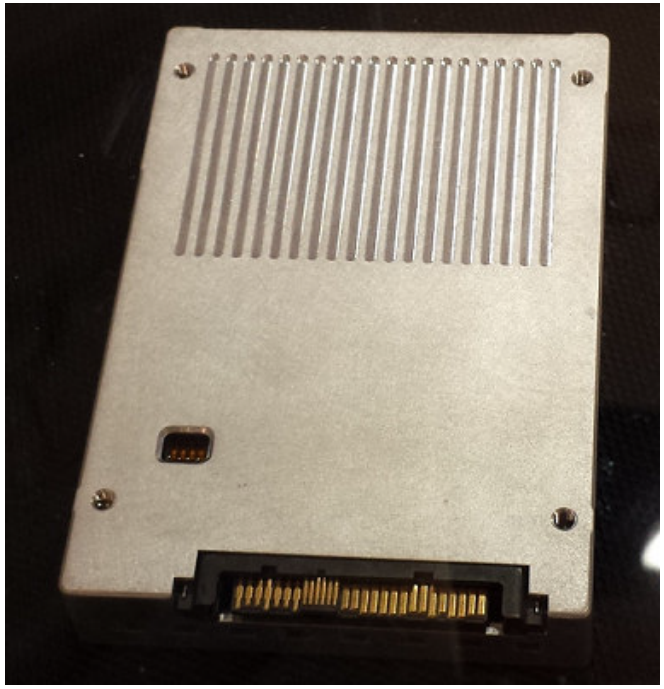
Temperature Problems

- Cold
  - Clocks and power supplies fail to start
- Hot
  - Component degradation
  - Reduced NAND retention
- NAND bits flip between temperature extremes

Temperature solutions

- Primarily an electrical problem
  - Select industrial-temperature rated components
  - Design robust power supplies
    - Passive components can change value at temp extremes

Temperature solutions



- Mechanical can help
  - Transfer of heat away from sensitive components
  - Use thermal interface material and creative enclosures

Temperature solutions

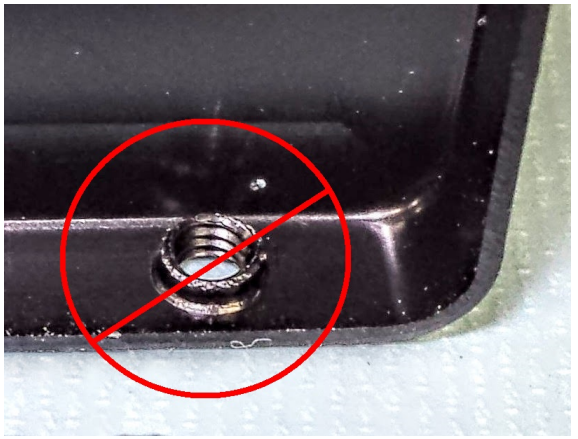
- Firmware can help
  - Add additional error correction codes
  - Refresh contents periodically
  - Handle any potential interrupt source (for example, floating GPIO pins)

Shock and vibration problems

- Causes structural damage to enclosure and PCB
- Wreak havoc on connectors

Shock and vibration solutions

- Primarily a mechanical problem
- Design thick, rugged enclosure
- Have more than a couple threads
- Apply staking and/or underfill
- Use flex cables to join PCBs



Unexpected power loss problems

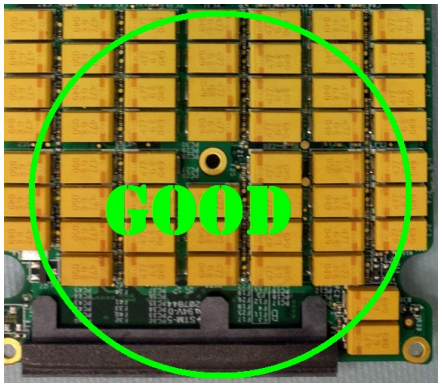
- Must save mapping tables and cached data
- Larger DRAM improves performance numbers, but takes more time to flush
- Super caps leak and fail faster at high temps
- Quick power cycles leave residual charge on capacitors confusing charging systems

Unexpected power loss solutions

- Mechanical solutions
  - Reduce temperature as discussed earlier
- Firmware solutions
  - Save only modified tables.
  - Reduce number of modified tables by periodically flushing them while power is stable
  - Disable extraneous circuits like SATA, LEDs, etc.

Unexpected power loss solutions

- Electrical solutions
  - Use discrete capacitors rather than super caps
  - De-rate capacitance at high temperatures
  - Use bleed resistor to drain residual charge



Conclusion

- Most SSD environments today are not rugged.
- Most SSDs do not need these solutions.
- Requires extra design time, testing, cost, etc.
- Requires multiple disciplines:
  - Mechanical
  - Electrical
  - Firmware

Conclusion

- SMART High Reliability Solutions
  - Has over 20 years of experience in rugged, solid-state storage
  - Has the solutions for rugged military and industrial applications
- Find us in booth #627 and ask us your ruggedization questions