



# StorCloud Inc.

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# Top Things To Know About Flash

- **Cost and density improvements continue**
  - 1x nm flash and 128Gb die is just around the corner
  - Oversupply of NAND flash most likely coming
- **Endurance continues to deteriorate**
  - Not a big problem for MLC based consumer and client PC products
  - Existing solutions not sufficient to enable 1x nm MLC in enterprise
- **Flash industry is changing**
  - Consumer flash products migrate to managed flash
  - PC market migrates from aftermarket to OEM SSD sales
  - Enterprise must migrate to vertically integrated solutions

# Consumer NAND Flash

- **Managing NAND flash is growing more and more complex**
  - LDPC, re-trimming, retry and more is needed
  - Solution required to simplify deployment of flash
- **Managed NAND becoming mainstream**
  - Decouples flash development from ASIC development cycles
  - Resolves misalignment of flash and controllers product life cycle
- **Raw NAND for very high volume applications only**
  - Very limited number of vendors due increased IP requirements
  - Controller vendors must cooperate more tightly with flash vendors

# Client NAND Flash

- **Flash SSD market is maturing and changing**
  - Shift from channel (aftermarket) to OEM dominated by flash vendors
  - Consequently shift from IOPS benchmarks to OEM value focus
- **Consolidation ending Wild West of SSDs era**
  - Many SSD vendors are mostly focused around integration of parts
  - They have limited control and knowledge over the SSD controller technology and consequently reliability of many SSDs sub-optimal
- **Flash is becoming performance limiter, not controller**
  - Already 64GB SSDs are lower performance than 128GB ones
  - Premium SSD mainstream collapsing into mainstream which is becoming dominated by flash vendors

# Enterprise NAND Flash

- **MLC cost required for mainstream enterprise adoption**
  - SLC or eMLC based solution unable to hit mass deployment price point
  - Reliability beyond RAISE, RAIN, RAID required to meet requirements
- **Flash requires vertical integration in enterprise**
  - 10x endurance improvement was sufficient for 10K P/E cycles MLC to match 100K P/E cycles SLC, but insufficient for 1-2K P/E cycles MLC
  - Further endurance gains can't be realized at controller or SSD level
- **The next 10x improvements in endurance already found!**
  - Endurance increase through over-provisioning and write reduction not sufficient for advanced node MLC to be used in enterprise
  - StorCloud Inc identified technical solutions for next 10x improvement in endurance and enabling 1x nm MLC in enterprise storage systems

*Thank you!*