Need for Differentiated Endurance Solutions
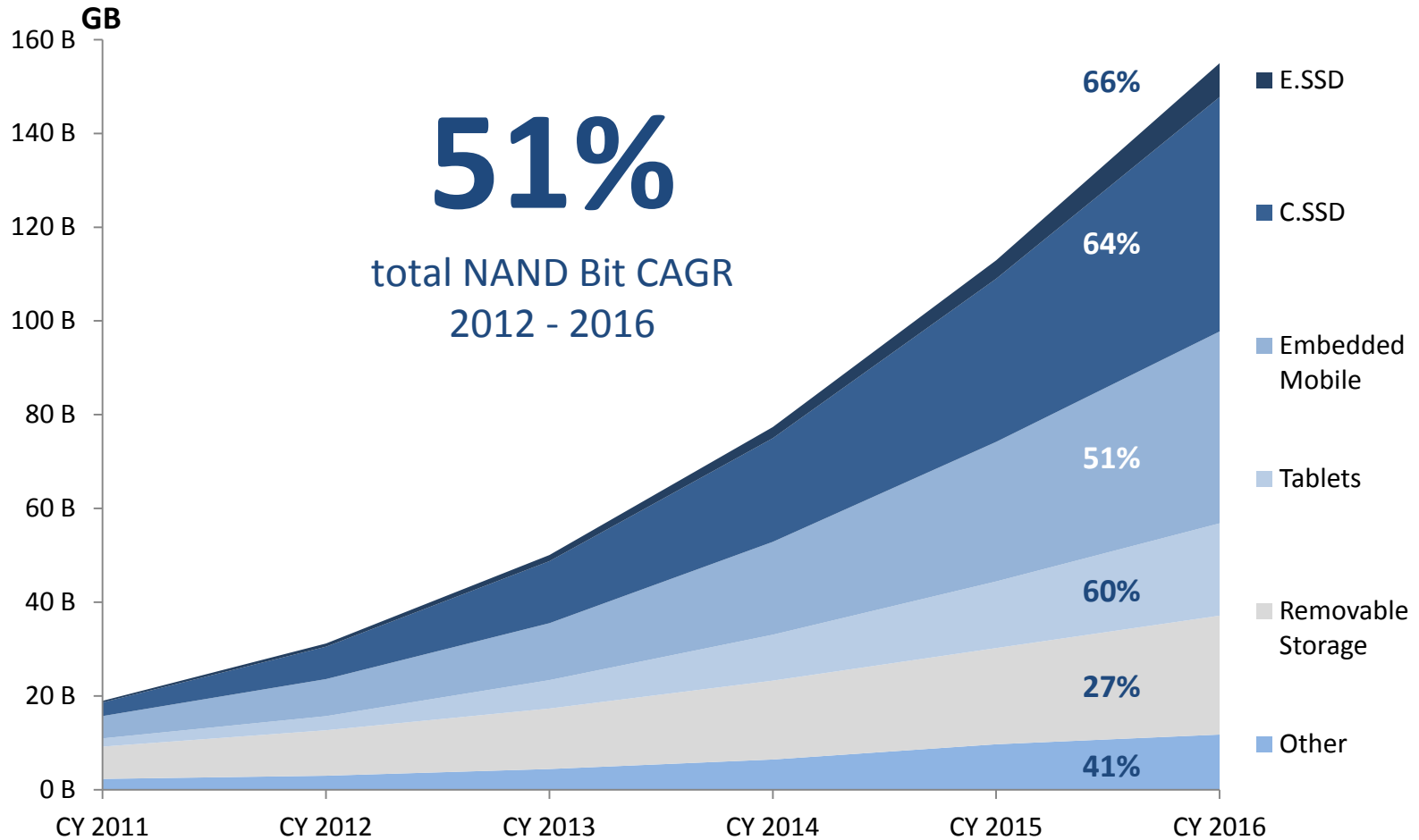
Ji Luo

Micron Technology
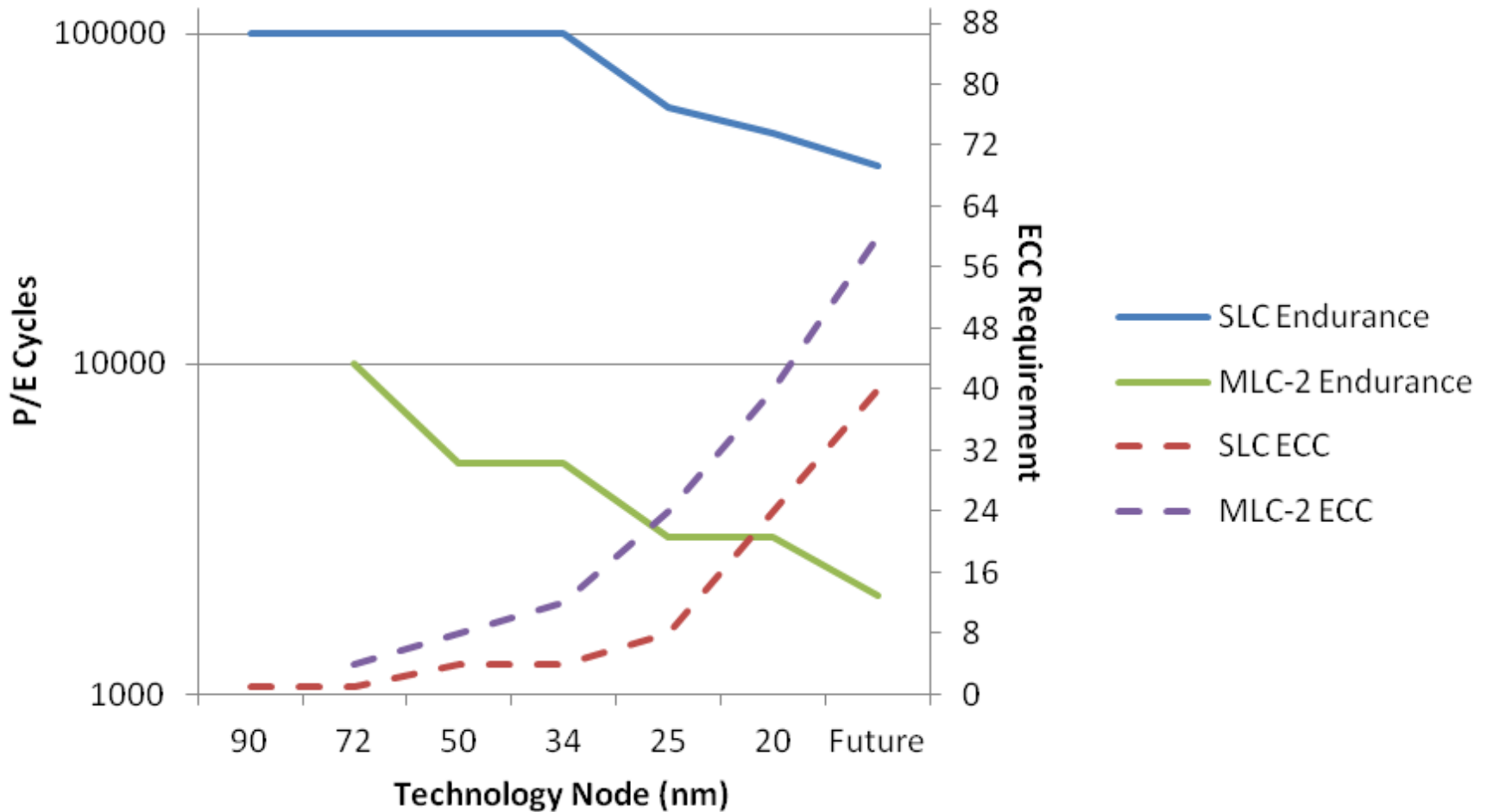
NSG Product Marketing Manager

NAND GB Growth By Segment

51%

total NAND Bit CAGR
2012 - 2016

Legend:
- E.SSD
- C.SSD
- Embedded Mobile
- Tablets
- Removable Storage
- Other

Segment percentages (2016): 66%, 64%, 51%, 60%, 27%, 41%

Y-axis (GB): 0 B, 20 B, 40 B, 60 B, 80 B, 100 B, 120 B, 140 B, 160 B

X-axis: CY 2011, CY 2012, CY 2013, CY 2014, CY 2015, CY 2016

Source: Micron

Current Endurance Trends vs. ECC

Source: Micron

Typical Density and Endurance Requirements / Segment

Application	2012 Mainstream MLC Product Density	Usage Model	Minimum Component P/E Cycle Expectation
Enterprise SSD	128-256GB	Mix Mode to Write Intensive	5K
Client SSD	64-128GB	Mix Mode	3K
Embedded Mobile	16GB	Read Intensive	3K
Tablets	4-8GB	Read Intensive	1.5K
Removable Storage	8-16GB	Read Intensive	500 Cycle

Key Careabouts Based on Usage

Read Intensive

- Fast data access
- Constrained by bus interface
- Read disturb for data integrity
- Low Latency

Mix Mode

- Needs based on usage model
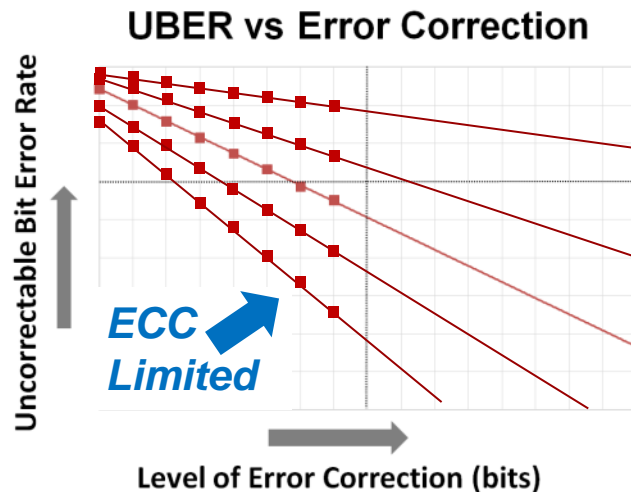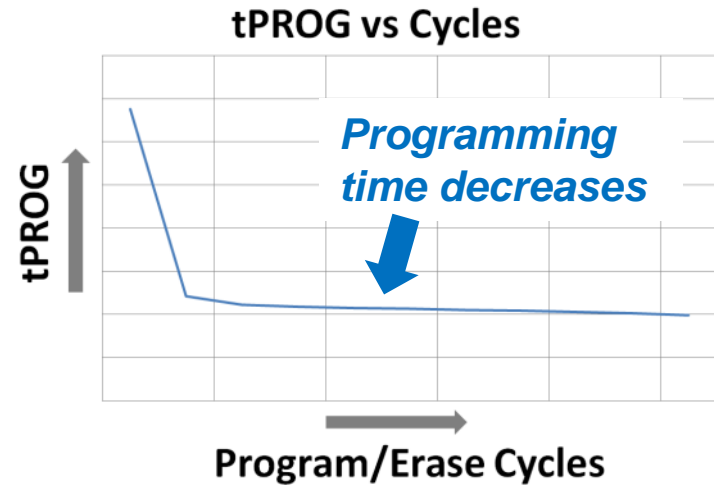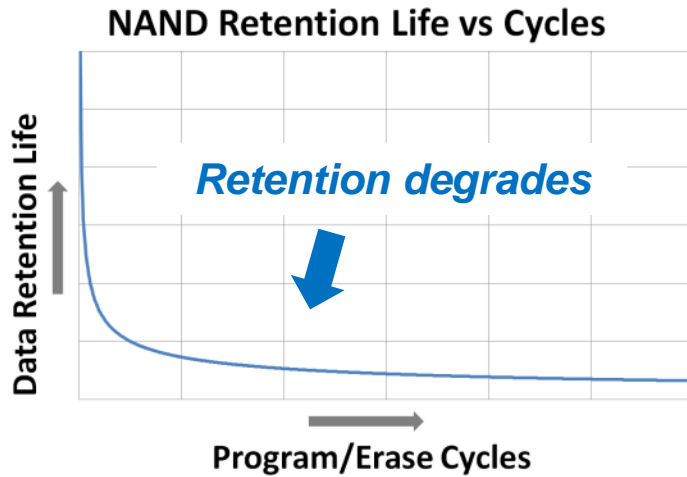- SLC partition to store code or cache data
- Low Latency

Write intensive

- Program and Erase Disturb
- Error management
- High Endurance important

Flash Usage

Cycling Effects on Retention, tPROG, and ECC

NAND Retention Life vs Cycles

Retention degrades

tPROG vs Cycles

Programming time decreases

UBER vs Error Correction

ECC Limited

Component tuning is required to maximize endurance

Ways to Tune Endurance
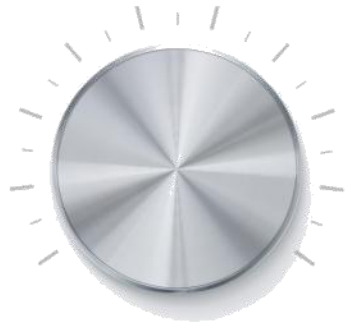
Component

- Reducing Retention
- Increasing Dwell Time
- Lowering Temperature
- Slowing Down Performance
- Increasing ECC

Controller

- Enhanced ECC and DSP
- Increase overprovisioning
- Reducing write amplification
- Increasing density

Conclusion

- Litho shrinks making endurance worse
- System level controls needed to maintain application endurance expectations
  - STEC Cellcare Technology*
  - Annobit Memory Signal Processing*
  - Micron RAIN Technology
  - LSI/Sandforce RAISE Technology*
- Tighter integration between NAND vendors and system controller critical in driving NAND adoption in the future

* Trademarks are the property of their respective owners