

MLC 스토리지의 신뢰성/수명 이슈

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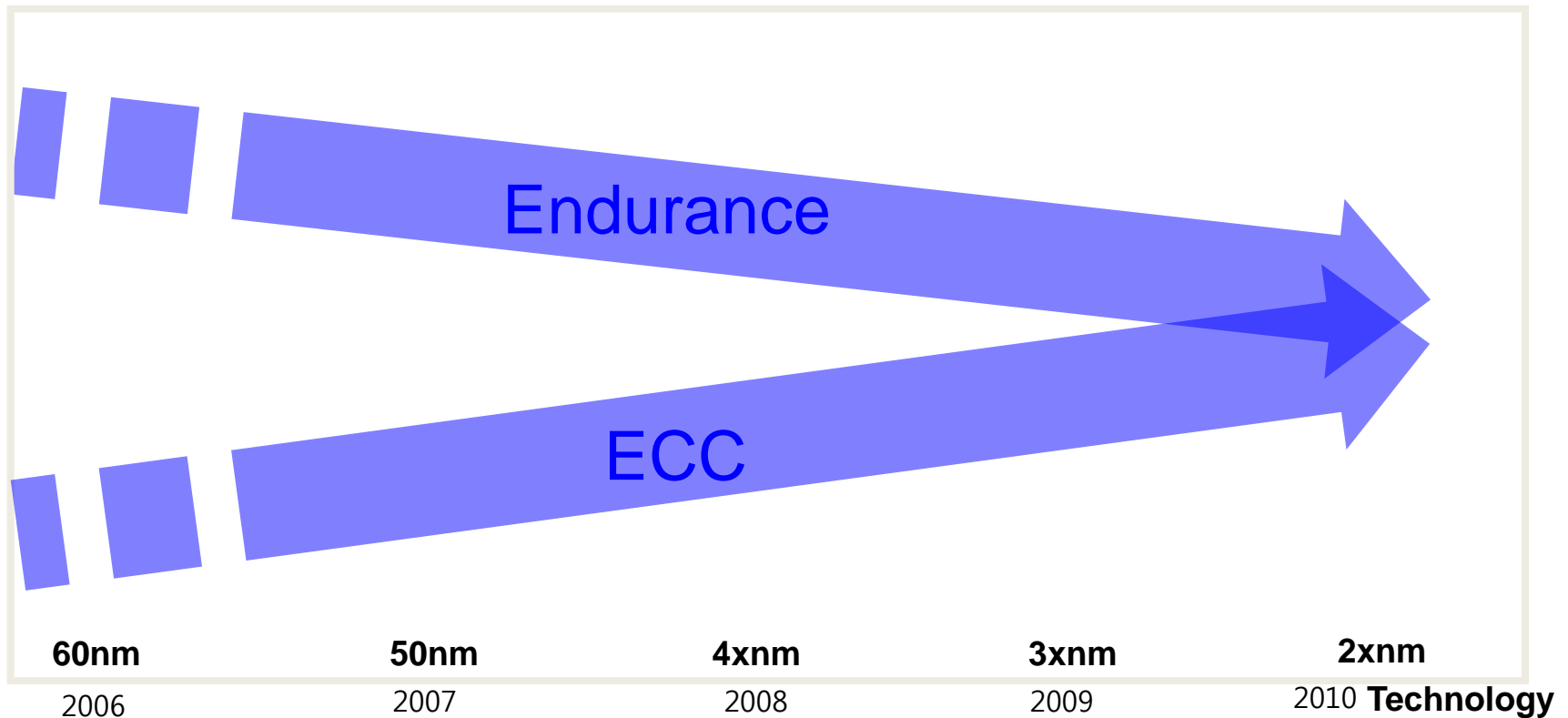
삼성전자(주), 메모리 사업부, SW선행연구팀

NVRAMOS 2010

SAMSUNG

Lifetime & Reliability of NAND

- Degradation of NAND reliability from scaling requires stronger ECC technologies.



Understanding SSD Lifetime

- SSD Lifetime = f{WAI, Performance(IOPS or MB/s)}

$$\text{Estimated Lifetime (year)} = \frac{(\text{Host write per P/E}) \times \text{P/E Limit}}{\text{Daily usage} \times 365 \text{ day / year}}$$

, where Host write per P/E = # of Host writes inducing Erase cycle of NAND Block = 1/WAI

, where Daily usage depends on performance (i.e., IOPS or MB/s)

- WAI (Wear Acceleration Index)

$$\text{WAI} = \frac{\text{Erase cycle}(P/E)}{\# \text{ of Host Writes } (\approx \text{IOPS})}$$

cf) WAF (Write Amplification Factor)

$$\text{WAF} = \frac{\text{Total amount of Physical Write}}{\text{Total amount of Host Write}}$$

SSD lifetime depends on 1. Host workload, 2. WAF(FTL Efficiency)

수명과 신뢰성 이슈 사항

- WAI/WAF을 낮추기 위한 소프트웨어 기술 필요
 - Wear-Leveling
 - Hot/Cold Separation
 - Mapping Algorithm
 - Very Low WAF
- 다양한 신뢰성 수준을 만족할 수 있는 기술 필요
 - JEDEC/SNIA, SSD 신뢰성 표준화 진행 중
 - Client SSD UBER: 10^{-15}
 - Enterprise SSD UBER: 10^{-17}
- 요구되는 신뢰수준의 ECC크기가 Spare크기보다 커져야만 한다면?