

Enabling MLC in Industrial and Embedded Storage

Tools & features to making the right choice

Axel Mehnert
VP Marketing



Need for ...

- Endurance
- Power-Fail robustness
- Data Retention
- Health monitoring

... and for cost-reduction

Industrial/Embedded Requirements

- Endurance
- Power-Fail robustness
- Data Retention
- Health monitoring

SLC	MLC
favorable	unfavorable
favorable	unfavorable
favorable	unfavorable
favorable	favorable

- Reduce WAF
- Paired Page
- Refresh Data



favorable



unfavorable

Endurance

- Need significant reduction of WAF: Unlike in SSD mapping cannot be stored in DRAM and controllers need to be robust and low-cost
- **hyMap approach**
 - Sub-page-based-mapping FTL
 - Mapping entirely stored in NAND
 - Transaction oriented with minimal overhead
 - Built-in redundancy to protect against sudden power-fail

Lifetime Estimation

- 2 chips 2x nm SLC, 60K P/E, 16K page, 4MB Block, 16GB device
- 9% Over Provisioning
- 1 drive write per day

hyMap[®]

Cluster	WAF	TBW	Life [years]
512b	39	24.9	4.3
4K	8	127.5	21.8
4M	1	960	164.4

Block Based Mapping

Cluster	WAF	TBW	Life [years]
512b	8192	0.1	0.02
4K	1024	0.9	0.2
4M	1	960	164.4

Lifetime Estimation

- 2 chips 1y nm **MLC**, 3K P/E, 16K page, 4MB Block, 16 GB device
- 9% Over Provisioning
- MLC reliable mode**
- 1 drive write per day

hyMap[®]

Cluster	WAF	TBW	Life [years]
512b	41	1.2	0.2
4K	10	5	0.9
4M	3	16	2.7

Block Based Mapping

Cluster	WAF	TBW	Life [years]
512b	8192	0.005	0.001
4K	1024	0.05	0.01
4M	1	48	8.2

Lifetime Estimation

- Same configurations
- Comparing hyMap with MLC and BBM with SLC

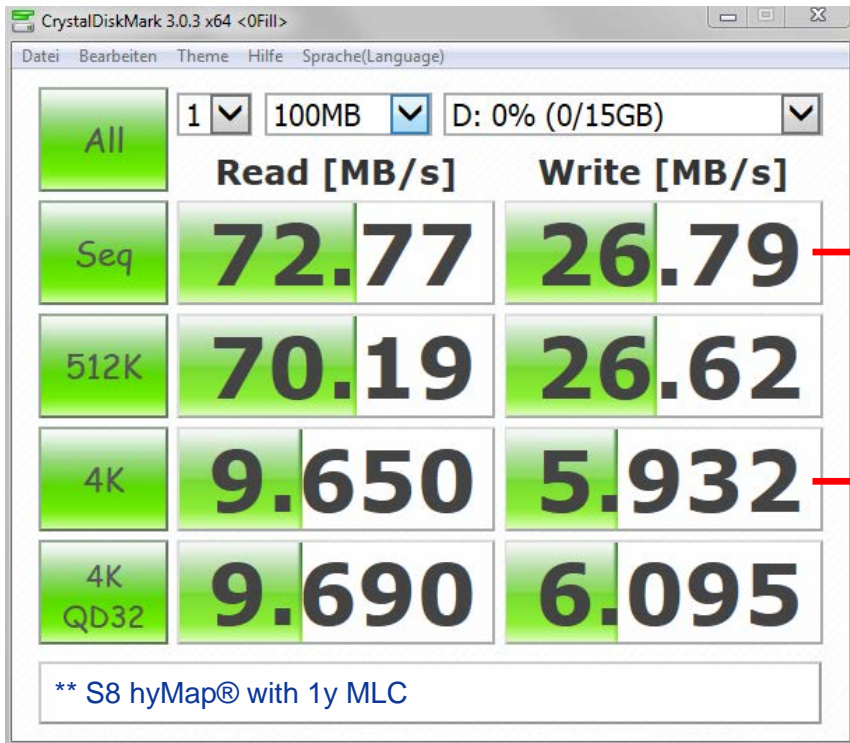
hyMap[®]

Cluster	WAF	TBW	Life [years]
512b	41	1.2	0.2
4K	10	5	0.9
4M	3	16	2.7

Block Based Mapping

Cluster	WAF	TBW	Life [years]
512b	8192	0.1	0.02
4K	1024	0.9	0.2
4M	1	960	164.4

Endurance & Performance

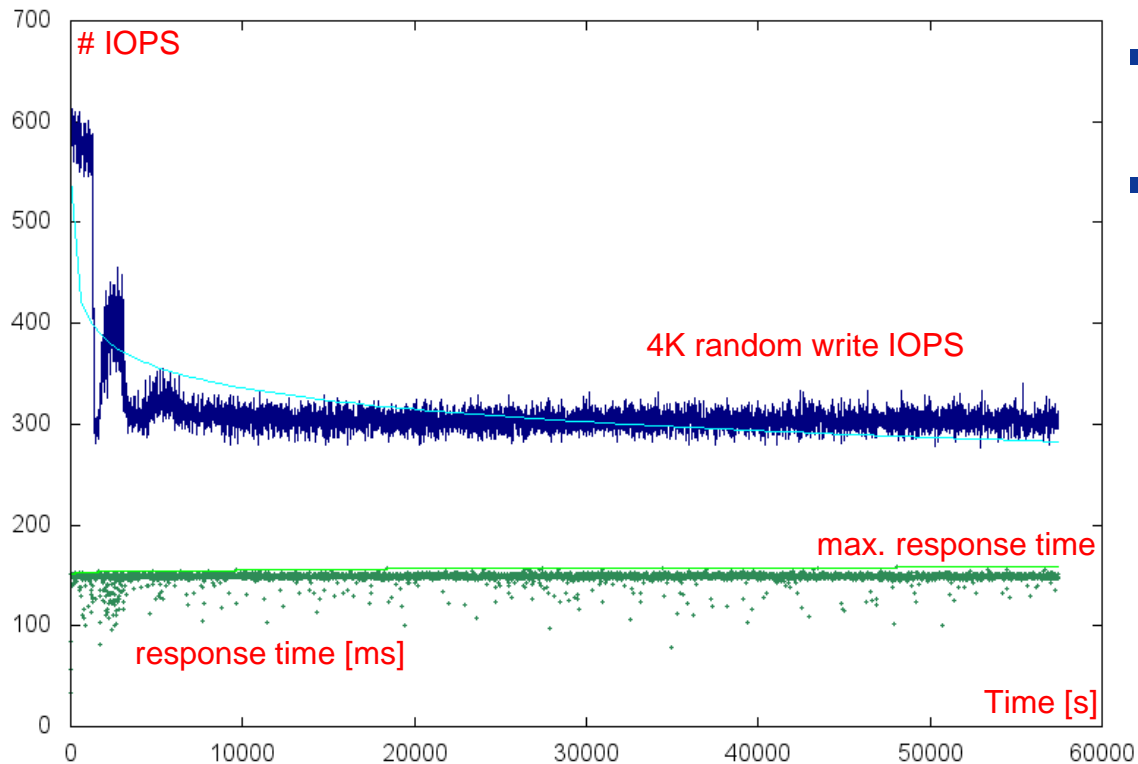


Sequential write WAF ~1

Random 4K WAF ~4.5

~1480 IOPS

Endurance & Performance



- About 320 steady state 4K random write IOPS
- About 150 ms maximum response time

** S8 hyMap® with 1y MLC

Data Retention

- Embedded systems are not regularly powered, not all areas are frequently read, and temperature requirements need to be considered
- **hyMap approach ...**
 - Up to 96-Bit/1K ECC
 - Read Retry
 - Near Miss ECC
 - Dynamic Data Refresh

Summary

- Endurance
- Power-Fail robustness
- Data Retention
- Health monitoring

SLC	MLC
favorable	unfavorable
favorable	unfavorable
favorable	unfavorable
favorable	favorable



favorable



unfavorable

Summary

- Endurance
- Power-Fail robustness
- Data Retention
- Health monitoring

SLC	MLC

- hyMap
- MLC reliable mode
- Dynamic Data Refresh
- VCs & hySMART



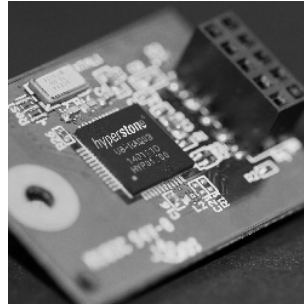
favorable



unfavorable

Hyperstone Products

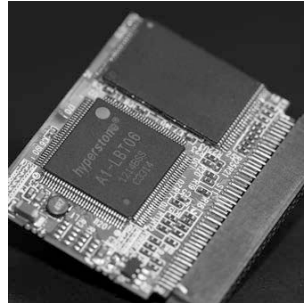
USB



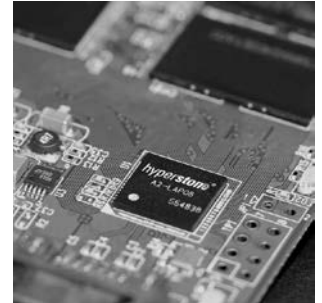
SD/eMMC



CF/PATA



SATA



Enabling MLC in Industrial and Embedded Storage

Thank you!

Axel Mehnert
VP Marketing

hyperston®