Flash Memory Summit

PHISON Knows What You Need

3D Flash Leads to More Powerful Embedded Applications

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Outline

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- Embedded SSD Unique in Every Way
- The Benefits as migrating to 3D Technology
- The Challenges on 3D NAND

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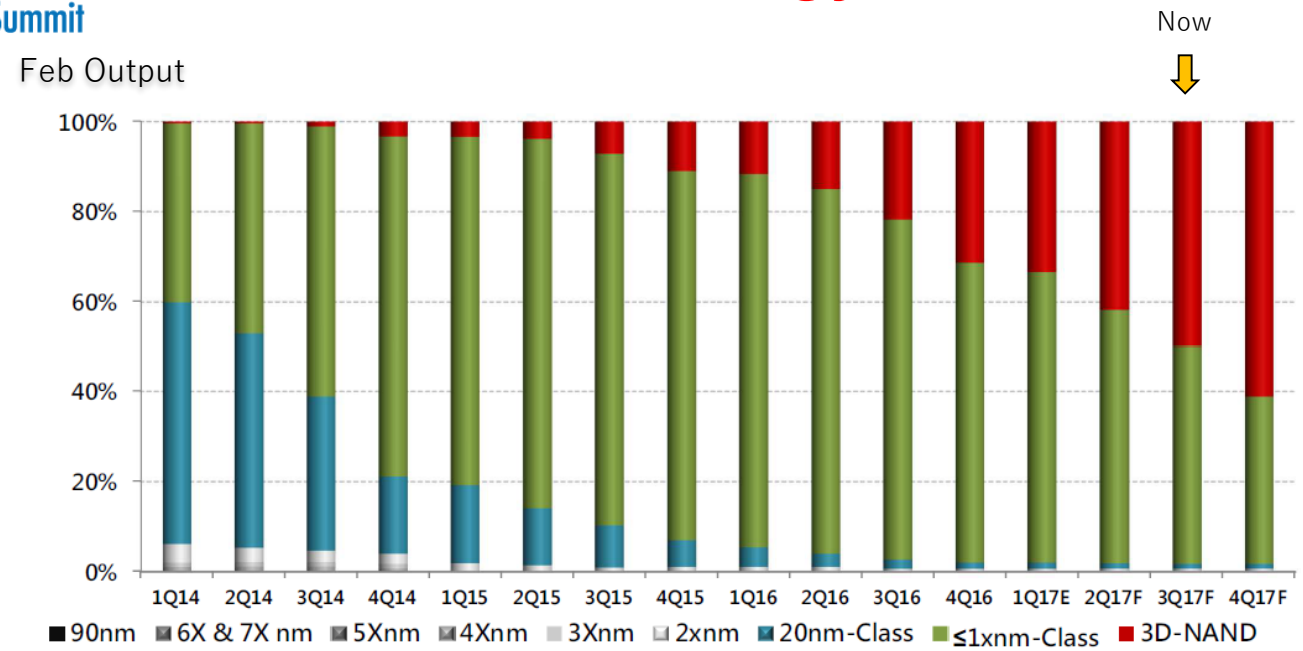
Embedded SSD - Unique in Every Way

Features	Usage Behavior	Validation
•Vaulting •pFail •SATA Link Loss •Logging •Encryption	•Read Intensive •4K Random •Mix WL •Read Only Mode	•Compatibility •Pattern scheme •Environment

AUTOMOTIVE	FACTORY AUTOMATION	TRANSPORTATION VIDEO SURVEILLANCE	KIOSK/GAMING/ DIGITAL SIGNAGE

NAND Technology Trend



- 2D NAND: No more migration after 1Znm process
- 3D NAND: >50% after Q4 17'

Source: DRAMeXchange, Feb, 2017

3D Advantage Over 2D NAND

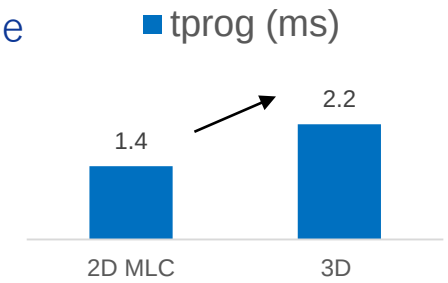
	2D MLC	3D TLC
Cost per bit	High $$	Low $ ✓
Die Density	64Gb and Up	128Gb and Up ✓
Max Data Rate	333- 400MT/s	400- 533MT/s ✓
Power	=	Up to 22% Power Efficiency ✓
Endurance	=	= (with LDPC) ✓
Package	=	Footprint match with 2D MLC ✓

3D Implement Challenges

- Challenge 1: **Throughput** impact on small capacity
- Challenge 2: **Latency** impact due to page # increase

Potential Impact 1: Throughput

- Problem: 1. Mono density double leads to less chip enable
  2. 3D flash program time increases



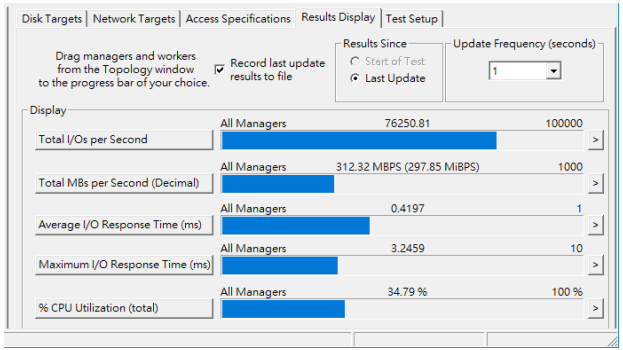
- Solution: Full program sequence (FPS) technology
  MB/s per CE speed improvement: 25MB/s → 45MB/s

	2D MLC	3D TLC (w/o FPS)	3D TLC (with FPS)
Performance (32GB)	520/100 (64Gb x 4 → 4CE)	550/50 (128Gb x 2 → 2CE)	550/90 (128Gb x 2 → 2CE)

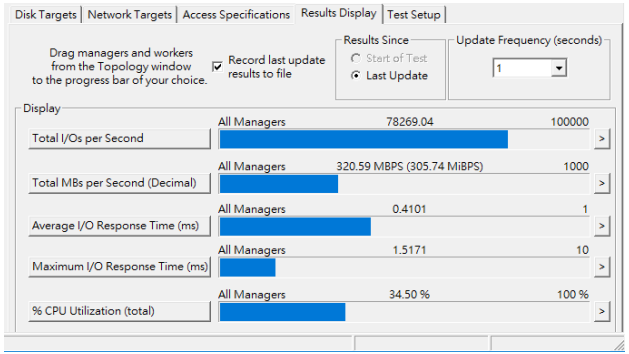
Potential Impact 2: Latency

- Problem: due to page # per block increase (256 → 768), it prolongs garbage collection time to free up one spare block which result to worse latency performance.
- Solution: Proprietary firmware GC optimization

2D MLC 480GB
Avg: 0.4197ms
Max: 3.2459ms



3D TLC 480GB
Avg: 0.4101ms
Max: 1.5171ms



Take-Aways

- 3D NAND anticipates continued MLC/TLC bit cost reduction while driving density growth over next years.
- The traditional rule of thumb still intact- Keeping flexibility, responsive, adaptive.
- 3D NAND brings benefits of density, power, endurance.
- Controller vender plays key role for conquering key challenges (throughput and latency) on 3D transition in embedded market.

For more information on Phison SSD Controllers, please visit us at

Booth #614

- Automotive
- Digital Signage
- UFS

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Thank You!