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Can Embedded Applications Utilize the Latest Flash Storage Technologies?

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The logo for Flash Memory Summit 2016, featuring a yellow sunburst icon above the text "Flash Memory" in red and black, with "SUMMIT" in white on a blue rectangular background below it.

Flash Memory Summit **Agenda**

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- Storage Tech Headlines!
- Embedded Applications Value set
- Flash Storage Technology Review
 - a) Industry Standards
 - b) Form-factors
 - c) SSD Feature Set
 - d) Media
- Back to the Question?
- Food For Thought...



Storage Tech Headlines!

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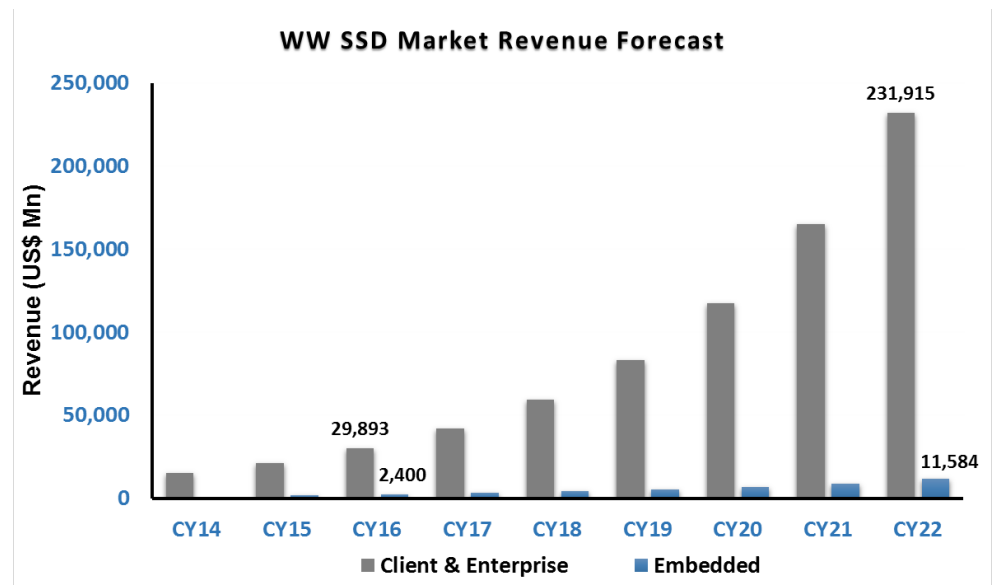
- Feb. - SanDisk Fusion ioMemory SSD announcement 3.2TB SSD - **\$17,870.00!!**
- Feb. - Shannon Systems Direct-IO 6.4TB Enterprise SSD – \$ Call
- Mar. - Intel 2.5" NVMe SSD 480GB - Random R/W 480K/170K IOPS
- Mar. - Samsung Introduces World's Largest SSD – **15.36TB!! (inc. free shipping!)**
- Mar. - Seagate & Micron Enterprise 12Gbps SAS SSD – 3.2TB, 10 DWPD
- Mar - Intel Announces New 3D NAND And Dual-Port NVMe SSDs – 2TB, 32 Layer 3D NAND
- Mar. - Intel SATA 6Gbps, 1TB TLC SSD – **0.1 DWPD "Read Centric"**
- Apr. - Toshiba PCIe Gen 3 NVMe 1.0 2.5" Enterprise SSD - 4TB, **Random R/W 660K/ 185K IOPS**
- Apr. - SK Hynix Enterprise M.2 SSD – 36 Layer 3D NAND, NVMe 1.2, 1.3 DWPD
- May - Seagate Nytro XP6500 Enterprise SSD – Flash Accelerator - Random R/W 300K/100K IOPS

Client & Enterprise:

- C&E has and will always dominate the WW SSD market, CAGR >40% thru CY22
- CY14 Client dominated the C&E Revenue, but Enterprise SSD has a greater YoY growth share

Embedded:

- Embedded estimated to be a \$2B WW market, assuming a CAGR of 20% = \$11.5B CY22
- Smaller market, supported by a large array of technologies & solutions sets
- Trend is toward leveraging solutions driven by C&E market, less customization, a little more compromise, but....



Source: TMR Analysis (August 2015)



Top 5 Storage Selection Criteria

Consumer/Client

Cost
Cost
Cost
Performance
Capacity

Embedded

Reliability
Endurance
Lifecycle
Cost
Power

Enterprise

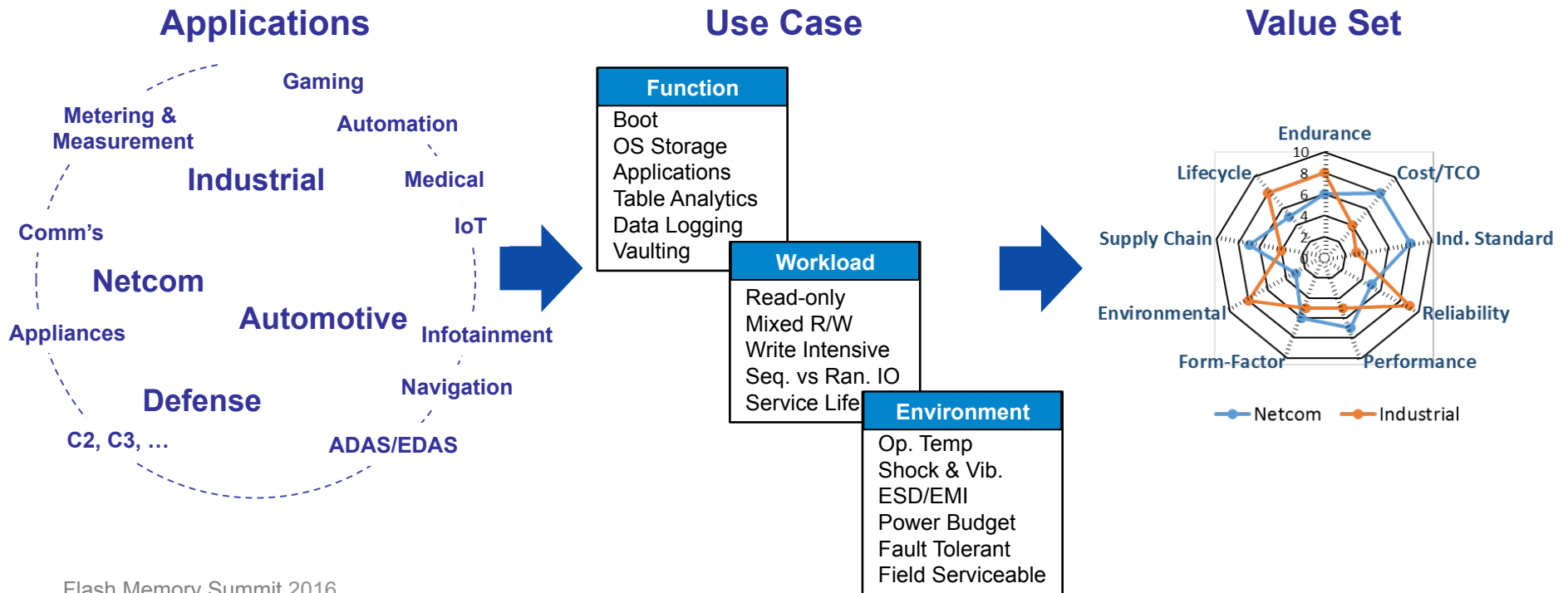
Performance
Capacity
Power
Cost
Reliability

Embedded Applications, typically (but not always) value

Reliability & Endurance over Performance

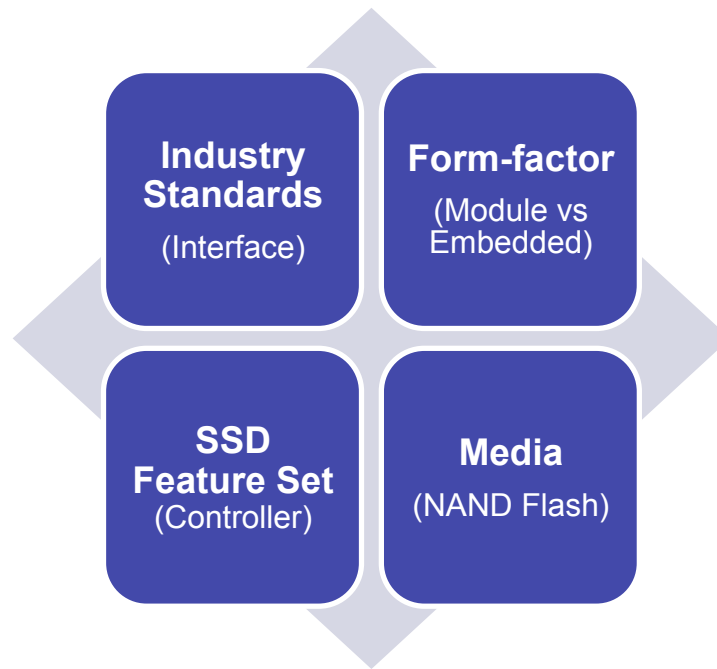
Product Lifecycle over Leading Edge Technologies

Quality/Service/Support (TCO) over Lowest "Initial" Cost

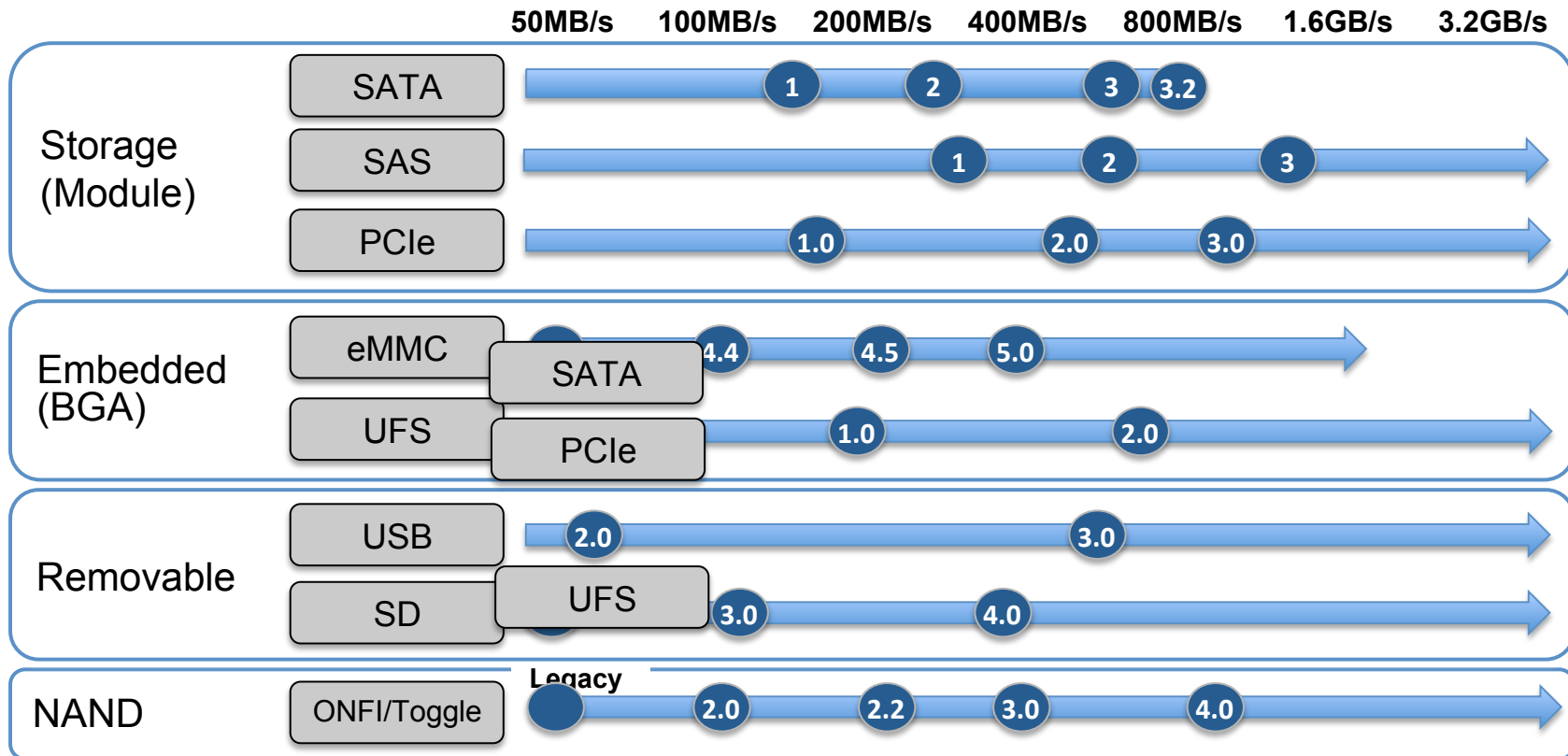









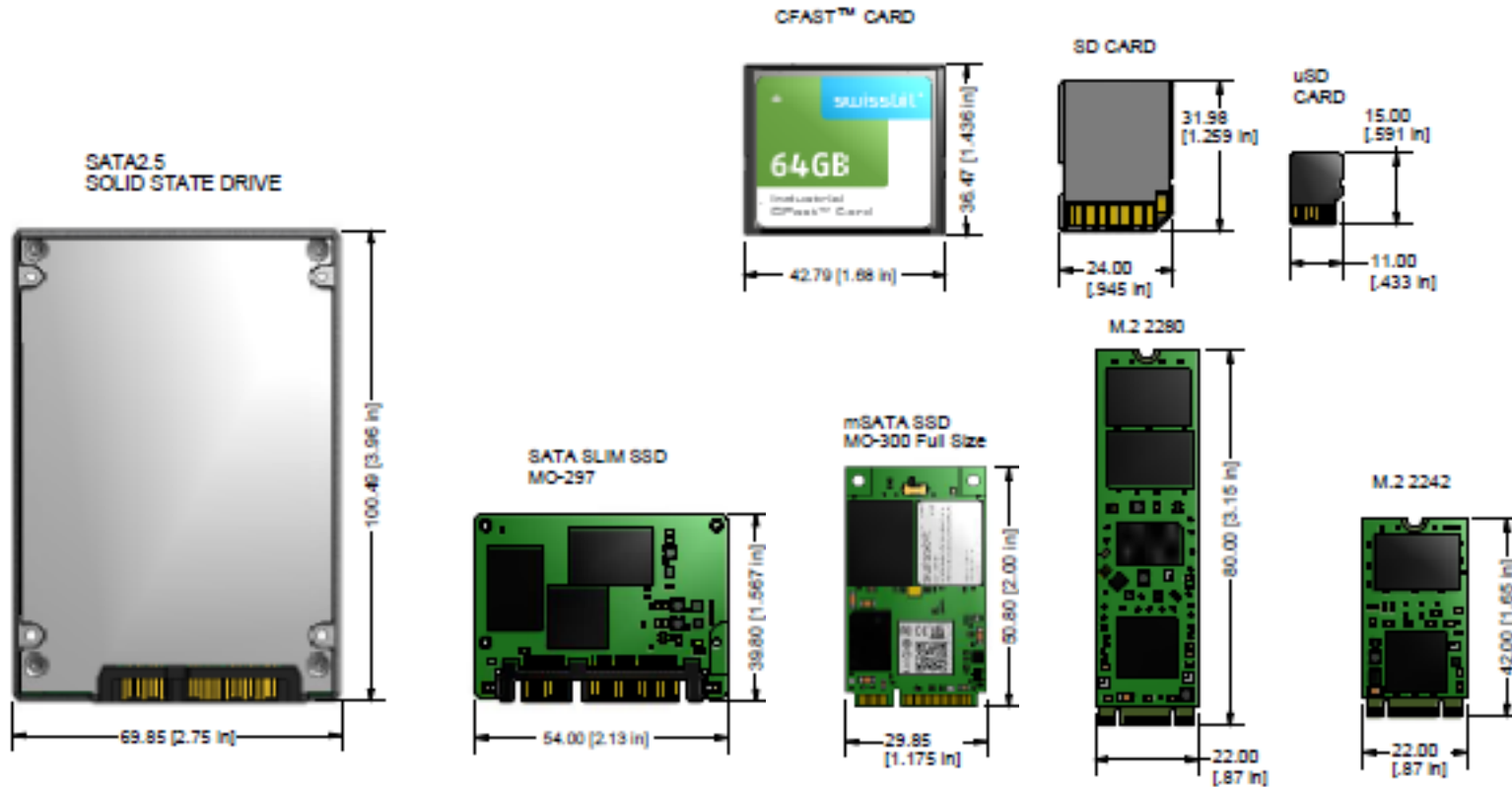
Flash Storage Technology Review ^{swissbit®}



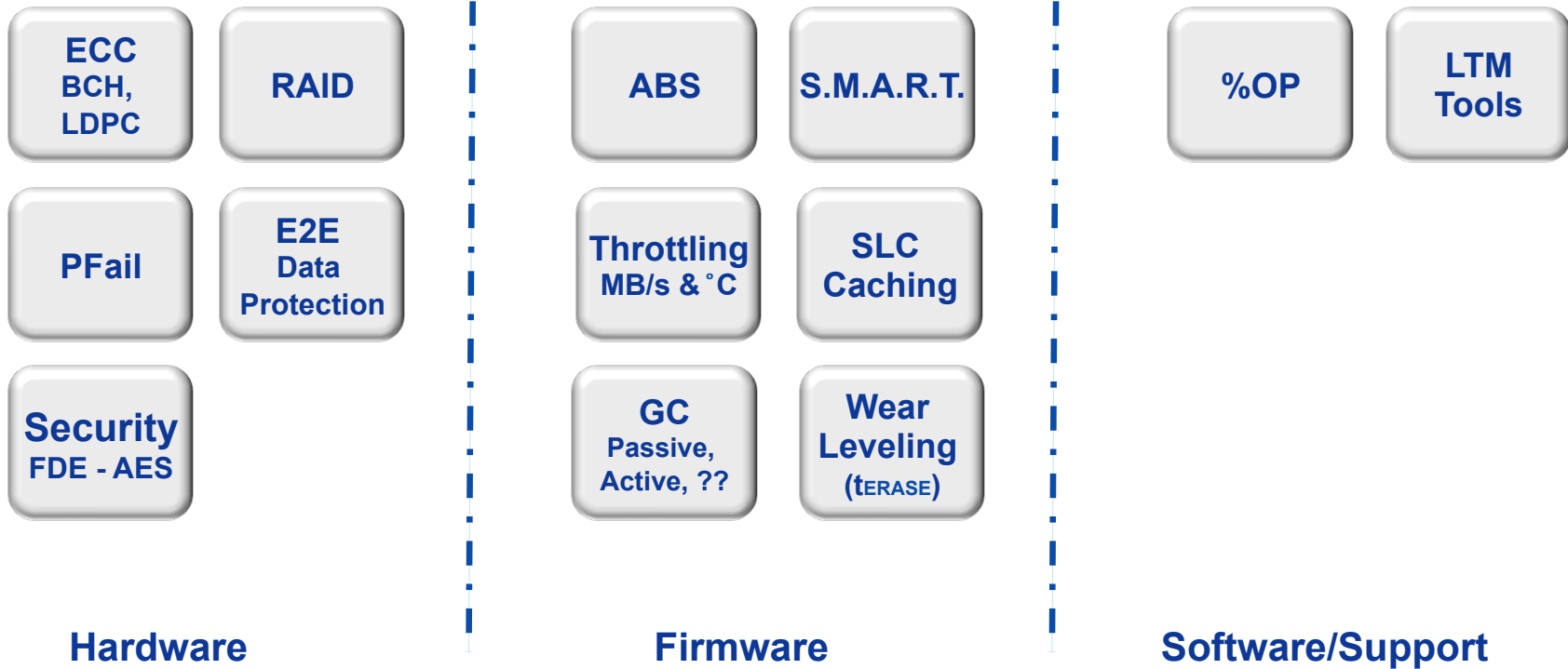
Storage Interface Roadmap



Standard	Strengths & Weaknesses	Embedded Adoption	
		Netcom	Industrial
 USB 3.0	+ Interface is pervasive & mature - 8b/10b encoding	✓ ✓	✓
 eMMC 5.1	+ CMD Queue Depth: 32 + Reliable Write Mode - Performance Limited	✓ ✓	✓ ✓
 UFS 2.1	+ Serial Attached SCSI - Many Chips sets lack dual port support	? ✗	? ✗
 SATA 3.1	+ Interface is pervasive & mature - Power Consumption	✓ ✓	✓ ✓
 PCIe 3.0	+ Bi-directional R/W + No Protocol Trans. Layer - Power Consumption	✓	?



SSD Feature Set (Controller)





Media (NAND Flash)

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- 2D Planar (SLC, pSLC, MLC) – anticipate a decline in production and market tightening, as the semi’s focus their attention on the emerging 3D NAND market demand
- 3D MLC is here, expect good traction for higher capacity embedded (Infrastructure) drives, but only after it is a proven solution for the target use cases
- 3D TLC will likely remain in the C&E space, Embedded customers don’t need the capacity and will value the endurance over GB’s
- NVM technologies (e.g., PCM, STT-MRAM, etc.) are coming but still “years” from being a real challenger to displace NAND

“Micron, Samsung in Flash Battle”
EETimes, Feb. 2016



TOSHIBA



SanDisk
a Western Digital brand



Back to the Question?

“Can Embedded Applications Utilize the Latest Flash Storage Technologies?”

- Yes! - Embedded Storage Applications have and will continue to benefit from the Latest Storage Technology developments driven by the Client & Enterprise market.
- Expect the NetCom market will actively leverage the PCIe transport and NVMe protocol benefits in next generation platforms (currently in development).
- Traditional Embedded Industrial applications are more likely to rely “Tried and True” (e.g., SD, eMMC, SATA, etc.) versus “Fast and Furious” (e.g., PCIe NVMe)



Food for Thought...

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Given the Embedded Applications Value set...

Is it possible that the majority of Embedded customers stay the course, picking up incremental C&E Storage Technology improvements (e.g., SSD Feature Set, NAND, etc.),

...and hold out for the “Big Bang!” disruptive innovation of NVM working memory/storage (i.e., Shared Memory) solution sets in the CY20+ timeframe?

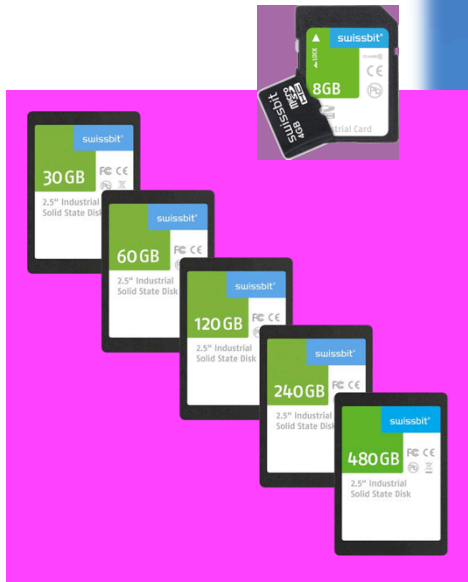
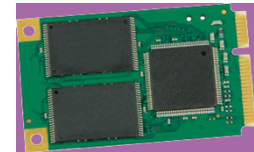
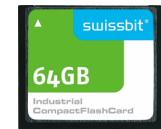
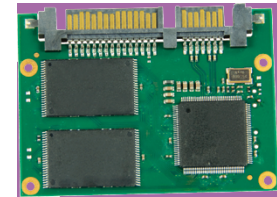


Quality is not an act,
it is a habit.

Aristotle, 352 BC

Thank You for Listening

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