Market Research Panel
MRES-201A-1

Market Research Track
8:30AM to 9:35AM
August 7, 2019

Industry Analyst Panel

Moderator: John Rotchford, Managing Director, SASI

Camberley Bates, Managing Director, Evaluator Group

Jean S. Bozman, Vice President, Hurwitz & Associates

Thomas Coughlin, President, Coughlin Associates

Chris DePuy, Co-Founder, The 650 Group

Flash Memory Venture Funding & M&A Insights

August 7, 2019

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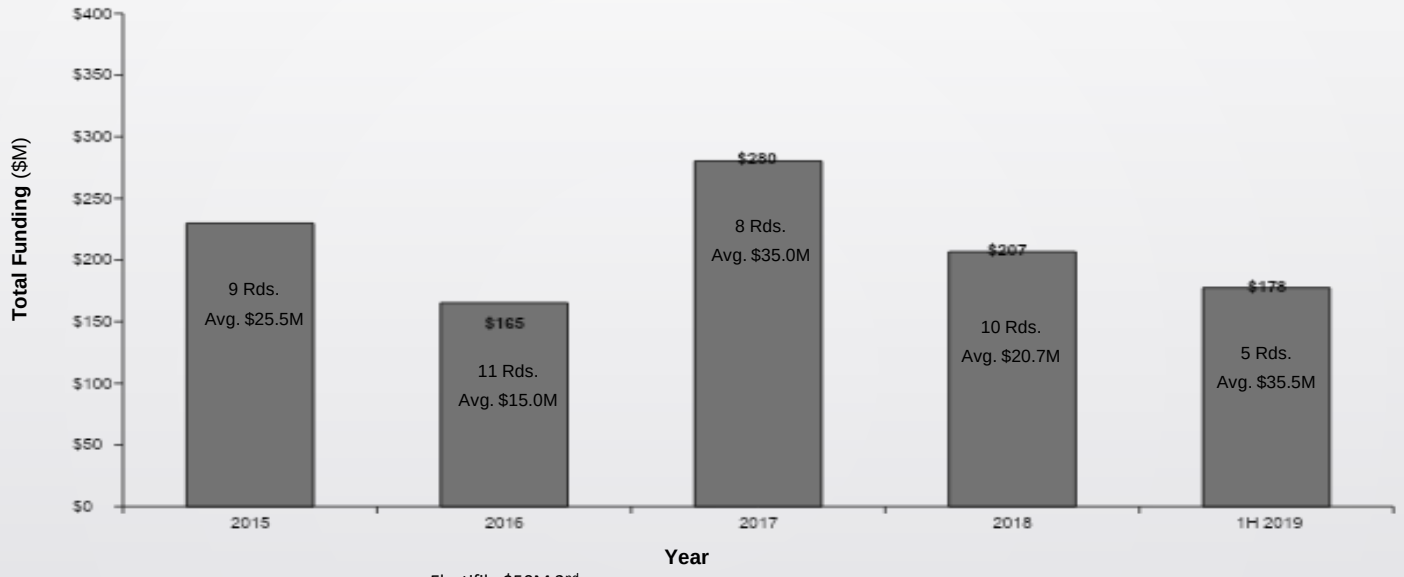
Flash Memory Venture Funding

A solid first half of 2019 with $178M in finding, led by Lightbits with an impressive $50M 1st round of funding which included strategic investors, Cisco, Dell and Micron…

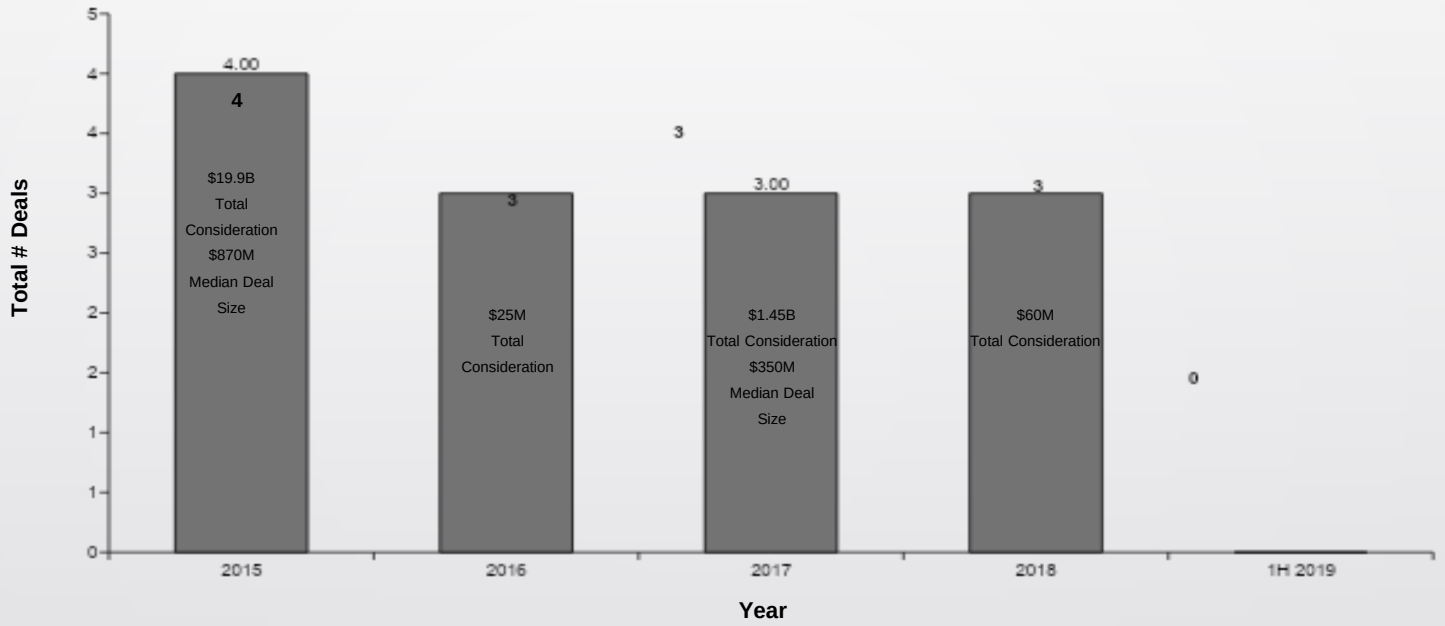


Top Five Rounds

2015	2016	2017	2018	1H 2019
Tegile $70M 4th Crossbar $35M 4th Nantero $31.5M 5th Everspin Tech $29M 2nd Crocus $21M 5th	Elastifile $50M 2nd Diablo Tech $37M 3rd Avalanche Tech 23M 6th Nantero $21 6th E8 Storage $12M 2nd	Kaminario $75M 5th Vexata $54M 4th CNEX Labs $38M 3rd Tegile $33M 5th Kalray $26M Later	Spin Transfer $52M 2nd Crocus Tech $35M 6th Nantero $30M 6th ScaleFlux $25M 2nd CNEX $23M 4th	Lightbits $50M 1st VAST Data $40M 2nd Avalanche $33 7th Pliops $30 2nd MemVerge $25M 1st

Flash Memory M&A

While venture funding remains strong, the M&A valve has been shut off…



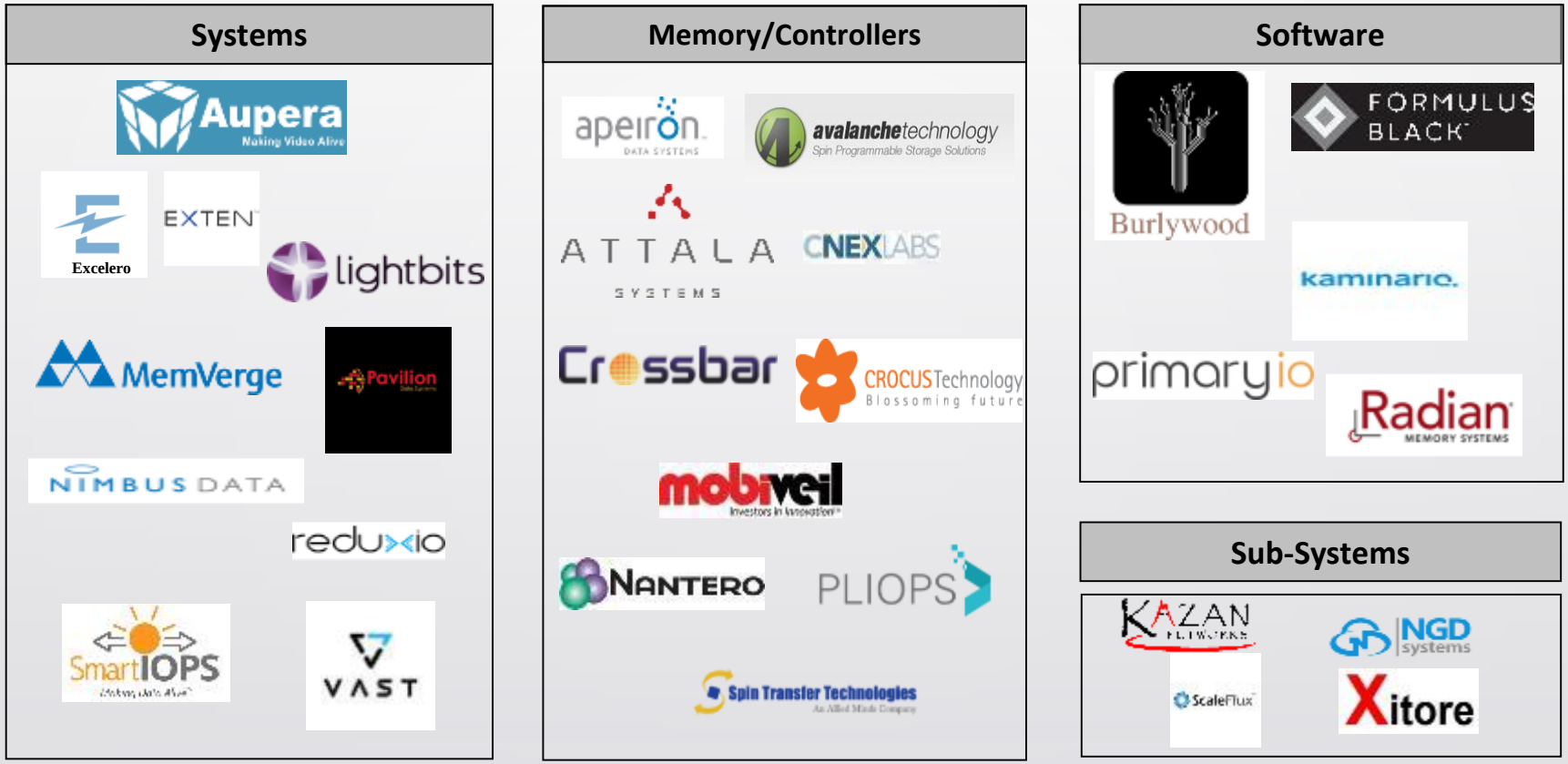
Top Deals

2015	2016	2017	2018
~~WD/SanDisk $19B~~ NetApp/SolidFire $870M Silicon Motion/Shannon Sys ~~$58M~~	Nutanix/PernixData $25M Pivot3/NexGen Stg Kingston/Imation	HPE/Nimble Storage $1.1B WD/Tegile $350M Soros/Violin $15M	DDN/Tintri $60M Violin/X-IO Storage Synopsys/Kilopass

However, its' already picking up in July/August with Storcentric acquisition of Vexata, Rambus acquisition of Northwest Logic and AWS purchase of E8 Storage

Flash Memory Venture Market Map

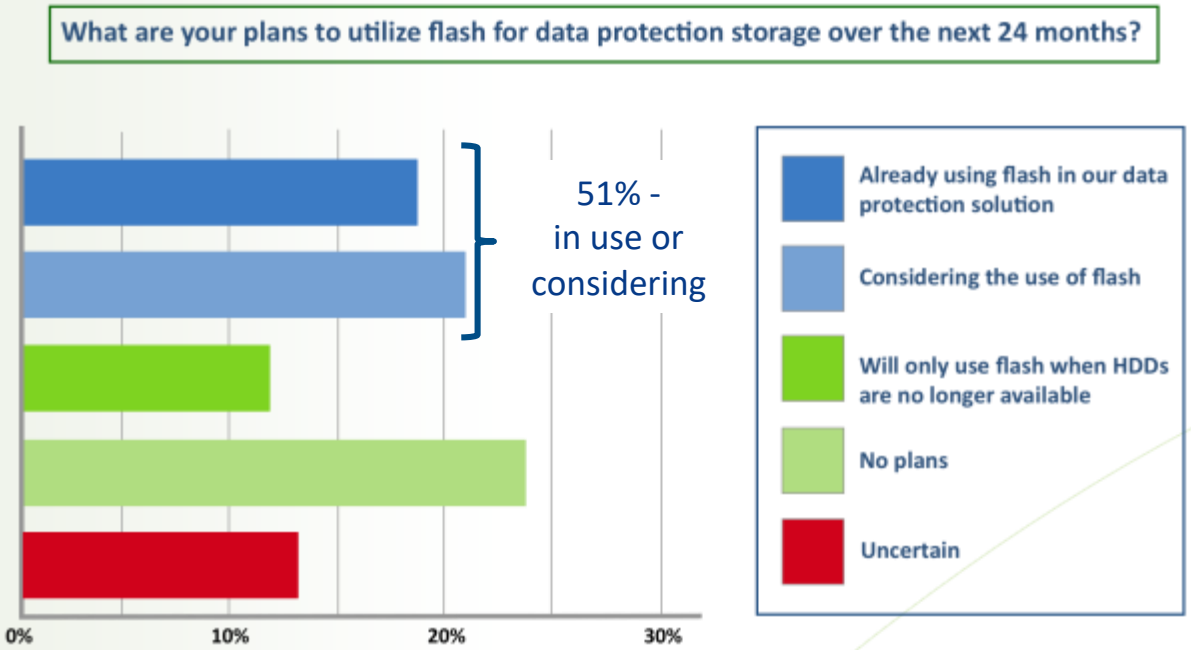
We expect VC funding to remain strong in the 2nd half of 2019 and we could also see another 3+ M&A trades happening before year end…



New(er) use cases for Flash

Camberley Bates, Managing Dir / Analyst

Flash and Data Protection



- "Using all –flash arrays… not that expensive for back up and DR"
- "We need performance (backup target) to finish faster"
- "Less Hardware maintenance"

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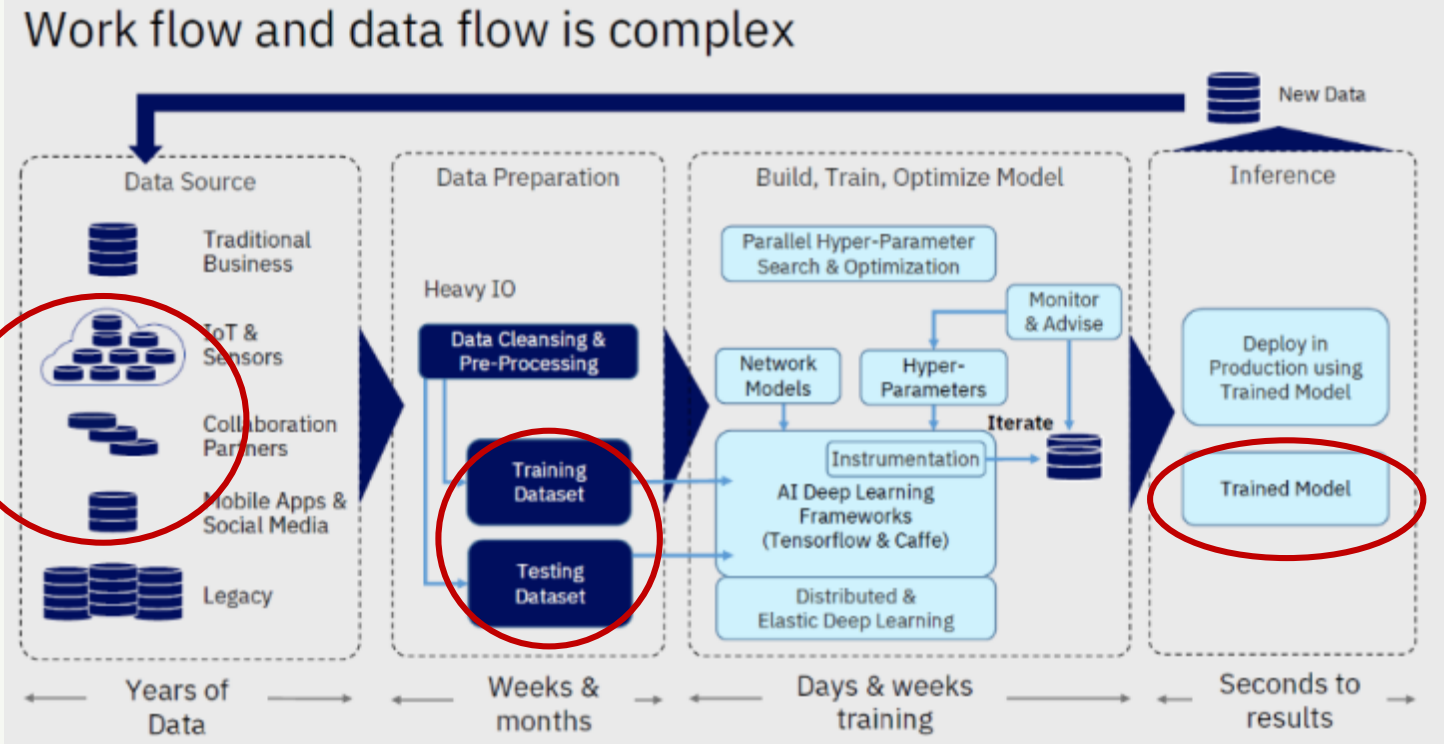
Flash and Analytics Flow



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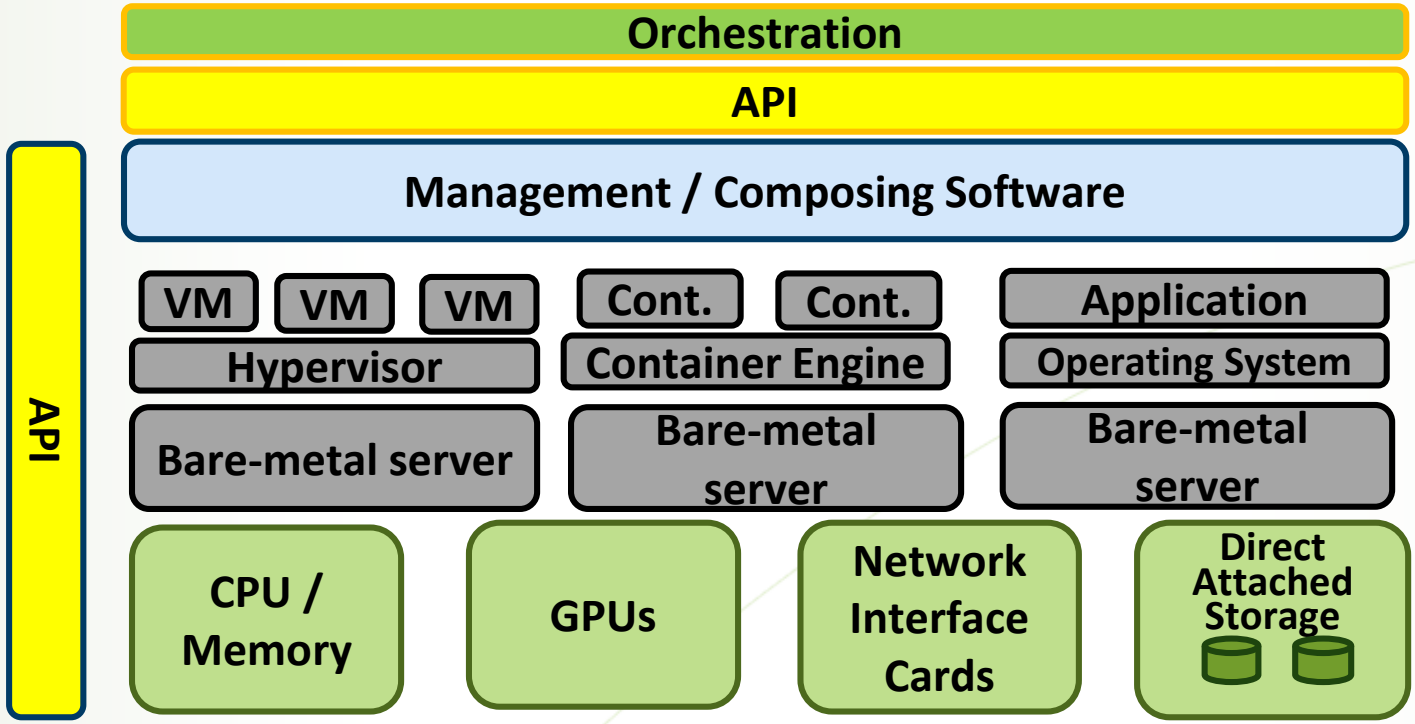
Composable Infrastructure



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Next in the Data Center

- Second Generation AFA Storage
- Long- term archive
  - High density 50TB SSD
  - 10++ year life of drives – eliminates tape or HDD migration

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Insight to Action

Cloud and Edge Will Drive Sustained Demand for Flash

Jean S. Bozman
Vice President and Principal Analyst
Hurwitz & Associates

The Business Impact of Hybrid Cloud

- Gathering more data for rapid decisions, business agility
- There's a need for fast, persistent storage
- Data is being stored closer to the customer
  - Examples: Financial, Retail, Oil/Gas refineries

Consolidation/Simplification/Migration

- As more apps move to Edge and Cloud, enterprise data centers must:
  - Identify apps for cloud migration
  - Clean up database sprawl
  - Replicate data across the hybrid cloud
  - Connect cloud “front-end” apps with “back-end” transactional databases
  - Partner with CSPs to apply AI to improve navigation of metadata

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Edge Computing Is Accelerating

- Demand for real-time analysis
- Often in remote sites
  - Oil refineries, retail stores, factories
  - IoT appliances/devices, self-driving vehicles
  - Hyper-converged systems
- Edge systems incorporate fast SSDs
- Analytics first, data transfer later
- New network fabrics to reduce latency
  - Leveraging NVMe for faster data transfers

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Hybrid Clouds Tap Data Differently

- Non-traditional data sources proliferate (social media, IoT)
- Dealing with 160 ZB+ of data worldwide by 2025
- Integrating end/end services (Transactional + Mobile)
- Cloud Object Storage
- Data Optimization for efficient use on-prem *and* off-prem
- Still key: Ensuring HA/DR and security for enterprise data

Building Out: What's Next

- Use NVMe for faster end-to-end data transfers from DC to cloud to edge
- Harmonize SQL databases with non-SQL ones in the enterprise mix
- Establish regional data "hubs"
- Replicate key data-sets across the cloud
- Go to hybrid cloud, leading to multi-cloud to leverage a range of cloud usage models

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Insight to Action

Time for New Memories?

Tom Coughlin

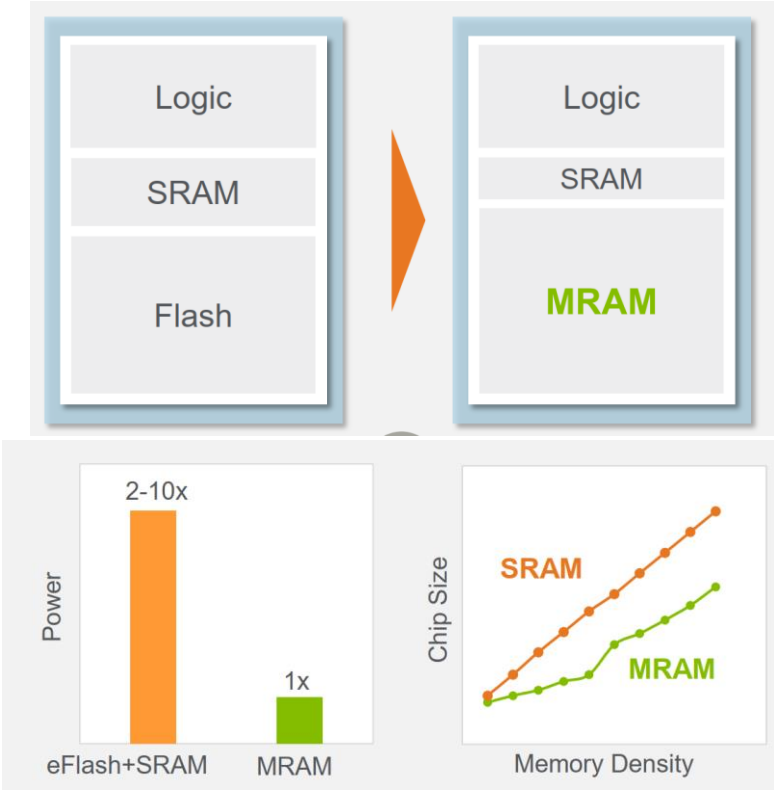
Coughlin Associates

www.tomcoughlin.com

MRAM In Embedded Devices

- MRAM is smaller than SRAM (with 5-6 transistors/cell)
- NOR Flash cannot shrink beyond about 22-28 nm
- MRAM could replace SRAM and NOR flash memories in embedded AI devices consuming less power with higher memory density

Images from Kevin Moraes, AMAT, 2019 Semicon



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MRAM AI Developments

- All the major semiconductor foundries have said they will provide embedded MRAM in SoC products including Samsung, TSMC, Global Foundries UMC, etc.
- Many of these foundries are also looking to move MRAM integration away from BEOL to earlier in the chip production process to reduce cost
- New tools are needed for MRAM, driving capital equipment spending

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Lightspeeur® 2802M, *Production AI Accelerator Chip with MRAM (from 2019 CES)*

- Includes: The GME (Gyrfalcon MRAM Engine)
- 9.9 TOPS/W in a 22nm ASIC
- Produced via TSMC Collaboration
- Industry leading features, like Non-Volatile Memory

~ 40 MB of Memory	Large embedded models	
	Multiple AI models :	
	Image Classification	Facial recognition
	Voice identification	Voice Commands
	Text to speech	And others…..
Power Savings	20-50% when compared to SRAM or “other MRAM”	
Custom Designs	One Time Programmable Memory	
	up to 10 ns Read Speed (~30 TOPS/W)	
	Non-Power Leakage	

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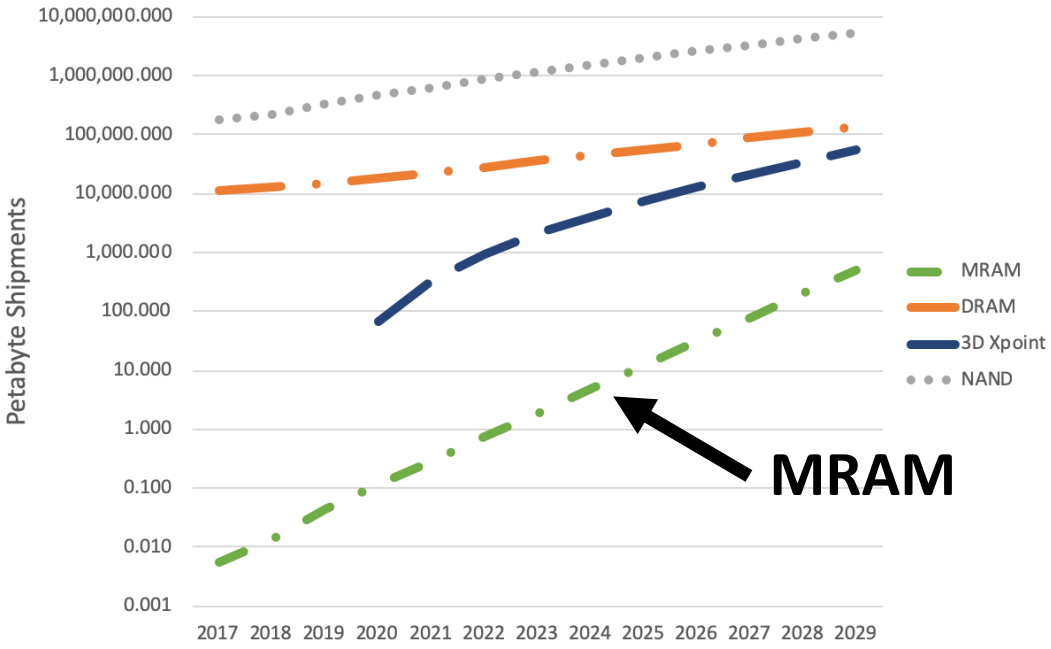
Growth in MRAM Memory Shipments



2019 Emerging Memories Ramp Up, Coughlin Associates and Objective Analysis, 2019

- MRAM will replace the bulk of embedded NOR and SRAM in SoCs, mostly for AI apps
- The chart shows projected baseline petabyte memory shipments from 2018-2029.

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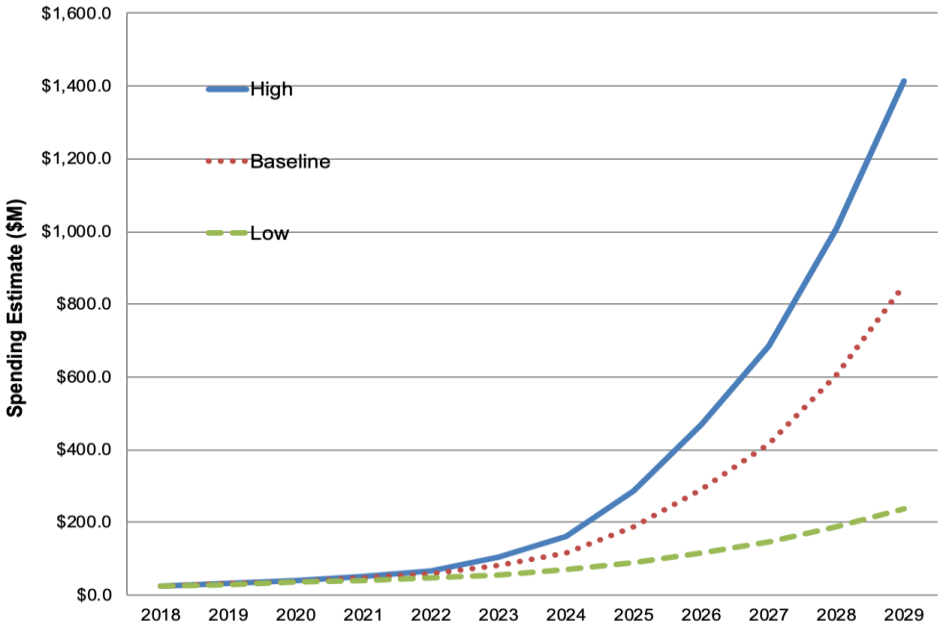
MRAM Capital Spending Up

The chart shows low, baseline and high MRAM manufacturing equipment spending estimates from 2018-2029.



2019 Emerging Memories Ramp Up, Coughlin Associates and Objective Analysis, 2019

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For Further Information

Report on Emerging Memories and Workshop on Emerging Memories and AI

EMERGING MEMORIES RAMP UP

Available June, 2019

This report, jointly produced by Objective Analysis and Coughlin Associates, provides an exhaustive look at emerging memory technologies and their interaction with standard memories, both as discrete devices and in embedded applications (the memories within logic chips like ASICs and MCUs). The report provides a well of technical information, market dynamics, forecasts, and competitive analyses of the leading companies. Forecasts show how the markets will grow not only for the technologies themselves, but also for the capital equipment used to produce them. Read this to understand the competitive landscape and market drivers for these new memories, and to learn how to profit from tomorrow's market.

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Order at: https://tomcoughlin.com/tech-papers/
or https://Objective-Analysis.com/reports/#Emerging

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EMAI 2019
Emerging Memory and Artificial Intelligence Workshop
Bechtel Conference Center at Encina Hall
Stanford University
August 29, 2019

This is a one-day workshop featuring invited experts speaking on emerging memory technology, such as MRAM, RRAM, FRAM and PCM as well as experts on applications using various types of AI, such as machine learning, talking about memory requirements for these applications. The morning will feature speakers on the foundational knowledge of emerging memory technologies and AI, with the afternoon featuring speakers on applications for AI including these applications using emerging memory technologies.

To register and for detailed event information, please visit:
https://emai19.sites.stanford.edu

650 GROUP
MARKET INTELLIGENCE RESEARCH

Presentation at Flash Memory Summit
Panel MRES-201A

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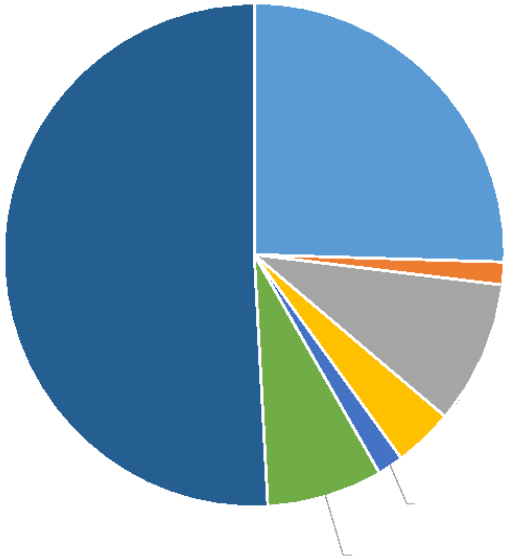
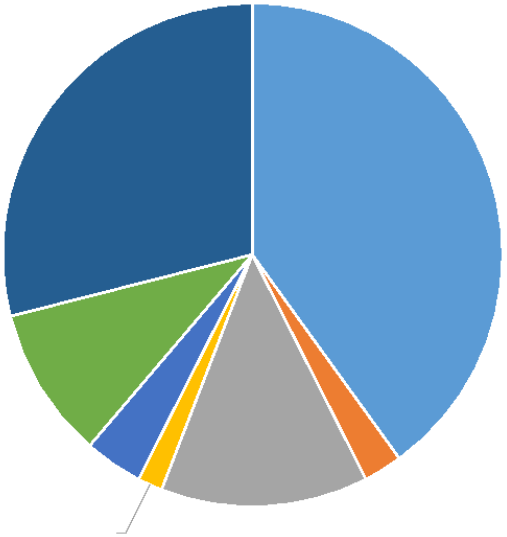
Storage Systems:
Customer Type – Total (I+E)





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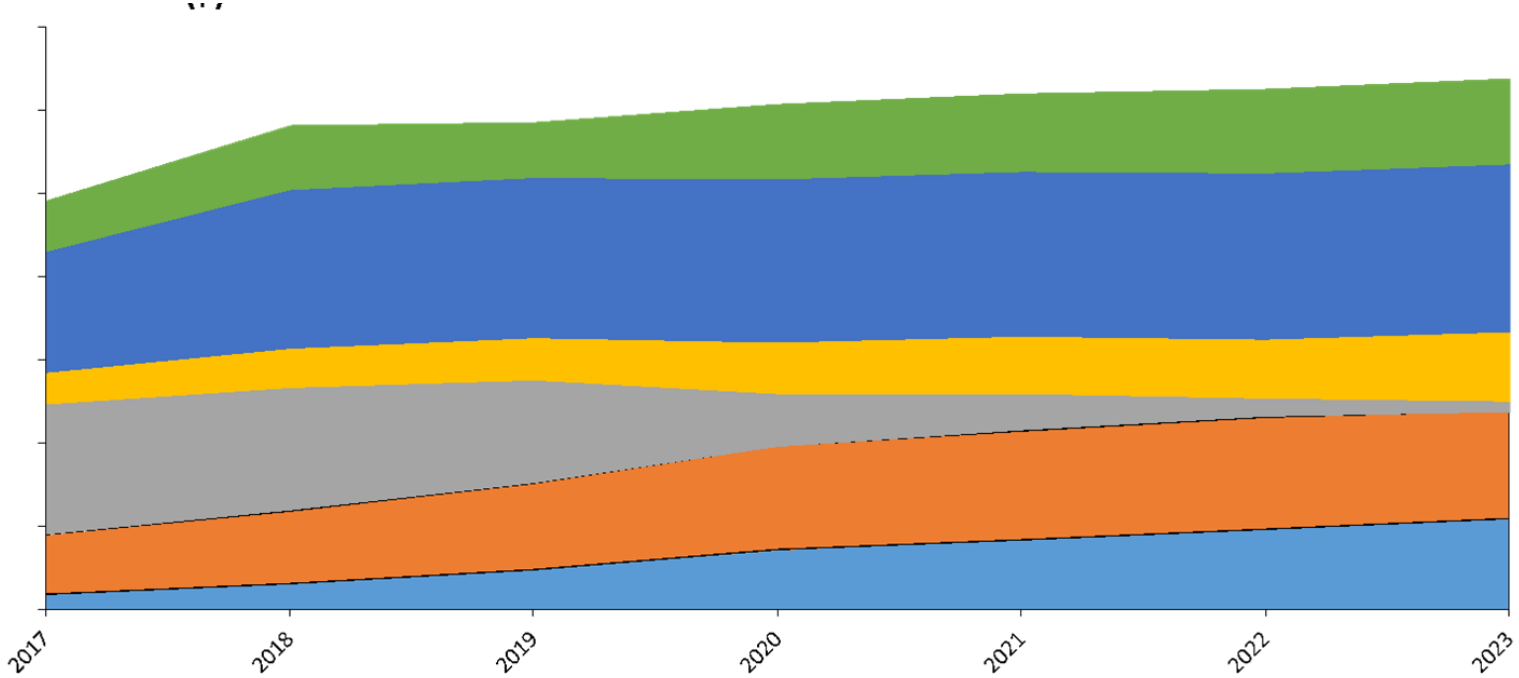
Storage Systems:
Equipment Type – Total (I+E)



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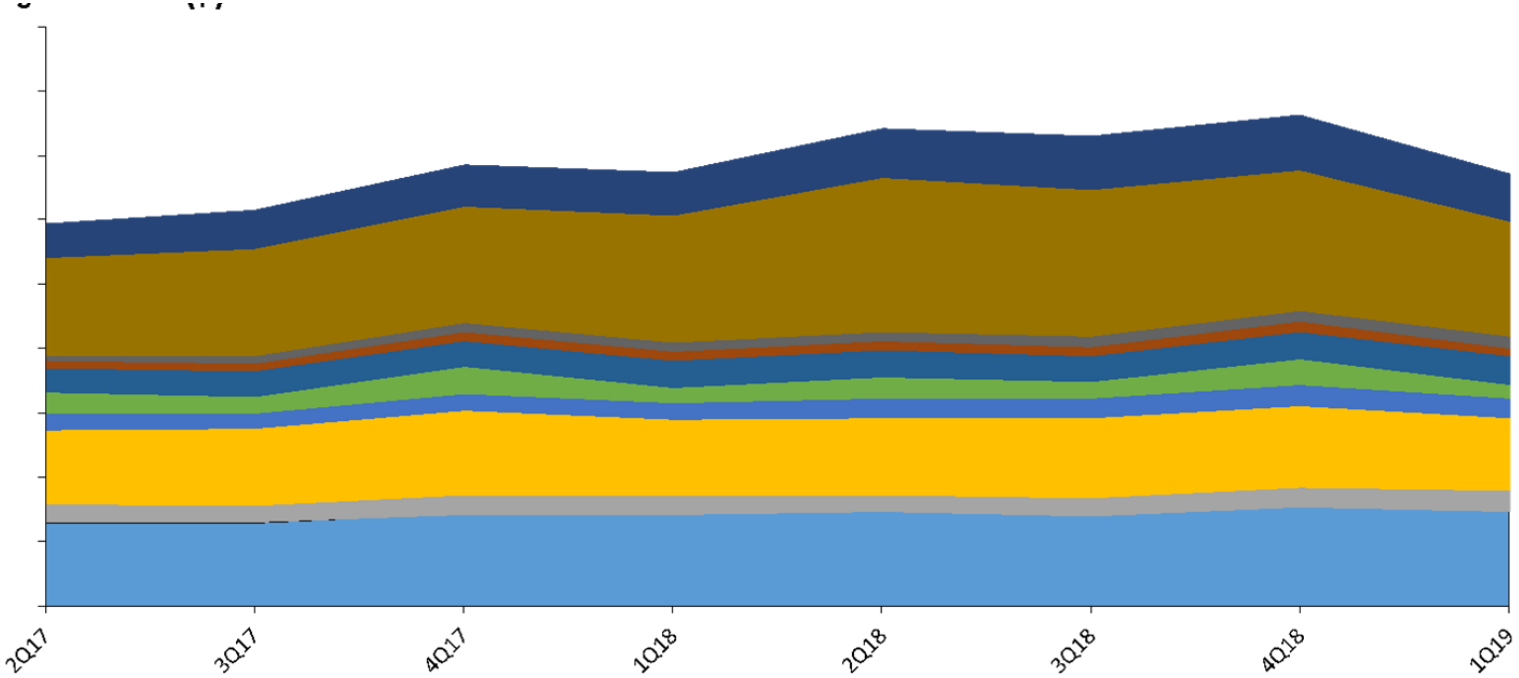
Storage Systems:
Vendor Landscape – Total (I+E)



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Company Overview

We started 650 Group to provide our subscribers and customers with a unique perspective on the industries we research. Our team has decades of experience researching our focus industries and in roles at companies similar to the ones we cover. We research the data center, communications and Information Technology markets.

- Founded in 2017 by Chris DePuy and Alan Weckel
- Headquartered in Silicon Valley
- Trusted source of research for system vendors, component manufacturers, service providers, sell-side, buy-side, and standards bodies

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Q & A