

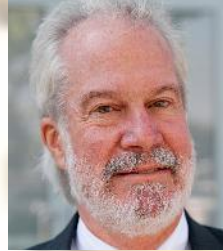


Emerging Memories The Next Big Market

Jim Handy

OBJECTIVE ANALYSIS

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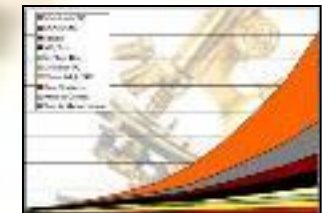
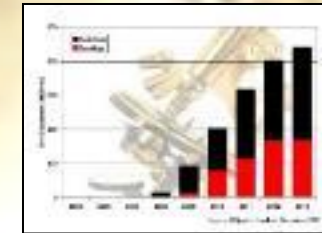


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OBJECTIVE ANALYSIS

Semiconductor Forecast Accuracy

Year	Forecast	Actual
<u>2008</u>	Zero growth at best	-3%
<u>2009</u>	Growth in the mid teens	-9%
<u>2010</u>	Should approach 30%	32%
<u>2011</u>	Muted revenue growth: 5%	0%
<u>2012</u>	Revenues drop as much as -5%	-2.7%
<u>2013</u>	Revenues increase nearly 10%	4.9%
<u>2014</u>	Revenues up 20%+	9.9%
<u>2015</u>	Revenues up ~10%	-0.2%
<u>2016</u>	Revenues up ~10%	1.1%
<u>2017</u>	Revenues up ~20%	22%
<u>2018</u>	Strong start supports 10+% growth	14%
<u>2019</u>	Semiconductors down -5%	-12.5%
<u>2020</u>	Zero growth at best	6.8%
<u>2021</u>	Revenues grow 6% by remaining flat	26.2%
<u>2022</u>	Total semi still grows 6%	3.2%
<u>2023</u>	Semiconductors decline 19%	TBD

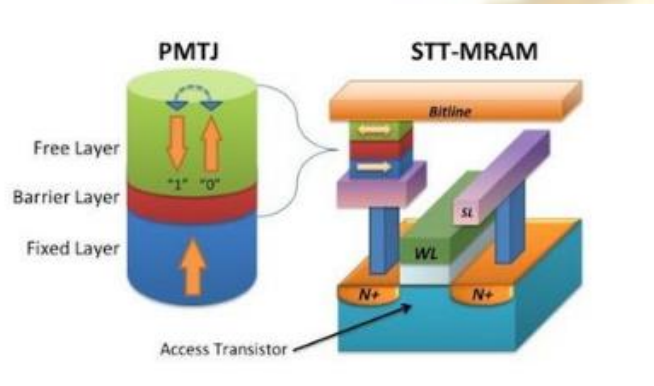


Outline

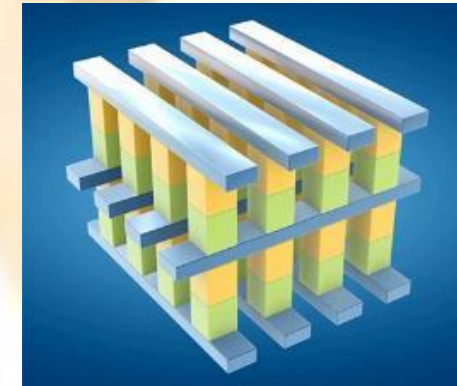
- Emerging memories are inevitable
- CXL will cause great change
- Chiplets will prevail

Many Good Contenders

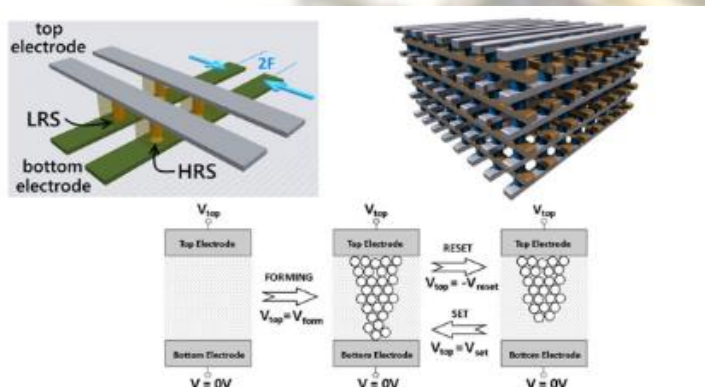
MRAM



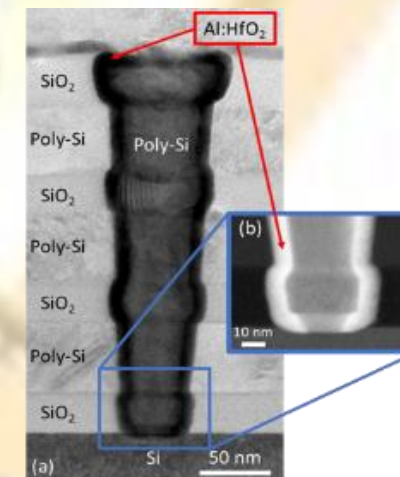
PCM



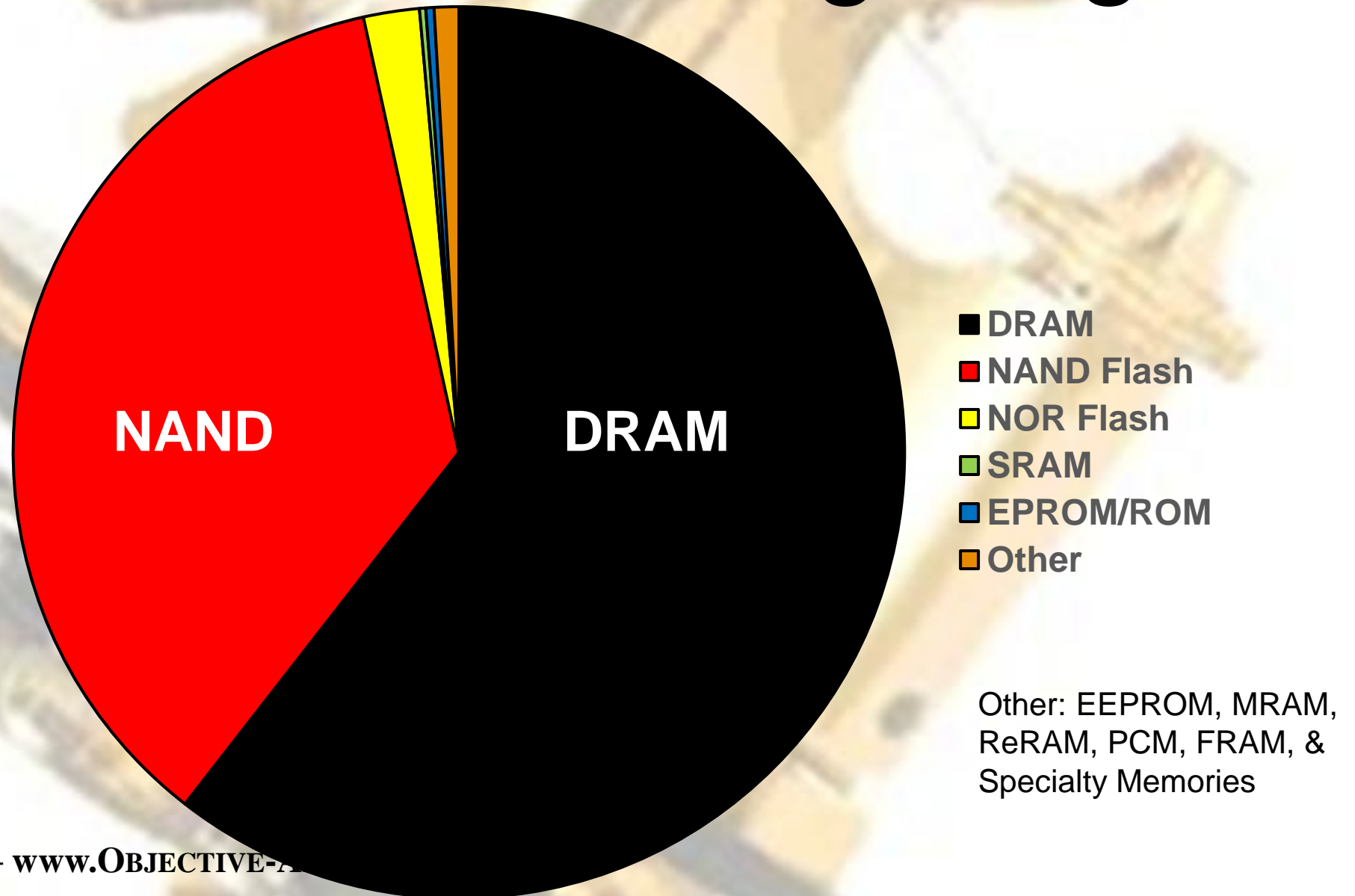
ReRAM



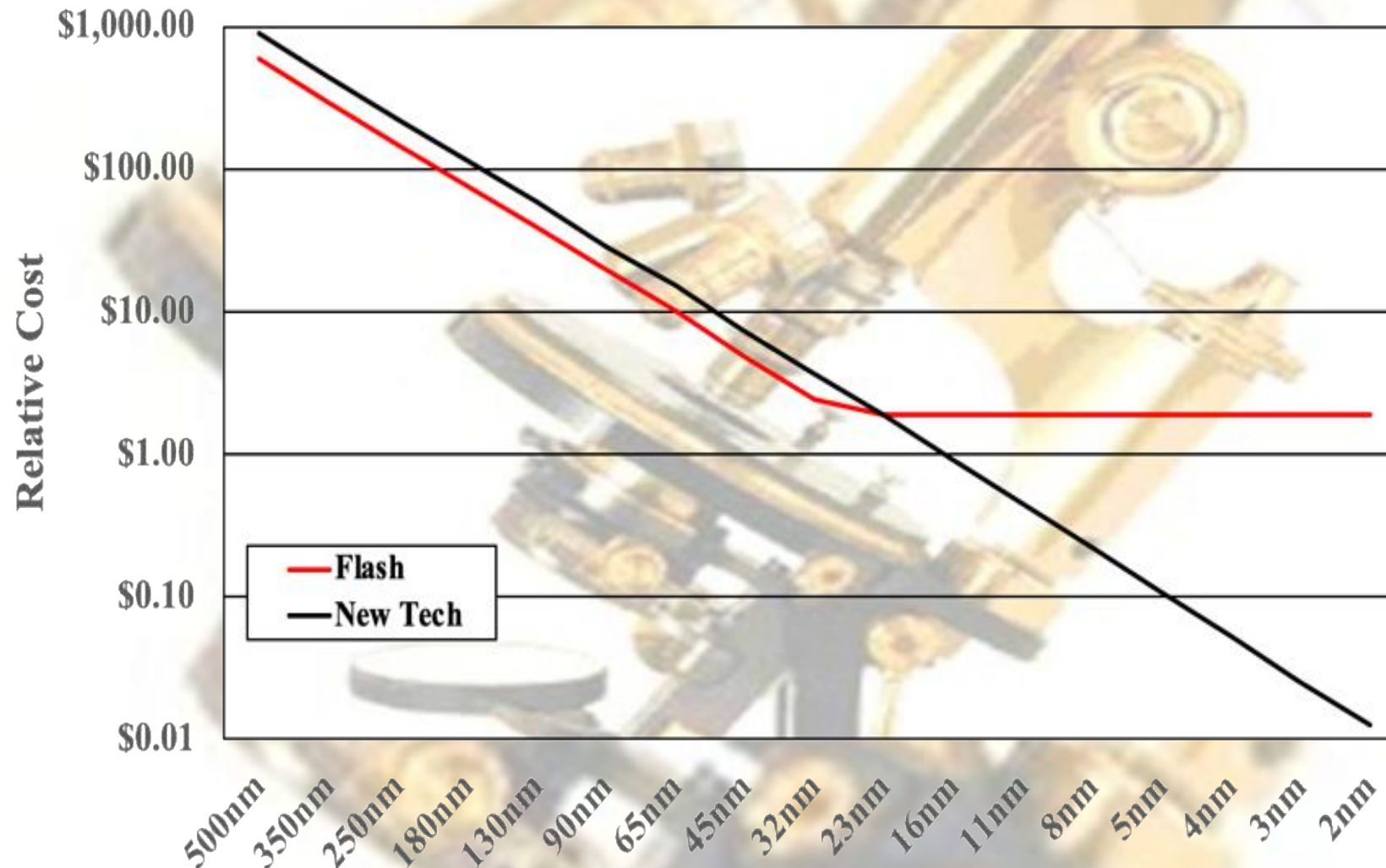
FRAM



DRAM & NAND Are Big Targets



Displacing DRAM & NAND



CXL Supports Emerging Memories

- CXL manages mixed memory speeds
 - Multiple memory types can tie to a single memory channel
- CXL supports persistent memory
 - Also, watch for Memory Semantic SSDs: MS-SSD
- CXL has a lot of support
 - Especially by hyperscalers and Intel

Chiplets Favor Emerging Memories



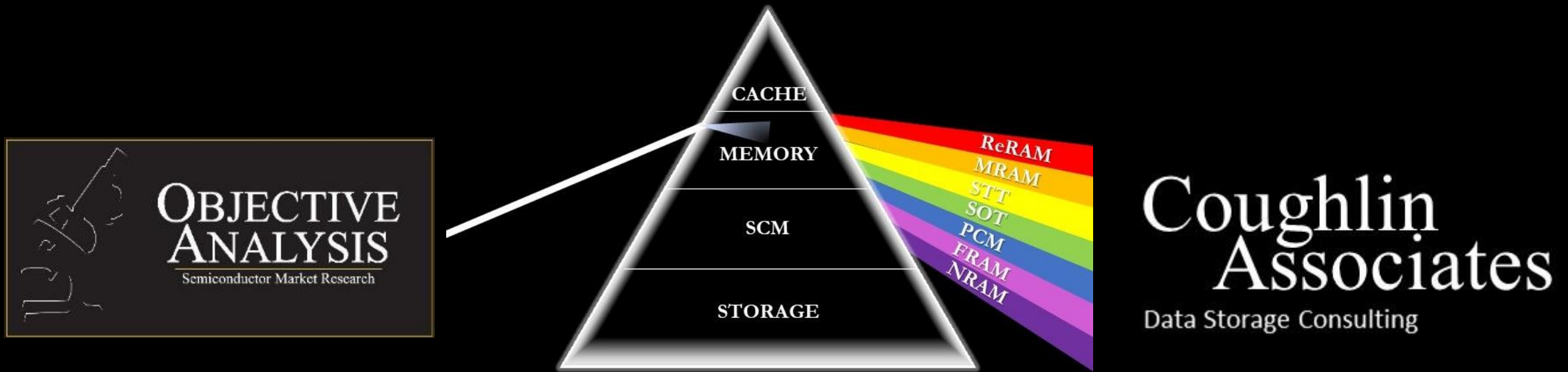
UCle is Based on CXL

- UCle = Chiplets with CXL interface
 - Persistent memory support
 - Also supports mixed speeds
- Chiplets are encouraging for emerging memories
 - Can reduce costs vs. embedded memory
 - Provides nonvolatile option to SRAM caches

Summary

- Emerging memories are catching on
- CXL supports emerging memories
- Chiplets will prevail
 - UCIe supports emerging memories

New Report: Emerging Memories Branch Out



Now Available!

<https://Objective-Analysis.com/reports/#Emerging>
<http://www.tomcoughlin.com/techpapers.htm>