

Emerging Memories Branch Out

A SNIA CMSI Webinar

Live: Monday, January 22, 2024, 10:00 am Pacific

On Demand: <https://bit.ly/EmergingMemories>

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SNIA CMSI Mission and Goals

www.snia.org/cmsi

The SNIA Compute, Memory, and Storage Initiative (CMSI) is dedicated to fostering the growth and success of the market for solid state storage, computational storage, persistent memory, and other advanced storage technologies in both commercial and consumer environments.

*Goal: **Educate** end users and industry about the technology and technical work that CMSI supports.*

*Goal: **Outreach** - Communicate the benefits of SNIA supported technologies and technical work.*

*Goal: **Enablement** - Make SNIA technical work easier to access and use.*

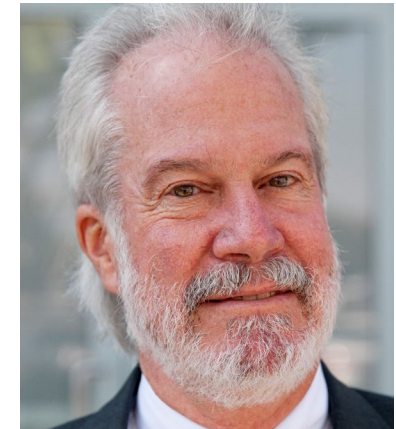
Introductions



Arthur Sainio
Moderator
Co-Chair,
SNIA Persistent Memory
Special Interest Group



Tom Coughlin
Presenter
President, Coughlin Associates
President, IEEE



Jim Handy
Presenter
President,
Objective Analysis

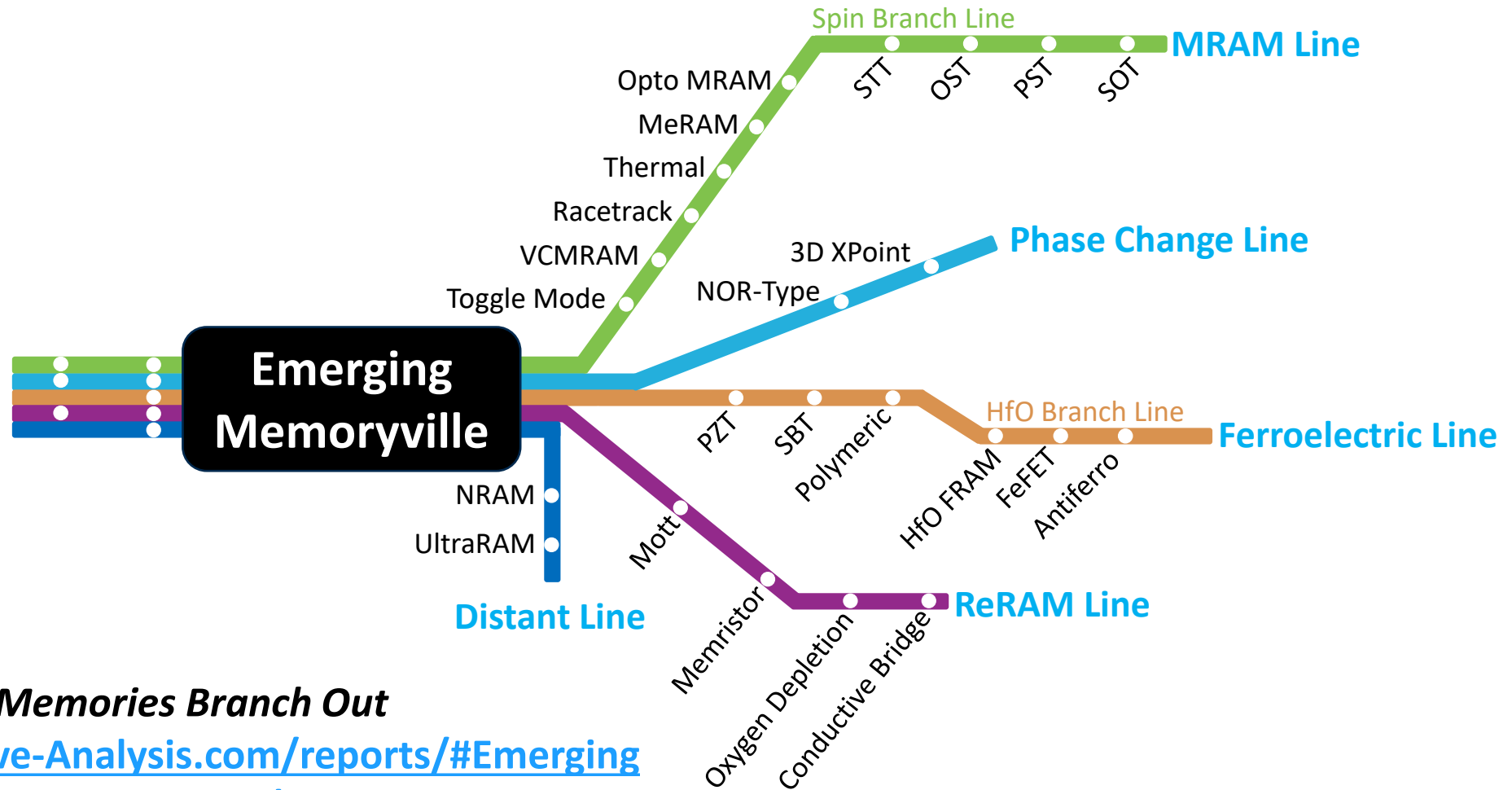
Outline

- Emerging memory's latest developments
- Growth: why, how, and when it's coming
- Impact on semiconductors & systems
- What you need to do
- Q&A

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No Shortage of Emerging Memory Technology Types



From: *Emerging Memories Branch Out*

<https://Objective-Analysis.com/reports/#Emerging>

<http://www.tomcoughlin.com/techpapers.htm>



Bonus: All Emerging Memories Are Persistent!

Emerging Memory Updates: MRAM & ReRAM

■ MRAM

- TSMC & Samsung producing MRAM-based SoCs in volume
 - Globalfoundries coming soon
 - NXP automotive MCU uses TSMC MRAM
 - Netsol launched stand-alone MRAM based on Samsung process
- Everspin modestly growing stand-alone MRAM chip revenues
- Avalanche selling into satellite applications

■ ReRAM

- Adesto CBRAM now at Globalfoundries
- Weebit Nano making important progress
- Panasonic ReRAM MCU now at Nuvoton
- Growing ReRAM focus in China

Emerging Memory Updates: PCM & FRAM

■ PCM

- Optane “Wind-Down” as of July 2022
 - Loss: ~\$10B
- STMicroelectronics still making PCM MCUs

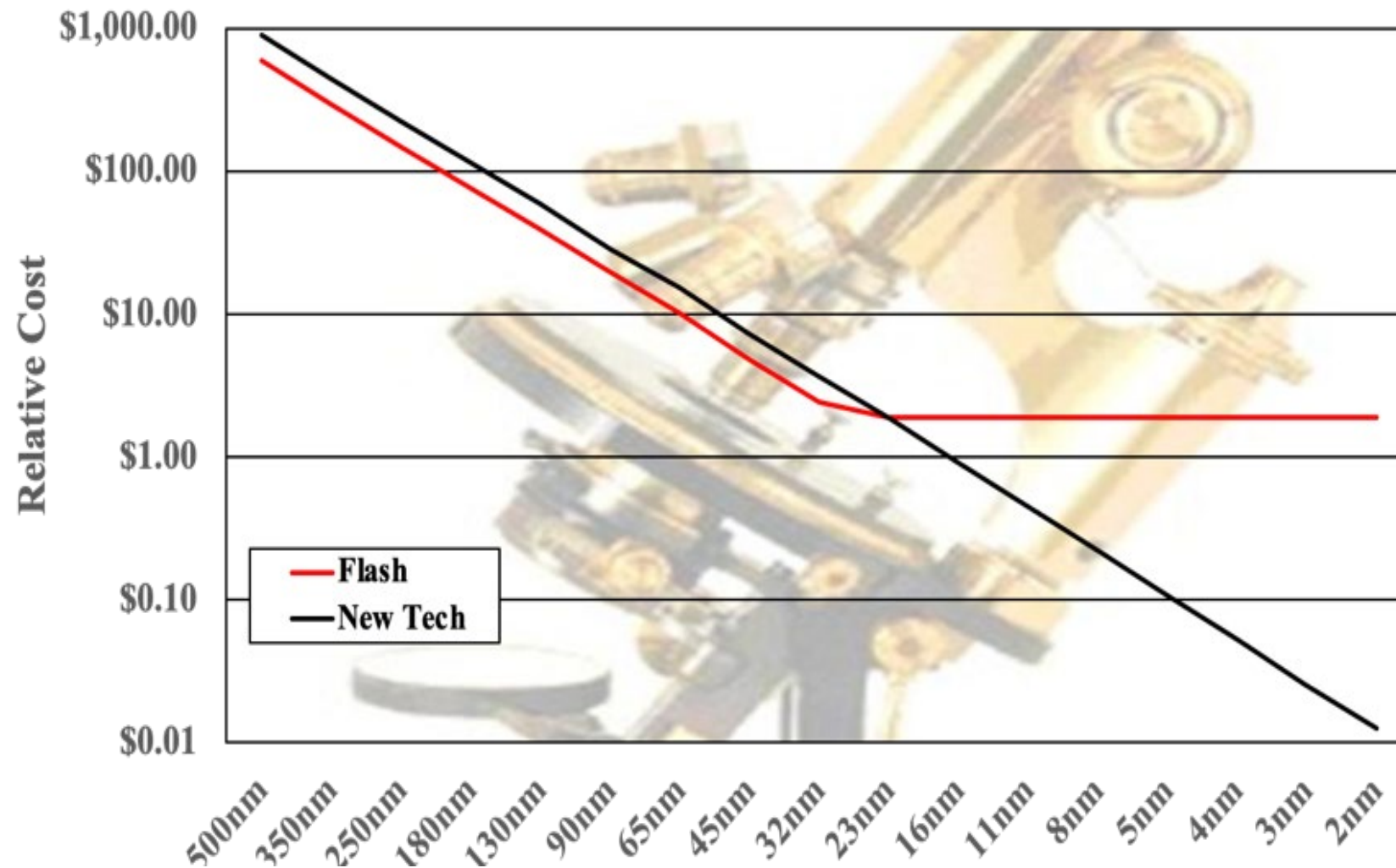
■ FRAM

- Micron presented 32Gb (4GB) NVDRAM chip at IEDM
- SK hynix 8Gb (1GB) FRAM in 2021 based on DRAM design

Economies of Scale Are Imperative

- Optane proved that to the market
 - Very Difficult to compete with DRAM and NAND flash on price
 - Stand-alone memory chips are commodities
- Embedded memories follow a different path
 - Scaling limit is forcing NOR out
 - SRAM also in trouble
 - An emerging memory will replace both of these
- Success in embedded will lead to stand-alone gains
 - It's a slow process

Why Emerging Memories are Gaining Ground



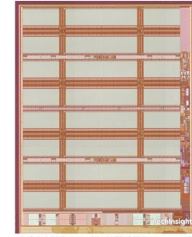
Source: Emerging Memories Branch Out

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- Emerging memory's latest developments
- **Growth: why, how, and when it's coming**
- Impact on semiconductors & systems
- What you need to do
- Q&A

Timeline for Change

- Embedded Memories
- CXL-attached memory
- Caches
- Chiplets



A 16nm 48K ARMv8-A processor die with TSMC 28nm 2D6C process on a 16nm 48K ARMv8-A die.



Logic

???

NAND

ReRAM?

DRAM

FRAM?

2015

2020

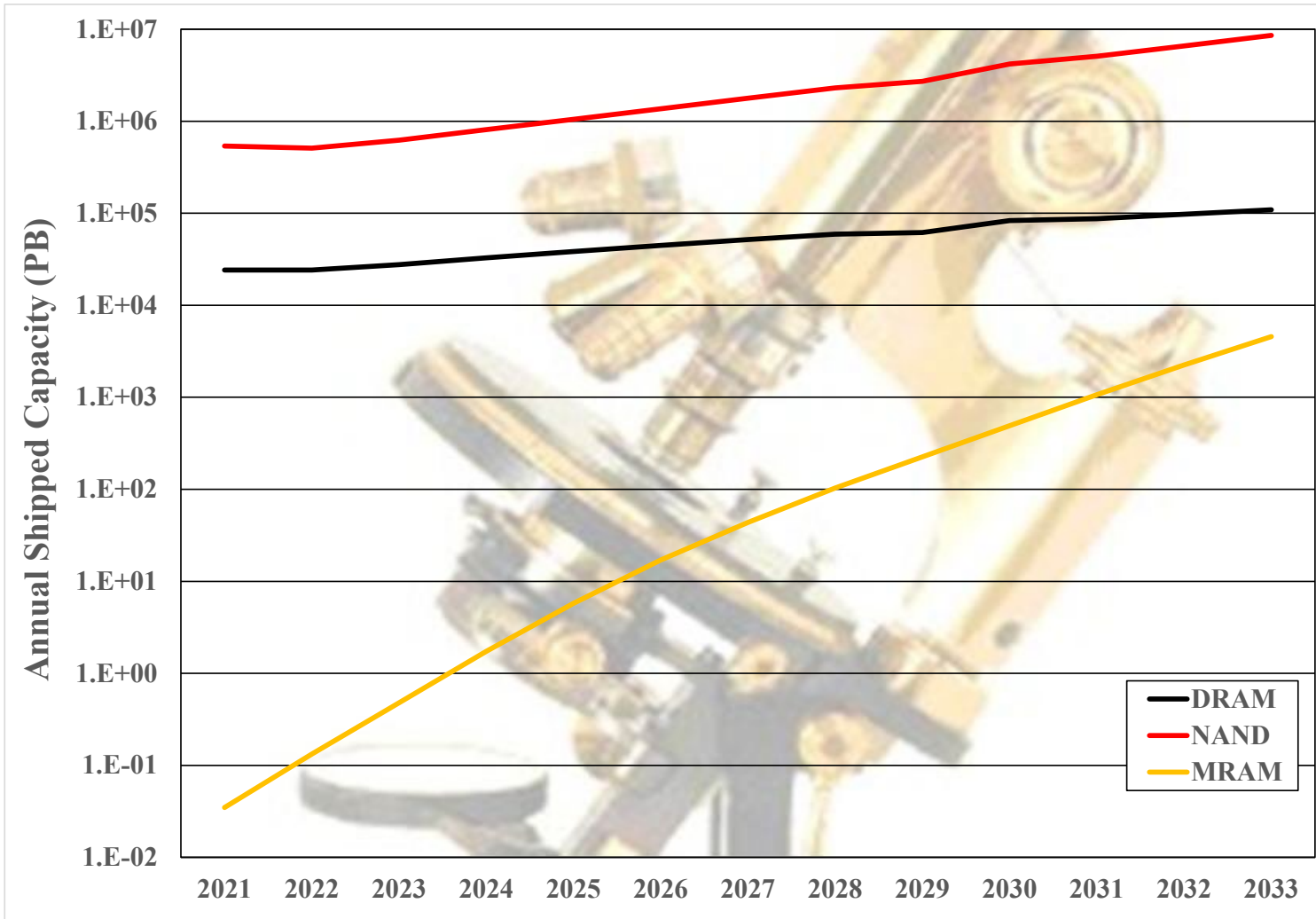
2025

2030

2035

Source: Objective Analysis

Emerging Memory Will See Strong Petabyte Growth



Source: Emerging Memories Branch Out

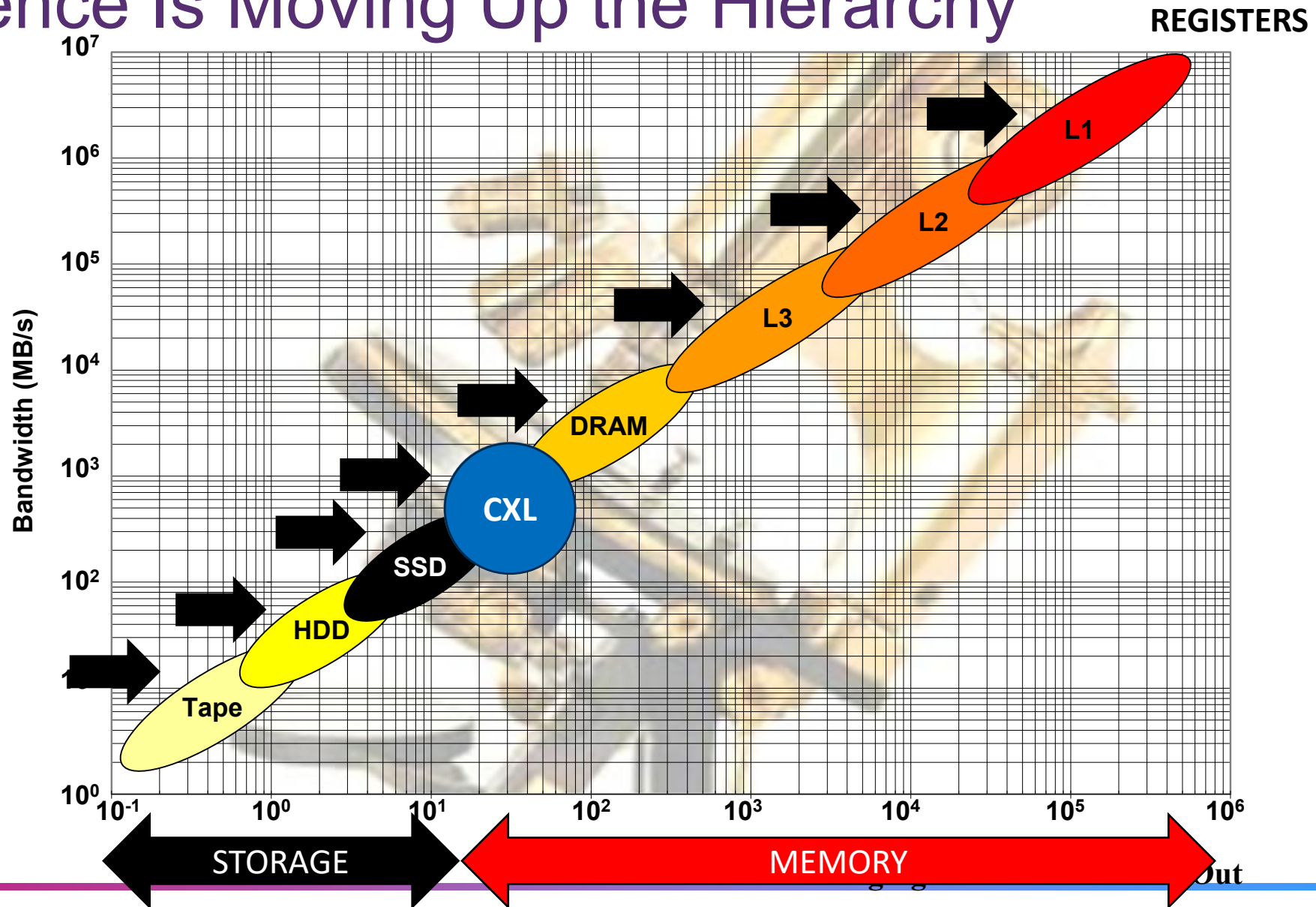
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- **Impact on semiconductors & systems**
- What you need to do
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Impact on Markets and Systems

- Persistence will close in from the top of the hierarchy
 - Processors will have persistent caches, then persistent registers
 - DRAM main memory will be caught in the middle
- Eventually DRAM will yield to a new memory
 - Too early to tell which one
- Systems must adapt to this new reality
 - Early movers will enjoy a strong advantage

Persistence Is Moving Up the Hierarchy



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Why New Memories Matter to You

- We all can hear a change coming
 - Optane almost got us there
 - Micron's new NVDRAM persistent DRAM
 - CXL supports emerging memory types
 - SRAM caches can't scale
- New layers of persistence need support
 - Persistence in memory
 - Persistent caches
 - Persistent registers
 - Security issues

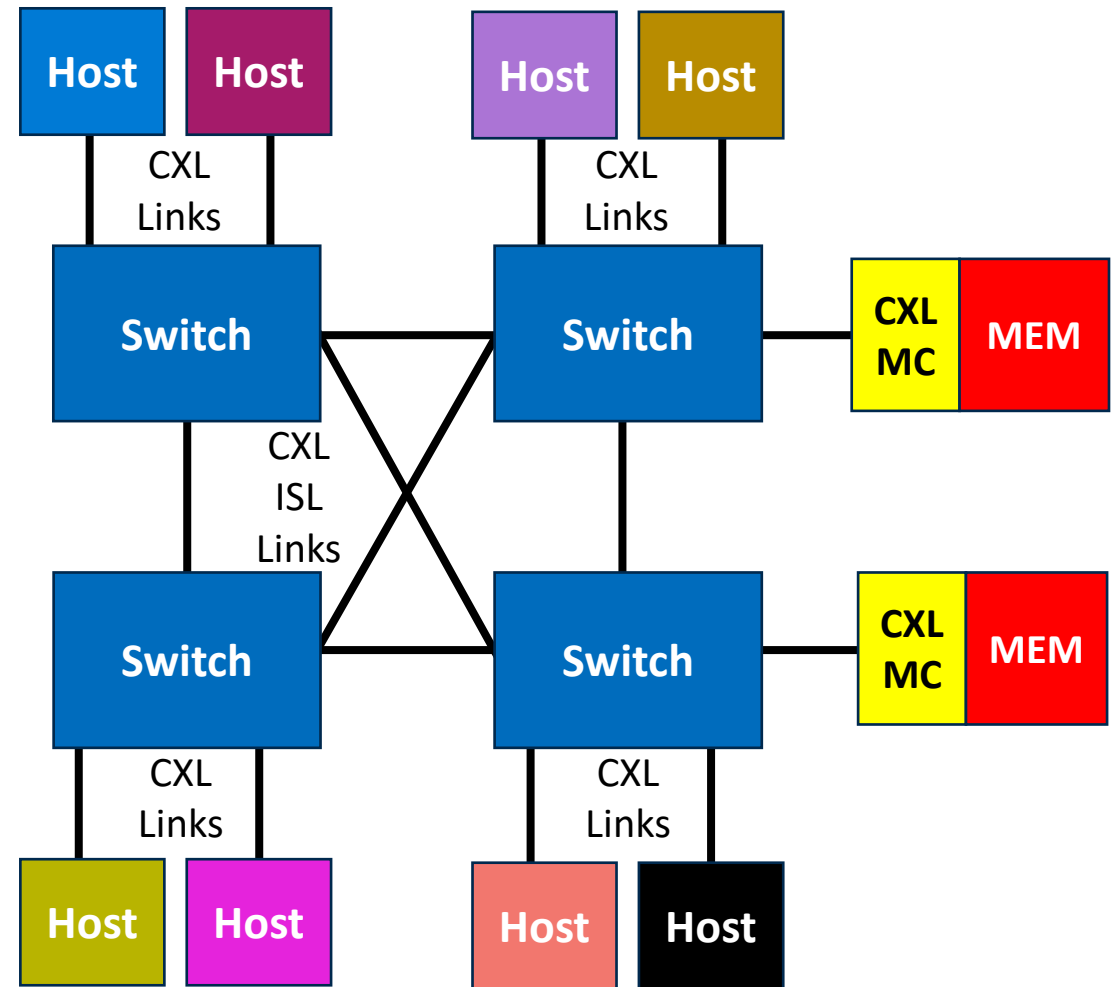


How CXL Supports Emerging Memories

- CXL manages mixed memory speeds
 - Multiple memory types can tie to a single memory channel
 - Supports NUMA: Nonuniform Memory Architecture
 - Read/write speeds no longer must be uniform vs. DRAM
 - Emerging memories have slower writes than reads
 - Unlike flash, they can write in place (no “Erase Before Write”)
- CXL supports persistent memory
 - Optane was one CXL application
 - Other emerging memories will fill that slot
 - Meanwhile, watch for Memory Semantic SSDs: MS-SSD

CXL's Impact

- CXL supports all memory types
 - New memories are all persistent
- Hyperscalers have big CXL plans
 - It saves them money, power, etc.
- Other users may come over time



The Future: Who Needs to Do What

- App developers
 - Consider ways to use persistence to advantage
- Systems & O/S developers
 - Provide tools to manage persistence consistently across platforms
- Hardware developers
 - Add security hooks
- End users
 - Think through strategies and security issues
- SNIA & standards organizations
 - Coordinate all these efforts

Summary

- Emerging memories are making headway
 - Anticipate persistent caches
- CXL makes persistence easy to add
 - Managing it is a different matter
- It needs your support
 - Get an early start to benefit from the change

Report: Emerging Memories Branch Out

<https://Objective-Analysis.com/reports/#Emerging>

<http://www.tomcoughlin.com/techpapers.htm>



QUESTIONS?

Attendee Actions

- Please **rate** this webcast, provide us with **feedback**, and look for the **Q&A** on our Compute+Memory+Storage Blog <https://sniacmsiblog.org/>
- Engage with us at upcoming **EVENTS**:
 - **MemCon – March 26-27, 2024 - live - in Mountain View CA** www.memorycon.com
 - **Sign up** for a MemCon **free webinar** in partnership with SNIA:
 - **How Are Technology Innovations Within CXL And HBM Shaping The Future Of Memory And Storage Use & Assembly**, <https://bit.ly/MemConSNIAWebinar>
 - **Tuesday, January 30, 2024 at 10:00 am Pacific**
 - **See us** at MemCon where SNIA will present on a memory panel and feature in their booth a CXL memory module system used in the SNIA Persistent Memory Workshop and Hackathon Program (www.snia.org/pmhackathon)
 - **SNIA Compute+Memory+Storage Summit – virtual - May 14-15, 2024**
 - **Complimentary Registration opens in March!** www.snia.org/cms-summit
- **ONLINE** - this webcast and many other videos and presentations on today's topics are in the [SNIA Educational Library](#)
- Join SNIA and the Persistent Memory Special Interest Group
 - www.snia.org/join
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