



SNIA<sup>™</sup> | COMPUTE, MEMORY,  
CMSI | AND STORAGE

# Uniting Compute, Memory, and Storage

SNIA Webcast  
June 2, 2020



# Today's Speakers



**Moderator:**  
**Alex McDonald**

NetApp  
Co-Chair, SNIA Compute, Memory,  
and Storage Initiative

**Presenter:**  
**Eli Tiomkin**

NGD Systems  
Chair, CMSI Computational Storage  
Special Interest Group

**Presenter:**  
**Jonmichael Hands**

Intel  
Co-Chair, CMSI SSD  
Special Interest Group

**Presenter:**  
**Jim Fister**

Director, SNIA Persistent Memory  
Enabling

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# SNIA-at-a-Glance



**185**  
industry leading  
organizations



**2,000**  
active contributing  
members



**50,000**  
IT end users & storage  
pros worldwide

# SNIA Areas of Focus

## PERSISTENT MEMORY

- Non-Volatile Memory Programming Model
- NVDIMMs

## COMPUTATIONAL STORAGE

- Services and Products
  - Drives, Processors, Arrays

## NETWORKED STORAGE

- Data Access Protocols
- Networking Technologies for Storage

## CLOUD STORAGE TECHNOLOGIES

- Data into and out of the Cloud
- Data Orchestration

## PHYSICAL STORAGE

- Connectors, Form Factors & Transceivers
- Hyperscaler Storage
- Object Drives
- Solid State Storage

## POWER EFFICIENCY MEASUREMENT

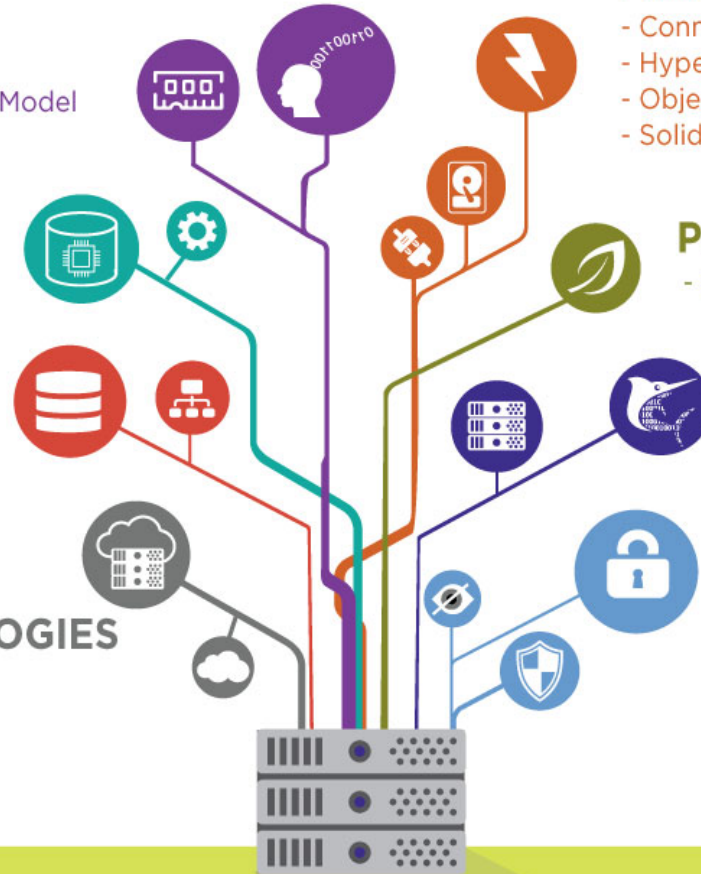
- SNIA Emerald™ Power Efficiency

## STORAGE MANAGEMENT

- Device and System Management
- Next Generation Storage Management API

## DATA GOVERNANCE & SECURITY

- Privacy and Data Protection Regulations
- Storage Security
- Integrity, Protection, Retention



# Our Topics Today

- What is and why Computational Storage?
- Where is Solid State Storage headed?
- What can we now do with Persistent Memory?
- And finally,
  - Why did SNIA bring these activities together?
  - How can we all play nice?

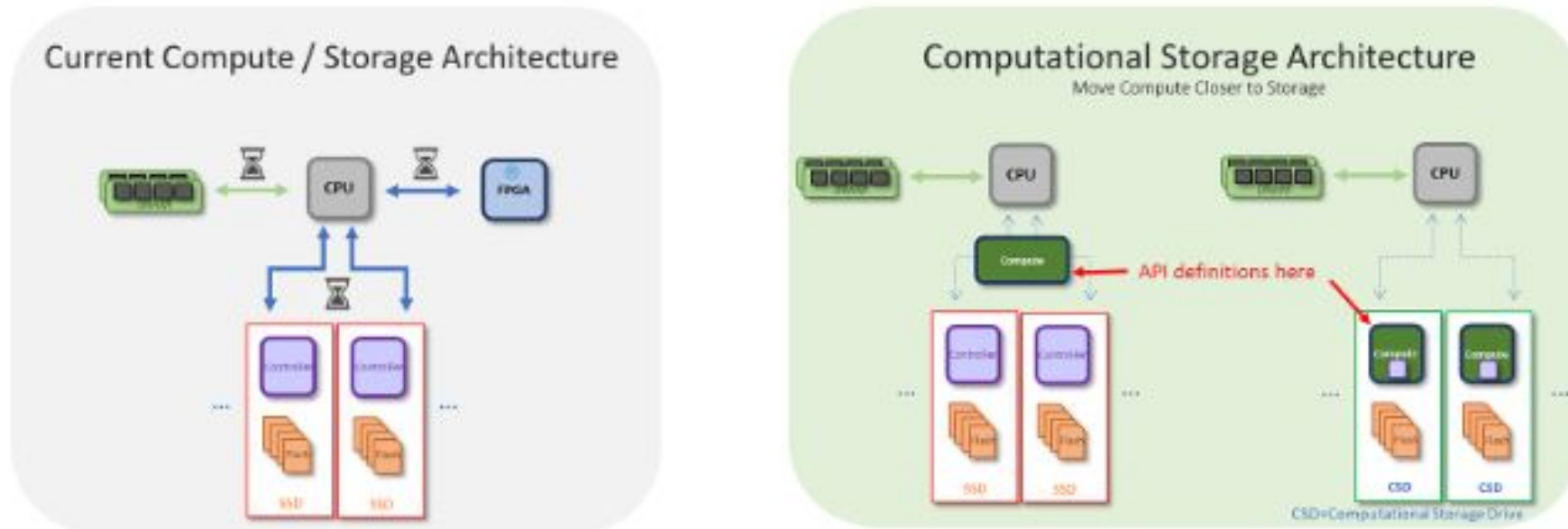
# Computational Storage

SNIA Computational Storage Technical Work Group

SNIA Computational Storage Special Interest Group

# What is Computational Storage?

- Computational Storage is defined as architectures that provide Computational Storage Services coupled to storage, offloading host processing, or reducing data movement.





# Many Factors Driving a Need for Computational Storage

## Keys To Harnessing The Data Tsunami



Jonathan Salem Baskin Contributor  
Jun 13, 2016, 10:00am • 1,486 views • #BigData

## The Big Data Tsunami



Author: Matt Ferrari  
Chief Technology Officer  
ClearDATA

## the Analytical Scientist Defying the Data Tsunami

AI Weekly: Computing power is shaping the future of AI

KHARI JOHNSON @KHARIJOHNSON MAY 18, 2018 7:14 PM

## NEAR-DATA PROCESSING: INSIGHTS

Near-Data Computation: Looking Beyond Bandwidth

Published in: [IEEE Micro](#) ( Volume: 34, [Issue: 4](#), July-Aug. 2014 )

Three motivating factors for using Edge Computing

IBM

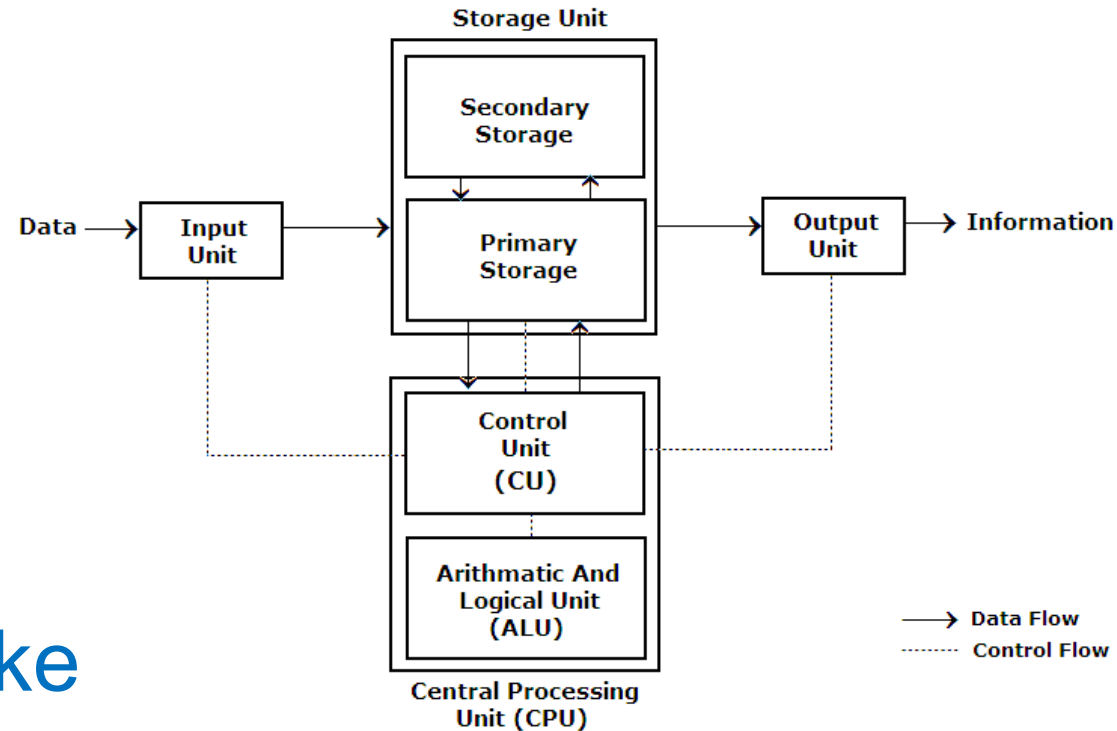
Internet of Things blog

1. Preserve privacy
2. Reduce latency
3. Be robust to connectivity issues

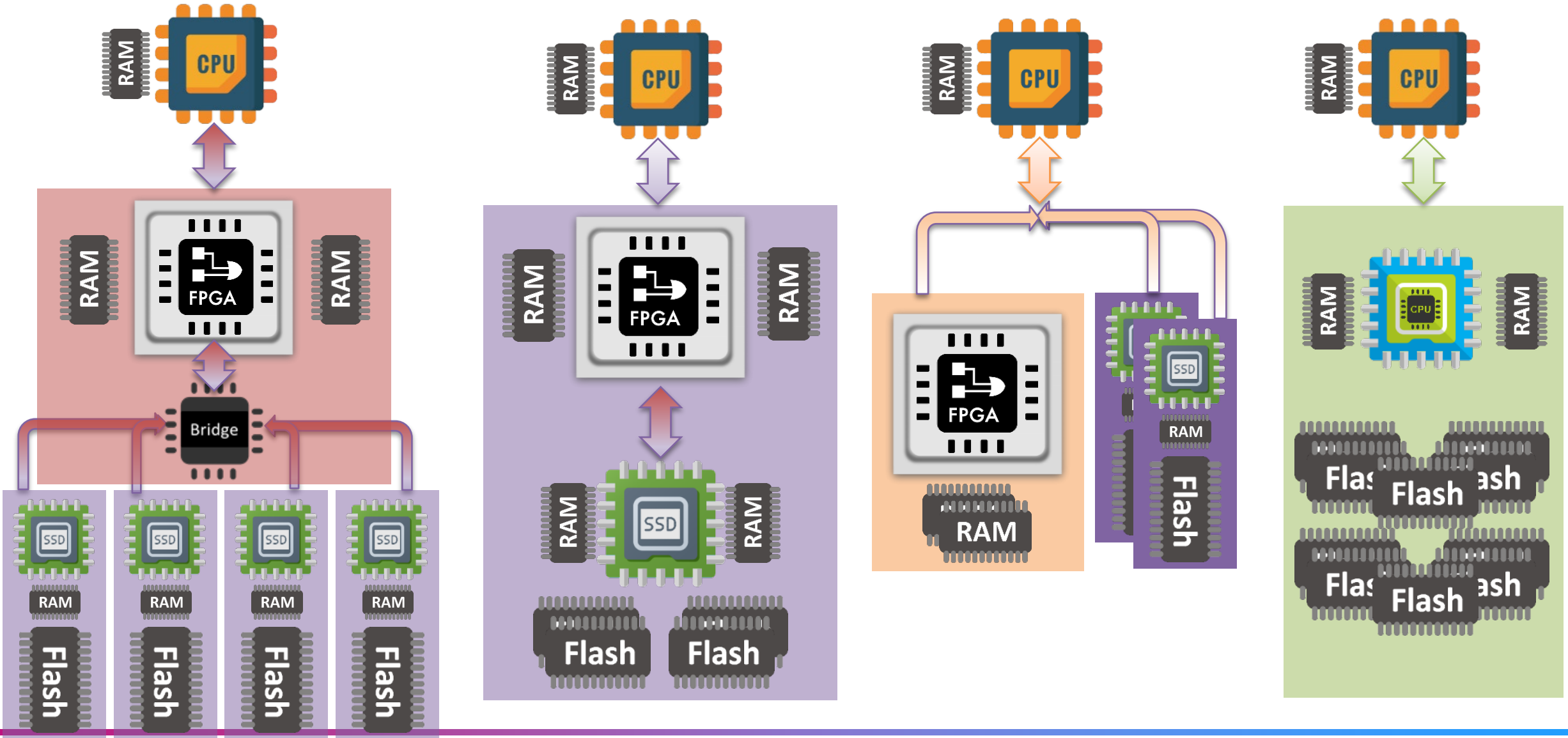
# Compute, Meet Data

- Based on the premise that storage capacity is growing, but **storage architecture has remained mostly unchanged** dating back to pre-tape and floppy...

How would you define changes to take advantage of Compute at Data?



# Current Instances of Computational Storage



# SNIA Computational Storage Technical Work Group

- 45 participating companies/202 member representatives
- Focus on definition list to ensure the TWG covers question on what computational storage is and what its products can be
- Drive to a scope and path to a universal usage model
- SNIA's Computational Storage Technical Work Group is developing a *Computational Storage Architecture and Programming Model* – defining recommended behavior for hardware and software that support computational storage
- [Download the latest version](#) – and make your comments at the [SNIA Feedback Portal](#)



Computational Storage  
Architecture and Programming  
Model

Version 0.3 Revision 1

Abstract: This SNIA document defines recommended behavior for hardware and software that supports Computational Storage.

# 45 Participating Companies - 202 Member Representatives





# Computational Storage Special Interest Group

- 10 member companies
- Educating on benefits, use models, and implementations of computational storage and soliciting input on the Computational Storage Technical Work Group draft [SNIA Computational Storage Architecture and Programming Model](#).
- Planned webcasts, videos, and presentations at virtual events

# Solid State Storage

SNIA Solid State Storage Technical Work Group

SNIA Solid State Drive Special Interest Group

# SNIA SSD Special Interest Group

- Expanding knowledge of [SSD form factors](#) and the optimum use of SSDs in enterprise, client, and application environments like hyperscalers via webcasts, videos, and presentations at virtual events.
- Close coordination with other standards organizations like NVM Express and SCSI Trade Association.

## Solid State Drive Form Factors

Solid-state drives (SSDs) are commonly used in client, hyperscale and enterprise compute environments. They typically come in three flavors: NVMe™, SAS, and SATA. Since SSDs are made from flash memory, they can be built in many different form factors. This resource guide is designed to provide information on the most common and current SSDs in their various form factors. In addition to the form factor dimensions, information such as use case, interface, protocol, and mechanical/electrical and connector specifications are provided.

Click on the names below to learn more about the many different SSD sizes and formats in a variety of form factors:

- EDSFF
- M.2
- 2.5-inch (U.2)
- Add In Cards

### EDSFF



EDSFF stands for Enterprise and Data Center SSD Form Factor. The family of specifications were developed by a group of 15 companies working together to address the concerns of data center storage, and are now maintained by SNIA as part of the SFF Technology Affiliate Technical Work Group (SFF TA TWG).

[Click here for full image.](#)

EDSFF offers a dynamic range of form factors that have advantages vs the incumbent SSD form factors in capacity, scalability, performance, serviceability, manageability, thermal and power management. Today all the EDSFF family of form factors share the same protocol (NVMe), the same interface (PCIe®), the same edge connector (SFF-TA-1002), the same pinout and functions (SFF-TA-1009). Infrastructure, especially test infrastructure, can be developed to support multiple EDSFF form factors. [Learn more about the EDSFF family.](#)

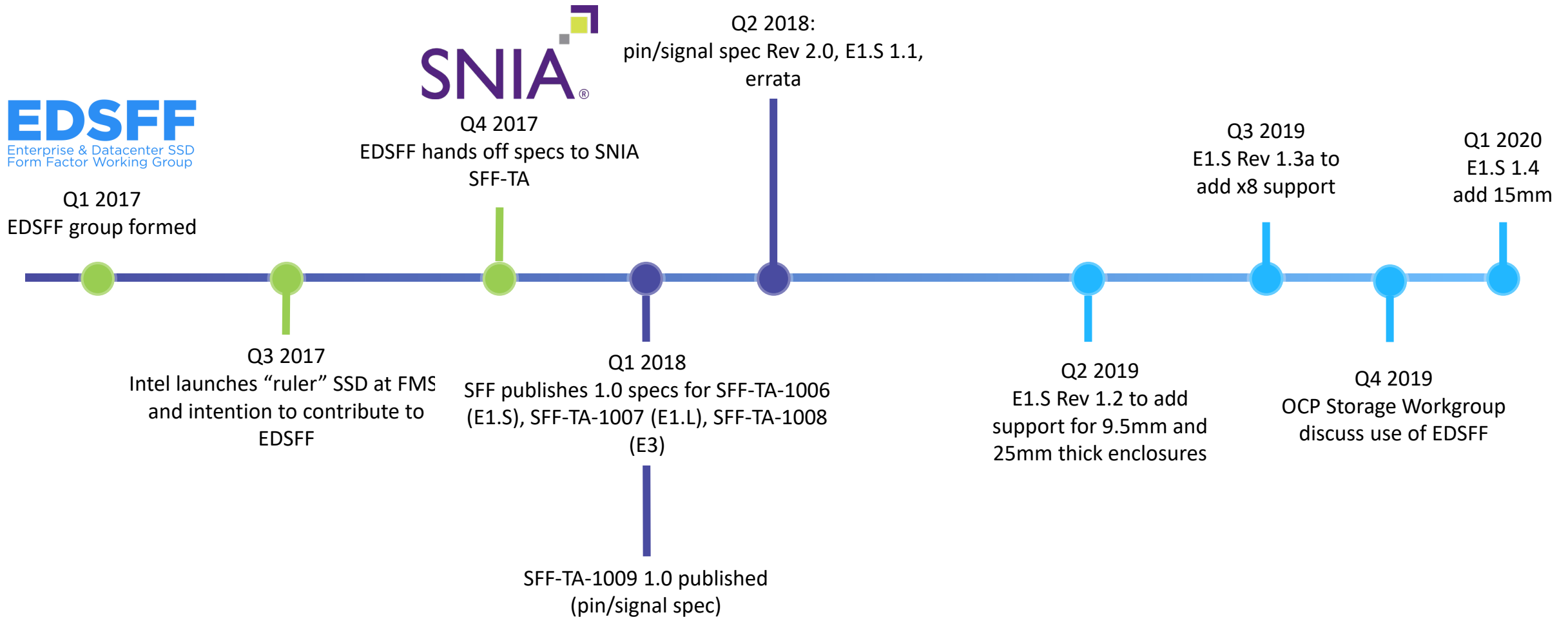
E1.L, EDSFF 1U Long



<https://www.snia.org/forums/cmsi/knowledge/formfactors>

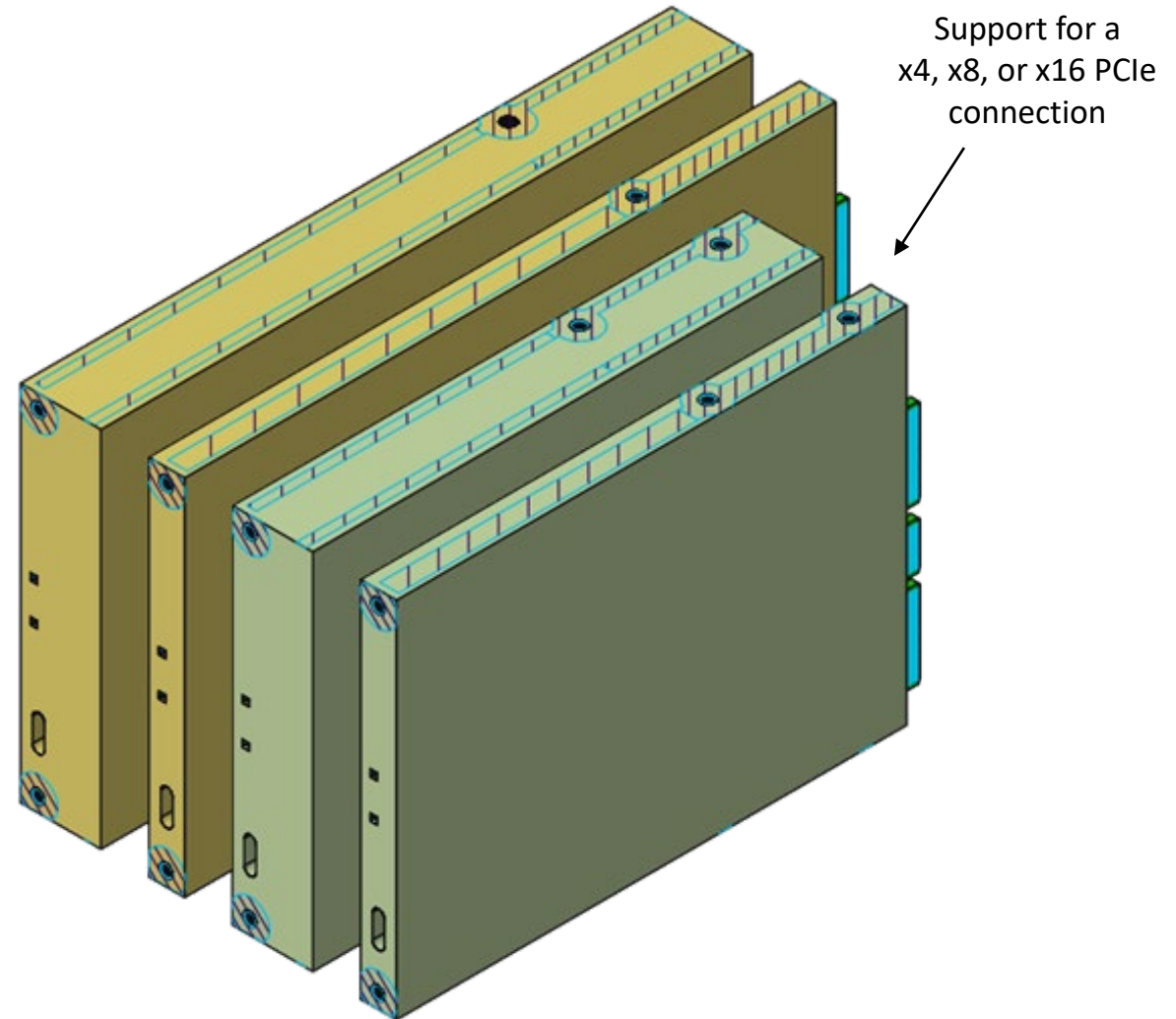


# EDSFF History



# E3 - updated!! SFF-TA-1008

- E3 is a family of four form factors with a common 76mm height
  - E3 FH  $\frac{3}{4}$  Length, 1x
    - 76mm x 112.75mm x 7.5mm
    - Supports up to 20W
    - Optimized for primary NAND storage in Servers
  - E3 FH  $\frac{3}{4}$  Length, 2x\*
    - 76mm x 112.75mm x 16.8mm
    - Supports up to 40W
    - Support for higher power devices like CXL based SCM
  - E3 FH Full Length, 1x
    - 76mm x 142.2mm x 7.5mm
    - Supports up to 35W
    - Support for higher capacity NAND storage
  - E3 FH Full Length, 2x\*
    - 76mm x 142.2mm x 16.8mm
    - Supports up to 70W
    - Support for higher power devices like FPGAs and accelerators



Note\* - A thick device will fit into two thin slots  
- A short device will fit into a long slot



# New – proposed at OCP, E1.S 15mm, SFF-TA-1006 1.4



- E1.S new thickness at 15mm, up to 25-35W @ 35C, 24x drives in 1U server
- Higher performance than U.2 in smaller form factor
- Scales to PCIe 5.0, 3D NAND and storage class memory (e.g. Intel® Optane™ SSD)
- Performance, power, and thermals for mainstream SSD capacities (4, 8, 16TB) in the next 2-5 years

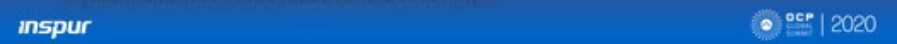
# EDSFF Platforms



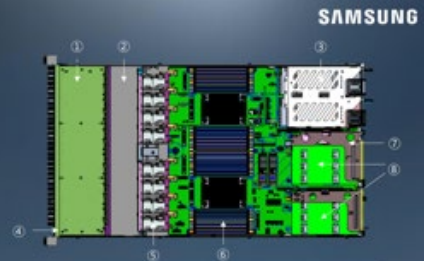
1U Open Hardware Platform for all Compute / Storage



- Same Chassis ; Different Flavors
- 10x SFF SATA/SAS/NVMe
- 4x LFF + 2x SFF Hybrid Design
- 32x ES.1 High Density Cache



## Poseidon Hardware



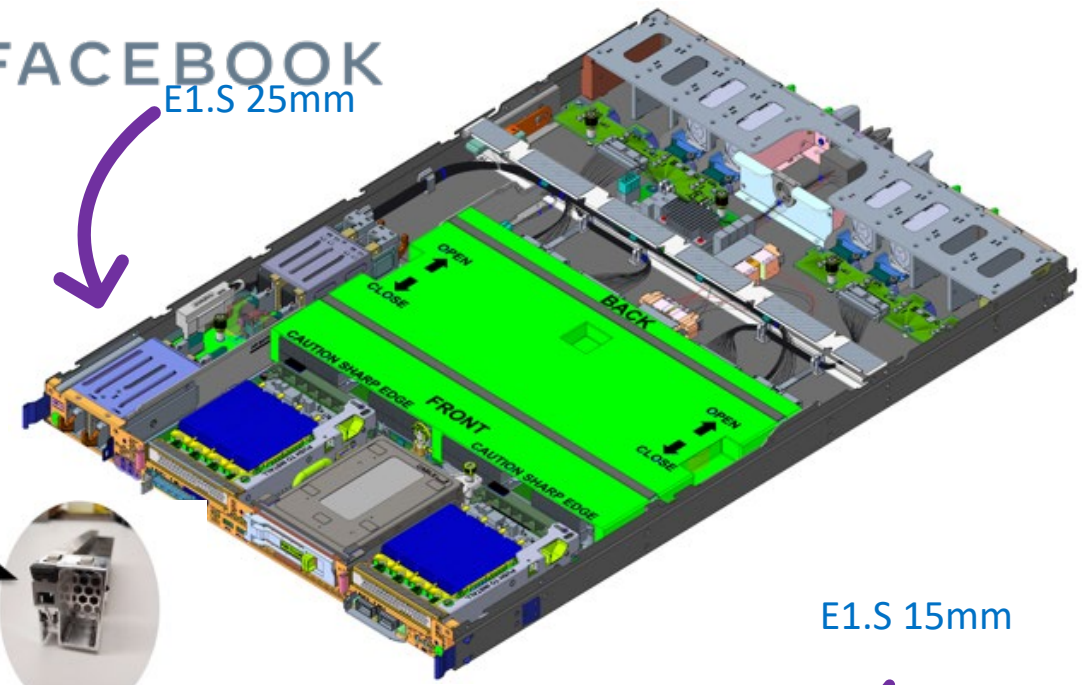
Chassis	EIA standard (19")
Form Factor	1U
Processor	Next Gen x86 Processor
# of Processors	2
Max # of Memory Slots	32
Memory Speed	3,200 MT/s
Network	RDMA / TCP
Network Speed	Up to 100 GbE * 6 port
PCIe Version	PCIe 4.0
Storage	E1.5 SSD * 32ea

- ① PM9A3 E1.5 SSD 32ea
- ② SSD Backplane 1ea
- ③ Power Supply Unit (PSU) 2ea
- ④ Front Panel & IO Module 1ea
- ⑤ System Fan 8ea
- ⑥ Motherboard 1ea
- ⑦ OCP Mezzanine NIC 1ea
- ⑧ PCIe Slot (FHHL Card) 2ea



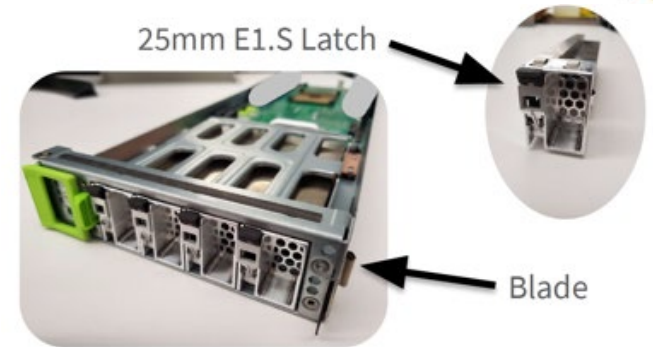
### FACEBOOK

E1.S 25mm



### Yosemite V3

25mm E1.S Latch

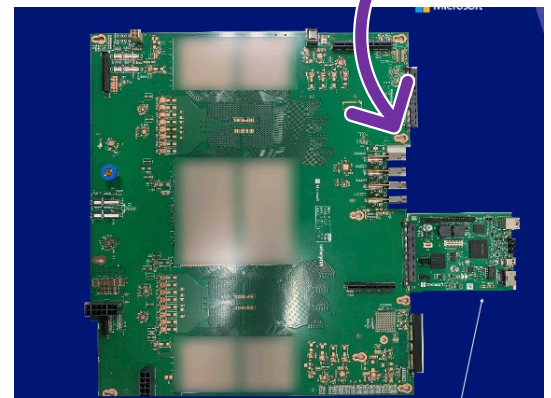


Blade

Chassis



E1.S 15mm



Microsoft Secure Control Module (SCM)



# E1.S SSD Vendor Ecosystem in FB presentation

E1.S 25mm Scales For The Future

**SAMSUNG**

**intel**

**KIOXIA**

**Western Digital**

**SK hynix**

**SiliconMotion**

**Micron**

**F A D U**

**OCP GLOBAL SUMMIT 2020**

STORAGE

E1.S 25mm Scaling For Now And The Future.



# Comparison Metrics: T-inlet and Flowrate

## - How do Designs Compare @ fixed 20W SSD PWR



STORAGE



	Width	SSDs / Platform	CFM/SSD	T-inlet "max air temp allowed"	dP SSD (in-H <sub>2</sub> O)	Platform CFM	PWR/SSD*	Total SSD PWR	Air T-rise
A	9.5	32	2.4	45	.62	76.8	20	640	16.3
B	15	24	3.6	57	.5	86.4	20	480	10.8
C	25	16	6.0	62	.24	96	20	320	6.5

Example:

- "Design A" allows a 45C T-inlet @ 640W total SSD power (or equivalent IOPs). A result of high total power and lower platform airflow is a 16C increase in air temp to downstream thermal subsystems.

- Alternatively, "Design B" allows a modest 480 SSD Watts (IOPs), it can support a T-inlet of 57C and

## E1.S 9.5, 15, and 25mm Width Platform Response - @70% Fan Speed; 20W

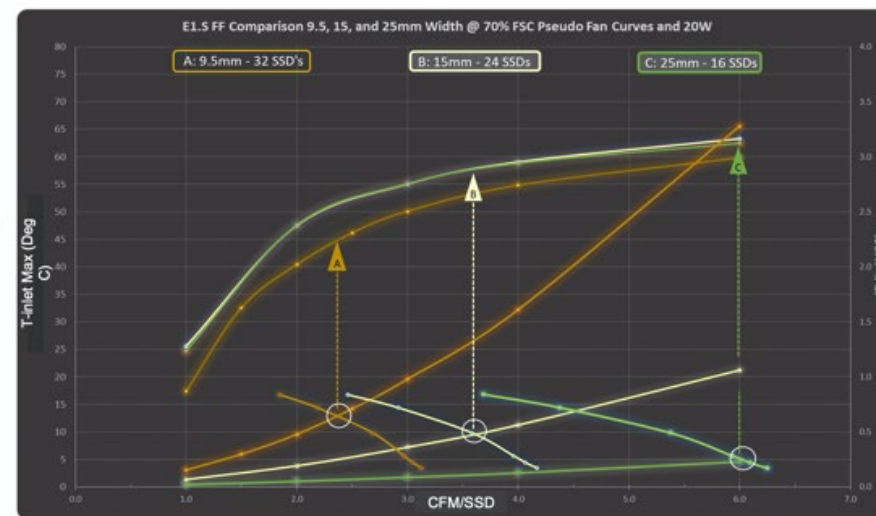


STORAGE

- Metrics provide understanding of an SSD form factor's ability to scale capacity, performance and cooling when integrated to a platform.
- It also provides insight to which form factor may benefit a platform thermally and or achieve fan power efficiency targets.

- This graph shows where 3 different SSDs operate (CFM) in same platform
  - A: 9.5mm @ 2.3 CFM
  - B: 15mm @ 3.6 CFM
  - C: 25mm @ 6.0 CFM
- Shows T-inlet allowable of the 3 SSD widths in context of the fan curves
  - A: 9.5mm = 45C T-inlet
  - B: 15mm = 57C T-inlet
  - C: 25mm = 62C T-inlet
- Allows key metrics such as total platform CFM for respective designs
 

SSD	Platform
A: 9.5mm 32 @ 2.3 CFM = 77 CFM	
B: 15mm 24 @ 3.6 CFM = 86 CFM	
C: 25mm 16 @ 6.0 CFM = 96 CFM	



DCP  
GLOBAL  
SUMMIT

# Persistent Memory

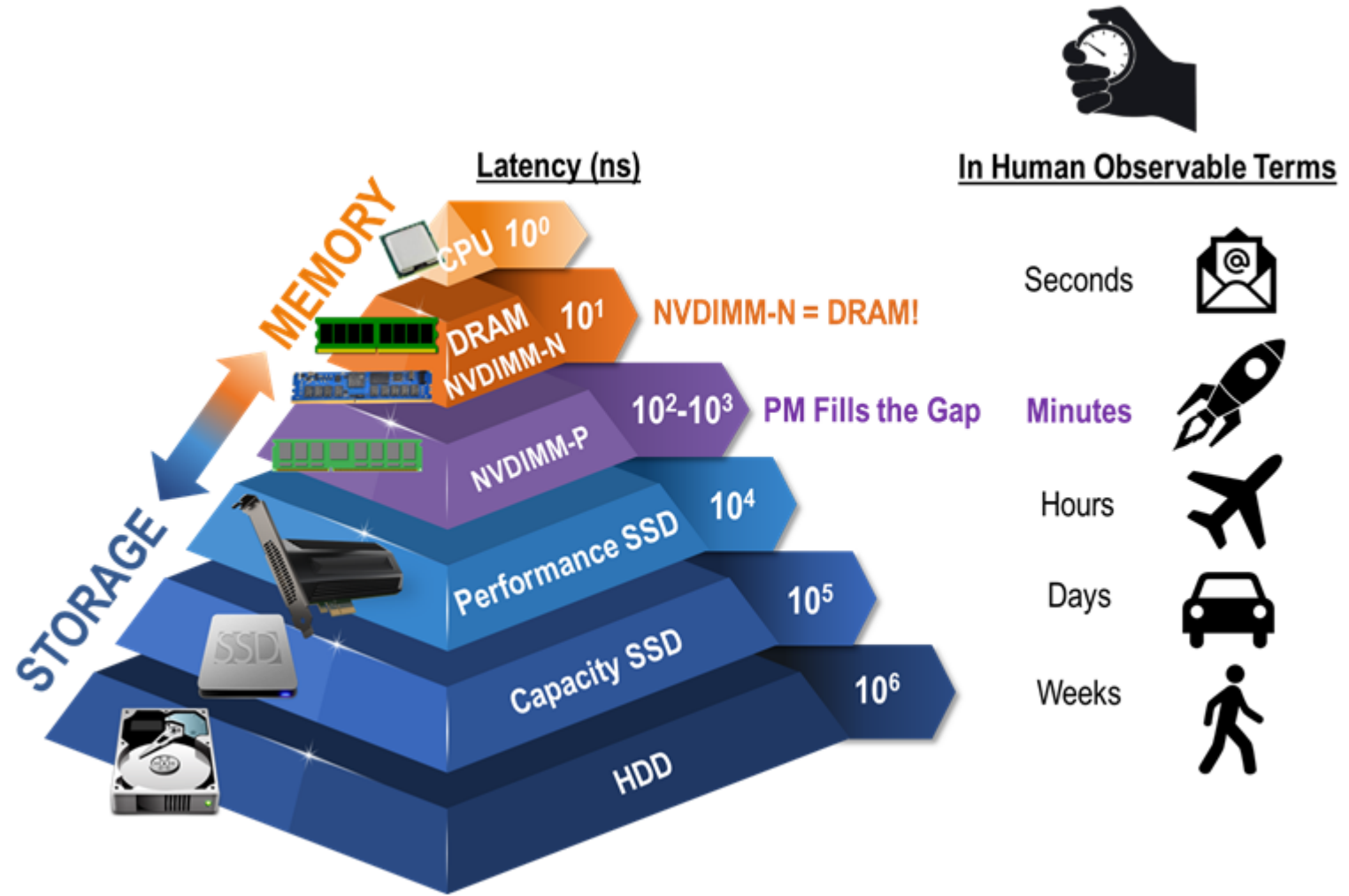
SNIA Persistent Memory Programming Technical Work Group

SNIA Persistent Memory & NVDIMM Special Interest Group



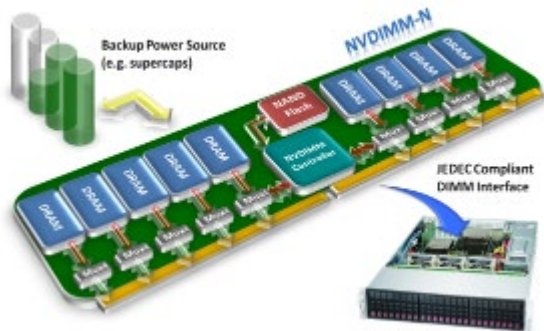
# What is Persistent Memory?

- Persistent Memory is non-volatile, byte addressable, low latency memory with densities greater than or equal to [Dynamic Random Access Memory \(DRAM\)](#). It is beneficial because it can dramatically increase system performance and enable a fundamental change in computing architecture. Applications, middleware, and operating systems are no longer bound by file system overhead in order to run persistent transactions.

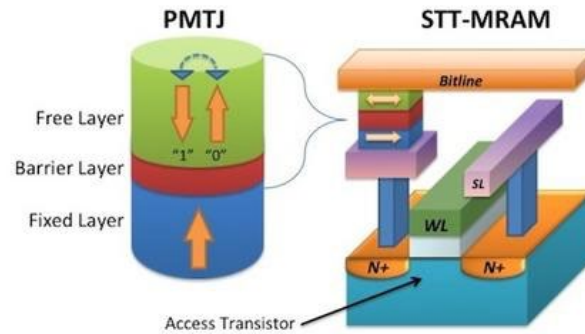


# Many Existing and Emerging Memory Types

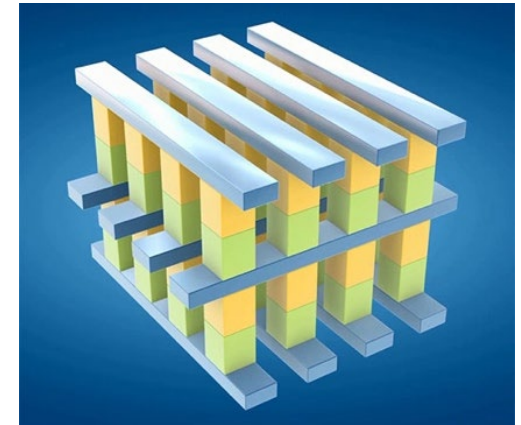
## NVDIMM-N



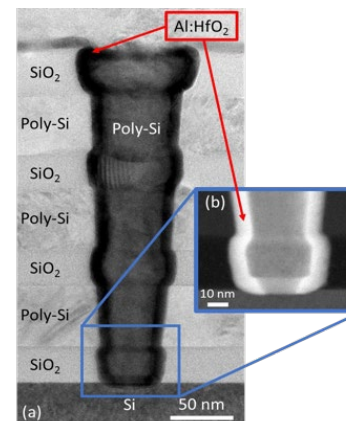
## MRAM



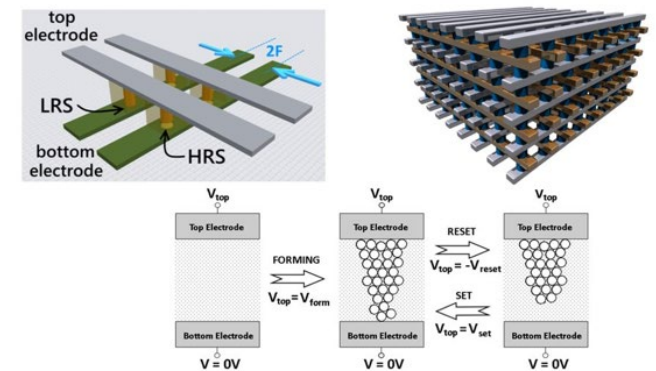
## PCM



## FRAM



## ReRAM



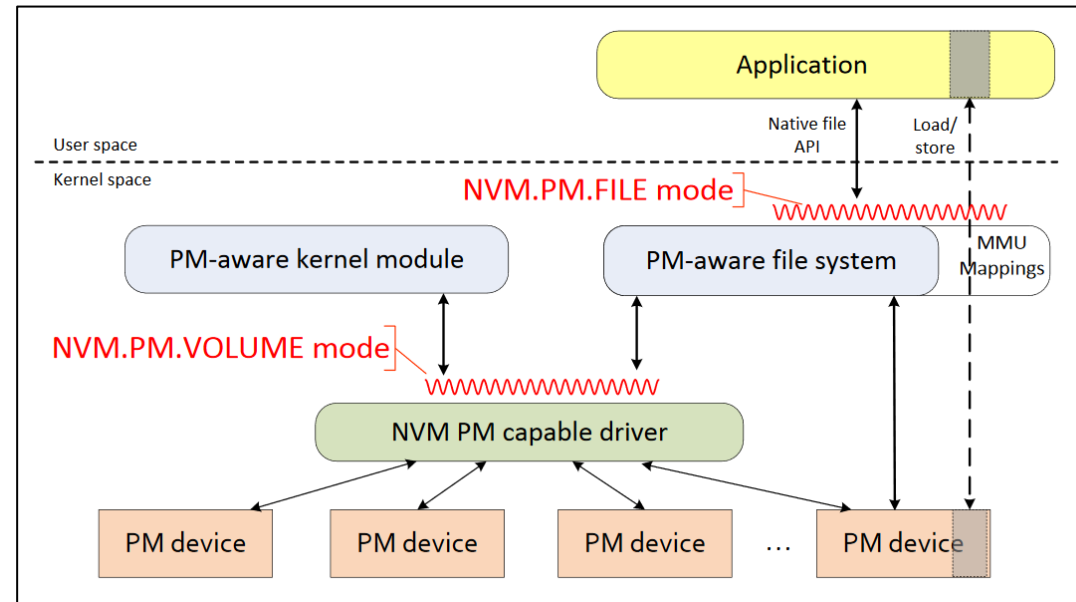
And They Are All Persistent!

# PM Needs Support

- **Hardware (JEDEC, Others)**
  - Supporting early development
  - Ongoing requirements
  - Form factors, interfaces
- **Software support (SNIA, Others)**
  - O/S support
  - Open source libraries
  - Application program support

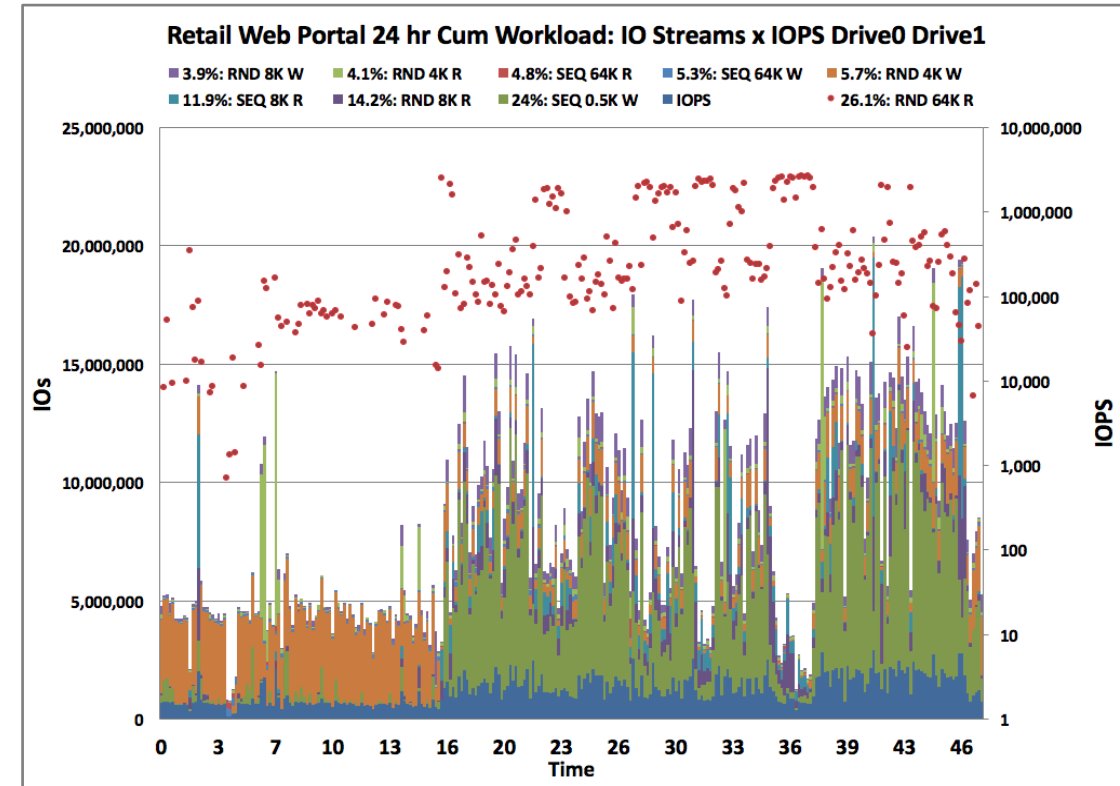
# SNIA Persistent Memory Programming Technical Work Group

- Developing a Persistent Memory Programming Model describing the behavior of a common set of software interfaces that provide access to non-volatile memory (NVM)



# SNIA Solid State Storage Technical Work Groups

- SSD drive and SSD system work groups
- Expertise in the area of SSD performance and behavior
- Solid State Storage Performance Test Specifications
  - SSDs
  - Persistent Memory
  - Real World Performance



Retail Web Portal 24 Hr Workload: IO Streams & IOPS



# SNIA Persistent Memory and NVDIMM SIG

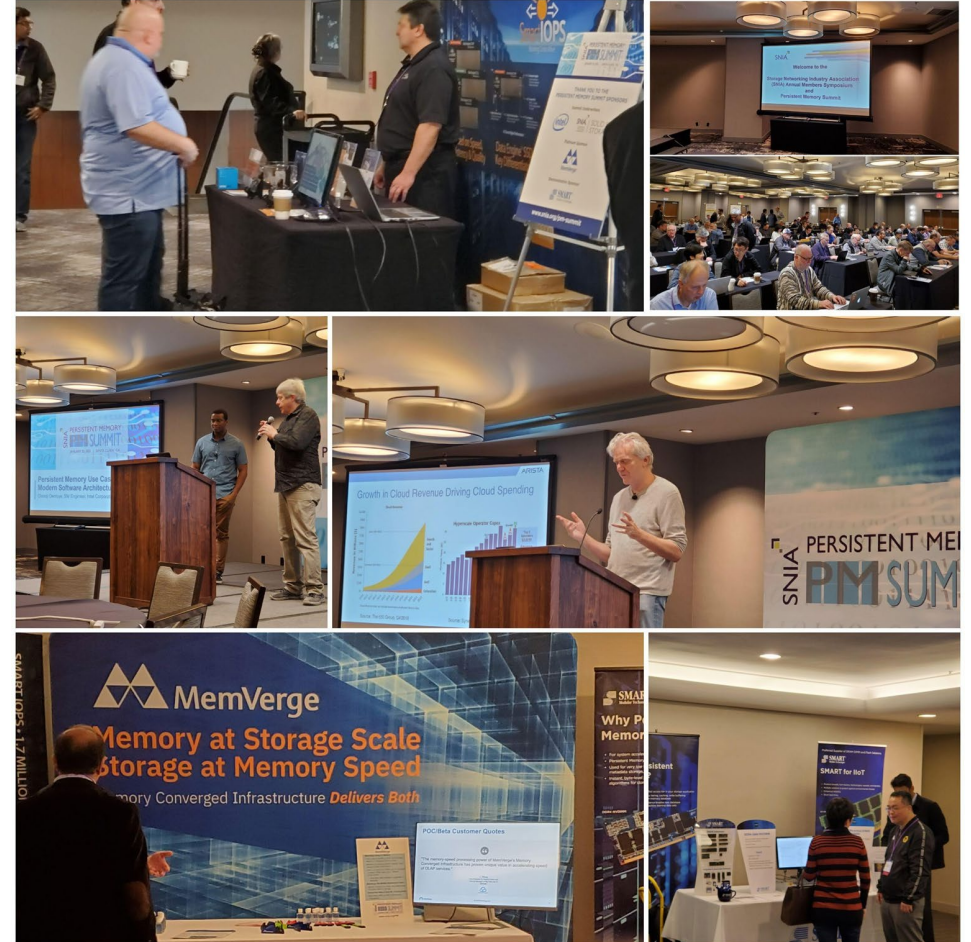
[snia.org/pm](https://snia.org/pm)

- Formed to accelerate the awareness and adoption of Persistent Memories for computing architectures
- Activities
  - Educate on the types, benefits, value, and integration of Persistent Memories
  - Communicate usage of the SNIA NVM Programming Model developed to simplify system integration of current and future PM technologies
  - Influence and collaborate with middleware and application vendors to support Persistent Memories
  - Develop user perspective case studies, best practices, and vertical industry requirements
  - Coordinate with industry standards groups and promote industry standards related to PM and NVDIMM
  - Synchronize and communicate a common Persistent Memory taxonomy



# 2020 – A Very Exciting Year for Persistent Memory!

- SNIA Persistent Memory Programming Model expanding  
<https://www.snia.org/forums/cmsi/nvmp>
  - PM Hardware Threat Model
  - PM Remote Access for High Avail White Paper
  - PM Atomics and Transactions White Paper
- SNIA 2020 Persistent Memory Summit a success
  - Videos and slides at [snia.org/pm-summit](https://www.snia.org/pm-summit)
- SNIA Persistent Memory & NVDIMM Special Interest Group is leading a program training software developers on programming persistent memory

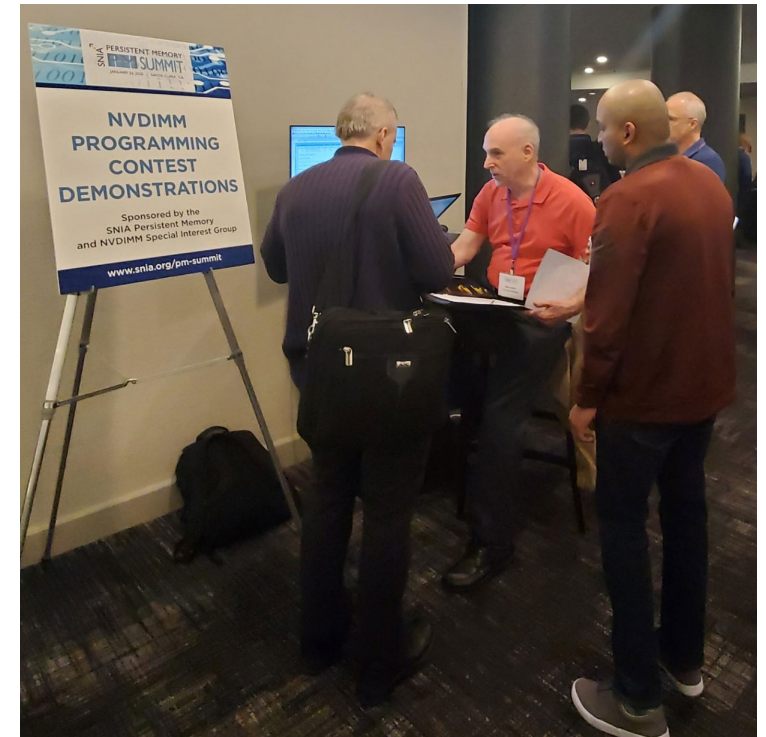




# Keys to Programming Persistent Memory

- Consistent Windows/Linux architecture model
- Variety of open-source tools and libraries
  - Persistent Memory Development Kit (PMDK)
  - Direct programming models
  - Multiple open-source file systems
- SNIA Hackathon program a success and continuing
  - 300+ software developers trained on PM programming
  - Cloud PM systems available to program today
  - Contact [pmhackathon@snia.org](mailto:pmhackathon@snia.org) for details

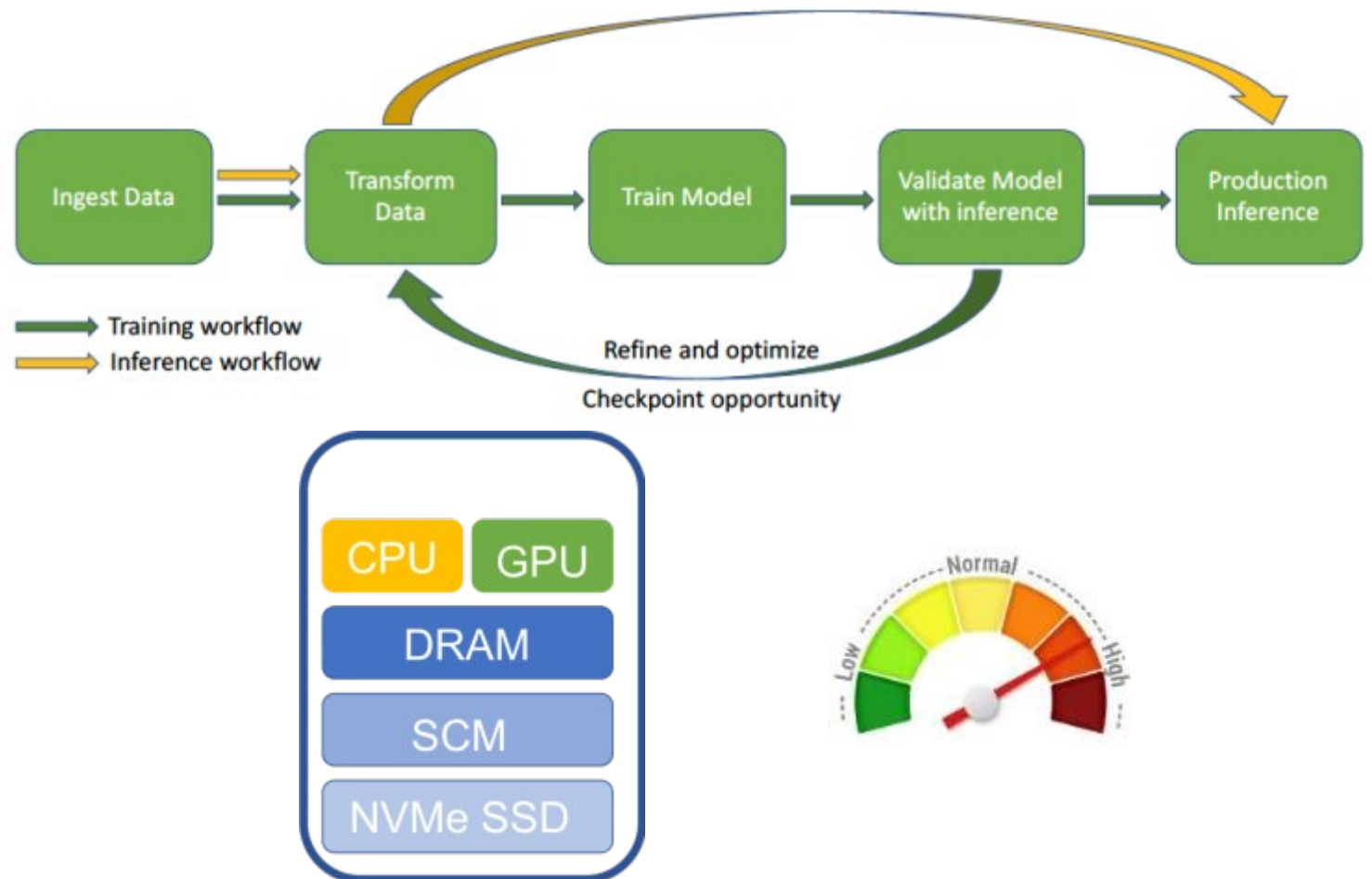
## SNIA 2020 PERSISTENT MEMORY HACKATHON



[pmhackathon@snia.org](mailto:pmhackathon@snia.org)

# PM Evolution: Why Persistent Memory in AI / ML?

- Challenge: Reducing overall time to discovery and insight based on Data Intensive ETL and Checkpoint Workloads
- Demanding I/O and computational performance for GPU accelerated ETL
- Varying I/O and computational performance driven by bandwidth and latency





# What Do Computational Storage Solid State Storage Persistent Memory Have In Common?

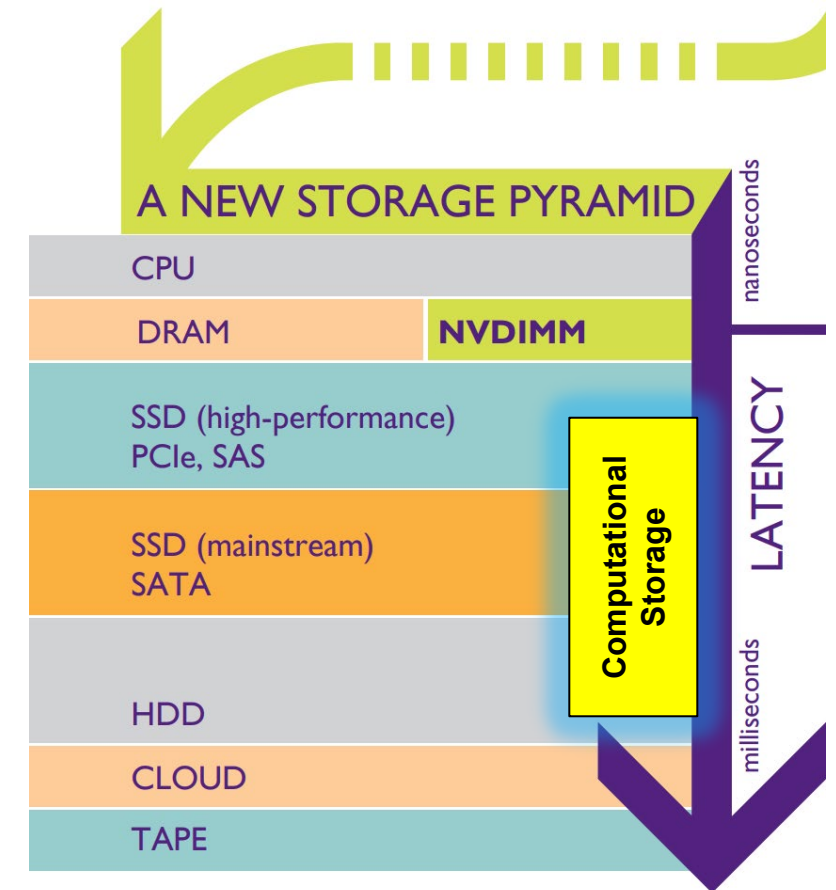


- Enormous developments in solid state memory, including NAND, and other emerging memories enable new architectural concepts such as persistent memory
- At the same time, semiconductor scaling has slowed, while demand for processing has increased
- We need to go beyond dedicated CPU technology to create adjacent processing technologies to off-load CPUs and provide low latency results
- This has led to an industry drive to combine processing with memory and storage, and to create new compute architectures and software to analyze and exploit the explosion of data creation over the next decade.

# Important Intersection of Compute, Memory, and Storage – *Playing Nice Together Is Needed*



- ✓ Solid state storage has been an important SNIA technology and education area for over a decade
- ✓ Gathering of use cases and education on persistent memory has been a part of SNIA work for six years
- ✓ And a new computational storage work area launched in late 2018
  - All this has led to the evolution of the SNIA Solid State Storage Initiative into the SNIA Compute, Memory, and Storage Initiative
  - Recognizes this fundamental opportunity to combine storage, memory, and compute in new, novel, and useful ways
  - Brings together technology, alliances, education, and outreach to better understand new opportunities and applications



# SNIA CMSI – Where Compute, Memory, and Storage Come Together

- Technical work
  - Architecture and programming specifications in computational storage and persistent memory
  - Architecture and application specifications in SSD form factors, PM and SSD performance
  - Joint activities with other alliances – NVM Express, JEDEC, OpenFabrics Alliance, Open Compute Project
- Outreach and evangelization
  - SNIA webcasts on usage, applications, and futures
  - SNIA video library playlists for education and sharing
  - Presentations and networking at virtual and physical events
  - Developer education through tutorials, hackathons, and technical symposia





# Where To Find Out More

- Website resources
  - [www.snia.org/computational](http://www.snia.org/computational)
  - [www.snia.org/pm](http://www.snia.org/pm)
  - [www.snia.org/sssi](http://www.snia.org/sssi)
- Twitter
  - [@sniasolidstate](https://twitter.com/sniasolidstate)
  - [@sniacomputation](https://twitter.com/sniacomputation)
- Blog
  - [SNIAComputeMemory&Storage](http://www.snia.org/blog)
- Videos
  - <https://www.youtube.com/user/SNIAVideo/playlists>
- Educational materials
  - <https://www.snia.org/educational-library>
- Joining SNIA and the Compute, Memory, and Storage Initiative
  - [https://www.snia.org/member\\_com/join-SNIA](https://www.snia.org/member_com/join-SNIA)

# Finally, Thanks for Watching Our Webcast

- Please rate this [webcast](#) and provide us with feedback
- A link to this webcast and the PDF of the slides are posted to the SNIA Compute Memory and Storage Initiative website at <https://www.snia.org/forums/cmsi/knowledge/articles-presentations>
- You can also find this [webcast](#) and many other videos and presentations on today's topics in the [SNIA Educational Library](#)
- A Q&A from this webcast will be posted to the SNIA CMSI on Compute, Memory, and Storage blog: [www.sniasssiblog.org](http://www.sniasssiblog.org)



**Everyone Wants Their Java to Persist**

May 20, 2020 | Jim Fister | Leave a comment

In this time of lockdown, I'm sure we're all getting a little off kilter. I mean, it's one thing to get caught up listening to tunes in your office to avoid going out and alerting your family of the fact that you haven't changed your shirt in two days. It's another thing to not know where a clean coffee cup is in the house so you can fill it and face the day starting sometime between 5AM and Noon. Okay, maybe we're just talking about me, sorry. But you get the point.

# Questions?

# Thank you!