



PMEM-201-1

Software and Applications

Chairs: Arthur Sainio, SMART Modular
Jeff Chang, AgigA Tech

Co-Chairs, SNIA Persistent Memory and NVDIMM SIG





Flash Memory Summit

Speakers – Part 1

- Doug Voigt, HPE
 - *The SNIA NVM Programming Model*
- David Tseng, Bigtera
 - *NVDIMM: The Savior of SSD Endurance in CEPH*
- Sreekanth Garigala, Western Digital
 - *Performance Benefits of NVDIMMs in Enterprise Data Storage Platforms*
- Myoungsoo Jung, Yonsei University
 - *Design of PRAM-based Persistent NVDIMM Controllers to Prepare the Data Age*



Panelists – Part 2

- Brian Bulkowski, Aerospike
- Scott Miller, Dreamworks Animation
- Jia Shi, Oracle
- Rakesh Radhakrishnan, VMware



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Upcoming Events Featuring Persistent Memory Talks

SDC 18
9/24-9/27 Santa Clara, CA

**Storage Developer
Conference
2018**

**SNIA PERSISTENT MEMORY
SUMMIT**

JANUARY 24, 2019 | SANTA CLARA, CA

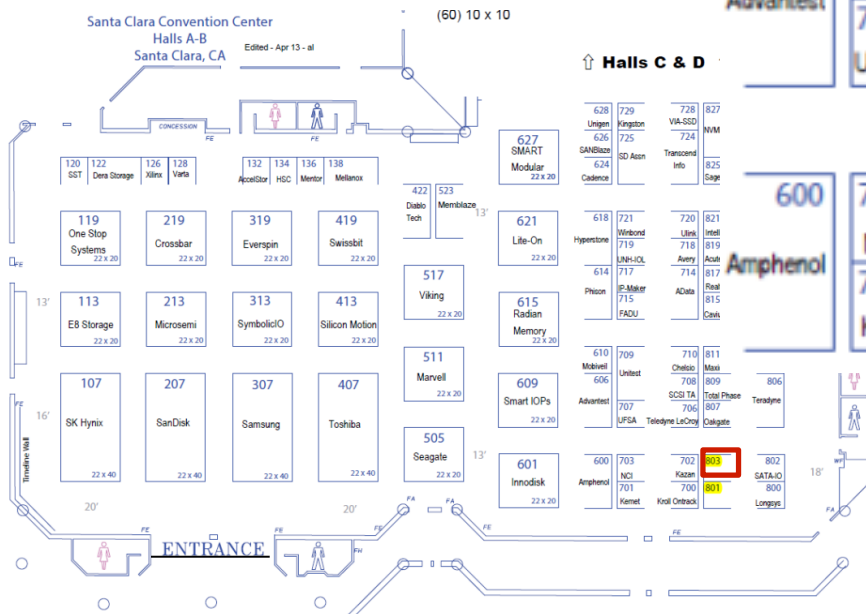
SDC discount
registration
cards in
FMS bags & at
**SNIA booth
820**

Complimentary
registration
now open at
**[snia.org/pm-
summit](http://snia.org/pm-summit)**



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Flash Memory Summit 2018 - Exhibit Floor



Mobiveil 606	Unitest 707	Chelsio 708	Maxiotek 809	Viavi Sys 806
Advantest	UFSA	SCSI TA 706	Total Phase 807	Teradyne
		Teledyne LeCroy	Oakgate	

600	703	702	803	802
Amphenol	NCI	Kazan	JEDEC	SATA-IO
	701	700	801	800
	Kemet	Kroll Ontrack		Longsys

Come and talk to us
and get involved!

JEDEC booth #803

FMS Persistent Memory Track Presented by: **SNIA** **JEDEC** **OPENFABRICS ALLIANCE**



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NVM Programming Model Overview and Status

System behaviors
for broad application support

By Doug Voigt



NVM Programming Model TWG - Mission

- Accelerate the availability of software that enables Persistent Memory (PM) hardware.
 - Hardware includes SSD's and PM
 - Software spans applications and OS's
- Create the NVM Programming Model
 - Describes application-visible behaviors
 - Allows API's to align with OS's
 - Describes opportunities in networks and processors

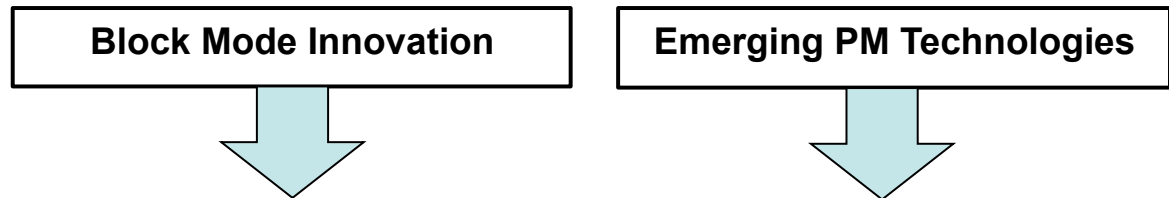


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SNIA NVM Programming Model

- Version 1.2 approved by SNIA in June 2017
- Expose new block and file features to applications
 - Atomicity capability and granularity
 - Thin provisioning management
- Use of memory mapped files for persistent memory
 - Existing abstraction that can act as a bridge
 - Limits the scope of application re-invention
 - Open source implementations available
- Programming Model, not API
 - Described in terms of attributes, actions and use cases
 - Implementations map actions and attributes to API's

The NVM Programming Model has 4 modes



	IO	Persistent Memory
User View	NVM.FILE	NVM.PM.FILE
Kernel Protected	NVM.BLOCK	NVM.PM.VOLUME
Media Type	Disk Drive	Persistent Memory
NVDIMM	Disk-Like	Memory-Like

The current version (1.2) of the specification is available at

https://www.snia.org/sites/default/files/technical_work/final/NVMProgrammingModel_v1.2.pdf



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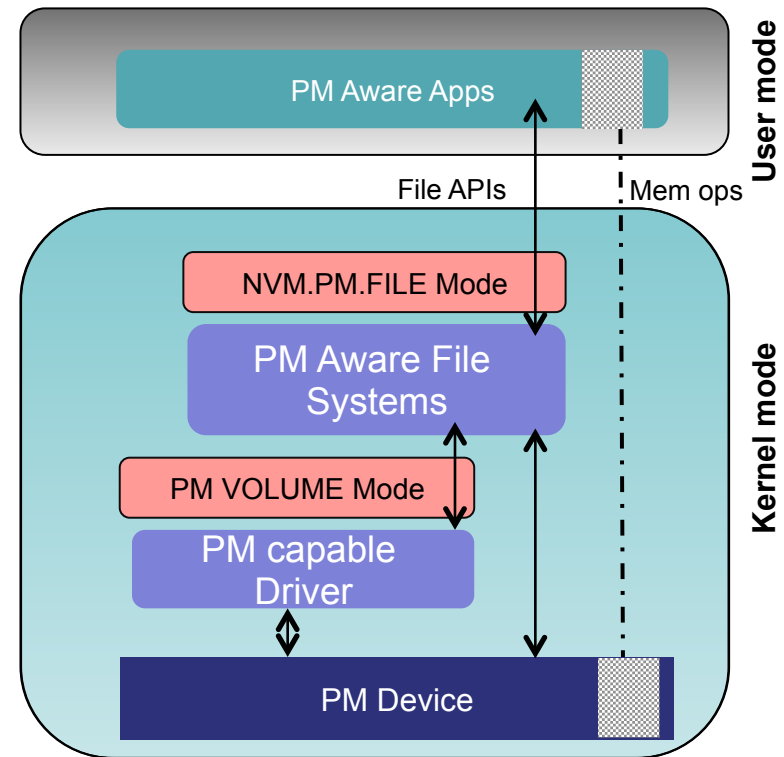
Programming Model Modes

- Block and File modes use IO
 - Data is read or written using RAM buffers
 - Software controls how to wait (context switch or poll)
 - Status is explicitly checked by software
- Volume and PM modes enable Load/Store/Move
 - Data is loaded into or stored from processor registers
 - Processor waits for data during instruction
 - No status returned – errors generate exceptions



Persistent Memory (PM) Modes

- NVM.PM.VOLUME Mode
 - Software abstraction for persistent memory hardware
 - Address ranges
 - Thin provisioning management
- NVM.PM.FILE Mode
 - Application behavior for accessing PM
 - Mapping PM files to application address space
 - Syncing PM files








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Past Accomplishments

- NVM Programming Model 1 published December 2013
- Best business application award, FMS 2014
- NVM Programming Model 1.1 published March 2015
- Remote Access for High Availability white paper published 2016
- PM Atomics Transactions white paper published 2016
- NVM Programming Model 1.2 published June 2017
 - Major new installment on error handling
 - Optimized Flush Allowed
 - Deep Flush

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Ongoing NVMPM Work Items

- NVM Programming Model Specification 1.3
 - Update specification to reflect learning from implementations
 - Incorporate learning from remote access white paper
 - Asynchronous Flush
 - Remote persistence ordering, error handling
- Remote Access Collaboration with OFA OFIWG
 - PM Remote Access for HA V1.1
 - Expand remote access use case enumeration
- PM Security threat model
 - Identify potential security gaps created by PM
- PM Management
 - Integration into Redfish and Swordfish



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Role of the NVM Programming Model

- Rally the industry around a view of Persistent Memory that is:
 - Application centric
 - Vendor neutral
 - Achievable today
 - Beyond storage
 - Applications
 - Memory
 - Networking
 - Processors

