Current Status and Overview of Industry Standards related to Persistent Memory

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Introduction

- There are several industry organizations that have ongoing standards work related to persistent memory

- Industry organizations we'll cover:
  - Storage Networking Industry Association - SNIA
  - Joint Electron Device Engineering Council – JEDEC
  - Open Fabrics Alliance – OFA
  - Other ancillary organizations

An Introduction to the
Storage Networking Industry Association

160
industry leading
organizations

2,500
active contributing
members

50,000
IT end users & storage
pros worldwide

SNIA Vision and Mission

Vision Statement

- Be the globally recognized and trusted authority for storage leadership, standards, and technology expertise.

Mission Statement

- Lead the storage industry worldwide in developing and promoting vendor-neutral architectures, standards and educational services that facilitate the efficient management, movement and security of information.
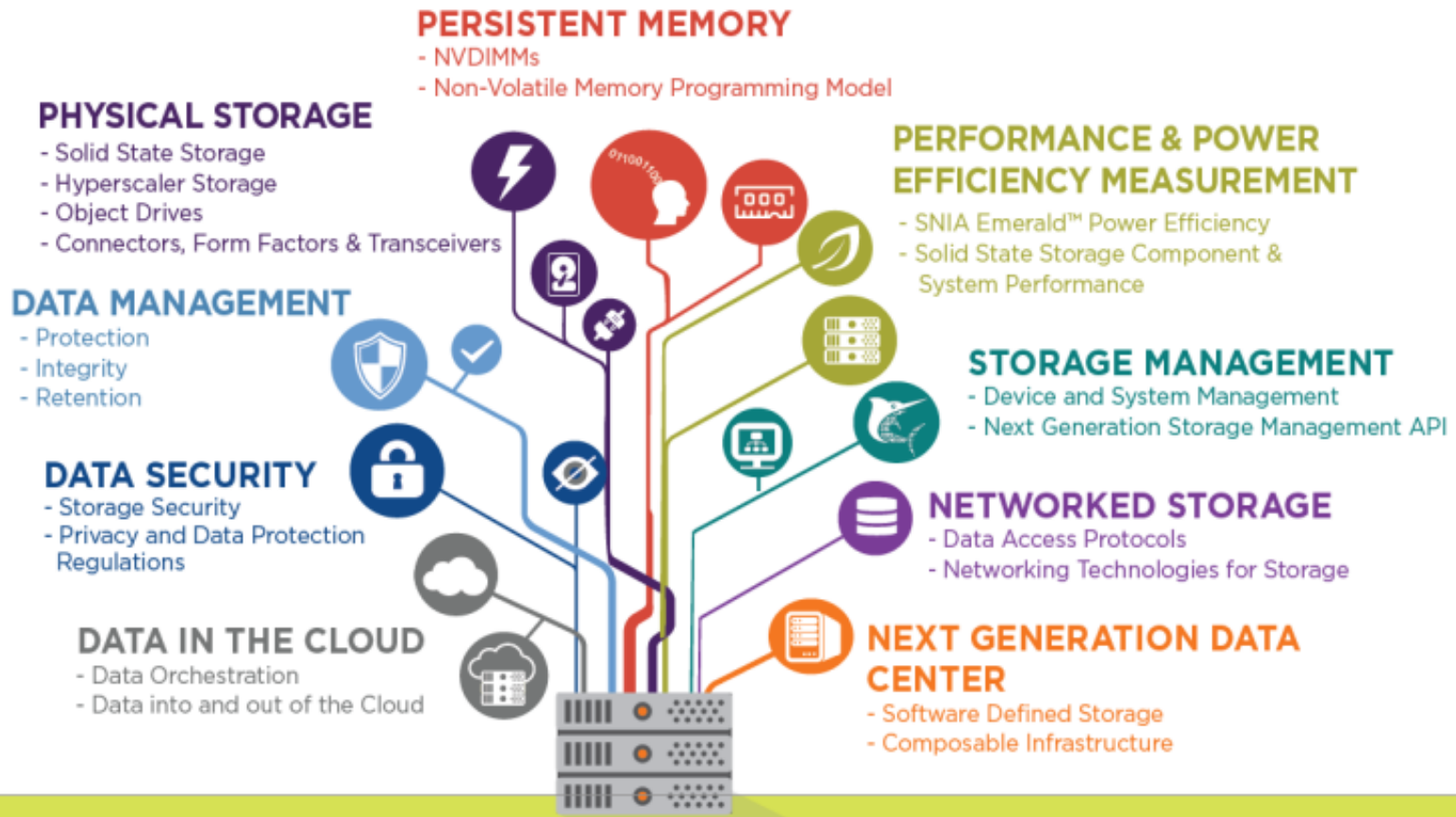
What SNIA Does

- **Standards Development and Adoption**
  - Spec development; submissions for International Standard ratification (ISO/IEC)
  - Open source software to accelerate adoption

- **Interoperability Assurance**
  - Plugfests & conformance testing

- **Technology Acceleration and Promotion**
  - Special Interest Groups to promote technologies
  - Vendor collaboration to accelerate adoption

- **Global Vendor-Neutral Education**
  - Peer-reviewed webcasts and tutorials
  - Conferences and presentations
  - White papers, articles, blogs, etc.
  - IT training and certification courses

PERSISTENT MEMORY
- NVDIMMs
- Non-Volatile Memory Programming Model

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

PERFORMANCE & POWER EFFICIENCY MEASUREMENT
- SNIA Emerald™ Power Efficiency
- Solid State Storage Component & System Performance

DATA MANAGEMENT
- Protection
- Integrity
- Retention

STORAGE MANAGEMENT
- Device and System Management
- Next Generation Storage Management API

DATA SECURITY
- Storage Security
- Privacy and Data Protection Regulations

NETWORKED STORAGE
- Data Access Protocols
- Networking Technologies for Storage

DATA IN THE CLOUD
- Data Orchestration
- Data into and out of the Cloud

NEXT GENERATION DATA CENTER
- Software Defined Storage
- Composable Infrastructure

PERSISTENT MEMORY
- Non-Volatile Memory Programming Model (NVMPM) v1.3
- Persistent Memory Hardware Threat Model v1.0
- NVMPM Remote Access for High Availability White Paper

PHYSICAL STORAGE
- SFF Technology Affiliate:
  Connector, Form Factor and Transceiver Standards
- Object Drive Key Value API Spec v1.0

PERFORMANCE & POWER EFFICIENCY MEASUREMENT
- SNIA Emerald™ Power Efficiency Measurement Spec v3.0 & v3.1
- Solid State Storage Performance Test Spec v2.0.1

DATA MANAGEMENT
- Linear Tape File System Format Spec v3.0

STORAGE MANAGEMENT
- Storage Management Interface Specification (SMI-S) v1.8

DATA SECURITY
- Data Protection White Paper
- Transport Layer Security for Storage Spec v1.1

NEXT GENERATION DATA CENTER
- SNIA Swordfish™ v1.0.6 – RESTful Storage Management API for Cloud Data Centers
- Swordfish Emulator and Basic Web Client software

DATA IN THE CLOUD
- Cloud Data Management Interface (CDMI) Spec v2.0
- CDMI Reference Implementation v1.0

Particular SNIA Efforts on PM

- **SNIA Technical Council & Technical Working Groups (TWGs)**
  - Non-volatile Memory Programming TWG
  - This is the body developing the NVM Programming Model

- **SNIA Standards (aka Technical Positions), Software & White Papers**
  - NVM Programming Model v1.2 (June 2017) – Technical Position
  - PM Remote Access for High Availability v1 (February 2016) –White Paper
  - PM Atomics and Transactions v1r1 (January 2017) – White Paper

- **SNIA Solid State Storage Initiative (SSSI)**
  - One of many Forums and Initiatives within SNIA
  - SSSI sponsors the Persistent Memory and NVDIMM Special Interest Group (SIG)
  - Deliverables: PM Summit, webcasts, videos, presentations, Tutorials

JEDEC

- ## Interesting history
  - Radio Manufacturers Association – 1924
  - Joint Electron Tube Engineering Council (JETEC) – 1944
    - Vacuum tube technology, etc.
  - JETEC expanded into solid-state technology to become JEDEC
    - 1958 – one council for tubes, one for semiconductors

JEDEC

- ## JEDEC has 11 Committees
  - The particular committee of interest to PM standardization is JC-45
  - Labeled "DRAM Modules"
  - Scope is to "develop standards for DRAM modules, cards, and socket interfaces"
  - These standards address architectural, electrical, test, and SPD issues relating to memory design and manufacturing for commercial applications
  - A memory "module" is single or multiple PCB(s) that predominantly include multiple memory, logic, and passive devices in a planar or 3D layout for use with sockets

JEDEC

- JC-45 has six subcommittees:
  - .1 – DRAM Modules
  - .3 – Buffered DRAM modules
  - .4 – Fully Buffered DRAM modules
  - .5 – Module Interconnect
  - .6 – Hybrid Modules
    - This is the subcommittee that governs NVDIMM work
    - Most recent – JESD248A – DDR4 NVDIMM-N (March 2018)
    - Governs all behavior of module including backup/restore

OFA

- ## Open-source based organization that:
  - Develops, tests, licenses and supports Open Fabrics S/W (OFS)
  - Mission
    - Develop and promote software that enables maximum application efficiency, by delivering wire-speed messaging, ultra-low latencies, and maximum bandwidth directly to applications with minimal CPU overhead
  - Leadership team from the HPC community (labs, vendors)
  - Four working groups – Enterprise, Interoperability, Marketing, Verbs

OFA

- **Enterprise working group**
  - Qualifies and tests Open Fabrics Enterprise Distribution (OFED)

- **Interfaces working group**
  - Develops, tests, distributes an extensible, open source framework that provides access to high-performance fabric interfaces and services

- **Interoperability working group**
  - Conducts and oversees interoperability testing in conjunction with University of New Hampshire (UNH)

Other Ancillary Organizations

- ## Infiniband Trade Association (IBTA)
  - ### Responsible for InfiniBand and RoCE specifications

- ## Internet Engineering Task Force (IETF)
  - ### Responsible for iWARP specification

- ## NVM Express
  - ### Responsible for NVM Express (NVMe) and NVM Express over Fabric (NVMe-oF) specifications

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