SNIA Solid State Storage Initiative
Solid State Storage Initiative

Mission

- Foster the Growth of SSDs in both the Enterprise and Client Markets

Methods

- Educate the Supplier and User Communities about solid state storage
- Promote and influence Standards for solid state storage
- Collaborate with other industry associations for success of solid state storage
NVDIMM – How it Works

- NVDIMM combines DRAM and Flash onto a single DIMM
- Operates as standard DRAM RDIMM
  - *Fast, low latency performance.*
- Host only addresses the DRAM and has no direct access to the flash (NVDIMM-N classification)
- NVDIMM contains switches to switch control back and forth between host and NVDIMM controller
- NVDIMM controller moves data from DRAM to flash upon power loss or other trigger; can back up portions or all of DRAM upon command
- If power fails, Supercaps (or other power source) provide back up power while DRAM is backed up to Flash
- MRC (Memory Reference Code) configures NVDIMM controller to move data back from Flash to DRAM when recovery is needed
- All the benefits of SSD with none of the performance limitations and best endurance
Industry Standardization

- NVDIMM gaining support from ecosystem
  - Intel DDR4 NVDIMM support for Grantley
  - Supermicro DDR4 NVDIMM support

- JEDEC Hybrid Memory Task Group
  - 12V and SAVE_n pins added to DDR4 DIMM socket
  - 12V in DDR4 socket will simplify NVDIMM power circuitry and cable routing

- SNIA NVDIMM SIG
  - Established in 2014 to promote adoption of NVDIMMs
Providing education on how system vendors can design in NVDIMMs

Communicating existing industry standards, and areas for vendor differentiation

Helping technology and solution vendors whose products integrate NVDIMMs to communicate their benefits and value to the greater market

Developing vendor-agnostic user perspective case studies, best practices, and vertical industry requirements
Any type of non-volatile memory including:

- **Block Accessible**
  - Disk form factor SSDs (SATA, SCSI, etc.)
  - NVM PCIe cards (NVMe), SCSI-Express, SATA Express
  - Vendor-specific

- **Byte Accessible**
  - Emerging persistent memory (PM) hardware (e.g., NVDIMMs)

**Persistent Memory:**

- Future technologies bring memory-like access for NVM devices
- Access time comparable to RAM
- PM Brings Storage to Memory Slots
  - Option for software to skip copying data from memory to disks
  - No need for specialized “I/O”
Need for A New Programming Model

❖ Current programming model
  ❖ Data records are created in volatile memory
    ➢ Memory operations
  ❖ Copied to HDD or SSD to make them persistent
    ➢ I/O operations

❖ Opportunities provided by NVM devices
  ❖ Software to skip the steps that copy data from memory to disks.
  ❖ Software can take advantage of the unique capabilities of both persistent memory and flash NVM

❖ Need for a new programming model
  ❖ Application writes persistent data directly to NVM which can be treated just like RAM
Need for A New Programming Model

With Next Generation NVM, the NVM is no longer the bottleneck
  – Need optimized platform storage interconnect
  – Need optimized software storage access methods
NVM Programming Technical Work Group is chartered to:

- Deliver specifications describing the behavior of a common set of software interfaces that provide access to NVM
- Encourage a common ecosystem for NVM-enabled software without limiting the ability to innovate
The SNIA NVM Programming Model defines new software programming models for NVM
- Describes extensions allowing software to utilize NVM features
- Enables designers to develop APIs that take advantage of NVM features and performance
- Defines software behavior for block-addressable NVM (SSDs) and byte-addressable NVM (certain NVDIMMs)

SNIA NVM Programming Model version 1 is available
- Work on new NVM programming capabilities is ongoing
Extensions to existing block addressable software stacks
Provide effective and more uniform use of NVM features
A new approach for persistent memory devices
Two primary modes
  - Devices providing block storage behavior
    - Block access
  - Devices providing memory behavior
    - Byte access
File and Block Mode Extensions

- **NVM.BLOCK Mode**
  - Targeted for file systems and block-aware applications
  - Atomic writes
  - Length and alignment granularities
  - Thin provisioning management

- **NVM.FILE Mode**
  - Targeted for file based apps.
  - Discovery and use of atomic write features
  - Discovery of granularities
Persistent Memory (PM) Modes

°F NVM.PM.VOLUME Mode
- Software abstraction for persistent memory hardware
- Address ranges
- Thin provisioning management

°F NVM.PM.FILE Mode
- Application behavior for accessing PM
- Mapping PM files to application address space
- Syncing PM files
NVM Programming Model - Version 1

- Approved by SNIA in December 2013
- Expose new features of block and file to applications
  - Atomicity capability and granularity
  - Thin provisioning management
  - Targeted for application and file system developers
- Use of memory mapped files for persistent memory
  - Existing abstraction that can act as a bridge to higher value from persistent memory
  - Limits the scope of re-invention from an application point of view
Programming Model - not an API specification

- NVM Programming Model defines behavior without specifying an API
- Implementations map actions and attributes to API elements
- Facilitates discovery of capabilities using attributes
- Usage illustrated as Use Cases
Additional
Solid State Storage Initiative
Focus Areas
Workload I/O Capture Program

- WIOCP software collects data which is used to determine the I/O characteristics of various applications.
- Understanding the I/O characteristics can help to identify which SSDs perform best under particular user workloads.
- No personal data is collected.
- WIOCP software runs in the background on a Windows system and does not measurably impact performance.
- Participate and be eligible to receive a gift card & win an SSD!
PCle SSD Committee

- Provides guidance to the marketplace on PCle SSDs, which can take the form of educational materials, best practices documents & SNIA standards
- Coordinates with other industry organizations involved in PCle SSD-related activities

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<th>ITEM</th>
<th>GROUP</th>
<th>STANDARD</th>
<th>CLIENT PCle SSD</th>
<th>ENTERPRISE PCle SSD</th>
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<td>PHYSICAL INTERFACE</td>
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<td>PCI Express</td>
<td>up to 2 LANES Drive</td>
<td>Up to 4 LANES</td>
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<td>SATA-IO</td>
<td>SATA Express</td>
<td>up to 4 LANES M.2 Card</td>
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<td>SSD FF WG</td>
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Understanding SSD Performance Project

- Intended to educate users about how to use the SSS PTS to make intelligent decisions about SSD performance
- The webpage contains a summary of SSS PTS performance data from actual enterprise and client SSDs
- Also available:
  - White paper & presentation
  - Webcast & video about the PTS

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<th>SNIA PTS SSD Performance Test Comparison</th>
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<td><strong>Calypso RTP 2.0</strong></td>
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<tr>
<td>MLC-B 160 GB</td>
<td>Intel 5520HC, Intel Xeon 5580</td>
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<tr>
<td>SLC-A 100 GB</td>
<td>Calypso CTS 6.5</td>
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<tr>
<td>SLC-B 100 GB</td>
<td>Cent OS 5.6</td>
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<th>Tests Run</th>
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<td>TP (Steady State)</td>
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<tr>
<td>LAT (Steady State)</td>
<td>Cent OS 5.6</td>
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SSD Features Rating Project

- Project goal is to better understand what users expect from SSDs
- Surveyed a wide spectrum of users
- Survey results available
  - White paper: SSDs – What’s Important to You?
  - LinkedIn group of same name
SSS Performance Test Specification

- The SSS PTS defines a suite of tests and test methodologies necessary to enable comparative testing of individual SSD performance
- Developed by SSS TWG
- Latest Specifications:
  - PTS Client v1.1
  - PTS Enterprise v1.1
SSS PTS Testing Service

- SSSI recommends a testing service where interested parties may submit their SSD products for testing to the SSS Performance Test Specification
- Testing is conducted by Calypso Systems, a certified SSS PTS testing facility
A webpage on the SSSI site dedicated to the standards involved in the design and testing of SSDs
SSD Form Factors Webpage

SSD form factors on the market today
Other SSSI Resources

- SSSI Blogroll - List of blogs that are dedicated to, or at least occasionally mention SSDs
- SSS Glossary - SSD technology and test terminology