NVMe™ Management Interface (NVMe-MI™) Workgroup Update

Sponsored by NVM Express® organization, the owner of NVMe™, NVMe-oF™ and NVMe-MI™ standards
Speakers

Austin Bolen

Myron Loewen

DELL EMC

intel
Agenda

- NVMe-MI™ Workgroup Update
- NVMe-MI 1.0a Overview
- What’s new in NVMe-MI 1.1
  - In-band NVMe-MI
  - Enclosure Management
  - Managing Multi NVM Subsystem Devices
- Summary
NVM Express®, Inc. 120+ Companies defining NVMe™ together

Board of Directors
13 elected companies, stewards of the technology & driving processes
Chair: Amber Huffman

Marketing Workgroup
NVMexpress.org, webcasts, tradeshows, social media, and press
Co-Chairs: Janene Ellefson and Jonmichael Hands

Technical Workgroup
NVMe Base and NVMe Over Fabrics
Chair: Amber Huffman

Management Intf. Workgroup
Out-of-band management over SMBus and PCIe® VDM
Chair: Peter Onufryk
Vice Chair: Austin Bolen

Interop (ICC) Workgroup
Interop & Conformance Testing in collaboration with UNH-IOL
Chair: Ryan Holmqvist

Facebook
Microsoft
Intel
Cisco
Dell EMC
Seagate
Toshiba
Micron
Oracle
Samsung
Microsemi
NetApp
Western Digital
Flash Memory Summit
NVM EXPRESS
NVM Express™ Roadmap

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- **NVM Express (NVMe)**
  - **NVMe 1.2 Nov’14**
    - Namespace Management
    - Controller Memory Buffer
    - Host Memory Buffer
    - Live Firmware Update
  - **NVMe 1.2.1 May’16**
  - **NVMe 1.3 May’17**
    - Sanitize
    - Streams
    - Virtualization
  - **NVMe (next)**
    - IO Determinism
    - Persistent Memory Region
    - Persistent Event Log
    - Multipathing

- **NVMe-oF Over Fabrics (NVMe-oF)**
  - **NVMe-oF 1.0 May’16**
    - Transport and protocol
    - RDMA binding
  - **NVMe-oF (next)**
    - Enhanced Discovery
    - In-band Authentication
    - TCP Transport Binding

- **NVMe Mgmt. Interface (NVMe-MI)**
  - **NVMe-MI 1.0 Nov’15**
    - Out-of-band management
    - Device discovery
    - Health & temp monitoring
    - Firmware Update
  - **NVMe-MI 1.0a April’17**
  - **NVMe-MI 1.1**
    - In-band Mechanism
    - Enclosure Management
    - Multi NVM Subsystem Devices

* Released NVMe specification
* Planned release
* Subject to change
NVMe-MI™ Ecosystem

- Commercial test equipment for NVMe-MI
- NVMe-MI 1.0a compliance testing program has been developed
  - Compliance testing started in the May 2017 NVMe™ Plugfest conducted by the University of New Hampshire Interoperability Laboratory (UNH-IOL)
  - 7 devices from multiple vendors have passed compliance testing and are on the NVMe-MI Integrators List
- Servers are shipping that support NVMe-MI
What is the NVMe™ Management Interface 1.0a?

A programming interface that allows out-of-band management of an NVMe Storage Device Field Replaceable Unit (FRU)
Out-of-Band Management and NVMe-MI™

- **Out-of-Band Management** – Management that operates with hardware resources and components that are *independent of the host operating system control*

- **NVMe™ Out-of-Band Management Interfaces**
  - SMBus/I2C
  - PCIe Vendor Defined Messages (VDM)
NVMe-MI™ Out-of-Band Protocol Layering

- Management Applications (e.g., Remote Console)
- Management Controller (BMC)
- NVMe Management Interface
- Management Component Transport Protocol (MCTP)
  - MCTP over SMBus/I2C Binding
  - MCTP over PCIe VDM Binding
- SMBus/I2C
- PCIe
- PCIe SSD
NVMe™ Storage Device in 1.0a

- **NVMe Storage Device** – One NVM Subsystem with one or more ports, vital product data (VPD), and an optional SMBus/I2C interface
In-Band Management and NVMe-MI™

- In-band mechanism allows application to tunnel NVMe-MI commands through NVMe™ driver
  - Two new NVMe Admin commands
    - NVMe-MI Send
    - NVMe-MI Receive

- Benefits
  - Provides management capabilities not available in-band via NVMe commands
    - Efficient NVM Subsystem health status reporting
    - Ability to manage NVMe at a FRU level
    - Vital Product Data (VPD) access
    - Enclosure management
 Plumbing in place for NVMe-MI over NVMe-oF™
Enclosure Management

- SES Based Enclosure Management
  - Technical proposal developed in NVMe-MI™ workgroup
  - While the NVMe™ and SCSI architectures differ, the elements of an enclosure and the capabilities required to manage these elements are the same
    - Example enclosure elements: power supplies, fans, display or indicators, locks, temperature sensors, current sensors, voltage sensors, and ports
  - Comprehensive enclosure management that leverages SCSI Enclosure Services (SES), a standard developed by T10 for management of enclosures using the SCSI architecture
Multi NVM Subsystem Management
**NVMe-MI™ 1.0a NVMe™ Storage Device**

- **NVM Storage Device** – One NVM Subsystem with one or more ports and an optional SMBus/I2C interface

![Diagram showing single and dual ported PCIe SSDs with SMBus/I2C interface](image)
NVMe™ Storage Device with Multiple NVM Subsystems

M.2 Carrier Board from Amfeltec

ANA Carrier Board from Facebook
SMBus Topology for NVMe-MI™ 1.0
Multiple NVM Subsystems on a single SMBus Port

• Describe topology in new VPD MultiRecord
• Add UDID types for additional devices like Mux
Support Expansion Connectors

- New VPD address to avoid conflicts with plugged in devices
- Optional Labels for each connector to assist technicians
A Connection Graph Between Element Types

- Host PCIe
- Host Power
- PCIe Switch
- SMBus Mux
- NVMe™ Subsystem
- NVMe Subsystem
- Expansion Connector
- Expansion Connector
Single Port Example (35 bytes of 256B EEPROM)

<table>
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<th>Type</th>
<th>Length</th>
<th>Form Factor</th>
<th>SMBus Dest</th>
<th>Link Options</th>
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<th>12V max 0Fh</th>
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2 NVM Subsystems with Mux (82)

- CPU
- BMC
- Root complex
- PCIe Switch
- Mux
- NVM Subsystem
  - MCTP
  - VPD

Dual Port with Expansion Connectors (78)

- CPU
- BMC
- Root complex
- PCIe Switch
- Mux
- NVM Subsystem
  - MCTP
  - VPD
Summary

- NVMe-MI™ 1.0a is gaining market acceptance and is available in shipping products
- NVMe-MI 1.1 is nearing completion
  - Significant new features
    - In-band mechanism
    - Enclosure management
    - Support for multi NVM subsystem management
- It is time to start thinking about anchor features for NVMe-MI 1.2
Additional Material on NVMe-MI™

- BrightTALK Webinar

- Flash Memory Summit 2017
  - Video:
    - [https://www.youtube.com/watch?v=daKL7tlvNlI](https://www.youtube.com/watch?v=daKL7tlvNlI)
    - [https://www.youtube.com/watch?v=Daqj-XqICo8](https://www.youtube.com/watch?v=Daqj-XqICo8)

- Flash Memory Summit 2015

- Flash Memory Summit 2014

- NVMe-MI Specification
  - [https://nvmexpress.org/resources/specifications/](https://nvmexpress.org/resources/specifications/)
References


MCTP Base Spec: https://www.dmtf.org/sites/default/files/standards/documents/DSP0236_1.3.0.pdf

MCTP SMBus/I2C Binding: https://www.dmtf.org/sites/default/files/standards/documents/DSP0237_1.1.0.pdf

MCTP PCIe VDM Binding: https://www.dmtf.org/sites/default/files/standards/documents/DSP0238_1.0.2.pdf