

NVM Express Q&A

February 12, 2014

Q1: What is NVM Express?

A1: NVM Express, informally NVMe, is an interface specification optimized for PCI Express[®] based solid state drives. The interface is defined in a scalable manner to efficiently support the needs of Enterprise and Client systems in a flexible way.

Q2: What are the benefits of NVM Express?

A2: NVM Express is an optimized, high performance, scalable host controller interface designed for Enterprise and Client PCIe SSDs. NVM Express revolutionizes storage by delivering faster access to data and lowering power consumption. This reduces the Total Cost of Ownership for Enterprise and extends battery life for mobile clients. NVM Express streamlines the legacy storage stack to significantly reduce latency, delivers higher Input/Output Operations per Second (IOPS) for a lower Total Cost of Ownership. Additional benefits for Enterprise and Client platforms include:

- Performance across multiple cores to quickly access critical data
- Scalability with headroom for current and future NVM performance
- End-to-end Data protection capabilities and support for standard security protocols, such as Trusted Computing Group

Q3: Is NVM Express an industry standard?

A3: NVM Express has been developed by an industry consortium, the NVM Express Workgroup. Version 1.0 of the interface specification was released on March 1, 2011. Version 1.1 was released on October 11, 2012.

Q4: Why is NVM Express good for the data center?

A4: Architected for performance, NVM Express provides the capabilities to meet the demands of Cloud, Internet Portal Data Centers and other High Performance Computing environments. For caching or across multiple drives, the benefits include:

- Unprecedented Input/Output Operations per Second (IOPS)
- Performance across multiple cores to quickly access critical data
- An optimized register interface and command set that simplifies host software, device firmware, and results in fewer CPU cycles per IO
- Scalability with headroom for current and future NVM performance
- End-to-end Data protection capabilities and support for standard security protocols, such as Trusted Computing Group
- Lower power consumption resulting in a lower Total Cost of Ownership and carbon footprint.

Q5: Is NVM Express only for Enterprise applications?

A5: NVM Express was designed for both Enterprise and Client applications. NVM Express is an optimized, high performance, scalable host controller interface designed for Enterprise and Client PCIe SSDs. NVM Express has an optimized and lean set of mandatory features. Optional

capabilities are defined for both Enterprise and Client segments. For example, there is an optional Reservations feature for multi-path configurations in Enterprise and there is an optional autonomous power state transition feature for additional power savings in Client. An SSD vendor selects the appropriate set of features based on customer need in each segment.

Q6: When will NVM Express supporting products ship?

A6: PCI Express SSDs supporting NVM Express are available today. Please contact your preferred SSD vendor or system vendor for information

Q7: Are NVM Express drivers available?

A7: Windows, Linux, Unix (FreeBSD), and UEFI open source drivers are currently available. The Linux driver has been integrated into the Linux kernel since 2012. Microsoft has included a NVMe inbox driver beginning with the Windows 8.1 and Windows Server 2012 R2 releases. In addition, Solaris and VMware drivers are in development to support NVM Express. As these drivers are available, information will be posted on nvmexpress.org.

Q8: Does NVMe offer any security features?

A8: The NVMe command set supports security container commands analogous to the security container commands found in the SCSI and ATA/ACS command sets, allowing NVMe-based SSDs to support industry standard security solutions such as the Opal SSC and Enterprise SSC specifications published by the Trusted Computing Group (TCG). Additionally, the NVMe Workgroup collaborated with the TCG Storage Workgroup to add support for the NVMe interface into the TCG Storage Interface Interactions Specification (http://www.trustedcomputinggroup.org/resources/storage_work_group_storage_interface_interactions_specification)

Q9: How does NVM Express compare to SOP/SCSI Express?

A9: NVM Express was designed from the ground up for NVM, ensuring that the interface could scale as future NVM technologies come to market that are ~1000x faster than NAND. SCSI Express has focused on maintaining full SCSI support at the SSD level. The difference in design has resulted in a command set of ~ 20 commands for NVM Express and 200+ for SCSI Express. NVM Express and SCSI Express are expected to be complimentary, each serving different OEM and customer needs.

For companies that have legacy software applications using the SCSI command set but want to use NVMe, there are software translations that can be performed in the NVMe host driver to provide this support (as is present in the Windows OFA open source driver).

Q10: How does NVM Express compare to SATA Express?

A10: SATA Express is a connector for 2.5" form factor SSDs, HDDs, and SSHDs. The host SATA Express connector supports a PCIe or SATA device being attached. The PCIe device may use the NVM Express or AHCI programming interface. The AHCI interface was designed for hard drives and has limited scaling; for example, the maximum IOPs is approximately 200,000 due to lack of MSI-X and interrupt steering support. In comparison, NVMe prototypes have measured over 1,000,000 IOPs.

Q11: Is there a specification currently available? If so where can I get a copy?

A11: Version 1.0 of the specification was released on March 1, 2011. The specification is now at 1.0e and incorporates errata that the membership has identified as part of implementing the interface. The 1.1 specification was published on October 11, 2012 and adds valued capabilities for Enterprise and Client platforms. The specifications can be found on the Specification page at <http://www.nvmexpress.org/specifications/>.

Q12: How is the specification developed? Can anyone contribute?

A12: The specification is developed by the NVM Express Working Group. Any company may join the Workgroup as a Contributor by signing the Participation Agreement and paying the membership dues. All Contributors have equal input into the development and evolution of the specification. The agreement can be found on the Join NVM Express page at <http://www.nvmexpress.org/join-nvme/>.

Q13: What is the legal framework of the NVM Express organization?

A13: NVM Express is an incorporated non-profit Special Interest Group. There are 3 categories of members, Promoters, Contributors and Adopters. The NVM Express group is led by 13 Promoter companies who have board seats and provide overall governance. Promoters are elected and serve two year terms. Contributor companies are welcome to participate in regularly scheduled technical working sessions that develop specifications and in marketing sessions to further adoption of the interface in the industry. Adopters have access to ratified Technical Proposals and are welcome to participate in NVM Express Marketing activities. Additional information is available in the Organization Bylaws located at <http://www.nvmexpress.org/join-nvme/>.

Q14: Who are the companies that form the NVM Express Promoters Group?

A14: The Promoters Group is composed of 13 companies, Cisco, Dell, EMC, HGST, Intel, LSI, Micron, NetApp, Oracle, PMC-Sierra, Samsung, SanDisk, and Seagate.

Q15: Are there annual dues?

A15: There are annual dues for each level of membership. Additional information regarding dues and benefits for the different membership levels is located on the Join NVM Express page at <http://www.nvmexpress.org/join-nvme/>.

Q16: How do I join?

A16: Information on joining NVM Express, membership dues and benefits are located on the Join NVM Express page at <http://www.nvmexpress.org/join-nvme/>.

Q17: Where can I learn more about NVM Express?

A17: Additional NVM Express information is located at www.nvmexpress.org.