

NVMe[®] Compliance Program: Preparing to Test New Features

Presented by Carter Snay, UNH-IOL

Webinar Hosted by NVM Express

Meet the Presenter

Carter Snay, UNH-IOL

- Technical Manager,
Data Center Technologies
- Testing & Customer Relations
- 5 years of experience working in
NVMe[®] technology



About the UNH InterOperability Laboratory (UNH-IOL)

- A neutral and independent lab that tests networking and data communications products for businesses across the globe.
- Started in 1988 on the University of New Hampshire Durham, NH campus.
- Non-profit organization and 100% funded by commercial industry with over 150+ member companies.
- State of the art facility with 28,000+ sq. ft. (1 hour outside Boston, USA).
- 4,200 sq. feet of pre-wired space dedicated to Plugfests.



The UNH-IOL and NVM Express Organization: History and Current Times

Connection with the NVM Express Organization:

Since 2012, NVM Express has collaborated with UNH-IOL to manage the Integrator's List based Test Program on behalf of NVM Express Organization



Develop Test Plans and Automated Test Software to Complete NVMe Compliance Testing



Continue to release software based on latest Technical Proposals, and perform independent compliance testing at the UNH-IOL Facility



Origin of NVMe[®] Specification and Importance of Testing

- Started with PCIe[®] as only transport
- Admin and NVM I/O Command Sets
- Testing for the last decade
- Conformance and Interoperability Testing
 - Why?
 - Making sure the product “just works!”



Test Plans Based on the Specifications

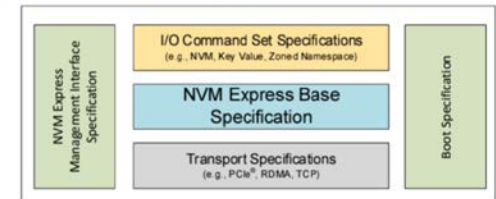
- Test published by the UNH-IOL, written in conjunction with the NVMe® Interop and Compliance Work Group
- Originally, 2-3 test plans were required for listing on Integrator's List
 - UNH-IOL NVMe Conformance
 - UNH-IOL NVMe Interoperability
 - UNH-IOL NVMe-MI Conformance (if supported)

Specifications

NVMe Specifications Overview

The NVMe Express® (NVMe®) family of specifications define how host software communicates with non-volatile memory across multiple transport protocols including PCIe®, SATA, RDMA, TCP and more. It is the industry standard for solid state drives (SSDs) in all form factors (U.2, M.2, AIC, EDSFF). NVMe Express is the industry standard for defining, managing and marketing NVMe technology. The latest versions of the family of specifications, NVMe 2.0 family of specifications, were published on June 3, 2021.

Guide to the NVMe Express Specification Family



Test Plan Development Process

1

Updates to test plans happen twice a year in order to keep pace with updates to the NVMe® specifications being developed at nvmexpress.org.



2

All Test Plan updates are created by NVMe Interop and Compliance Committee.



3

All updates are approved and voted on by the NVMe Technical Work Group and the NVMe Board of Directors.



4

All new tests added are made FYI, since in many cases there are no existing product in the market. This gives time for the Test Plan, DUT, and test scripts to be vetted.



The NVMe[®] Integrator's List

NVMe™ Integrator's List

The NVMe Integrator's List (IL) contains useful information about NVMe Products that UNH IOI has performed interoperability and conformance testing during an NVMe plugfest or through test reservations at our lab. Successful completion of such conformance tests when combined with satisfactory operation in UNH IOI's interoperability tests provides a reasonable level of confidence that the Product Under Test will function properly in many NVMe environments.

UNH IOI is happy to be collaborating with the NVMe Organization on the creation and maintenance of the NVMe Integrator's List. More information on NVMe Products can be found at nvmexpress.org/products.



NVMe™ Integrator's List v18.0 | NVMe-oF™ Integrator's List

- NVMe Integrator's List Policy v18.0

NVMe Devices

Product Name + Firmware Version	Product Type	PCIe Gen	NVMe Base Spec Version	NVMe-MI Spec Version	Form Factor	I/O Command Sets Supported	Interop Program Revision	Date Listed	Further Info
FORESEE XP2000 Firmware Version: V181890L	NVMe-SSD	PCIe Gen4	1.4	N/A	M.2	NVM	v18.0	November 17th, 2022	http://www.longsys.com/
FORESEE XP1100 Firmware Version: 1.1.9.1	NVMe-SSD	PCIe Gen4	1.4	N/A	M.2	NVM	v18.0	November 17th, 2022	http://www.longsys.com/
INNOCRIT Donghu-Z1 Firmware Version: 2.22.6.0	NVMe-SSD	PCIe Gen4	1.4	N/A	U.2	2NS	v18.0	April 10th, 2023	https://www.innocritcorp.com/
INNOCRIT Dongting-N1 Firmware Version: 3.C.1.3T	NVMe-SSD	PCIe Gen4	1.4	N/A	M.2	NVM	v18.0	November 17th, 2022	https://www.innocritcorp.com/
Inspur NS4500G, NS6600G2 Firmware Version: YCM2122C	NVMe-SSD	PCIe Gen4	1.4	N/A	U.2	NVM	v18.0	February 7, 2023	https://inspur.com/
KIOXIA BG6 Firmware Version: N/A	NVMe-SSD	Gen4	1.4	N/A	M.2	NVM	v18.0	March 28, 2023	https://www.kioxia.com
KIOXIA KD7P Firmware Version: 18F7700W	NVMe-SSD	Gen4	2.0	1.1	E1.5	NVM	v18.0	November 18th, 2022	https://www.kioxia.com
Longsys OSCA836 Firmware Version: N.J000113	NVMe-SSD	Gen4	1.4	1.1	U.2	NVM	v18.0	January 25, 2023	www.longsys.com
Micron 6500 Firmware Version: E3M3M02E	NVMe-SSD	Gen4	1.4	1.2	U.2, E1.1	NVM	v18.0	February 28, 2023	https://www.micron.com/products
Micron 2550 Firmware Version: 70LEVLN	NVMe-SSD	Gen4	1.4	1.2	M.2	NVM	v18.0	March 31, 2023	www.micron.com/products/ssd/pxe

Phison PS5026-E26 Gen5 SSD Firmware Version: EQFM2L10	NVMe SSD	Gen 5	2.0	N/A	M.2	NVM	v18.0	March 1, 2023	https://phisonblog.com/meet-the-pi-controller/ https://www.phison.com/en/solution/ssdtop/pcie
Realtek RTS5727DL Firmware Version: VF001C0B	NVMe SSD	Gen4	1.4	N/A	M.2	NVM	v18.0	November 21st, 2022	https://www.realtek.com
Realtek RTS5711DL Firmware Version: VF001C0B	NVMe SSD	Gen4	1.4	N/A	M.2	NVM	v18.0	November 21st, 2022	https://www.realtek.com
Realtek RTS5768DL Firmware Version: VF001C0B	NVMe SSD	Gen3	1.4	N/A	M.2	NVM	v18.0	November 21st, 2022	https://www.realtek.com
Seagate Nytro 5050 Firmware Version: SE05A444	NVMe SSD	Gen4	1.4	N/A	U.3	NVM	v18.0	December 16, 2022	www.seagate.com
Shenzhen Unionmemory Information System Limited AMS20 Firmware Version: 1.0L0520	NVMe SSD	Gen3	1.4	N/A	2242 M.2	NVM	v18.0	May 1, 2023	https://www.unionmem.com/
SK Hynix PE9010 Firmware Version : 0.0.0	NVMe SSD	Gen3x4	2.0	1.2	M.2	NVM	v18.0	April 17, 2023	www.skhynix.com

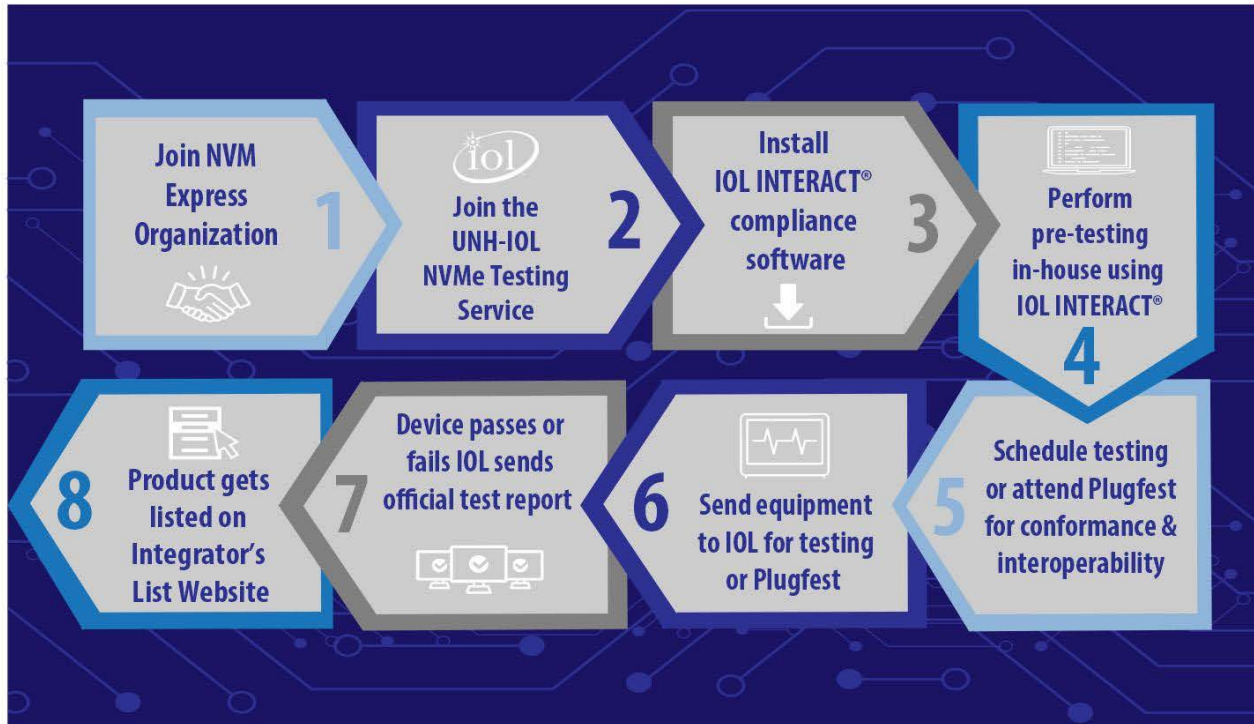
NVMe™ Integrator's List v17.0 | NVMe-oF™ Integrator's List

- NVMe Integrator's List Policy v17.0

NVMe Devices

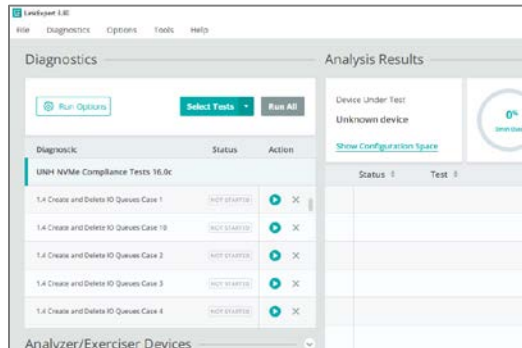
Product Name + Firmware Version	Product Type	PCIe Gen	NVMe Base Spec Version	NVMe-MI Spec Version	Form Factor	I/O Command Sets Supported	Interop Program Revision	Date Listed	Further Info
DERA D7400 Series Firmware Version: D7Y5M0M, VC230114	NVMe SSD	Gen4	2.0	1.2	U.2	NVM	v17.0	November 3, 2022	www.derastorage.com
Hefei Datang Storage DTS510P series Firmware Version: DDPST4.0	NVMe SSD	Gen3x4	1.4	NA	U.2	NVM	v17.0	September 28, 2022	http://www.dstorage.com.cn
Kingston OMxPGP4xxx Firmware Version: HPS1	NVMe SSD	Gen4	1.4	NA	M.2	NVM	v17.0	June 22, 2022	https://www.kingston.com/uk



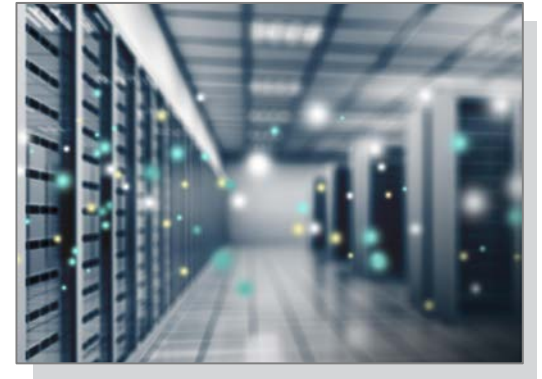
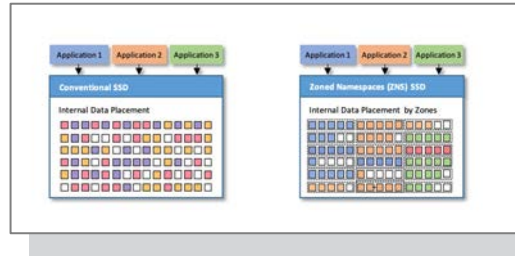
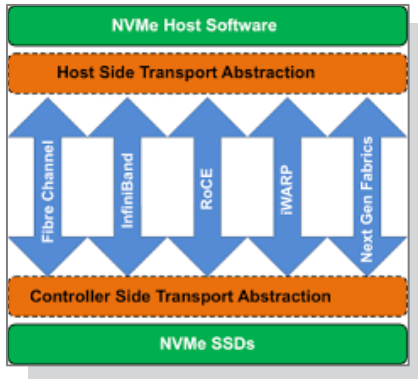


The Test Tools

Conformance testing done with IOL INTERACT PC Edition and LeCroy Edition for automated testing



Focus for Upcoming Test Features



TP2016

- TP 4146 Flexible Data Placement
- TP 4097a Abort Enhancements
- TP 4136 Should to Shall Conversion Catch-up
- TP 4145 Namespace Admin Label
- TP 4115 ZNS namespace and capacity report enhancements



[home](#) » [nvme interop](#) » [documents](#) » [phase 2 tps](#) » [tp2016 icc plugfest 20 fall 2023 phase 2 2023.05.25](#)

TP 4146 Flexible Data Placement

Completed a FDP Proof of
Concept Compliance Testing
at NVMe Plugfest #19

60

New (FYI) tests created for
FDP in the next test plan

Tests to cover

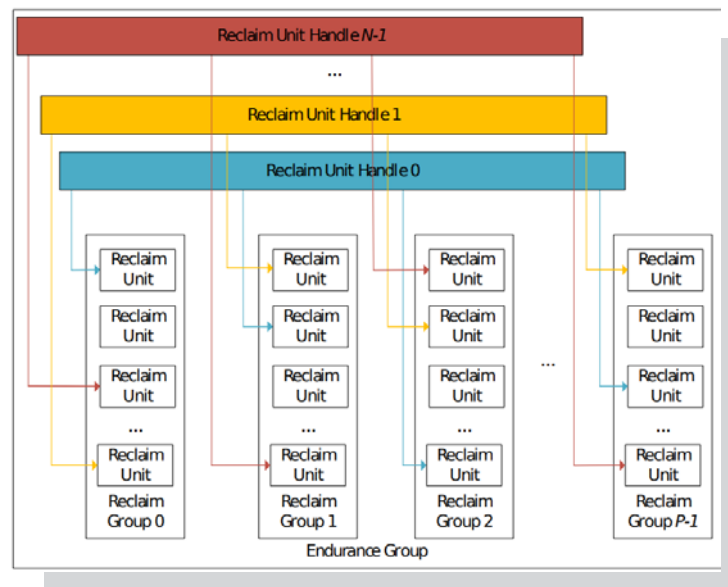
- I/O Management
Send/Receive
- Get and Set Features for
FID 1Dh
- NS management in
Endurance Groups,
configuration of FDP using
set features
- FDP Related Log Page
Tests (20h-23h)

TP 4146 Flexible Data Placement Cont.

More Test Cases

- Identify Controller Valid Values for FDP
- Flexible Data Placement Events Feature 1Eh
- Namespace Management Command
- Write Commands
- Format Command

More subcases for each of these, which will be available towards the end of summer as we create the actual test procedures



TP 4097a Abort Enhancements

New tests required for this TP to test the functionality of the new Cancel Command, and new conditions for Abort Requested Statuses

Tests for new possible command result statuses (i.e. Invalid Command ID)

Functional test of cancel command on single commands and multiple commands, and negative tests associated with these actions

Queues based testing, sending cancel command with valid in invalid SQIDs, and to multiple namespaces

TP 4136 Should to Shall Conversion Catch-up

Majority of the initial test finding is based on the word "Shall", this TP required checking of existing tests as well as the creation of new ones (15)

- FID 83h shall not be savable – New Tests to verify with Get Feature
- Tests for triggering command sequence errors during I/O Operations
- Asynchronous Event request command - Shall added to state the controller shall not return a CQE, test 1.7.2 "Outstanding Commands Aborted after Reset" only applicable to 1.4 drives or previous specs now

Should



Shall

TP 4145 Namespace Admin Label

Optional New Feature that is resulting in 6 new test cases

- General Set Feature tests ensuring the host can use this feature and modify the value if supported
- Test to verify that this feature is saveable as dictated by the TP
- Sanitize verification tests

ZNS Testing over Multiple Transports

- Ongoing Effort to perform this testing
- Goal to complete testing on 3 different solutions, find possible problems in test and device
- Determine limitations of kernel and of the transport



How to Test and Be Ready for Certification

Getting the software prior to sending device in for certification testing



The University of New Hampshire uses OneDrive for all filesharing



Attend NVMe ICC Meetings to discuss what items are most important for testing

- Technical Proposals are selected based on what seems highest priority by the NVMe TWG, all feedback and suggestions are welcome

What Happens if the Device Under Test Fails?

What is a failure?

What is the difference between an FYI and a Mandatory failure?

How quickly can it be corrected?

How can unexpected failures be avoided?

What about failures that I think are due to the software, or test procedure?

ICC Calls

Interop and Compliance Committee (ICC)

Chair: Ryan Holmqvist, Intel

Meets every other Tuesday 2PM Eastern / 11AM Pacific

Announcements/Meeting invites made on ICC reflector and on nvmexpress.org



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