# UNH-IOL
# NVMe Test ~~Consortium~~ing Service

### NVMe Integrators List Policy
### *Version 8.0a*
*Policy Document*



*Last Updated : ~~August 28, 2017~~September 12, 2017*

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# MODIFICATION RECORD

2012 October 29 (Version 1.0 DRAFT)
  David Woolf: Initial Release

2012 November 19 (Version 1.0 DRAFT)
  David Woolf: Changed Windows Driver requirement from being exclusively the Windows OFA reference driver to being any Windows driver.

2012 December 3 (Version 1.0 DRAFT)
  David Woolf: Added 'Definitions' section.  Added requirement for testing against Linux Reference Driver. Clarified requirements for NVMe Devices vs. NVMe Host Platforms.

2013 April 30 (Version 1.0 DRAFT)
  David Woolf: Modified information to be included in each device listing.

2013 May 9 (Version 1.0)
  David Woolf: Final Release

2013 July 29 (Version 1.1 DRAFT)
  David Woolf: Modified information to be included in each device listed. Increased number of test platforms used from 4 to 5, and increased number of passing test platforms from 3 to 4. Specified that a Host Platform need only be tested using one operating system.

2013 August 7 (Version 1.1 DRAFT)
  David Woolf: Editorial fixes.

2013 November 7 (Version 1.1 DRAFT)
 David Woolf: Added exception for test 1.5 which only needs to be tested with one test platform. Added proposed wording for High Volume Listings policy.

2013 December 13 (Version 1.1 DRAFT)
 David Woolf: Reformatted policy document.  Removed wording for High Volume Listing Policy. Added wording to clarify that all potential NVMe form factors are eligible for the list, and that drives in the same family but different form factors may be listed by similarity.

2013 December 16 (Version 1.1 DRAFT)
 David Woolf: Added cross reference to UNH-IOL equipment list to show what platforms are available for interoperability testing. Removed reference to boot test requirements.

2013 December 19 (Version 1.1)
 David Woolf: Added links to UNH-IOL NVMe Test Suites page to help readers find the necessary test procedures.

2014 July 14 (Version 1.1b)
 David Woolf: Upgraded requirements for interop testing in section 4. Updated Test Suite references.

2014 September 30 (Version 1.1b)
 David Woolf: Downgraded requirements for interop testing in section 4 per direction from NVM Express Organization.

2014 October 20 (Version 1.1b)
 David Woolf: Added clarification that devices advertising support for an earlier revision of the NVMe specification may still be eligible for newer revisions of the NVMe Integrators List.

2015 February 12 (Version 1.2)
David Woolf: Added new requirements based on NVMe Promoters group feedback.

2015 April 7 (Version 1.2)
David Woolf: Clarifications, editorial fixes.

2015 April 13 (Version 1.2)
David Woolf: Added Group 7 and Group 8 tests to Table 1.

2015 April 14 (Version 1.2)
David Woolf: Fixed broken web links in Section 4.

2015 November 5 (Version 1.2.1)
David Woolf: Replaced references to SFF-8639 with U.2. Modified requirements for Boot Test to be performed with 2 hosts.

2015 November 23 (Version 1.2.1)
David Woolf: Updated table 2 to reflect updates to conformance test suite.

2015 December 11 (Version 1.2.1)
David Woolf: Updated Table 1 to reflect that interop Test 1.5, may not be required for certain types of FPGA based NVMe IP Devices.

2016 January 28 (Version 1.2.1)
David Woolf: Updated Table 1 to match changes made to the NVMe Interoperability Test Suite v1.2.1 document in November 2015, indicating that the Boot Test is mandatory for hosts.

2016 May 17 (Version 6.0 r01)
David Woolf: Updated document name to reflect new numbering scheme.

2016 May 24 (Version 6.0 r02)
David Woolf: Removed tables of Mandatory/FYI tests and moved them to the respective test suite documents. Updated references.

2016 May 31 (Version 6.0 r03)
David Woolf: Added reference to Appendix G of NVMe Interop Test Suite. Removed text outlining Integrators List test requirements, since this is now documented in Appendix G of the NVMe Interop Test Suite.

2016 December 8 (Version 6.0 r04)
David Woolf: Added Section 7 discussing Appeals process.

2017 January 26 (Version 7.0 r01)
David Woolf: Added section discussing NVMe-MI Integrators List.

2017 February 7 (Version 7.0 r02)
David Woolf: Edits to eligibility requirements to enhance readability.

2017 March 22 (Version 7.0)
David Woolf: Final release to UNH-IOL website ahead of May 2017 Plugfest #7.

2017 June 17 (Version 7.0a)
David Woolf: Added text to section 7 to describe escalation of waiver requests. Added Section 8 to clarify expectations of how ECNs and TPs will be handled.

2017 August 28 (Version 8.0)
David Woolf: Added section on NVMe Fabrics Integrators List.

2017 September 12 (Version 8.0a)
David Woolf: Added Fibre Channel and Ethernet Switches as eligible products for the NVMe over Fabrics Integrators List.

# INTRODUCTION

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards-based products by providing a neutral environment where a product can be tested against other implementations of a common standard, both in terms of interoperability and conformance. The NVMe Promoters Group and UNH-IOL have worked closely to define test procedures and policies for a public NVMe Integrators List. This document describes the Integrators List, how to qualify products for it, and policies surrounding the Integrators List. The goal of the NVMe Integrators List is to help implementers evaluate the NVMe functionality of their products.

# REFERENCES

The following documents are referenced in this text:

1. UNH-IOL NVMe Conformance Test Suite v8.0
2. UNH-IOL NVMe Interoperability Test Suite v8.0
3. UNH-IOL NVMe-MI Conformance Test Suite v8.0
4. UNH-IOL NVMeoF Interoperability Test Suite v8.0

## Section  1: Integrators List Policies

**Overview:** This section describes policies and procedures for listing qualifying products on the NVMe Integrators List.

**1 - Purpose**

This document outlines the policies for the NVMe and NVMe-MI Integrators Lists, hereafter referred to collectively as the Integrators Lists (ILs). This document will show how companies participating in UNH-IOL testing services can have their products included in these public Integrators Lists.

       The Integrators Lists will serve as a means for component suppliers to indicate conformance to NVMe specifications and interoperability with other NVMe products. While listing on any of the Integrators Lists does not guarantee conformance or interoperability it provides a reasonable degree of confidence that a tested product will work well in a multi-vendor environment.

**2 - Location**

The Integrators Lists will be hosted on the UNH-IOL website at www.iol.unh.edu. The exact URLs will be published by UNH-IOL. Each Integrators List will be linked to from nvmexpress.org. The lists will be maintained by UNH-IOL. Each Integrators List site will link back to nvmexpress.org.

**3 - Definitions**

*NVMe Device* - an NVMe SSD, SSD Controller, or SSD Controller IP.

*NVMe-MI Device* - an NVMe SSD, SSD Controller, or SSD Controller IP which supports NVMe-MI.

*NVMe Host Platform* - Any combination of PCIe Host hardware (Motherboard or add-in card), NVMe Host Software (OS/Driver), and/or IP, that allows communication with an NVMe enabled SSD. Examples of an NVMe Host Platform are: server, server board, motherboard, add-in card, RAID Controller, or IP device.

*NVMe-MI Host Platform* - Any combination of PCIe Host hardware (Motherboard or add-in card), NVMe Host Software (OS/Driver), and/or IP, that allows communication with an NVMe enabled SSD and supports NVMe-MI. Examples of an NVMe-MI Host Platform are: server, server board, motherboard, add-in card, RAID Controller, or IP device.

*Product Under Test* - The NVMe Host Platform or NVMe Device being tested to determine eligibility for the NVMe Integrators List.

*Interop Partner* - An NVMe Host Platform or NVMe Device that is tested with the Product Under Test according to the NVMe Interop Test Suite Document to determine the eligibility of the Product Under Test for the NVMe Integrators List.

**4 - Eligibility**

The following table outlines what sorts of products can be eligible for each Integrators List. Eligibility for one Integrators List is not dependent on qualification for any other Integrators List.

| Integrators List | Accepts Product Types |
|---|---|
| NVMe | NVMe Host Platform<br>NVMe Device<br>NVMe PCIe Switch |
| NVMe-MI | NVMe-MI Device |
| NVMeoF | NVMeoF FC Target<br>NVMeoF FC Initiator<br>NVMeoF Fibre Channel Switch<br>NVMeoF RoCE Target<br>NVMeoF RoCE Initiator<br>NVMeoF Ethernet Switch |

> **Comment [RH1]:** Should we add "NVMe PCIe Switch"?

> **Comment [RH2]:** Prefix each with "NVMeof" to be consistent/clear

Products must meet the following requirements to be eligible for each respective Integrators Lists.

***If the Product Under Test is an NVMe Device*:** In order for the product to be eligible for the NVMe Integrators List there must be a UNH-IOL NVMe Conformance Test Report for the product with no failing items. The Test Report must be completed according to the most recent version of the UNH-IOL NVMe Conformance Test Suite (CTS) Document available publically on the UNH-IOL website (https://www.iol.unh.edu/testing/storage/nvme/test-suites).

Additionally, in order for an NVMe Device product to be eligible for the NVMe Integrators List there must be a UNH-IOL NVMe Interop Test Report for the product. The Test Report must be completed according to the most recent version of the UNH-IOL NVMe Interop Test Suite (ITS) Document available publically on the UNH-IOL website (https://www.iol.unh.edu/testing/storage/nvme/test-suites). The Interop Test Report must document that the product under test meets the NVMe Integrators List requirements set out in Appendix G of the NVMe Interop Test Suite.

***If the Product Under Test is an NVMe-MI Device*:** In order for the product to be eligible for the NVMe-MI Integrators List there must be a UNH-IOL NVMe-MI Conformance Test Report for the product with no failing items. The Test Report must be completed according to the most recent version of the UNH-IOL NVMe-MI Conformance Test Suite (CTS) Document available publically on the UNH-IOL website (https://www.iol.unh.edu/testing/storage/nvme/test-suites).

***If the Product Under Test is an NVMe Host Platform:*** In order for an NVMe Host Platform product to be eligible for the NVMe Integrators List there must be a UNH-IOL NVMe Interop Test Report for the product. The Interop Test Report must document that the product under test meets the NVMe Integrators List requirements set out in Appendix G of the UNH-IOL NVMe Interop Test Suite.

***If the Product Under Test is an NVMeoF FC or Ethernet Target*:** In order for the product to be eligible for the NVMeoF Integrators List there must be a UNH-IOL NVMe Conformance Test Report for the product with no failing items that are marked as applicable to Fabrics. The Test Report must be completed according to the most recent version of the UNH-IOL NVMe Conformance Test Suite (CTS) Document available publically on the UNH-IOL website (https://www.iol.unh.edu/testing/storage/nvme/test-suites).

> **Comment [RH3]:** Which is the correct abbreviation? "NVMeoF" or "NVMeof"? We should be consistent/correct

> **Comment [RH4]:** Make generic "NVMeoF Target"

> **Comment [RH5]:** Spell check

> **Comment [RH6]:** Make generic "NVMeoF Target"

Additionally, in order for an NVMeoF FC or Ethernet Target product to be eligible for the NVMeoF Integrators List there must be a UNH-IOL NVMeoF Interop Test Report for the product. The Test Report must be completed according to the most recent version of the UNH-IOL NVMeoF Interop Test Suite (ITS) Document available publically on the UNH-IOL website (https://www.iol.unh.edu/testing/storage/nvme/test-suites). The Interop Test

Report must document that the product under test meets the NVMe Integrators List requirements set out in Appendix C of the NVMeoF Interop Test Suite.

***If the Product Under Test is an NVMeoF FC or Ethernet Initiator:*** In order for an NVMeoF FC or Ethernet Initiator product to be eligible for the NVMeoF Integrators List there must be a UNH-IOL NVMeoF Interop Test Report for the product. The Interop Test Report must document that the product under test meets the NVMeOF Integrators List requirements set out in Appendix C of the UNH-IOL NVMeoF Interop Test Suite.

***If the Product Under Test is an NVMeoF Switch:*** In order for an NVMeoF Switch product to be eligible for the NVMeoF Integrators List there must be a UNH-IOL NVMeoF Interop Test Report for the product. The Interop Test Report must document that the product under test meets the NVMeOF Integrators List requirements set out in Appendix C of the UNH-IOL NVMeoF Interop Test Suite.

**All Product Types:** The Interop and Conformance Test Suites define the interop and conformance test requirements, showing which items are 'Mandatory', 'FYI', or 'In Progress', as well as how many interop partners a test must be performed with.

Some tests in the respective Interop and Conformance Test Suite may be defined as 'FYI' or 'In Progress' and are not considered necessary to qualify a Product Under Test for an Integrators List. Tests defined as FYI may become mandatory in the future.

A CTS document may include tests for optional features defined in the associated specification. If a Product Under Test does not support certain optional features, those items would be marked as 'Not Applicable' in the Conformance Test Report, would not be considered a failing item, and would not disqualify a device from the Integrators List. If a Product Under Test claims support for an optional feature, and that feature is included in the current CTS document test requirements, the Product Under Test must pass the test for that feature in order to be eligible for the Integrators List.

If a Product Under Test advertises support for an earlier revision of the specification, but supports all mandatory requirements in a newer version of the NVMe specification, the product would still be eligible for listing under the newer version of the associated Integrators List. This may be the case if a new Integrator's List Program Revision introduced support for new optional features, but no new mandatory features.

When UNH-IOL issues reports for a product, they will include a notice on whether the Product Under Test is eligible for the associated Integrators List or not. In order to have an eligible product included on the Integrators List, the participating company must specifically request UNH-IOL to list the eligible products. Products will not be automatically listed. UNH-IOL will not list products that are not eligible. UNH-IOL will not list products that the participating company has not requested to have listed on the Integrators List.

A participating company could request conformance and interop testing according to the most recent version of the CTS and ITS, but not immediately request a product be posted to the IL, perhaps waiting for the product to be announced publically. If the CTS or ITS changes after the product is tested, but before the request for listing occurs, the product would remain eligible for listing, but the listing would indicate which CTS and ITS version the test was performed to.

A participating company may request testing be performed on their product according to the previous version of the CTS or ITS (rather than the most recent version). If the testing is performed using the previous version of the CTS or ITS, within 6 months of the release date of the newest CTS or ITS, the product would be eligible for the Integrators List. If the testing is performed using the previous version of the CTS or ITS, more than 6 months after the release date of the newest CTS or ITS, the product would not be eligible for the Integrators List.

**Comment [RH7]:** Make generic "NVMeoF Initiator"

**Comment [RH8]:** Make generic "NVMeoF Initator"

**Comment [RH9]:** Should "NVMe PCIe Switch" have a similar section?

**Comment [RH10]:** Make generic "NVMeoF Switch"

**Comment [RH11]:** Make generic "NVMeoF Switch"

**5 - Information in Listing**

The following information must be provided with each listing request, this information will be included in the listing on the public Integrators Lists.

- Product, includes Manufacturer, Model Name and Family Name (i.e. different capacities of one SSD are in a single family)
- Product type (see table above for accepted Product Types for each Integrators List).
- Operating System (Host Platforms Only)
- Driver (Host Platforms Only)
- Firmware revision (Devices Only)
- Interop Program Revision (i.e. 1.0, 1.1, 1.2 etc…)
- Date of listing
- Test ID
- Further Information (primary contact or website)

IL listing is considered permanent. If the CTS or ITS is revised, listings for previously tested products will remain on the public IL (i.e. listings for products tested against version 1.0, are not removed when version 1.1 becomes available).

**6 - Listing by Similarity**

It is expected that some products will have differences that do not affect NVMe operation, such as form factor, storage capacity, or endurance parameters. In cases such as this, a participating company can request that certain products be added to a product listing, thus they are listed by similarity. The products listed by similarity must have the same Firmware revision and Model Name, and the listing company confirms that the products are materially similar with no substantive changes to the NVMe interface. A Listing by Similarity request form will need to be submitted to UNH-IOL.

**7 - Appeals**

While every effort is made to ensure that Integrators List testing is performed accurately, and that the test cases are based on the specification, it is possible that there will be cases of tests being performed improperly, implemented improperly, or being invalid. Sometimes this may result in a Failing test result, which hinders a product from being added to an Integrators List. This section defines an appeals process whereby a company can appeal a failing result and obtain a waiver for a particular test result to allow the product to be listed.

This process is intended to be used when a test has been performed at the UNH-IOL, either during a plugfest or during scheduled testing, and the company whose product has been tested believes that the test was performed improperly, implemented improperly, or the test itself is invalid. If a test has not yet been performed on the product at UNH-IOL, its best to raise the issue with the NVMe Interop and Compliance committee (NVMe-ICC), and allow review of the test implementation, or if the test case itself is valid or not. This appeals process can be utilized for both 'FYI' and 'Mandatory' tests.

If a company wishes to file an appeal, the following information should be provided to UNH-IOL via nvmelab@iol.unh.edu:

- Company Name
- Company Representative
- Product Name
- Name of failing test being appealed
- Version of test software being used
- Complete test logs showing the test failure
- Brief written justification for the appeal, describing whether the company believes that the test was performed improperly, the test is implemented improperly, or the test case itself is invalid.

The following is a description of how different types of appeals will be dealt with:

**Test Performed Improperly:** If an appeal asserts that a test has been performed improperly, UNH-IOL will examine the appeal request and any test logs provided. If UNH-IOL agrees with the appealing company that the test was performed improperly, a new test report will be provided with the corrected test results. This may or may not require a retest. UNH-IOL will make every effort to perform this review in a timely fashion. The new test report will indicate "Passed Appeal #ABCD".

**Test Implemented Improperly:** If an appeal asserts that a test has been implemented improperly, UNH-IOL will raise the appeal for discussion on the next scheduled NVMe-ICC conference call. UNH-IOL will not identify the company raising the appeal. The NVMe-ICC will examine the test implementation to determine if the test is properly implemented or not. If the NVMe-ICC reaches consensus that the test is implemented correctly, no further action is taken. If the NVMe-ICC reaches consensus that the test is not implemented correctly, the following steps will be taken:

- UNH-IOL and NVMe-ICC will work together to outline what is necessary to correct the test implementation. UNH-IOL will make every effort to perform these corrections in a timely fashion.
- UNH-IOL will provide a corrected test report with an indication that the previously failing test case is now considered "Passed Appeal #ABCD Granted" due to an appeal to the NVMe-ICC. The test case will thereafter not be considered necessary for integrators list qualification. The corrected test report will include a brief description of the appeal on either the cover page or Appendix.

**Test Case Invalid:** For all appeals of this sort, UNH-IOL will raise the appeal for discussion on the next scheduled NVMe-ICC conference call. UNH-IOL will not identify the company raising the appeal. The NVMe-ICC will examine the test case to determine if the test is valid or not. If the NVMe-ICC reaches consensus that the test is valid, no further action is taken. If the NVMe-ICC reaches consensus that the test is invalid, the following steps will be taken:

- UNH-IOL and NVMe-ICC will work together to determine if the test case should be corrected or removed.
- UNH-IOL will provide a corrected test report with an indication that the previously failing test case is now considered "Passed Appeal #ABCD Granted" due to an appeal to the NVMe-ICC. The test case will thereafter not be considered necessary for integrators list qualification. The corrected test report will include a brief description of the appeal on either the cover page or Appendix.

In all cases, if the appeal is successful, a new test report is issued, and any failure related to that appeal will no longer be considered as part of Integrators List qualification. If an appeal is denied, a new test report will be issued with the test case result as "Fail Appeal #ABCD Denied".

UNH-IOL will maintain a record of appeals, with pertinent information, and the decision of the ICC.

**Escalation of Appeals:** The following describes the expected order of escalation of appeals that may be followed.

1. Appeal to UNH-IOL for Retest
   a. If it is believed that the test was not run correctly, then UNH-IOL may re-run the test **as documented**, time permitting.
2. Written appeal to the ICC

   a. If an ICC result, test, documentation, or anything else is in question, then a written appeal can be submitted to the ICC for decision.
3. Written appeal to the NVMe Org Board of Directors.

   a. If an incompatible change breaks ICC testing (ex. ECN, TP, specification revision, etc.), then the ICC will submit a written request to the Board regarding guidance for waivers, deadlines, policy, etc. This may result in a 7-day online vote from the Board.

b. If the written appeal to the ICC results in an unsatisfactory decision, then the customer may request the appeal to be submitted to the Board for final decision. This may result in a 7-day online vote from the Board.
c. If the ICC requires clarification, then the ICC will submit a written request to the Board. This may result in a 7-day online vote from the Board.
d. If the ICC recommends a waiver for a valid test, then the ICC will submit a written request to the Board. This may result in a 7-day online vote from the Board.

**8 – Specification Versions, ECNs, TPs**

- There are currently no plans to deprecate versions of the specifications.
- Backwards compatible TPs and ECNs discovered by standard mechanisms will be tested.
- Policies regarding TPs, ECNs, and specification versions that are not backwards compatible will be decided by the Board as defined above in "Written appeal to the NVMe Org Board of Directors".