What has Changed?

SNIA Emerald™ Power Efficiency Measurement Specification V2.0.2 to V2.1.1

Version 1.0 Revision 3

SNIA Emerald™

April 8, 2016

About the SNIA

The Storage Networking Industry Association is a not-for-profit global organization, made up of member companies spanning the global storage market. SNIA's mission is to lead the storage industry worldwide in developing and promoting standards, technologies, and educational services to empower organizations in the management of information. To this end, the SNIA is uniquely committed to delivering standards, education, and services that will propel open storage networking solutions into the broader market. For more information, visit www.snia.org.

About the SNIA Green Storage Initiative

SNIA's Green Storage Initiative (GSI) is dedicated to advancing energy efficiency and conservation in all networked storage technologies in an effort to minimize the environmental impact of data storage operations. SNIA's Green Storage activities take place in two separate working bodies, the SNIA Green Storage Technical Working Group (TWG) and the Green Storage Initiative. The TWG is focused on developing test metrics by which energy consumption and efficiency can be measured. The Green Storage Initiative is focused on creating and publicizing best practices for energy efficient storage networking, educating the IT community, and promoting storage–centric applications that reduce storage footprint and associated power requirements.

About the SNIA Emerald™ Program

The SNIA Emerald™ Program is a vendor-neutral, public service to the storage industry and end users that is sponsored and operated by the SNIA GSI. The program supports the use and evolution of the SNIA Emerald Power Efficiency Measurement Specification and the publication and use of product test data based on the Specification. The measurement procedure and test metrics are documented in the SNIA Emerald™ Power Efficiency Specification, which was developed, released, and is maintained by the Green Storage TWG under the guidance of the GSI.

The program provides a standardized way of reporting vendor-performed test results that characterize the various aspects of storage system energy usage and efficiency. Those test results—which are based on performance under different workload metrics—are combined with other power-related information about storage systems and their components. The

Program offers a common repository, accessible to the public, where test results are presented in a consistent format that can be used to help determine facility power usage and efficiency for data storage solutions, as well as the costs to operate such systems.

The EPA ENERGY STAR® Data Center Storage Program is based on the methodology defined in the Specification and offers another vehicle for publication of product test results created in accordance with the Specification.

Suggestions for revisions to this guide and questions concerning implementation of the *SNIA Emerald™ Power Efficiency Measurement Specification Version 2.1.1* can be directed (via email) to greentwg-chair@snia.org.

Contents

1 Introduction

This document provides a summary overview of the changes made to the *SNIA Emerald™ Power Efficiency Measurement Specification V2.0.2* (referred to within this document as simply the *Measurement Specification*), developed as part of the *SNIA Emerald™ Program, which result in V2.1.1*. The *Measurement Specification V2.1.1* is an editorial, clarification, and refinement upgrade from V2.0.2. Any conflict between this document and the *Measurement Specifications* shall defer to the *Measurement Specifications*.

1.1 Audience

The target audience of this document includes organizations and individuals planning for and testing in accordance with the *Measurement Specification V2.1.1*. An organization or individual performing such testing is referred to as a test sponsor.

Test sponsors are urged to carefully read the *Measurement Specification V2.1.1* in order to become aware of all changes.

1.2 References

Measurement Specification versions V2.0.2 and V2.1.1 are available on the SNIA website: http://www.snia.org/tech_activities/standards/curr_standards/emerald.

Further documentation is available at the *SNIA Emerald™* website http://www.sniaemerald.com/download.

2 Changes from V2.0.2 to V2.1.1

NOTE: All references (to sections, figures, and tables) in this section pertain to the *Measurement Specification V2.1.1* unless otherwise noted.

NOTE: Test sponsors should not expect significantly different SUT metric results between V2.0.2 and V2.1.1 given all other test conditions are the same (e.g., SUT configuration, initial conditions, test environment, benchmark driver type, revision, script parameters, etc.).

2.1 Instrumentation (Section 7.3.5 and Annex A)

The suggested power meter list was clarified in Annex A and referenced in Section 7.3.5. Instead of creating a separate list of suggested power meters to use, the reference is to the same list of devices approved for use with the SPEC power benchmark.

2.2 Benchmark Driver (Section 7.3.7)

Use of Vdbench as the benchmark driver for _all_ Emerald tests is now required, as are all related scripts, with details and download access site references located in Section 7.3.7. Related material was moved from V2.0.2 Annex B (Required Benchmark Drivers) to Section 7.3.7.

2.3 Variable IO (Section 7.3.8.3.4)

The Variable IO section was augmented to include support for both 512B and 4KB native storage devices:

- A 4KB Table 13 was added to the Section 7.3.8.3.4 *Variable IO*.

- The IO transfer size used within the Hot Band IO profile is now listed for 512B and 4KB native devices in Tables 12 and 13, respectively.

2.4 Metric Stability Assessment (Sections 7.3.18 and 7.4.3.5)

The SUT metric stability criterion as a test for metric measurement interval flatness was refined and augmented in Sections 7.3.18 and 7.4.3.5. There are now two methods to assess stability:

1. A maximum allowed slope of a linear approximation determined from a least squares linear fit (new).
2. A smoothing function consisting of a weighed moving average (mathematically similar to the previous method in V2.0.2).

V2.1.1 contains complete procedures for testing both methods against a selected metric measurement interval. Both methods must pass to confirm stability.

2.5 Online and Near-Online Testing (Section 7.4, Annex B)

The Online and Near-Online testing sections were combined into Section 7.4. Previously written as two separate sections, these were combined because the tests for both taxonomy categories are essentially identical. Where exceptions exist, these are noted.

In addition, the following changes were made to help simplify the test and reporting processes:

- The minimum active test phase duration for Online/Near Online was changed from 30 to 40 minutes. See Section 7.4.3.3 and Annex B.

- The number of required reported/disclosed parameters was reduced.

2.6 Pre-fill Test (Section 7.4.1)

The SUT pre-fill test section was changed:

- The pre-fill test for Online and Near-Online must now pre-fill a minimum of 50% (was previously 56%) of the formatted storage. See Section 7.4.1.2.

- The definition of the pre-fill compressions requirements has been refined. See Section 7.4.1.2.

2.7 SUT Conditioning Test (Section 7.4.2)

The SUT conditioning test was changed to make one adjustment and one simplification:

- The SUT conditioning response time was changed from 30ms to 20ms in Section 7.4.2.4 in order to align with active test phase response time requirements in Section 7.4.3.5.

- The need to establish stability at the end of the SUT conditioning test was eliminated.

2.8 Active Test (Section 7.4.3)

The active test was changed for added flexibility. In V2.0.2, metric stability, as used for primary metric calculations, is required during the last 30 minutes of each test phase. In V2.1.1 the requirement was changed such that any stable continuous 30-minute measurement interval during a test phase can be used for primary metric calculations. See Section 7.4.3.5.

2.9 Capacity Optimization Test (Section 7.4.5)

Several changes were made to the Capacity Optimization Test section. These included editorial, functional, simplification and use case coverage modifications impacting all subsections:

- In Section 7.4.5.2 *Testing Requirements*, added a "container" definition. This term means a collection of logical blocks, e.g. a LUN.

- In Section 7.4.5.3 *Generating Data Sets*, updated Table 17 by including both bit-level and pattern-oriented compression methods to the compressible test data set. This was done to help assure that a wider range of SUT compression methods was covered. Also added a link reference to the SNIA Emerald site for the data set generator.

- In Section 7.4.5.5 *Thin Provisioning Heuristics*, modified and simplified the steps needed to establish thin provisioning capability (a simpler test procedure from V2.0.2).

- For Sections 7.4.5.6 *Data Deduplication Heuristics* and 7.4.5.8 *Compression Heuristics*, allowed the test container to accommodate larger data set sizes (>2GB) by adding 2GB irreducible data sets, each with different "salt" values, to the respective 2GB dedupable or compressible data set. This change supports SUT configurations where activation of deduplication and/or compression functionality requires data set sizes greater than 2GB. For example, if a particular SUT configuration supporting deduplication requires a minimum 8GB block, the test container could be comprised of the 2GB dedupable data set together with three instances of the 2GB irreducible data set, each with a different salt value to assure the 6GB irreducible portion is collectively irreducible. The test sponsor determines the appropriate test container size. Text in these sections was edited to reflect this change.

- The formulas used for calculating the amount of formatted capacity saved by deduplication and compression were clarified. See Sections 7.4.5.6, list item 8 and 7.4.5.8, list item 8.

2.10 Measurement Requirements (Annex B)

The annexes were changed:

- V2.0.2 Annex C was changed to Annex B.

- The title of Annex B was changed to indicate that the annex is normative.

- The Minimum Test Duration time in Table B-1 for the Online/Near-Online Active Test was updated to 40 minutes.