ENERGY STAR
Data Center Storage
Version 1.0 Specification Overview

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Agenda

Topic
Meeting Introduction
Definitions and Product Scope
Power Supply and Power Modeling Requirements
Energy Efficiency Feature Requirements
Information Reporting Requirements
Testing Data Requirements
Data Displayed on ENERGY STAR Website
Storage Product Family Variation Allowances
Standard Performance Data Measurement and Output
Test Method and Remaining Version 1.0 Timeline

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ENERGY STAR Data Center Work

- Products:
  - UPS Version 1.0, since mid-2012
  - Servers Version 2.0, since 12/2013
  - Storage Version 1.0, since 12/2013
  - Large Network Equipment under development
- Buildings:
  - Data Center labeling program since 2011
- Case studies/outreach/other
  - “Top 12” program
    - Highlights case studies, develops educational materials for data center operators.
  - Data Center Cooling
    - Approach under active review
- Intelligent/system efficiency workshop
  - Held at ITI mid-June 2014
  - How to address network/system efficiency opportunities
  - Ongoing discussion, more meetings planned

Adoption of Version 2.0.1 SNIA Emerald™ Specification

- EPA adopted V2.0.2 Emerald specification in the latest version of the ENERGY STAR Final Storage Program Requirements (Rev. March 2014)

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Definitions

- Align with the SNIA dictionary whenever possible
- ENERGY STAR product family concept
  - Test a subset of total model configs.
  - Results represent a wider selection of configs.
- Product family defined in Section I, w/ guidance on:
  - The range of system sizes (device count) that fall within a product family
  - Configurations for certification using multiple storage device types and/or workload types

SNIA Taxonomy Review

Attribute	Classification					
	Online 1	Online 2	Online 3	Online 4	Online 5	Online 6
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential
MaxTTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
User-Accessible Data	Required	Required	Required	Required	Required	Required
Connectivity	Not specified	Connected to single or multiple hosts	Network-connected	Network-connected	Network-connected	Network-connected
Consumer/ Component	Yes	No	No	No	No	No
Integrated Storage Controller	Optional	Optional	Required	Required	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required	Required
No SPOF	Optional	Optional	Optional	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Required
Maximum Supported Configuration	≥1	≥ 4	≥ 12	> 100	>400	>400

In Scope

- Online 2, 3, or 4, also must:
  1. Contain a controller with advanced data recovery capability (no JBODs allowed)
  2. Support Block I/O storage functionality
  3. Implement either scale-up or scale-out storage

Out of Scope

- Storage devices out of scope are:
  - Near-online
  - Removable Media Library
  - Virtual Media Library
  - Adjunct Storage Products
  - Interconnect Elements

Out of Scope

- Personal / Portable Data Storage Products
- Computer Servers
- Blade Storage Products
- Direct Attached Storage Products
- Network Attached Storage products that cannot perform Block I/O
- Storage Products capable of object based storage

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Power Supply Requirements

- 80 Plus Silver
  - PSUs for primary components
  - i.e. PSUs for controllers, drawers
- All other power supplies excluded from this requirement.

Power Modeling Requirements

- Power/performance modelers allowed for certification
  - Subject to criteria outlined later
- If modeled data is used for certification:
  - Partner is expected to make power modeling tools, that can characterize the system, available to purchasers of the storage product.
  - Should provide performance/watt data for user-selected configuration characteristics

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Energy Efficiency Feature Requirements

- Adaptive Active Cooling:
  - Must utilize adaptive cooling tech that scales cooling to the current needs of the product.
- COMs:
  - Make available in quantities greater or equal to those listed in Table 4.

Energy Efficiency Feature Requirements - COMs

Table 3: Recognized COM Features

Feature	Verification Requirement
COM: Thin Provisioning	SNIA verification test
COM: Data Deduplication	SNIA verification test
COM: Compression	SNIA verification test
COM: Delta Snapshots	SNIA verification test[3]

Table 4: COM Requirements for Online 2, 3, and 4 Systems

Storage Product Category	Minimum number of COMs required to be made available
Online 2	0
Online 3	1
Online 4	1

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Information Reporting Requirements

- For every required test point, submit:

Workload Test
Hot Band
Random Read
Random Write
Sequential Read
Sequential Write
Ready Idle

Workload Weighting Requirements

- Manufacturers will optimize storage products for specific types of optimization based on the individual workloads specified in Table 6:

Table 6: Workload Weighting Requirements

Workload Test	Transaction Optimization	Streaming Optimization	Capacity Optimization
Hot Band	100%	0%	0%
Sequential Read	0%	70%	0%
Sequential Write	0%	30%	0%
Ready Idle	0%	0%	100%

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Testing Data Requirements

- Strongly encourage review of Sections:
  - 3.5.3
  - 3.5.4
  - 3.5.5
- Contain detailed recipe for designing, testing product families plus data points recorded.

Testing Scale Up Products

1. Choose a workload
2. Choose projected most commonly sold storage device
3. Estimate optimal performance point (given device type, workload)
4. Choose family range endpoints for test:
   - Either -15% performance drop off points or -40/+15% standard range
5. Test optimal and endpoints
6. To add more configs (same workload, different device type):
   - If they fall w/i device replacement requirements, they're "free."
   - If not, construct a new config with them and just test at the optimal point—no endpoints.
   - If a modeler is available and is within 10% of the already-tested optimal point, modeler results may be submitted in place of physical testing for the addtional configuration optimal points
7. Repeat 1 – 6 for different workloads, add to product family

Testing Scale-out Products

- Same as for scale-up systems, but with following change to qualification range:
  - Only test the smallest marketed quantity of storage controllers / nodes available
  - Additional systems with a larger quantity of storage controllers may be optionally submitted

Testing Data General Rules

- Section 3.5.3.vii
- Configurations consisting of exclusively SSDs are not required to submit physical data, unless the SSD device is representative of the most commonly sold drive for that workload type
- Verification of COM features is only required on one storage device
- If automated storage tiering is enabled during testing, multi-storage device groups necessary for tiering may be counted as single storage devices when determining testing and qualification ranges, so long as the ratio of each device within a group remains as constant as possible

Testing Data General Rules

- If a product is not marketed with a storage device configurability or scalability that can achieve either the smaller or larger test points in system size required, then these points are not required
- Product families may not be based solely on Capacity workloads
  - Capacity must be submitted in addition to one or more other optimizations (transaction and/or streaming)

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Data Displayed on ENERGY STAR Website

- A list of qualified configurations within a family, including performance/watt data for the applicable workloads in Table 7:

Table 7: Active and Idle State Efficiency Test Results Displayed on the ENERGY STAR Website

Workload Test	Transaction Optimization	Streaming Optimization	Capacity Optimization
Hot Band	Yes	No	No
Random Read	Yes	No	No
Random Write	Yes	No	No
Sequential Read	No	Yes	No
Sequential Write	No	Yes	No
Ready Idle	Yes	Yes	Yes

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Storage Product Variation Allowances

- Once a product is qualified, system performance/watt may not change by more than 20% as defined in Table 6 (with the exception of Ready Idle)
- If >20%, must test new optimal configuration
  - Added to the existing product family
  - Expands scope of product family

Storage Product Variation Allowances

- To replace storage devices in a storage product without retesting, the following rules apply:
  - No change in:
    - Interface type, quantity, and transfer speed
  - Only an increase in the following:
    - Data capabilities, power management features, capacity, and cache size
  - Limited ±% variations of change in the following:
    - Average seek time, average latency, average power consumption, rotational speed and sustained transfer rate

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Standard Performance Data Measurement and Output Requirements

- Report input power at system level
  - Online 3 and Online 4 only
  - Optionally report inlet air temperature too
- Implementation shall follow the reporting and sampling requirements in Sections 3.7.2 and 3.7.3 of the specification.
- iPDUs may be used to fulfill these requirements if the storage product cannot
  - iPDUs must be made available for purchase with the storage product

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Test Method – Deviations from SNIA Emerald™ Specification

- Online 2 storage products must contain a controller with advanced data recovery capability
- Storage products shipped with COMs must disable all COMs that are capable of being disabled during the following tests:
  - SUT Pre-fill Test
  - SUT Conditioning Test
  - Active State Test
  - Ready State Idle Test

Test Method – Deviations from SNIA Emerald™ Specification

- Network Attached Storage (NAS) products that ship with Block I/O capability shall be tested under the following additional requirements:
  1. All usable storage devices not needed for minimal NAS capability shall be allocated to Block I/O for all testing
  2. NAS functionality shall be enabled for all testing
  3. No external NAS storage requests shall be presented to a product during testing

Version 2.0 Development

- V2.0 development planned to launch end of 2015
  - Dependent on:
    - Test Procedure status (expand scope)
    - Data available for analysis (levels, less testing, etc.)
  - Announcement letter with discussion doc first.
  - Subsequently start working on Draft 1.
- Between now and end of 2015:
  - Possibly two “off season” meetings
    - Discuss data entry issues (Q4 2014?)
    - Analyze ENERGY STAR database prior to Version 2.0 development (2015)
    - Discuss other issues of concern with ENERGY STAR Storage

References and resources

- ENERGY STAR Data Center Storage specification revision:
  - www.energystar.gov/NewSpecs
  - Select “Data Center Storage”

Questions?

Please send any questions to:
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Thank You!

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