

ENERGY STAR

Data Center Storage Meeting

Final Draft Version 1.0 Specification

July 9, 2013

Agenda



Topic

Meeting Introduction

Definitions

Product Scope and Power Supply Requirements

**Energy Efficiency Feature / Information Reporting /
Workload Weighting Requirements**

Testing Data Requirements

Data Displayed on ENERGY STAR Website

Storage Product Family Variation Allowances

Standard Performance Data Measurement and Output

Future Revisions, Test Method, Remaining Timeline

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Goals and Notes



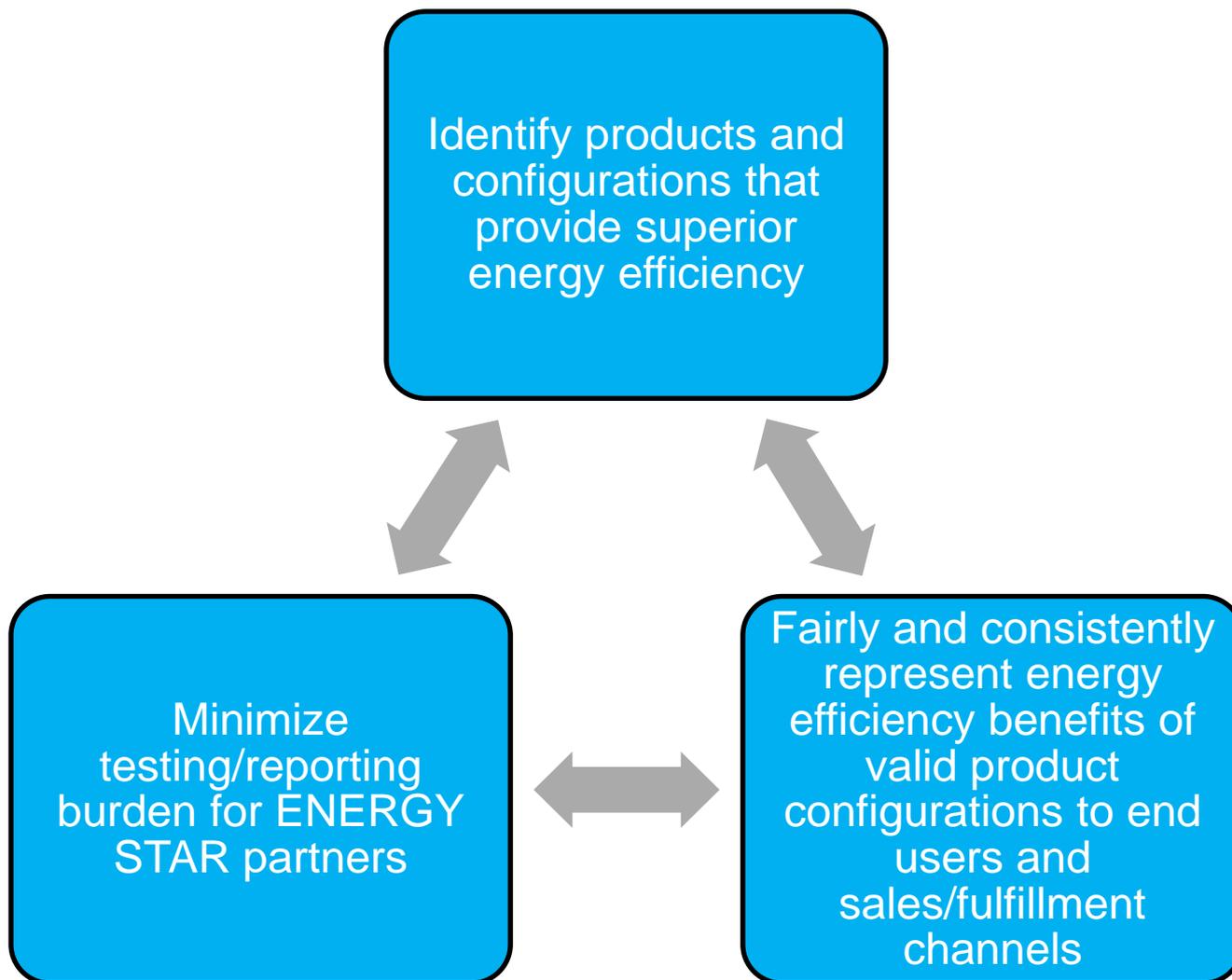
- Review of changes between Draft 4 and Final Draft
- Opportunity for questions, comments from stakeholders
- Note: All slides will be posted to ENERGY STAR Data Center Storage website

Introductions



- RJ Meyers – EPA, ENERGY STAR
- John Clinger – ICF International
- Emmy Phelan – ICF International
- Al Thomason – TBWC, LLC

Review of ENERGY STAR Goals



Adoption of Version 2.0.1 SNIA Emerald™ Specification



- EPA adopted V2.0.0 Emerald specification in the ENERGY STAR Final Draft Storage specification and test method.
- EPA is looking forward to the upcoming release of the V2.0.1 Emerald specification which provides additional guidance for testing storage products with automated storage tiering technology. This version will be referenced in the final ENERGY STAR Storage program requirements.

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Definitions



- Align with the SNIA dictionary whenever possible
- Product family is defined in Section I, and provides guidance on:
 - Defining the range of system sizes that fall within a product family
 - How to create configurations for certification using multiple storage device types and/or workload types

Definitions



- Single-output Power Supply:
 - Clarified less than *or equal to* 20 watt total for all non primary and/or standby outputs.
- Optimal Configuration
 - Clarified that the optimal configuration is the maximum peak energy efficiency value for that given workload type.

Definitions



- Qualification Ranges:
 - Applied rounding guidance to all storage products
 - Separated allowable qualification ranges into either fixed points (-20%, +5% device count) or flexible points, with the flexible points maintaining performance/watt values within 15% of the optimal point
 - See Section 3.5 in the specification for more details on these ranges

Definitions



- Scale-up and Scale-out Storage:
 - Similar to centralized and distributed controller storage definitions in Draft 4.
 - Clarified how redundant controllers are accounted for
- Automated Storage Tiering:
 - Capability that allows storage products to intelligently organize and store data across multiple device types within the same product

Definitions



- Systems Composed of Multiple Device Types in an Optimal Configuration:
 - Auto-tiered device combinations must be tested with automated tiering enabled
 - The ratio of device types in an auto-tiered submission must remain as constant as possible when creating product families
 - Auto-tiered device combinations may be combined with single devices under the same product family
 - End-user selectable automated tiering functionality must be included in all multiple-device configurations sold as ENERGY STAR

Definitions



- Advanced Data Recovery Capability:
 - Removed the previous Parity RAID definition in Draft 4
 - New generalized definition aligns with the description of Parity RAID in Draft 4, allowing for error detection and correction features other than high level RAID solutions

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In Scope Revisions



1. Revised the RAID controller requirement to requiring a controller with advanced data recovery capability
2. Removed the reference to object based storage
3. Changed the terms centralized and distributed controller storage to scale-up and scale-out storage respectively

Out of Scope Revisions



- Removed reference to products without a RAID controller
- Clarified that storage products capable of any level of object based storage are excluded from scope

Power Supply Requirements



- Consolidated Tables 1 and 2 to a single row each since all PSUs must meet 80 PLUS Silver levels

Table 1: Efficiency Requirements for PSUs

PSU Type	Rated Output Power	20% Load	50% Load	100% Load
Redundant and Non-Redundant Capable PSU	All Output Levels	85%	89%	85%

Table 2: Power Factor Requirements for PSUs

PSU Type	Rated Output Power	20% Load	50% Load	100% Load
Redundant and Non-Redundant Capable PSU	All Output Levels	0.80	0.90	0.95

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Energy Efficiency Feature Requirements



- Parity RAID Requirement:
 - Removed this requirement from previous Draft 4. The requirement for Advanced Data Recovery Capability is clearly stated in the scope section of the specification.
- Adaptive Active Cooling:
 - Removed the reference to ambient air temperature conditions in proximity to the storage product
 - Requirement is now implementation-agnostic

Information Reporting Requirements



- Simplified and revised Table 5 to clarify the required test workloads for all qualified configurations.

Table 5: Required Workload Tests for all Configurations

Workload Test
Hot Band
Random Read
Random Write
Sequential Read
Sequential Write
Ready Idle ³

Workload Weighting Requirements



- Hot band workload is a combination of random and sequential workloads
 - Skewed towards random workloads
 - Will represent random workloads in transaction based configurations when calculating workload weightings.
- Manufacturers should use Table 6 to guide the creation of Optimal Configurations:

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 instructions for designing, testing product families plus data points recorded.

Test Data for Scale-up, Physical Data only



- For a given workload type (e.g. transaction):
 - Physically test the optimal configuration point and applicable qualification range endpoints for the most commonly sold storage device
 - For additional storage devices in this workload type, only the optimal configuration points for those storage devices are required to be physically tested

Test Data for Scale-up, both Modeled and Physical Data



- For a given workload type (e.g. transaction):
 - Physically test the optimal configuration point and applicable qualification range endpoints for the most commonly sold storage device
 - Verify that modeled data for that configuration (using the same storage device) is within $\pm 5\%$ of the physical data collected above.
 - If within 5%, additional storage devices for the same workload type may submit modeled data for the optimal configuration point and additional points.
 - If not, follow Physical Data Only instructions on last slide.

Test Data for Scale-out Storage 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)
 - Specification scope focused on Online systems. Online functionality is important.

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- Product model name, model number, and SKU or other configuration identification number;
- A list of important product characteristics, including;
 - System configuration;
 - Storage controller details (e.g. model name and number);
 - Software configuration;
 - Storage controller power supply information;
 - Storage device drawer power supply information;
 - Storage devices used per optimization points
 - Input power and environmental characteristics during testing;
 - System power optimization capabilities;
 - Inlet air temperature and power consumption reporting capabilities.

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



- Storage products contain many sub-systems and components
 - Over time, changes to these can greatly change system performance
 - Raises concerns with “freshness” of data
 - Up-to-date public facing data
 - Ability to have recent data for Storage Version 2.0 development, other programs/specifications globally.

Storage Product Variation Allowances



- Current system level proposal:
 - Once a product is qualified, system performance/watt may not change by more than 20%, using weightings 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



- Current device level proposal:
 - Storage Device Replacement Requirements
- Revisions to Storage Device Replacement Requirements:
 - Removed form factor requirement
 - Changed allowance from $\pm 5\%$ to $\pm 10\%$ for the following variables:
 - Average seek time
 - Average latency
 - Reported average power consumption
 - Rotational speed
 - Changed allowance from $\pm 5\%$ to $-5\% / +15\%$ for sustained transfer rate

Storage Product Variation Allowances



- EPA seeks feedback on these proposals
- Goal: Ensure reasonably “fresh” and representative data without imposing undue re-testing burden on stakeholders.

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Standard Performance Data Measurement and Output Requirements



- Data Elements:
 - Clarified that input power and inlet air temperature measurements shall be collected at the system level in Version 1.0, at the discretion of the manufacturer
- Sampling Requirements:
 - Removed the rolling average input power calculation requirement from Version 1.0
 - EPA encourages stakeholders to provide this ability and will investigate requiring it in Version 2.0

Standard Performance Data Measurement and Output Requirements



- Requirements for iPDUs
 - Clarified that iPDUs which are used to satisfy the requirements of Section 3.7 must be available on the manufacturer's website or in marketing material along with the storage product information.
 - Third party sources for iPDUs are allowed, but the iPDUs must be listed as a marketed and supported option for the storage product being qualified.

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Considerations for Future Revisions



1. Active and Idle State Efficiency Criteria
2. Right sizing of power supplies
3. Redundant Power Supply Standby
4. Expansion of Scope
 - Larger Online products
 - Near-Online
 - Removable Media Libraries
 - Virtual Media Libraries
 - NAS-only products
 - SAN equipment if not covered in Large Network Equipment

Test Method



- Added guidance for European Three-phase input voltage and frequency requirements
 - Tables 1, 2, and 3 harmonize with the voltage and frequency requirements in the ENERGY STAR Version 2.0 Computer Servers Program Requirements, other than voltage tolerance for products with rated power > 1500W
 - This value has been changed from $\pm 4\%$ to $\pm 5\%$ in the Final Draft Test Method
 - Intended to reduce need for expensive power conditioners during testing

Verification Testing



- EPA does not plan to require physical verification testing of storage products in Version 1.0.
- Potential paper verification of specification sheets for replaced storage devices and power supply efficiency results is still under consideration.

Remaining Version 1.0 Timeline



- June 20: Final Draft specification and test method released
- June 24 – 26:
 - SNIA Emerald test training for CBs, labs.
 - ENERGY STAR specification training for CBs, labs
- July 9: Final Draft stakeholder webinar
- July 15: Final Draft written comments due
- Late July:
 - Draft QPX form released for stakeholder review
 - Comments due +3 weeks later
- Early August:
 - Final Storage Program Requirements released
- Late August:
 - QPX system finalized
 - CB can start submitting applications
 - Submit test QPX data
- September 15: Deadline for first batch of CB applications
- October 1: EPA announces recognized CBs
- Early November: Version 1.0 Storage is effective
 - Note this is a three month delay until effective date
 - Due to unique complexity of this product category

References and Resources



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

Reminder

Written comments on Final Draft due to EPA no later than July 15: storage@energystar.gov

Thank You!



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