



ENERGY STAR

Data Center Storage Meeting

Draft 4 Version 1.0 Specification

April 2, 2013

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Goals and Notes



- High-level review and discussion of key topics presented in Draft 4
- Opportunity for further detail in advance of stakeholders formulating written feedback
- Note: All slides will be posted to ENERGY STAR Data Center Storage website

Introductions



RJ Meyers
EPA, ENERGY STAR
(202) 343-9923
Meyers.Robert@epa.gov

John Clinger
ICF International
(215) 967-9407
John.Clinger@icfi.com

Emmy Phelan
ICF International
(202) 862-1145
Emmy.Phelan@icfi.com

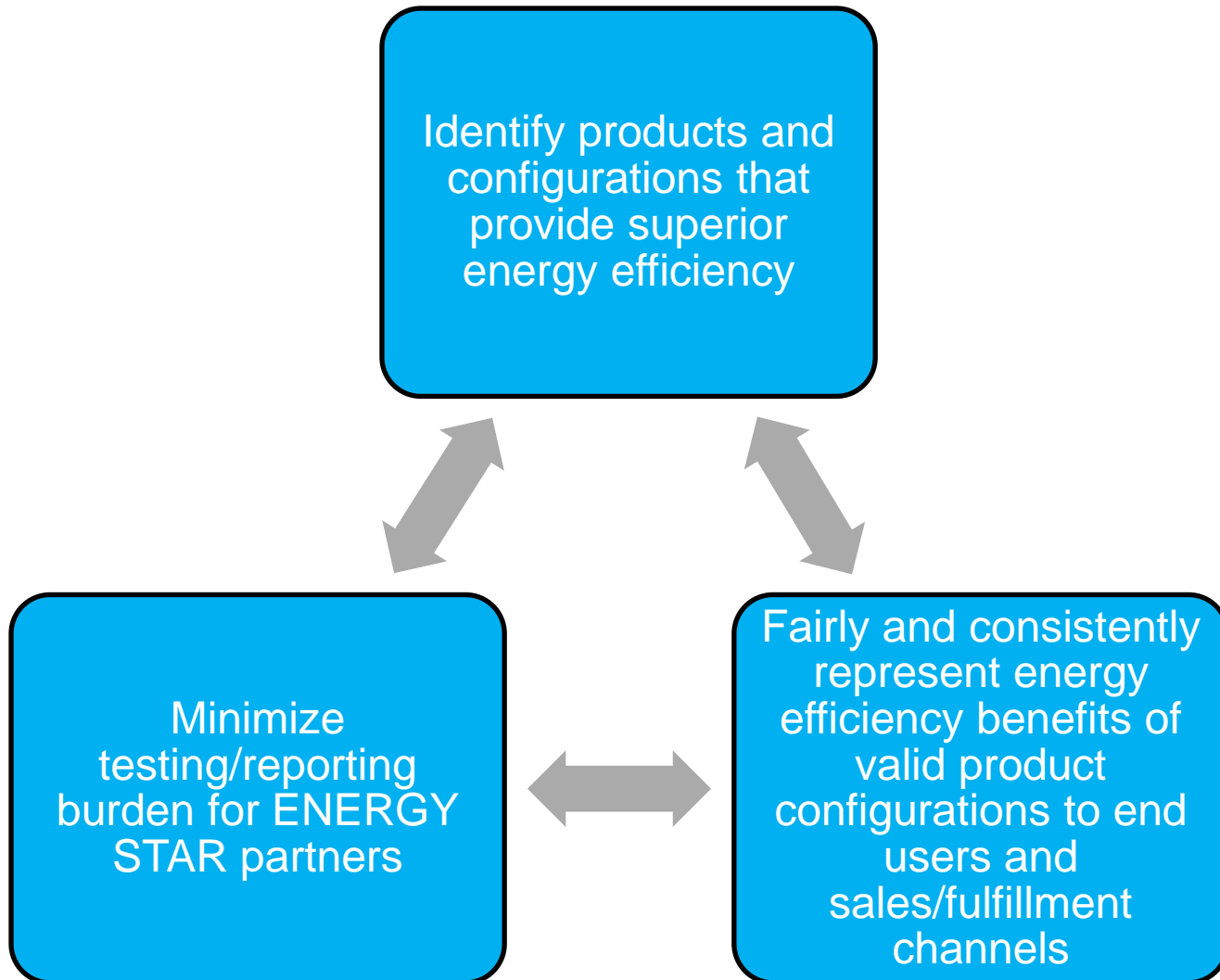
Al Thomason
TBWC, LLC
(503) 708-7881
thomasonw@gmail.com

Call-in Information



- Audio provided via conference call in:
- **Call in:** +1.877.423.6338 (inside U.S.)
+1.571.281.2578 (outside the U.S.)
- **Code:** 436598
- Please keep phone lines on mute unless speaking
- Please refer to the agenda for approximate discussion timing

Review of ENERGY STAR Goals



Adoption of Version 2.0 SNIA Emerald™ Specification



- Adopted V2.0 Emerald specification in
 - ENERGY STAR Draft 4 Storage specification
 - ENERGY STAR Draft 2 Storage test method
- EPA is aware of ongoing testing to verify the performance of some aspects of the V2.0 Emerald specification
 - Reserves the right to revert to the V1.0 Emerald specification in the ENERGY STAR Final Draft Storage specification and test method depending on the outcome of this additional work

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Definitions



- Revised
 - Computer Server
 - Product Family Structure
 - Optimal Configuration
 - Minimum and Maximum Qualified Configurations
 - Combinations of Optimal Configurations
 - Capacity Optimization Family Restriction
- New
 - Expanded Maximum Qualified Configuration
 - Centralized and Distributed Controller Storage
- Removed
 - Scale-up and Scale-out Storage
 - Replaced by centralized and distributed definitions, above

Definitions - Revisions



- Computer Server
 - Harmonized with the Computer Server definition in the Final Draft Version 2.0 ENERGY STAR Computer Servers specification.

Definitions – Revisions



- Optimal Configuration:
 - Clarified that energy efficiency performance in this configuration shall be measured in performance/watt
- Maximum and Minimum Qualified Configuration:
 - Added “qualified” to clarify that the lower and upper bound of this range reflect the range eligible for qualification, not the full range of system sizes sold

Definitions – Revisions



- Combinations of Optimal Configurations:
 - Clarified that Section 1.I.7 applies to both qualified storage devices and validated replacement storage devices
 - Also provided additional clarity on drawer rounding in Section 1.I.7.vi
- Capacity Optimization Family Restrictions:
 - Added the requirement that for each storage device qualified under capacity optimization, a corresponding transaction and/or streaming optimization configuration must be submitted

Definitions – New



- Expanded Maximum Qualified Configuration:
 - Added to allow the increase of the maximum range of qualification if all conditions are met
 - Compliments the expanded minimum qualified configuration, from Draft 3
 - Expanded the allowable change of performance/watt when expanding the minimum and maximum qualified configuration from 10% to 15%

Definitions – New



- **Centralized Controller Storage:**
 - Replaces scale-up storage. Defined as a controller which has a view of all the storage devices in the storage product. Adding redundant controllers which share the same full system view also meets this definition.
- **Distributed Controller Storage:**
 - Replaces scale-out storage. Defined as two or more discreet storage controllers, each of which only have a partial view to a partition of the overall system's storage devices, which appear as one storage product to attached computer servers. Discrete controllers may be deployed with some level of redundancy.

Scope Revisions



- RAID language revision:
 - Clarified that all qualified products must include a controller with advanced data recovery capability, including but not limited to RAID
- Centralized and Distributed Controller Storage are both included in scope in the Draft 4 specification.
 - New Distributed Controller Storage requirements found in Section 3.5.5

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Power Supply Requirements



- Retaining the previous Draft 3 levels for 20%, 50%, and 100% load points
- Removed the 10% load point requirements based on stakeholder feedback:
 - Allows stakeholders to focus on enhancing efficiency at the other load points where storage products primarily operate
- EPA will provide the option of reporting 10% load point data in addition to the required 20%, 50%, 100% load point data

Power Modeling Requirements



- Power Modeling Presale Tool:
 - Clarified that for Online 4 systems that use modeled data to qualify, EPA expects manufacturers to make the following available to qualified purchasers:
 - Power modeling tool which provides estimated power usage of deployed product for their configuration
 - Modeled performance/watt data for the purchasers configuration

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Energy Efficiency Feature Requirements



- Parity RAID requirement:
 - Revised so that newer technologies that make intelligent use of mirroring are not excluded (e.g. grid technology)
- Adaptive “active” cooling:
 - Clarified that adaptive cooling only applies to actively cooled devices in the storage product

Energy Efficiency Feature Requirements - COMs



- Revised COMs required to be made available
 - Products with competitive performance/watt results that only offer one COM are present in today's market

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

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Information Reporting Requirements



- Active and Idle State Efficiency Disclosure:
 - All active and idle state test results shall be reported to EPA
 - Active and idle state test data in the fields labeled “required” in Table 5 shall be reported on the ENERGY STAR website
 - Mixed Workload 1 and Mixed Workload 2 have been replaced with the Hot Band Workload developed in the V2.0 Emerald™ specification

Information Reporting Requirements



Table 5: Active and Idle State Efficiency Test Results Displayed on the ENERGY STAR Website

Workload Test	Transaction Optimization	Streaming Optimization	Capacity Optimization
Hot Band	Required	Optional	Optional
Random Read	Required	Optional	Optional
Random Write	Required	Optional	Optional
Sequential Read	Optional	Required	Optional
Sequential Write	Optional	Required	Optional
Ready Idle	Required	Required	Required

Workload Weighting Requirements



- Mixed 1 and Mixed 2 have been replaced with the Hot Band workload to accurately assess systems that incorporate caching
- Simplified assumptions in Table 6 to present a reasonable representation of each optimization category, based on feedback from stakeholders

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%

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Testing Requirements for Distributed Controller Storage



- Distributed controller storage product testing
 - Same procedure as centralized controller storage products
 - Test configuration with the smallest marketed quantity of storage controllers available
 - For systems sold with a fixed number of storage devices, test with the fixed number of devices allowed in the storage product

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Features

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Storage Device Replacement Requirements



- Combined rotational and non-rotational into one section
 - Exceptions stated as needed
- Made the following requirement revisions:
 - Power management related features cannot be removed in replacement devices
 - Allowance for minor differences in rotational speed, and for devices that can operate at multiple spindle speeds
 - Replacement devices may contain more cache than the original device

Agenda



Topic

Meeting Introduction

Definitions and Product Scope

Power Supply and Power Modeling

Energy Efficiency Feature

Information Reporting

Distributed Controller Testing

Storage Device Replacement

Standard Performance Data Measurement and Output

Test Method

Remaining topics, meeting summary and closing

Standard Performance Data Measurement and Output Requirements



- Section 3.7 (power reporting) no longer applies to Online 2 systems
- Revised sampling requirements
 - Harmonize with the Version 2.0 ENERGY STAR Computer Servers specification where appropriate
 - Guidance added on how systems that implement time stamping can meet requirements, and how storage products are expected to interact with external management software

Agenda



Topic
Meeting Introduction
Definitions and Product Scope
Power Supply and Power Modeling
Energy Efficiency Features
Information Reporting
Distributed Controller Testing
Storage Device Replacement
Standard Performance Data Measurement and Output
Test Method
Remaining topics, meeting summary and closing

Test Method Revisions Overview



- Three phase power and dc power
- Removal of 24 hour Ready Idle Test
- Addition of SUT Pre-Fill Test
- Clarifications on COM testing

Test Method Revisions



- Added three phase power requirements
 - Harmonizing with the Version 2.0 ENERGY STAR Computer Servers test method.
 - Three phase power is supported by the V2.0 Emerald™ specification.
- Dc requirements have been removed as they are not support by the V2.0 Emerald specification

Test Method Revisions



- Idle test now 2 hours
 - Aligned with the V2.0 Emerald™ specification approach
 - EPA is still concerned about capturing overall idle state behavior and maintenance activities, but understands that simply testing for 24 hours does not fix this and mostly adds extra test burden.

Test Method Revisions



- Added the SUT Pre-Fill Test
 - Harmonize with the new Section 7.4.1: Online SUT Pre-fill Test in the V2.0 Emerald™ specification
- SUT Pre-Fill Test is required to accurately evaluate the new Hot Band workload

Test Method Revisions



- Clarifications for COM testing:
 - All COMs that are capable of being disabled during testing must be disabled during the following:
 - SUT Pre-Fill Test
 - SUT Conditioning Test
 - Active State Test
 - Ready Idle State Test
 - COM validation testing is only required to be performed once per series of configuration tests for a product family

Agenda



Topic
Meeting Introduction
Definitions and Product Scope
Power Supply and Power Modeling
Energy Efficiency Feature
Information Reporting
Distributed Controller Testing
Storage Device Replacement
Standard Performance Data Measurement and Output
Test Method
Remaining topics, meeting summary and closing



Remaining Topics Overview

- Common Product Family Attribute: Cache
- Auto-tiering and mixed drive systems
- Development of NAS file based energy efficiency performance tool
- Remaining timeline for Version 1.0

Common Product Family

Attribute: Cache Size



- EPA received feedback to allow less cache in qualified products than the amount using during testing
 - Stakeholders may select any amount of cache when qualifying a system but that amount will act as a cache “floor” for qualified systems in that product family
 - This approach eliminates the possibility of system performance of a qualified storage product suffering due to smaller cache size

Auto-tiering and Mixed Drive System Configurations



- EPA supports further revision of the V2.0 Emerald™ specification
 - Should allow for the evaluation of auto-tiered, mixed drive systems in the Version 1.0 ENERGY STAR Storage specification.
- EPA will review any changes to the Emerald specification and subsequent validation testing for potential inclusion in the Final Draft specification and test method.

Development of NAS File Based Energy Efficiency Performance Tool



- EPA is supportive of industry efforts to develop additional testing for active NAS energy efficiency performance
- EPA seeks input for future development efforts for this type of test method

Remaining Version 1.0 Timeline



- Late May: Final Draft release
 - Should allow time for hot banding, auto-tiering issues review
- June 24 – 26:
 - SNIA Emerald test training for CBs, labs.
 - ENERGY STAR specification training for CBs, labs
- Early July: Final specification release
- Early October: Specification effective
 - Currently planning 3 month delay until effective date
 - Question: From stakeholder point of view, is this period necessary?

Additional Input from Industry



- EPA looks forward to additional data and feedback on the following issues prior to publishing the Final Draft specification
 - Continued testing of the Version 2.0 Emerald™ specification when using the latest version of Vdbench (5.0.4, RC5)
 - Additional validation testing on auto-tiered mixed drive systems using the Version 2.0 Emerald specification Hot Band workload
- EPA is especially interested in
 - Physical data from multiple manufacturers showing that the Hot Band workload provides additional benefit for auto-tiered mixed drive systems
 - Hot Band workload run-rules so that testing labs can test auto-tiered mixed drive systems using settings which produce repeatable and meaningful results

References and resources



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

Reminder

Written comments on Draft 4 due to EPA no later than April 19, 2013. storage@energystar.gov

Thank You!



RJ Meyers
EPA, ENERGY STAR
(202) 343-9923
Meyers.Robert@epa.gov

John Clinger
ICF International
(215) 967-9407
John.Clinger@icfi.com

Emmy Phelan
ICF International
(202) 862-1145
Emmy.Phelan@icfi.com

Al Thomason
TBWC, LLC
(503) 708-7881
thomasonw@gmail.com