COMPUTERWORLD SNIA

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Transforming the Information Infrastructure: Build, Manage, Optimize.

FALL 2011

The SNIA Emerald™ Program

Power Efficiency in the Storage World

SNIA Emerald™

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GSI Board Member

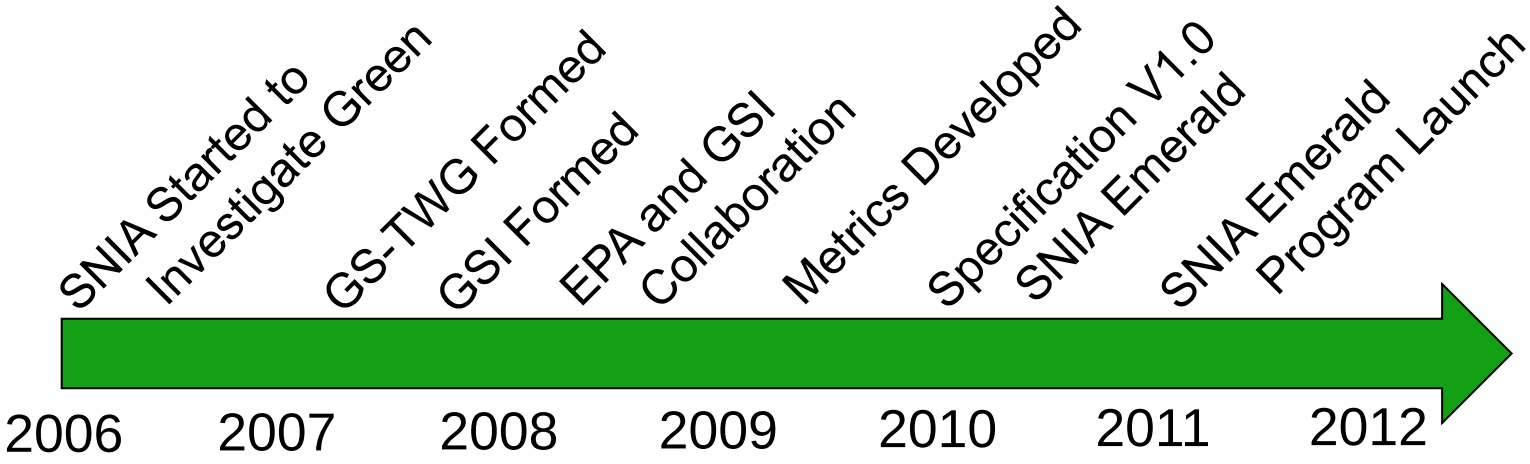
SNIA Green Storage Initiative

Introducing the SNIA Emerald Program

- A History of Green in Storage
- The Green Storage Initiative and TWG
- The Metrics
  - Technical Working Group Activities
- Taxonomy
- The SNIA Emerald Program
- The SNIA Emerald Program Website
- Summary

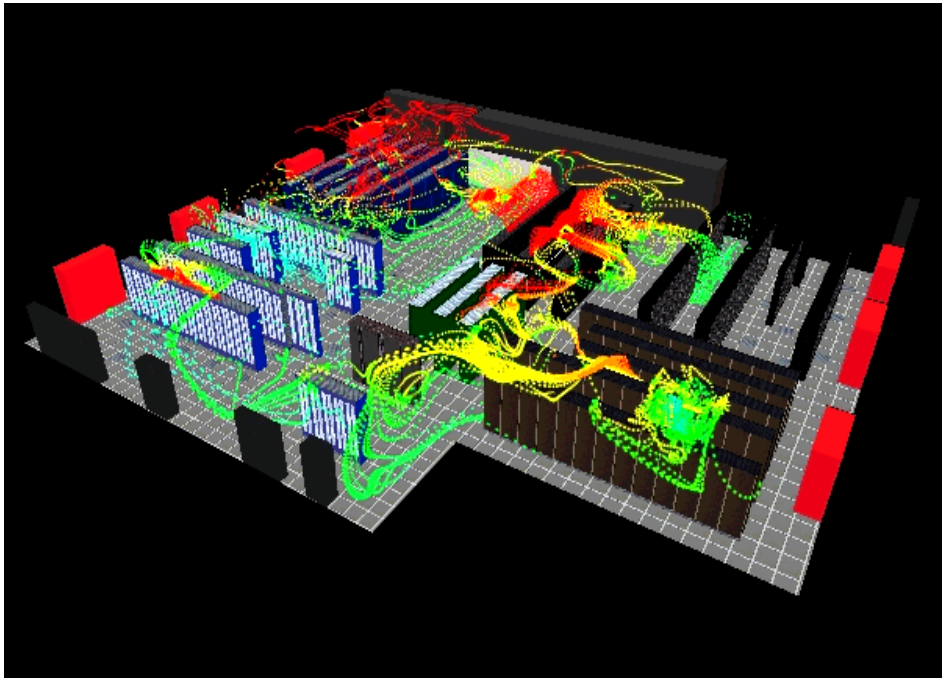
A bit of Green Storage history

- Energy efficiency has been a “hot topic” for years
- The SNIA became involved in 2006
- The Green Storage TWG formed in 2007
- The Green Storage Initiative of the SNIA was formed in 2008
- The EPA began work with the Storage Industry in 2008



A history of Green in the Datacenter

Power Consumption in the Datacenter



Server/Storage	**50%**
Computer Rm. AC	**34%**
Conversion	**7%**
Network	**7%**
Lighting	**2%**

Compute resources and particularly **servers/Storage** are at the heart of a complex, evolving system!

Source: APC

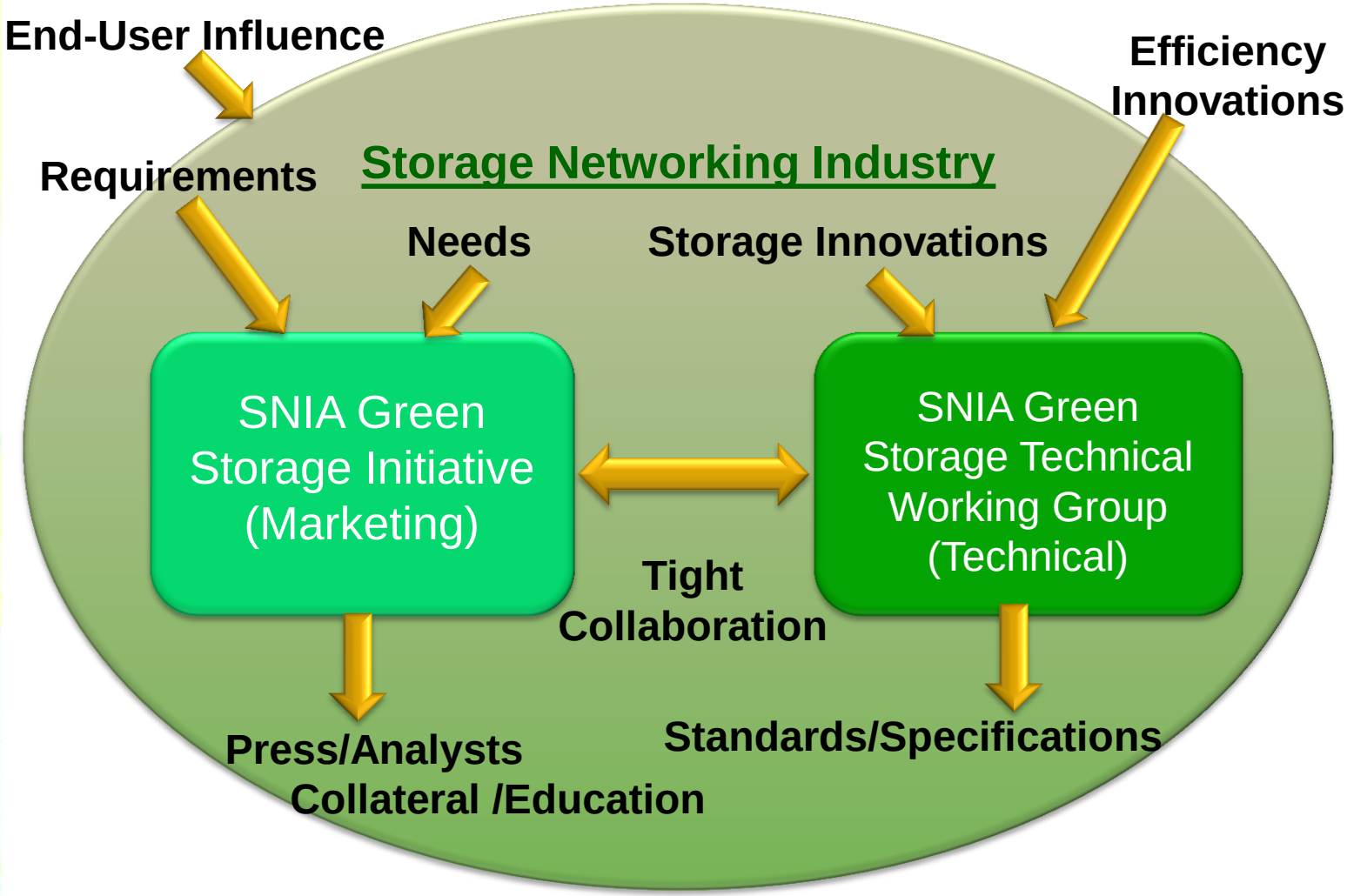
What is the Green Storage Initiative?

"The SNIA Green Storage Initiative (GSI) is dedicated to advancing energy efficiency and conservation in all networked storage technologies and minimizing the environmental impact of data storage operations."

The GSI's mission

- Conduct research on power and cooling issues confronting storage admins
- Educate vendor and user communities about power conservation*
- Focus attention on energy efficiency for networked storage infrastructures
- Provide input to the SNIA Green Storage TWG
- Provide external advocacy and support of the technical work of the GS-TWG

All lead directly to the SNIA Emerald Program


End-User Influence
Efficiency Innovations
Requirements
Storage Networking Industry
Needs
Storage Innovations
SNIA Green Storage Initiative (Marketing)
SNIA Green Storage Technical Working Group (Technical)
Tight Collaboration
Press/Analysts Collateral /Education
Standards/Specifications

Anatomy of a Storage System

- System design, complexity and redundancy vary depending on applications & usage
- Component designs, software features, and workload affect power consumption and efficiency

Apps

Software

Switches

Appliances

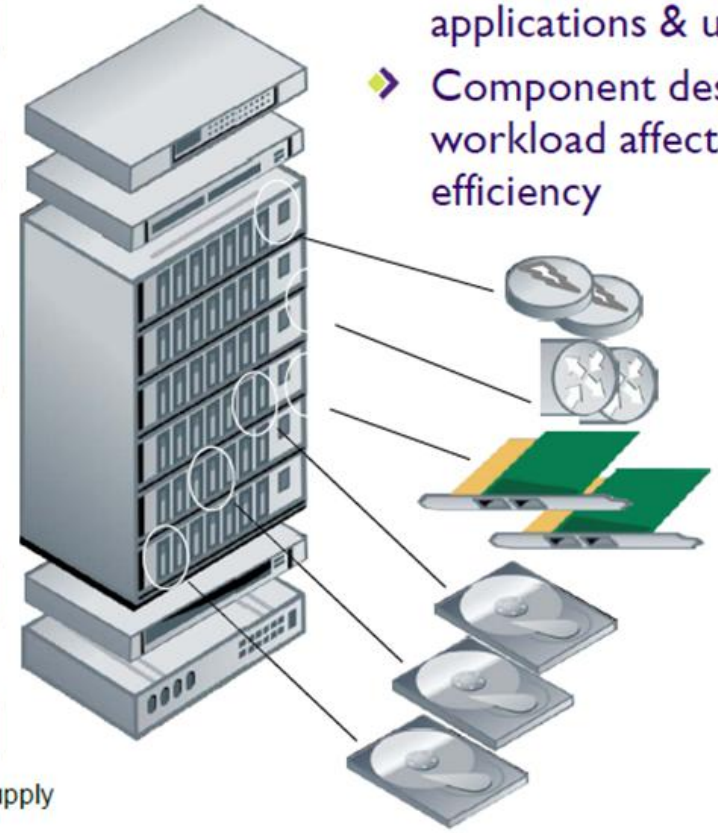
Disk Arrays

PDUs

Power Distribution Unit

UPSs

Uninterruptible Power Supply



Power Supplies

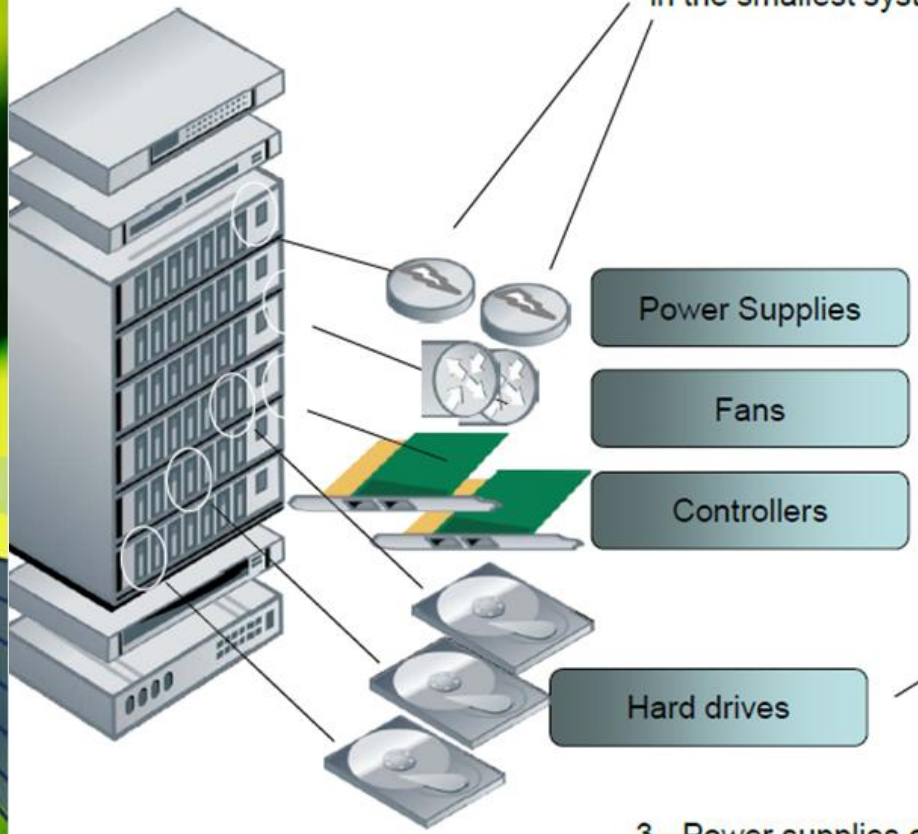
Fans

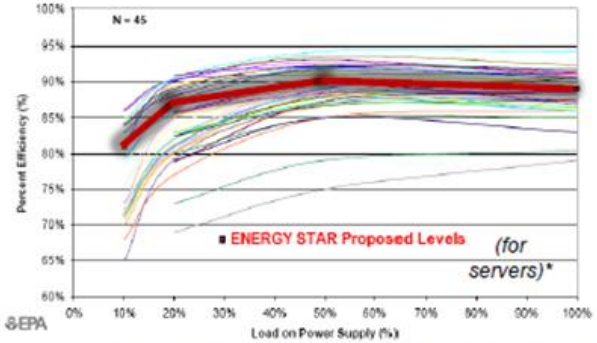
Controllers

Hard drives

Storage – Power Supply Efficiency

1 - Redundant power supplies are standard, except in the smallest systems





*presented by EPA at ENERGY STAR Computer Server Stakeholder Meetings; July 2008

2 - Significant mechanical components, require dual-output power supplies (12V, 5V)

3 - Power supplies often custom-designed for reliability

What impacts power consumption

- Storage Capacity / Usage efficiency
  - Increasing data ► larger capacity ► more disks
  - Redundant copies ► magnify capacity needs
  - Variability in usage and utilization ► inefficiencies
  - What's valuable data? Retention policy?
- Data transfer rate / access speed
  - High IO bandwidth ► rotational speed, striping
  - Low access times ► faster actuators, speeds, caches
  - Time-to-data consideration
- Data integrity
  - Inefficiencies die to survivability requirements
- Data availability / system reliability
  - RAID, redundancy

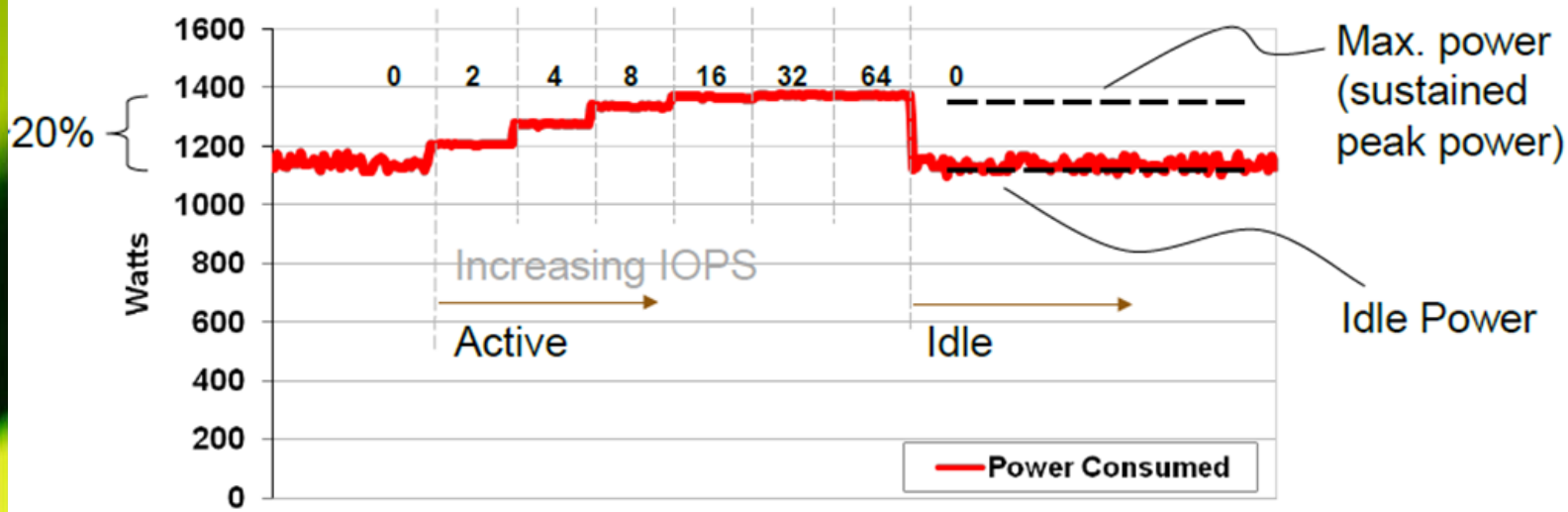
Potential paths to “Green”

- Improve usage efficiency
  - De-duplication
  - Thin provisioning
- Minimize energy consumption
  - Improved component designs –high efficiency power supplies
  - Variants of MAID – idle and spin down
- New technologies
  - Solid state storage
  - Alternative+hybrid system designs (opportunity to rethink)

Idle Power vs. Active Power

- Idle Mode
  - Storage system is protecting data, ready to process IOs
  - Background maintenance & optimization tasks on-going
  - Factors: time-to-data, overhead electronics, fan, maintenance
  - Systems are idle large fractions of time
- Active Mode
  - Storage system is carrying IOs
  - Background tasks continue in parallel
  - Factors: workload (seq/random), response time, throughput
  - Evaluate a variety of workloads, plus sustained peak power

Example Power Measurement



- Ideally, systems consume minimum power in all modes
  - Example above shows idle is 80% of max
- Power consumed is not linearly proportional to workload
  - Indicates potential opportunity for improvement

Metrics Innovations

- Workload considerations
  - Data at rest – Idle power (GB/W)
  - Data in flight – Throughput (MB/s)
  - Data at work – Performance (IOPS)
- Metrics
  - GB/W, MB/s/W, IOPS/W, others
- Reliability / Availability / Serviceability considerations
  - Latency (time to data)
  - Redundancy level (RAID efficiency, failure resilience)

Storage Power - Idle

Equation 6-1: Average Idle Power

$$P_i = \frac{\sum W_i}{n}$$

Where:

- *P_i is average idle power*
- *W_i is power in watts measured in each sampling interval i*
- *n is the number of samples gathered by the power meter during the measurement interval.*

Idle Metric

Equation 7-1 SNIA Idle Power Metric

$$P = \frac{C}{P_i}$$

Where:

- *P is the SNIA Idle Power Metric*
- *C is the total capacity of the SUT*
- *P_i is the average idle power*

Storage System Coverage for Testing

- V1.0 of the Specification Only covers Certain Storage Systems
- The universe of coverage is identified by the Taxonomy
- The Taxonomy identifies the extent of coverage of the Specification

Grey means not currently covered

GS-TWG Taxonomy - Overview

Category / Level	Overall Taxonomy					
	Online	Near Online	Removable Media Library	Virtual Media Library	Adjunct Product	Interconnect Element
Consumer/ Component	Online 1	Near Online 1	Removable 1	Virtual 1		
Low-End	Online 2	Near Online 2	Removable 2	Virtual 2		
Mid-range	Online 3	Near Online 3	Removable 3	Virtual 3		
	Online 4	Near Online 4				
High-end	Online 5	Near Online 5	Removable 5	Virtual 5		
Mainframe	Online 6	Near Online 6	Removable 6	Virtual 6		

Attribute	Category					
	Online	Near Online	Removable Media Library	Virtual Media Library	Adjunct Product	Interconnect Element
Access Pattern	Random/ Sequential	Random/ Sequential	Sequential	Sequential		
Max TTFD (t)	t < 80 ms	t > 80 ms	t > 80 ms t < 5 min	t < 80 ms	t < 80 ms	t < 80 ms
User Accessible Data	Required	Required	Required	Required	Prohibited	Prohibited

Grey means not currently covered

GS-TWG Taxonomy - Online

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
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
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Required
Integrated Storage Controller	Optional	Optional	Required	Required	Required	Required
Maximum Configuration	≥ 1	≥ 4	≥ 12	>100	>400	>400
Max TTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
No SPOF	Optional	Optional	Optional	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required	Required
User-Accessible Data	Required	Required	Required	Required	Required	Required

Grey means not currently covered

GS-TWG Taxonomy – Near Online

Attribute	Classification					
	Near Online 1	Near Online 2	Near Online 3	Near Online 4	Near Online 5	Near Online 6
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential		Random/ Sequential	Random/ Sequential
Connectivity	Not specified	Network-connected	Network-connected		Network-connected	Network-connected
Consumer/ Component	Yes	No	No		No	No
FBA/CKD Support	Optional	Optional	Optional		Optional	Optional
Integrated Storage Controller	Optional	Optional	Required		Required	Required
Maximum Configuration	≥ 1	≥ 4	≥ 12		>100	>1000
Max TTFD (t)	t > 80 ms	t > 80 ms	t > 80 ms		t > 80 ms	t > 80 ms
No SPOF	Optional	Optional	Optional		Optional	Required
Non-Disruptive Serviceability	Optional	Optional	Optional		Optional	Required
Storage Protection	Optional	Optional	Required		Required	Required
User-Accessible Data	Required	Required	Required		Required	Required

Grey means not currently covered

GS-TWG Taxonomy - Libraries

Attribute	Classification					
	Removable 1	Removable 2	Removable 3	Removable 4	Removable 5	Removable 6
Access Pattern	Sequential	Sequential	Sequential		Sequential	Sequential
Maximum Drive Count	Not specified	4	≥ 5		≥ 25	≥ 25
Max TTFD (t)	80ms<t<5m	80ms<t<5m	80ms<t<5m		80ms<t<5m	80ms<t<5m
No SPOF	Optional	Optional	Optional		Optional	Required
Non-Disruptive Serviceability	Optional	Optional	Optional		Optional	Required
Robotics	Prohibited	Required	Required		Required	Required
User-Accessible Data	Required	Required	Required		Required	Required

Attribute	Classification					
	Virtual 1	Virtual 2	Virtual 3	Virtual 4	Virtual 5	Virtual 6
Access Pattern	Sequential	Sequential	Sequential		Sequential	Sequential
Maximum Drive Count	12	>12	>48		>96	>96
Max TTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms		t < 80 ms	t < 80 ms
Storage Protection						
No SPOF	Optional	Optional	Optional		Optional	Required
Non-Disruptive Serviceability	Optional	Optional	Optional		Optional	Required
User-Accessible Data	Required	Required	Required		Required	Required

The SNIA Emerald™

Where are we?

- We understand the Green goals
- We've developed Green metrics
- We have all this Green data,

So, now what do we do?!

The SNIA Emerald Program

- A program designed to provide a fair and equitable central repository of meaningful power efficiency test results of Storage Systems
- Allows the display, submission and management of power efficiency test results and metrics through a publicly accessible Website
- Logo and Trademark Licensing for submittals – Audited and Unaudited
    - Value to both vendors and end-users
- Ensures test results of the metrics are properly vetted
    - Results are policed by the industry
- Maintains close collaboration with the EPA and the ENERGY STAR for Storage program and work with International Standards agencies
- Test procedure and policies openly available to the public
- Membership in the SNIA or GSI not required

What the SNIA Emerald Program means

- Central location for finding Power Efficiency of Storage Systems
- Easily Identifiable Logo and Trademark
- Motivation for continuously improving Power Efficiency
- Meaningful industry metrics
- Continuously updating industry metrics and add-ons
- Coordination with US and International agencies
- Vendor neutrality of results
- Best practices for the industry

SNIA Emerald™

How much does it cost?

- End users: No cost – Pure benefit!
- Test Sponsors: Cost of the testing + Submission fee
- Test Sponsors: Any Auditor fees for Audited Test Data Results
- Test Sponsors: Graduated and fair scale Submission fee based on membership
    - GSI Voting Members $ 375 (First 8 Submissions Free/yr)
    - GSI Non-voting Members $ 500 (First 4 Submissions Free/yr)
    - SNIA Members $ 750
    - Non Members $1,500
- GSI Board sets the rate annually
- Product Family definition still being worked out

The Process

- Download specification
- Determine if test is to be Audited or Unaudited
- If Audited, select an Auditor and coordinate testing
- Test the Storage System product
- Create Test Data Report
- Submit Test Data Results to the SNIA Emerald website
- The SNIA Emerald™ Audited or Unaudited logo and trademark may be used immediately after posting by the SNIA Emerald Administrator

The Challenge

- Anyone may submit a challenge during probationary period
- Challenge is vetted by the SNIA Emerald Administrator
- Challenger and Challengee attempt resolution on their own
- If the challenge goes forward
    - Challenge is placed on the RCC docket
    - Retest by Challengee may be required
    - Determination of validity is determined
- If Challenge is valid, the RCC determines resolution

Auditor Qualifications

•Prior familiarity and extensive knowledge of the GSI organization and GS-TWG.

•Capability to provide adequate auditing coverage (e.g., time, location, Specification knowledge).

•Extensive knowledge and experience in storage systems and power efficiency measurements.

•Ability to perform the duties of the job in an independent manner (i.e., free of conflicts-of-interest).

•Pass a GS-TWG Auditor Examination or Take an Authorized Course

•Be approved by a GSI Board

Website: www.SNIAEmerald.com

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SNIA Emerald Program

Welcome to the SNIA Emerald™ Program website.

The purpose of the SNIA (Storage Networking Industry Association) Emerald Program is to provide public access to storage system power usage and efficiency through use of a well-defined testing procedure, and additional information related to system power. The measurement procedure, the SNIA Emerald™ Power Efficiency Measurement Specification (Specification), was developed and released, and is maintained by the Green Storage Technical Working Group (GS-TWG) under the guidance of the Green Storage Initiative (GSI) of the SNIA. Use of the Specification with the intent of posting the Results to the SNIA Emerald Program central repository and obtaining a SNIA Emerald Program trademark and logo requires the results to be used in accordance with the SNIA Emerald™ Program rules, which are available on the submission form.

The SNIA Emerald Program is sponsored, operated, and promoted by the SNIA GSI. The SNIA is a non-profit, international organization of manufacturers, systems integrators, developers, systems vendors, industry professionals, and end users. The GSI is responsible for managing the SNIA Emerald Program, providing input and guidance to the GS-TWG, and general marketing of energy efficiency activities within the SNIA and the storage networking industry.

Help us make the SNIA Emerald shine!

- Send us your feedback
- What more would you like to see?
- What would you like to change?
- What questions do you have we should add to the FAQ?

Send your feedback to: Info@SNIAEmerald.com

Summary

- Metrics developed through industry efforts
- "Green" is good!
  - Cost effective energy efficiencies
  - Great engineering challenge – do more with less
- SNIA Emerald Program
  - Launch today!
  - Trademarks and logos

Questions?

Thanks…and *REMEMBER*

Please fill out our evaluations!

5 = "That's great! Thanks!"
4 = "Mighty kind of you!
3 = "Hope you enjoyed this!"
2 = "Better Luck Next Time."
1 = "We won't go here"

This One

Questions?

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