



# The SNIA Emerald™ Program

## Power Efficiency in the Storage World



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SNIA Green Storage Initiative



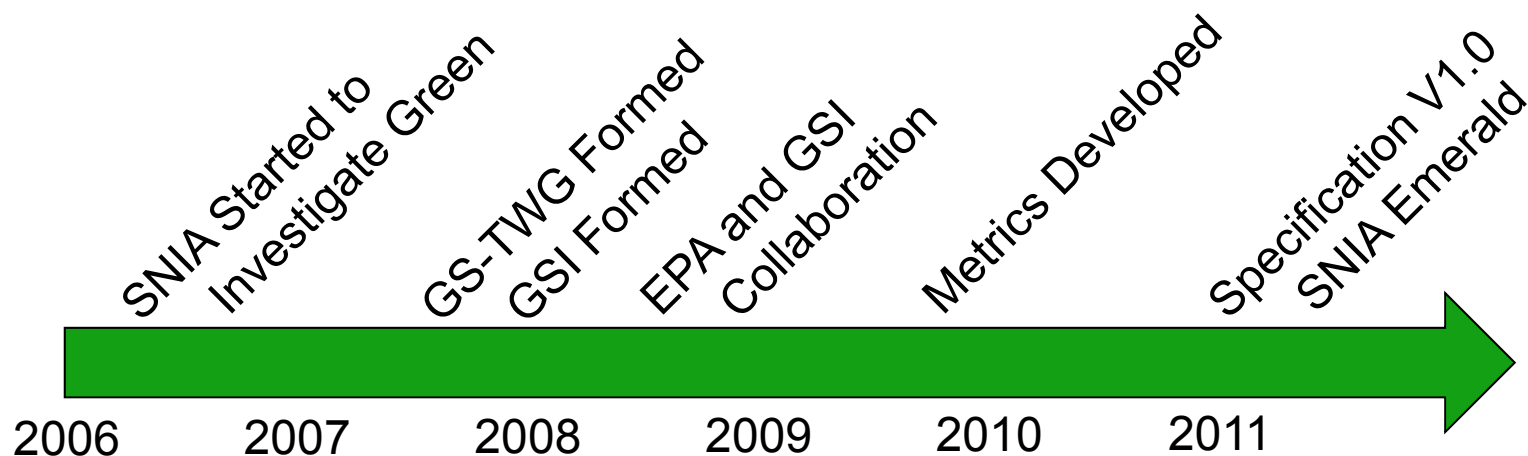
## Introducing the SNIA Emerald Program

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



## A bit of Green Storage history

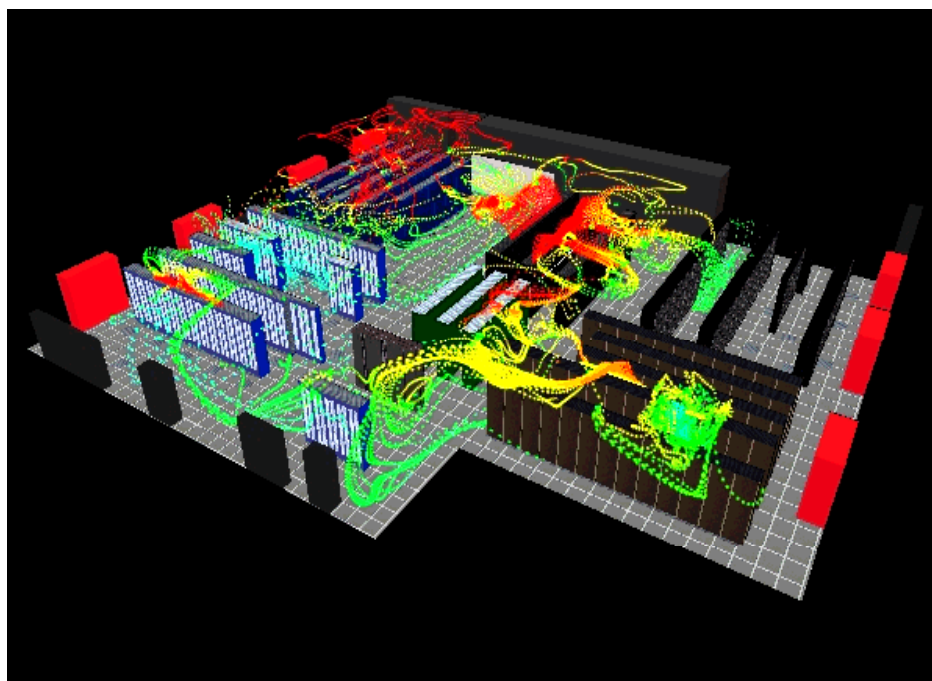
- Energy efficiency has been a “hot topic” for years
- The SNIA became involved in 2006
- The Green Storage TWG formed in 2007
- The Green Storage Initiative of the SNIA was formed in 2008
- The EPA began work with the Storage Industry in 2008





## 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?

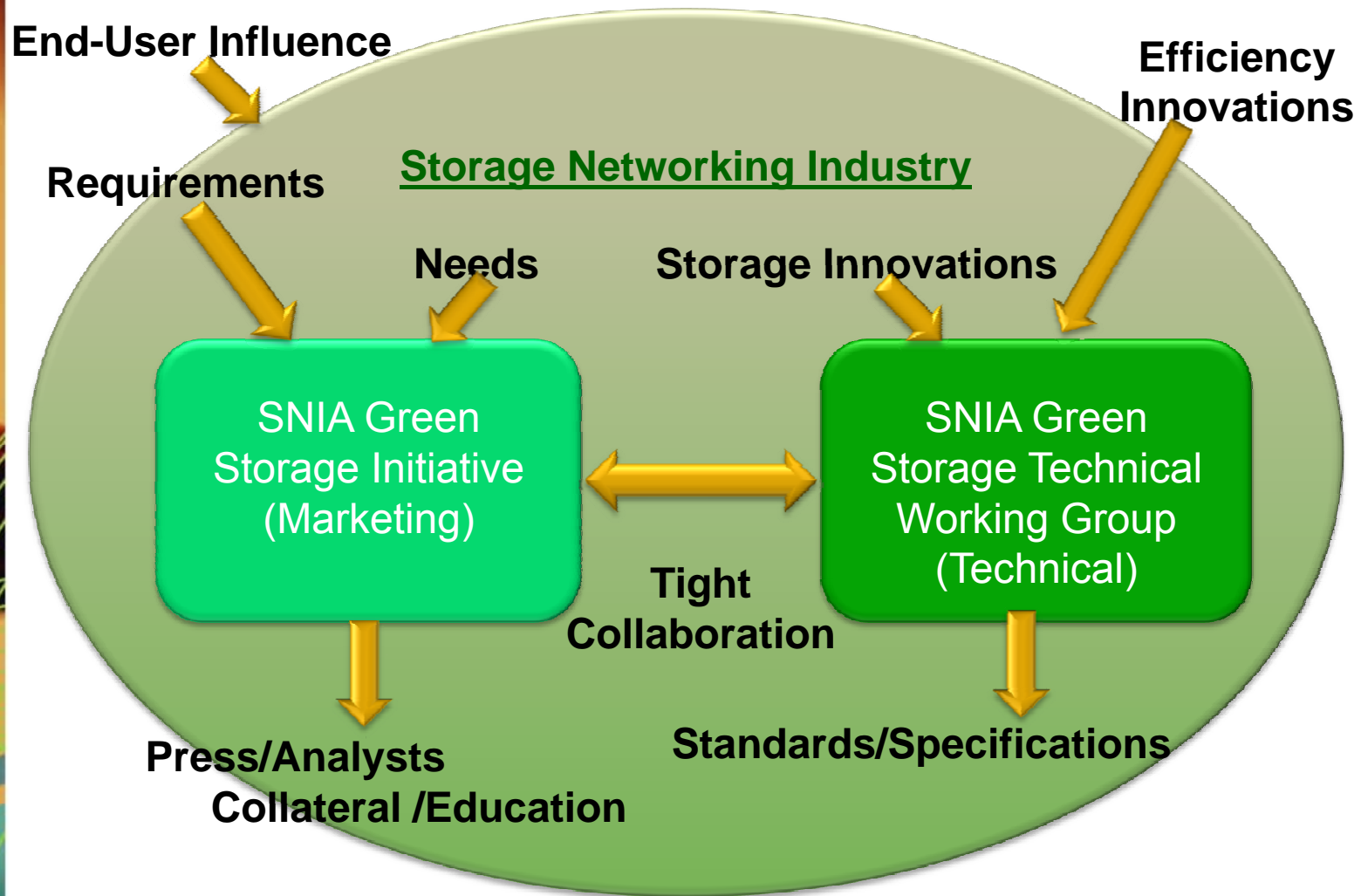
“The SNIA Green Storage Initiative (GSI) is dedicated to advancing energy efficiency and conservation in all networked storage technologies and minimizing the environmental impact of data storage operations.”

### **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

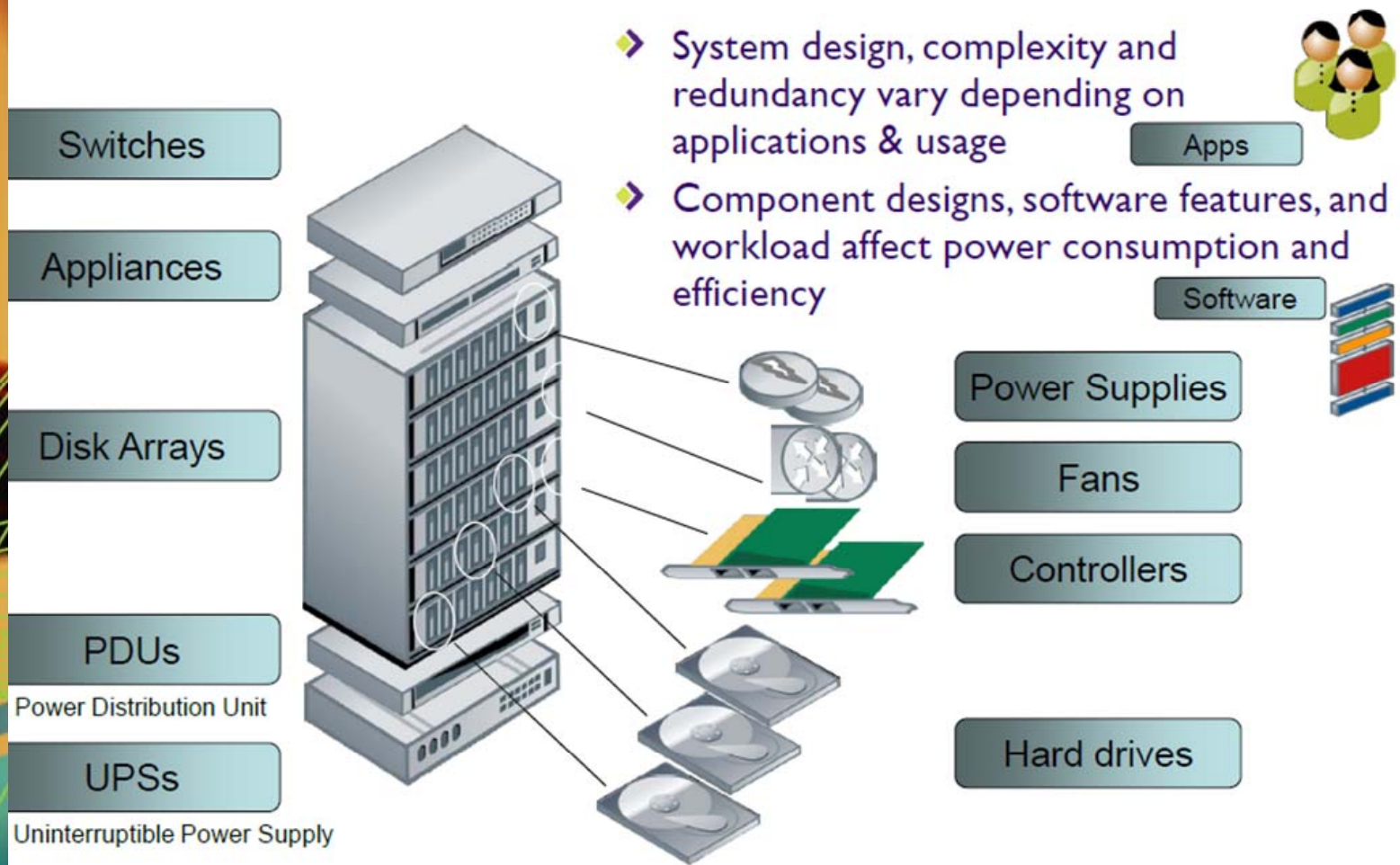
**All lead directly to the SNIA Emerald Program**





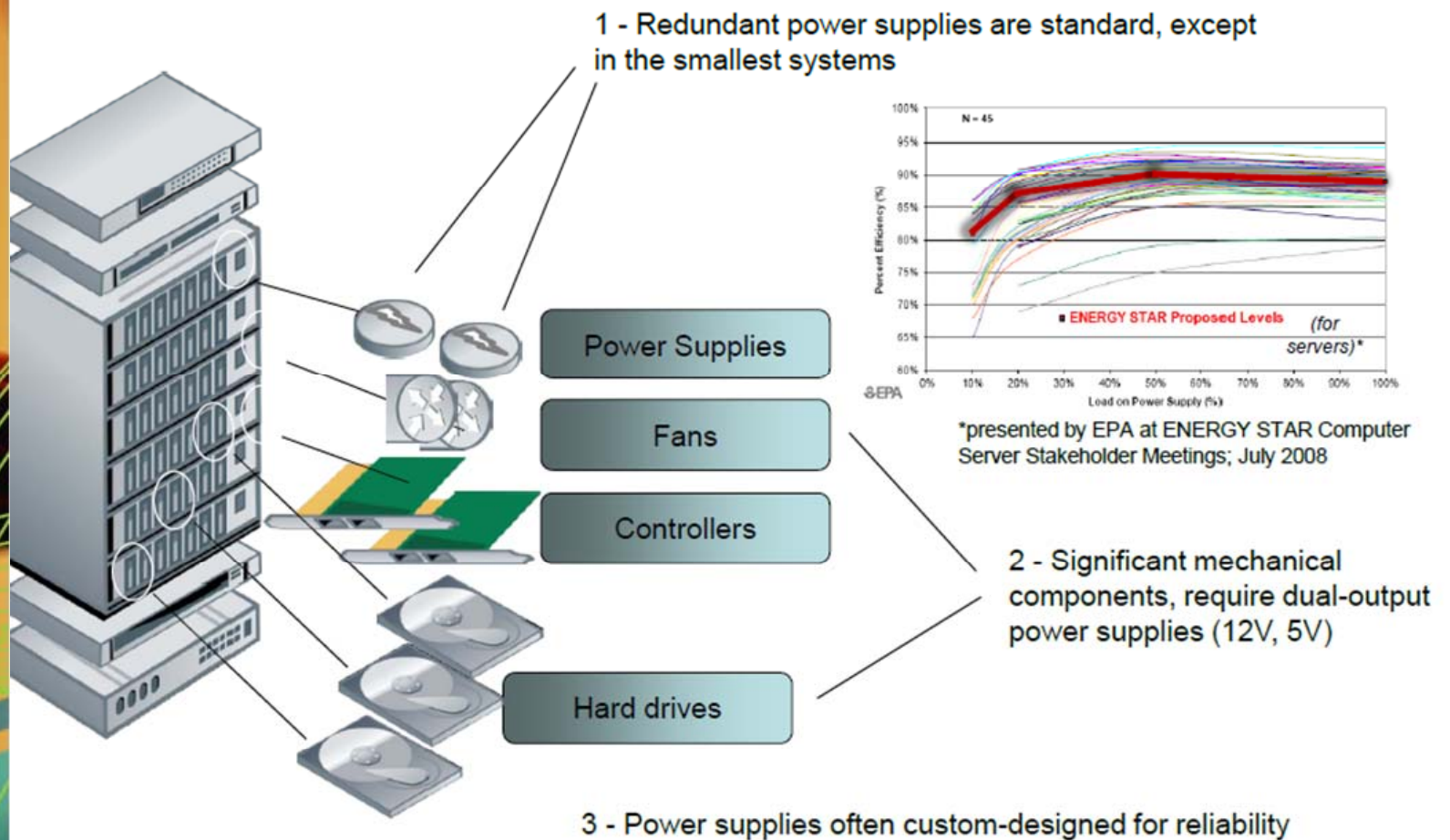


## Anatomy of a Storage System





## Storage – Power Supply Efficiency







## 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 due 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)

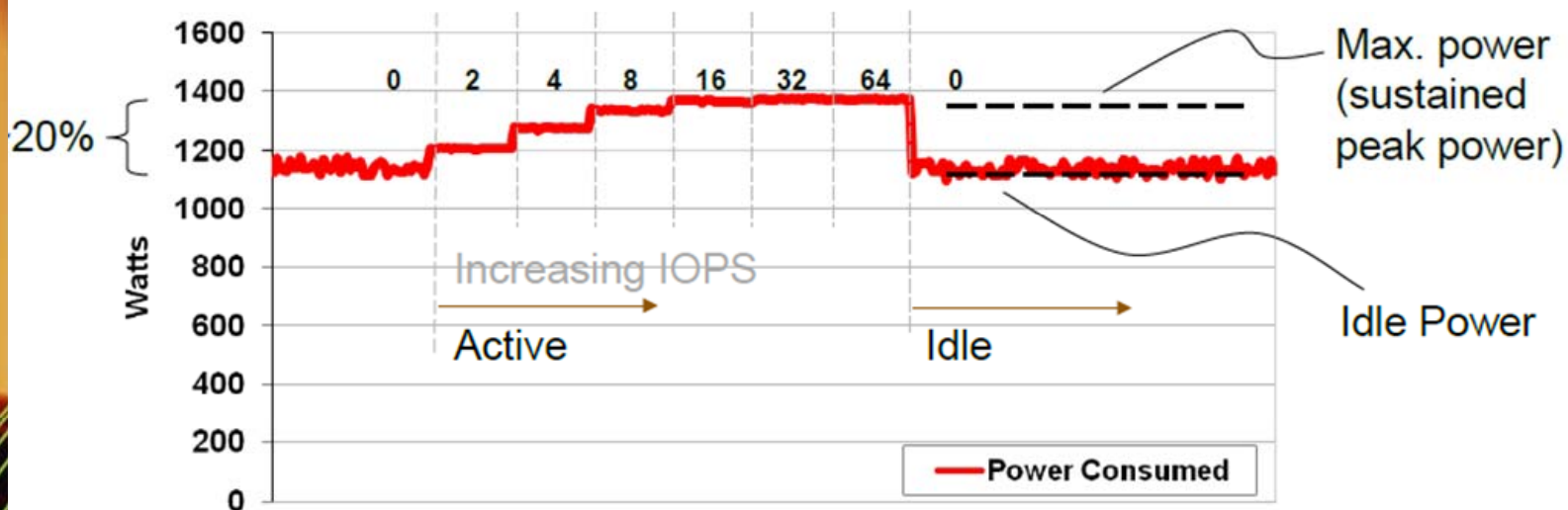


## Idle Power vs. Active Power

- 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



## GS-TWG Taxonomy - Overview

Category Level	Online	Near-Online	Removable Media	Virtual Media Library	Adjunct	Interconnect
Consumer	Online-1		Removable-1			
Low-end	Online-2	NearOnline-1	Removable-2	Virtual-1		
Mid-range	Online-3	NearOnline-2	Removable-3	Virtual-2		
High-end	Online-4	NearOnline-3	Removable-4	Virtual-3		
Mainframe	Online-5		Removable-5			©SNIA 2009

Grey means not currently covered

Development of the full taxonomy was a lengthy process...



## GS-TWG Taxonomy - Online

Grey means  
not  
currently  
covered

Attribute	Classification				
	Online-1	Online-2	Online-3	Online-4	Online-5
Access Pattern	Random	Random	Random	Random	Random
Connectivity	Not specified	Connected to single or multiple hosts	Network-connected	Network-connected	Network-connected
Integrated Storage Controller	Optional	Optional	Required	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Required
Maximum Configuration	4	> 4	> 4	> 100	> 1000
MaxTTD(t)	$t \leq 80\text{ms}$	$t > 80\text{ms}$	$t > 80\text{ms}$ $t \leq 5 \text{ min}$	$t \leq 80\text{ms}$	$t \leq 80\text{ms}$
No SPOF	Optional	Optional	Optional	Required	Required
Integrated PDU and UPS	Optional	Optional	Optional	Optional	Required
Deskside	Yes	No	No	No	No
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required
User Accessible Data	Required	Required	Required	Required	Required





## GS-TWG Taxonomy – Near Online

Attribute	Classification		
	NearOnline-1	NearOnline-2	NearOnline-3
Access Pattern	Random	Random	Random
Connectivity	Network-connected	Network-connected	Network-connected
Integrated Storage Controller	Optional	Required	Required
Storage Protection	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional
Maximum Configuration	4	> 4	> 100
MaxTTD(t)	t > 80ms	t > 80ms	t > 80ms
No SPOF	Optional	Optional	Required
Integrated PDU and UPS	Optional	Optional	Optional
Deskside	Yes	No	No
Non-Disruptive Serviceability	Optional	Optional	Required
User Accessible Data	Required	Required	Required



## GS-TWG Taxonomy - Libraries

**Grey means  
not  
currently  
covered**

Attribute	Classification				
	Removable-1	Removable-2	Removable-3	Removable-4	Removable-5
Access Pattern	Sequential write	Sequential write	Sequential write	Sequential write	Sequential write
MaxTTD(t)	$80\text{ms} \leq t < 5 \text{ m}$	$80\text{ms} \leq t < 5 \text{ m}$	$80\text{ms} \leq t < 5 \text{ m}$	$80\text{ms} \leq t < 5 \text{ m}$	$80\text{ms} \leq t < 5 \text{ m}$
No SPOF	Optional	Optional	Optional	Required	Required
Robotics	Prohibited	Required	Optional	Optional	Required
Maximum Drive Count	Not specified	$\leq 4$	$\geq 5$	$\geq 25$	$\geq 25$
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required
User Accessible Data	Required	Required	Required	Required	Required

Attribute	Classification		
	Virtual-1	Virtual-2	Virtual-3
Access Pattern	Sequential write	Sequential write	Sequential write
Connectivity	Network-connected	Network-connected	Network-connected
FICON Support	Optional	Optional	Required
Maximum Configuration	100	$> 100$	$> 100$
MaxTTD(t)	$t \leq 80\text{ms}$	$t \leq 80\text{ms}$	$t \leq 80\text{ms}$
No SPOF	Optional	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Required
User Accessible Data	Required	Required	Required



## 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



## 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
- 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
- Vendor neutrality of results
- Best practices for the industry





## How much does it cost?

- End users: No cost – Pure benefit!
- Test Sponsors: Cost of the testing + Submission fee
- Test Sponsor: Any Auditor fees
- Test Sponsors: Graduated and fair scale Submission fee based on membership
  - GSI Voting Members \$ 375 (First 8 Submittals Free)
  - GSI Non-voting Members \$ 500 (First 4 Submittals Free)
  - 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 Report
- Submit Test Results to the SNIA Emerald website
  - Payment is required at time of submittal
- The SNIA Emerald™ Audited or Unaudited logo and trademark may be used immediately





## 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](http://www.SNIAEmerald.com)



**SNIA Emerald™**  
Green Storage Initiative

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#### SNIA Emerald

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#### Program Process

- [Documents and Downloads](#)

#### Test Process

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#### Questions

- [FAQ](#)

#### Related Industry Links

- [SNIA](#)
- [Green Storage Initiative](#)
- [The Green Grid](#)

## SNIA Emerald Program

Welcome to the SNIA Emerald™ Program website. **Going LIVE in the second half of 2011!**

The purpose of the SNIA 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 GS-TWG under the guidance of the GSI. 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 License requires the results to be used in accordance with the SNIA Emerald™ Program Policies and Procedures document also obtainable [here](#).

The SNIA Emerald Program is sponsored, operated, and promoted by the Storage Networking Industry Association (SNIA) Green Storage Initiative (GSI). The program is scheduled to be fully operational in the second half of 2011. 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 Green Storage Technical Working Group (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](mailto: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 in 2H’11
  - Trademarks and logos



# Questions?

**Thanks...and**  
***REMEMBER***

**Please fill out our evaluations!**



This One

**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"**

**Questions?**

Tom (T2) Hammond-Doel  
Thomas.Hammond-Doel@LSI.com

An abstract background graphic featuring a green vertical bar on the left, a blue and orange curved shape in the center, and a network of green lines radiating from the center towards the right. The text "Driving Innovation Through the Information Infrastructure" is overlaid on this graphic in a bold, white, sans-serif font.

# **Driving Innovation Through the Information Infrastructure**

**SPRING 2011**