Agenda

- SNIA GSI Overview
- SNIA Emerald™ Power Efficiency Measurement Specification
- SNIA Emerald™ Program
- SNIA Green Storage Tutorials
The GSI’s Mission

- To conduct research on power and cooling issues confronting storage administrators
- Educate the vendor and user community about the importance of power conservation in shared storage environments
- Leverage SNW and other SNIA and partner conferences to focus attention on energy efficiency for networked storage infrastructures
- Provide input to the SNIA Green Storage TWWG on requirements for green storage metrics and standards
- Provide external advocacy and support of the technical work of the SNIA Green Storage Technical Working Group

Current GSI Members

Members as of 10.1.11
Agenda

- SNIA GSI Overview
- SNIA Emerald™ Power Efficiency Measurement Specification
- SNIA Emerald™ Program
- SNIA Green Storage Tutorials
Challenge: Measuring Energy and Efficiency
System, sub-system, and various configurations

- System design, complexity and redundancy vary depending on applications & usage
- Component designs, software features, and workload affect power consumption and efficiency
SNIA Combined Work Effort
An industry effort, still ongoing

- 25 companies in SNIA Green Storage TWG
- 11 companies in SNIA GSI
- Decomposing the storage system challenge
- Observed industry efforts for servers: SPEC, EPA, etc.
- Three years significant technical work
  - Many iterations of system testing, data analysis and methodology review
- Power supply efficiency work
  - ClimateSavers, EPRI, ECOS
- Power measurement tools
  - Reference SPEC
SNIA Emerald™ Power Efficiency Measurement Specification

**Taxonomy:** An industry-wide means of segmenting storage systems for products that span the range from consumer solutions to enterprise configurations which will be used to categorize the test results.

**Test Methodology:** A detailed and consistent means of testing various types of storage systems with load generators and power measurement instruments.

**Test Metrics - Idle Measurement Test:** The idle test applies to storage systems and components which are configured, powered up, connected to one or more hosts and capable of satisfying externally initiated, application-level initiated IO requests within normal response time constraints, but no such IO requests are being submitted.

**Test Metrics - Active Measurement Test:** Testing of storage products and components are said to be in an “active” state when they are processing externally initiated, application-level requests for data transfer between host(s) and the storage product(s).

**Capacity Optimization:** The specification and program test report do address disclosing configuration information for the system under test about energy-saving storage capacity optimizations that the system may have including features such as deduplication and thin provisioning.

## Storage Taxonomy

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Pattern</td>
<td>Online: Random/Sequential; Near Online: Random/Sequential; Removable Media Library: Sequential; Virtual Media Library: Sequential</td>
</tr>
<tr>
<td>MaxTTFD (t)</td>
<td>Online: t &lt; 80 ms; Near Online: t &gt; 80 ms; Removable Media Library: t &gt; 80 ms; Virtual Media Library: t &lt; 80 ms</td>
</tr>
<tr>
<td>User Accessible Data</td>
<td>Online: Required; Near Online: Required; Removable Media Library: Required; Virtual Media Library: Required; Adjunct Product: Prohibited; Interconnect Element: Prohibited</td>
</tr>
</tbody>
</table>
### Storage Taxonomy (cont’d)

<table>
<thead>
<tr>
<th>Level</th>
<th>Category</th>
<th>Online</th>
<th>Near Online</th>
<th>Removable Media Library</th>
<th>Virtual Media Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer/Component</td>
<td>Online 1</td>
<td></td>
<td>Near Online 1</td>
<td>Removable 1</td>
<td>Virtual 1</td>
</tr>
<tr>
<td>Low-end</td>
<td>Online 2</td>
<td></td>
<td>Near Online 2</td>
<td>Removable 2</td>
<td>Virtual 2</td>
</tr>
<tr>
<td>Mid-range</td>
<td>Online 3</td>
<td></td>
<td>Near Online 3</td>
<td>Removable 3</td>
<td>Virtual 3</td>
</tr>
<tr>
<td></td>
<td>Online 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-end</td>
<td>Online 5</td>
<td></td>
<td>Near Online 5</td>
<td>Removable 5</td>
<td>Virtual 5</td>
</tr>
<tr>
<td>Mainframe</td>
<td>Online 6</td>
<td></td>
<td>Near Online 6</td>
<td>Removable 6</td>
<td>Virtual 6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjunct Product</th>
<th>Interconnect Element</th>
</tr>
</thead>
</table>
SNIA Emerald™ User Guide for Measurement Specification

- How to, step-by-step guidance and recommendations
- How to submit test results to the SNIA Emerald™ Program
- Develop a product family definition beyond the SNIA Emerald Measurement Specification taxonomy
- Arriving at appropriate system configurations to test
- Set-up system under test and complete the measurement sequence
- Sample workload scripts for tools to generate IO workload
- How to avoid test and measurement mistakes and problems
Storage System Testing for Power Efficiency

System Under Test (SUT)

- Benchmark Driver System
  - e.g. IOMETER or Vdbench
- Environmental Meter for Temp. and Hum.
- Power Meter
  - e.g. Yokogawa or others….

- System Under Test (SUT) pre-test measurement conditioning
- Active workload generation and measurements
- Idle workload and measurements
- Capacity optimization method (COM) verification.
### C.1 Data Collection Requirements

A summary of the data collection requirements for the benchmark driver is provided in Table C-1.

#### Table C-1 Data Collection Summary

<table>
<thead>
<tr>
<th>Test</th>
<th>Collection Interval (seconds)</th>
<th>Minimum Benchmark Driver Data Collection</th>
<th>Minimum Test Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Power Meter</td>
<td>Temp Meter</td>
<td>Online/ Near Online</td>
</tr>
<tr>
<td>Conditioning</td>
<td>5</td>
<td>60</td>
<td>Response Time (per 1m Interval)</td>
</tr>
<tr>
<td>Active</td>
<td>5</td>
<td>60</td>
<td>Response Time (per 1m Interval)</td>
</tr>
<tr>
<td>Idle</td>
<td>5</td>
<td>60</td>
<td>N/A</td>
</tr>
</tbody>
</table>
8.2 Primary Metrics

This revision of the specification defines the following primary metrics:

- **POWER EFFICIENCY** for each test phase for Online and Near Online systems (see 8.3):
  - \( EP_{MW1} \) for Mixed Workload 1
  - \( EP_{MW2} \) for Mixed Workload 2
  - \( EP_{RR} \) for Random Read
  - \( EP_{RW} \) for Random Write
  - \( EP_{SR} \) for Sequential Read
  - \( EP_{SW} \) for Sequential Write
  - \( EP_{RI} \) for Ready Idle
- **POWER EFFICIENCY** for each test phase for Removable Media Library systems (see 8.4):
  - \( EP_{SW} \) for Sequential Write
  - \( EP_{SR} \) for Sequential Read
  - \( EP_{RI} \) for Ready Idle
- **POWER EFFICIENCY** for each test phase for Virtual Media Library systems (see 8.5):
  - \( EP_{SW} \) for Sequential Write
  - \( EP_{SR} \) for Sequential Read
  - \( EP_{RI} \) for Ready Idle

### Online Storage

- **Active Metrics** ("work")
  - \( IOs/Watt \) (R/W)
  - \( MBs/Watt \) (Sequential)

- **Idle Metric** ("capacity")
  - \( GB/Watt \)
Capacity Optimization

The COMs tests are existence tests.

They include:

- Delta Snapshots (read and write)
- Thin Provisioning
- Data De-duplication
- RAID groups
- Compression
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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, 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.

Why use the Emerald Program? [Read more here.]
SNIA Emerald™ Program

- Open, public web-based repository location for SNIA Emerald™ Program Test Data Reports based on SNIA Measurements Specification
  - The report includes information related to system power including system configuration details such as storage device types, RAS features and their configuration, and power supply types.
- Easily identifiable program logo
- Voluntary, low cost program for manufacturers
  - Options to self-measure or third party measurement
  - No SNIA membership required
- Free to download the specifications, user guides, and test data report access
- The report data can help IT professionals make storage platform selections as part of an overall Green IT and Sustainability objective.
- Sign up for the mailing list: www.SNIAEmerald.com
SNIA Emerald™ Program
Intended Users of the Program

Program Participants and Test Sponsors
- Manufacturers of Storage Systems
- Resellers/OEMs of Storage Systems
- Professional Services
  - Independent Testing Labs
  - Test Auditors

Consumers of SNIA Emerald Test Data Reports
- IT Decision Makers
- Manufacturers of Storage Systems
- National bodies focused on Green IT initiatives
SNIA Emerald™ Program Fees

- **Test Data Report Submission**
  - **SNIA GSI Member**
    - Voting member, first 8 are free, >8 $375
    - Non-voting member, first 4 are free, >4 $500
    - Test bundles, 10 for the price of 7, to supplement GSI membership entitlements
      - Non-voting member, $3,500
      - Voting member, $2,625
  - **SNIA Member, but not a SNIA GSI Member**
    - $750
  - **Industry at Large, not a member of SNIA**
    - $1,500
- **SNIA Members Fee**
  - Depending on membership type and level, $2,500-$40,000
  - Special membership programs offered throughout the year are discounted
- **SNIA GSI Membership Fee**
  - Voting - $9,000
  - Non-voting - $4,500
  - Special membership programs offered throughout the year are discounted
- **Fee structure is cost recovery only to cover expenses of test data administration and program administration**
- **Free/No cost for end users to download results**
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For access to SNIA Green Storage Tutorials, please visit:

- [http://www.snia.org/forums/green/knowledge/tutorials](http://www.snia.org/forums/green/knowledge/tutorials)
- OR