Tiered Storage Deployments with 24G SAS

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Agenda

- Enterprise Storage Market Update
- 24G SAS Enhancements
- Data Center Applications and Examples
- Storage Tiers Using 24G SAS
- Key Takeaways
All Enterprise Storage Exabytes (2019-2024)

SAS Connected Storage Continues Strong Growth

Source: TRENDFOCUS, August 2020 (https://trendfocus.com/)
Enterprise SSD Storage Exabytes (2019-2024)

Source: TRENDFOCUS, August 2020 (https://trendfocus.com/)
SAS Intersects New Media Innovations

Storage media is ever-changing to increase IOPS and capacity and to provide lowest cost per GB

<table>
<thead>
<tr>
<th>Innovation</th>
<th>Media</th>
<th>Focus</th>
<th>SAS’s Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>MultiLink SAS™</td>
<td>HDD/SSD</td>
<td>Performance</td>
<td>Wide Device Connections</td>
</tr>
<tr>
<td>Storage Intelligence</td>
<td>SSD</td>
<td>Performance</td>
<td>Dedicated SSD Commands</td>
</tr>
<tr>
<td>TDMR (Two-Dimensional Magnetic Recording)</td>
<td>HDD</td>
<td>Faster Write Performance</td>
<td>HDD Connectivity</td>
</tr>
<tr>
<td>HAMR (Heat Assisted Magnetic Recording)</td>
<td>HDD</td>
<td>Capacity</td>
<td>HDD Connectivity</td>
</tr>
<tr>
<td>MAMR (Microwave Assisted Magnetic Recording)</td>
<td>HDD</td>
<td>Capacity</td>
<td>HDD Connectivity</td>
</tr>
<tr>
<td>SMR (Shingled Magnetic Recording)</td>
<td>HDD</td>
<td>Capacity</td>
<td>ZBC</td>
</tr>
<tr>
<td>HSMR (Hybrid Shingled Magnetic Recording)</td>
<td>HDD</td>
<td>Capacity</td>
<td>ZBC2</td>
</tr>
<tr>
<td>Multi-Actuator</td>
<td>HDD</td>
<td>Performance (IOPs/TB)</td>
<td>Multi LUN Connections</td>
</tr>
<tr>
<td>QLC (Quad-Level Cell) NAND</td>
<td>SSD</td>
<td>Capacity</td>
<td>ZBC</td>
</tr>
</tbody>
</table>
Specifications/Enhancements Timeline

**Physical Layer**
- **SAS-2**
  - 6Gb/s link rate
  - Zoning
  - Managed cables
  - Power management
  - Cable management

- **SAS-2.1**
  - Transmitter training
  - Optical cables

- **SPL-2**
  - Transmitter training
  - Optical cables

- **SPL-3**
  - Persistent connections
  - Power primitives

- **SPL-4**
  - SAS packets
  - Fairness
  - Active PHY Transmitter Adjustment (APTA)

- **SPL-5**
  - Re-timers
  - Wide ports
  - Interleaving
  - Obsolete muxing

**SAS Protocol Layer**
- **SAS-3**
  - 12Gb/s link rate
  - Decision Feedback Equalization (DFE)
  - Transmitter training
  - Crosstalk

- **SPL-4**
  - SAS packets
  - Fairness
  - Active PHY Transmitter Adjustment (APTA)

- **SPL-5**
  - Re-timers
  - Wide ports
  - Interleaving
  - Obsolete muxing

**SCSI Command Layer**
- **SAS-4**
  - 22.5 GBaud
  - 20-bit Forward Error Correction
  - 128b/130b encoding, packets
  - Insertion loss specifications
  - SlimSAS and MiniLink connectors

- **SPC / SBC / SAM / SES / SAT**
  - SCSI evolutions for ZBC, etc.
  - Rebuild assist for SSDs

- **ZBC**
  - Support SMR
  - Zoned blocks
  - Zoned format

- **ZBC-2**
  - Dynamic zones
  - Sanitize rules
Data Center Storage Applications

- IoT
- AI and Machine Learning
- Business Analytics
- Financial Trading
- Business Transactions
- Gaming and VR
- Content Delivery
- Application Delivery
- Web Hosting
- Cloud Storage
- Social Media

Read Intensive

Write Intensive

Low Performance

High Performance
Data Everywhere (and Every Way)
Social Media Example

Navigation / Community

Stories

News Feed

Ads / Promotions

Chat
### Social Media Tiered Storage Example

<table>
<thead>
<tr>
<th>Social Media Application</th>
<th>Function</th>
<th>HW Storage Support</th>
<th>Storage Cap/Perf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OS &amp; Web Server</td>
<td>Mirrored Boot Volume</td>
<td>Low/ Low</td>
</tr>
<tr>
<td></td>
<td>Database for User data</td>
<td>SAS HDD/SSD w/RAID</td>
<td>Medium/ High IOP</td>
</tr>
<tr>
<td></td>
<td>Object Store</td>
<td>Lots of SATA devices</td>
<td>High/ Low</td>
</tr>
<tr>
<td></td>
<td>Cache for Application &amp; User Data</td>
<td>1 or 2 SSDs, Lots of DDR</td>
<td>Low / High IOP</td>
</tr>
</tbody>
</table>

And what about analytics?
With a dataset of millions of users, what can we do??
Scalable, Flexible Storage – Hot Tier

- Data center applications
  - Financial Trading
  - Gaming / VR
  - Business Transactions
  - AI and Machine Learning

- Storage requirements
  - Performance (IOPS)

- Features of 24G SAS that benefit this tier
  - Support for high-performance SAS and SATA SSDs
  - Cost-performance point ($ / IOPS)
Scalable, Flexible Storage – Warm Tier

- Data center applications
  - IoT
  - Business Analytics
  - Social Media

- Storage requirements
  - Scalability
  - Balance of capacity, performance, and cost
  - Redundancy

- Features of 24G SAS that benefit this tier
  - Dynamic scaling up to 64K devices
  - Support for high-performance SAS HDDs
  - Reliability: Multi-path fail-over, RAID
Scalable, Flexible Storage – Cold Tier

- **Data center applications**
  - Social Media
  - Cloud storage
  - IoT

- **Storage requirements**
  - Large-scale
  - Low power and low cost
  - High capacity ($/GB)

- **Features of 24G SAS that benefit this tier**
  - Flexibility to support SATA HDDs
  - Dynamic scaling up to 64K devices
  - Rack-level and data-center level reach

Cascaded JBODs (with SAS expanders) of SATA SMR HDDs
24G SAS Ecosystem Readiness in 2020

- Ecosystem is on track for SAS-4 production readiness in 2020
  - SAS-4 analyzers have been sampling since last year

- Cables and connectors: both existing and new form-factors ready for 24G SAS

- SAS-4 controllers and expanders aligned with upcoming Gen4 platform launches

- New HDD/SSD capabilities to intersect with 24G SAS ecosystem
  - MultiLink SSDs
  - Multi-Actuator
  - Hybrid SMR
  - HAMR / MAMR
Key Takeaways

- 24G SAS addresses the accelerating demand for storage
- SAS continues to innovate around the reliability of storage
- SAS architecture is optimized for scalable, flexible deployments, serviced by tiers of storage
- SAS is ubiquitous and is not going away anytime soon
- 24G SAS components are available today, with more to be announced
Thank You!

For more information about the SCSI Trade Association and 24G SAS, visit us at:

www.scsita.org

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