Scale your Data Center with SAS

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Abstract

- As SSDs become increasingly common, it’s important that you select a highly-scalable storage protocol with a strong feature roadmap designed to take advantage of the unique properties of random access, memory-based storage. During this session, storage experts will discuss how 24G SAS retains significant advantages when deployed in enterprise solutions as compared to protocols that rely on PCIe as the underlying data transport. Learn how SAS can help you in the real world with its ability to significantly scale, manageability, true HOT swap capability and error handling at a system level. Applications driving 24G SAS, the ecosystem it operates in and the underlying technology will be addressed.
Today’s Takeaways

- **Flexibility of SAS is Unparalleled**
  - Media flexibility
  - Scalability
  - System architectures

- **SAS Technology Addresses a Very Large, Growing Market**

- **SAS Continues to Evolve through Innovation**
  - Performance
  - Features
SAS – Preserving the Past, Creating the Future

**Preserve Legacy SCSI**
- 25 years of SCSI middleware

**Future Architected**
- Protocol extends to new technologies
- Serial, switchable
- SFF connectors

**Customer Choice**
- 3.5” and 2.5” form factors
- Plug compatible
- Multi-protocol

**Usability**
- Dual-ported
- Point-to-point
- Cost equal to SCSI

**Scalable**
- 1000s of connections

**Performance**
- Wide ports
- Interconnect
- MultiLink SAS™
- Low overhead
SAS & SATA Span the Storage Spectrum

- Controllers/ROCs/HBAs
- Expanders
- SAS/SATA HDDs
- SAS/SATA SSDs
- SAS/SATA tape

SAS is the Predominant Enterprise Drive Interface
Scalability in Server & Hyper-Converged Architectures

Simple DAS
- High Performance
- Inexpensive
- Modular

Extended DAS
- Pay-as-you-grow
- High Capacity
Scalability in External Storage Architectures

External Storage:
- Native High-Availability
- Modular
- Simplified, Robust Cabling
- Scales to 1000s of Devices
### Protocols Compared

<table>
<thead>
<tr>
<th></th>
<th>x1 24G SAS</th>
<th>x1 NVMe (Gen4)</th>
<th>x4 NVMe (Gen4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance (Bandwidth)</td>
<td>19.2 Gb/s</td>
<td>15.8 Gb/s</td>
<td>63.0 Gb/s</td>
</tr>
<tr>
<td>Performance (Read Latency*)</td>
<td>15.9us</td>
<td>15.7us</td>
<td>11.3us</td>
</tr>
<tr>
<td>Scalability</td>
<td>1000’s of Devices</td>
<td>10’s of Devices</td>
<td>10’s of Devices</td>
</tr>
<tr>
<td>Typical Power (Enclosure Dependent)</td>
<td>9W</td>
<td>9W</td>
<td>12-25W</td>
</tr>
<tr>
<td>Flexibility</td>
<td>12G SAS HDD&amp;SSD 6G SAS/SATA HDD&amp;SSD</td>
<td>NVMe Gen4 SSDs, NVMe Gen3 SSDs</td>
<td>NVMe Gen4 SSDs, NVMe Gen3 SSDs</td>
</tr>
<tr>
<td>Manageability</td>
<td>SES-2, SMP</td>
<td>Early Deployment</td>
<td>Early Deployment</td>
</tr>
<tr>
<td>Availability</td>
<td>Native Dual Port</td>
<td>Early Deployment</td>
<td>Early Deployment</td>
</tr>
<tr>
<td>Channel Length</td>
<td>~19” FR4, 6m Cu Cable, 300m AOC</td>
<td>~10” FR4, 1m Cu Cable</td>
<td>~10” FR4, 1m Cu Cable</td>
</tr>
</tbody>
</table>

*Latency includes OS, driver, HBA (if required) and flight time, media access times not included.*
## Today’s Bandwidth by the Numbers

<table>
<thead>
<tr>
<th>No. of Links / Lanes</th>
<th>SATA</th>
<th>x1 PCIe 3.0</th>
<th>x1 12Gb/s SAS</th>
<th>x2 PCIe 3.0</th>
<th>x2 12Gb/s SAS MultiLink SAS™</th>
<th>x4 PCIe 3.0</th>
<th>x4 12Gb/s SAS MultiLink SAS™</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>Transfer Rate per Link/Lane</strong></td>
<td>6 Gb/s</td>
<td>8 Gb/s</td>
<td>12 Gb/s</td>
<td>8 Gb/s</td>
<td>12 Gb/s</td>
<td>8 Gb/s</td>
<td>12 Gb/s</td>
</tr>
<tr>
<td><strong>Max Bandwidth</strong></td>
<td>0.6 GB/s</td>
<td>2.0 GB/s</td>
<td>2.4 GB/s</td>
<td>4.0 GB/s</td>
<td>4.8 GB/s</td>
<td>8.0 GB/s</td>
<td>9.6 GB/s</td>
</tr>
</tbody>
</table>

SAS Supplies 20% More bandwidth Per Lane

Moving forward, each of the protocols are doubling their max bandwidth.
Read Latencies Dominated by NAND Latencies (and will continue to increase)
Enterprise Unit Shipments

Worldwide Enterprise Shipments, 2016-2021

- >75% of All Enterprise Shipments through 2021 Require SAS Infrastructure

Source: IDC, May 2017
Nearline HDDs, both SATA and SAS, will be the dominant storage devices for bit growth over the coming years, ensuring SAS a long and healthy life!

SAS as one of the key protocols represents, in some way, almost all capacity shipped when combining HDD & SSD volumes.
The Promise Land of SSDs (with SAS)

Source: TRENDFOCUS, August 2017
SAS Technology Roadmap

- **First Plugfest**
  - (leading edge)

- **3Gb/s SAS**

- **6Gb/s SAS**

- **12Gb/s SAS**

- **24G SAS**

- **Next Gen SAS**

First End-User Products
- (approximately 12–18 months later)

Source: SCSI Trade Association – July 2017
Recent Innovations in SAS

- Storage Intelligence
- Persistent Connections
- Enhanced Power Control
- Shingled Magnetic Recording Support

Recent SAS Innovations - the Focus of the May 2016 SAS Plugfest
Storage Intelligence

- Streams
  - Provides hints to SSD about data sets that have similar expected lifetimes
  - Reduces intermixing of data from different applications, thus reducing fragmentation during garbage collection
  - Improves performance
  - Reduces write amplification and improves endurance

- Background Activity Control
  - Provides hints to SSD to optimize timing of background activities (e.g., garbage collection)
  - Provides more consistent performance during peak activity times

- Improved Buffering and Fairness for Mixing of Different Speed Devices
Why Shingled Magnetic Recording?

**Areal Density Accelerator**
- Much higher track density
- Overall AD growth 25%/Y vs. 15%/Y
- 65% greater maximum capacity by 2020
The Need for Speed

500 Hours of Video Uploaded Per Minute, Feb 2017
(Source: Smart Insights)

DoD Drones Capable of Capturing 430 PB/Day

Estimated 20.4B Connected Devices by 2020
(Source: Gartner)

Surveillance Cameras Capture 2.5 EB/Day in 2019
(Source: IHS Inc.)
24G SAS Objectives

- Double the Effective Bandwidth of 12Gb/s SAS
- Backwards Compatibility
  - Support for two generations of backward compatibility
  - Leverage existing ecosystem (tools, test equipment)
- Preserve the Existing SAS Value Proposition
  - Reliability – Robust error handling
  - Scalability – Scalable to 1,000s of devices
  - Flexibility – SAS infrastructure supports SAS and SATA devices
  - Serviceability – Surprise add/remove media and cables
  - Manageability – Storage management built into the standard
- Align with Next-Generation Platform Launches
Key Messages

- **Flexibility of SAS is Unparalleled**
  - Media flexibility
  - Scalability
  - System architectures

- **SAS Technology Addresses a Very Large, Growing Market**

- **SAS Continues to Evolve**
  - Performance
  - Features
  - Advanced Roadmap