SCSI Standards and Technology Update

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SCSI continues to be the backbone of enterprise storage deployments and continues to rapidly evolve by adding new features, capabilities, and performance enhancements. This presentation includes an up-to-the-minute recap of the latest additions to the SAS standard and roadmaps, the status of 12Gb/s SAS deployment, advanced connectivity solutions, MultiLink SAS™, and 24Gb/s SAS development. Presenters will also provide updates on new SCSI features such as Storage Intelligence and Zoned Block Commands (ZBC) for shingled magnetic recording.
SCSI Standards and Technology Update

- 12Gb/s SAS
- New SCSI Features
- Advanced Connectivity
- MultiLink SAS™ and U.2
- 24Gb/s SAS
SAS Spans the Storage Spectrum

**SAS Fabrics**
- SAS Expanders
- SAS Switches
- Port Multiplexers

**Direct Attach Storage**
- Controllers/ROCs/HBAs*
- SDS HBAs
- Expanders
- Storage Blades

**External Storage**
- NAS/SAN Heads
- Native SAS Connect
- Controllers/ROCs/HBAs*
- Expanders
- SAS/SATA Bridges

**HDD/SSD**
- SAS SSDs
- SATA SSDs
- SAS HDDs
- SATA HDDs
- Near-Line SAS HDDs

*SAS is the Universal Storage Interface*

*ROC = RAID on a Chip
HBA = Host Bus Adapter*
SAS Technology Roadmap

First Plugfest (leading edge)

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


3Gb/s SAS
6Gb/s SAS
12Gb/s SAS
24Gb/s SAS

Source: SCSI Trade Association – Aug 2015
12Gb/s SAS (Protocol Layer)

- 12Gb/s SAS Enabled the Intel Grantley Server Processor Launch
  - Consists of SPL-2/3 and SAS-3
- SPL-2 Published 3/2013
  - Transmitter Training
  - Enhanced Power Control
- SPL-3 Published 11/2014
  - Persistent Connections
  - Expander Forced Normal Completion of Connections

Largely SSD Enhancements
Shingled Magnetic Recording

- **Drive Managed**
  - Drive autonomously hides all SMR issues
  - Workloads can affect performance

- **Host Managed**
  - New device type
  - Extensions to ATA and SCSI command sets (ZAC & ZBC)
  - Sequential writes are required

- **Host Aware**
  - Superset of Drive Managed and Host Managed
  - Extensions to ATA and SCSI command sets (ZAC & ZBC)
  - Sequential writes are preferred

**Available Today**

**ZBC & ZAC Expected to Be Complete by the End of 2015**
12Gb/s SAS (PHY Layer)

- **SAS-2.1 Published 11/2011**
  - Managed connectivity
  - Converged high-density connectivity – Mini-SAS HD
    - SFF-8644 (external connector)
    - SFF-8643 (internal connector)
  - Active copper support
  - Optical support

- **SAS-3 Published 10/2014**
  - 12 Gb/s SAS interface
  - Transmitter training
  - x4 backplane connector
  - Optical Mini-SAS HD connector
SAS Advanced Connectivity Objectives

- Simplify Cable & Connector Options
  - 2X density improvement
- Provide Managed Connectivity Standards
  - Active copper solution to 20m
  - Optical solution to 100m
- Supports 6Gb/s, 12Gb/s & 24 Gb/s

SAS Deployments

Supply power here for active cabling

Cable provides active component for optical or copper

SAS-2.1 standardizes OOB for active cables

Passive, Active Copper, and Optical use same connector

Mini-SAS HD connectors courtesy: Project T10/2125-D Revision 04
17 September 2009, ANSI SAS-2.1
Advanced Connectivity: Managed Cables

- New in SAS-2.1, Fully Deployed in SAS-3
- OOB (Out of Band) Method of Controlling the Interface
- EEPROM (or microprocessor) in the Cable End Communicates Via I²C to the System
- Enables Support For Passive Cu, Active Cu & Active Optical Cables From a Single HBA
SAS External Cabling Solutions

100+ meters (optical)
- SFF-8674 (Mini SAS HD)
- SFF-8665 (QSFP28)
- SFF-8644 (Mini SAS HD)
- SFF-8685 (QSFP14)
- SFF-8088 (Mini SAS)

20 meters (active copper)
- SFF-8674 (Mini SAS HD)
- SFF-8665 (QSFP28)
- SFF-8644 (Mini SAS HD)
- SFF-8685 (QSFP14)
- SFF-8088 (Mini SAS)

6 meters (passive copper)
- SFF-8674 (Mini SAS HD)
- SFF-8665 (QSFP28)
- SFF-8644 (Mini SAS HD)
- SFF-8685 (QSFP14)
- SFF-8088 (Mini SAS) *

* SFF-8088 passive copper up to 10m

SAS Connectivity Management

Unmanaged

Source: SCSI Trade Association – Aug 2015

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SAS Internal Cabling Solutions

1m (passive copper)

SFF-9401 (Provides recommended pinouts to bridge from previous connectors to SAS-4 connectors)

SFF-8621 (MiniLink)
SFF-8655 (Slim SAS)
SFF-8673 (Mini SAS HD)
SFF-8643 (Mini SAS HD)
SFF-8087 (Mini SAS)

SAS-1 / SAS1.1  SAS-2  SAS-2.1  SAS-3  SAS-4

Source: SCSI Trade Association – Aug 2015
### SAS Device to Mid-Plane Interconnects

| Multi-Function (4-Port I/O) | SFF-8638 | Two 2x ports at up to 48Gb/s each  
One 4x port at up to 96Gb/s  
Four 1x ports at up to 24Gb/s each |
|-----------------------------|----------|--------------------------------------------------------------------------------|
| SFF-8639 (aka U.2) | Two 2x ports at up to 24Gb/s each  
One 4x port at up to 48Gb/s  
Four 1x ports at up to 12Gb/s each |
| Multi-link SAS™ (4-Port I/O) | SFF-8640 | Two 2x ports at up to 48Gb/s each  
One 4x port at up to 96Gb/s  
Four 1x ports at up to 24Gb/s each |
| SFF-8630 | Two 2x ports at up to 24Gb/s each  
One 4x port at up to 48Gb/s  
Four 1x ports at up to 12Gb/s each |
| Standard Dual-Port (2-Port I/O) | SFF-8681 | Two 1x ports at up to 24Gb/s each  
One 2x port at up to 48Gb/s |
| SFF-8680 | Two 1x ports at up to 12Gb/s each  
One 2x port at up to 24Gb/s |
| SFF-8482 | Two 1x ports at up to 3Gb/s each  
One 1x port at up to 3Gb/s |

**Note:**

Data rates shown will double when full-duplexed.

**Source:** SCSI Trade Association – Aug 2015
U.2 Components (formerly Express Bay)

- Multifunction Connector
- Cooling
- 25W Power
- Accessibility / Serviceability
- Traditional Drive Form Factor
U.2

- Up to 25 Watts
  - For both SAS and PCIe
- SFF-8639 connector
- PCI-SIG electrical specification

**Objectives**

- Preserve the enterprise storage experience for PCIe storage
- Meet SSD performance demands
- Serviceable, hot-pluggable Express Bay opens up new possibilities …
SAS Connector Compatibility

1 Max two links operational
2 Four links operational
3 Two or four links operational depending on host provisioning
U.2 Summary

- Preserves the Enterprise Storage Experience for PCI Express Storage
- Meets SSD Performance Demands with PCIe, SAS, or SATA
- Serviceable, Accessible Bay Offers Configurability
24Gb/s 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 & SATA Devices
  - **Serviceability** – Surprise Add/Remove Media & Cables
  - **Manageability** – Storage Management Built into the Standard
- Align with a 2019 Platform Launch
24Gb/s SAS Characteristics

- 22.5 Gbaud
- Efficient Encoding – 128b/130b
- 20 Bit Forward Error Correction
  - Targeting a 30dB channel
- Protocol & Block Level Enhancements
  - SMP priorities
  - Storage Intelligence
  - Zone Block commands
- In Flight
  - Channel model (leveraging OIF-CEI & IEEE)
  - SAS-4 transmitter training algorithm (continuous adaptation)
  - Fairness enhancements
Summary

- SCSI Standards Continue to Evolve & Adapt
- New Features for Performance & Efficiency Being Added
- Proven Stable Protocol
  - Standards updates
  - Meeting schedules
  - Discussions
- Stay Up-To-Date with the SCSI Trade Association ([http://www.scsita.org](http://www.scsita.org))
  - Press releases
  - Articles
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