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Serial ATA (SATA 3.2) & Serial Attached SCSI (SAS 3.0)

Let MindShare Bring "Serial ATA (SATA) and Serial Attached SCSI (SAS)" to Life for You through an interactive classroom style, demonstrations, and hands-on exercises. This course covers both SATA 3.2 (including SATA Express and M.2) and SAS 3.0 from a hardware design and validation perspective. Practical examples of the discovery process, transactions on the link, and error conditions help provide a great introduction for those new to this material. MindShare's established background in legacy platform design, coupled with a comprehensive understanding of the latest bus technologies, provides rich insight into the SATA and SAS designs and results in a superior training experience. This course will provide the kind of in-depth information, example implementations, and practical guidance that will give your team a running start on these topics.

You Will Learn:

- An overview of the SATA model
- To verify proper command protocol and proper FIS (Frame Information Structure) protocol from a SATA analyzer capture
- Actions taken by each SATA layer
- SATA link training sequence
- Operation and performance advantages of Native Command Queuing (NCQ)
- Details of the SATA Express implementation and features
- Details associated with the M.2 sockets and modules for SSD applications
- An overview of SAS System topology considerations
- How connections are built and the rules for handling them, such as routing and arbitration
- How the SAS infrastructure handles SCSI and ATA protocols
- The responsibilities of each design layer
- The SAS link training sequence
- How SAS problems are reported and handled
- How Expander devices build connections and handle zoning
- The differences for using SATA in a SAS topology

Course Length: 4 Days

Who Should Attend?

Hardware designers, software developers, and system validation engineers will all benefit from this course. Both hardware and software requirements of a SATA subsystem are detailed and explained through numerous examples and the use of protocol analyzer traces.

Course Contents:

PART 1: SATA

- SATA Overview
  - Evolution of Parallel ATA
  - Motivation for SATA
  - SATA Overview
- FIS Protocol Overview
  - FIS Types & Formats
  - Transport & Link Protocol Details
  - FIS Retry (Transport Layer)
  - Data Flow Control
  - Physical Layer Functions
  - Error Detection & Handling
- Command & Control Protocols
  - Command Protocol

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    - Control Protocol
    - Native Command Queuing (NCQ)
- Server Implementations
    - Port Multipliers
    - Port Selectors
    - Enclosure Services
- Physical Layer Overview
    - Initialization
    - AFE & Electrical Details
    - Link Power Management
    - Hot Plug
    - Built-In Test (BIST)
    - Cables/Connectors
- SATA Express (SATA-IO) Overview
    - Introduction to SATA Express
    - Connectors / Receptacles
    - PCIe Drives/SATA Drives/SATA Legacy Drives
- M.2 Sockets & Modules (PCI SIG) Overview
    - Introduction to M.2
    - Socket 2 & Socket 3 for SSDs
    - M.2 Supports SATA/PCIe Speeds
    - Module dimensions
    - M.2 Pinouts

PART II: SAS

- Introduction to SAS
- Introduction to Architectural Layers
- Expander Devices
- Application Layer Responsibilities
    - Discovery process
- Transport layer Responsibilities
    - Protocols
        - SSP and Error Handling
        - STP
        - SMP
    - Frames
    - IUs
- Port Layer Responsibilities
    - Call Center Model
- Link Layer Responsibilities
    - Primitives
    - Address Frames
    - Serial Support
    - Connections
    - Arbitration
    - Protocol Differences
    - ACK/NAK Protocol
    - Flow Control
- Phy Layer Responsibilities
    - Encoding, OOB, Initialization, Resets
- Physical Layer Responsibilities
    - Differential signaling
    - Inter-Symbol Interference and Compensation
    - Data rate negotiation

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- Expander Devices
  - Discovery
  - Building Connections
  - Connection Arbitration
  - Zoning
- SATA Support
  - STP Protocol
  - SATA Initialization
- Changes for SAS 2.0 and 3.0

Recommended Prerequisites:

A solid understanding of one or more storage bus protocols such as ATA, SCSI, or similar architecture is recommended but not required.

Course Material:

1) Presentation PDF handout
2) MindShare's SATA Storage Technology eBook
   Author: Don Anderson
   Publisher: MindShare Press
3) MindShare's SAS Storage Architecture eBook
   Author: Mike Jackson
4) Optional: SAS 1.0 eLearning course
5) Optional: SATA 3.2 eLearning course
6) Optional: Advanced Host Controller Interface (AHCI) eLearning course