

UFS 4.0 Architecture Training

Let MindShare bring “UFS 4.0 Architecture” to life for you

MindShare's Universal Flash Storage (UFS) course begins with a high-level view of the architecture that provides the big-picture context of the hardware architecture and software interactions. Then, we drill down into details for each aspect of the UFS architecture.

You Will Learn:

- UFS model and design goals
- Definition and functionality of the design layers
- Overview of the software stack
- Basics of the UFS Host Controller Interface model
 - Device initialization
 - How command queues are set up and managed
 - How software informs the controller of new commands and learns when commands have been completed
- Extended features defined
- Error reporting structures defined
- Definition and functionality of the physical interface to the system
 - UniPro
 - M-PHY
- Power management options for the device and the UniPro interface

Who Should Attend?

This course is hardware-oriented, but is suitable for both hardware and software engineers because the registers used to control the hardware are described in detail. The course is ideal for RTL-, chip-, system- or system board-level design engineers who need a broad understanding of UFS.

Course Length: 4 days

Course Outline:

Part 1 - Introduction

- Background and design goals
- UFS concepts and definitions
 - Small Computer System Interface (SCSI) objects and interactions
 - SCSI command set overview
- Host-Controller Interface overview
- UFS layers overview
- Host-Controller Interface (HCI) overview
 - Queue Management
 - Doorbell Head and Tail registers
 - Legacy Transfer requests
 - Multiple Circular Queues (MCQ)
 - Register overview
 - Initialization
- UFS Layers Overview
 - Application Layer
 - Commands delivered from HCI
 - Device manager overview
 - Task manager overview
 - Mechanism for Transfer requests
 - Transport Layer

- Definition of UFS Protocol Information Units (UPIUs)
- UniPro Interconnect (UIC) Layer

Part 2 – Host-Controller Interface (HCI)

- Legacy HCI Transfer Requests
 - Definition of Transfer Request Descriptors
 - Types of Physical Region Descriptor Tables
 - Command priority
 - Within a command queue
 - Between Logical Units
 - Data UPIUs
 - Transfer hints from device within data UPIUs
- Multiple Circular Queues
 - Comparison with NVMe
 - Initializing queues and supporting memory structures
 - Example of tracking queue pointers
- HCI Register Details
 - Capability, status, operational, interrupts, and error structures
- HCI Initialization
 - Set up registers
 - Initialize all 3 layers
 - Host-Device optimizations
 - Timestamps
 - Context management
 - Event alerts
 - UIC Initialization

Part 3 – Application and Transport Layers

- Simplified list of SCSI Commands supported
- Setup and use of Logical Units in device
- Exception events
- Dynamic Capacity feature to extend drive life
- Data caching feature
- Details of UPIUs
- Details of UFS descriptors, attributes, and flags, accessed with Query commands
- Extended features
 - Host Performance Booster
 - File-Based Optimization
 - Unified Memory Extension
- Error reporting

Part 4 – UFS Interconnect Layer

- MIPI UniPro overview
- Definition of terms
- UniPro Layers
 - Transport layer (L4)
 - Network layer (L3)

- Link layer (L2)
 - Flow control protocol
 - Frame acknowledgement protocol
- Phy Adapter layer (L1.5) and M-PHY (L1)
 - Transmitter operation
 - Receiver operation
- M-PHY (L1) details
 - Definition of terms
 - Signaling rates
 - 8b/10b Encoding
 - Power conservation
 - Maintaining signal integrity
 - M-PHY Module state machines
- Link Initialization
 - UniPro state machine
 - Low-speed mode startup sequence
 - High-speed mode startup sequence
 - Discovery and Configuration
 - Determine shared capabilities
 - Configure attributes

Part 5 – Power Management

- Device power management
 - Power mode states
 - Power changes
- UniPro power management
 - State machine
 - Power changes

Additional Topic – Reference M-PHY Module Interface (RMMI)

- Introduction
- Definition of terms
- Examples of operation
- Protocol throttling

Course Material:

- PDF of course slides
- Optional add-on: UFS 4.0 eLearning Course (discounted pricing applies)

Recommended Prerequisites:

Previous exposure to SCSI, and a serial transport like PCIe is very helpful. Such familiarity is expected and so those topics are not covered in detail.