IS4 - Universal Flash Storage (UFS 2.0)

This course covers UFS 2.0 , which is the enhanced version of MMC standard

OBJECTIVES

- This course explains how SCSI commands are transported over UFS.
- The hardware layer is detailed, including the analog part.
- Using UniPro as a tunnel to transport upper protocols.
- The course explains how command can be queued, enabling multi-threading.
- The course describes the low power modes.
- Secure aspects, such as secure erase and authenticated transfers are explained.
- The UFS Host Controller Interface is also covered.

A more detailed course description is available on request at training@ac6-training.com

Prerequisites

- Experience of mass-storage interface, such as SD/MMC, USB mass storage class or SATA is recommended.

Course Environment

- Theoretical course
  - PDF course material (in English) supplemented by a printed version for face-to-face courses.
  - Online courses are dispensed using the Teams video-conferencing system.
  - The trainer answers trainees' questions during the training and provide technical and pedagogical assistance.
- At the start of each session the trainer will interact with the trainees to ensure the course fits their expectations and correct if needed

Target Audience

- Any embedded systems engineer or technician with the above prerequisites.

Course Outline

OVERVIEW

- Objectives of UFS specification, relationship with MIPI
- Universal SCSI command set, transport over UFS
- Layered specification
- System model, definition of what is a Logical Unit
- Comparing UFS with MMC, highlighting the differences

M-PHY

- Architecture and operation
- Termination scheme
- Signaling schemes
- Pulse Width Modulation
- Embedding clock into the bitstream, 8b10b coding
- Control symbols
- DC-balancing, running disparity

- PHY state definition
- Transitions between states
- HS-MODE BURST Operation
- Bidirectional SYS-BURST Clocking
- Multilane Operation
- Test modes
- Electrical characteristics, eye-diagrams
- UFS requirements regarding M-PHY attributes

UNIPRO

- Overview of UNIPRO layered protocol
- UNIPRO LINK LAYER
- UNIPRO NETWORK LAYER
- UNIPRO TRANSPORT LAYER

UFS INTERCONNECT

- Clock, reset and power supplies
- Reset, power-up and power-down sequences
- Power modes, relationship with Link power states
- Logical Unit reset

UFS TRANSPORT PROTOCOL (UTP)

- UPIU generic format
- Data pacing on write transactions
- UCS related UPIUs
- Task management related UPIUs
- Query related UPIUs

SCSI COMMANDS

- Command Descriptor Block
- Detailing the INQUIRY Command
- Managing a Block cache in the device
- Detailing the REQUEST_SENSE Command
- Detailing the READ_CAPACITY Command
- READ, WRITE and PRE-FETCH Commands
- SYNCHRONIZE_CACHE Command
- Sequence to write data and verify them
- VERIFY Command
- Thin provisioning, logical block address space vs physical block address space
- UNMAP Command
- FORMAT_UNIT Command

SECURITY

- Secure mode, secure removal, Purge operation
- Device data protection
- Replay Protected Memory Block
- Security protocol commands
- Authenticated read and write sequences

UFS FUNCTIONAL DESCRIPTION

- Data transfer rules with RTT
- Boot Logical Units operation

- Logical Unit management
- Logical block provisioning
- Host device interaction
- Background operation mode
- Dynamic device capability
- Data reliability
- Context management
- System data tag mechanism
- Reporting exception events to the host

UFS DESCRIPTORS

- Descriptor, attributes and flags
- Enumeration
- Accessing descriptors

HOST CONTROLLER INTERFACE

- UTMRD list
- UTRD list, UTP transfer request descriptor, UTP command descriptor
- Implementing DMA transfer through Physical Region Descriptor Table
- UniPro / M-PHY software interface, UIC command
- Interrupt management, aggregation