



## **FC5 - MPC8641(D) implementation**

**This course covers Freescale MPC8641 and MPC8641D single- and dual-  
core Power CPUs**

### **Objectives**

- The course clarifies the architecture of the MPC8641D, particularly the operation of the coherency module that interconnects the e600s to memory and high-speed interfaces.
- Cache coherency protocol is introduced in increasing depth.
- The e600 core is viewed in detail, especially the AltiVec units that enable vector processing.
- The boot sequence and the clocking are explained.
- The course focuses on the hardware implementation of the MPC8641D.
- A long introduction to DDR SDRAM operation is done before studying the DDR SDRAM controller.
- An in-depth description of the RapidIO port and the PCI-Express port is done.
- The course highlights both hardware and software implementation of gigabit / fast / Ethernet controllers.

*A more detailed course description is available on request at [info@ac6-training.com](mailto:info@ac6-training.com)*

### **Prerequisites and related courses**

- Experience of a 32-bit processor or DSP is mandatory.
- Knowledge of the RapidIO (course [IC5](#)) and PCI Express bus (course [IC4](#)) is recommended.

### **Plan**

#### **MPC8641D OVERVIEW**

##### **Overview**

- e600 core, usage of a dual core device
- Coherency Module
- Examples of data flow through the MPC8641D
- Address map, local access windows
- Outbound and inbound address translation windows

#### **e600 CORE**

## PIPELINE

- Pipeline basics
- Introduction to e600 pipeline
- e600 pipeline implementation
- Execution serialization, purpose of the isync instruction
- Branch management
- Guarded memory
- Coding guidelines
- Performance monitor

## INTERNAL DATA AND INSTRUCTION PATHS

- L1 and L2 cache loading, hit under miss
- The MSS [Memory Sub System]
- The load fold queue
- The store miss merging advantage when several vectors must be stored
- The BIU [Bus Interface Unit]
- Purpose of sync and eieio instructions

## L1 AND L2 CACHES

- Cache basics
- e600 L1 cache : PLRU algorithm, HID0/ICTRL programming interface, way locking
- L1 data cache flush
- Transient load instructions benefits
- L2 cache organization
- L2 replacement algorithm selection, L2 locking
- Cache coherency basics
- MESI snooping sequences involving 2 e600s and a PCI Express master

## e600 PROGRAMMING

- User and supervisor registers
- The system call communication path between applications and RTOS
- Integer load / store instructions, boolean semaphore management
- IEEE754 basics
- FPU operation : FPSCR register, IEEE vs non-IEEE mode
- The EABI
- Code and data sections, small data areas benefits

## ALTIVEC

- Altivec introduction, SIMD processing
- Intra vs inter element instructions
- Altivec registers, VSCR initialization
- ANSI C extension to support vector operators, new C types, new castings, vector declaration and initialization
- Altivec implementation on the e600 : the VALU and the VPU execution units
- Data streams management
- EABI extension to support Altivec

## THE MEMORY MANAGEMENT UNIT

- MMU goals
- Enabling 4 additional BATs
- 32-bit or 36-bit real address size selection

- WIMG attributes definition, page and block access rights definition
- Page protection through VSID selection
- TLB organization, TLB software management
- Page translation : PTEG selection, tablesearch, PTE content
- Software vs hardware TLB reload
- MMU implementation in real-time sensitive applications

### **THE EXCEPTION MECHANISM**

- Exception state saving and restoring through SRR0/SRR1 registers
- Exception management
- Recoverable vs non recoverable interrupts
- Requirements to support exception nesting
- Performance monitor

### **MPC8641D INFRASTRUCTURE**

#### **RESET AND CLOCKING**

- Platform clock
- RapidIO transmit clock source selection
- Power-on reset sequence, use of the I2C interface to access a serial ROM
- Power-on reset configuration
- Boot page translation

#### **MPX COHERENCY MODULE**

- I/O arbiter
- MPX arbiter
- Transaction queue
- Global data multiplexor
- MPX interface

#### **MULTIPROCESSOR PERIPHERAL INTERRUPT CONTROLLER**

- Open PIC architecture compatibility
- Interrupt nesting
- Description of the 4 timers / counters
- Message interrupts
- e600-to-e600 interrupt capability

#### **DDR-SDRAM MEMORY CONTROLLER**

- DDR2 operation
- Command truth table
- Hardware interface
- Refresh types
- Bank activation, read, write and precharge timing diagrams, page mode
- ECC error correction
- Initial configuration following Power-on-Reset
- Address decode
- Timing parameters programming
- FCRAM interface commands

#### **LOCAL BUS CONTROLLER**

- Multiplexed 32-bit address and data transfers
- Burst support
- Dynamic bus sizing
- GPCM, UPMs and SDR SDRAM states machines

### **INTEGRATED DMA CONTROLLER**

- Priority between the 4 channels
- Support for cascading descriptor chains
- Scatter / gathering
- Selectable hardware enforced coherency
- Ability to start DMA from external 3-pin interface

### **SERIAL RapidIO INTERFACE**

- Message Unit, direct vs chaining mode operation
- RapidIO doorbell and port-write unit
- Accessing configuration registers via RapidIO packets
- Programming inbound and outbound ATMUs
- Error handling

### **PCI EXPRESS INTERFACE**

- Modes of operation, Root Complex / Endpoint
- Byte swapping
- Transaction ordering rules
- Programming inbound and outbound ATMUs
- Configuration, initialization

### **PERFORMANCE MONITOR AND DEBUG FEATURES**

- Event counting
- Threshold events
- Watchpoint facility
- Trace buffer

### **MPC8641D INPUT / OUTPUT PERIPHERALS**

### **THE ETHERNET CONTROLLERS**

- 802.3 specification fundamentals : the 3 layers PHY, MAC and control
- Frame format with and without VLAN option
- Address recognition, pattern matching
- Buffer descriptors management
- The enhanced three-speed Ethernet controllers (eTSECs)
- Physical interfaces : GMII, MII, TBI or RGMII
- Buffer descriptor management
- Layer 2 acceleration accept or reject on address or pattern match
- 256-entry hash table for unicast and multicast
- IPv4, TCP and UDP checksum verification and generation
- Quality of service support

### **I2C CONTROLLERS**

- I2C protocol fundamentals : addressing, multimaster operation
- Transmit and receive sequence

## SERIAL INTERFACE

- Introduction to UART protocol
- Description of the NS€50/16550 compliant Uarts
- Flow control signal management

## Renseignements pratiques

**Duration : 5 days**  
**Cost : 2100 € HT**



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