FC4 - MPC8610 implementation

This course covers NXP MPC8610 Power CPU

Objectives

- The course clarifies the architecture of the MPC8610, particularly the operation of the coherency. module that interconnects the e600 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 MPC8610.
- A long introduction to DDR2 SDRAM operation is done before studying the DDR SDRAM controller.
- An in-depth description of the PCI-Express port is done.
- The course highlights both hardware and software implementation of integrated peripherals.
- This course has been delivered to companies involved in the design of avionics equipments.

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

Prerequisites

- Experience of a 32-bit processor or DSP is mandatory.
- Knowledge of PCI Express bus (see our cours IC4 - PCI Express 3.0) is recommended.

Environnement du cours

- Cours théorique
  - Support de cours au format PDF (en anglais) et une version imprimée lors des sessions en présentiel
  - Cours dispensé via le système de visioconférence Teams (si à distance)
  - Le formateur répond aux questions des stagiaires en direct pendant la formation et fournit une assistance technique et pédagogique
- Au début de chaque demi-journée une période est réservée à une interaction avec les stagiaires pour s'assurer que le cours répond à leurs attentes et l'adapter si nécessaire

Audience visée

- Tout ingénieur ou technicien en systèmes embarqués possédant les prérequis ci-dessus.

Modalités d'évaluation

- Les prérequis indiqués ci-dessus sont évalués avant la formation par l'encadrement technique du stagiaire dans son entreprise, ou par le stagiaire lui-même dans le cas exceptionnel d'un stagiaire individuel.
- Les progrès des stagiaires sont évalués par des quizz proposés en fin des sections pour vérifier que les stagiaires ont assimilé les points présentés
- En fin de formation, une attestation et un certificat attestant que le stagiaire a suivi le cours avec succès.
  - En cas de problème dû à un manque de prérequis de la part du stagiaire, constaté lors de la formation, une formation différente ou complémentaire lui est proposée, en général pour conforter ses prérequis, en accord avec son responsable en entreprise le cas échéant.

Plan

MPC8610 OVERVIEW

Overview

- Key features
- e600 core
- Coherency Module
- High-speed IO interfaces
- Examples of data flow through the MPC8610
- Understanding the operation of OCeaN switches
- 36-bit internal addressing
- Address map, local access windows
- Outbound and inbound address translation windows

e600 CORE

PIPELINE

- Introduction to e600 pipeline
- e600 pipeline implementation
- Issue queue resource requirements
- Execution model
- Dispatch conditions, completion conditions
- Execution serialization
- Branch management
- Guarded memory

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 mechanism
- The BIU [Bus Interface Unit]
- Purpose of sync and eieio instructions

L1 AND L2 CACHES

- Cache basics
- Cache related page / block attributes
- e600 L1 cache
- Transient load instructions benefits
- L2 cache organization
- Cache coherency basics
- The MESI L1 data line states
- MESI snooping sequences involving the e600 and a PCI Express master
- Cache related instructions

e600 PROGRAMMING

- User and supervisor registers
- Branch instructions
- The system call communication path between applications and RTOS

- Integer load / store instructions, boolean semaphore management
- Integer arithmetic and logic instructions
- IEEE754 basics
- FPU operation
- The EABI
- Code and data sections, small data areas benefits

ALTIVEC

- Altivec introduction, SIMD processing
- Intra vs inter element instructions
- ANSI C extension to support vector operators
- Vector load / store instructions
- Vector integer instructions
- Vector float instructions
- Vector permut instructions
- Data streams management
- EABI extension to support Altivec

THE MEMORY MANAGEMENT UNIT

- MMU goals
- The PowerPC address processing
- 32-bit or 36-bit real address size selection
- WIMG attributes definition
- Process protection through VSID selection
- TLB organization
- Page translation
- Software vs hardware TLB reload
- MMU implementation in real-time sensitive applications

THE EXCEPTION MECHANISM

- Supervisor registers : MSR, DAR,DSISR
- Exception state saving and restoring
- Exception management
- Recoverable vs non recoverable interrupts
- Registers updating related to the exception cause
- Requirements to support exception nesting

MPC8610 INFRASTRUCTURE

RESET AND CLOCKING

- Platform clock
- Power-on reset sequence
- Boot page translation
- Power management

MPX COHERENCY MODULE

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

PROGRAMMABLE INTERRUPT CONTROLLER

- Open PIC architecture compatibility
- Interrupt nesting

- Description of the 4 timers / counters
- Message interrupts

DDR-SDRAM MEMORY CONTROLLER

- DDR2 operation
- Jedec specification basics
- Hardware interface
- Bank activation
- ECC error correction
- On-die termination and driver calibration
- Introduction to the DDR-SDRAM controller
- Address decode
- Timing parameters programming
- Initialization routine

ENHANCED LOCAL BUS CONTROLLER

- Multiplexed or non-multiplexed address and data buses
- Burst support
- GPCM, UPMs states machines
- Interfacing to ZBT SRAMs
- Interfacing to DSP host ports
- NAND flash controller

INTEGRATED DMA CONTROLLERS

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

PCI INTERFACE

- Bridge features
- Inbound transactions handling, Outbound transactions handling
- PCI-to-memory and memory-to-PCI streaming
- Host vs agent configuration

PCI EXPRESS INTERFACE

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

PERFORMANCE MONITOR AND DEBUG FEATURES

- Event counting
- Chaining, triggering
- Watchpoint facility
- Trace buffer

MPC8610 INPUT / OUTPUT PERIPHERALS

DISPLAY INTERFACE UNIT

- Display interfaces
- Display color depth

- Plane blending
- Utilization of area descriptor
- Moving images through the dedicated DMA channel

I2C CONTROLLERS

- I2C protocol fundamentals
- Transfer timing diagrams, SCL and SDA pins
- Transmit and receive sequence

SERIAL INTERFACE

- Introduction to UART protocol
- Description of the NS16552 compliant Uarts
- Flow control signal management

SPI

- SPI protocol fundamentals
- Transmit sequence
- Receive sequence

SYNCHRONOUS SERIAL CONTROLLER

- Independent clock and frame sync signals for each receiver and transmitter
- I2S analog interface support
- Time Division Multiplexed support

Renseignements pratiques

Renseignements : 5 jours