



FPQ8 - MPC834X implementation

This course covers PowerQUICC II Pro MPC834X processors, such as MPC8349A

Objectives

- The course focuses on the sequencer that interconnects e300, DDR SDRAM, PCI and external bus.
- Cache coherency protocol is introduced in increasing depth.
- The 32-bit e300 core is viewed in detail, especially the MMU and the cache.
- The boot sequence and the clocking are explained.
- The course focuses on hardware implementation of the MPC834X.
- A long introduction to DDR SDRAM operation is done before studying the DDR SDRAM controller.
- An in-depth description of the PCI controllers is performed.
- The course highlights both hardware and software implementation of gigabit / fast / Ethernet controllers.
- The USB interfaces are also detailed.
- Generation of a Linux image and Root File System by using LTIB can also be included into the training.
- This course has been delivered several times to companies developing avionics equipments.

A lot of programming examples have been developed by ACSYS to explain the boot sequence and the operation of complex peripherals, such as USB and Ethernet.

- They have been developed with Diab Data compiler and are executed under Lauterbach debugger.

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

Prerequisites and related courses

- The knowledge of the following interconnect standards may be required:
 - PCI, see our course reference [IC1 - PCI 3.0](#) course
 - Gigabit Ethernet, see our course reference [N1 - Ethernet and switching](#) course
 - USB 2.0, see our course reference [IP2 - USB 2.0](#) course

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

INTRODUCTION TO MPC834X

OVERVIEW

- General features
- Enhancements compared to MPC824X
- Block diagram
- Features of the MPC8343E, MPC8347E, MPC8349E and MPC8349EA

THE e300 CORE

THE INSTRUCTION PIPELINE

- Pipeline basics
- Branch processing unit
- Branch instructions
- Simplified branch mnemonics

DATA PATHS

- Load / store buffers
- Sync and eieio instruction

CACHES

- Cache basics
- Cache locking
- L1 caches
- Cache coherency mechanism
- The MEI state machine
- Management of cache enabled pages shared with PCI DMAs
- Reservation coherency
- Cache related instructions
- Software enforced cache coherency
- Cache flush routine

SOFTWARE IMPLEMENTATION

- PowerPC architecture specification, the 3 books UISA, VEA and OEA
- e300 registers
- Addressing modes, load / store instructions
- Integer instructions
- Rotate instructions : inserting and extracting bitfields
- IEEE754 basics, floating points numbers encoding
- The PowerPC EABI

THE MMU

- Thread vs process
- Introduction to real, block and segmentation / pagination translations
- Real mode restrictions
- Memory attributes and access rights definition

- Virtual space benefit, page protection through segmentation
- TLBs organization
- Pagination : PTE table organization, tablesearch algorithm
- Explanation of hash value and API field
- MMU implementation in real-time sensitive applications

THE EXCEPTION MECHANISM

- MSR, SPRG0-3, DAR and DSISR supervisor registers description
- Save / restore registers SRR0/SRR1, rfi instruction
- Exception management mechanism
- Requirements to allow exception nesting

THE DEBUG PORT

- JTAG emulation, restrictions
- Real time trace requirements
- Code instrumentation
- Hardware breakpoints

THE PLATFORM CONFIGURATION

POWER, RESET AND CLOCKING

- DC and AC electrical characteristics
- Power management control
- Reset causes
- Reset configuration words source, boot from I2C or boot from EEPROM
- PCI Host / Agent configuration, PCI1 and PCI2 arbiter configuration
- Clocking in PCI Host mode
- External clock inputs
- System PLL ratio
- Delay Locked Loop

ADDRESS TRANSLATION AND MAPPING

- Local memory map
- Local access windows
- Inbound and outbound windows definition

ARBITER AND BUS MONITOR

- External signal description
- PCI outbound window definition
- Transaction forwarding

SEQUENCER

- Coherent system bus overview
- Bus error detection
- Initialization sequence

GENERAL PURPOSE INPUTS / OUTPUTS

- Pin model
- Direction definition
- Interrupt inputs

THE DDR MEMORY CONTROLLER

- DDR-SDRAM operation
- Jedec specification basics, mode register initialization, bank selection and precharge
- Hardware interface
- Bank activation, read, write and precharge timing diagrams, page mode
- ECC error correction
- DDR-SDRAM controller introduction
- Initial configuration following Power-on-Reset
- Address decode
- Timing parameters programming
- Initialization routine

LOCAL BUS CONTROLLER

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

PCI BUS INTERFACES

- Bridge features
- Data flows : Read prefetch and write posting FIFOs
- Inbound transactions handling, Outbound transactions handling in both modes
- PCI bus arbitration
- PCI hierarchy configuration

INTEGRATED DMA CONTROLLER

- Priority between the 4 channels
- Support for cascading descriptor chains
- Scatter / gathering
- Selectable hardware enforced coherency
- Concurrent execution across multiple channels with programmable bandwidth control
- Messaging unit
- Doorbells management

INTEGRATED PROGRAMMABLE INTERRUPT CONTROLLER

- Interrupt masking
- Definition of interrupt priorities
- Interrupt management, vector register
- Requirements to support nesting
- Machine check interrupts

TIMERS

- Software watchdog timer
- Real time clock module
- Periodic Interval Timer
- General Purpose Timers, cascaded modes, capture operation

INTEGRATED PERIPHERALS

SECURITY ENGINE

- Introduction to DES and 3DES algorithms
- Data packet descriptors
- Crypto channels
- Link tables

THE ETHERNET CONTROLLERS

- 802.3 specification fundamentals
- Address recognition, pattern matching
- MII interface
- Buffer descriptors management
- The three-speed Ethernet controllers (TSECs)
- 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

THE USB 2.0 CONTROLLERS

- Multi-port host (MPH) and dual-role (DR) module
- EHCI implementation
- UTMI / ULPI interfaces to the transceiver
- OTG support
- Dedicated DMA channels
- Endpoints configuration
- Queue Element transfer descriptor
- Management of isochronous pipes

LOW SPEED PERIPHERALS

- Description of the NS16450/16550 compliant Uarts
- FIFO mode
- Flow control signal management
- I2C protocol fundamentals
- Transmit and receive sequence
- SPI protocol basics
- Master vs slave operation

Linux Target Image Builder (LTIB)

GENERATING THE LINUX KERNEL IMAGE

- Introducing the tools required to generate the kernel image
- What is required on the host before installing LTIB
- Common package selection screen
- Common target system configuration screen
- Building a complete BSP with the default configurations
- Creating a Root Filesystems image
- e-configuring the kernel under LTIB
- Selecting user-space packages
- Setup the bootloader arguments to use the exported RFS
- Debugging Uboot and the kernel by using Trace32

- Command line options
- Adding a new package
- Other deployment methods
- Creating a new package and integrating it into LTIB
 - A lot of labs have been created to explain the usage of LTIB