



## P2 - PPC440 core implementation

*This course covers the IBM Power 445 core*

### Objectives

- A boot firmware that initializes the MMU has been developed to explain the boot sequence.
- Internal debug facilities are described.
- The course focusses on 440 low level programming, especially the PowerPC EABI.
- Examples of exception handlers are provided.
- A DFT has been developed to explain how to use mac instructions.
- The Floating Point Unit operation is described.
- The PLB ports as well as debug related signals are described to facilitate the hardware implementation.
  
- This course has been delivered several times to engineers developing ASICs based on PPC440 and to engineers implementing Xilinx FPGAs containing PPC440 core(s).

Labs are compiled with Diab Data compiler and run under Lauterbach Trace32 debugger.

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

### Prerequisites

- Experience of a 32 bit processor or DSP is mandatory.

### 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.

## Plan du cours

### INTRODUCTION TO 440

- Internal architecture overview
- Connection to peripheral IPs
- Clocking
- Programming model

### THE CORE ARCHITECTURE

- Pipeline basics
- 5-stage pipeline operation
- Speculative execution, guarded memory

- Cache basics
- Data flow between external memory and caches
- Cache programming interface
- Process vs thread
- Memory Management Unit
- Translation Lookaside Buffer initialisation
- Cache control and debugging features
- Load / store buffer, speculative loads

## **BOOK E COMPLIANT CORE**

- Book E objectives
- Branch instructions
- Load / store instructions
- Semaphore management with lwarx / stwcx. Instructions
- Arithmetical and logical instructions
- The PowerPC EABI
- Cache related instructions
- 16-bit mac instructions to develop fixed point DSP algorithms
- Exception processing
- Syndrome registers updating when an exception is taken
- Core timers : PIT, FIT and WDT
- Reset

## **INTEGRATED DEBUG FACILITIES**

- JTAG emulator use
- Real time trace when the PowerPC core executes cached instructions
- Hardware vs software breakpoints

## **HARDWARE IMPLEMENTATION OF THE PPC440 CORE**

- External connections
- Clock and power management interface
- CPU control interface
- Reset interface
- External interrupt controller interface
- Instruction-side local bus interface
- Data-side local bus interface
- DCR interface

## **APU CONTROLLER**

- Connection to the native instruction pipeline
- External coprocessor module
- Software interface
- Class of instruction
- Developing a custom instruction set relying on an external coprocessor
- Floating point simple and double precision instructions