



## **P1 - PPC405 core implementation**

**This course covers the IBM Power 405 core**

### **Objectives**

- A boot firmware that initializes the MMU has been developed to explain the boot sequence.
- Internal debug facilities are described.
- OCM memory benefits compared to cache are highlighted.
- The course focusses on 405 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 PLB and OCM 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 PPC405 and to engineers implementing Xilinx FPGAs containing PPC405 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 [info@ac6-formation.com](mailto:info@ac6-formation.com)*

### **Prerequisites**

- Experience of a 32 bit processor or DSP is mandatory

### **Plan**

#### **INTRODUCTION TO 405**

- Architecture of a 405-based System-on-Chip
- Programming model, the 4 register groups GPRs, SPRs, DCRs and memory mapped

#### **THE CORE ARCHITECTURE**

- 5-stage pipeline operation
- Instructions flows through the pipeline
- Speculative execution, guarded memory, SGR register
- Serialization : prefetch barrier implementation by means of unconditional branch instructions, isync instruction
- Cache basics : organization, replacement algorithm, write policies
- Data flow between external memory and caches
- Cache programming interface
- Memory Management Unit : memory attributes definition (cache enabled / cache inhibited, copyback / writethrough)
- Translation Lookaside Buffer initialisation

- Parity control for caches and UTLB
- Cache control and debugging features
- Load / store buffer, sync instruction

## PowerPC ARCHITECTURE FOR EMBEDDED APPLICATIONS

- Branch instructions
- System call instruction
- Load / store instructions
- Semaphore management with lwarx / stwxc. Instructions
- Arithmetical and logical instructions
- The PowerPC EABI
- Cache related instructions
- 16-bit mac instructions
- Exception processing
- Critical versus non critical interrupts
- Syndrome registers updating when an exception is taken
- Core timers : PIT, FIT and WDT
- Reset

## INTEGRATED DEBUG FACILITIES

- JTAG debug
- Logic analyser connection through Mictor connectors
- The 405 instruction trace port
- Hardware vs software breakpoints

## HARDWARE IMPLEMENTATION OF THE PPC405 CORE

- External connections
- Clock and power management interface
- CPU control interface
- Reset interface
- External interrupt controller interface
- The OCM busses
- 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 instructions
- Developing a custom instruction set relying on an external coprocessor

## Renseignements pratiques

**Duration : 3 days**  
**Cost : 1650 € HT**



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