



## AT3 - AT91RM9200 microcontroller implementation

*This course covers AT91RM9200 ARM-based MCU family*

### Objectives

- The course details the hardware implementation of the AT91RM9200.
- The ARM920T operation is detailed, particularly cache and MMU.
- The boot sequence and the clocking are explained.
- Practical labs on integrated peripherals are based on I/O functions provided by Atmel.
- The course provides examples of internal peripheral software drivers.
  
- Note that ACSYS does not sell emulation probes and IDEs. Consequently this course has not been designed to convince attendees to buy a particular IDE. The unique objective consists in providing sufficient knowledge to attendees so that they can successfully design a system based on AT91RM9200.
  
- This course has been delivered several times to companies developing embedded systems, such as medical equipments.
  
- Note that an additional day on Linux porting onto an AT91RM9200 board may be appended.

A lot of programming examples have been developed by ACSYS to explain the boot sequence, the vector table and the operation of embedded peripherals.

- They have been developed with 2 different IDEs : Keil and IAR.
- Consequently for on site course, it is up to the customer to select the IDE under which labs will be run.

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

### Prerequisites and related courses

- This course provides an overview of the ARM920T core. Our course reference cours [R1 - ARM7/9 implementation](#) details the operation of this core.
- The following courses could be of interest:
  - USB Full Speed High Speed and USB On-The-Go, reference cours [IP2 - USB 2.0](#)
  - Ethernet and switching, reference cours [N1 - Ethernet and switching](#)
  - CAN bus, reference cours [IA1 - CAN bus](#)

### Environnement du cours

- Cours théorique
  - Support de cours imprimé et au format PDF (en anglais).
  - 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 AT91RM9200

### Overview

- ARM core based architecture, AMBA buses
- The main three blocks : platform, core and input / output peripherals

## THE PROCESSOR CORE

### THE ARM920T CORE

- Presentation of the core, architecture and programming model
- Operating modes : user, system, super, IRQ, FIQ, undef and abort
- ARM vs Thumb instruction sets, interworking
- Access to memory-mapped locations, addressing modes
- Stack management
- C-to-Assembly interface
- Exception mechanism, handler table
- MMU, format of page descriptor tables
- Cache operation
- Debug facilities

## PLATFORM

### INFRASTRUCTURE

- Power supplies, internal regulator
- Power-on sequence
- Clock generator, on-chip oscillator, PLL
- Boot program
- Memory controller
- Internal high-speed flash
- External Bus Interface
- Power management controller
- Advanced interrupt controller
- Parallel input / output controller
- Peripheral DMA controller

## INTEGRATED I/Os

### TIMERS

- Periodic Interval Timer
- Windowed Watchdog
- Real-time timer
- 3-channel timer / counter

### COMMUNICATION CONTROLLERS

- 2-wire interface
  - I2C protocol basics

- Transmit and receive sequences
- SPI
  - Master / slave operation
  - External chip-select
  - Transfer sequence
- USART
  - Individual baud rate generators
  - IrDA modulation / demodulation
  - RS485 support
  - Flow control
- Synchronous Serial Controller
  - I2S analog interface support
  - Time Division Multiplexed support
  - High speed continuous data stream capabilities
- Ethernet MAC
  - Full duplex vs half duplex operation
  - Accessing PHY registers, auto-negotiation
  - Receive and Transmit buffer management, buffer descriptors
  - Incoming frame filtering
- USB device
  - Full speed operation
  - Endpoint configuration
- USB host
  - Overview of the OHCI specification
  - Understanding how USB packets are prepared and scheduled for transmission, transfer descriptor
- Multimedia Card Interface (on demand)
  - MMC and SD card basics
  - Command / response protocol
  - Read sequence
  - Write sequence
  - Related interrupts