



## FA4 - i.MX6 Implementation

*This course describes the i.MX6 Dual and Quad core SoC*

### OBJECTIVES

- The course details the hardware implementation of the i.MX6 SoC.
- The course focuses on the boot sequence, the clocking and the power management strategies.
- The course explains all parameters that affect the performance of the system in order to easily perform the final tuning.
- The multiple complex units involved in multimedia management are covered in depth.
- An overview of the Cortex-A9MP core helps to understand issues caused by MMU, cache and snooping.
- Interrupt management through ARM GIC is explained through a lab.
- The course also covers the hardware implementation, particularly the DDR3 and NAND flash controllers.
  
- Note that these course outlines cover all units within the i.MX6
  - According to the actual reference chosen by the customer, some chapters may be removed.
- Products and services offered by ACSYS:
  - ACSYS is able to assist the customer by providing consultancies. Typical expertises are done during board bringup, hardware schematics review, software debugging, performance tuning.

This course is only provided on-demand; A more detailed course description is available on request at [formation@ac6-formation.com](mailto:formation@ac6-formation.com)

This document is necessary to tailor the course to the specific customer needs and to define the exact schedule.

### Prerequisites and related courses

- This course provides only an overview of the Cortex-A9MP
- Our course reference cours [R1 - ARM7/9 implementation](#) details the operation of this complex ARM CPU.
- Our course reference cours [RC1 - NEON-v7 programming](#) explains how to vectorize and implement algorithms to be executed by NEON SIMD engine.
  
- 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](#)
  - IEEE1588, reference cours [N2 - IEEE1588 - Precise Time Protocol](#)
  - CAN bus, reference cours [IA1 - CAN bus](#)
  - Memory cards, reference cours [IS2 - eMMC 5.0](#)
  - SATA, reference cours [IS3 - Serial ATA III](#)
  - PCI Express, reference cours [IC4 - PCI Express 3.0](#)

### 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

## ARCHITECTURE OF i.MX6

- ARM core based architecture
- On-chip memories
- Clarifying the internal data paths: AXI interconnect, AHB bus, peripheral buses
- Organization of a board based on i.MX6
- Memory mapping

## SYSTEM CONTROL

- IOMUX module, understanding how to select the function supported by each pin
- Pad settings
- General Purpose Input interrupt request capability

## THE ARM CORTEX-A9MP CORE - OVERVIEW

- Instruction sets
- Pipeline description
- MMU and TLBs
- Level 1 caches
- Cache coherency

## THE CORTEX-A9MP PLATFORM

- Cortex-A9MP and PL310 L2 cache IP instantiation options
- Integrated interrupt controller (GIC), detail of interrupt mapping
- AHB to IP Bridge
- AHB-to-APBH Bridge with DMA
- NIC-301 AXI interconnect

## RESET AND CLOCKING

- Power supplies
- Clock Control Module
- System Reset Controller
- General Power Controller

## DEBUG ARCHITECTURE

- Introduction to CoreSight, DAP features
- System Secure Controller SJC
- Embedded Trace Macrocell
- Cross Triggering Interfaces

## SYSTEM SECURITY

- ARM TrustZone architecture
- Cryptographic Acceleration and Assurance Module
- Secure Non Volatile Storage
- Run-Time Integrity Checker
- Central Security Unit
- Advanced High Assurance boot

## **SMART DMA CONTROLLER**

- Overview, basic script routines
- Mapping DMA requests to channels
- Channel priority definition
- Scheduler
- Instruction description
- PCU states
- Context switching

## **ACCESSING EXTERNAL MEMORIES**

- Multi-Mode DDR Controller
- General-Purpose Media Interface
- EIM unit

## **MASS-STORAGE INTERFACES**

- S-ATA II
- Ultra SDHC

## **VIDEO PROCESSING UNITS**

- A simple processing flow of Multimedia application
- Video Processing Unit
- Image Processing Unit v3
- Graphics Processing Unit 2D
- Graphics Processing Unit 3D

## **AUDIO RELATED INTERFACES**

- Overview of audio subsystem
- SSI interfaces
- Digital audio multiplexor
- SPDIF transmitter
- Enhanced Serial Audio Interface (ESAI)
- Asynchronous Sample Rate Converter
- PWM

## **PCIe CONTROLLER**

- Gen 2 operation
- 1-lane
- Configuration as Agent or Root Complex
- Interrupt management
- PHY parameterizing

## **COMMUNICATION CONTROLLERS**

- HSI
- Enhanced CSPI
- I2C interfaces
- UART
- USB
- Gigabit Ethernet Controller
- MediaLB
- FlexCAN controllers