

## IN1 - Pentium-M implementation

This course covers Intel Pentium-M X86 low power processor

### Objectives

- Optimized code writing based on pipeline knowledge.
- Data flows between SDRAM, L1 caches and L2 are explained.
- MESI cache coherency protocol is introduced in increasing depth.
- Vector instructions are viewed in detail.
- The course details the system startup sequence, particularly in multi-core platforms.
- The various modes of the memory management unit are described.
- This course has been delivered to several companies developing embedded systems.

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

### 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.

### Evaluation modalities

- The prerequisites indicated above are assessed before the training by the technical supervision of the trainee in his company, or by the trainee himself in the exceptional case of an individual trainee.
- Trainee progress is assessed by quizzes offered at the end of various sections to verify that the trainees have assimilated the points presented
- At the end of the training, each trainee receives a certificate attesting that they have successfully completed the course.
  - In the event of a problem, discovered during the course, due to a lack of prerequisites by the trainee a different or additional training is offered to them, generally to reinforce their prerequisites, in agreement with their company manager if applicable.

### Plan

#### INTRODUCTION TO PENTIUM-M

- Overview, implementation of IA-32 architecture
- Operation modes
- X86 fundamentals

## REAL MODE

- Privilege levels
- Segments
- Accessing High Memory Area
- Flat mode

## PROTECTED MODE

- Virtual memory
- X86 virtual mode
- Task management
- Segment descriptors : GDT vs LDT
- Code segment, conforming vs non-conforming segments
- Call gate utilization
- Data segment

## MULTITASK HARDWARE MECHANISMS

- Task State Segment [TSS]
- Task gate
- Task switching
- I/O space protection

## PAGE TRANSLATION

- 386 page translation
- PDE and PTE format
- Privilege level checking
- Pentium 4-MB pages
- PAE-36
- PSE-36

## VIRTUAL MODE X86

- VMM requirements
- Video frame buffer virtualization

## MEMORY TYPES

- Memory Type and Range Registers
- Page attribute table

## EXCEPTION MANAGEMENT

- Vector table
- Priority between exceptions
- Exception management in real mode
- Exception management in protected mode
- Interrupt and trap gates
- Exception return
- Exception management in VM86 mode
- Acceleration mechanisms : sysenter and sysexit instructions

## LOCAL APIC

- Interrupt management in SMP platforms
- Local interrupts
- Interrupt management sequence
- IPI generation and reception

- Message Signaled Interrupts
- MSI utilization in Pentium platforms

## POWER MANAGEMENT

- Pentium-II power management, state machine
- Pentium-M power management, deeper sleep new state
- SpeedStep technology
- System Management Mode
- Interrupt management when SMM is active
- Transition to Power-Down

## SYSTEM STARTUP

- Hardware configuration
- Processor state after a reset
- Selecting the bootstrap processor
- Configuring Auxiliary processors
- Microcode update

## INSTRUCTION PIPELINE

- Detail of the 11 stages
- Hyper-threading, Pentium-4 implementation
- CPU resource utilization
- Instruction execution steps

## CACHES

- L2 cache organization
- Hit under miss
- Miss under miss
- Squashing

## PROGRAMMING

- Mixing 16-bit and 32-bit codes
- I/O space access instructions
- Addressing modes
- SSE instructions, register set

## Renseignements pratiques

**Duration : 3 days**  
**Cost : 1750 € HT**