MoPCoM SOC/SOPC

Using MARTE in a Codesign Methodology

Modeling & specialization of Plateforms & MDA COMponents for SoC/SoPC
Outline

- **MoPCom consortium in brief**
  - Complementary points of view

- **Abstraction levels & Codesign flow**
  - Three levels of abstractions & their respective goals
  - Use of SPEM to formalize it
  - Use of **MARTE**
    - Stereotypes identified, for each level

- **Tools**
  - Rhapsody, MDWorkbench, Kermeta
  - Tools integration

- **Experiments**
  - Iterative process

- **Feedback on possible hard points related to MARTE**
MoPCoM Consortium in brief

- **Goal:**
  - use of MDA techniques & tools for SOC/SOPC

- **Industrials**
  - **Thales Airborne Systems:**
    - SoPC (FPGA)
  - **Thomson Silicon Components:**
    - SoC (ASIC)
  - **SME:** **Sodius**
    - MDA tool vendor

- **Academics**
  - **ENSIETA:** MDA
  - **IRISA Triskell team:** Kermeta
  - **Lab-STICC (formerly LESTER):** HW/SW codesign, MDA
  - **SUPELEC:** HW/SW codesign, FPGA

- **Funding:**
  - Partially by the Brittany & Pays-de-Loire region
  - Partially by ANR (National Research Agency)
  - Started in 2007
The need for MDA approach based on standards

THALES
- Common formalism for system/hardware/software
- High level approach to increase productivity
- Portability and functionality/architecture independence
- Process formalization for certification

THOMSON
- Huge complexity of emerging video standards (H264,SVC, …)
  - Almost nobody knows the standard in its entirety
  - Mixture of various interacting algorithms & constraints
  - Difficult to identify, extract, analyze, rework
- Hardware targets possibly with reuse in mind
  - Need to high performance accelerators
    - Dedicated (Hardwired) or programmable (SIMD)
  - Multi-processor
  - Complex communications infrastructures
Qualities of the required industrial process

- **Effectiveness**
  - Process must help to produce the right product, e.g. corresponding to the customer needs

- **Maintainability**
  - Intentions of the designers must be clear in order to quickly and easily make changes (improvements or faults)

- **Predictability**
  - A good process must help to plan and estimate the work, costs and risks

- **Repeatability**
  - Ad hoc processes are not replicable. It is much faster and easier to adapt an existing process model

- **Quality**
  - Ensure the product satisfies customer’s desires

- **Improvement**
  - Modeling process help its improvement

- **Tracking**
  - Modeling process help to follow its status

- **Hardiness**
Abstraction Levels and Design Flow
MOPCOM Abstraction levels

- **APA (Abstract Platform Architecture)**
  - Concurrent interacting tasks
    - Point-to-point communications
    - Models of computation: possibly multi-MoC (CSP, KPN)

- **EPA (Execution Platform Architecture)**
  - Still abstract behavioral modeling
  - **Explicit topology** of main hardware components
    - Resource sharing
  - Transaction-level (function calls) + protocols

- **DPA (Detailed Platform Architecture)**
  - Detailed platform, cycle-accurate & pin-accurate
  - Accurate measures and possible feedback on previous levels
  - Enable VHDL code generation
Increasing level of details in the platform
- Application should remain unmodified as much as possible

MoPCoM Codesign flow
Resort to SPEM (System and Software Process Engineering Modeling)

- The MoPCoM project aims at tooling a codesign process based on a UML/MDA approach
- Indeed, this process must be described using well-adapted formalisms,
- In order to formalize the MoPCoM approach, we use a modified SPEM profile that addresses the MDA concerns,
- The process model capitalizes know-what and know-how,
- At each stage, roles, activities, models and relationships among them are described and documented
**MARTE usage**

- **Huge set of concepts**
  - roughly 30 packages, 150 stereotypes, 100 types, >500 attributes
- **No methodology** to support activity based on MARTE
How MARTE is used

- **APA level**
  - Packages General Resource Modeling & RTMoCC
  - Package NFP_Constraint

- **EPA level**
  - Packages Software Resource Modeling and RTMoCC
  - Package Hardware Resource Modeling + HWLogical and RTMoCC
  - Package Allocation and NFP_Constraint

- **DPA level**
  - Packages Software Resource Modeling and RTMoCC
  - Package Hardware Resource Modeling + Physical and RTMoCC
  - Package Allocation and NFP_Constraint
  - Time
MDA tools in MoPCoM
Tools interactions

Kermeta  
(metamodelling)

Rhapsody  
(modeling)

MDWorkbench  
(transformation & generation)

Process, MARTE Profile, Properties (.prp, .xml, .ini)
Connectors RW

Metamodels (.ecore)

Models
Properties

Connectors R/W

UML models

Rules & Templates

Excel Models (.csv)

Code VHDL (.vhd)
Documents (.doc)
Others (*.*)

Design of the flow – Use of the flow

DATE 2008 – Friday, 14 March
Integrating MARTE in Rhapsody

MDWorkbench

MARTE Profile

UML 2.1 model

*.xmi

UML 2.1 model

Rhapsody model

MDW rules

Word document

Doc MARTE

Doc Mapping

MARTE Profile Rhapsody format

MARTE Scripts MDW format

UML 2.1 / Rhapsody

DATE 2008 – Friday, 14 March
Kermeta: metamodelling

- Language extension of EMOF
- Framework to create metamodels
- Test their operational semantics
H264 experiment at DPA

Abstraction levels

Allocation

C++ used as action language
Feedback on potential improvements
Potential improvements

- **Allocations tooling**
- **Action semantics**
  - Essential for the capture of algorithms
  - Need to be defined

- **The notion of MoC appears in MARTE but…**
  - They should be connected to the behavioral descriptions
  - Synchronous languages as the semantic glue?

- **Need for more than ’90 VHDL graphical tools**
  - Banished from many design teams
  - Clear need for behavioral synthesis
    - Catapult?
    - Gaut?
  - Or rely on generic components
    - DMA → Kernel → DMA
    - control/data/communications

DATE 2008 – Friday, 14 March
Conclusions

MoPCoM (www.mopcom.fr)

- Interest of two main industrial partners for SoC/SoPC using MDA+MARTE

- Some paths described on
  - How to integrate the tools in a usable environment

- Very first experiments of MARTE on codesign

MARTE

- Right elements to support a codesign framework
Thanks a lot!

Questions?