From UML to SystemC: Intensive signal processing application

Jean-Luc Dekeyser

dekeyser@lifl.fr

http://www.lifl.fr/west/

« Y » model for SoC design

- 3 models
  - ISP applications
  - Target architectures
  - Mapping of applications on architectures

- Model separation allows reuse
- Typical programming techniques in SoC design

User applications

Models

Compilers → VC
Model Driven Engineering

- Model Driven Architecture (MDA) approach for SoC design
- PIM to PIM transformation mapping/scheduling
- Automatic generation of high-level SystemC specifications from ISP description
  - PIM to PSM transformation
  - Platform description model of SystemC ISP domain
- Profiling and performance evaluation
- Toward SW/HW co-design
  - Modeling at different abstraction levels
  - Ensures bit accuracy and cycle accuracy
  - Industrial IP libraries (VIPLibrary:ST, ARM, ...) and academic (SoCLib)

The “Y” Model and MDA: Metamodel View

*Distributed Process Network
Model Driven Engineering for ISP

- MOF domain
- UML Profile
- Metamodel application
- Platform description
- Mapping rules
- SystemC code generation
- Ptolemy
- Refinement
- PIM
- PSM
- Internal representation

Model to Model Transformations ISP ⇔ SystemC

- Application High Level Modeling (UML 2)
- UML2 metamodel
- ISP metamodel
- SystemC metamodel
- SystemC transformations rules
- C++ Code
- Model transformation engine
- Hardware transformations rules
- Hardware metamodel
- save/load
Status

- Visual modeling of Intensive Signal Processing Application
- Eclipse Plugin
- Metamodel and UML profile of ISP
- Model to model transformation and code generation
  - UML TAU G2 <-> ISP
  - ISP -> SystemC
- ISP domain in SystemC (KPN execution model)
- Distributed SystemC runtime
  - Socket
  - Corba
- Multi abstraction level SystemC simulation

Application PIM: ISP Example
BiProcessor with SAM

\[ s : \text{SAM} \]

\[ b : \text{Bus} \]

\[ p_1 : \text{Proc} \]

\[ p_2 : \text{Proc} \]
Distributed SystemC in CORBA

- IPs are available on server hosts
- Each IP or IP group must be encapsulated in a SystemC module (corba_server_if)
- Transport object: remote method invocation on CORBA bus (set/get on ports)
- Clocked modules to support synchronization of distributed IPs

SystemC multi-abstraction level

- What: Connecting together IPs described at different abstraction levels
- Why: Easy and fast simulation platform with existing IPs
- How: Data conversion and protocol conversion
  - Construction of level adapters by rule compositions (No library)
    - Transformation rules (transformation of the ports)
    - Association rules (transformation and definition of ports protocols)
Future works

- A Full « Y-model »
  - Extend ISP model with control-flow model (esterel)
  - Hardware hierarchical specification (Syndex oriented)
  - Mapping specification and optimization techniques
- A MDA style
  - MOF definition of metamodels
  - MDATransf tool
  - Mapping rules towards Esterel/scade
  - PDM of SystemC ISP domain
  - Multi-language PSM, Multi-PSM

Collaborations

- UML2.0 Profil
  - P2I Itia Project
  - PROTES (Carroll Inria, CEA, Thales)
  - Standardisation action at OMG
- Around SystemC
  - Collaboration with Irvine (D Gajski) SpecC
  - TIMA Grenoble (Dynamic scheduling)
  - Soclib
  - EuroSoc
  - ECSI