

# *ARTIST2 – Year 1 Review*

*Grenoble, October 3rd-4th, 2005*

*Cluster*

## Modeling and Components

*Bengt Jonsson, Uppsala: Cluster coordinator*  
*Susanne Graf, VERIMAG: Platform on M&C*  
*François Terrier, CEA: UML for RTES*

# Outline of the Presentation

## **Description of the Area**

- Main Research Trends
- Industrial Applications

## **State of Integration in Europe**

- Interaction of the Cluster with other Communities
- Main Aims for Integration through Artist2

## **Presentation of the Cluster**

- Core and Affiliated Partners, Competencies and Roles
- Research Activities & Platform
- Spreading Excellence & Mobility

## **Overall Aims and Achievements, Vision for the Cluster**

- Aims and Achievements
- Vision and Long-Term Goals
- 18 month work programme

# Motivation: Component Technology

## Advances in last decade

- ❖ Widespread component technologies w. syntactic interface declarations, platforms (.NET, Java EB, ...)
- ❖ Domain-specific technologies for RTES (Koala, ...)

## Missing

- ❖ Support for Behavioral & Non-functional properties (QoS, ...)
  - Specification (contracts)
  - Enforcement, Prediction of System properties
  - Support by tools
  - Standardized notations

## Ongoing Work in Various Institutions

- ❖ Techniques and tools for analyzing system properties,
- ❖ Development of component models f. various applications,
- ❖ Standardization of notations

## Technology f. Model Driven Design

### ❖ Modeling Languages and tools:

modeling, code generation, simulation, test generation

- UML-based: Rhapsody, Tau, Rational, ...
- Synchronous Languages: Esterel, Scade, Sildex, ...
- Control: Matlab/Simulink/Stateflow

### ❖ Virtual prototyping tools

- Ptolemy, Simulink/Stateflow, Boldstroke, ...

### Some Missing Pieces

- Interoperability between tools/modeling notations, e.g., for **design of heterogeneous systems**,
- Behavioral and extra-functional properties:
  - Handling implementation platform dependency/portability*
  - V&V across wide range of environments, scenarios, e.g., by formal techniques.*

# Some Industrial Applications

## ❖ Automotive industry

- Integration of Software Components on single ECU,
- Software Components may be distributed
- Timing and Resource Analysis
- Preventing Interference between Software Components
- Ongoing Work: EEA-EAST, AUTOSAR

## ❖ Industrial automation

- Large complex real-time systems, w hard temporal, MTBF, req.s
- Desire: Allow integration of 3<sup>rd</sup> party components,

## ❖ Consumer Electronics

- Challenge: manage many variations and versions of the products
- Separation of product development from components development in order to achieve component reuse
- Prediction of Extra-Functional Properties (QoS, resources)

# State of Integration in Europe

## ❖ Existing Work Directions

- Representation of non-functional properties in design,
- Standardization of design notations
- Techniques and Tools f. specification and analysis of functional and non-functional system properties
- Methodologies for handling system properties in specific applications (e.g., Real-Time Systems with FP Scheduling)
- Technology for Model-Driven Engineering (e.g., Model Transformation)
- Frameworks and theories for component-based system design,  
*Compositional Analysis of System Properties*  
*Heterogeneous system design*

# Main Aims for Integration

## ❖ Aims

- Connect teams focusing on representation in design notations  
*w. teams working on tools for specification and analysis*
- Drive standardization of design notations
- Develop fundamental theory/concepts for component-based design

## ❖ Means

- Bridges between existing tools
- Standardization work in OMG
- Seminars/Workshops to exchange/converge on views, focussed research on specific issues

## ❖ Obstacles and Opportunities

- Limited funding -> catalyze initiation of larger projects w. tool activity

## Cluster Members

- Core Partners:

- CEA
- France Telecom R&D
- INRIA
- Uppsala
- VERIMAG

- Affiliated Partners

- Aalborg
- Cantabria
- Dortmund
- EPFL Lausanne
- Mälardalen
- OFFIS
- Timisoara

- Industrial Affiliates

- ABB
- ARTiSAN
- DaimlerChrysler
- Thales



## Cluster Expertise

- **CEA:** Modeling, Model Transformation, UML, Test case generation
- **France Telecom R&D:** ,V&V, Performance Analysis, Architecture
- **INRIA:** MDE, Contracts,
- **Uppsala:** Semantics, Verification, Compositionality
- **VERIMAG:** Semantics, Design of RTES, Tools for Design and Validation, Verification and Testing
- **Aalborg,** Modeling, Testing, Verification, Tools
- **Cantabria** Scheduling, Modeling, UML.
- **Dortmund** V&V Tools, Tool Integration
- **EPFL Lausanne** Timed and Hybrid Systems, V&V, Contracts
- **Mälardalen** Architecture, Component-Based Development
- **OFFIS** Modeling, V&V, Semantic Foundations,
- **Timisoara** Specification and Verification of Timing Properties.

# Cluster Activities

## 1. JPRA: Component Modeling and Composition

- Develop understanding of and general techniques for handling *heterogeneity, resources, behavior, timing, QoS, composability*  
core participants: Uppsala, CEA, FTRD, INRIA, VERIMAG

## 2. JPRA: UML for Real-Time Embedded Systems

- Handling central aspects of RTES in UML based notations  
integrating results on component modeling and composition  
core participants: CEA, INRIA, VERIMAG

## 3. JPIA: Platform for Modeling and Components

- Connecting existing pieces into a platform for modeling real-time systems.
  - Modeling front-end(s) for RT-UML*
  - Validation and analysis tools*
  - Code Generation tools*
- core participants: VERIMAG, CEA, FTRD, INRIA, Uppsala

# Spreading Excellence

- ❖ SVERTS workshop at UML 2004
- ❖ Workshop, KeyNote at EuroMicro 2005
- ❖ Tutorials at
  - ICSE 2005 on Component-based Design
  - Int. School on MDA, Brest, 2004.
  - Int. School on Formal Methods for the Design of RT Systems, Bertinoro, 2004.
- ❖ Book:
  - Component-Based Software Engineering [TU Eindhoven/  
Mälardalen, in progress]
- ❖ FMCO (Formal Methods for Components and Objects) 2004
- ❖ ARTIST2 Summer School, Uppsala, Sept. 2005
- ❖ Workshops at Models 2005 (now)

# Overall Aims and Achievements

- ❖ Common Understanding of Basic Issues in Component-Based Design
  - Establishment of Several Research Collaborations, e.g.,  
IF for components <-> Metropolis
- ❖ Connection between Tools
  - Promotion of interconnections between tools (IF, KerMeta, TIMES, ...)
  - Catalyze initiation of larger research projects
- ❖ Drive standardization of design notation
  - Submission process in progress [MARTE at OMG]
  - Setup of submission team [ProMarte]

## Vision and Long-Term Perspective

- ❖ Development of Well-Understood Principles for Component-Based Design of Embedded Systems
- ❖ Working Connections between Tools for various design activities
- ❖ Successful Submission, answering the RFP MARTE at OMG.

## 18-Month work Programme

- ❖ Identification of Common Issues with other clusters
- > Merge with HRT Cluster to form New Cluster:

### **Real Time Components**

- ❖ Activities from previous cluster
- ❖ Platform
- ❖ Standardization