

MARTE InfoDay: INTRODUCTION

L. RIOUX (THALES)

Around 3 years ago at burlingame

- 26 January 2005



➔ **MARTE RFP Voted at RTESS**



**RTE
Domain**

MARTE: A bridge between UML and RTE

Unified Real-Time and Embedded language

- Remind: Why UML was borned ?
 - Too many Object-Oriented approaches
 - Too many Object-Oriented languages
 - Too many different tools
 - Need to train engineer to a lot of different tools and languages
 - Need to have abstract view to help to design OO software systems.
- ➔ Need to unified all these languages around a unique, common and shared language: UML
- For RTE systems, it is the same situation:
 - Too many specific Real-Time and Embedded approaches
 - Too many RTE languages
 - Too many different tool
 - Big Problem of tools, languages approaches interoperability.
 - Engineers need to understand the specification
 - Same issues than before UML, then same solution:
 - ➔ **NEED A Unified Modeling Language for RTE Systems**

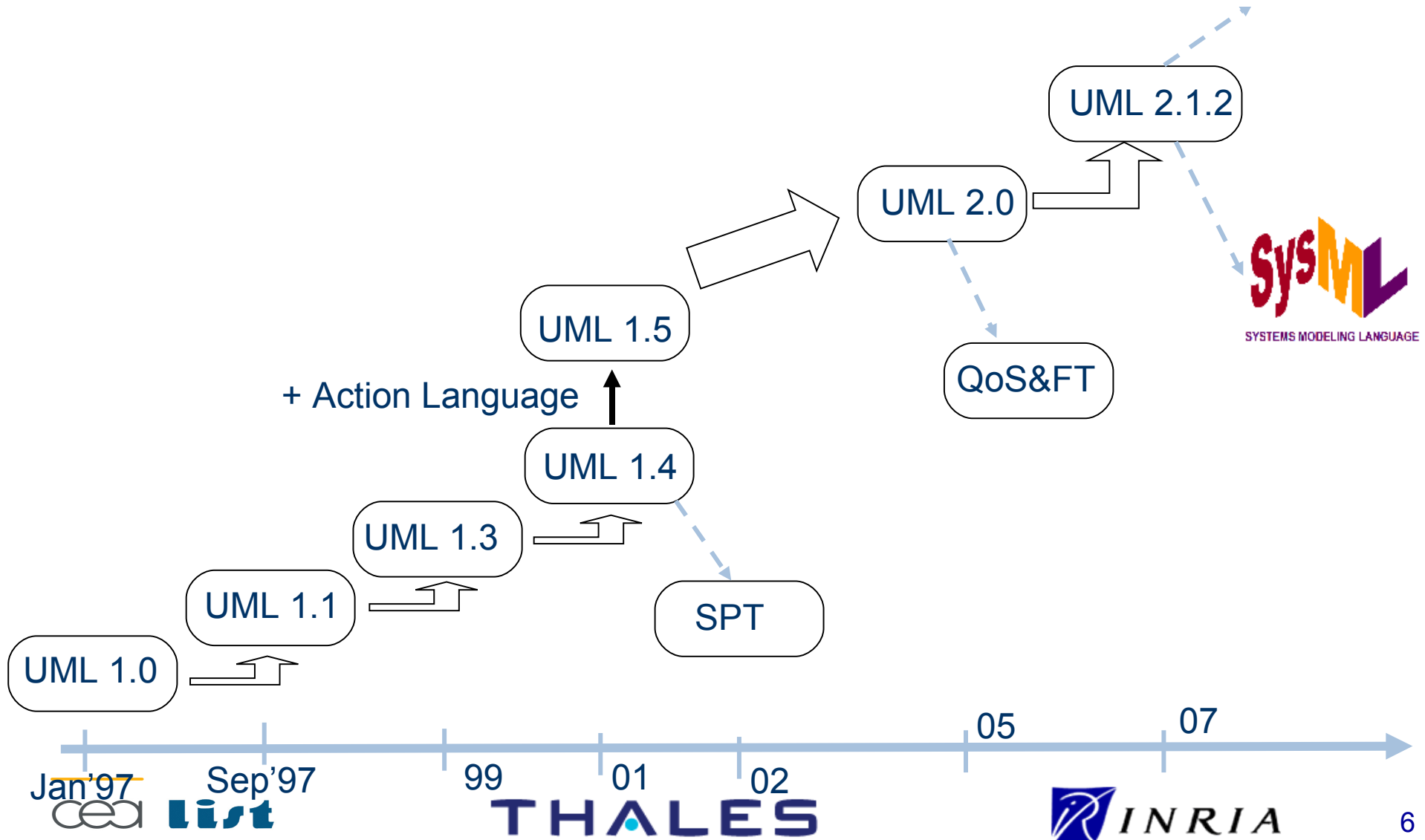
- **Benefits expected (by THALES) for a Unified Language in RTE systems:**
 - Tools interoperability
 - Choose the best tool, not the best language or approach.
 - Concentrate effort of the tool, not on the language and the approach
 - Increase competition between tool vendors.
 - Easier to train System and software engineers to a unique language
 - Help to Share specification, documents, ...
 - Possibility to define a unique corporate methodology to design and validate RTE systems
 - Less investments for a Tool'Up process for RTE Systems
 - all methodology customizations can be done around a unique language (less cases to take into account).
 - Based on UML
 - Junior engineers come with UML knowledge
 - UML has proved its benefits
 - The most adopted graphics language in the industry to design systems and software.
 - All new benefits of UML will provide benefits to all language based on UML
 - Capabilities to use all MDA technologies
 - Compliant with the MDE approach.

- **UML: Unified Modeling Language**
- **SysML: UML profile for System Engineering**
- ➔ **1st Standard UML for system Engineering**

- **MARTE: Modeling and Analysis of Real-Time and Embedded systems**
- ➔ **1st OMG Standard UML based for Modeling RTE systems**

INITIATIVE Launched by THALES, INRIA and CEA :

- ➔ **INRIA-Aoste, INRIA-Expresso, INRIA-DaRT**
- ➔ **CEA-LIST**



- **“The UML profile for MARTE addresses modeling and analysis of real-time and embedded systems, including their software and hardware aspects”**
- **Key features**
 - Provides support for non-functional property modeling
 - Adds rich time and resource models to UML
 - Defines concepts for software and hardware platform modeling
 - Defines concepts for allocation of applications on platforms
 - Provides support for quantitative analysis (e.g. scheduling, performance)
 - Complies with UML 2.1.x and other existing OMG standards
 - Replaces the UML SPT profile 1.1
- **MARTE specification adopted in June 2007**
 - Beta document available: <http://www.omg.org/cgi-bin/doc?ptc/2007-08-04>
 - Finalization Task Force comments deadline: December 22nd 2007

- **MARTE is composed by an infrastructure (foundations):**

- Non-Functional Properties modeling (NFPs)
- Time modeling (Time)
- Generic Resource Modeling (GRM)
- General Component Model (GCM)
- Allocation modeling (Alloc)

- **Independent Modeling sub-profiles:**

- RTE Model of Computation & Communication (RTEMoCC)
- Software Resource Modeling (SRM)
- Hardware Resource Modeling (HRM)

- **Independent Analysis sub-profiles**

- Generic Quantitative Analysis Modeling (GQAM)
- Schedulability Analysis Modeling
- Performance Analysis Modeling (PAM)

The PROMARTE TEAM:

■ Tool vendors

- ARTiSAN Software Tools*
- International Business Machines (IBM)*
- Mentor Graphics Corporation*
- Softeam*
- Telelogic AB (I-Logix*)
- Tri-Pacific Software
- No Magic
- The Mathworks

■ Industrial companies

- Alcatel*
- France Telecom
- Lockheed Martin*
- Thales*

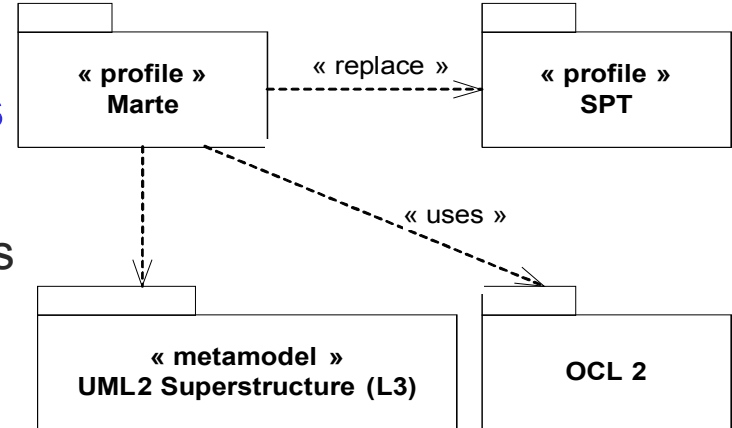
■ Academics

- Carleton University
- Commissariat à l'Energie Atomique
- ESEO
- ENSIETA
- INRIA
- INSA from Lyon
- Software Engineering Institute (Carnegie Mellon University)
- Universidad de Cantabria

- * Submitters to the OMG UML for MARTE RFP

■ Relationships with generic OMG standards

- Profiles the UML 2 superstructure meta-model
- Uses OCL 2 for description of domain constraints



■ Relationships with RTE specific OMG standards

- The UML profile for Modeling QoS and FT Characteristics and Mechanisms
 - Addressed through MARTE NFP package
- The UML profile for SoC
 - More specific than MARTE purpose
- The Real-Time CORBA profile
 - Real-Time CORBA based architecture can be annotated for analysis with MARTE
- The UML profile for Systems Engineering (SysML)
 - Specialization of SysML allocation concepts and reuse of flow-related concepts
 - Ongoing discussion to include VSL in next SysML version
 - Overlap of team members

- **MARTE Overview**

■ Time Modeling:

- Any thing related to time may explicitly refer to a clock
- Time is multiform (not limited to “physical” time)
- Support distribution, clock uncertainties
- Design vs. Runtime clocks

→ Support synchronous clock

■ Non Functional Properties (NFP)

→ Value Specification Language (VSL)

- New standard language for Non Functional Properties
- Extensible with the VSL
 - Good discussions to introduce this language in UML or SysML

■ Introduced to cope with various component-like models

- UML2, SysML, Spirit, AADL, Lightweight-CCM, EAST-ADL2, Autosar, ...
- Relies mainly on UML structured classes, on top of which a support for SysML blocks has been added
- Provide a support for Lightweight-CCM, AADL and EAST-ADL2, Spirit and Autosar
- Support control flow and data flow architecture

■ Allocations

- Allocate an application element to an execution platform element
- Refine a general element into specific elements
- Align with the SysML allocation definition

- **Logical view (functional modeling)**
 - Provides a description of functional properties
 - Based on a functional classification of hardware resources:
 - HwComputing resources
 - HwStorage resources
 - HwCommunication resources
 - HwTiming resources
 - HwDevice resources
- **Physical view**
 - Provides a description of physical properties
 - HwLayout, HwPower

■ Scheduling Analysis

- Modeling for analysis techniques taking into account scheduling aspects
 - Provides high-level analysis constructs
 - Sensitivity analysis, parametric analysis
 - Observers for time constraints and time predictions at analysis context level
 - Supports most common scheduling analysis techniques
 - RMA-based, holistic techniques and modular techniques

■ Performance Analysis

- Supports most common performance analysis techniques
 - Queuing Networks and extensions, Petri Nets, simulation

- **MARTE provide following libraries:**
 - OSEK/VDX OS
 - ARINC-653

- **MARTE Guidance for AADL applications (see later)**

- **MARTE is just a Language !! (UML extensions)**
 - Offer you standard concepts
 - You have to define your methodology and your tools adaptation
- **MARTE do not tell you:**
 - How to design your real-time and embedded systems
 - How to model your RTE systems for Analysis purpose
 - How to model you RTE system for System C generation or ARINC.
 - How to model in abstract way your RTE system Hardware

10:00 – 10:30 Non-Functional Properties Language, *Huascar Espinoza, Doctor, CEA*

10:30 – 11:00 Time Mode, *Frederic Mallet, professor assistant, INRIA*

11:00 – 11:30 Resources Modeling, *Sebastien Gerard, Doctor, CEA LIST*

11:30 – 12:00 Generic Quantitative Analysis Modeling, *Murray Woodside, Professor, University of Carleton*

12:00 – 14:00 Lunch

14:00 – 14:45 Performance Analysis, *Murray Woodside, Professor, University of Carleton*

14:45 – 15:15 Scheduling Analysis, *Julio Medina, Doctor, University of Cantabria*

15:15 – 15:30 Afternoon Break

15:30 – 16:30 Early Adopter Case Study: MARTE Experimentation in Industry

Using MARTE to Design an Avionic System – *Sebastien Demathieu - THALES*

16:30 – 16:50 PapyrusUML / MARTE, *Sebastien Gerard doctor, CEA-List*

16:50 – 17:15 MARTE/AADL Support Demonstration, *Laurent Rioux, Doctor, THALES*

17:15 – 17:30 Conclusions - *Laurent Rioux, Doctor, THALES*