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UML profile for MARTE RFP (Modeling and Analysis of Real-Time and Embedded systems)

INRIA, THALES, CEA

cea list THALES INRIA

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Objectives

- **Modeling**
  - Behavior / Operational Semantics of applications (Software)
  - Structural description of implementation platforms (Hardware)
  - Allocation
- **Complement works on ADL modeling**
  - AADL, SysML, UML4SoC
- **… and beyond the profile**
  - Create an environment for analysis, optimization, validation/test, code generation for Embedded Systems

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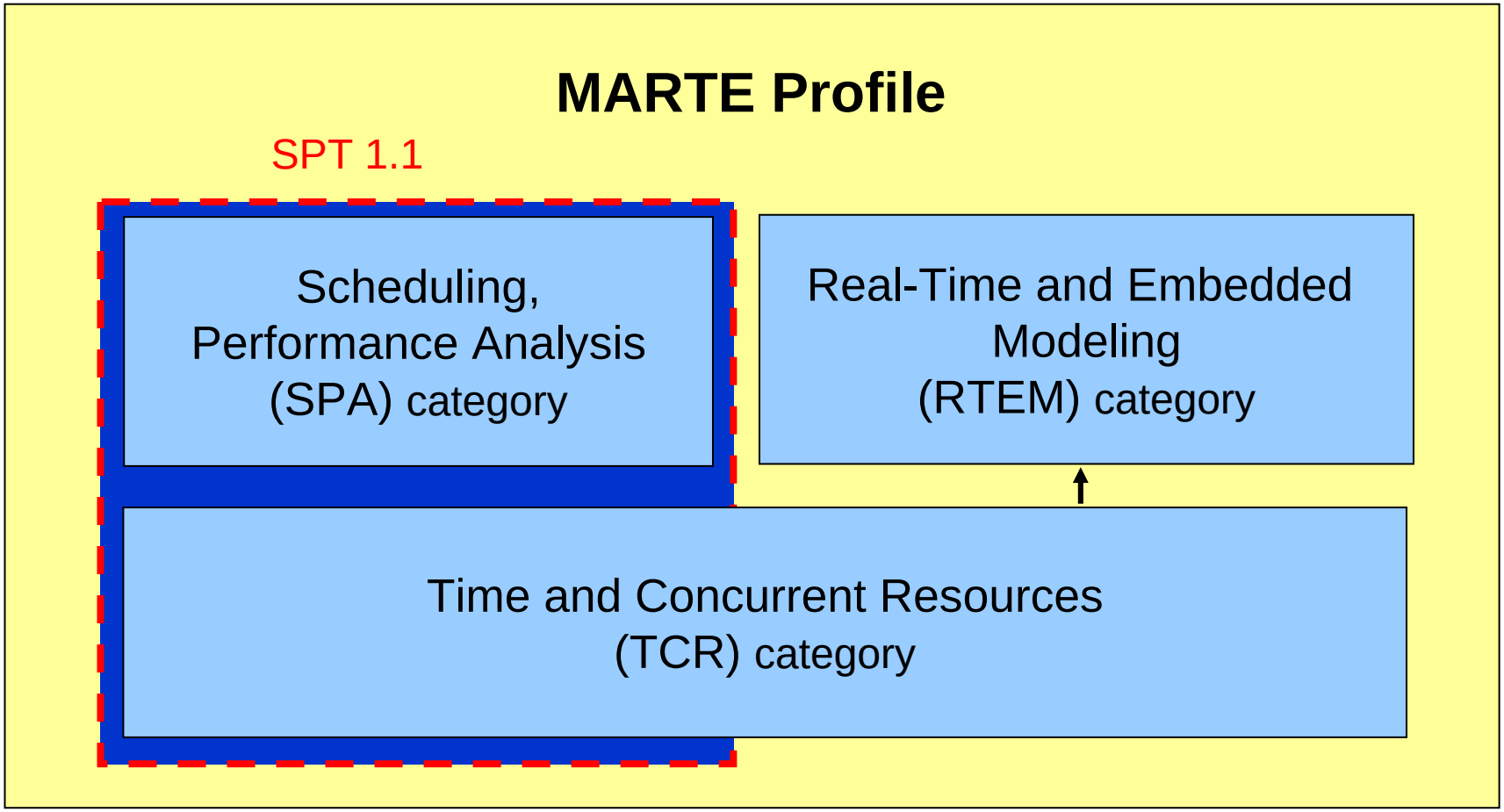
General Requirements

- **UML Profile for modeling and analysis of real-time and embedded (MARTE) systems including its software and hardware aspects**
  - The Proposals will define a UML profile
    - Relying on a conceptual model definition
  - It shall be possible to use independently software and hardware parts of the profile
  - It shall comply with standards
    - UML 2.0
    - UML profiles for QoS&FT, Testing
    - Forthcoming UML profile for SE (SysML)
  - It shall update the SPT profile 1.1

MARTE Profile architecture



Requirements for TCR category: Time, Concurrency and Resources (1/2)

- **Time models**
  - Asynchronous / Synchronous (discrete) / Real-time
    - Asynchronous/Causal
    - Synchronous/Clocked: simultaneity, priority
    - Real-time/Continuous: time and performance specification, measurement
- **Clock synchronization for concurrent applications**

Requirements for TCR category: Time, Concurrency and Resources (2/2)

- **Define modeling entities to specify tasking models**
- **Support concurrency models**
- **Support for deployment**
  - *software on hardware, application on tasking models*

- **Resources model to provide an abstract view of hardware architecture**
- **Define high-level modeling constructs for factorization of repetitive structures** *(for both hardware and software)*

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SPA category

- **Support for modeling different kinds of duration model**
  - WCET, BCET, ACET, etc.
- **Support for describing parameterized expressions for performance and schedulability annotations**
  - QoS, Scheduling policy
- **Support for multiple delay requirements for any timing interval**
  - Deadline, percentile, mean, variance, distribution, etc.

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RTEM category:
Embedded requirements

- **Shall define specific embedded QoS**
  - power consumption, program size, data size, memory budget, etc.

- **Support at least fully static resources allocation to the application:**
  - For applications completely known at compile-time,
  - Where processing does not depend on consumed data

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RTEM category: *Behavior Requirements*

- **Provide the means to specify models of computation (MoC), in relation to a specific time model from the TRC sub-profile, for data-flow and control-flow,** *and their interactions*
  - Synchronous reactive, Discrete time, Synchronous dataflow, …
- **Support fully deterministic behavior modeling**
  - Reproducible behavior amenable to formal analysis

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RTEM category: *Structure Requirements*

- **High-level modeling constructs for factorization of repetitive structures** for both hardware and software, and their allocation
- **Support allocation modeling on hardware abstractions**
  - software portability and reuse across hardware devices
- **Support component-based RTE hardware architecture modeling, using TCR hardware resource models**

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RTEM category: Illustration of requirement #23

- **Field: intensive computation embedded systems**
  - Lots of computations, possibly in parallel
  - Several computation units
- **Applications domains**
  - Signal processing, image processing, mobile devices
- **Concepts**
  - Repetition of structural elements (possibly multi-dimensional)
  - Topological description of relations between repeated elements
  - Compact expression
- **Unique factorization mechanisms for modeling**
  - Hardware: available parallelism
  - Application: potential parallelism
  - Allocation relationships

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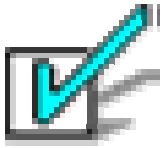
Roadmap

- RFP voted at Burlingame (February 2005)



- LOI: June 05 (Boston meeting)
- Initial submission: November 05
- Revised submission: June 06
- Vote : September 2006