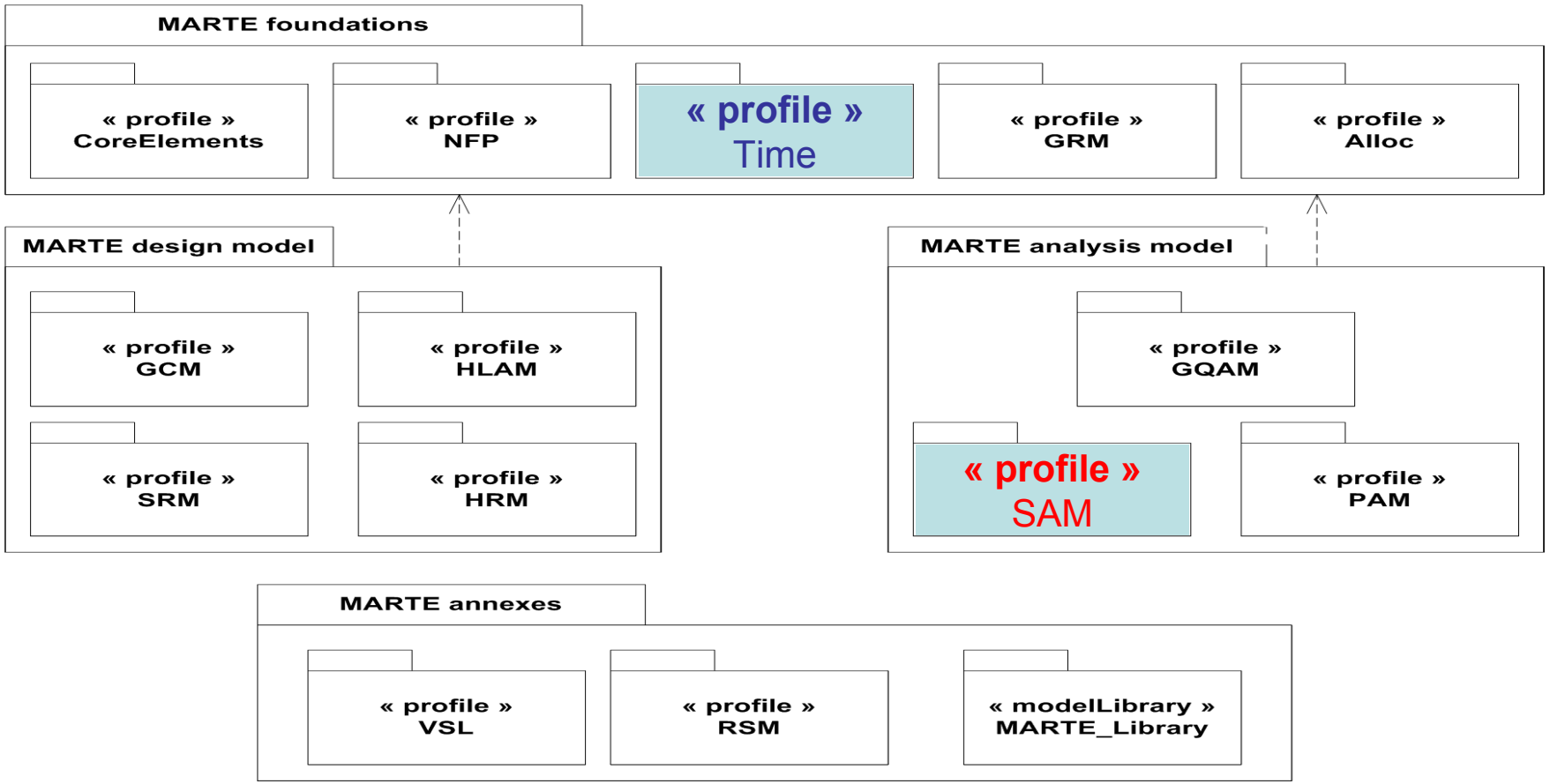
Clock Calculus in MARTE

Frédéric Mallet
Université de Nice Sophia Antipolis
Aoste – INRIA/I3S

OMG UML2 Profile for MARTE

- **M**odeling and **A**nalysis of **R**eal-**T**ime and **E**mbedded systems
  - Beta3 (ptc/09-05-13): Adoption late June !

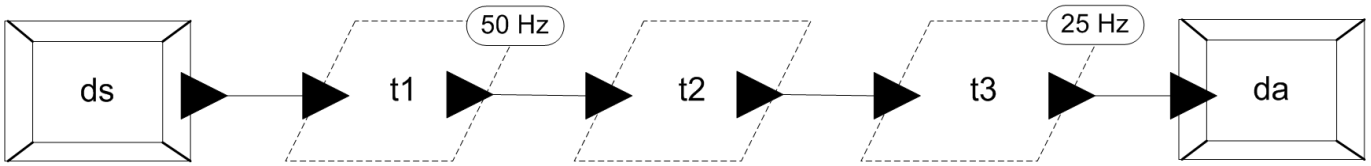


SAM - Schedulability Analysis Modeling

- Relies on GQAM
  - **G**eneric **Q**uantitative **A**nalysis **M**odeling
- Generic concepts to support schedulability analysis
  - Classic/generalized RMA, holistic approaches, extended timed automata
- Analysis context: Workload, Resources, Observers
  - Workload: Events with an arrival pattern, scenarios, steps, flows
  - Resources: NFP; Usages: Atomic, Priority, Exclusions
  - Observers: Latency/Timing
- Code Generators, MARTE to:
  - RapidRMA (TriPacific)
  - AADL: Ocarina/Cheddar

MARTE Time Model

- Define a Timed Causality Model for UML
  - Polychronous systems, tagged signal model, ptolemy, …
  - Mix asynchronous (Event Structures, Petri Nets) and synchronous operators
- Broad enough to cover several Models of Computations
  - "**Clock**": set of instants (point in time) at which something happens (message sent/received, action starts/finishes, …)
  - **TimeStructure**: set of clocks + constraints
  - Give an explicit execution semantics to (UML) models
    - MoCC = library of user-defined constraints (ex.: SDF)
- Timing Analysis = Clock Calculus (Process Networks, Synchronous languages)
  - Give one possible schedule: simulation
  - All valid schedules: exhaustive

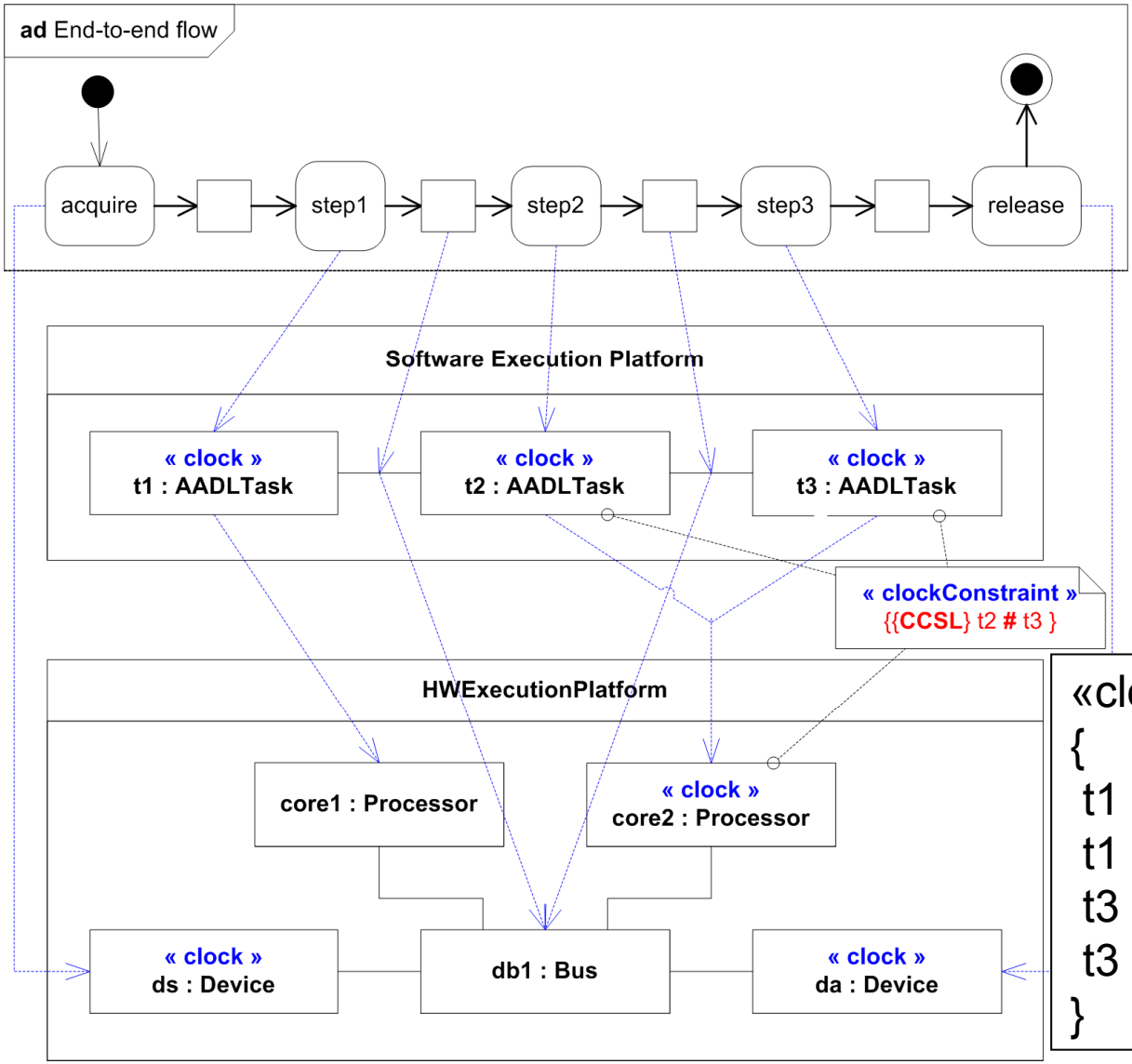


Exemple

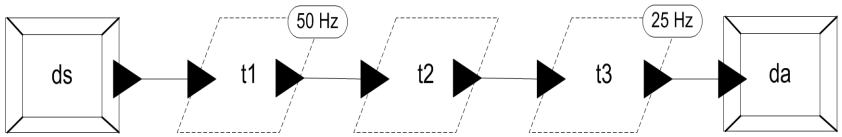
Application

Software execution platform

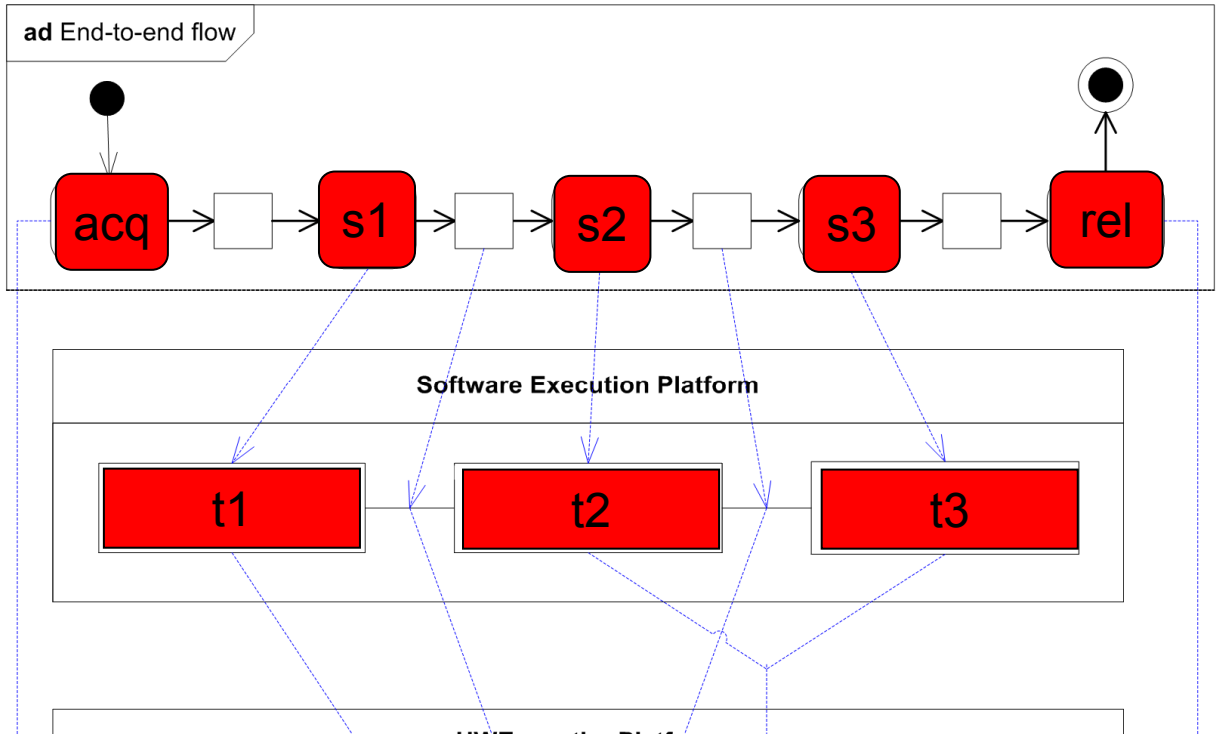
Hardware execution platform

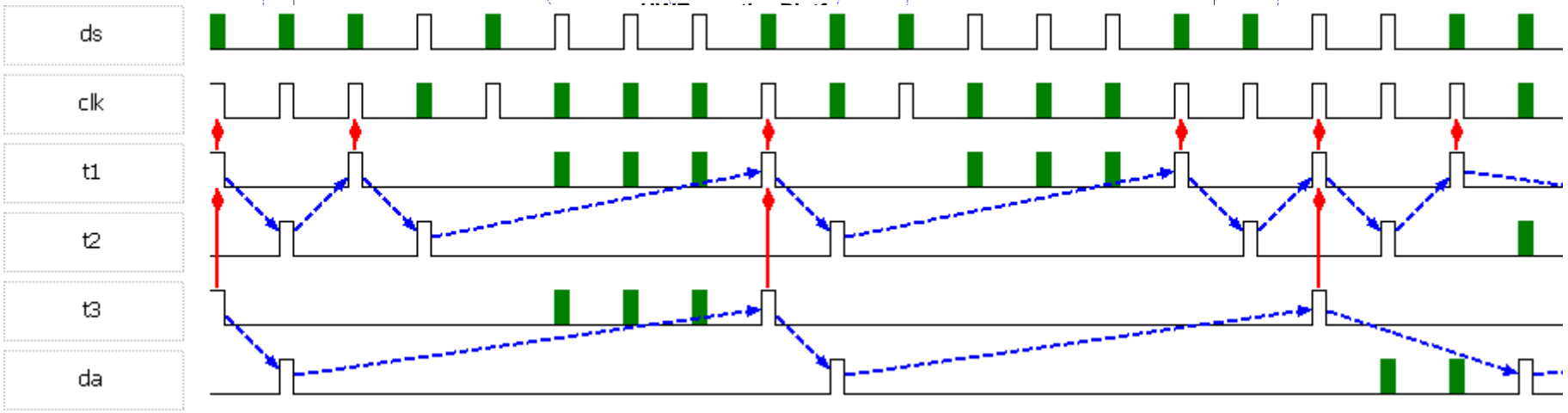


«clockConstraint»
{
t1 = clk **FB** $(10)^{\omega}$;
t1 ~ t2;
t3 = t1 **FB** $(01)^{\omega}$;
t3 ~ da;
}



Executable Specification





Conclusion

- MDE for Real-Time Embedded systems
  - Heterogeneous models:
    - Different assumptions, different communities, different formal models
    - Similar representations (State-based or data-flow + components)
- Whatever the scheduling theory/policy
  - Semantics must be explicit within the model
  - If models are to be merged, combined, exchanged between different analysis tools