Model Driven Development of High Integrity Applications Based on Reusable Assets

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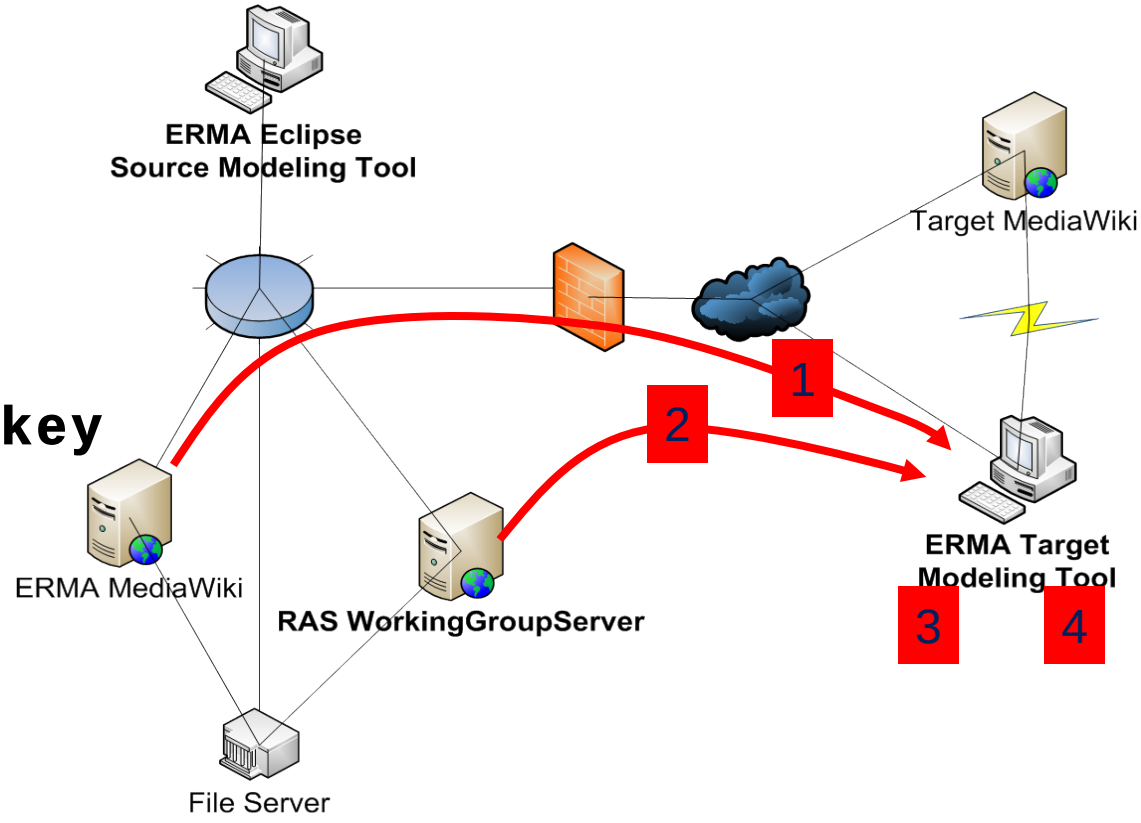
Topics

- Modelling Tool Assets and Modelling Tool Configurations
  - Modelling tools: one asset for multiple tools
- Modelling Assets for High Integrity Applications
  - *UML2RTSJ* : RTSJ applications in UML
  - *UML2AdaRavenscar* : Ada Ravenscar Applications in UML
  - *MAST_RMA* : Modelling MAST in eclipse modelling tools
  - *MARTE1x1* : MARTE Profile
  - *MARTE_SA_Gen* : Integration of MARTE, RTSJ, AdaRavenscar and MAST
- Application example: tele-presence robot

Modelling Tool Assets

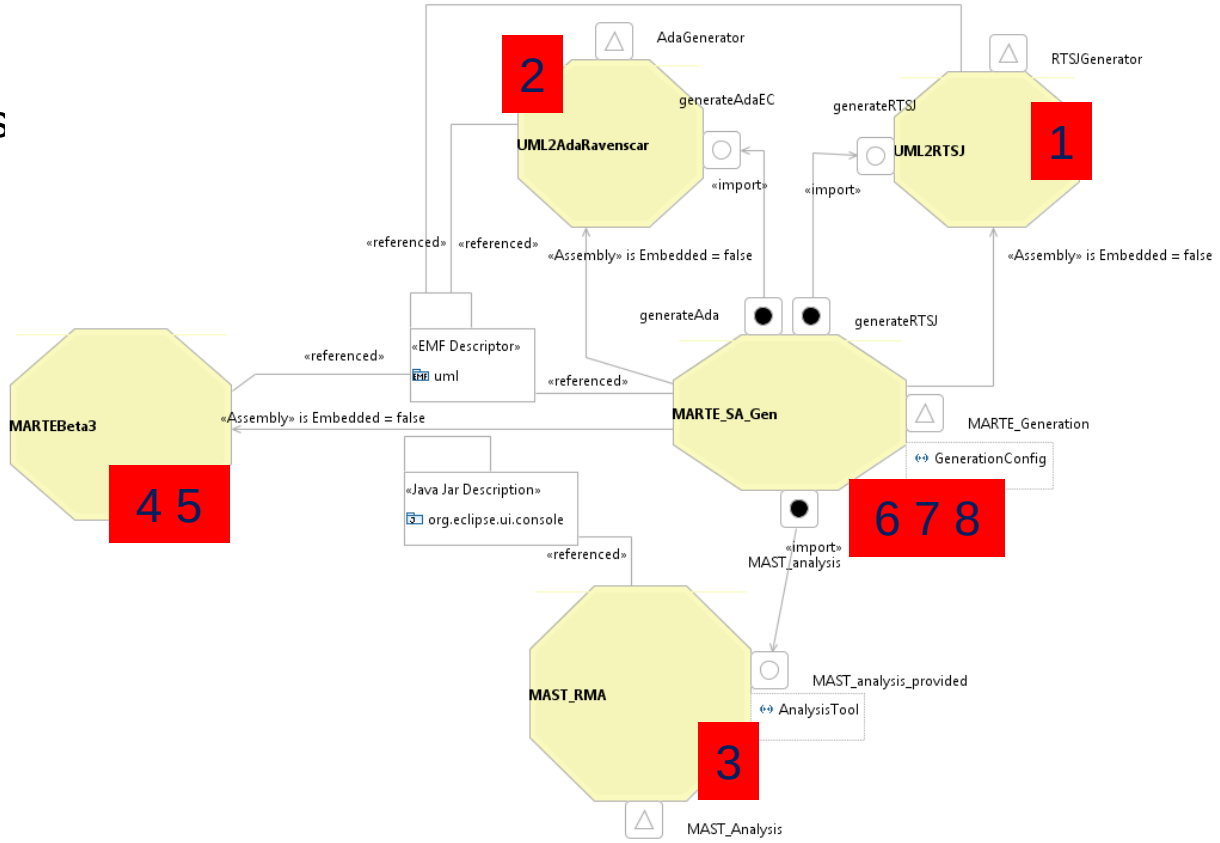
- ERMA provides support to reuse *same modelling tools* in *multiple modelling tools*
  1. Install ERMA
  2. Import Assets
  3. Deploy Assets
  4. Install Assets

- The **deployment** is **key** It customizes
  1. UML Profiles
  2. Model libraries
  3. Commands & Inter Assets Communication
  4. Software Behaviours



Modelling Assets For Development of High Integrity Applications

- Software development
  1. Generators for RTSJ
  2. Generators for Ada
- Models Analysis
  3. Scheduling Analys
- UML for Real-Time
  4. MARTE 1.1
  5. Edition support
- Tool Integration
  6. Mapping from MARTE 2 MAST
  7. MARTE 2 RTSJ
  8. MARTE 2 Ada



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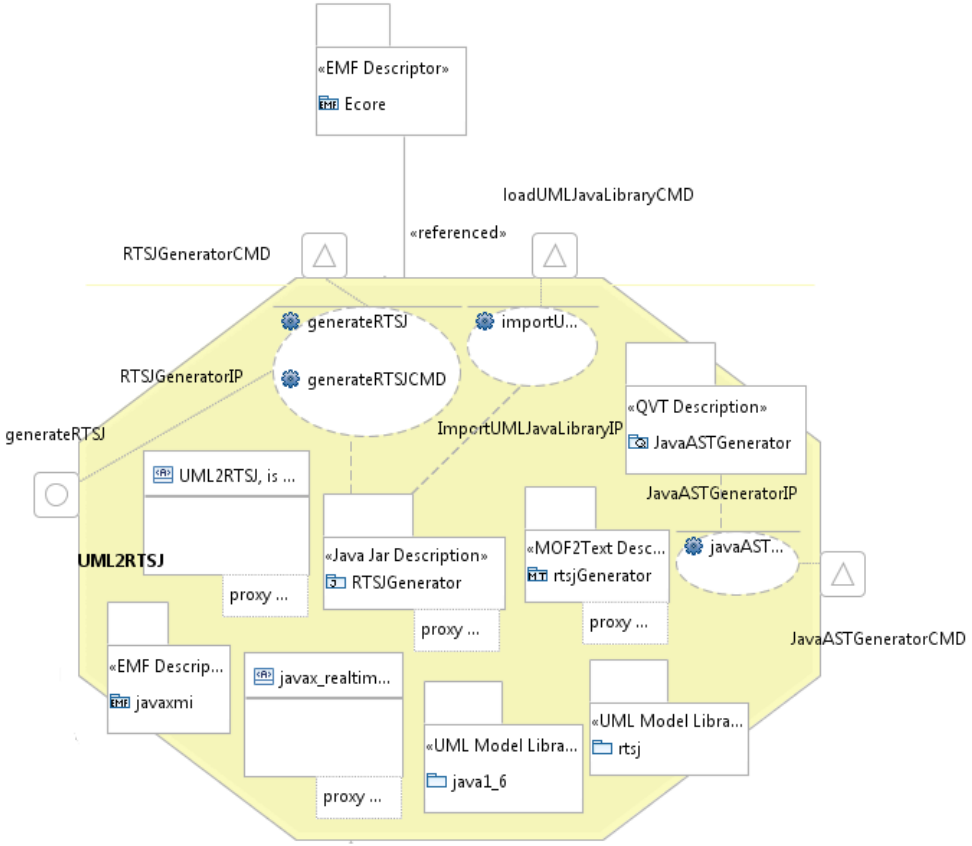
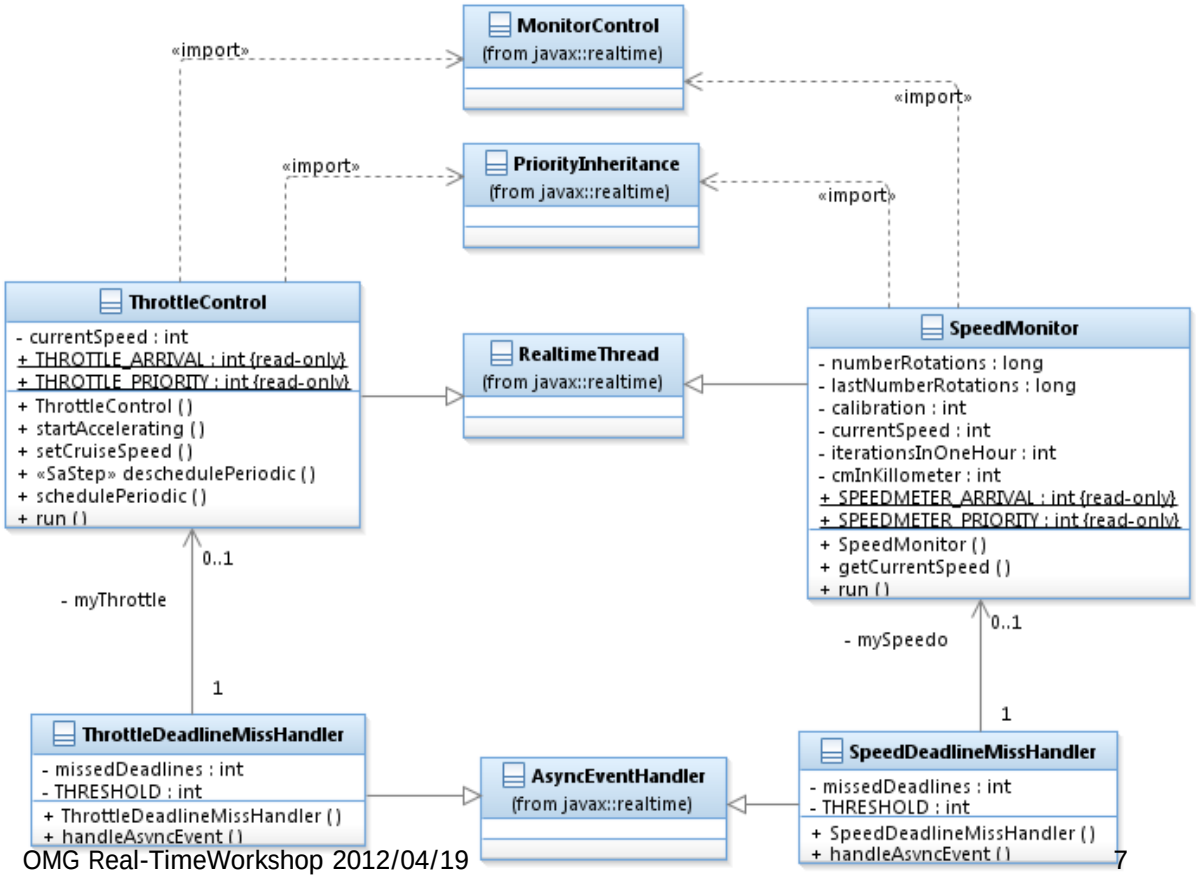
UML2RTSJ : RTSJ applications in UML

- The kernel of UML2RTSJ is a Java AST metamodel
  - Represents Java programs as ecore models
- UML model library for representation of
  - RTSJ library
  - Some basic Java libraries
- QVT transformations from UML 2.2 L0 to javaxmi
- MOF2Text generators from javaxmi to Java (Jamaica)
- Three basic commands
  - Load UML library (javax.rtsj)
  - Generate javaxmi from UML package
  - Generate Java from javaxmi Model



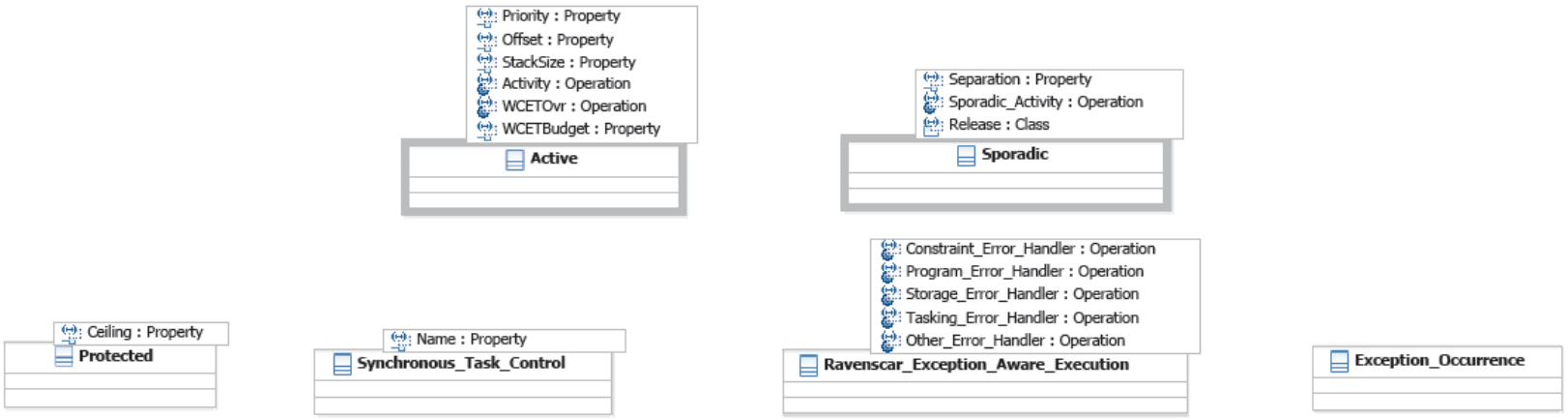
UML2RTSJ : RTSJ applications in UML

- Cruise Control Example modelled with UML/RTSJ: AsyncEvent, RealtimeThread, MonitorControl, …
- UML model elements handled are UML Infrastructure (Classes, Association, Operations, Instance specifications, …) and some UML 2.2 L1 elements: Interfaces
- We create the model (based on RTSJ UML model library) and then
  - Generate Java AST (this the L0 of Java applications)
  - Generate Java code



UML2AdaRavenscar : Ada applications in UML

- Ada Ravenscar centre is the UML neutral model of Ada applications
- Generates pattern based plain UML output model
  - Only standard UML 2.2 types and data types
  - Most common real-time patterns (periodic, sporadic, shared...)
  - Generic UML classes with direct translation to Ada generic packages
  - MOF2Text generators to Ada Ravenscar

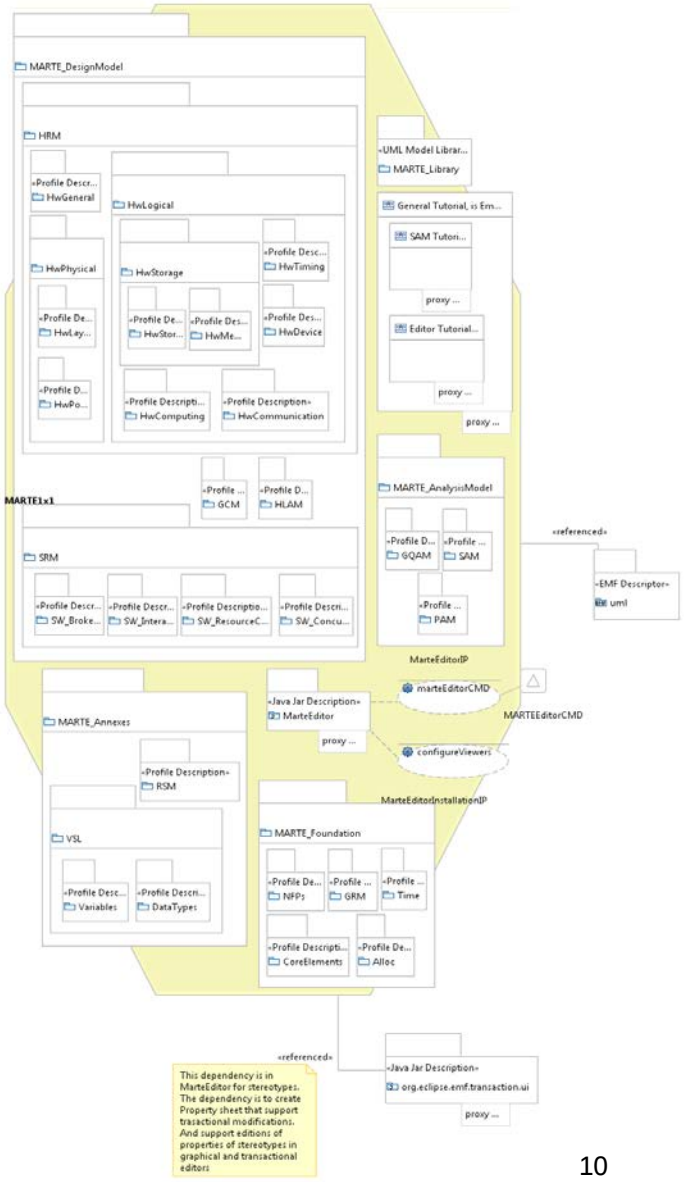


MAST (1.3.8) Asset

- Integration of MAST into eclipse
- **EMF Models**
  - MAST Modelling - representation of MAST input models in ecore
  - MAST Results - representation of MAST output models in ecore
- **Artefacts** - mast analysis and convert programs
- **Editors** - edition based on navigators of MAST analysis and MAST result models
- **Commands** for invocation of MAST analysis
- Parameters for **configuration** of analysis
  - Unified time unit
  - MAST analysis method

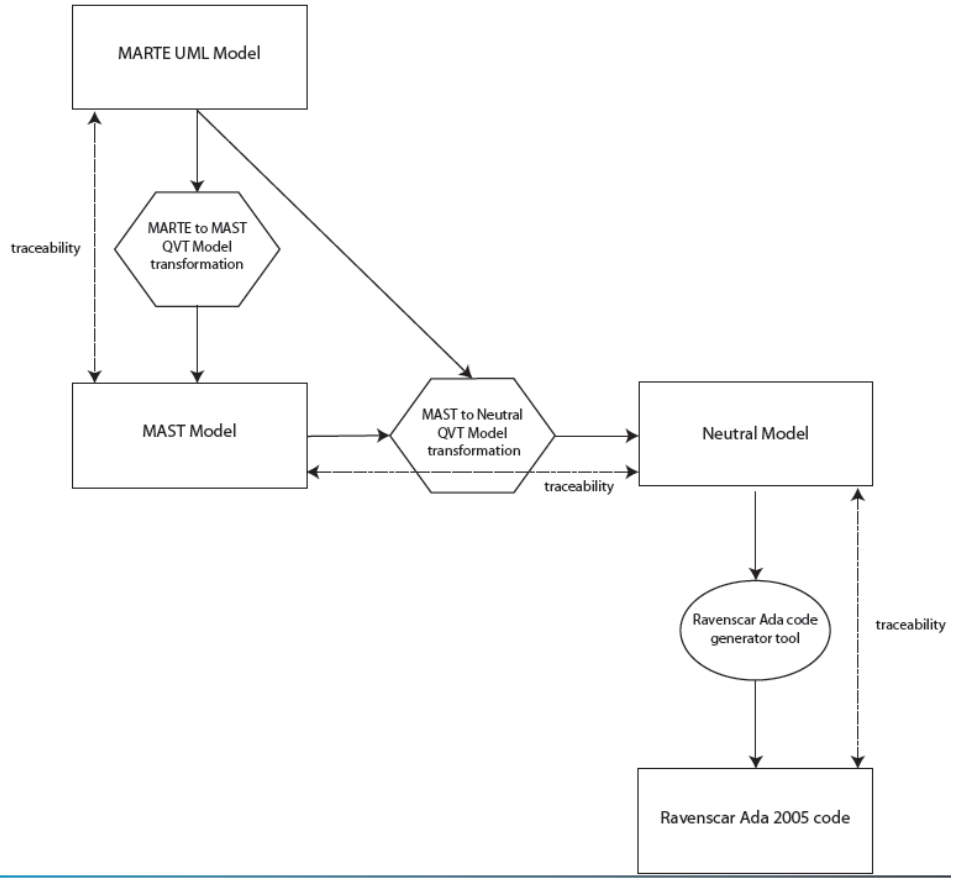
MARTE1x1 : MARTE Profile

- MARTE1x1 asset was designed as interchange language from CHESS ML to transformators to analysis/code
  - MARTE 1.1 profiles
  - MARTE Model Library
  - Tool independent URIs
- There is not VSL and it supports XMI of MARTE standards
- We have included ours editors of MARTE stereotypes. This is supported in: UML2, RSA, Papyrus



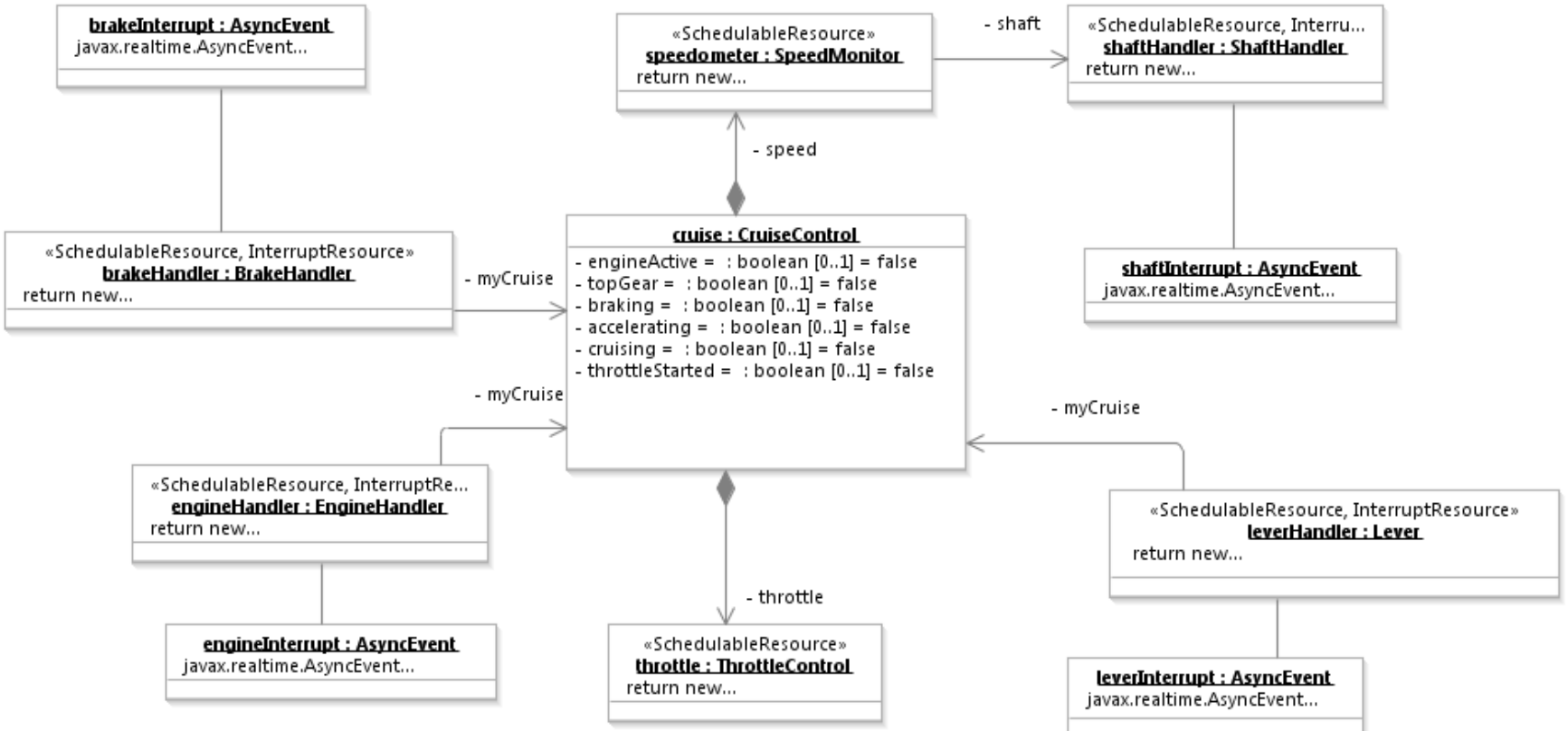
MARTE_SA_Gen : Integration of MARTE, RTSJ, AdaRavenscar and MAST

- *MARTE_SA_Gen* purpose: integrate MARTE, MAST analysis, and RTSJ or Ada Ravenscar platform
- *MARTE_SA_Gen* includes some QVTO transformators, modules, and libraries for generation of MAST models, and to extend RTSJ/Ada generators based on MARTE
- Input Model of *MARTE_SA_Gen*
  - UML+SAM+GQAM+GRM
- Output Models
  - Ada Neutral UML
  - RTSJ Javaxmi
  - MAST model
- Round-trip transformator from MAST result to UML+SAM+GQAM



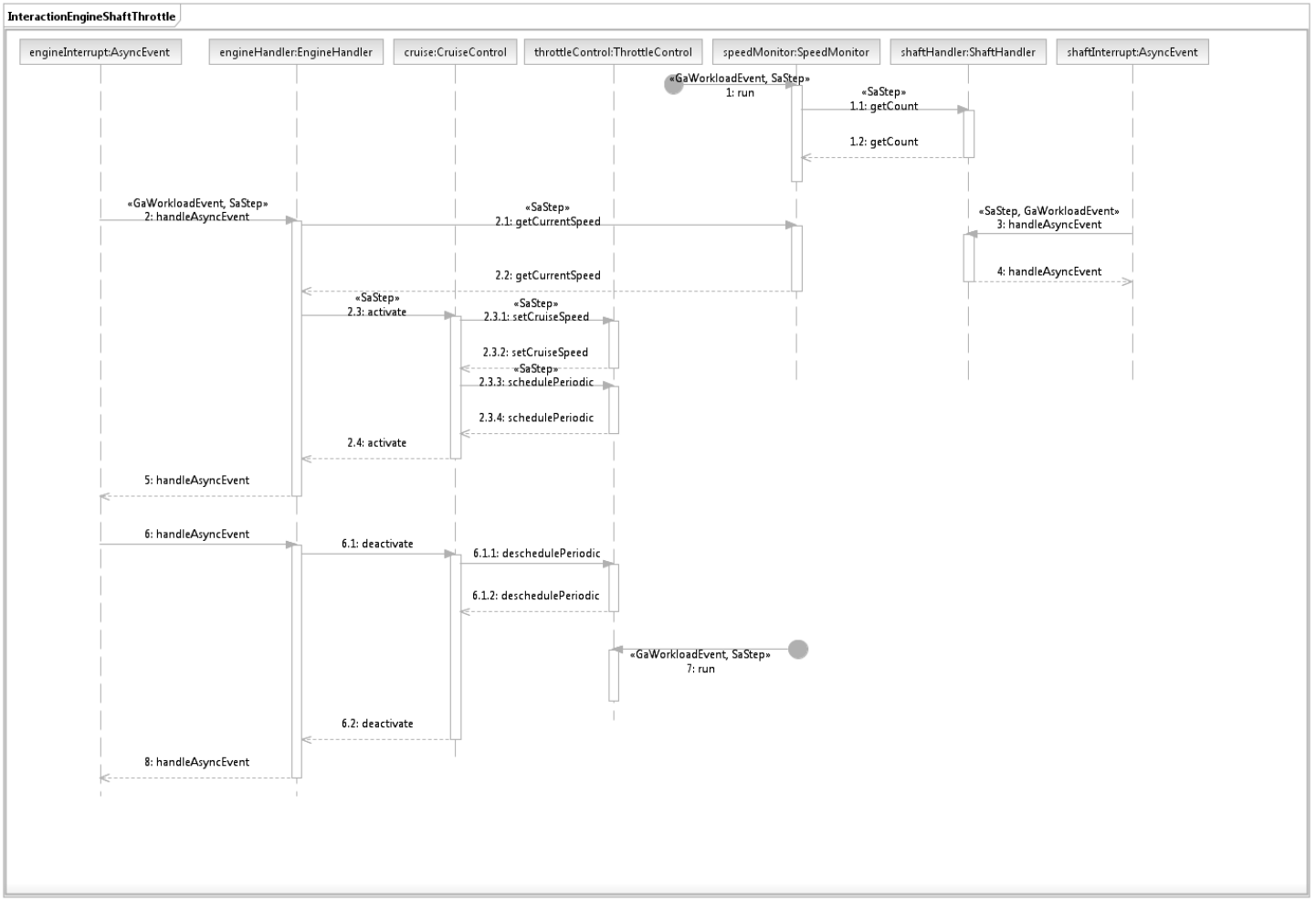
MARTE_SA_Gen : Integration of MARTE-MAST

- *MARTE_SA_Gen* generates MAST models based on SAM-GQAM-GMR without any assumption about execution platform
- SAM-GQAM-GRM annotates any UML models: e.g. RTSJ model with object and behaviour diagrams (e.g. sequence, activity, …)



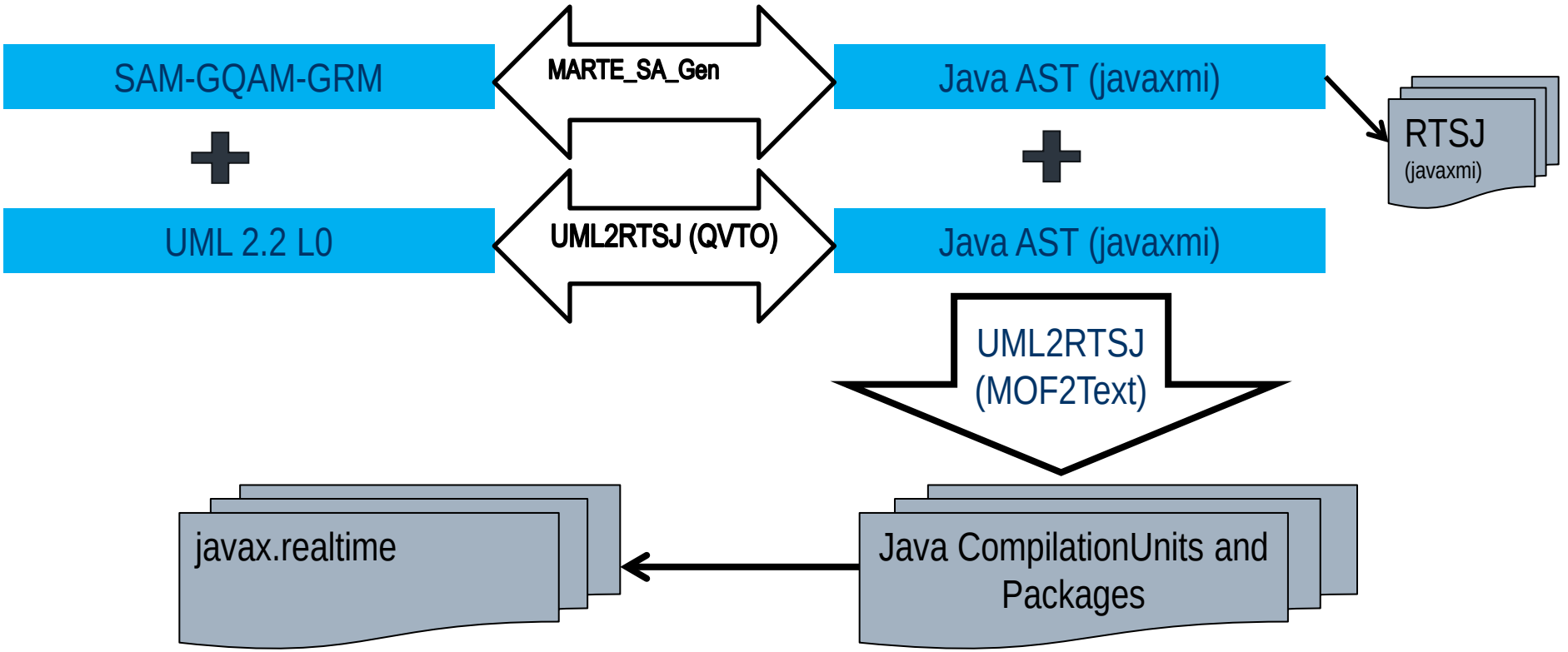
MARTE_SA_Gen : Integration of MARTE-MAST

- SAM-GQAM-GRM is a parallel model of software model
- Both can contain inconsistencies



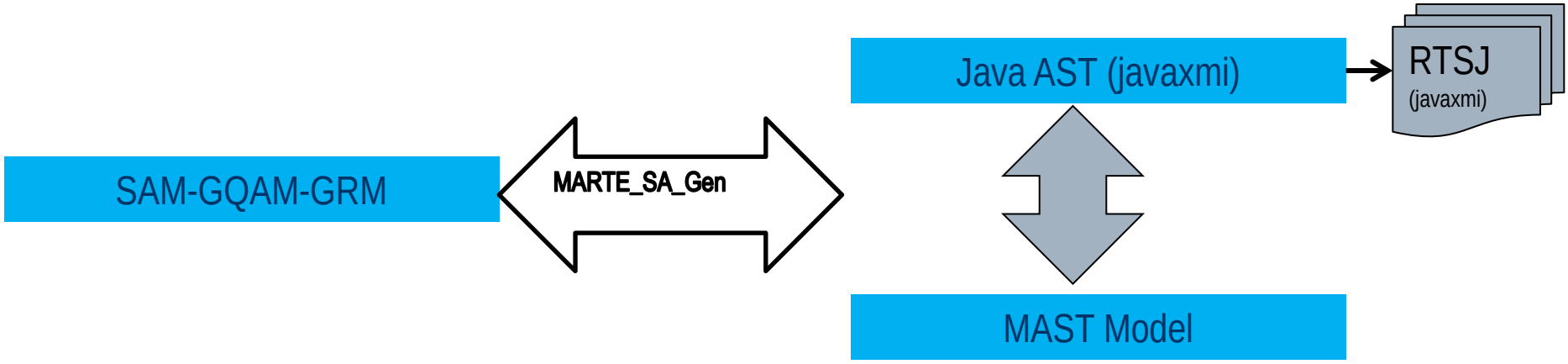
MARTE_SA_Gen : Integration of MARTE-MAST-RTSJ

- UML2RTSJ supports the mapping from UML 2.2 L0 to Javaxmi
- MARTE_SA_Gen extends this for the integration of MARTE-SAM-GQAM-GRM into javaxmi models
- Java AST models based on RTSJ (javaxmi) are consistent with MAST models generated



MARTE_SA_Gen : Integration of MARTE-MAST-RTSJ

- What are the differences of UML+RTSJ Model Library and UML+MARTE
  - UML+RTSJ includes explicit references to RTSJ library (types, method calls, generalizations, …)
  - UML+MARTE does not include any reference to RTSJ. Any reference to RTSJ in Java code is generated based on SAM-GQAM-GRM
  - UML+RTSJ are based on Java primitive types (e.g. long, void, …)
  - UML+MARTE do not use Java types.
  - The consistency of MAST model and RTSJ behaviour depends on modeller
  - MARTE_SA_Gen guarantees the consistency of MAST and RTSJ behaviour



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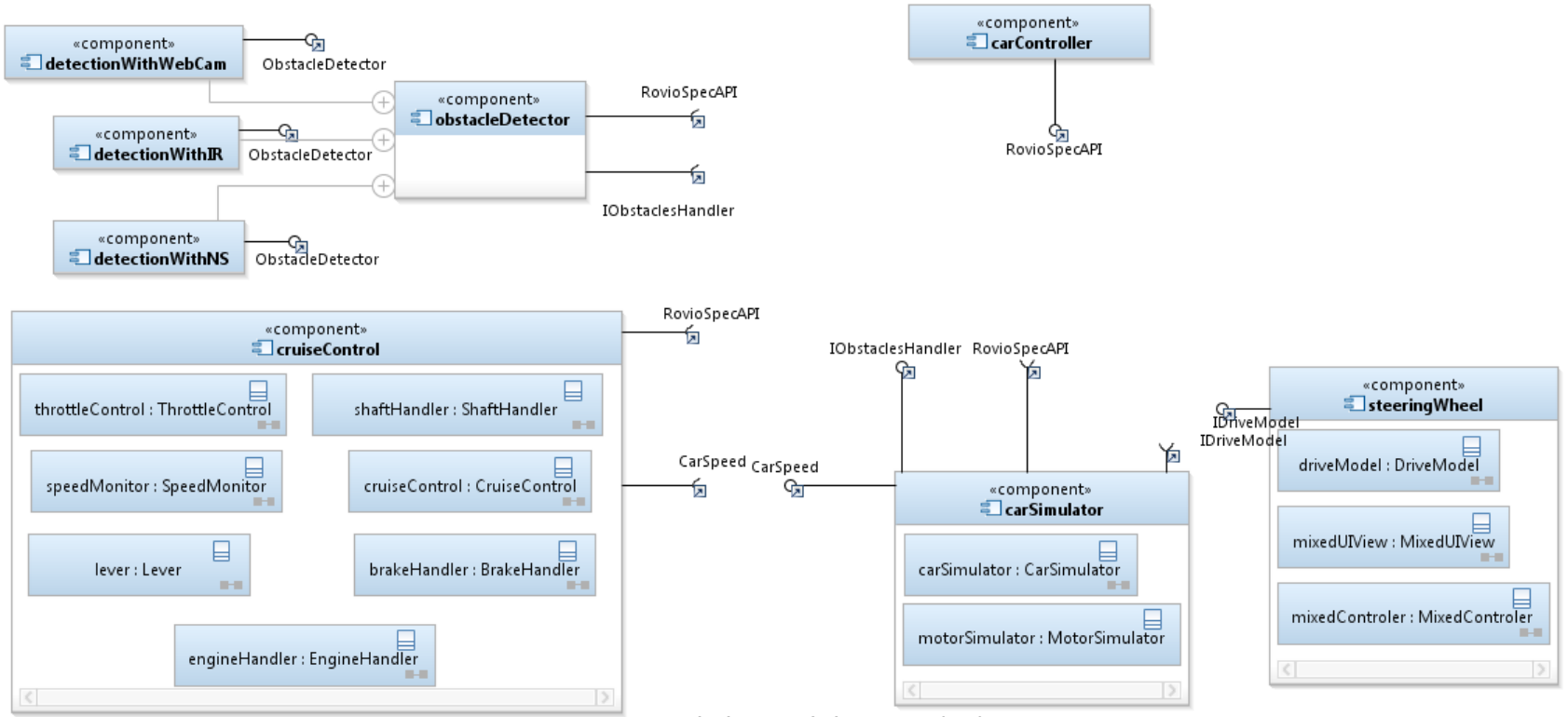
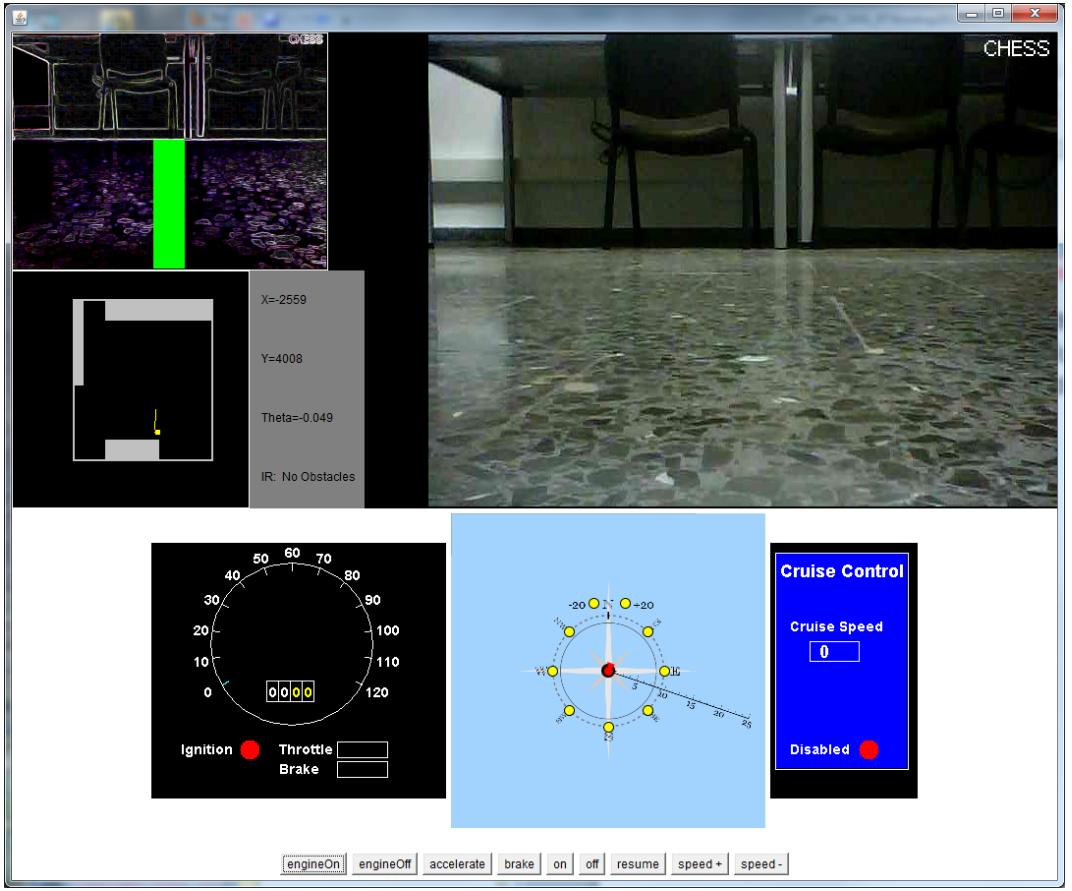
Application Example: tele-presence car

- Tele-drive for a tele-presence car. Main components:
  - Steering wheel and throttle pedal handlers
  - Cruise control system: handlers of brake, throttle, lever, speed and engine, and control
  - Combined obstacles detector: indoor localization sensor, webcam images filter, IR detector



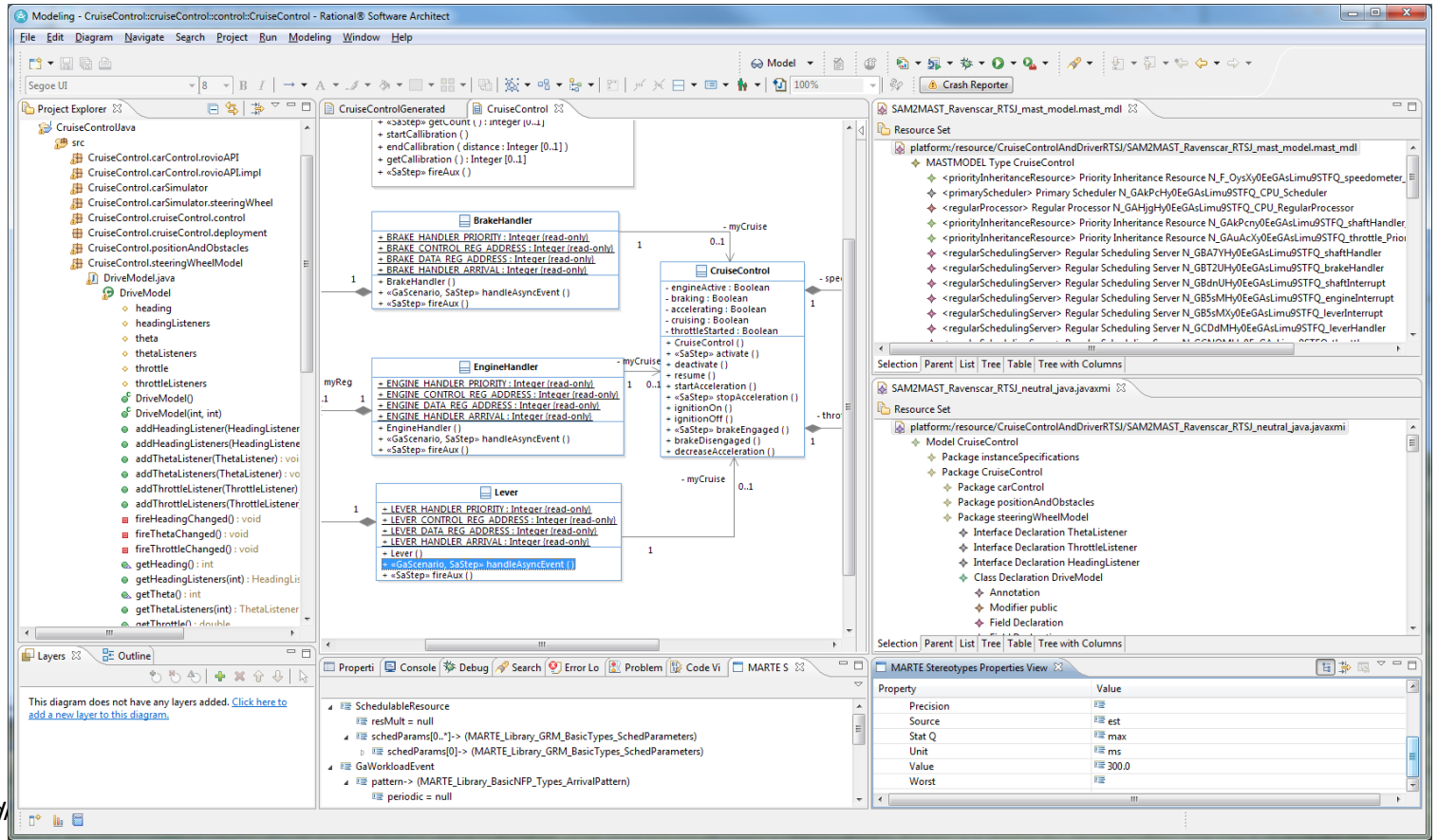
Application Example: tele-presence car

- Transformations and generators provides:
  - MAST scheduling analysis for schedulable resources
  - RTSJ Java code-> RTSJ code generated + logical code in Opaque Behaviors



Application Example: tele-presence car

- Modelling and programming languages:
  - UML+MARTE
  - Scheduling analysis models
  - Java+RTSJ, Ada-Ravenscar+ORK



Tools available

http://www.erma-assets.org

- Eclipse Indigo with ERMA 64K and 32K
- Eclipse Indigo 64K with ERMA and Papyrus
- ERMA plug-ins site
- ERMA plug-ins for RSA 8.0.3
- ERMA Safety-aware Assets
  - S&D Profiles and Model Libraries
  - FTA & FMECA Eclipse Languages
  - UML to FTA & FMECA transformations
  - Item Toolkit Bridges
- ERMA Assets
  - MARTE 1.1 Conform Standard and Stereotypes Editor
  - RTSJ and Ada-Ravenscar Modelling tools
  - MAST Eclipse Languages
  - MARTE to MAST, RTSJ and Ravenscar generators