



servicerobotics

Autonomous Mobile Service Robots

Model Driven Software Development in Service Robotics – *It really works !*

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<http://www.zafh-servicerobotik.de/ULM/index.php>

<http://www.hs-ulm.de/schlegel>

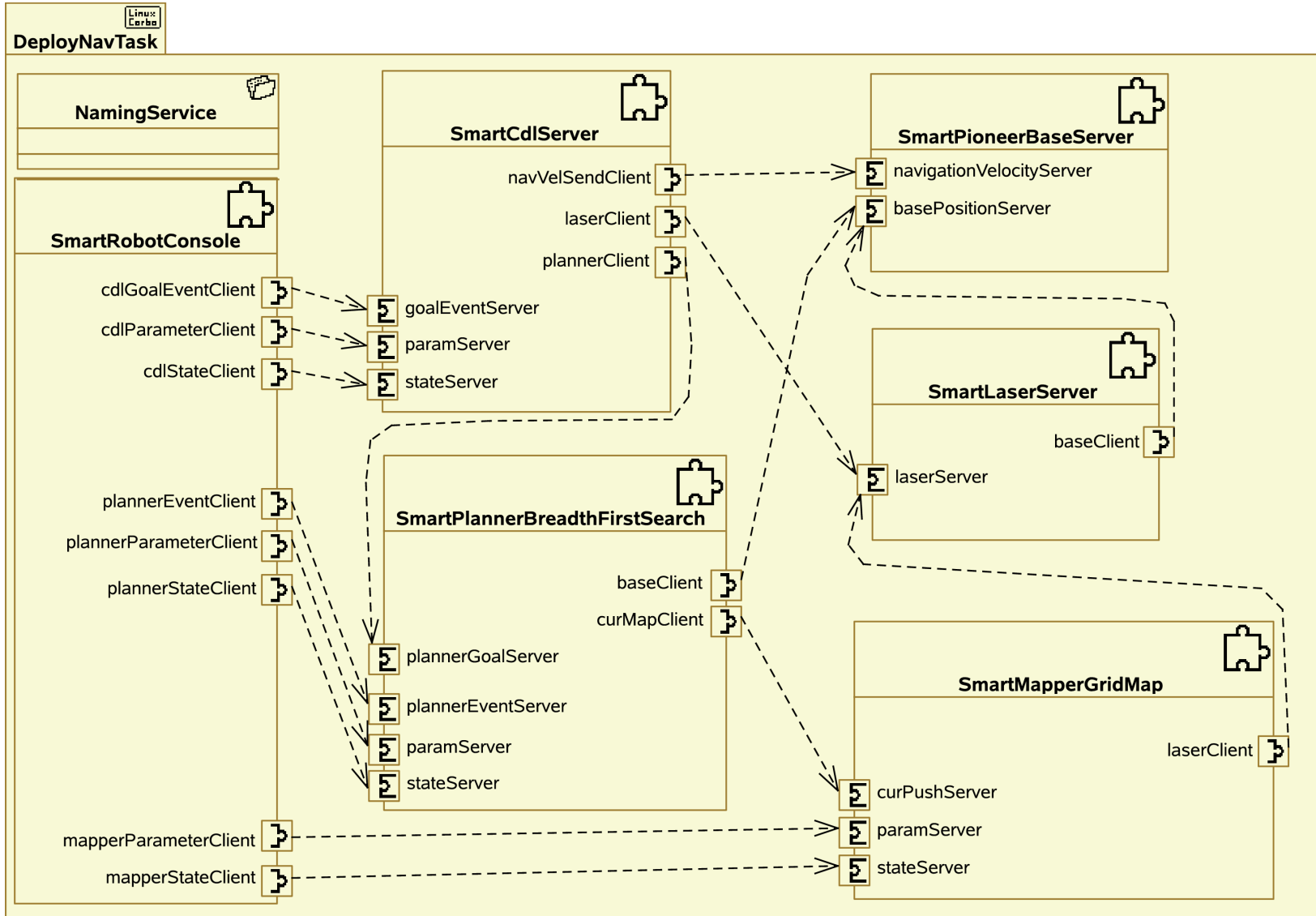
<http://smart-robotics.sourceforge.net/>

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Model Driven Software Development Example / Navigation Task

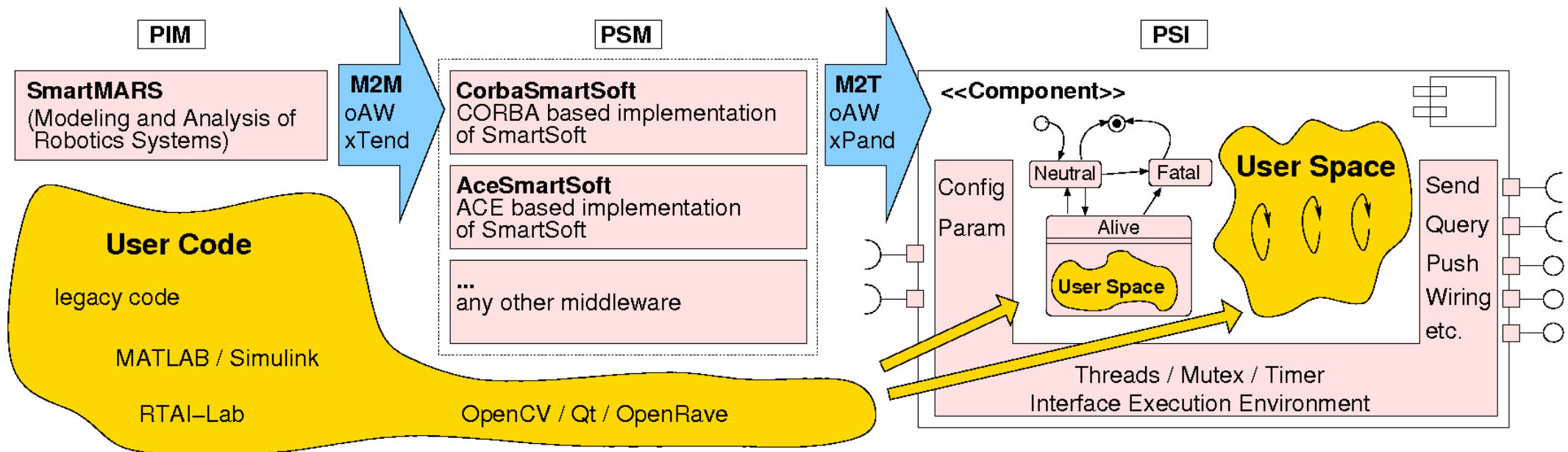


Model Driven Software Development

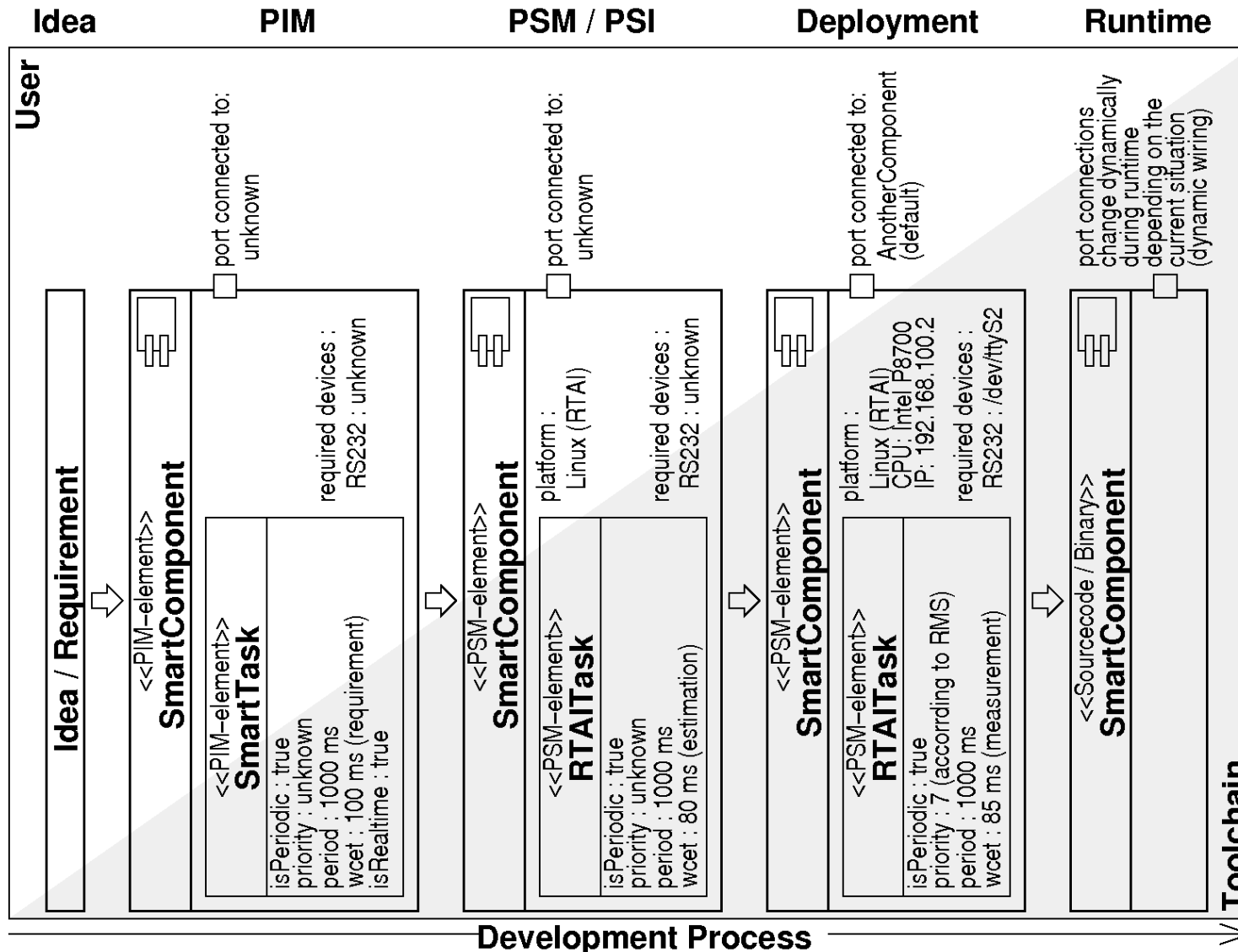
SmartMDSD

Illustration of our development process

- UML 2.0 profile for robotics component model
- covers component development, system composition, deployment
- based on standards: UML 2.0, Open Architecture Ware, Eclipse, etc.
- different runtime platforms, middleware systems etc.



Model Driven Software Development SmartMDSD



Model Driven Software Development SmartMDSD



Benefits of our development process:

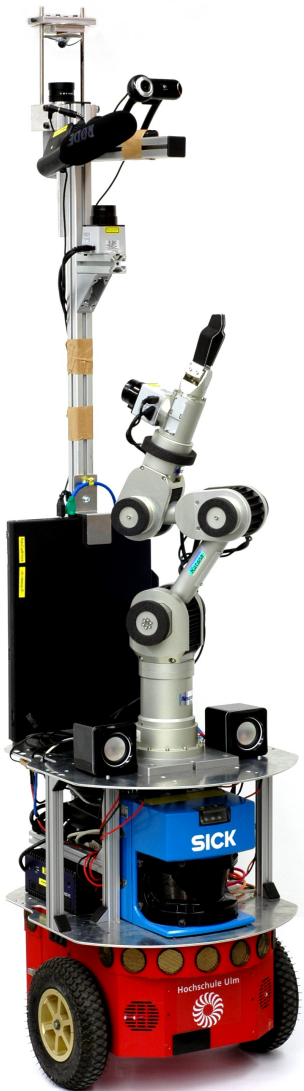
- get rid of hand-crafted single unit service robot systems
- compose them out of standard components with explicitly stated properties
- be able to reuse / modify solutions expressed at a model level
- take advantage from the knowledge of software engineers that is encoded in the code transformers
- be able to verify properties (or at least provide conformance checks)

▪ **be able to address resource awareness !!**

and many many more good reasons

Engineering the software development process in robotics is one of the basic necessities towards industrial-strength service robotic systems

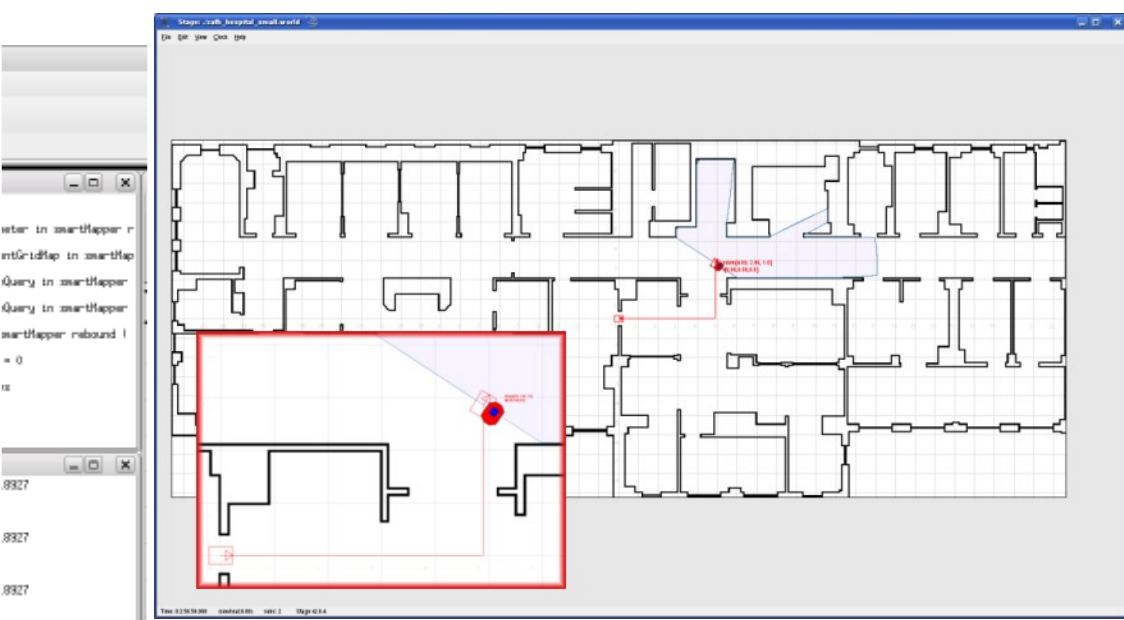
Model Driven Software Development SmartMDSD



Experience made with our development process

- systematically handle integration of systems of the complexity of service robots and to overcome plumbing
- tools like OpenArchitectureWare, Eclipse etc. are matured enough to be used in robotics
- there are many experienced people out there being already familiar with the tools, can start immediately using them and can just focus on robotics
- design patterns, best practices, approved solutions can be made available within the code generators such that even novices can immediately take advantage from that coded and immense experience
- provides the perfect granularity for system design, component development, composability, freedom within components, tool support etc.

Model Driven Software Development Examples / Simulation Player/Stage



```

PLANNER next goal (4900,2900) goal (4900,2900)
PLANNER: ok
State active in processing-loop: 0
PLANNER Robot position pos (4934,2862)
PLANNER next goal (4900,2900) goal (4900,2900)
PLANNER: ok
State active in processing-loop: 0
PLANNER Robot position pos (4934,2862)
PLANNER next goal (4900,2900) goal (4900,2900)
PLANNER: ok
State active in processing-loop: 0
    
```

```

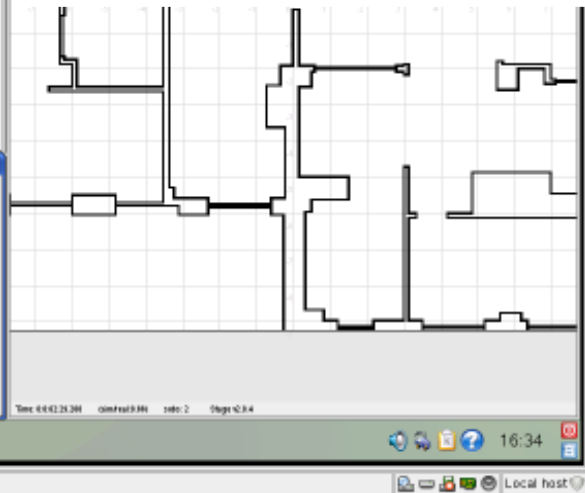
[distance to goal: 39.0901 approachDistance: 100
CIL EVENT CIL_GOAL_REACHED FIRED!
GOAL REACHED !!!!!!! actpos 4934,66 2862,32 89.8927
goal 0 0
Performing state change: moverobot -> neutral
quitHandler deactivate moverobot
quitHandler deactivate nonneutral
CIL_SET_MOVE_STRATEGY: CIL_REACTIVE selected
CIL_SET_FREE_BEHAVIOR: CIL_FREE_BEHAVIOR selected
CIL_SET_LOOKUP_TABLE: CIL_DEFAULT_LOOKUP selected
CIL_SET_TRANS_VELOCITY: Parameters: 0.800
    
```

```

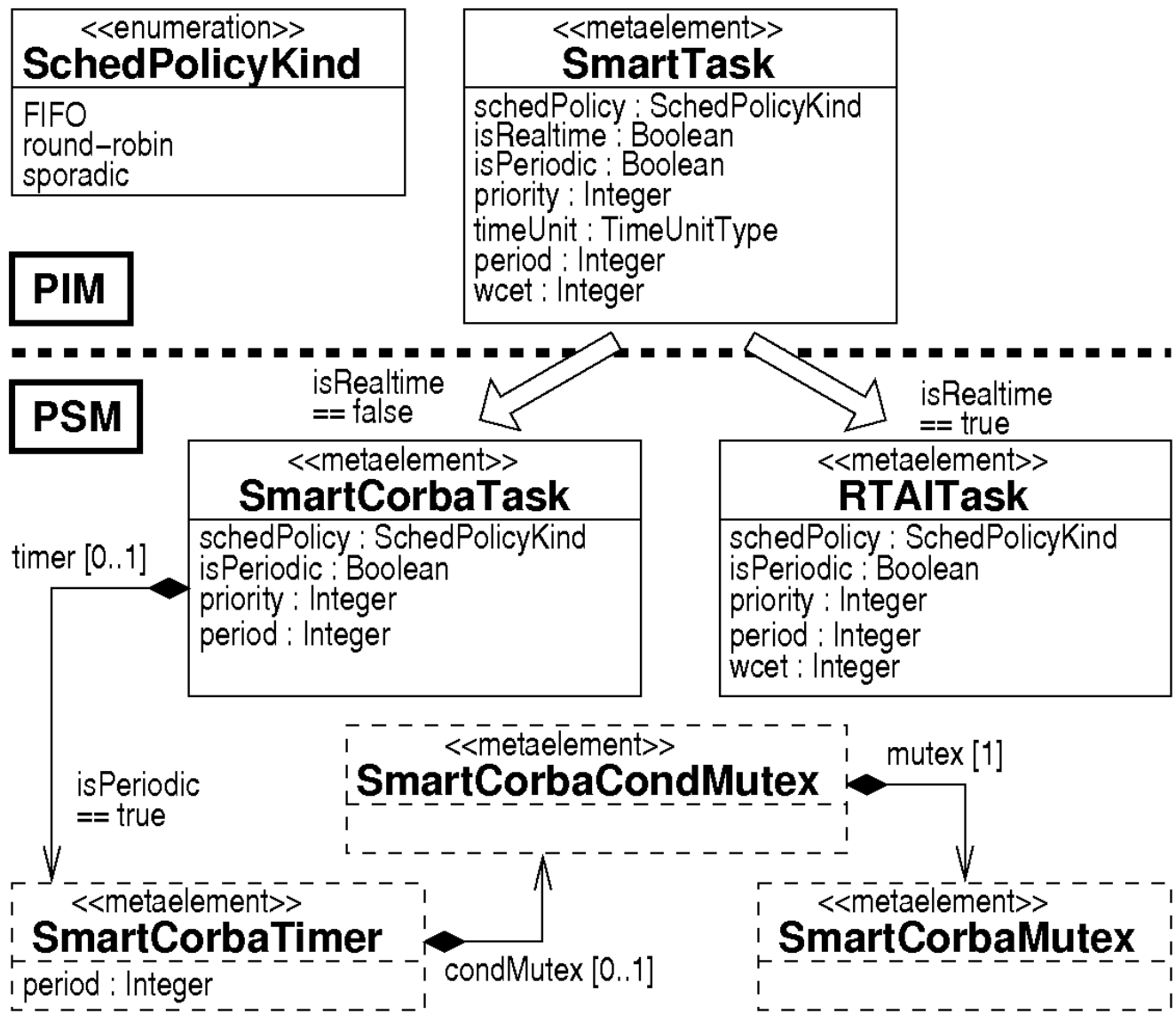
... connected to [smartCdlServer:sendCdlParameter]
To start the demo set CIL in moverobot state!

Main Menu:
01 - Happer state
02 - Happer parameter
03 - Planner state
04 - Planner parameter
05 - ForkLift command
06 - CIL state
07 - CIL parameter
08 - Jaws
<ctrl> + <0> for exit

please choose number:
    
```

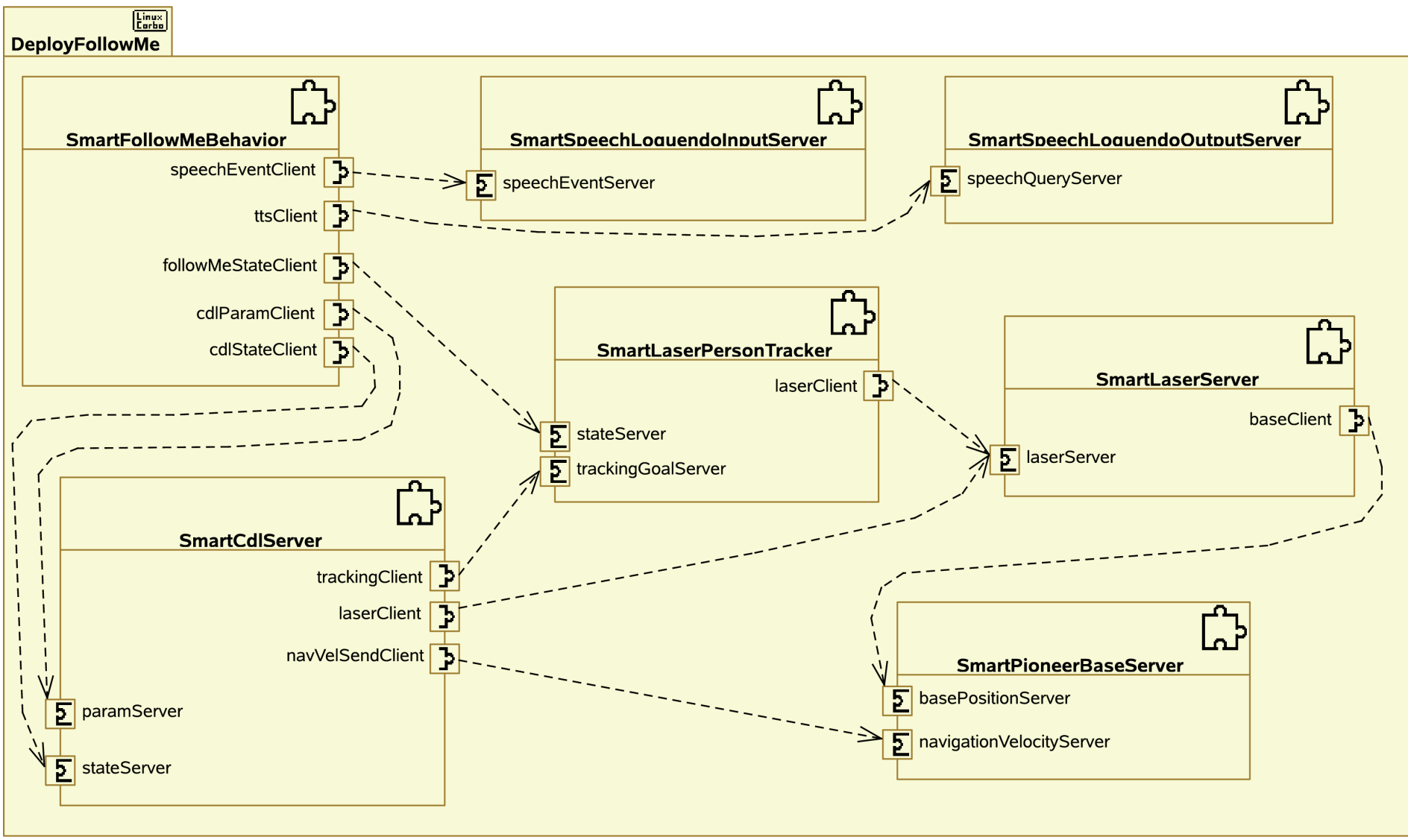


Model Driven Software Development Examples / SmartMDSD / Real-Time Task



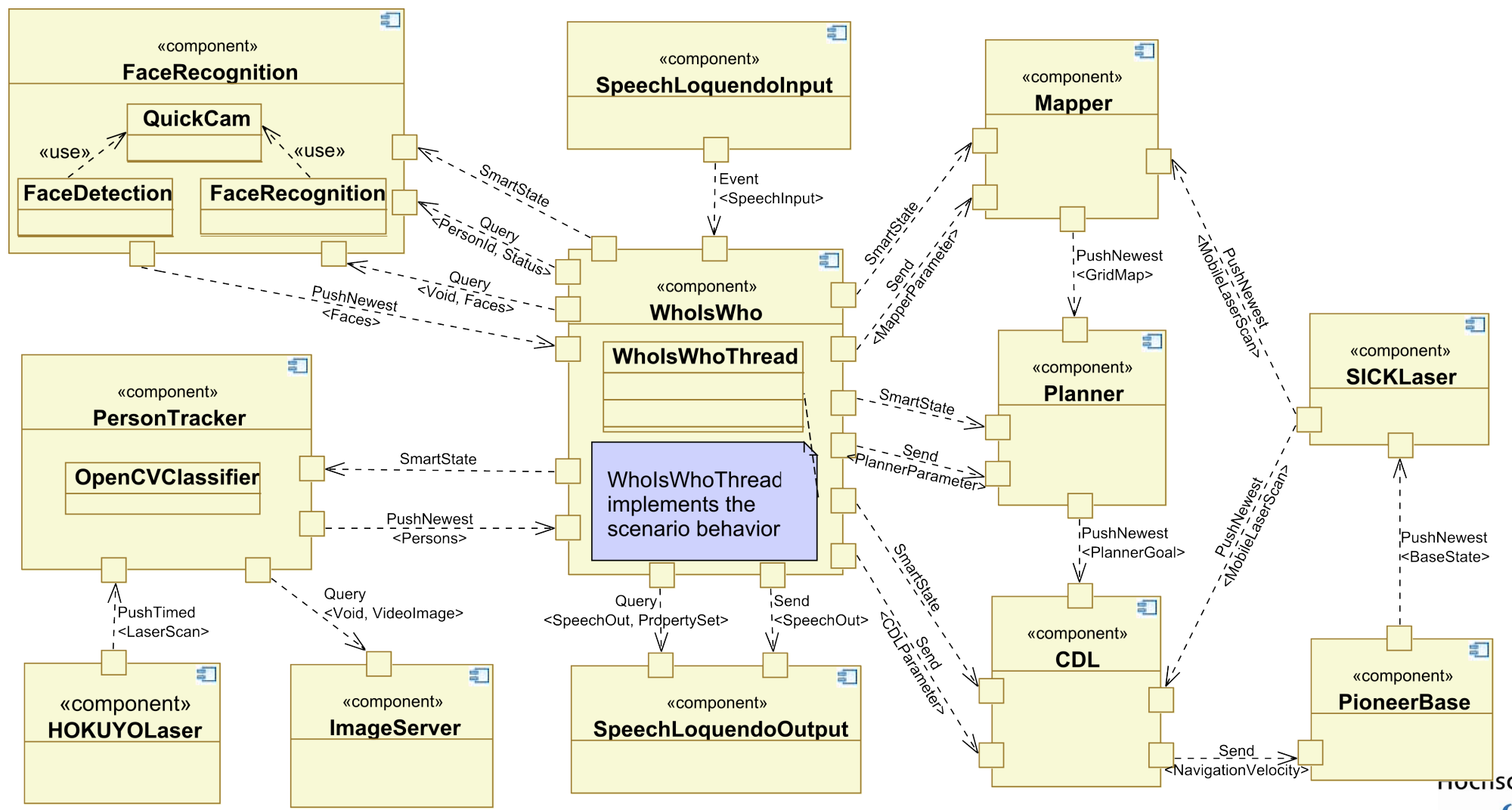
Model Driven Software Development

Examples / Robocup@Home / "FollowMe"

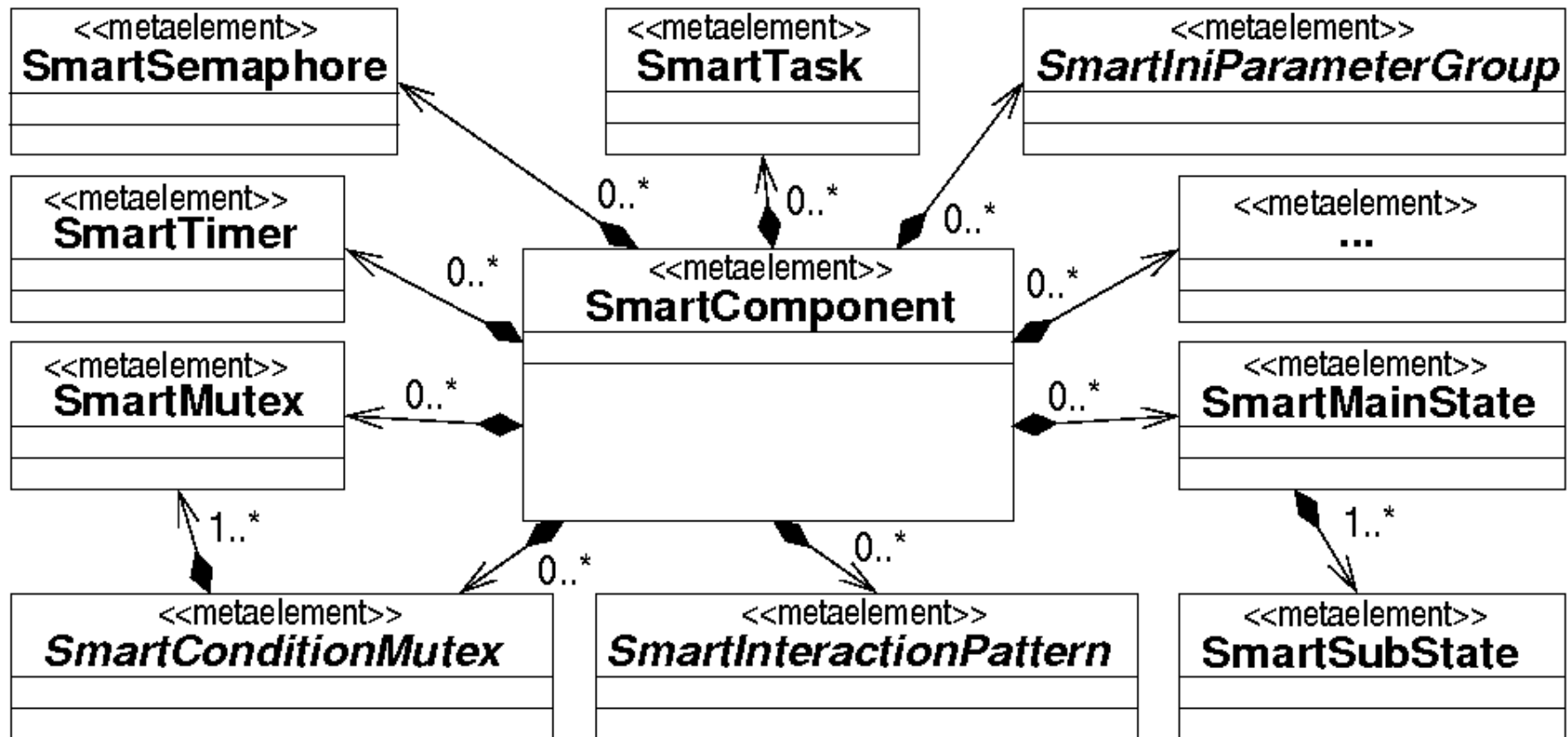


Model Driven Software Development

Examples / Robocup@Home / “WholsWho”

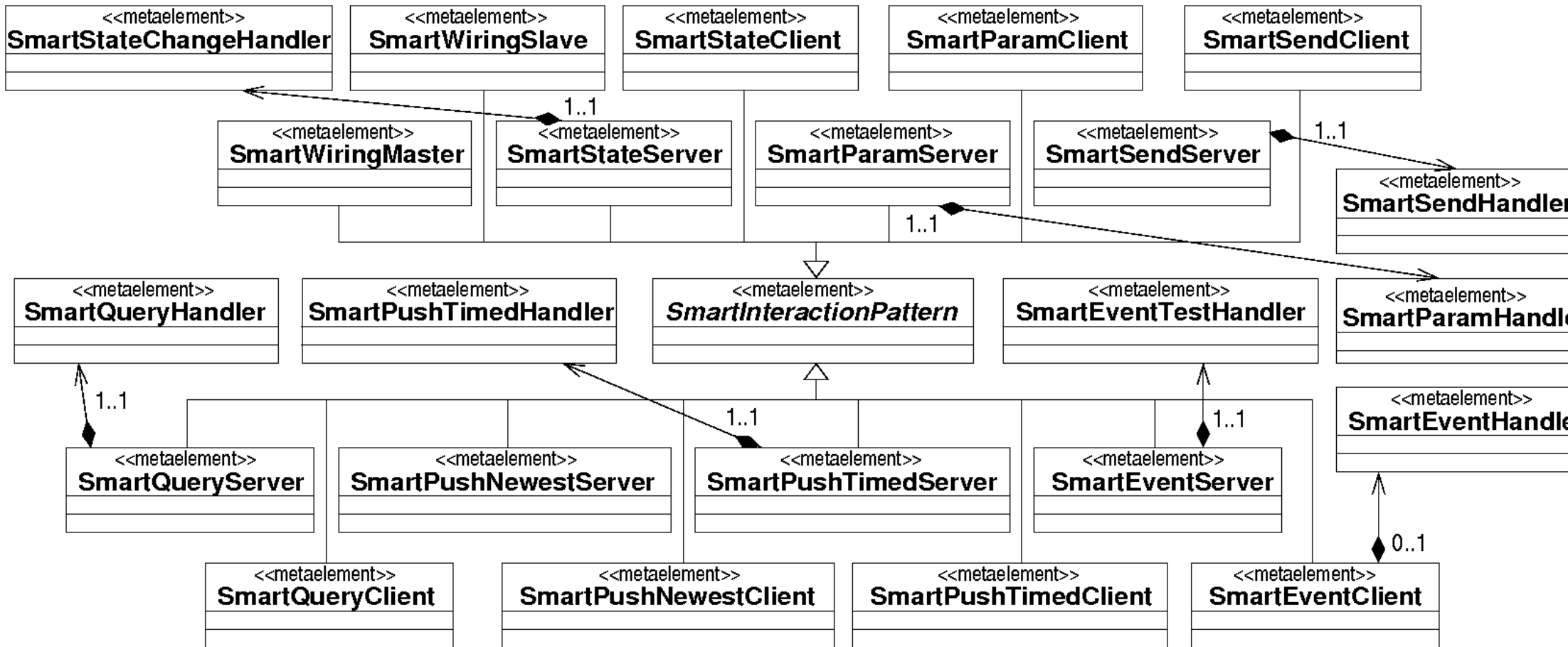


Model Driven Software Development Metamodels (partial view)





Model Driven Software Development Metamodels (partial view)





Model Driven Software Development

It is all available (LGPL) ...

- **Toolchain based on Open Architecture Ware**
 - fully integrated into Eclipse
 - <http://www.openarchitectureware.org/>
- **MDSD Toolchain Example**
 - PIM: SmartMARS robotics profile (Modeling and Analysis of Robotics Systems)
 - PSM: SmartSoft in different implementations but with the same semantics !
 - can be easily adapted to different profiles / profile extensions / PSMs
- **Short Summary on SmartSoft [LGPL]**
 - <http://smart-robotics.sourceforge.net/>
 - <http://www.zafh-servicerobotik.de/ULM/en/smartsoft.php>
 - CORBA (ACE/TAO) based SmartSoft
 - on sourceforge with various robotics components and simulators etc.
 - in use in research and industry
 - ACE (without CORBA) based SmartSoft
 - on sourceforge [Linux, Windows]
 - in use in research and industry
 - oAW Toolchain for SmartSoft
 - on sourceforge ***(including Screenscasts and Tutorials)***

