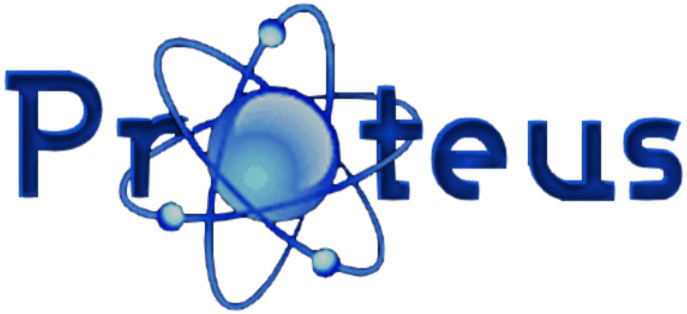


*P*latform for *RO*botic modeling and *T*ransformations for *E*nd-*U*sers and *S*cientific communities

A Robotic Ontology

S. Dhouib[1], J.L. Farges[2], B. Patin[3], S. Stinckwich[4] (Speaker)

[1]CEA, [2]ONERA, [3]DASSAULT-AVIATION, [4]GREYC

IEEE ORA group, Tokyo
November, 3, 2013

Outline

- Structure

- Kernel layer
- Information layer
- System layer
- Environment layer
- Robot layer
- Humanoid layer
- Ontology and RobotML meta-model

- Supplementary data

RobotML ontologies' structure

OpenCyc: Upper ontology used for inferences
Wikipedia: References used for description
DEVS as a guideline

ROBOT

It describes robots

… Robot, ManipulatorRobot, MobileRobot, UnmannedSystem, ...

SYSTEM

what are the possible systems of a robot

… DeviceSystem,ActuatorSystem, SensorSystem,PowerSystem,, ...

MISSION

It describes a mission that can be used by the components

… MissionObjective,MissionType,, ...

EXPERIMENT

It describes experiments process

…Problem, Solution, Assessment...

SIMULATION

It describes how system can live inside software, hardware, etc

… Simulation, Probe, providesLifeTo, ...

ENVIRONMENT

It describes were the robots evolve and defines the interactions propagation

… Atmosphere, LandSurface, BuildingFloor, ...

INFORMATION

It describe data pieces that can be used in different parts / differents modules

… algorithms, software modules, ...

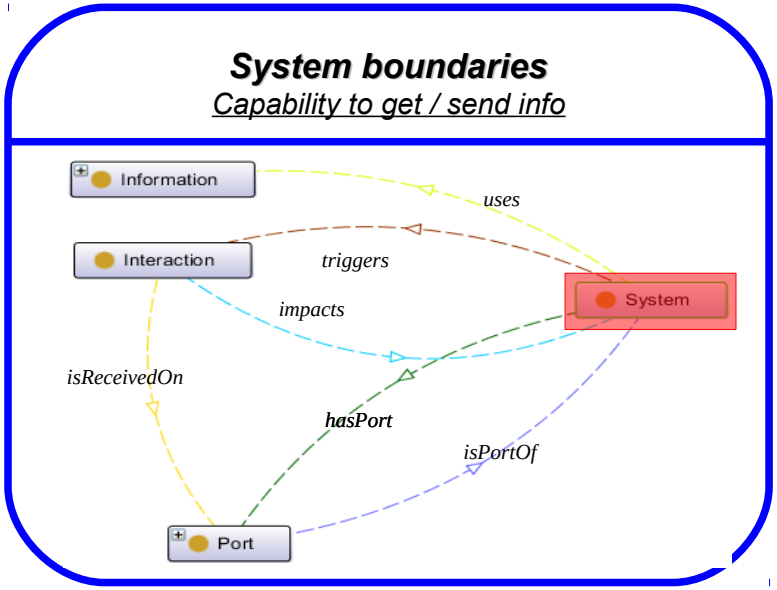
KERNEL

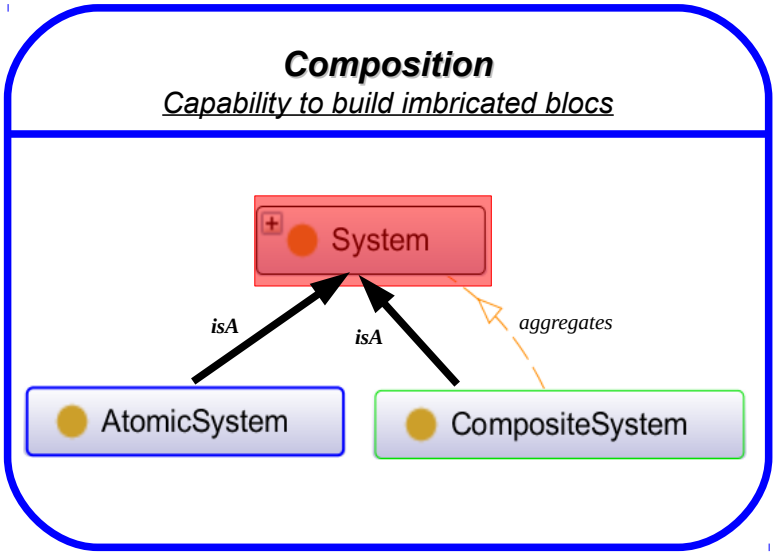
Generic concepts necessary to describe a scenario

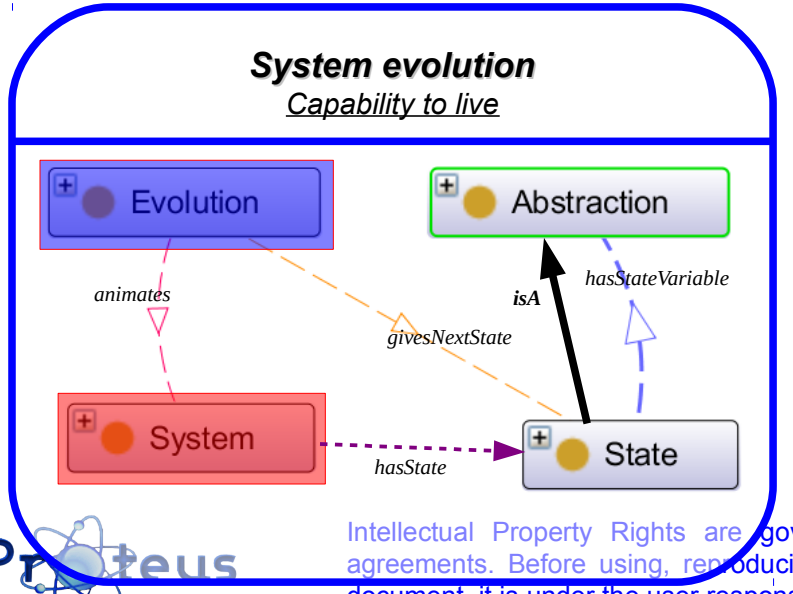
…PhysicalObject, Interaction, System...

ONTOLOGIES INTRODUCED

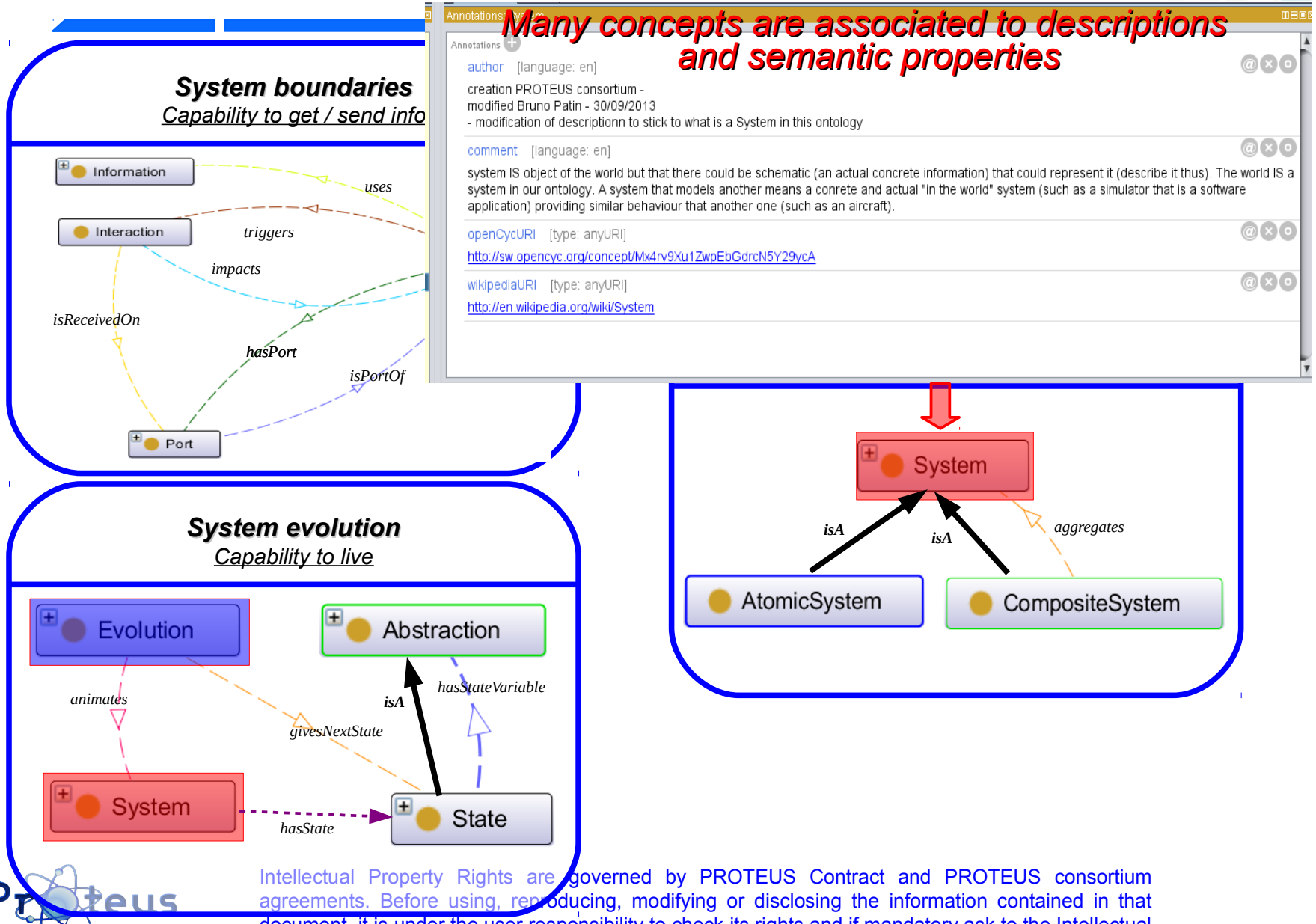
KERNEL – 1 / 2







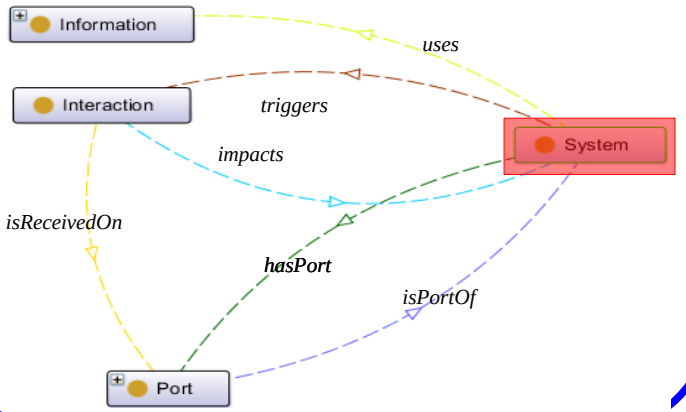
KERNEL – 1 / 2



KERNEL – 1 / 2

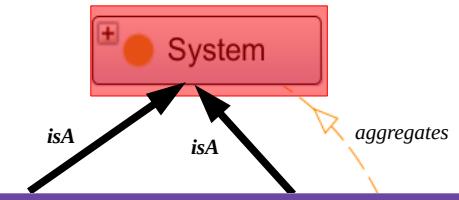
System boundaries

Capability to get / send info



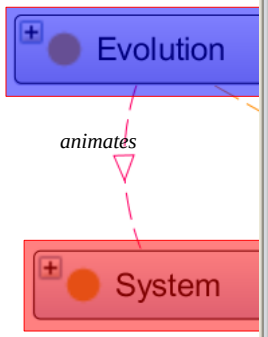
Composition

Capability to build imbricated blocs

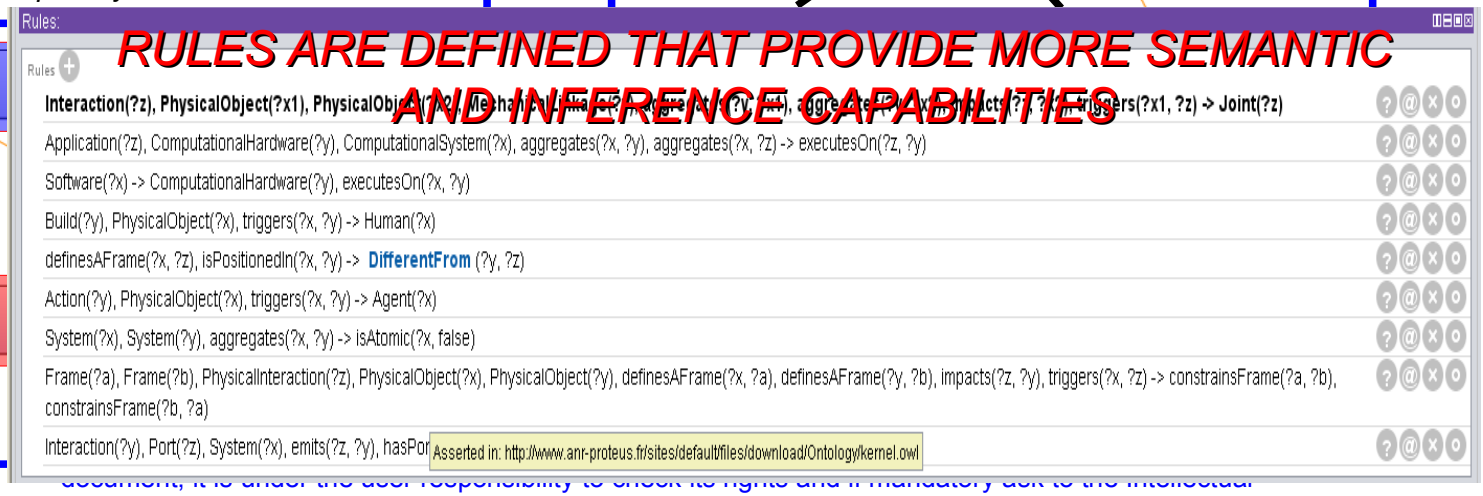


System evolution

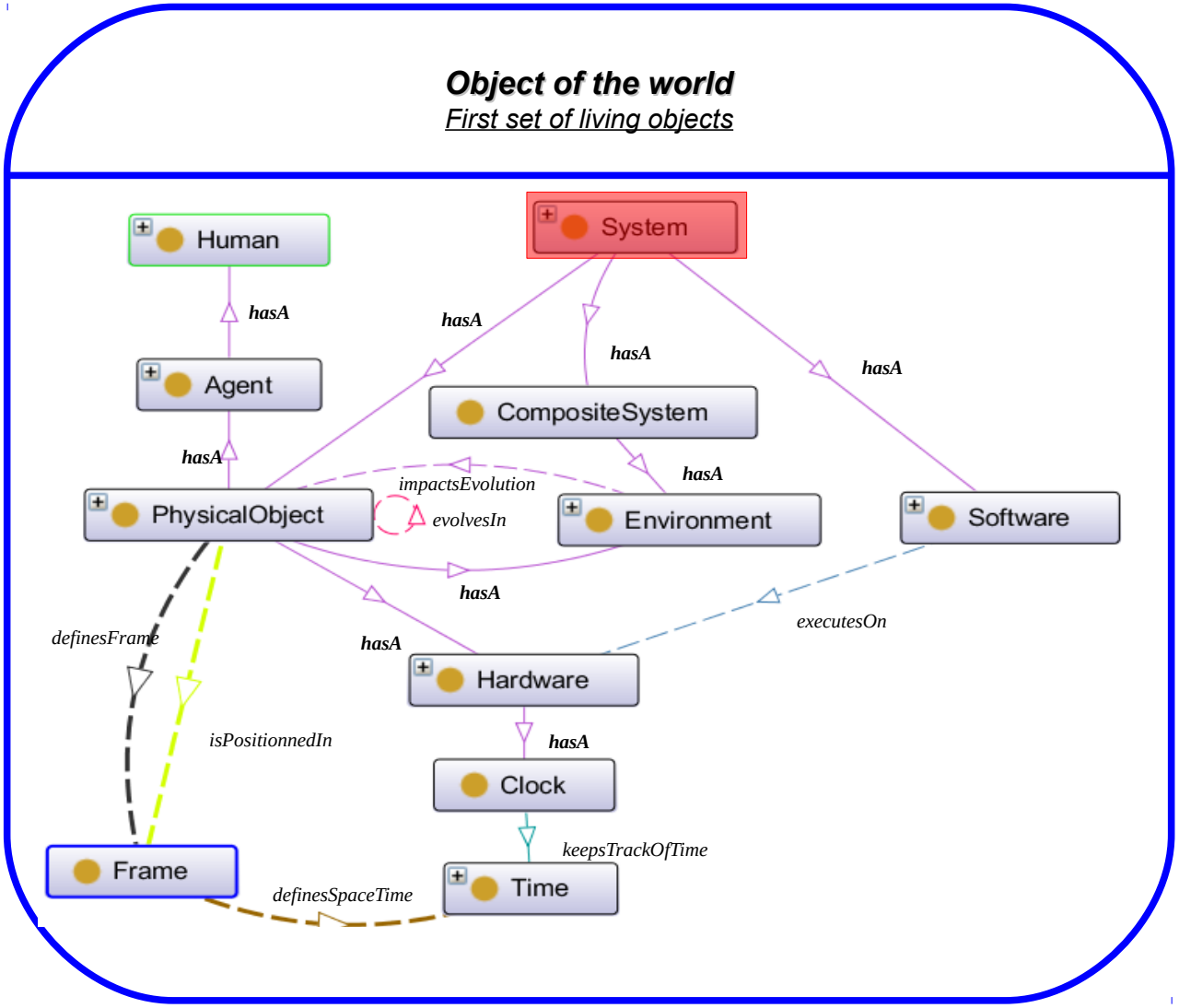
Capability to live



RULES ARE DEFINED THAT PROVIDE MORE SEMANTIC AND INFERENCE CAPABILITIES



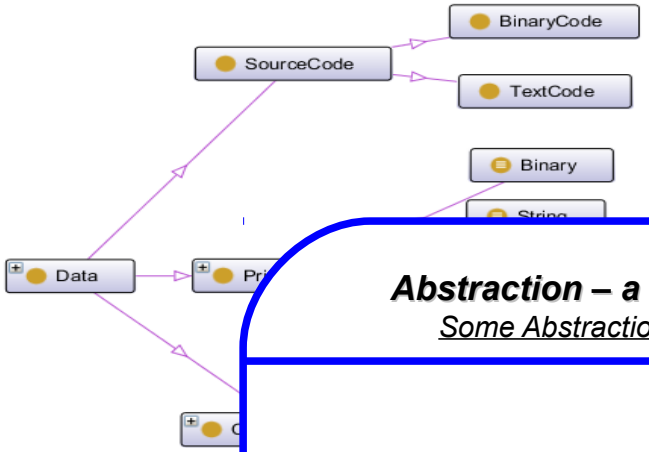
KERNEL – 2 / 2



INFORMATION

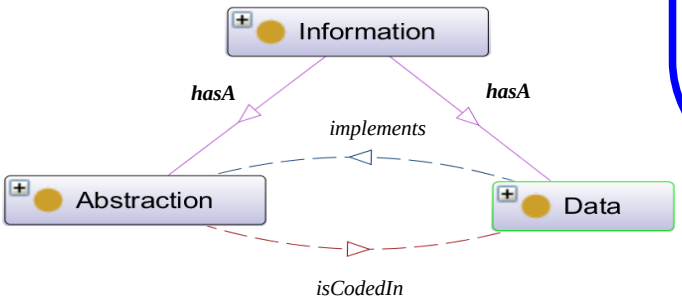
Data – a first zoology

Some Data definitions



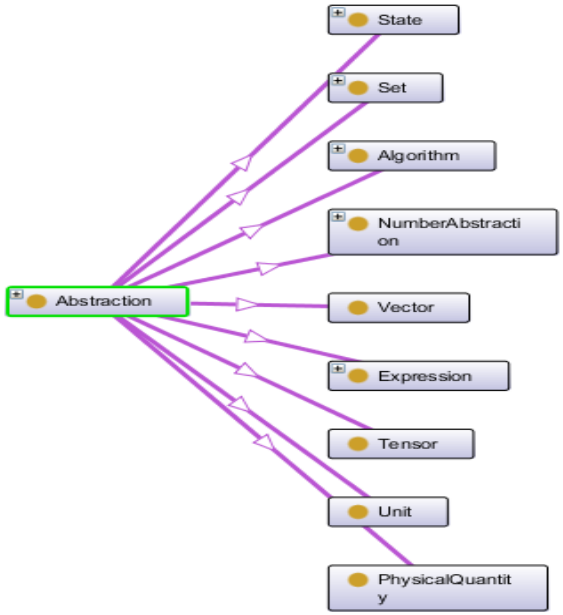
Abstract vs Actual information

Platon and Aristote



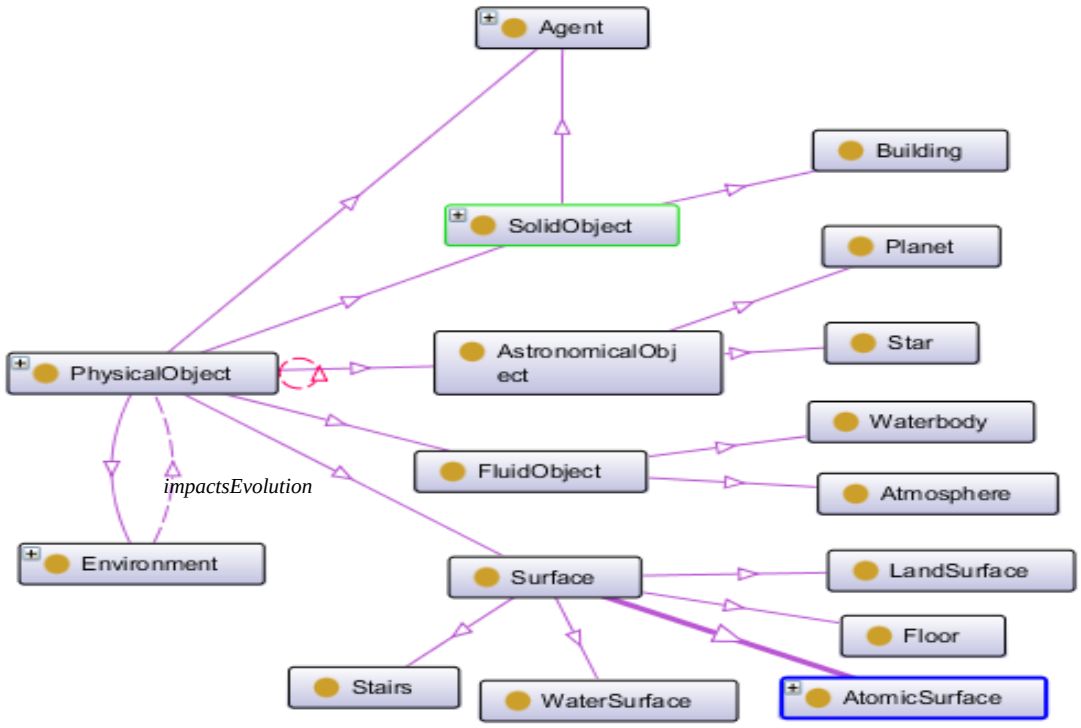
Abstraction – a first zoology

Some Abstraction definitions



ENVIRONMENT

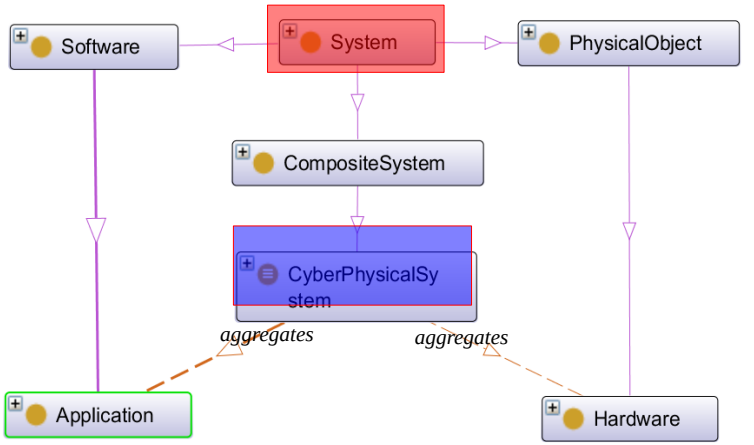
Environment object zoology



SYSTEM – 1 / 2

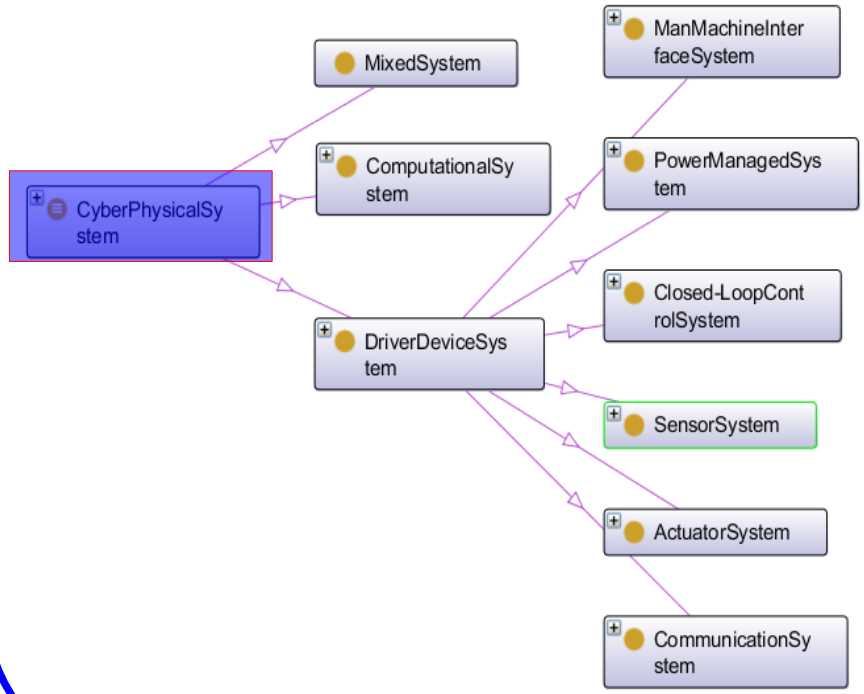
Cyber Physical system - composition

Mechanism to aggregate hardware to software

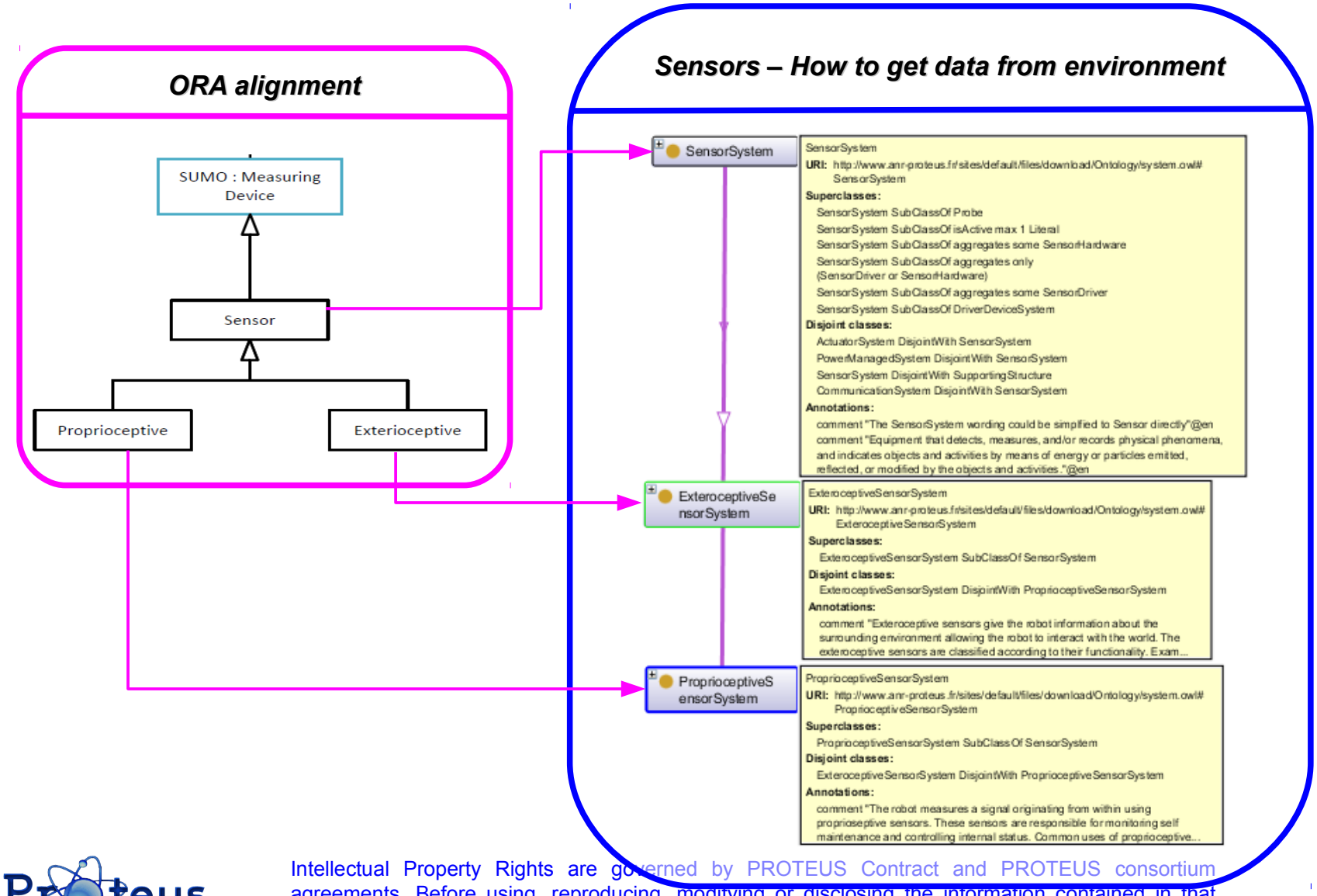


Cyber Physical systems - zoology

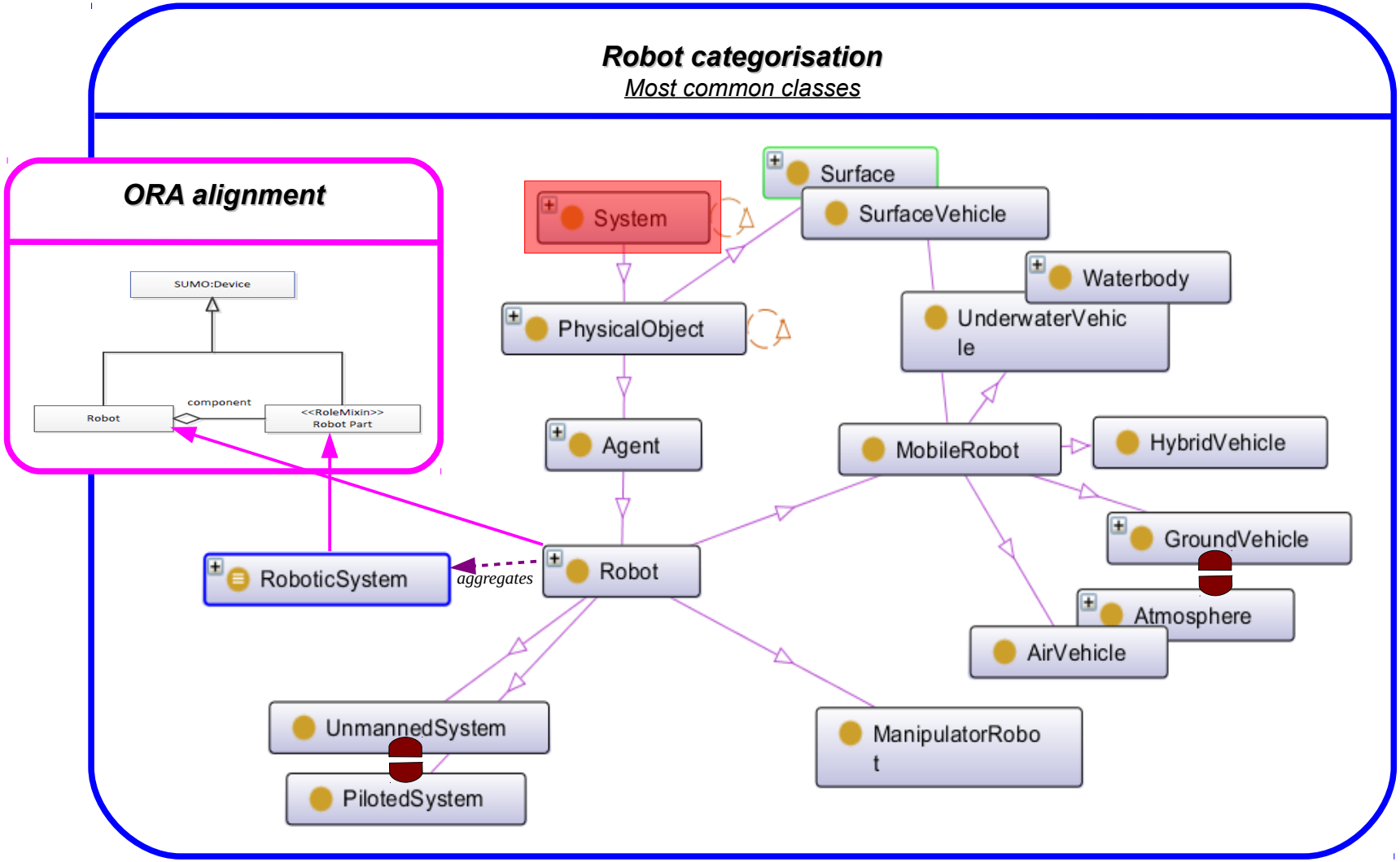
zoology



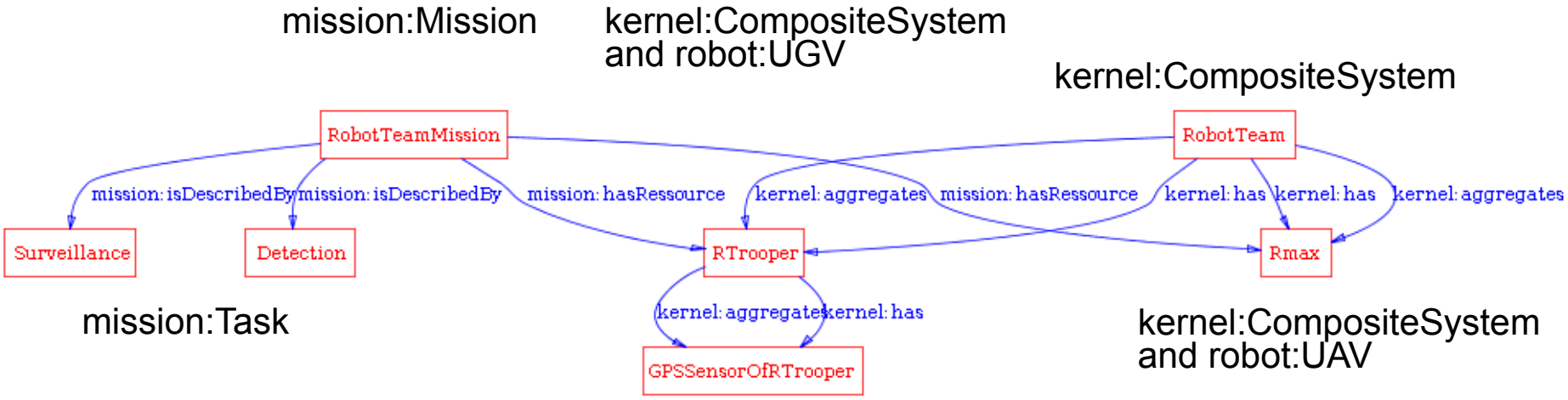
SYSTEM – 2 / 2



ROBOT – some key concepts



Validation – An example: part of Air-ground scenario



From Ontology to RobotML DSL

State of the art on middlewares , simulators and DSLs for robotics systems

1. DSL Requirements

Verification

Robotic Ontology

2. Domain Model

3. DSL Implementation

4. Modeling Tools development

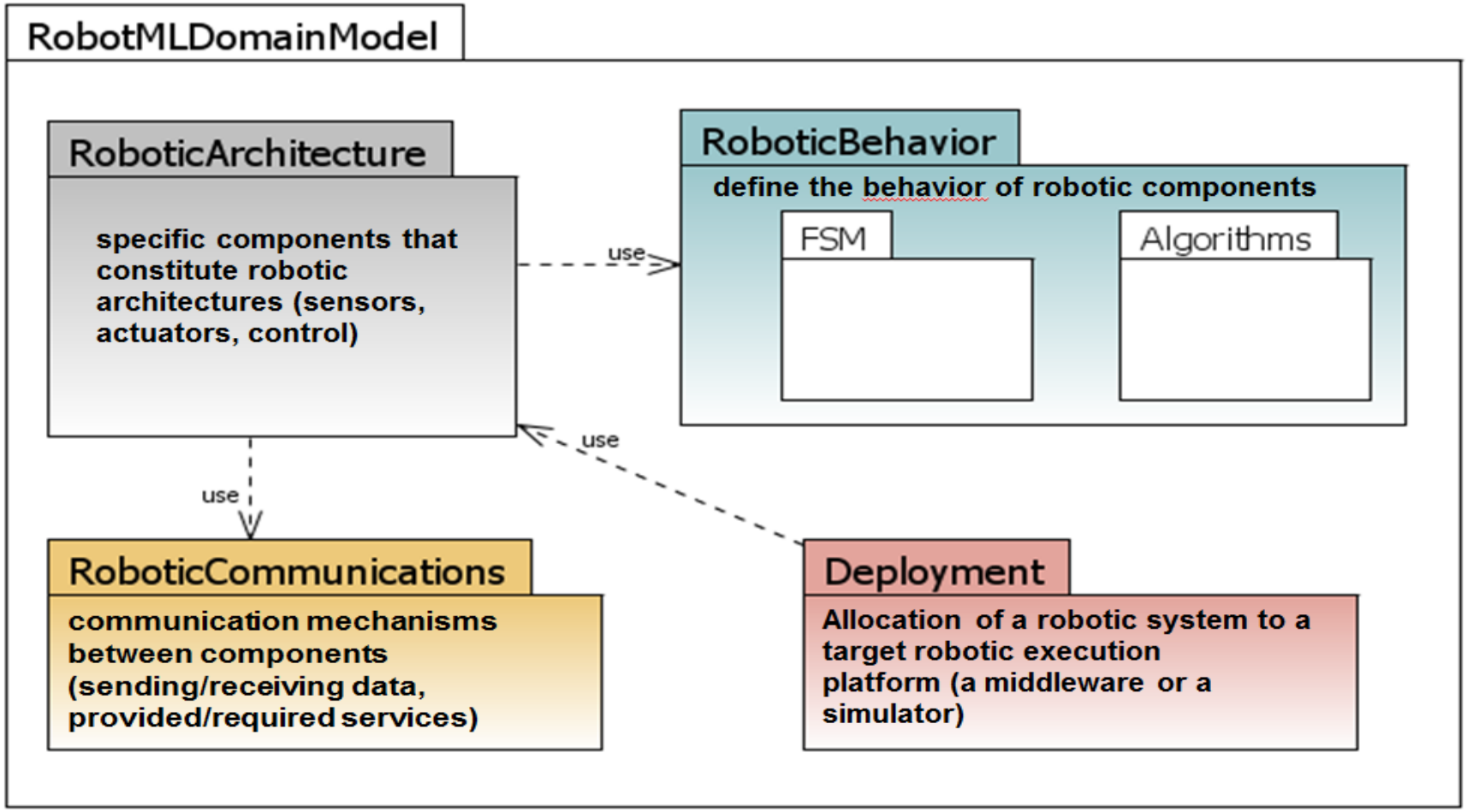
papyrus

Robot ML

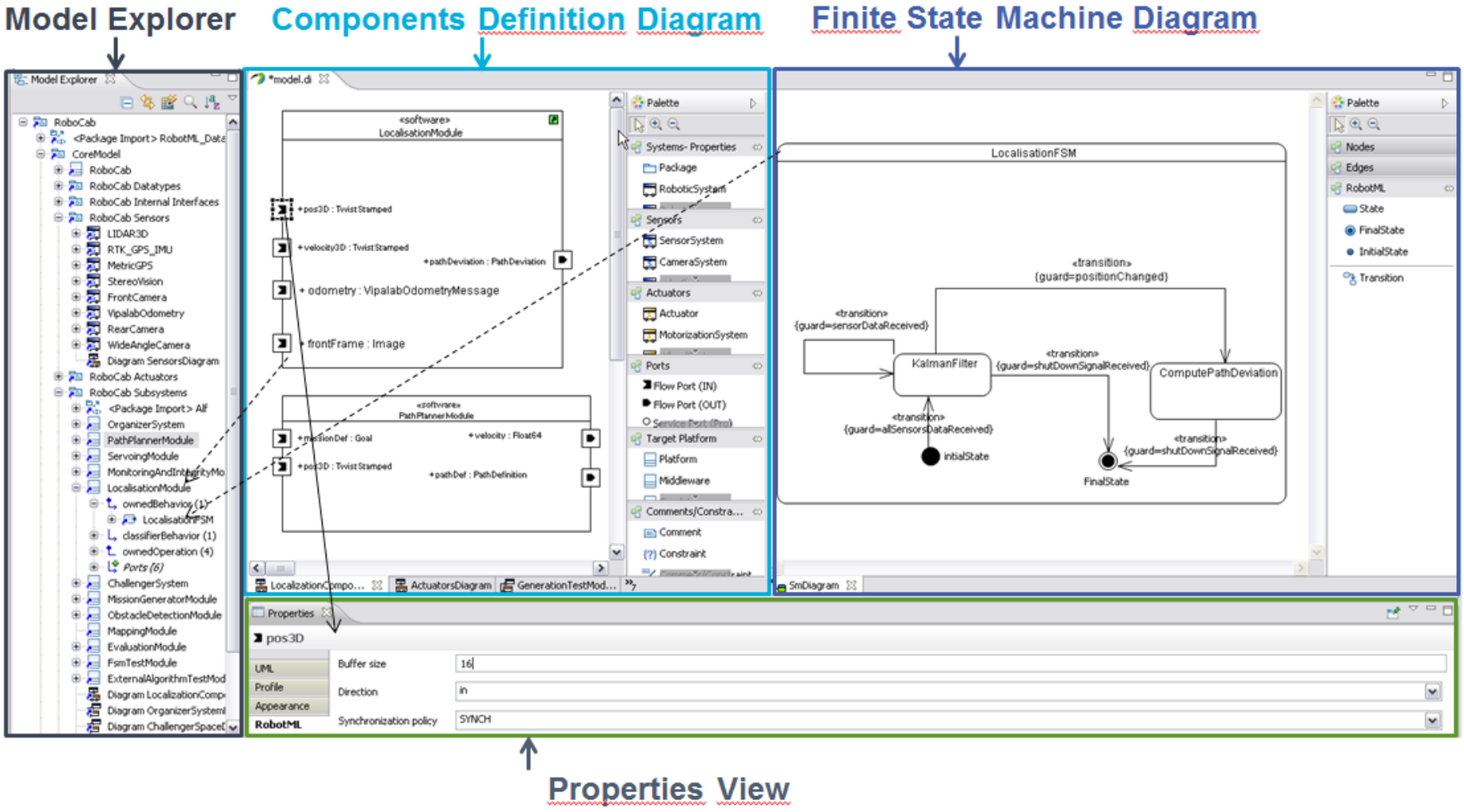
Ontology / DSL relationships

Ontology (OWL)	Domain model (UML class diagram)
Concept	Class
subClassOf	Generalization
Property	Association
Property:IsA	Inheritance
Property:HasA	Composition
Cardinality	Multiplicity

RobotML Meta-Model



RobotML Modelling Environment



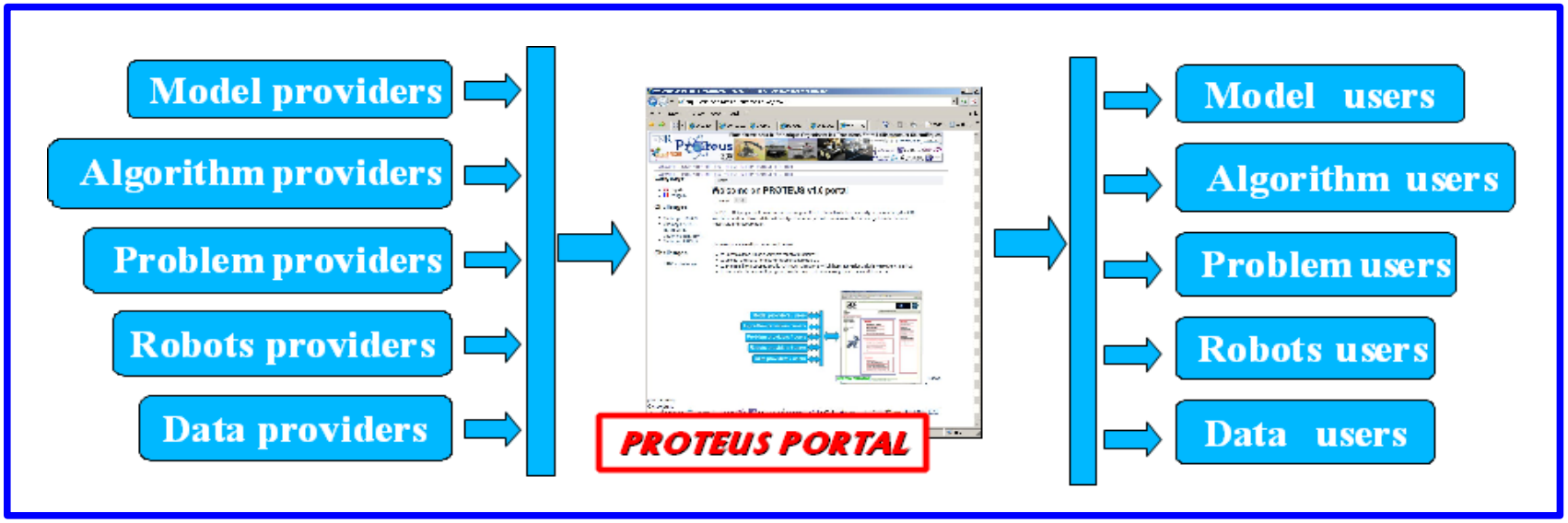
Some Conclusions

- This ontology includes more than:
  - 364 classes
  - 185 properties
  - 31 data types
- Nothing actually new, but common frame:
  - Able to describe some scenarios
  - Shareable by robotic community
  - Able to ground a Domain Specific Language (DSL) for robotics
    - Automatic simulation assembly
    - Robotic middleware projection
    - G. Lortal, S. Dhouib and S. Gérard (2011) Integrating Ontological Domain Knowlege into a Robotic DSL, Models in Software Engineering, Lecture Notes in Computer Science, Volume 6627, 401-414
- Work in progress because of expected feedback from:
  - Language developers
  - Challenge providers and challengers
  - **Alignment to existing efforts such as ORA**
  - **New field such as "Humanoid robotics"**
  - **New expected project to integrate explicitly *"knowledge"***

Questions ?

PROTEUS

PROTEUS is a Platform for organizing exchanges between industry and academics in the robotic domain



Use of a common language

Development of a theory grounding the vocabulary

Specification of the theory with an ontology*

**** Ontology : formal representation of knowledge describing a domain***

State of the art* of ontologies for the robotic domain

Gives Ontology	← *(Objective*	*and Scope)*
MLCOF	To help object recognition by robot	Robot context
OMRKF	To organize robot knowledge	Robot context
OCOA	To develop a control architecture	Control architecture of a model with components
Deplanques	To assess decisional autonomy	Robotics and environment
Schlenoff and Messina	To support development, test and certification of robotic technologies	Urban search and rescue missions
RoSta	To standardize	Mobile, handling and service robotics
PROTEUS	***To support exchanges***	***Mobile Robotics***

**** not exhaustive, see for example***

http://lists.w3.org/Archives/Public/public-xg-ssn/2009Aug/att-0037/SSN-XG_StateOfArt.pdf&usg=AFQjCNGMxI0CHy4FJuxquXVneXfJF6k2tg