

An Introduction to JaCaMo

Viviana Mascardi and Rafael Bordini

DIBRIS – University of Genoa

(RB on Sabbatical from PUCRS funded by CAPES)



PUCRS

Outline

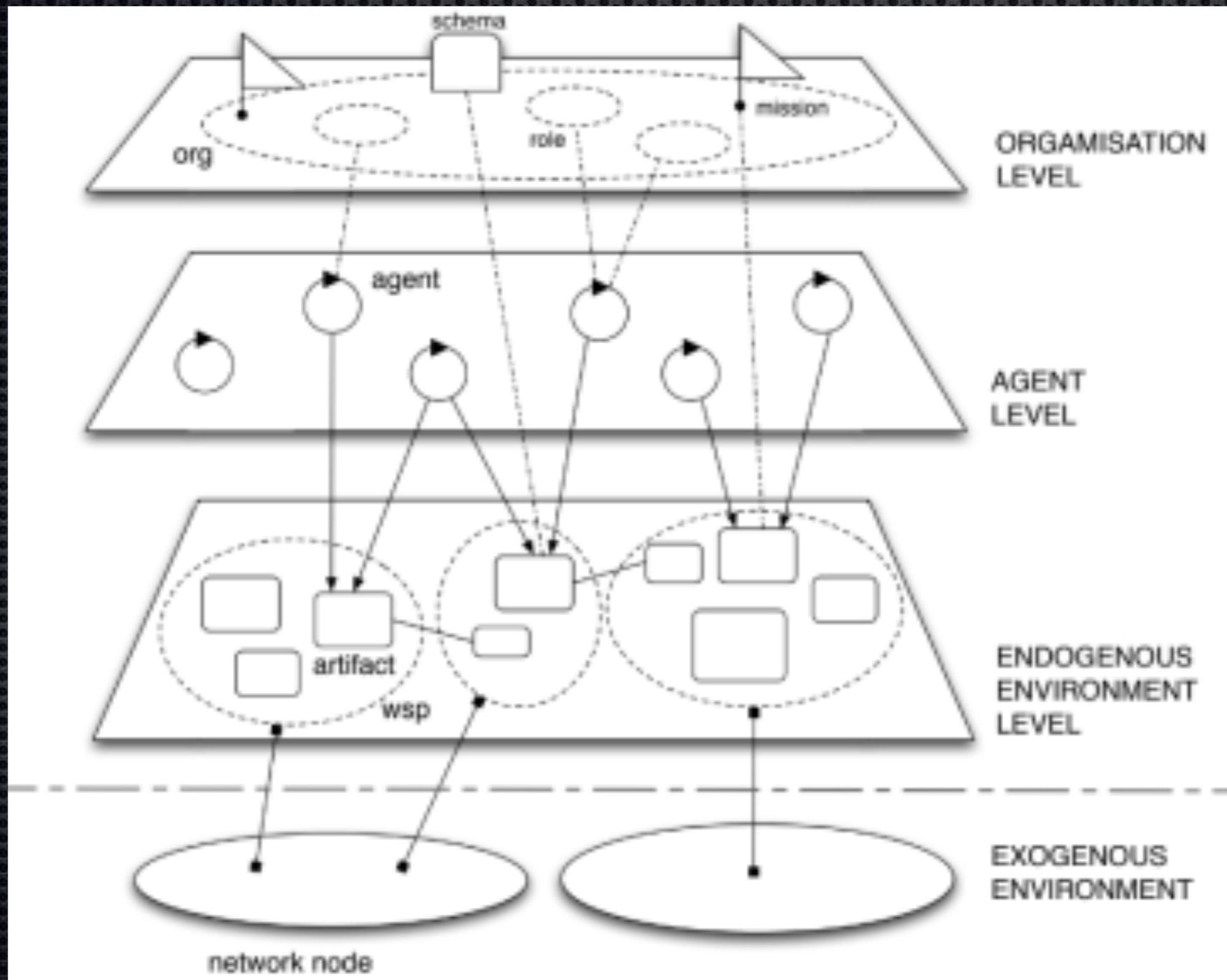
- ✦ Overview of JaCaMo
- ✦ (*Jason*)
- ✦ CArtAgO
- ✦ Moise
- ✦ Final view of JaCaMo

Overview of JaCaMo

From AOP to MAOP

- ✦ Combination of AOP with organisational and environment models
- ✦ JaCaMo was among the first working agent platforms to have abstractions at social, individual, and environment levels
- ✦ First-class abstractions at all 3 levels begins to unravel the full potential of MAOP
- ✦ We need to program Autonomous Agents as well as Organisations, Groups, Roles, Norms, Artifacts, ...
- ✦ JaCaMo = **J**ason (agent dimension), **C**artago (environment dimension), **M**oise (organisation dimension)
- ✦ Developed by **Jomi Hübner, Alessandro Ricci, Rafael Bordini, and Olivier Boissier**

JaCaMo Dimensions

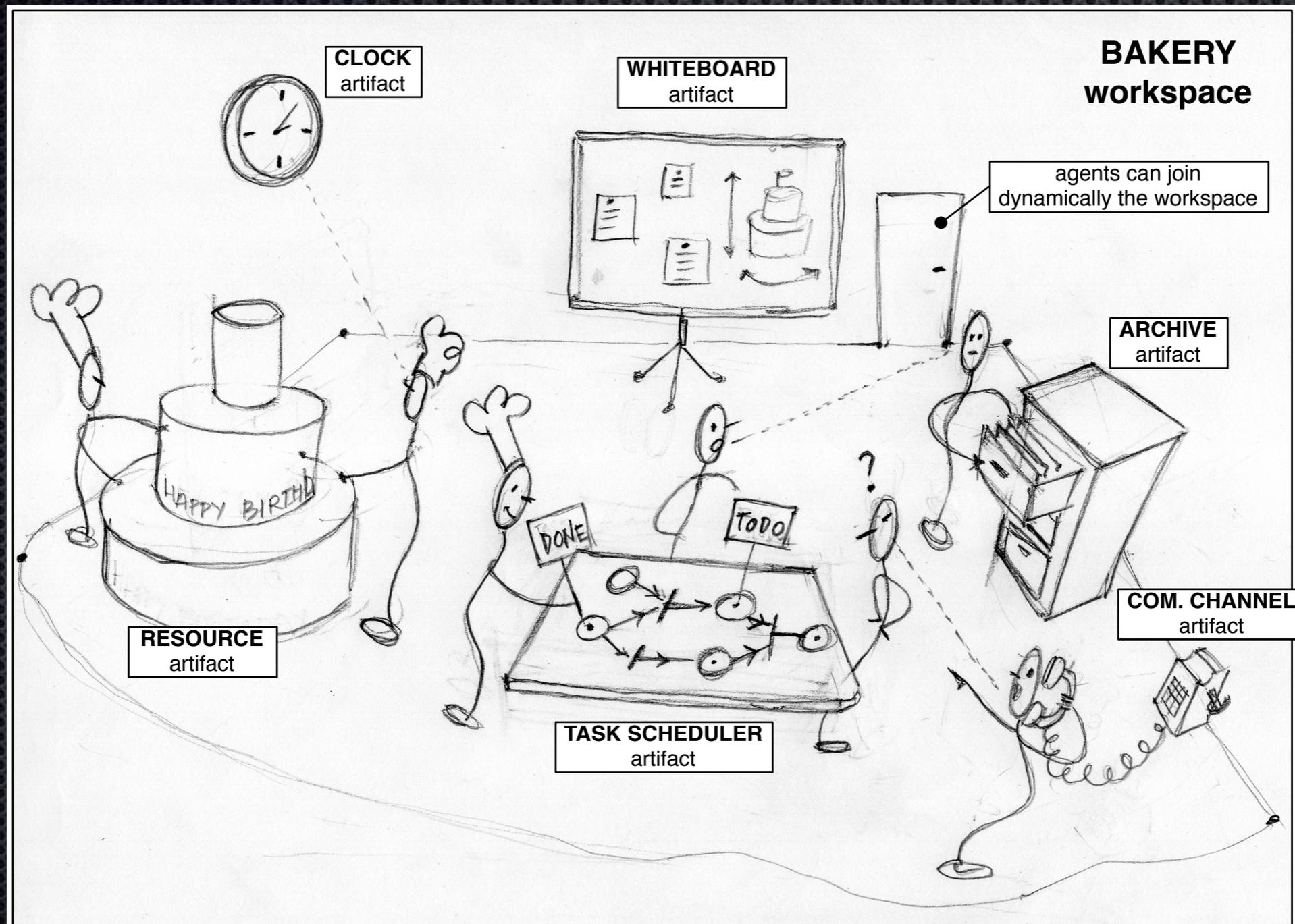


Jason

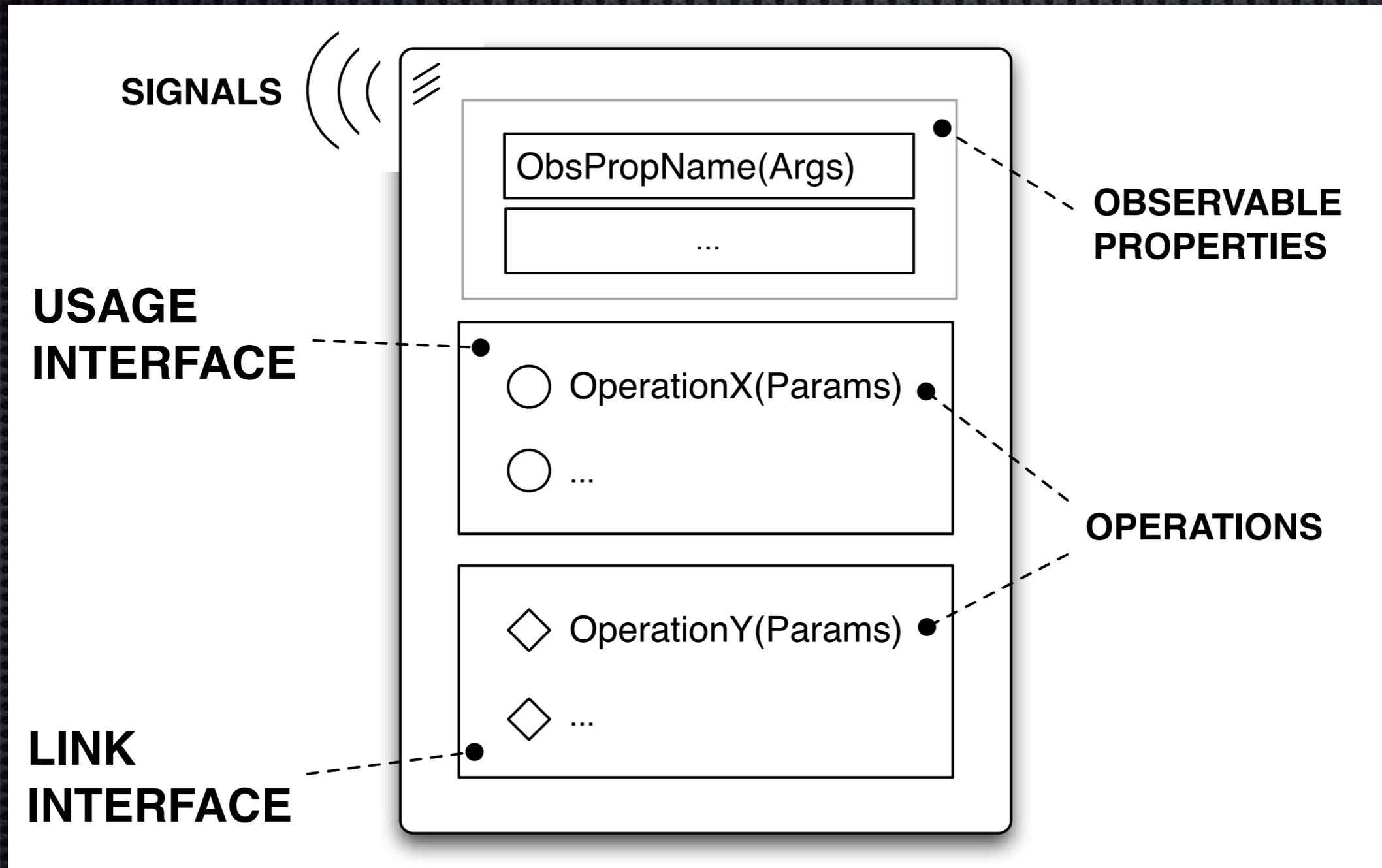
You already know about it!

CARTAgO

The A&A Model



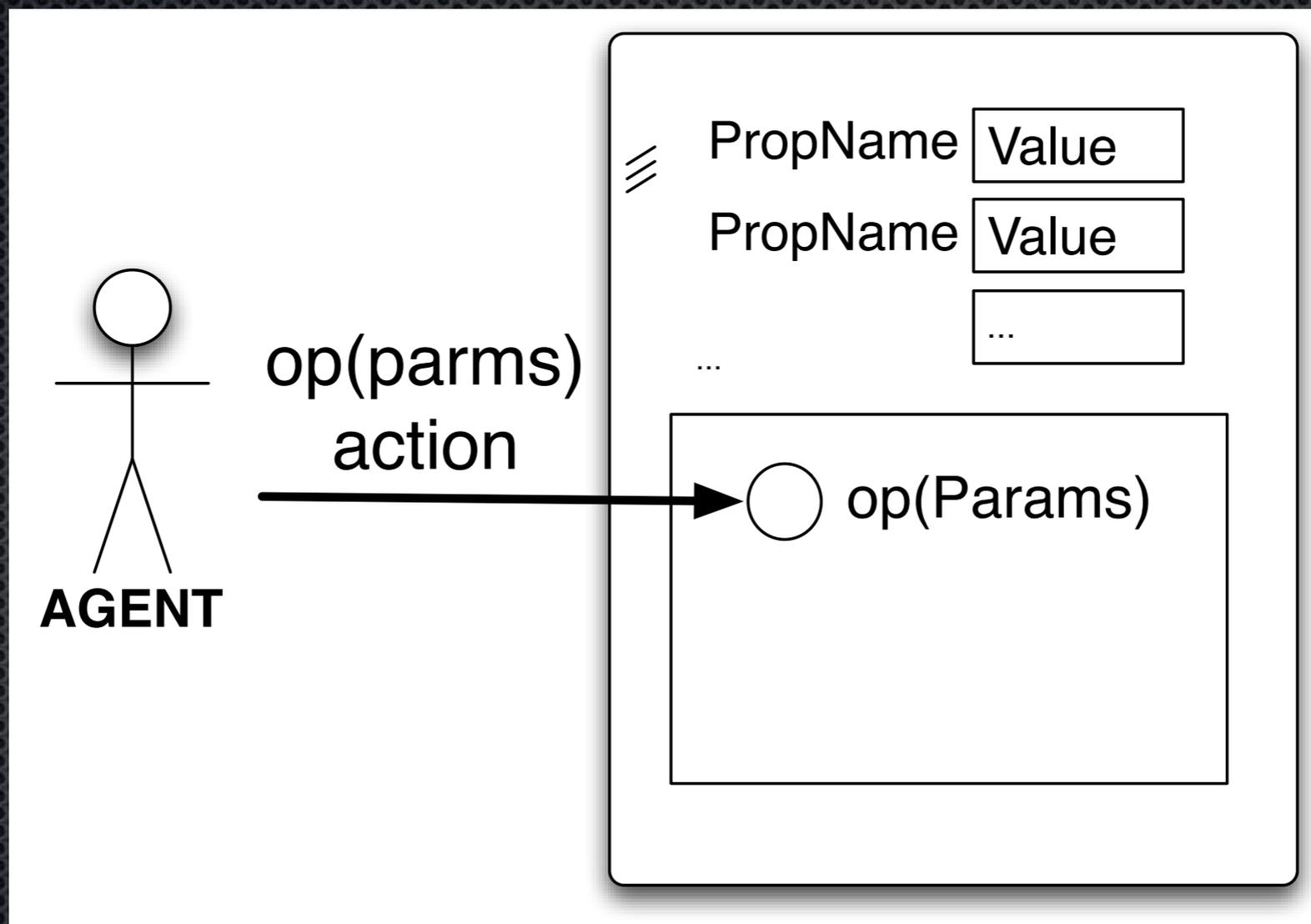
An Artifact



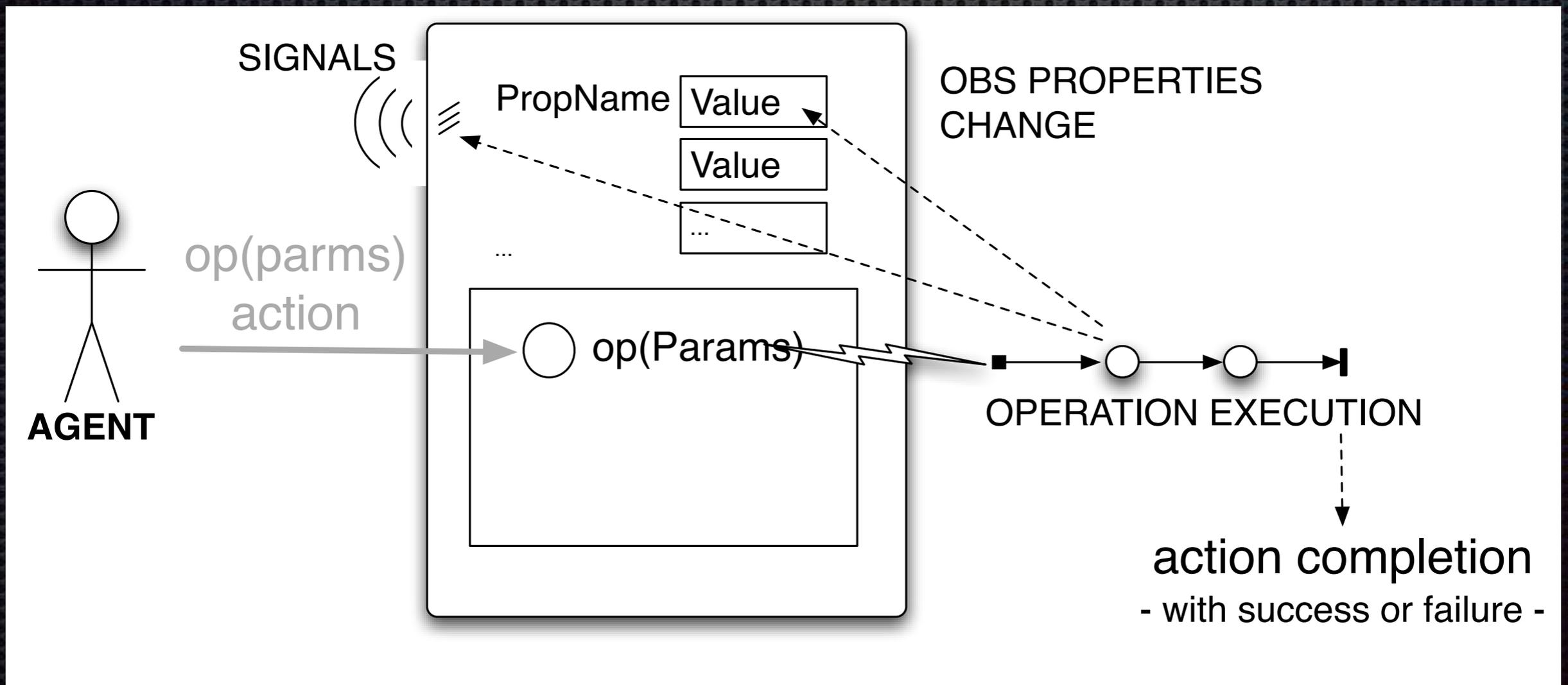
Workspaces

- ✦ Shared by Agents and Artefacts
- ✦ Gives a topology for the environment
- ✦ Each workspace may run in a different host
- ✦ Agents can **join** as many workspaces as they want
- ✦ Agents can **focus**, use and create artefacts in the workspaces they join

Agent Action



Agent Action



C4Jason

- ✦ Interface between **Jason** and CArtAgO
- ✦ All artifact operations automatically become environment actions available for the agent to execute at the AgentSpeak level when the agent joins a workspace
- ✦ Artifact observable properties become agent beliefs annotated as originating from an environment artifact when the agent focuses on the artifact; signals are only belief events without actual changes in the belief base

CArtAgO

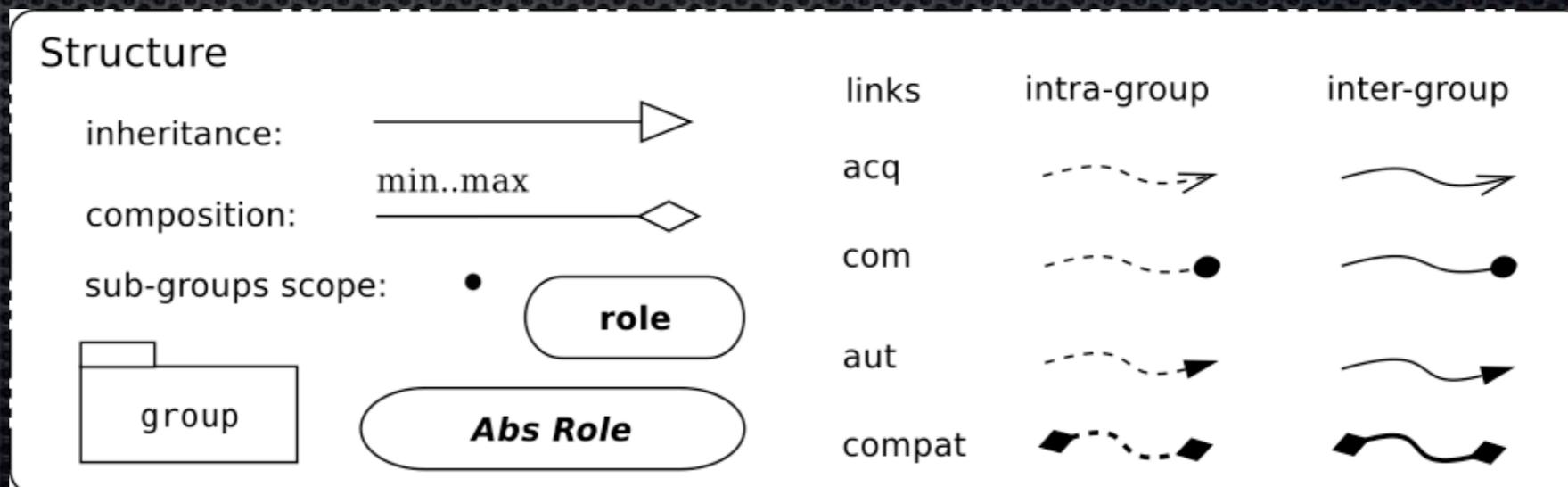
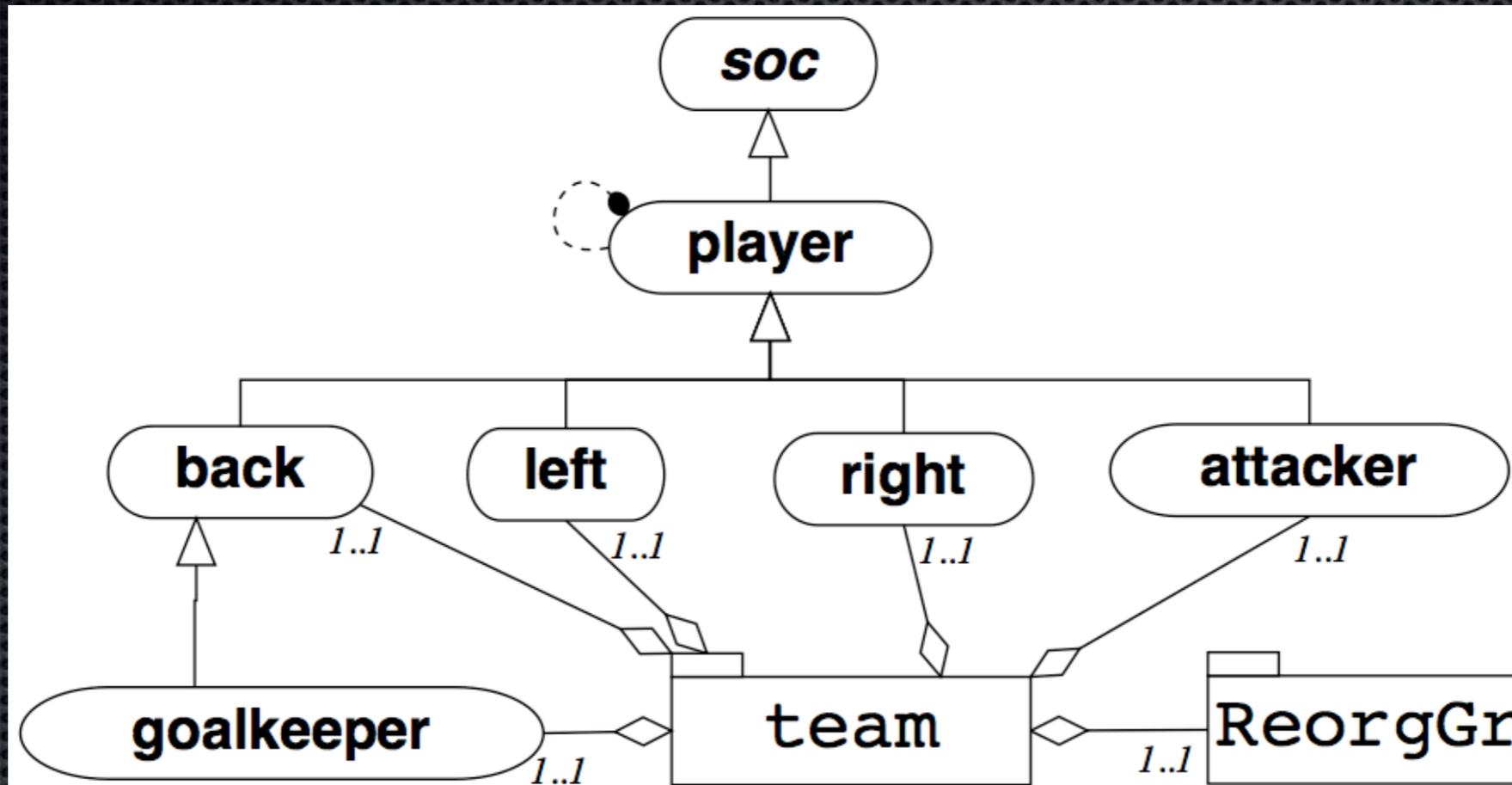
- ✦ Common ARtifact infrastructure for AGent Open environment (CArtAgO)
- ✦ [*Ricci, A., Piunti, M., and Viroli, M. 2010. Environment programming in multi-agent systems – an artifact-based perspective. Journal of Autonomous Agents and Multi-Agent Systems.*]
- ✦ Developed by Alessandro Ricci et al.
- ✦ Available at <http://cartago.sourceforge.net>

MOISE

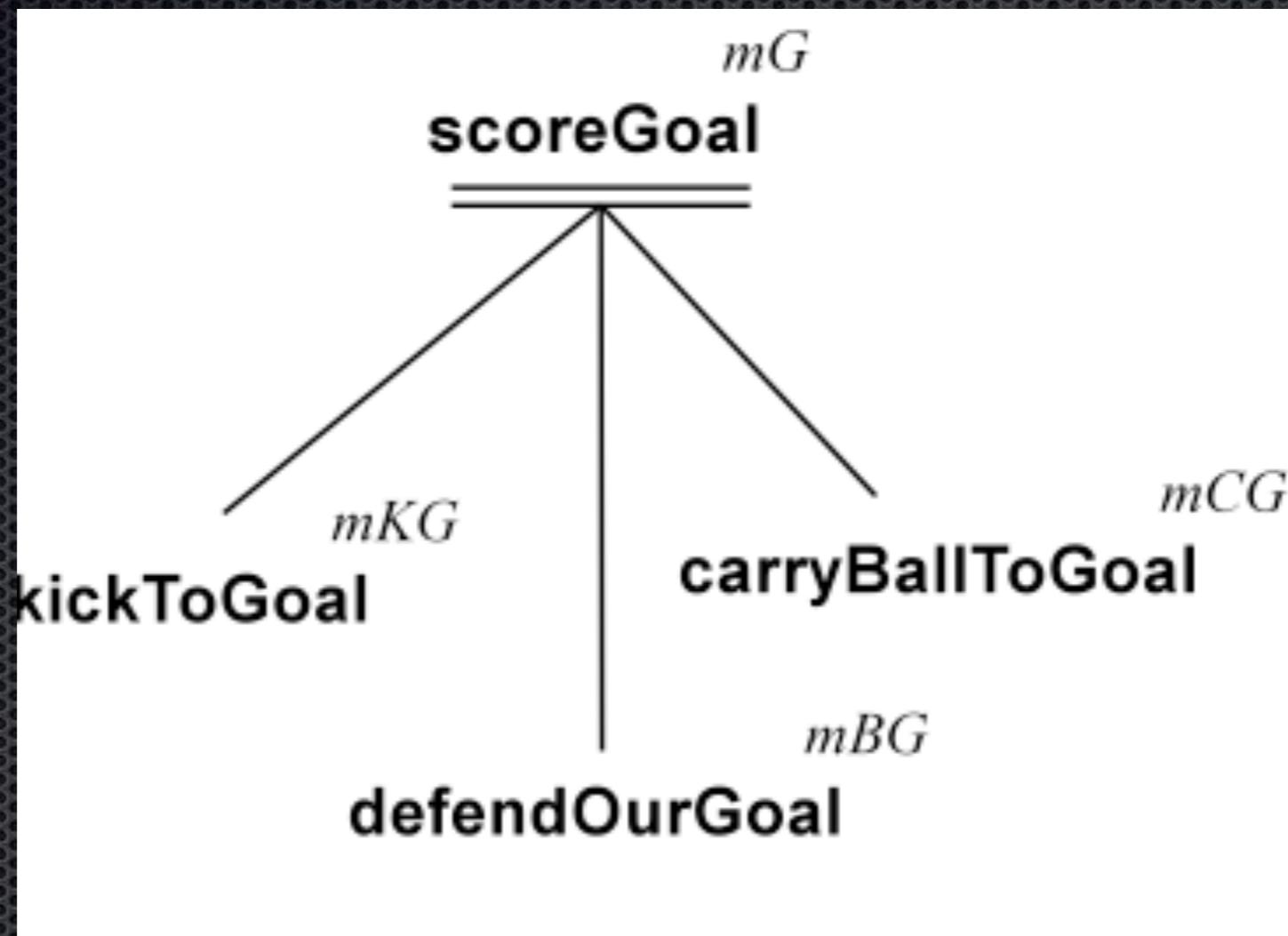
About MOISE

- ✦ An approach to MAS organisations
- ✦ 3 main components of an organisational model:
 - ✦ Structural Specification (groups, roles, ...)
 - ✦ Functional Specification (schemes, missions, ...)
 - ✦ Normative Specification (obligations, ...)
- ✦ Organisation Management Infra-structure: run-time coordination, regulation, enforcement, etc.

Structural Specification



Functional Specification



Scheme

missions

goal



sequence



choice



parallelism

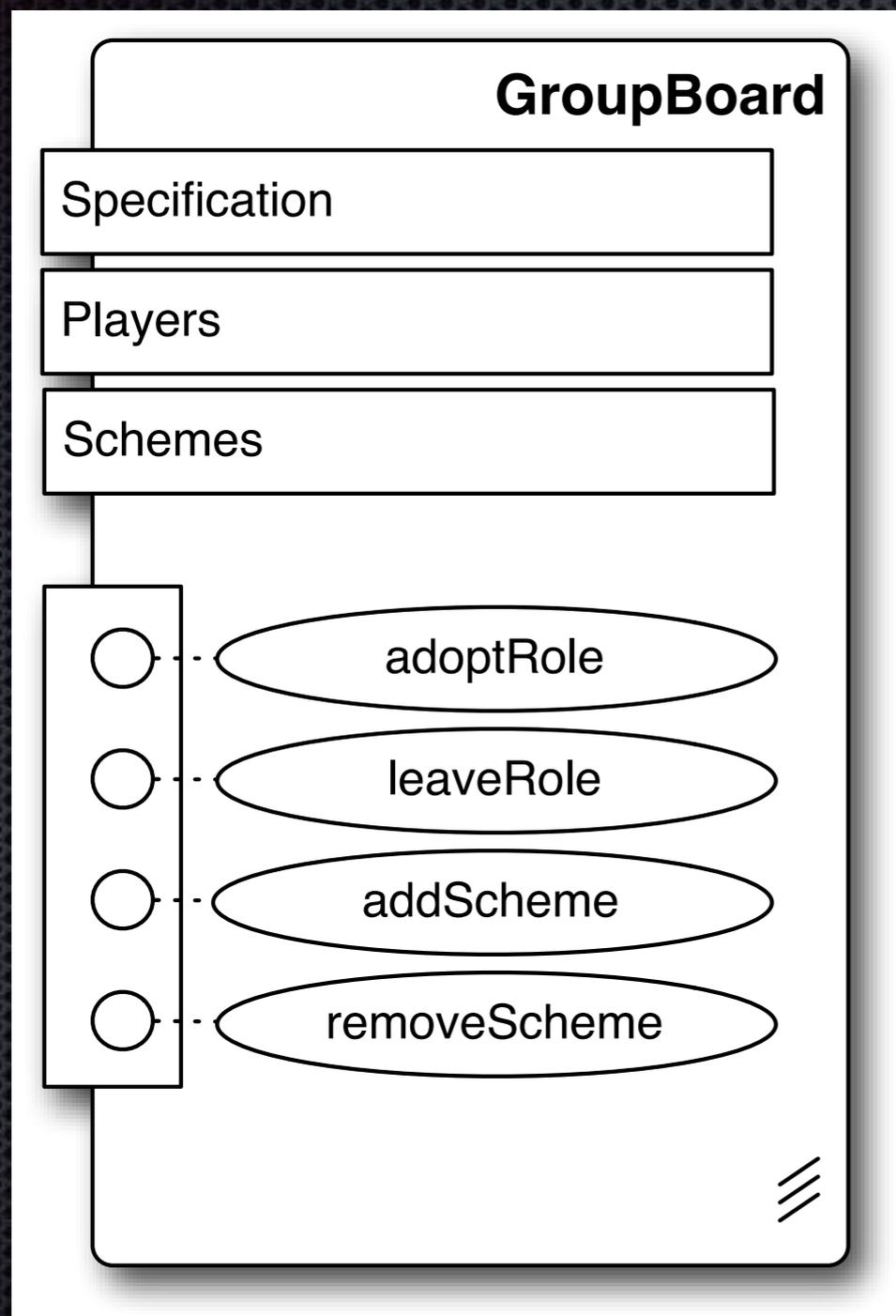
Normative Specification

role	deontic	mission		TTF
<i>back</i>	<i>obliged</i>	<i>m1</i>	get the ball, go ...	1 minute
<i>left</i>	<i>obliged</i>	<i>m2</i>	be placed at ..., kick ...	3 minute
<i>right</i>	<i>obliged</i>	<i>m2</i>		1 day
<i>attacker</i>	<i>obliged</i>	<i>m3</i>	kick to the goal, ...	30 seconds

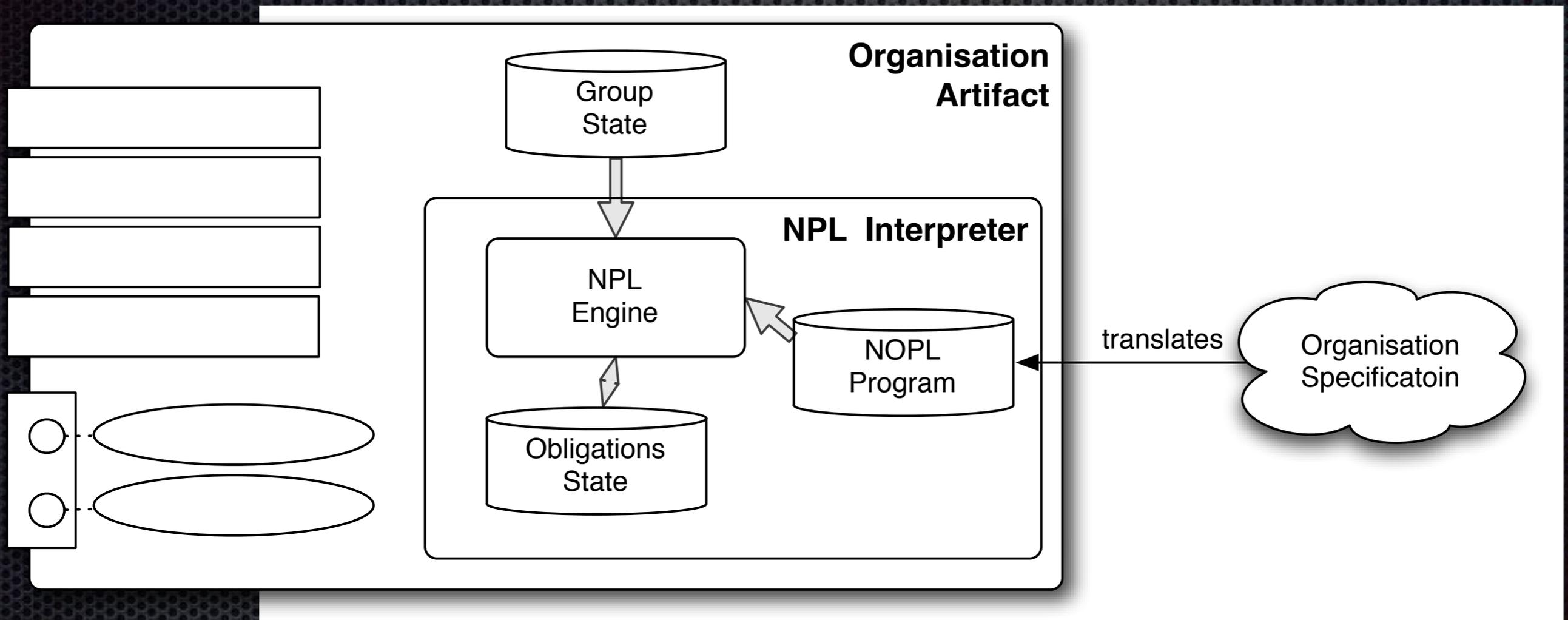
ORA4MAS

- ✦ An artifact-based implementation of the MOISE organisation management infrastructure
- ✦ Artifacts for groups and schemes
 - ✦ GroupBoard and SchemeBoard artifact types
 - ✦ Instances automatically generated from the MOISE specification
- ✦ Naturally distributed organisation management

ORA4MAS



ORA4MAS



NPL: Normative Programming Language (Hübner, Boissier, Bordini)

MOISE

- ✦ For more details see:

[Hübner, J. F., Sichman, J. S., and Boissier, O. 2007. Developing Organised Multi-Agent Systems Using the MOISE+ Model: Programming Issues at the System and Agent Levels. Agent-Oriented Software Engineering, 1(3/4):370–395.]

[Hübner, J. F., Boissier, O., Kitio, R., and Ricci, A. 2009. Instrumenting multi-agent organisations with organisational artifacts and agents: “Giving the organisational power back to the agents”. Journal of Autonomous Agents and Multi-Agent Systems.]

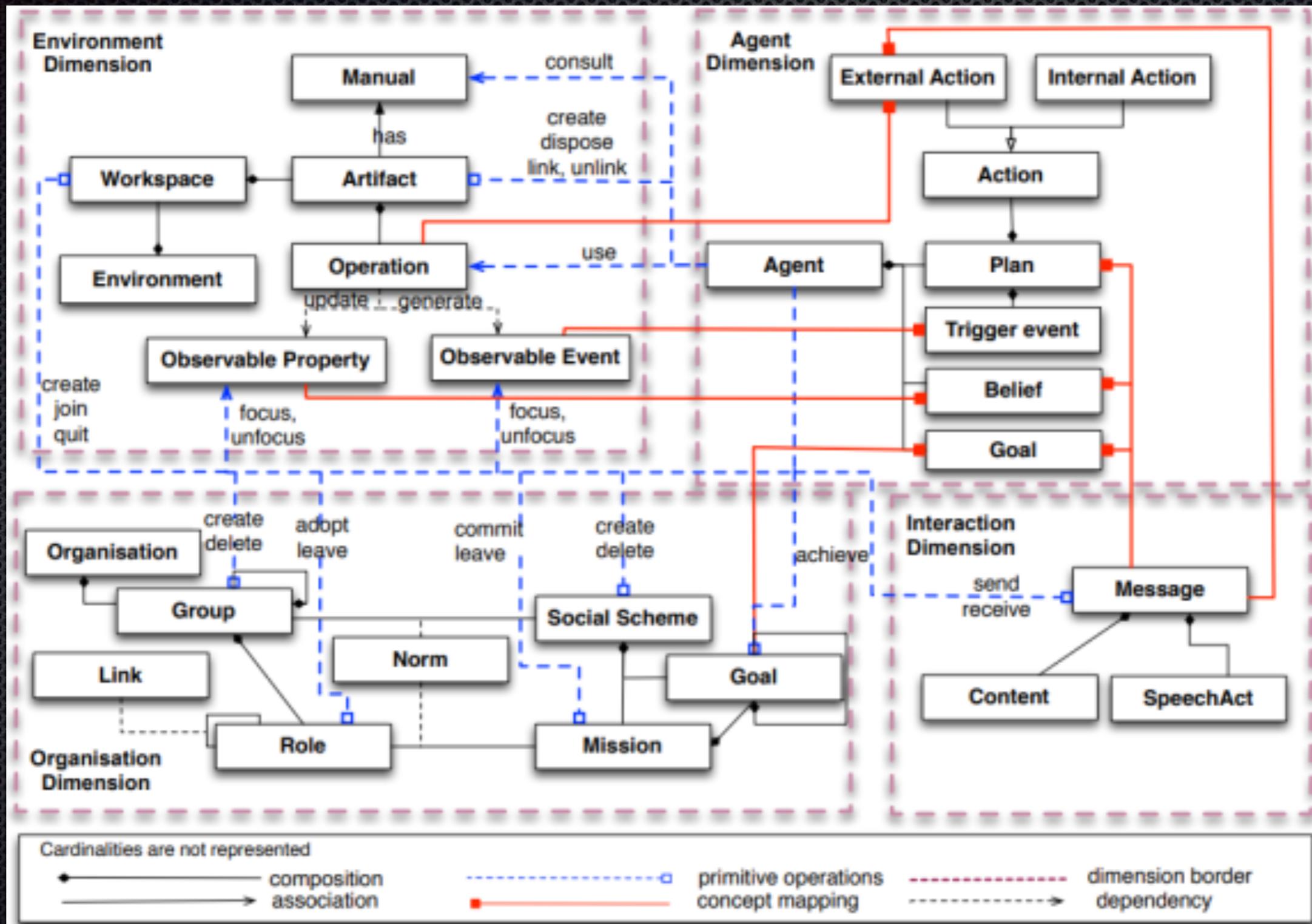
- ✦ Developed by Jomi Hübner

- ✦ Available at

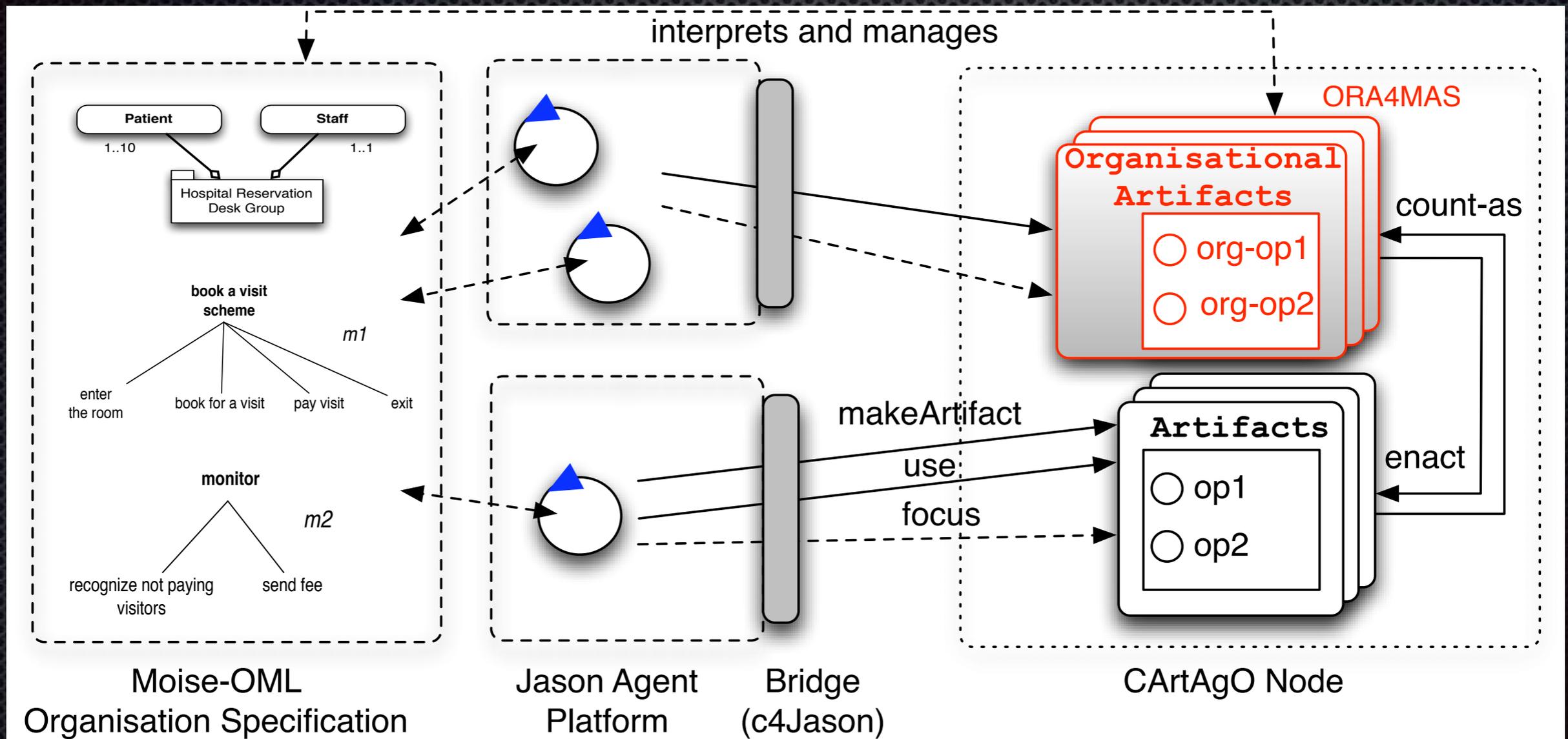
<http://moise.sourceforge.net>

Final view of JaCaMo

JaCaMo Metamodel



JaCaMo Platform



.jcm Project File

```
mas helloworld_demo {  
  agent hello {  
    focus : lectureroom.bb  
  }  
  
  agent world {  
    focus : lectureroom.bb  
  }  
  
  workspace lectureroom {  
    artifact bb : fixtures.blackboard()  
  }  
}
```

```
organisation phdcourse : course.xml {  
  group lg1 : lecture_grp {  
    responsible-for : phdc1  
    players: hello hrole  
           world wrole  
    debug  
  }  
  scheme phdc1 : lecture_sch {  
    debug  
  }  
  ...  
}
```

JaCaMo

- ✦ Available at <http://jacamo.sourceforge.net>

Acknowledgements

- ✦ PUCRS and CAPES
- ✦ Jomi Hübner, Alessandro Ricci, and Olivier Boissier for some of the slides