

# Multi-Agent Oriented Programming

## – Overview –

### The JaCaMo Multi-Agent Programming Platform

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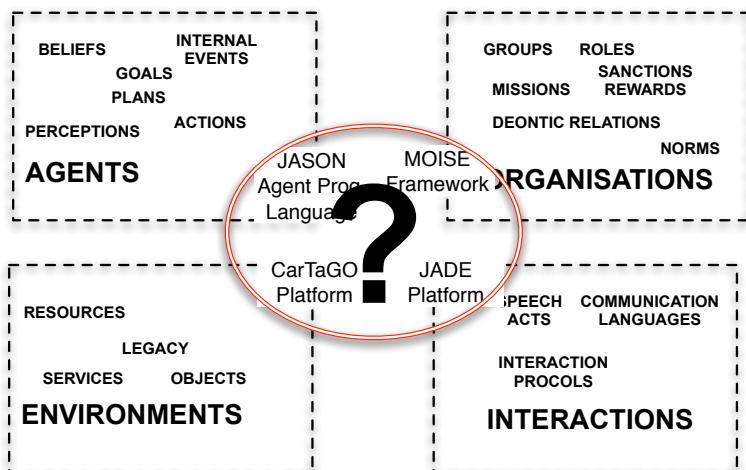
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## Outline

- ① Origins and Fundamentals
- ② MAOP Perspective: JaCaMo Platform

Fundamentals MAOP

### How do we go to MAOP?



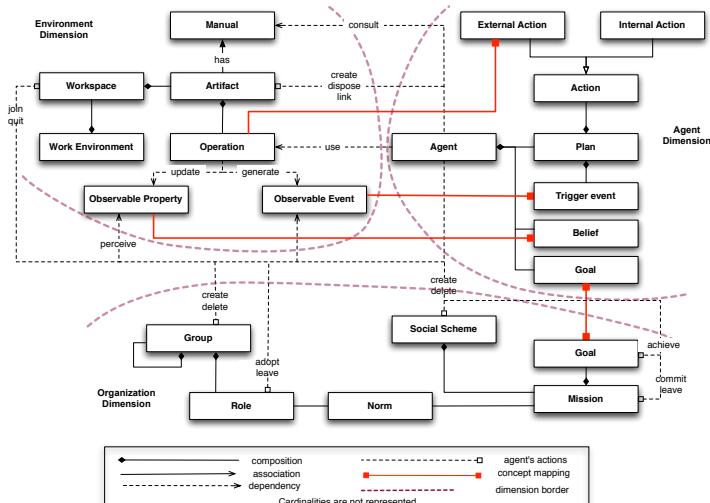
Which platform, Which Programming Environment?

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Fundamentals MAOP

### A+E+O meta-model



Based on A&A [Omicini et al., 2008], Jason, Moise meta-models



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## JaCaMo Platform

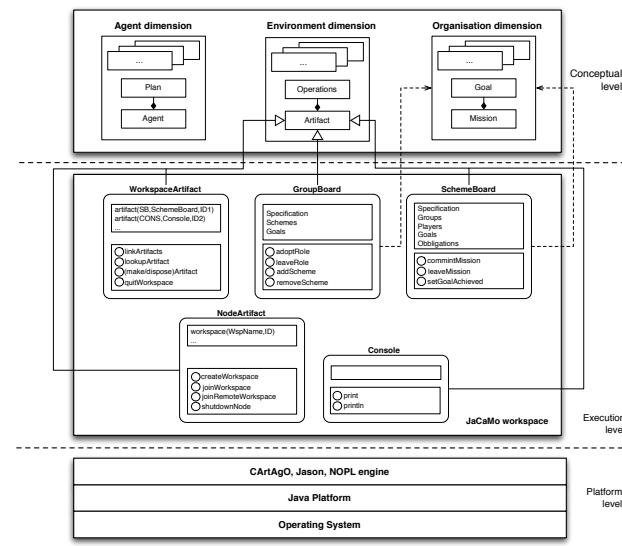
### 1 Origins and Fundamentals

### 2 MAOP Perspective: JaCaMo Platform

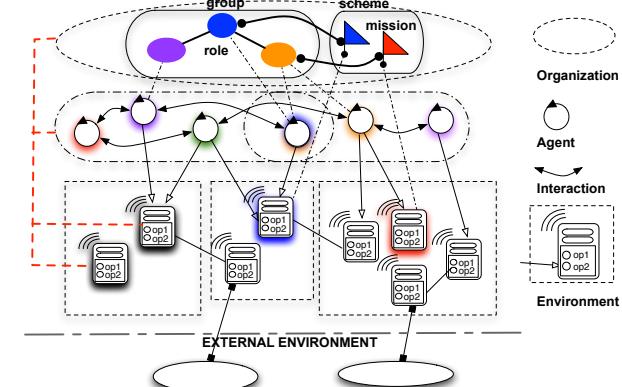
- ▶ Agent: *Jason* agents [Bordini et al., 2007]
- ▶ Environment: CArtAgO platform [Ricci et al., 2009]
- ▶ Organization: based on an extended/refactored version of the MOISE Framework
- ▶ Seamless Integration in the JaCaMo platform with dedicated bridges for
  - ▶ A-E (c4Jason, c4Jadex [Ricci et al., 2009])
  - ▶ E-O (count-as/enact rules [Pianti et al., 2009])
  - ▶ A-O ( $\mathcal{J}$ -MOISE<sup>+</sup> [Hübner et al., 2007] Action/Perception MOISE<sup>+</sup> organizational events and actions integration within *Jason*)



## JaCaMo Platform



## JaCaMo Platform



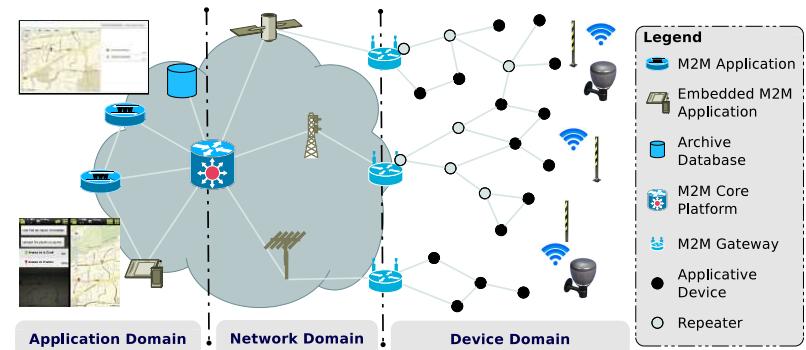
JaCaMo Platform: <http://jacamo.sourceforge.net>



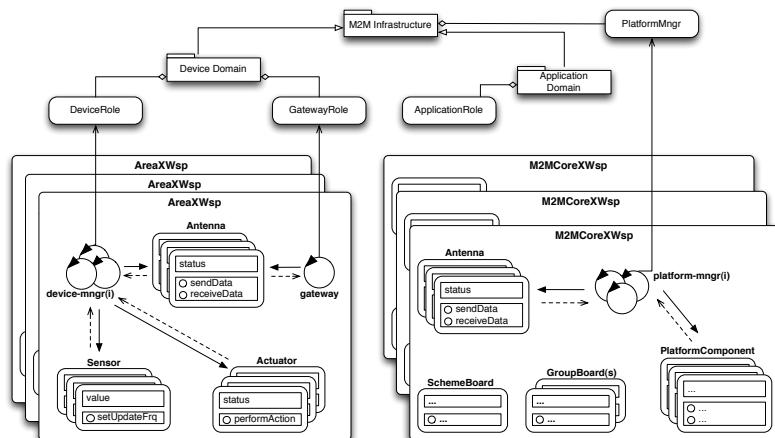
## Ongoing and Related Research

- ▶ Unifying agents, environments and organisation perspectives
  - ▶ Volcano platform [Ricordel and Demazeau, 2002]
  - ▶ MASK platform [Occello et al., 2004]
  - ▶ MASQ [Stratulat et al., 2009], extending AGRE and AGREEN
  - ▶ Embodied organisations [Piunti, 2010]
  - ▶ Situated E-Institutions [Campos et al., 2009]
- ▶ Normative programming and infrastructures [Hübler et al., 2009, Tinnemeier et al., 2009, Dastani et al., 2009]

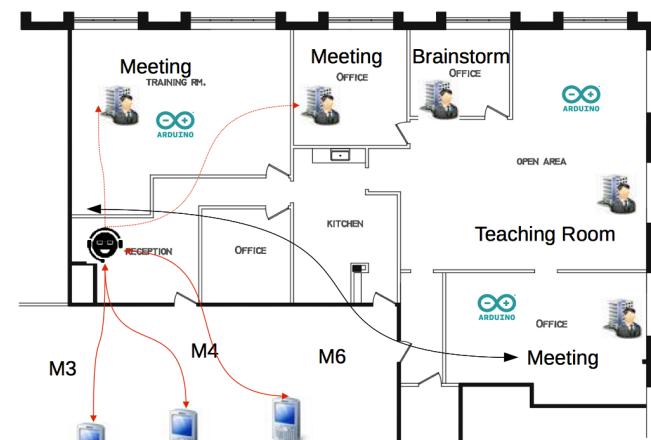
## Application Example with JaCaMo: M2M Agile Governance



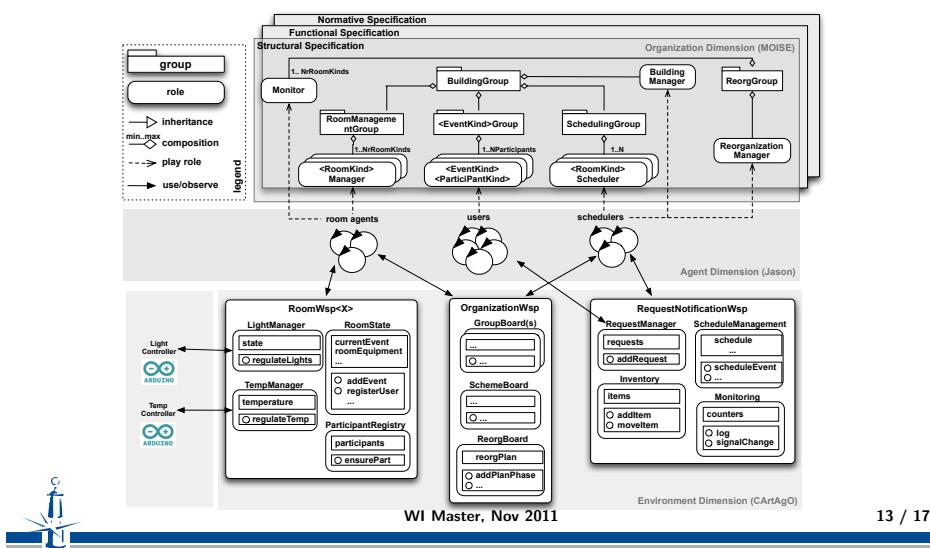
## Application Example with JaCaMo: M2M Agile Governance (2)



## Application Example with JaCaMo: RoomBooking Management



## Application Example with JaCaMo: RoomBooking Management (2)



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## Bibliography I

- Bordini, R. H., Hübner, J. F., and Wooldridge, M. (2007). *Programming Multi-Agent Systems in AgentSpeak using Jason*. Wiley Series in Agent Technology. John Wiley & Sons.
- Campos, J., López-Sánchez, M., Rodríguez-Aguilar, J. A., and Esteva, M. (2009). Formalising situatedness and adaptation in electronic institutions. In *Coordination, Organizations, Institutions and Norms in Agent Systems IV*, volume 5428/2009 of *LNCS*. Springer Berlin / Heidelberg.
- Dastani, M., Tinnemeier, N., and Meyer, J.-J. C. (2009). A programming language for normative multi-agent systems. In *Multi-Agent Systems: Semantics and Dynamics of Organizational Models*. IGI-Global.
- Hübner, J. F., Boissier, O., and Bordini, R. H. (2009). Normative programming for organisation management infrastructures. In *MALLOW Workshop on Coordination, Organization, Institutions and Norms in Agent Systems in Online Communities (COIN-MALLOW 2009)*.



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## Bibliography II

- 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.
- Occello, M., Baeijns, C., Demazeau, Y., and Koning, J.-L. (2004). MASK: An AEIO toolbox to design and build multi-agent systems. In et al., C., editor, *Knowledge Engineering and Agent Technology*, IOS Series on Frontiers in AI and Applications. IOS press, Amsterdam.
- Omicini, A., Ricci, A., and Viroli, M. (2008). Artifacts in the A&A meta-model for multi-agent systems. *Autonomous Agents and Multi-Agent Systems*, 17(3):432–456.
- Piunti, M. (2010). Embodied organizations: a unifying perspective in programming agents, organizations and environments. PhD thesis.



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## Bibliography III

- Piunti, M., Ricci, A., Boissier, O., and Hubner, J. (2009). Embodying organisations in multi-agent work environments. In *IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT 2009)*, Milan, Italy.
- Ricci, A., Piunti, M., Viroli, M., and Omicini, A. (2009). Environment programming in CArtAgO. In *Multi-Agent Programming: Languages, Platforms and Applications*, Vol.2. Springer.
- Ricordel, P. and Demazeau, Y. (2002). VOLCANO: a vowels-oriented multi-agent platform. In Dunin-Keplicz and Nawarecki, editors, *Proceedings of the International Conference of Central Eastern Europe on Multi-Agent Systems (CEEMAS'01)*, volume 2296 of *LNAI*, pages 252–262. Springer Verlag.
- Stratulat, T., Ferber, J., and Tranier, J. (2009). MASQ: towards an integral approach to interaction. In *AAMAS* (2), pages 813–820.



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## Bibliography IV



Tinnemeier, N., Dastani, M., Meyer, J.-J., and van der Torre, L. (2009).  
Programming normative artifacts with declarative obligations and prohibitions.  
In *IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT 2009)*.

