Dynamic Contextual Regulations in Open Multi-agent Systems

Carolina Howard Felicíssimo

DI – PUC-RIO, Rua Marquês de São Vicente 225, Gávea, RJ, Brazil
cfelicissimo@inf.puc-rio.br

1 Introduction

Following software engineering approaches for the Semantic Web (SW) and also Hendler's vision [3], I believe that the SW will not be a unique large complex Web, but it will be composed, mainly, of several small contextualized domain applications. These domain applications will be, in my opinion, Multi-Agent Systems (MAS) [5]. MAS have emerged as a promising approach for the development of information systems, which are constituted of cooperative goal-oriented problem-solving entities (named agents) [6]. Agent-based computing is rapidly emerging as a powerful technology for the development of distributed and complex information systems.

Information systems for a very dynamic, open and distributed domain (like the SW one) are always subject to unanticipated events [4] caused by their members that may not be compliant with to recommendations of correct behaviors. This risk imposes the necessity for regulatory mechanisms to prevent undesirable actions to happen and to inspire trust to its members. However, in open domains, no centralized control is feasible. Key characteristics of such domains are: agent heterogeneity, conflicting individual goals and limited trust [1]. Heterogeneity and autonomy rule out any assumption concerning the way agents are constructed and behave. So, an external control, dynamically created or modified, and not hard coded into agent implementations, may be the only viable solution for regulations in open systems [2].

2 Contextual Regulations in Open MAS with DynaCROM

My Ph.D. proposal is a novel regulatory approach for dynamic contextual regulations in open multi-agent systems, called DynaCROM. Toward dynamic compositions of contextual laws, from four levels of abstractions (Environment, Organization, Role and Interaction), I propose to easily oversee agent actions. Thus, cooperation among agents, playing the same or different roles, from the same or different organizations and environments, is enhanced with a confidence layer of laws.

DynaCROM is based on top-down modeling of contextual laws, on a normative meta-ontology for law semantics and on a rule support for composing and inferring contextual laws. Developers aiming to use DynaCROM, should perform the following steps: classify and organize user defined laws according to its top-down modeling; explicitly represent these laws into an instance of the DynaCROM meta-ontology; and define compositions of contextual laws by activating and deactivating rules. In DynaCROM, an ontology instance represents the regulatory contexts (expressed by

I. Cruz et al. (Eds.): ISWC 2006, LNCS 4273, pp. 974 – 975, 2006.

related concepts in the ontology structure) and also represents the user defined environment, organization, role and interaction laws (expressed by instances in the ontology data). Contextual laws are automatically composed and deduced by a rule-based inference engine, according to the ontology instance and active rules.

The main asset of organizing laws into regulatory contexts, from different levels of abstractions, and use rules and a rule-based inference engine is to permit flexibility while enforcing laws. Doing so, system regulations can be dynamically relaxed or restricted by simply changing sets of rules for new compositions of contextual laws. DynaCROM rules are *ontology-based*, i.e. they are created according to the ontology structure by only linking related concepts. Consequently, the numbers of rules and possible customized compositions of contextual law, for each regulatory context, are finite. For instance, 349 customized compositions of environment, organization, role and interaction laws are achieved with 19 rules (1 rule for the environment context, 5 for the organization context, 6 for the role context and 7 for the interaction context). All these rules are provided by the DynaCROM implementation, which is summarized as a JADE behavior [7]. Agents enhanced with the DynaCROM behavior are aware of the system regulation and, so, can take more precise decisions.

3 Conclusion

In this paper, I present DynaCROM – a straightforward method to, smoothly, apply and manage regulatory dynamics in open applications (like the SW ones). For future work, I am currently studying four main research lines: context-aware systems; action ontologies; simulations of regulated open MAS; and libraries of agent behaviors. The idea is to explore, independently, each of these research lines and to enhance DynaCROM, if good results appear. My Ph.D. research aims to contribute to the fields of regulation and cooperation in open MAS, enabling their agent societies. Thus, I believe that the SW represents a perfect scenario.

References

1. Artikis, A.; Pitt, J. and Sergot, M. *Animated specifications of computational societies*. In Proc. of AAMAS-2002, Part III, p. 1053-1061, Italy.
2. Grizard, A.; Vercouter, L.; Stratulat, T. and Muller, G.; *A peer-to-peer normative system to achieve social order*. In Proc. of COIN@AAMAS-2006, Japan.
3. Hendler, J.; *Agents and the Semantic Web*. In IEEE Intelligent Systems & their applications. 2001.16(2)30-37.
4. Hewitt, C.; *Open Information Systems Semantics for Distributed Artificial Intelligence*. AI. V.47, I.1-3, p.79-106. 1991. ISSN: 0004-3702.
5. Huhns, M. and Stephens, L.; *Multi-Agent Systems and Societies of Agents*. G. Weiss (ed.), Multi-Agent Systems, ISBN 0-262-23203-0, MIT Press. 1999.
6. Jennings, N.; Sycara, K. and Wooldridge, M.; *A Roadmap of Agent Research and Development*. Journal of Agents and Multi-Agent Systems, 1:p.7-38, 1998.
7. Tilab Company. (2006) JADE. In: <http://jade.tilab.com/>.