

Agent Description Ontology

– Version 2 *

(CFP6 014)

Ryusuke Masuoka (masuoka@flab.fujitsu.co.jp)
Akira Sato (satoyan@flab.fujitsu.co.jp)
Intelligent Systems Laboratory
Computer Systems Laboratories
Fujitsu Laboratories Ltd.
2-2-1 Momochihama, Sawara-ku
Fukuoka 814-8588, Japan

Contents

1 Introduction	1
2 Agent Description Ontology	2
3 Agent Description Ontology Examples	3
3.1 Those used in AGENTPRO	4
3.2 Those already in the Specs	4
4 Conclusion	5

1 Introduction

We propose “Agent Description Ontology – Version 2” as a response to FIPA’s Sixth Call for Proposal [6].

This document proposes an ontology for describing agents’ aspects such as agents’ knowledge, capability, and attributes. The ontology will include the terms and their semantics for such descriptions. This ontology should make it possible for agents to communicate their identity to each other.

Agents need shared models to establish the real interoperability between agents. Syntaxes alone does not establish the interoperability. Agents need semantics in the

*Revision: 2.7

form of ontology to address specific topics. The most important topic between agents is the topic of agents themselves.

This proposal has the relationships to the following parts of FIPA documents:

- a normative topic, “Description of agent and platform ontologies” in the section 3.1 Agent Configuration Management of FIPA’s Sixth Call for Proposal [6].
- Section 7.4 “Ontologies for Profile Management and Mobile Device Capabilities” of FIPA’s Sixth Call for Proposal [6].
- Section 9 “FIPA Agent Management Ontology” of Agent Management [2].
- Section 8 “Mobility Ontology” of Agent Management Support for Mobility [4].

We believe that “Agent Description Ontology” should be discussed and adopted as a standard for the following reasons.

Realization of efficient communication between agents When we scrutinize the case of human communication, it is very difficult for two persons to talk with each other without the knowledge of the counterpart even if they speak the same language.

If agents are deprived of the capability to communicate what they are and what they can do, agents need to go through a very inefficient process of building the models of other agents from indirect evidences.

Agent Description Ontology should make it possible for agents to communicate their attributes and capabilities. Agents can build models of other agents rapidly through the direct messaging, and then efficient communication between them can be established.

Realization of agent services In order to realize the agent services such as brokerage/recruitment/recommendation, agents need to have accurate models of other agents.

KQML specification [1] defines advertise messages. KQML specifies that an advertise message has the KQML message as its content. Therefore an advertise message can only communicate the message-handling capability of the sender agent by a matching pattern. If we restrict the agents to the advertise messages as the ways to convey their capabilities, this would greatly restrict the possibilities of agent services. It should be very difficult to realize content-based brokerage for example. ¹ We need predicates, of which semantics are defined in the ontology, to provide a variety of such agent services.

Human benefits When “Agent Description Ontology” is prepared, a particular agent will be described using this ontology. We believe that this would benefit the people, especially the developers and users of agent systems in the current situation where the definitions of agents are just abundant.

¹We have realized content-based brokerage service in our next product AGENTPRO based on SAGE (Smart AGent Environment) [9].

The ontology does not give a unique definition of what an agent is, but does give dimensions to measure agents. This makes it possible to position agents in those dimensions and to compare them. Developers and users of agent systems can then decide much easily which agent system to adopt.

2 Agent Description Ontology

We believe “Agent Description Ontology” should include, but not limited to, the followings. We list possible normative topics first.

Name of the ontology We need to give the name of the ontology that should appear as the value for the :ontology parameter of the ACL message. If the terms are appropriately categorized, we need to give names for ontologies corresponding to those categories.

Framework to express agent models We need the framework to express agent models, which the ontology will be based on. This may be a meta-ontology in one of first order logic languages. In order to make the standard language-independent, we can take such an approach for example to provide models in graphs and serializations of the models into SL, KIF, XML [11], etc. This is a similar approach to that of RDF (Resource Description Framework) [10].

Content of the ontology We need to standardize the content of the ontology, which is the essential part of this proposal. We need the terms for the predicates to describe the agents and possibly the values or the formats of the values for those predicates. Here we list the categorized list for the possible terms. These categories may not be exhaustive and may be reorganized during the discussion.

- Terms for describing agent’s knowledge
 - Range of agent’s VKB (Virtual Knowledge Base)
 - * Syntactical range of VKB
 - * Semantic range of VKB
- Terms for describing agent’s capability
 - Inference capability
 - Protocols the agent can handle
 - Communicative acts the agent can handle
 - Languages the agent can handle
 - Mobility related capability
 - Access methods (email address, URL)
- Terms for describing agent’s attributes
 - Groups the agent belongs to
 - Specialty of the agent
 - History of the agent

- Access restrictions of the agent

Here follows the list of possible informative topics.

Example descriptions Example descriptions of agents using the ontology

Example of agent services Example of agent services (such as content-based brokerage) realized by using the ontology

3 Agent Description Ontology Examples

In this section, we try to give some examples of Agent Description Ontologies.

3.1 Those used in AGENTPRO

We are going to release an agent system product, "AGENTPRO."

We use a kind of agent description ontologies to communicate agents' knowledge, capabilities, and attributes to other agents in AGENTPRO. We use unary, binary, quaternary relations to express such information.

We try to place agent names and ontology names in the relations explicitly. This is because the information expressed in those relations stand on its own, so that agents can use such descriptions of other agents. This explicitness also allows agents to pass on such information to other agents.

We give some of those examples here.

The following tells the agent, "agent-name" can handle the ontology "ontology-name."

```
(handles-ontology agent-name ontology-name)
```

The following tells the agent, "agent-name" can handle the sentence, (price ?x ?price) in the ontology "ontology-name" such that ?x is actually a KIF variable or a product and that ?price is a KIF variable or less than 5000.

```
(handles agent-name ontology-name
 '(price ?x ?price)
 '(and (or (kif-variable ?x) (product ?x))
       (or (kif-variable ?price) (< 5000 ?price))))
```

The following tells the agent, "agent-name" can handle the logical combinations of acceptable sentences.

```
(handles-logical-combinations-of-acceptable-sentences
 agent-name)
```

3.2 Those already in the Specs

In this section, we try to point out kinds of agent description ontologies already in the FIPA specifications.

There is section 9 “FIPA Agent Management Ontology” of Agent Management [2]. The things missing in Section 9 “FIPA Agent Management Ontology” of Agent Management [2], which are listed in section 2:

- Terms for describing agent’s knowledge
- Terms for describing agent’s capability
 - Inference capability
 - Communicative acts the agent can handle
 - Languages (such as KIF, SL) the agent can handle
- Terms for describing agent’s attributes.

We can find a mobility related capabilities ontology in Section 8 “Mobility Ontology” of Agent Management Support for Mobility [4].

4 Conclusion

As we stated above, ontologies for describing agents are of critical importance to building efficient agent systems. It is also essential for developers and users to understand the positions of agent systems they are going to use.

We believe “Agent Description Ontology” is ready for being discussed and adopted as a standard within the FIPA initiative.

Currently we use a proprietary ontology for that purpose, but we would like to adopt the standard when the standard is produced.

References

- [1] Tim Finin and et al.,
The DARPA Knowledge Sharing Initiative External Interfaces Working Group,
“Specification of the KQML Agent Communication Language,” 1994/2/9,
<http://logic.stanford.edu/papers/kqml.ps>
- [2] FIPA,
FIPA Spec 1 - 1998, Agent Management.
- [3] FIPA,
FIPA Spec 2 - 1998, Agent Communication Language.
- [4] FIPA,
FIPA Spec 11 - 1998, Agent Management Support for Mobility.

- [5] FIPA,
FIPA Spec 12 - 1998, Ontology Service.
- [6] FIPA,
FIPA's Sixth Call for Proposal,
<http://www.fipa.org/cfp/cfp6.html>
- [7] M.R.Genesereth and R.E.Fikes,
"Knowledge Interchange Format Version 3.0 Reference Manual," Technical Report Logic-92-1, Computer Science Department, Stanford Univ., 1992/6.
- [8] M.R.Genesereth and S.P.Ketchpel,
"Software Agents," Comm. ACM Vol.37 No.7, 1994.
- [9] R. Masuoka, et al., "SAGE and Its Application to Inter-company EC", Proceedings of PAAM98, pp.123 - 135.
- [10] Resource Description Framework (RDF),
<http://www.w3.org/RDF/>
- [11] eXtensible Markup Language (XML),
<http://www.w3.org/XML/>