Policies for Role Based Agents in Environments with Changing Ontologies (Extended Abstract)

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ABSTRACT
Software agents try to achieve the goals of roles that they have in an environment. It is supposed that the dynamic structure of role based agents can be connected with updatable domain ontologies of the environment. Ontology evolution can cause the update of agent behaviors or access restrictions to ontological elements. So regulation for the agent behaviors may be needed. Our motivation is to create a suitable policy model for agents, environments and organizations when ontologies in the environment can change.

Categories and Subject Descriptors
I.2.11 [**Distributed Artificial Intelligence**]: Multiagent systems

General Terms
Design, Security

Keywords
Policy, ontology, multi-agent system environment

1. INTRODUCTION
Ontological changes in an agent's knowledgebase or environment is an encountered issue while developing a multi-agent system. After perception of ontological changes by role based agents (or environment), suitable behaviors should be assigned to the role based agents in multi-agent system scenarios. For example, while an agent playing a role is executing a plan according to the individuals in its accessed ontologies, changing individuals can lead changes of the agent behavior or the agent can't achieve an action that is fulfilled before. If we focus on environmental point of view, policy rules in an environment are combined structure of the role ontology, domain ontology and change metadata ontology in our approach. These rules implemented for the environment should be executed to maintain the role playing agents lifecycle. When ontological changes are observed by related artifacts, these changes should be informed to environmental policy manager for regulating role based agent behaviors. From the organizational perspective, there should be a rule meta definition that is designed to regulate agent-based, environmental and organizational aspects.

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2. ROLE BASED AGENT POLICY RULES FOR ONTOLOGICAL CHANGES
Based on changing ontologies, role based agents should also change the plans and the accessed resources. For the regulation of agent behavior, tracing of ontology changes and application of formal policy rules have to be carried out.

OWLdiff [2] is a project to compare and merge two ontologies developed using OWL API. It detects ontological updates by different units of the system and manages merging simultaneous updates. Pellet reasoner supports OWLdiff to control whether two ontologies are semantically same. In this work, our goal is to understand if role based agent can perform its task after the change of role related ontological data.

To realize our goal, changing ontologies are loaded and compared by OWLdiff and OWL API based basic structures (like rdfs:subClassOf, rdf:type) that have been transformed to Jena API to be reasoned using SPARQL language based constructs. In our approach subclass relations have been changed between roles and individuals. After changing individuals, related roles are tested if they still perform their operation correctly. Our rules have been reasoned by ARQ, a SPARQL engine, with queries appropriate to our rules similar to [3].

3. ENVIRONMENT PERSPECTIVE FOR ROLE BASED POLICY RULES
CartAgO [4] is a framework to program virtual environments for multi-agent systems. [4] defines artifacts to use resources during the common activities between agents themselves and agents/environment.

In Figure 1, the interaction between agent and environment has been shown according to changing ontologies. There are two kinds of initialization phases in the environment as Environment Initialization and Agent Initialization:

Environment Initialization: Environment has to be initialized for using policy rules to react ontological changes. So artifacts for possible changing constructs of domain ontologies are created. Metadata knowledge of changeable entities have been defined by an extension [5] of Ontology Metadata Vocabulary [6]. *Change Detection Manager* manages the artifact changes to inform *Environment Policy Manager*.

Role Ontology includes role definitions and static separation of duty (SSD) constraints. Static separation of duty constraints cause an agent to own non-conflicting roles. Role and SSD information are transferred to *Environment Policy Manager* after transformed to CartAgO policy constructs.

Agent Initialization: When an agent wants to act in the environment, firstly it accesses the *Role Ontology* to achieve its goals. It obtains the related roles with the help of SSD constraints. Played roles by the agents have been registered to *Role Facilitator* as CartAgO role entities. A Role Server which includes authentication process of agents has been considered as a future work.

After initialization processes, when a change in an ontology have been noticed, *Change Detection Manager* informs the related artifact change to *Environment Policy Manager*. Environment Policy Manager keeps policy rules as *<Role.Goal, Condition, Action, Role.Goal>*. By this way, if a condition that causes the change of a goal is observed, *Action* informs the role based agents which have been registered to *Role Facilitator* about ontological access or goal update.

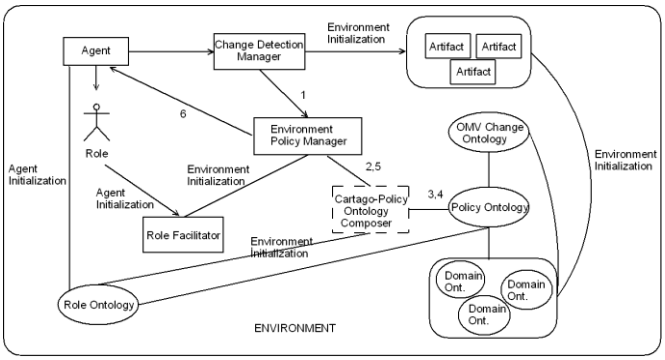

Figure 1. Policy based approach to environment for changing ontologies

During the adaptation process of role and RBAC formalisms to an environment, policy artifact definitions have been used. For example, when a role including a policy has been played by an agent, policy artifact has to gain *AlwaysAllowUse* right of CartAgO to access different artifacts or resources in the environment. In a more complex condition, using an *AlwaysAllowLinkPolicy* right can provide us to use different policy artifacts of a role based agent together.

4. ORGANIZATION PERSPECTIVE FOR ROLE BASED POLICY RULES

Role based agents which achieve their goals by the help of ontologies are related with the organizational rules and goals. While the organizational goals and rules have been executed by an agent, policy rules also have to be taken into consideration.

In Figure 2, an organization diagram including security package has been shown. *Semantic Security Rule* defined in Figure 1 has been extending *Rule* concept of organization. When *Security Goal* needs using more than one artifact of the environment that organization operates, *Security Task*s that own *Semantic Security Rule* definitions have been operated by *Security Goal*. Before *Security Goal* divides its goals to subtasks and rules, tasks have to be determined whether security requirements are *System Specific Requirement* or *Agent Specific Requirement.* According to these requirements, *Security Goal* of the role detects which *Security Task*s it will operate. When *Security Goal* has been loaded by the *Role* in the *Organization,* the agent can fulfill its goals and it complies with the rules according to *Security Goal* definitions.

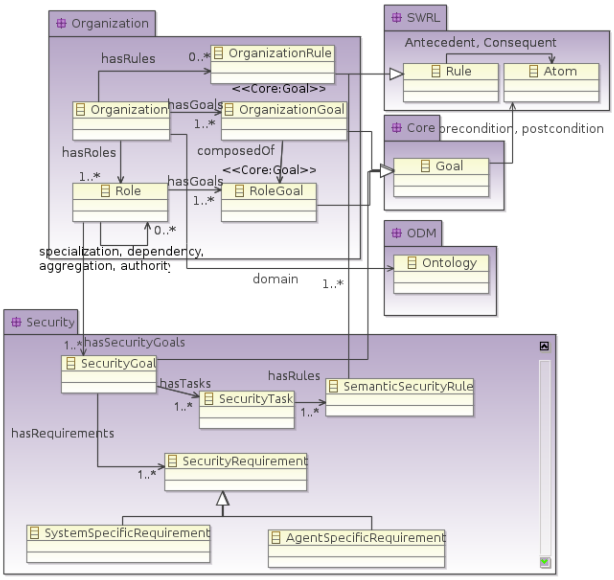

Figure 2. Organization structure including policy constructs

As a future work, there should be defined a model which maps ontological Role definitions and Role class of CartAgO to run environmental and organizational scenarios.

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