Proceedings of the 2017 Winter Simulation Conference
W. K. V. Chan, A. D'Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page, eds.

ONTOLOGY-BASED MODELING FRAMEWORK TO GENERATE FEDERATION OBJECT MODEL IN THE SUPPLY CHAIN DOMAIN

Juan L. Sarli

Instituto de Diseño y Desarrollo (INGAR)
CONICET – Universidad Tecnológica Nacional
Avellaneda 3657
Santa Fe, 3000, ARGENTINA

ABSTRACT

Federation Object Model (FOM) guarantees interoperability among systems in High Level Architecture simulations. The FOM is a domain-specific document that requires an agreement among participants of simulation. This work presents a modeling framework based on an ontology network to conceptualize supply chain and simulation domains. This framework is the foundation of a software tool for a semiautomatic generation of a FOM. The ontology network formalizes a supply chain (SC) operations reference model to depict, in a common terminology, a SC. Besides, through the execution of derived axioms, integrity axioms and rules in the ontology network the composition of the SC model is validated, taking into account the syntactic and semantic correctness of the FOM.

1 INTRODUCTION

High Level Architecture (HLA) standard is the most used framework for distributed simulation (DS). It provides a general framework within which simulation developers can structure and describe their simulation applications. It organizes a distributed simulation through federation and federates concepts. To guarantee interoperability among systems, HLA uses FOM concept, which is an xml document (W3C 2015) containing the interchanged data and interactions among participants during the simulation run.

In particular, HLA addresses two key issues: promotes interoperability among simulators and assists in the reuse of them in different contexts. Thus, one of the most critical activities is the generation of FOM, which is domain dependent and requires an agreement among participants.

With the aim to reduce the effort and time needed to develop a FOM for a DS in SC domain, this work presents a modeling framework based on an ontology network.

2 ONTOLOGY-BASED MODELING FRAMEWORK

The modeling framework uses supply chain operations reference (SCOR) model, it has drag and drop components, to describe a SC in a common terminology (SCOR 2012). It allows SC to describe its organization with processes and inter-organizational relations among members. The framework mainly focuses on interactions among participants because it represents fundamental information for the FOM creation, where parameters, objects and attributes are defined.

The modeling framework consists of SCOR components to model a SC, the ontology network SCFHLA to verify if the model composition is correct and a parser algorithm to transform information of the ontology instances into an xml document.

The fundamental domains of the SCFHLA ontology network are SC and federation. The SC domain models SCOR concepts as metrics and performance attributes. The federation domain models HLA federation concepts as federates, federations, user objects and interactions. In Figure 1, both domains with its fundamental concepts are described. The meta-relationships (relationship between concepts of different

ontologies) are represented by dotted lines while the relationships in each domain are drawing with a continuous line. A more thorough description of the SCHFLA ontology network is presented in the full paper (Sarli, Gutiérrez, and Leone 2016).

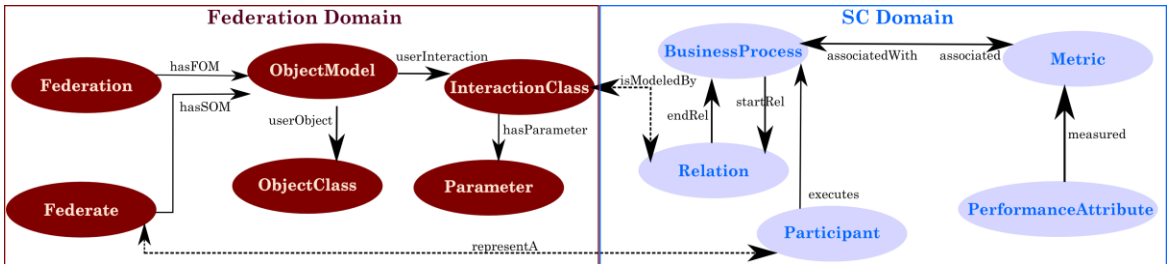

Figure 1: Supply Chain and federation domains of SCHFLA.

Once a model is designed in the framework, the SC domain in ontology network is populated with instances that contain the information of the previous model. The generated instances are linked to instances of a federation domain through a set of rules implemented in Semantic Web Rule Language (SWRL) (O'Connor et al. 2005). In Figure 2, as an example, a rule to link the concept *Relation* from SC domain to the concept *InteractionClass* from federation domain is presented.

Relation(?r) ^ relationName(?r,?n) ^ relationParameter(?r,?p) -> InteractionClass(?r) ^ Parameter(?pa) ^ interactionClassName(?r,?n) ^ hasParameter(?r,?pa) ^ parameterName(?pa, ?p)

Figure 2: A SWRL rule to link concepts from different domains.

These rules are applied to populate the federation domain ontology. At this point the framework has withal the instances and necessary conditions to execute the parser algorithm. The parser algorithm has to generate management and user information. Management information is related to how manage services provided by the run-time infrastructure implementation. User information is related to objects and interactions defined by the SC model. The management information is generated using a configuration file. The main challenge here is how to perform the second task. Thus, the parser algorithm takes as input instances from federation domain ontology to generate as output the xml document. Through the use of the JDOM library (JDOM 2017) the parser transforms each instantiated concept from the federation domain ontology into an xml tag with the same name. The algorithm uses the information obtained from the instances to complete the attributes of the created tags in the file.

Current research work is aimed to adapt simulation components to facilitate development and execution of a DS of SC in order to prove the proposed approach and the generated FOM. Furthermore, as part of our future work a set of rules is defined in order to check the integrity among FOM and simulation object models.

REFERENCES

JDOM. 2017. Accessed May 11. http://www.jdom.org/index.html.

O'Connor, Martin, Holger Knublauch, S. W. Tu, and M. A. Musen. 2005. "Writing Rules for the Semantic Web Using SWRL and Jess." *Protégé With Rules WS, Madrid*. https://www.researchgate.net/profile/Martin_Oconnor3/publication/239616230_Writing_Rules_for_the_Semantic_Web_using_SWRL_and_Jess/links/53d08ce10cf25dc05cfe4861.pdf.

Sarli, Juan L., M. Milagros Gutiérrez, and Horacio P. Leone. 2016. "Ontology-Based Semantic Model of Supply Chains for Modeling and Simulation in Distributed Environment." In *Proceedings of the 2016 Winter Simulation Conference*, 1182–1193. IEEE Press. http://dl.acm.org/citation.cfm?id=3042249.

SCOR. 2012. The Supply Chain Council.

W3C. 2015. "Extensible Markup Language (XML)." Accessed April 6 2016. https://www.w3.org/XML/.