Towards a Visual Tool Environment for Reconfigurable Algebraic High-Level Nets based on the Eclipse Modeling Framework and AGG

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Introduction

In [1], the concept of reconfigurable place/transition (P/T) nets has been introduced that useful to model changes of the net structure while the system is kept running. In detail, a reconfigurable P/T-net consists of a P/T-net and a set of net transformation rules. Thus, not only the successor marking can be computed but also the net structure can be changed by rule application to obtain a new P/T-net that is more appropriate with respect to some requirements of the environment. Moreover, these activities can be interleaved.

Since then, the idea has been developed further to so-called *Reconfigurable Object Nets (RONs)* [2]. RONs support the visual specification of controlled rule-based net transformations of place/transition nets (P/T nets). RONs are high-level nets (system nets) with two types of tokens: object nets (place/transition nets) and net transformation rules (a dedicated type of graph transformation rules). System net transitions can be of type FIRE, STANDARD, SPLIT or APPLYRULE. Firing of system net transitions thus either trigger the firing of an object net transition (type FIRE), or transport object net tokens through the system net (type STANDARD), or apply a net transformation rule to an object net (type APPLYRULE), e.g. to model net reconfigurations, or separate a single object net into its unconnected components (type SPLIT). A visual editor and simulator for RONs has been developed as a plug-in for Eclipse using the Eclipse Modeling Framework (EMF) and Graphical Editor Framework (GEF) plug-ins [3]. A screenshot of the RON-tool is shown in Fig. 1, where an object net can be seen in the upper view, a net reconfiguration rule in the center, and the system net at the bottom.

General Approach

The disadvantage of the RON approach and tool is the limitation of object nets to P/T nets and the limitation of the underlying semantics of RONs due to its fixed semantics given by the four available types for high-level transitions. Often, a more general approach is preferred where the type of object nets and the behavior of reconfigurations can be defined in a more flexible way.

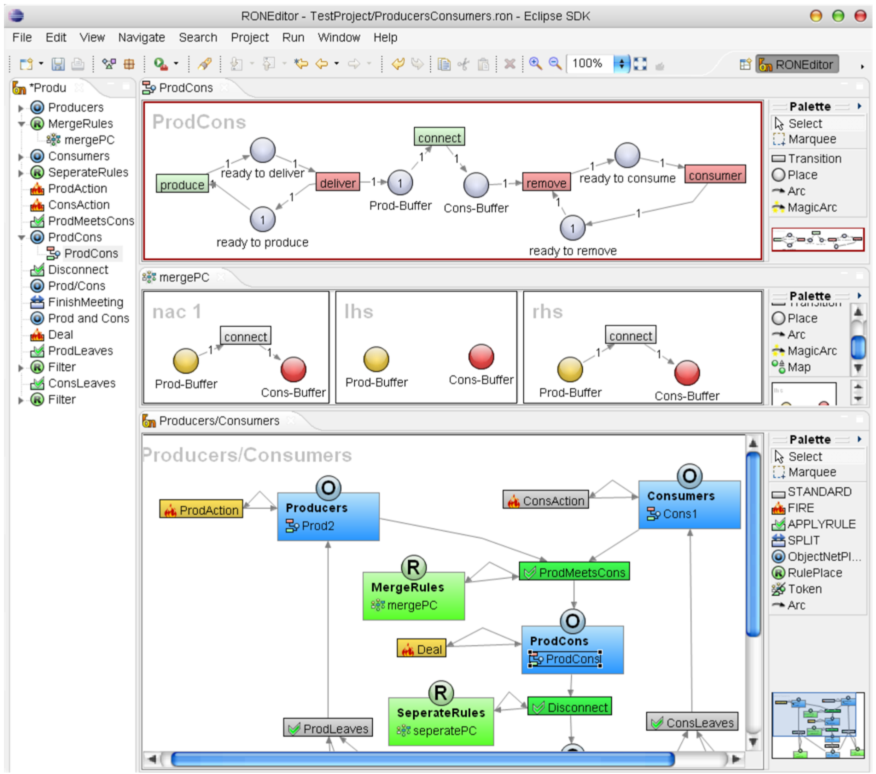

Fig. 1. The RON environment for P/T Net Reconfiguration

As a first step towards a more general net reconfiguration tool, we propose to use high level nets as object nets which in turn use tokens containing data instead of simple black tokens. In a further step, the system net of the RON may be configured in a way such that different transition types in addition to the aforementioned four types can be used. By adding this kind of flexibility to the tool it will have the power to model reconfigurable algebraic high-level nets as used in [4]. Using this more general approach, tokens may have an arbitrary structure and could even be algebraic high-level nets with structured tokens in turn. In principle, a normal RON then can be defined formally in terms of an algebraic high-level (AHL) net where the tokens are data elements of a suitable algebra representing P/T nets.

Implementation

To support this very general approach, a development environment for algebraic high-level nets is currently implemented which allows the user to model AHL nets in a visual editor, to simulate the firing behavior of AHL nets, and to reconfigure AHL nets by defining and applying AHL net transformation rules.

This basic AHL net environment shall be designed in a way that enables to implement visualizations for the respective token structure. To this end, existing frameworks based on the Eclipse Modeling Framework [5] are used, in particular the Graphical Editing Framework GEF [6] and the Multi-View Editor Framework MuVitor [7]. MuVitor simplifies the complexity of GEF for the purpose of creating multi views as they are needed e.g. for the rule editors to establish mappings between different rule sides and application conditions. For the simulation of AHL net firing behavior and the reconfiguration of AHL nets we use the graph transformation engine AGG [8].

The main issue while implementing an AHL net editor except for the graphical editor itself is to provide a user-friendly way of creating an algebraic specification along with its algebras. This includes the evaluation of terms over the specification in a given algebra. To solve these issues, the algebraic specification may be defined in a textual editor which is generated by Xtext [9], resulting in a complete EMF representation of the algebraic specification. The evaluation of terms of the specification to elements of the given algebra is provided by an evaluator class written especially for this purpose. This evaluator is well tested and provides evaluation with and without variables.

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