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Title: An experimental approach towards the XML representation of Petri net models

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An experimental approach towards the XML representation of Petri net models

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1 Introduction

At the present time present, the Petri net community is supporting a Petri nets standardization procedure at International Standards Organisation (ISO) [3]. However, one aspect of the standardisation has not been addressed yet: the definition of an interchange standard between tools. Currently, XML [5], a recommendation of the World Wide Web Consortium (W3C) [4], is the trend for interchange of information between applications. Among the reasons for the success of XML we can underline the following ones:

- A text-only representation which allows the data to be read by anyone, even though it is produced for machines;
- Separation of content from presentation which avoids the mistake of HTML. Now the presentation of data depends on the application;
- And most important, the support for XML by a community of developers who provides the tools necessary for a quick integration of XML in applications (e.g. XML parser, XML editor).

Due to these characteristics, XML has aroused the interest of Petri nets tool developers who would like to use it in order to store the models produced with their tools.

However, the benefits of XML in terms of interchange can only be reaped if an interchange format is defined first. Therefore we have set up a research team to discuss the adequacy of XML for an interchange standard

for Petri net tools. In this paper, we first present the motivations of the team and its proposed course of action, then we give the first results of our actions.

2 Team and Motivation

The story of this work began during an informal session of ICTAPN'99, in Williamsburg, which took place in a restaurant of the colonial city. The audience, composed of French-speaking people, pointed out the fact that, at this moment, exchanging Petri nets between related tools was very difficult. This situation was due to the lack of widely accepted interchange format for Petri nets. According to this fact, the audience decided to start a small working group, with the following objectives:

1) To define a general-purpose interchange format among Petri nets tools — it must be noticed that the intent is not to define an interchange model of Petri nets, but an interchange language (i.e. syntax) allowing various tools to import the syntactic definition of Petri nets generated by other tools;
2) To implement this format in a small set of prototype tools.

Hence, a small team composed of people from Paris (LIP6, tool is FrameKit), Lausanne (EPFL, tool is CoopnTools) and Toulouse (LIHS, tool is PetShop) had a few meetings since fall 1999. It appeared soon that:

1) Even if Petri nets have graphical representations, the interchange format must be text-based to cope with as many tools as possible;
2) The interchange format must be flexible enough such that any tool can store and reload any Petri nets of its underlying model;
3) It must be flexible enough such that any tool can read as much information as possible from a text generated by another tool, according to the common characteristics of both underlying models of Petri nets.

Accordingly, we chose to explore an interchange format based on XML, due to the flexibility of this language.

The next step resided in the careful exploration of the kinship relations between current Petri net dialects. Once again, recall that our intent is not to produce a format suited for this particular tool or this other one, but a general interchange format, which can be used by as many tools as possible. We defined the main characteristics of the various usual Petri nets, and prepared a form to be filled by the designers of Petri nets tools [1]. This form was submitted in the Petri net mailing list in early 2000. Next section is devoted to the presentation and analysis of the answers we received [2]. We plan now:

1) To build a taxonomy of Petri net dialects highlighting their general structure, their similarities and differences, as resulting from the analysis of the answers we received;
2) To propose a draft of an XML-based format (i.e. a XML DTD) built according to this taxonomy;
3) If possible, to provide a prototype implementation of this draft in our tools;
4) To expose the preliminary work to the Petri net community; and enlarge the working group to any interested designer of Petri net tool;
5) And to finalize the format and provide implementations.

3 Results

3.1 Questionnaire

In order to build the questionnaire, we have identified five areas of interest to Petri nets tools:

- **Petri net definition,** which is surveys the type system supported by the tool;
- **Place definition**, which focuses on the characteristics of the places, found in models built with the help of the tool. However, like for transitions and arcs, we try do not try to capture graphical information about

places, but structural characteristics (e.g. the type (typed vs. untyped) and kind (capacity, priority, time) of a place). The purpose of this section of the questionnaire is also to determine the characteristics of the marking of the place;
- **Transition definition** ;which gathers information on the transitions;
- **Arc definition** which gathers information related to the expression and the type of the arcs;
- **Net composition** which gathers information about the method used to compose nets (hierarchy, modularity or inclusion) and about the way the coordination between nets is achieved.

Naturally the questionnaire cannot cover all the existing characteristics of Petri net tools. Therefore we allowed some free space for users comments. Also some characteristics of Petri nets elements are not indicated in the questionnaire as we guess that they have to exist. For example, we assume that places and transitions are identifiable. One last point is that we know that tools have to represent graphically the Petri net elements and for that reason they will store graphical information. But such information is left outside this study.

3.2 Analysis

3.2.1 Comments on answers

By mid May (the official deadline for submissions for the tool survey) we have received thirty five answers. The exhaustive content of the answers is available on the web site [2]. However, due to the tight schedule, only a subset of these answers is analysed hereafter. We intend to publish the analysis of the whole set of answers as a research report that will be publicly available on the same web site as above.
In this paper, we focus on the first nine received answers that concern the following tools: CPN-AMI, CoopnTools, DAWN Tool, Design/CPN, HIQPN-Tool, Maria, PetriSim, PetShop and Renew. The questionnaire was well understood; but we got indications that some of the terms used in the questionnaire were unclear (e.g. *timed* and *delay* for places and transitions). The need for a **glossary** seems to be a requirement for more accurate answers. Similarly, some terms need to be **generalised** (e.g. *FIFO* is a special case of *queue* for places).

3.2.2 Taxonomy

We now give a synthesis of the information gathered:
- **Petri net definition**. All tools, (except PetriSim which supports Place/Transition nets), handle colour. Colour functions fall into two categories: on the one hand linear functions and, on the other hand, filtering or aggregation functions;
- **Place definition**. All tools, except PetriSim, use typed places. Places have many common characteristics (type, kind) and mostly differ in the number of characteristics that they support. In fact they differ by their kind (FIFO, etc). The marking of places falls into three categories: integer, bags or terms.
- **Transition definition**. The tools have common definitions and differ principally on the type of transitions;
- **Arc definition**. All tools use complex expressions, except PetriSim that only support integers. We observed a variety of arc types; but , on the other hand, we felt that arc types needed a better definitions (test, double arc, fair arc, flexible arc) in order to have consistent answers.
- **Petri net composition**. We can distinguish two groups of tools according to composition those that use hierarchy and those that use modularity. As far as coordination is concerned, we observe a variety of techniques ranging from fusion techniques (place or transition), to message passing, transaction, reference and synchronous channels.

From the information gathered we deduced two conclusions and one hypothesis:
1) At this point we have observed some common needs for the Petri nets tools, that make us feel confident in the task of standardisation of a XML format. For example, it is clear that places have or not a type, and also that they have a variable set of characteristics that need to be accessed by the tools;

2) Some design goals are emerging, like the flexibility of the notation and object-orientation. For example some tools support multiple characteristics for a place (e.g. PetShop allows transitions to be both synchronized and invocation) while others do not allow that feature (e.g. PetriSim). We will have to define a flexible notation that is not a hindrance for tools when they only use a subset of existing features;
3) It might be possible to use an object-oriented approach to build a taxonomy that can help us in order to define the interchange format. Object-orientation appears when we consider the different characteristics of Petri nets elements. For example we may derive from the questionnaire that there are two classes *Places* and its subclass *TypedPlaces* that have a list of characteristics in common. We can further this approach and try to classify the tools according to the features they have in common (**Fig. 1**). In that figure some tools are found in different boxes which shows that we will need multiple inheritance.

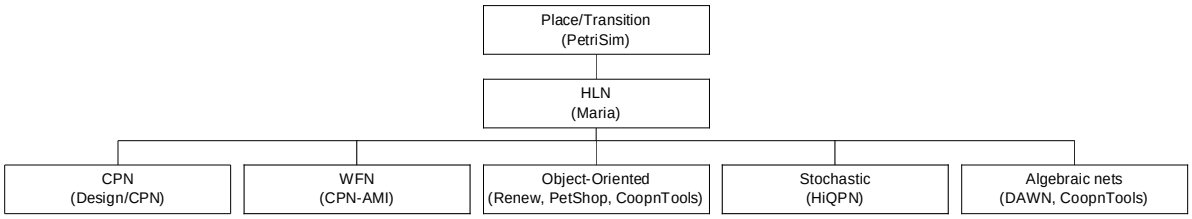

Fig. 1 Preliminary taxonomy

4 Conclusion

This paper has presented the experimental work performed by a team of Petri net researchers in order to define a general-purpose interchange format among Petri nets tools. A questionnaire has been elaborated to survey the needs of the available Petri nets tools in five areas: net definition, place definition, transition definition, arc definition and net composition. This questionnaire has been submitted to the Petri net community in March and we have processed the first nine answers. We have analysed the first results and have derived a preliminary taxonomy of the Petri net formalism. As we are only interested in defining an interchange format for Petri net tools, this taxonomy only accounts for the formalism as implemented in the tools that support them. We have observed that some common needs exist that support the hypothesis that an interchange format is possible. The work we have presented will be continued as we will update the results according to the answers that are yet to come.

5 References

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