# Separating Conceptual and Visual Aspects in Meta-Modelling

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**Abstract.** ATHENE is a modelling environment which allows for creating meta-models and models based on these, aimed at generating an ontology of the modelled content. This work deals with the question on whether and how to separate the conceptual part of a (meta-)model from its graphical representation. We provide an overview on existing ontology- and meta-modelling approaches compared to ATHENE and develop a conceptual basis for enhancing the meta$^2$ level of the tool.

## 1 Introduction

Nowadays, semantic technologies have matured and are now well established. There usually are, however, two major drawbacks when working with such technologies: First, the tools are often too complex for business users that do not think in terms of concepts, instances and properties. Second, building ontologies is time-consuming and not that easy: while ontology experts lack the insight into the business knowledge, the domain expert lacks the expertise to create a formally correct description (i.e. model) of her knowledge. To solve these issues, the University of Applied Sciences Northwestern Switzerland is developing the ATHENE environment. The ATHENE modelling environment applies a meta-modelling approach as described in many sources, such as [7] or [4] to define domain-specific graphical notations and generic operations to transform the end user's models into an ontology. The metamodels themselves are represented as ontologies combining the conceptual domain and the visualisation.

A weakness discovered when combining conceptual and visual aspects of a model was found when similar individuals occur in more than one model or multiple times in the same model: this results in multiple model-elements which actually mean the same thing (e.g. with different positions). Further on, as each model-element has individual visual attribute-values like position or size it cannot represent classes. By attaching information on visualisation to the conceptual elements, obviously artificial data (e.g. the position of a task inside a process model) is added to the ontology. This data has, however, nothing to do with the real things that the ontology should represent.

These reasons led to the intention to separate the visualisation from the actual ontology model.

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## 2 Related Work

The main differentiation of ATHENE compared to other approaches to model ontologies is that it focuses on the modelling of domain specific notations and only generates an ontology internally, whilst other tools like Dome[1] (DERI Ontology Management Environment), Protégé[2], or OntoEdit [13], [12] remain in the thinking of concepts and properties and model them mainly as concept-trees. As graph-based visualisation is mostly an additional option or the visualisation is predefined and independent from the meaning of the type (e.g. the shape of the concept computer is similar to the one of the concept person), the ontology (conceptual model) is clearly separated from the notation.

Several tools which apply meta-modelling approaches are available. The main distinction of ATHENE is its ontology orientation. Unlike other environments like GME (Generic modelling environment) [9] or Eclipse GMF (Graphical Modelling Framework) ATHENE does not aim at code generation. Whilst for example GMF has a clear separation of notation and abstract syntax, several tools and approaches directly attach the visual information (e.g. ADONIS [1], GME [9]).

The importance of separating the abstract syntax from the graphical notation is pointed out by numerous authors. [2] mentions for example the reusability of visualisation objects and advantage when changing notations. [10] clearly proposes to map the notation onto the abstract syntax. In his E3-Model [5] shows how views and presentation relate to models.

Different approaches do also exist for the actual separation. Examples are the semantic visualisation approach [2], or the schema-based approach [3]. For ATHENE a mapping-approach which in particular leans on the concept of the GMF will be described in the next chapter.

## 3 Mapping Approach in ATHENE

A distinct mapping of the visual elements to the abstract elements of a model enables in particular reusability of visual elements, allows for different visual representations of a specific element and offers an anchor to attach further definitions like behavioural specifications or attribute mappings.

The resulting (partially simplified) meta[2] model of ATHENE is presented in (Fig. 1). There may exist model-types that consist of object-types. Specialised object-types are edges and container types which have predefined relational attributes. All elements may have attributes. With this part of the meta[2] model, the abstract meta-models are defined. Each model-type also refers to the mappings that connect the abstract elements with certain visual elements, denoted as "element view" and specialised by object-, relation- and container-view offering different visualisation properties. The property mappings, which are attached to the element mappings offer possibilities to influence the visualisation depending on values of an abstract element's attribute.

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[1] DOME: http://dome.sourceforge.net/

[2] protégé: http://protege.stanford.edu/

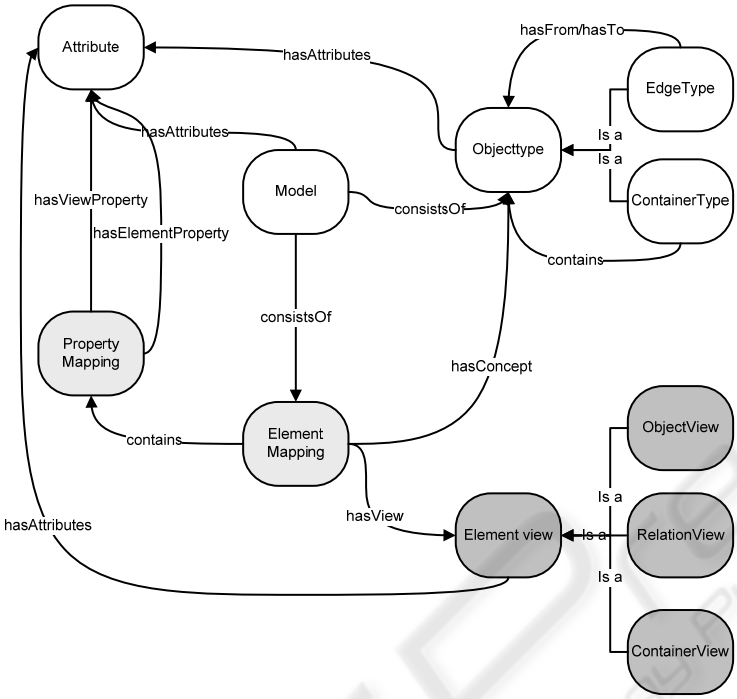


**Fig. 1.** Conceptual meta$^2$ model with mapping.

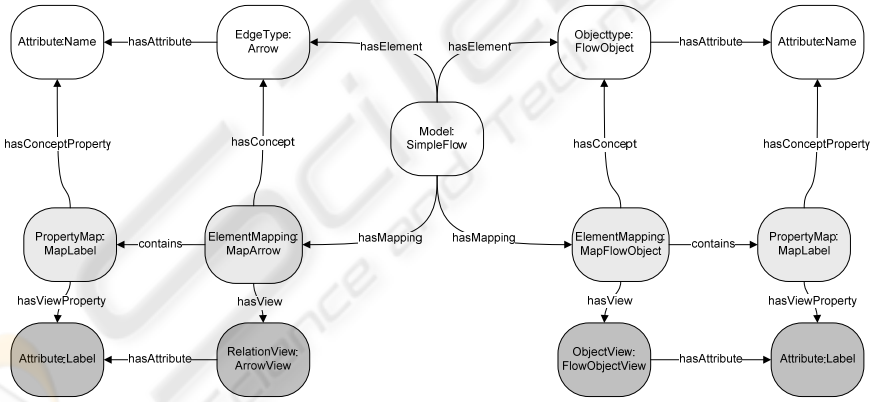


**Fig. 2.** Simple metamodel based on the reworked meta$^2$ model.

Fig. 2 shows a very simple meta-model ("SimpleFlow") consisting of only one object-type ("FlowObject") and an edge-type ("Arrow"). The abstract attribute 'Name' is used as label of the visual elements through the property map ("MapLabel").

Finally Fig. 3 shows the model "Example" of type "SimpleFlow". It simply contains of two flow objects (Element 1 and 2) and a relation between these objects.

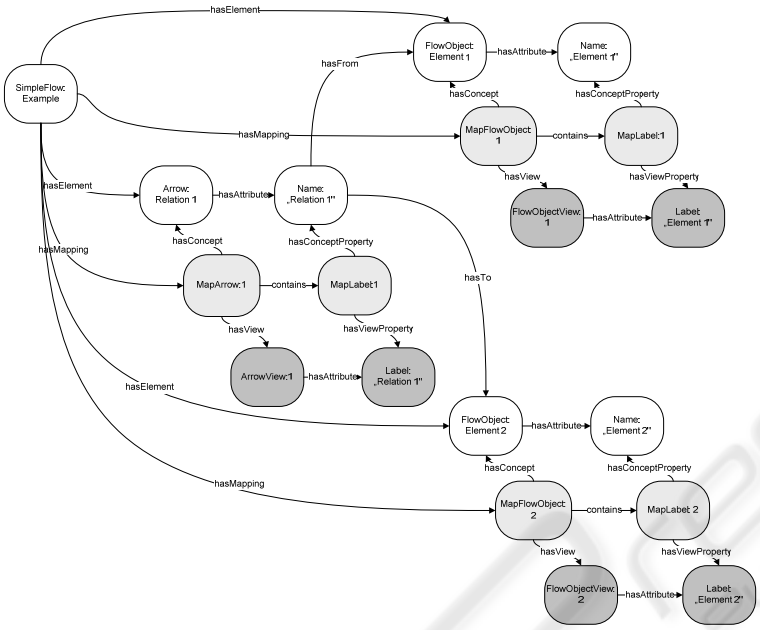


**Fig. 3.** Example model based on the metamodel "SimpleFlow".

## 4 Conclusions

On the basis of application scenarios and related literature, several arguments were worked out for the separation of abstract models and their visual representations. These arguments especially concern flexibility and reusability and do confirm our intentions. The only disadvantages found are concerned the simplicity and redundancy, as in any approach, the separation obviously requires per conceptual element at least another element for each of its visualisations and, for flexibility reasons, even an additional mapping element.

In consequence, an extension of the existing meta$^2$-model in ATHENE based on a mapping approach was developed. The approach offers high flexibility and offers potentials for further research. In the next step, a prototypical implementation will be completed and tested.

The literature study also gave indications for further research topics. Namely, the conceptual model could be revised on basis of OMG's Ontology Definition Metamodel. Especially possible enhancements of variability and functionality, e.g. more sophisticated approaches to define visual elements, dependency of properties and reusing parts of the visualisation could be reached by approaches like the usage of vector graphics and constraint languages as mentioned in [2] and [3]. Further on, ATHENE does not support modelling rules at the moment, hence defining and verifying constraints is a related important future task.

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