Abstract. This paper discusses platform independent web application modeling in the context of model-driven engineering. A specific metamodel (and associated notation), companion of the UML metamodel, is introduced and motivated for the modeling of dynamic web specific concerns. Web applications are represented in three independent aspects (business, hypertext and presentation). A kind of action language (based on OCL and Java) is used throughout these aspects to write methods and actions, specify constraints and express conditions. The concepts described in the paper have been implemented in a tool and operational model-driven web information systems have been successfully deployed.

Keywords: model-driven engineering, MDA, web, metamodel, PIM.

1 Introduction

At the end of the year 2000, the OMG proposed a radical move from object composition to model transformation [1], and started to promote MDA (Model Driven Architecture) a model-driven engineering framework to manipulate both PIMs (Platform Independent Models) and PSMs (Platform Specific Models). The OMG also defined a four level meta-modeling architecture, and UML was elected to play a key role in this architecture, being both a general purpose modeling language, and (for its core part) a language to define metamodels. As MDA will become mainstream, more and more specific metamodels will have to be defined, to address domain specific modeling requirements. Examples of such metamodels are CWM (Common Warehouse Metamodel) and SPEM (Software Process Engineering Metamodel). It is likely that MDA will be applied to a wide range of different domains.

We found interesting to apply the MDA vision to web engineering; a field where traditional software engineering has not been very successful, mostly because of the gap between software design concepts and the low-level web implementation model [2].
We believe that model engineering gives the opportunity to reinject good software engineering practices into web application developments. Models, together with aspects, favor the collaborative work while preserving different stakeholder’s points of view. Graphic designers should be able to continue to create static presentation artifacts, and the software engineers should use models to explain how these static artifacts (or part of them named fragments) get combined and augmented with dynamic business information coming from the business model and hypertext logic coming from the hypertext model.

The work described in this paper has been done in the context of the development of Netsilon [3] a visual model-driven environment dedicated to web application development. We will present a metamodel specific to dynamic web page composition and navigation. This metamodel has to be used as a companion metamodel of UML in order to build PIMs for web information systems. A graphic notation, based on directed graphs, will also be presented.

2 Web Applications

A web application is an information system which supports user-interaction through web based interfaces. Typical web applications feature data persistence, transaction support and dynamic web page composition.

A web application is split into a client side part, which is running in a web browser, and a server side part, which is running on a web server. The client side is responsible for page rendering while the server side is responsible for business process execution and web page construction. The process of page construction varies widely in dynamicity, ranging from completely static, in the case of predefined HTML pages, to totally dynamically constructed pages, when the HTML pages are the result of some computation on the server.

A web interaction can be decomposed into three steps:

- **Request.** The user sends a request to the web server, usually via a web page already visualized in a web browser. Requests can be sent to the server either as forms or as links.
- **Processing.** The Web server receives the request, and performs various actions so as to elaborate a web page, which contains the results of the request. This web page is then transferred to the web browser from where the request originated.
- **Answer.** The browser renders the results of the request, either in place or in another browser window.

A web page may be composed of several kinds of graphic information, both textual and multimedia. These graphic components are mostly produced with specialized authoring tools, using direct manipulation and wysiwig editors.

When it comes to visualize a web page in a web browser, these various components have to be glued together by HTML formatted text, which is either embedding some of the page content (for instance the text) or referencing the files that contains the data (for instance the images). This process may involve translations as well, for instance to translate XML code into HTML.

In the case of dynamic web pages, the final HTML formatted text is not stored on the server, but is generated at runtime, by programs either compiled (like Java) or...