

# Challenges for Model-Based User Interfaces: Multimedia and The Web of Things

Pablo Cesar, Jack Jansen, Dick C.A. Bulterman  
CWI: Centrum Wiskunde & Informatica  
Science Park 123, 1098 XG Amsterdam  
The Netherlands

[p.s.cesar@cwi.nl](mailto:p.s.cesar@cwi.nl), [jack.jansen@cwi.nl](mailto:jack.jansen@cwi.nl), [dick.bulterman@cwi.nl](mailto:dick.bulterman@cwi.nl)



## Abstract

This paper discusses two upcoming challenges for model-based user interfaces: multimedia and the Web of Things. On the one hand, multimedia content and real-time media transmission have their own temporal model – state – that has to be seamlessly integrated into the user interface event model. On the other hand, thousands of interconnected objects that can act as input and output devices impose unforeseen challenges for the user interface mapping into the real world.

## 1 Introduction

For paving the way for future innovations, standards are needed. Adequate structured models lower the barriers for newcomers, they assure interoperability between different players, and they foster new services. In particular we are interested in two convergent directions: multimedia composition and synchronization models [8], and user interface models that can be used for adapting the multimedia experience to the user's physical environment and context [3].

SMIL [2] is a W3C Recommendation that enables authoring multimedia experience. It is a declarative language that provides mechanisms for describing the temporal and spatial composition of distributed media items. Any author can thus specify how, where, and when to render a set of media items. Multimedia rendering is timed-based, where temporal events and synchronization play an important role. While static user interfaces are controlled by the user actions, multimedia user interfaces have to seamlessly react to both user events and temporal events. Rich Web applications [7] might be described using SMIL for synchronous multimedia, XForms UI controls [1] for the abstract presentation, and XML instances in XForms for storing the data model.

Dave Ragget described the Web of Things as “the potential for applying Web technologies to distributed applications of all kinds of devices” [5]. The Web of Things is motivated by the continuing fall in cost for adding computing and network capabilities in real world objects. The goal of the Web of Things is make real world

objects accessible through Web technologies. In particular our interest lies in the development of a standardized model for multimedia experiences' front-ends. The front-ends will support dynamic configuration of the user interface based on the user's physical environment. We can identify a number of challenges. First, intelligent mechanisms and pragmatic algorithms are required for analysing the user environment – devices, people, and capabilities – and for configuring the environment to best serve the user. Second, after concrete user interfaces are realized, multimedia experiences require to be synchronized across the physical environment of the user.

Model-based user interface<sup>1</sup> researches authoring frameworks for creating tomorrow's Web applications that can be tailored for a wide range of user preferences and devices capabilities. As shown in Figure 1 it defines a layered model that includes: the Task and domain model, the abstract user interface, the concrete user interface, and the final user interface. The task and domain models are a description of the application domain knowledge. The abstract user interface is a modality independent description of the UI. The concrete user interface is a modality dependent description of the UI. And the final user interface is a modality and technology specific instance of the UI. User Interface extensible Markup Language (UsiXML) [6] is a User Interface Description Language that follows the layered model explained above.

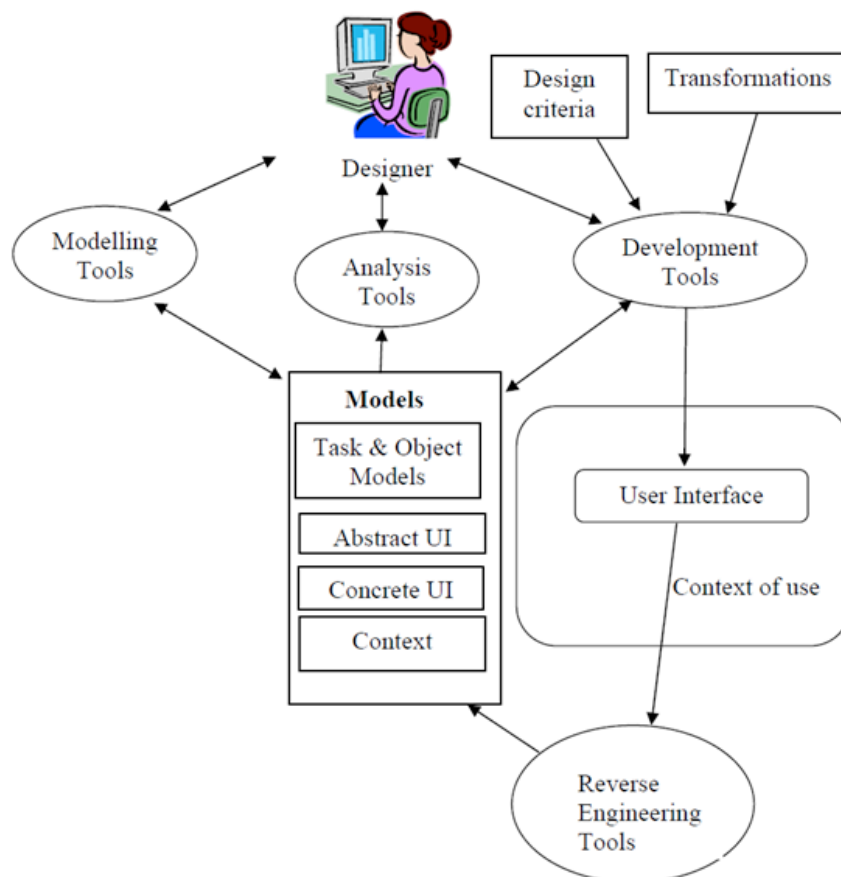


Figure 1. Models and Related Tools in the Model-based Development Process [4].

<sup>1</sup> [http://www.w3.org/2005/Incubator/model-based-ui/wiki/Main\\_Page](http://www.w3.org/2005/Incubator/model-based-ui/wiki/Main_Page)

## 2 Scenario

Current solutions are insufficient for the scenarios in which multimedia rendering and the Web of Things are combined. Let's consider the following scenario: Andy finds an empty table in the café and puts his mobile down on it. The table, which is also a smart display, allows Andy to associate his mobile device with it. After associating, the table presents Andy with a personalised display with access to all of his own information and applications. Andy selects the collaboration tool, which connects him remotely to a lecture. The café's table provides a larger display and more comfortable keyboard than on his mobile device, however as this is a semi-public location the audio from the lecture is routed to Andy's wireless headset and Andy's interaction with the lecture will be through a text interface projected in the table. The modality of the interaction has been determined by both the context, e.g. the semi-public location, and Andy's own preferences, e.g. using his wireless headset. He was able to configure the smart space to better suit his needs.

## 3 Challenges

Based on the discussion above we can identify a number of challenges for future model-based user interface research:

- Model-Based User Interfaces provide a layered approach for modelling abstract user interfaces. Nevertheless, extensions to current models might be required for accommodating the requirements imposed by real world objects.
- In the past multimedia and synchronization have not been thoroughly considered in model-based user interfaces. First, the concrete user interface needs to support synchronization across real world objects. Second, the model needs to accommodate time events, in addition to user events.
- Real-world objects can be used for analysing the physical environment of the user; that is, as virtual input devices. For example, cameras can be used to sense a user's hand gesture. The model needs to manage thus distributed processing across multiple devices.

## References

- [1] Boyer, J. 2009. XForms 1.1. *W3C Recommendation*.
- [2] Bulterman, D.C.A., et al. 2008. Synchronized Multimedia Integration Language (SMIL 3.0). *W3C Recommendation*.
- [3] Kernchen, R., Cesar, P., Meissner, S., Boussard, M., Moessner, K., Hesselman, C., and Vaishnavi, I. 2010. Intelligent Multimedia Presentation Delivery in Ubiquitous Multi-Device Scenarios. *IEEE MultiMedia*, 17(2).
- [4] Paternò, F. 2005. Model-Based Tools for Pervasive Usability. *Interacting with Computers*, 17(3): 291-315.
- [5] Ragget, D. 2010. The Web of Things: extending the Web into the real world. Proceedings of SOFSEM, pp. 96-107.
- [6] Vanderdonckt, J. 2005. A MDA-Compliant Environment for Developing User Interfaces of Information Systems. Proceedings of CAiSE, pp. 16-31.
- [7] Wiecha, C., Birbeck, M., Boyer, J., Jansen, J., Pemberton, S., and Rosmaita, G. 2009. Rich Web Application Backplane XG Final Report. *W3C Incubator Group Report*.
- [8] Williams, D., Ursu, M., Cesar, P., Bergstrom, K., Kegel, I., and Meenowa, J. An Emergent Role for TV in Social Communication. Proceedings of the *European Conference on Interactive*, pp. 19-28.