# Chapter 1.14
# A Generic Adaptation Framework for Web–Based Hypermedia Systems

**Alexandros Paramythis**
*Institute of Computer Science, Foundation for Research and Technology - Hellas, Greece*

**Constantine Stephanidis**
*Institute of Computer Science, Foundation for Research and Technology - Hellas, Greece*
*University of Crete, Greece*

## ABSTRACT

This chapter introduces a framework intended for facilitating the implementation of Web-based adaptive hypermedia systems. The framework is orthogonal to Web "serving" approaches, and poses only minimal requirements in that direction. As such, it can be easily integrated into existing, non-adaptive Web-publishing solutions. This chapter presents in detail several aspects of the framework, and provides an overview of its application in the European Commission-funded IST-1999-20656 PALIO project ("Personalised Access to Local Information and Services for Tourists"). Furthermore, it discusses some of the lessons learned from our work on the framework thus far, as well as what we consider the most likely directions of future work in the area.

## INTRODUCTION

Adaptation characterises software products that automatically configure their parameters according to the given attributes of individual users (e.g., mental/motor/sensory characteristics, requirements, and preferences), and to the particular context of use (e.g., hardware and software platform, environment of use). Adaptive software systems have been considered in a wide range of research efforts. The relevant literature offers a wealth of examples illustrating tools for constructing adaptive interaction (e.g., Brusilovsky, Kobsa, & Vassileva, 1998; Horvitz, Breese, Heckerman, Hovel, & Rommelse, 1998; Kobsa, & Pohl, 1995), and case studies in which adaptive interface technology has improved, or has the potential to improve, the usability of an

interactive system (e.g., Dieterich, Malinowski, Kühme, & Schneider-Hufschmidt, 1993; Benyon, 1997).

Adaptive hypermedia systems (AHS for short), in particular, are part of a relatively new area that has drawn considerable attention since the advent of the Web. There exist today numerous AHS, in various applications domains, with a great variety of capabilities (see, e.g., Ardissono, & Goy, 1999; Balabanovic, & Shoham, 1997; Brusilovsky, Kobsa, & Vassileva, 1998; Henze, 2001; Oppermann, & Specht, 1998; Kobsa, 2001). Major categories of AHS include educational hypermedia, online information systems, online help systems, information retrieval systems, and institutional hypermedia.

This chapter presents a generic framework for the development of adaptive Web-based hypermedia systems and services. Adaptation, in this context, implies the capability, on the part of the system, to capture and represent knowledge concerning alternative instantiations suitable for different users, contexts, purposes, and so forth, as well as for reasoning about those alternatives to arrive at adaptation decisions. Furthermore, adaptation implies the capability of assembling, coherently presenting, and managing at run-time the appropriate alternatives for the current user, purpose, and context of use.

In the context of this chapter, the term "framework" is used to refer to an architectural design describing the components of the system and the way they interact (Campbell, Islam, Johnson, Kougiouris, & Madany, 1997). The confines of an architectural framework for software systems are perhaps best described as per Jacobson, Griss, and Johnson (1997):

*The software architecture, first of all, defines a structure. Software components have to fit into some kind of design…Second, the architecture defines the interfaces between components. It defines the patterns by which information is passed back and forth through these interfaces.*

The presented framework comprises both implemented components and specifications (in the form of programmatic interfaces and associated semantic "contracts") of how core and external components interact to attain adaptive system behaviour. The framework has been implemented in Java and comprises concrete classes, which implement the functionality of the core components, as well as abstract classes and interfaces, which are used when integrating external components with the framework.

The main characteristics of the framework can be summarised as follows: support for declarative specification of adaptive system behaviour; composition of adaptive hypermedia techniques from lower-level adaptation actions; inherent support for different approaches to representing and evaluating user and context models, as well as adaptation logic itself; domain-independence, coupled with provisions for capturing the semantics and specificities of individual application domains; and, finally, orthogonal applicability to any document-centric hypermedia system with XML-compliant output.

The framework under discussion was employed in the development of the PALIO tourist information system. The European Commission-funded IST-1999-20656 PALIO project ("Personalised Access to Local Information and Services for Tourists"; see section "Applying the Framework in PALIO") addressed the issue of universal access to community-wide services, based on content and user interface adaptation beyond desktop access. The presented framework was used to enable adaptive system behaviour at the interaction and content levels, on the basis of user and context characteristics (including terminal device capabilities, user location, etc.). The evaluation of the resulting information system by end users provided very positive feedback with respect to the system's adaptive features.

The rest of this chapter is structured as follows. The next section introduces the framework itself. The presentation commences with an account of

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