

# Personalization Services for the Semantic Web: The Personal Reader Framework

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**Abstract.** The Personal Reader framework implements a service-based architecture for developing and maintaining personalization functionalities on the Semantic Web, stemming from disciplines like e.g. adaptive hypermedia systems or collaborative filtering systems. A modular framework of components / services - for providing the user interface, for mediating between user requests and available personalization services, for user modeling, for providing personal recommendations and context information, et cetera, is the core of the Personal Reader framework. When a user is viewing some Web Content (the "Reader" part of the Personal Reader) s/he receives additional, personal information on the context of this particular Web content (the "Personal" part of the Personal Reader). Personal Readers have been developed for the area of e-Learning (Java, Semantic Web), and for browsing scientific publications.

**keywords:** personalization for the semantic web, personalization services; personalization architectures

## 1 Introduction

The amount of available electronic information increases from day to day. The usefulness of information for a person depends on various factors, among them are the timely presentation of information, the preciseness of presented information, the information content, and the prospective context of use. With the idea of a Semantic Web [2] in which machines can understand, process and reason about resources to provide better and more comfortable support for humans in interacting with the World Wide Web, the question of personalizing the interaction with web content is at hand: Estimating the individual requirements of the user for accessing the information, learning about a user's needs from previous interactions, recognizing the actual access context, in order to support the user to retrieve and access the part of information from the World Wide Web which fits best to his or her current, individual needs.

Within the Personal Reader project, we have developed a framework for designing, implementing, and maintaining *personalized* Web Content Readers. The Personal Reader framework makes use of recent Semantic Web technologies for

realizing a service-based environment for implementing and accessing personalization services. Several, distributed services - for providing the user interface, for mediating between user requests and available personalization services, for user modeling, for providing personal recommendations and context information, et cetera, form the core of the Personal Reader framework [5]. The communications between all services is syntactically based on RDF descriptions. E.g. the request for getting personal recommendations for a learning resource for a certain user is provided by an RDF description which is exchanged between the components mediator and personal recommendations. Thus each component is a service, which is usually independent from the others and which can interact with them by "understanding" the RDF notifications they send. The common "understanding" is realized by referring to semantics in the ontologies used in the RDF descriptions which provide the valid vocabulary (see [4, 5]). Prototypes of Personal Readers have been developed for the area of e-Learning (Java, Semantic Web), and for browsing scientific publications.

This paper gives an overview on the Personal Reader framework. In section 2 we outline the service-based architecture of the Personal Reader framework. Section 3 describes the realization of Personal Reader instances within the framework.

## 2 Architecture of the Personal Reader Framework

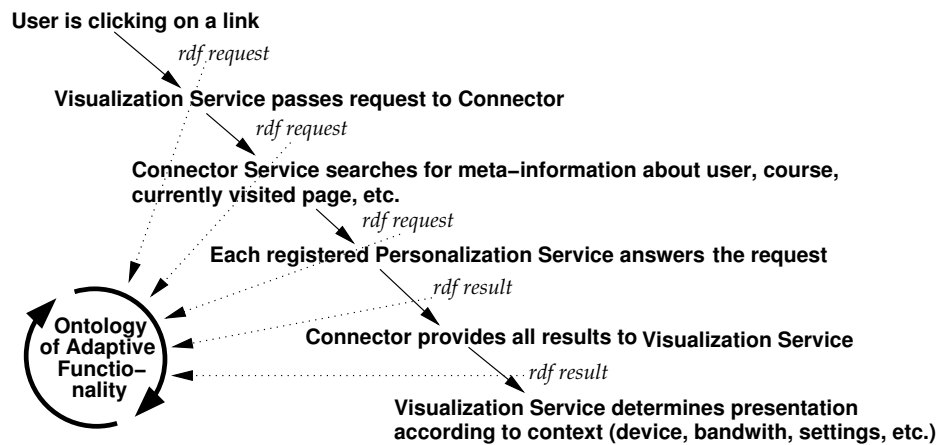
The architecture of the Personal Reader framework (PRF) makes use of recent Semantic Web technologies for realizing a service-based environment for implementing and accessing personalization services. The core component of the PRF is the so-called *connector service* whose task is to pass requests and processing results between the user interface component and available personalization services, and to supply user profile information, and available metadata descriptions on learning objects, courses, etc. In this way, the connector service is the mediator between all services in the PRF.

Two different kinds of services - apart from the connector service - are used in the PRF: personalization services and visualization services. Each *personalization service* offers some adaptive functionality, e.g. recommends learning objects, points to more detailed information, quizzes, exercises, etc. personalization services are available to the PRF via a service registry using the WSDL (Web Service Description Language, [9]). Thus, service detection and invocation takes place via the connector service which ask the web service registry for available personalization services, and selects appropriate services based on the service descriptions available via the registry.

The task of the *visualization services* is to provide the user interface for the Personal Readers: interpret the results of the personalization services to the user, and create the actual interface with reader-part and personalization-part.

The basic implementation guideline in the Personal Reader framework is the following: Whenever a service has to communicate with other services, we use RDF (Resource Description Framework, [6]) for describing requests, processing

results, and answers. This has the immediate advantage, that all components of the Personal Reader framework (visualization services or personalization services) can be independently developed, changed or substituted, as long as the interface protocol given in the RDF descriptions is respected. To make these RDF descriptions “understandable” for all services, they all externalize their meaning by referring to (one or several) ontologies. We have developed an ontology for describing adaptive functionality, the l3s-ontology<sup>1</sup>. Whenever a personalization service is implemented, the provided adaptation of this service is described with respect to this adaptation ontology, such that each visualization service can interpret the meaning of the adaptation, and can decide which presentation of the results should be used in accordance to the device that the user currently has, or the available bandwidth. This has the consequence, that local context adaptation (e.g. adaptation based on the capabilities of the user’s device, bandwidth, environment, etc.) is not done by the personalization services, but by the visualization services. Figure 1 depicts the data flow in the PRF.



**Fig. 1.** The communication flow in the Personal Reader framework: All communication is done via RDF-descriptions for requests and answers. The RDF descriptions are understood by the components via the *ontology of adaptive functionality*

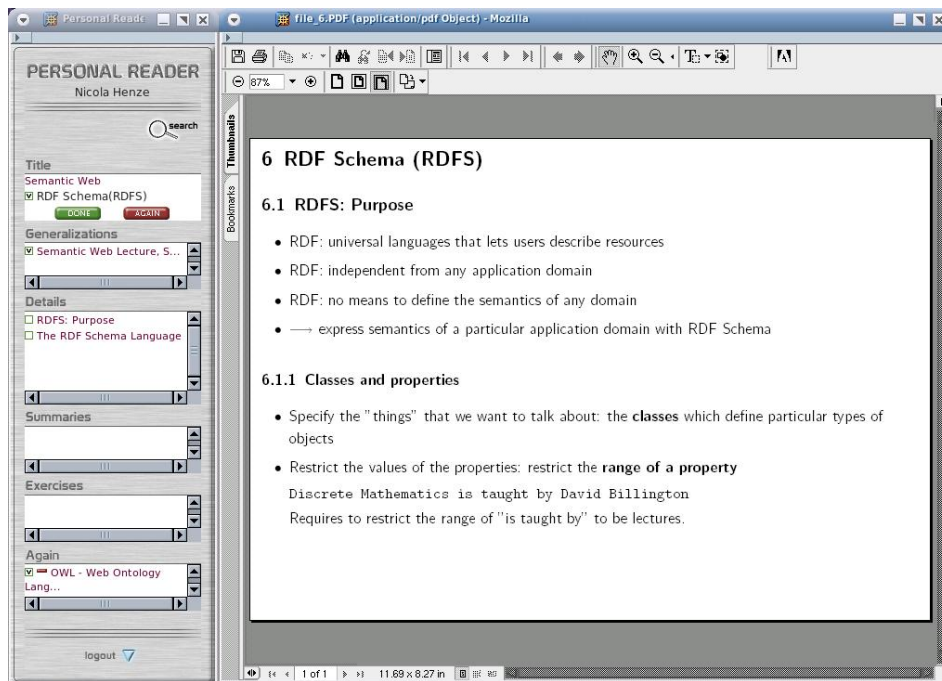
### 3 Proof-of-Concept: Personal Readers for e-Learning and for Browsing Scientific Publications

#### 3.1 Personal Readers for e-Learning

The Personal Readers for e-Learning [3] (see Figure 2) provide a learner with a personal interface for regarding learning resources: the Personal Annotation

<sup>1</sup> <http://www.personal-reader.de/rdf/l3s.rdf>

Service recommends the learner next learning steps to take, points to examples, summary pages, more detailed information, etc., and always recommends the most appropriate of these information according to the learner's current knowledge, his/her learning style, learning goal, background, etc. The Personal search service extracts information from the actually regarded learning resource and checks for related information in other e-Learning corpora, and recommends retrieved results. If you want to set up your own Personal Reader instance for a course you are running, you need to provide RDF description on the learning resources of this course (examples of such RDF descriptions can be found following the link Resources on this project page, and a link to some domain ontology describing the application domain of your course, which you also use to annotate your resources.



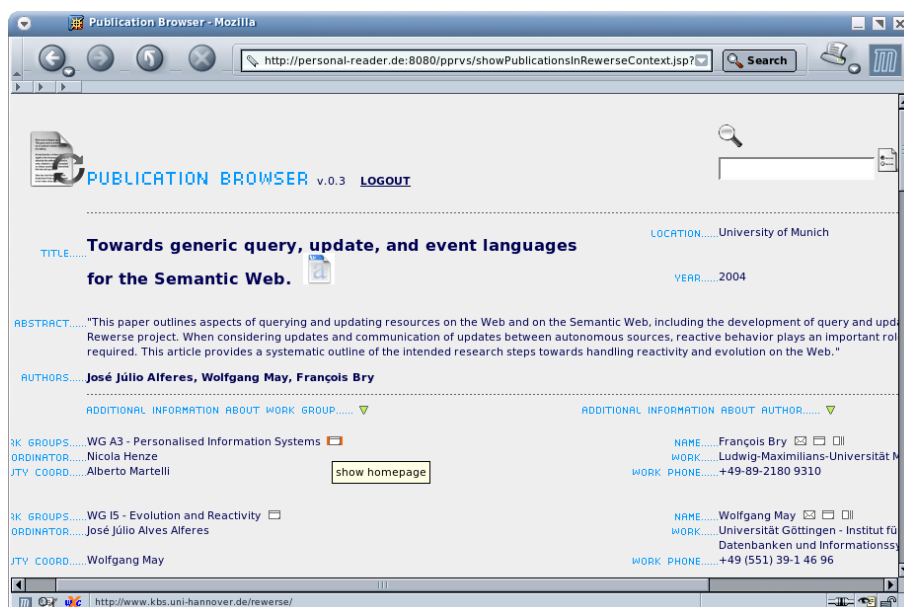
**Fig. 2.** Screenshot of the Personal Reader for learning about the Semantic Web. The Personal Reader consists of a browser for learning resources *the Reader part*, and a sidebar or remote, which displays the results of the personalization services, e.g. individual recommendations for learning resources, contextual information, pointers to further learning resources, quizzes, examples, etc., *the Personal part*.

*Highlights:*

- easy creation of personalized Readers for learning object annotated according to LOM standard;
- demonstrates: re-usable personalization functionality for e-Learning courses;
- reasoning for the personalization services is realized using TRIPLE [8]

### 3.2 The Personal Publication Reader

The Personal Publication Reader [1] (see Figure 3) has been developed for the Network of Excellence REVERSE for providing a personal interface to the publications developed in the project: All web-pages containing information about publications of the REVERSE network are periodically crawled and new information is automatically detected, extracted and indexed in the repository of semantic descriptions of the REVERSE network. This information, with ex-



**Fig. 3.** Screenshot of the Personal Publication Reader. When a user is viewing some publication, s/he receives additional, personal information on the context of this publication within the REVERSE project: background information about the persons and working groups carrying out this kind of or related research, additional information about the authors, etc.

tracted information on the project REVERSE, on people involved in the project, their research interests, etc., is used to provide more information on each publication: who has authored it, which research groups are related to this kind of research, which other publications are published by the research group, which

other publications of the author are available, which other publications are on the similar research, etc.

*Highlights:*

- automatized annotation of Web data: automatic extraction of Web data, and automatized annotation of extracted data with meaningful semantic information (powered by the Lixto Suite, [www.lixt.com](http://www.lixt.com)) ;
- demonstrates: personalized content syndication;
- reasoning for the personalization service is realized Jena's RDQL language [7].

## 4 Conclusion

We have presented a framework for designing, implementing and maintaining adaptive *Reader* applications for the Semantic Web. The Personal Reader framework is based on the idea of establishing personalization functionality as services on the Semantic Web. The realization of personalization functionality is done on the logic layer of the Semantic Web tower, making use of description and rule language recently developed in the context of the Semantic Web. We have tested the framework with example readers in the area of e-Learning (Java programming, Semantic Web), and for browsing scientific publications of the EU-founded Network of Excellence REWERSE. The current state of the project can be followed at [www.personal-reader.de](http://www.personal-reader.de), where all the realized prototypes are available, too.

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