

XFormsDB

An XForms-Based Framework for Simplifying
Web Application Development

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Presentation Outline

- **Part I** **Introduction**
- **Part II** **Background**
- **Part III** **The XFormsDB Markup Language**
- **Part IV** **The XFormsDB Framework**
- **Part V** **Sample Web Applications**
- **Part VI** **Conclusions**

Part I

Introduction

Introduction

- Developing even simple multi-user Web applications is a **complex task**
- The author has to **master many** programming languages and paradigms
 - **Client side:** (X)HTML+CSS+JavaScript
 - **Server side:** PHP/J2EE/Ruby on Rails
 - **Database:** SQL/Object-Relational Mapping (ORM)
- The bulk of Web content authors are **non-programmers**

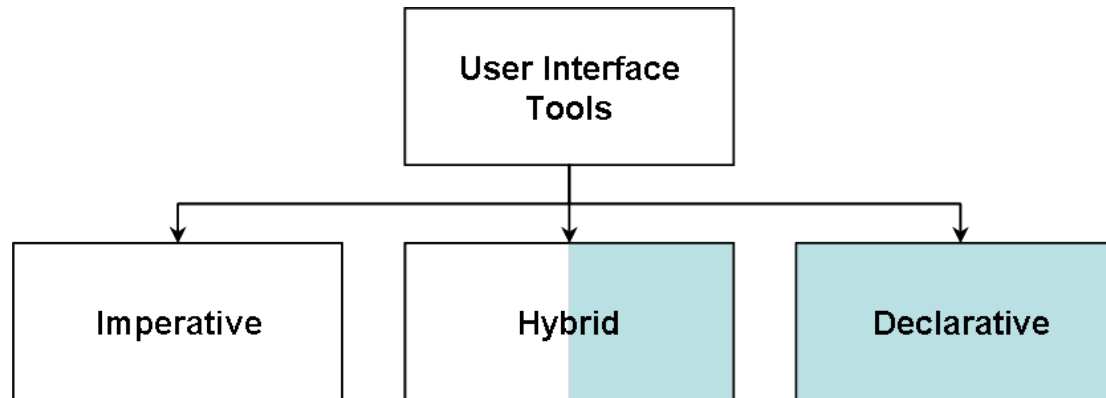
The Main Research Question

Is it possible to **extend** the **XForms** markup language in such a way that users can build useful, highly interactive multi-user Web applications quickly and easily using purely **declarative languages**?

Part II

Background

Classification of User Interface Tools



■ Imperative

- Describes **how** things should be done
- Java Applets (1995)
- Google Web Toolkit (2006)

■ Hybrid

- A **combination** of declarative and imperative constructs
- AJAX (2005) — **The current Web**

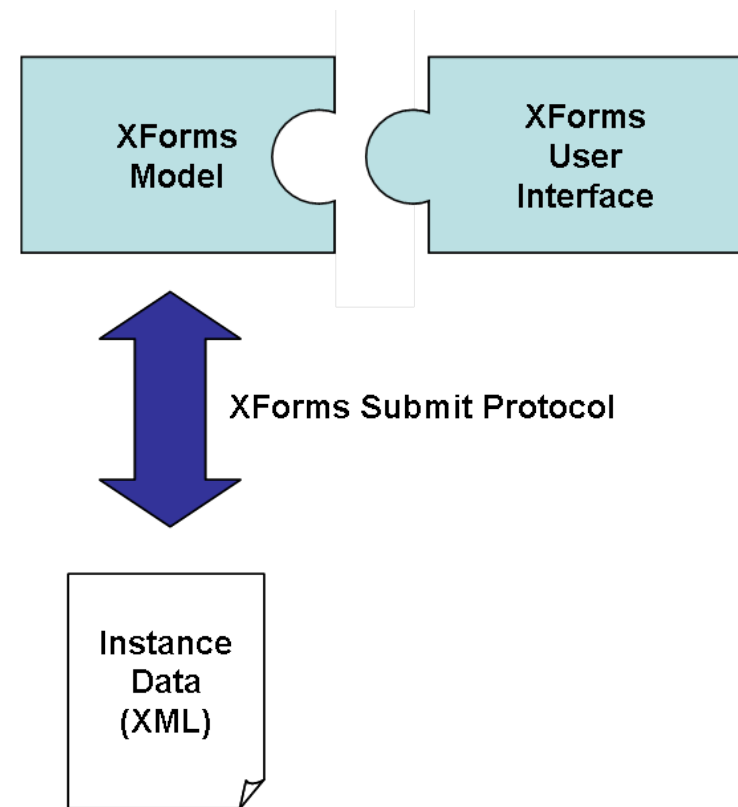
■ Declarative

- Describes **what** should be done
- W3C HTML (1992)
- W3C XForms (2003)

- **An XML-based forms technology and the successor to HTML forms**
 - A high-level **declarative language** for defining rich Web user interfaces
 - Not compatible with HTML 4 forms
 - Client-side technology
- **W3C Recommendation since 2003**
- **The latest version: XForms 1.1**
 - W3C Recommendation since October 2009
 - New and improved action handlers
 - More powerful action processing facilities for executing conditional actions and iterations
 - **Turing complete**

XForms Architecture

- **Instance Data (XML)**
 - Form data
- **XForms Model**
 - Non-visual part of a form
 - Validation, constraints, calculations
- **XForms User Interface**
 - Form controls
- **XForms Submit Protocol**
 - Defines how XForms sends and receives **Instance Data (XML)** to and from the server



Example: An XHTML+XForms Document

```
<?xml version="1.0" encoding="UTF-8"?>
<html xmlns="http://www.w3.org/1999/xhtml" xmlns:ev="http://www.w3.org/2001/xml-events" xmlns:xforms="http://
  www.w3.org/2002/xforms">
  <head>
    <title>Mailing List</title>
    <xforms:model>
      <xforms:instance id="form-instance">
        <form xmlns=""><email /></form>
      </xforms:instance>
      <xforms:bind nodeset="instance( 'form-instance' )/email" type="xforms:email" required="true()" />
      <xforms:submission id="form-submission" ref="instance( 'form-instance' )" resource="/form-handler"
        method="post" replace="none">
        <xforms:load resource="thankyou.xhtml" ev:event="xforms-submit-done" />
        <xforms:load resource="error.xhtml" ev:event="xforms-submit-error" />
      </xforms:submission>
    </xforms:model>
  </head>
  <body>
    <h1>Mailing List</h1>
    <p>
      <xforms:input ref="instance( 'form-instance' )/email"><xforms:label>Email:</xforms:label></xforms:input>
      <xforms:submit submission="form-submission"><xforms:label>Subscribe</xforms:label></xforms:submit>
    </p>
  </body>
</html>
```

Related Work

■ XForms/REST/XQuery (XRX)

- A simple and elegant zero translation Web application architecture
- **XForms** (on the client side), **REST** (interfaces), and **XQuery** (on the server side)
- Somewhat limited without XQuery extensions

■ eXist-db

- A native XML database with broad support for standards, technologies, and APIs
- Based on the **XRX** architecture
- Provides common server-side functionalities through **XQuery extension** modules
- Does not integrate seamlessly with **XForms**

■ Orbeon Forms

- A framework for building **XML**-centric Web applications based on **MVC** architecture
- **Extends XForms** with user interface controls and convenience features
- Provides common server-side functionalities through its **XML processors**

Part III

The XFormsDB Markup Language

Overview

- **An extension to the XForms markup language**
 - A pure superset of **XForms 1.1**
- **Naturally extends XForms with the most common server-side and database related functionalities**
 - Can be thought of as **"XForms Server Pages"**
 - Functionalities include, among others: querying and updating (**with** or **without** data synchronization) data stored in data sources, error handling, state maintenance as well as authentication and access control
 - **Easily extensible**, i.e., new server-side functionalities can be easily added to the language

Language Extensions

- **The XFormsDB namespace URI**
 - <http://www.tml.tkk.fi/2007/xformsdb>
- **The `xformsdb:instance` Element**
 - A wrapper for all XFormsDB-related requests to be submitted
- **The XFormsDB-related Requests**
 - `xformsdb:state`, `xformsdb:login`, `xformsdb:logout`, `xformsdb:user`, `xformsdb:query`, `xformsdb:file`, and `xformsdb:cookie`
 - New XFormsDB-related requests can be easily added
- **The `xformsdb:submission` Element**
 - For submitting XFormsDB-related requests
- **The `xformsdb-request-error` Event**
 - Dispatched as an indication of a failure of an XFormsDB-related request submission and/or execution process

Language Extensions (cont.)

- **The `xformsdb:secview` Element**
 - Provides **role-based** access control
- **The `xformsdb:include` Element**
 - Provides an inclusion mechanism to facilitate modularity
- **The `xformsdb_users.xml` Document**
 - Realm, i.e., contains **usernames** and **passwords** that identify valid users of a Web application, plus an enumeration of the list of **roles** associated with each valid user
- **The `xformsdb_files.xml` Document**
 - Contains the **metadata** about files associated with a Web application

Example: An XHTML+XFormsDB Document

```
<?xml version="1.0" encoding="UTF-8"?>
<html xmlns="http://www.w3.org/1999/xhtml" xmlns:ev="http://www.w3.org/2001/xml-events" xmlns:xforms="http://
www.w3.org/2002/xforms" xmlns:xformsdb="http://www.tml.tkk.fi/2007/xformsdb">
<head>
  <title>Mailing List</title>
  <xforms:model>
    <xforms:instance id="form-instance">
      <form xmlns=""><email /></form>
    </xforms:instance>
    <xforms:bind nodeset="instance( 'form-instance' )/email" type="xforms:email" required="true()" />
    <xforms:bind nodeset="instance( 'form-request-instance' )/xformsdb:var[ @name = 'email' ]"
      calculate="instance( 'form-instance' )/email" />
    <xformsdb:instance id="form-request-instance">
      <xformsdb:query datasrc="mailing-list-data-source" doc="mailing_list.xml">
        <xformsdb:expression resource="xq/form_handler.xq" />
        <xformsdb:var name="email" />
      </xformsdb:query>
    </xformsdb:instance>
    <xformsdb:submission id="form-submission" requestinstance="form-request-instance"
      expressiontype="all" replace="none">
      <xforms:load resource="thankyou.xhtml" ev:event="xforms-submit-done" />
      <xforms:load resource="error.xhtml" ev:event="xformsdb-request-error" />
    </xformsdb:submission>
  </xforms:model>
</head>
```

...

Part IV

The XFormsDB Framework

Overview

- Implements the **XFormsDB** markup language
- A **Java**-based, generic server-side component
 - Provides the integration services to heterogeneous data sources as well as common server-side functionalities
- **Bundled with**
 - An XForms processor (**Orbeon Forms**)
 - A native XML database (**eXist-db**)
- An extremely powerful **XForms/REST/XQuery (XRX)** framework
 - Allows for the rapid development of entire Web applications using a **single** document and under a **single** programming paradigm

Key Features

- **Support for different types of user agents**
 - **XForms 1.1**, **AJAX**, and **plain (X)HTML**
- **Support for different types of data sources**
 - **XML documents** and **eXist-db (NXD)**
 - Can be extended to support for other types of data sources (e.g., relational databases)
- **Query and update data stored in data sources**
 - Query expressions based on **XPath** and **XQuery**
 - Update expressions **with** data synchronization (**XPath**) or **without** data synchronization (**XQuery Update**)
- **Error handling**
 - Error message with error code and error description is sent to the user agent
 - Detailed information about the occurred error is written to a log file on the server

Key Features (cont.)

- **Session management**
 - Cookies and URL rewriting
- **State maintenance**
 - In-memory session object (XML Instance Data) and parameters in URL
- **Authentication and access control**
 - User authentication
 - Role-based authorization
 - Login and logout
- **Reuse of code fragments**
 - `<xformsdb:include resource="..." />`

Key Features (cont.)

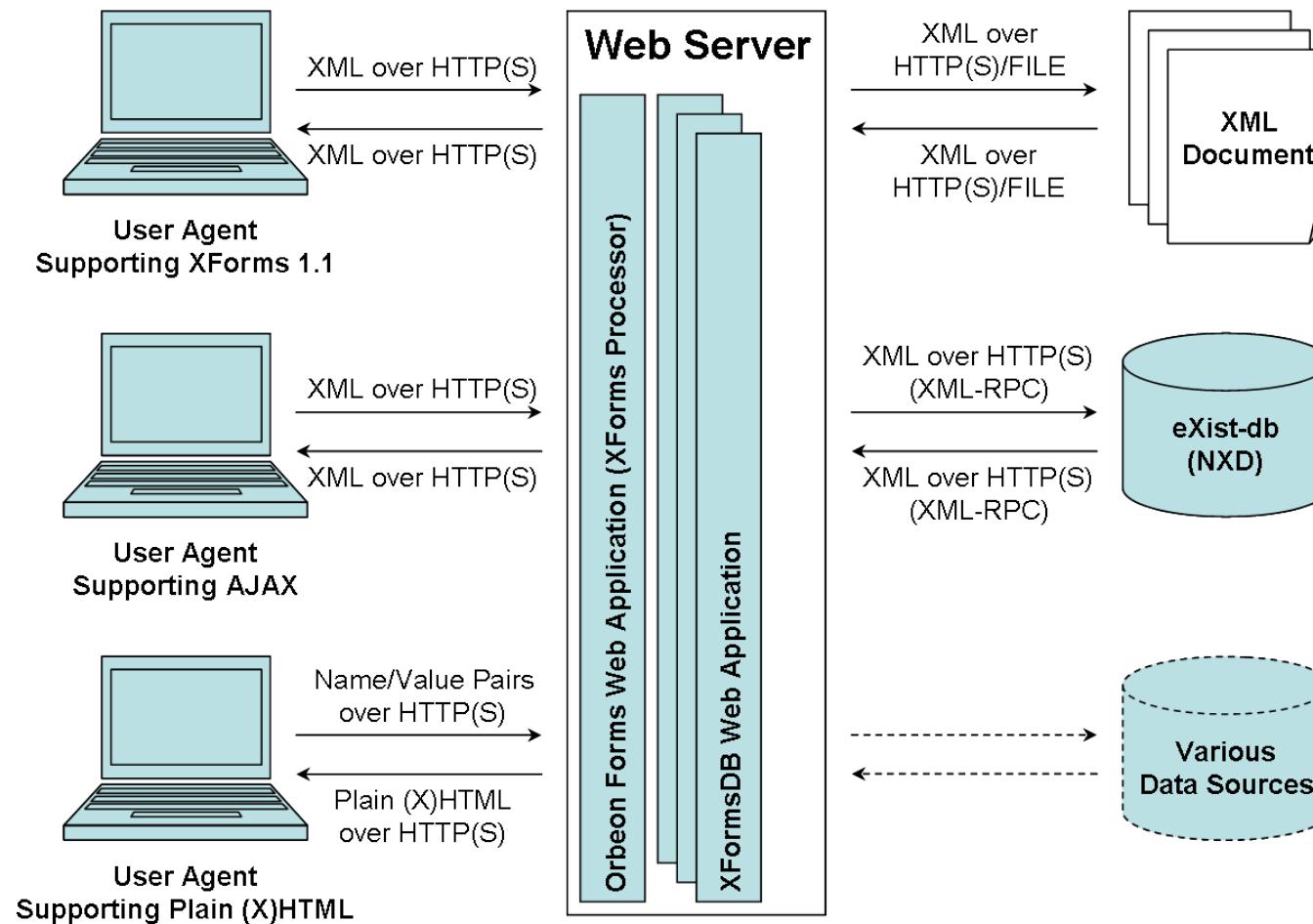
- **File management**

- Upload, download, list, delete, and update files stored in **XFormsDB**

- **Security**

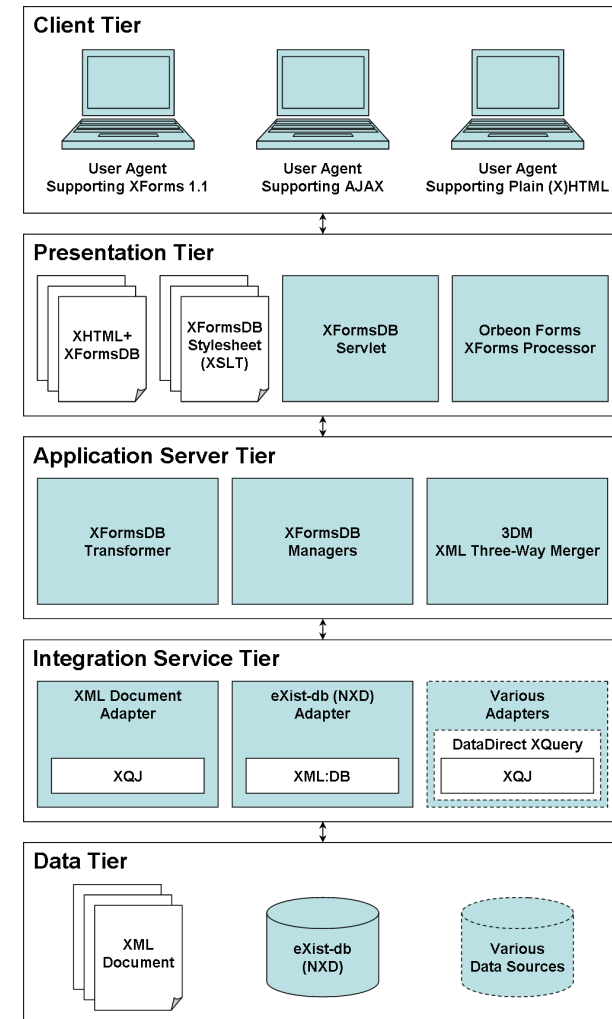
- Role-based views
- Secured users, queries, and files
- Hashed passwords

High-Level Architecture

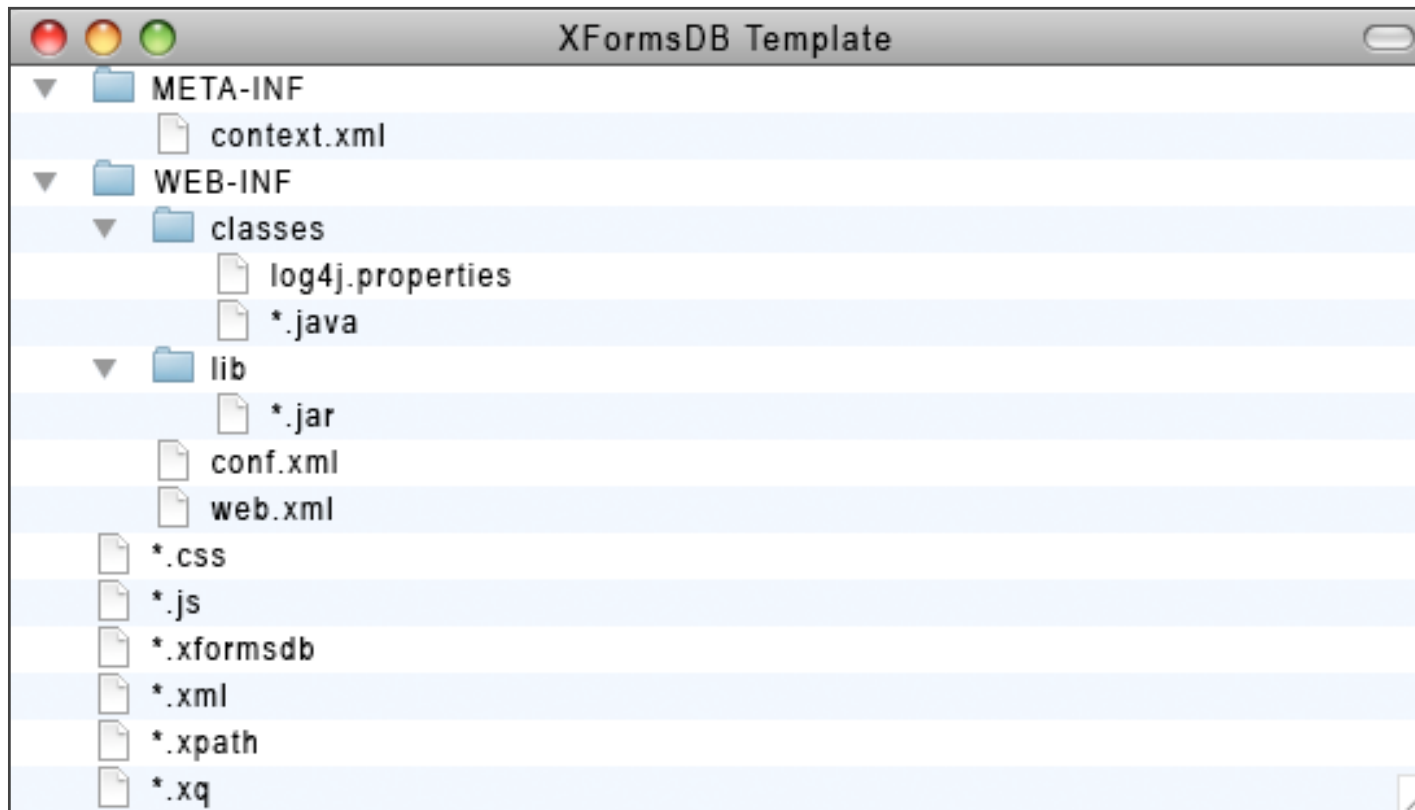


Modules and Tiers

- **Five logical tiers**
 - Client Tier
 - Presentation Tier
 - Application Server Tier
 - Integration Service Tier
 - Data Tier
- **Support for other types of data sources (e.g., relational databases) can be easily added as well**
 - **DataDirect XQuery Middleware**

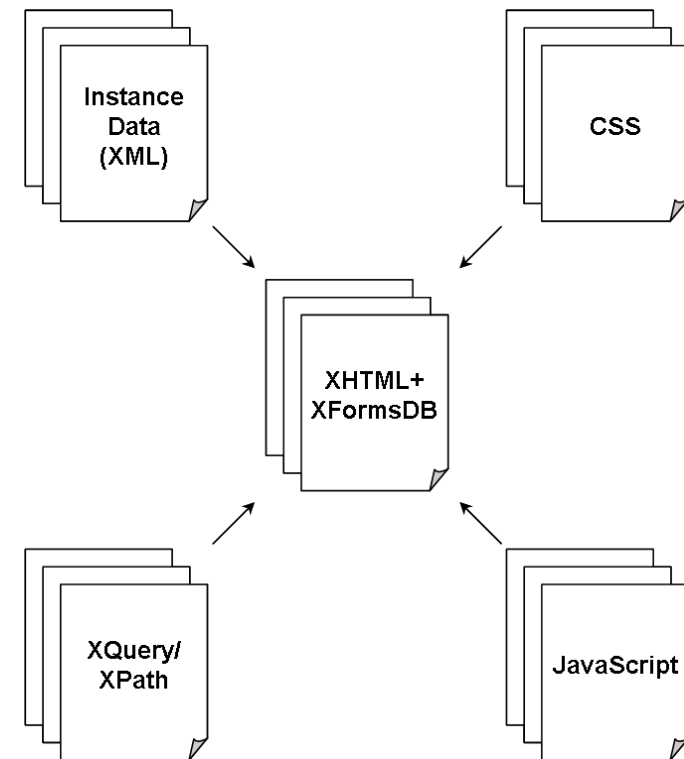


Web Application Directory Structure



Web Page Components

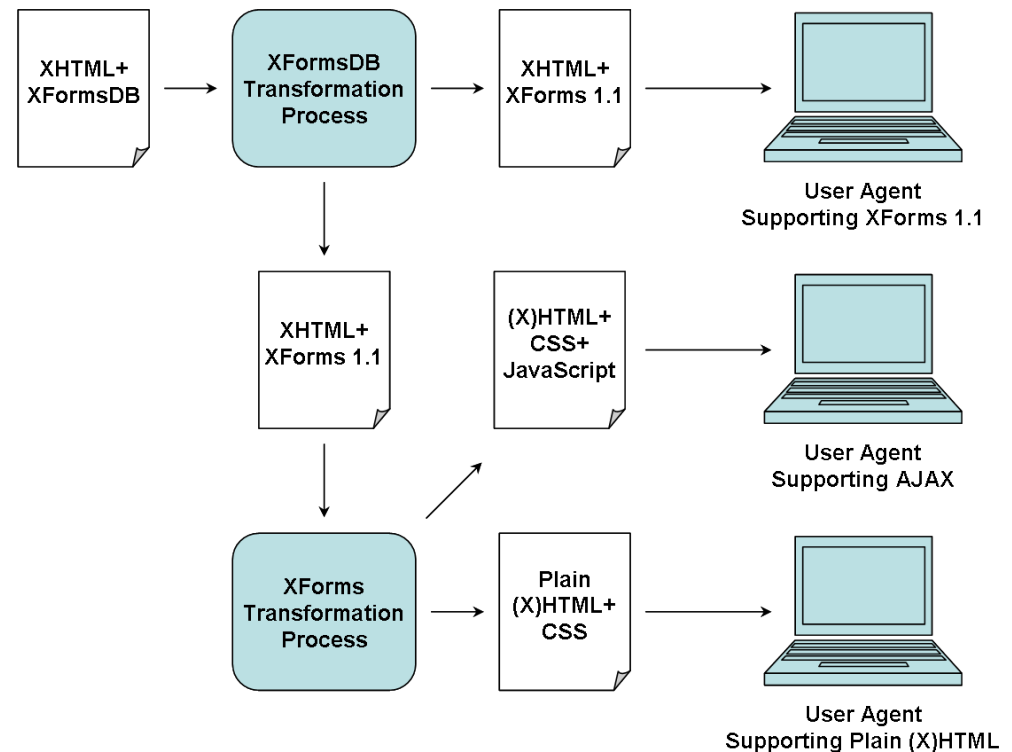
- The main Web standards and technologies used are
 - **XHTML** for document structure
 - **XForms** for user interaction
 - **XFormsDB** for data access and common server-side tasks
 - **XML** for data model and interchange
 - **CSS** for visual layout and presentation
 - **XQuery** and **XPath** for querying data
 - **JavaScript** for animation and additional interaction



Transformation Processes

- **Two separate server-side transformation processes**

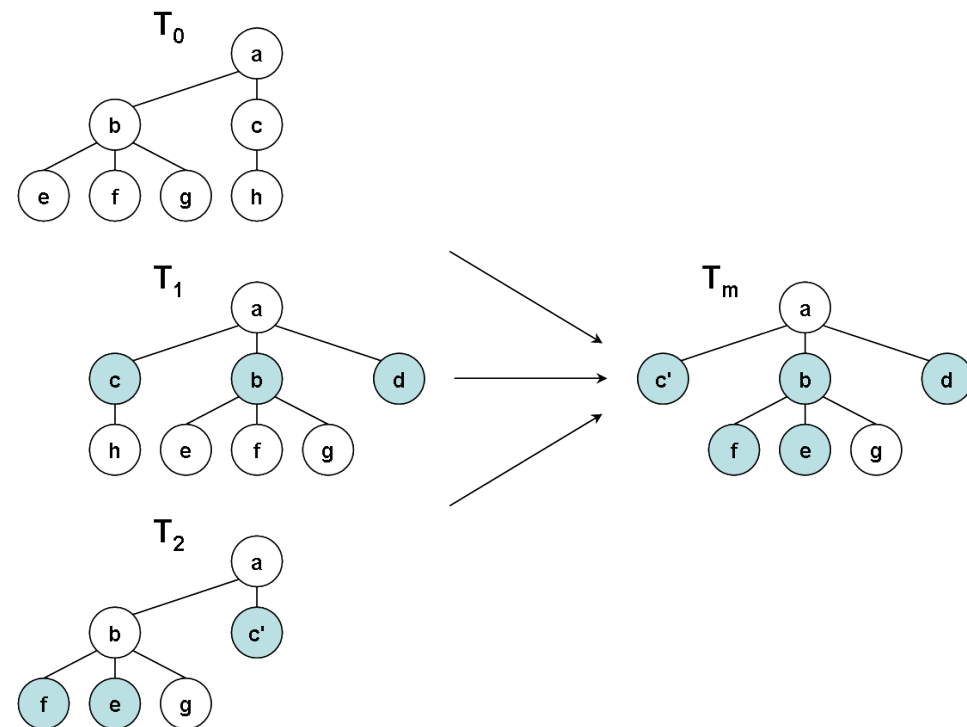
- XHTML+XFormsDB to XHTML+XForms 1.1
- XHTML+XForms 1.1 to (X)HTML+CSS+JavaScript or plain (X)HTML+CSS



Data Synchronization

■ Data synchronization

- Built-in support for synchronized updates
- Uses **3DM**, a middleware for performing three-way merging of XML documents
- Detects and handles **update**, **insert**, and **delete** operations as well as **moves** and **copies** of entire subtrees
- In case of a merge conflict, an appropriate error message is reported back to the form



Part V

Sample Web Applications

■ Personal Information Management (PIM)

- A simple Web application for storing, browsing, and managing information about your personal contacts
- Consists of a single Web page
- **Key features:** sorting data, internationalization, and data access

■ Blog


- An online journal or diary Web tool for publishing personal contents
- A simplified version of publicly available software
- Contains three Web pages and multiple complex data source queries
- **Key features:** a real-life Web application of today

Screenshots

Personal Information Management (PIM): Contacts

Suomeksi | [På svenska](#) | [In English](#)

Henkilökohtaisten Tietojen Hallinta (PIM): Yhteyshenkilöt

 Yhteyshenkilöiden tallentaminen onnistui.

[Lisää yhteyshenkilö](#) | [Tallenna yhteyshenkilöt](#)

| Yhteyshenkilöt | |
|---|---|
| Nimi | Toiminnot |
| ▶ Petri Vuorimaa | Muuta Poista? kyllä tai ei |
| ▶ Oskari Koskimies | Muuta Poista? kyllä tai ei |
| ▶ Mikko Honkala | Muuta Poista |
| ▼ Markku Pekka Mikael Laine | Muuta Poista |

Nimi:

Titteli:

Yritys:

Katuosoite:

Kaupunki:

Osavaltio:

Postinumero:

Maa:

Puhelin:

Faksi:

Matkapuhelin:

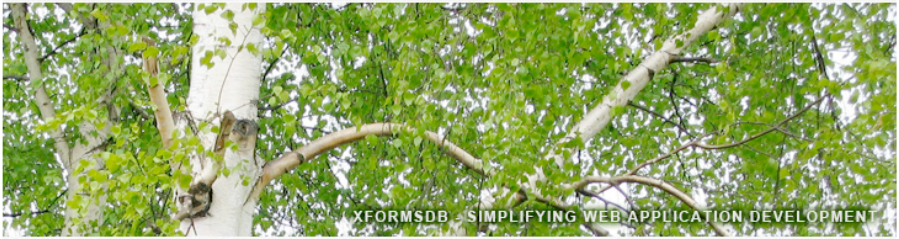
Sähköposti:

▶ [Emilia Mendes](#) [Muuta](#) [Poista](#)

Tulokset 1 - 5, yhteensä 5

XFormsDB Blog - Administration

XFORMSDB BLOG - ADMINISTRATION



XFORMSDB - SIMPLIFYING WEB APPLICATION DEVELOPMENT

MANAGE COMMENTS

Browse archive...

October 2007

| Comment | Actions |
|---|---|
| ▶ The XFormsDB framework should be p... | Edit Delete |
| ▼ There are a wide variety of studen... MARKKU LAINE // October 2, 2007 | Edit Delete |
| <div>There are a wide variety of student restaurants available across campus.</div> | |
| ▶ Not all houses/apartments are insu... | Edit Delete |
| ▶ Pedestrian lights work a bit diffe... | Edit Delete |
| ▶ New Zealand has left-hand traffic ... | Edit Delete |

Results 1 - 5 of 5

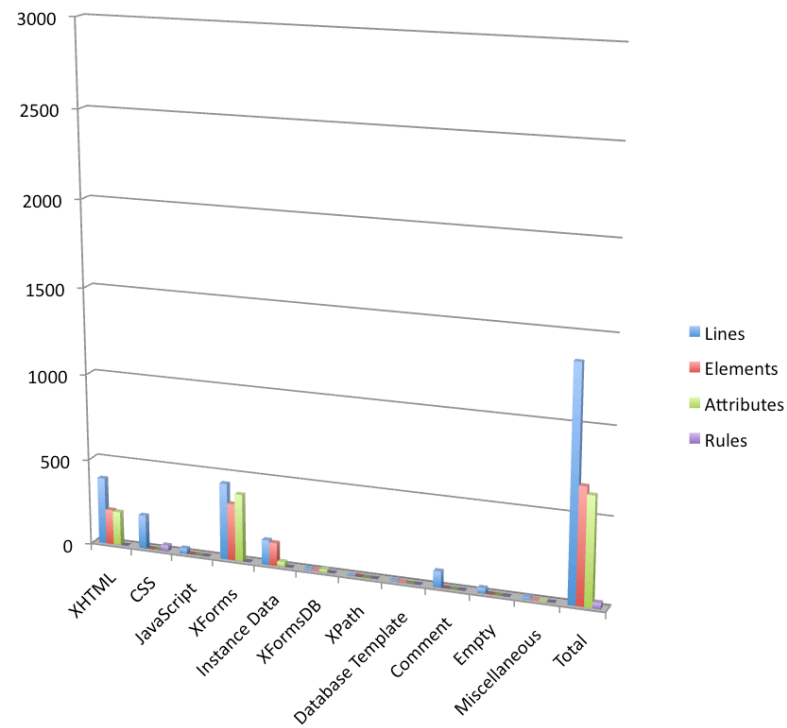
ACTIONS

- [Write a post](#)
- [Manage posts](#)
- [Manage comments](#)

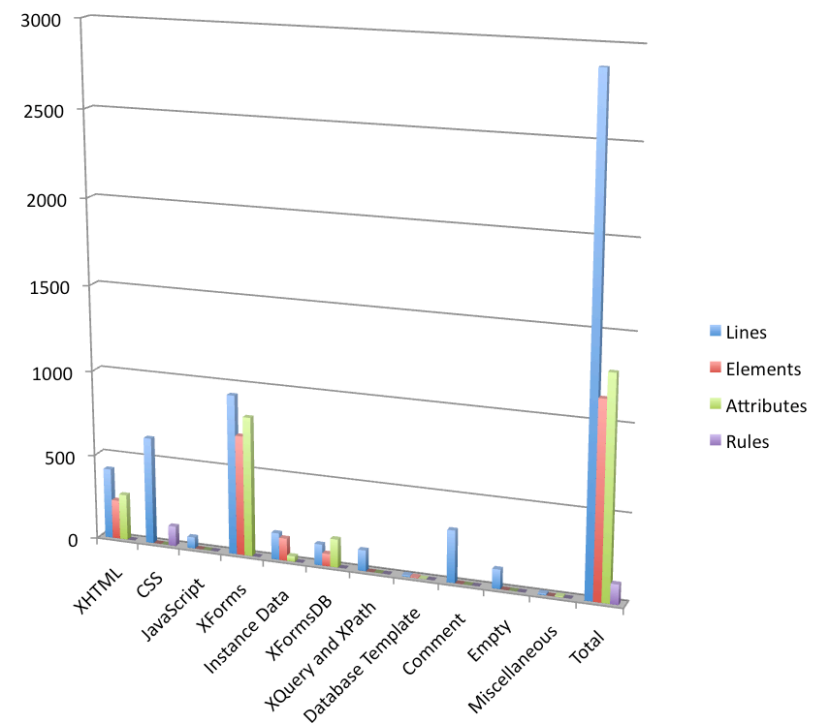
Copyright © XFormsDB 2007. All rights reserved. | [Logout](#) » [Public](#)

Metrics

PIM component metrics



Blog component metrics



Metrics (cont.)

■ Personal Information Management (PIM)

- **Response size metrics (front page):** Requests - 17 and Size - 154.3 kB (Empty cache), Requests - 12 and Size 13.0 kB (Primed Cache)
- **Response time metrics (front page):** Time - 2.2 s (Empty Cache), Time - 1.3 s (Primed Cache)
- **The sizes of the WAR files:** 37.9 kB (Lite version) and 17.6 MB (Standalone version)

■ Blog

- **Response size metrics (front page):** Requests - 17 and Size - 486.8 kB (Empty cache), Requests - 12 and Size 4.1 kB (Primed Cache)
- **Response time metrics (front page):** Time - 2.1 s (Empty Cache), Time - 1.2 s (Primed Cache)
- **The sizes of the WAR files:** 406.1 kB (Lite version) and 17.9 MB (Standalone version)

Part VI

Conclusions

Results

- **The XFormsDB markup language**

- **Naturally extends** the XForms markup language to include the most common server-side functionalities
- New server-side functionalities can be **easily added** to the language
- For users who are already familiar with XForms, the language is relatively **easy to learn**

- **The XFormsDB framework**

- Supports most common browsers and heterogeneous data sources
- Includes built-in support for synchronized updates
- Allows for the rapid development of entire Web applications using a **single document** and under a **single programming model**

Future Work

- **Refine the syntax of the XFormsDB markup language**
- **Implement support for a subset of XML Binding Language (XBL) 2.0 on the server side**
 - Allows the use of highly reusable components
- **Implement a Web-based visual tool for developing XFormsDB Web applications**
 - Makes the technology accessible to **non-technical users**
- **Add built-in support for OpenID authentication**
 - Users could use an existing account to sign in to XFormsDB Web applications
- **Improve current transaction support**
 - Grouping of synchronized updates

Thank You!

Questions? Comments?

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