A CLIENT-SERVER MODEL FOR EDITING ODF DOCUMENTS ON MOBILE DEVICES

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ABSTRACT

Open Document Format (ODF) is a popular office document format accepted by most of modern desktop office suites. The aim of our project is to create a software suite of specialized mobile ODF schemata and editors to provide support of editing ODF-based documents on mobile devices. Number of tests have been carried out with prototype tools focusing on the resource net of transferring, visualizing and editing simple ODF documents. Based on test results we have found that the limited capacity of mobile devices (compared to desktop computers) implies that documents in their original form cannot be handled on mobile devices. In this paper we investigate the methods and background of ODF-based document transfer and edition in a client-server model.

Keywords: mobile office, mobile software, ODF, XML, RELAX NG, schema, schema transformation

1. INTRODUCTION

The continuous evolution of mobile devices provides the possibility of implementing mobile software to handle office documents. Open Document Format (ODF) is an open standard and accepted by numerous office suites on desktop computers. The aim of our project is to establish a client-server software model enabling document distribution over computers and mobile devices, and editing office documents on the mobile site.

We implemented special editor prototypes to measure the editing capabilities of a wide range of mobile devices. We generated a variety of documents of different complexity and size, and measured the resource need of different editor operations performed on test documents through a scripting interface [3]. ODF documents complexity can be characterized by the narrowest schema derivative of ODF schema the document is conformed to.

Prototypes have proved that mobile devices with different capabilities (processor capacity, display size, memory, software platform) are able to handle documents of different complexity and size. This paper focuses on document transformation needed to distribute ODF documents over mobile devices and desktop computers. Distribution includes extracting a part or a whole document from desktop site, transferring extractions to mobile site, edit them there and transfer them back.

ODF as a set of XML documents [7] is described by Open Document Format Specification [2, 3] in terms of a RELAX NG [4, 5] schema. The complexity of documents to be transferred to a mobile device can be tailored by transforming the original ODF schema to a derivative, which excludes certain semantic structures. Different derivatives are required for different devices and user requirements. Schema derivatives provide the rules for transforming the original document to the one which on the one hand matches user requirements, on the other hand suits to specific device capabilities.

Since it is not possible that each set of user requirements could meet the capabilities of each unique device, a (relatively small) number of document class, called profiles, has been introduced to classify user requirements and device capabilities.

The rest of the paper is organized as follows. In section 2 document distribution is detailed. Section 3 discusses profiles and the profile selection based on information of the mobile device. The method of schema transformation is detailed in section 4. We discuss document transformation in section 5. Our conclusion is given in section 6.

2. DISTRIBUTING ODF DOCUMENTS OVER SERVER AND CLIENT

In our approach editing documents on a mobile platform is achieved by document independent preparations, and handling the document in question.

Document independent preparation to establish proper software environment:

1. Profile selection: Mobile users select the proper profile considering the capacity of the mobile device and their document handling’s requirements. The decision process can be supported by a simple program that discovers the properties of the given device, and suggests an appropriate profile. The user can override this suggestion risking bad performance for a wider spectrum of features to access. This selection should be made once, before the first use of the mobile editor, and may be overridden later.

2. Schema derivation: A schema for each profile defined should be derived by transforming the original ODF schema using a macro language under development. Derived schemata keep conformity against RELAX NG grammar. Schema transformation is
performed only once, and has to be repeated only if
the ODF schema or the profile set is changed.

Handling document, an interaction between desktop
computer and mobile device:

1. Document transformation: When the mobile device
connects to the computer and requests a given docu-
ment, the server site identifies the profile and trans-
forms the document by using the appropriate schema.
Transforming the document those parts of the doc-
ument that are not conform against the schema se-
lected are replaced by unique, typed markers. Re-
placed parts are stored along with their markers in a
separate document on the computer.

2. Editing on the mobile device: The transformed doc-
ument is sent to the mobile device, where it can be
viewed and changed by the client program. As mark-
ers are typed, they can be displayed as icons if appro-
priate. During the edition process the document con-
formity against the derived schema is kept. The latter
guarantees that the markers can be replaced later by
the original components. The new document is sent
back to the computer.

3. Document reconstruction: Markers are replaced by
the original components and the result is a new doc-
ument that is valid against the ODF schema.

3. PROFILE SELECTION

Mobile devices perform differently. Some have lots of
memory, some have fast processors. Others may lack good
hardware, but their optimized software still provide a good
performance. All these factors contribute to the overall per-
formance of a device, and none of them may be neglected
when estimating the performance of our software with dif-
erent profiles.

The software platform chosen as the Java Micro Edition
that hides low-level hardware information, e.g. the speed
of the processor, the amount of internal memory available
etc. The capabilities of a mobile device should therefore be
estimated by benchmarking the cost of the operations to be
performed. Building a resource model \[8\] consists of three
steps:

1. Identifying schema-related operations: Different
profile-associated schemata provided for the user re-
quirements involve working with different objects
like tables, graphics, paragraphs, charts etc. Work-
ing with an object means executing some of the basic
operations. In each schema derivations we determine
the frequency of each basic operation. This has to be
done only once for each schema.

2. Identifying device profile: Before running the mobile
editor for the first time, a series of tests are executed
on the mobile device to measure the performance of
different basic operations. We have defined the ba-
sic operations required for editing documents, and
grouped into several categories as follows:

- **File operations** – reading and writing files from
  and onto internal memory or memory card, parsing XML, extracting and compressing ZIP
  files.
- **String operations** – string concatenation, sub-
  string look-up.
- **Display operations** – displaying various user in-
  terface elements.

3. Offering a schema derivative: Based on the costs
of basic operations and their frequency, we can es-
imate the total amount of costs concerning a derived
schema. By defining a threshold based on the de-
vice profile, schema derivatives can be offered for
the user. Users have the possibility to override the
schema selection manually, but that may cause a
lower application performance.

4. SCHEMA TRANSFORMATIONS

Before all, it is important to see that a RELAX
NG grammar defines document frames by using pat-
terns \(<define...> ... </define>\) and inside that
frame patterns \(<element...> ... </element>\), and
\(<attribute...>... </attribute>\) for the latter also
permitting the form \(<attribute.../>\). Due to that any
schema transformation resulting in some derivative can be
composed by a particular sequences of of schema transfor-
mation primitives defined as follows:

1. removing \(<define...> ... </define>\) patterns by
  name, together with all \(<ref.../>\) patterns refer-
  encing the same name,

2. introducing new \(<define...> ... </define>\) pat-
  terns,

3. removing \(<element...> ... </element>\) patterns
  by name, together with all \(<ref.../>\) patterns refer-
  encing the same name,

4. introducing new \(<element...> ... </element>\)
  patterns,

5. removing \(<attribute...> ... </attribute>\)
  or \(<attribute.../>\) pattern, together with all
  \(<ref.../>\) patterns referencing the same name,

6. introducing new \(<attribute...> ... </attribute>\)
  or \(<attribute.../>\) patterns,

7. removing content-less patterns (like \(<choice>
  </choice>\), etc), occasionally resulted by remove
  operations numbered \[1,3,5\]

It is obvious that any schema transformation can be de-
scribed as a particular sequence of the primitives above. As
previously stated, for each profile there is an associated derived schema. The question is how particular profiles can be achieved for users. One way is to predefine a collection of editor profiles and, for users, the only possibility to select one of them. The disadvantages of this way is that it makes a strong restriction for users. Another way is to allow the user to freely describe a desired schema transformation as a particular sequence of the primitives above. This way seems a better one, but only for those users who are familiar with ODF grammars. An ideal way would be to provide a formal document frame and style description system in strong relationship with schema transformation primitives in which users may and can freely construct their ideal document style and frame. This way is even much rather ideal, since it offer the possibility of computer controlled automatic generation of the adequate macro definitions and embedding guaranteeing derived schema’s consistency and conformity.

5. DOCUMENT TRANSFORMATION

A document is transformed before transferring to the mobile device according to the RELAX NG schema relating to the selected profile. Transformation takes the document and the RELAX NG schema as input, and outputs two files:

- The transformed document contains typed markers each equipped with a unique ID.
- Marker definition file is an XML document containing pairs of markers and XML fragments. When committing mobile site changes, each marker is replaced with the associated XML fragment. Since markers are typed the document conformity against ODF schema is guaranteed.

The transformation is done by validating the document against the schema derivative. Whenever a document fragment is found (a sub-tree in the graph representation of the document) which is not allowed by the derived schema, we place a typed marker with a unique ID in its place while saving the replaced document fragment in the marker definition file associated with the marker. This means we provide a bijection between markers and document fragments.

Here we present a basic example. Let the input document fragment be:

```
...<table name="FirstTable" style="FirstTable">
  <column style="FirstTable.A" />
  <column style="FirstTable.B" />
  <row style="FirstTable.1">
    <cell style="FirstTable.A1">
      Hello
      <list>
        <item>First</item>
        <item>Second</item>
      </list>
    </cell>
  </row>
</table>
...```

Let us suppose that the schema does not allow placing a list inside a table. The transformed document is as follows:

```
...<table name="FirstTable" style="FirstTable">
  <column style="FirstTable.A" />
  <column style="FirstTable.B" />
  <row style="FirstTable.1">
    <cell style="FirstTable.A1">
      Hello
      <marker type="list" id="0" />
    </cell>
    <cell style="FirstTable.B1">
      World
    </cell>
  </row>
</table>
...```

The marker definition file:

```
...<markerDefinition>
  <marker type="list" id="0" />
  <list>
    <item>First</item>
    <item>Second</item>
  </list>
</markerDefinition>
...```

6. CONCLUSIONS

Our idea was to equip mobile devices schema-controlled office-document editor. Our mobile site editor prototypes’ measurement results concluded that there is no possibility providing the same schema-controlled editor for each mobile platform unless we restrict its operation set and style capabilities according to the most primitive mobile device environment. As a consequence we should provide an editor which can adapt to all-time document complexity and mobile device resources. Schema-controlled edition of documents needs to perform ODF schema transformations along with schema-conform document transformations. There is a need for a user-friendly formal document-frame and document-style base set from which users can freely build their desired document structure and desired style, which can be translated into a sequence of schema transformation primitives.

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