Time-sensitive Linking Mechanisms on the Future Web

Anneli Heimbürger

VTT Information Technology

Abstract. In our paper we will investigate the possibility of applying the XML Linking Language (XLink) to time-sensitive applications. In time-sensitive applications fragments of documents are to be composed on fly to form a time-dependent document assembly. The multiple linking mechanism specified by the W3C's XML Linking Language is one way to approach the time-sensitivity problem in wired and wireless applications. Links with multiple endpoints connect not only two but also a set of related nodes. When a user initiates a link with multiple endpoints, he/she can be requested to choose between the available options or automatically shown the most decent destination defined by the user's time profile. We also introduce scenarios for time-sensitive applications.

1 Introduction

Hypermedia links play an important role in tracking the relationships within and among sets of data. Methods and tools to manage the full life cycle of links are essential for developing and maintaining high-quality hypermedia applications for wired and wireless networks of the future. Open hypermedia is an area that has been studied by the hypermedia community for several years and for which a number of systems have been implemented [3, 13]. In open hypermedia systems (OHS), links are managed and stored in special databases called link databases or linkbases. Link databases offer possibilities for filtering, sorting, analysing and processing link collections. It is possible to treat collections of links as independent databases, which could lead to new categories of marketable information. For example, collections of customised link sets related to a specific time period could be sold as separate products. The XML Linking Language (XLink), the recommendation of the World Wide Web Consortium (W3C), is increasingly moving the Web towards the open hypermedia approach [10, 12].

The remainder of the paper is organised as follows. The concept of time-sensitivity is introduced in Section 2. Scenarios for time-sensitive linking applications are presented in Section 3. Multiple linking mechanisms defined by the XML Linking Language are described in Section 4. We conclude in Section 5.

2 Time-sensitivity

Time-sensitivity is one special case of the broader concept of context sensitivity. In time-sensitive applications we can identify the following levels: a) related information and/or pieces of information are functions of time, b) connections, i.e. links, between information and/or pieces of information are functions of time, and c) related information and/or pieces of information as well as the links between them are functions of time.

In our research, time-sensitivity can be predictable temporal relationships among elements included in an application. In this case, temporal rules can be resolved and defined before the application runs. Non-predictable temporal relations can be modelled with time-sensitive link traversals. Non-predictability creates a temporal order of events that occur during runtime in time-sensitive applications. Each instantiation can be different.

In our case, the core components of a time-sensitive linking architecture are domain-specific content management, time ontologies and linkbases. By means of a domain analysis, time-sensitive pieces of information related to the application concerned will be identified. The temporal rules will be defined and a time ontology created. The ontology will contain general and application-specific rules. There already exist some time ontologies [1, 2, 4, 5, 14] which could be useful in our problem.

3 Scenarios for Time-sensitive Applications

One of the basic characteristics of news materials is time-sensitivity, both from the producers' and users' point of view. News and document sets could be composed on the fly according to some time criteria. Personalised or user group-specific news sets such as a financial news service for SMEs, according to some time interval or time and subject criteria, is one possible application of time-sensitive linking mechanisms [9].

Time-sensitive linking mechanisms can also support optional services in an integrated news publishing system such as filtering out identical or similar news stories and showing to a user only the most relevant story with links to others.

The XLink specification provides interesting possibilities to manage technical customer documentation in extranet and intranet environments. In troubleshooting

situations in industry, instructions are needed quickly. Time is an essential element when composing instructions on the fly, because the different parts of the document assembly depend on how long the situation has continued.

Time-sensitive linking tools for project managers such as automatic alarming mechanisms for project communications and knowledge management systems in distributed multi-organisational project environments offer interesting possibilities for applications. The idea is that a project manager receives an alarm message when a group of linked documents or some of them are approaching some pre-defined status in time.

Other examples of time-sensitive applications are temporal mobile information services during cultural and sport events lasting several days as well as timetables for travelling services. Also training, educational and museum materials where time is the main point of view are challenging applications.

4 XLink's Multiple Linking Mechanism

The Extensible Markup Language (XML), based on the SGML [6], is starting to revolutionise the way data and documents are produced and managed on the Web and elsewhere. The XML Linking Language family promises to do the same for hypermedia linking. XLink specifies how separate documents should be linked to one another, and how structures within XML documents should be addressed [12]. XLink provides much more powerful link representation and addressing features than HTML.

Link management based on the XLink language makes it possible for the same information to be relinked automatically. XLink provides nested information hierarchies, many-to-one and one-to-many relationships between documents. Various sets of links can be associated with the same content to create user group-oriented views to information. XLink's ability to define more structure for links makes them easier to control. This leads to easier maintenance and to greater possibilities for automated processing. XLink is increasingly moving the Web towards the open hypermedia where links can (a) have semantic and behaviour attributes, i.e. associated metadata, (b) have an arbitrary number of resources, and (c) be maintained in separate link databases.

The XML Linking Language specifies the concept of extended links. An extended link is a link that associates an arbitrary number of resources. Multiple links can also be used to automatically select the most decent destination by applying a filter. It would be even more desirable to filter by semantic criteria such as time and a user's task or profile. An extended link can, for instance, associate five resources and provide traversal rules among them. Resources are called participants and transition rules arcs. The traversal rules are necessary because without

them the resources are associated in no particular order, with no implication as to whether and how individual resources are accessed.

The arc-rules can vary according to the situations currently at hand. For time-sensitive applications we need an XLink attribute and mechanisms for managing temporal rules between contents and fragments of contents. At the moment the XLink specification does not support temporal ruling. We are interested in investigating more precisely the possibilities for associating temporal rules to extended link structure. There are at least the following possibilities: (a) to extend the arc-element's "from-to" structure with conditional time parameters, (b) to construct an XLink linkbase of temporal rules based on a time ontology, and (c) a combination of these two.

5 Conclusion and Issues for Further Research

In this study, features of link management in time-sensitive context have been discussed. The study has concentrated on the issues related to extended links defined in the XLink specification. Scenarios for time-sensitive linking applications have been introduced. At the moment there exist some XLink implementations. However, neither of these have any straight support for temporal rules. The demonstration building environment in our project will based on Doczilla (CiTEC Inc.), X-Fetch Suite (Republica Inc.) and Kronodoc (Kronodoc Inc.). Doczilla already supports some XLink-features. X-Fetch Suite is a toolkit for building XML-applications. Kronodoc is a Web-based project communications and knowledge management software. We will also do some experiments with W3C's Amaya browser.

The next steps of our study will involve selecting an application, making a deeper analysis of time-sensitivity, creating an ontology, making a more precise analysis of time-sensitive linking mechanisms in different mark-up languages [7, 8, 11], and building up a demonstrator. We will also report our research results to W3C's XML Linking Language Group.

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