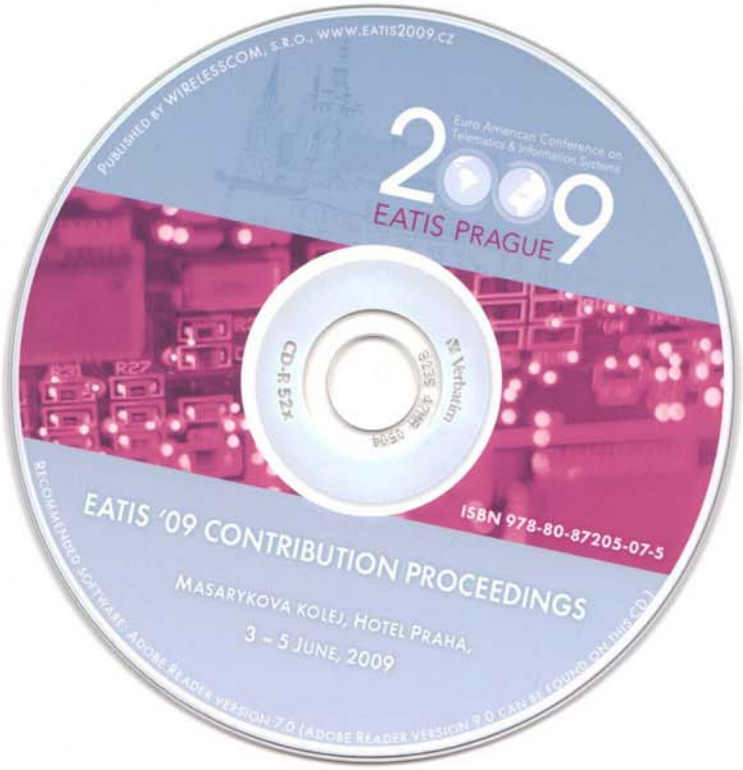
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Semantic Traffic Applications based on DatexII

J. Javier Samper
Computer Sciences Department in University of Valencia
Vicente Andrés Estellés
46100 Burjassot, Valencia, Spain
Jose.J.Samper@uv.es

F. Javier Adell
Robotics Institute in University of Valencia
Polígono de la Coma
46071 Paterna, Valencia, Spain
jadell@robotica.uv.es

Jose Fco. García
Computer Sciences Department in University of Valencia
Vicente Andrés Estellés
46100 Burjassot, Valencia, Spain
j.francisco.garcia@uv.es

J. José Martinez
Computer Sciences Department in University of Valencia
Vicente Andrés Estellés
46100 Burjassot, Valencia, Spain
juan.martinez-dura@uv.es

Jose Vidal
Robotics Institute in University of Valencia
Polígono de la Coma
46071 Paterna, Valencia, Spain
jvidal@robotica.uv.es

ABSTRACT

In this work we demonstrate a particular use of ontologies based on the European specifications DATEXII. These specifications are designed and developed as a traffic and travel data exchange mechanism by a European task force to set up and standardise the interface between traffic control and information centres. It is the reference for applications that are developed and implemented in Europe.

This language describes concepts and structures of data related to traffic, but the description is just syntactic, not semantic. Therefore the objective to be reached in this part of the research has been to develop a semantic description in order to carry out some applications like syndication and a Maps representation of DatexII data.

Categories and Subject Descriptors

I.2.12 [**Intelligent Web Services and Semantic Web**]: Internet reasoning services, Ontology design

General Terms

Design, Languages

Keywords

Ontologies, Semantic descriptions, Traffic information

1. INTRODUCTION

Semantic Web was born with the aim of increasing the current web through the creation of semantic relationships among different elements of information such as a column of a database, a field in a form or the description of an ebay item.

There are many applications which have been developed under the set of contents of the Semantic Web. These are some of them:

- Data Integration. In these cases, integration means the effort made to find semantic links among the formats to be mixed, which results in a unique integrating format of representation compatible with the original formats.
- Discovering and Classification of Resources. By offering new experience to the user regarding searches and representation of the results found.
- Description of Resources. The Semantic Web offers great solutions to describe and define resources. The base of the Semantic Web is the meaning of content, the information which explains the meaning of the information.

On the other hand, the DatexII standard [1] has already been defined. It represents a well-defined format of information about traffic. DatexII sets the relations between a large amount of issues related to any traffic situation and the exchange of all this content by the European management traffic center.

It could be thought that the Semantic Web has nothing to offer to a well-defined and unified format. However, if we look at the origin of the data, we can see the system gathering information from different fields, being each of them dealt with in a particular way. DatexII format joins the following in the same point: information related to traffic, accidents, road works, vehicles, weather, and so on. We thought that the Semantic Web gave us a great chance to integrate all this information with specialized external sources in each field. The advantages are obvious, if we define the information in the same way, we will get compatible data.

Section 2 will show a short description of the ontology which has been defined based on DatexII, and introduce the main concepts which were used in the different ontologies and vocabularies in order to carry out syndication and a GoogleMaps [2] representation of DatexII data. Section 3 will outline the different libraries which were developed and the open source APIs which were used to build them, then the use and the complete process which was followed to develop the application will be shown in detail. Finally, section 4 will offer the conclusions to this research as well as the future work which is being planned.

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2. DATEXII ONTOLOGY

To start with, we built an ontology [3] to define the concepts related to traffic, its situations and its elements, which were present in the DatexII standard. In order to build the ontology, the Protégé OWL Editor tool [4] was used, focusing on the OWL-DL ontology description language. The RDFS alternative was not enough to define the depth of the information found in the standard, although we only described the part related to traffic. In the same way, going beyond the limits of the DL species could be considered as a future limitation if we try to look for inference in the model.

Due to the big amount of information which the standard holds, we decided to focus on the traffic situations and the traffic elements. We set aside the information regarding the publication of content and the details about types and characteristics of vehicles.

The Situation concept defines any situation or traffic event could ever happen in a real scenario. Describing in detail the situation element is far of the purpose of this article but we have to give some directions to help to understand the rest.

When we speak of a situation, it has been to define what kind of situation happens. DatexII defines a hierarchy of types of situations: due to actions of operators on the road, to events not related to the road or elements of situations due to traffic. Among the latter there are more subdivisions: Accidents, abnormal traffic …

In addition to this hierarchy, each situation contains information on the event itself: impact that has resulted, its validity, the cause that led to, and many more. The hierarchical structure of the concept "Situation", defined in the ontology created, is shown in Figure 1. Obviously, each element has certain restrictions and properties.

On the other hand, Dublin Core vocabulary [5] is destined to be the backbone of syndication, because it has properties well defined and accepted by the community: date, title, creator, description, etc. Taking the advantage of the syndication, as a semantic solution, allows the addition of any supplementary element, then the location by coordinates using the Geo vocabulary [6] was added. So, it allows the representation of information through Google Maps, because these maps use latitude and longitude to position the elements.

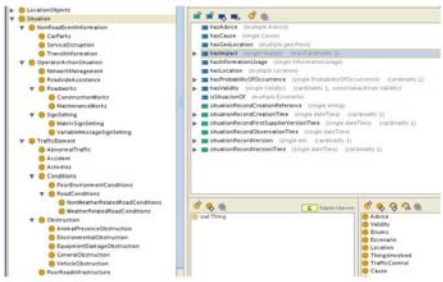

Figure 1. Hierarchical structure of the concept "Situation"

3. APPLICATIONS OF DATEXII ONTOLOGY

This section will present the various libraries developed and the open source APIs that have been used for this project. We introduce the needed tips to carry out syndication and a representation through GoogleMaps of DatexII content.

As said before, the ontology represents a big quantity of info but an element is emphasized, traffic situations. We will make a syndication exercise taking as root, the DatexII element, Situation.

For using the ontology described, it was required a generation of semantic content as individuals. To accomplish this task we chose Jena [7] as development platform, because it provides a stable and powerful data model on which convert DatexII data to RDF data.

The aim was to make a translation in a reasonable time and that could be automated easily, so it could be used in other systems without making any changes to the original.

XML files were took like input parameters, so for its reading was necessary the use of XMLBeans [8], because it is a technology for accessing XML by binding it to Java types. Once the information is retrieved, the program is responsible for building the semantic data model, and finally it can be exported to a file in any of the RDF formats: N3, Turtle or RDF/XML.

This work has been compressed as a library called Datex2RDF. In Figure 2 is shown how to use it. Special attention should be paid using an ontology about classification of vehicles defined in a different project of our group of research [9]

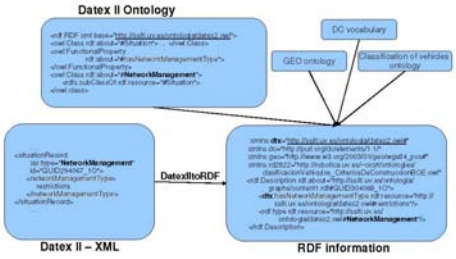

Figure 2. Use of Datex2RDF.

Other library developed was RDFtoFeed. It allows you to create syndication feeds from Jena models. First, the search for information in the semantic model was done with SPARQL. Next, the information retrieved is introduced in a Sun Microsystems API, ROME [10], because it is an open source project aimed at developing a set of Atom/RSS Java utilities that make it easy to work in Java with most syndication formats: RSS 1.0, RSS 2.0, Atom, etc.

Therefore, using Datex2toRDF and RDFtoFeed can be obtained feeds of traffic information in a methodology compatible with DatexII.

3.1 Implementation and usage

The DatexII standard does not define implicitly the most common elements of syndication such as the name of a situation, a simple

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description … When a RDF object is build through Datex2toRDF, it was added more information using other vocabularies like Dublin Core, together with DatexII information. In this way, there is more information about a traffic situation. Figure 3 shows an example of RDF object as result of this process.

```
<rdf:Description
rdf:about="http://ssiti.uv.es/ontologia/grapha/content1.rdf#GUID304068_10">
<dc:title>GUID0870906000l_30</dc:title>
<dc:subject>MaintenanceWorks::Situation</dc:subject>
<dtx:hasValidity
rdf:resource="http://ssiti.uv.es/ontologia/grapha/content1.rdf#Validity_GUID304
068_10"/>
<dc:description>MaintenanceWorks situation.
      Created at Thu Sep 06 05:26:00 GMT+01:00 2007 by www.dgt.es
     The situation has a Validity: Validity_GUID0870906000l_30
     The validity expires at Tue Oct 17 15:00:00 GMT+01:00 2006
</dc:description>
<rdf:type
rdf:resource="http://ssiti.uv.es/ontologia/datex2.owl#NetworkManagement"/>
```

Figure 3. RDF description.

Definition of a RSS file is trivial at this moment, because the necessary elements for syndication are defined in the RDF object, and they can be obtained with a SPARQL query. Additionally, it is defined a filter to define a syndication feed for each traffic situation category: MaintenanceWorks, NonRoadEventInformation, Accidents, Conditions, etc.

The Geo vocabulary is used for adding the location by coordinates in latitude and longitude. Then, it was defined concepts of type geo:Point with properties geo:lat and geo:long. Figure 4 shows the code necessary to define positions with this vocabulary.

```
<rdf:Description
rdf:about="http://ssiti.uv.es/ontologia/grapha/content1.rdf#GeoPoint5002_GUID30
9755_1R">
    <geo:long
rdf:datatype="http://www.w3.org/2001/XMLSchema#float">2.08126</geo:long>
    <geo:lat
rdf:datatype="http://www.w3.org/2001/XMLSchema#float">41.32929</geo:lat>
    <rdf:type rdf:resource="http://www.w3.org/2003/01/geo/wgs84_pos#Point"/>
</rdf:Description>
```

Figure 4. Definition of positions.

Figure 5 shows how is used the feed syndication with a reader like Thunderbird [11].

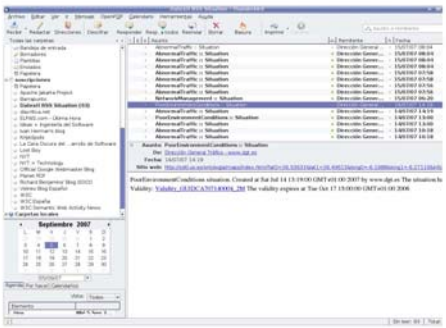

Figure 5. Syndication feeds in Thunderbird.

Figure 6 shows how is located a traffic situation, defined in our process, in a Google Map.

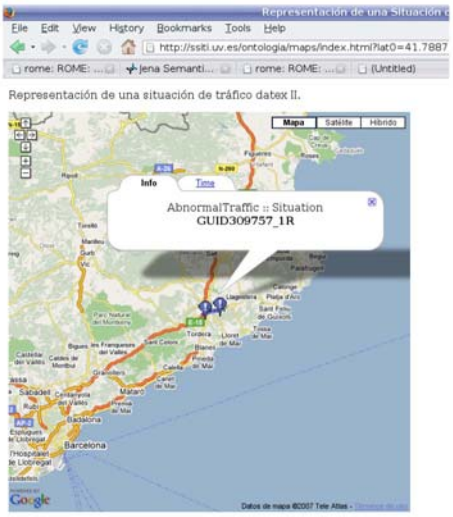

Figure 6. Representation of a traffic situation in GoogleMaps.

4. CONCLUSIONS AND FUTURE WORK

In this work has been defined a knowledge base of traffic information from DatexII format. This semantic approach allows an easy update and extensibility. In this sense, it was used concepts defined in more detail in other ontologies, and then there is more precise information about a traffic situation than in a DatexII description.

It was developed a library named DatexIItoRDF, which convert the DatexII model in XML to an RDF model. The fact that it is a multiplatform library allows its use in any semantic project which needs DatexII information. Two applications defined are syndication with our library named RDFtoFeed and location in GoogleMaps to represent traffic situations.

An interesting and natural future work could be the validation of the data obtained with the application DatexIItoRDF. This task could be done easily with OWL-DL reasoners, because our ontology is defined in this language.

5. ACKNOWLEDGMENTS

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