Data, Information and Process integration with Semantic Web Services

DIP

Data, Information and Process Integration with Semantic Web Services

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Deliverable

WP 9: eGovernment Case Study

D9.11

SWS Enhanced GIS prototype (IRSIII) v1.0

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EXECUTIVE SUMMARY

This deliverable describes the first version of the SWS enhanced GIS prototype. It has been developed in IRSIII [3]: Internet Reasoning Server from OU which is WSMO compliant.

This prototype contributes to the following golden bullet of DIP: Real Use Case Implementation of SWS in the e-Government sector.

This prototype focuses on a SWS-based Emergency Management System (EMS). The prototype has been developed to fulfill Essex County Council's (ECC) needs to access geospatial data for emergency management and to share it with other partners (e.g.: police, ambulance services, meteorological office, other public organizations, etc) during an emergency situation.

The approach of using traditional Geographical Information Systems (GIS) to access spatial-related data is not always satisfactory as users have to cope with distributed heterogeneous data sources to find appropriate resources for particular situations. It is sometimes slow in response which is contrary to the nature of the need for information access in an emergency situation.

This prototype develops a Semantic Web GIS in which data sources and services are made available through SWS, described by ontologies, allowing interoperability as well as reasoning to create a comprehensive response adapted to user goals.

The deliverable is intended to be read by DIP technical partners to inform them of the way in which the tools/technology has been used to create a use case scenario. In addition, it will be of interest to the end-user community and other data suppliers (e.g.: Essex County Council and other public authorities' emergency planners, police, Essex Fire & Rescue Service, ambulance service, highways and transport, meteorological office, Ordnance Survey, BAA safety services, Essex Rover Rescue.)

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Abstract (for dissemination)	Public organisations access geospatial data for management as well as for communication purposes. The approach of using traditional Geographical Information Systems (GIS) to access spatial-related data is not always satisfactory as users have to cope with distributed heterogeneous data sources to find appropriate resources for particular situations. This prototype develops a Semantic Web 'GIS' in which data sources and services are made available through SWS, described by ontologies, allowing interoperability as well as reasoning to create a comprehensive response adapted to user goals. We focus on an Emergency Management System as a practical example to show the full potential of this technology.
Keywords	Prototype, emergency planning, GIS, IRSII, Spatial-related data (SRD), Emergency Management System (EMS)

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ACRONYMS/GLOSSARY

BAA British Airports Authority

ECC Essex County Council

EMS Emergency Management System

EPO Emergency Planning Officer

GIS Geographical Information Services

IRSIII Internet Reasoning Server 3

OU Open University

SRD Spatially Related Data

SWS Semantic Web Service

WP9 Work Package 9

WgM Web Service-Goal mediator

WSMO Web Service Modelling Ontology

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1 Introduction

In an emergency situation, multiple agencies need to collaborate, sharing accurate data and information about actions to be performed in real-time. In such a situation, there is usually a need for geospatial data of the type which is traditionally managed with the help of Geographical Information Systems (GIS).

Unfortunately, GIS are often centralized and isolated systems, and heterogeneity issues arise from the way different organisation collect and manage data, according to a particular view of the world. This is often a barrier to geospatial data exchange. The lack, and maybe the impossibility, of consensus about the spatial domain limits communication and knowledge of available information, leading to inaccuracies whilst introducing an increased amount of manual work. These inefficiencies can lead to adverse consequences in an emergency situation. Please refer to D9.6 (Chapter 2 and Annex3/General Questions/Heterogeneity problems) for a detailed explanation and examples of data heterogeneity in GIS.

In order to alleviate this we have developed a Semantic Web GIS Emergency Management System (EMS) relying on WSMO-based SWS technologies. The EMS helps the Emergency Planning Officers (EPOs) to retrieve, display, and interact with the relevant information more easily. This can include, according to the kind of emergency, weather forecasts, available emergency services, evacuation procedures and routes, supplies providers, available rest centres, categories of affected and vulnerable people, nature and location of damaged or endangered facilities, access to critical 'hotspots', etc. As a result, the agencies involved are able to extend their knowledge about the emergency situation by making use of data held by other agencies which otherwise might not be accessible to them or slow to obtain manually.

2 Architecture

We have created a multi-layered architecture, which is depicted below in Figure 1. Dark boxes represent the main modules of the prototype, white ones are external distributed resources.

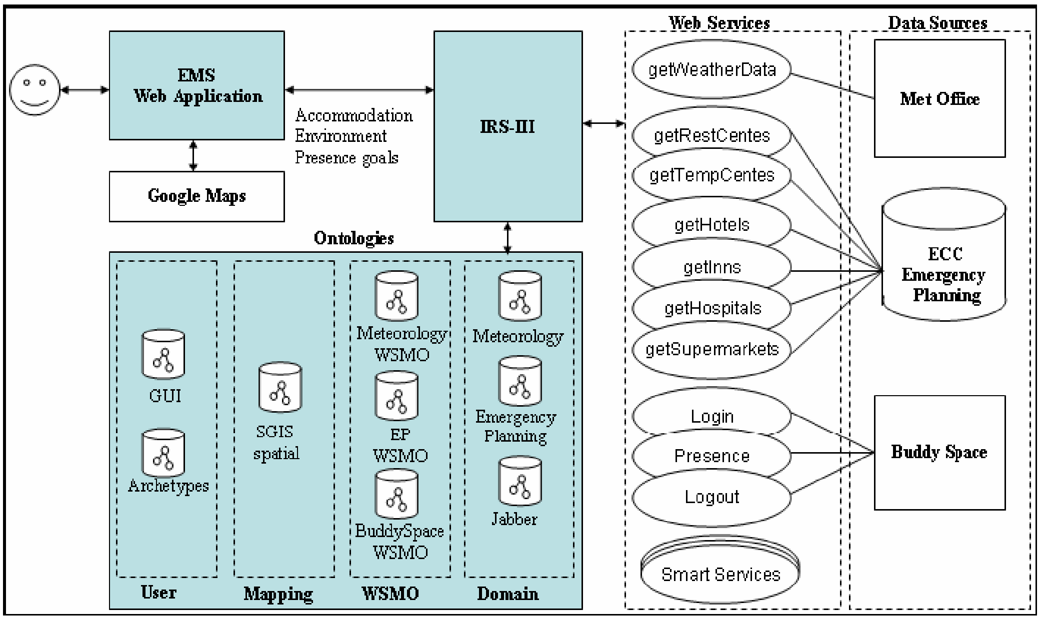

Figure 1 - Architecture of the EMS prototype.

For a more detailed explanation of the EMS architecture please refer to D9.10, paragraph 2.1 (Architecture).

2.1.1 Data Sources

The EMS aggregates data from three different sources, namely: Meteorological Office in the UK, ECC Emergency Planning department, and buddy space (an instant messaging tool created by the OU).

For a more detailed explanation of the EMS data sources please refer to D9.10, paragraph 2.2 (Data).

2.1.2 Services

We distinguish two classes of services: 'data' and 'smart'. The former refers to the three data sources described above, which are exposed by means of WS. Smart services represent specific emergency planning reasoning and operations on the data provided by the data services. They are implemented in Common Lisp and published by means of IRS-III [3].

For a more detailed explanation of the EMS architecture please refer to D9.10, paragraph 2.3 (Services).

2.1.3 Ontologies

There are several ontologies which have been developed to semantically support the EMS system. They are divided into two different categories: user and domain ontologies. The following list provides a brief overview of these:

User ontologies

• HCI (Human-Computer Interaction) Ontology: composed of HCI and user-oriented concepts. This allows further specialisation of the lowered results on the particular interface used (e.g. stating that Google Maps [1] API is used, defining "pretty names" for ontology elements, etc.).

• Archetypes Ontology: defines cognitive feelings. For example: "a *hospital*, is a *container* of people and can provide temporary *shelter*, it can be also assimilated to the more universal concept of *building*"

Domain ontologies

• SGIS Spatial Ontology: Describes high level but common concepts of GIS, such as points, spatial objects with attributes, polygons, and fields.

• Meteorology, Emergency Planning and Jabber [2] Domain Ontologies: representing the concepts used to describe the services attached to the data sources, such as snow and rain for Meteorological Office, hospitals and supermarkets for ECC Emergency Planning, session and presences for Jabber [2]. These are part of the domain ontology layer.

2.1.4 WSMO Descriptions

WSMO based Goals, Mediators, and WS descriptions in the prototype refer to the Meteorological Office, ECC Emergency Planning, and BuddySpace WS. Goal descriptions are using user ontologies, while Web Service descriptions are linked to domain ones. Finally, mediators link goals and web services of each ontology, resolving any mismatches. Figure 2 depicts the structure and interactions of the WSMO description of the EMS prototype (to avoid cluttering the diagram Web Services (WS) balloons have been omitted)

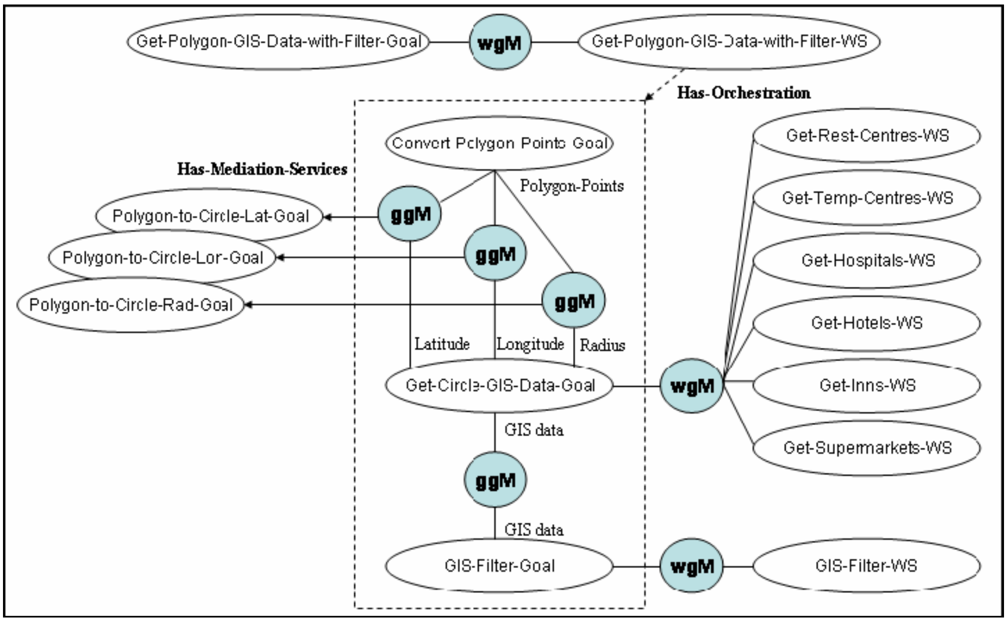

Figure 2 - Structure of the WSMO description of the EMS prototype.

Legend: ggM: goal-goal mediator, wgM: web service-goal mediator.

3 INTERFACE

The user interface has been developed using Web standards: XHTML and CSS are used for presentation, JavaScript (i.e. EcmaScript) is used to handle user interaction and AJAX provides IRS-III [3] goal invocation. One of the main components of the interface is a map, which uses the Google Maps [1] API to display polygons and objects (custom images) at specific coordinates and zoom levels. These objects are displayed in a pop up window or in a hovering transparent region over the maps.

The following scenario can be recreated in this demo: An EPO needs to know where the most suitable rest centres are within a certain area in order to evacuate people involved in an emergency situation (people stranded on a motorway, casualties, etc). He might afterwards want to locate and contact relevant rescue corps in the area. To achieve this, the EPO would perform the following tasks on the GUI:

1. Based on external information from the Meteorological Office the EPO draws a polygon on the map, then, assigns a hazard type to the region (a snow storm or a snow hazard in this first version of the prototype)*.

* This step is going to be improved retrieving weather-related data automatically from the Meteorological Office through a real-time WS in the following version of the prototype.

2. The EPO clicks within the displayed hazard region to bring up a menu of the available goals. In this case (Figure 3a) three goals are available: show available shelters; login to BuddySpace; and get the presence information for emergency services.
3. The EPO asks for the available rest centres within the region he previously defined. A group of suitable rest centres is depicted on the maps in their respective locations. By clicking on any of them, relevant information is displayed in a pop-up menu (e.g.: contact person, telephone, capacity, facilities, etc.) (Figure3b).
4. The EPO requests to see the presence status for all the emergency services and other relevant people within the region. After invoking this goal, all the available "buddies" are displayed on the map in their current location. The EPO can then initiate an online discussion with any of them (Figure 3c)*.

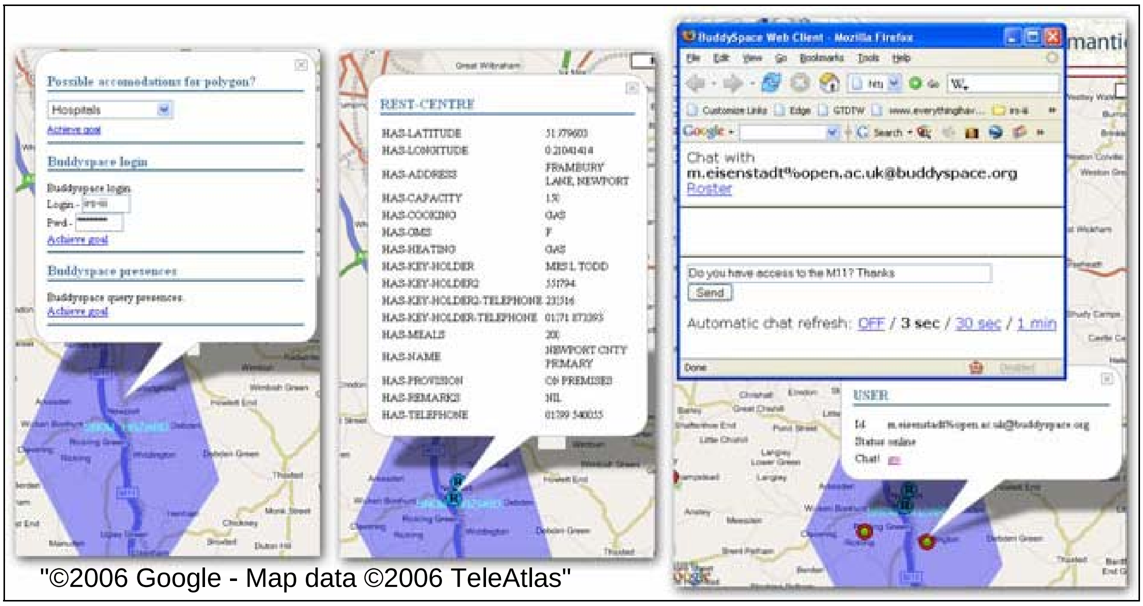

Figure 3 - Three views of the application in use

3a) Goals available for the snow hazard, 3b) obtaining detailed information for a specific rest centre, 3c) initiating a discussion with an online emergency worker.

4 ON-LINE DEMO

A screencast of the interaction as well as a live version are available online: http://irs-test.open.ac.uk/sgis-dev/ (to be used with the latest version of the Firefox Web browser[1])

* We foresee this feature might be useful to contact relevant people in real-time through GPS systems during an emergency situation.

1 http://www.mozilla.com/firefox

5 Conclusion

This prototype has been developed by several partners working together, each one's roles are the following:

- ECC
  - Narrow the area of scope: define the subject of the application.
  - Requirements specifications: Identify and subsequently interview a number of stakeholders in order to find out their needs and requirements. Translate these needs into WMOS: Define wich Goals, Mediators Web Services are needed (their relations and inputs/outputs). This is given to BT and the OU for implementation. Gather relevant data which is going to be provided as WS from the users. This data is then passed onto BT.
  - Creation of ontologies to support the semantic descriptions: With the material from the interviews and closely working with the users/stakeholders ECC has created several ontologies in WSML using DIP tools (mainly WSMO Studio). The users are asked to define their domain of work in order to model it into ontologies, but they are asked to do so in a high level, non technical way. After gathering all the information ECC models this knowledge. They may be contacted again in order to polish some concepts.
- BT
  - Creation of a central repository: replicate the data from the stakeholders into a centralised repository. (Oracle Spatial Database)
  - Creation of WS: Creation of a number of WS in order to provide the data in the way is needed by the prototype.
- OU
  - Creation of WSMO description: translation from the natural-language descriptions into WSMO descriptions (of WS, Mediators and Goals) with support of the ontologies.
  - Creation of new ontologies that might be needed to support WSMO components
  - Development of the interface prototype: from the user's interviews they develop the GUI with the desired functionality.

This is the manual labour undertaken by WP9. Once done this, the prototype is highly scalable, as new goals can be added very easily in order to connect new WS provided by new data providers. These can reuse already existing ontologies or add their new ones. After semantically describing the goal, WS and possible mediators the system is ready to work with these new SWS.

6 References

[1] **Google. Google maps/local.** http://maps.google.com/.

[2] **Jabber,** http://www.jabber.org/

[3] **IRS-III: A Platform and Infrastructure for Creating WSMO-based Semantic Web Services.** Domingue, L. Cabral, F. Hakimpour, D. Sell and E. Motta. Proceedings of the Workshop on WSMO Implementations, Frankfurt, Germany. CEUR Workshop Proceedings, Vol. 113, (2004).