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GIS WSMO descriptions

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EXECUTIVE SUMMARY

This document provides the WSMO descriptions for the Semantic Web Services developed for 'GIS prototype' (also referred here as the *Emergency planning prototype*) as described in previous WP9.6 deliverable. This application is intended to support decision making processes in the emergency field within Essex County Council (ECC) and its partners. We outline a Semantic GIS system; several data sources and services are made available through Semantic Web Services, while ontologies allow computers to interoperate and combine information, creating a comprehensive response adapted to user needs. The reported descriptions include domain ontologies for ECC Emergency Planning (View Essex), Meteorological Office, and Buddy Space related services as well as descriptions of WSMO goals, Web Services and Mediators developed in IRS-III.

This deliverable is directly related to deliverable D9.9 (GIS Ontology).

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Abstract (for dissemination)	WP9 is about a case study on e-government. This document provides the WSMO descriptions for the Semantic Web Services developed for the 'GIS prototype'.
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ACRONYMS/GLOSSARY

ECC Essex County Council

GIS Geographical Information Systems

SW Semantic Web

SWS Semantic Web Service(s)

WS Web Service

WSDL Web Service Definition Language

WSMO Web Service Modelling Ontology

WP9 Work package 9

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1 INTRODUCTION

This document provides the WSMO descriptions for the Semantic Web Services developed for 'GIS prototype' (also referred here as the *Emergency planning prototype*) as described in previous WP9.6 deliverable.

The resulting system retrieves, displays, and allows users to interact with emergency related information: weather forecasts, available rescue corps, evacuation procedures, supplies providers, available rest centres, categories of affected and vulnerable people, nature and location of damaged or endangered facilities, access of critical spots, etc. It assists the emergency planner officer in the task of automatically gathering relevant information in a particular emergency situation. Agencies can choose only to expose selected functionalities, without providing restricted and sensitive/private data. As a result, involved agencies become able extend their knowledge about the emergency situation by making use of different functionalities based on data hold by other agencies which otherwise might not be accessible to them or slow to obtain.

The following WSMO descriptions were developed using IRS-III and include domain ontologies for the ECC Emergency Planning (View Essex), Meteorological Office, and Buddy Space related services.

These descriptions are still under development as new information and data sources come up from the research being done by WP9 members. Therefore this document will be updated with new versions as soon as they are ready.

2 OVERVIEW OF THE EMERGENCY PLANNING PROTOTYPE

The context of the prototype is the Essex County Council (ECC) Emergency Planning Department. ECC is a large local authority in South East England (UK). Following several interviews with SRD holders in ECC it was decided to focus the scenario on the ECC Emergency Planning department, and more concretely, on a real past emergency situation: a snowstorm which occurred in the vicinity of Stansted airport on 31ST January 2003 [2]. The EMS prototype is a decision support system, which assists the end user –currently the Emergency Planning Officer (EPO), but extensible to other emergency corps: ambulance service, fire service, police, etc. – in gathering information related to a certain type of event, quicker and more accurately.

Data was replicated – from ECC Emergency Department and the Meteorological Office, in order to compare EPOs decisions regarding contact with rescue corps and voluntary associations, the actions necessary to provide refuge and supplies to trapped travelers, etc. – with those of the prototype users.

2.1 Architecture

Figure 1 shows the overall architecture of our prototype.

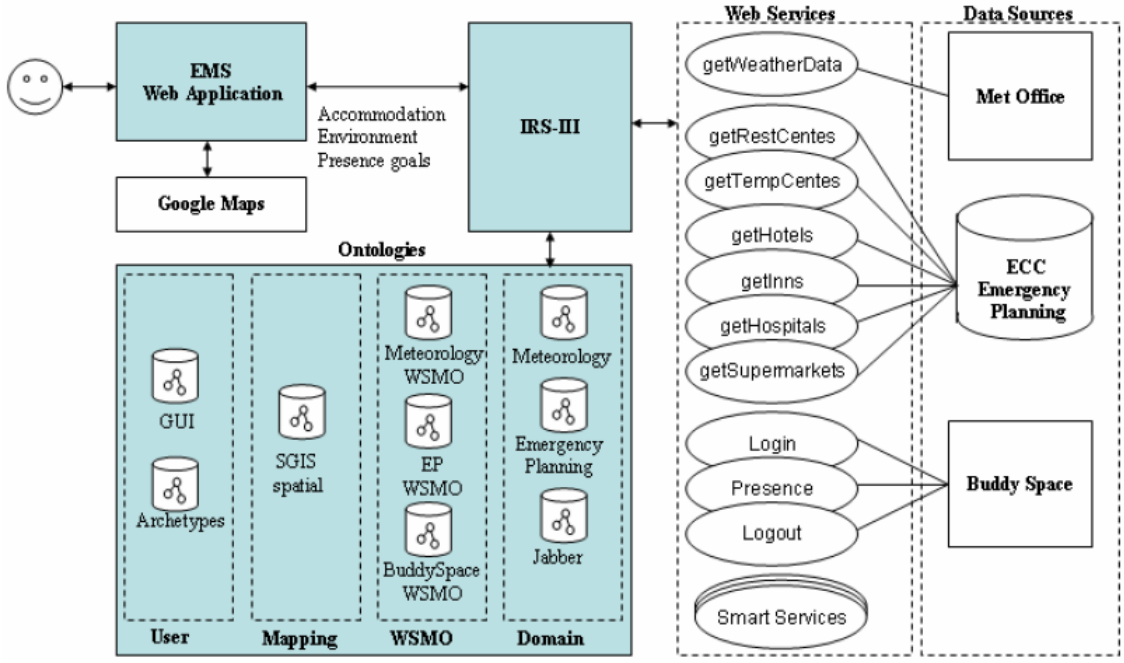

Figure 1. Architecture: the gray boxes represent the main modules of our EMS.

The data and functionalities of the involved data sources are exposed by means of Web Services, semantically described by Ontologies, and accessible to the EPO through the EMS Web Application which presents a web interface using Google Maps [1]. At the heart of the system lies IRS-III; it handles accommodation, environment and presence goal invocations, discovers and selects the SWS that satisfies the goals, manages SWS orchestration and mediation, executes the WS, and returns the WS mediated results.

2.2 Data

The EMS aggregates data and functionalities from three different sources:

- *Meteorological Office* in the UK, which provides environmental (e.g. weather forecast) data.
- *ECC Emergency Planning* is a collaboration between ECC and British Telecommunications (BT) which resulted in the creation and maintenance of central spatial data repository for the County, related agencies such as district councils, and eventually the general public (via the Internet) as expected by it [3]. We adopt it for retrieving SRD and, in particular, accommodation information regarding the buildings that can be used as shelters during an emergency.
- *BuddySpace* is an Instant Messaging client providing lightweight communication and collaboration means [4]. It allows: (i) presence management, (ii) customizable and interactive graphical visualizations (e.g. maps), (iii) automated contact list generation which eases access to a community, and (iv) a high degree of scalability. The client is built on top of the instant messaging protocol Jabber [5] that supports conversations and presence awareness. More context information can be pushed or requested from location-aware technology or knowledge of a particular community. Filtering of such contextual information, provided by BuddySpace, allows users or systems to find relevant people (functional role and spatial position) in a given

emergency situation, and to easily interact with them through text chat. Interestingly enough in an emergency situation, BuddySpace client interfaces can be accessed using smartphones.

2.3 Services

We distinguish two classes of services: ***data*** and ***smart***. The former refer to the three data sources introduced above, and are exposed by means of WS:

- *Meteorological Office service*. It provides weather information (e.g. snowfall) in specific square spatial areas.
- *Emergency Planning services*. They provide the following SRD: *primary* and *temporary rest centres*, *hotels*, *inns*, *hospitals*, and *supermarkets*. Each WS requires a query area as input, and returns the list of required shelters in that area, together with their properties, such as address, key holder, telephone number, etc. The query area is a circle represented by the centre point (in longitude and latitude) and a radius.
- *BuddySpace services*. They allow the EPO to connect to BuddySpace system, retrieve the list of relevant presences, and disconnect.

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. In particular, we created some *Filter Services* that select the GIS data responding to emergency-specific requirements (e.g. rest centres with heating system, hotels with at least 40 beds, easy accessible hospital, etc.). They describe the usual EPOs selection criteria and protocols. As a result the EPO automatically receive only the most suitable information in a specific situation.

3 WSMO DESCRIPTIONS

3.1 Domain Ontologies

The following ontologies have been developed to semantically support the SWS:

- *GUI Ontology*: this ontology is composed of user-oriented concepts, and allows to further specialize the lowered results on the particular interface which is used (e.g. stating that Google Maps API is used, defining ‘pretty names’, etc).
- *Archetypes Ontology*: this minimal ontological commitment tries to provide a cognitively meaningful insight into the nature of a specialized object; by conveying the cognitive ('naïve') feeling that e.g. a hospital, as a 'container' of people and provider of 'shelter' can be assimilated to the more universal concept of 'house', considered as an archetypal concept (they are related to and include ‘image schemata’ which require minimal explanation). It is assumed that any client, whilst maybe lacking the specific representation for the concept, knows how to display such archetypes.
- *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 Domain Ontology*: representing the concepts used to describe the services attached to the data sources, such as snow and

rain for Met Office, hospitals and supermarkets for ECC Emergency Planning, session and presences for Jabber.

The existence of several domain ontologies reflects our decoupling approach, where the different actor viewpoints/terminologies (user and two data providers) are independently represented.

3.2 WSMO Goals, Web Services and Mediators

The WSMO based Goals, Mediators, and Web Services descriptions of our prototype refer to the Met Office, ECC Emergency Planning, and BuddySpace WS. In Annex 1, we report two IRS-III browser screenshots that show the complete list of the developed WSMO descriptions.

Goal descriptions are related to user ontologies, while Web Service descriptions are linked to domain ones. Finally, mediators link goal and web services of each ontology, solving existing mismatches.

To illustrate this interaction, we describe in the following (Figure 2) the structure of the WSMO descriptions associated with one of the goals (*Get-Polygon-GIS-data-with-Filter-Goal*).

```
(DEF-CLASS GET-POLYGON-GIS-DATA-WITH-FILTER-GOAL
           (GOAL)
           ?GOAL
           ((HAS-INPUT-ROLE
             :VALUE
             HAS-METHOD
             :VALUE
             HAS-POLYGON-POINTS
             :VALUE
             HAS-SPATIAL-OBJECT-QUERY)
            (HAS-INPUT-SOAP-BINDING
             :VALUE
             (HAS-METHOD "string")
             :VALUE
             (HAS-POLYGON-POINTS "sexpr")
             :VALUE
             (HAS-SPATIAL-OBJECT-QUERY "sexpr"))
            (HAS-OUTPUT-ROLE :VALUE HAS-POLYGON-GIS-DATA)
            (HAS-OUTPUT-SOAP-BINDING
             :VALUE
             (HAS-POLYGON-GIS-DATA "xml"))
            (HAS-METHOD :TYPE METHOD)
            (HAS-POLYGON-POINTS :TYPE LIST)
            (HAS-SPATIAL-OBJECT-QUERY :TYPE SPATIAL-OBJECT-QUERY)
            (HAS-POLYGON-GIS-DATA :TYPE LIST)
            (HAS-NON-FUNCTIONAL-PROPERTIES
             :VALUE
             GET-POLYGON-GIS-DATA-WITH-FILTER-GOAL-NON-FUNCTIONAL-PROPERTIES)))
```

This goal describes the request of a class of shelter (hospital, inn, hotel, etc.) in a delimited query area. The user (i) specifies the query area through a sequence of at least three points (a polygon) before (ii) selecting the requested class of shelter. The ECC Emergency Planning WS return the specific class of shelter in a circular query area. The obtained results have to be filtered in order to return only the shelter responding to the emergency-specific requirements (in our case study a snowstorm).

The problems are: (1) selecting the adequate ECC Emergency Planning WS; (2) meditating the difference in area representations (polygon vs circular) between goal and the web services; (3) orchestrating the retrieve and filter data operations.

As described in [6] and [7], IRS-III offers approaches to solve these problems:

1. *WS Selection*: each WSMO description of an ECC Emergency Planning service defines, in its capability, the specific class of shelter that the service provides. All descriptions are linked to the *Get-Circle-GIS-Data-Goal* by means of a unique wg-mediator. The inputs of the goal specify the class of shelter, and the circular query area. At invocation IRS-III discovers through the wg-mediator all web services associated to it, and selects one on the base of the specific class of shelter described in web-service capabilities.

```
;; Goal

(DEF-CLASS GET-CIRCLE-GIS-DATA-GOAL
           (GOAL)
           ?GOAL
           ((HAS-INPUT-ROLE
             :VALUE
             HAS-METHOD
             :VALUE
             HAS-LATITUDE
             :VALUE
             HAS-LONGITUDE
             :VALUE
             HAS-RADIUS
             :VALUE
             HAS-SPATIAL-OBJECT-QUERY)
            (HAS-INPUT-SOAP-BINDING
             :VALUE
             (HAS-METHOD "string")
             :VALUE
             (HAS-LATITUDE "float")
             :VALUE
             (HAS-LONGITUDE "float")
             :VALUE
             (HAS-RADIUS "int")
             :VALUE
             (HAS-SPATIAL-OBJECT-QUERY "sexpr"))
            (HAS-OUTPUT-ROLE :VALUE HAS-GIS-DATA)
            (HAS-OUTPUT-SOAP-BINDING :VALUE (HAS-GIS-DATA "xml"))
            (HAS-METHOD :TYPE METHOD)
            (HAS-LATITUDE :TYPE FLOAT)
            (HAS-LONGITUDE :TYPE FLOAT)
            (HAS-RADIUS :TYPE INTEGER)
            (HAS-GIS-DATA :TYPE LIST)
            (HAS-SPATIAL-OBJECT-QUERY :TYPE SPATIAL-OBJECT-QUERY)
            (HAS-NON-FUNCTIONAL-PROPERTIES
             :VALUE
             GET-GIS-DATA-GOAL-NON-FUNCTIONAL-PROPERTIES)))
;; Mediator
(DEF-CLASS GET-CIRCLE-GIS-DATA-MEDIATOR
           (WG-MEDIATOR)
           ?MEDIATOR
           ((HAS-SOURCE-COMPONENT :VALUE GET-CIRCLE-GIS-DATA-GOAL)
            (HAS-NON-FUNCTIONAL-PROPERTIES
             :VALUE
             GET-GIS-DATA-MEDIATOR-NON-FUNCTIONAL-PROPERTIES)))

;; Example of WS and Its Capability
(DEF-CLASS GET-ECC-HOSPITALS-WEB-SERVICE
           (WEB-SERVICE)
           ?WEB-SERVICE
           ((HAS-CAPABILITY
             :VALUE
             GET-ECC-HOSPITALS-WEB-SERVICE-CAPABILITY)
            (HAS-INTERFACE
             :VALUE
             GET-ECC-HOSPITALS-WEB-SERVICE-INTERFACE)
            (HAS-NON-FUNCTIONAL-PROPERTIES
             :VALUE
             GET-ECC-HOSPITALS-WEB-SERVICE-NON-FUNCTIONAL-PROPERTIES)))
```

```
(DEF-CLASS GET-ECC-HOSPITALS-WEB-SERVICE-CAPABILITY
           (CAPABILITY)
           ?CAPABILITY
           ((USED-MEDIATOR :VALUE GET-GIS-DATA-MEDIATOR)
            (HAS-ASSUMPTION
             :VALUE
             (KAPPA
              (?WEB-SERVICE)
              (= (WSMO-ROLE-VALUE
                  ?WEB-SERVICE
                  'HAS-SPATIAL-OBJECT-QUERY)
                 'HOSPITALSQUERY)))
            (HAS-NON-FUNCTIONAL-PROPERTIES
             :VALUE
             GET-ECC-HOSPITALS-WEB-SERVICE-CAPABILITY-NON-FUNCTIONAL-PROPERTIES)))
```

2. *Area mediation and orchestration*: *Get-Polygon-GIS-data-with-Filter-Goal* is associated to a unique web service that orchestrates – invoking in sequence – three sub-goals: the first simply gets the list of polygon points from the input; the second is the above mentioned *Get-Circle-GIS-Data-Goal*; finally, the third invokes the smart service that filters the list of GIS data.

```
;; orchestration
(DEF-CLASS GET-POLYGON-GIS-DATA-WITH-FILTER-WEB-SERVICE-INTERFACE-ORCHESTRATION-PROBLEM-
SOLVING-PATTERN
           (PROBLEM-SOLVING-PATTERN)
           ((HAS-BODY
             :VALUE
             ((ORCH-SEQ
               GET-POLYGON-GIS-DATA-GOAL
               GET-GIS-DATA-GOAL
               GIS-FILTER-GOAL)))))
;; gg mediator

(DEF-CLASS POLYGON-TO-CIRCLE-CENTER-LATITUDE-GG-MEDIATOR
           (GG-MEDIATOR)
           ?MEDIATOR
           ((HAS-SOURCE-COMPONENT :VALUE GET-POLYGON-GIS-DATA-GOAL)
            (HAS-TARGET-COMPONENT :VALUE GET-GIS-DATA-GOAL)
            (HAS-MEDIATION-SERVICE
             :VALUE
             POLYGON-TO-CIRCLE-CENTER-LATITUDE-GOAL)
            (HAS-NON-FUNCTIONAL-PROPERTIES
             :VALUE
             POLYGON-TO-CIRCLE-CENTER-LATITUDE-GG-MEDIATOR-NON-FUNCTIONAL-PROPERTIES)))
```

The first two sub-goals are linked by means of three gg-mediators (ggM) that convert the list of polygon points provided by the first sub-goal to the centre (latitude and longitude) and radius of the circle that circumscribe that polygon. To accomplish this, we created three mediation services invoked through: *Polygon-to-Circle-Lat-Goal*, *Polygon-to-Circle-Lon-Goal*, and *Polygon-to-Circle-Rad-Goal* (wg-mediators and web services balloons were omitted to avoid cluttering the diagram). The results of the mediation services and the class of shelter are the inputs of the second sub-goal. A unique gg-mediator connects the output of the second to the input of the third sub-goal. No mediation service is necessary.

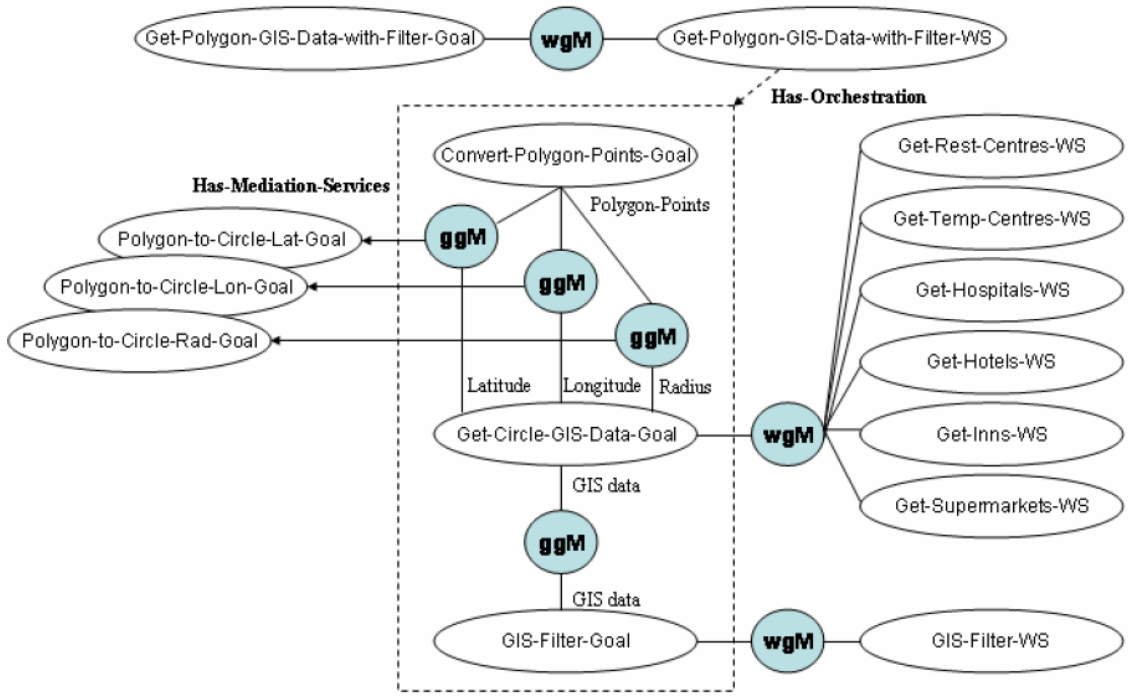

Figure 2. Sample structure of WSMO description.

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ANNEX 1 – LIBRARIES OF WSMO DESCRIPTIONS.

Figure 3. Library of WSMO Goal, Mediator, and Web Service descriptions for describing 'ECC Emergency Planning'.

Figure 4. Library of WSMO Goal, Mediator, and Web Service descriptions for describing 'BuddySpace'.